RIPARIAN CONDITIONS ALONG THE SAN PEDRO RIVER

PROPER FUNCTIONING CONDITION
RIPARIAN ASSESSMENT REPORT

THE NATIONAL RIPARIAN SERVICE TEAM
NOVEMBER 2012

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National Riparian Service Team

November 2012

Executive Summary

As part of an effort to begin working with stakeholders in a different and more collaborative way, the Bureau of Land Management (BLM) requested assistance from the National Riparian Service Team (NRST) relative to the management of the San Pedro River through the San Pedro Riparian National Conservation Area (SPRNCA). Beginning in April 2011, the NRST has worked closely with local BLM managers, specialists, partners and other interested stakeholders to implement an integrated technical and social approach focused on understanding how riparian conditions within the SPRNCA have changed since designation, and what the BLM and larger community can do to insure management will achieve Congressional direction to conserve, protect and enhance the riparian area into the future.

Most recently, interested stakeholders joined the NRST and local BLM managers and specialists in conducting Proper Functioning Condition (PFC) riparian assessments on approximately 51 miles of the San Pedro River through the SPRNCA during April 11-20, 2012. The PFC assessment method provides a framework for evaluating physical functionality based on hydrology, vegetation and erosion/deposition attributes and processes. Assessment findings provide an important foundation for understanding the current condition of a system, limiting factors within and outside BLM control, and areas where additional information is needed. This understanding then informs the process by which objectives relating to desired future riparian conditions are set, and alternative management and monitoring approaches are considered. Most BLM State Offices consider PFC riparian assessments as the accepted protocol for determining compliance with Agency Land Health Standards and establishing baseline conditions in advance of Resource Management Planning (RMP) efforts, such as the one currently underway for the SPRNCA. While there have been many scientific investigations and reports on various aspects of the San Pedro River, this was the first integrated assessment that synthesized existing information and resulted in a report of current on-the-ground conditions, on a reach-by-reach basis, throughout the SPRNCA.

Reach-Based Findings, Issues and Management Considerations

The PFC assessments provide a description of the current riparian condition of individual reaches of the San Pedro River compared to their potential, or the highest ecological status that could be attained in the current climate given no political, social or economic constraints. Potential descriptions for the San Pedro River include the combination of vegetation and channel characteristics that could develop during a management time scale of 5-50 years. Although, prior to the 1880s, the San Pedro River through much of the SPRNCA was a cienega; it is currently evolving from a major period of channel incision where it was transformed into a high-energy, confined river system. In addition to geomorphic changes, the climatic and hydrologic regimes that affected the river have also changed significantly and are not likely to revert back to historic conditions within a management time scale. Thus, the reach-based potentials described

in 2012 categorize reaches A-E as perennial, F as transitioning from perennial to intermittent, and G-J as intermittent based on permanence of streamflow and associated vegetative communities.

The assessment findings provide evidence that the physical function and ecological health of the San Pedro River through the SPRNCA has improved dramatically since designation, largely due to the 1989 decision to end permitted livestock grazing along the river. Although recovery may have been possible with managed grazing, relief from grazing pressure has allowed development of riparian vegetation and channel characteristics that greatly improve the function and sustainability of the San Pedro River. Continued recovery in all reaches is necessary to meet Congressional direction, but significant positive changes have occurred already. Of the approximately 51 miles assessed, 27.4 miles (54%) were rated as PFC, and the remaining 23.4 miles (46%) rated as Functional at Risk (FAR). The FAR reaches were further assigned apparent trend: 8.9 miles showed an upward trend, 10.3 miles showed a not apparent trend, and 4.2 miles (the northernmost reach below St. David's diversion) showed a downward trend.

Reach-specific assessment findings, issues and management considerations are discussed in detail within the report. For reaches rated FAR with either a downward or not apparent trend, the NRST recommends the establishment of a monitoring strategy to measure change over time in key PFC checklist items marked 'no.' Additionally, since reach J is the only reach rated as FAR with a downward trend, it requires immediate management action be taken to eliminate those stressors that are within management control. The main impacts limiting the ability of reach J to achieve PFC are the St. David's diversion, livestock grazing and off-highway vehicle use. The latter two uses are currently unauthorized and within BLM management purview to address.

Overarching Findings, Issues and Management Considerations

In addition to reach-based information, the PFC assessment also provided insight into larger ecological processes and management issues affecting the San Pedro River through the SPRNCA.

The Importance of Continued Groundwater and Surface Water in Relation to Riparian Vegetation and Channel Characteristics

Pumping of groundwater that serves as the lifeblood for the San Pedro River and its tributaries poses significant threats to the long-term function and sustainability of the San Pedro River. Studies show that groundwater is being pumped in excess of the amount of recharge; if balance is not achieved the river will eventually become seriously impaired or lost. Continuing depletion of groundwater sources to the river will negate the positive effects of BLM management over the past 25 years. Although the PFC assessment found little evidence that current riparian condition are being negatively affected by groundwater depletion to date, it is well known that the effects to vegetation and channel conditions will lag behind reduced flows. If, or once, groundwater recharge to the San Pedro River is lost, the impacts will likely be irreversible.

The fact that 72% of the river was determined to be in PFC or FAR with an upward trend is evidence that the system has the attributes and processes in place to further improve. However, the groundwater pumping deficit issue must be addressed now while the river still has the ability to take advantage of the water it receives from both surface and groundwater flows for system

recovery. The final chapter to the sustainability of the San Pedro River will be written by the actions taken by the BLM and associated communities and partners in resolving the groundwater and surface water issues. The BLM should continue working with others in a cooperative and coordinated approach to resolve these issues, while concurrently pursuing perfection of water rights for instream flows and groundwater levels as directed by Congress.

Additionally, groundwater levels must be monitored, with priority given to: (1) wells in areas close to the river, and (2) wells in areas of high groundwater withdrawal where modeling suggests an expanding cone of depression. This information is needed to truly understand changes in groundwater flows critical to the sustainability of the San Pedro River within the SPRNCA. The NRST recommends that an analysis similar to what is provided in the 321 report[1] be extended to the wells closest to the river, and results produced in cooperation with the U.S. Geological Survey (USGS). Finally, the NRST recommends hiring a hydrologist dedicated to the SPRNCA and the Las Cienegas National Conservation Area to serve as a monitoring coordinator.

The Role of Water and Sediment in Relation to Channel Evolution

Another overarching consideration relates to the tributaries and sediment that enter the San Pedro River along its length. One of the important aspects of understanding the evolution of the San Pedro system following channel incision is determining whether the sediment supply from tributaries is causing impaired conditions along the river. To this end, the NRST examined the balance between water and sediment conveyed to and by the San Pedro River and determined that in all but three reaches (A, D and H) the sediment is not excessive. However, protection of both the flow and the sediment regime of this river are crucial to its continued evolution and survival. By all indications, the San Pedro River is no longer incising and is aggrading by building a floodplain and by narrowing its channel. In the context of channel evolution, those are favorable signs indicating that some reaches have achieved proper functioning condition while others are moving in that direction. Consequently, the NRST recommends against using active restoration practices in the San Pedro River channel, such as induced meanders. Sound riparian management and passive restoration practices should be adequate to facilitate completion of the channel evolutionary process.

For the reaches noted above, which contain evidence that sediment loads and transport capacity are out of balance, the NRST recommends a detailed analysis be done to determine the hydrologic impacts of agricultural dikes, railroad beds, and abandoned gravel pits within the SPRNCA, as well as conducting cooperative watershed condition assessment of tributary drainages. Another study should evaluate whether treatments to reduce mesquite in selected sites on the pre-entrenchment terrace would improve grass cover and better control upland hydrology and sediment supply.

[1] The Upper San Pedro Partnership (USPP) was formed in 1998 and legislatively recognized in 2003 as an important entity dedicated to responding to aquifer depletion in the Sierra Vista sub-watershed with passage of the Defense Authorization Act. Section 321 of this legislation requires the Secretary of the Interior, in consultation with the Secretaries of Defense and Agriculture, and in cooperation with the Partnership, to prepare an annual report to Congress, referred to as the 321 Report. This report includes the water use management and conservation measures that have been implemented and are needed to restore and maintain the sustainable yield of the regional aquifer, by and after September 30, 2011.

The Contribution of Cottonwood and other Riparian Vegetation in Relation to the Recovery of the San Pedro River System

PFC assessment findings indicate that cottonwood and other trees are critical to the recovery of the river channel both as living trees and also as dead and down wood. The live trees with their heavy, strong roots are essential to anchoring banks in place, and providing stable sites where riparian plant species, including bulrush and other herbaceous vegetation in combination with seep willow and other shrubs/trees, can further anchor channel banks and contribute to channel narrowing and floodplain development. Riparian vegetation functions to: (1 slow water velocity during floods, (2 capture sediments, which creates sites for water storage, (3) increase infiltration and soil-moisture retention by adding organic matter and creating macropores via root channels, and (4) slow the release of subsurface waters to surface waters. While many people have expressed concern that cottonwoods contribute to considerable water loss in evapotranspiration, the river could not continue to develop and improve without them. Vegetation, both large and small, holds the river and floodplain together and provides for the function necessary to create aquatic and riparian values within the SPRNCA.

Current cottonwood galleries in reaches rated PFC were primarily fully stocked stands, and since the rate of channel migration is lower now than before the galleries were established, there is less area for establishment of new trees from seed. As a result, the acres of cottonwood and number of large trees are decreasing and will continue to do so naturally; loss to wild or prescribed fire would accelerate this process. Preservation and protection of existing cottonwood galleries should be a part of a vegetation management plan and a well-developed fuels and wildlife management plan. The protection of cottonwood trees is definitely important in reaches rated as FAR, because these reaches in particular are dependent on cottonwood trees (living and dead) for energy dissipation, streambank protection, and floodwater capture and storage.

The Negative Effects of Continued Livestock Grazing on Riparian Recovery

One of the major decisions made in 1989 through the SPRNCA's original management plan(s was to end permitted livestock grazing in areas along the river. As previously noted, this has allowed development of riparian vegetation and channel characteristics that greatly improve the function and sustainability of the San Pedro River. A key finding of this assessment, however, is that while the BLM made efforts to eliminate trespass livestock in the SPRNA, more needs to be done and State Office support is needed. Livestock use is, to some degree, retarding recovery of sections of the river; unauthorized grazing was found all along the river, but the detrimental impacts were more visible in localized areas within certain reaches.

Trespass livestock grazing in the river corridor must be eliminated to provide the maximum opportunity for continued improvement and evolution of the river. Furthermore, PFC assessment findings indicate that the riparian corridor and river are not yet to a point, overall, that livestock grazing could be permitted along the San Pedro River without retarding improvement or even causing impairment.

Other Management Issues to be addressed as Part of a Comprehensive Recovery Plan for the SPRNCA

Tamarisk (Saltcedar)

Tamarisk is found throughout the San Pedro River within the SPRNCA with increasing populations and density moving northward from the United States border. It is found only occasionally in the upper (southern) reaches, in part due to aggressive control efforts by BLM and partners. In the lower (northern reaches of the SPRNCA, tamarisk will potentially displace most of the willow and cottonwood over time without aggressive control; this is due to its ability to spread rapidly and its deep roots that can tap into water tables beyond the reach of young cottonwood and willow. The NRST supports and endorses the SPRNCA's existing tamarisk management plan.

Fire and Fuels

The risks of major, high-intensity wildfires are great given the observed fuel loadings and types of fuels within the SPRNCA. A comprehensive public/private approach should be undertaken to develop strategies and tactics for managing fuels and vegetation within and near the SPRNCA. In addition to protecting cottonwood stands to the extent practical, the NRST suggests the RMP revision include an analysis of opportunities to use fire, mechanical treatments, cattle and/or other livestock as a way of managing vegetation and fuels on grasses on the pre-entrenchment terrace, including previous agricultural fields. The risk of fire moving into the riparian area is high due to the existing stands of dead and dry material. Periodic defoliation by some process is needed to improve the health and vigor of the grasses, which will also help improve watershed condition and benefit the river.

Beaver

In the PFC assessment, beaver dams are considered because they can be hydrologic modifiers. Overall, beaver were seen as a positive contributor to river health due to extended time of water retention behind dams. The important role of beaver, like cottonwood, is another area where increased information and public education efforts are needed. The BLM should also work with private landowners and the Arizona Game and Fish Department to minimize undesirable impacts.

OHV and Pedestrian Trails

Because riparian recovery is relatively recent and riparian plant communities are weakly developed in many areas, small disturbances can have profound effects by retarding recovery or reversing earlier trends in recovery of riparian areas. PFC assessment findings indicate that unauthorized off-highway vehicle traffic and unregulated foot traffic has compacted soil, trampled and destroyed riparian vegetation, altered streambanks and increased channel erosion. Efforts to reduce these impacts should be undertaken.

Railroad Bed

The abandoned railroad bed that runs along much of the San Pedro River has, and continues to alter surface flow and contribute eroded material directly to the river. The NRST recommends the BLM conduct an inventory to determine the location and extent of altered surface drainage and maintenance needs. In addition, the BLM should explore various options to retire or acquire the right-of-way for the abandoned railroad.

Agricultural Dikes

In sections of the San Pedro River, dikes were constructed to divert surface drainage around abandoned agricultural fields. These dikes alter natural hydrologic patterns, causing some reaches of the San Pedro River to receive less water and sediment, whereas others may receive too much. A thorough field investigation of the dikes is needed to understand the extent of the impact. Where there is evidence that diverted flow patterns are creating increases in peak discharge and increased erosive potential, steps should be taken to remedy the situation.

Groundwater Augmentation

A number of groundwater augmentation strategies are currently being reviewed for their potential contribution to balance pumping with recharge. Additional water in Reach A could accelerate recovery of the needed vegetation characteristics. Additional water in Reaches B through E could extend perennial flow further downstream in Reach F. A third location would be to provide additional recharge water to the Babocomari River, which might also positively influence the water in the San Pedro River.

One strategy discussed during the PFC assessment was the use of detention basins in ephemeral channels. The NRST cautions that these detention basins are not without possible unintended consequences due to alterations in sediment balance. As a result, the location of future structures is an important consideration.

Recommended Next Steps

The PFC Riparian Assessment Report for the San Pedro River through the SPRNCA concludes with a discussion of three recommended next steps. The first is to complete the SPRNCA RMP revision process that is currently underway. The number and types of issues raised by the PFC assessment and preceding steps in the NRST assistance process clearly point to the need for an up-to-date plan for managing the SPRNCA. Although some of the riparian issues can be resolved on a project or location basis, the greater need is for a comprehensive analysis and planning effort that fully engages the many partners and broader public.

The second step is to develop baseline information and an objective driven monitoring strategy. With the legal mandate to conserve, protect and enhance the riparian, aquatic, and other named resources, a robust monitoring plan is critical to mission success. Although monitoring is known to exist, much of this is not corporate in nature or readily available to interested publics or management. Moving forward into the revision of the RMP and the establishment of monitoring programs, it is critical to know where information has been collected, what information is available, and what has been learned to date. In addition to the ongoing wet-dry mapping, which

not only provides highly valuable information to management about river conditions but is also a highly educational activity that increases public support for the San Pedro River, the NRST outlines a variety of other monitoring needs for the SPRNCA. With appropriate training, volunteers can assist technical staff on some of these monitoring efforts and take the lead on others.

The third recommendation is to expand opportunities for community education and service. Throughout the course of NRST assistance, it became apparent that there is a lack of information, or misinformation, regarding riparian ecology and function. Volunteers can assist BLM with riparian education and interpretation, as well as implementing management actions. Suggested informational topics and management activities are outlined in the report.

Introduction

As part of an effort to begin working with stakeholders in a different and more collaborative way, the Bureau of Land Management (BLM) in Arizona requested assistance from the National Riparian Service Team (NRST) relative to the management of the San Pedro River within the San Pedro Riparian National Conservation Area (SPRNCA). The NRST is an interagency team (BLM, Forest Service, in cooperation with Natural Resources Conservation Service) that implements the Creeks and Communities Strategy across the Western United States[2]. The focus of the Creeks and Communities Strategy is working with land managers and interested stakeholders to build relationships and establish a common vision for riparian area management that is based on a shared understanding of current riparian condition in relation to an area's potential[3]. This understanding of important riparian attributes and processes then forms the foundation upon which objectives relating to desired future riparian conditions are set, and alternative management and monitoring approaches are considered.

For the past year, the BLM in Arizona has been working with the NRST to implement the Creeks and Communities strategy within the SPRNCA. Most recently, interested individuals from surrounding communities, and BLM managers and specialists joined the NRST as they conducted Proper Functioning Condition (PFC) riparian assessments (Prichard et al. 1998) on approximately 51 miles of the San Pedro River through the SPRNCA, during April 11-20, 2012. The objective was to assess the current functional condition of the river and riparian conditions nearly 25 years after Congressional designation of the SPRNCA. As part of designation, Congress directed the Secretary of the Interior to manage the SPRNCA in a manner that "conserves, protects, and enhances the riparian area and the aquatic, wildlife, archeological, paleontological, scientific, cultural, educational, and recreational resources of the conservation area" (United States Code 2002:1). The PFC assessment provides information to better understand how riparian conditions have changed since designation and what the BLM and larger community can do to ensure management will achieve Congressional direction into the future.

[2] For more information about the Creeks and Communities Strategy, visit www.blm.gov/or/programs/nrst

[3] Riparian potential is defined as the highest ecological status a riparian-wetland area can attain in the present climate given no political, social, or economic constraints (Prichard et al. 1998 . For the purposes of this report, it is described by the combination of vegetation and channel characteristics that could develop during a management time scale of 5-50 years given no human impacts.

Two stories have emerged from the assessment concerning the recovery, health and sustainability of the San Pedro River, as well as the hope for meeting the intent of Congress when they established the NCA, and ensuring that this national treasure will continue to be a living laboratory and source of joy and inspiration for future generations. The first is being written on the land and is a dramatic lesson in the evolutionary and recuperative powers of rivers and streams. This story is based on the interaction of soil, water and vegetation along the course of this living river. The second story is about groundwater, and is being written deep within the earth in the lands surrounding the SPRNCA; out of sight and mind for many members of the community. Pumping of the groundwater aquifer that serves as the lifeblood for the San Pedro River and its tributaries is threatening the river's future existence. Studies show that groundwater is being pumped in excess of the amount of recharge; if balance is not achieved, the San Pedro River will eventually become seriously impaired or lost (Upper San Pedro Partnership 2012). Many of the dead rivers that currently dot the American West serve as a testament to the possibility of this outcome.

Since the rights to groundwater use in Arizona are essentially unregulated outside of Active Management Areas and Irrigation Non-Expansion Areas, the aquifer that supplies much of the baseflow to the San Pedro River is facing a *tragedy of the commons*. Hardin (1968) described this as a dilemma arising from the situation in which multiple individuals, acting independently and rationally and consulting their own self-interest, will ultimately deplete a shared limited resource, even when it is clear that it is not in anyone's long-term interest for this to happen. Groundwater pumping is the ultimate threat to the sustainability of the San Pedro River, as well as the economy and culture of Fort Huachuca, Sierra Vista and the surrounding region. The final chapter to the sustainability of the San Pedro River will be written by actions taken by the BLM, and associated communities and partners in resolving the issues posed by this second story. The BLM should continue working with others in a cooperative and coordinated approach to resolve the groundwater and surface water issues in the Upper San Pedro Basin. Concurrently, the BLM should pursue perfection of water rights for instream flows and groundwater levels as directed by Congress.

This report focuses on the function and sustainability of the San Pedro River though the SPRNCA, which falls within BLM management authority. The PFC assessment findings are focused on riparian conditions along the main channel of the San Pedro River within the SPRNCA (see Appendix A for reach-based PFC assessment information). The assessment did not evaluate the condition of tributaries or uplands, nor did it directly ascertain groundwater conditions. PFC Assessment findings indicate that the current condition of 72% of the San Pedro River within the SPRNCA is either properly functioning or in an upward trend (moving toward PFC). However, continuing depletion of groundwater sources to the river will eventually negate the positive effects of BLM's management over the past 25 years. Although the PFC assessment found little evidence that current riparian conditions are being negatively affected by groundwater depletion to date; it is well known that effects to vegetation and channel conditions will lag behind reduced flows. If, or once, groundwater recharge to the San Pedro River is lost, the impacts will likely be irreversible. The fact that 72% of the river was determined to be in PFC or FAR with an upward trend is evidence that the system has the attributes and processes in place to further improve. However, the groundwater pumping deficit issue must be addressed now while the river still has the ability to take advantage of the water it receives from both surface and groundwater flows for system recovery.

History of the Creeks and Communities Effort within the SPRNCA

When the NRST first became involved in working with the BLM and its partners over management of the SPRNCA, a situation assessment was conducted and a report published on April 26, 2011 (NRST 2011). As noted in the report, the issues regarding the SPRNCA fall at two scales – those relating to the larger San Pedro watershed and those relating more specifically to the management of the SPRNCA. Declining surface water levels and an inability to balance the groundwater budget are watershed scale issues, which if not resolved threaten the future health of the San Pedro River. At the scale of the SPRNCA, clear and comprehensive knowledge about the current condition of riparian health after 25 years of management did not exist, and the current management plan is a combination of several plans that were difficult to either obtain or gain a clear sense of direction, objectives, and purpose. These factors seriously impair the ability of the BLM to meet their management challenges.

The NRST recognized that the larger watershed-scale issues and the future health of the San Pedro River, and thus the SPRNCA, are inexorably linked. However, at the conclusion of the situation assessment, the team determined that its assistance would be most effective if it focused on the scale of establishing a common vision among the BLM and stakeholders for the future management of the SPRNCA. A vision, based on an understanding of current riparian condition in relation to potential, would then inform the selection of appropriate management and monitoring approaches needed to conserve, protect and enhance this national treasure. Engendering this type of understanding and building needed relationships and trust among land managers and stakeholders are at the heart of the Creeks and Communities Strategy.

Following the situation assessment, the NRST met with BLM personnel and stakeholders to review findings, gauge support for continued team involvement and identify the steps needed to create a common understanding of river and riparian conditions within the SPRNCA. The first identified step was for the team to meet with the various researchers and specialists working on, or familiar with the San Pedro River, to gain a better understanding of current information and determine if any gaps exist. This occurred in July 2011. It became evident that even though there is a considerable amount of information about the San Pedro River (e.g. Leenhouts et al. 2006), information regarding current (2012) riparian condition *compared to potential*, on a reach-by-reach basis did not exist. Because this information represents the starting point in BLM regulations for managing land health, an action plan was developed to collect the information in advance of the upcoming Resource Management Plan (RMP) revision process. The proposed action plan was widely shared with interested stakeholders through a variety of community-oriented meetings and workshops. Stakeholders were generally supportive of moving forward, and many expressed interest in participating in activities.

An accurate assessment of current riparian condition requires an understanding of riparian potential – or the highest ecological status an area can attain under natural conditions (in the absence of human impacts). In order to describe riparian potential condition on a reach-by-reach basis throughout the SPRNCA, the NRST hired a contractor to lead an effort to synthesize existing information regarding the San Pedro River. The resulting report, 'Riparian Conditions along the San Pedro River - Potential Natural Communities and Factors Limiting Their Occurrence' (Fogg et al. 2012), was then reviewed by many of the technical specialists involved in the July 2011 meeting, as well as by interested stakeholders, and BLM staff from the Gila District Office, Tucson Field Office, and Arizona State Office. The final descriptions of potential

provide a benchmark against which to compare current riparian condition (status) within the SPRNCA using the PFC riparian assessment method. They also provide the basis for development of management objectives relating to the desired future condition of these areas.

The formal PFC assessment of the San Pedro River within the SPRNCA occurred over ten days, in April 2012. The NRST was accompanied by the Gila District interdisciplinary team (see Appendix B for professional biographies), and they along with managers and interested stakeholders (see Appendix C for a complete list of assessment participants) had the opportunity to walk, observe, and discuss the entire length of the San Pedro River within the SPRNCA. The assessment findings are documented within this report. The final phase of this effort will be a series of stakeholder meetings to review assessment findings and explore next steps in terms of the following: (1) how the BLM can best use the information and stakeholder interest that has been generated as they move forward with the RMP revision process, and (2) how the larger community can use the assessment results, coupled with resultant BLM decisions regarding future riparian management goals, to inform watershed scale efforts.

The Riparian Proper Functioning Condition Assessment Method

The PFC assessment method, described in BLM Technical Reference 1737-15 A User Guide to Assessing Proper Functioning Condition and the Supporting Science for Lotic Areas (Prichard et al. 1998), was the protocol used for the assessment of the San Pedro River. The protocol grew out of a need at the national level for the BLM to assess conditions of streams and wetlands across all of its managed landscapes relatively rapidly. The PFC assessment has been the standard protocol for stream assessments for the BLM since 1993 and has been applied on over 40,000 miles of public land streams under their management. Most BLM State Offices consider PFC assessment as the standard protocol for determining compliance with Land Health Standards concerning riparian-wetland areas.

The PFC assessment method utilizes two assessment checklists; one for flowing water systems such as rivers, streams, and springs (lotic) and one for wetlands such as lakes, ponds, seeps, bogs, and meadows (lentic). The checklists provide the framework for evaluating physical functionality based on hydrology, vegetation, and erosion/deposition attributes and processes. Prior to completing the checklist, an interdisciplinary team gathers existing information and delineates the stream into reaches, each having common attributes, processes, management and potential. The assessment is used to identify any significant attributes or processes that may be out of balance with natural processes necessary for a system to function properly and maintain its channel dimension, pattern and profile with respect to its landscape setting, during moderately high flood events. PFC, a qualitative, science-based assessment, serves to interpret the assemblage of attributes and processes within a given riparian system. Use of this method requires an interdisciplinary team which should include specialists in vegetation, soils, hydrology, and biology (Prichard et al. 1993). Some specialists may be able to address more than one skill area based on their knowledge and experience.

Prichard et al. (1998) list the purpose of each item, examples of how the item would be answered in different situations, and supporting science. A final determination of condition is made based on the mix of “yes” and “no” answers, factored with the importance of each checklist item in terms of the specific reach being assessed and its potential. This process requires highly

experienced and knowledgeable team members, and discussion is critical in order to understand differing perspectives and achieve agreement on the summary rating. The qualitative PFC assessment provides an important foundation for understanding the current condition of a system, describing limiting factors and identifying areas where additional information is needed to provide a more clear and conclusive picture of the situation. While the ultimate goal is interdisciplinary team consensus during the assessment process, there are instances where disagreements remain. In those instances, individual team members are required to use an accepted quantitative method to gather additional data for verification or monitoring.

Potential and Capability

An important determination prior to and during the PFC field assessment is the potential and capability of each reach. **Potential** is defined as the highest ecological status a riparian-wetland area can attain in the present climate given no political, social, or economic constraints (Prichard et al. 1998). Potential includes the combination of vegetation and channel characteristics that could develop during a management time scale of 5-50 years, and is often referred to as the potential natural community. It is applied to the PFC assessment by considering and answering each item of the checklist relative to the attributes and processes that can occur within a particular riparian system. Based on the potential of a reach, certain checklist items may not be applicable (i.e. the attributes and processes do not exist within that type of reach). In this case, the item is answered "not applicable" on the checklist. When the possibility does exist for a "yes" answer, a determination of whether the item should be answered "yes" or "no" is made based on the attributes and processes that system needs for function.

Capability is defined as the highest ecological status an area can attain given political, social, or economic constraints, which are often referred to as limiting factors (Prichard et al. 1998). On some streams, human activity has interfered with natural stream processes in such a way that the stream cannot recover to its natural potential. Examples of this might be dams that regulate amount and timing of flows, roads or railroad grades that cut off access to large portions of a stream valley, dikes that confine stream channels, or groundwater pumping/irrigation withdrawals that reduce the amount of water available to streams. In the PFC assessment, these are indicated as capability factors. Capability only applies to limiting factors that the land manager for a given area cannot eliminate or change through a management action. Actions such as grazing, timber harvest, and road construction practices are generally within the discretion of the manager, can be changed, and are not considered capability factors.

Functional Ratings

The PFC assessment recognizes three categories of stream functionality; proper functioning condition (PFC), functional-at risk (FAR), and nonfunctional (NF . A riparian-wetland area is considered to be in **proper functioning condition** when adequate vegetation, landform, or large woody debris is present to:

- Dissipate stream energy associated with high stream flows, thereby reducing erosion and improving water quality;
- Filter sediment, capture bedload, and aid floodplain development;
- Improve flood-water retention and ground-water recharge;
- Develop root masses that stabilize stream banks against cutting action;
- Develop diverse ponding and channel characteristics *to provide* the habitat and the water depth, duration, and temperature necessary for fish production, waterfowl breeding, and other uses; and
- Support greater biodiversity.

Riparian-wetland areas that are, for the most part, in functional condition but an existing soil, water, or vegetation attribute makes them susceptible to impairment during moderately high flood events are considered **functional-at risk**. Streams rated FAR are also given a trend determination of upward (improving or moving towards PFC), downward (becoming worse or moving away from PFC) or not apparent. N**onfunctional** riparian-wetland areas clearly do not provide adequate vegetation, landform, or large woody material to dissipate stream energy associated with high flows and thus are not reducing erosion, improving water quality, etc.

A trend determination is only assigned to streams rated FAR. If there is insufficient evidence to make a determination that there is a trend toward PFC (upward) or away from PFC (downward), then the trend is not apparent. Most frequently, vegetation is the primary determining factor for trend, particularly on low-gradient alluvial streams. Factors such as increasing distribution and composition of obligate wetland and facultative wetland plants (indicative of saturated or high soil moisture), and reduction of upland plants in riparian areas may be important trend indicators. The presence of certain colonizing species like watercress, backed up by stabilizing vegetation like bulrushes and seep willow is an example of another indicator of recruitment of riparian plants and an upward trend. Other indicators are new shoots from rhizomatous species and the presence of multiple age classes, especially seedlings and young, of woody species. In the early years of recovery, vegetative expression (height and quantity of above-ground material) is often visually very evident, whereas later, important changes in species composition, plant vigor, density of stabilizing communities, root extension and other changes are sometimes less obvious. Trend determinations require highly experienced interdisciplinary teams, as the indicators often times are complex.

Monitored trend can be measured and/or determined by comparing the present situation with previous photos, trend studies (such as vegetation transects and surveyed channel cross sections), inventories, and any other relevant information. Where none of these exist, or are inadequate to determine a monitored trend on the reach, the interdisciplinary team uses their experience to gauge **apparent trend** (an interpretation of trend based on observation and professional judgment at a single point in time). For FAR reaches with no apparent trend, the first management action may be to establish monitoring sites to determine monitored trend. PFC itself is NOT a monitoring approach or process. Ideally it should be a one-time assessment that sets the course for future management and monitoring.

Each rating occurs over a range; for example a reach rated PFC may be “just barely” PFC or near potential or somewhere in between. For the SPRNCA assessment, a thermometer schematic (Figure 1 was included on the PFC assessment form that enabled the interdisciplinary team to illustrate where they felt a reach was, within the range of the rating categories, based on their

knowledge and experience. This is also an indication of the evolutionary stage (i.e., upper, middle or lower part of the PFC or FAR rating) of each reach. Reaches rated very high within the PFC range are approaching potential vegetation and channel characteristics, while those rated low within the PFC range are functionally capable of handling moderately high floods but may need a long time to reach potential.

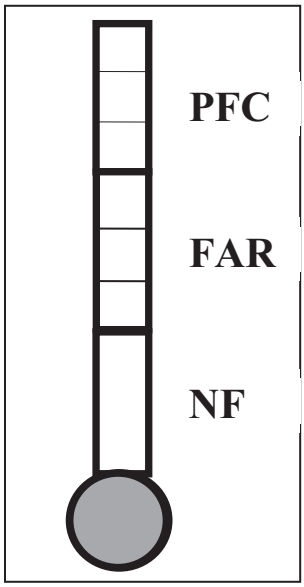

Figure 1. Stylized "thermometer" for recording where within the functional ratings a reach is considered to be.

Figure 2 shows the seral stages [4] associated with NF, FAR, and PFC. NF reaches have few or none of the attributes and processes necessary to dissipate stream energy or perform other needed functions. Streams that are FAR but just below PFC may rapidly progress to PFC with the right combination of management and flow events. However, FAR streams that are just above NF may take decades to develop the attributes and processes necessary to move to PFC. The values on which management should be focused occur largely at PFC because below that condition, they are not considered sustainable in moderately high floods (e.g. 5-, 10-, and 20- year events). Stream improvement is seldom a linear process and the trajectory of progress typically exhibits several oscillations over time. Streams go through periods of improvement, deterioration, and back to improvement, until they are at PFC. Extreme events such as 100-year events occur infrequently and have such power that riparian areas in PFC can unravel, at least in places, yet they normally recover much faster than similar streams that are less than PFC.

[4] Seral stages: a series of plant communities that follows another in time on a specific site.

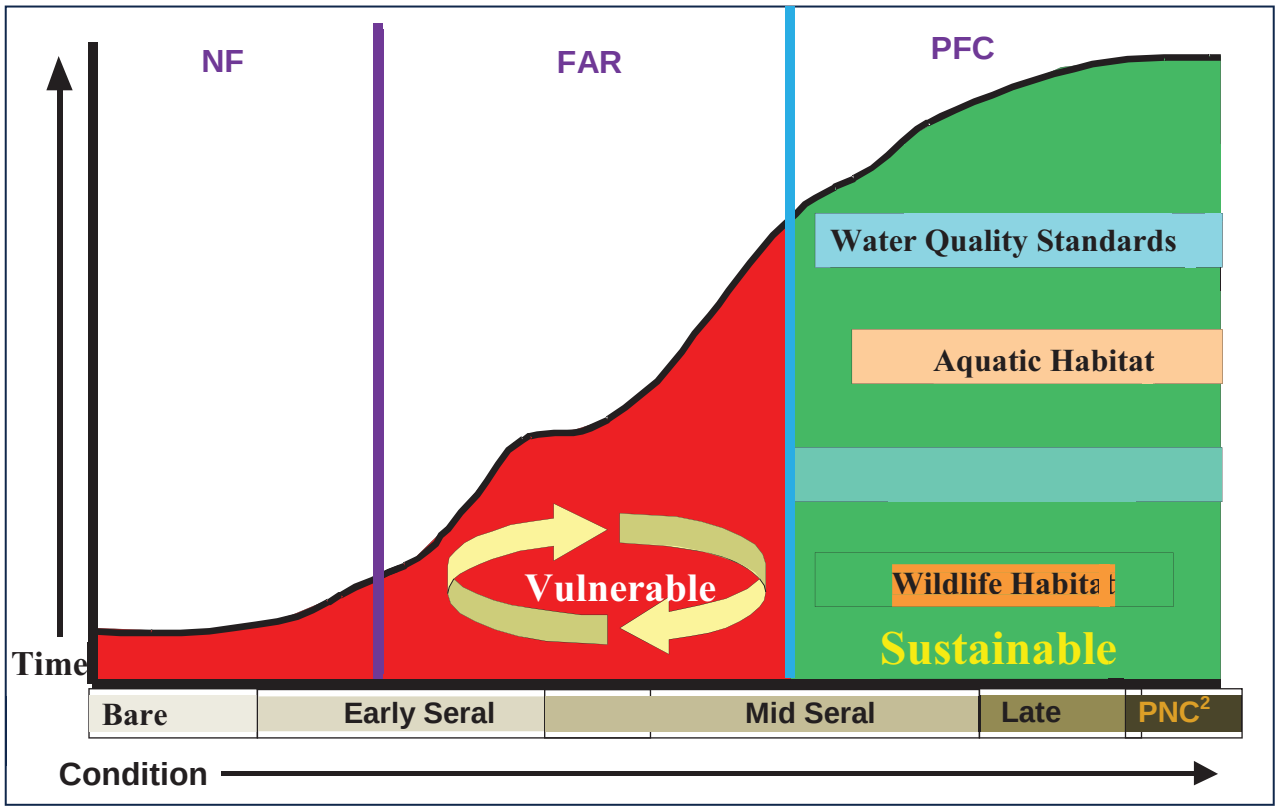

Figure 2. Example of succession as it relates to stream recovery and function. [1] Decision space represents having proper functioning condition in the system so that resource goals and objectives are realistic and can be sustainable. [2] PNC stands for potential natural community, which is the biotic community that would become established if all successional sequences were completed without interferences under the present environmental conditions.

PFC Assessment Contribution to Management of the SPRNCA

The PFC assessment is a beginning step in a comprehensive process for riparian management. Both the process and the results help agencies, partners and citizen groups build an understanding of the physical processes that are governing the river. PFC assessment findings give a portrayal of current condition and provide indicators of the ability of the river and riparian area to produce certain values. The information garnered from the PFC assessment of the San Pedro River, along with knowledge of resource values, is essential to interdisciplinary team, land manager, and stakeholder efforts in developing riparian management objectives, riparian management plans, and monitoring strategies that will demonstrate achievement of desired results over time. In order to be useful, the PFC assessment results must be incorporated into an integrated riparian management process, which includes the RMP revision process that is currently underway for the SPRNCA.

Legislation directs the Secretary of the Interior to manage the SPRNCA in a manner that conserves, protects, and enhances the riparian area and other resources. Stakeholders want to know what that means on the ground and what it will take to meet that direction, including the associated economic and social implications. BLM decisions and analysis regarding management direction are made through a RMP development process. One component of a revised management plan for the SPRNCA is an understanding of current riparian conditions as compared to potential and desired conditions, and how these have changed since designation. Current actions that limit attainment of desired conditions both within and outside BLM control

must also be identified, along with future riparian management objectives for the SPRNCA, approaches and needed actions for meeting them, and strategies/actions for monitoring progress.

The PFC assessment is a protocol used by BLM to meet its requirements for determining land health standards and engaging the public in this process. A broad and diverse group of public and other stakeholders are concerned about the future of SPRNCA, and successful outcomes will depend on an engaged and supportive public. The PFC assessment also provides a vehicle for engaging in high-level, field-based, interdisciplinary discussions (including with stakeholders) about riparian function and needs within the SPRNCA as part of an effort to develop a common vision for the future management of this important area. The PFC assessment provides a current description of existing condition, as well as an opportunity to crosswalk with the riparian condition classes developed by Stromberg and others which are based on nine field-measured vegetation traits that are sensitive to changes in streamflow permanence or ground-water levels (Leenhouts et al. 2006). This will serve as the foundation for the riparian portion of the RMP. The knowledge gained during the PFC assessment helps point to what should be monitored with quantitative methods to track change over time. It also helps inform RMP level management decisions such as those relating to grazing, fire and vegetation management. The information and recommendations contained in this report outline a number of things to consider as part of the RMP revision process.

In addition to contributing important information to the RMP process and management of riparian areas within the SPRNCA, the information obtained through the PFC assessment and associated processes will also contribute to answering some of the larger watershed-level questions. Although the final riparian condition determinations will not resolve the issues related to declining river flows or an unbalanced groundwater budget, the information garnered from this effort will contribute to the BLM's ability to more effectively engage as a partner in these discussions. For instance, the BLM will be in a better position to discuss how riparian vegetation influences water availability through both evapotranspiration and acting as an agent for alluvial aquifer recharge during flood events, as well as their management objectives concerning riparian vegetation. Additionally, they will be able to provide rationale for important efforts such as groundwater monitoring, as well as initiation of new monitoring as part of a comprehensive strategy for understanding why certain reaches are not moving toward desired conditions or are in decline.

PFC Assessment of the San Pedro River through SPRNCA

Reach-Based Findings, Issues and Management Considerations

Potential Descriptions

The potential of individual reaches of the San Pedro River were defined in Fogg et al. (2012 and vetted in February 2012 through a public process that included scientists from the USGS, University of Arizona, Arizona State University, U.S. Bureau of Reclamation, Fort Huachuca, The Nature Conservancy, and stakeholders from Friends of San Pedro, Community Watershed Alliance, Audubon Society, citizens of Sierra Vista and Cochise County and BLM staff from the Arizona State Office, Gila District Office and Tucson Field Office. Input from this review

process was incorporated into the potential document and reviewed again by the NRST and the Gila District interdisciplinary team prior to conducting the PFC assessments in April 2012.

Prior to the 1880s, much of the San Pedro River through the SPRNCA was a cienega - a broad, marshy environment, dominated by dense herbaceous, obligate wetland vegetation in a low-gradient, low energy stream system (Figure 3 -- stage I; Henderson and Minckley 1984). During the late 1800s and early 1900s, the San Pedro River experienced a major period of channel incision and was transformed from a low-energy system with widespread cienegas to a high-energy, incised river system (Figure 3 – stage II; Hereford 1993). During the first half of the twentieth century, the energetic San Pedro River meandered rapidly across its valley bottom, gradually widening its inset floodplain (Figure 3 – stages III and IV; Hereford 1993). Since approximately the 1950s (Hereford, 1993), the rate of lateral channel migration has decreased and the establishment of riparian vegetation has helped to capture suspended sediment to build a wide floodplain with progressively deeper alluvium (Figure 3 – stages IV and V). The widening and aggradation of the floodplain has corresponded to a narrowing of the channel. These geomorphic changes to floodplain and channel have been most evident since 1989, when BLM ceased authorized livestock grazing along the San Pedro River. Vegetation expression following livestock removal improved trapping of suspended sediment.

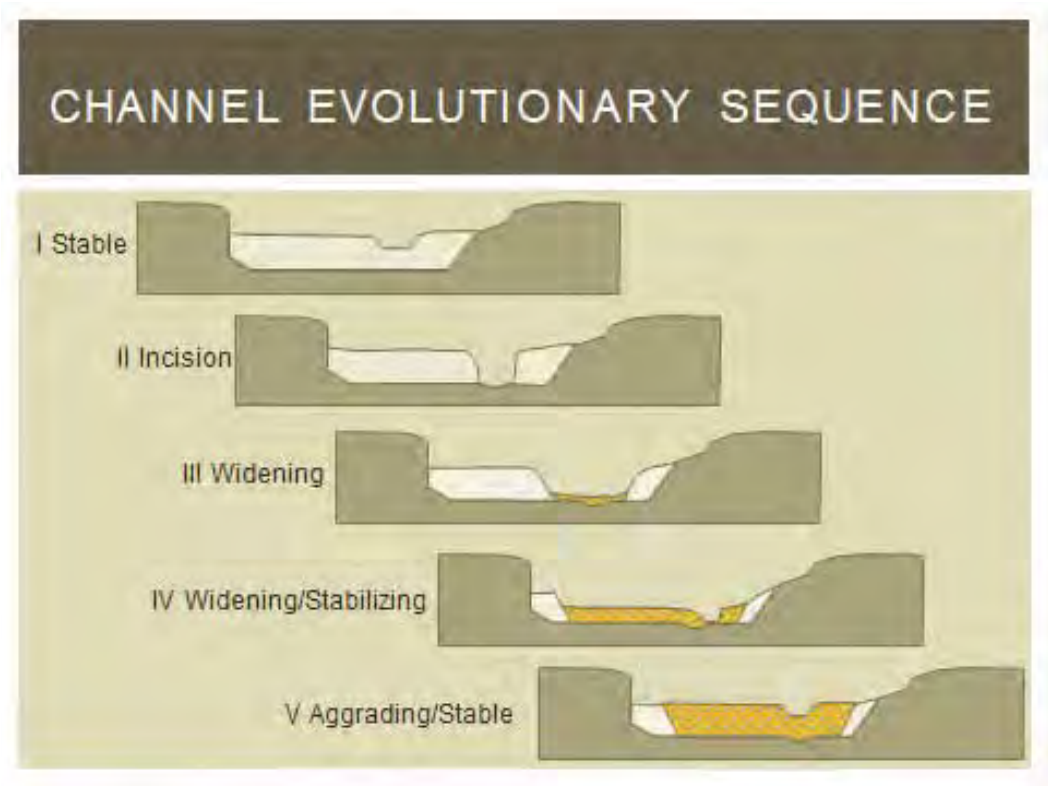

Figure 3. Simplified schematic illustrations of the channel evolutionary process that stream systems experience during an episode of channel incision and recovery to another stable form. The process of channel incision (stage I to II) can occur quickly, over a few years to a couple decades; whereas the recovery period (stage II to V) commonly occurs over a few decades to a couple centuries.

Although the NRST fully expects channel evolution to continue toward a more stable system, the time required for the channel evolution process to complete its course may take many decades. Continuation of channel evolution is also contingent on implementation of effective riparian

management, existence of favorable climatic and hydrologic regimes, and continuance of groundwater discharge to the stream channel (or at least maintenance of water-table elevations that are within the rooting depth of obligate wetland plants). The climatic conditions of the Little Ice Age, during which time a cienega reportedly formed along parts of the San Pedro River, were fairly unique in the Holocene. Additionally, from both an annual and a cumulative perspective, more water is being removed from the aquifer than is being recharged (Upper San Pedro Partnership 2012). Many people have concluded that the current flow regime and condition of the San Pedro River have already been altered as a result. Thus, it is highly speculative to manage for a potential that existed under a hydrologic and climatic regime and geomorphic conditions that may never occur again, and not likely to develop during a management time scale of 5-50 years.

Fogg et al. (2012) used several lines of evidence to determine potential, including the hydrogeology of regional aquifers in the upper San Pedro watershed (Figure 4), the distribution and effect of a fine-textured (silt and clay restrictive unit in the upper basin fill (Figures 5 and 6), and the effect of the St. David diversion on streamflow duration. Reaches A through D are gaining reaches, meaning they receive groundwater from the regional basin aquifer in the Upper San Pedro Basin. The bedrock constriction at the north end of the Charleston Hills also forces regional groundwater toward the surface and into the San Pedro River (Figure 4). In addition, the location of a fine-textured restrictive unit underlying much of the San Pedro River in these reaches affects transmission losses from the channel to the regional aquifer and the groundwater flow rate from the regional aquifer to the San Pedro River (Figures 4, 5, and 6). And in some cases when the restrictive unit is west of the San Pedro channel, it can produce artesian conditions that force groundwater to well upward into the channel (Pool and Coes 1999).

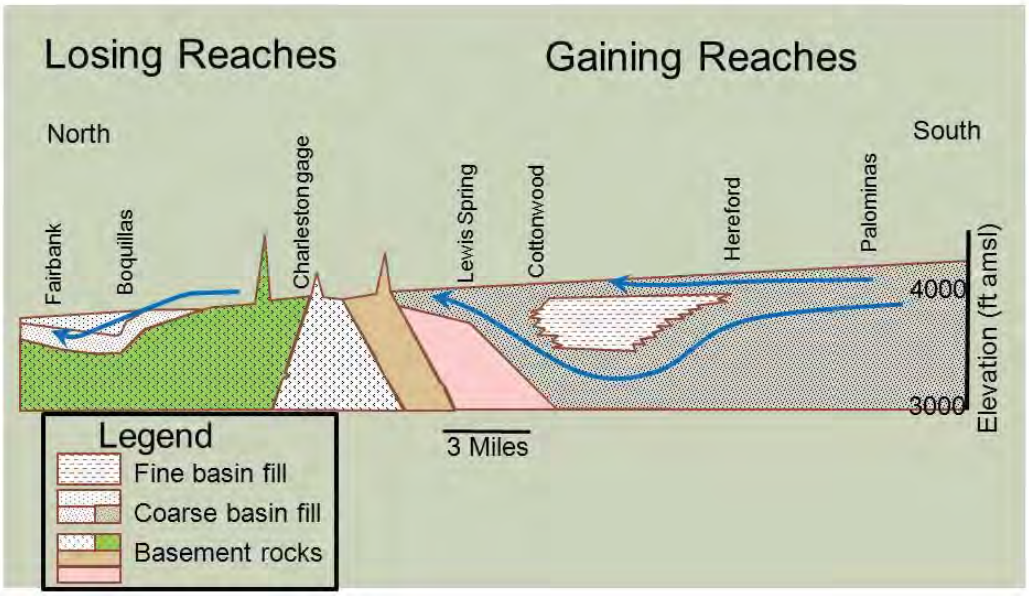

Figure 4. Simplified geologic cross-section of part of the Upper San Pedro Basin from the international border to Fairbank. Blue lines illustrate generalized water-flow patterns. Groundwater is maintained at or near the surface when it passes over restrictive units, such as fine-textured basin fill. Also, groundwater is forced upward by shallow basement rocks at the Charleston Hills. Surface water infiltrates into coarse basin fill and coarse alluvium north of the Charleston Hills.

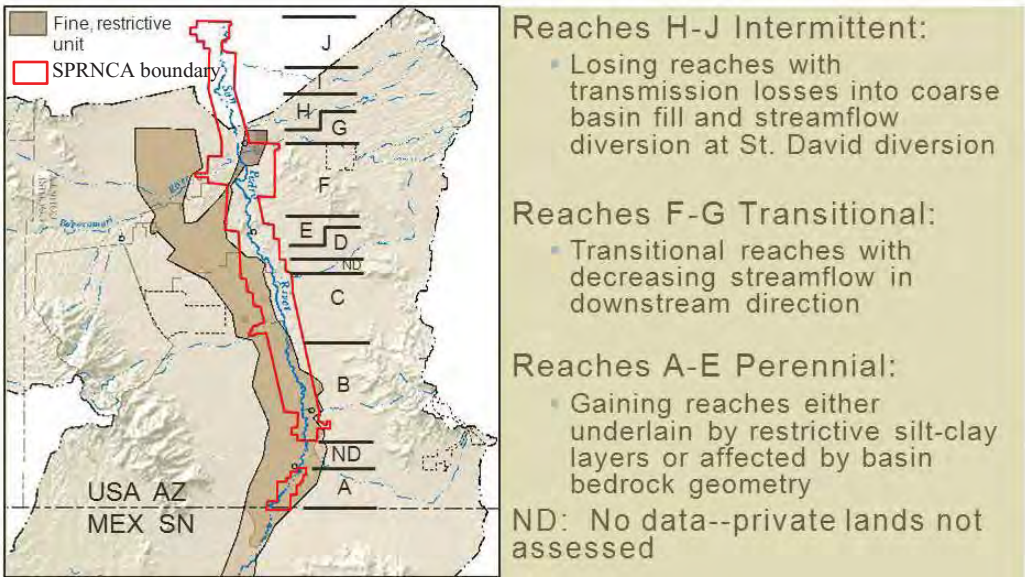

Figure 5. Map illustrates the approximate location of fine-textured (silt-clay) layer in the Upper San Pedro Basin (adapted from Leake et al. 2008).

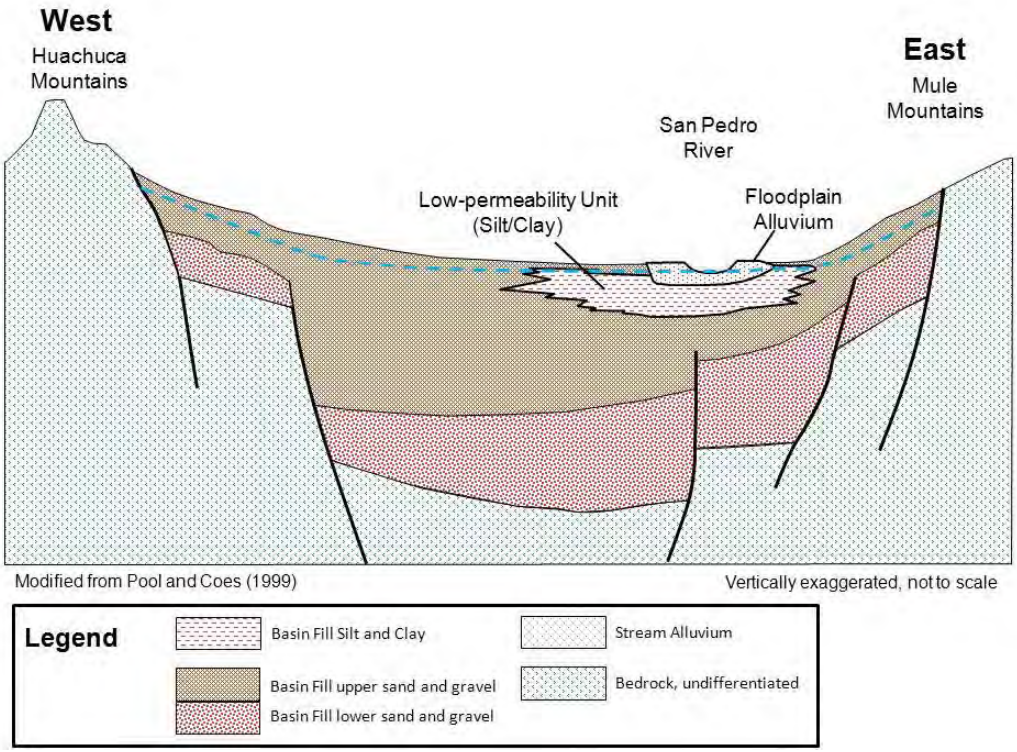

Figure 6. Simplified geologic cross-section of the Upper San Pedro Basin illustrating the role a fine-textured (silt/clay), low permeability unit can have on either isolating the San Pedro River from the regional aquifer, or reducing transmission losses from the channel to regional aquifers.

Reaches E and F traverse an area where bedrock is at or near the surface (Figure 4). These reaches have the potential for perennial or nearly perennial flow, due to a "pour-over" effect. Water forced to the surface in reaches A through D will pour over the lip of the bedrock at the north end of the Upper San Pedro Basin, flow downstream and will sustain perennial conditions for as long as possible until water begins to infiltrate into the coarse basin fill north of the Charleston Hills (Figure 4). For this reason, reach F is seen as transitioning from perennial to intermittent conditions. Groundwater pumping, drought, storm runoff, and surface diversions upstream of the Charleston Hills will affect the length and time of wetted channel conditions in reach F and possibly reach G.

Reaches H through J are primarily losing reaches as stream discharge infiltrates into the coarse alluvium and basin fill north of the Charleston Hills (Figure 4), especially downstream of the confluence with Willow Wash. There is no known or practical management alternative within the immediate control of the BLM that can change these reaches from intermittent to perennial flow within a management time scale. In addition, the existing legal water rights that divert water from the San Pedro River at the St. David diversion constitute a limiting factor currently beyond the control of BLM management; consequently the current capability of reach J will prevent it from becoming perennially flowing. Finally, some short intervals within reach I contain obligate wetland and facultative wetland riparian plants that suggest they might have the potential for perennial flow (Fogg et al. 2012), but these are small, discreet, isolated intervals and are not representative of conditions observed throughout the reach. Therefore, the existing hydrogeologic information suggests that the potential of reach I is intermittent flow (Table 1).

Reach-Based PFC Assessment Summary

Approximately 51 miles of the San Pedro River were delineated into 10 discrete reaches, varying in length from a little over one mile to more than 12 miles (Figure 7). During the assessment, the interdisciplinary team walked each reach, discussed observations and took photographs and notes. At the end of each reach, the 17 individual PFC checklist items (Figure 8) were discussed, issued identified, and responses, ratings (Table 2 and rationale recorded. Appendix D contains a listing of riparian issues prioritized by reach developed from the group's discussion.

Today on more than half its length, the riparian areas along the San Pedro River have reached a point where they are resilient to the most common flood events. Of the approximate 51 miles assessed, 27.4 miles (54%) are at PFC; these reaches have the ability to maintain their dimension, pattern and profile in moderately high flood events. Another 8.9 miles (18%) are rated FAR with an upward trend, 4.2 miles (8%) at the northern end below the St. David diversion dam are FAR with a downward trend, and 10.3 miles (20%) are FAR with no apparent trend (Table 1 . Appendix E contains a spreadsheet of riparian plants observed by reach.

Arizona State BLM Land Health Standards require that streams be managed in a manner that allows them to receive a rating of PFC or FAR with an upward trend. Not apparent or downward trend does not meet that standard and management actions to improve riparian health are required if the limiting factors are within BLM's control. If limiting factors are outside BLM's control, then coordination with other land owners and the public is essential to ensure the watershed is not contributing to riparian impairment.

Management action is needed on the lowest reach (reach J). Reach J was rated as FAR with a downward trend, and it was determined that conditions will not improve without changes in management. The main impacts limiting the ability of the reach to achieve PFC are the St. David's diversion, livestock grazing, and off-highway vehicle use. Impacts resulting from the diversion of stream flow at the St. David's diversion are outside the control of the BLM manager and cannot be changed under current BLM authority, although opportunities may exist to work with the Saint David Irrigation District on flow issues and management of their pop-up dam. Livestock and off-highway vehicle use, on the other hand, do fall under the BLM's management purview, and neither use is currently authorized. Elimination of these unauthorized uses would be a major step in helping recovery of reach J and are given increased importance since that is the only management action that can be taken directly by the BLM to improve condition of the reach.

For the reaches rated with either a not apparent or downward trend, the NRST recommends the first action be establishment of a monitoring strategy to measure change over time in *key* PFC checklist attributes marked "no." Most of the comparisons between the 1987 photographs and visual observations indicate a clear improvement in riparian health, however, the NRST feels that in the reaches rated below standard, improvement had either stalled or even changed to a downward trend. Where trend was not apparent to the team, monitoring can help determine if trend is actually up or down.

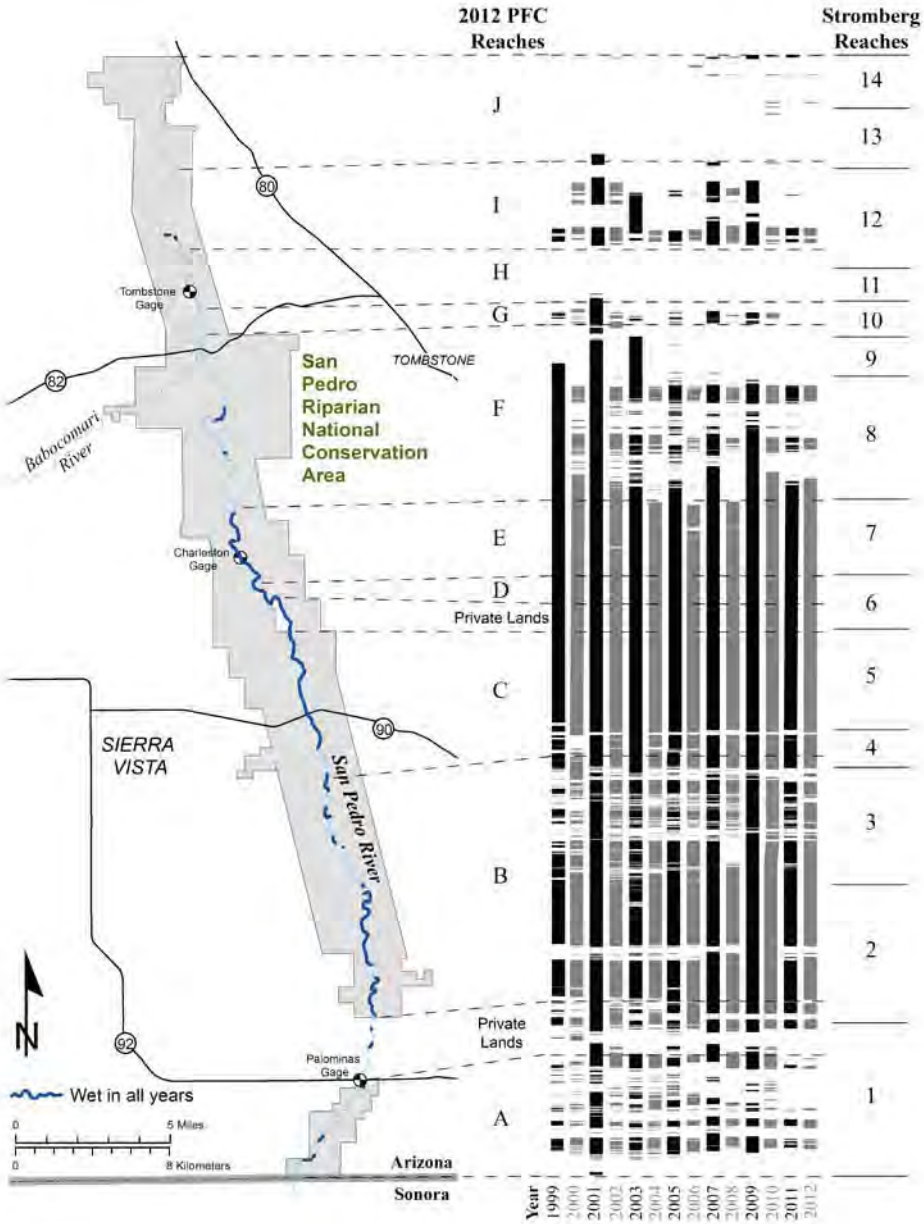

Figure 7. PFC assessment reaches, also showing Stomberg reaches from Leenhouts 2006 and wet/dry mapping results as of 2012 courtesy of The Nature Conservancy. The heavy river line (darker blue shows reaches which were mapped as consistently wet in all 14 years surveyed. Bars on right side represent wet reaches for each year, 1999–2012. The black and gray lines are different colors simply to provide visual clarity. For more information on interpreting the wet/dry mapping results go to

Table 1: Summary of PFC Ratings by Reach						
PFC Reach	Stromberg Reach[1]	Reach Length (miles)[2]	Permanence of Streamflow at Potential[3]	Functional Rating	Trend on FAR	Relative Scale on Thermometer
A	1	6.1	Perennial[4]	FAR	NA	Middle
B	2, 3, some 4	12	Perennial	PFC		Lower
C	rest of 4 + 5	6.3	Perennial	PFC		Lower
D	6	1.4	Perennial	FAR	NA	Upper
E	7	3.8	Perennial	PFC		Lower
F	8, 9, some of 10	8.9	Perennial transitioning to intermittent[5]	FAR	upward	Middle
G	rest of 10	1.0	Intermittent	PFC		Middle
H	11, some of 12	2.8	Intermittent	FAR	NA	Middle
I	rest of 12	4.3	Intermittent with short perennial intervals	PFC		Middle
J	13, 14	4.2[6]	Intermittent	FAR	downward	Lower
		50.8				

[1] Stromberg reaches are displayed because Fogg et al. 2012 describes the potential of reaches based on the work of Stromberg and others documented in Leenhouts et al. 2006.
[2] From map measurements.
[3] Fogg et al. 2012 describes the potential plant communities of Stromberg reaches (Figure 7) by the expected permanence of streamflow at potential (perennial or intermittent), on three zones of geomorphic interest (terraces, floodplains, channel bed and banks). The information was verified by field examination of conditions by the interdisciplinary team.
[4] Although reach A is the most enigmatic reach due to spatial heterogeneity of channel bed and bank materials, indications are the reach has the potential for vegetation characteristics of perennial flow.
[5] Reach F is a losing reach, since basement rock that forced groundwater to the surface in the Charleston Hills drops off to great depth north of the Hills. Streamflow permanence at potential is expected to transition from perennial to intermittent along the reach.
[6] Reach J is approximately 5.5 miles long. The amount walked was 4.2 miles.

