HYDROGEOMORPHIC EVALUATION OF ECOSYSTEM RESTORATION AND MANAGEMENT OPTIONS FOR ALAMOSA NATIONAL WILDLIFE REFUGE

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U. S. Fish and Wildlife Service Region 6
134 Union Blvd.
Lakewood, Colorado

By:

Mickey E. Heitmeyer
Greenbrier Wetland Services
Rt. 2, Box 2735
Advance, MO 63730

and

Cary M. Aloia
Wetland Dynamics
3393 E CR 9 S
Monte Vista, CO 81144

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Mickey E. Heitmeyer, PhD
Greenbrier Wetland Services
Route 2, Box 2735
Advance, MO 63730
www.GreenbrierWetland.com

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CONTENTS

EXECUTIVE SUMMARY v

INTRODUCTION 1

THE HISTORICAL ALAMOSA ECOSYSTEM 5
- Geology and Geomorphology 5
- Soils 6
- Topography 7
- Climate and Hydrology 7
- Plant and Animal Communities 15
  - Floodplain Wetlands 16
  - Riparian Woodland 18
  - Salt Desert Shrub 18
  - Key Animal Species 19
  - Historical Distribution and Extent of Plant Communities 20

CHANGES TO THE ALAMOSA ECOSYSTEM 29
- SLV Settlement and Land Use Changes 29
- Contemporary Hydrologic and Vegetation Community Changes at Alamosa NWR 32
  - Water Sources 32
  - Refuge Water and Habitat Management and Ecosystem Changes 37
- Changes in Animal Populations 42

OPTIONS FOR ECOSYSTEM RESTORATION AND MANAGEMENT 45

General Recommendations For Ecosystem Restoration And Management 46

Specific Recommendations For Ecosystem Restoration And Management 55

MONITORING AND EVALUATION 59

Groundwater and Surface Water Quality and Quantity 59

Restoring Natural Water Flow Patterns and Water Regimes 60

Long-term Changes in Vegetation and Animal Communities 60

ACKNOWLEDGEMENTS 63

LITERATURE CITED 65

Cary Aloia

Cary Aloia

EXECUTIVE SUMMARY

This report provides a hydrogeomorphic (HGM) evaluation of ecosystem restoration and management options for Alamosa National Wildlife Refuge (NWR) in the central portion of the San Luis Valley (SLV) in south-central Colorado. Alamosa NWR contains 12,026 acres and was established in 1962. Most of the refuge is located within the historic Rio Grande floodplain; Hansen's Bluff, an outcrop of Pleistocene-age Alamosa Formation upland hills, forms the east boundary of the refuge. Floodplain wetlands, wet meadows, riparian woodland, and salt desert shrub vegetation communities historically, and currently, compose refuge habitats.

Many land and water changes have occurred throughout the SLV, and at Alamosa NWR, since European settlement. Agricultural irrigation systems were extensively developed in the SLV beginning in the late-1800s, and included diversion of water from the Rio Grande and other rivers/creeks, exploitation of groundwater, and various use and diversion of prior-used water drained from agricultural fields after irrigation. Use and allocation of both surface and groundwater in the SLV have been regulated through many complex water right agreements. Water available for wetland management on Alamosa NWR has become more limited over time. In addition to the extensive alterations in land and water uses in the SLV region, the U.S. Fish and Wildlife Service (USFWS) also modified landform and water distribution on Alamosa NWR after it was established. These modifications included the construction of extensive water management infrastructure and the conversion of former meadow and shrub areas to artificially flooded wetlands. The ecological consequences of long-term diversion of water and consistent flooding of areas formerly in salt desert shrub habitats have included increased soil salinity in some areas, alterations to the presence and distribution of native vegetation species, altered resource availability to native animal species, and

invasion and establishment of non-native plants, especially tall whitetop (*Lepidium latifolium*).

In 2003, a Comprehensive Conservation Plan (CCP) was prepared for Alamosa and Monte Vista NWRs. Since that time, management of Alamosa NWR has sought to implement CCP goals, but also recognized constraints of water availability and the need for more holistic management approaches. In 2011, the USFWS initiated a new CCP planning process for the SLV NWR Complex, including Alamosa NWR. This HGM report provides information to support the new CCP and subsequent management of Alamosa NWR with the following objectives:

1. Describe the pre-European settlement (hereafter Presettlement) ecosystem condition and ecological processes in the Alamosa NWR region.
2. Document changes in the Alamosa NWR ecosystem from the Presettlement period with specific reference to alterations in hydrology, vegetation community structure and distribution, and resource availability to key fish and wildlife species.
3. Identify restoration and management options and ecological attributes needed to restore specific habitats and conditions within the Alamosa NWR region.

Information was obtained on historical and contemporary geology and geomorphology, soils, topography, climate and hydrology, and plant/animal communities of the Alamosa NWR region. The surficial geomorphology of Alamosa NWR is dominated by Quaternary-age alluvial deposits of the Rio Grande floodplain. Lateral migrations of the Rio Grande and three major tributaries, La Jara and Rock Creeks and the Alamosa River, that enter the Rio Grande near the east side of Alamosa NWR created many geomorphic surfaces on the refuge including split river channels, abandoned channel sloughs and oxbows, natural levees, scroll bars, and terraces. Three major soil-landform associations with 29 distinct soil types are present on the refuge and the distribution of soil types reflects historical deposition and movement of floodplain sediments. The majority of Alamosa NWR contains Alamosa-Vastine-Alluvial Association soils that are deep loams commonly flooded in spring.

