

Planning for Large Scale Habitat Restoration in the Socorro Valley, New Mexico

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Abstract—One initiative for large scale habitat restoration on the Rio Grande in central New Mexico is being led by a nonprofit organization, the Save Our Bosque Task Force. The Task Force has just completed a conceptual restoration plan for a 72-kilometer reach of river. The goals of the plan were to determine the potential for enhanced biological diversity through improved management of river processes. The specific river issues addressed in the plan include endangered species habitat improvement, fire management, and increased biodiversity through exotic species control and native plant establishment. Important water issues addressed by this plan include existing and potential use by the mosaic of habitats along the river and potential savings through improved management and delivery. Restoration of river processes coupled with exotic species control, bank destabilization, wetland enhancement, sand bar maintenance, grassland reestablishment, and other techniques could improve the diversity of native riparian plants on approximately 8,500 hectares of active floodplain under the jurisdiction of federal, state, local government agencies and private landowners. Areas where flooding occurs less frequently are designated as suitable for reestablishment of grasslands and more open forest/savannas. These areas are predicted to provide the greatest water savings. Restoration projects in areas where flooding occurs more frequently would focus on reestablishment and maintenance of cottonwood/willow forests of different age classes, wet meadows, and permanent wetlands. In this way, the diverse mosaic of habitat that occurred on the Rio Grande could be restored and maintained while addressing important socioeconomic issues, such as water use and fire. This plan is presently being used by water and land managers, private landowners, and other local interests to guide implementation of large scale resource management efforts.

Introduction

The importance of river processes such as flood pulses, connectivity between the channel and adjacent floodplain, and groundwater recharge to the long-term viability of river ecosystems has been documented by a number of researchers (Ellis and others 2002, Molles 1998, Crawford and others 1993, Sparks 1995, Auble and others 1994). The Save Our Bosque Task Force's (Task Force) Conceptual Restoration Plan for the Rio Grande from San Acacia to San Marcial, New Mexico (plan), was developed in a five phase process to evaluate the potential to restore river processes and thereby increase biological diversity on a 72 kilometer (45 mile) reach of Rio Grande in central New Mexico, the Socorro valley. The importance of riparian systems in the overall biodiversity of the planet, particularly in arid regions has

also been well-documented (Naiman and others 1993, Briggs 1996, Crawford and others 1996). The Task Force planning effort is meant to serve as a tool to landowners and management agencies interested in improving the health of the Rio Grande ecosystem within current constraints.

This valley is a unique blend of small communities, agricultural fields, the Rio Grande, and its associated habitats. Economic interests in the valley include agriculture, science and research interests, a state university, private businesses, and ecotourism of which the Bosque del Apache NWR and Sevilleta NWR are a part. Stakeholder involvement through an oversight committee and a series of public meetings improved the final product by incorporating the issues and expertise of those involved in land and water management and private interests.

The Rio Grande of the Socorro valley now occupies approximately one third of its original floodplain. It is confined by a flood control levee along its western bank. There is no levee on the eastern bank, which allows the river at high flows to spread out on a floodplain of approximately 6,900 ha (17,000 acres). There is an extensive drainage and water delivery system associated with agriculture and water management interests.

Table 1. Suggested San Acacia flood frequency in cfs.

Probability	Return Period	Post Cochiti 1974-2002	Entire Record 1936-2002	Suggested Flood Peak Discharge
0.8	1.25	3700	3750	3700
0.5	2	5660	4140	5660
0.2	5	8480	6280	8480
0.1	10	10400	9740	10400
0.04	25	12800	14200	14200
0.02	50	14600	22800	22800
0.01	100	16400	32500	32500
0.002	500	20500	64900	6490

Methods

Data Collection and Analysis

One of the purposes of the plan was to review the available information on historic Rio Grande hydrology, channel morphology and vegetation composition. Historically, the Rio Grande's most dramatic physical and biological changes occurred during flood and avulsion events (Carter 1953, Lee 1907). The scouring of the floodplain, movement of sediment through the system, plant establishment, and recharge of wetlands and shallow groundwater all related to some extent to these events. The resulting forests, wetlands, wet meadows, scrublands, alkali flats and savannas were a significant portion of the floodplain community when Europeans arrived (Scurlock 1998). Understanding these river processes and the changes to physical and biological aspects of the system tied to water and related land resource development since the 1800s were a part of the initial analysis for plan preparation.

