Survey of Critical Wetlands and Riparian Areas in El Paso and Pueblo Counties, Colorado

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Knowledge to Go Places

Cover photo: Haynes Creek at Pueblo Chemical Depot

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USER'S GUIDE

The *Survey of Critical Wetland and Riparian Areas in El Paso and Pueblo Counties* was conducted simultaneously with the Colorado Natural Heritage Program *Survey of Critical Biological Resources of El Paso County*. The projects were two essentially distinct projects that are highly integrated with respect to methodology and fieldwork. This report reflects the separate nature of the projects by being organized in two separate reports. Both projects utilized the same Natural Heritage methodology that is used throughout the globe, and both searched for and assessed the plants, animals, and plant communities on the Colorado Natural Heritage Program's list of rare and imperiled elements of biodiversity. Each report prioritizes potential conservation areas based on the relative significance of the biodiversity they support and the urgency for protection of the site. All information explaining Natural Heritage methodology and ranks is repeated in each report, so that each report can stand alone and be used independently of the other. A Survey of Critical Biological Resources of Pueblo County is scheduled to be conducted during the 2001and 2002 field seasons.

This report, *Survey of Critical Wetland and Riparian Areas in El Paso and Pueblo Counties*, presents results of surveys within wetland and riparian areas in both counties. The second report, *Survey of Critical Biological Resources of El Paso County*, presents *all* potential conservation areas identified in El Paso County that support rare and imperiled plants, animals, and significant plant communities, including wetland and riparian areas. A similar report will be prepared for Pueblo County following the 2001 and 2002 field seasons. This wetland and riparian report differs from the more comprehensive El Paso County report in that it includes wetlands and riparian areas in Pueblo County, and includes an assessment of the restoration potential and the wetland functions performed at each site that was surveyed. Functional assessments are intended to provide the user with a more complete picture of the value wetlands and riparian areas provide to El Paso and Pueblo county residents.

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EXECUTIVE SUMMARY

Citizens of El Paso and Pueblo counties are concerned about issues of open space, wildlife habitat, and conservation of their unique natural surroundings. They recognize the need to plan for the conservation of the plants, animals and plant communities that are native to El Paso and Pueblo counties. They also recognize that with limited resources, it is important to prioritize their conservation efforts. The need for information on the locations of the most significant biological resources of the area is urgent. In 2000, the Colorado Natural Heritage Program (CNHP), in cooperation with Colorado Division of Wildlife's (CDOW) Wetlands Program, proposed to the Colorado Department of Natural Resources (CDNR) through a grant from the Environmental Protection Agency (EPA), Region VIII to survey for critical wetlands and riparian areas within El Paso and Pueblo counties. The survey summarized in this report was conducted concurrently with a Great Outdoors Colorado (GOCO) funded survey of critical biological resources of El Paso County. The goal of the project was to systematically identify the localities of rare, threatened, or endangered species dependent on wetland and riparian areas and the locations of significant natural wetland and riparian plant communities.

This project supports the CDNR's effort to strategically protect Colorado's wetland resources. The results of this survey support **six** statewide wetland efforts:

(1) the Colorado Wetlands Initiative Legacy Project, a wetlands protection partnership that includes the Colorado Division of Wildlife, the Colorado Office of The Nature Conservancy, Colorado State Parks, Partners for Wildlife, Ducks Unlimited, and GOCO;
(2) the Playa Lakes/Arkansas River Wetland Focus Area Strategic Plan;
(3) CNHP's Comprehensive Statewide Wetland Classification and Characterization Project;
(4) The Nature Conservancy's Priority Conservation Sites in the Chico Basin Priority Area;
(5) the hydrogeomorphic (HGM) wetland functional assessment program; and
(6) the Wetland Bioassessment method or Index of Biological Integrity (IBI) project.

This project supports the IBI and HGM development process by identifying potential reference wetlands and the range of variation and potential subclasses within El Paso and Pueblo counties, and by performing a qualitative wetland functional assessment to guide future quantitative efforts in assessing the range of variation within a subclass. CNHP's wetland work provides input to the Wetlands Initiative Partners (e.g., The Nature Conservancy) and the Colorado Wetlands Partnership by identifying potential sites for protection and restoration. Finally, the results of this survey will be incorporated into CNHP's Comprehensive Statewide Wetlands Classification.

Field surveys began in June 2000 and continued through November 2000. Wetlands and riparian areas occurring on private lands were given the highest priority for inventory. Such locations were identified by: (1) examining existing biological data for rare or

imperiled plant and animal species and significant plant communities (collectively called **elements**) from the Colorado Natural Heritage Program's database, (2) accumulating additional existing information on these elements and, (3) conducting extensive field surveys. Areas that were found to contain significant elements were delineated as "Potential Conservation Areas." These areas were prioritized by their biological urgency (the most rare or imperiled) and their ability to maintain viable populations of the elements (degree of threat). A functional assessment was conducted at most of the wetland and riparian areas visited using a modified version of the Montana Wetland Field Evaluation Form (Berglund 1996) and the hydrogeomorphic approach (HGM) (Brinson 1993). The restoration potential of each site was also noted.