The climate of the SLV is semi-arid, with cold winters and moderate summers. Alamosa NWR receives about seven inches of precipitation per year, with 60% occurring as rain in July and August. Long-term precipitation data suggest that alternating low and high yearly precipitation patterns recur at about 20- to 30-year intervals. Generally, the long-term trend for total water year precipitation is increasing over time. Historically, Alamosa NWR received surface water inputs from the Rio Grande and its tributaries and the relatively limited onsite precipitation. Annual variation in mountain snowpack historically influenced Rio Grande and tributary discharge, sediment transfer and deposition, and duration of flood events on Alamosa NWR. Historically, the high Rio Grande discharges in spring following snow melt caused at least some overbank and/or backwater flooding into and through its floodplain at Alamosa NWR in most years. Groundwater seeps along the base of Hansen's Bluff also formerly were common. Two main aquifers, the shallow unconfined and the deeper confined, underlie the SLV.

Historically, Alamosa NWR contained predominantly herbaceous wetland and wet meadow plant communities in the Rio Grande floodplain, narrow riparian woodland along the Rio Grande, small seep wetlands along the base of Hansen's Bluff, and salt desert shrub on higher elevation floodplain terraces and upland areas adjacent to the floodplain. An HGM matrix of relationships of major plant communities to geomorphic surface, soil, general topographic position, and hydrology at Alamosa NWR was developed. The ecological attributes identified in the HGM matrix were used to make a model map of the potential distribution of historical vegetation communities at Alamosa NWR to provide some guidance to future community restoration activities.

The many changes to the Alamosa NWR ecosystem are chronicled in the report including discussion of early settlement and land use changes, contemporary hydrologic and vegetation community changes, and refuge development and management. The primary change to the ecosystem structure, function, and processes at Alamosa NWR since the late-1800s has been the extensive alterations of SLV-wide, and refuge-specific, distribution, chronology, and abundance of surface and groundwater. The history of water diversion,

use, and management throughout the SLV, both prior to, and after refuge establishment is complex. Past management objectives for Alamosa NWR promoted increased wetland area with relatively consistent annual water management, mostly for breeding ducks, and has exacerbated certain local ecosystem changes. For example, the annually consistent diversion of water to irrigate extensive areas including many former shrub and seasonal meadow habitats has: 1) converted meadow and shrub sites to more persistent tall emergent habitats; 2) modified and/or eliminated natural surface water flow pathways and patterns across the refuge; 3) facilitated invasion and expansion of non-native plant species; and 4) altered basic soil and topographic characteristics of the system.

Based on information obtained and evaluated in this HGM study, we believe that future restoration and management of Alamosa NWR should consider the following goals where possible:

1. Restore and manage natural hydrologic flow patterns and regimes throughout the Rio Grande floodplain.
2. Restore and manage the distribution, type, and extent of natural vegetation communities in relation to hydrogeomorphic attributes.
3. Encourage management strategies that can emulate natural disturbance events including flooding, drought, fire, and herbivory.

Specific recommendations for each of the above ecosystem restoration and management option goals are provided in the report. For goal #1 they include:

- Restore water distribution to historical drainages by routing surface water north to south and west to east to allow for gravity-fed sheetflow throughout the Rio Grande floodplain.
- Remove or modify water delivery infrastructure to allow flow through natural drainages.
- Remove islands and associated borrow ditches that artificially impound water.

- Replace water-control structures that do not have adequate capacity or are restricting water flows.
- Provide water delivery through ditches, levees, and roads that will allow water to flow through natural drainage areas.
- Prevent artificial ponding of water along roads and levees where it prevents water flow through drainages and sheetflow across the area.
- Manage water regimes in wetland units to emulate natural seasonal and interannual dynamics.
- Prevent impounding water in former salt desert shrub areas in the northern portions of the refuge.
- Further evaluate the New Ditch Diversion site and structures related to refuge restoration potentials.
- Develop a strategic water management plan that identifies specific objectives for the distribution, timing, and extent of water resources.

Specific recommendations for Goal #2 include:

- Restore and manage semipermanently flooded wetlands in Marsh and Vastine soil types within or adjacent to abandoned river channels and near historic seeps along Hansen's Bluff.
- Restore seasonal wetlands in Vastine soils paralleling the Rio Grande riparian corridor and along old drainage pathways.
- Restore wet meadow communities on Loamy and Wet Alluvial Lands, Alamosa, Vastine, and La Jara soil types with short duration spring and early summer flooding regimes.
- Provide water conditions in and near Sandy Alluvial Land soils to promote regeneration of existing cottonwood and willow.
- Restore salt desert shrub communities on Hapney-Hooper-Corlett Association soils.
- Control invasive plant species throughout the refuge, especially in native wetland locations.

Specific recommendations for Goal #3 include:

- Allow or mimic natural overbank flood events if possible by providing the Rio Grande access to its historic floodplain.
- Provide vegetation and soil disturbance events at more natural intervals.
- Mimic historical river/floodplain scouring events through mechanical or chemical treatments.
- Consider use of fire, grazing, mowing, and haying to manage succession stage and composition of vegetation communities based on plant phenologies in seasonal wetland and wet meadow communities.

Future management of Alamosa NWR should include regular monitoring and directed studies to determine how ecosystem structure and function are changing, regardless of whether restoration and management options identified in this report are undertaken. Management activities on Alamosa NWR should be done in an adaptive management framework where: 1) predictions about community response and water issues are made relative to specific management actions and 2) follow-up monitoring is conducted to evaluate ecosystem responses to the action. Especially important categories of information and monitoring needs for Alamosa NWR include:

- Surface and groundwater quantity and quality
- Restoring natural water flow patterns and water regimes
- Long-term changes in vegetation and animal communities

Cary Aloia