

San Simon Watershed Assessment and Restoration Plan

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Abstract

This paper describes a partnership of the Bureau of Land Management (BLM), the Bureau of Reclamation (Reclamation), the University of Arizona, and the Arizona Department of Water Resources (DWR). The partnership is assessing and restoring the San Simon watershed, a sub-basin in the Upper Gila River Watershed. EPA selected that watershed as one of 12 Clean Water Action Plan Showcase Watersheds.

The San Simon River incised early in the 20th century. Primary land uses within the San Simon Watershed include recreation, a designated OHV use area, farming, and livestock grazing. BLM installed grade control structures on the San Simon River and tributaries, beginning in the 1930s. The purpose of the grade control was to halt channel incision and degradation of the watershed land resources. In all, there are 19 major detention dams, several dikes, and earth structures. They all require assessment to determine effectiveness and condition for repair/maintenance. The Safford Field Office proposes to complete an assessment of the San Simon River watershed as a prerequisite to a community-based planning effort setting the future direction and management of the watershed.

The assessment will answer three questions:

1. Are the existing grade control structures effective?
 - a) Are the structures hydraulically and geomorphically effective?
 - b) Is maintenance of the existing structures cost-effective?

2. Would additional grade control structures hasten the restoration of the river and tributary channels, and aid in the recovery of the watershed?
3. How does the Resources Inventory and Assessment of the uplands and the San Simon channel depend upon the grade control structures?

Keywords: watershed, restoration, incision, fluvial geomorphology, resource inventory

Introduction

In 2001, the BLM Safford Field Office, in conjunction with the San Carlos/Safford/Duncan Watershed Group (SSD), began a four year community-based watershed evaluation and plan for the San Simon River and watershed. Figure 1 shows the location of the San Simon watershed in southeastern Arizona. There are some anecdotal signs of resource improvement on the San Simon. However, there is uncertainty surrounding the rate of improvement. The purpose of this planning effort is to determine the overall effectiveness of the restoration work done on the San Simon over the past 70 plus years, and where to focus future restoration efforts.

Preliminary plans are for the Bureau of Reclamation to conduct a fluvial geomorphology study of the San Simon River corridor. This study will determine if the San Simon has achieved a new dynamic equilibrium. The study will also focus on causation in areas that continue to erode. The fluvial geomorphology study is an extension of a larger effort on the Upper Gila Watershed by Reclamation and the SSD. The SSD, in cooperation with the Bureau of Reclamation, is currently conducting a fluvial geomorphology study of the main stem of the Gila River, to which the San Simon is a major tributary.