Results of the wetland and riparian survey confirm that El Paso and Pueblo counties contain areas with high biological significance and a diverse array of wetlands that support a wide variety of plants, animals, and plant communities. At least 31 major wetland/riparian plant communities, three plants, one mammal, one bird, two fish, and one amphibian from the CNHP list of rare and imperiled plants, animals, and plant communities are known to occur in, or are associated with, wetlands in El Paso and Pueblo counties.

Twenty-five wetland and riparian sites of biodiversity significance are profiled in this report as Potential Conservation Areas (PCAs). These sites represent the best examples of 31 wetland and riparian communities observed on the private and public lands visited. CNHP believes these sites include those wetlands that most merit conservation efforts, while emphasizing that protecting only these sites will, in no way, adequately protect all the values associated with wetlands in El Paso and Pueblo counties. Despite the best efforts during one field season, it is likely that some elements that are present were not documented during the survey due to either lack of access, phenology (reproductive timing) of species, or time constraints. Future surveys will likely identify additional areas of biological significance that have not been identified in this report. The delineation of PCA boundaries in this report does not confer any regulatory protection on recommended areas. They are intended to be used to support wise planning and decision making for the conservation of these significant areas. Additional information may be requested from Colorado Natural Heritage Program, 254 General Services Building, Colorado State University, Fort Collins, CO 80523.

Protection and/or proper management of the PCAs would help to conserve the biological integrity of El Paso County, Pueblo County, and Colorado. Of these sites, several stand out as very significant such as Buffalograss Playas with the best known native habitat for an endemic plant, plains ambrosia; Chico Creek with its diversity of wetlands and native population of Arkansas darter, a plains fish listed as threatened by the state of Colorado; Severy Creek, a high elevation stream supporting a native population of greenback cutthroat trout; and Monument Creek with its population of Preble's meadow jumping mouse.

Of the 25 wetland and riparian PCAs, we identified seven of **very high significance** (B2), 10 of **high significance** (B3), and eight of **moderate significance** (B4). Overall,

the concentration and quality of imperiled elements and habitats attest to the fact that conservation efforts in El Paso and Pueblo counties will have both state and global significance.

The results of the survey will be provided to the county in GIS format and will be available to the public on the CNHP website (http:\\www.cnhp.colostate.edu).

CONSERVATION STRATEGIES

Conservation strategies can be classified as three major types:

(1) Land protection can be accomplished through conservation easements, land exchanges, long term leases, purchase of mineral or grazing rights, acquisition, or government regulation;
(2) Management of the land can be influenced so that significant resources are protected; and
(3) Public education about the significant ecological values of the county will engender support for land use decisions that protect these values.

The first necessary step, identification of the significant elements of biodiversity in the county, and their locations, has been taken with this survey. The next step is to use this information to conserve these elements and sites. Specific protection and management needs are addressed under the descriptions of individual PCAs. However, some general recommendations for conservation of biological diversity in El Paso and Pueblo counties are given here:

1. Develop and implement a plan for protecting the Proposed Conservation Areas profiled in this report, with most attention directed toward sites with biodiversity rank (B-rank) B1, B2 and B3. The sites in this report provide a basic framework for implementing a comprehensive conservation program. The B1, B2 and B3 sites, because they have global significance, are in need of priority attention. Consider purchasing development rights or outright purchase from willing owners of land for significant sites that are in need of protection. Support local organizations, such as land trusts, in purchasing or acquiring conservation easements for protection of biological diversity or open space. Explore opportunities to form partnerships to access federal funding for conservation projects. Continue to promote cooperation among local entities to preserve the counties' biodiversity.

2. Use this report in the review of proposed activities in or near Potential Conservation Areas to determine whether activities do or do not adversely affect elements of biodiversity. All of the areas presented contain natural heritage elements of state or global significance. Also, consider the potential natural heritage values of all other sites for which land use decisions are made**,** using this report as a guide for values to be considered. Insist on careful assessments of potential damages, including weed invasion and fragmentation.

Certain land use activities in or near a site may affect the element(s) present there. Wetland and riparian areas are particularly susceptible to impacts from off-site activities if the activities affect water quality or hydrologic regimes. In addition, cumulative impacts from many small changes can have effects as profound and far-reaching as one large change. As proposed land use changes within El Paso and Pueblo counties are considered, they should be compared to the maps presented herein. If a proposed project has the potential to impact a site, planning personnel should contact persons,

organizations, or agencies with the appropriate biological expertise for input in the planning process. The Colorado Natural Heritage Program routinely conducts site specific environmental reviews and should be considered a valuable resource. In addition, one of our key partners, the Colorado Division of Wildlife, should be consulted. To contact CNHP's Environmental Review Coordinator call 970-491-7331.