The Rio Grande of the past century has been used to support agriculture and growing human settlements (Clark 1987, Simmons 1972). The infrastructure established in the floodplain limited the floodplain available for river flows and riparian habitats, altered the flood pulses and disrupted the sediment supply (Crawford and others 1993). The responses of the river to this altered regime have included narrowing of the active channel, degradation and in some areas accelerated aggradation, and limited overbank flooding within this "active floodplain" (Bullard 1993, LaGasse 1981). Earlier in the 20th century, the introduction of exotic plant species, primarily saltcedar (*Tamarix* sp.), altered the plant community throughout much of the river's length as well (Everitt 1998).

Extensive data collection in the Socorro valley by a number of federal and state agencies informed the analysis of past channel and floodplain dynamics, predicted trends in hydrology and geomorphology, and vegetation community alterations and succession. Fluvial

geomorphology including bed slope analysis, sediment analysis and predicted yield, and the delineation of subreaches (upstream to downstream: Escondida, San Antonio and Refuge) based on these characteristics was included in this phase of the planning effort. A flood frequency analysis was completed using the San Acacia gauge at the upstream end of the plan area (table 1). The vegetation classification system originally used (Hink and Ohmart 1984) in this plan has now been updated and a plan revision includes this more recent information (BOR 2004). This evaluation of river processes and historic biological diversity informs the subsequent discussions on the feasibility of restoring these processes in this reach of river and possible benefits from that restoration.

Specific River Issues

A number of issues including threat of wildfire, channel conveyance capacity and flood potential, and the present condition of terrestrial and aquatic habitats and their use of water are important to the local stakeholders of the valley (Task Force unpublished information). Important institutional constraints and resource management goals were also considered in conjunction with these issues.

To evaluate the channel capacity and flood potential, the bankfull discharge of each subreach, spring flushing flows, areas of inundation and a flood frequency analysis were developed for restoration designs. Calibration of a two dimensional flood routing model (FLO2D; Tetra Tech ISG 2000) for this reach had been accomplished earlier by other entities. This method of predicting overbank flows (fig. 1), area of inundation, velocity, and depth of water was used throughout the plan development for addressing issues of flooding, water use, and predicted plant community establishment and viability. Sediment loading and sand bar dynamics through the reach were considered in terms of channel capacity, vegetation establishment, as well as aquatic habitat diversity.

To characterize the existing habitat value and determine possible future conditions in riparian habitats,

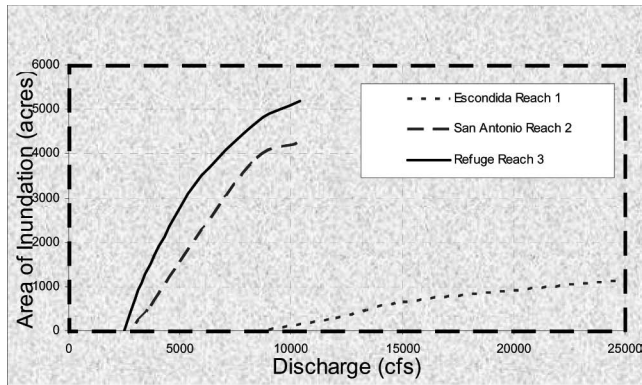


Figure 1. Area of overbank flooding by subreach.

recent vegetation maps and historic descriptions of the plant community “mosaic” of the valley floodplain were used (BOR 2002, Crawford and others 1993, Campbell and Dick-Peddie 1964). Biologically diverse habitat areas attract a more diverse fauna than monotypic saltcedar stands (Bosque del Apache NWR unpublished data, Ellis 1995, Naiman and others 1993). Native woodlands were characterized by an overstory of cottonwood (*Populus deltoides*) and Goodding’s black willow (*Salix gooddingii*) with an understory of coyote willow (*Salix exigua*), New Mexico olive (*Foresteria pubescens*), screw-bean mesquite (*Prosopis pubescens*), and seepwillow (*Baccharis* sp.). The resulting mapping products were used to distinguish sensitive areas for protection from wildfire and to calculate estimates for current water use without restoration.

The potential for water savings through the reach was calculated using the vegetation and predicted flood area maps and the most recent information on evapotranspiration estimates for the area (Cleverly and others 2001, King and Bawazir 2000). A comparison of pre-restoration and predicted future condition without restoration water use was compared with water use associated with improved habitat diversity and restored river processes. An initial description of the groundwater/surface water dynamics through the reach was attempted but existing information on this important aspect of the ecosystem is limited. Research currently underway will inform and improve the analysis of this interaction and become part of future updates to the plan (Bowman and others 2002).