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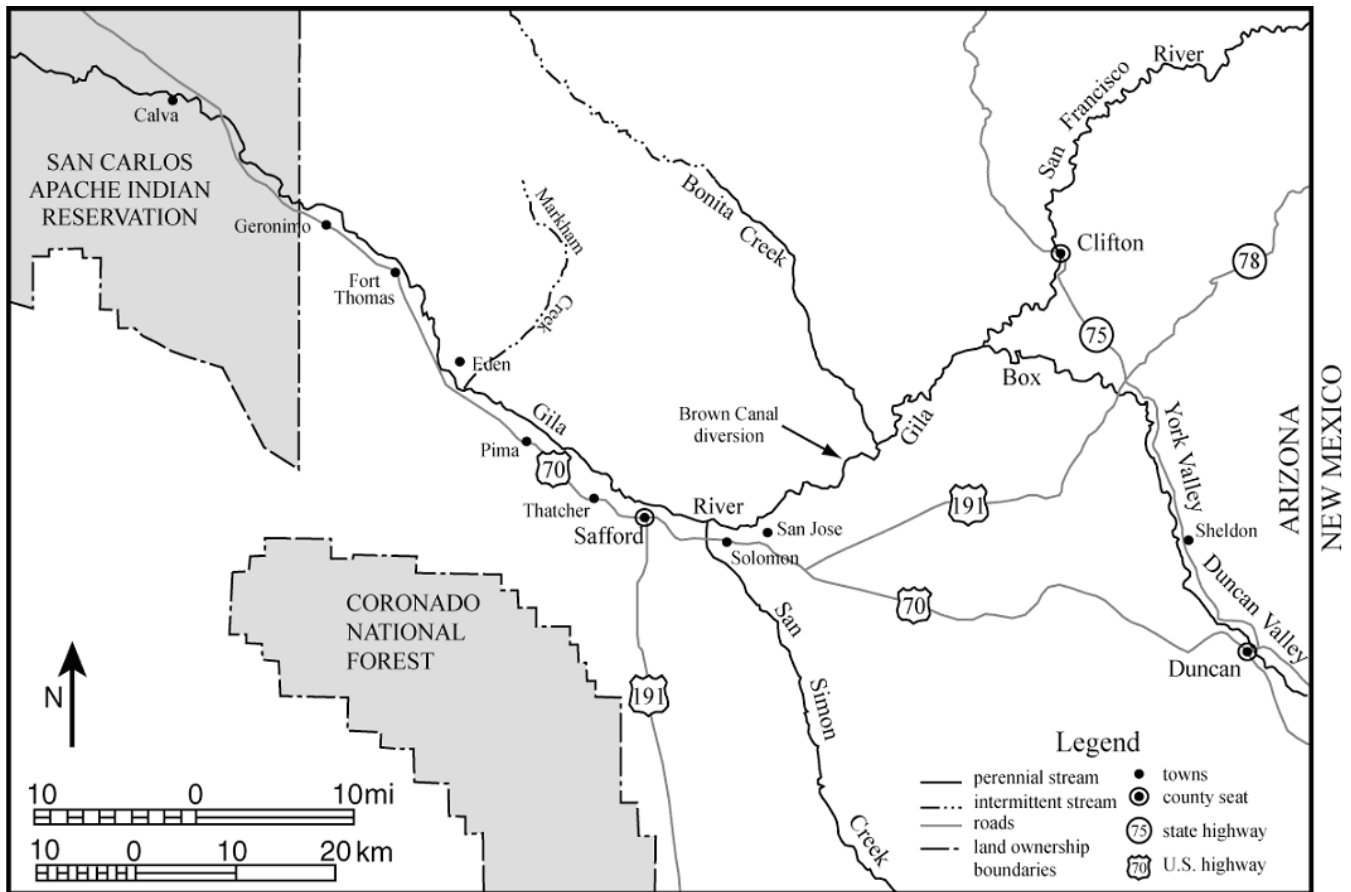


Figure 1. Location map of San Simon Creek (River).

Upon completion of the initial resource evaluation, the partners will develop a community-based plan that will present recommendations for future restoration actions on the San Simon. Actions could be: to do no more work, maintenance of existing structure, abandonment of some existing structures, construction of additional structures(which have been proposed in previous plans, but not constructed), increase effort on small scale erosion control work on the upper watershed.

Project Description

The Upper Gila River Watershed in Arizona is one of the most important watersheds in the nation. The Environmental Protection Agency identified the watershed as one of 12 showcase watersheds under the Clean Water Action Plan. The San Simon is a sub-watershed, part of the Upper Gila River Watershed. The San Carlos/Safford/Duncan Watershed Group (SSD) identifies the San Simon as an important component of the causative factors on the mainstem Gila River below Solomon, Arizona. In FY 2001, the BLM determined that the San

Simon watershed is one of the top ten watersheds in need of restoration.

The BLM Safford Field Office (SFO) administers about 750,000 acres in the watershed. Primary land uses within the San Simon Watershed include; Recreation, a Designated Off-Highway-Vehicle use area, farming and livestock grazing. The primary objective of the management is to improve water quality by decreasing San Simon watershed silt load and salt load into the Gila River. There is a present need to evaluate past restoration work, to determine its effectiveness, and to evaluate resource conditions of the San Simon. A detailed resource inventory and assessment will form the basis of future planning efforts.