3. Recognize the importance of all natural communities and lands at all elevations. Although much effort in the past has been directed at protecting the most scenic, high elevation areas, the lower elevations, such as shortgrass prairie or oak shrublands along the foothills, have received less attention. While the specific sites identified here contain the known locations of significant elements of natural diversity, protection of large areas in each vegetation type, especially where these are connected, may ensure that we do not lose species that have not yet been located. Work to protect large blocks of land in each of the major vegetation types in the counties, and avoid fragmenting large natural areas unnecessarily with roads, trails, etc. Although large migrating animals like deer and elk are not tracked by CNHP as rare species, they are a part of our natural diversity, and their needs for winter range and protected corridors to food and water should be taken into consideration. Fragmentation of the landscape also affects smaller animals and plants, opening more edge habitats and introducing exotic species. Encourage cluster developments that designate large common areas for preservation of natural communities, as an alternative to scattering residences over the landscape with a house on each 35-acre parcel. Work with developers early in the planning process to educate them about the benefits of retaining natural areas. Locate trails and roads to minimize impacts on native plants and animals. See Forman and Alexander (1998) for an excellent review of the literature on the ecological effects of roads. See the booklet published by the State Trails Program (Colorado Department of Natural Resources 1998) for suggestions regarding planning trails with minimum impacts to wildlife.

4. Develop and implement comprehensive programs to address loss of wetlands. In conjunction with the information contained in this report, information regarding the degree and trend of loss for all wetland types (e.g., salt meadows, emergent marshes, riparian forests, seeps/springs, etc.) should be sought and utilized to design and implement a comprehensive approach to the management and protection of El Paso and Pueblo county wetlands. Such an effort could provide a blueprint for wetland conservation in the counties. Encourage and support statewide wetland protection efforts such as CDOW's Wetlands Partnership. County governments are encouraged to support research efforts on wetlands to aid in their conservation. Countywide education on the importance of wetlands could be implemented through the county extension service or other local agencies. Encourage communication and cooperation with landowners regarding protection of wetlands in El Paso and Pueblo counties. Utilize the expertise and breadth of experience within the Playa Lakes/Arkansas River Wetland Focus Area Committee.

5. Increase efforts to protect biodiversity, promote cooperation and incentives among landowners, pertinent government agencies, and non-profit conservation organizations, and increase public awareness of the benefits of protecting significant

natural areas. Involve all stakeholders in land use planning. The long-term protection of natural diversity in El Paso and Pueblo counties will be facilitated with the cooperation of many private landowners, businesses, government agencies, and non-government organizations. Efforts to provide stronger ties among federal, state, local, and private interests involved in the protection or management of natural lands will increase the chance of success. Expand public and staff awareness of El Paso and Pueblo counties' natural heritage and its need for protection by providing community education and forums where protection of our natural heritage is discussed.

6. Promote wise management of the biodiversity resources that exist within El Paso and Pueblo counties, recognizing that delineation of potential conservation areas does not by itself provide protection of the plants, animals, and plant communities. Development of a site specific conservation plan is a necessary component of the long-term protection of a Potential Conservation Area. Because some of the most serious impacts to El Paso and Pueblo counties' ecosystems are at a large scale (e.g., altered hydrology, residential encroachment, and non-native species invasion), considering each area in the context of its surroundings is critical. Several organizations and agencies are available for consultation in the development of conservation plans, including the Colorado Natural Heritage Program, the Colorado Division of Wildlife, the Natural Resources Conservation Service, The Nature Conservancy, and various academic institutions. With the rate of population growth in Colorado, rare and imperiled species will continue to decline if not given appropriate protection. Increasing the public's knowledge of the remaining significant areas will build support for the initiatives necessary to protect them, and allow proactive planning. Encourage good management by supporting incentives to landowners for improvements such as fencing riparian areas, controlling weeds, and restoring wildlife habitat.

7. Stay informed and involved in public land management decisions. About five percent of El Paso and Pueblo counties is owned by the U.S. Forest Service and Bureau of Land Management with an additional 14 percent owned by the State Land Board. Many of the sites identified here are on public land that may be protected from development, but not from incompatible uses. Even ownership is not always secure, since the federal and state agencies are becoming more and more involved in land exchanges. The Pike and San Isabel National Forests are in the process of developing new or revised management plans and are seeking public input. Encourage protection for the most biologically significant sites on public lands by implementation of compatible management designated in Forest Management Plans, Grazing Management Plans, etc.

8. Continue inventories where necessary, including inventories for species that cannot be surveyed adequately in one field season and inventories on lands that CNHP could not access in 2000. Not all targeted inventory areas can be field surveyed in one year due to either lack of access, phenology of species, or time constraints. Because some species are ephemeral or migratory, completing an inventory in one field season is often difficult. Despite the best efforts during one field season, it is likely that some elements that are present were not documented during the survey and other important sites have not been identified in this report.

9. Continue to take a proactive approach to weed control in the counties. Give adequate support, in funding and staff, to the county Weed Management offices for weed control. Recognize that weeds affect both agriculture and native plant communities. Discourage the introduction and/or sale of non-native species that are known to significantly impact natural areas. These include, but are not limited to, tamarisk, Russian olive, purple loosestrife, and non-native fish species. Natural area managers, public agencies, and private landowners should be encouraged to remove these species from their properties. Encourage the use of native species for revegetation and landscaping efforts. Ideally, seed should be locally harvested. This includes any seeding done on county road right-of ways. The Colorado Natural Areas Program has published a book entitled *Native Plant Revegetation Guide for Colorado* that describes appropriate species to be used for revegetation. This resource is available on the World Wide Web at http://cnap.state.co.us/cnap/Revegetation_Guide/Reveg_index.html.