Table 2: Summary Table of Functional Ratings and Responses* to the 17 PFC Checklist Items by Reach

Reach	Rating	Trend#	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
A	FAR	NA	YES	NO	NO	YES	NO	YES	YES	YES	YES	Y/N	YES	YES	YES	NA	NO	YES	NO
B	PFC		YES	NO	NO	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	NA	YES	YES	YES
C	PFC		YES	NO	NO	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	NA	YES	YES	YES
D	FAR	NA	YES	NO	YES	YES	YES	YES	YES	YES	YES	YES	NO	YES	YES	NA	YES	YES	Y/N
E	PFC		YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	NA	YES	YES	YES
F	FAR	Up	NO	NO	NO	YES	YES	YES	YES	YES	YES	YES	NO	YES	NO	NA	YES	YES	NO
G	PFC		YES	NA	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	NA	YES	YES	YES
H	FAR	NA	NA	NA	YES	Y/N	NO	YES	YES	YES	YES	Y/N	NO	YES	NO	NA	YES	YES	NO
I	PFC		YES	NA	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
J	FAR	Down	NO	NA	NO	NO	NO	YES	YES	NO	YES	NO	NO	NO	NO	YES	NO	YES	NO

* Responses "Yes" for individual attributes or processes that are properly functioning, "No" for those that are not properly functioning, "NA" for those that are not applicable, and "Y/N" for both yes and no in part. Details of each response are provided in the narrative of each reach and in Appendix A: Reach Based Information.

Trends for Functional-at risk (FAR) reaches are either "Up" for reaches showing an improving trend, "Down" for those showing declining condition, and "NA" for those where the trend in condition is not apparent.

HYDROLOGICAL
1) Floodplain above bankfull is inundated in "relatively frequent" events
2) Where beaver dams are present are they active and stable
3) Sinuosity, width/depth ratio, and gradient are in balance with the landscape setting (i.e., landform, geology, and bioclimatic region)
4) Riparian-wetland area is widening or has achieved potential extent
5) Upland watershed is not contributing to riparian-wetland degradation

VEGETATION
6) Diverse age-class distribution of riparian-wetland vegetation (recruitment for maintenance/recovery
7 Diverse composition of riparian-wetland vegetation (for maintenance/recovery (*species present*
8) Species present indicate maintenance of riparian-wetland soil moisture characteristics
9) Streambank vegetation is comprised of those plants or plant communities that have root masses capable of withstanding high streamflow events (*community types present*
10 Riparian-wetland plants exhibit high vigor
11 Adequate riparian-wetland vegetative cover present to protect banks and dissipate energy during high flows (*enough*)
12 Plant communities are an adequate source of coarse and/or large woody material *(for maintenance/recovery)*

EROSION DEPOSITION
13) Floodplain and channel characteristics (i.e., rocks, overflow channels, coarse and/or large woody material adequate to dissipate energy
14) Point bars are revegetating with riparian-wetland vegetation
15) Lateral stream movement is associated with natural sinuosity
16) System is vertically stable (*not downcutting*
17) Stream is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition)

Figure 8. PFC Lotic Assessment Checklist Items

Reach A: PFC Assessment Narrative

Reach Overview

Reach A begins at the international boundary south of Palominas, AZ, and extends to the Highway 92 bridge over the San Pedro River; a distance of approximately 6 miles. It includes the public lands in Stromberg reach 1.

Reach Potential and Limitations

At potential, vegetation communities that are characteristic of perennial flow should be expected in this reach; however, the current flow regime represents a limitation to riparian potential. Temporal variability of base flows is compounded with spatial variability. The wet/dry map indicates a great deal of spatial heterogeneity in this reach with the border segment virtually always dry in June and another segment, less than two miles downstream, having water in it every year of the survey.

PFC Findings

Reach A was assessed on April 11, 2012. The reach was rated Functional-at risk with a not apparent trend. The primary rationale for the rating was that the sandy sediments are not being processed in the mid-section of the reach, leading to dry sections where flow is below/within the surface sands/gravels. Photos from the beginning and end of the reach show improvement over time, but there was no evidence in the dry mid-section to indicate improvement. Vegetative components are largely in working order, but an increased presence of bulrush and seep willow is needed for further development of channel narrowing and deepening. They are present, but not in the amount and/or community types necessary to help process sediments. It was speculated that upstream areas may be deficient in these species causing inadequate seed availability for this reach. Reach A might benefit from a program of planting seeds and/or plugs of bulrush in sections where there is adequate water and little or no presence of the species. Bulrush plays an extremely important role in bank stabilization and channel processes, and it might be possible to accelerate development of bulrush communities through planting.

Abundance of key stabilizing species including spikerush, Baltic rush and bulrush greatly increases in downstream reaches. Cottonwood trees were heavily infested with tent caterpillars, apparently an annual occurrence, but have generally healthy architecture to the crowns indicating that the stresses are being offset by growth in June and beyond. The drier center section of the reach may be an exception to this, but with wetted sections above and below it seems unlikely that groundwater is unavailable to cottonwood roots.

Floodplain areas with large amounts of organic material in the form of large, coarse and small wood, along with buried grasses and other vegetation, are building and increasing the water storage potential in portions of the reach. Over time, this will potentially increase return flows to the river during periods of low flow.

Overview of Key Attributes and Findings

Hydrology – Floodplain features are present to allow for frequent flood access, and to dissipate energy during frequent floods in sections where silt/clay is part of the substrate and narrower channels have formed. Coarse sediment areas result in a wider active channel, less frequent access to floodplain and a poorly formed channel. Cottonwood regeneration since 1987 is clearly evident on photo point pictures and is having positive impacts on channel and floodplain characteristics. Processing of sediments will be enhanced over time by increases in smaller woody and herbaceous species both in the active channel and on the banks.

The current channel has had at least one section straightened in the past for agricultural purposes. Heavy ingrowth of cottonwood has basically locked the meander pattern in place; rather than having the natural looping meanders typical of many streams with wide valleys and low gradients, the San Pedro becomes blocked by large wood deposits and the channel jumps to another high water channel or cuts around the blockages. This is considered the natural process for the stream at this stage of evolution. Because the gradient is so flat, there are only very small increases in overall gradient when the channel changes locations.

all beaver dam; building on sediment deposit, ch of the river.

Upstream view; channel dry to waypoint 813; no surface flow due to porous sediments. sand/gravel.

Vegetation – All the components are present for continuing recovery towards proper functioning condition and beyond, but in places much of the bank stability is being provided by cottonwood trees and very cohesive soils that resist erosion. Expansion of herbaceous species and seep willow within the active channel along the base flow elevation and toe of bank slopes will assist in formation of improved channel shape. Multiple age classes of cottonwood trees were seen except for seedling and young. The youngest age class was about 10-20 years, but given the episodic regeneration typical of cottonwood stands throughout its range, this is not considered a problem. The heavy infestation of tent caterpillars was an obvious drain on tree health at least in the short term, but observations suggests that essentially full recovery follows during most monsoon seasons. It was noted that some sections, including the drier center section, often displays yellow leaves during portions of some growing seasons. The cottonwoods in the dry mid-section also had more dead branches, but the willows and herbaceous species exhibited high vigor, so the cause of the dead branches is unknown. Localized patches of dead or stressed mature seep willow were observed, probably from record low temperatures in Feburary 2011; however, the overwhelming majority of seep willow in the reach was observed to be vigorous.

Erosion/Deposition – High flows that get out onto the frequent floodplain are effectively processed through the combination of vertical structure, large and coarse wood and well-developed vegetation on the floodplain. However, as noted earlier, sandy sediments are not being processed in the mid-section of the reach, leading to dry sections where flow is below/within the surface sands/gravels. As is true of several major river systems in the west (i.e., John Day in Oregon, Upper Missouri in Montana), continued channel narrowing and stability can occur by riparian vegetation becoming established within the active channel, particularly associated with the base flow level. Vegetation, including seep willow, bulrush and other sedges and rushes, are critical to this process. While some vegetation within the active channel may get scoured in flood flows, once established it tends to regenerate relatively quickly following scouring. Herbaceous vegetation and seep willow in the active channel and on the floodplain is a consistent feature in the downstream perennial reaches, but is only just beginning to establish in places in reach A.

Reach B: PFC Assessment Narrative

Reach Overview

Reach B begins at the Waters Creek road and extends north for 12 miles to Cottonwood. It encompasses Stromberg reaches 2, 3 and some of 4, excluding any private property.

Reach Potential and Limitations

Beginning about two miles south of Hereford and continuing north to the Cottonwood biomonitoring site, flow is characterized as spatially interrupted and temporally intermittent. However, wet-dry mapping indicates these reaches are predominantly wet, and several of the "dry" segments may be associated with short reaches of coarser substrate (hence hyporheic flow where water flows through the substrate rather than on the surface) downstream of tributary inputs. In addition, despite the general aridity of the past eight years, the proportion of Stromberg reaches 2 through 4 with surface flow during the wet-dry mapping has increased in recent years, likely as a result of discontinued agricultural pumping in the Hereford area (Dale Turner [The Nature Conservancy], personal communication, 2012). Reach B has the potential to support plant communities associated with perennial flow. Presently, locations upstream of tributary mouths represent the best sites for herbaceous colonizers/stabilizers to establish; enhanced conditions of base flow would support more widespread occurrence of these species.

PFC Findings

Reach B was assessed between April 12-14, 2012. It was rated Proper Functioning Condition, in the lower third of the rating class. Fogg et al. 2012 documented that in most of the perennial sections of the San Pedro River, a repeating pattern in terms of river form is expected. Sediment fans develop at the mouths of ephemeral tributaries. These form a partial barrier to flows and water backs up on the upstream side. As the stream cuts through the fans, an area of riffle develops and the stream transitions to a standard form of stream with a base flow channel and floodplain development. This pattern was observed throughout reach B. Reach B has better developed riparian vegetation than reach A, with cottonwood the dominant species along with seep willow, bulrush and other minor species.

Channel characteristics are also much better developed in reach B due to the abundance of bulrush and seep willow. In one extensive section of the reach, much of the cottonwood was eliminated in a wildfire several decades ago, but the herbaceous and smaller tree/shrub species are doing an excellent job of narrowing and deepening the channel. The floodplain has increased considerably in terms of aggradation and extension. Roughness on the floodplain from standing vegetation and dead/down materials captures sediment, which raises the level of the floodplain and overflow channels, followed by narrowing of the channel which allows more water to get onto the floodplain during flood flows.

There remains considerable opportunity for both improved channel characteristics and vegetation conditions in reach B. There are many sections where the riparian area will continue to expand, and have increasingly dense and strong plant communities develop. Water storage is increased within the floodplain area as this occurs.

Overview of Key Attributes and Findings

Hydrology – Floodplains that are accessible in frequent flood events (1-3 year events), are available throughout most of the reach. Sinuosity is affected by several short sections that were straightened for agricultural purposes prior to BLM acquisition, and there are two more recent meander cut-offs that were noted for follow-up monitoring. The banks on the straight sections are not eroding due to cottonwood/willow providing stability, along with highly cohesive soils that resist erosion along portions of the banks. It is suspected that some of the energy during high flows is being used to mobilize the bed. As water volume and velocity increases in the channel, in sand bed sections, the channel bottom is scoured, temporarily deepening the flow. As flows reduce, the sand from upstream sources refills the bed. Checklist item three was given a "no" response due to the minor channel alterations from straightening and the two meander cut-offs and their effect on gradient and sinuosity. These are relatively minor issues for the reach overall. This "no" is not significant for physical function because a large majority of the banks are stable and the reach is processing sediment appropriately.

Vegetation - It was noted that much of the herbaceous vegetation is relatively young and indicates recovery since livestock removal about 25 years ago. Bulrush in particular appears abundant in many portions of the reach, and is forming community types that will be very important over time for stable bank and channel development.

Cottonwood in the upper and lower portions of the reach line the banks of the stream as well as the overflow channels and old meander cut-offs, forming extensive galleries in places. The banks are highly stable and the cottonwood galleries are fully stocked stands. The mid-section of the reach burned in about 1996, and that section has only single trees or short lines of trees along the bank. Vegetation, including seep willow, bulrush, spikerush, Goodding's willow, sacaton and other plants provide the needed stability. It is expected that cottonwood galleries on post-entrenchment terraces will decrease in extent naturally as trees age and die, and sacaton will dominate those sites. Closer to the existing channel, the floodplain will continue to provide sites suitable for cottonwood trees to become established, albeit in a narrower band. Fires have locally reduced the extent of some cottonwood galleries in reach B, but recruitment of new cottonwoods is unlikely in this reach given the low rates of channel meandering and the extensive stands of sacaton and Johnson grass.

Erosion/Deposition – The presence of accessible floodplains with adequate roughness created by both herbaceous and woody vegetation, along with frequent deposits of large and coarse wood, helps dissipate energy and allows water to soak in and extend the wetted period for the reach and possibly downstream reaches. Sediment from tributaries was processing well, usually in the first 100-200 yards below the tributary mouths.

standard form – cottonwoods
hed after ones behind, leaning o

Upstream view; bulrush wading into channel and moving up the bank, narrowing channel, expanding riparian area, ponded form.

Reach C: PFC Assessment Narrative

Reach Overview

Reach C is 6.6 miles long and includes a portion of Stromberg reach 4 and all of Stromberg Reach 5.

Reach Potential and Limitations

At potential, vegetation communities that are characteristic of perennial flow should be expected. Reach C supports the native plant communities described previously for perennial flow along the river. However, recent declines in baseflow in this perennial section of the San Pedro River have raised concerns about the sustainability of natural groundwater discharge to the river and the floodplain alluvium. Survival and expansion of hydric herbaceous communities described for the active channel of perennial reaches depends on continued and sustained discharge from the regional groundwater flow system.

PFC Findings

Reach C was assessed on April 13, 2012. It was rated Proper Functioning Condition, in the lower third of the rating category. The primary rationale for the rating was that there were only two items given a "no" response and neither were considered significant for function in this reach (sinuosity due to some channel straightening, and presence of unstable beaver dams). The reach contains well-developed and robust vegetation and is developing the appropriate channel characteristics, exhibits stable banks, and adequate floodplain access. Reach C has two fences

that were constructed on the streambank, probably to protect the railroad bed. The fence across from Garden Wash is still intact and on the streambank, the one farther downstream is now in the channel due to bank erosion. There were varied opinions whether pulling them out would cause more harm than good.

Overview of Key Attributes and Findings

Hydrology – Throughout most sections of the reach, the frequent floodplain is accessible during 1-2 year events. While beaver dams are present, they are not stable and tend to wash out during periods of high flows, but they rebuild during low water periods. Beaver tend to locate dams on the tributary sediment fans; the tributary fans largely control the gradient even without dams. The beaver dams provide additional important water storage during low water periods.

Sinuosity was rated "no" as some past straightening has occurred for agricultural purposes and possibly for the highway bridge, but even the straightened areas are relatively stable due to cottonwood trees, willow, and other vegetation armoring the banks. The riparian area is expanding with both woody vegetation, largely seep willow, and strong herbaceous communities that are expanding both into the river channel and up the banks to the frequent floodplain.

Very vigorous bulrush stand, some 6' tall, extends from channel to atop the frequent floodplain.

Cottonwood trees on left at base of terrace; floodplain area, active channel bar right.

Vegetation – All vegetation items were given a "yes" response. Bulrush communities were notably more developed in portions of this reach than upstream; they were very vigorous and showed considerable expansion. A wildfire reduced the extent of cottonwood trees downstream from the bridge; many sites are now occupied primarily by Goodding's willow and seep willow.

Erosion/Deposition – Similar to reach B, the ephemeral tributaries deliver high amounts of sediment that create the multiple river forms – standard form, ponded form, fan/transition form, which are part of the potential. The existing combination of well-developed and expanding woody and herbaceous vegetation plus large woody material is able to appropriately process the sediments from the reach and tributaries during high flows, and adequate water is maintained during low flow periods. However, continuing channel evolution and development of vigorous and dense vegetation communities is important for sustainability and increased water storage in floodplain areas.

Reach D: PFC Assessment Narrative

Reach Overview

Reach D (part of Stromberg reach 6) is a 1.4 mile reach. About half of the upper portion of Stromberg reach 6 is private land; no assessment was made of conditions on private lands.

Reach Potential and Limitations

At potential, vegetation communities that are characteristic of perennial flow should be expected. In reach D, survival and expansion of hydric herbaceous communities described for the active channel of perennial reaches depends on continued and sustained discharge from the regional groundwater flow system.

PFC Findings

Reach D was assessed on April 16, 2012. It was rated as Functional-at risk with a not apparent trend. The reach is very close to PFC, and could quickly move upward to the next category in a short time (likely only a few years) with total elimination of grazing impacts. The primary reason for the FAR not apparent trend rating was inadequate riparian vegetative cover to protect banks during high flows. The cause is partially due to unauthorized and unmanaged grazing. Cattle and deer are grazing bulrush and seep willow on accessible bars, and hoof damage is occurring to developing communities of bulrush that are in tender stages. Without these impacts, trend would be upward based on overall vegetation development.

Several large washes deliver considerable amounts of coarse sediment to the stream in this reach. The depth of some of the deposits makes it difficult to establish vegetation; coarse materials dry more rapidly than the plant roots can grow to reach groundwater depths. These bars sometimes pulse down the stream, scouring out sides. As more vegetation is established over time, the stream will be able to more effectively process the contributed sediments.

Overview of Key Attributes and Findings

Hydrology – A floodplain is available and accessed, although it appears to be less accessible to the most frequent flows than floodplains higher up-river. A key need for reach D is to continue expansion of the riparian zone; narrowing the channel inward to develop a more efficient river for processing sediments, and expanding up the banks to increase strength and stability from the low flow channel to the top of the frequent floodplain.

Small unstable beaver dam on tributary fan, several dams in reach, not being maintained.

Moson Wash (also called Escapule Wash) carries much sediment during high flow events.

Vegetation – All vegetation items were given a "yes" response, except item 11 because the amount of stabilizing vegetative cover is inadequate, and overall the stream in this reach is earlier in its evolution in terms of vegetation development. As noted above, development is being retarded by unauthorized grazing. However, the riparian area is expanding in most places. Over time, much more bulrush is expected to develop in this reach.

Erosion/Deposition – Given current channel conditions and vegetation, the river has difficulty processing the heavy sediment load that is provided by the two large washes in this reach. While there was some initial thought given to the hypothesis that this might be the expected natural condition based on reach potential; the interdisciplinary team ultimately noted that there is room for improvement. If vegetation is allowed to improve and increase along the banks, it will help narrow the channel, and improve the processing of sediments by: (1) getting flood flows out of the channel, (2 reducing energy by increasing deposition on the floodplain, and (3) improving efficiency of within channel sediment transport.

Reach E: PFC Assessment Narrative

Reach Overview

Reach E is 3.8 miles in length. PFC reach E corresponds to Stromberg reach 7. The reach is more naturally confined by the Charleston Hills than above reaches, resulting in a narrow river valley with room for only small areas of floodplain adjacent to the river.

Reach Potential and Limitations

At potential, vegetation communities that are characteristic of perennial flow should be expected. In reach E, confinement of post-entrenchment surfaces by shallow bedrock is a limitation for storage of floodwaters that would benefit downstream reaches. In addition, survival and expansion of hydric herbaceous communities described for the active channel of perennial reaches depends on continued and sustained discharge from the regional ground-water flow system.

PFC Findings

Reach E was assessed on April 16, 2012. It was rated as Proper Functioning Condition, in the lower third of the rating category. The primary rationale for the rating was all pertinent assessment items were given a "yes" response. This was the first reach that recruitment of very young cottonwood seedlings (1-3 years) was observed near the channel in several locations (root sprouts were observed upstream). Other vegetation, including bulrush, showed clear expansion along the active channel and banks. There is the opportunity for continuing improvement of vegetation and narrowing of the active channel over time as the riparian area expands inward. However, the reach, in its current state, has the ability to retain its dimension, pattern and profile through moderately high flood events.

Down view to old Charleston Bridge showing excellent bulrush and Baltic rush growth, both banks.

Small patch of young cottonwood trees established from seeds.

Overview of Key Attributes and Findings

Hydrology – Reach E is a landform-controlled reach with naturally low sinuosity and only narrow areas of floodplain adjacent to the river. It primarily serves as a transport reach. A few sections likely have reached the potential extent of riparian vegetation, while others will continue to expand. Only one beaver dam was noted, located near the beginning of the reach, at the lower end of a tributary fan. The dam is being maintained by beaver and is one of the more stable dams observed on the river (see below).

Beaver dam, upstream view, provides additional water storage for plant establishment, some vegetation growing on dam.

Vegetation – The reach is well-vegetated throughout, with a full complement of woody species with diverse age classes including young cottonwood trees, bulrush, Baltic rush, and spikerush, often forming well-developed communities. These communities are expected to continue to expand well into the future, moving the reach condition towards potential.

Erosion/Deposition – In the area of the old Charleston town site, several large washes provide large sediment inputs to the river causing the channel to jump from one side of the river bed to the other, frequently. However, the river effectively processes this sediment in a relatively short distance downstream.

Reach F: PFC Assessment Narrative

Reach Overview

Reach F is 8.9 miles long. It is a combination of Stromberg reaches 8 and 9, plus a 1.1 mile length of reach 10 to the Fairbanks trestle. During pre-work, the interdisciplinary team planned for reach F to end at the mouth of Walnut Gulch; however, once in the field, they agreed that the characteristics of the reach continued down to the Fairbanks trestle.

Reach Potential and Limitations

Along this reach, flow transitions from perennial to intermittent. The upper portion of the reach should be able to support vegetation characteristic of perennial flow. The lower portion should support vegetation characteristic of intermittent flow. The extent of base flow depends on the total amount of water in the system upstream; flow persists through the entire length only in the wettest years. Improvement in bank storage and release here and upstream, and continued groundwater inputs here and upstream, could extend perennial flow farther down this reach.

PFC Findings

Reach F was assessed April 16-17, 2012. It was rated as Functional-at risk with an upward trend and falling in the middle third of the rating category. The primary rationale for the rating was that while vegetative condition was improving in all categories, key riparian plant species are not present in adequate amounts to stabilize the banks and impede mobilization of the stream bed during high flows. If the vegetation continues to improve, improvement in channel characteristics will follow.

Overview of Key Attributes and Findings

Hydrology – Floodplain access was not evenly distributed throughout the reach. For the first mile, the channel was overly wide. The width/depth ratio was out of proportion to the valley, limiting floodplain access. It was also noted that the stream is still developing sinuosity and cutting into the terrace in places. No engineered straightening was observed. Finally, the riparian area is clearly expanding, evidenced by both the existing condition of vegetation and also comparison of current conditions with historical photos.

Vegetation – Improvement is needed in the amount of stabilizing vegetative cover. This stream type should have a minimum of 70% of the bank protected by stabilizer plant species along with embedded wood and/or rock; however, it currently ranges between 50-60% based on ocular estimates. All of the other vegetative elements are in working order and will continue to evolve towards more stability given continuation of existing management and no loss of groundwater inputs to the reach.

Erosion/Deposition – Reach F does not produce the same type of sediment fans at the mouth of ephemeral tributaries with a ponded form above, as seen in previous reaches. Where good vegetative cover exists in combination with a suitable floodplain area, sediment is being processed well. However, major portions of the upper and lower end are overly wide sand bed channels where deposits are moved around and not stabilized by vegetation. Continued recovery should include expansion of stabilizing herbaceous plant community types along both the lower edge of the bank and along the low water channel. This will improve the processing of transported sediments, allowing them to be captured and aid in floodplain development.

Group looking for indicators and measuring level of frequent floodplain.

Stream cutting into terrace, strong cottonwood roots forced river to cut upstream; seep willow on point bar.

Reach G: PFC Assessment Narrative

Reach Overview

Reach G begins at the Fairbanks Railroad trestle. It was modified in the field by adding the first 1.1 miles to reach F due to the similarities in vegetation and channel characteristics; the remainder of reach G is 1.0 miles long and is part of Stromberg reach 10.

Reach Potential and Limitations

Reach G is predominantly a sand-bed channel with significant amounts of gravel and coarse material. This wide, shallow, coarse channel displays substantial infiltration through the bed so that the river no longer maintains perennial flow. Potential riparian vegetation for this reach is typical of that characterized for intermittent stream reaches.

PFC Findings

Reach G was assessed April 18, 2012. It was rated as Properly Functioning Condition in the middle third of the rating category. All checklist items were given "yes" responses with the exception of beaver dams (NA) and checklist item 14 regarding point bars (NA). This intermittent section is progressing well towards potential, and developing the appropriate vegetation, floodplain and channel characteristics consistent with its intermittent status. Bedrock rises to the surface at the lower end of the reach, helping to keep more water on the surface.

Downstream view, relatively narrow U-shaped channel. Well-developed vegetation for intermittent reach.

Tamarisk providing vertical structure that stops and holds large/coarse wood in place.

Overview of Key Attributes and Findings

Hydrology – This somewhat confined reach has an appropriate width/depth ratio; floodplain access is likely limited to those flows associated with 3-year flood events. There was discussion that the sand bed mobilizes to increase conveyance during high flow events but some areas may be inundated in more frequent flood events. Although not at potential, the riparian area is widening due to well-developed and expanding vegetation communities. As the riparian vegetation continues to expand toward the stream (assuming the riparian area does not dry out

and contract due to groundwater pumping), channel narrowing will occur and provide additional opportunity for overbank flows. Channel deposits appear smooth and sediments are being processed well, easily in balance with the amount of water supplied by the watershed.

Vegetation – All vegetation items were given a "yes" response for both woody and herbaceous species; the percentage of bank cover is easily adequate and appears to be more than is necessary for function (has approximately 80% cover at this time). Further downstream in the intermittent reaches, tamarisk (an invasive species) has increased. Recruitment potential for large wood is somewhat limited in this reach because; in general, there is only a narrow band of cottonwood along the banks, but no galleries. However, when considered in combination with the cottonwood trees present in upstream reaches, they are considered adequate to provide the recruitment necessary for function.

Erosion/Deposition – All attributes and processes are operating well in reach G and all items were given a "yes" response. Stable banks were noted.

Reach H: PFC Assessment Narrative

Reach Overview

Reach H generally corresponds to Stromberg reach 11, and is 2.8 miles in length. The reach was modified in the field due to some changed conditions starting above the mouth of Willow Wash and extending into the first part of Stromberg reach 12.

Bedrock is exposed at the beginning of the reach, and then shortly thereafter Willow Wash enters the San Pedro River and fundamentally alters the stream throughout the reach (Figure 9). Willow Wash is an ephemeral wash associated with a much larger watershed than Walnut Gulch, which enters a few miles upstream. As a result, it is contributing more sediment and coarser sediment to the river, than Walnut Gulch.

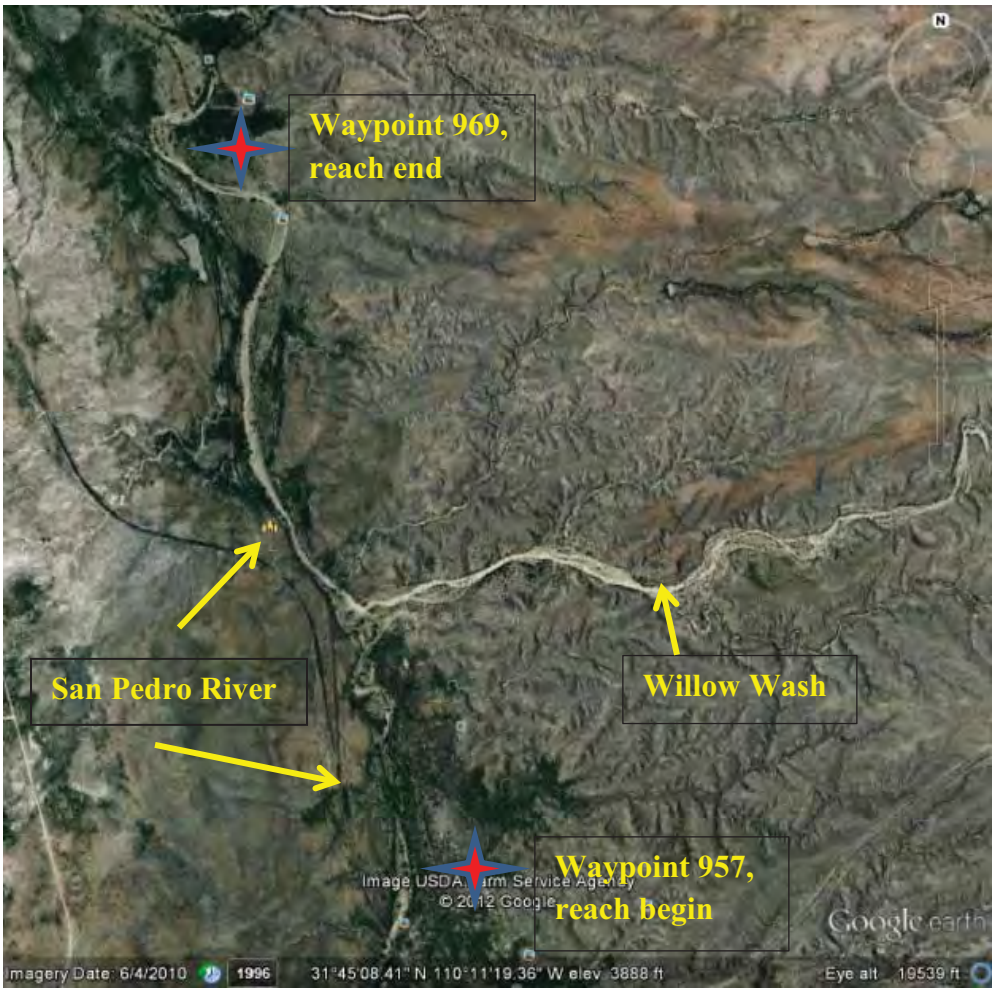

Figure 9. Google Earth image showing Willow Wash entering San Pedro River.

Reach Potential and Limitations

In reach H, the San Pedro River is predominantly a sand-bed channel with some gravel and coarse material. This wide and shallow channel displays substantial infiltration of water through the bed so that the river no longer maintains perennial flow. Potential riparian vegetation is typical of that characterized previously for intermittent stream reaches. Willow Wash sediment contributions dominate the condition of this reach, an element that is clearly visible on aerial photographs (Figure 9).

PFC Findings

Reach H was assessed on April 18, 2012. It was rated as Functional-at risk with a not apparent trend. The primary rationale for the rating is inadequate vegetation along the channel and floodplain to effectively capture sediments during high flows. More vegetation is needed to capture available wood and provide additional roughness to slow water velocity for sediment capture.

While intermittent, reach H should have more well-developed vegetation than it currently does; reaches above and below reach H have much better riparian vegetation conditions. The large

amounts of sediment flowing from Willow Wash seem to overwhelm the river's ability to adequately process them as needed for vegetation to establish. A review of successive photos beginning at the photo point at the mouth of Willow Wash (looking north), show a series of recovery years, from 1987 to 1998. Prior to 2004, major flows of sediment from Willow Wash were deposited in the San Pedro River.

Down channel just below Willow Wash showing large cobble bed.

Upstream view.

The river was able to rebound and recovery is seen again between 2005 and 2008 when another flood flow occurred from Willow Wash. While there is a visible increase in riparian vegetation between the 2008 photo and the 2012 photos, it is likely inadequate at this time to establish an upward trend given the sediment from Willow Wash. Reach recovery has been essentially stalled due to repeated high flow events, thus no apparent trend was noted.

Overview of Key Attributes and Findings

Hydrology – Lack of adequate floodplain areas along much of the reach is considered a problem for sediment processing. There was an obvious lack of mature shrubs (or small trees) close to the channel to capture available logs to help build areas for sediment deposit and bank building. Additionally, the sand-bed channels are likely mobilizing during high flows, lowering the bed and then refilling as water levels subside. As a result, the reach is unable to establish a functional floodplain. Riparian vegetation, which could help narrow the channel and develop the floodplain by widening the riparian area inward, was patchy.

There are two theories as to why sediment is not being processed well along much of the reach: (1) there is excess sediment supplied by the watershed (i.e., Willow Wash), or (2) because of the intermittent nature of the flows and naturally high sediment inputs from the watershed, it is taking longer for riparian recovery on this reach.

Vegetation – While the species needed for riparian function are present, including young cottonwood, reach H needs much more vegetation along the banks to help develop improved floodplain characteristics. There were more facultative and facultative-wetland species present here than in previous reaches, as would be expected in an intermittent section. Ash, a tree that grows in drier conditions, was more common than in higher reaches. Overall, vigor was high on ash, deer grass and other species, however, some dead/dying tops were observed in the willows and cottonwood trees between Willow Wash and Tombstone gage. Furthermore, reach H has

apparently lost cottonwood trees, in small patches, from wildfire. Large woody material from upstream reaches will be important for continued recovery. Some cottonwood trees are showing signs of stress in reach H (dead tops). Groundwater data is necessary to determine the cause so appropriate management actions can be identified.

Erosion/Deposition – As previously noted, there is a need for improved floodplain characteristics to better manage water and sediment. Currently, there is inadequate roughness to slow water, allow for sediments to deposit and become vegetated. In particular, there is a need to develop more woody structure such as cottonwood trees along the floodplain to stop large/coarse wood. In some places tamarisk was fulfilling that functional need.

Reach I: PFC Assessment Narrative

Reach Overview

Reach I is 4.3 miles in length, and generally correspond to Stromberg reach 12. Stromberg's reach break between 11 and 12 did not correspond with a clear change in channel morphology and riparian vegetation, so the bottom of reach H and the beginning of reach I was modified in the field to go farther downstream from the original reach delineation. The revised reach begins near Contention, and ends at the St. David diversion. Although this reach lies between reach H and J, which were both rated functional-at risk, reach I was in surprisingly good functional condition.

Reach Potential and Limitations

The wet/dry map done by The Nature Conservancy and BLM shows that a substantial length of reach I has surface water in the channel through the dry season in some years. The reasons for this are not entirely clear. One theory is that the wet segments are where the river runs parallel to groundwater level contours and groundwater is discharged. It appears that short segments of this otherwise intermittent reach may be capable of maintaining plant communities more characteristic of perennial reaches. In particular, a short segment near the beginning of the reach has been wet in all 14 years of wet/dry mapping.

PFC Findings

Reach I was assessed on April 19, 2012. It was rated as Proper Functioning Condition in the middle two-thirds of the rating category. The primary rationale for the rating is that every pertinent checklist item was given a "yes" response. Some sections appeared to have reached the potential extent of riparian vegetation, while others can still expand. As noted in the discussion on potential, this reach is substantially different from the reach immediately up and downstream. The vegetation and channel characteristics of reach H (upstream) are simply overwhelmed by the frequent and large infusions of coarse sediments from Willow Wash, and most of the water flows through the sands and gravels. As a result, the river is unable to manage the large sediment inputs and forms floodplains in reach H. At the beginning of reach I, however, there is a dramatic change. The channel narrows, water is much more consistent on the surface, vegetation associated with perennial flows is present throughout most of the reach at the expected locations, and there is clear evidence of riparian expansion, both on the low bars and near the bankfull level.

Overview of Key Attributes and Findings

Hydrology –Reach I is characterized by a narrow channel, abundant floodplain areas frequently accessed by high flows, and cottonwood galleries; not just a band of cottonwood as in the reaches above and below. These galleries are accessed by overflow channels. The channel is comprised of much finer materials (silt/clay than the reaches either above or below, much of which comes from the wash where the railroad grade is immediately adjacent to the stream. The change in character is very evident from the beginning of reach I in terms of both vegetation and channel characteristics. The well-developed riparian vegetation has been able to effectively capture sediment, thereby narrowing the channel and increasing floodplain access. In places, the stream is still increasing its length by cutting into the pre-entrenchment terrace. Ponded form was not found in this reach, nor any beaver activity or dams.

Vegetation – All the vegetation items were given a "yes" response. There is an expanding area of herbaceous and woody vegetation along most of the channel that will facilitate channel narrowing and further improve the ability of the reach to process sediments.

Downstream view showing very healthy vegetation and narrowed channel near beginning of reach.

Upstream – retake of photo at Summers Well – point bar vegetating from active channel to floodplain.

Erosion/Deposition – Floodplain features and overflow channels, coupled with well-developed stabilizing vegetation on the banks, are working well to dissipate the energy from flood events. Bars along the reach are vegetating well; unlike most other reaches a few well-defined point bars were noted (see photos above). About half way down the reach, a tributary delivers clay to the river which holds more soil moisture.

Reach J: PFC Assessment Narrative

Reach Overview

Reach J is 5.5 miles long. Only the first 4.2 miles were assessed from St. David diversion down to the private land boundary at the flowing well (Stromberg reach 13 and about half of 14).

Reach Potential and Limitations

Reach J is composed of a wide, shallow, sand and gravel channel susceptible to high infiltration losses along its entire length. In addition, the St. David diversion at the upstream end, at times, diverts surface flow from the river. For these reasons, reach J is dry a good portion of the year. The potential vegetation communities should have the same characteristic of those along intermittent reaches discussed earlier. Limitations arise from the loss of base flow and the diversion of stream flow.

Near the downstream boundary of the SPRNCA, springs and artesian wells outside the stream channel indicate regional groundwater discharge from the confined, deep aquifer in this area. St. David Cienega lies west of the river here and is reportedly supplied by artesian water. Apparently, the silt/clay confining layer that separates the base of the pre-entrenchment alluvium from the top of the basin-fill is only partially effective at limiting upward movement of deep groundwater in this area. However, the expression of this water source in the vegetation along the river primarily occurs downstream of reach J and the SPRNCA boundary.

PFC Findings

Reach J was assessed April 20, 2012. It was rated as Functional-at risk with a downward trend, just barely above non-functional. The reach is behaving more like an ephemeral channel in terms of its hydrology and erosion-deposition; but the presence of riparian vegetation provides evidence of a relatively accessible water table along at least parts of the reach. Cottonwood trees were present along parts of the reach as well. On the intermittent scale between perennial and ephemeral, reach J is on the drier end. The primary rationale for the rating is that basically none of the needed channel characteristics were functioning. While the right kind of riparian plants were present along most of the reach, vigor was relatively low on seep willow near the top of the reach. Young cottonwood showed evidence of livestock use over a period of several years that is preventing the trees from developing normal growth form. Goodding's willow, an obligate wetland species, occurred in portions of the reach but was noted to be low in vigor on some sites. Lack of vigor was the primary factor in the downward trend determination because recovery is dependent on increasing plant species required for function, and a lack of vigor in these species will prevent recovery.

Overview of Key Attributes and Findings

Hydrology – The channel in reach J is functioning more as an ephemeral system than an intermittent, as described in the reach potential section. Well defined banks and the needed floodplain area are not present along most of the reach. Sediment depositions are not being vegetated or appropriately processed. There is a decided lack of floodplain and/or channel roughness that could serve to slow water during high flows to set up vegetation recovery. During flows that are high enough to be diverted but not blow out the push up dam, water is lost to the St. David diversion. Additionally, modeling shows groundwater pumping has negatively affected the Babocomari River flow (Lacher 2011), and subsequently less water is available to all the downstream reaches including reach J. Repeat photos compared to 1987 demonstrate improvement in terms of some bank formation and an expanding riparian area. In 1987, it is likely the stream would have been rated non-functional, but repeat photos are only available at a few points making it somewhat difficult to come to that determination.

Vegetation – The primary woody riparian species are Goodding's willow, an obligate plant species, along with seep willow, ash, tamarisk, and cottonwood trees. The primary herbaceous species is sacaton, a facultative grass. Rabbitsfoot grass was common, and was the only herbaceous species that occurs more in wet areas than dry. Vigor was observed to be a problem; at the upper portion of the reach, seep willow exhibited low vigor (yellow leaves (chlorosis), but improved lower downstream. Goodding's willow also appeared stressed (dead tops) in portions of the reach. Young cottonwood trees had a clubbed growth form from repeated livestock browsing. While there was good diversity in woody species and age class, there was an inadequate amount present for bank stabilization and not enough large wood being grown in the reach for long-term maintenance. Additionally, there was a lack of woody structure along the channel and banks to stop large/coarse wood to facilitate deposition and channel formation. Large wood being entrained is critical to the health of all reaches of the San Pedro River within the SPRNCA.

Seep willow is developing on some of the bars (a clear increase based on historical photos) and will begin to capture smaller wood and sediments if expansion continues. In this stream system, seep willow plays an important role in early stabilization of bars and capture of sediments and organic materials that facilitate improvement. Given the high diversity of suitable riparian woody species along with multiple age classes, the vegetation foundation for recovery is present, contributing to the rationale for the functional-at risk rating. Two important components of recovery for reach J are: (1) the need to release of young cottonwood to grow into trees (current browsing is preventing this), and (2) the need to improve the vigor and expansion of seep willow bands and patches along the channel.

Erosion/Deposition – There is inadequate area of accessible floodplain, overflow channels, and other features that could slow down water and improve conditions for accelerating vegetation growth that is critical to development of channel and floodplain characteristics. The over-wide channel transports all the water through the reach, along with wood and debris and sediments that could build a healthier system if it could be slowed, processed and vegetated.

Young cottonwood with mid-age and older in back left; off-highway vehicle tracks throughout.

Young cottonwood appears more shrub-like than tree form from repeated grazing.

Overarching Findings, Issues and Management Considerations

Groundwater Connection to Riparian Vegetation

Findings/Observations

The most common concern expressed by people about the San Pedro River is whether or not groundwater pumping within the regional and near-river aquifers is currently, or will soon be, diminishing flows within the river. Although the PFC assessment protocol does not directly evaluate groundwater impacts, the current conditions of the stream channel and riparian vegetation can reflect an impact related to groundwater conditions. Groundwater and baseflow modeling efforts on done by the Upper San Pedro Partnership and others provide information on what has happened in the past and likely future scenarios (e.g., Lacher 2011). Stream gage measurements clearly show diminished San Pedro River flows over a sustained period of time; this may be a result of reduced groundwater discharge to the channel, long-term drought, or a combination of both (a groundwater pumping deficit aggravates the effects of drought on groundwater discharge to the river).

Hereford (1993) noted during his investigation of the San Pedro River twenty years ago that riparian vegetation had successfully colonized the post-entrenchment channel and that the existing flow regimen was adequate to support riparian vegetation. The recently completed PFC assessment of the San Pedro River came to the same conclusion. The team found no clear evidence that would indicate significant impacts to the riparian vegetation or channel form from groundwater lowering at this time. Some riparian vegetation did show signs of stress in a few places (e.g., cottonwood trees with contracted canopies or dead tops), but all reaches, except reach J, were dominated by healthy plants. This does not mean that groundwater levels are not declining; rather, it means that the assessment found little evidence that the current conditions of riparian health are being seriously affected by groundwater depletion to date. However, it is important to note that effects to vegetation and channel conditions will lag behind reduced flows. *By the time vegetation shows the impacts of groundwater depletion, it will likely be past the time that impacts could be halted or reversed.* If Lacher's (2011:4) prediction that "much of the San Pedro and Babocomari Rivers will cease to have perennial baseflow over the next century as a result of increased groundwater pumping" ultimately came to pass, it would have a negative impact on the physical functioning of the system.

Issues

In reaches H through J, the assessment team discussed whether the potential should be that of an intermittent or perennial system. However, the riparian plant communities observed and documented on terraces, floodplains, and streambanks were those that are expected at potential for intermittent streams as described by Fogg et al. (2012) and Stromberg et al. (2005) and were consistent with the existing hydrogeologic information for these reaches.

Some members of the Gila District interdisciplinary team felt that some dead or low-vigor plants were indicators of groundwater decline in some localities. The NRST reviewed the observations and concluded that these cases were not indicators of groundwater decline. In some instances the low-vigor, dying, or dead plants reflected damage from a late frost in the early spring of 2012. But the dominance of healthy plants was sufficient to counter any frost damage. Another

indicator of plant stress resulted from an infestation of tent caterpillars that was especially evident in reaches A through C. The herbivory by tent caterpillars also is not evidence of water-table decline. To the contrary, because caterpillars were browsing newly formed leaves and buds throughout the entire canopy of mature cottonwood trees, the opposite could be concluded. Obviously, sap flow was reaching the entire canopy of cottonwood trees, so this stress did not indicate a drop in water table. Elsewhere, cottonwood trees with a contracted crown were cited as evidence of groundwater decline. However, the contraction of the crown of a single cottonwood tree, or of a small group of cottonwood trees, is not definitive evidence of water-table decline (Figures 10a and 10b), especially when adjacent trees are robust and exhibit full canopies.

The reasons for lost vigor of individual plants are many. But water-table decline should be ubiquitous within a reach and evident in the following ways:

- Shallow-rooted, herbaceous riparian plants should be more sensitive to water-table decline than deep-rooted, riparian trees and shrubs; consequently the more sensitive herbaceous plants will show signs of water stress before deep-rooted tree species.
- The contraction of canopies should be observable across complete galleries of riparian trees, not individual trees within a gallery (Figures 10a and 10b).

Figure 10a. An individual, mature cottonwood tree near the Tombstone gage in reach H has limited extent of live canopy. The cause of canopy reduction is unknown due to the comparative vigor of adjacent trees. The slope in the background leads up to the Presidio.

Figure 10b. All the other mature cottonwood trees observed within one-half mile downstream of the Tombstone gage (shown at right) have fully leafed canopies and appear completely vigorous. This suggests that individual trees with canopy reduction have health matters unrelated to a declining water table, which should affect all trees within an equal-age cohort similarly.

Management Considerations

In addition to the BLM's efforts to pursue perfection of water rights for instream flows and groundwater levels as directed by Congress, the most important NRST recommendation is for the BLM to regularly monitor the wells close to the river that are intended to measure groundwater flow and hydraulic gradient. This monitoring effort must also incorporate elements of a quality assurance program. The NRST also recommends that analysis of historical water levels—similar to the analysis provided for a few wells in the 321 report—be extended to all shallow wells along the river with historical water-level data. The NRST suggests that periodic

reports summarizing water-level data be produced in cooperation with the USGS. [5] This will turn data into information that is useful for management, and it is the only way of knowing whether or not groundwater discharge to the river is reduced. It will be valuable information to go along with the regional aquifer well data presented in the 321 report (Upper San Pedro Partnership 2012).

Also, if riparian vegetation is showing signs of stress, groundwater monitoring from a nearby well would help with the interpretation of whether the stress is from drying or other causes. Unfortunately, the NRST was not provided with monitoring data from any of the BLM wells closest to the river and/or areas where vegetative stress was noted.[6] The best scientific approach to understanding whether there is reduced groundwater flowing to the San Pedro River is through monitoring the water-table level in wells located in areas of high groundwater withdrawal where modeling suggests an expanding cone of depression, and in wells located close to the river. Currently, important monitoring wells that have been a responsibility of the BLM have not been monitored over the past two years due to a staffing loss[7].

The potential for reach A is perennial flow; however, parts of the reach are seasonally dry. Therefore, restoration of perennial flow is a high management priority for this reach. Additionally, groundwater modeling (Lacher 2011) has projected that reaches D through G will be most affected by the cone of depression created by groundwater pumping in the Sierra Vista subwatershed and along the Babocomari River. See Appendix D for more information.

Tributaries and Sediment

Findings/Observations

The form of much of the river and the processing of sediments and water are highly related to the tributaries that enter along its length. As noted in Fogg et al. (2012), and verified during the field assessments, a repeated pattern of channel forms is associated with inputs of sediment from major tributaries along the river. Effects are observed upstream, at the mouth, and downstream of tributaries and result in increased diversity in terms of habitat niches throughout the length of the river. At the tributary mouth, large amounts of sediment result in a grade control for the section of channel above the mouth, usually creating a ponded area that may extend for ½ mile upstream of the tributary mouth. As the stream cuts through the tributary mouth sediment, a riffle section is created that is steeper in gradient for a short distance, and then usually, within a distance of 100-200 yards, a more standard form or channel shape of a low-gradient stream

[5] The NRST recognizes that some of this data is part of the BLM's water right claim and is currently attorney-client privileged information. However, it is also very important information for the public to understand in order to support the hard choices that go along with dealing with the groundwater pumping deficit

[6] The NRST recognizes that the data from nine of the 72 BLM wells are currently attorney-client privileged information and unable to be publically shared. However, access to this information would have helped the team more conclusively determine the effect of reduced groundwater levels on riparian vegetation in the few areas where stress was noted.

[7] Since the loss of a Hydrologic Technician in October 2011, many of the 72 wells that were regularly monitored before that have not been monitored on a regular basis. USGS was contracted to monitor those 72 wells plus the nine wells close to the river associated with the Federal Reserve water rights claim from October 2011 to December 2011. BLM staff now regularly monitors the nine wells associated with the Federal Reserve water rights claim, some of which are equipped with transducers which collect data on a regular basis between monitoring visits (Ben Lomeli, personal communication, October 9, 2012).

follows. Each of these forms (ponded form, transition form, and standard form) provides important habitat needs. For example, the Huachuca water umbel tends to be found in the standard form of perennial reaches, whereas the transition sections may offer important spawning habitat for some fish species (e.g., desert sucker). And the ponded form provides habitat for beaver and some fish. In addition, the ponded form upstream of tributary mouth fans is believed to represent conditions where future cienegas are most likely to form (Henderson and Hinkley 1984, pp. 164-165; Fogg et al. 2012, p. 18).

As the river transitions from largely perennial in the upper reaches to largely intermittent at the north end, the ponded form is lost. Reach E is the most northern extent of the ponded form associated with tributary fans.

One of the important aspects of understanding the evolution of the San Pedro system following channel incision is determining whether the sediment supply from tributaries is causing impaired conditions along the San Pedro River. To this end, the NRST examined the balance between water and sediment conveyed to and by the San Pedro River. The team gave special attention to the deposits that formed at the mouth of many ephemeral tributaries and the deposits and channel patterns that resulted downstream of the tributary mouth fans. The sediment-water balance provides information on the capacity of the San Pedro River to process its sediment load.

The potential document (Fogg et al. 2012) included a discussion of tributary-mouth fans and served as the basis for interpreting sediment load from tributary streams and the capacity for the San Pedro River to process its sediment load. Comparatively steep, ephemeral channels deliver sediment episodically to the San Pedro River in response to isolated, high-intensity storm runoff. Much of the sediment that accumulates at the tributary mouth remains there until peak discharges occur on the lower gradient trunk stream (i.e., San Pedro River). The peak flows on the San Pedro River generally occur at different times and in response to different hydro-meteorological events than those on ephemeral tributaries.

Sediment yield from ephemeral tributaries is typically high because these channels lack the riparian vegetative cover that protects stream banks from erosion and traps sediment in suspension. Furthermore, sediment yield is especially naturally high in semiarid environments (such as the Upper San Pedro Basin) as predicted by the Langbein-Schumm (1958) rule (Figure 11). The Langbein-Schumm rule illustrates that the relation between precipitation and sediment yield is not linear; rather sediment yield peaks under semiarid conditions because increasing precipitation offers the potential to move more sediment; however, it also promotes greater plant cover. Therefore, it is natural to find a lot of sediment deposited at the mouth of ephemeral tributary streams, particularly in the arid lands of the American southwest. Furthermore, large tributary fans, specifically those large enough to decrease gradient and to pond water upstream of fans, are ubiquitous in arid lands and have been previously described in the scientific literature (e.g., Cooley et al. 1977; Triska 1984; Miller et al. 2001, 2004; Germanoski and Miller 2004; Jewett et al. 2004; Chambers et al. 2011). Hendrickson and Minckley (1984) discuss this process in southeastern Arizona streams and note that tributary mouth fans can pond water that creates conditions conducive for cienega formation, which is also mentioned in Fogg et al. (2012). Large tributary mouth fans were common in reaches A through D, regardless of the degree of urbanization in the watershed or whether the tributaries drained areas east or west of the San Pedro River.

The idea of excessive sedimentation must be evaluated in terms of whether the San Pedro River has the transport capacity to process the sediment delivered by ephemeral channels. When sediment load exceeds transport capacity, then one expects to see a continuum of conditions reflecting transport deficiencies. A first indicator of excessive sediment load is a change in particle size of the stream bed, followed next by construction of mid-channel bars, then streambed aggradation (Parker 199; Wilcock et al. 2009). Very late, or advanced, indicators of excessive sediment load include changes in stream pattern (e.g., shift from single-thread to braided channel) and finally channel slope, as these changes require much time and rearrangement of large volumes of sediment (Parker 1990; Wilcock et al. 2009).

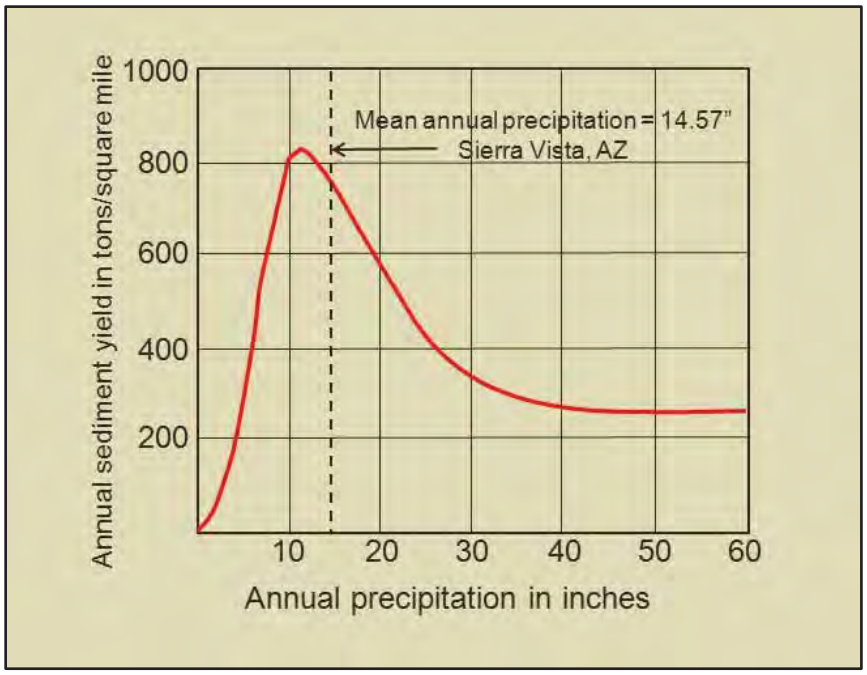

Figure 11. Langbein-Schumm (1958) sediment-yield curve illustrates that the highest natural sediment yields occur in semiarid environments where the potential for precipitation to move sediment is high, yet the vegetative cover in uplands is relatively sparse. When annual precipitation increases above the mean levels of semiarid environments, it supports more vegetation cover, which in turn protects the land surface and decreases erosion and sediment yield.

Although one or more members of the Gila District interdiciplinary team suggested that the low sinuosity was an indication that stream slope was too steep in an effort to move excess sediment, this suggestion was not consistent with any observed changes that should precede slope changes. Specifically, the NRST did not observe a change in surface textures in the stream bed, which were similar to subsurface textures in the channel bed and the textures observed in the bed of tributaries. Furthermore, the channel had some active channel bars, but nowhere (beyond the tributary mouth fans) were mid-channel bars or braided-channel pattern observed—the telltale indicators of excessive sediment and the telltale precursor to any increase in channel slope. The fact that standard, single-thread channel form occurs within a couple hundred meters of tributary mouths is an indication that the San Pedro River has the transport capacity to move the sediment load fed to it by its tributaries. Finally, excess sedimentation should be accompanied with unstable channels, which in turn are suggested by a lack of bankfull indicators. However, in reaches A through G and I, bankfull indicators were all well developed and apparent.

Physical evidence of overbank aggradation was observed in many places, particularly in reaches A through E. Most of the aggradation is wash load (also called suspended load), composed of fine particles, silt and clay, that are readily suspended in the water column and trapped by vegetation on stream banks, or the floodplain as a consequence of overbank flooding. Aggradation of the floodplain is consistent with the NRST findings that much of the San Pedro River has been undergoing a cycle of channel evolution since about the 1880s or 1890s (Figure 3; also see Figure 4 in Fogg et al. 2012) and is now in channel evolutionary stages IV to V, which includes processes of floodplain widening and floodplain aggradation. NRST findings are consistent with those of Hereford's (1993), who also observed that the San Pedro River system has been stable or stabilizing since about 1955. His study of a sequence of aerial photographs indicates the San Pedro River had high rates of lateral channel movement and floodplain widening from about 1900 to 1955 and then the channel evolutionary pattern shifted to vertical aggradation after 1955. Evidence of vertical aggradation includes the accumulation of finely-laminated, fine sediment on stream banks and floodplains (Figure 12a), and the burial of tree root crowns by several feet of fine-textured, overbank sediment (Figure 12b; also see Figure 2 in Fogg et al. 2012). Additional, anecdotal evidence of aggradation derives from the need to attach vertical extensions on some monitoring wells because the ground elevation has risen to the point of burying or nearly burying the tops of the wells (Jim Fogg, pers. comm. 2012).

Figure 12a. Recent accumulations of woody material and mud-cracked, fine-textured sediments (left foreground) are ubiquitous on the floodplain and streambank, particularly in reaches A through E, G, and I.

Figure 12b. The visible bases of tree trunks are straight and lack the flared morphology that occurs when the root crown is at the ground surface. Straight trunk morphology indicates floodplain aggradation since tree germination. Some root crowns are buried by several feet of sediment.