The San Simon River was incised early in the 20th century. In an attempt to stop this incision, slow sediment delivery, and restore the river channel, BLM installed grade control structures on the San Simon River and its tributaries. This was a multi million-dollar effort. The structures are numerous, including at least 19 major detention dams, several

dikes, and several earth structures, totaling miles in length. With age, these now require assessment to determine effectiveness and condition of the structure for repair/maintenance. Determining the effectiveness of the watershed restoration efforts in the past 70 years on the San Simon is critical to any future planning effort. The Safford Field Office proposes to complete an entire assessment of the San Simon River watershed as a prerequisite to a community-based planning effort that would set the direction for management of the watershed in the future. The three phases of the assessment are detailed in the following sections.

Phase I: Geomorphic and engineering analysis of the San Simon River and tributaries

There are four primary tasks necessary to complete Phase I of the assessment. The following list summarizes the major tasks:

- Task 1 – Mapping
- Task 2 – Catalog of Historical Changes
- Task 3 – Geomorphic and Engineering Analysis of Channel
- Task 4 – Channel Assessment Including Structures and Predictive Qualitative Model

The purpose of the four primary tasks is to answer these fundamental questions:

1. Are the existing grade control structures effective?
 - a) Are the structures hydraulically and geomorphically effective?
 - b) Based upon their hydraulic and geomorphic effectiveness, is maintenance of the existing structures cost effective?
2. Based upon the status and effectiveness of the existing structures, would additional structures hasten the restoration of the river and tributary channels and aid in the recovery of the watershed?
3. What are the critical hydraulic, geomorphic, range, and resource considerations for future management decisions on the San Simon River and major tributaries.

Methods

Orthophotography – Orthophotographs are scheduled to be completed as part of an existing project with existing funds. BLM and ADWR are

funding the aerial photography and ground control, as well as the orthophotographs.

Topography – Detailed Digital Terrain Model (DTM) will be constructed in the state plane coordinate system.

Catalog of Historical Changes – Collect Historical Photographs & Historical Information – Reclamation will collect, review, and document historical information about the San Simon River. This information includes historical aerial photographs, maps, photography, and written accounts. Reclamation will then use this information to develop a history of channel changes.

Digitize 1935 Plane Table Survey – BLM will provide to Reclamation either the original or a copy of the 1935 Plane Table Survey now in the possession of BLM. Reclamation will digitize the survey map for comparison of the 1935 topography to the 2001 DTM.

Volumetric Comparison 1935 to 2001 – Reclamation will compare the 1935 plane table survey of the San Simon River to the 2001 topographic map. Using computer based CAD tools, Reclamation will calculate changes in the volumes of material along the river channel compared to 1935. This calculation provides a quantitative measure of channel change over this 66-year period. Areas of volume loss and gain will be depicted on the map along with the corresponding amounts.

Develop History of Channel Changes – Reclamation will use the catalog of historical photographs and historical changes to chronicle the changes in the San Simon River channel. Reclamation will document progression of the historical channel changes of the San Simon River based on aerial photography, other historical information, and comparison of the 1935 and 2001 topography. The history of the channel changes facilitates comparison of historical channel change, watershed changes, and land use.

Compare, Analyze, and Summarize – Reclamation will compare, analyze, and summarize the results of the volumetric analysis and the history of channel changes. Reclamation will develop a model of historical channel change.

Map Channel Characteristics – Reclamation will divide the San Simon River into mapable units based on physical characteristics of the channel.

Reclamation will then map the river using these units, forming the basis for future channel management.

Analysis of Geologic Controls on Channel Erosion – The underlying geology controls the incision of the San Simon River and its key tributaries. The extent of key geologic units may control future incision. The identification of these natural controls and their location will play a vital role in the development of a predictive model of channel change. In particular, these controls and their locations may inform management decisions of where to place or not place additional grade control in the system if additional grade control is necessary and potentially effective.

Quantification of Channel Characteristics – Reclamation will measure the physical (hydraulic, bank geometry, geomorphic) characteristics of key channel and tributary reaches. These measurements are important for the monitoring of future channel changes resulting from management actions, the development of a predictive model of channel change (Task 4), and for use in the stable channel analysis.