INTRODUCTION

Wetlands are places where soils are inundated or saturated with water long enough and frequently enough to significantly affect the plants and animals that live and grow there. Until recently, most people viewed wetlands as a hindrance to productive land use. Consequently, many wetlands across North America were purposefully drained. Since 1986, wetlands have been lost at a rate of 58,500 acres/year in the continental U.S. (Dahl 2000). In Colorado an estimated 1 million acres of wetlands (50 percent of the total for the state) were lost prior to 1980 (Dahl 1990).

Although the rate of wetland loss in El Paso and Pueblo counties is difficult to quantify, it is clear that many wetlands, especially along the Arkansas River and other riparian areas, have been lost or profoundly altered from their pre-settlement state. Development, agriculture, grazing, construction of reservoirs, and water diversions have had many impacts on wetlands throughout the study area. Fertile soils and available water for irrigation make floodplains productive areas for agriculture. Since the nineteenth century, hydrological diversions and the installation of groundwater wells have been developed for irrigation and drinking water supplies. Such activities have eliminated or altered some wetlands, and created other wetlands that are very different from those in existence prior to European settlement. It is clear that with the current rate of land use conversion and the lack of comprehensive wetland protection programs, wetlands will continue to be lost or dramatically altered.

Increasingly, local Colorado governments and federal agencies, particularly in rapidly growing parts of the state, are expressing a desire to better understand their natural heritage resources, including wetlands. The Colorado Natural Heritage Program (CNHP) approached this project with the intent of addressing this desire.

The wetland inventory of El Paso and Pueblo counties, conducted by CNHP, is a part of ongoing wetland inventories of Colorado counties by CNHP. To date, similar inventories have been conducted in all or parts of eleven counties. In addition to the county inventories, a statewide riparian vegetation classification study was conducted (Kittel et al. 1999a). The riparian classification study included sites located in El Paso and Pueblo counties. Currently, CNHP is working on the Comprehensive Statewide Wetland Characterization and Classification Project. This project is compiling data from multiple sources, including CNHP's Riparian Classification, to produce a comprehensive wetland classification for Colorado.

The primary objective of this project was to identify biologically significant wetlands within El Paso and Pueblo counties, with an emphasis on private lands. The *Survey of Critical Wetlands and Riparian Areas in El Paso and Pueblo Counties* used the methodology that is used worldwide throughout Natural Heritage Programs and Conservation Data Centers. The primary focus was to identify the locations of the wetland plant and animal populations and plant communities on CNHP's list of rare and imperiled elements of biodiversity, assess their conservation value, and systematically

prioritize these for conservation action. Wetland functions and restoration potential for each site visited were also assessed.

The locations of biologically significant wetlands were identified by:

- Examining existing biological data for rare or imperiled plant and animal species and significant plant communities (collectively called **elements)**;
- Accumulating additional existing information (e.g., interviews of local experts)
- Conducting extensive field surveys.

Locations in the county with natural heritage significance (those places where elements have been documented) are presented in this report as potential conservation areas (PCAs). The goal is to identify a land area that can provide the habitat and ecological needs upon which a particular element or suite of elements depends for their continued existence. The best available knowledge of each species' life history is used to delineate PCA boundaries in conjunction with information about topographic, geomorphic, and hydrologic features, vegetative cover, and current and potential land uses to delineate PCA boundaries.

The PCA boundaries delineated in this report do not confer any regulatory protection of the site, nor do they automatically recommend exclusion of all activity. It is hypothesized that some activities will prove degrading to the element(s) or the ecological processes on which they depend, while others will not. The boundaries represent the best professional estimate of the primary area supporting the long-term survival of the targeted species or plant communities and are presented for planning purposes. They delineate ecologically sensitive areas where land-use practices should be carefully planned and managed to ensure that they are compatible with protection of natural heritage resources and sensitive species. Please note that these boundaries are based primarily on our understanding of the ecological systems. A thorough analysis of the human context and potential stresses was not conducted. All land within the conservation planning boundary should be considered an integral part of a complex economic, social, and ecological landscape that requires wise land-use planning at all levels.

CNHP uses the Heritage Ranking Methodology to prioritize conservation actions by identifying those areas that have the greatest chance of conservation success for the most imperiled elements. The sites are prioritized according to their **biodiversity significance rank**, or "B-rank," which ranges from B1 (outstanding significance) to B5 (general or statewide significance). These ranks are based on the conservation (imperilment or rarity) ranks for each element and the element occurrence ranks (quality rank) for that particular location. Therefore, the highest quality occurrences (those with the greatest likelihood of long-term survival) of the most imperiled elements are the highest priority (receive the highest B-rank). See the section on Natural Heritage Ranking System for more details. The B1-B3 sites are the highest priorities for conservation actions. The sum of all the sites in this report represents the area CNHP recommends for protection in order to preserve the natural heritage of El Paso and Pueblo counties' wetlands.

THE NATURAL HERITAGE NETWORK RANKING SYSTEM

Just as ancient artifacts and historic buildings represent our cultural heritage, a diversity of plant and animal species and their habitats represent our "natural heritage." Colorado's natural heritage encompasses a wide variety of ecosystems from tallgrass prairie and shortgrass high plains to alpine cirques and rugged peaks, from canyon lands and sagebrush deserts to dense subalpine spruce-fir forests and wide-open tundra.