The basic premise for evaluating appropriate plant community reestablishment at this conceptual level and relating that to potential water savings was to assume that riparian plant establishment will be determined by connectivity to the channel, shallow groundwater table and flood frequency. The occasional very high flows through the reach could establish patches of dense vegetation at higher elevations, but the ability of those plants to

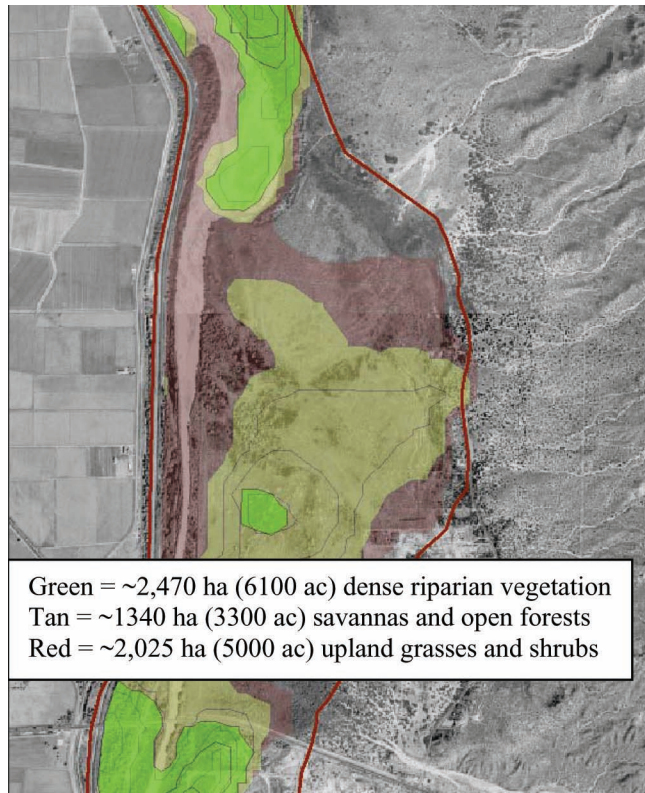


Figure 2. Flood frequency related to present and reestablished plant communities.

survive could be limited by the local groundwater gradient to the west. Areas currently vegetated with exotic tree species that were flooded only at infrequent flood intervals would be reestablished as open grasslands. Those areas that were more closely associated with the channel and groundwater would most likely be vegetated with riparian habitats of dense structure. Estimated area of grassland, savanna, wetland, and forest were calculated and used in subsequent evaluation of biological diversity and water use (fig. 2).

Institutional constraints on the system were evaluated as well. The Middle Rio Grande of New Mexico has commitments for water delivery to sovereign tribal nations and downstream users (Rivera 1999). The current delivery of water to legal users is based on prior appropriations but the Middle Rio Grande has not been adjudicated. The river channel through the Socorro valley and the Low Flow Conveyance Channel have served as delivery systems to downstream water users. Management alternatives within current authorities were reviewed as a part of plan formation.

Development of the Restoration Concepts and Strategies

An exercise to determine the initial ranking of proposed restoration components was accomplished

through a series of workshops with oversight committee members, local professionals in the fields of hydrology, geomorphology, engineering and biology, and interested citizens. A video of the Rio Grande through the reach was available during discussions. A decision-making matrix was developed to aid in determining qualitative values to the physical and biological attributes, resource use and benefits, possible adverse impacts, potential techniques and final ranking of restoration technique and purpose. Definitions and instructions for matrix components were developed and distributed to participants as well. The matrix resulted in an initial prioritization of restoration by subreach to assist in restoration plan development.

Results

Development of the Conceptual Restoration Plan

Results of the decision-making exercise showed that restoration of periodic higher flows, restrictions on floodplain development and other “passive” restoration techniques are considered essential to the enhancement of biological diversity through this reach of river. This is similar to results of other larger scale evaluations of the Rio Grande completed recently (Tetra Tech, Inc. 2002, Crawford and others 1993). The importance of controlling exotic vegetation and diversifying the habitats along the river were reflected in ranking as well. Hard engineering techniques such as rip rap placement and channel gradient control structures ranked very low in terms of benefit to this reach of river. Restoration project areas were selected based on improved river-floodplain connectivity, environmental compatibility, likelihood of success, consistency with other restoration activities in the subreach, cost, construction feasibility, long-term sustainability, potential response to adaptive management, potential water salvage, and potential conflicts.