Hydraulic Analysis of Grade Control Structures – Reclamation will evaluate individual grade control structures for their hydraulic and geomorphic effectiveness. The evaluation includes determining the hydraulic range of influence upstream and downstream from the grade control structure, and an estimate channel change since installation of the grade control.

Stable Channel Analysis – This cross-section based analysis of channel stability balances sediment transport, channel roughness, and water discharge. It will provide an indication of channel stability relative to slope, width, and depth. This will help determine the effectiveness of existing and potential future grade control. In particular, Reclamation hypothesizes that the stable channel analysis will indicate if there are reaches where the channel is too steep, thus requiring additional grade control, and how the channel has approached stability in areas upstream of existing grade control structures.

Channel Assessment including Structures and Predictive Qualitative Model – Reclamation will develop a coherent qualitative model of potential future San Simon River channel change. The model will include existing grade control and identify locations to effectively place grade control structures

in the future. The results will also identify any current grade control that is either ineffective or not serving its intended purpose. This model will form the basis for future management decisions for the San Simon River and major tributaries.

Phase II: Resources inventory and assessment of the uplands and the San Simon channel

In addition to the Geomorphic and Engineering Analysis, the SFO feels there is additional information needed to complete the watershed assessment. They include:

- Inventory of existing grade control structures, dikes, and dams
- Road inventory
- Retaking historic photos
- Ecological site inventory
- Complete cultural resource inventory
- Complete stream and riparian inventory
- Complete a threatened and endangered species habitat inventory
- Avian corridor inventory and other wildlife inventories
- Complete standards and guidelines evaluation and rangeland monitoring
- Complete paleontology inventory
- Develop a GIS database

First year

- **Inventory of Existing Grade Control Structures, Dikes and Dams.** Beginning in 1930 the CCC, Soil Erosion Service, SCS, BLM and private parties began construction a variety of grade control structures in the San Simon Watershed. There has never been a complete inventory of these structures.
- **Road Inventory.** Roads are suspected to be a major contributing factor to sediment loading directly into the San Simon Channel, and indirectly into the Gila River. Together these water bodies support 3 T&E fish species and one T&E bird species. Roads also contribute to surface erosion factors which contribute to the deterioration of numerous cultural resources.
- **Orthophotography.** Orthophotographs are part of an existing project with existing funds. BLM and ADWR are funding the aerial photography and ground control, as well as the orthophotographs.

Second year

- **Repeat Historical Photography.** There are several hundred historical photo of the San Simon Valley dating from 1860-1970. These photographs provide a valuable insight to the change on the San Simon. Selected scenes would be re-photographed.
- **Ecological Site Inventory.** This effort is in direct support of Arizona Standards for Rangeland Health. It provides an inventory of ecological sites based on soil and vegetation. This inventory will serve all resource disciplines by providing ecological status for DPC objectives. This inventory is being developed for GIS format and will fulfill BLM Geospatial Metadata standards. This is part of a coordinated effort with the Coronado National forest and the University of Arizona.
- **Complete Cultural Resource Inventory.** A Class II cultural resource inventory would be completed covering the San Simon Valley. Sample units would be selected along the eroded San Simon channel and major tributaries to inventory at the Class III (intensive) level. An ethnoecology study would be completed by contract for the San Simon watershed. The study would consist of library/archival research and informant interviews to collect information on: the watershed's past environment; historic and present land uses; changes in the environment resulting from these uses; the areas present environment; and recommendations for management.
- **Complete Stream and Riparian Inventory.** Research and develop inventory methods for ephemeral drainages. In coordination with a State-wide effort in Arizona, partnering with USFS and the National Riparian Team.
- **Complete a Threatened and Endangered Species Habitat Inventory.** Black-tailed prairie dog inventory for potential habitat.
- **Avian Corridor Inventory and Other Wildlife Inventories.** Complete inventory of avian species within the San Simon watershed. This area appears to function as a sky island corridor connecting mountain ranges in Mexico with the Gila River.
- **Complete Standards and Guidelines Evaluation and Rangeland Monitoring.** AZ Standards for Rangeland Health Evaluations within the San Simon watershed. This effort will consist of monitoring indicators of rangeland health to determine if allotments within the watershed are meeting the Arizona rangeland

health standards. This is part of a coordinated effort with the University of Arizona and the Coronado National Forest.