These widely diversified habitats are determined by water availability, temperature extremes, altitude, geologic history, and land use history. The species that inhabit each of these ecosystems have adapted to the specific set of conditions found there. But, because human influence today touches every part of the Colorado environment, we are responsible for understanding our impacts and carefully planning our actions to ensure our natural heritage persists for future generations.

Some generalist species, like house finches, have flourished over the last century, having adapted to habitats altered by humans. However, many other species are specialized to survive in vulnerable Colorado habitats; among them are Pikes Peak spring parsley (a wildflower), the Arkansas darter (a fish), and the Pawnee montane skipper (a butterfly). These species have special requirements for survival that may be threatened by incompatible land management practices and competition from non-native species. Many of these species have become imperiled not only in Colorado, but also throughout their range of distribution, some existing in less than five populations in the entire world. The decline of these specialized species often indicates disruptions that could permanently alter entire ecosystems. Thus, recognition of rare and imperiled species is crucial to preserving Colorado's diverse natural heritage.

Colorado is inhabited by some 800 vertebrate species and subspecies, and tens of thousands of invertebrate species. In addition, the state has approximately 4,300 species of plants and more than 450 recognized plant communities that represent terrestrial and wetland ecosystems. It is this rich natural heritage that has provided the basis for Colorado's diverse economy. Some components of this heritage have always been rare, while others have become imperiled with human-induced changes in the landscape. This decline in biological diversity is a global trend resulting from human population growth, land development, and subsequent habitat loss. Globally, the loss in species diversity has become so rapid and severe that Wilson (1988) has compared the phenomenon to the great natural catastrophes at the end of the Paleozoic and Mesozoic eras.

The need to address this loss in biological diversity has been recognized for decades in the scientific community. However, many conservation efforts made in this country were not based upon preserving biological diversity; instead, they primarily focused on preserving game animals, striking scenery, and locally favorite open spaces. To address the absence of a methodical, scientifically based approach to preserving biological diversity, Dr. Robert Jenkins of The Nature Conservancy pioneered the Natural Heritage Methodology in the early '70s.

Recognizing that rare and imperiled species are more likely to become extinct than common ones, the Natural Heritage Methodology ranks species according to their rarity or degree of imperilment. The ranking system is scientifically based upon the number of known locations of the species as well as its biology and known threats. By ranking the relative rareness or imperilment of a species, the quality of its populations, and the importance of associated conservation sites, the methodology can facilitate the prioritization of conservation efforts so the most rare and imperiled species may be preserved first. As the scientific community began to realize that plant communities are equally important as individual species, this methodology has also been applied to ranking and preserving rare plant communities, as well as the best examples of common communities.

The Natural Heritage Methodology is used by Natural Heritage Programs throughout North, Central, and South America, forming an international database network. The 85 Natural Heritage Network data centers are located in each of the 50 U.S. states, five provinces of Canada, and 13 countries in South and Central America and the Caribbean. This network enables scientists to monitor the status of species from a state, national, and global perspective. Information collected by the Natural Heritage Programs can provide a means to protect species before the need for legal endangerment status arises. It can also enable conservationists and natural resource managers to make informed, objective decisions in prioritizing and focusing conservation efforts.

What is Biological Diversity?

Protecting biological diversity has become an important management issue for many natural resource professionals. Biological diversity at its most basic level includes the full range of species on Earth, from single-celled species such as bacteria and protists through the multicellular kingdoms of plants and animals. At finer levels of organization, biological diversity includes the genetic variation within species, both among geographically separated populations and among individuals within a single population. On a wider scale, diversity includes variations in the biological communities in which species live, the ecosystems in which communities exist, and the interactions between these levels. All levels are necessary for the continued survival of species and plant communities, and all are important for the well being of humans. It stands to reason that biological diversity should be of concern to all people.

The biological diversity of an area can be described at four levels:

1. **Genetic Diversity** — the genetic variation within a population and among populations of a plant or animal species. The genetic makeup of a species varies between populations within its geographic range. Loss of a population results in a loss of genetic diversity for that species and a reduction of total biological diversity for the region. Once lost, this unique genetic information cannot be reclaimed.

2. **Species Diversity** — the total number and abundance of plant and animal species and subspecies in an area.

3. **Community Diversity** — the variety of plant communities within an area that represent the range of species relationships and inter-dependence. These communities may be diagnostic or even restricted to an area. It is within communities that all life dwells.

4. **Landscape Diversity** — the type, condition, pattern, and connectedness of natural communities. A landscape consisting of a mosaic of natural communities may contain one multifaceted ecosystem, such as a wetland ecosystem. A landscape also may contain several distinct ecosystems, such as a riparian corridor meandering through shortgrass prairie. Fragmentation of landscapes, loss of connections and migratory corridors, and loss of natural communities all result in a loss of biological diversity for a region. Humans and the results of their activities are integral parts of most landscapes.