In summary, the San Pedro River appears to be aggrading by building a floodplain and by narrowing its channel. In the context of channel evolution, these are favorable signs indicating that some reaches have reached proper functioning condition and that others are moving in that direction. By all indications, the San Pedro River is processing the wash load by building floodplains through vertical aggradation. Features such as mid-channel bars and braided-channel patterns were not observed downstream of tributary mouth fans, supporting the conclusion that sediment is not excessive. Furthermore, the NRST concurs with Hereford (1993:42), who stated, "Factors that reduce runoff volume, increase salinity, change runoff seasonality, or reduce sediment loads are detrimental to the riparian community." Protection of both the flow and the sediment regime of this river are crucial to its continued evolution and survival.

Issues

Although most reaches appear to be processing sediment adequately, reaches A, D, and H contain evidence that sediment loads and transport capacity are out of balance. The condition in reach A is the most enigmatic. During the April 2012 assessment, streamflow was observed in the upper and lower parts of reach A but the channel was dry in the middle interval of the reach. One possibility for the lost streamflow is that sediment is accumulating in the channel and streamflow becomes hyporheic, meaning it becomes subterranean and flows through the sediment below the channel bed. The part of the channel where streamflow is lost coincides with an area where there are agricultural fields bordering the channel. Dikes were constructed to protect the agricultural fields from discharge in ephemeral tributaries and, it seems, they have limited sediment delivery and discharge from the ephemeral tributaries. Consequently, the San Pedro River may not be receiving all the discharge it needs to move sediment through the reach.

Alternatively, reach A showed declining function from historical groundwater pumping for agricultural irrigation. Recently, The Nature Conservancy purchased and retired groundwater rights in this area, and wet-dry monitoring results show an increase in length of wetted channel within reach A, suggesting that water-table elevations are rising and streamflow conditions are improving.

The watersheds of tributaries in reach D need to be assessed to see if the amount of sediment delivered to the river is natural or has been increased due to urban development in the Sierra Vista subwatershed. Likewise, Willow Wash, which joins the San Pedro River in reach H, has had a series of high-sediment input events over the past 25 years. Each event tends to undue the riparian recovery observed during the preceding few years. A watershed analysis of Willow Wash might reveal the source of the copious sediment and whether this volume is natural or excessive.

Management Considerations

The health of the river and its riparian areas is related in part to the health of the uplands. The NRST recommends that a detailed analysis be done to determine the hydrologic impacts of agricultural dikes, railroad beds, and abandoned gravel pits within the SPRNCA, as well as conducting cooperative watershed condition assessments of tributary drainages, and follow-up with watershed improvement plans where indicated, with priority on tributaries that drain into reaches A, D, and H (Appendix D). Another study should be conducted to evaluate whether treatments to reduce mesquite in selected sites on the pre-entrenchment terrace would improve grass cover and better control upland hydrology and sediment supply.

Channel Evolution

Findings/Observations

The San Pedro River began downcutting around 1890 from its downstream end and progressing upstream to and beyond the international border (Hereford 1993). What had been a broad low-gradient valley with a shallow meandering stream (Figure 3, stage I flowing through a generally marshy environment became a high-energy gully with the river flowing at the bottom (Figure 3, stage II). Hereford (1993) used a sequence of aerial photographs to document channel evolution

from the early to late 20th century. The photography indicates the channel and floodplain widened in many places from the early 20th century to about 1955 (Figure 3, stages III and IV . From 1955 to the present, the channel has meandered little and the floodplain has evolved primarily from vertical aggradation (Figure 3, stage IV; also see Figures 12a and 12b; and Figures 2 and 3 in Fogg et al. 2012). After livestock were removed from the San Pedro River within SPRNCA in 1989, riparian vegetation has expanded tremendously. This vegetation has trapped sediment during high flows, which in turn has built stream banks and formed a narrower, deeper channel. Continuing evolution of the channel will likely occur in timeframes measured in decades before levels of dynamic stability are attained similar to those that occurred prior to entrenchment in the late 19th century.

Although the channel has meandered little in the past 50 or more years (Hereford 1993), the dominant channel- and floodplain-forming processes result from vertical aggradation and episodic lateral movement of the channel. Episodic lateral movement occurs when large woody debris jams or large volumes of sediment delivered by tributaries obstruct the main channel and divert flow into an overflow channel which then evolves into the dominant channel. This process is most common in the transition form, which occurs at or immediately downstream of tributary fans (refer to Fogg et al. 2012). This channel-switching process is more akin to channel avulsion and not to point-bar meandering (Appendix A, reach B, photo 53 shows an example of this).

Various depositional bars were observed in the San Pedro River channel; the interpretation and significance of these were discussed during the assessment. The NRST found very few point bars in the San Pedro River (Figure 13a). A true point bar is recognized by an upward-fining sequence of sediment (e.g., gravel sediment near the base, grading to silt and clay at the top) that occurs on the inside of a meander bend and extends from the channel bed to the floodplain (Figure 13a). In contrast, alternating, or side bars form on either side of a meandering, low-flow thalweg (Figures 13b and 14). Side bars are not point bars as they do not: (1) show a depositional form in which the top of the bar is connected to the floodplain (i.e., bankfull elevation), (2) have an active cutbank that has retreated laterally as a consequence of point-bar deposition and expansion, (3) coincide with lateral movement of the channel and development of channel sinuosity as a consequence of deposition, and (4) have a meander length that is typically 10-14 times channel width and a radius of curvature at the apex of the bend that is 2-3 times the channel width (Figures 13b and 14). Therefore, it is inappropriate to use side bars to determine checklist item 14, which is specific to point bars. Active-channel bars commonly form below the scour line; therefore, there is little opportunity to form and retain stabilizing plant communities on active-channel bars.

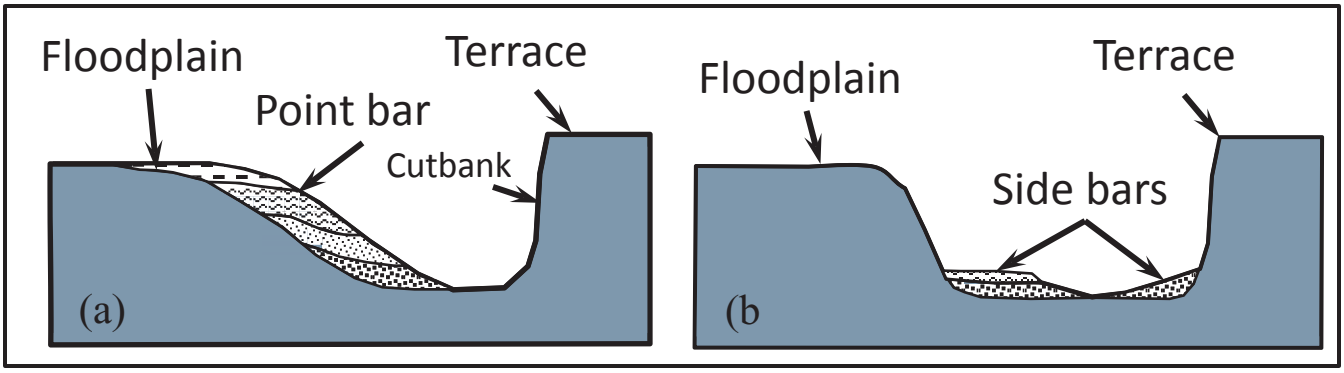

Figure 13. Channel cross-sectional diagrams illustrating (a point-bar deposits grade upward from coarse to fine sediment and merge at their top with the floodplain; and (b) side, alternating, or active-channel bars occur on the channel bed and do not form a streambank deposit that merges with the floodplain.

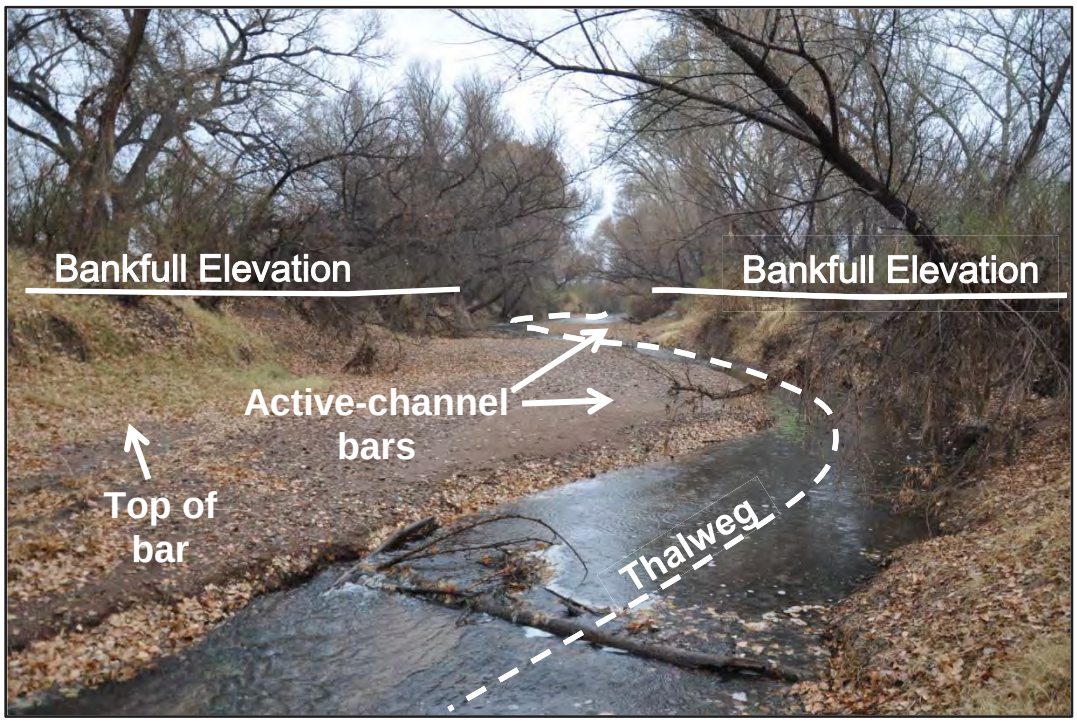

Figure 14. A low-flow thalweg (dashed line) illustrates sinuosity within a straight channel. The alternating bars are active-channel bars, not point bars. These active-channel bars do not show: (1) a depositional form in which the top of the bar is connected to the floodplain (bankfull elevation , (2) an active cutbank that has retreated laterally as a consequence of point-bar deposition and expansion, (3) lateral movement of the channel and development of channel sinuosity as a consequence of point-bar deposition, and (4 a meander length that is typically 10-14 times channel width and a radius of curvature at the apex of the bend that is 2-3 times the channel width. The radius of curvature displayed here is less than the channel width.

Issues

One issue raised during the assessment discussions was the consideration of active versus passive restoration of some sections of the river. Passive restoration is a management choice to allow the river to recover using its own processes and timescales. Active restoration involves some level of engineered approaches such as addition of in-channel engineered structures or use

of less intrusive practices, such as induced meanders (Zeedyk and Van Clothier 2009). The most commonly discussed active restoration strategy for the San Pedro River was the use of induced meanders.

Management Considerations

Passive restoration is a least cost and least risk approach to recovery. The NRST agrees with Hereford's (1993:42 conclusion that "maintaining a healthy, reproducing riparian plant community is probably the most important management strategy." Though some have suggested the use of induced meanders to accelerate restoration, Zeedyk and Van Clothier (2009), the leading advocates of induced meanders emphatically point out that induced meanders are "…***for the treatment of incised channels only"*** (Zeedyk and Van Clothier 2009:81; emphasis used by original authors). They stress that "…**the goal of Induced Meandering is to halt further downcutting while simultaneously initiating floodplain development**." (Zeedyk and Van Clothier 2009:72; emphasis used by original authors).

Active restoration practices, such as induced meanders, are typically reserved for unstable channels (e.g., those in channel evolutionary stages II or III, Figure 3 . There are no known case studies where stabilized or stabilizing systems are deliberately destabilized for the sake of riparian restoration. Hereford (1993) found that the San Pedro River has been stable since about 1955. The NRST concurs with Hereford's findings that the San Pedro River is no longer incising; instead it has now formed a new, inset floodplain, is stable, and is clearly aggrading vertically (Figure 3, channel evolutionary stages IV and V). Consequently, the NRST recommends against using engineered structures or induced meanders in the San Pedro River channel. Sound riparian management and passive restoration practices should be adequate to complete the channel evolutionary process.

Furthermore, because the San Pedro River incised more than 100 years ago and is now transitioning from channel evolutionary stage IV to V, the time and need for active restoration practices has passed. Installing structures or features now could destabilize a system that is either stable (i.e., reaches at PFC) or stabilizing (i.e., reaches at FAR). Not only would active restoration activities be counterproductive, they would generate great costs in human labor, materials, and money. Finally, because the river is subject to large and energetic monsoonal flood events, active restoration structures would be highly vulnerable to failure and could initiate severe, unintended channel and floodplain responses, setting back the progress made during the past 100 years of channel evolution and particularly the past 25 years of management since the SPRNCA was established by Congress.

Fremont Cottonwood Trees and Goodding's Willow

Findings/Observations

Extensive areas of floodplain have existed along most of the San Pedro River since about 1955 (Hereford 1993). As the floodplain becomes a large "sponge" of intermixed sediments and organic materials that stores water from flood events, it can slowly release water to enhance base flows within the river. This also helps mitigate the effects of prolonged dry periods, because water remains available at a level that can be reached by the root systems of riparian vegetation.

For example, a flood in October 2000 expanded the spatial extent of perennial flow into 2001 (Stromberg et al. 2006). Stream evolution in reaches B through E, all with essentially perennial flow, has reached the point where vegetation captures sediments that result in relatively rapid aggradation of the floodplain (captured under items 1 and 13 of the PFC assessment, see Figure 8), development of channel characteristics (item 3), and more frequent floodplain inundation (item 1).

Large wood is important for dissipating energy in the San Pedro River system, and the Fremont cottonwood stands will be an important source of large woody material for decades to come (checklist items 6 and 12 of the PFC assessment). Organic matter that forms from large amounts of buried plants, dead wood, and litter will increase floodplain capacity to provide stored water for plant growth and river flow in dry periods. Soils with large amounts of organic material have the ability to store and slowly release much larger volumes of water over time than just mineral soil alone (Hudson 1994). This reservoir of water in the soil is not just theoretical; volumes can be estimated based on the depth (thickness), width (extent), effective field porosity, and organic content of the younger alluvium (Holocene deposits) within the SPRNCA. Over time, this storage will provide more water to the channel, increase the growing period, and potentially help increase the length of perennially wetted channel and duration of stream flow in intermittent reaches. Both groundwater contribution from the regional aquifer and stored water from floods are needed to sustain base flows.

The extensive areas of cottonwood, along with Goodding's willow, ash, other trees, and sacaton, aided the process of floodplain aggradation and channel development and will continue to be essential given the high energies associated with flood events. Much of the desired channel narrowing and sediment capture is now being done with seep willow and bulrush in combination with large and coarse wood. Seep willow and bulrush can spread rapidly when well established and form well-developed communities that protect the banks from erosion, capture sediments and organic materials, and build banks, thereby narrowing the channel. As the channel narrows, less water is needed to fill the channel and inundate portions of the floodplain where water can infiltrate floodplain soils and recharge the floodplain aquifer. The large, strong cottonwood trees and Goodding's willow provide the overall environment where the understory species can contribute to maintaining the channel's dimension, pattern, and profile. Riparian development largely occurs near the top of the banks by cottonwood, willow, and other trees along with seep willow, and sometimes within the active channel by seep willow, bulrush, and other herbaceous stabilizers.

Without cottonwood trees and Goodding's willow providing large pieces of dead wood and strong living roots, the San Pedro River would simply have a broader flat sand bed, with few or none of the associated values that led to the designation of the SPRNCA. The same amount of water would flow through the system, but rather than part of it being captured in the floodplain and slowly released, it would pass through the system, similar to most other large rivers in Arizona. The San Pedro River is more than just the water that flows in its channel; it is part of a complete ecosystem that requires all the pieces to be in place in order to function.

The current cottonwood galleries in reaches rated PFC are primarily fully stocked stands of mature trees and since the rate of channel migration is lower now than before the galleries were established, there is less area for establishment of new trees from seed. Cottonwood trees are

vulnerable to wildfire, evidenced by areas where cottonwood galleries were lost in relatively recent fires.

Issues

Misunderstanding about the role of cottonwood trees and other vegetation in stream evolution and recovery was revealed in ongoing discussions with the public and BLM partners concerning the San Pedro River. Some people questioned the importance of cottonwood trees and whether it would be better to remove the trees to reduce the amount of evapotranspiration that occurs. The thought is that more water would be available to the river if the trees and other vegetation were not using up so much groundwater. This was a similar concern on many streams in the western United States in the middle part of the 20th century when major efforts were undertaken to remove cottonwood and willow from streambanks. Normally, the trees and shrubs were sprayed with herbicides and as they died, their roots lost the needed strength to hold the banks in place; and so many streams either widened or downcut during subsequent periods of high flow. Additionally, many miles of streams were straightened to either make farming operations easier or to drain wet areas. Many streams downcut as a result of these practices and the values being sought by the landowners and managers were lost. Not until the latter part of the century did scientists and riparian management practitioners begin to understand and teach the value of riparian areas and the key role that vegetation plays on many stream types. It is undeniable that trees use water (evapotranspiration); however, it is also true that riparian vegetation aids in floodplain development, dissipates streamflow energy, and provides organic matter which facilitates flood water storage. More importantly, these are also the conditions upon which the SPRNCA was established.

Another issue is related to the factors that permit establishment of new cohorts, or galleries, of cottonwood trees. Some members of the Gila District interdisciplinary team questioned why old galleries of cottonwood trees did not have any young seedlings. The question illustrates some fundamental misunderstandings concerning the processes that affect cottonwood recruitment. Simply put, cottonwood trees are a disturbance-dependent species. Overbank flooding is the primary disturbance that generates establishment of a new cottonwood gallery. Establishment of seedlings within an existing cottonwood gallery is rare, because seedlings have difficulty surviving under the shady canopy of older trees; have trouble competing where grass and other herbaceous vegetation is already established; and have very specific soil-moisture requirements, which are typically satisfied by certain floods. Young cottonwood trees within older galleries rarely established from seeds; typically they form from root sprouting.

Since the pioneering work of Everitt (1968), riparian ecologists and fluvial geomorphologists have long recognized that large riparian trees, especially cottonwood trees, tend to establish in equal-aged cohorts, which mature into equal-aged galleries. Establishment typically results from the relatively rare coincidence of several factors: (1) a flood that occurs coincident with or immediately prior to seed release, (2) a flood that deposits sediment on a floodplain to create a bare mineral surface to serve as a seed bed, devoid of or lightly covered with competing herbaceous vegetation, (3) a flood that recharges a shallow alluvial aquifer, which provides necessary moisture to seedlings, and (4 moist post-germination conditions that permit growth of the roots of seedlings to keep pace with the decline of the water table during the first and second growing seasons. The coincidence of these conditions is rare; and researchers (Hupp and Osterkamp 1985; Stromberg et al. 1991, 1993; Johnson 1994; Scott et al. 1996, 1997; Shafroth et

al. 1998, Gonzalez 2001a, 2001b) have found that recruitment of new cohorts of cottonwood trees typically occurs, on average, once every 10, 20, or more years.

In perhaps the most geographically relevant study of cottonwood germination, Stromberg (1998) reviewed the establishment of Fremont cottonwood along the upper San Pedro River through the SPRNCA. She noted that from the 1890s through the 1970s, flood events that generated establishment of new cohorts of cottonwood trees occurred, on average, less than once per decade, and only in the 1960s was there more than one establishment event per decade. During the 1980s and 1990s, there were 2 and 3 recruitment events per decade, respectively (Stromberg 1998). However, even though the 40-year interval from 1960s through 1990s had more frequent establishment events than the prior 70 years, the spatial area of galleries established since 1960 is less than that established prior to 1960. The decrease in spatial area is directly related to the change in channel evolutionary processes in the 1950s. Hereford (1993) demonstrated through study of a time series of aerial photographs that the San Pedro River floodplain was evolving primarily through lateral migration (i.e., channel meandering) until the 1950s and has been evolving through vertical aggradation (i.e., by storage of suspended sediment on the floodplain) and channel narrowing since the 1950s. Consequently when the active channel was wide, and the channel meander rate was high, the spatial extent of newly-formed galleries was relatively large. But when the width of the active channel decreased, the channel meandered little, and the floodplain aggraded vertically by capturing sediment, newly-formed galleries were relatively small and tended to occur in very narrow bands along the narrowing channel.

The NRST believes that the smaller size of galleries since the 1950s creates the illusion of lower cottonwood establishment. In truth, there have been more frequent establishment events since the 1950s than in the decades earlier (Figure 15; Stromberg 1998).

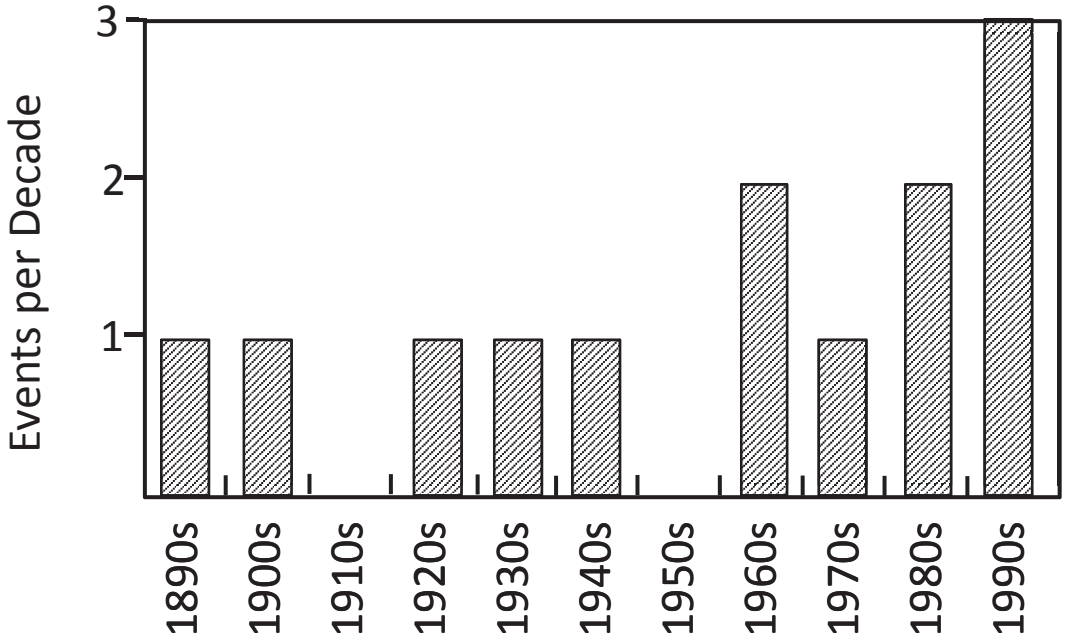

Figure 15. From the 1890s through the 1970s, flood events that generated establishment of new cohorts of cottonwood trees occurred on average once per decade, and only in the 1960s was there more than one establishment event per decade (from Stromberg, 1998). During the 1980s and 1990s, there were 2 and 3 recruitment events per decade, respectively (from Stromberg 1998). However, even though the 40-year interval from 1960s through 1990s had more frequent establishment events, the spatial area of galleries established since the 1950s is less than that established prior to the 1950s. The decrease in spatial area is directly related to the change in channel evolutionary processes at about this time. As Hereford (1993, pp. 21-24) demonstrated through study of a time series of aerial photographs, the San Pedro floodplain was evolving primarily through lateral migration (i.e., channel meandering) until the 1950s and has been evolving through vertical aggradation (i.e., by storing suspended sediment on the floodplain) and channel narrowing since the 1950s.

An individual gallery typically does not contain a broad range of age classes. The norm is for each gallery to have an equal-age cohort. However, a determination of age-class structure is not made at the scale of an individual gallery. Instead, the age of each gallery is aggregated at the reach scale (Figures 16a and 16b) to determine the structure of age classes when assessing item 6 of the PFC checklist.

Figure 16a. Mature cottonwood trees of approximately equal age line both banks of the San Pedro River a few hundred meters downstream of Boquillas Wash in reach G. These mature trees all have full canopies, broad, thick branches, and large diameter trunks.

Figure 16b. An equal-age stand of young cottonwood trees occurs on the streambank in reach G. This gallery is much younger than the one depicted in Figure 14a, as suggested by the shorter tree height, narrower crown profile, thinner branches, and smaller trunk diameter.

Management Considerations

In many reaches, cottonwood trees are at or near maximum stocking, so the management concern is taking care of existing cottonwood trees. There will be natural mortality from insects, disease, and beaver; these generally should be allowed to continue with natural processes and outcomes. However, to the extent practical, preservation and protection of existing cottonwood galleries should be a part of a vegetation management plan, and well-developed fuels and wildfire management plans (see Fire and Fuels Management below). The protection of cottonwood trees is definitely important in reaches with a functional status of FAR, because these reaches in particular, are dependent on cottonwood trees (living and dead) for energy dissipation, streambank protection, and floodwater capture and storage.

Fires have locally reduced the extent of some cottonwood galleries in reach B, but recruitment of new cottonwoods is unlikely in this reach given the low rates of channel meandering and the extensive stands of sacaton and Johnson grass. Some cottonwood trees are showing signs of stress in reaches H (dead tops). Groundwater data is necessary to determine the cause, so the appropriate management actions can be identified. Recruitment of cottonwood trees is failing in reach J because of browsing from trespass livestock.

Livestock Impacts

Findings/Observations

One of the major decisions made in 1989 through SPRNCA's original plan was to exclude livestock grazing from areas along the river. An extensive collection of photographs taken along the river in the summer of 1987 clearly demonstrate a river with very little riparian vegetative cover and degraded channel conditions. Cottonwood trees had become well established along most of the river's length and although some channel definition was forming, most reaches continued to be characterized by an overly wide and flat channel. Some Goodding's willow and seep willow are visible in photos, but are not abundant. Little herbaceous vegetation is evident in the 1987 photos, and what is there tended to be very low-growing forms, or forbs that may not have been palatable to livestock. It is likely that the source of livestock water primarily came

from the river itself, so the herbaceous vegetation that existed was grazed and trampled multiple times each year. This kept these plants in a state of very low vigor. In that state, even a few cows throughout the river corridor could keep the vegetation in poor condition. After livestock removal, repeated photographs document a rapid increase in cottonwood and willow species along much of the river. Release from the effects of continuous grazing also resulted in colonization by important woody shrubs and herbaceous species including seep willow, bulrush, and other strongly rooted riparian species.

A key finding of this assessment, however, is that while the BLM has made efforts to eliminate use by trespass livestock in the SPRNCA, it is still occurring and to some degree retarding recovery of sections of the river. Unauthorized grazing was found all along the river, but the detrimental impacts were more visible in localized areas and within certain reaches (see Appendix D). This provides evidence that the riparian area is not yet to a point, overall, that livestock grazing could be permitted along the San Pedro River without retarding improvement or even causing impairment. Expansion of the riparian vegetation has reached the point where rapid change is possible in many places, however, low amounts of unmanaged grazing is impacting development of vigorous stabilizing riparian communities where livestock access the streamside area. The damaging impact observed was occurring both from livestock foraging and also by livestock trampling which can destabilize streambanks and shear plant rhizomes. On reach J, which is FAR with a downward trend, livestock use on cottonwood regeneration was identified as a significant management issue that was retarding recovery.

Issues

Trespass livestock is an issue along the river corridor throughout the SPRNCA[8], and even though only a small number of animals use the areas along the river, that livestock use is unauthorized[9]. At some times of the year, the riparian vegetation growing on the low bars adjacent to the river is essentially the only green forage available thus attracting cows; and water is always an attractant in areas where it is in short supply. Although the area being affected by unauthorized grazing is quite small in relation to the overall area, in some sections it is clearly having some effect on recovery. Unauthorized livestock grazing is retarding the recovery of sections of the river, and needs to be eliminated. There is also browsing and grazing by deer, wild pigs, and other wild herbivores, but these impacts were considered minimal by the NRST at this time, and not influencing recovery.

Management Considerations

Eliminate trespass livestock in the river corridor to provide the maximum opportunity for continued improvement and evolution of the river. This is a high priority in reaches B, D and J; and a medium priority in reaches C and F (Appendix D). Based on the PFC assessment findings, the riparian corridor and river are not yet to a point, overall, that livestock grazing could be permitted along the San Pedro River without retarding improvement or even causing impairment.

[8] The river corridor is not a part of the three BLM allotments where livestock grazing is authorized to occur in the NCA. Grazing is authorized on the private land within the river corridor; however, that allotment is not currently grazed and has not been in many years.

[9] NCA staff has made efforts to control unauthorized use in the river corridor, but more needs to be done and State Office support is required for resolution of this issue.

Use this information along with other data and perspectives when re-evaluating grazing use in the SPRNCA during the RMP revision process.

Tamarisk (Saltcedar)

Findings/Observations

Tamarisk is an aggressive non-native species that occurs across much of the western United States. It often out-competes native vegetation and is extremely difficult to control through mechanical or chemical means. Tamarisk is found throughout the San Pedro River within SPRNCA with increasing populations and density south to north. It is found only occasionally in the uppermost reaches, in part due to aggressive control efforts by BLM and partners. In the lowest sections of the SPRNCA, tamarisk will potentially displace most of the willow and cottonwood over time without aggressive control; this is due to its ability to spread rapidly and its deep roots that can tap into water tables beyond the reach of young cottonwood and willow.

The Gila District BLM has an active and aggressive plan and program for managing tamarisk. Fundamentally, the strategy entails complete control and elimination to the extent possible in the upper reaches. In the lower reaches, tamarisk is eliminated as far north as is economically feasible; at some point, populations of tamarisk are simply too large and too difficult to access and treat economically. This approach allows for prioritization of limited budget and staff for doing the work. In the lowest end, the focus is on keeping areas around springs or wetter areas free of tamarisk.

Economics aside, the longer tamarisk expansion can be kept at bay, the higher the opportunity for more desirable species including velvet ash and cottonwood to occupy sites if water availability increases in the various sections of the lower river. Beyond that, the question about the structural, ecological and physical value of tamarisk compared to other vegetation that might establish needs to be considered. Where conditions are suitable for desired riparian vegetation and the tamarisk component is small, complete control is possible and the expectation is no reduction of physical function. On the lower reaches, in places, it is one of the primary stabilizing species able to exist with the deeper water tables; if removed, there needs to be consideration of what will replace it. In places in the southwest, tamarisk provides some habitat for species like the Southwestern Willow Flycatcher, an endangered species.

Issues

Tamarisk cannot be completely eliminated from the San Pedro River given its widespread occurrence and aggressive growth habits. The current SPRNCA plan for managing this species recognizes this, but it is unknown what level of public knowledge and support exists for the approach outlined in the plan, and whether it might be possible to increase efforts and monetary support with higher levels of understanding and support by partners. At its worst, the spread of tamarisk and the displacement of native species could greatly diminish current riparian conditions, leaving BLM unable to meet the legal mandate to conserve, protect, and enhance riparian and aquatic values.

Management Recommendations

The NRST supports and endorses the existing SPRNCA tamarisk management plan. Since tamarisk invasion is generally greatest in the northern reaches and decreases upstream, the highest priority for treatment is in reaches A through G; with medium priority given to reaches H and I (Appendix D). In the lower reaches, where the amount of tamarisk is treatable, address tamarisk in stages so excessive bare banks are not created all at once, and consider planting cottonwood poles and willow cuttings on dryer sites. The depth of the planting hole must be sufficient for the lower portion of the planted cutting to remain in contact with groundwater throughout the growing season, or regular watering of the planted trees would be required.

Fire and Fuels Management

Findings/Observations

Fire and fuels management was almost a continuing conversation among interdisciplinary team members during the assessment. In several reaches, the impacts of wildfire on cottonwood and other tree species was very evident. Large areas of what previously were cottonwood galleries had burned, and only a few trees or a line of single trees along the river remained. The loss of patches of trees did not cause large scale destabilization of banks or other adverse effects to the channel, but rather promoted herbaceous plants that also stabilize banks. However, it is desirable to maintain the maximum number of cottonwood stands to achieve both riparian function and associated resource values.

Mature cottonwood stands on post-entrenchment terraces will naturally decline over time owing to natural senescence and yield predominantly sacaton terraces (Fogg et al. 2012). Loss to wildfire or prescribed fire would accelerate that process as was observed in the field. At the same time, the risks of major high-intensity wildfires are great given the observed fuel loading of sacaton and mesquite communities within the SPRNCA.

Because the SPRNCA is a relatively narrow band of public land, wildfire can quickly spread from private to public lands and vice versa. This increases the risk and complexity of prescribed fire management, while highlighting the dangers of wildfires to property, lives, and the riparian ecosystem.

Issues

There is a continuing high risk of losing cottonwood galleries and trees from wildfire. In contrast, lack of fire creates decadent sacaton grasslands that are at low vigor and threatened with replacement by mesquite or other less desirable species. Lack of vigor and root growth on grasses on the pre-entrenchment terrace can also accelerate invasion by mesquite.

Management Considerations

Fire and fuels management is a high priority on reaches A through D and F through I; a medium priority on reach E; and a low priority on reach J. A comprehensive public/private approach should be undertaken to develop strategies and tactics for managing fuels within and near the SPRNCA. This would entail working with adjacent landowners and cooperating partners such as

the Natural Resources Conservation Service, Fort Huachuca, non-profit organizations, etc., to have a more comprehensive fuels program than one simply focused on the SPRNCA. The NRST recommends that high levels of protection and value be accorded to the cottonwood stands, and prescriptions developed that provide the least risk for killing cottonwood. Also, part of monitoring and tracking woody floodplain vegetation over time should include an analysis to learn where cottonwood stands have already been eliminated or greatly reduced due to wildfire, and where cottonwood trees have been able to reestablish after fire.

RMP revision should include an analysis of opportunities to use fire, mechanical treatments, cattle, and/or other livestock as a way of managing vegetation and fuels on grasses on the pre-entrenchment terrace, including previous agricultural fields. In places, the stands of grasses have little growth opportunity due to the dry material from previous years that intercepts sunlight and prevents development of needed photosynthetic material. The risk of fire moving into the riparian area is high from this same dead and dry material. Periodic defoliation by some process (fire, mechanical treatment, grazing) is needed to improve the health and vigor of the grasses, which will also help improve watershed condition and benefit the river.

Beaver Management

Findings/Observations

Beavers were extirpated from the upper San Pedro River by 1894. Fifteen beavers were reintroduced during 1999, 2000, and 2002. By 2008, the estimated beaver population was approximately 150, based on about 20 colonies with 33 dams, with additional beaver reported in Mexico and as far north as Aravaipa Canyon (BLM 2009).

In the PFC assessment, beaver dams are considered because they can be hydrologic modifiers. Beaver dams and ponds serve to decrease flow velocity, store sediment and nutrients, and reduce channel bed and bank erosion. The ponded water often adds to vegetative diversity and productivity. In the SPRNCA, beavers often utilize the grade control of the tributary fans as a place to locate their low dams. These tributary fans provide a partial barrier to flow and create the ponded form discussed previously. The low beaver dams increase the amount and length of ponded water upstream with relatively little effort. While these low dams may typically blow out during floods, they are thought to be important because the beavers rebuild the dams, and the dams increase the elevation of ponded water that is stored and slowly released in the drier season. Beaver also used existing structure in places, such as down wood and logs, to serve as a foundation for their dams, increasing strength and stability. Beaver dam building activity was noted from reach A, through reach F, with only minor evidence (such as cutting on small trees) further downstream. This may be due to a combination of an increasingly wide sand-bed channel and decreased water availability. Overall, the beaver were seen as a positive contributor to river health due to the increased retention time of water behind dams. The loss of some cottonwood trees due to beaver activity did not cause destabilizing of banks or other adverse effects to the channel.

Issues

Indirectly, the interdisciplinary team heard concerns expressed by a few neighboring private landowners about impacts beaver were having on irrigation systems and vegetation. Earlier,

people had mentioned that they had concerns about the beaver cutting down cottonwood within the SPRNCA, and in several areas individual trees had been protected by wrapping them with mesh wire. There is a beaver reintroduction Biological Opinion in place, and monitoring is ongoing.

Management Considerations

The best beaver habitat is tied to the most reliable instream flows, which currently occur in reaches B through E, and has the potential to develop throughout reach A (Appendix D). The ecological role of beaver is another element where increased information and education efforts are needed. Beaver play important roles in the health of ecosystems in a variety of ways, and need the support of a knowledgeable public. Beaver also can cause damage to private property at times, and the BLM needs to work closely with neighboring landowners and the Arizona Game and Fish Department to minimize undesirable impacts.

Off-Highway Vehicle Traffic and Foot Trails

Findings/Observations

Unauthorized off-highway vehicle (OHV) traffic within the channel and floodplain has created localized alteration of stream banks, trampled and destroyed riparian vegetation, and increased channel erosion. This traffic is most pronounced in reach A near the international border; reach D near the private property around Escapule; Charleston reach E and Contention reach I, and reach J where there are numerous access points for OHV entry into the riparian area. (Appendix D). Unregulated foot traffic from recreationists and illegal immigrants along the banks of the San Pedro River compacts soil, tramples vegetation, and decreases bank stability. These problems are most evident in reach A and reach B near the San Pedro House, and reach G near Fairbank; however, evidence of pedestrian trampling was observed in every reach (Appendix D).

Issues

Because riparian recovery is relatively recent and riparian plant communities are weakly developed in many areas, little disturbances can have profound effects by retarding recovery or reversing earlier trends in recovery of riparian areas. Riparian plants and streambanks, weakened by off-highway and foot traffic, are more easily destabilized by low and moderate flow events than are healthy plants and stable banks. Stream recovery is either retarded or reversed when banks are unstable.

Management Recommendations

Direct communication with Border Patrol officials could reduce impacts to streambanks from OHV traffic, but some level of use for legitimate law-enforcement purposes is to be expected. OHV traffic from nearby residents and recreationists can be better regulated through improved fence maintenance and a change from barbwire/smooth wire fences to cable or pipe/rail fences in selected areas. Improved trail design, maintenance, and signage along with educational outreach to recreationists can reduce pedestrian impacts to the riparian zone. Kiosks at all trailheads, docents from the Friends of San Pedro River, and hunting regulation brochures can be effective ways to communicate resource concerns and a tread-lightly policy.

Railroad Bed

Findings/Observations

An abandoned railroad bed runs along much of the San Pedro River. In many places this bed alters surface flow. In a few places, the bed is close enough to the channel to contribute eroded material directly to the river. Currently, the railroad bed serves as a convenient vehicular travel corridor for administrative purposes.

Issues

The railroad grade has blocked many surface drainages and diverted flow into tributaries that pass the railroad grade under bridges or culverts. The slag and other materials used to build the railroad bed may contain toxic materials that should be kept out of aquatic and riparian areas.

Management Recommendations

The NRST recommends the BLM conduct an inventory to determine the location and extent of altered surface drainage and maintenance needs (i.e., blocked or damaged culverts, locations where railroad-bed material is or could enter the river, etc. . The railroad bed is near the river in reaches C, E, F and I, but the highest priority for management is given to reaches C and I because these are areas where slag is likely to enter to river (Appendix D). Consider moving material that may contain contaminants away from the eroding bank, without inhibiting the formation of new sinuosity in the channel. In addition, the BLM needs to continue to explore various options to retire or acquire the right-of-way for the abandoned railroad. Acquisition of the right-of-way could ensure proper treatment of potential contaminants, regular maintenance, and a possible rail-to-trail conversion.

Agricultural Dikes

Findings/Observations

Dikes were constructed to divert surface drainage around abandoned agricultural fields in reaches A, B, and C. These dikes alter natural hydrologic patterns, may increase discharge in some tributaries that bypass the dikes, and capture sediment that would otherwise flow into the San Pedro River. A thorough investigation of the dikes is needed to understand the extent of the impact.

Issues

The dikes alter natural hydrologic patterns, which means some reaches of the San Pedro River receive less water and sediment, whereas others receive too much water and sediment. This may create localized problems of erosion and deposition. Lack of maintenance leads to the dike being breached in places - surface water now flows over or through the dike rather than through culverts or around the dike to major tributaries that bypass the dikes.

Management Recommendations

Inventory and evaluate the effects of the dikes on surface and ground-water hydrology (determine if ponded areas behind dikes act as recharge). Where there is evidence that diverted flow patterns are creating increases in peak discharge and increased erosive potential, take steps to remedy the situation. Replace plugged or damaged culverts. Alternatively, the entire dike, or selected segments, could be removed to restore natural hydrologic patterns. This is a medium priority in reaches A, B and C (Appendix D).

Groundwater Augmentation

Findings/Observations

While there are no direct findings/observations relating to groundwater augmentation, it was a topic that was frequently discussed during the NRST assistance process.

Issues

Plans and actions to use urban storm-water runoff to augment groundwater that would flow to the San Pedro River are frequently discussed. These and other groundwater-augmentation proposals have been extensively studied (Bureau of Reclamation 2007, Stantec GSA 2006) as to their potential contribution to balance pumping with recharge, in response to the Section 321 requirements. The objective of urban storm-water projects is to collect storm-water runoff into a storm sewer before it flows into natural channels, which avoids the issue of acquiring a surface water right, and recharging that water close to the river. Water quality and unit cost (annual cost per acre-foot of recharge) are major considerations in this alternative.

Another action that is often mentioned as potentially important is to increase the number of detention basins in ephemeral channels. These detention basins are not without possible unintended consequences due to alterations in sediment balance. As described in the Tributaries and Sediment section of this report, the PFC assessment raised awareness and understanding of the important role of sediment inputs to the stream from its many tributaries. By their nature, detention structures in channels intercept not only water, but also sediment. The location of future structures is an important consideration. Detention structures far down the tributaries and close to the San Pedro River may intercept sediment that is important to the continuing evolution of the river channel. Off-channel recharge basins or detention basins higher in tributaries are less likely to affect sediment balance. Unit cost, total water yield, annual maintenance costs associated with dredging sediment, and legal issues concerning “diversion” of water in natural channels are all issues related to detention basins.

Management Considerations

Additional water in reach A could accelerate recovery of the needed vegetation characteristics. Additional water in reaches B through E could extend perennial flow further downstream in reach F. A third location would be to provide additional recharge water to the Babocomari River, which might also positively influence the water in the San Pedro River. Use the best science available when considering urban storm water for recharging the aquifer, and the building of detention structures in ephemeral channels so the potential alteration of sediment inputs to the

river is given complete analysis prior to locating and installing structures. Other forms of improving natural groundwater recharge should be evaluated via watershed assessments and plans on the SPRNCA and cooperatively in the larger basin.

Recommended Next Steps

SPRNCA Resource Management Plan Revision

The number and types of issues raised by the PFC assessment and preceding steps in the NRST process clearly point to the need for an up-to-date plan for managing the SPRNCA. The current management plan is a combination of several plans that are tenuously connected and difficult to either obtain or gain clarity of direction from, and are inadequate to manage the conditions and challenges that face the SPRNCA today. Although some of the riparian issues can be resolved on a project or location basis, the greater need is for a comprehensive analysis and planning effort that fully engages the many partners and broader public. The PFC assessment provides considerable information and insight into existing conditions and needs of the riparian area and beyond in some instances, but information alone does not resolve issues. Careful consideration of the situation, alternative courses of management, and the costs and benefits of those approaches need to be provided by the BLM, and decisions made about how to best meet the needs of the legislative mandate in keeping with demands and issues raised by the community. Additionally, the costs and impacts of activities away from the SPRNCA, including groundwater pumping, even though not in BLM's control, need to be fully analyzed and disclosed to the public and governmental agencies.

Management Considerations

The NRST recommends the BLM: (1) reestablish the SPRNCA Advisory Committee called for in the enabling legislation as part of the process of developing a revised or new comprehensive management plan, (2 initiate collaborative approaches to bringing together the many government and private partners very early in the process of planning, and continue a transparent and open process, (3) continue to nourish existing relationships, and develop additional relationships locally and regionally with the people who will be critical to success of the effort, and (4) identify a plan coordinator for an effort that will be complex, multifaceted, and potentially contentious.

Development of Baseline Information and a Monitoring Strategy

With the legal mandate to conserve, protect and enhance the riparian, aquatic and other named resources, a robust monitoring program is critical to mission success. Although monitoring is known to exist, much of this is not corporate in nature or readily available to interested publics or management (channel cross-sections surveys, vegetation transects, surface flow, etc.). Monitoring needs range from widespread and extensive information to very local and intensive monitoring. Two primary aspects are important: (1) obtaining information using scientifically based protocols in order to understand condition, trend and management needs, and (2) effective use of tools that result in the least cost.

An important first step is to organize and interpret existing monitoring information. There is a wealth of scientific studies and information relevant to the SPRNCA (particularly regarding the riparian and aquatic environment that likely exceeds the amount and quality of information collected on almost any other BLM National Landscape Conservation System unit. Some of this information provides baseline conditions that date back to the designation of the SPRNCA and even earlier, but it was not evident that much of it has been interpreted to inform management. Moving forward into the revision of the RMP and the establishment of monitoring programs, it is critical to know where information has been collected, what information is available, and what has been learned to date.

In addition to BLM employees, the SPRNCA is fortunate to have a strong group of interested and highly committed people who want to insure the long-term sustainability of the NCA. This includes groups such as the Friends of the San Pedro River, the Community Watershed Alliance, as well as other non-governmental organizations. The highlight of the volunteer work is the annual wet-dry mapping, a joint effort of the BLM, The Nature Conservancy, Friends of the San Pedro and others. Each year volunteers walk every reach of the San Pedro River during the third weekend of June, and document where surface water is present the estimated driest part of the year. This survey not only provides highly valuable information to management about the river conditions, but is also a highly educational event that increases public support for the San Pedro River. The annual wet-dry mapping is an outstanding example of employing good science in a way that fully engages people who care about the San Pedro River. The repeat measurements will provide increasingly important understanding of the river's condition. All of those involved in conducting and documenting this study deserve great appreciation.

Many types of additional monitoring have been called for as a result of the PFC assessment. Although it is important to utilize scientific and defensible protocols for collecting management information, many of the tools and processes can be taught to diverse groups of people. There are some people who are already well-versed in topics like botany, geology and hydrology who regularly volunteer with others on the SPRNCA. This is a rich and largely untapped resource available to the SPRNCA. With appropriate training, volunteers can assist technical staff on some of these monitoring efforts and take the lead on others. Some of the monitoring needs include:

- Groundwater monitoring,
- Riparian vegetation monitoring transects,
- Remote sensing mapping (e.g., Light detection and ranging (LiDAR), aerial photography including VLSA or very large scale aerial photography
- Photo-point development and periodic re-takes of both new and already established sites [establish photo-points on each form of the river (ponded, tributary fan, standard) and take photos at consistent times of the year],
- Channel cross-section measurements, of both existing and new cross-sections [investigate whether existing cross-section data was monumented for repeat measurements (Jackson et al. 1987, Leenhouts 2006)],
- A monitoring plan, and periodic monitoring results and interpretation reports that provide a discussion of the management implications so management can adapt to new information and changing conditions.

The NRST agrees with Stromberg's suggestions for long-term monitoring of riparian condition (from July 2011 technical meeting PowerPoint presentation) to: (1) measure vegetation transects

to detect changes to dry-season streamside herbaceous vegetation [addition of Multiple Indicator Monitoring at designated monitoring areas (Burton et al. 2011) may be needed to supplement the Stromberg bio-hydrology belt transects], and (2) replace field monitoring of woody floodplain vegetation with remote sensing mapping. Include related aquatic measures to monitoring plans in consultation with biologists as well. The NRST recommends hiring a hydrologist dedicated to the SPRNCA and the Las Cienegas NCA to serve as a monitoring coordinator.

Expansion of Opportunities for Community Education and Service

Throughout the course of NRST assistance, it became apparent that there is a lack of information, or misinformation, regarding riparian ecology and function. Volunteers can assist BLM with riparian education and interpretation, as well as implementing management actions. Volunteers already do a variety of important work, including interpretive walks along the San Pedro River and managing facilities including the San Pedro House and Fairbank site. Leading up to the PFC assessment and during it, people were interested in learning of more opportunities to contribute time and effort on behalf of the river.

There are many retired people and others who have high levels of education and understanding of riparian relationships on the San Pedro River and are capable of providing more information about ecological relationships to the public. Some topics could include:

- Importance and ecology of cottonwood/Gooding's willow and other riparian vegetation communities along the San Pedro River,
- Ecological importance and function of beaver,
- Important riparian plants and their ecology along the San Pedro River,
- Channel evolution, pre and post entrenchment,
- Channel and floodplain characteristics and processes with an emphasis on their role in aquifer recharge and supporting riparian plant communities,
- The role of fire in the landscape and riparian areas, and
- Community efforts to augment water flows to the San Pedro River.

There are likely a variety of tasks that volunteers could perform in small to large trained groups:

- Documentation and removal of unusable fencing,
- Establishment, maintenance and signage of appropriate foot trails, with emphasis on current trails that are excessively eroding.
- Documentation and condition survey of signs within the SPRNCA, interpretive and otherwise, and
- Maintenance of existing perimeter fences to exclude livestock from the river.

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APPENDICES

Appendix A: Reach Based Information

Appendix A contains the reach based information from the PFC assessments. Each reach section has the following documentation:

1. Reach narrative
2. PFC assessment form
3. Plant list
4. Photos taken during the assessment
5. Map that shows reach breaks and the photo's GPS waypoints
6. Google Earth image showing reach breaks
7. Historic photos
8. Waypoint log

PFC Assessment Form

Name of Riparian-Wetland Area: **San Pedro River**

Date: **4/11/2012** Segment/Reach ID: **PFC Reach A**

ID Team Observers: Mike Lunn, Janice Staats, Wayne Elmore, Mark Gonzalez, Jim Fogg, Steve Smith, Ben Lomeli, Jeff Simms, Marcia Radke, Eric Baker, Heather Swanson, Catie Fenn, Ryan Pitts

Yes	No	N/A	HYDROLOGICAL
X			**1) Floodplain above bankfull is inundated in "relatively frequent" events** Frequent floodflows are capable of spreading out on a low-lying area adjacent to the channel in most of the reach on one side or the other. Some short sections are too entrenched for frequent floodflows to access the floodplain. Moody and Odem 1999 report the following bankfull features from USGS Palominas gage: cross-sectional area of 310 square feet, velocity 5.8 feet per second, discharge 1800 cubic feet per second (cfs), 1.1-year recurrence interval. USGS documents report on the 2-year recurrence interval of 5810 cfs. In places, there is a natural levee where cottonwood has stabilized the banks and captured sediments, with adjacent overflow channels, where frequent flood flows are expected to access. See page 12, figure 2 from Leenhouts et al. 2006 which shows the 2-year event spreading across the post-entrenchment floodplain. The existing channel width and mean depth were estimated to calculate cross-sectional area, and in several areas it appears the top of the bank coincides with a cross-sectional area that makes sense with floodplain inundation. For example, width 75 feet X mean depth 4 feet = 300 square feet; width 50 feet X mean depth 9 feet = 450 square feet. There is sediment aggradation on the floodplain when water does overflow the banks. Flood debris is widespread. Part of what we are observing is from 2000-2010 peak flows, all higher than 3180 cfs except 2009, range from 905-15,900 cfs. Banks are not eroding.
	X		**2) Where beaver dams are present are they active and stable** There are a number of active dams along with blown out inactive ones. Many of the dams are built on top of tributary fan sediments that are already ponding water behind them. The beaver are taking advantage of the ponding, and the dams they build add inches up to feet to the ponded area. Could see old dams with holes but another beaver dam built nearby. The dams are relatively low in elevation compared to the size of the channel, so they blow out at high flow, but get rebuilt and hold back water during low flow periods. When they blow out, they do not unleash tremendous energies and do not result in degradation because of their size and the fact that the tributary fan provides grade control. *This item was answered "yes" in the field because we were focusing on no resulting deterioration, but as we moved downstream we decided to answer "no" focusing on beaver dams that are not active or stable, and documenting that the "no" answer is not causing problems with function. This item's answer was changed to be consistent with the way we answered in the other reaches.*
	X		**3) Sinuosity, width/depth ratio, and gradient are in balance with the landscape setting (i.e., landform, geology, and bioclimatic region)** Channel geometry and meander geometry are not in sync. Sinuosity is lower than expected, even for a sandy southwestern stream type. There is at least 1 mile of artificial straightening evident on the aerial photograph. One section was straightened and bermed which artificially cut off a large looping meander. Having a lower sinuosity than expected is not causing deterioration of function because riparian vegetation has stabilized the streambanks. It also appears to not be increasing meander at this time because of the sandy bedload and moving the material through the system. In a few places the river is still eroding the pre-entrenchment terrace, widening the post entrenchment valley bottom, and the eroded soil becomes part of the floodplain, which we interpret as positive for development of function.
X			**4) Riparian-wetland area is widening or has achieved potential extent** Saw 10-20 year old cottonwood trees in places that used to be only sand (based on 1987 photo points and tree age). The riparian area is widening with cottonwood and willow on streambanks and floodplains, but has not achieved potential extent. In places bulrush, spike rush, Bermuda

			grass, and woody plants are establishing in the active channel and moving up to the bankfull stage. This is helping to stabilize the channel and build bars that are expected to narrow the channel and widen the riparian zone over time. Sacaton on the terrace has increased in vigor and occupancy following the April 2003 fire.
	X		**5) Upland watershed is not contributing to riparian-wetland degradation** "No," agricultural dikes and channel straightening/repositioning have severed the connection between the San Pedro River and its tributaries in Reach A. Consequently, it appears sediment is not being processed properly in the middle segment of Reach A where the water disappears and flows subsurface through the sand. With improved conditions the whole reach could be perennial. Activities in Mexico may be having an effect on the sediment/water balance.

Yes	No	N/A	VEGETATION
X			**6) Diverse age-class distribution of riparian-wetland vegetation (recruitment for maintenance/recovery)** Multiple age classes of both woody and herbaceous species present. Cottonwoods - young and mature trees observed. The lack of cottonwood sprouts is not a problem because the existing trees have a closed canopy along the banks, so there are currently very few sites for sprouts to get started. Cottonwood gets established in episodic recruitment events associated floods that coincide with seed dispersal. Successful establishment usually includes subsequent spring and summer flows that allow the seedling roots to reach the permanent water table. Stromberg 1998 found that most of the cottonwoods that have established since 1960 date to years with floods from October to March. There were small spots of mature stressed or dead seep willow, but other areas with healthy young and mature seep willow.
X			**7) Diverse composition of riparian-wetland vegetation (for maintenance/recovery) (*species present*)** The composition is diverse for maintenance and recovery. See plant list.
X			**8) Species present indicate maintenance of riparian-wetland soil moisture characteristics** Facultative wetland and some obligate wetland species present. See plant list for wetland indicator categories of species present. Less cover of herbaceous obligate species in the channel than downstream perennial reaches.
X			**9) Streambank vegetation is comprised of those plants or plant communities that have root masses capable of withstanding high streamflow events (*community types present*)** Cottonwood community type present. Horsetail was the most commonly seen herbaceous community type. Cottonwood, seep willow, and equisetum were common in the reach. Key stabilizing species including spikerush, Baltic rush and bulrush were much less common in this reach than in successive lower reaches. See plant list for stability class and abundance of species present.
X	**X** **(Cotton-wood in patches)**		**10) Riparian-wetland plants exhibit high vigor** In past years, patches of cottonwood trees in this reach have shown water stress in June (yellow leaves). This year, tent caterpillars have defoliated many of the trees, but it is common that tent caterpillars defoliate leaves, and then another set of leaves comes out. There are a few leafed out trees without tent caterpillars that were vigorous, and not all of the trees have leafed out yet. The cottonwoods in the dry middle section have more dead branches, but the willows and herbaceous species exhibit high vigor. There are small spots of dead or stressed mature seep willow along the banks which is not a problem for function because of all the other vigorous seep willow in the reach. Record cold winter temperature in February 2011 may have damaged this species (3 °F (−16 °C) in Sierra Vista .
X			**11) Adequate riparian-wetland vegetative cover present to protect banks and dissipate energy during high flows (*enough*)** High percentage of cottonwood stabilizers covering the banks. Soils varied from cohesive soil to noncohesive sands. Smaller patches of cottonwood/seep willow were observed on the most stable sites. There are some steep bare banks with cottonwood growing on top where we discussed the amount of bare ground between tree trunks and steepness of the bank, and how there were small sections that had seep willow growing in front of the cottonwoods that create a different shaped

			bank, yet both are stable. While the answer is overall yes, greatly increased presence of bulrush and seep willow is needed for development of narrower channels and lower width/depth ratios. The current vegetation cannot properly manage the sediments in a way to create more efficient channels.
X			**12) Plant communities are an adequate source of coarse and/or large woody material (for maintenance/recovery)** Cottonwood and willow in multiple age classes are growing along the reach.

Yes	No	N/A	EROSION DEPOSITION
X			**13) Floodplain and channel characteristics (i.e., rocks, overflow channels, coarse and/or large woody material) adequate to dissipate energy** Large woody material and overflow channels are dissipating energy during high flows. Sediments are being deposited in overflow channels.
	X[1]		**14) Point bars are revegetating with riparian-wetland vegetation** Since the 1950s (see Hereford 1993, pp. 20-24), the San Pedro River has done very little meandering; consequently, there are few true point bars. The dominant channel and floodplain forming processes result from episodic channel switching when large woody debris jams or large volumes of sediment, delivered by tributaries, obstruct the main channel and divert flow into an overflow channel, which then evolves into the dominant channel. This process is most common in the transition form, which occurs at or immediately downstream of tributary fans (refer to Fogg et al. 2012, pp. 17-18). We answered this item "no" because a few large depositional bars in this reach are not revegetating because the water drains quickly from the coarse (sand, gravel, and cobble) sediment; and these active-channel deposits are remobilized with each large flood event.
	X		**15) Lateral stream movement is associated with natural sinuosity** Channel appears to jump around based on large wood deposits more frequently than Reaches B, C, D, and E. The braiding in the last part of the reach is expected because it is associated with a tributary fan deposit and probably backwater effects of the bridge.
X			**16) System is vertically stable (*not downcutting*)** No headcuts present. 100 yards from the upper end of the reach there is a stair stepped channel adjustment which is probably the stream cutting through a deposition, not a headcut.
	X		**17) Stream is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition)** Dry section in mid-reach indicates stream is not able to process sediments (sand) properly.

Remarks

The interrupted flow in the middle of the reach is not in association with tributaries creating a fan, but mostly because of coarse sediments in a wide channel. This reach has variable channel form which reflects the bed material changes (sandy = wide, more silt = narrow . There are three types of cross-sections: (1) relatively normal sized channel with well-developed banks with trees growing along the edge, (2) relatively large overflow channel next to a natural levee created by the stability of trees, next to a relatively small channel, and (3 wide shallow channel.

Vegetative attributes are largely in working order except for cottonwood vigor in the middle of the reach. We saw evidence of the April 2003 fire on the sacaton upland from the border to the first round oxbow.

"Not Apparent" trend rating was primarily based on perceived inability of reach to process sediment which may be a more important indicator than the vegetation. Expansion of seep willow is seen as an important component of improvement.

[1] In retrospect, the answer to item 14 is "n/a" because point-bar extension has not been the dominant floodplain forming process since the 1950s. Point bars are rarely observed except near confluences with large tributaries. Overbank flooding with vertical floodplain aggradation has been the dominant floodplain process for more than 50 years along most of the upper San Pedro River.

There is an obvious improved difference between the 1987 photo point and what we see now, but a lack of clear evidence that improvement is continuing. Reach should have a better distribution of stabilizing community types that capture fine sediments and change the geometry of the channel by narrowing and increasing areas for overbank flows.

Overbank flooding with vertical floodplain aggradation has been the dominant floodplain process for more than 50 years along most of the upper San Pedro River.

Reach A might benefit from a program of planting seeds and/or plugs of bulrush in sections where there is adequate water and little or no presence of the species. Bulrush plays an extremely important role in bank stabilization and channel processes, and it might be possible to accelerate development of bulrush communities through planting.