- **Complete Paleontology Inventory.** Paleontological resources have been found at the 3,000-foot elevation level. Excavations are on going and efforts have been coordinated with the Mesa Museum. These resources have included glyptodons, tortoises, and bears. These resources may be extensive, and there is a need to do a complete inventory.
- **Develop a GIS Database**
- **Project Coordinator.** Oversees administration of all resource inventory contracts throughout the assessment and planning efforts for the San Simon Watershed. The Contract Administrator would assure product review is performed by all BLM and Reclamation specialists, assure quality control, and tracks scope of work, time tables and budget.
- **University of Arizona - Office of Arid Land Studies.** An academic course began in the fall of 2001 that explores aspects of resource use and management in arid land ecosystems. It focuses on the drivers and consequences of management interventions, coupled with natural environmental change. Students are currently organizing old archive files, using remote sensing to map sheet eroded areas, and retaking historical photographs. Dr. Ray Turner, author of *The Changing Mile*, has volunteered his services as part of this project.

Third year

- **Ecological Site Inventory.** This effort is in direct support of Arizona Standards for Rangeland Health. It provides an inventory of ecological sites based on soil and vegetation. This inventory will serve all resource disciplines by providing ecological status for DPC objectives. This inventory is being developed for GIS format and will fulfill BLM Geospatial Metadata standards. This is part of a coordinated effort with the Coronado National forest and the University of Arizona.
- **Complete Cultural Resource Inventory.** A Class II cultural resource inventory would be completed covering the San Simon Valley.
- **Stream and Riparian Inventory.** Research and develop inventory methods for ephemeral drainages. In coordination with a State-wide effort in Arizona, partnering with USFS and the National Riparian Team.

- **Avian Corridor Inventory.** Complete inventory of avian species within the San Simon watershed. This area appears to function as a sky island corridor connecting mountain ranges in Mexico with the Gila River.
- **Paleontological Inventory.** Continue ongoing inventory of paleo resources found within the 3,000 foot elevation zone of the Whitlock Mountains.
- **Continue to Develop a GIS Database**

Fourth year

- **San Simon Watershed Assessment.** Assimilation of resource inventory reports and results of geomorphic studies. Complete all data digitizing into GIS, report preparation and publishing.

Phase III: Community-based partnership

As part of this phase a community-based partnership training would be offered to the community. This would allow for a coordinated and interdisciplinary planning effort. This effort is necessary to allow the community to partake in planning for the management goals and objectives for the watershed and development implementation actions necessary to achieve them.

Project goals are:

1. The determination of effectiveness of 70 years of watershed restoration efforts.
2. Determine the status of the San Simon Watershed, both uplands and channel.
3. Proper inventory, evaluation and assessment of all resources.
4. Management of threatened and endangered and special status species.
5. Identifying long-term uses and management opportunities and goals for the watershed and its natural resources.

At this point, inventory and assessment of the structures will have been completed. Resource inventories will be underway and some will be complete enough to begin forming analyses and interpretation. There will be a big picture to look at with fragmented resource inventories in place. It is now time to form the official community-based partnership and work group to look at the big picture, and discuss the social/political questions provided by the restoration effort.

Fifth year

- **Community-Based Partnership.** Provide training locally to interested public for development of a watershed plan. Identify committed participants for the planning effort.
- **Project Coordinator.** Once the Watershed Assessment contracts are completed, the project coordinator would assist the BLM field office planner with the community-based planning effort. This coordinator would also assist with efforts of the Safford/San Carlo/Duncan Watershed Council.

Sixth year

- **San Simon Watershed Plan.** Cost associated with plan development and printing.
- **Project Coordinator.** Once the Watershed Assessment contracts are completed, the project coordinator would assist the BLM field office planner with the community-based planning effort. This coordinator would also assist with efforts of the Safford/San Carlo/Duncan Watershed Council.