The conservation of biological diversity must include all levels of diversity: genetic, species, community, and landscape. Each level is dependent on the other levels and inextricably linked. In addition, and all too often omitted, humans are also closely linked to all levels of this hierarchy. We at the Colorado Natural Heritage Program believe that a healthy natural environment and a healthy human environment go hand in hand, and that recognition of the most imperiled species is an important step in comprehensive conservation planning.

Colorado's Natural Heritage Program

To place this document in context, it is useful to understand the history and functions of the Colorado Natural Heritage Program (CNHP).

CNHP is the state's primary comprehensive biological diversity data center, gathering information and field observations to help develop statewide conservation priorities. After operating in the Colorado Division of Parks and Outdoor Recreation for 14 years, the Program was relocated to the University of Colorado Museum in 1992, and then to the College of Natural Resources at Colorado State University in 1994, where it has operated ever since.

The multi-disciplinary team of scientists, planners, and information managers at CNHP gathers comprehensive information on the rare, threatened, and endangered species and significant plant communities of Colorado. Life history, status, and locational data are incorporated into a continually updated data system. Sources include published and unpublished literature, museum and herbaria labels, and field surveys conducted by knowledgeable naturalists, experts, agency personnel, and our own staff of botanists, ecologists, and zoologists.

The Biological and Conservation Data System (BCD), developed by The Nature Conservancy, is used by all natural heritage programs to house data about imperiled species. This data includes taxonomic group, global and state rarity rank, federal and state legal status, observation source, observation date, county, township, range, watershed, and other relevant facts and observations. CNHP also uses the Biological Diversity Tracking System (BIOTICs) for digitizing and mapping occurrences of rare

plants, animals, and plant communities. These rare species and plant communities are referred to as **elements of natural diversity** or simply **elements**.

Concentrating on site-specific data for each element enables CNHP to evaluate the significance of each location for the conservation of biological diversity in Colorado and in the nation. By using species imperilment ranks and quality ratings for each location, priorities can be established to guide conservation action. A continually updated locational database and priority-setting system such as that maintained by CNHP provides an effective, proactive land-planning tool.

To assist in biological diversity conservation efforts, CNHP scientists strive to answer questions such as:

- What species and ecological communities exist in the area of interest?
- Which are at greatest risk of extinction or are otherwise significant from a conservation perspective?
- What are their biological and ecological characteristics, and where precisely are these priority species or communities found?
- What is their condition at these locations, and what processes or activities are sustaining or threatening them?
- Where are the most important sites to protect?
- Who owns or manages those places deemed most important to protect, and what is threatening those places?
- What actions are needed for the protection of those sites and the significant elements of biological diversity they contain?
- How can we measure our progress toward conservation goals?

CNHP has effective working relationships with several state and federal agencies, including the Colorado Department of Natural Resources, the Colorado Division of Wildlife, the Bureau of Land Management, and the U.S. Forest Service. Numerous local governments and private entities, such as consulting firms, educators, landowners, county commissioners, and non-profit organizations, also work closely with CNHP. Use of the data by many different individuals and organizations encourages a proactive approach to conservation, thereby reducing the potential for conflict.

The Natural Heritage Ranking System

Key to the functioning of Natural Heritage Programs is the concept of setting priorities for information gathering and inventory. The number of possible facts and observations that can be gathered about the natural world is essentially limitless. The financial and human resources available to gather such information are not. Because biological inventories tend to be woefully underfunded, there is a premium on devising systems that are both effective in providing information that meets users' needs and efficient in gathering that information. The cornerstone of heritage inventories is the use of a ranking system to achieve these twin objectives of effectiveness and efficiency.

Ranking species and ecological communities according to their imperilment status provides guidance for where natural heritage programs should focus their information-gathering activities. For species deemed secure, only general information needs to be maintained by natural heritage programs. Fortunately, the more common and secure species constitute the majority of most groups of organisms. On the other hand, for those species that are by their nature rare or otherwise threatened, more detailed information is needed. Because of these species' very rarity, gathering comprehensive and detailed population data on them is possible, even if difficult. Gathering similarly comprehensive information on more abundant species would pose a far greater challenge.

To determine the status of species within Colorado, CNHP gathers information on plants, animals, and plant communities. Each of these elements of natural diversity is assigned a rank that indicates its relative degree of imperilment on a five-point scale (for example, 1 = extremely rare/imperiled, 5 = abundant/secure). The primary criterion for ranking elements is the number of occurrences (in other words, the number of known distinct localities or populations). This factor is weighted more heavily than other factors because an element found in one place is more imperiled than something found in twenty-one places. Also of importance is the size of the geographic range, the number of individuals, trends in population and distribution, identifiable threats, and the number of already protected occurrences.

Element imperilment ranks are assigned both in terms of the element's degree of imperilment within Colorado (its State or S-rank) and the element's imperilment over its entire range (its Global or G-rank). Taken together, these two ranks indicate the degree of imperilment of an element. For example, the lynx, which is thought to be secure in northern North America but is known from less than 5 current locations in Colorado, is ranked G5S1 (globally secure, but critically imperiled in this state). The Rocky Mountain Columbine (*Aquilegia saximontana*), which is known only in Colorado from about 30 locations, is ranked a G3S3 (vulnerable both in the state and globally, since it only occurs in Colorado and then in small numbers). Further, a tiger beetle that is only known from one location in the world at the Great Sand Dunes National Monument is ranked G1S1 (critically imperiled both in the state and globally, because it exists in a single location). CNHP actively collects, maps, and electronically processes specific occurrence information for animal and plant species considered extremely imperiled to vulnerable in the state (S1 - S3). Several factors, such as rarity, evolutionary distinctiveness, and endemism (restrictiveness of habitat), contribute to the conservation priority of each species. Certain species are "watchlisted," meaning that specific occurrence data are collected and periodically analyzed to determine whether more active tracking is warranted. A complete description of each of the Natural Heritage ranks is provided in Table 2.