SUMMARY DETERMINATION

Functional Rating:
:

___ Proper Functioning Condition

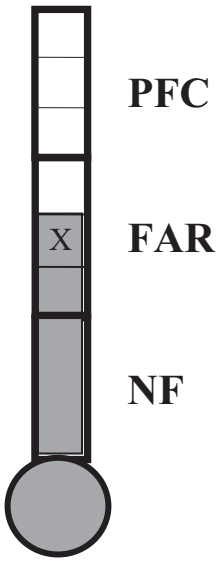
_X_ Functional - At Risk

___ Nonfunctional

___ Unknown

Trend for Functional - At Risk:

___ Upward
___ Downward
_X_ Not Apparent



Are factors contributing to unacceptable conditions outside the control of the manager?

Yes _X_
No ___

If yes, what are those factors?

___ Flow regulations
___ Mining activities
_X_ Upstream channel conditions
___ Channelization
___ Road encroachment
___ Oil field water discharge
___ Augmented flows
_X_ Other (specify Mexico ground water use?

(Revised 1998) (7/12/04)

SPRNCA Plant List for PFC Assessment

(Not a complete list of species present)

Reach Palominas, Reach A Date April 11, 2012

	Sedges/Grasses	Scientific Name	WIC	SC	AB	LOC
	Spikerush CT	*Eleocharis spp.*		H		
X	Common spikerush	*Eleocharis palustris*	OBL	H	1	A c
X	Parish spikerush	*Eleocharis parishii*	FACW	H	1	A c
	Beaked spikerush	*Eleocharis rosellata*	OBL	L		
	Threesquare bulrush	*Schoenoplectus americanus*	OBL	H		
X	Hardstem bulrush CT	*Schoenoplectus spp.*		H	2	A
X	Hardstem bulrush	*Schoenoplectus acuta*	OBL	H	2	A
X	Baltic rush CT	*Juncus spp.*	OBL	H	1	A
X	Baltic rush	*Juncus balticus*	OBL	H	2	A
	Arizona rush	*Juncus interior*	FAC	M		
X	Torrey's rush	*Juncus torreyi*	FACW	H	1	A
	Cattail	*Typha latafolia*	OBL	H		
	Clustered field sedge	*Carex praegracillis*	OBL	H		
	Flat sedge	*Cyperus odoratus*	FACW+	M		
X	Johnson grass	*Sorghum halapense*	FACU+	M	4	F B
X	Bermuda grass	*Cynodon dactylon*	FACU	M	4	F B
X	Barnyard grass	*Echinochloa crus-galli*	FACW	L	4	A c
X	Rabbitsfoot grass	*Polypogon monspeliensis*	FACW	L	3	A c
X	Smooth horsetail	*Equisetum laevigatum*	FACW	L	2	B
	Alkali Sacaton	*Sporobolus airoides*	FAC	M		
X	Giant Sacaton	*Sporobolus wrightii*	FAC	M	4	F T B
	Spike dropseed	*Sporobolus contractus*	FACU	L		
	Sand dropseed	*Sporobolus cryptandrus*	FACU	L		
X	Deer grass	*Muhlenbergia rigens*	FAC	H	2	A
X	Vine Mesquite	*Panicum obtusum*	FAC	M	1	F
X	Beardless wildrye	*Leymus triticoides*	FAC	M	2	B
X	Canadian horseweed	*Conyza canadensis*	FACU	M	1	A b
X	Lehman lovegrass	*Eragrostis lehmanniana*				F

	Forbs	Scientific name	WIC	SC	AB	LOC
X	Spiny aster	*Chloracantha spinosa*	FACW	H		
X	Curly top knotweed	*Polygonum lapathifolium*	OBL	L		
X	Sweet Clover	*Melilotus indicus*	*FACU+*	L		
X	Speedwell	*Veronica spp.*	OBL	L		
X	Buttercup	Ranunculus	OBL	L	1	A
X	Monkeyflower	*Mimulus spp*	OBL	L	1	A
X	Huachuca water umbel	*Lilaeopsis schaffneriana* spp. *recurva*	OBL	L	1	A
X	Thurber's sneezeweed	*Helenium thurberi*	OBL	L	1	A
X	Thurber's Pepperweed	*Lepedium thurberi*	OBL	L	1	A

	Trees/Shrubs	Scientific names	WIC	SC	AB	LOC
X	Cottonwood/Goodding willow CT			H	4	B
	Cottonwood /Mixed hardwood CT			H		
X	Freemont Cottonwood	*Populus fremontii*	FACW	H	4	B F
	Freemont Cottonwood/ Johnsongrass CT					
X	Goodding willow	*Salix gooddingii*	OBL	H	4	B F
	Goodding willow/Bulrush CT			H		
	Goodding willow/ Johnsongrass CT			H		
X	Coyote willow	*Salix exigua*	OBL	M	2	F
	Yewleaf willow	*Salix taxifolia*	FACW	H		
X	Seep willow	*Baccharis salicifolia*	FACW	M	3	B
	Desert broom	*Baccharis sarothroides*	FACW	M		
	Yerba de pasmo	*Baccharis pteronoides*				
X	Tamarisk (DEAD)	*Tamarix ramosissima*	FACW	H		
X	Mexican elderberry	*Sambucus nigra*	FAC	M	2	F
X	Western soapberry	*Sapindus saponaria*	UPL	M	1	F
X	Netleaf hackberry	*Celtis reticulata*	FACU	M	1	F
X	Arizona walnut	*Juglans major*	FACW	H	2	B F
X	Velvet ash	*Fraxinus velutina*	FAC +	L	2	B F
	Honey locust	*Gleditsia triacanthos*	FAC	M		
	White mulberry	*Morus alba*	FAC	M		
	Texas mulberry	*Morus microphylla*	FACU	M		
	Tree tobacco	*Nicotiana glauca*	FAC	M		
X	Velvet mesquite	*Prosopis velutina*	FAC	M	4	F T
	Golden current	*Ribes aureum*	FACW	H		
X	Little-leaf sumac	*Rhus microphylla*	FACU	M	2	B F
X	Rubber rabbitbrush	*Ericameria nauseosa*	UPL	M	1	B
	Burrobrush	*Hymenoclea monogyra*	UPL	M		

WIC = Wetland **I**ndicator **C**ategories, OBL = Obligate wetland; FACW = Facultative Wetland; FAC = Facultative; FACU = Facultative Upland. From Reed, P.B. 1988. National list of plant species that occur in wetlands: Southwest (Region 7). A positive (+) or negative (-) sign was used with the Facultative Indicator categories to more specifically define the regional frequency of occurrence in wetlands. The positive sign indicates a frequency toward the higher end of the category (more frequently found in wetlands), and a negative sign indicates a frequency toward the lower end of the category (less frequently found in wetlands).
SC = Stability **C**lass: low (L), moderate (M), high (H), adapted from Burton, T.A, S.J. Smith, and E.R. Cowley. 2011. Riparian area management: multiple indicator monitoring (MIM) of stream channels and streamside vegetation. TR 1737-23; Winward, A.H. 2000. Monitoring the vegetation resources in riparian areas. USDA Forest Service Rocky Mountain Research Station General Technical Report RMRS-GTR-47.; Nelle, S. 2011. Common plants of riparian areas – Southwestern Texas-Northern Mexico with wetland indicator (WI) and draft stability rating (SR); and NRCS National Plant Database.
AB = Abundance (1-4). 1 = present but with only 1 to a few individuals; 2 = found occasionally; 3 = common; 4 = abundant .
LOC = Location(s): active channel(AC), stream bank(B), frequent floodplain(F), terrace (T).
CT = Community **T**ype

San Pedro River Photo Sheets
SPRNCA, Reach A
Photographer: Mike Lunn, April 11, 2012

1 – Waypoint 793 – upstream to steel rail fence on International border.

2 – Waypoint 793 - downstream into reach.

3 – Showing initial channel features with cottonwood on frequent floodplain.

4 – "U" shaped channel.

5 – River cutting towards terrace, three levels visible; active channel, frequent floodplain, terrace.

6 - Little herbaceous cover in active channel, mostly cottonwood w/seep willow at or above bankfull.

San Pedro River Photo Sheets
SPRNCA, Reach A
Photographer: Mike Lunn, April 11, 2012

7 – Seep willow and cottonwood on meander.

8 – Floodplain moving on lower part of meander, cottonwood right established on earlier freq. floodplain.

9 – Long straight section of overflow channel.

10 – Long pool from the backwater effects of a tributary fan (“ponded” channel form , lower end with large cobble.

11 – Large cobble forming pond, tributary fan likely source.

12 – Initial beaver activity noted.

San Pedro River Photo Sheets
SPRNCA, Reach A
Photographer: Mike Lunn, April 11, 2012

13– Waypoint 803 upstream to small beaver dam building on sediment deposit.

14 – Upstream in confined section.

15 – Example of a long pool from the backwater effects of a tributary fan (“ponded” channel form .

16 - Waypoint 805 – large beaver dam – even these large dams likely wash out each high flow but are important at low flow.

17 – Waypoint 806, straightened section, more meander expected given substrate and valley width.

18 – Waypoint 807, large wood deposit forming meander to left.

San Pedro River Photo Sheets
SPRNCA, Reach
Photographer: Mike Lunn, April

19 – Waypoint 808, looking upstream at last surface water before interrupted section.

20 – Waypoint 809, small series of pools begin here.

21 - Waypoint 810 – persistent water in narrow channel, bar to left is in active channel.

22 – Waypoint 811, dry overflow channel left, stream channel to right of large wood deposit.

23 – Channel on stream right of woodpile.

24 – Waypoint 812 surface flow diminishes.

San Pedro River Photo Sheets
SPRNCA, Reach A
Photographer: Mike Lunn, April 11, 2012

25 – Waypoint 813, cottonwood on upper extent of frequent floodplain – not well leafed, caterpillar infestation.

26 – Waypoint 814, upstream view, channel dry to waypoint 813.

27 – Waypoint 815, down view, surface flow for short distance.

28 – Waypoint 816. Overflow channel with large wood deposits, sporadic pools & wetted sections to waypoint 817.

29 – Waypoint 817, dry begins.

30 – Waypoint 818, small community of Baltic rush forming, a few cottonwood stressed/dying here.

San Pedro River Photo Sheets
SPRNCA, Reach A
Photographer: Mike Lunn, April 11, 2012

31 – Waypoint 819, some surface flow by large wood pile.

32 – Waypoint 820, large pile of large wood off-channel (stream left) looking upstream.

33 – Waypoint 820, down view of huge deposits of wood.

34 – Waypoint 821, upstream to beaver pond on stream right.

35 – Huachuca water umbel just downstream from beaver dam.

36 – Characteristic community of lime-green, twisted growth form of water umbel in algae.

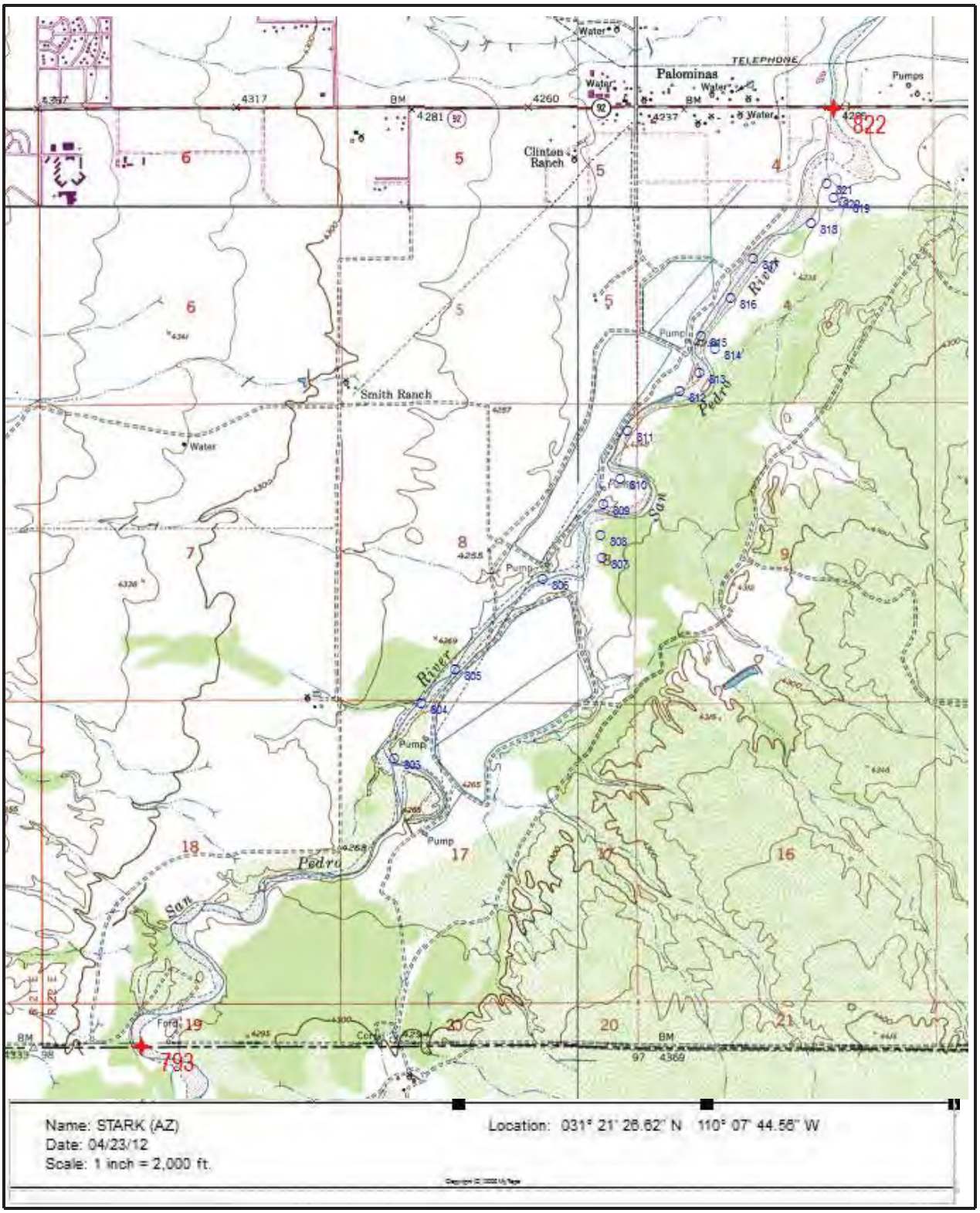
San Pedro River Photo Sheets
SPRNCA, Reach A
Photographer: Mike Lunn, April 11, 2012

37 – Water umbel showing roots.

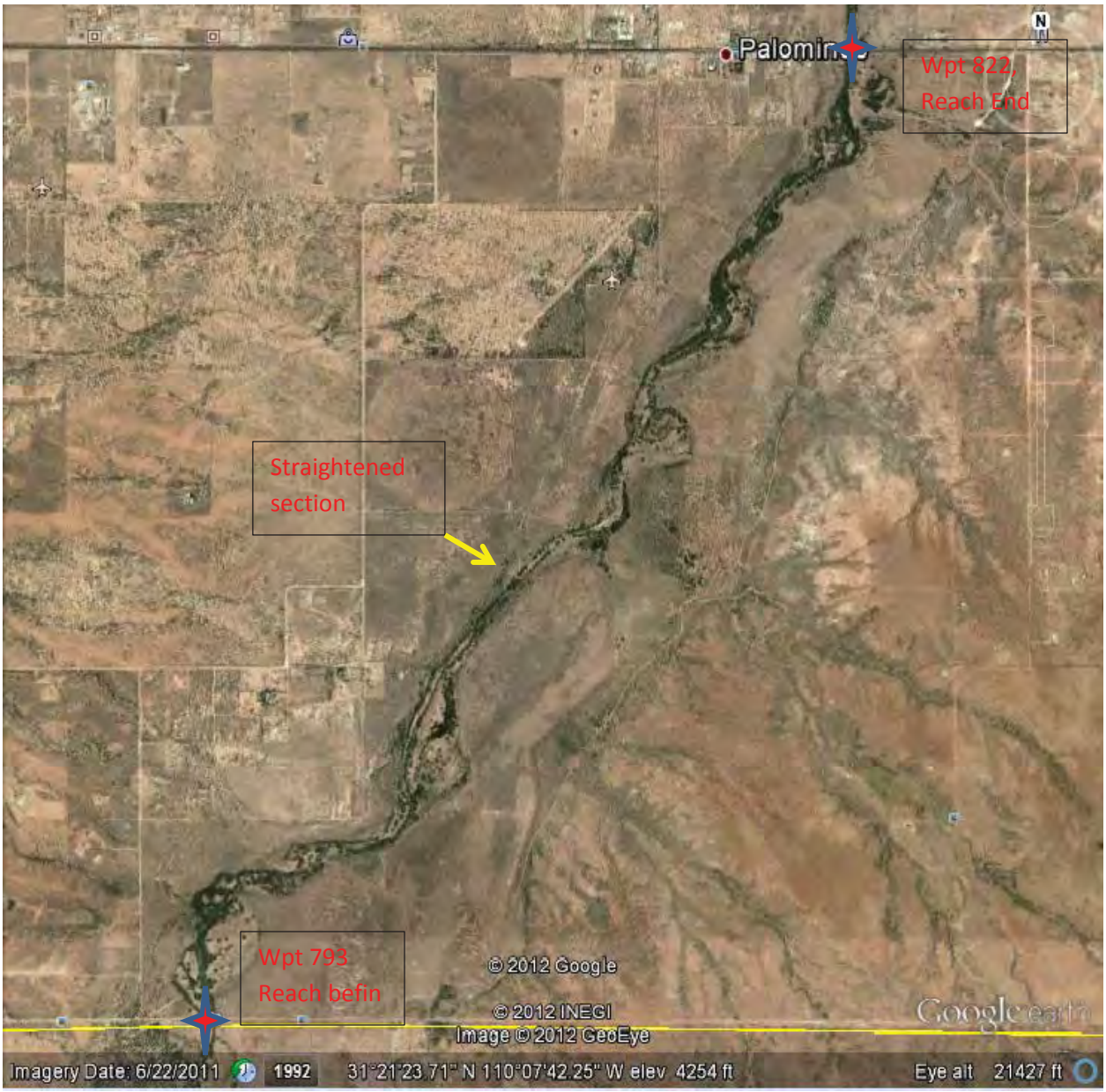
38 – Very loosely rooted, wonder how it stays in place during high flows.

39 – Another small patch of umbel just downstream.

40 – Waypoint 822, upstream view from bridge.



San Pedro River – San Pedro Riparian National Conservation Area A
PFC Reach A – Completed April 11, 2012 – Scale Approximate
Waypoints 793 - 822


Palomino
Wpt 822,
Reach End
Straightened
section
Wpt 793
Reach befin
© 2012 Google
© 2012 INEGI
Image © 2012 GeoEye
Google earth
Imagery Date: 6/22/2011
1992
31°21'23.71" N 110°07'42.25" W elev 4254 ft
Eye alt 21427 ft

Reach A Historic Photos

A series of photos from 1987 to 2012 display major evolutionary changes in the channel and vegetation. These photos were taken at the Mexico border and at the lower end of the reach from the bridge. They display the major changes that occur in relatively short time periods in this flashy river.

Reach A Looking South (Upstream) Across Border Fence

July 6, 1987

August 11. 1992

June 19, 1995

September 1, 1998

Reach A Looking South (Upstream) Across Border Fence (continued)

June 18, 2004

June 9, 2005

June 25,2008

April 11, 2012

Reach A
Mexican Border north (downstream)

July 6, 1987

July 1 1992

August 11, 1992

June 19, 1995

September 1, 1998

June 25, 2008

April 13, 2012

Reach A
Highway 92 Bridge Looking North (Upstream)

July 6, 1987

July 17, 1992

January 20, 1993

August 3, 1998

July 2, 2008

April 13, 2012

San Pedro PFC Assessment
Waypoint Log
Reach A

793	11-APR-12 8:04:32AM	N31 20.056	W110 08.870	4257 ft	reach break, photos 1-2
803	11-APR-12 10:04:40AM	N31 20.891	W110 08.172	4300 ft	photo 13
804	11-APR-12 10:13:20AM	N31 21.052	W110 08.084	4238 ft	large gravel bar, no photo
805	11-APR-12 10:22:39AM	N31 21.153	W110 07.967	4268 ft	photo 16
806	11-APR-12 10:52:03AM	N31 21.416	W110 07.666	4265 ft	photo 17
807	11-APR-12 11:00:13AM	N31 21.487	W110 07.466	4233 ft	photo 18
808	11-APR-12 11:05:06AM	N31 21.555	W110 07.470	4257 ft	photo 19
809	11-APR-12 11:46:36AM	N31 21.642	W110 07.460	4263 ft	photo 20
810	11-APR-12 11:53:22AM	N31 21.719	W110 07.395	4262 ft	photo 21
811	11-APR-12 12:06:36PM	N31 21.857	W110 07.367	4248 ft	photo 22
812	11-APR-12 12:15:50PM	N31 21.977	W110 07.192	4221 ft	photo 24
813	11-APR-12 12:21:41PM	N31 22.029	W110 07.121	4250 ft	photo 25
814	11-APR-12 12:26:03PM	N31 22.097	W110 07.072	4198 ft	photo 26
815	11-APR-12 12:31:57PM	N31 22.137	W110 07.118	4239 ft	photo 27
816	11-APR-12 12:39:15PM	N31 22.250	W110 07.020	4236 ft	photo 28
817	11-APR-12 12:45:02PM	N31 22.366	W110 06.939	4239 ft	photo 29
818	11-APR-12 12:57:51PM	N31 22.467	W110 06.744	4212 ft	photo 30
819	11-APR-12 1:06:10PM	N31 22.528	W110 06.634	4252 ft	photo 31
820	11-APR-12 1:09:19PM	N31 22.543	W110 06.667	4257 ft	photos 32-33
821	11-APR-12 1:15:07PM	N31 22.581	W110 06.689	4231 ft	photo34
822	11-APR-12 1:43:18PM	N31 22.794	W110 06.660	4227 ft	reach break, photo 40

PFC Assessment Form

Name of Riparian-Wetland Area: **San Pedro River**

Date: **4/12,13,15/2012** Segment/Reach ID: **PFC Reach B - 12 miles**

ID Team Observers: Mike Lunn, Janice Staats, Wayne Elmore, Mark Gonzalez, Jim Fogg (4/12-13), Steve Leonard (4/15), Steve Smith (4/12), Ben Lomeli, Jeff Simms, Marcia Radke, Eric Baker, Heather Swanson, Catie Fenn, Ryan Pitts

Yes	No	N/A	HYDROLOGICAL
X			**1) Floodplain above bankfull is inundated in "relatively frequent" events** Frequent floodplains, although narrow and discontinuous in some places, are evident and accessible.
	X		**2) Where beaver dams are present are they active and stable** The dams are relatively low in elevation compared to the size of the channel. They blow out at high flow; some get rebuilt and hold back water during low flow periods. When they blow out, they do not unleash tremendous energies and do not result in deterioration of riparian function because of their size and the fact that the tributary fans provide grade control.
	X		**3) Sinuosity, width/depth ratio, and gradient are in balance with the landscape setting (i.e., landform, geology, and bioclimatic region)** Sinuosity is lower than expected for the stream type. Parts of the river were straightened for agricultural reasons (upper and lower parts of reach). The majority of banks on the straight sections are not eroding due to cottonwood/willow providing stability, and the energy during high flows is being used to mobilize the bed. There are two relatively recent channel location changes that slightly lower the sinuosity locally (see figure A1 below . From the Google Earth image it can be seen that the north channel shift is associated with a tributary fan, the south one is not. This "no" is not significant for physical function because of the stable banks and because the reach is processing sediment appropriately (see item 17).
X			**4) Riparian-wetland area is widening or has achieved potential extent** Riparian species established on floodplain and some on in-channel bars. Bulrush communities on the in-channel bars are expanding into the channel and up the banks. The riparian area is expanding in this reach more so than PFC Reach A, especially in the lower section of PFC Reach B.
X			**5) Upland watershed is not contributing to riparian-wetland degradation** No evidence of riparian-wetland degradation. There are two meander cut-offs in 12 miles that could be related to a change in sediment from the uplands (see Google Earth image below). They are expected to stabilize but should be monitored. The sediment fans from tributaries are part of the potential; they are not causing deterioration of condition.

Yes	No	N/A	VEGETATION
X			**6) Diverse age-class distribution of riparian-wetland vegetation (recruitment for maintenance/recovery)** Yes for both woodies and herbaceous. On a cut-off meander there are cottonwood sprouts and young and several age classes in seep willow. Many cottonwood trees in the 10-20 year age class present. Most individual or small groups of regeneration from buried logs or roots, but larger patches of 20 year old cottonwoods (and younger) came from successful regeneration following flood events.
X			**7) Diverse composition of riparian-wetland vegetation (for maintenance/recovery) (*species present*)** Composition is diverse. See plant list.
X			**8) Species present indicate maintenance of riparian-wetland soil moisture characteristics** Numerous obligate wetland species present. See species list.
X			**9) Streambank vegetation is comprised of those plants or plant communities that have root masses capable of withstanding high streamflow events (*community types present*)**

			Stabilizing plant community types present. See species list.
X			**10) Riparian-wetland plants exhibit high vigor** Tent caterpillars have defoliated many of the cottonwood trees. It is common that tent caterpillars defoliate leaves early in the spring, the caterpillars cacoon, and then another set of leaves comes out in the summer. High vigor on herbaceous plants and willows. No contracted or spiky cottonwood tops, mostly rounded tops indicating short-term stress from the caterpillars. Some seep willow die-back, possibly related to extremely cold weather last winter, but also considerable young/mid-age classes, which are vigorous. Browsed bulrush set back, but still appears to have high vigor, thick stems.
X			**11) Adequate riparian-wetland vegetative cover present to protect banks and dissipate energy during high flows (*enough*)** Well vegetated on floodplain, bankfull and many places along active channel. Evidence of livestock use on a few low bars where accessible, scattered throughout reach.
X			**12) Plant communities are an adequate source of coarse and/or large woody material (for maintenance/recovery)** Multiple age classes of cottonwood and willow are growing on the floodplain and banks; plus large amounts of down woody material. Large section of reach had cottonwood removed by wildfire, now has a narrow band of trees growing along the banks. The big meanders and other areas in the broad floodplain have cottonwood galleries. Plant communities are an adequate source of large woody material on the reach as a whole.

Yes	No	N/A	EROSION DEPOSITION
X			**13) Floodplain and channel characteristics (i.e., rocks, overflow channels, coarse and/or large woody material) adequate to dissipate energy** Lots of big log jams. Even in fire area with tree loss, sacaton slowing high flows in spots (overflow channels) along with woody debris piles. Numerous overflow channels, broad floodplains with roughness elements to dissipate energy.
X[1]			**14) Point bars are revegetating with riparian-wetland vegetation** Since the 1950s (see Hereford 1993, pp. 20-24), the San Pedro River has done very little meandering; consequently, there are few true point bars. The dominant channel and floodplain forming processes result from episodic channel switching when large woody debris jams or large volumes of sediment, delivered by tributaries, obstruct the main channel and divert flow into an overflow channel, which then evolves into the dominant channel. This process is most common in the transition form, which occurs at or immediately downstream of tributary fans (refer to Fogg et al. 2012, pp. 17-18). We answered this item "yes" because the upper banks are well vegetated with trees, seep willows, etc., and stable.
X			**15) Lateral stream movement is associated with natural sinuosity** There is no excessive lateral stream movement. Stream movement is associated with the channel switching between active and overflow channels related to flow blockages from log jams and tributary sediment deposition.
X			**16) System is vertically stable (*not downcutting*)** No headcuts.
X			**17) Stream is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition)** Within several hundred yards of tributary fans, sediments are processed and regular stream form develops. Two relatively recent channel shifts noted (see Figure A1 below), due to switching among active and overflow channels related to flow blockages from tributary sediments or log jams. The north channel shift is associated with tributary fans, the south one is not. Google Earth images show numerous old "loops" or large meanders that have been cut off and

[1] In retrospect, the answer to item 14 is "n/a" because point-bar extension has not been the dominant floodplain forming process since the 1950s. Point bars are rarely observed except near confluences with large tributaries. Overbank flooding with vertical floodplain aggradation has been the dominant floodplain process for more than 50 years along most of the upper San Pedro River.

			resulted in more floodplain and water storage opportunities as the riparian area recovered over time.

Remarks

The majority of the reach is functional, with only small parts of the reach that are a cause of concern (i.e., the two relatively recent channel location changes, see Figure A1 below . The change in slope due to the channel shifts is very small over the 12-mile reach, but monitoring will help with understanding them better.

The two "no" answers (item 2 and 3) are not significant to physical function as evidenced by "yes" answers on item 1 and all the vegetation and erosion/deposition items.

There are agriculture dikes that parallel the river in parts of this reach. Because of the change in slope from the hillsides to the riparian area, sediment from overland flow would drop out even without the dikes. There are some places where the captured water is not ponding, but is flowing behind the dike until it reaches a tributary, causing erosion. Where the water actually does pond, there are questions as to whether it soaks in to recharge the aquifer, or is it mostly evaporating? It was counted as recharge in the last 321 report. More information is needed to fully understand the effects of the dikes.

Figure A1. The white arrows are pointing to two relatively recent channel location changes. Also note the agricultural berms west of the river, the railroad grade east of the river, and that some tributaries are no longer visibly connected to the San Pedro River.

Each tributary delivers different amounts of water and sediment, as well as different sediment sizes, which influences the soil characteristics of the San Pedro River. Precipitation events do not affect the tributaries equally.

Some people thought the reach was too long, but it was homogenous in terms of water availability and very predictable in terms of repeating patterns of ponded form, tributary fan, transition section, and regular form. Consideration was given to describing an inclusion where the 1997 fire occurred, but the conditions still fit the same potential description; just had less cottonwood than the rest of the reach. The fire area was long enough to be its own reach, but the foundation elements of function were considered adequately similar to keep a single reach. It was clear in that area that bulrush and willows will play a major role in the continuing evolution of this type reach, particularly as cottonwood senesces over time.

Some of the in-channel bars have riparian vegetation established and expanding, providing micro-habitat for water umbel. There was visual evidence of livestock use on a few low bars where accessible, scattered throughout reach.

SUMMARY DETERMINATION

Functional Rating:
:

_X_ Proper Functioning Condition

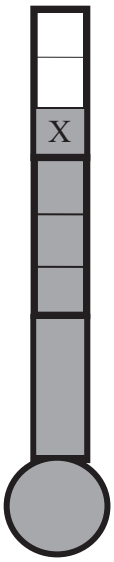
___ Functional - At Risk

___ Nonfunctional

___ Unknown

Trend for Functional - At Risk:

___ Upward
___ Downward
___ Not Apparent



Are factors contributing to unacceptable conditions outside the control of the manager?

Yes ___
No ____
Stream has been channelized in several places, but not to unacceptable conditions.

If yes, what are those factors?

___ Flow regulations
___ Mining activities
___ Upstream channel conditions
___ Channelization
___ Road encroachment
___ Oil field water discharge
___ Augmented flows
___ Other (specify _____

(Revised 1998) (7/12/04

SPRNCA Plant List for PFC Assessment

(Not a complete list of species present)

Reach B Date 4/12, 13, 15/2012

	Sedges/Grasses	Scientific Name	WIC	SC	AB	LOC
X	Spikerush CT	*Eleocharis spp.*		H	2	A
	Common spikerush	*Eleocharis palustris*	OBL	H		
	Parish spikerush	*Eleocharis parishii*	FACW	H		
	Beaked spikerush	*Eleocharis rosellata*	OBL	L		
	Threesquare bulrush	*Schoenoplectus americanus*	OBL	H		
X	Hardstem bulrush CT	*Schoenoplectus spp.*		H	3	A B
X	Hardstem bulrush	*Schoenoplectus acuta*	OBL	H	3	A B
	Baltic rush CT	*Juncus spp.*	OBL	H		
X	Baltic rush	*Juncus balticus*	OBL	H	2	A B
	Arizona rush	*Juncus interior*	FAC	M		
X	Torrey's rush	*Juncus torreyi*	FACW	H	1	A
X	Cattail	*Typha latafolia*	OBL	H	1	A
	Clustered field sedge	*Carex praegracillis*	OBL	H		
	Flat sedge	*Cyperus odoratus*	FACW+	M		
X	Johnson grass	*Sorghum halapense*	FACU+	M	4	A B
X	Bermuda grass	*Cynodon dactylon*	FACU	M	4	B F
	Barnyard grass	*Echinochloa crus-galli*	FACW	L		
X	Rabbitsfoot grass	*Polypogon monspeliensis*	FACW	L	4	A
X	Smooth horsetail	*Equisetum laevigatum*	FACW	L	2	B A
	Alkali Sacaton	*Sporobolus airoides*	FAC	M		
X	Giant Sacaton	*Sporobolus wrightii*	FAC	M	4	T F B
	Spike dropseed	*Sporobolus contractus*	FACU	L		
	Sand dropseed	*Sporobolus cryptandrus*	FACU	L		
X	Deer grass	*Muhlenbergia rigens*	FAC	H	2	B
	Vine Mesquite	*Panicum obtusum*	FAC	M		
	Beardless wildrye	*Leymus triticoides*	FAC	M		
	Canadian horseweed	*Conyza canadensis*	FACU	M		
X		*Eleocharis sp*			1	A
X	Pale wolfberry	*Lycium pallidum*			1	T
X	Canadian wildrye	*Elymus canadensis*	FAC		1	F A

	Forbs	Scientific name	WIC	SC	AB	LOC
	Spiny aster	*Chloracantha spinosa*	FACW	H		
	Curly top knotweed	*Polygonum lapathifolium*	OBL	L		
X	Sweet Clover	*Melilotus indicus*	*FACU+*	L	3	A B
	Speedwell	*Veronica spp.*	OBL	L		
X	Huachuca water umbel	*Lilaeopsis schaffneriana* spp. *recurva*	OBL		2	A
X	Creeping yellowcress	Rorripa sylvestris	OBL		4	A
X	Southwest prickly poppy	Argemone pleiacantha			2	F
X	Buttercup	*Ranunculus spp*			2	A

	Trees/Shrubs	Scientific names	WIC	SC	AB	LOC
X	Cottonwood/Goodding willow CT			H	2	B F
X	Cottonwood /Mixed hardwood CT			H	1	F
X	Freemont Cottonwood	*Populus fremontii*	FACW	H	2	B F
X	Freemont Cottonwood/ Johnsongrass CT				2	F
X	Goodding willow	*Salix gooddingii*	OBL	H	1	B F
X	Goodding willow/Bulrush CT			H	2	B F
X	Goodding willow/ Johnsongrass CT			H	3	F
X	Coyote willow	*Salix exigua*	OBL	M	2	F (old channel)
X	Yewleaf willow	*Salix taxifolia*	FACW	H	1	A
X	Seep willow	*Baccharis salicifolia*	FACW	M	3	B
	Desert broom	*Baccharis sarothroides*	FACW	M		
	Yerba de pasmo	*Baccharis pteronoides*				
X	Tamarisk	*Tamarix ramosissima*	FACW	H	2	F B
	Mexican elderberry	*Sambucus nigra*	FAC	M		
	Western soapberry	*Sapindus saponaria*	UPL	M		
X	Netleaf hackberry	*Celtis reticulata*	FACU	M	2	F
X	Arizona walnut	*Juglans major*	FACW	H	1	F
X	Arizona ash	*Fraxinus velutina*	FAC +	L	1	F
	Honey locust	*Gleditsia triacanthos*	FAC	M		
	White mulberry	*Morus alba*	FAC	M		
	Texas mulberry	*Morus microphylla*	FACU	M		
	Tree tobacco	*Nicotiana glauca*	FAC	M		
X	Velvet mesquite	*Prosopis velutina*	FAC	M	2	F T
	Golden current	*Ribes aureum*	FACW	H		
	Little-leaf sumac	*Rhus microphylla*	FACU	M		
X	Rubber rabbitbrush	*Ericameria nauseosa*	UPL	M	2	F
X	Burrobrush	*Hymenoclea monogyra*	UPL	M	1	F

WIC = **W**etland **I**ndicator **C**ategories, OBL = Obligate wetland; FACW = Facultative Wetland; FAC = Facultative; FACU = Facultative Upland. From Reed, P.B. 1988. National list of plant species that occur in wetlands: Southwest (Region 7). A positive (+) or negative (-) sign was used with the Facultative Indicator categories to more specifically define the regional frequency of occurrence in wetlands. The positive sign indicates a frequency toward the higher end of the category (more frequently found in wetlands), and a negative sign indicates a frequency toward the lower end of the category (less frequently found in wetlands).
SC = **S**tability **C**lass: low (L), moderate (M), high (H), adapted from Burton, T.A, S.J. Smith, and E.R. Cowley. 2011. Riparian area management: multiple indicator monitoring (MIM) of stream channels and streamside vegetation. TR 1737-23; Winward, A.H. 2000. Monitoring the vegetation resources in riparian areas. USDA Forest Service Rocky Mountain Research Station General Technical Report RMRS-GTR-47.; Nelle, S. 2011. Common plants of riparian areas – Southwestern Texas-Northern Mexico with wetland indicator (WI) and draft stability rating (SR); and NRCS National Plant Database.
AB = **Ab**undance (1-4). 1 = present but with only 1 to a few individuals; 2 = found occasionally; 3 = common; 4 = abundant .
LOC = **Loc**ation(s): active channel(AC), stream bank(B), frequent floodplain(F), terrace (T).
CT = **C**ommunity **T**ype

41 – Waypoint 823, upper reach end, down view from private land fence. Note aggradation of sediments on cottonwoods.

42 – Waypoint 824, 1st of 3 photos showing bar, cutbank and terrace. Line of seep/coyote willow near level of base flow on bar, barren from there to bankfull.

43 – Continuing around meander, cutting action causing some collapse of terrace, extending length of stream.

44 – Lower end of bar, willows on right started at lower elevation than current frequent floodplain, now being undercut as meander increases.

45 – Colonizing herbaceous plants.

46 – Cottonwood was undercut by stream and fell, but roots stayed attached and now limbs are becoming new trees.

47 – Waypoint 825 - above current frequent floodplain, but at earlier time Gooding willow established behind cottonwood, probably at lower elevation than now.

48 – Waypoint 826 - transition going to standard form. Trees along right bank established after ones behind, leaning out over river for sunlight.

49 – Discussing what we've been seeing so far on the reach, we tried to group up several times a day to make sure we were seeing the same things.

50 – Waypoint 827 - upstream to overflow channel (photo left), standard form river channel photo right.

51 – Waypoint 828 - note thalweg forming in colonizing vegetation, rivers/streams want to meander.

52 – Below waypoint 828 - looking down to debris jam/beaver dam, channel filled with herbaceous growth as sediments collect. May develop cienega characteristics if holds.

53 – Below waypoint 828 dam, lower end of beaver dam on tributary fan, pond extends upstream nearly ½ mile.

54 – Waypoint 829 – defoliated cottonwood trees from the caterpillars.

55 – Shrubs and trees growing near the banks.

56 – Caterpillars that have fallen from the trees.

57 – More caterpillars.

58 – Waypoint 831 – Ponded form created by tributary fan.

59 – Waypoint 832 – lower end of beaver dam on tributary fan, pond backs up nearly ½ mile upstream.

60 – Tributary fan area, same beaver dam as waypoint 832.

61 – Beaver dam at end of ponded form.

62- Waypoint 833, cobble to left (stream right) of channel is almost like cement, transition section of stream.

63 – Waypoint 834, very large beaver dam with advantage provided by large down tree.

64– Waypoint 835 - upstream view of dam, good stabilizing vegetation forming below.

65 –Waypoint 836, Bermuda grass on low-cohesive soils, stream washed around bank behind during previous high flow.

66 – Taking notes on beaver dam.

67 – Waypoint 837 - large sediment deposit, stream adjusting grade through sediments.

68 – Reflection picture.

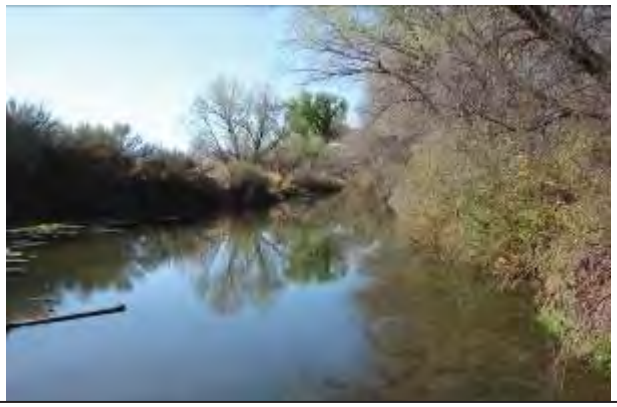
69 – Waypoint 838 - large sediment deposit, showing stream transition through it on both sides.

70 – Waypoint 840 - upstream view from Hereford bridge.

San Pedro River Photo Sheets
SPRNCA, Reach B middle
Photographer: Mike Lunn, April 13, 2012

71 – Waypoint 840, downstream from Hereford bridge.

72 – Waypoint 841, downstream view of tributary sediment fan, very small beaver dam present, transition section form.



73 – Waypoint 841, upstream view of ponded form.

74 – Waypoint 842, bulrush community on left bank, colonizers right bank.

75 – Bulrush communities beginning to form on both banks, still lack needed density.

76 –Waypoint 843, downstream view, standard form pool/riffle.

San Pedro River Photo Sheets
SPRNCA, Reach B middle
Photographer: Mike Lunn, April 13, 2012

77 - Waypoint 844, down view, bulrush colonizing both sides.

78 - Waypoint 845, beginning of section burned by fire 20 years ago, only small band of cottonwood remains in places.

79 – Same location, cattle have eaten all the bulrush on this accessible bar, vigorous bulrush across stream against bank.

80 - Waypoint 846, note aggraded active channel left, strong vegetation below and at bankfull levels.

81 – Waypoint 847, down view, excellent vegetative bank cover both sides.

82 – Down view, very narrow channel with down fire-killed cottonwood.

San Pedro River Photo Sheets
SPRNCA, Reach B middle
Photographer: Mike Lunn, April 13, 2012

83 – Waypoint 849, narrowing channel, bulrush expanding riparian area both inward and outward.

84 – Waypoint 850, upstream view, bulrush wading into channel, narrowing channel, expanding riparian area.

85 – Waypoint 851, large cottonwood that survived fire, along with excellent herbaceous vegetation.

86 – Waypoint 852, tributary sediment fan with ponded form above, very small beaver dam photo right.

87 – Down through riffle transition zone, important habitat area for some species of fish.

88 – Waypoint 853, down view, bulrush communities expanding both sides

San Pedro River Photo Sheets
SPRNCA, Reach
Photographer: Mike Lunn, April

89 – Waypoint 854, upstream view of riffle to pond. Grazing/ trampling retarding recovery.

90 – Waypoint 854, downstream view changing back to standard form.

91 – Upstream view, livestock retarding vegetation recovery on bar.

92 – Waypoint 855 - representative photo.

93 – Looking down overflow channel, well vegetated, to River.

94 – Waypoint 856 - excellent site for establishment of colonizer/stabilizing plants. Seep willow on right.

San Pedro River Photo Sheets
SPRNCA, Reach B middle
Photographer: Mike Lunn, April 13, 2012

95 – Waypoint 857, wide ponded form, excellent herbaceous vegetation.

96 – Waypoint 858, across river view to mouth of Hunter Wash.

97 – Looking down to sediment fan and large wood jam formed by flows from Hunter wash.

98 – Downstream view through large wood deposits.

99– Waypoint 890, beginning of extensive cohort of 5-10 year old cottonwood, upstream all has been older.

100 – More young cottonwood in two separate lines, planted by different flood events but relatively close in time.

101 –Waypoint 891, upstream view of beaver dam contributing to ponded form above.

102 – Waypoint 892, tall bulrush creating stable community, expanding up bank and into water.

103 – Waypoint 893, young cottonwood stand similar age to that close to river, but at edge of terrace some 300 yards from current active channel.

104 – Waypoint 894, tent caterpillars on Huachuca water umbel. Not a normal host, but just an overload of caterpillars.

105 – More water umbel.

106 – Excellent bulrush on both banks, probably helped by hydrologic modification from log pile downstream.

107 – Downstream view, little distance between stream and terrace on left.

108 – Waypoint 896 - downstream view, ponded form.

109 – Waypoint 897 - excellent herbaceous and woody vegetation both sides.

110 – Waypoint 898, mouth of Miller Wash looking up the wash.

111 – Downstream from mouth of wash, fine sediments being deposited.

112 – Overflow channel cuts off a long loop in the river, appears stable.

113 – Waypoint 899, new cottonwood (from buried tree) in overflow channel.

114 – Waypoint 899 - more young cottonwood.

115 – Waypoint 900, downstream, ponded form.

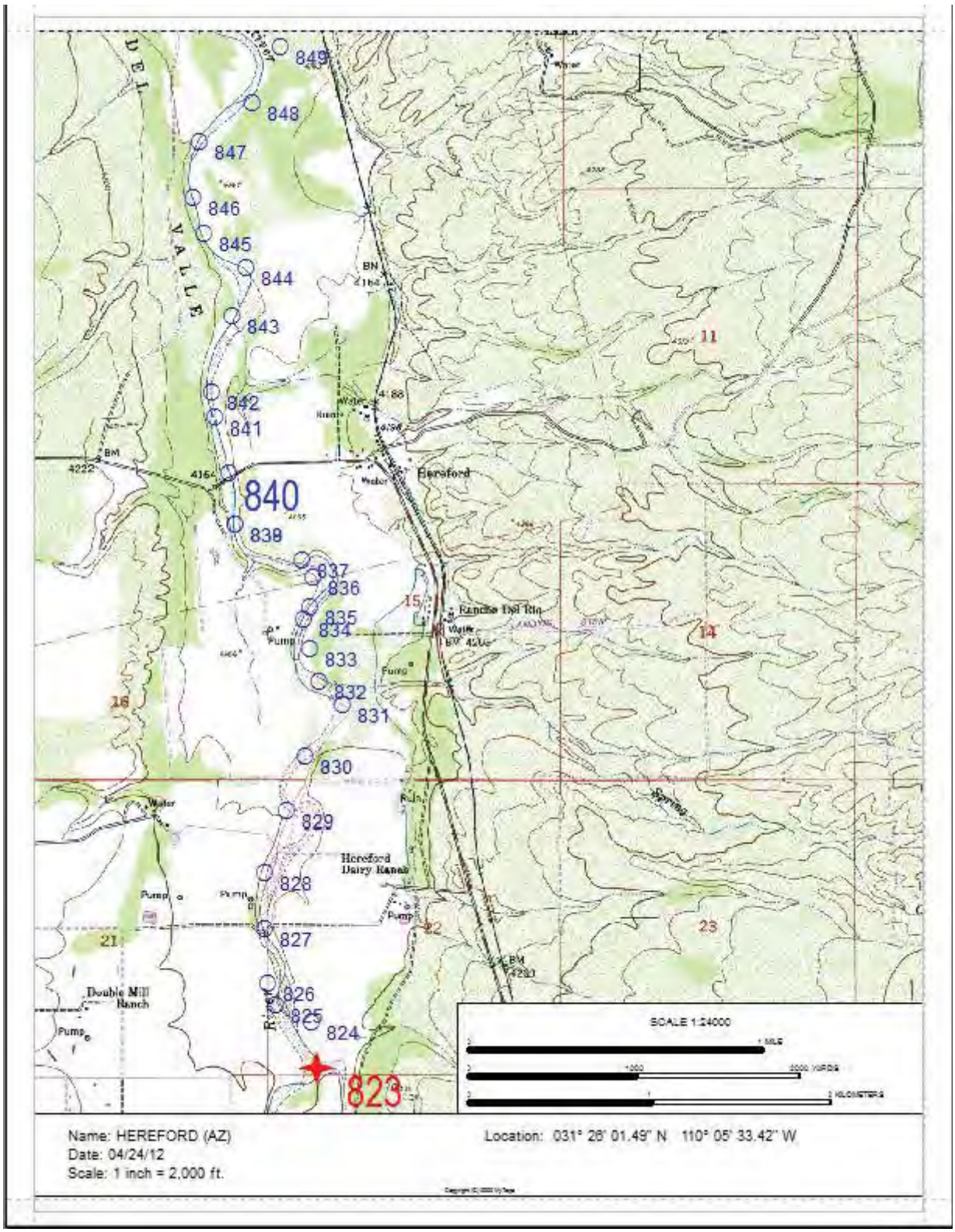
116 – Waypoint 901, very large and old cottonwood, likely predates the downcutting of the cienega.

117 – Another large, old tree on the old terrace.

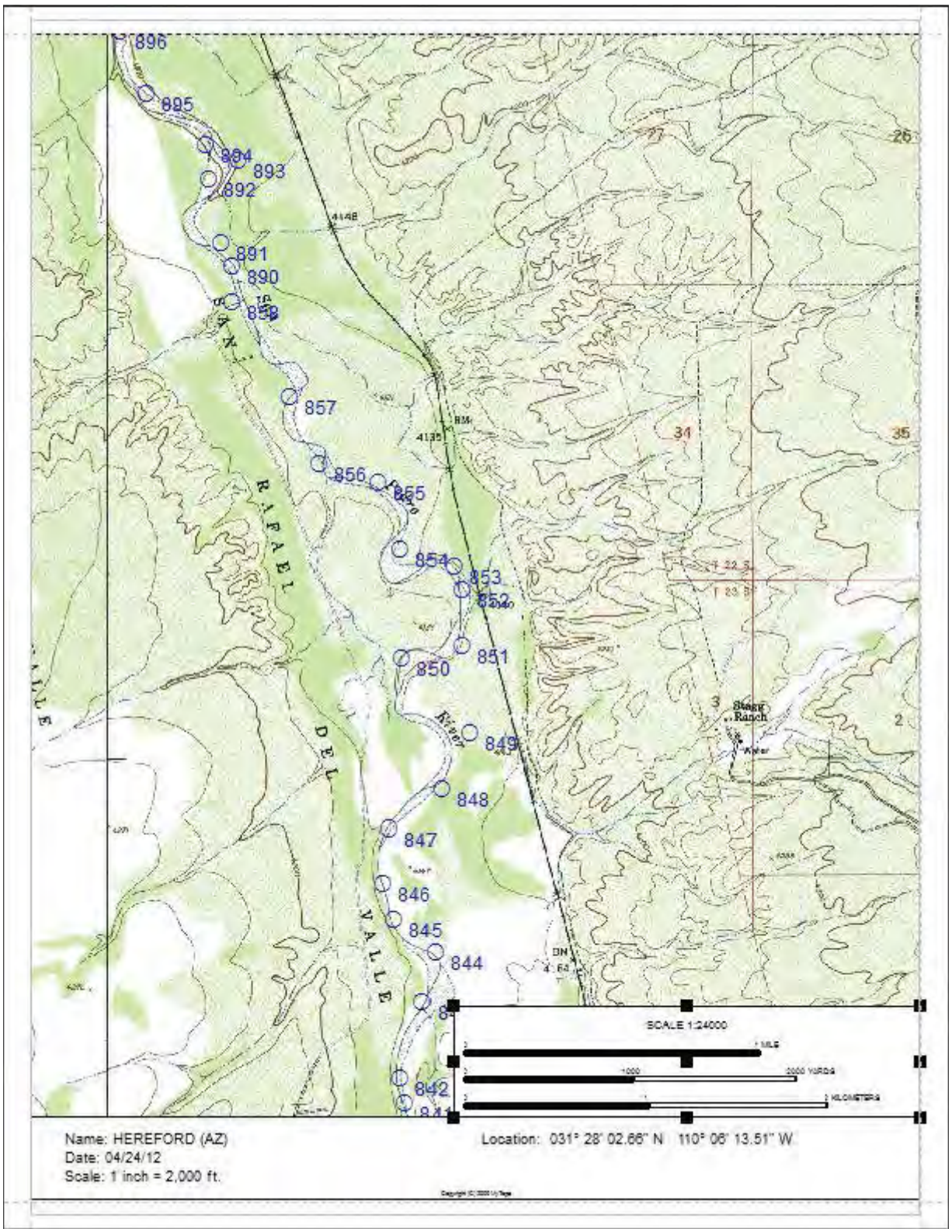
118 – Waypoint 902, upstream view.

119 – Waypoint 902, downstream view.

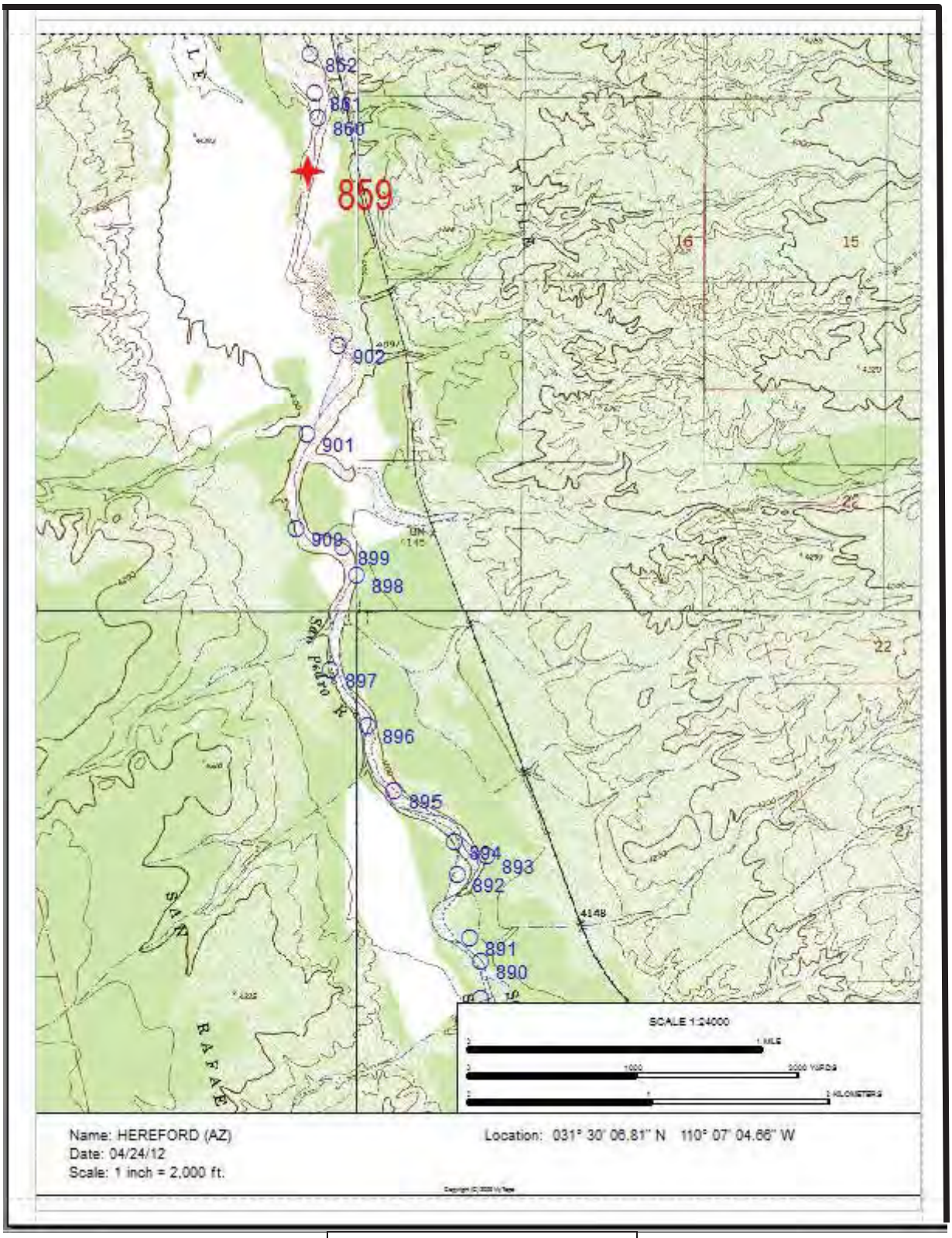
120 – Waypoint 859, upstream view from reach end, mid channel bar.



SPRNCA PFC Reach B (south section)
Waypoints 823 – 849 (reach continues north)
April 12, 2012



SPRNCA PFC Reach B middle
Waypoints 844 – 895
April 13, 2012



SPRNCA PFC Reach B north
Waypoints 890 – 859
April 15, 2012

SPRNCA Reach B
South section

Reach B, wpt 858
Middle section
Fire affected
section of reach
Reach B, wpt 840
Middle section
Hereford
© 2012 Google
Image USDA Farm Service Agency
© 2012 INEGI
Image © 2012 GeoEye
Google earth
Imagery Date: 6/22/2011
1992
31°27'24.75" N 110°06'21.65" W elev 4153 ft
Eye alt 21350 ft

Wpt 859 north section ends, reach ends
Wpt 858, north section begin
© 2012 Google
© 2012 INEGI
Image © 2012 GeoEye
Google earth
Imagery Date: 6/22/2011
1992
31°30'04.79" N 110°07'29.02" W elev 4117 ft
Eye alt 21323 ft

Reach B
San Pedro River above Hereford Bridge, looking upstream (south) towards the bridge

July 6, 1987

July 1, 1992

July 17, 1992

August 3, 1998

June 7, 2004

San Pedro PFC Assessment
Waypoint Log
Reach B

April 12, 2012

823	12-APR-12 7:47:25AM	N31 24.548 W110 06.277	4192 ft	reach break, photo 41
824	12-APR-12 8:17:01AM	N31 24.696 W110 06.171	4182 ft	photo 42
825	12-APR-12 8:49:38AM	N31 24.749 W110 06.292	4204 ft	photo 47
826	12-APR-12 8:55:22AM	N31 24.811 W110 06.319	4182 ft	photo 48
827	12-APR-12 9:52:28AM	N31 24.974 W110 06.333	4212 ft	photo 50
828	12-APR-12 10:02:13AM	N31 25.139 W110 06.334	4189 ft	photos 51-52
829	12-APR-12 10:20:59AM	N31 25.325 W110 06.257	4202 ft	photo 54
830	12-APR-12 10:36:32AM	N31 25.484 W110 06.191	4190 ft	photo 55
831	12-APR-12 10:50:09AM	N31 25.635 W110 06.062	4202 ft	photo 58
832	12-APR-12 10:59:05AM	N31 25.708 W110 06.144	4149 ft	photo 59
833	12-APR-12 12:17:27PM	N31 25.801 W110 06.175	4173 ft	photo 62
834	12-APR-12 12:23:11PM	N31 25.889 W110 06.197	4172 ft	photo 63
835	12-APR-12 12:26:19PM	N31 25.929 W110 06.176	4179 ft	photo 64
836	12-APR-12 12:34:47PM	N31 26.013 W110 06.167	4174 ft	photo 65
837	12-APR-12 12:42:50PM	N31 26.068 W110 06.202	4184 ft	photo 67
838	12-APR-12 12:57:45PM	N31 26.171 W110 06.436	4153 ft	photo 69
840	12-APR-12 1:06:08PM	N31 26.307 W110 06.456	4161 ft	photos 70-71

April 13, 2012

841	13-APR-12 7:57:09AM	N31 26.489 W110 06.506	4153 ft	photos 72-73
842	13-APR-12 8:08:30AM	N31 26.562 W110 06.517	4167 ft	photo 74
843	13-APR-12 8:23:22AM	N31 26.786 W110 06.447	4146 ft	photo 76
844	13-APR-12 8:42:35AM	N31 26.932 W110 06.396	4153 ft	photo 77

845	13-APR-12 8:57:46AM	N31 27.030 W110 06.541	4141 ft	photos 78-79
846	13-APR-12 9:17:25AM	N31 27.136 W110 06.579	4186 ft	photo 80
847	13-APR-12 9:49:45AM	N31 27.301 W110 06.557	4154 ft	photo 81
848	13-APR-12 10:02:58AM	N31 27.419 W110 06.373	4145 ft	photo 82
849	13-APR-12 10:17:28AM	N31 27.584 W110 06.275	4145 ft	photo 83
850	13-APR-12 10:52:00AM	N31 27.804 W110 06.512	4147 ft	photo 84
851	13-APR-12 11:01:16AM	N31 27.839 W110 06.304	4141 ft	photo 85
852	13-APR-12 11:39:55AM	N31 28.005 W110 06.307	4135 ft	photo 86
853	13-APR-12 11:48:31AM	N31 28.076 W110 06.333	4128 ft	photo 88
854	13-APR-12 12:03:05PM	N31 28.126 W110 06.519	4134 ft	photos 89-90
855	13-APR-12 12:16:29PM	N31 28.324 W110 06.594	4130 ft	photo 92
856	13-APR-12 12:33:08PM	N31 28.380 W110 06.801	4115 ft	photo 94
857	13-APR-12 12:43:05PM	N31 28.576 W110 06.904	4107 ft	photo 95
858	13-APR-12 1:00:20PM	N31 28.857 W110 07.101	4112 ft	photo 96

April 15, 2012

890	15-APR-12 8:30:53AM	N31 28.966 W110 07.103	4141 ft	photo 99
891	15-APR-12 8:40:12AM	N31 29.034 W110 07.140	4117 ft	photo 101
892	15-APR-12 9:08:51AM	N31 29.222 W110 07.186	4127 ft	photo 102
893	15-APR-12 9:17:07AM	N31 29.277 W110 07.078	4153 ft	photo 103
894	15-APR-12 9:37:03AM	N31 29.322 W110 07.193	4142 ft	photo 104
896	15-APR-12 11:13:59AM	N31 29.665 W110 07.494	4118 ft	photo 108
897	15-APR-12 12:19:09PM	N31 29.833 W110 07.627	4092 ft	photo 109
898	15-APR-12 12:42:36PM	N31 30.111 W110 07.534	4076 ft	photo 110
899	15-APR-12 12:49:21PM	N31 30.194 W110 07.582	4105 ft	photos 113-114
900	15-APR-12 1:05:51PM	N31 30.251 W110 07.742	4109 ft	photo 115

901	15-APR-12 1:29:01PM	N31 30.533 W110 07.709	4090 ft	photo 116
902	15-APR-12 1:43:27PM	N31 30.795 W110 07.599	4125 ft	photos 118-119

April 14, 2012

859	14-APR-12 7:57:19AM	N31 31.310 W110 07.708	4079 ft	reach break, photo 120

PFC Assessment Form

Name of Riparian-Wetland Area: **San Pedro River**

Date: **4/14/12** Segment/Reach ID: **Reach C**

ID Team Observers: Mike Lunn, Janice Staats, Wayne Elmore, Mark Gonzalez, Jim Fogg, Ben Lomeli, Jeff Simms, Marcia Radke, Eric Baker, Heather Swanson, Catie Fenn, Ryan Pitts

Yes	No	N/A	HYDROLOGICAL
X			**1) Floodplain above bankfull is inundated in "relatively frequent" events** Yes, floodplain accessible throughout most of the reach in one-two year events.
	X		**2) Where beaver dams are present are they active and stable** The dams are relatively low in elevation compared to the size of the channel. They blow out with high flows, some get rebuilt and hold back water during low flow periods. When they blow out, they do not unleash tremendous energies and do not result in deterioration of riparian function because of their size and the fact that the tributary fans provide grade control.
	X		**3) Sinuosity, width/depth ratio, and gradient are in balance with the landscape setting (i.e., landform, geology, and bioclimatic region)** Sinuosity is lower than expected for the stream type. A segment was straightened for agricultural reasons, and perhaps as part of the Highway 90 bridge. The banks on the straight sections are not eroding due to cottonwood/willow/seep willow providing stability, and the energy during high flows is being used to mobilize a sand bed. This "no" is not significant for physical function because of the stable banks and because the reach is processing sediment appropriately (see item 17).
X			**4) Riparian-wetland area is widening or has achieved potential extent** The riparian area is expanding both into the channel and on the floodplain and bars. In places bulrushes are expanding into standing water.
X			**5) Upland watershed is not contributing to riparian-wetland degradation** No degradation noted in reach.