Benefits

The benefits of the assessment would be the determination of the overall effectiveness of the past 70 years of restoration work and identify where we need to focus restoration efforts to improve and restore the watershed condition for our community-based planning effort. Specifically, we would be able to characterize the environmental changes over the last 70 years and assess probable causes and consequences of changes to base our planning effort on.

The affect of the uplands on the water quality in the Gila River has been an issue for many years. There are three threatened and endangered fish species in the Gila River and tributaries, including the spikedace, razorback sucker, and loach minnow. There are two threatened and endangered birds species, the cactus ferruginous pigmy owl and southwestern willow flycatcher are also found along the Gila River and possibly some tributaries. In the uplands of the San Simon there is the lesser long nose bat. Section 7 consultation is complete on all species for the Safford Field Office Resource Management Plan and the grazing program. Upon completion of the community-based watershed plan there may be a need to re-consult.

Water quality and quantity have been a long standing issue on the Upper Gila Watershed, with on

going litigation over both subjects. The Clean Water Act placed the responsibility upon the states to implement many portions of the Act including reduction in non-point source pollution. The Clean Water Action Plan has directed agencies to take a holistic management approach to improving the water resources. This effort is being made through the Gila Monster Watershed Council for the whole Upper Gila Watershed and through the San Carlos/Safford/Duncan Watershed Group in Arizona. This effort was initiated in 1993 and is a community-based effort that has wide local and national support.

Public lands in the San Simon Watershed contribute substantially to silt load entering into the Gila River and into the San Carlos Reservoir. During the 1930s the US Geological Survey estimated as much as 30% of the silt load entering into the San Carlos Reservoir came from the San Simon watershed. Over the years the watershed has improved but is still a highly eroding area. Much of the watershed of the Gila River is on public lands; effective management will require a joint effort from both public and private lands.

Budget and personnel constraints have prevented the bureau from doing a proper assessment and planning for the watershed. Another major concern is the inability to do proper maintenance on roads and existing structures that affect watershed function. Without proper maintenance these contribute to soil erosion and deterioration of water quality in the Gila River. Roads need to be inventoried and classified and their contribution to sediment monitored. Future conservation work and management needs to take place within the watershed in order to be in compliance with parts of the Clean Water Act.

Partnerships

The Upper Gila Watershed has many on going projects that focus on public and private lands. Many cooperators participate. The primary funds come through:

1. Arizona Water Protection Fund (~\$500,000 grant)
2. Bureau of Reclamation (~\$500,000 grant)
3. University of Arizona (\$150,000 through in kind service)

4. Arizona Department of Environmental Quality, 319 grants for various projects (\$100,000)
5. Arizona Department of Water Resources various grants (\$78,000 grant)
6. Watershed Affiliates (\$200,000 through in kind service).

The following list of watershed affiliates have been contributing to similar projects on the Gila River through the Arizona Gila Monster Watershed Council. The San Simon discharges into the Gila River and the San Simon project is of great interest to the Gila Monster Watershed Council. The affiliates include: Gila Valley NRCD; Farm Bureau; Phelps Dodge Mining Company; Arizona Cattle Growers; Gila Valley Irrigation District; Franklin Irrigation District; Graham and Greenlee County Boards of Supervisors; City Councils of Safford, Thatcher, and Pima; Chambers of Commerce of Safford, Thatcher and Pima; The Nature Conservancy; San Carlos Apache Tribe; Natural Resource Conservation Districts; Federal agencies including Bureau of Reclamation, Environmental Protection Agency, U.S. Forest Service, and U.S. Fish and Wildlife Service; State agencies including Arizona Game and Fish Department, Arizona Geological Survey, Arizona Department of Environmental Quality, and Eastern Arizona College; and a variety of private citizens.

Conclusions

Together, the partners are prepared to study the past restoration actions, and to propose new actions to accelerate watershed and river restoration on the San Simon River and Watershed. The study is causation based, using the latest in analytical and resource inventory tools.

Acknowledgments

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