This single rank system works readily for all species except those that are migratory. Animals that migrate may spend only a portion of their life cycles within the state. In these cases, it is necessary to distinguish between breeding, non-breeding, and resident species. As noted in Table 2, ranks followed by a "B," for example S1B, indicate that the rank applies only to the status of breeding occurrences. Similarly, ranks followed by an "N," for example S4N, refer to non-breeding status, typically during migration and

winter. Elements without this notation are believed to be year-round residents within the state.

Table 1. Definition of Natural Heritage Imperilment Ranks
Global imperilment ranks are based on the range-wide status of a species. State imperilment ranks are based on the status of a species in an individual state. State and Global ranks are denoted with an "S" or a "G" respectively, followed by a number or letter. **These ranks should not be interpreted as legal designations.**

G/S1	Critically imperiled globally/state because of rarity (5 or fewer occurrences in the world/state; or 1,000 or fewer individuals), or because some factor of its biology makes it especially vulnerable to extinction.
G/S2	Imperiled globally/state because of rarity (6 to 20 occurrences, or 1,000 to 3,000 individuals), or because other factors demonstrably make it very vulnerable to extinction throughout its range.
G/S3	Vulnerable through its range or found locally in a restricted range (21 to 100 occurrences, or 3,000 to 10,000 individuals).
G/S4	Apparently secure globally/state, though it may be quite rare in parts of its range, especially at the periphery. Usually more than 100 occurrences and 10,000 individuals.
G/S5	Demonstrably secure globally/state, though it may be quite rare in parts of its range, especially at the periphery.
G/SX	Presumed extinct globally, or extirpated within the state.
G#?	Indicates uncertainty about an assigned global rank.
G/SU	Unable to assign rank due to lack of available information.
GQ	Indicates uncertainty about taxonomic status.
G/SH	Historically known, but usually not verified for an extended period of time.
G#T#	Trinomial rank (T) is used for subspecies or varieties. These taxa are ranked on the same criteria as G1-G5.
S#B	Refers to the breeding season imperilment of elements that are not permanent residents.
S#N	Refers to the non-breeding season imperilment of elements that are not permanent residents. Where no consistent location can be discerned for migrants or non-breeding populations, a rank of SZN is used.
SZ	Migrant whose occurrences are too irregular, transitory, and/or dispersed to be reliably identified, mapped, and protected.
SA	Accidental in the state.
SR	Reported to occur in the state but unverified.
S?	Unranked. Some evidence that species may be imperiled, but awaiting formal rarity ranking.

Note: Where two numbers appear in a state or global rank (for example, S2S3), the rank of the element is unclear but likely within the stated range.

Legal Designations

Natural Heritage imperilment ranks should not be interpreted as legal designations. Although most species protected under state or federal endangered species laws are extremely rare, not all rare species receive legal protection. Legal status is designated by either the U.S. Fish and Wildlife Service under the Endangered Species Act or by the Colorado Division of Wildlife under Colorado Statutes 33-2-105 Article 2. In addition, the U.S. Forest Service recognizes some species as "Sensitive," as does the Bureau of Land Management. Table 3 defines the special status assigned by these agencies and provides a key to abbreviations used by CNHP.

Candidate species for listing as endangered or threatened under the Endangered Species Act are indicated with a "C". While obsolete legal status codes (Category 2 and 3) are no longer used, CNHP will continue to maintain them in its Biological and Conservation Data system for reference.

Table 2. Federal and State Agency Special Designations.

Federal Status:

1. U.S. Fish and Wildlife Service (58 Federal Register 51147, 1993) and (61 Federal Register 7598, 1996)

LE Listed Endangered: defined as a species, subspecies, or variety in danger of extinction throughout all or a significant portion of its range.

E(S/A) Endangered: treated as endangered due to similarity of appearance with listed species.

LT Listed Threatened: defined as a species, subspecies, or variety likely to become endangered in the foreseeable future throughout all or a significant portion of its range.

P Proposed: taxa formally proposed for listing as Endangered or Threatened (a proposal has been published in the Federal Register, but not a final rule).

C Candidate: taxa for which substantial biological information exists on file to support proposals to list them as endangered or threatened, but no proposal has been published yet in the Federal Register.

2. U.S. Forest Service (Forest Service Manual 2670.5) (noted by the Forest Service as "S")

FS Sensitive: those plant and animal species identified by the Regional Forester for which population viability is a concern as evidenced by:

- Significant current or predicted downward trends in population numbers or density.
- Significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution.