Yes	No	N/A	VEGETATION
X			**6) Diverse age-class distribution of riparian-wetland vegetation (recruitment for maintenance/recovery)** Young and mature cottonwood present; cottonwoods sprouting from buried logs. Several age classes of willow. Young, mature, decadent, and dead seep willow present. Age classes of herbaceous species evidenced by community type development and expansion (especially bulrush and spikerush).
X			**7) Diverse composition of riparian-wetland vegetation (for maintenance/recovery) (*species present*)** Composition is diverse. See plant list.
X			**8) Species present indicate maintenance of riparian-wetland soil moisture characteristics** Obligate wetland species present. See plant list.
X			**9) Streambank vegetation is comprised of those plants or plant communities that have root masses capable of withstanding high streamflow events (*community types present*)** Both woody and herbaceous dominated community types well developed. Sacaton and spiny aster on terraces.
X			**10) Riparian-wetland plants exhibit high vigor** Some bulrush grazed but on a reach basis herbaceous vigor is good; plants that had been grazed were still vigorous. Some large seep willow is dead, but not an overall vigor problem because there are young and mature in many other places.
X			**11) Adequate riparian-wetland vegetative cover present to protect banks and dissipate energy during high flows (*enough*)** Very good cover provided by embedded wood and vegetation, only bare areas were in active channel. Between Little Lewis Draw and Lewis Spring, the river is cutting into the pre-

			entrenchment terrace, which is good for adding sinuosity.
X			**12) Plant communities are an adequate source of coarse and/or large woody material (for maintenance/recovery)** Future supply will come from older cottonwood and younger willow. There is a cottonwood gallery south of the bridge. Not as many trees and more open north of the bridge due to fire.

Yes	No	N/A	EROSION DEPOSITION
X			**13) Floodplain and channel characteristics (i.e., rocks, overflow channels, coarse and/or large woody material) adequate to dissipate energy** Overflow channels present, some with cobbles and gravels. Lots of large wood. Building meanders that will lengthen channel, reduce grade, dissipate energy.
X[1]	**X**[1]		**14) Point bars are revegetating with riparian-wetland vegetation** Since the 1950s (see Hereford 1993, pp. 20-24), the San Pedro River has done very little meandering; consequently, there are few true point bars. The dominant channel and floodplain forming processes result from episodic channel switching when large woody debris jams or large volumes of sediment, delivered by tributaries, obstruct the main channel and divert flow into an overflow channel, which then evolves into the dominant channel. This process is most common in the transition form, which occurs at or immediately downstream of tributary fans (refer to Fogg et al. 2012, pp. 17-18). We chose to answer this item "yes" and "no." "Yes," because (1) most of the upper banks are well vegetated with trees, seep willows, etc., and stable, (2) there is a lot of seep willow growing at bankfull in many parts of the reach, and (3 three point bars above the bridge are well vegetated with seep willow and Bermuda grass. "No," because some of the point bars are revegetating and some are not, mostly in the lower ¼ of the reach. Where point bars exist, livestock are grazing accessible new growth, particularly on bulrush.
X			**15) Lateral stream movement is associated with natural sinuosity** There is no excessive lateral stream movement. Stream movement is associated with the channel switching between active and overflow channels related to flow blockages from log jams and tributary sediment deposition. Most streambanks are not eroding due to cottonwood/willow providing stability, and also some very cohesive soils in places. The ponded channel forms are quite straight.
X			**16) System is vertically stable (*not downcutting*)** No downcutting observed.
X			**17) Stream is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition)** There are sediment depositions that didn't appear to be associated with the mouth of a tributary, but by looking at the aerial photographs we could see that where some tributaries enter, the river has shifted across their alluvial fans over time. The ephemeral tributaries deliver a lot of sediment that creates the multiple stream forms – standard form, ponded form, fan/ transition form, which are part of the potential.

Remarks

All the tributary channels pass under the railroad grade.

There are two heavy steel and mesh fences on or near the streambank that we think were built to protect the railroad bed by making the banks in those locations rigid, and deflecting high flows away from overflow channels (photo 132 and

[1] In retrospect, the answer to item 14 is "n/a" because point-bar extension has not been the dominant floodplain forming process since the 1950s. Point bars are rarely observed except near confluences with large tributaries. Overbank flooding with vertical floodplain aggradation has been the dominant floodplain process for more than 50 years along most of the upper San Pedro River.

photo 156). The fence across from Garden Wash is still intact and on the streambank, the one farther downstream is now in the channel due to bank erosion. There were varied opinions whether pulling them out would cause more harm than good.

Similar to PFC Reach B, there are agriculture dikes that parallel the river in parts of this reach. Because of the change in slope from the hillsides to the riparian area, sediment from overland flow would drop out even without the dikes. There are some places where the captured water is not ponding, but is flowing behind the dike until it reaches a tributary, causing erosion. Where the water actually does pond, there are questions as to whether it soaks in to recharge the aquifer, or is it mostly evaporating? It was counted as recharge in the last 321 report. More information is needed to fully understand the effects of the dikes.

Salt cedar present downstream of Little Lewis Wash on the pre-entrenchment terrace and floodplain.

SUMMARY DETERMINATION

Functional Rating:
:

_X__ Proper Functioning Condition

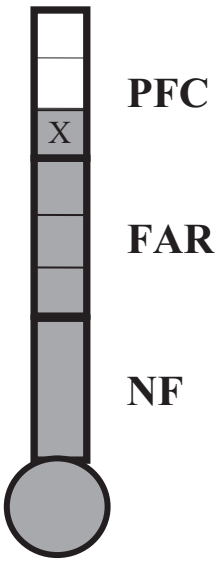
___ Functional - At Risk

___ Nonfunctional

___ Unknown

Trend for Functional - At Risk:

___ Upward
___ Downward
___ Not Apparent



Are factors contributing to unacceptable conditions outside the control of the manager?

Yes ___
No _X__
Concern about possibilities that ground water pumping is or will impact reach.

If yes, what are those factors?

___ Flow regulations
___ Mining activities
___ Upstream channel conditions
___ Channelization
___ Road encroachment
___ Oil field water discharge
___ Augmented flows
___ Other (specify _____

(Revised 1998) (7/12/04)

SPRNCA Plant List for PFC Assessment

(Not a complete list of species present)

Reach C Date April 14, 2012

	Sedges/Grasses	Scientific Name	WIC	SC	AB	LOC
X	Spikerush CT	*Eleocharis spp.*		H	2	A
X	Common spikerush	*Eleocharis palustris*	OBL	H	1	A
	Parish spikerush	*Eleocharis parishii*	FACW	H		
	Beaked spikerush	*Eleocharis rosellata*	OBL	L		
	Threesquare bulrush	*Schoenoplectus americanus*	OBL	H		
X	Hardstem bulrush CT	*Schoenoplectus spp.*		H	4	A
X	Hardstem bulrush	*Schoenoplectus acuta*	OBL	H	4	A
X	Baltic rush CT	*Juncus spp.*	OBL	H		
X	Baltic rush	*Juncus balticus*	OBL	H	2	A
	Arizona rush	*Juncus interior*	FAC	M		
X	Torrey's rush	*Juncus torreyi*	FACW	H	1	A
X	Cattail	*Typha latafolia*	OBL	H	1	A
	Clustered field sedge	*Carex praegracillis*	OBL	H		
	Flat sedge	*Cyperus odoratus*	FACW+	M		
X	Johnson grass	*Sorghum halapense*	FACU+	M	4	B F A
X	Bermuda grass	*Cynodon dactylon*	FACU	M		
X	Barnyard grass	*Echinochloa crus-galli*	FACW	L	4	A
X	Rabbitsfoot grass	*Polypogon monspeliensis*	FACW	L	4	A
X	Smooth horsetail	*Equisetum laevigatum*	FACW	L	4	A B
	Alkali Sacaton	*Sporobolus airoides*	FAC	M		
X	Giant Sacaton	*Sporobolus wrightii*	FAC	M	4	F B A
	Spike dropseed	*Sporobolus contractus*	FACU	L		
	Sand dropseed	*Sporobolus cryptandrus*	FACU	L		
X	Deer grass	*Muhlenbergia rigens*	FAC	H	2	B
	Vine Mesquite	*Panicum obtusum*	FAC	M		
	Beardless wildrye	*Leymus triticoides*	FAC	M		
	Canadian horseweed	*Conyza canadensis*	FACU	M		
X	Canadian wildrye	*Elymus canadensis*	FACU	L	2	B F

	Forbs	Scientific name	WIC	SC	AB	LOC
X	Spiny aster	*Chloracantha spinosa*	FACW	H	2/3	F
	Curly top knotweed	*Polygonum lapathifolium*	OBL	L		
X	Sweet Clover	*Melilotus indicus*	*FACU+*	L	2	A B
X	Speedwell	Veronica spp.	OBL	L		A
X	Creeping yellowcress	Rorripa sylvestris				
X	Southwestern prickly poppy	*Argemone pleiacantha*	FACU+			F
X	Buttercup	*Ranunculus spp*	OBL	L		A
X	Huachuca water umbel	*Lilaeopsis schaffneriana* spp. *recurva*	OBL	L	1	A

	Trees/Shrubs	Scientific names	WIC	SC	AB	LOC
X	Cottonwood/Goodding willow CT			H	4	F
X	Cottonwood /Mixed hardwood CT			H	1	F
X	Freemont Cottonwood	*Populus fremontii*	FACW	H	4	B F
X	Freemont Cottonwood/ Johnsongrass CT			H	3	B F
X	Goodding willow	*Salix gooddingii*	OBL	H	3	B F
X	Goodding willow/Bulrush CT			H		
X	Goodding willow/ Johnsongrass CT			H		
	Coyote willow	*Salix exigua*	OBL	M		
?	Yewleaf willow	*Salix taxifolia*	FACW	H		
X	Seep willow	*Baccharis salicifolia*	FACW	M	4	A B F
	Desert broom	*Baccharis sarothroides*	FACW	M		
	Yerba de pasmo	*Baccharis pteronoides*				
X	Tamarisk	*Tamarix ramosissima*	FACW	H	1	F
	Mexican elderberry	*Sambucus nigra*	FAC	M		
	Western soapberry	*Sapindus saponaria*	UPL	M		
X	Netleaf hackberry	*Celtis reticulata*	FACU	M	2	F
X	Arizona walnut	*Juglans major*	FACW	H	1	F
X	Velvet ash	*Fraxinus velutina*	FAC +	L	1	F
	Honey locust	*Gleditsia triacanthos*	FAC	M		
	White mulberry	*Morus alba*	FAC	M		
	Texas mulberry	*Morus microphylla*	FACU	M		
	Tree tobacco	*Nicotiana glauca*	FAC	M		
X	Velvet mesquite	*Prosopis velutina*	FAC	M	2/3	F
	Golden current	*Ribes aureum*	FACW	H		
X	Little-leaf sumac	*Rhus microphylla*	FACU	M	1	F
X	Rubber rabbitbrush	*Ericameria nauseosa*	UPL	M	2	F
X	Burrobrush	*Hymenoclea monogyra*	UPL	M	1	F

WIC = **W**etland **I**ndicator **C**ategories, OBL = Obligate wetland; FACW = Facultative Wetland; FAC = Facultative; FACU = Facultative Upland. From Reed, P.B. 1988. National list of plant species that occur in wetlands: Southwest (Region 7). A positive (+) or negative (-) sign was used with the Facultative Indicator categories to more specifically define the regional frequency of occurrence in wetlands. The positive sign indicates a frequency toward the higher end of the category (more frequently found in wetlands), and a negative sign indicates a frequency toward the lower end of the category (less frequently found in wetlands).
SC = **S**tability **C**lass: low (L), moderate (M), high (H), adapted from Burton, T.A, S.J. Smith, and E.R. Cowley. 2011. Riparian area management: multiple indicator monitoring (MIM) of stream channels and streamside vegetation. TR 1737-23; Winward, A.H. 2000. Monitoring the vegetation resources in riparian areas. USDA Forest Service Rocky Mountain Research Station General Technical Report RMRS-GTR-47.; Nelle, S. 2011. Common plants of riparian areas – Southwestern Texas-Northern Mexico with wetland indicator (WI) and draft stability rating (SR); and NRCS National Plant Database.
AB = **Ab**undance (1-4). 1 = present but with only 1 to a few individuals; 2 = found occasionally; 3 = common; 4 = abundant .
LOC = **Loc**ation(s): active channel(AC), stream bank(B), frequent floodplain(F), terrace (T).
CT = **C**ommunity **T**ype

San Pedro River Photo Sheets
SPRNCA, Reach C
Photographer: Mike Lunn, April 14, 2012

121 – Waypoint 859 downstream at reach beginning, standard form channel with bulrush and other herbaceous vegetation.

122 – Large wood on back edge of floodplain, local citizen (Marsha) breaking trail.

123 – Waypoint 860, channel goes left, secondary overflow channel right, downstream view.

124 – Waypoint 861, riffle cutting through sediment fan deposited by tributary at lower end of pond form.

125 – Waypoint 862, good bulrush communities forming, widening riparian zone both inward and outward.

126 – Waypoint 863, dry wash enters river, sediment and large/ coarse wood deposited.

San Pedro River Photo Sheets
SPRNCA, Reach C
Photographer: Mike Lunn, April 14, 2012

127 – Waypoint 864, very vigorous bulrush stand, some 6' tall, extends from channel to well upon the frequent floodplain.

128 – Waypoint 865, transition section through sediment fan, reach condition below determines length of transition.

129 – Waypoint 866, heavy canopy and fresh deposition likely limits herbaceous vegetation.

130 – Waypoint 867, lower end of transition, heavy load of large and coarse wood.

131 – Caterpillars are EVERYWHERE!

132 – Waypoint 868, railroad fence, heavy steel and mesh installed to keep channel from moving close to railroad tracks.

San Pedro River Photo Sheets
SPRNCA, Reach C
Photographer: Mike Lunn, April 14, 2012

133 – Waypoint 869, view across river up Garden Wash, heavy deposition of sediments.

134 – Aggradation of floodplain has nearly buried this vertical steel post, likely over 6' above ground when put in.

135 – View across the relatively wide frequent floodplain to the terrace behind.

136 – Waypoint 870, upstream view near wash mouth.

137 – Downstream view, showing deposition settling out.

138 – Waypoint 871, cottonwood on left at base of terrace, flood plain area, active channel bar right.

San Pedro River Photo Sheets
SPRNCA, Reach C
Photographer: Mike Lunn, April 14, 2012

139 - Waypoint 872, stream cutting into terrace on stream left

140 – Waypoint 873, upstream view from under highway 90 bridge.

141 – Waypoint 873, downstream below bridge.

142 – Waypoint 874, downstream view, ponded form below.

143 - Waypoint 875, cottonwood lost in early fire, more willow and herbaceous.

144 – Waypoint 876, ponded form.

an Pedro River Photo Sheets
SPRNCA, Reach C
Photographer: Mike Lunn, April 14, 2012

145 – Waypoint 877, looking down and across mouth of Picnic Wash to San Pedro.

146 – Waypoint 878, lower end of Picnic Wash cobble deposition.

147 – Waypoint 879, upstream view – channel has moved stream right from earlier location.

148 – Waypoint 879, downstream view.

149 – Waypoint 880, good bank development downstream, some tamarisk on left bank floodplain here.

150 – Waypoint 881, upstream view of Little Lewis Draw, cottonwood indicates connection to floodplain in draw.

San Pedro River Photo Sheets
SPRNCA, Reach C
Photographer: Mike Lunn, April 14, 2012

151 – Down to mouth of draw.

152 – Waypoint 882, upstream view.

153 – Waypoint 882, downstream. Stream hits well anchored bank, cuts left around forming bar .

154 – Waypoint 883, upstream view – lots of hydraulic activity in area above.

155 – Waypoint 884, downstream ponded section, still few cottonwoods but herbaceous performing well.

156 – Waypoint 885, down view, another fence protecting railroad grade/bridge abutment.

San Pedro River Photo Sheets
SPRNCA, Reach C
Photographer: Mike Lunn, April 14, 2012

157 – Upstream to abutment across from mouth of Murray Draw.

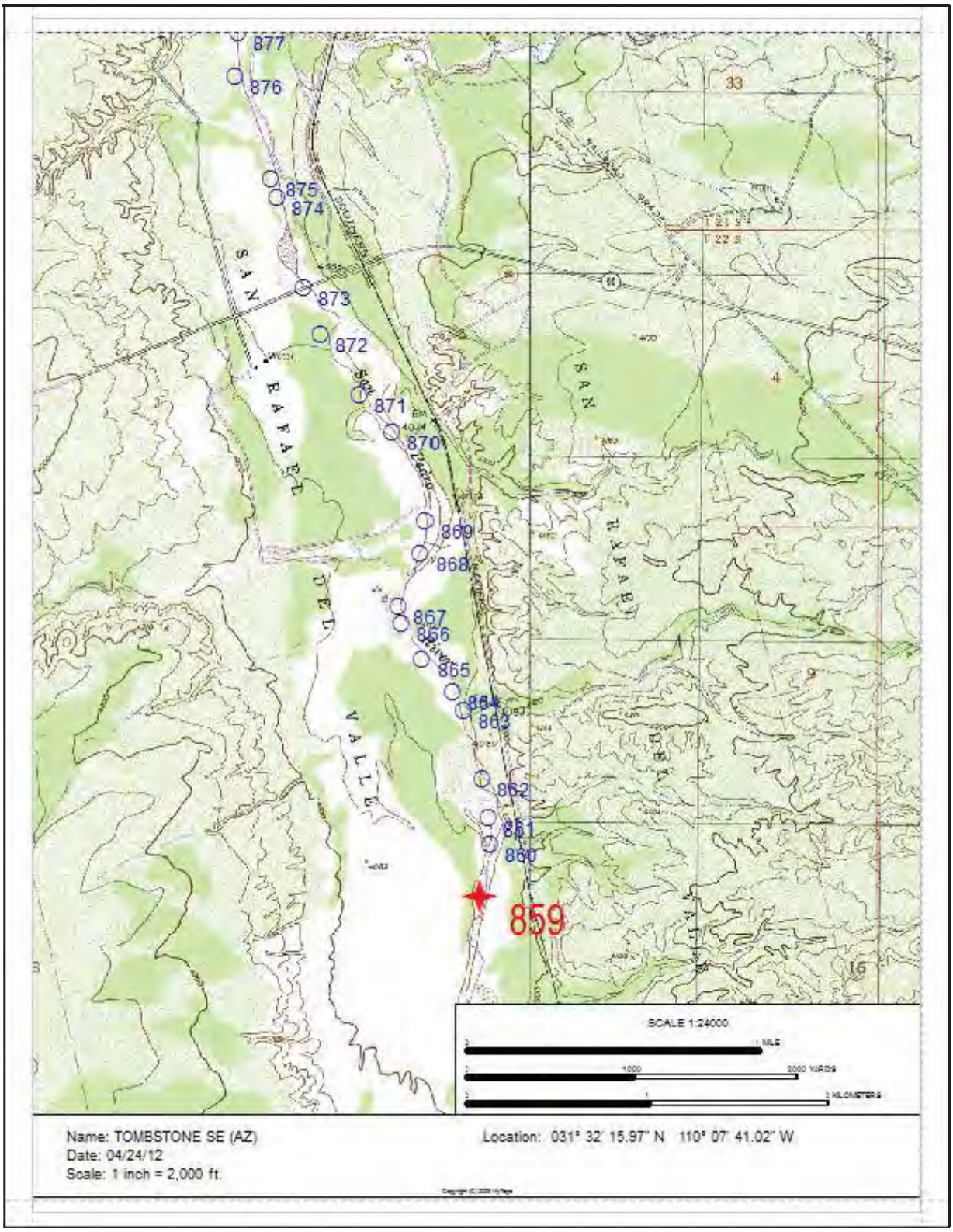
158 – Waypoint 886, upstream in tributary from Lewis Spring.

159 – Waypoint 887, down, heavy growth of stabilizing herb-aceous, including Baltic rush on caved bank segment middle.

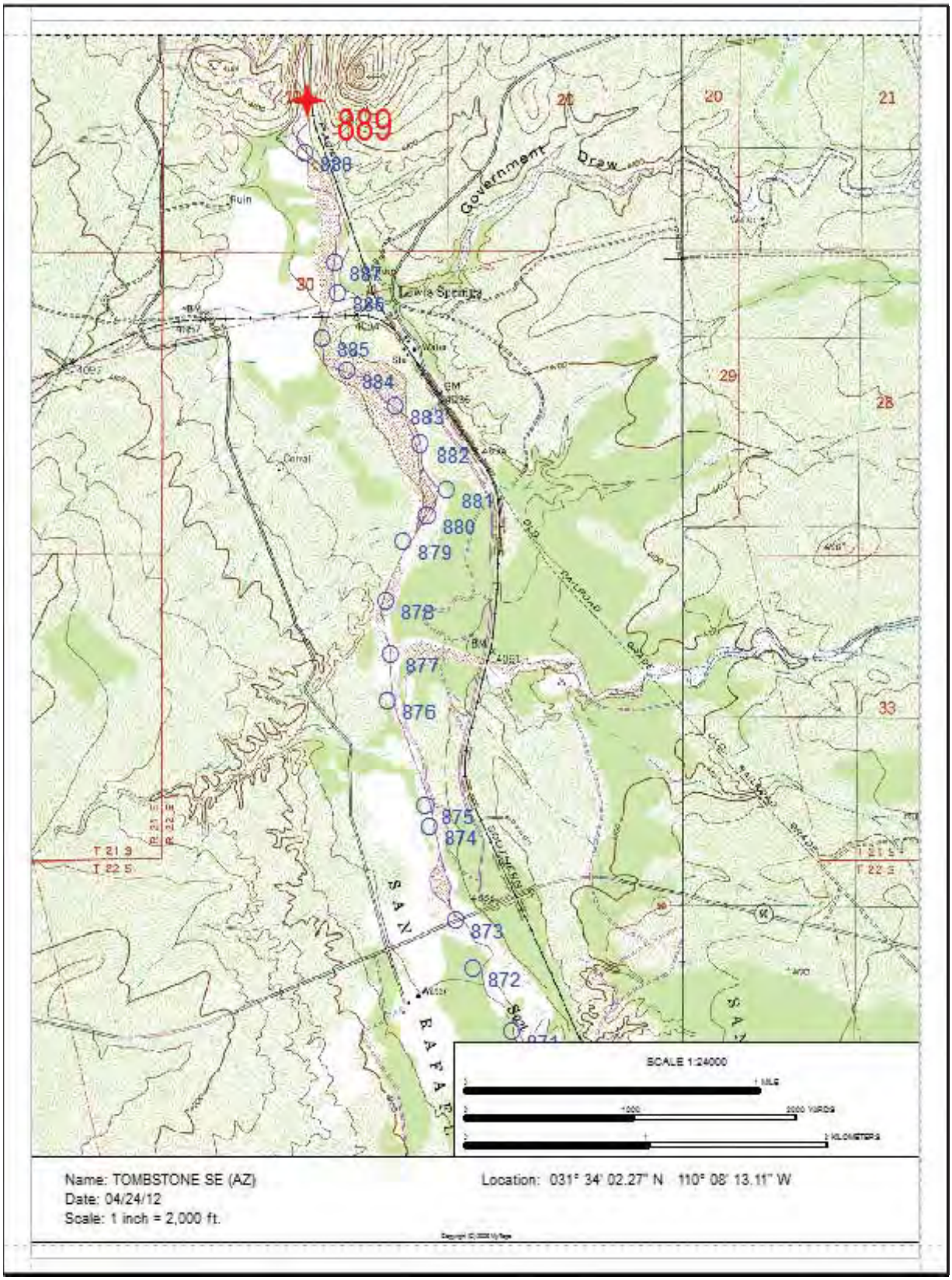
160 – Waypoint 888, upstream view

161 – Waypoint 888, downstream view.

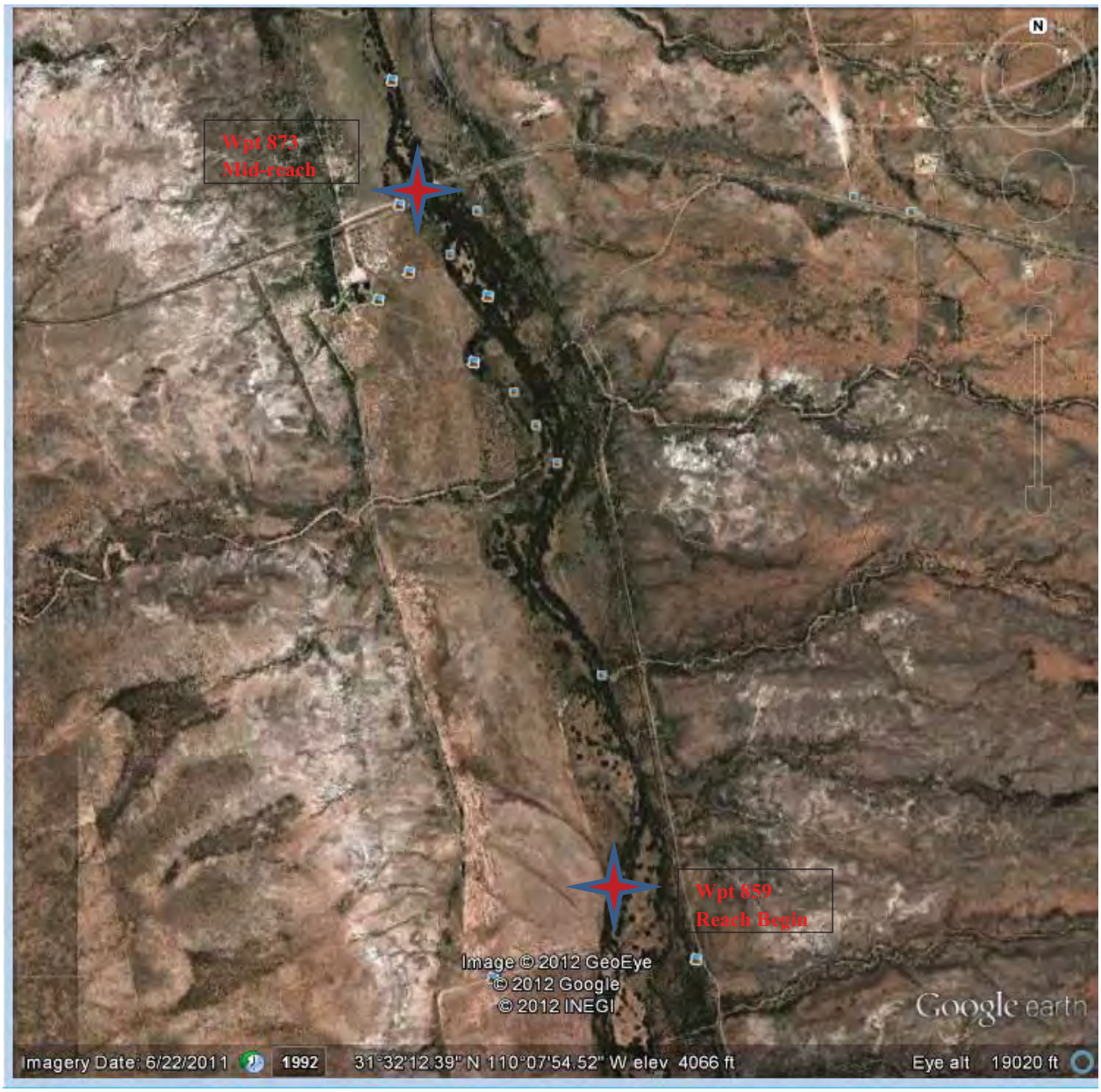
162 – Waypoint 889, upstream view from reach end.



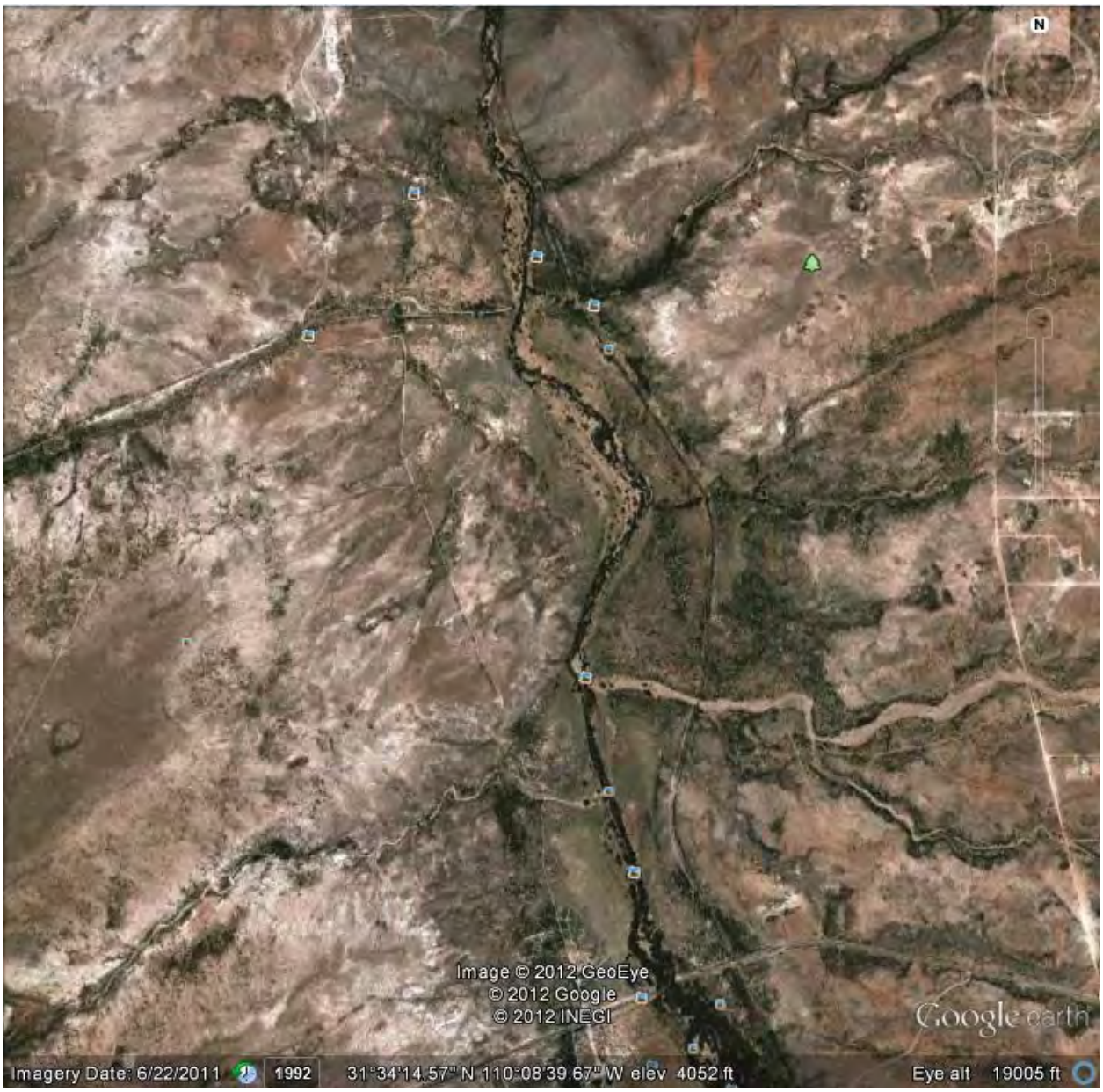
SPRNCA Reach C south
Waypoints 859 – 873
April 14, 2012

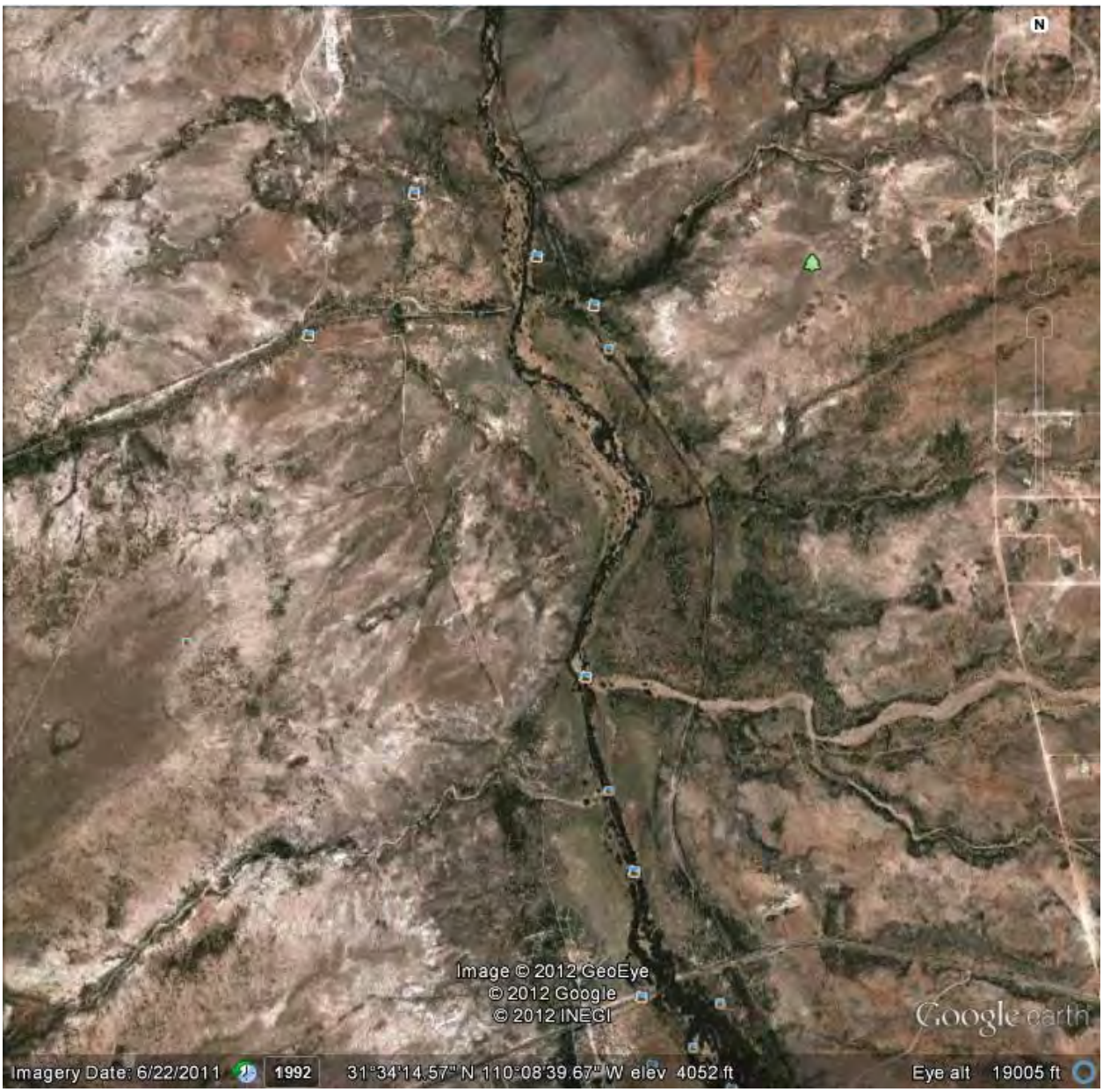


SPRNCA PFC Reach C north
Waypoints 873 – 889
April 14, 2012



SPRNCA Reach C,
South section, wpt 859 - 873


N
Image © 2012 GeoEye
© 2012 Google
© 2012 INEGI
Google earth
Imagery Date: 6/22/2011
1992
31°34'14.57" N 110°08'39.67" W elev 4052 ft
Eye alt 19005 ft



SPRNCA PFC, Reach C north half – wpts 873 - 889

Reach C
San Pedro River at Garden Wash looking upstream (south)

July 4, 1987

July 2, 1992

August 10, 1998

September 3, 2003

August 5, 2008

April 14, 2012
Opposite side of stream
from photo point,
upstream view

Reach C
San Pedro River at Garden Wash, looking downstream (north)

July 4, 1987

June 6, 1990

July 2, 1992

June 23, 1995

August 10, 1998

September 12, 2003

August 5, 2008

April 14, 2012

April 14, 2012
Steel post in ground next to walking stick is believed to be same as in photo taken in 1987, shows extent of aggradation.

Reach C
San Pedro River at Highway 90 Bridge,
looking upstream (south)

July 4, 1987

July 6, 1992

July 31, 1992

September 11, 1992

July, 3, 1995

August 3, 1998

June 30, 2008

April 14, 2012, view from beneath bridge looking upstream

Reach C
San Pedro River at Highway 90 Bridge,
view downstream (north)

July 4, 1987

June 6, 1990

June 6, 1992

January 20, 1993

July 3, 1995

August 3, 1998

June 3, 2008

April 14, 2012
Taken from stream
level, downstream view

Reach C
San Pedro River above Highway 90 bridge, looking upstream (south) towards bridge

July 4, 1987

June 6, 1990

July 6. 1992

July 3, 1995

August 3, 1998

July 1, 2004

June 30, 2008

San Pedro PFC Assessment
Waypoint Log
Reach C

859	14-APR-12 7:57:19AM	N31 31.310 W110 07.708	4079 ft	reach break, photo 121
860	14-APR-12 8:23:26AM	N31 31.469 W110 07.669	4082 ft	photo 123
861	14-APR-12 8:32:07AM	N31 31.545 W110 07.677	4075 ft	photo 124
862	14-APR-12 8:40:03AM	N31 31.660 W110 07.698	4086 ft	photo 125
863	14-APR-12 8:58:31AM	N31 31.865 W110 07.761	4049 ft	photo 126
864	14-APR-12 9:10:21AM	N31 31.919 W110 07.802	4068 ft	photo 127
865	14-APR-12 9:19:26AM	N31 32.017 W110 07.906	4065 ft	photo 128
866	14-APR-12 9:27:03AM	N31 32.122 W110 07.979	4073 ft	photo 129
867	14-APR-12 9:33:05AM	N31 32.173 W110 07.988	4074 ft	photo 130
868	14-APR-12 9:45:19AM	N31 32.330 W110 07.913	4069 ft	photo 132
869	14-APR-12 9:58:30AM	N31 32.428 W110 07.900	4082 ft	photo 133
870	14-APR-12 10:16:43AM	N31 32.687 W110 08.008	4071 ft	photos 136, 137
871	14-APR-12 10:33:53AM	N31 32.799 W110 08.125	4049 ft	photo 138
872	14-APR-12 10:53:59AM	N31 32.980 W110 08.261	4062 ft	photo 139
873	14-APR-12 11:00:53AM	N31 33.118 W110 08.318	4051 ft	photo 140
874	14-APR-12 11:20:17AM	N31 33.383 W110 08.409	4058 ft	photo 142
875	14-APR-12 11:25:15AM	N31 33.441 W110 08.430	4052 ft	photo 143
876	14-APR-12 12:05:30PM	N31 33.741 W110 08.554	4056 ft	photo 144
877	14-APR-12 12:16:09PM	N31 33.877 W110 08.544	4054 ft	photo 145
878	14-APR-12 12:24:08PM	N31 34.028 W110 08.564	4030 ft	photo 146
879	14-APR-12 12:32:35PM	N31 34.196 W110 08.502	4030 ft	photos 147-148
880	14-APR-12 12:40:12PM	N31 34.272 W110 08.424	4024 ft	photo 149
881	14-APR-12 12:47:26PM	N31 34.346 W110 08.350	4023 ft	photo 150

882	14-APR-12 12:58:54PM	N31 34.479 W110 08.446	4041 ft	photos 152-153
883	14-APR-12 1:09:56PM	N31 34.585 W110 08.529	4023 ft	photo 154
884	14-APR-12 1:20:25PM	N31 34.685 W110 08.695	4053 ft	photo 155
885	14-APR-12 1:27:46PM	N31 34.778 W110 08.784	4023 ft	photo 156
886	14-APR-12 1:39:18PM	N31 34.908 W110 08.732	4018 ft	photo 158
887	14-APR-12 1:44:17PM	N31 34.994 W110 08.741	4004 ft	photo 159
888	14-APR-12 2:04:00PM	N31 35.307 W110 08.842	4019 ft	photos 160-161
889	14-APR-12 2:10:47PM	N31 35.456 W110 08.835	4011 ft	reach break, photo 162

PFC Assessment Form

Name of Riparian-Wetland Area: **San Pedro River**

Date: **4/16/2012** Segment/Reach ID: **PFC Reach D**

ID Team Observers: Mike Lunn, Janice Staats, Steve Leonard, Mark Gonzalez, Jim Fogg, Ben Lomeli, Jeff Simms, Marcia Radke, Eric Baker, Heather Swanson, Catie Fenn, Ryan Pitts

Yes	No	N/A	HYDROLOGICAL
X			**1) Floodplain above bankfull is inundated in "relatively frequent" events** Yes, floodplain accessible throughout some of the reach in one-two year events. Wide floodplain but may not be inundated as frequently as Reaches A-C.
	X		**2) Where beaver dams are present are they active and stable** Three beaver dams, all blown out and inactive. The dams are relatively low in elevation compared to the size of the channel, so when they blew out at high flow, they did not unleash tremendous energies and did not result in degradation because of their size.
X			**3) Sinuosity, width/depth ratio, and gradient are in balance with the landscape setting (i.e., landform, geology, and bioclimatic region)** No straightening here. The channel dimensions look more like a classic Rosgen C stream type than Reaches A-C (see photo 163).
X			**4) Riparian-wetland area is widening or has achieved potential extent** Has not come close to potential but is expanding both inward and outward (see photo 168).
X			**5) Upland watershed is not contributing to riparian-wetland degradation** Although the sediments from tributaries are expected to change the channel form, the fan form projects farther downstream below Moson Wash (also called Escapole Wash) than below other washes.

Yes	No	N/A	VEGETATION
X			**6) Diverse age-class distribution of riparian-wetland vegetation (recruitment for maintenance/recovery)** There is diverse age-class distribution on cottonwoods (2-3 age-classes), Goodding's willow, seep willow, and herbaceous vegetation. Less recruitment on streamside bars and steeper banks in active channel than previous reaches.
X			**7) Diverse composition of riparian-wetland vegetation (for maintenance/recovery) (*species present*)** Composition is diverse. See plant list.
X			**8) Species present indicate maintenance of riparian-wetland soil moisture characteristics** Obligate wetland species present. See plant list.
X			**9) Streambank vegetation is comprised of those plants or plant communities that have root masses capable of withstanding high streamflow events (*community types present*)** Cottonwood/Goodding's willow/seep willow community type well developed. See plant list.
X			**10) Riparian-wetland plants exhibit high vigor** Vigor is good on woody and herbaceous plants. Most of the banks are not accessible to cattle and are getting recruitment and displaying high vigor on herbaceous and woody plants. Cattle/deer grazing bulrush and seep willow on accessible bars, but those constitute a relatively small portion of overall bank length within the reach. Vigor was overall good but unauthorized cattle use and trampling should clearly be eliminated. Grazing on bars is believed to be retarding recovery on those specific sites.
	X		**11) Adequate riparian-wetland vegetative cover present to protect banks and dissipate energy during high flows (*enough*)** Open bars and patchy cover, mostly below Moson Wash; more bulrush along with seep willow are needed; they are present and expanding but not adequate at this time.

X			**12) Plant communities are an adequate source of coarse and/or large woody material (for maintenance/recovery)** Both cottonwood and willow.

Yes	No	N/A	EROSION DEPOSITION
X			**13) Floodplain and channel characteristics (i.e., rocks, overflow channels, coarse and/or large woody material) adequate to dissipate energy** Overflow channels across a wider alluvial valley bottom and large woody material present to dissipate energy.
	X[1]		**14) Point bars are revegetating with riparian-wetland vegetation** Since the 1950s (see Hereford 1993, pp. 20-24), the San Pedro River has done very little meandering; consequently, there are few true point bars. The dominant channel and floodplain forming processes result from episodic channel switching when large woody debris jams or large volumes of sediment, delivered by tributaries, obstruct the main channel and divert flow into an overflow channel, which then evolves into the dominant channel. This process is most common in the transition form, which occurs at or immediately downstream of tributary fans (refer to Fogg et al. 2012, pp. 17-18). We answered this item "no" because the few point bars on the lower part of the reach have a band of vegetation growing at the water's edge (seep willow, bulrush), but have large bare ground areas above that.
X			**15) Lateral stream movement is associated with natural sinuosity** Wider valley bottom but still similar to what was seen in above reaches.
X			**16) System is vertically stable (*not downcutting*)** Yes, based on location of cottonwoods and willow on streambanks and floodplain surfaces.
X	**X**		**17) Stream is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition)** Answered both "yes" and "no" because this item has both positive and negative attributes in this reach. Positive: the valley bottom narrows at the bottom end of the reach which naturally produces a backwater affect and a coarse deposit. Most depositions have a smooth outline, not piled up. Negative: cuts, mixed cobble bar heights even above Moson Wash, the fan form projects downstream farther below Moson Wash (also called Escapole Wash) than below other washes (see photo 169). As noted in checklist item 11, adequate vegetation currently does not exist to better process sediments, and this contributes to the "no" part of the answer.

Remarks

Without the unauthorized grazing use that is impacting some of the accessible bars and lower bank areas within the reach, trend would be upward; normally the ratings for vegetation as shown on this reach result in upward trend. But there is also no doubt that on those grazed sites, there is at least short-term retardation of improvement as removal of the top of the plants causes the plant to shift from carbohydrate storage in the roots to replacing photosynthetic material.

This is the first reach where we saw foam on the water, which can be investigated during water quality studies. There may be some release of pollutants into the stream although no source was noted.

[1] In retrospect, the answer to item 14 is "n/a" because point-bar extension has not been the dominant floodplain forming process since the 1950s. Point bars are rarely observed except near confluences with large tributaries. Overbank flooding with vertical floodplain aggradation has been the dominant floodplain process for more than 50 years along most of the upper San Pedro River.

SUMMARY DETERMINATION

Functional Rating:
:

___ Proper Functioning Condition

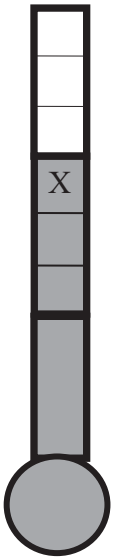
_X_ Functional - At Risk

___ Nonfunctional

___ Unknown

Trend for Functional - At Risk:

___ Upward
___ Downward
_X_ Not Apparent:



PFC

FAR

NF

Are factors contributing to unacceptable conditions outside the control of the manager?

Yes ___
No _X_ No unacceptable conditions noted.

If yes, what are those factors?

___ Flow regulations
___ Mining activities
___ Upstream channel conditions
___ Channelization
___ Road encroachment
___ Oil field water discharge
___ Augmented flows
___ Other (specify _____

(Revised 1998) (7/12/04)

SPRNCA Plant List for PFC Assessment

(Not a complete list of species present)

Reach D Date 4/16/2012

	Sedges/Grasses	Scientific Name	WIC	SC	AB	LOC
	Spikerush CT	*Eleocharis spp.*		H		
	Common spikerush	*Eleocharis palustris*	OBL	H		
	Parish spikerush	*Eleocharis parishii*	FACW	H		
	Beaked spikerush	*Eleocharis rosellata*	OBL	L		
X	Threesquare bulrush	*Schoenoplectus americanus*	OBL	H	2	A
	Hardstem bulrush CT	*Schoenoplectus spp.*		H		
X	Hardstem bulrush	*Schoenoplectus acuta*	OBL	H	3	A
	Baltic rush CT	*Juncus spp.*	OBL	H		
X	Baltic rush	*Juncus balticus*	OBL	H		
	Arizona rush	*Juncus interior*	FAC	M		
X	Torrey's rush	*Juncus torreyi*	FACW	H		
X	Cattail	*Typha latafolia*	OBL	H		
	Clustered field sedge	*Carex praegracillis*	OBL	H		
	Flat sedge	*Cyperus odoratus*	FACW+	M		
X	Johnson grass	*Sorghum halapense*	FACU+	M	4	B F
X	Bermuda grass	*Cynodon dactylon*	FACU	M	4	B F
	Barnyard grass	*Echinochloa crus-galli*	FACW	L		
X	Rabbitsfoot grass	*Polypogon monspeliensis*	FACW	L	4	B
X	Smooth horsetail	*Equisetum laevigatum*	FACW	L	2	A
	Alkali Sacaton	*Sporobolus airoides*	FAC	M		
X	Giant Sacaton	*Sporobolus wrightii*	FAC	M	4	F B
	Spike dropseed	*Sporobolus contractus*	FACU	L		
	Sand dropseed	*Sporobolus cryptandrus*	FACU	L		
	Deer grass	*Muhlenbergia rigens*	FAC	H		
	Vine Mesquite	*Panicum obtusum*	FAC	M		
X	Canadian wildrye	*Elymus canadensis*	FAC	M	2	F
	Canadian horseweed	*Conyza canadensis*	FACU	M		
X	Spikerush, spp	*Eleocharis, sp*			2	A
X	Lehman lovegrass	*Eragrostis lehmanniana*			1	F
X	Sideoats grama	*Bouteloua curtipendula*				
X	Knotgrass	*Paspalum distichum*	OBL			

	Forbs	Scientific name	WIC	SC	AB	LOC
X	Spiny aster	*Chloracantha spinosa*	FACW	H	2	F
	Curly top knotweed	*Polygonum lapathifolium*	OBL	L		
X	Sweet Clover	*Melilotus indicus*	*FACU+*	L	*3*	B
X	Speedwell	*Veronica spp.*	OBL	L	1	A
X	Desert horse purslane	*Trianthema portulacastrum*			1	A
X	Monkeyflower	*Ranunculus spp*			1	A
X	Thurber's sneezeweed	*Helenium thurberi*	OBL	L	1	A
X	Thurber's Pepperweed	*Lepedium thurberi*	OBL	L	1	A

	Trees/Shrubs	Scientific names	WIC	SC	AB	LOC
X	Cottonwood/Goodding willow CT			H	4	B
	Cottonwood /Mixed hardwood CT			H		
X	Freemont Cottonwood	*Populus fremontii*	FACW	H	4	B F
X	Freemont Cottonwood/ Johnsongrass CT				3	B F
X	Goodding willow	*Salix gooddingii*	OBL	H	4	B
	Goodding willow/Bulrush CT			H		
	Goodding willow/ Johnsongrass CT			H		
	Coyote willow	*Salix exigua*	OBL	M		
X	Yewleaf willow	*Salix taxifolia*	FACW	H		
X	Seep willow	*Baccharis salicifolia*	FACW	M	4	B A
	Desert broom	*Baccharis sarothroides*	FACW	M		
	Yerba de pasmo	*Baccharis pteronoides*				
X	Tamarisk	*Tamarix ramosissima*	FACW	H	2	F
	Mexican elderberry	*Sambucus nigra*	FAC	M		
	Western soapberry	*Sapindus saponaria*	UPL	M		
X	Netleaf hackberry	*Celtis reticulata*	FACU	M	2	F
	Arizona walnut	*Juglans major*	FACW	H		
X	Velvet ash	*Fraxinus velutina*	FAC +	L	1	F
	Honey locust	*Gleditsia triacanthos*	FAC	M		
	White mulberry	*Morus alba*	FAC	M		
	Texas mulberry	*Morus microphylla*	FACU	M		
	Tree tobacco	*Nicotiana glauca*	FAC	M		
X	Velvet mesquite	*Prosopis velutina*	FAC	M	4	F
	Golden current	*Ribes aureum*	FACW	H		
	Little-leaf sumac	*Rhus microphylla*	FACU	M		
X	Rubber rabbitbrush	*Ericameria nauseosa*	UPL	M	3	F
X	Burrobrush	*Hymenoclea monogyra*	UPL	M	2	F

WIC = **W**etland **I**ndicator **C**ategories, OBL = Obligate wetland; FACW = Facultative Wetland; FAC = Facultative; FACU = Facultative Upland. From Reed, P.B. 1988. National list of plant species that occur in wetlands: Southwest (Region 7). A positive (+) or negative (-) sign was used with the Facultative Indicator categories to more specifically define the regional frequency of occurrence in wetlands. The positive sign indicates a frequency toward the higher end of the category (more frequently found in wetlands), and a negative sign indicates a frequency toward the lower end of the category (less frequently found in wetlands).
SC = **S**tability **C**lass: low (L), moderate (M), high (H), adapted from Burton, T.A, S.J. Smith, and E.R. Cowley. 2011. Riparian area management: multiple indicator monitoring (MIM) of stream channels and streamside vegetation. TR 1737-23; Winward, A.H. 2000. Monitoring the vegetation resources in riparian areas. USDA Forest Service Rocky Mountain Research Station General Technical Report RMRS-GTR-47.; Nelle, S. 2011. Common plants of riparian areas – Southwestern Texas-Northern Mexico with wetland indicator (WI) and draft stability rating (SR); and NRCS National Plant Database.
AB = **Ab**undance (1-4). 1 = present but with only 1 to a few individuals; 2 = found occasionally; 3 = common; 4 = abundant .
LOC = **Loc**ation(s): active channel(AC), stream bank(B), frequent floodplain(F), terrace (T).
CT = **C**ommunity **T**ype

San Pedro River Photo Sheets
SPRNCA, Reach D
Photographer: Mike Lunn, April 16, 2012

163 – Waypoint 903, downstream from reach beginning, mouth of wash – wide valley.

164 – Large cottonwood undercut and down, forcing meander development.

165 – Waypoint 905, small unstable beaver dam on sediment pile, several dams not being maintained.

166 – Waypoint 906, downstream view. More herbaceous vegetation is needed on the bars/banks to process sediments.

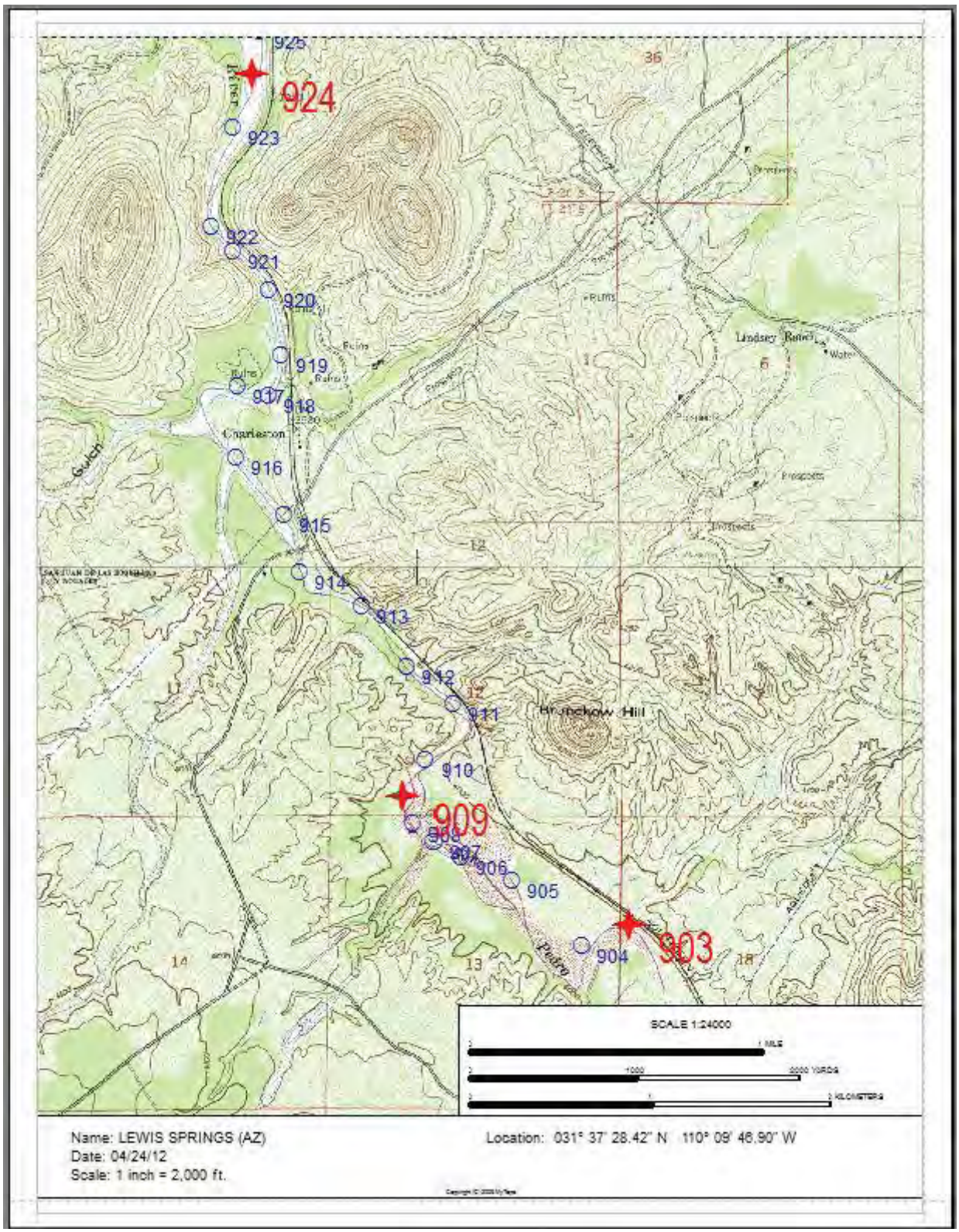
167 – Waypoint 907, up Escapoule Wash. These ephemeral washes carry much sediment during monsoon storms.