A series of maps focusing on the different river issues and the recommended techniques to address these issues was produced. The “Restoration Lyte Plan” was developed to present implementation focusing on fire protection, exotic species removal and minimal habitat diversification. This version was envisioned to address immediate needs with limited costs. The Water Salvage Plan and the Drought Reduction Plan have been combined into a Drought Impacts Plan that addresses the critical issues during prolonged dry periods. Opportunities for water savings through exotic species control, fire management, endangered species habitat protection, and limiting vegetation encroachment in

the main channel are included in this mapping product. Some of the restoration projects have been designed to enhance or restore habitat for both the endangered Rio Grande silvery minnow and Southwestern willow flycatcher. These projects are highlighted in the Habitat Diversity and Endangered Species Habitat Plan and the River Dynamics Plan. The Long Term Comprehensive Plan consists of all the selected projects from each theme. This mapping product provides a tool to discuss long term trends in biodiversity, water use, channel dynamics, endangered species habitat availability, and fire protection along the 72-hectare river reach with a look at balancing these priorities. Different versions were developed to aid a number of diverse resource managers in the area. The Task Force, in conjunction with interested floodplain landowners and management agencies, are prioritizing restoration projects based on a phased implementation strategy and available budget.

Monitoring and Adaptive Management Strategy

The Adaptive Management Plan includes coordination with other stakeholders in the valley through the formation of a work group. There is an urgent need to understand the ecological effects of restoration as implementation moves forward and to develop new management options to sustain these projects. The first priority of the work group will be to evaluate channel and riparian changes and propose priorities for addressing undesirable trends in biological diversity. While it is recommended that restoration components be sustained by prescribed flow recommendations, the success of some restoration activities will be contingent on an adaptive management plan that has an appropriate maintenance response when flows are not available. Successful adaptive management of this reach of river will depend on agency cooperation and public involvement.

The second priority will be to implement a monitoring program to identify the monitoring needs in terms of baseline hydrographic, biological, vegetation and geomorphic data and long term monitoring of trends in the ecosystem. As a part of this monitoring program, information to assess restoration success or failure would be gathered. It is envisioned that the monitoring program developed by the work group will build from the existing programs of resource agencies and researchers working in the Socorro valley (BOR unpublished data, Bestgen and Platania 1989, Hildebrandt and Ohmart 1982, Muldavin and others 2000, Coonrod and others 2002, Massong and others 2002, Stromberg and others 1991, FLO Engineering 1999). The plan outlines suggested focus areas, parameters, and schedules for

monitoring the abiotic and biotic components of Rio Grande ecosystem.

The third priority is to develop a set of guidelines for responding to ecosystem changes observed through implementation of the monitoring program. Recommended responses to undesirable conditions in terms of flood frequency and duration, vegetation encroachment, levee instability, bank erosion and channel migration, failure to induce overbank flooding, river desiccation, sediment plugs, and high soil salinity are proposed in this Plan.

Other Products of the Plan

A list of Rio Grande water resource projects, cross section plots, a database index, and review comments and responses are included in the appendices along with an extended bibliography. This bibliography is broken down by topics including endangered species, general data, geology, geomorphology, history and culture, hydrology, general categories, groundwater, surface water, legal and administrative, maps, riparian habitat, river restoration, sediment load, vegetation, and wildlife.

Discussion

Plan updates will be necessary as new monitoring information, current research and new techniques become available. The Task Force has plans to evaluate recent groundwater information and a draft surface water/groundwater model for the area (Bowman and others 2002) for inclusion in future drafts. Current copies are available at the Middle Rio Grande Bosque Initiative website (www.mrgbi.fws.gov). This information will improve restoration selection and feasibility in the valley. It will also improve the analysis of current water use by the natural system in this reach and the potential for water savings. The FLO2D model will need to be calibrated during the next large sustained flood event to improve the accuracy of this flood routing model in the Socorro valley.

The Task Force is working with private landowners to develop restoration plans for their particular parcels based on general information derived from the plan and proposed site specific monitoring. The Task Force hopes to convene the Adaptive Management Work Group in early 2005 to begin establishing the monitoring program.

Since this effort was accomplished to address issues on the active river floodplain (east of the flood control levee), the Task Force did not include evaluation of water use, land ownership or other important concerns in the valley west of the levee. It is the Task Force's intention to use this CRP as a planning tool for its work in the valley

and to make it available to other agencies for their use. Quantifying potential water savings and improved land management opportunities adds information to a larger discussion on Rio Grande water issues.

Funding for the development of the plan by contractor Tetra Tech, ISG was provided by the Turner Foundation, World Wildlife Fund, McCune Charitable Foundation, Friends of the Bosque del Apache NWR, Bosque Initiative, LightHawk, U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers, and Middle Rio Grande ESA Collaborative Program.

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