168 – Waypoint 907, down river looking at bars left, seep willow and bulrush on right bank.

San Pedro River Photo Sheets
SPRNCA, Reach D
Photographer: Mike Lunn, April 16, 2012

169 – Waypoint 908, downstream view of cobble from Escapoule Wash.

170 – Waypoint 909, end of reach, upriver view. Immediately below is big cobble deposit, river turns right.



SPRNCA PFC Reach D
Waypoints 903 – 909
April 16, 2012

SPRNCA Reach D
Wpt 903-909

Reach D
San Pedro River at Escapule Wash,
looking upstream (south)

July 4, 1987

June 20, 1990

July 7, 1992

May 30, 1996

July 8, 1998

July 14, 2003

August 26, 2005

June 27, 2008

Reach D
San Pedro River at Escapule Wash, looking downstream (north)

7-4-1987

6-20-1990

7-7-1992

5-30-1996

8-7-1998

7-14-2003

8-26-2004

6-27-2008

Reach D
San Pedro River at Escapule Wash, across river view looking up the wash

July 4, 1987

June 20, 1990

July, 7, 1992

May 30, 1996

August 7, 1998

July 14, 2003

August 26, 2005

June 27, 2008

April 16, 2012

San Pedro PFC Assessment
Waypoint Log
Reach D

904	16-APR-12 8:18:32AM	N31 36.382 W110 09.460	3950 ft	reach break, photo 163
905	16-APR-12 8:38:07AM	N31 36.575 W110 09.706	3996 ft	photo 165
906	16-APR-12 8:49:52AM	N31 36.645 W110 09.885	4004 ft	photo 166
907	16-APR-12 8:55:29AM	N31 36.688 W110 09.980	3989 ft	photos 167-168
908	16-APR-12 9:07:15AM	N31 36.746 W110 10.052	3998 ft	photo 169
909	16-APR-12 9:12:17AM	N31 36.824 W110 10.088	3974 ft	reach break, photo 170

PFC Assessment Form

Name of Riparian-Wetland Area: **San Pedro River**

Date: **4/16/2012** Segment/Reach ID: **PFC Reach E**

ID Team Observers: Mike Lunn, Janice Staats, Steve Leonard, Mark Gonzalez, Jim Fogg, Ben Lomeli, Jeff Simms, Marcia Radke, Eric Baker, Heather Swanson, Catie Fenn, Ryan Pitts

Yes	No	N/A	HYDROLOGICAL
X			**1) Floodplain above bankfull is inundated in "relatively frequent" events** Floodplain inundation is appropriate for the confined landform.
X			**2) Where beaver dams are present are they active and stable** One active and stable beaver dam at top of reach, nearly 2 feet tall. Still not hydrological modifier at high flow, but provides higher levels of water storage at low flows. Grass growing on west side.
X			**3) Sinuosity, width/depth ratio, and gradient are in balance with the landscape setting (i.e., landform, geology, and bioclimatic region)** Channel characteristics are appropriate for confined landform. There is naturally low sinuosity, and wider width/depth ratio related to coarser bed and bank material.
X			**4) Riparian-wetland area is widening or has achieved potential extent** Good cottonwood recruitment at lower end of reach shows expanding riparian area, portions are at potential extent.
X			**5) Upland watershed is not contributing to riparian-wetland degradation** No degradation observed, no excessive erosion or deposition observed. This is a transport reach.

Yes	No	N/A	VEGETATION
X			**6) Diverse age-class distribution of riparian-wetland vegetation (recruitment for maintenance/recovery)** Multiple age class on cottonwood, including regeneration. Approximately 2 year old cottonwood observed. The 2010 monsoon provided conditions for recruitment. Bulrush communities expanding by rhizomes pushing up new plants. 8' tall walnut on bar.
X			**7) Diverse composition of riparian-wetland vegetation (for maintenance/recovery) (*species present*)** Composition is diverse. See plant list.
X			**8) Species present indicate maintenance of riparian-wetland soil moisture characteristics** Obligate wetland species present. See plant list.
X			**9) Streambank vegetation is comprised of those plants or plant communities that have root masses capable of withstanding high streamflow events (*community types present*)** Stabilizing plant community types present. See plant list.
X			**10) Riparian-wetland plants exhibit high vigor** Overall high vigor in herbaceous and woody plants. Some concern over seep willow in places; dies back in dense stands. One possible explanation for this is record low temperature in February 2011 which caused a hard freeze and mortality (3 °F (−16 °C) in Sierra Vista). Noted some rush with yellow bands caused by an insect.
X			**11) Adequate riparian-wetland vegetative cover present to protect banks and dissipate energy during high flows (*enough*)** Visually estimated that 85% of the banks are covered with riparian vegetation, which is more than adequate for this stream type (minimum for "yes" answer is 70% cover for this stream type).
X			**12) Plant communities are an adequate source of coarse and/or large woody material (for maintenance/recovery)** All sizes of trees available, big ones and smaller ones to take their place.

Yes	No	N/A	EROSION DEPOSITION
X			**13) Floodplain and channel characteristics (i.e., rocks, overflow channels, coarse and/or large woody material) adequate to dissipate energy** Given small floodplain, large woody material doing most of work.
		X	**14) Point bars are revegetating with riparian-wetland vegetation** One point bar with cottonwood seedlings and seep willow, all grazed, but is atypical for the reach and this stream type.
X			**15) Lateral stream movement is associated with natural sinuosity** Where three tributaries come together, very dynamic; has jumped channels about every other year, but moves back to a stable channel form just downstream.
X			**16) System is vertically stable (*not downcutting*)** No headcuts observed.
X			**17) Stream is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition)** No excessive erosion or deposition. Large sediment inputs from three tributaries near Charleston town site affect channel form as expected, returns to standard form. Vegetated banks continue to improve and handle high bedload from tributaries. This is mostly a transport reach due to valley confinement.

Remarks

Even though the reach rated as proper functioning condition, there is opportunity for channel narrowing which would move sediment through the reach more efficiently.

The ponded form does not occur in this reach due to the valley bottom confinement. Floods do not spread on a wide floodplain, so there is more depth to floodflows and more sheer stress. The tributary fans cannot develop and hold water back; there is a pattern of riffles and pools instead.

SUMMARY DETERMINATION

Functional Rating:
:

_X_ Proper Functioning Condition

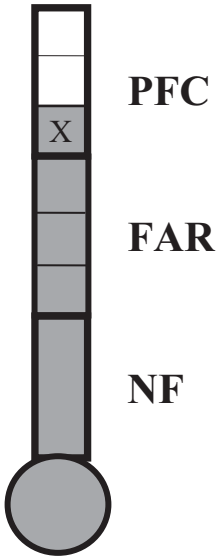
___ Functional - At Risk

___ Nonfunctional

___ Unknown

Trend for Functional - At Risk:

___ Upward
___ Downward
___ Not Apparent



Are factors contributing to unacceptable conditions outside the control of the manager?

Yes ___
No ___

If yes, what are those factors?

___ Flow regulations
___ Mining activities
___ Upstream channel conditions
___ Channelization
___ Road encroachment
___ Oil field water discharge
___ Augmented flows
___ Other (specify _____

(Revised 1998) (7/12/04)

SPRNCA Plant List for PFC Assessment

(Not a complete list of species present)

Reach E Date April 16, 2012

	Sedges/Grasses	Scientific Name	WIC	SC	AB	LOC
	Spikerush CT	*Eleocharis spp.*		H		
	Common spikerush	*Eleocharis palustris*	OBL	H		
	Parish spikerush	*Eleocharis parishii*	FACW	H		
	Beaked spikerush	*Eleocharis rosellata*	OBL	L		
	Threesquare bulrush	*Schoenoplectus americanus*	OBL	H		
	Hardstem bulrush CT	*Schoenoplectus spp.*		H		
X	Hardstem bulrush	*Schoenoplectus acuta*	OBL	H	4	A B
	Baltic rush CT	*Juncus spp.*	OBL	H		
X	Baltic rush	*Juncus balticus*	OBL	H	2	A
	Arizona rush	*Juncus interior*	FAC	M		
X	Torrey's rush	*Juncus torreyi*	FACW	H	2	A
X	Cattail	*Typha latafolia*	OBL	H	1	A
	Clustered field sedge	*Carex praegracillis*	OBL	H		
	Flat sedge	*Cyperus odoratus*	FACW+	M	4	F B
X	Johnson grass	*Sorghum halapense*	FACU+	M	4	F B
X	Bermuda grass	*Cynodon dactylon*	FACU	M	4	A
	Barnyard grass	*Echinochloa crus-galli*	FACW	L		
X	Rabbitsfoot grass	*Polypogon monspeliensis*	FACW	L		
X	Smooth horsetail	*Equisetum laevigatum*	FACW	L	3	A B
	Alkali Sacaton	*Sporobolus airoides*	FAC	M		
X	Giant Sacaton	*Sporobolus wrightii*	FAC	M	4	F T
	Spike dropseed	*Sporobolus contractus*	FACU	L		
	Sand dropseed	*Sporobolus cryptandrus*	FACU	L		
X	Deer grass	*Muhlenbergia rigens*	FAC	H	2	B
	Vine Mesquite	*Panicum obtusum*	FAC	M		
	Beardless wildrye	*Leymus triticoides*	FAC	M		
	Canadian horseweed	*Conyza canadensis*	FACU	M		
X	Plains bristlegrass	*Setaria vulpiseta*			1	F
X	Lehmann lovegrass	*Eragrostis lehmanniana*			1	F

	Forbs	Scientific name	WIC	SC	AB	LOC
X	Spiny aster	*Chloracantha spinosa*	FACW	H	2	F T
	Curly top knotweed	*Polygonum lapathifolium*	OBL	L		
X	Sweet Clover	*Melilotus indicus*	*FACU+*	L	3	B
X	Speedwell	*Veronica spp.*	OBL	L	2	A
X	Muskgrass	*Chara*			3	A
X	Creeping yellowcress	*Rorripa sylvestris*	OBL		2	A
X	Monkeyflower	*Mimulus*			1	A

	Trees/Shrubs	Scientific names	WIC	SC	AB	LOC
X	Cottonwood/Goodding willow CT			H	4	B
	Cottonwood /Mixed hardwood CT			H		
X	Freemont Cottonwood	*Populus fremontii*	FACW	H	4	B
	Freemont Cottonwood/ Johnsongrass CT					
	Goodding willow	*Salix gooddingii*	OBL	H		
	Goodding willow/Bulrush CT			H		
	Goodding willow/ Johnsongrass CT			H		
	Coyote willow	*Salix exigua*	OBL	M		
	Yewleaf willow	*Salix taxifolia*	FACW	H		
X	Seep willow	*Baccharis salicifolia*	FACW	M	4	B A
X	Desert broom	*Baccharis sarothroides*	FACW	M	1	F
	Yerba de pasmo	*Baccharis pteronoides*				
X	Tamarisk	*Tamarix ramosissima*	FACW	H	1	F
	Mexican elderberry	*Sambucus nigra*	FAC	M		
	Western soapberry	*Sapindus saponaria*	UPL	M		
X	Netleaf hackberry	*Celtis reticulata*	FACU	M	1	F
X	Arizona walnut	*Juglans major*	FACW	H	1	B
X	Arizona ash	*Fraxinus arizonicus*	FAC +	L	1	F
	Honey locust	*Gleditsia triacanthos*	FAC	M		
	White mulberry	*Morus alba*	FAC	M		
	Texas mulberry	*Morus microphylla*	FACU	M		
	Tree tobacco	*Nicotiana glauca*	FAC	M		
X	Velvet mesquite	*Prosopis velutina*	FAC	M		F T
	Golden current	*Ribes aureum*	FACW	H		
	Little-leaf sumac	*Rhus microphylla*	FACU	M		
	Rubber rabbitbrush	*Ericameria nauseosa*	UPL	M		
X	Burrobrush	*Hymenoclea monogyra*	UPL	M	2	F
X	Freemont Cottonwood/ w bulrush CT		OBL	H	1	B

WIC = **W**etland **I**ndicator **C**ategories, OBL = Obligate wetland; FACW = Facultative Wetland; FAC = Facultative; FACU = Facultative Upland. From Reed, P.B. 1988. National list of plant species that occur in wetlands: Southwest (Region 7). A positive (+) or negative (-) sign was used with the Facultative Indicator categories to more specifically define the regional frequency of occurrence in wetlands. The positive sign indicates a frequency toward the higher end of the category (more frequently found in wetlands), and a negative sign indicates a frequency toward the lower end of the category (less frequently found in wetlands).
SC = **S**tability **C**lass: low (L), moderate (M), high (H), adapted from Burton, T.A, S.J. Smith, and E.R. Cowley. 2011. Riparian area management: multiple indicator monitoring (MIM) of stream channels and streamside vegetation. TR 1737-23; Winward, A.H. 2000. Monitoring the vegetation resources in riparian areas. USDA Forest Service Rocky Mountain Research Station General Technical Report RMRS-GTR-47.; Nelle, S. 2011. Common plants of riparian areas – Southwestern Texas-Northern Mexico with wetland indicator (WI) and draft stability rating (SR); and NRCS National Plant Database.
AB = **Ab**undance (1-4). 1 = present but with only 1 to a few individuals; 2 = found occasionally; 3 = common; 4 = abundant .
LOC = **Loc**ation(s): active channel(AC), stream bank(B), frequent floodplain(F), terrace (T).
CT = **C**ommunity **T**ype

San Pedro River Photo Sheets
SPRNCA, Reach E
Photographer: Mike Lunn, April 16, 2012

171 – Waypoint 909, downstream from reach beginning, heavy cobble.

172 – Waypoint 910, beaver dam, upstream view, provides additional water storage for plant establishment.

173 – Waypoint 910, down view, bulrush developing right, seep willow on left bank.

174 – Waypoint 911, bulrush rhizome extending toward stream, rhizome at least 1'deep, starting new plants (white tip).

175 – Waypoint 912, downstream view, bulrush on opposite bank.

176 – Waypoint 913, upstream view, good vegetation development.

San Pedro River Photo Sheets
SPRNCA, Reach E
Photographer: Mike Lunn, April 16, 2012

177 – Waypoint 913, down view.

178 – Waypoint 914, down view to old Charleston Bridge.

179 – Waypoint 915, rocky section below bridge.

180 – Waypoint 916, across stream up large wash.

181 – Waypoint 916, downstream view.

182 – Waypoint 917, upstream – several tribs add sediments above here, very sandy channel. Old Charlestown townsite.

San Pedro River Photo Sheets
SPRNCA, Reach E
Photographer: Mike Lunn, April 16, 2012

183 – Waypoint 917, downstream view, river is doing lots of moving around here over past several years.

184 – Waypoint 918, downstream view, railroad grade fence on right bank.

185 – Waypoint 919, upstream view.

186 – Waypoint 919, downstream view, good bulrush left.

187 – Waypoint 920, more confined section.

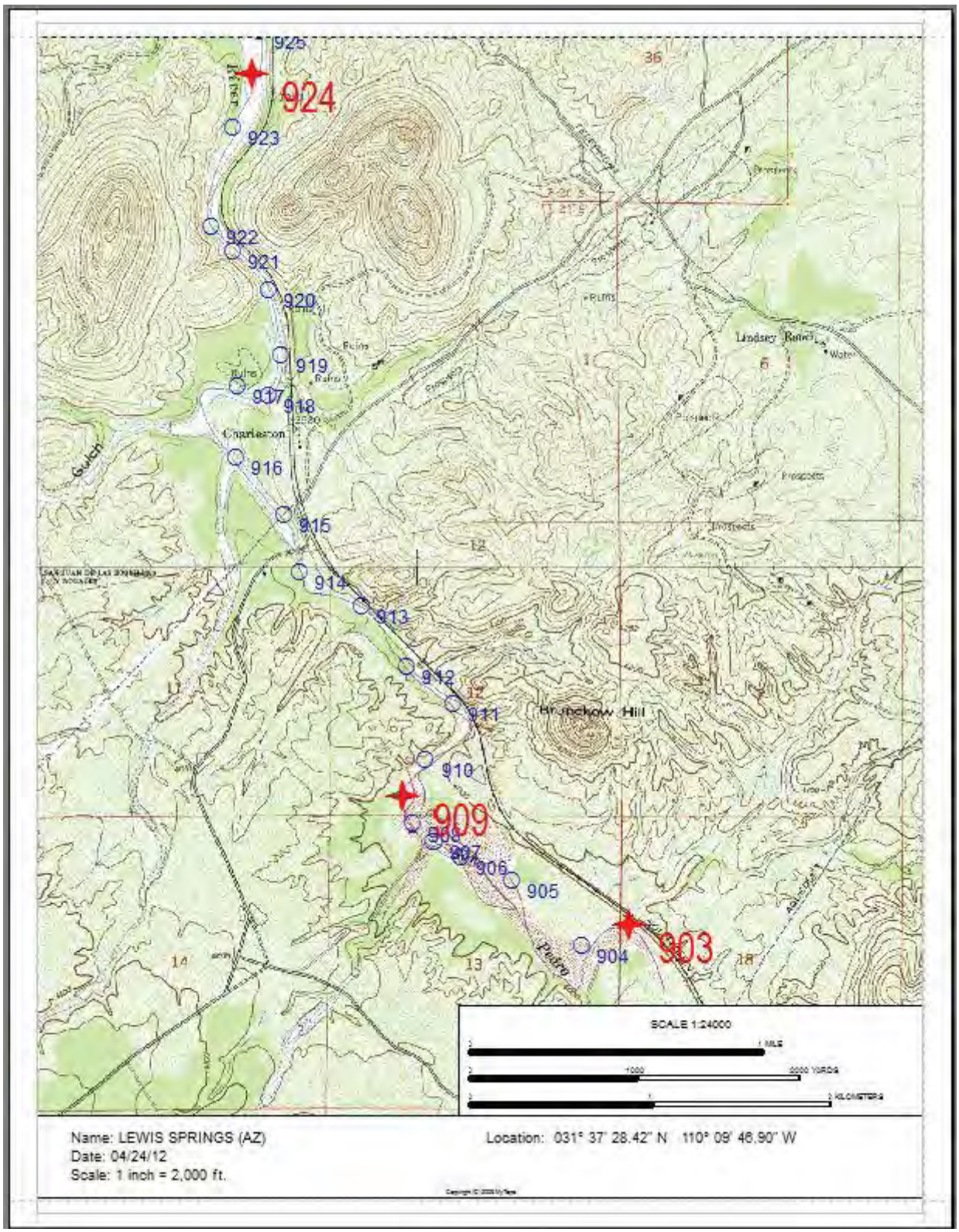
188 – Waypoint 92, cottonwood regeneration established; first seedlings observed in any reach.

San Pedro River Photo Sheets
SPRNCA, Reach E
Photographer: Mike Lunn, April 16. 2012

189 – Waypoint 923, upstream.

190 – Waypoint 923, downstream.

191 – Waypoint 924, upstream at reach end.



SPRNCA PFC Reach E
Waypoints 909 – 924
April 16, 2012

SPRNCA Reach E
Wpt 909 - 924

Reach E
San Pedro River upstream of Charleston Bridge, looking downstream (north) at bridge

June 6, 1987

June 20, 1990

July 2 , 1992

July 30 , 1998

July 22 , 2003

July 8 2008

April 16, 2012

Reach E
San Pedro River at Charleston Bridge, looking downstream (north)

6-28-1987

8-3-1988 new bridge

10-2-1989 fire effects

6-20-1990

7-2-1992

7-17-1992

1-19-1993

8-3-1998

8-3-1998

7-22-2003

7-8-2008

4-16-2012

Reach E
San Pedro River below Charleston Bridge, looking upstream (south) at bridge

June 27, 1987

June 20, 1990

July 2, 1992

January 19, 1993

July 30, 1998

July 22, 2003

July 8, 2008

San Pedro PFC Assessment
Waypoint Log
Reach E

909	16-APR-12 9:12:17AM	N31 36.824 W110 10.088	3974 ft	reach break, photo 171
910	16-APR-12 10:17:49AM	N31 36.936 W110 10.005	3976 ft	photos 172-173
911	16-APR-12 10:34:07AM	N31 37.101 W110 09.907	3989 ft	photo 174
912	16-APR-12 10:45:38AM	N31 37.208 W110 10.069	4008 ft	photo 175
913	16-APR-12 10:57:30AM	N31 37.389 W110 10.226	3970 ft	photos 176-177
914	16-APR-12 11:06:21AM	N31 37.493 W110 10.447	3957 ft	photo 178
915	16-APR-12 11:48:00AM	N31 37.662 W110 10.497	3964 ft	photo179
916	16-APR-12 11:56:18AM	N31 37.829 W110 10.667	3982 ft	photos 180-181
917	16-APR-12 12:05:12PM	N31 38.042 W110 10.661	3948 ft	photos 182-183
918	16-APR-12 12:12:43PM	N31 38.017 W110 10.554	3966 ft	photo 184
919	16-APR-12 12:20:19PM	N31 38.137 W110 10.511	3979 ft	photos 185-186
920	16-APR-12 12:26:42PM	N31 38.328 W110 10.551	3923 ft	photo 187
921	16-APR-12 12:37:01PM	N31 38.442 W110 10.674	3976 ft	photo 188
923	16-APR-12 1:02:40PM	N31 38.811 W110 10.677	3898 ft	photos 189-190
924	16-APR-12 1:09:09PM	N31 38.948 W110 10.582	3930 ft	reach break, photos 191

PFC Assessment Form

Name of Riparian-Wetland Area: **San Pedro River**

Date: **4/17/2012** Segment/Reach ID: **PFC Reach F**

ID Team Observers: Mike Lunn, Janice Staats, Steve Leonard, Mark Gonzalez, Jim Fogg, Ben Lomeli, Jeff Simms, Marcia Radke, Eric Baker, Heather Swanson, Catie Fenn, Ryan Pitts

Yes	No	N/A	HYDROLOGICAL
	X		**1) Floodplain above bankfull is inundated in "relatively frequent" events** Frequent floodplain access is not extensive and effective enough for "yes" answer. Patchy, some sections lack accessible floodplain, the channel has the shape of a Rosgen F stream type in the first mile; very wide channel towards lower end of reach. Two-year flow about 6000 cubic feet per second. The amount of mobile sand bed during floods contributes to lack of floodplain access.
	X		**2) Where beaver dams are present are they active and stable** Only one small dam, not stable, apparently not active, breached. No negative implication to bankfull channel shape.
	X		**3) Sinuosity, width/depth ratio, and gradient are in balance with the landscape setting (i.e., landform, geology, and bioclimatic region)** The "no" answer is due to the overly wide channel in many sections, even for a sand bed stream type. Other comments: No channel straightening in this reach. There are patchy spots of more stabilizing vegetation which holds a narrower channel in place. The river is cutting into the terrace in a few spots, increasing the sinuosity.
X			**4) Riparian-wetland area is widening or has achieved potential extent** 1987 photo point looking up Boquillas Wash shows amazing change, riparian area expanding inward with herbaceous vegetation, seep willow, young cottonwood/willow.
X			**5) Upland watershed is not contributing to riparian-wetland degradation** Most of the mobile sediments are from in-channel sources. There are two or three bigger, steep-sided depositional bars which were not being processed well, but most were of expected size and smooth shaped.

Yes	No	N/A	VEGETATION
X			**6) Diverse age-class distribution of riparian-wetland vegetation (recruitment for maintenance/recovery)** Multiple age-classes of cottonwood, willow, bulrush. Young cottonwood seen estimated at 2-5 years old. Good expression of herbaceous plants spreading. Bulrush community types present.
X			**7) Diverse composition of riparian-wetland vegetation (for maintenance/recovery) (*species present*)** Composition is diverse. See plant list.
X			**8) Species present indicate maintenance of riparian-wetland soil moisture characteristics** Obligate wetland, facultative wetland and facultative species present, appropriate for the intermittent nature of this reach. See plant list.
X			**9) Streambank vegetation is comprised of those plants or plant communities that have root masses capable of withstanding high streamflow events (*community types present*)** Stabilizing plant community types present. See plant list.
X			**10) Riparian-wetland plants exhibit high vigor** There are dead mature seep willows, probably due to a freeze in February 2011, but lots of other seep willows are vigorous. Lots of very healthy bulrush. Patchy grazing effects, lot of wildlife use as well as some cow. Have seen yellow tops on trees in some Junes.
	X		**11) Adequate riparian-wetland vegetative cover present to protect banks and dissipate energy during high flows (*enough*)** Minimum of 70% cover needed to be adequate, but only has between 50%-60% in patches at present.

X			**12) Plant communities are an adequate source of coarse and/or large woody material (for maintenance/recovery)** All sizes of cottonwood and Goodding's willow growing throughout reach (young, middle age, some older large ones .but bandwidth very narrow on cottonwood, needs to expand to galleries where possible in areas where flooding can scour sites away from channel. Trees developing into a size that can be hydrologic modifiers. With young and middle age is adequate for continuing recovery.

Yes	No	N/A	EROSION DEPOSITION
	X		**13) Floodplain and channel characteristics (i.e., rocks, overflow channels, coarse and/or large woody material) adequate to dissipate energy** Inadequate channel stabilizing vegetation to impede mobility of sediments, also lack adequate size (width floodplains to dissipate energy. Evidence that sand bed channel mobilizes in high flows which improves conveyance, but reduces overflow onto floodplain areas. Lack effective floodplain function in most places. Mobile bed keeps it from going out on a floodplain more often, at least in places. No overflow channels developed. 1987 photo point documents the riparian area has expanded in 25 years, far more sustainable than in 1987.
	X[1]		**14) Point bars are revegetating with riparian-wetland vegetation** Since the 1950s (see Hereford 1993, pp. 20-24), the San Pedro River has done very little meandering; consequently, there are few true point bars. The dominant channel and floodplain forming processes result from episodic channel switching when large woody debris jams or large volumes of sediment, delivered by tributaries, obstruct the main channel and divert flow into an overflow channel, which then evolves into the dominant channel. This process is most common in the transition form, which occurs at or immediately downstream of tributary fans (refer to Fogg et al. 2012, pp. 17-18). We answered "no" because of the over-wide channel with large, bare areas between top/bottom of bars. There were low amounts of seep willow on in-channel bars. More vegetation on in-channel bars will somewhat moderate the mobilization of the sand bed during flooding, improving access to the floodplain and higher surfaces. Riparian vegetation developing on downstream end of some bars, related to access to floodplain and water availability.
X			**15) Lateral stream movement is associated with natural sinuosity** While not as sinuous as it could be, lateral movement is not excessive or accelerated. Railroad fence and abutment are two rigid points before Highway 82 bridge.
X			**16) System is vertically stable (*not downcutting*)** No visible downcutting.
	X		**17) Stream is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition)** Some over steepened bars observed, but the "no" answer is associated more with a wide channel that is not able to process sediment appropriately and is not building a floodplain and streambanks. Development of more continuous vegetation will lead to improved channel form.

Remarks

The lower reach break was relocated based on observations in the field. It was moved from waypoint 951 to waypoint 954.

Saw paleo-cienega soils on cutbanks in this reach (see photo 195).

Functional rating. Seven out of 17 checklist items have "no" answers. The main items that led to the functional at-risk

[1] In retrospect, the answer to item 14 is "n/a" because point-bar extension has not been the dominant floodplain forming process since the 1950s. Point bars are rarely observed except near confluences with large tributaries. Overbank flooding with vertical floodplain aggradation has been the dominant floodplain process for more than 50 years along most of the upper San Pedro River.

rating are item 1 (floodplain access), item 3 (overly wide channel) and item 13 (floodplain characteristics).

Trend. Although the Charleston USGS gage and the wet/dry mapping demonstrate that this reach is getting drier, the effects are not yet visible in the vegetation or channel, or from any of the photo points that were made available during the assessment. It was said that there are some photos that show the vegetation is getting worse, but these photos were not made available to the group to interpret. From the information we had available, we determined the trend is upward. The evidence for upward trend: 1987 photo-point comparison, riparian vegetation establishment and channel narrowing in places, no contraction of cottonwood canopy. Once vegetative cover is adequate, channel formation will really take off.

Stromberg condition classes and monitoring. Had a discussion about how Stromberg's work defines the thresholds of depth to ground water and stream flow permanence as it affects riparian vegetation. See tables below.

Stromberg (see Stromberg report for standard deviations)					
Condition Classes	Condition Score	Condition Description	Flow permanence (%)	Mean floodplain groundwater depth (meters)	Ground water fluctuation (meters
Dry – class 1	1.0 to 1.5	Reduced water availability or stressors producing similar effects	17-48	2.5-3.5	1.8
Intermediate – class 2	1.51 to 2.5	Intermediate conditions	63-78	2.5-3.0	0.9
Wet – class 3	2.51 to 3.0	No water stress	98-100	1.6-1.7	0.3

Stromberg reach 8	
Site name Boquillas	Condition score 2.39
Site name Boquillas north	Condition score 2.56
Stomberg reach 9	
Site name Fairbank	Condition score 2.06

This is a key reach along with PFC Reach A (Palominas) to monitor and document which changes are taking place over time. Riparian recovery usually is demonstrated first with an increase in riparian vegetation. Channel characteristics lag, habitat and water quality lag. Deterioration of condition is the other way around, riparian vegetation decreases first, then the channel conditions deteriorate.

In this reach, the vegetation has been improving since establishment of the Riparian National Conservation Area and cessation of grazing within the riparian area. Now, if the groundwater level drops, the effects will not be evident right away in the vegetation or the channel, so must monitor both the groundwater levels and vegetation to interpret the situation correctly.

This is a losing reach, as water flows downstream it infiltrates into the bed.

This reach does not currently produce the same type of fans at mouths of ephemeral washes/tributaries and associated ponded form as seen upstream.

SUMMARY DETERMINATION

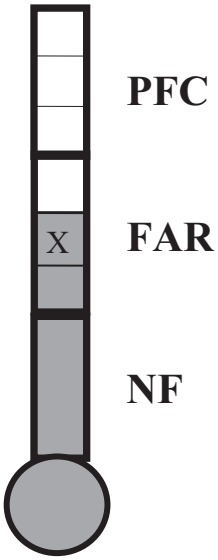
Functional Rating:
:

___ Proper Functioning Condition

_X_ Functional - At Risk

___ Nonfunctional

___ Unknown



Trend for Functional - At Risk:

_X_ Upward
___ Downward
___ Not Apparent

Are factors contributing to unacceptable conditions outside the control of the manager?

Yes ___
No _X__
Possibly groundwater pumping, but no unacceptable conditions evident. Ground-water losses may be impacting surface flows.

If yes, what are those factors?

___ Flow regulations
___ Mining activities
___ Upstream channel conditions
___ Channelization
___ Road encroachment
___ Oil field water discharge
___ Augmented flows
___ Other (specify _____

(Revised 1998) (7/12/04)

SPRNCA Plant List for PFC Assessment

(Not a complete list of species present)

Reach F Date 4/16-17/2012

	Sedges/Grasses	Scientific Name	WIC	SC	AB	LOC
	Spikerush CT	*Eleocharis spp.*		H		
X	Common spikerush	*Eleocharis palustris*	OBL	H	1	A
	Parish spikerush	*Eleocharis parishii*	FACW	H		
	Beaked spikerush	*Eleocharis rosellata*	OBL	L		
	Threesquare bulrush	*Schoenoplectus americanus*	OBL	H		
	Hardstem bulrush CT	*Schoenoplectus spp.*		H		
X	Hardstem bulrush	*Schoenoplectus acuta*	OBL	H	3	A B
	Baltic rush CT	*Juncus spp.*	OBL	H		
X	Baltic rush	*Juncus balticus*	OBL	H	2	B A
	Arizona rush	*Juncus interior*	FAC	M		
X	Torrey's rush	*Juncus torreyi*	FACW	H	1	B
	Cattail	*Typha latafolia*	OBL	H		
	Clustered field sedge	*Carex praegracillis*	OBL	H		
	Flat sedge	*Cyperus odoratus*	FACW+	M		
X	Johnson grass	*Sorghum halapense*	FACU+	M	4	F
X	Bermuda grass	*Cynodon dactylon*	FACU	M	4	F
X	Barnyard grass	*Echinochloa crus-galli*	FACW	L	1	B
X	Rabbitsfoot grass	*Polypogon monspeliensis*	FACW	L	2	A B
X	Smooth horsetail	*Equisetum laevigatum*	FACW	L	3	A B
	Alkali Sacaton	*Sporobolus airoides*	FAC	M		
X	Giant Sacaton	*Sporobolus wrightii*	FAC	M	4	F
	Spike dropseed	*Sporobolus contractus*	FACU	L		
	Sand dropseed	*Sporobolus cryptandrus*	FACU	L		
X	Deer grass	*Muhlenbergia rigens*	FAC	H	2	B
	Vine Mesquite	*Panicum obtusum*	FAC	M		
X	Canadian wildrye	*Leymus canadensis*	FAC	M	2	B
	Canadian horseweed	*Conyza canadensis*	FACU	M		
X	Sideoats grama	*Bouteloua curtipendula*	UPL		2	F
X	Purple threeawn	*Aristada purpurea*	UPL		1	F
X	Cane beardgrass	*Bothriochloa barbinodis*	UPL		2	F
X	Spikerush, spp	Eleocharis spp				
X	Lehmann lovegrass	*Eragrostis lehmanniana*				

	Forbs	Scientific name	WIC	SC	AB	LOC
	Spiny aster	*Chloracantha spinosa*	FACW	H		
	Curly top knotweed	*Polygonum lapathifolium*	OBL	L		
X	Sweet Clover	*Melilotus indicus*	*FACU+*	L	3	*B*
X	Speedwell	*Veronica spp.*	OBL	L	2	A
X	Thurber's sneezeweed	*Helenium thurberi*	OBL		2	B
X	alfalfa	*Medicago sativa*	UPL		1	A
X	Creeping yellowcress	*Rorripa sylvestris*	OBL		1	A
	Thurber's pepperweed	*Lepidium thurberi*	FACU		2	B

	Trees/Shrubs	Scientific names	WIC	SC	AB	LOC
X	Cottonwood/Goodding willow CT			H	4	B
X	Cottonwood /Mixed hardwood CT			H	1	F
X	Freemont Cottonwood	*Populus fremontii*	FACW	H	4	B F
X	Freemont Cottonwood/ Johnsongrass CT				2	B F
X	Goodding willow	*Salix gooddingii*	OBL	H	4	B
	Goodding willow/Bulrush CT			H		
	Goodding willow/ Johnsongrass CT			H		
	Coyote willow	*Salix exigua*	OBL	M		
	Yewleaf willow	*Salix taxifolia*	FACW	H		
X	Seep willow	*Baccharis salicifolia*	FACW	M	4	B A
	Desert broom	*Baccharis sarothroides*	FACW	M		
	Yerba de pasmo	*Baccharis pteronoides*				
X	Tamarisk	*Tamarix ramosissima*	FACW	H	2	F
	Mexican elderberry	*Sambucus nigra*	FAC	M		
	Western soapberry	*Sapindus saponaria*	UPL	M		
X	Netleaf hackberry	*Celtis reticulata*	FACU	M	2	F
	Arizona walnut	*Juglans major*	FACW	H		
X	Velvet ash	*Fraxinus velutina*	FAC +	L		
	Honey locust	*Gleditsia triacanthos*	FAC	M		
	White mulberry	*Morus alba*	FAC	M		
	Texas mulberry	*Morus microphylla*	FACU	M		
	Tree tobacco	*Nicotiana glauca*	FAC	M		
X	Velvet mesquite	*Prosopis velutina*	FAC	M	4	T F
	Golden current	*Ribes aureum*	FACW	H		
	Little-leaf sumac	*Rhus microphylla*	FACU	M		
X	Rubber rabbitbrush	*Ericameria nauseosa*	UPL	M	3	F
X	Burrobrush	*Hymenoclea monogyra*	UPL	M	3	F
X	Brickelbush	Brickellia spp. (about 12 species in AZ)			2	F

WIC = **W**etland **I**ndicator **C**ategories, OBL = Obligate wetland; FACW = Facultative Wetland; FAC = Facultative; FACU = Facultative Upland. From Reed, P.B. 1988. National list of plant species that occur in wetlands: Southwest (Region 7). A positive (+) or negative (-) sign was used with the Facultative Indicator categories to more specifically define the regional frequency of occurrence in wetlands. The positive sign indicates a frequency toward the higher end of the category (more frequently found in wetlands), and a negative sign indicates a frequency toward the lower end of the category (less frequently found in wetlands).
SC = **S**tability **C**lass: low (L), moderate (M), high (H), adapted from Burton, T.A, S.J. Smith, and E.R. Cowley. 2011. Riparian area management: multiple indicator monitoring (MIM) of stream channels and streamside vegetation. TR 1737-23; Winward, A.H. 2000. Monitoring the vegetation resources in riparian areas. USDA Forest Service Rocky Mountain Research Station General Technical Report RMRS-GTR-47.; Nelle, S. 2011. Common plants of riparian areas – Southwestern Texas-Northern Mexico with wetland indicator (WI) and draft stability rating (SR); and NRCS National Plant Database.
AB = **Ab**undance (1-4). 1 = present but with only 1 to a few individuals; 2 = found occasionally; 3 = common; 4 = abundant .
LOC = **Loc**ation(s): active channel(AC), stream bank(B), frequent floodplain(F), terrace (T).
CT = **C**ommunity **T**ype

San Pedro River Photo Sheets
SPRNCA, Reach F
Photographer: Mike Lunn, April 16, 2012

192 – Waypoint 924, reach begins, down view.

193 - Waypoint 925, downstream view.

194 – Waypoint 926, down view showing wide frequent floodplain left.

195 – Terrace on right, paleocienega soils displayed.

196 – Waypoint 927, down.

197 – Waypoint 928, lower end of tributary fan, large amounts of wood hung up in cottonwoods.

San Pedro River Photo Sheets
SPRNCA, Reach F
Photographer: Mike Lunn, April 16, 2012

198 – Waypoint 929, up stream view.

199 – Waypoint 929, downstream view.

200 - Waypoint 930, left bank very heavily vegetated with stabilizing seep willow and other vegetation.

201 – Down, short confined section where terraces pinch.

202 – Waypoint 932, down view showing narrow channel.

203 – Waypoint 933, wash enters stream.

San Pedro River Photo Sheets
SPRNCA, Reach F
Photographer: Mike Lunn, April 17, 2012

204 – Waypoint 934, upstream view.

205 – Waypoint 934, down view.

206 – Waypoint 935, upstream view, bulrush forms on bar and bank.

207 – Waypoint 935, down view.

208 – Waypoint 936, lines an patches of seep willow.

209 – Group looking for indicators of level of frequent floodplain.

San Pedro River Photo Sheets
SPRNCA, Reach F
Photographer: Mike Lunn, April 17, 2012

210 – Jeff (blue shirt) pointing out where he believes bankfull level is.

211 – Waypoint 938, still working to determine frequent floodplain level.

212 – Waypoint 939, upstream view, young cottonwood on opposite bank.

213 – Waypoint 939, downstream view.

214 – Waypoint 940, floodplain building on opposite bank, cutting into near bank.

215 – Waypoint 941, discussing point bars, paleocienega soils, tamarisk near channel.

San Pedro River Photo Sheets
SPRNCA, Reach F
Photographer: Mike Lunn, April 17, 2012

216 – Waypoint 942, down view on sharp bend.

217 – Waypoint 942, upstream view.

218 - Cottonwood regeneration on bars.

219 – River cutting into terrace.

220 – As stream cuts, low bar formed below roots, point bar vegetating with seep willow.

221 – Waypoint 944, upstream view, cottonwood and large wood deposits along with seep willow.

San Pedro River Photo Sheets
SPRNCA, Reach F
Photographer: Mike Lunn, April 17, 2012

222 - Waypoint 944, down view from same spot.

223 – Waypoint 945, overflow channel strongly vegetating with seep willow and bulrush.

224 – Another view looking down of overflow channel.

225 – Very large cottonwood fell over some years ago, lower limbs are now becoming trees – roots still in water table.

226 – Cottonwood roots, still attached and in water table.

227 – Trying to retake 1987 photo of Boquillas Wash.

San Pedro River Photo Sheets
SPRNCA, Reach F
Photographer: Mike Lunn, April 17, 2012

228 – Another angle from overflow channel.

229 – Another angle, Dale Turner in lower right.

230 – Longer lens up Boquillas Wash.

231 – Waypoint 946, down view of meander.

232 – Waypoint 947, down view, capturing new sediments with stabilizing vegetation.

233 – Waypoint 947, upstream view.

San Pedro River Photo Sheets
SPRNCA, Reach F
Photographer: Mike Lunn, April 17, 2012

234 – Waypoint 948, upstream view, much wider active channel.

235 – Waypoint 948, downstream view.

236 – Downstream, terrace visible in lower part of photo, line of seep willow at water edge right.

237 – Waypoint 950, down to old railroad grade fence and abutment.

238 – Waypoint 951, at Walnut Gulch, upstream.

239 – View up Walnut Gulch.

San Pedro River Photo Sheets
SPRNCA, Reach F
Photographer: Mike Lunn, April 17-18

240 – Waypoint 951 - down view below Walnut Gulch.

241 – Waypoint 952 – upstream on San Pedro opposite mouth of Babocamari.

243 – Waypoint 952 – downstream to Fairbanks bridge.

244 – Upstream from Fairbanks bridge.

245 – Downstream from bridge.

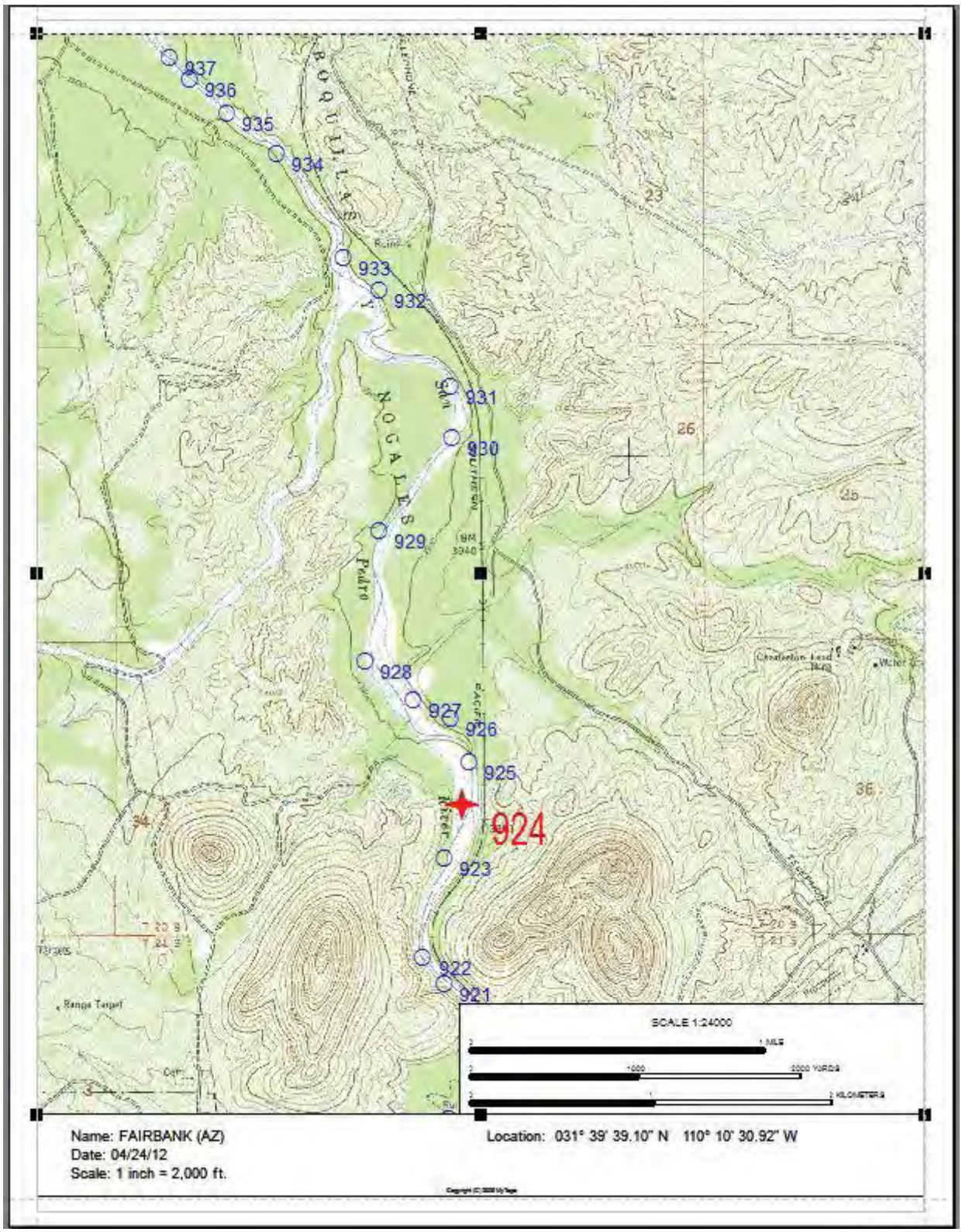
San Pedro River Photo Sheets
SPRNCA, Reach F
Photographer: Mike Lunn, April 17-18

246 – Waypoint 953 – channel bar forming, willow, young cottonwood and seep willow present.

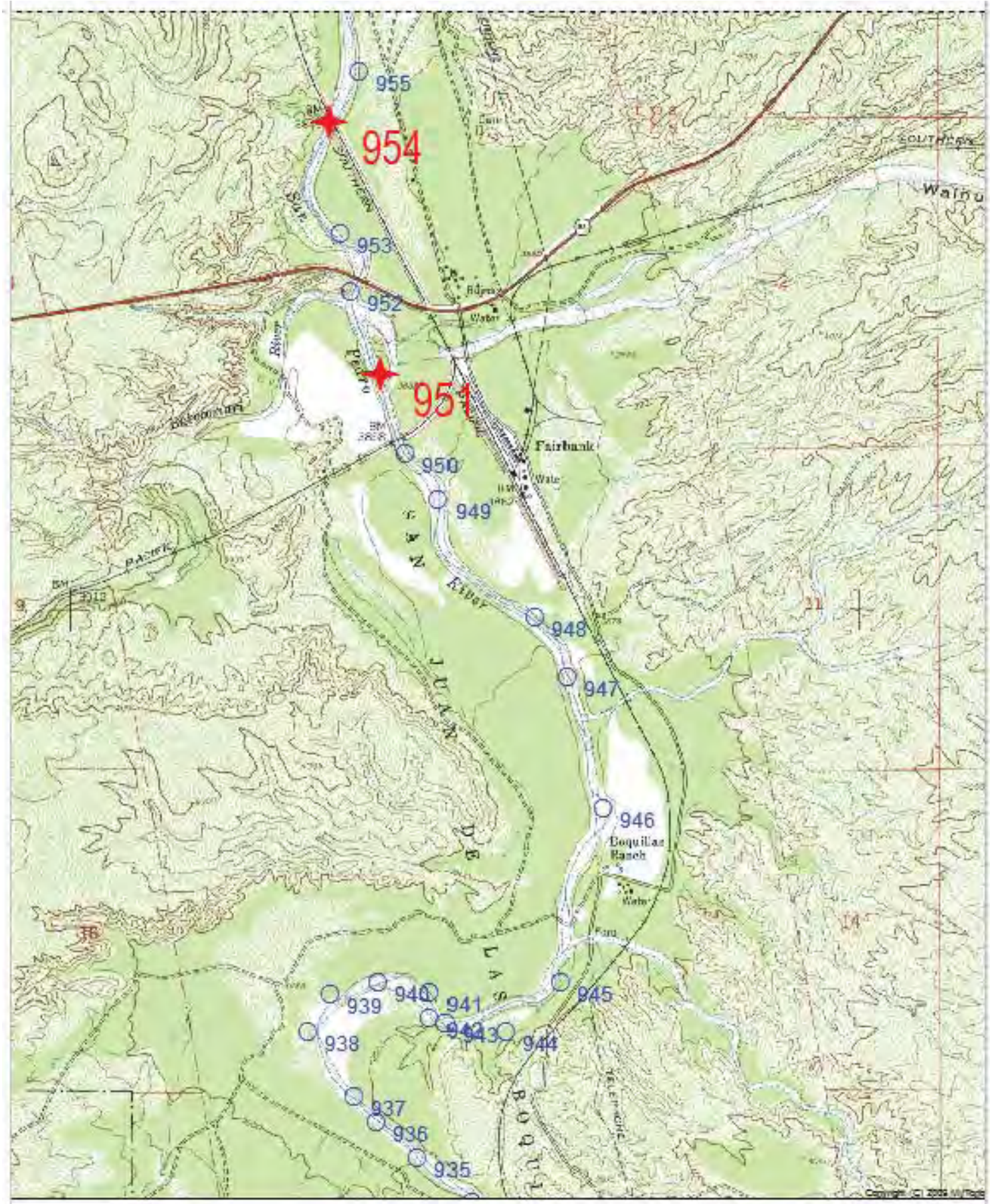
247 – Seep willow and young cottonwood on low bar.

248 – Waypoint 954 - upstream view from Fairbanks trestle. End Reach F.

Photo taken 6/20/1987 from same location as photo 248.



SPRNCA PFC Reach F south
Waypoints 924 – 935
April 17, 2012

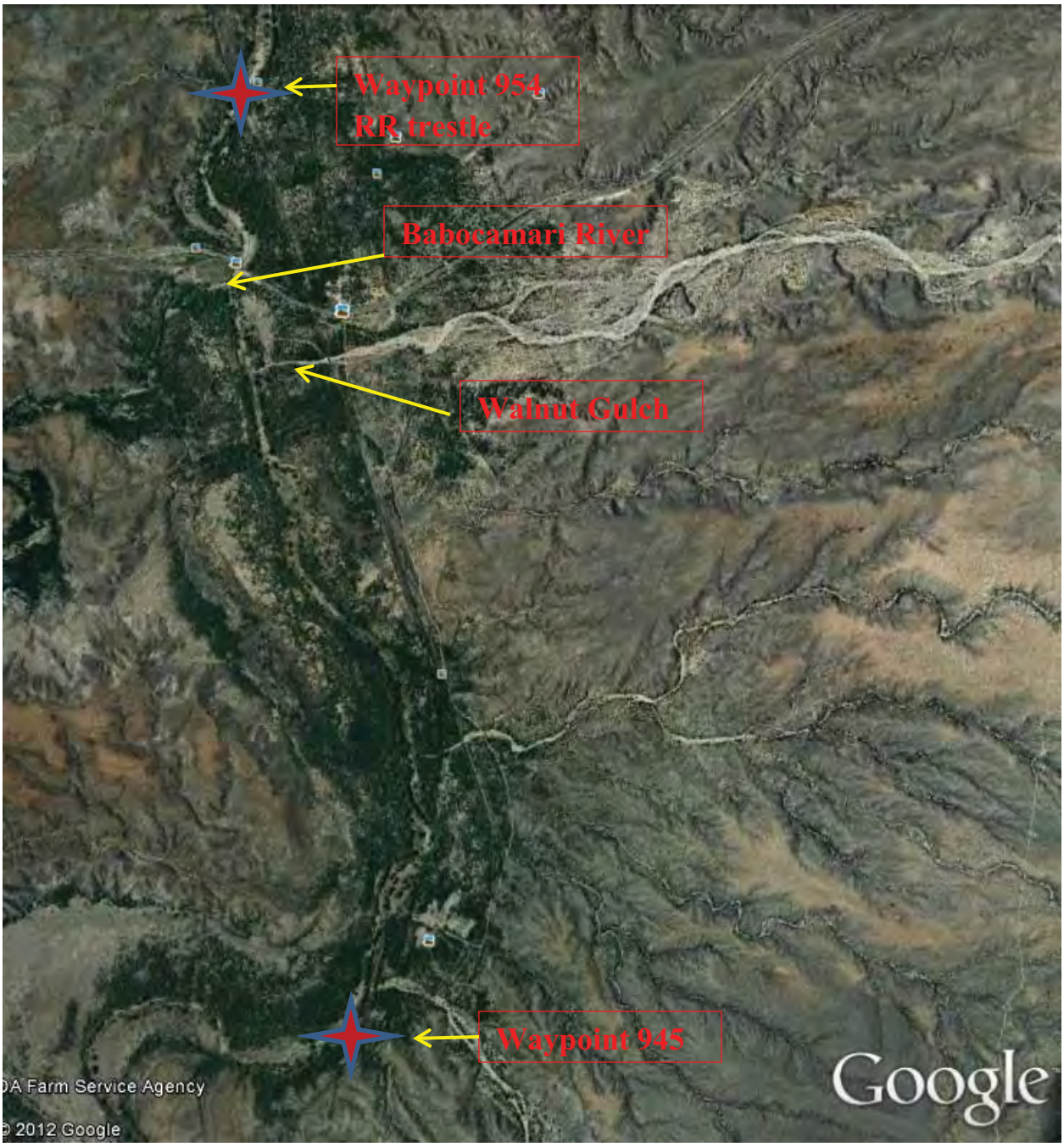


Name: FAIRBANK (AZ)
Date: 05/23/12
Scale: 1 inch = 2,000 ft.

Location: 031° 42' 30.66" N 110° 11' 08.56" W

SPRNCA PFC Reach F North
Waypoints 935 – 954
April 16, 2012

SPRNCA Reach F
South section,
Wpt 924 - 945



SPRNCA Reach F
North section
Wpt 945 - 954

Reach F
Looking across San Pedro River, up Boquillas Wash

July 27, 1987

July 7, 1992

July 29, 1998

July 10, 2003

July 24, 2008

April 17, 2012

Reach F
San Pedro River at Highway 82 Bridge,
looking upstream (south)

June 21, 1987

September, 1987

July 6, 1992

January 19, 1993

July 21, 1998

July 10, 2003

June 26, 2008

April 18, 2012

Reach F
San Pedro River at Highway 82 bridge, looking downstream (north)

July 21, 1987

November 7, 1987

July 6, 1992

July 21, 1998

July 10, 2003

May 4, 2005

June 26, 2008

April 18, 2012

Reach F
San Pedro River looking down (north) to Fairbanks railroad bridge

July 21, 1987

July 7, 1992

July 28, 1998

May 18, 2004

May 4, 2005

June 6, 2005

June 26, 2008

Reach F
San Pedro River at Fairbanks railroad bridge, looking downstream (north)

June 20, 1987

October, 1987

July 7, 1992

July 27, 1998

May 18, 2004

June 6, 2005

June 26, 2008

April 18, 2012

Reach F

San Pedro River north of Fairbanks trestle south view

6-21-1987

7-7-1992

7-20-1998

5-18-2004

5-04-2005

6-06-2005

Reach F
San Pedro River at Fairbanks railroad trestle, looking upstream (south)

June 20, 1987

September 1987

July 7, 1992

July 27, 1998

May 18, 2004

June 6, 2005

June 26, 2008

April 18, 2012

San Pedro PFC Assessment
Waypoint Log
Reach F

924	16-APR-12 1:09:09PM	N31 38.948 W110 10.582	3930 ft	reach break, photo 192
925	16-APR-12 2:05:53PM	N31 39.100 W110 10.587	3956 ft	photo 193
926	16-APR-12 2:14:25PM	N31 39.225 W110 10.653	3951 ft	photo194
927	16-APR-12 2:21:19PM	N31 39.281 W110 10.785	3944 ft	photo 196
928	16-APR-12 2:28:50PM	N31 39.397 W110 10.952	3947 ft	photo197
929	16-APR-12 2:49:44PM	N31 39.785 W110 10.901	3925 ft	photos 198-199
930	16-APR-12 3:02:11PM	N31 40.059 W110 10.647	3912 ft	photo 200
931	16-APR-12 3:17:42PM	N31 40.214 W110 10.652	3899 ft	photo 201
932	16-APR-12 3:32:54PM	N31 40.498 W110 10.901	3940 ft	photo 202
933	16-APR-12 3:39:19PM	N31 40.594 W110 11.028	3913 ft	photo 203
934	17-APR-12 8:26:20AM	N31 40.904 W110 11.260	3953 ft	photos 204-205
935	17-APR-12 8:34:39AM	N31 41.021 W110 11.432	3893 ft	photos 206-207
936	17-APR-12 8:40:57AM	N31 41.121 W110 11.560	3890 ft	photo 208
938	17-APR-12 8:58:52AM	N31 41.362 W110 11.778	3857 ft	photo 211
939	17-APR-12 9:06:24AM	N31 41.465 W110 11.711	3887 ft	photos 212-213
940	17-APR-12 9:16:56AM	N31 41.499 W110 11.557	3859 ft	photo 214
941	17-APR-12 9:26:47AM	N31 41.469 W110 11.396	3869 ft	photo 215
942	17-APR-12 9:37:56AM	N31 41.401 W110 11.392	3873 ft	photos 216-217
944	17-APR-12 9:52:19AM	N31 41.362 W110 11.151	3893 ft	photo 221-222
945	17-APR-12 10:46:17AM	N31 41.497 W110 10.975	3936 ft	photo 223
946	17-APR-12 11:35:56AM	N31 41.966 W110 10.841	3874 ft	photo 231
947	17-APR-12 11:52:48AM	N31 42.319 W110 10.959	3868 ft	photos 232-233
948	17-APR-12 12:01:33PM	N31 42.481 W110 11.061	3828 ft	photos 234-235

949	17-APR-12 12:36:06PM	N31 42.799 W110 11.368	3852 ft	photo 236
950	17-APR-12 12:45:50PM	N31 42.925 W110 11.472	3844 ft	photo 237
951	17-APR-12 12:56:19PM	N31 43.136 W110 11.551	3821 ft	photos 238, 240
952	18-APR-12 8:21:39AM	N31 43.361 W110 11.642	3819 ft	photo 241-243
953	18-APR-12 8:45:01AM	N31 43.519 W110 11.679	3836 ft	photo 246
954	18-APR-12 9:04:50AM	N31 43.817 W110 11.699	3855 ft	reach break, photo 248

PFC Assessment Form

Name of Riparian-Wetland Area: **San Pedro River**

Date: **4/18/2012** Segment/Reach ID: **PFC Reach G**

ID Team Observers: Mike Lunn, Janice Staats, Steve Leonard, Mark Gonzalez, Ben Lomeli, Jeff Simms, Marcia Radke, Eric Baker, Heather Swanson, Catie Fenn, Jim Fogg, Ryan Pitts,

Yes	No	N/A	HYDROLOGICAL
X			**1) Floodplain above bankfull is inundated in "relatively frequent" events** Yes, at least during 3-year event. Stable banks. Sand bed is most likely mobilizing during high flow events.
		X	**2) Where beaver dams are present are they active and stable**
X			**3) Sinuosity, width/depth ratio, and gradient are in balance with the landscape setting (i.e., landform, geology, and bioclimatic region)** Excellent width/depth ratio, expected sinuosity and gradient (see photo 251).
X			**4) Riparian-wetland area is widening or has achieved potential extent** Mostly expanding inwards towards channel, not nearly to potential extent at this time.
X			**5) Upland watershed is not contributing to riparian-wetland degradation** Deposits all smooth shaped; no evidence of degradation.

Yes	No	N/A	VEGETATION
X			**6) Diverse age-class distribution of riparian-wetland vegetation (recruitment for maintenance/recovery)** Diverse age-classes on both woody and herbaceous species.
X			**7) Diverse composition of riparian-wetland vegetation (for maintenance/recovery) (*species present*)** Composition is diverse. See plant list.
X			**8) Species present indicate maintenance of riparian-wetland soil moisture characteristics** Obligate wetland species present, more obligates than lower end of Reach F. See plant list.
X			**9) Streambank vegetation is comprised of those plants or plant communities that have root masses capable of withstanding high streamflow events (*community types present*)** Stabilizing plant community types present. See plant list.
X			**10) Riparian-wetland plants exhibit high vigor** High vigor on both woody and herbaceous. Some browsing on young cottonwood, but enough have released to provide multiple age classes with good vigor.
X			**11) Adequate riparian-wetland vegetative cover present to protect banks and dissipate energy during high flows (*enough*)** Visually estimated that reach has at least 80% cover, which is adequate for this stream type.
X			**12) Plant communities are an adequate source of coarse and/or large woody material (for maintenance/recovery)** Narrow band of cottonwood along stream, plus receives woody material from upstream reaches.

Yes	No	N/A	EROSION DEPOSITION
X			**13) Floodplain and channel characteristics (i.e., rocks, overflow channels, coarse and/or large woody material) adequate to dissipate energy** Overflow channels and wood jams are present. As flow rises, bed scour probably occurs to increase conveyance.
		X	**14) Point bars are revegetating with riparian-wetland vegetation** No point bars expected.

X			**15) Lateral stream movement is associated with natural sinuosity** Stable, no excessive lateral movement.
X			**16) System is vertically stable (*not downcutting*)** No headcuts.
X			**17) Stream is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition)** Stable banks.

Remarks

The reach is in proper functioning condition for an intermittent flow regime, but it is not at potential natural community or desired condition. The riparian area can continue to expand inward and outward.

Bedrock is constraining the sandy alluvium and bringing water to the surface and there are more obligate plant communities along this reach that have access to water during the growing season. The channel is narrower as a result and potentially will continue to narrow.

We again discussed groundwater concerns, but the visual evidence from the assessment indicated no adverse impacts at this time to either the channel or vegetation characteristics.

SUMMARY DETERMINATION

Functional Rating:
:

_X_ Proper Functioning Condition

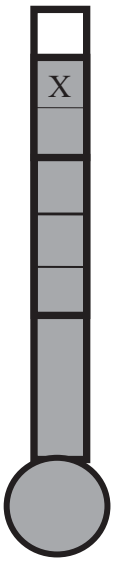
___ Functional - At Risk

___ Nonfunctional

___ Unknown

Trend for Functional - At Risk:

___ Upward
___ Downward
___ Not Apparent



Are factors contributing to unacceptable conditions outside the control of the manager?

Yes ___
No _X_
No unacceptable conditions noted.

If yes, what are those factors?

___ Flow regulations
___ Mining activities
___ Upstream channel conditions
___ Channelization
___ Road encroachment
___ Oil field water discharge
___ Augmented flows
___ Other (specify _____

(Revised 1998) (7/12/04)

SPRNCA Plant List for PFC Assessment

(Not a complete list of species present)

Reach G Date April 18, 2012

	Sedges/Grasses	Scientific Name	WIC	SC	AB	LOC
	Spikerush CT	*Eleocharis spp.*		H		
X	Common spikerush	*Eleocharis palustris*	OBL	H	2	A
	Parish spikerush	*Eleocharis parishii*	FACW	H		
	Beaked spikerush	*Eleocharis rosellata*	OBL	L		
	Threesquare bulrush	*Schoenoplectus americanus*	OBL	H		
	Hardstem bulrush CT	*Schoenoplectus spp.*		H		
X	Hardstem bulrush	*Schoenoplectus acuta*	OBL	H	3	A
	Baltic rush CT	*Juncus spp.*	OBL	H		
X	Baltic rush	*Juncus balticus*	OBL	H	2	A
	Arizona rush	*Juncus interior*	FAC	M		
X	Torrey's rush	*Juncus torreyi*	FACW	H	2	A
	Cattail	*Typha latafolia*	OBL	H		
	Clustered field sedge	*Carex praegracillis*	OBL	H		
	Flat sedge	*Cyperus odoratus*	FACW+	M		
X	Johnson grass	*Sorghum halapense*	FACU+	M	4	F B
X	Bermuda grass	*Cynodon dactylon*	FACU	M	4	B F
	Barnyard grass	*Echinochloa crus-galli*	FACW	L		
X	Rabbitsfoot grass	*Polypogon monspeliensis*	FACW	L	3	A
	Smooth horsetail	*Equisetum laevigatum*	FACW	L		
	Alkali Sacaton	*Sporobolus airoides*	FAC	M		
X	Giant Sacaton	*Sporobolus wrightii*	FAC	M	4	F T
X	Spike dropseed	*Sporobolus contractus*	FACU	L	1	F
	Sand dropseed	*Sporobolus cryptandrus*	FACU	L		
X	Deer grass	*Muhlenbergia rigens*	FAC	H	2	B
	Vine Mesquite	*Panicum obtusum*	FAC	M		
	Beardless wildrye	*Leymus triticoides*	FAC	M		
	Canadian horseweed	*Conyza canadensis*	FACU	M		
X	Cane beardgrass	*Bothriochloa barbinodis*	UPL		1	F
X	Lehman lovegrass	*Eragrostis lehmanniana*			1	F A
X	Plains bristlegrass	*Setaria mochrastachya*			1	F
X	Three awn	*Aristida purpurascens*	UPL		1	F
X	Spikerush	*Eleocharis sp*			1	A

	Forbs	Scientific name	WIC	SC	AB	LOC
X	Spiny aster	*Chloracantha spinosa*	FACW	H	2	F
	Curly top knotweed	*Polygonum lapathifolium*	OBL	L		
X	Sweet Clover	*Melilotus indicus*	*FACU+*	L	2	B A
	Speedwell	*Veronica spp.*	OBL	L		
X	Thurber's sneezeweed	*Helenium thurberi*	OBL		1	B

	Trees/Shrubs	Scientific names	WIC	SC	AB	LOC
X	Cottonwood/Goodding willow CT			H	4	B
	Cottonwood /Mixed hardwood CT			H		
X	Freemont Cottonwood	*Populus fremontii*	FACW	H	4	B
	Freemont Cottonwood/ Johnsongrass CT					
X	Goodding willow	*Salix gooddingii*	OBL	H	4	B
	Goodding willow/Bulrush CT			H		
	Goodding willow/ Johnsongrass CT			H		
	Coyote willow	*Salix exigua*	OBL	M		
	Yewleaf willow	*Salix taxifolia*	FACW	H		
X	Seep willow	*Baccharis salicifolia*	FACW	M	4	B A
	Desert broom	*Baccharis sarothroides*	FACW	M		
	Yerba de pasmo	*Baccharis pteronoides*				
X	Tamarisk	*Tamarix ramosissima*	FACW	H	4	B F
	Mexican elderberry	*Sambucus nigra*	FAC	M		
	Western soapberry	*Sapindus saponaria*	UPL	M		
	Netleaf hackberry	*Celtis reticulata*	FACU	M		
	Arizona walnut	*Juglans major*	FACW	H		
X	Velvet ash	*Fraxinus velutina*	FAC +	L	1	F
	Honey locust	*Gleditsia triacanthos*	FAC	M		
	White mulberry	*Morus alba*	FAC	M		
X	Texas mulberry	*Morus microphylla*	FACU	M	1	F
	Tree tobacco	*Nicotiana glauca*	FAC	M		
X	Velvet mesquite	*Prosopis velutina*	FAC	M	4	T F
	Golden current	*Ribes aureum*	FACW	H		
	Little-leaf sumac	*Rhus microphylla*	FACU	M		
X	Rubber rabbitbrush	*Ericameria nauseosa*	UPL	M	2	F
X	Burrobrush	*Hymenoclea monogyra*	UPL	M	2	F
X	4-wing saltbush	*Atriplex canescens*	UPL		1	F

WIC = **W**etland **I**ndicator **C**ategories, OBL = Obligate wetland; FACW = Facultative Wetland; FAC = Facultative; FACU = Facultative Upland. From Reed, P.B. 1988. National list of plant species that occur in wetlands: Southwest (Region 7). A positive (+) or negative (-) sign was used with the Facultative Indicator categories to more specifically define the regional frequency of occurrence in wetlands. The positive sign indicates a frequency toward the higher end of the category (more frequently found in wetlands), and a negative sign indicates a frequency toward the lower end of the category (less frequently found in wetlands).
SC = **S**tability **C**lass: low (L), moderate (M), high (H), adapted from Burton, T.A, S.J. Smith, and E.R. Cowley. 2011. Riparian area management: multiple indicator monitoring (MIM) of stream channels and streamside vegetation. TR 1737-23; Winward, A.H. 2000. Monitoring the vegetation resources in riparian areas. USDA Forest Service Rocky Mountain Research Station General Technical Report RMRS-GTR-47.; Nelle, S. 2011. Common plants of riparian areas – Southwestern Texas-Northern Mexico with wetland indicator (WI) and draft stability rating (SR); and NRCS National Plant Database.
AB = **Ab**undance (1-4). 1 = present but with only 1 to a few individuals; 2 = found occasionally; 3 = common; 4 = abundant .
LOC = **Loc**ation(s): active channel(AC), stream bank(B), frequent floodplain(F), terrace (T).
CT = **C**ommunity **T**ype

San Pedro River Photo Sheets
SPRNCA, Reach G
Photographer: Mike Lunn, April 18, 2012

249 – Waypoint 954, down from trestle, retake of 1987 photo, much more distinct narrow channel on right, more vegetation.

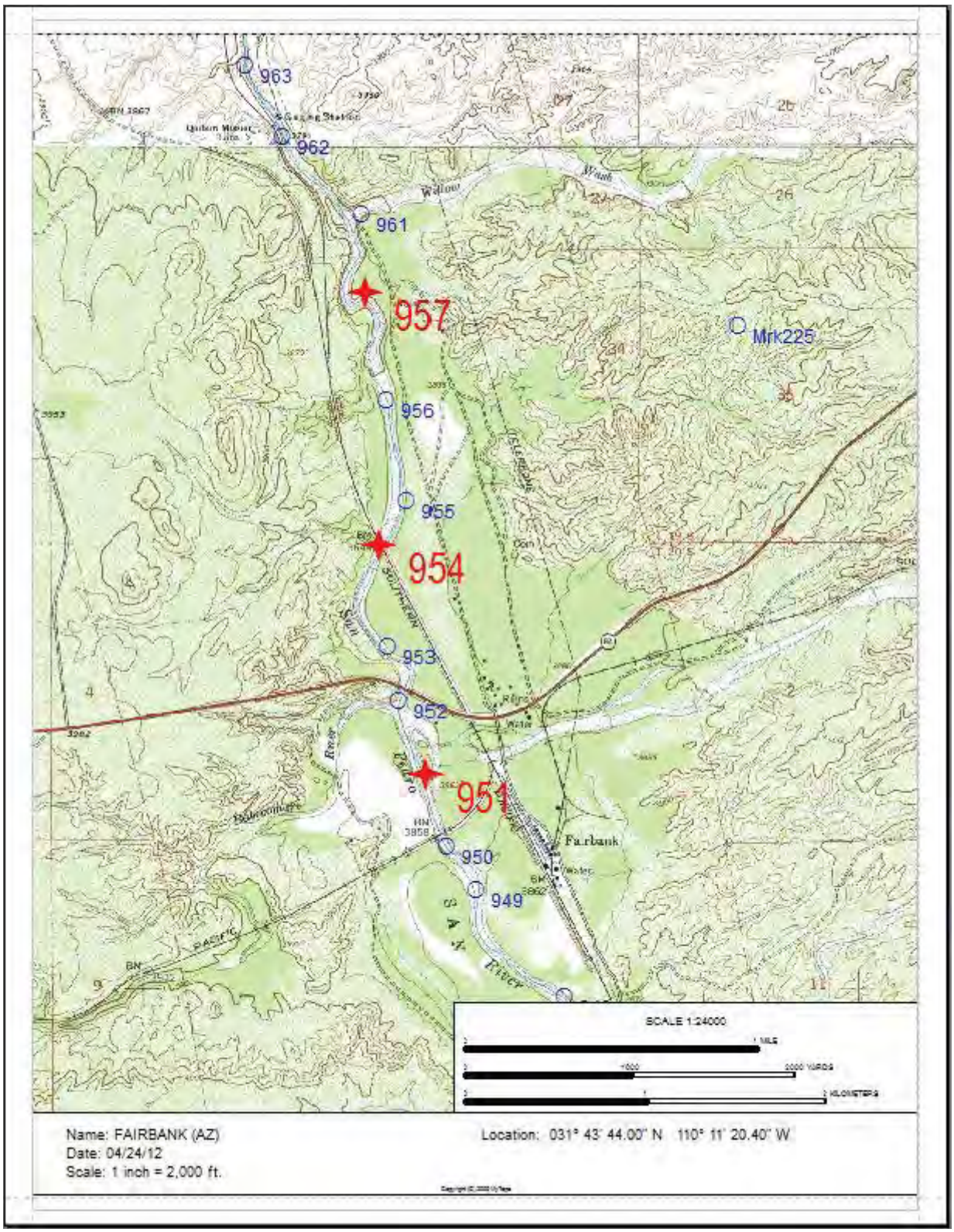
June 1987 photo from trestle down – same view as photo 249.

shaped channel, excellent vegetation for intermittent reach.

Riv

nt 956 - downstream view.

SPRNCA, Reach G
Photographer: Mike Lunn, April 18, 2012



SPRNCA PFC Reach G
G Waypoints 954 – 957
April 18, 2012

SPRNCA PFC Reach G Google map
Waypoint 954 - 957

Reach G
View upstream to trestle

6-19-1987

7-7-1992

7-20-1998

5-18-2004

5-4-2005

6-6-2005

06-26-2008

06-06-2005 water umbel

San Pedro PFC Assessment
Waypoint Log
Reach G

954	18-APR-12 9:04:50AM	N31 43.817 W110 11.699	3855 ft	reach break, photo 249
955	18-APR-12 9:20:23AM	N31 43.952 W110 11.615	3832 ft	photos 250-251
956	18-APR-12 9:33:59AM	N31 44.251 W110 11.686	3851 ft	photos 252-253
957	18-APR-12 9:58:07AM	N31 44.583 W110 11.745	3816 ft	reach break, photos 255-256

PFC Assessment Form

Name of Riparian-Wetland Area: **San Pedro River**

Date: **4/18/2012** Segment/Reach ID: **PFC Reach H**

ID Team Observers: Mike Lunn, Janice Staats, Steve Leonard, Mark Gonzalez, Ben Lomeli, Jeff Simms, Marcia Radke, Eric Baker, Heather Swanson, Catie Fenn, Jim Fogg, Ryan Pitts

Yes	No	N/A	HYDROLOGICAL
	X	X	**1) Floodplain above bankfull is inundated in "relatively frequent" events** During floods, non-cohesive, sand-bed channels will commonly mobilize the bed and increase the size of the channel, and then fill back in as the flows recede. During floods, standing waves are evidence that dunes and anti-dunes move down the river. Item 1 is not applicable in those situations because significant overbank flooding is not expected. However, it was obvious from reaches upstream and downstream of Reach H that it does not take a large amount of cohesion in the bed for that process to be altered. In those other reaches, there are linear strands of vegetation and an "inner" channel where the vegetation was able to capture and stabilize enough fine, cohesive sediment to persist through subsequent floods. Below Willow Wash, the system is so dominated by non-cohesive sediments that development of that inner channel does not occur. Because of the voluminous and coarse sediment inputs from Willow Wash, there remains a question about whether Reach H should be able to develop the same vegetation characteristics as above/below the reach and then over time develop a floodplain for this intermittent reach, albeit a slow process.
		X	**2) Where beaver dams are present are they active and stable**
X			**3) Sinuosity, width/depth ratio, and gradient are in balance with the landscape setting (i.e., landform, geology, and bioclimatic region)** Question about width/depth ratio, but widest parts are near tributary mouths which are expected to be wider due to the fan form of the channel below tributaries.
X	X		**4) Riparian-wetland area is widening or has achieved potential extent** Answered both “yes” and “no” because the reach shows attributes of both riparian expansion in places and riparian contraction in others. Riparian vegetation is expanding on some bars. Some new regeneration of woody species. In some spots, riparian vegetation is holding, building banks, channel characteristics developing with overflow channels. Salt cedar is presently not affecting the function of the system, even though it is displacing natives and has more bare ground underneath. Ash is more drought tolerant, and there is more of it in this reach. Crowns dying on some of the cottonwood trees. There are spots where the sacaton is dying back with bare ground in between. Compared to 1987 photo point at Willow Wash, the riparian area has expanded; but sequential photos between 1987 and the present demonstrate several major flow events from Willow Wash that overwhelms recovery.
	X		**5) Upland watershed is not contributing to riparian-wetland degradation** In-channel bars larger than expected, not able to establish vegetation. Base flows are cutting through fan deposits, not gullying. There are active headcuts and widening gullies in the tributaries that could be delivering excessive sediments directly to this reach. Google Earth image clearly shows the impacts Willow Wash has on Reach H, which simply overwhelms recovery processes for several years following major events.

Yes	No	N/A	VEGETATION
X			**6) Diverse age-class distribution of riparian-wetland vegetation (recruitment for maintenance/recovery)** Cottonwood, ash and willow are present in young and older age classes.
X			**7) Diverse composition of riparian-wetland vegetation (for maintenance/recovery) (*species present*)** Yes, based on expectation for intermittent reach. Seep willow on streambanks. Also reach has cottonwood, Goodding willow, and ash. Ash may replace cottonwood if reach becomes drier as

			it tolerates drier conditions. See plant list.
X			**8) Species present indicate maintenance of riparian-wetland soil moisture characteristics** Mostly facultative wet and facultative species as expected for an intermittent reach. See plant list.
X			**9) Streambank vegetation is comprised of those plants or plant communities that have root masses capable of withstanding high streamflow events (*community types present*)** Cottonwood/tamarisk community types have developed in sections. See plant list.
X	X		**10) Riparian-wetland plants exhibit high vigor** Ash, deer grass, and other species exhibit high vigor. From Willow Wash to Tombstone gage the cottonwoods and willow display some dead tops indicating low vigor for those trees (see photo 265). Upstream of Willow Wash and downstream of Tombstone gage, the cottonwood and willow appear to be vigorous and in fine health (see photos 264 and 268).
	X		**11) Adequate riparian-wetland vegetative cover present to protect banks and dissipate energy during high flows (*enough*)** Still expect well-formed vegetated banks; currently not nearly enough; too many places without bank development; photo 274 shows an example of this.
X			**12) Plant communities are an adequate source of coarse and/or large woody material (for maintenance/recovery)** Cottonwood canopy really opened up; lost gallery style, more of a single band along stream. Not adequate based only on this reach, but a lot of wood comes from upstream reaches. Google Earth and ground observations show valley width adequate for much more cottonwood but given episodic nature of cottonwood regeneration and complex requirements for regeneration success, it may not happen (see photo 268).

Yes	No	N/A	EROSION DEPOSITION
	X		**13) Floodplain and channel characteristics (i.e., rocks, overflow channels, coarse and/or large woody material) adequate to dissipate energy** Channel, floodplain, and overflow channels have very little roughness that would slow water velocity and help with deposition. Needs vegetation on bars, seep willow to capture coarse and small wood, additional stiff vertical structure to capture large wood.
		X	**14) Point bars are revegetating with riparian-wetland vegetation** No point bars; N/A, lateral bars only.
X			**15) Lateral stream movement is associated with natural sinuosity** Little lateral instability. Terrace cutbanks creating more sinuosity, channel stable within the belt of the trees.
X			**16) System is vertically stable (*not downcutting*)** Base flows are cutting through tributary deposits adjusting gradient, but no headcuts (see photo 270).
	X		**17) Stream is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition)** Bars are oversized. See item 5.

Remarks

There is a large range of attributes and processes for intermittent reaches based on water availability, where flows range from almost ephemeral to almost perennial. The soils and riparian vegetation on this reach are evidence that it has water available a good portion of the growing season. It is a losing reach, but still should have streambanks that are more vegetated and better defined. Expect few obligate wetland species, but expect cover of facultative wetland, facultative, and even some facultative upland species. Regeneration periodicity events of cottonwood and willow species may be extended, greater than 20 years or so; less frequent as it gets dryer. On an intermittent reach like this one, recovery of riparian vegetation and channel characteristics is not expected to occur as quickly as on the perennial reaches.

Cottonwood trees are showing signs of stress in parts of Reaches H (dead tops). Groundwater data are necessary to determine the cause so the appropriate management actions can be determined.

Presence of salt cedar does not necessarily indicate water stress. The amount here now does not indicate anything yet, so good time to treat it.

In this sand bed reach, when flows come up, if more conveyance is needed the bed scours and then fills back in. If the scour and fill are not too deep, herbaceous vegetation can respond and come back quickly. This is a process that creates sites for riparian vegetation regeneration.

A short segment of the reach near the Tombstone gage had cottonwood trees with dead tops.

The severity of the "no" answers on items 11 and 13 and the "yes" answers on vegetation items 6, 7, 8, 9 lead to the functional at-risk rating. The trend is not apparent because there is no evidence of a clear trend. Photo sequence shows repeating, relatively frequent sediment dumps from Willow Wash that prevent the reach from long-term recovery. Based on the amount of discussion about trend, it needs to be verified.

A 2009 photo shows a healthy cottonwood tree that now has a dead top. Water stress could be letting in disease, or disease could be adding to water stress, but monitoring well information is needed to interpret this correctly.

SUMMARY DETERMINATION

Functional Rating:
:

___ Proper Functioning Condition

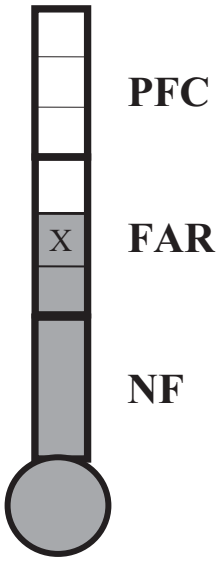
_X_ Functional - At Risk

___ Nonfunctional

___ Unknown

Trend for Functional - At Risk:

___ Upward
___ Downward
_X_ Not Apparent



Are factors contributing to unacceptable conditions outside the control of the manager?

Yes _X_
No ___

If yes, what are those factors?

___ Flow regulations
___ Mining activities
___ Upstream channel conditions
___ Channelization
___ Road encroachment
___ Oil field water discharge
___ Augmented flows
_X_ Other (specify Downward flows measured at USGS near Tombstone gage.

(Revised 1998) (7/12/04)

SPRNCA Plant List for PFC Assessment

(Not a complete list of species present)

Reach H Date April 18, 2012

	Sedges/Grasses	Scientific Name	WIC	SC	AB	LOC
	Spikerush CT	*Eleocharis spp.*		H		
	Common spikerush	*Eleocharis palustris*	OBL	H		
	Parish spikerush	*Eleocharis parishii*	FACW	H		
	Beaked spikerush	*Eleocharis rosellata*	OBL	L		
	Threesquare bulrush	*Schoenoplectus americanus*	OBL	H		
	Hardstem bulrush CT	*Schoenoplectus spp.*		H		
	Hardstem bulrush	*Schoenoplectus acuta*	OBL	H		
	Baltic rush CT	*Juncus spp.*	OBL	H		
	Baltic rush	*Juncus balticus*	OBL	H		
	Arizona rush	*Juncus interior*	FAC	M		
	Torrey's rush	*Juncus torreyi*	FACW	H		
	Cattail	*Typha latafolia*	OBL	H		
	Clustered field sedge	*Carex praegracillis*	OBL	H		
	Flat sedge	*Cyperus odoratus*	FACW+	M		
X	Johnson grass	*Sorghum halapense*	FACU+	M	4	F
X	Bermuda grass	*Cynodon dactylon*	FACU	M	4	B F
	Barnyard grass	*Echinochloa crus-galli*	FACW	L		
X	Rabbitsfoot grass	*Polypogon monspeliensis*	FACW	L	3	A
	Smooth horsetail	*Equisetum laevigatum*	FACW	L		
	Alkali Sacaton	*Sporobolus airoides*	FAC	M		
X	Giant Sacaton	*Sporobolus wrightii*	FAC	M	4	F T
	Spike dropseed	*Sporobolus contractus*	FACU	L		
	Sand dropseed	*Sporobolus cryptandrus*	FACU	L		
X	Deer grass	*Muhlenbergia rigens*	FAC	H		B A
	Vine Mesquite	*Panicum obtusum*	FAC	M		
	Beardless wildrye	*Leymus triticoides*	FAC	M		
	Canadian horseweed	*Conyza canadensis*	FACU	M		
X	Spikerush, spp	*Eleocharis sp*			1	A

	Forbs	Scientific name	WIC	SC	AB	LOC
	Spiny aster	*Chloracantha spinosa*	FACW	H		
	Curly top knotweed	*Polygonum lapathifolium*	OBL	L		
X	Sweet Clover	*Melilotus indicus*	*FACU+*	L	2	A
	Speedwell	*Veronica spp.*	OBL	L		

	Trees/Shrubs	Scientific names	WIC	SC	AB	LOC
	Cottonwood/Goodding willow CT			H		
	Cottonwood /Mixed hardwood CT			H		
X	Freemont Cottonwood	*Populus fremontii*	FACW	H	3	B
	Freemont Cottonwood/ Johnsongrass CT					

X	Goodding willow	*Salix gooddingii*	OBL	H	3	B
	Goodding willow/Bulrush CT			H		
	Goodding willow/ Johnsongrass CT			H		
	Coyote willow	*Salix exigua*	OBL	M		
	Yewleaf willow	*Salix taxifolia*	FACW	H		
X	Seep willow	*Baccharis salicifolia*	FACW	M	4	B
	Desert broom	*Baccharis sarothroides*	FACW	M		
	Yerba de pasmo	*Baccharis pteronoides*				
X	Tamarisk	*Tamarix ramosissima*	FACW	H	3	F B
	Mexican elderberry	*Sambucus nigra*	FAC	M		
	Western soapberry	*Sapindus saponaria*	UPL	M		
X	Netleaf hackberry	*Celtis reticulata*	FACU	M	2	F
X	Arizona walnut	*Juglans major*	FACW	H	2	F
X	Velvet ash	*Fraxinus arizonica*	FAC +	L	2	F B
	Honey locust	*Gleditsia triacanthos*	FAC	M		
	White mulberry	*Morus alba*	FAC	M		
	Texas mulberry	*Morus microphylla*	FACU	M		
	Tree tobacco	*Nicotiana glauca*	FAC	M		
X	Velvet mesquite	*Prosopis velutina*	FAC	M	4	T F
	Golden current	*Ribes aureum*	FACW	H		
X	Little-leaf sumac	*Rhus microphylla*	FACU	M	1	F
X	Rubber rabbitbrush	*Ericameria nauseosa*	UPL	M	2	F
X	Burrobrush	*Hymenoclea monogyra*	UPL	M	2	F
X	Cottonwood/ tamarisk community type				2	F

WIC = **W**etland **I**ndicator **C**ategories, OBL = Obligate wetland; FACW = Facultative Wetland; FAC = Facultative; FACU = Facultative Upland. From Reed, P.B. 1988. National list of plant species that occur in wetlands: Southwest (Region 7). A positive (+) or negative (-) sign was used with the Facultative Indicator categories to more specifically define the regional frequency of occurrence in wetlands. The positive sign indicates a frequency toward the higher end of the category (more frequently found in wetlands), and a negative sign indicates a frequency toward the lower end of the category (less frequently found in wetlands).
SC = **S**tability **C**lass: low (L), moderate (M), high (H), adapted from Burton, T.A, S.J. Smith, and E.R. Cowley. 2011. Riparian area management: multiple indicator monitoring (MIM) of stream channels and streamside vegetation. TR 1737-23; Winward, A.H. 2000. Monitoring the vegetation resources in riparian areas. USDA Forest Service Rocky Mountain Research Station General Technical Report RMRS-GTR-47.; Nelle, S. 2011. Common plants of riparian areas – Southwestern Texas-Northern Mexico with wetland indicator (WI) and draft stability rating (SR); and NRCS National Plant Database.
AB = **Ab**undance (1-4). 1 = present but with only 1 to a few individuals; 2 = found occasionally; 3 = common; 4 = abundant .
LOC = **Loc**ation(s): active channel(AC), stream bank(B), frequent floodplain(F), terrace (T).
CT = **C**ommunity **T**ype

San Pedro River Photo Sheets
SPRNCA, Reach H
Photographer: Mike Lunn, April 18, 2012

San Pedro River Photo Sheets
SPRNCA, Reach H
Photographer: Mike Lunn, April 18, 2012

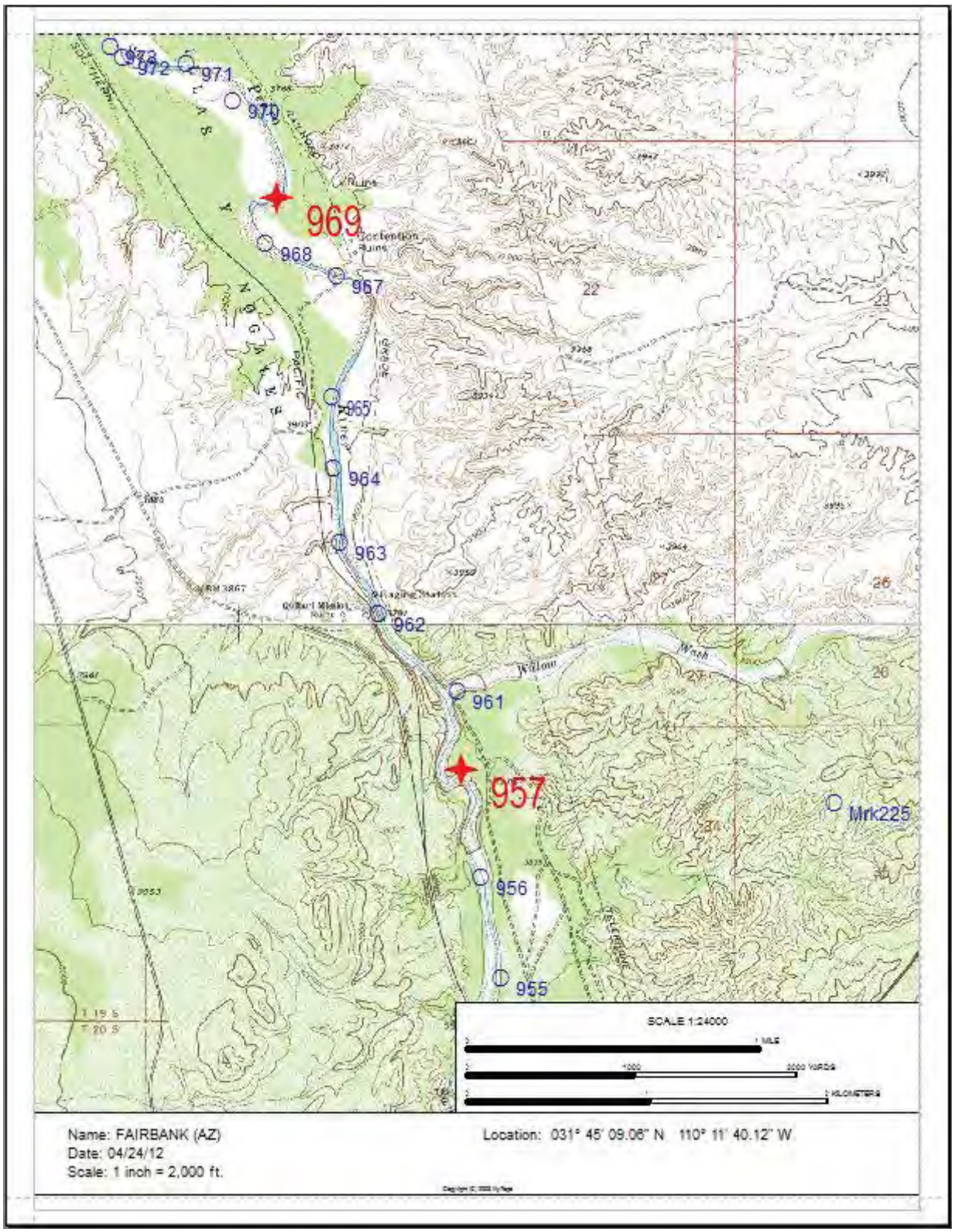
San Pedro River Photo Sheets
SPRNCA, Reach H
Photographer: Mike Lunn, April 18, 2012

Water flows across sill into a channel on right.

San Pedro River Photo Sheets
SPRNCA, Reach H
Photographer: Mike Lunn, April 18, 2012

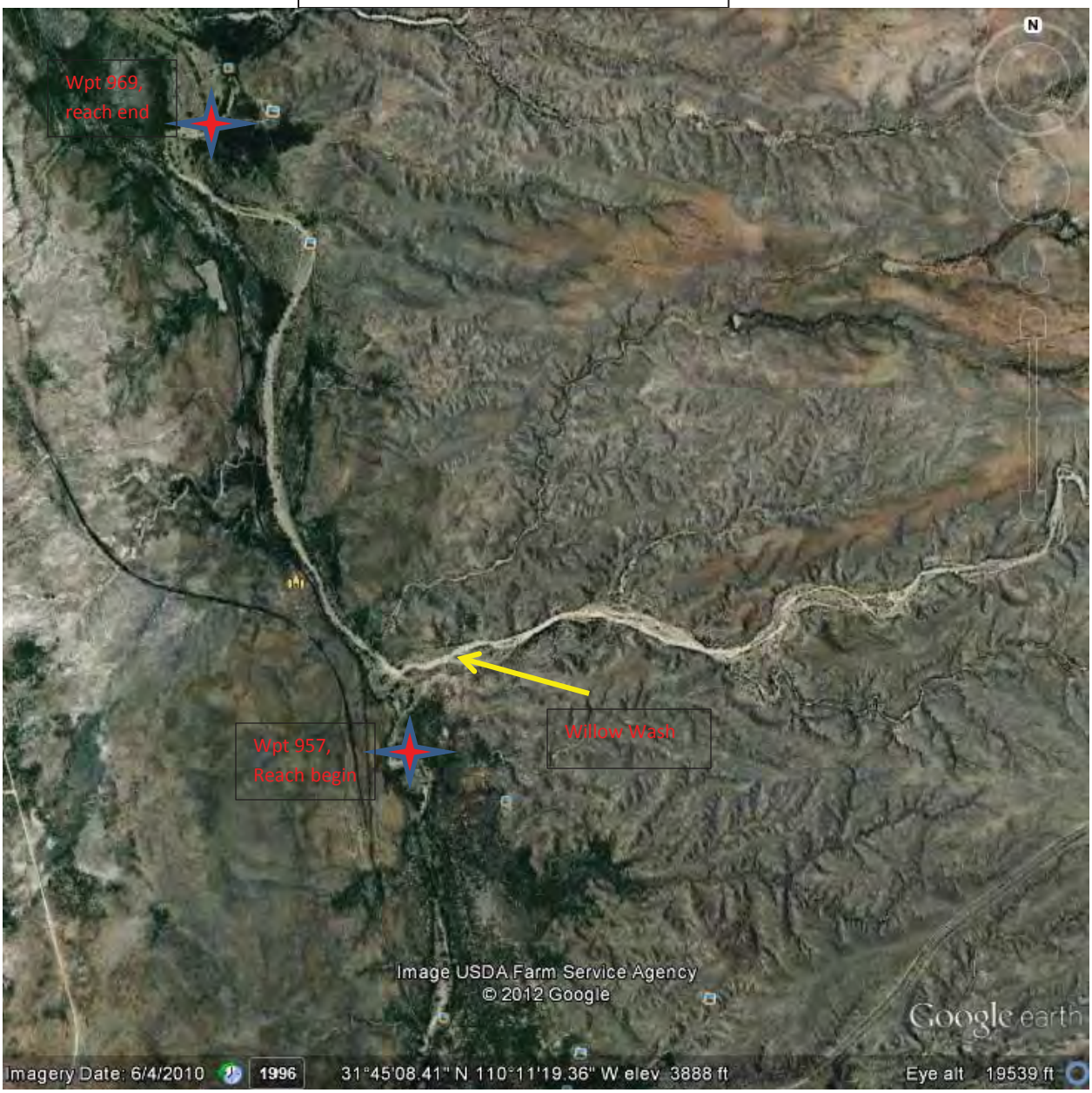
vertical structure to stop large coarse wood.

healthy stand of seep willows. End of reach.



SPRNCA PFC Reach H
Waypoints 957 – 969
April 18, 2012

SPRNCA PFC Reach H – Google Earth



Reach H
San Pedro River at Willow Wash, looking downstream (north)

June 19, 1987

July 7, 1992

July 30, 1998

June 28, 2004

May 27, 2005

July 24, 2008

April 18, 2012

San Pedro PFC Assessment
Waypoint Log
Reach H

957	18-APR-12 9:58:07AM	N31 44.583 W110 11.745	3816 ft	reach break, photo 256
961	18-APR-12 11:18:13AM	N31 44.805 W110 11.771	3843 ft	photo 259
962	18-APR-12 11:32:44AM	N31 45.035 W110 12.046	3805 ft	photos 265-266
963	18-APR-12 11:53:34AM	N31 45.246 W110 12.179	3796 ft	photos 267-268
964	18-APR-12 12:09:18PM	N31 45.466 W110 12.201	3799 ft	photos 269-270
965	18-APR-12 12:17:49PM	N31 45.684 W110 12.199	3791 ft	photos 271-272
967	19-APR-12 7:59:47AM	N31 46.037 W110 12.189	3765 ft	photos 273-274
968	19-APR-12 8:26:18AM	N31 46.137 W110 12.439	3760 ft	photo 275
969	19-APR-12 8:43:11AM	N31 46.269 W110 12.401	3760 ft	reach break, photo 276

PFC Assessment Form

Name of Riparian-Wetland Area: **San Pedro River**

Date: **4/19/2012** Segment/Reach ID: **PFC Reach I**

ID Team Observers: Mike Lunn, Janice Staats, Steve Leonard, Jim Fogg, Ben Lomeli, Jeff Simms, Marcia Radke, Eric Baker, Heather Swanson, Catie Fenn, Ryan Pitts

Yes	No	N/A	HYDROLOGICAL
X			**1) Floodplain above bankfull is inundated in "relatively frequent" events** Well-formed banks and floodplain/overflow channel characteristics. This reach has enough cohesion in bed materials and more vegetation which impedes bed mobilization, so frequent floodflows are getting out on floodplain in many places.
		X	**2) Where beaver dams are present are they active and stable**
X			**3) Sinuosity, width/depth ratio, and gradient are in balance with the landscape setting (i.e., landform, geology, and bioclimatic region)** Channel size smaller than upstream reaches, but may be due to lower flows. Channel well developed.
X			**4) Riparian-wetland area is widening or has achieved potential extent** Some places may be near potential extent. Good bank extension and channel narrowing (from riparian expansion) in other places (see photo 291).
X			**5) Upland watershed is not contributing to riparian-wetland degradation** No visual evidence in channel or on banks of deterioration. Channel handling sediments well.

Yes	No	N/A	VEGETATION
X			**6) Diverse age-class distribution of riparian-wetland vegetation (recruitment for maintenance/recovery)** Seep willow, several age-classes evident, good recruitment. Multiple age-classes of cottonwood, ash, herbaceous species and salt cedar (see photo 290).
X			**7) Diverse composition of riparian-wetland vegetation (for maintenance/recovery) (*species present*)** Composition is diverse. See plant list.
X			**8) Species present indicate maintenance of riparian-wetland soil moisture characteristics** Obligate wetland species present (two species of bulrush, Baltic rush). Lots of facultative wetland species. See plant list.
X			**9) Streambank vegetation is comprised of those plants or plant communities that have root masses capable of withstanding high streamflow events (*community types present*)** Stabilizing plant community types present (see photo 277). See plant list.
X			**10) Riparian-wetland plants exhibit high vigor** Fewer stressed cottonwood, good vigor in seep willow, communities of bulrush and Baltic rush forming. Some stressed and dead cottonwood from wildfire in one section that killed some cottonwoods. There were areas of thick cottonwood trees, some of the younger trees are dying, probably as a result of natural thinning. Overall very good vigor.
X			**11) Adequate riparian-wetland vegetative cover present to protect banks and dissipate energy during high flows (*enough*)** Deer grass, seep willow, cottonwoods (10-40 years old) right on bank. Older cottonwood on terrace.
X			**12) Plant communities are an adequate source of coarse and/or large woody material (for maintenance/recovery)** Cottonwood gallery along river, plus upstream sources. Good structure for holding infusions of large wood also (see photo 292).

Yes	No	N/A	EROSION DEPOSITION
X			**13) Floodplain and channel characteristics (i.e., rocks, overflow channels, coarse and/or large woody material) adequate to dissipate energy** Lots of overflow channels with live trees and shrubs trapping large woody material. Stable banks.
X			**14) Point bars are revegetating with riparian-wetland vegetation** Revegetation of bars is patchy but mostly yes. Some barren point bars, some with bands of seep willow. Tamarisk is recruiting faster than cottonwood and willow because of the intermittent nature of the stream and episodic recruitment events for cottonwoods and willow. Cottonwoods and willows sprouting from buried limbs.
X			**15) Lateral stream movement is associated with natural sinuosity** No excessive lateral movement. At the end of the reach there are large cantilever overhang failures on the terrace cut, yet the opposite side of the river is revegetating (see photos 307 and 308).
X			**16) System is vertically stable (*not downcutting*)** No headcuts.
X			**17) Stream is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition)** Processing sediments due to good vegetative cover. Clay in channel bed and banks holds more soil moisture (see photos 287 and 290).

Remarks

Clays are delivered to the channel from the wash under the railroad trestle.

Some of the overflow channels are wider on their upstream side and narrow down as they drain back into the main channel. This could be because water infiltrates into the coarse bed of the overflow channels.

The lower end of the reach is St. David Diversion which is a push up dam (see photo 310a).

The reach is in proper functioning condition, about half way up towards potential natural community due to the riparian vegetative cover and well developed channel characteristics.

SUMMARY DETERMINATION

Functional Rating:
:

_X_ Proper Functioning Condition

___ Functional - At Risk

___ Nonfunctional

___ Unknown

Trend for Functional - At Risk:

___ Upward
___ Downward
___ Not Apparent

Are factors contributing to unacceptable conditions outside the control of the manager?

Yes ___
No _X_

If yes, what are those factors?
___ Flow regulations
___ Mining activities
___ Upstream channel conditions
___ Channelization
___ Road encroachment
___ Oil field water discharge
___ Augmented flows
___ Other (specify) _____

(Revised 1998) (7/12/04)

SPRNCA Plant List for PFC Assessment

(Not a complete list of species present)

Reach I Date April 19, 2012

	Sedges/Grasses	Scientific Name	WIC	SC	AB	LOC
	Spikerush CT	*Eleocharis spp.*		H		
X	Common spikerush	*Eleocharis palustris*	OBL	H	1	A
	Parish spikerush	*Eleocharis parishii*	FACW	H		
	Beaked spikerush	*Eleocharis rosellata*	OBL	L		
X	Threesquare bulrush	*Schoenoplectus americanus*	OBL	H	1	A
	Hardstem bulrush CT	*Schoenoplectus spp.*		H		
X	Hardstem bulrush	*Schoenoplectus acuta*	OBL	H	2	A B
	Baltic rush CT	*Juncus spp.*	OBL	H		
X	Baltic rush	*Juncus balticus*	OBL	H	2	A
	Arizona rush	*Juncus interior*	FAC	M		
	Torrey's rush	*Juncus torreyi*	FACW	H		
	Cattail	*Typha latafolia*	OBL	H		
	Clustered field sedge	*Carex praegracillis*	OBL	H		
	Flat sedge	*Cyperus odoratus*	FACW+	M		
X	Johnson grass	*Sorghum halapense*	FACU+	M	4	F B
X	Bermuda grass	*Cynodon dactylon*	FACU	M	4	B F
	Barnyard grass	*Echinochloa crus-galli*	FACW	L		
X	Rabbitsfoot grass	*Polypogon monspeliensis*	FACW	L	2	A
X	Smooth horsetail	*Equisetum laevigatum*	FACW	L	2	B A
	Alkali Sacaton	*Sporobolus airoides*	FAC	M		
X	Giant Sacaton	*Sporobolus wrightii*	FAC	M	4	F T
	Spike dropseed	*Sporobolus contractus*	FACU	L		
	Sand dropseed	*Sporobolus cryptandrus*	FACU	L		
X	Deer grass	*Muhlenbergia rigens*	FAC	H	4	B
	Vine Mesquite	*Panicum obtusum*	FAC	M		
	Beardless wildrye	*Leymus triticoides*	FAC	M		
X	Canadian horseweed	*Conyza canadensis*	FACU	M	1	A
X	Lehman lovegrass	*Eragrostis lehmanniana*			2	F A
X	Spikerush	*Eleocharis spp.*			1	A

	Forbs	Scientific name	WIC	SC	AB	LOC
	Spiny aster	*Chloracantha spinosa*	FACW	H		
	Curly top knotweed	*Polygonum lapathifolium*	OBL	L		
X	Sweet Clover	*Melilotus indicus*	*FACU+*	L	2	A B
	Speedwell	*Veronica spp.*	OBL	L		
X	Thurber's sneezeweed	*Helenium thurberi*	OBL		2	B

	Trees/Shrubs	Scientific names	WIC	SC	AB	LOC
X	Cottonwood/Goodding willow CT			H	3	B
	Cottonwood /Mixed hardwood CT			H		
X	Freemont Cottonwood	*Populus fremontii*	FACW	H	4	B F
	Freemont Cottonwood/ Johnsongrass CT					
X	Goodding willow	*Salix gooddingii*	OBL	H	3	B
	Goodding willow/Bulrush CT			H		
	Goodding willow/ Johnsongrass CT			H		
	Coyote willow	*Salix exigua*	OBL	M		
	Yewleaf willow	*Salix taxifolia*	FACW	H		
X	Seep willow	*Baccharis salicifolia*	FACW	M	4	B A
X	Desert broom	*Baccharis sarothroides*	FACW	M	1	F
	Yerba de pasmo	*Baccharis pteronoides*				
X	Tamarisk	*Tamarix ramosissima*	FACW	H	4	F B
	Mexican elderberry	*Sambucus nigra*	FAC	M		
	Western soapberry	*Sapindus saponaria*	UPL	M		
X	Netleaf hackberry	*Celtis reticulata*	FACU	M	2	F
	Arizona walnut	*Juglans major*	FACW	H		
X	Velvet ash	*Fraxinus velutina*	FAC +	L	2	F
	Honey locust	*Gleditsia triacanthos*	FAC	M		
	White mulberry	*Morus alba*	FAC	M		
	Texas mulberry	*Morus microphylla*	FACU	M		
	Tree tobacco	*Nicotiana glauca*	FAC	M		
X	Velvet mesquite	*Prosopis velutina*	FAC	M	4	T F
	Golden current	*Ribes aureum*	FACW	H		
	Little-leaf sumac	*Rhus microphylla*	FACU	M		
X	Rubber rabbitbrush	*Ericameria nauseosa*	UPL	M	3	F
X	Burrobrush	*Hymenoclea monogyra*	UPL	M	2	F
X	4-wing saltbush	*Atriplex canescens*			3	T

WIC = **W**etland **I**ndicator **C**ategories, OBL = Obligate wetland; FACW = Facultative Wetland; FAC = Facultative; FACU = Facultative Upland. From Reed, P.B. 1988. National list of plant species that occur in wetlands: Southwest (Region 7). A positive (+) or negative (-) sign was used with the Facultative Indicator categories to more specifically define the regional frequency of occurrence in wetlands. The positive sign indicates a frequency toward the higher end of the category (more frequently found in wetlands), and a negative sign indicates a frequency toward the lower end of the category (less frequently found in wetlands).
SC = **S**tability **C**lass: low (L), moderate (M), high (H), adapted from Burton, T.A, S.J. Smith, and E.R. Cowley. 2011. Riparian area management: multiple indicator monitoring (MIM) of stream channels and streamside vegetation. TR 1737-23; Winward, A.H. 2000. Monitoring the vegetation resources in riparian areas. USDA Forest Service Rocky Mountain Research Station General Technical Report RMRS-GTR-47.; Nelle, S. 2011. Common plants of riparian areas – Southwestern Texas-Northern Mexico with wetland indicator (WI) and draft stability rating (SR); and NRCS National Plant Database.
AB = **Ab**undance (1-4). 1 = present but with only 1 to a few individuals; 2 = found occasionally; 3 = common; 4 = abundant .
LOC = **Loc**ation(s): active channel(AC), stream bank(B), frequent floodplain(F), terrace (T).
CT = **C**ommunity **T**ype

San Pedro River Photo Sheets
SPRNCA, Reach I
Photographer: Mike Lunn, April 19, 2012

outward from channel.

narrowed channel near beginning of reach.

adds water.

San Pedro River Photo Sheets
SPRNCA, Reach I
Photographer: Mike Lunn, April 19, 2012

on left bank.

forming on bar.

added in this section, helping maintain surface water.

San Pedro River Photo Sheets
SPRNCA, Reach I
Photographer: Mike Lunn, April 19, 2012

Regeneration towards lower end of bar, More clay in reach.

upstream view, expanding both in and out.

growing in reach.

San Pedro River Photo Sheets
SPRNCA, Reach I
Photographer: Mike Lunn, April 18, 2012

295 – Waypoint 981, narrow confined channel, well vegetated with seep willow, cottonwood. Note OHV tracks.

296 – Waypoint 981, downstream view.

297 – Waypoint 982, upstream – retake of photo Summers Well – point bar vegetating from active channel to floodplain.

298 – Waypoint 982, downstream retake Summers well.

299 – Waypoint 983, downstream view, good floodplain access and roughness.

300 – Waypoint 983, upstream view.

San Pedro River Photo Sheets
SPRNCA, Reach I
Photographer: Mike Lunn, April 19, 2012

301 – Waypoint 984, upstream view, good Baltic rush communities forming outer edge of active channel.

302 – Waypoint 984, down - most cottonwood along channel in this reach is in younger age classes (10-40 years).

303 – Waypoint 985, up to narrow area, stream widens as it approaches lower end of reach.

304 – Waypoint 985, downstream view.

305 – Upstream view.

306 – Downstream view.

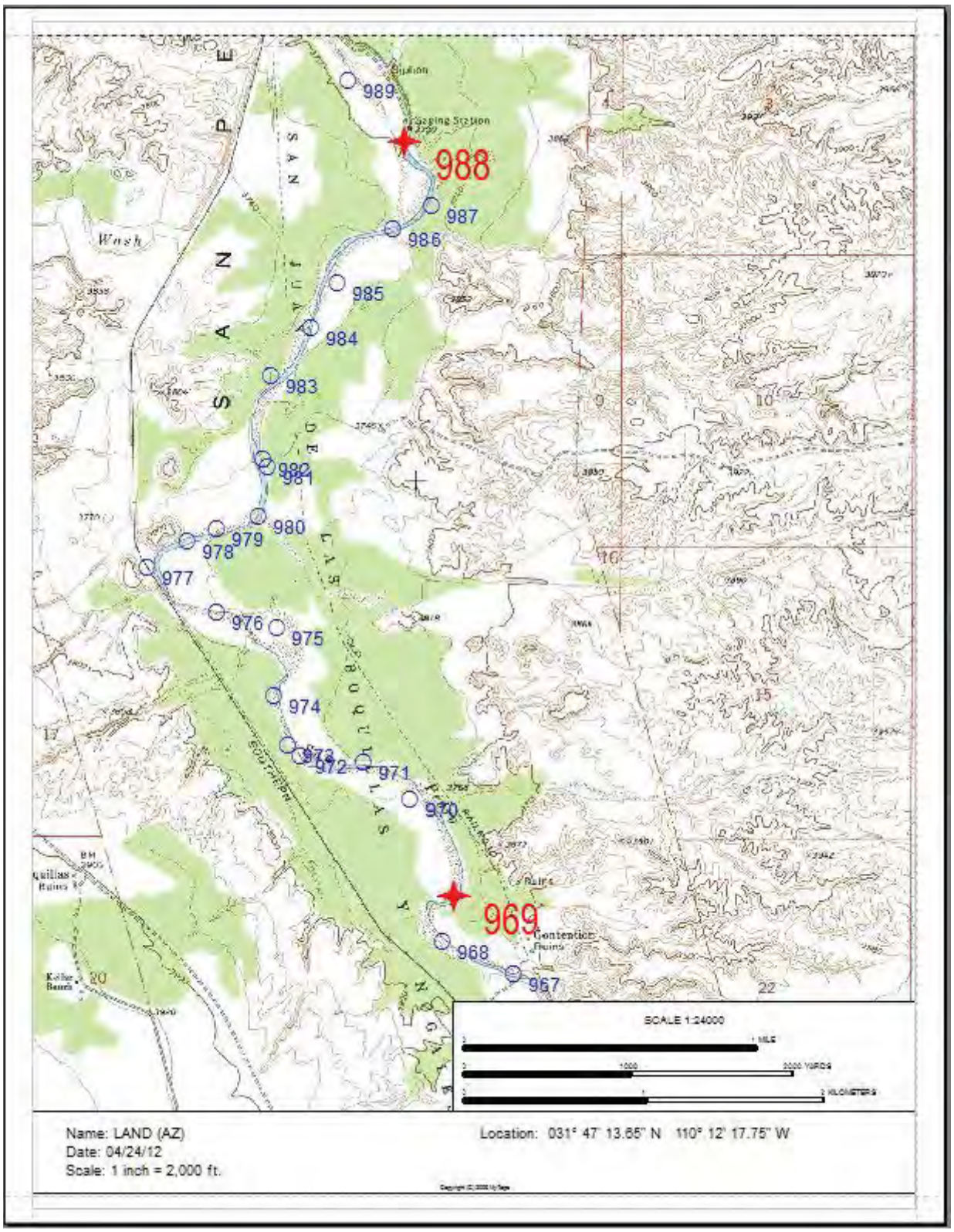
San Pedro River Photo Sheets
SPRNCA, Reach I
Photographer: Mike Lunn, April 19, 2012

309 – Upstream view.

310 – Downstream, St. David Diversion Dam, newly rebuilt of bulldozed earth in background.

310a – Cropped photo.

311 – Waypoint 988, upstream from top of dam.



SPRNCA PFC Reach I
Waypoints 969 – 988
April 19, 2012

SPRNCA PFC Reach I – Google Earth Image

Reach I
San Pedro River at Summers Well
looking upstream (south)

August 10, 2004

May 27, 2005

July 28, 2008

April 19, 2012

Reach I
San Pedro River at Summers Well,
looking downstream (north)

August 10, 2004

May 27, 2005

July 28, 2008

April 19, 2012

San Pedro PFC Assessment
Waypoint Log
Reach I

969	19-APR-12 8:43:11AM	N31 46.269 W110 12.401	3760 ft	reach break
970	19-APR-12 9:07:53AM	N31 46.559 W110 12.552	3748 ft	photo 277
971	19-APR-12 9:17:46AM	N31 46.668 W110 12.718	3731 ft	photo 278
972	19-APR-12 9:27:34AM	N31 46.687 W110 12.936	3740 ft	photo 281
973	19-APR-12 9:32:52AM	N31 46.717 W110 12.983	3747 ft	photos 282-283
974	19-APR-12 9:50:01AM	N31 46.867 W110 13.028	3750 ft	photos 284-285
975	19-APR-12 9:57:56AM	N31 47.068 W110 13.017	3755 ft	photo 286
976	19-APR-12 10:06:50AM	N31 47.114 W110 13.228	3750 ft	photo 287-288
977	19-APR-12 10:23:35AM	N31 47.248 W110 13.474	3743 ft	photos 289-290
978	19-APR-12 10:33:02AM	N31 47.328 W110 13.331	3738 ft	photo 291
979	19-APR-12 10:41:25AM	N31 47.365 W110 13.232	3720 ft	photo 292
980	19-APR-12 10:47:42AM	N31 47.402 W110 13.084	3731 ft	photos 293-294
981	19-APR-12 10:55:31AM	N31 47.548 W110 13.052	3759 ft	photos 295-296
982	19-APR-12 11:06:24AM	N31 47.573 W110 13.067	3746 ft	photo 297-298
983	19-APR-12 11:41:25AM	N31 47.818 W110 13.043	3721 ft	photos 299-300
984	19-APR-12 11:50:04AM	N31 47.965 W110 12.900	3720 ft	photos 301-302
985	19-APR-12 11:58:16AM	N31 48.097 W110 12.808	3718 ft	photos 303-304
986	19-APR-12 12:06:38PM	N31 48.255 W110 12.614	3703 ft	photos 305-306
987	19-APR-12 12:15:12PM	N31 48.324 W110 12.476	3689 ft	photo 307
988	19-APR-12 12:27:16PM	N31 48.515 W110 12.578	3717 ft	reach break, photo 311

PFC Assessment Form

Name of Riparian-Wetland Area: **San Pedro River**

Date: **4/20/2012** Segment/Reach ID: **PFC Reach J**

ID Team Observers: Mike Lunn, Janice Staats, Steve Leonard, Jim Fogg, Ben Lomeli, Jeff Simms, Marcia Radke, Eric Baker, Heather Swanson, Catie Fenn, Ryan Pitts

Yes	No	N/A	HYDROLOGICAL
	X		**1) Floodplain above bankfull is inundated in "relatively frequent" events** From a geomorphic perspective, this channel is behaving more like an ephemeral channel than its potential to be intermittent, shifting channels, no real floodplain, and mostly active channel with deposits at different elevations. On the spectrum of intermittent ranging from almost perennial to almost ephemeral, this reach is currently on the low end, yet should be in better condition than it is.
		X	**2) Where beaver dams are present are they active and stable**
	X		**3) Sinuosity, width/depth ratio, and gradient are in balance with the landscape setting (i.e., landform, geology, and bioclimatic region)** Width/depth ratio out of balance throughout. Bank characteristics not well defined.
	X		**4) Riparian-wetland area is widening or has achieved potential extent** Minimal/no riparian area expansion, but photos show more in-channel vegetation now than in 1987. There is some seep willow growing in the channel (see photo 051), but much more is needed to impede sand mobilization and begin to catch woody material to build channel characteristics.
	X		**5) Upland watershed is not contributing to riparian-wetland degradation** Way too much sediment not being processed or vegetated - some of the most unstable bed throughout SPRNCA. Transitory channels shift all across active channel, depositions of many different heights.

Yes	No	N/A	VEGETATION
X			**6) Diverse age-class distribution of riparian-wetland vegetation (recruitment for maintenance/recovery)** Two age-classes of younger cottonwood - young and very old cottonwood, missing a middle age class. Several age-classes of seep willow, Goodding's willow, tamarisk. More recent recruitment of young cottonwood, little recent recruitment of other species.
X			**7) Diverse composition of riparian-wetland vegetation (for maintenance/recovery) (*species present*)** Composition is diverse. For an intermittent reach, expected species present. See plant list.
	X		**8) Species present indicate maintenance of riparian-wetland soil moisture characteristics** No, even though cottonwood able to reach water table along portions of reach. Only obligate wetland specie was Goodding's willow. See plant list.
X			**9) Streambank vegetation is comprised of those plants or plant communities that have root masses capable of withstanding high stream flow events (*community types present*)** Yes, for deer grass, seep willow, and cottonwood, forming recognizable communities in some short sections. See plant list.
	X		**10) Riparian-wetland plants exhibit high vigor** Arrested growth form on young cottonwood which shows they are browsed every year (see photo 056). Old cottonwood vigorous. Seep willow not vigorous (yellow leaves), especially in the first half of the reach. Goodding's willow tended to be down in vigor, some have dead tops.Variation in some smaller sections, better vigor on seep willow in bottom half of reach.
	X		**11) Adequate riparian-wetland vegetative cover present to protect banks and dissipate energy during high flows (*enough*)** Percent cover is 60% or less.

	X		**12) Plant communities are an adequate source of coarse and/or large woody material (for maintenance/recovery)** Not enough cottonwood/willow/ash growing in the riparian area.

Yes	No	N/A	EROSION DEPOSITION
	X		**13) Floodplain and channel characteristics (i.e., rocks, overflow channels, coarse and/or large woody material) adequate to dissipate energy** Floods stay in over-widened channel; few obstructions to slow water velocity (see photo 047). There is little vertical structure like trees or strong shrubs adjacent to channel to capture wood during high flows so whatever wood enters the reach likely blows on through.
X			**14) Point bars are revegetating with riparian-wetland vegetation** Some bars are revegetating with seep willow, but it is a weak "yes."
	X		**15) Lateral stream movement is associated with natural sinuosity** Stream moves across active channel differently in every flow, thalweg changes with every event.
X			**16) System is vertically stable (*not downcutting*)** No downcutting observed.
	X		**17) Stream is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition)** Evidence for excessive deposition is all the bars at different heights. The interaction of soil/landform, riparian vegetation, and water is not is balance, as evidenced by the other "no" answers. More bedload stabilization and healthier seep willow/cottonwood needed to foster recovery such as that exhibited in Photo 052.

Remarks

Water was flowing into the river corridor from a tributary that gets water from artesian wells, and perhaps seepage from St. David Cienega.

There was considerable discussion about the functional rating (functional at-risk versus nonfunctional). Reach was rated as functional-at risk because all the vegetative components are present and at a stage where they could improve. As vegetation develops, the channel characteristics could also improve. It was recognized that the stream is at the lower end of the intermittent spectrum in terms of flow regime. The beginning of this reach is affected by diversion of flows from the St. David Diversion (a push up dam). This is a capability issue that is outside the control of the Bureau of Land Management. Reduced flows from the Babocamari River also may have a negative impact on function.

There was also considerable discussion about trend (not apparent or downward). Because many plants were not vigorous, the decision was to go with a downward trend (seep willow with yellow leaves, young cottonwood with arrested growth form, and some Goodding's willow with dead tops). Stromberg data is showing an increase in tamarisk. Clearly this reach needs help; the diversion and groundwater pumping may be key parts of the reason this reach is in a downward trend, but elimination of stressors such as livestock browsing and OHV use could stimulate some level of recovery with the existing condition.

Push up dam at St. David diversion stops portion of flows, particularly those below bankfull.

SUMMARY DETERMINATION

Functional Rating:
:

___ Proper Functioning Condition

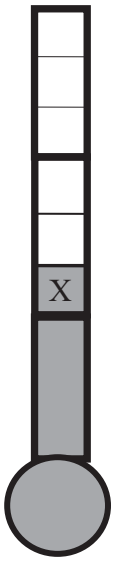
_X_ Functional - At Risk

___ Nonfunctional

___ Unknown

Trend for Functional - At Risk:

___ Upward
_X_ Downward
___ Not Apparent



PFC

FAR

NF

Are factors contributing to unacceptable conditions outside the control of the manager?

Yes _X_
No ___
St. David Irrigation Diversion

If yes, what are those factors?

_X_ Flow regulations
___ Mining activities
___ Upstream channel conditions
___ Channelization
___ Road encroachment
___ Oil field water discharge
___ Augmented flows
_X_ Other (specify) Groundwater pumping

(Revised 1998) (7/12/04)

SPRNCA Plant List for PFC Assessment

(Not a complete list of species present)

Reach J Date April 20, 2012

	Sedges/Grasses	Scientific Name	WIC	SC	AB	LOC
	Spikerush CT	*Eleocharis spp.*		H		
	Common spikerush	*Eleocharis palustris*	OBL	H		
	Parish spikerush	*Eleocharis parishii*	FACW	H		
	Beaked spikerush	*Eleocharis rosellata*	OBL	L		
	Threesquare bulrush	*Schoenoplectus americanus*	OBL	H		
	Hardstem bulrush CT	*Schoenoplectus spp.*		H		
	Hardstem bulrush	*Schoenoplectus acuta*	OBL	H		
	Baltic rush CT	*Juncus spp.*	OBL	H		
	Baltic rush	*Juncus balticus*	OBL	H		
	Arizona rush	*Juncus interior*	FAC	M		
	Torrey's rush	*Juncus torreyi*	FACW	H		
	Cattail	*Typha latafolia*	OBL	H		
	Clustered field sedge	*Carex praegracillis*	OBL	H		
X	Flat sedge	*Cyperus odoratus*	FACW+	M	1	At w
X	Johnson grass	*Sorghum halapense*	FACU+	M	4	F B
X	Bermuda grass	*Cynodon dactylon*	FACU	M	4	B F
	Barnyard grass	*Echinochloa crus-galli*	FACW	L		
X	Rabbitsfoot grass	*Polypogon monspeliensis*	FACW	L	1	A
	Smooth horsetail	*Equisetum laevigatum*	FACW	L		
	Alkali Sacaton	*Sporobolus airoides*	FAC	M		
X	Giant Sacaton	*Sporobolus wrightii*	FAC	M	4	F T
	Spike dropseed	*Sporobolus contractus*	FACU	L		
X	Sand dropseed	*Sporobolus cryptandrus*	FACU	L	1	B
X	Deer grass	*Muhlenbergia rigens*	FAC	H	1	B
	Vine Mesquite	*Panicum obtusum*	FAC	M		
	Beardless wildrye	*Leymus triticoides*	FAC	M		
	Canadian horseweed	*Conyza canadensis*	FACU	M		
X	Lehmann lovegrass	*Eragrostis lehmmaniana*			2	F
X	Spikerush, spp	*Eleocharis spp*			1	At well

	Forbs	Scientific name	WIC	SC	AB	LOC
X	Spiny aster	*Chloracantha spinosa*	FACW	H	1	B
	Curly top knotweed	*Polygonum lapathifolium*	OBL	L		
X	Sweet Clover	*Melilotus indicus*	*FACU+*	L	1	A
	Speedwell	*Veronica spp.*	OBL	L		
X	Buttercup	*Ranunculus*				At well
X	Creeping yellowcress	*Rorippa sylvestris*	OBL			At well
X	Water parsnip	*Berula erecta*	OBL			At well

	Trees/Shrubs	Scientific names	WIC	SC	AB	LOC
	Cottonwood/Goodding willow CT			H		
	Cottonwood /Mixed hardwood CT			H		
X	Freemont Cottonwood	*Populus fremontii*	FACW	H	3	B F
	Freemont Cottonwood/ Johnsongrass CT					
X	Goodding willow	*Salix gooddingii*	OBL	H	2	B
	Goodding willow/Bulrush CT			H		
	Goodding willow/ Johnsongrass CT			H		
	Coyote willow	*Salix exigua*	OBL	M		
	Yewleaf willow	*Salix taxifolia*	FACW	H		
X	Seep willow	*Baccharis salicifolia*	FACW	M	3	B A
X	Desert broom	*Baccharis sarothroides*	FACW	M	2	B
	Yerba de pasmo	*Baccharis pteronoides*				
X	Tamarisk	*Tamarix ramosissima*	FACW	H	4	F B T
X	Mexican elderberry	*Sambucus nigra*	FAC	M	1	F
	Western soapberry	*Sapindus saponaria*	UPL	M		
X	Netleaf hackberry	*Celtis reticulata*	FACU	M	2	F
	Arizona walnut	*Juglans major*	FACW	H		
X	Velvet ash	*Fraxinus velutina*	FAC +	L	2	F
	Honey locust	*Gleditsia triacanthos*	FAC	M		
	White mulberry	*Morus alba*	FAC	M		
	Texas mulberry	*Morus microphylla*	FACU	M		
	Tree tobacco	*Nicotiana glauca*	FAC	M		
X	Velvet mesquite	*Prosopis velutina*	FAC	M	4	T F
	Golden current	*Ribes aureum*	FACW	H		
X	Little-leaf sumac	*Rhus microphylla*	FACU	M	1	T F
X	Rubber rabbitbrush	*Ericameria nauseosa*	UPL	M	2	F
	Burrobrush	*Hymenoclea monogyra*	UPL	M		
X	greythorn	Ziziphus obtusifolia			1	T
X	4-wing saltbush	*Atriplex canescens*	UPL		2	T

WIC = **W**etland **I**ndicator **C**ategories, OBL = Obligate wetland; FACW = Facultative Wetland; FAC = Facultative; FACU = Facultative Upland. From Reed, P.B. 1988. National list of plant species that occur in wetlands: Southwest (Region 7). A positive (+) or negative (-) sign was used with the Facultative Indicator categories to more specifically define the regional frequency of occurrence in wetlands. The positive sign indicates a frequency toward the higher end of the category (more frequently found in wetlands), and a negative sign indicates a frequency toward the lower end of the category (less frequently found in wetlands).
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LOC = **Loc**ation(s): active channel(AC), stream bank(B), frequent floodplain(F), terrace (T).
CT = **C**ommunity **T**ype

San Pedro River Photo Sheets
SPRNCA, Reach J
Photographer: Mike Lunn, April 20, 2012

314 – Waypoint 989 - down view, multiple ages of cottonwood trees.

315 – Waypoint 990, upstream, losing most of near channel cottonwood, only seep willow/tamarisk.

316 – Waypoint 990, down view – really different from all the upstream reaches.

317 – Waypoint 991, upstream.

San Pedro River Photo Sheets
SPRNCA, Reach J
Photographer: Mike Lunn, April 20, 2012

320 – Waypoint 992 - retake of Clifford Wash 1987 photo, upstream, much more seep willow and herbaceous vegetation.

321 – Waypoint 992 - downriver, more woody vegetation than 1987 photos.

322 – Waypoint 992 - not as easy to match reference hill but close to same place as 1987 photo.

323 – Waypoint 993 - young cottonwood with mid-age and older in back left, OHV tracks throughout reach.

San Pedro River Photo Sheets
SPRNCA, Reach J
Photographer: Mike Lunn, April 20, 2012

324 – Waypoint 994 - cottonwood regeneration, tamarisk right center. Cottonwood is more bush style than tree form.

325 – Bush growth form on cottonwood trees.

328 – Retake of 1987 gas pipeline down, not quite same angle, but a floodplain does exist now where none did before.

San Pedro River Photo Sheets
SPRNCA, Reach J
Photographer: Mike Lunn, April 20, 2012

329 – Waypoint 995 - retake of 1987 gas pipeline up, fire has burned cottonwood to left of butte since 1987.

June 20, 1987 photo of pipeline, pipeline buried in past two years.

330 – Waypoint 996, upstream view.

331 – Waypoint 996, downstream view.

332 - Waypoint 996, upstream view.

333 – Downstream view.

San Pedro River Photo Sheets
SPRNCA, Reach J
Photographer: Mike Lunn, April 20, 2012

Cienega enters San Pedro from gas pipeline diversion.

336 – Waypoint 998, downstream view.

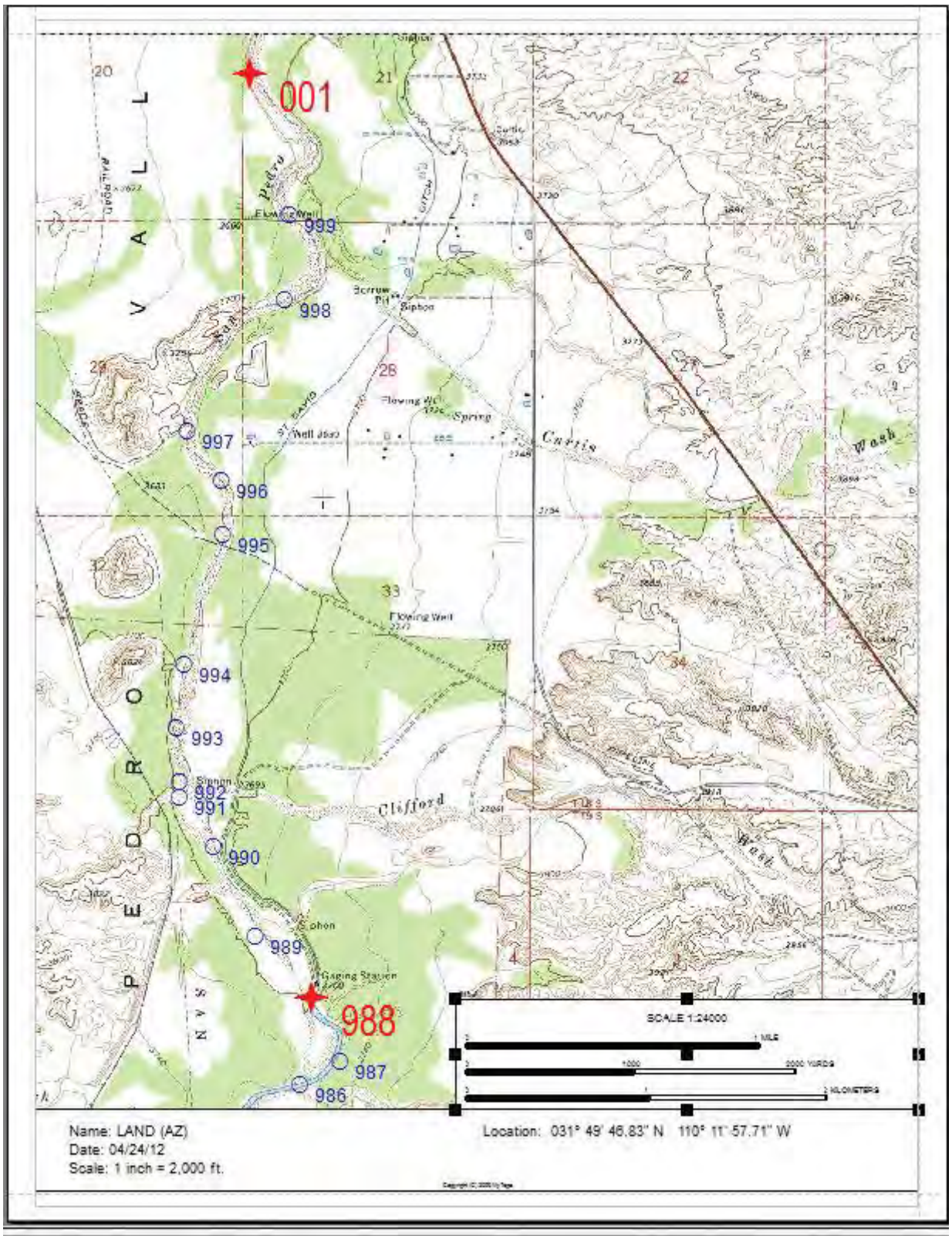
337 - Upstream at mouth of Curtis Wash.

338 - View up Curtis Wash.

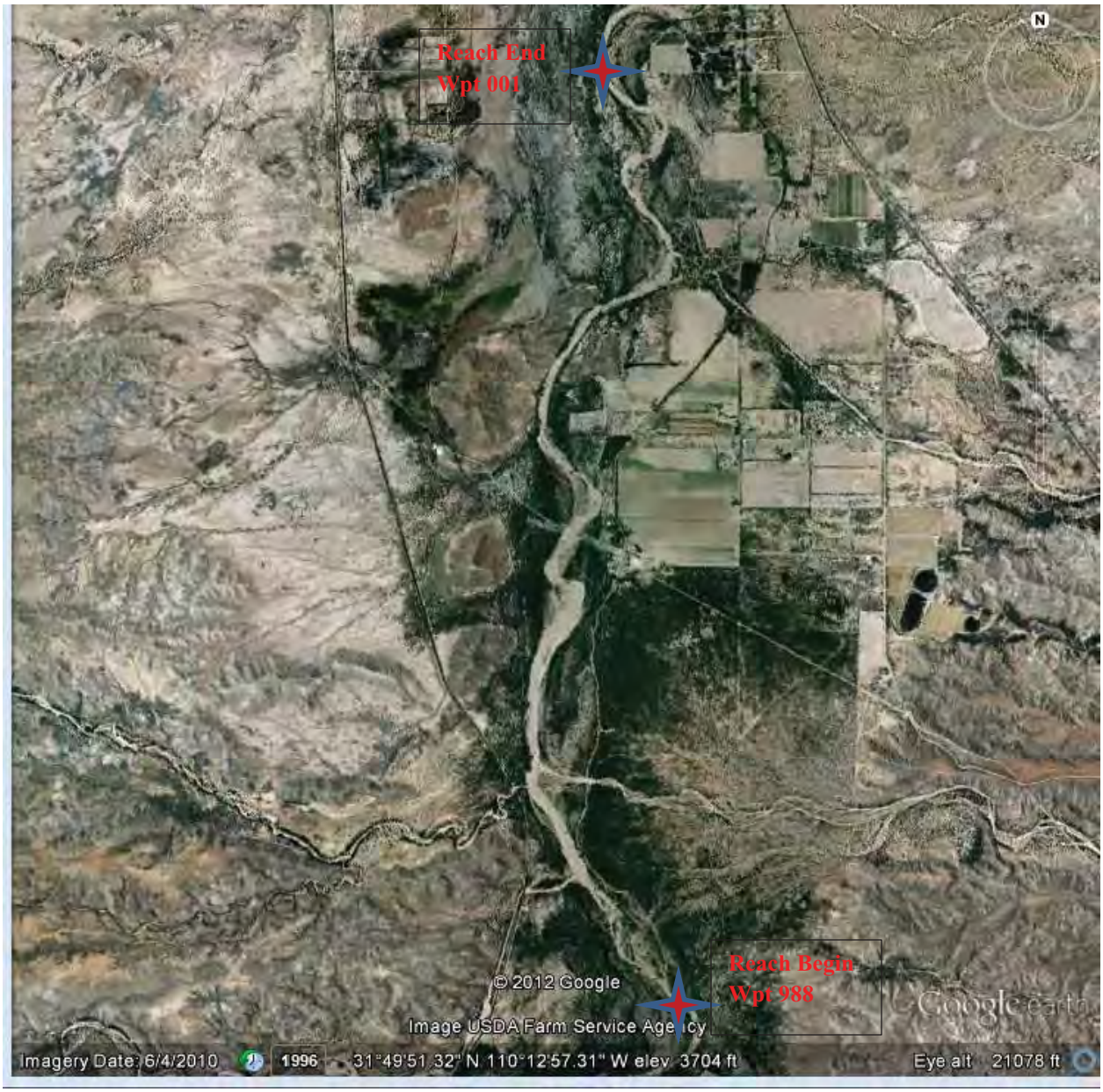
339 – Downstream from mouth of Curtis Wash.

San Pedro River Photo Sheets
SPRNCA, Reach J
Photographer: Mike Lunn, April 20, 2012

342 – Waypoint 001 – as far as we walked in this reach. The reach and SPRNCA boundaries are downstream.



SPRNCA PFC Reach J
Waypoints 988 – 001
April 20, 2012



SPRNCA PFC Reach J
Wpt 988 - 001

Clifford Wash upstream

6-20-87

6-28-04

5-27-05

7-9-08

June 20, 1987

June 28, 2004

May 27, 2005

July 9, 2008

4.20.2012

Reach H
Clifford Wash
Downstream

Reach J
San Pedro River looking upstream at pipeline crossing
(now buried)

June 20, 1987

June 23, 2004

May 27, 2005

July 28, 2008

April 20, 2012
Pipeline recently buried here, considerable disturbance downstream from location

Reach J
San Pedro River looking downstream (north) at pipeline crossing (now buried, not overhead)

June 20, 1987

June 23, 2004

May 27, 2005

July 28, 2008
Wrong date, SPR was flooding on 7/28/2008

April 20, 2012

San Pedro PFC Assessment
Waypoint Log
Reach J

988	19-APR-12 12:27:16PM	N31 48.515 W110 12.578	3717 ft	reach break, photo 312
989	20-APR-12 8:33:36AM	N31 48.699 W110 12.773	3709 ft	photos 313-314
990	20-APR-12 8:46:12AM	N31 48.965 W110 12.918	3699 ft	photos 315-316
991	20-APR-12 8:53:36AM	N31 49.113 W110 13.038	3687 ft	photos 317-319
992	20-APR-12 9:04:13AM	N31 49.157 W110 13.034	3696 ft	photos 320-322
993	20-APR-12 9:13:44AM	N31 49.320 W110 13.050	3675 ft	photo 323
994	20-APR-12 9:27:54AM	N31 49.509 W110 13.019	3685 ft	photo 324
995	20-APR-12 9:55:26AM	N31 49.896 W110 12.883	3679 ft	photo 329
996	20-APR-12 10:06:34AM	N31 50.056 W110 12.893	3688 ft	photos 330-332
997	20-APR-12 10:14:03AM	N31 50.203 W110 13.011	3662 ft	photo 334
998	20-APR-12 10:52:59AM	N31 50.591 W110 12.672	3653 ft	photo 335-336
999	20-APR-12 11:17:44AM	N31 50.848 W110 12.654	3696 ft	photos 340-341
001	20-APR-12 11:37:21AM	N31 51.265 W110 12.795	3649 ft	photo 342

We exited the river at waypoint 001 and did not see the rest of the reach on the ground. The end of reach J is downstream at SPRNCA boundary.

Appendix B – Specialist Professional Biographies

National Riparian Service Team Members and Contractors

Steve Smith is a Rangeland/Riparian Specialist and has been the Team Leader of the National Riparian Service Team since 2008. Previously, he served as the Idaho BLM Riparian and Range Ecology and Monitoring Program Lead, and as a Rangeland/Riparian Specialist on the Dixie, Black Hills, Sawtooth, and Humboldt National Forests. Steve graduated from Utah State University with a B.S. in Environmental Studies/Forestry with post-graduate studies in Ecology and Range Science. Steve's primary technical background and interest is in riparian ecology and monitoring and he is a co-author and instructor of the widely used stream monitoring protocol; Multiple Indicator Monitoring (MIM) of Stream Channels and Streamside Vegetation. Throughout his 24 year career, Steve has continuously sought out opportunities to learn, study, practice, and teach riparian concepts, and has repeatedly experienced the value of cooperative riparian restoration and management.

Janice Staats graduated from Utah State University in 1986 with a B.S. in Watershed Science. Prior to becoming the National Riparian Service Team's Hydrologist in 1996, Janice worked as a Hydrologist for the USGS Water Resources Division Albany Sub-District in New York, the White Mountain National Forest in New Hampshire, the Challis National Forest in Idaho, and the Dixie National Forest in Utah. As the NRST Hydrologist, Janice has co-authored technical references for lotic and lentic PFC Assessments and Riparian-Wetland Soils and conducted hundreds of workshops throughout the western United States, Canada, and Mexico. During her tenure on the team, she has also assessed hundreds of miles of streams and participated in numerous assistance efforts involving place-based problem solving around riparian issues.

M**ark Gonzalez** has studied and worked on stream systems for the past 30 years. Since 2012, he has been a Riparian Ecologist (Soil Scientist and Geomorphologist) with the interagency National Riparian Service Team. Prior to this, he worked as a Watershed/Soils Program Manager for the U.S. Forest Service on the Dakota Prairie National Grasslands; a Geologist with the North Dakota Geological Survey; a professor in the Geography Department at the University of Denver; and a visiting scientist with the U.S. Geological Survey in Denver, Colorado. Mark received a B.A. degree in Geology from Carleton College, Northfield, Minnesota, an M.S. degree in Geography and an M.S. degree in Land Resources from the University of Wisconsin-Madison, and a Ph.D. degree in Earth and Planetary Sciences from the University of New Mexico.

Jim Fogg is a private contractor to the National Riparian Service Team with more than 35 years professional experience in watershed hydrology and stream ecology. He received his B.S. in Environmental Biology from Bradley University and his M.S. in Watershed Science from Colorado State University. Between an early position as a consulting stream ecologist for Ecology Consultants, Inc. and more recently as president and principal investigator for Lowclouds Hydrology, Inc., Jim worked for more than 32 years as a watershed hydrologist for the Bureau of Land Management, U.S. Forest Service, and the U.S. Geological Survey where he gained extensive experience assessing hydrologic effects of mining, forestry, and grazing. Jim also served as the BLM Surface-Water Specialist for nearly 20 years where he provided agency-

wide guidance and training, as well as project management and hydrologic analysis for instream flow studies, riparian assessments, and stream restoration initiatives.

Wayne Elmore has 44 years of experience working on riparian ecosystems. He has authored or co-authored over 40 publications on the ecology, management, restoration, and policies of riparian ecosystems, and given over 600 speeches and lectures at national symposiums, workshops, universities, and meetings. His academic training includes a B.S. in Forest Management with a minor in Botany from Oklahoma State University as well as post-graduate courses in Wildlife and Fisheries Management. As a field biologist with the BLM, Wayne's pioneering work in riparian ecology and management gained him the honor of numerous awards including the Chevron National Conservation Award and the National Fish and Wildlife Foundation Chuck Yeager Award and also resulted in appointments to such efforts as the Spotted Owl Recovery Team and the State of Oregon's Independent Multidisciplinary Science Team for Salmon and Watersheds. Wayne helped develop and lead the BLM's Riparian Program throughout the early 1990's. In 1996, he founded and became the first Team Leader of the National Riparian Service Team implementing an interagency effort of the BLM, Forest Service, in partnership with the Natural Resources Conservation Service, aimed at accelerating cooperative riparian restoration and management, primarily in the western United States. Currently, Wayne is the CEO of Full Stream Consulting, Inc., continuing his work on riparian resource ecology, restoration and management.

Steve Leonard has over 35 years' experience nationally and internationally in rangeland ecology and grazing management with the private sector, the Bureau of Land Management and various interagency teams. He has published over 30 papers and references, including being a co-author for the lotic and lentic PFC Assessment, Riparian-Wetland Soils and Riparian Grazing technical references. Steve received a B.S. in Range and Forest Management from Colorado State University in 1973 and completed additional non-degree graduate studies in stream hydrology and range ecology at University of Nevada, Reno. Before retiring from the BLM, Steve was the Ecologist and Grazing Management Specialist for the National Riparian Service Team. Prior to that, he served as the Rangeland Co-Lead on the Interior Columbia Basin Science Assessment and as Range Scientist on the National Soil-Range Team participating in the development of several riparian assessment protocols. Steve was also the Utah BLM Rangeland Inventory and Monitoring Program Lead, a Range Conservationist in New Mexico and Colorado, and a Ranch Manager in Colorado. During his Federal career, Steve received the Department of Interior Honor Award for Superior Service and the Society for Range Management Outstanding Achievement Award. He is a certified Range Management Consultant and Certified Professional in Rangeland Management. Steve is currently the proprietor of Cowdance Range and Riparian Consulting.

Mike Lunn graduated from Oklahoma State University in 1968 with a B.S. in Forest Management. He has 44 years of experience confronting and resolving complex natural resource and community issues, including 12 years as Forest Supervisor on the Tongass and Siskiyou National Forests. His background includes planning, problem solving and decision making in the natural resource arena, organizational development and consensus building. Mike has been a part time member of the National Riparian Service Team since 1996, serving as a Conflict Resolution Specialist. He also contracts with associates to do interdisciplinary stream

assessments on public and private lands, as well as teach collaboration and consensus skills. From 2002 until 2011, he served as the facilitator for the Crook County Natural Resources Committee, whose charge was to provide advice on natural resource issues to the county, work to develop collaborative solutions with Federal and State agencies, and to provide education to the community on important local issues. Mike is currently proprietor of Sustainable Solutions.

BLM Gila District Interdisciplinary Team Members

Marcia Radke has a B.S. in Wildlife Ecology from University of Arizona, and an M.S. in Zoology from Eastern New Mexico University. She began working as a biologist 34 years ago conducting research on effects of grassland restoration on wildlife at the now Buenos Aires National Wildlife Refuge. Since then, Marcia has worked in five western states for state agencies such as Arizona Game and Fish at Raymond Buffalo Ranch, Washington Dept. of Fish and Wildlife in Adams and Franklin Counties as a Habitat Development Specialist, and Oregon Dept. of Forestry as a Fire Lookout near Sycan Marsh. She has worked for federal agencies including BLM in the Alturas Field Office, and U.S. Fish and Wildlife Service at the Malheur and Sonny Bono Salton Sea National Wildlife Refuges, and the Dexter National Fish Hatchery. Marcia worked for Battelle Pacific Northwest Laboratory as a Technical Specialist on the Basalt Waste Isolation Project at Hanford Nuclear Reservation, and as a consultant for British Columbia Conservation Foundation (burrowing owl), AScI Corporation (rare and candidate plant species at Ft. Irwin), University of New Mexico (lesser prairie chicken), New Mexico Share with Wildlife (barking frog), and University of Arizona (prescribed fire on Ft. Huachuca). Marcia is currently the Wildlife Biologist for BLM Tucson Field Office.

Ben Lomeli has a B.S. in Watershed Hydrology/Natural Resource Management from the University of Arizona. For the past 35 years, he has served as a Consulting Hydrologist and Natural Resources Scientist within the government and private sector. His background includes engineering, water rights, riparian ecosystems, flood control, riverine morphology, grazing systems, erosion control, site and water development, groundwater, and international issues. Ben currently serves as the Hydrologist for the BLM Tucson Field Office. He is a certified floodplain manager and sustainability teacher for Cochise College; and serves on the International Boundary Waters Commission's South East Arizona Citizen's Forum and Santa Cruz County Flood Control District Advisory Board. His previous work experience includes: middle school math and science teacher at Mexicayotl Academy; Water Resources Manager at Rick Engineering Company; Chief Hydrologist at Greg Carlson Engineering, LLC; Senior Hydrologist at Tetra Tech Engineering; Water Resources Specialist at AZ Dept. of Water Resources; Hydrologist on the Kaibab National Forest; and President of the Friends of the Santa Cruz River.

Jeff Simms earned a B.S in Fisheries Science in 1984 followed by an M.S. in Wildlife and Fisheries Science in 1987, both from the University of Arizona, Tucson. He began his career with the BLM in 1990 with appointments on the Gila and Tucson Resource Areas and at the BLM Arizona State Office. Jeff is currently the Fisheries Biologist assigned to the Tucson Field Office covering aquatic habitat and endangered species issues in the Santa Cruz, San Pedro and Gila River basins. During his career, Jeff has accomplished numerous riparian and aquatic

habitat assessment and restoration projects and participated in several reintroductions of native fish species. Recent accomplishments include working on an EIS examining the impacts of uranium mining adjacent to Grand Canyon National Park, assessing Gila topminnow population trends in Cienega Creek, research into factors limiting success of establishing new populations of frogs and fish in southern Arizona, development of a water rights strategy for the San Pedro Riparian NCA, studies to determine the upper temperature tolerance of San Pedro River fisheries, and an aquatic resource inventory through the Gila Box Riparian NCA. Throughout his career, Jeff has authored a number of papers and presentations and maintains membership in the Desert Fishes Council, American Fisheries Society, the Southwestern Association of Naturalists and the American Water Resources Association.

Heather L. Swanson graduated from the University of Arizona with a B.S. in Ecology and Evolutionary Biology. She started with the BLM as a volunteer in 2004 doing avian research. In 2007, Heather was hired as a student intern and upon graduation became a Natural Resource Specialist, her current position.

Catherine (Catie) Fenn received her Bachelor of Science from Northern Arizona University in Natural Resource Management in 1984. Over the past 33 years she has worked for the U.S. Forest Service, the National Park Service, and the BLM. In her current position she is the Outdoor Recreation Planner and National Landscape Conservation System specialist, also covering Wilderness Management, for the BLM Tucson Field Office. Over the past 16 years, Catie gained extensive experience with community-based collaborative planning processes combined with traditional government management styles while assigned to Las Cienegas National Conservation Area. Catie spent her earlier career years directly in the field as a Ranger, where duties ranged from monitoring and gathering ecological site information in riparian areas for hydrologists, biologists, and range specialists, to interpreting natural, recreational and cultural resources to the public through publications and working extensively with the public and various non-profit organizations.

Eric Baker graduated from New Mexico State University in 2008 with a B.S. in Rangeland Management. He has been directly involved with working rangelands and livestock his entire life and an interest in vegetation treatments and rangeland improvements influenced his decision to become a Rangeland Management Specialist. Eric has been with the BLM since the fall of 2008.

Appendix C – PFC Assessment Participants

Interdisciplinary Team Members

National Riparian Service Team
Steve Smith, Team Leader (Range/Riparian Specialist)
Janice Staats (Hydrologist)
Mark Gonzalez (Riparian Ecologist – Soil Scientist/Geomorphologist)
Wayne Elmore (Riparian Specialist)
Steve Leonard (Rangeland/Riparian Ecologist)
Mike Lunn (Facilitator/Conflict Management Specialist)

SPRNCA BLM Interdisciplinary Team
Marcia Radke (Wildlife Biologist)
Ben Lomeli (Hydrologist)
Jeff Simms (Fisheries Biologist)
Heather Swanson (Natural Resource Specialist)
Catherine Fenn (Recreation Planner)
Eric Baker (Range Management Specialist)

BLM Managers/Staff

Tom Dabbs (Gila District Manager)
Mary Kralovec (Assistant District Manager)
Mark Rekshynskyj (SPRNCA & La Cienegas Field Manager)
Ryan Pitts (Renewable Resources Team Leader)
Bill Wells (AZ BLM Hydrologist)

Stakeholders

Beatrice Richardson
Heidi Lauchstedt
Bob Pape
Aloah Pope
Joseph (David) Chan
Mark Levy
Dale Turner
Moira Hough
Ryan Lee
Anne Lee
Howard Buchanan
Brooke Bushman
Jerry Winslow
Leon Watson
Donald Buchanan
Mary Darling
Shar Porier
Bernard Stalmann
Marcia Devere
Ron Serviss
Berry Sneider
Diane Laush

Appendix D - Riparian Issues Prioritized by Reach

Issue	Reaches*									
	A	B	C	D	E	F	G	H	I	J
Water-Table Elevations	H	L	M	H	H	H	H	M	M	NA
Channel Evolution	L	L	L	L	NA	L	NA	L	L	NA
Tributary Sediment	H	L	L	M	L	L	L	H	L	L
Livestock	L	H	M	H	L	M	L	L	L	H
Cottonwood Trees	L	L	L	L	L	L	L	H	L	H
Tamarisk	H	H	H	H	H	H	H	M	M	L
Fire and Fuels	H	H	H	H	M	H	H	H	H	L
Beaver	H	H	H	H	H	M	L	NA	L	NA
Off-Highway Vehicles	H	L	L	M	H	H	L	L	H	H
Foot Trails	M	M	M	L	M	L	M	L	M	L
Railroad Bed	L	L	H	L	M	M	L	L	H	L
Agricultural Dikes	M	M	M	NA	NA	NA	NA	NA	NA	NA
*Priority ratings: H = highest priority; M = medium; L = lowest; NA = not applicable.										

Water-Table Elevations: The potential for reach A is perennial flow; however, parts of the reach are seasonally dry. Therefore, restoration of perennial flow should be a management priority, which will be partially dependent on activities in Mexico, and may be beyond management control. Reaches B through C receive discharge from the regional aquifer and are currently best insulated from water-table decline. Groundwater modeling (Lacher 2011) has projected that reaches D through G will be most affected by the cone of depression created by groundwater pumping in the Sierra Vista subwatershed and along the Babocomari River. Reach J is downstream of the St. David diversion, and the diversion is outside of BLM Manager's direct control.

Channel Evolution: Though some have suggested the use of induced meanders to accelerate restoration, Zeedyk and Van Clothier (2009) point out that induced meanders are "…*for the treatment of incised channels only*" (Zeedyk and Van Clothier 2009:81). Since the San Pedro River is no longer incising, it is not recommended to do induced meandering in reaches displayed as lowest priority. Reaches E and G are displayed as NA priority because they are predominantly transport reaches and partially controlled by bedrock. Reach J is displayed as NA priority because it is compromised by diversion of surface water, so there is no point to managing for channel evolution there. Reach C has two fences that were constructed on the streambank, probably to protect the railroad bed. The fence across from Garden Wash is still intact and on the streambank (photo 132), the one farther downstream is now in the channel due to bank erosion (photo 156). There were varied opinions whether pulling them out would cause more harm than good.

Tributary Sediment: Agricultural dikes and channel straightening/repositioning have severed the connection between the San Pedro River and its tributaries in reach A. Consequently, it appears sediment is not being processed properly in the middle segment of reach A. Sediment contributed by tributaries in reach D and Willow Wash in reach H is voluminous and coarse-textured. It is having an adverse effect on channel evolution and establishment of riparian vegetation. An analysis of upland conditions and sediment sources in the those tributary drain basins will help determine whether the amount of sediment being delivered to the San Pedro River is natural or has been accelerated.

Livestock: Impacts to riparian vegetation from trespass grazing are most evident and have had the greatest effect on preventing recovery in reach J. The land-ownership patterns make reaches B and D highly vulnerable to trespass grazing too, and reach C to a slightly lesser degree.

Cottonwood Trees: Some cottonwood trees are showing signs of stress in reach H (dead tops). Groundwater data are necessary to determine the cause so the appropriate management actions can be identified. Recruitment of cottonwood trees is failing in reach J because of browsing from trespass

livestock. In many reaches, cottonwood trees are at or near maximum stocking, so the management concern is taking care of existing cottonwood trees. Fires have locally reduced the extent of some cottonwood galleries in reach B, but recruitment of new cottonwoods is unlikely in this reach given the low rates of channel meandering and the extensive stands of sacaton and Johnson grass.

Tamarisk: Tamarisk invasion is generally greatest in the northern reaches and decreases upstream. The current management plan expends the greatest effort on tamarisk in the southern (upstream) reaches and recognizes the increased cost, diminished opportunities for success, and overwhelming existing populations of tamarisk in downstream reaches. The existing tamarisk treatment plan is well thought out and should be continued.

Fire/Fuels: The sacaton/mesquite community is the potential natural community on much of the pre-entrenchment terrace along the San Pedro River. Sacaton dominates when and where there is a near natural fire regime; mesquite dominates when and where fire suppression reduces the amount of land burned and frequency of burns. Mesquite has the capacity to affect riparian areas by tapping into a shallow aquifer and using large quantities of groundwater. Prescribed fire could be advantageous near many of the lower reaches (G through J) where mesquite have invaded at the expense of other woody trees and shrubs and/or sacaton. Treatment should be focused on creating a natural, shifting mosaic of mesquite on the landscape while reducing its spread and density on sites where sacaton would dominate under a natural fire regime. Wildfire and the mesquite/sacaton fuel levels pose a threat to cottonwood trees and private property. The cottonwood stands are best developed in reaches A through D, and then generally decline in spatial extent and abundance in lower reaches. The district should continue its planning efforts to develop an integrated wildfire/prescribed fire management plan.

Beaver: The best beaver habitat is tied to the most reliable instream flows, which occur in reaches B through E, and has the potential to develop throughout reach A. Seasonally dry reaches (H and J) offer no viable beaver habitat.

Off-Highway Vehicle Traffic: Unauthorized off-highway vehicle traffic within the channel and floodplain has created localized alteration of stream banks, trampled and destroyed riparian vegetation, and increased channel erosion. This traffic is most pronounced in reach A near the international border; reach D near the private property around Escapule; and reaches E and J where there are numerous access points for off-highway vehicle entry into the riparian area.

Foot Trails: Unregulated foot traffic, from recreationalists and illegal immigrants along the banks of the San Pedro River compacts soil, tramples vegetation, and decreases bank stability. These problems are most evident in reach B near the San Pedro House, reach C, and reach G near Fairbank; however, evidence of pedestrian trampling was observed in every reach.

Railroad Bed: Slag should be prevented from entering the river. There are only a few places where slag is likely to enter the river and these sites are given the highest priority. The railroad bed is near the river in reaches C, E, F and I. Beyond riparian issues, railroad bed management is given a moderate priority because of safety issues related to maintenance, especially of bridges, culverts, and trestles.

Agricultural Dikes: Agricultural fields and dikes are common along reaches A, B, and C and even in these reaches, management of agricultural dikes would be secondary to other management activities; therefore treatment of dikes would likely not rate higher than medium priority.

Appendix E - Plants by Reach (SPRNCA PFC Assessment, April 2012)

				REACH A		REACH B		REACH C		REACH D		REACH E		REACH F		REACH G		REACH H		REACH I		REACH J	
Common Name	**Scientific Name**	**WIC**	**SC**	**AB**	**LOC**	**AB**	**LOC**	**AB**	**LOC**	**AB**	**LOC**	**AB**	**LOC**	**AB**	**LOC**	**AB**	**LOC**	**AB**	**LOC**	**AB**	**LOC**	**AB**	**LOC**
Sedges/Grasses																							
Spikerush CT	*Eleocharis spp.*		H			2	A	2	A														
Common spikerush	*Eleocharis palustris*	OBL	H	1	A C			1	A					1	A	2	A			1	A		
Parish spikerush	*Eleocharis parishii*	FACW	H	1	A C																		
Beaked spikerush	*Eleocharis rosellata*	OBL	L																				
Threesquare bulrush	*Schoenoplectus americanus*	OBL	H							2	A									1	A		
Hardstem bulrush CT	*Schoenoplectus spp.*		H	2	A	3	A B	4	A														
Hardstem bulrush	*Schoenoplectus acuta*	OBL	H	2	A	3	A B	4	A	3	A	4	A B	3	A B	3	A			2	A B		
Baltic rush CT	*Juncus spp.*	OBL	H	1	A																		
Baltic rush	*Juncus balticus*	OBL	H	2	A	2	A B	2	A			2	A	2	B A	2	A			2	A		
Arizona rush	*Juncus interior*	FAC	M																				
Torrey's rush	*Juncus torreyi*	FACW	H	1	A	1	A	1	A			2	A	1	B	2	A						
Cattail	*Typha latifolia*	OBL	H			1	A	1	A			1	A										
Clustered field sedge	*Carex praegracilis*	OBL	H																				
Flat sedge	*Cyperus odoratus*	FACW+	M									4	F B									1	well
Johnson grass	*Sorghum halepense*	FACU+	M	4	F B	4	B F T	4	B F A	4	B F	4	F B	4	F	4	F B	4	F	4	F B	4	F B
Bermuda grass	*Cynodon dactylon*	FACU	M	4	F B	4	B F T			4	B F	4	A	4	F	4	B F	4	B F	4	B F	4	B F
Barnyard grass	*Echinochloa crus-galli*	FACW	L	4	A C			4	A					1	B								
Rabbitsfoot grass	*Polypogon monspeliensis*	FACW	L	3	A C	4	A	4	A	4	B			2	A B	3	A	3	A	2	A	1	A
Smooth horsetail	*Equisetum laevigatum*	FACW	L	2	B	2	B A	4	A B	2	A	3	A B	3	A B					2	B A		
Alkali Sacaton	*Sporobolus airoides*	FAC	M																				
Giant Sacaton	*Sporobolus wrightii*	FAC	M	4	F T B	4	T F B	4	F B A	4	F B	4	F T	4	F	4	F T	4	F T	4	F T	4	F T
Common Name	**Scientific Name**	**WIC**	**SC**	**AB**	**LOC**	**AB**	**LOC**	**AB**	**LOC**	**AB**	**LOC**	**AB**	**LOC**	**AB**	**LOC**	**AB**	**LOC**	**AB**	**LOC**	**AB**	**LOC**	**AB**	**LOC**
Spike dropseed	*Sporobolus contractus*	FACU	L													1	F						
Sand dropseed	*Sporobolus cryptandrus*	FACU	L																			1	B
Deer grass	*Muhlenbergia rigens*	FAC	H	2	A	2	B	2	B			2	B	2	B	2	B		B A	4	B	1	B
Vine Mesquite	*Panicum obtusum*	FAC	M	1	F																		
Beardless wildrye	*Leymus triticoides*	FAC	M	2	B					2	F			2	B								
Plains bristlegrass	*Setaria vulpiseta*											1	F			1	F A						
Canadian horseweed	*Conyza canadensis*	FACU	M	1	A B															1	A		
threeawn	*Aristida purpurea*													1	F	1	F						
Sideoats grama	*Bouteloua curtipendula*													2	F								
Knotgrass	*Paspalum distichum*																						
Lehman lovegrass	*Eragrostis lehmanniana*	UPL	-		F					1	1	1	F			1	F A			2	F A	2	F

				REACH A		REACH B		REACH C		REACH D		REACH E		REACH F		REACH G		REACH H		REACH I		REACH J	
Common Name	**Scientific Name**	**WIC**	**SC**	**AB**	**LOC**	**AB**	**LOC**	**AB**	**LOC**	**AB**	**LOC**	**AB**	**LOC**	**AB**	**LOC**	**AB**	**LOC**	**AB**	**LOC**	**AB**	**LOC**	**AB**	**LOC**
Cane beardgrass	*Bothriochloa barbinodis*													2	F	1	F						
Canadian wildrye	*Elymus canadensis*	FACU	L			1		2	B F	2	F												
spikerush	*Eleocharis spp.*							1	A	2	A					1	A						
sand spikerush	*Eleocharis montevidensis*	OBL	M					2	A									1	A	1	A		
Forbs																							
Spiny aster	*Chloracantha spinosa*	FACW	H	2	B			2/3	F	2	F	2	F T			2	F					1	B
Curly top knotweed	*Polygonum lapathifolium*	OBL	L	L	A											2	B A						
Sweet Clover	*Melilotus indicus*	*FACU+*	L	3	A B	3	A B	2	A B	3	B	3	B	3	B			2	A	2	A B	1	A
Speedwell	Veronica spp.	OBL	L	2	A				A	1	A	2	A	2	A	1	B						
Buttercup	*Ranunculus, spp.*	OBL	L	1	A																		
Monkeyflower	*Mimulus, Spp*	OBL	L	1	A							1	A										
Huachuca Water umbel	*Lilaeopsis schaffneriana*	OBL	L	1	A																		
Thurbers Sneezeweed	*Helenium thurberi*	OBL	L	1	A									2	B	1	B			2	B		
Thurbers Pepperweed	*Lepedium thurberi*	OBL	L	1	A									2	B								
Muskgrass	*Chara sp*											3	A										
Creeping yellowcress	*Rorripa sylvestris*	OBL	L								A	2	A	1	A								
alfalfa	*Medicago sativa*													1	A								
prickly poppy	*Argemone pleiacantha*	UPL																					
Trees/Shrubs																							
Cottonwood/Goodding willow CT			H	4	B	2	B F	4	F	4	B	4	B	4	B	4	B			3	B		
Cottonwood /Mixed hardwood CT			H			1	F	1	F					1	F								
Freemont Cottonwood	*Populus fremontii*	FACW	H	4	B F	2	B F	4	B F	4	B F	4	B	4	B F	4	B	3	B	4	B F	3	B F
Freemont Cottonwood/ Johnsongrass CT						2	F	3	B F	3	B F			2	B F								
Goodding willow	*Salix gooddingii*	OBL	H	4	B F	1	B F	3	B F	4	B			4	B	4	B	3	B	3	B	2	B
Common Name	**Scientific Name**	**WIC**	**SC**	**AB**	**LOC**	**AB**	**LOC**	**AB**	**LOC**	**AB**	**LOC**	**AB**	**LOC**	**AB**	**LOC**	**AB**	**LOC**	**AB**	**LOC**	**AB**	**LOC**	**AB**	**LOC**
Goodding willow/Bulrush CT			H			2	B F																
Goodding willow/ Johnsongrass CT			H			3	F																
Coyote willow	*Salix exigua*	OBL	M	2	F	2	F																
Yewleaf willow	*Salix taxifolia*	FACW	H			1	A																
Seep willow	*Baccharis salicifolia*	FACW	M	3	B	3	B	4	A B F	4	B A	4	B A	4	B A	4	B A	4	B	4	B A	3	B A
Desert broom	*Baccharis sarothroides*	FACW	M									1	F							1	F	2	B

				REACH A		REACH B		REACH C		REACH D		REACH E		REACH F		REACH G		REACH H		REACH I		REACH J	
Common Name	**Scientific Name**	**WIC**	**SC**	**AB**	**LOC**	**AB**	**LOC**	**AB**	**LOC**	**AB**	**LOC**	**AB**	**LOC**	**AB**	**LOC**	**AB**	**LOC**	**AB**	**LOC**	**AB**	**LOC**	**AB**	**LOC**
Yerba de pasmo	*Baccharis pteronoides*																						
Tamarisk	*Tamarix ramosissima*	FACW	H			2	F B	1	F	2	F	1	F	2	F	4	B F	3	F B	4	F B	4	F B T
Mexican elderberry	*Sambucus nigra*	FAC	M	2	F																	1	F
Western soapberry	*Sapindus saponaria*	UPL	M	1	F																		
Netleaf hackberry	*Celtis reticulata*	FACU	M	1	F	2	F	2	F	2	F	1	F	2	F			2	F	2	F	2	F
Arizona walnut	*Juglans major*	FACW	H	2	B F	1	F	1	F			1	B					2	F				
Velvet ash	*Fraxinus velutina*	FAC +	L	2	B F	1	F	1	F	1	F	1	F			1	F	2	F B	2	F	2	F
Honey locust	*Gleditsia triacanthos*	FAC	M																				
White mulberry	*Morus alba*	FAC	M																				
Texas mulberry	*Morus microphylla*	FACU	M													1	F						
Tree tobacco	*Nicotiana glauca*	FAC	M																				
Velvet mesquite	*Prosopis velutina*	FAC	M	4	F T	2	F T	2/3	F	4	F		F T	4	T F	4	T F	4	T F	4	T F	4	T F
Golden current	*Ribes aureum*	FACW	H																				
Little-leaf sumac	*Rhus microphylla*	FACU	M	2	B F			1	F									1	F			1	T F
Rubber rabbitbrush	*Ericameria nauseosa*	UPL	M	1	B	2	F	2	F	3	F			3	F	2	F	2	F	3	F	2	F
Pale wolfberry	*Lycium pallidum*	UPL	M			1	T																
Brickelbush	Brickellia spp.													2	F								
Burrobrush	*Hymenoclea monogyra*	UPL	M			1	F	1	F	2	F	2	F	3	F	2	F	2	F	2	F		
Greythorn	*Ziziphus obtusifolia*																					1	T
4-winged salt bush	*Atriplex canescens*															1	B			3	T	2	T

CT = community type

WIC = Wetland Indicator Categories: OBL=obligate wetland, FACW = facultative wetland, FAC=facultative, FACU= facultative upland. From Reed, P.B. 1988. National list of plant

SC = Stability class: low (L), moderate (M), high (H), adapted from Burton, T.A, S.J. Smith, and E.R. Cowley. 2011. Riparian area management: multiple indicator monitoring (MIM) of

AB = Abundance (1-4). 1=present but with only 1 to a few individuals; 2=found occasionally; 3=common; 4=abundant.

LOC = Location(s): A=active channel, B=bankfull, F=frequent floodplain, T=terrace.

Appendix F – Frequently Asked Questions and Answers

1. What good is a Proper Functioning Condition assessment of the San Pedro River that doesn't account for loss of water from groundwater pumping?

The PFC assessment is designed to assess the current condition of the San Pedro River compared to what it could be under natural conditions (potential), unaffected by human activities, in the present climate. The potential descriptions (Fogg et al. 2012) do not account for loss of water from groundwater pumping because it is a human activity. During the PFC assessment, no clear evidence was observed that would substantiate a determination of significant impacts to the riparian vegetation or the condition of the channel from groundwater decline. Impacts associated with a declining water table would be reflected in the vegetation. While there were a few short segments within a few reaches dominated by low vigor cottonwood trees, Goodding's willow, or seep willow, a clear causal link could not be made because stress to those plants could have been from other causes.

Although the PFC assessment found little evidence that current riparian conditions are being negatively affected by groundwater depletion to date; it is well known that the effects to vegetation and channel conditions will lag behind reduced flows. If, or once, groundwater recharge to the San Pedro River is lost, the impacts will likely be irreversible.

The fact that 72% of the river was determined to be in PFC or FAR with an upward trend is evidence that the system has the attributes and processes in place to further improve. However, the groundwater pumping deficit issue must be addressed now while the river still has the ability to take advantage of the water it receives from both surface and groundwater flows for system recovery

It is widely recognized that one possible future outcome is that the river will dry up if the community and State fail to act to maintain the groundwater supply to the river over time; however, it is also possible that actions will be taken that keep the river flowing and healthy as Congress intended in the designation of the SPRNCA. Although the PFC assessment does not speak to the groundwater issue, it does provide pertinent information to the BLM and public about management and monitoring needs that will be important in the upcoming revision of the SPRNCA management plan.

2. Why does the PFC assessment process emphasize physical function and not biological elements such as fish habitat, water temperature, and other important values?

When looking at stream condition it is necessary to consider both the physical condition and the biological condition and their interactions. However, underlying both of these is the physical function of streams and the PFC assessment provides an analysis of the foundation upon which aquatic systems are formed and sustained. Although the PFC assessment doesn't directly assess habitat components or complexity, it does assess functions that produce habitat components through observation of a number of critical physical attributes and processes. By searching out and considering the factors that drive physical function, valuable clues are revealed about limiting factors and what may be causing any unacceptable conditions of concern.

The San Pedro River downcut more than 100 years ago and major changes in the channel and floodplains have occurred over time. For channels to obtain stability after disturbance they must undergo adjustments to once again come into balance with larger scale watershed processes. This involves streambank and floodplain rebuilding as well as changes in sinuosity and gradient, to name a few of these major processes. As this occurs, the stream will experience cycles of channel narrowing during periods of low flows and low sediment input, i.e., the absence of stream altering storm events, followed by significant sediment deposition during stream building events. These later events result in building up of the stream channel and associated floodplain which in turn causes widening of the stream. The result is an apparent negative trend in width-depth ratio. However, if proper management continues, sediment deposits will vegetate and stream narrowing will resume. These cycles repeat until the stream once again has established a channel and floodplain adequate to handle the streamflows and bedload produced by the larger scale watershed processes. Only after the stream channel has stabilized can the channel morphology and aquatic habitat be expected to begin to exhibit characteristics that indicate measurable improvement.

With the current condition of the river, a number of reaches were rated at PFC which indicates that the channel and vegetation will largely be maintained even during periods of moderately high flood flows. This is one level of sustainability; continuing improvement beyond PFC will enable the stream to develop and maintain habitat features such as pools and riffles, overhanging cover and other important characteristics. As the river deepens and narrows where it can, and builds floodplain areas that absorb high water and slowly release the water during dry periods, instream flows may be increased and water temperatures decreased. But these values are not sustainable until the river is able to manage the physics of flowing water and sediment at different levels, without major alterations to the channel, vegetation and floodplain.

While the assessment does look at beaver dams in particular, it is because of their role as hydrologic modifiers. Beaver dams play a significant role along many sections of the San Pedro River in terms of creating areas of ponded water that enhance bank storage which is slowly released during the low flow season, and facilitating vegetative diversity and productivity.

3. The PFC assessment method is a qualitative approach that many believe is subjective; why wasn't a more science-based or quantitative approach used to assess the San Pedro River?

As is the case with any course of study, different approaches come with their own set of costs and benefits. Qualitative approaches are not necessarily better or worse than quantitative ones; one is more appropriate than the other depending upon the study purpose. In this case, a decision was made to use the PFC assessment method because: (1) it is the designated method for complying with BLM Land Heath Standards concerning riparian condition, (2) it provided the opportunity to walk, observe, and discuss the entire stretch of river with an interdisciplinary team, and (3) it included the opportunity with interested stakeholders to foster awareness and learning. While the PFC assessment is qualitative, it is also science based. PFC assessment was developed to meet the need for a rapid assessment and prioritization tool. When incorporated

into an integrated riparian management process, PFC assessment results inform the collection of quantitative information critical to determining baseline conditions and monitoring future trends.

The use of a PFC assessment is similar to the type of approach undertaken by medical practitioners. First, it requires the use of highly knowledgeable and experienced practitioners who are able to interpret visual indicators in the field because of their extensive history measuring those same indicators. When you go to the doctor because you are sick, they do not usually begin the visit by ordering numerous and intensive tests. Rather, they might take your temperature, ask about pain, and look for obvious signs of distress. Then a course of action ranging from further tests to recommendations for treatment is provided by the physician based on knowledge and experience.

4. Congress directed the BLM to manage the SPRNCA in a way that *"conserves, protects, and enhances the riparian area…"* and other named resources. How will the public know that the BLM is accomplishing that direction?

After 25 years, the overall activities[1] associated with the PFC assessment demonstrate that significant improvement in the condition of the river and riparian areas has occurred under BLM management. The upcoming revision of the management plan for the SPRNCA will compare the current conditions of the river and riparian areas with the desired conditions. A range of management alternatives will be established and analysis performed to determine the costs and benefits ecologically, socially and economically of each. A final decision will be made by the BLM manager and a plan, including management objectives for the SPRNCA, will be implemented. It is through a program of systematic monitoring that both the agency and the public will know if the objectives set forth in the RMP and the Congressional intent are being met. The NRST views monitoring as critical and recommends establishment of a Monitoring Coordinator to focus solely on this effort and creating a focused strategy that will include stakeholder involvement.

5. Cottonwood trees are a big user of water, as are other plants. Wouldn't it be better to remove a lot of the cottonwood trees so the water could stay in the river?

While cottonwood trees do transpire a lot of water (Leenhouts 2006), the trees provide structural integrity to the building and holding of the banks and floodplains that are essential to the health of the river. When alive, their strong roots anchor the floodplain, capturing sediments and organic materials that provide the foundation for recovery. When they die, they often are incorporated into the floodplain or channel, still providing structure and adding organic materials that help store more water and develop channel and floodplain characteristics. One could compare the importance of cottonwood along the riverbank to the need for rebar in cement or studs in walls for strength. All streams do not need large wood to function properly, but the San Pedro River definitely does.

After viewing the entire San Pedro River through the SPRNCA, the NRST believes the cottonwood trees to be an integral part of a healthy river, and recommends that any management

[1] Those activities include the technical meeting in July, 2011 that brought forth the known science about the river, followed by development of the Potential document (Fogg et al. 2012), the field assessment and this report.

strategy employed allow for the protection of cottonwood and large woody material. It is expected that cottonwood galleries on post-entrenchment terraces will decrease in extent naturally as trees age and die, and sacaton will dominate those sites. Closer to the existing channel, the floodplain continues to provide sites suitable for cottonwood trees to become established, albeit in a narrower band.

6. Detention basins are proposed for some areas to help recharge water into the regional or alluvial aquifer; are these good for the river?

This is a question that is not easily answered. The Upper San Pedro Partnership is looking for solutions to the groundwater deficit, and capturing surface runoff from uplands in a recharge basin and building dams in tributary channels are alternatives being studied and debated. While the NRST does not have a definitive answer, the team suggests that structures that capture runoff from impervious surfaces such as roads, parking lots, roofs, etc. are less problematic than structures that block drainages close to the river. A balance of both water and sediment coming into the river from upstream and tributaries is critical to the continuing recovery of the San Pedro River. Sediment is captured and held in place by riparian vegetation and large woody material, building up the floodplain, building streambanks, and over time improving the health of the riparian area. To lessen the possibility of unintended consequences, use the best science available when considering structures that would block tributaries close to the river so the potential alteration of sediment inputs is given complete analysis prior to locating and building structures.

7. Did the assessments provide any information about where augmented water supplies to the river would make important differences?

Additional water in reach A could accelerate recovery of the needed vegetation characteristics. Reach A, beginning at the international border, was identified as having the potential to become perennial over time, and to support the vegetation communities typical of the other perennial reaches. Currently major sections go dry. The team found that the vegetation species mix in reach A is similar to that in the downstream perennial reach, but isn't nearly as widespread nor as abundant throughout the reach. Cottonwood has provided the foundation, but large increases in the amount of seep willow and hardstem bulrush along with other woody and herbaceous vegetation are needed to improve channel characteristics and processing of sediments.

Additional water in reaches B through E could extend perennial flow further downstream in reach F. In reach F, streamflow permanence at potential is expected to transition from perennial to intermittent, since basement rock that forced groundwater to the surface in the Charleston Hills drops off to great depth north of the Hills. Important contributions of water are made by delivery from upstream reaches as well as groundwater, and as floodplain storage increases higher in the system, it is believed that more of reach F will remain wetted throughout the year.

A third location would be the Babocomari River. Lacher 2011 model results show ground-water pumping has already reduced baseflows in that stream. Providing additional recharge water to the Babocomari River might also positively influence the water in the San Pedro River.