3. Bureau of Land Management (BLM Manual 6840.06D) (noted by BLM as "S")

BLM Sensitive: those species found on public lands, designated by a State Director, that could easily become endangered or extinct in a state. The protection provided for sensitive species is the same as that provided for C (candidate) species.

State Status:

The Colorado Division of Wildlife has developed categories of imperilment for nongame species (refer to the Colorado Division of Wildlife's Chapter 10 – Nongame Wildlife of the Wildlife Commission's regulations). The categories being used and the associated CNHP codes are provided below.

E Endangered: those species or subspecies of native wildlife whose prospects for survival or recruitment within this state are in jeopardy, as determined by the Commission.

T Threatened: those species or subspecies of native wildlife which, as determined by the Commission, are not in immediate jeopardy of extinction but are vulnerable because they exist in such small numbers, are so extremely restricted in their range, or are experiencing such low recruitment or survival that they may become extinct.

SC Special Concern: those species or subspecies of native wildlife that have been removed from the state threatened or endangered list within the last five years; are proposed for federal listing (or are a federal listing "candidate species") and are not already state listed; have experienced, based on the best available data, a downward trend in numbers or distribution lasting at least five years that may lead to an endangered or threatened status; or are otherwise determined to be vulnerable in Colorado.

Element Occurrence Ranking

Actual locations of elements, whether they are single organisms, populations, or plant communities, are referred to as **element occurrences**. The element occurrence is considered the most fundamental unit of conservation interest and is at the heart of the Natural Heritage Methodology. To prioritize element occurrences for a given species, an element occurrence rank (EO-Rank) is assigned according to the ecological quality of the occurrences whenever sufficient information is available. This ranking system is designed to indicate which occurrences are the healthiest and ecologically the most viable, thus focusing conservation efforts where they will be most successful. The EO-Rank is based on three factors:

Size – a measure of the area or abundance of the element's occurrence, relative to other known, and/or presumed viable, examples. Takes into account factors such as area of occupancy, population abundance, population density, population fluctuation, and minimum dynamic area (which is the area needed to ensure survival or re-establishment of an element after natural disturbance).

Condition/Quality – an integrated measure of the composition, structure, and biotic interactions that characterize the occurrence. This includes factors

such as reproduction, age structure, biological composition (such as the presence of exotic versus native species), structure (for example, canopy, understory, and ground cover in a forest community), and biotic interactions (such as levels of competition, predation, and disease).

Landscape Context – an integrated measure of two factors: the dominant environmental regimes and processes that establish and maintain the element, and connectivity. *Dominant environmental regimes and processes* include herbivory, hydrologic and water chemistry regimes (surface and groundwater), geomorphic processes, climatic regimes (temperature and precipitation), fire regimes, and many kinds of natural disturbances. *Connectivity* includes such factors as a species having access to habitats and resources needed for life cycle completion, fragmentation of ecological communities and systems, and the ability of the species to respond to environmental change through dispersal, migration, or re-colonization.

Each of these factors is rated on a scale of A through D, with A representing an excellent grade and D representing a poor grade. These grades are then averaged to determine an appropriate EO-Rank for the occurrence. If not enough information is available to rank an element occurrence, an EO-Rank of E is assigned. EO-Ranks and their definitions are as follows:

A Excellent: the occurrence is relatively large, pristine, defensible, and viable.

B Good: the occurrence is small but in good condition, or large but removed from its natural condition, and/or not viable and defensible.

C Fair: the occurrence is small, in poor condition, and possibly of questionable viability.

D Poor: the occurrence does not merit conservation efforts because it is too degraded or not viable.

H Historic: known from historical record, but not verified for an extended period of time.

X Extirpated.

E Extant: the occurrence does exist but not enough information is available to rank using the above ranks.

F Failed to find: the occurrence could not be relocated.

Potential Conservation Areas

In order to successfully protect populations or occurrences, it is helpful to delineate Potential Conservation Areas (PCAs). These PCAs focus on capturing the ecological processes that are necessary to support the continued existence of a particular element occurrence of natural heritage significance. Potential Conservation Areas may include a single occurrence of a rare element or a suite of rare element occurrences or significant features.

The goal of the PCA process is to identify a land area that can provide the habitat and ecological processes upon which a particular element occurrence, or suite of element occurrences, depends for its continued existence. The best available knowledge about each species' life history is used in conjunction with information about topographic, geomorphic, and hydrologic features; vegetative cover; and current and potential land uses. In developing the boundaries of a PCA, CNHP scientists consider a number of factors that include, but are not limited to:

- ecological processes necessary to maintain or improve existing conditions;
- species movement and migration corridors;
- maintenance of surface water quality within the PCA and the surrounding watershed;
- maintenance of the hydrologic integrity of the groundwater;
- land intended to buffer the PCA against future changes in the use of surrounding lands;
- exclusion or control of invasive exotic species;
- land necessary for management or monitoring activities.

The boundaries presented are meant to be used for conservation planning purposes and have no legal status. **The proposed boundary does not automatically recommend exclusion of all activity.** Rather, the boundaries designate ecologically significant areas in which land managers may wish to consider how specific activities or land use changes within or near the PCAs affect the natural heritage resources and sensitive species on which the PCA is based. **Please note that these boundaries are based on our best estimate of the primary area supporting the long-term survival of targeted species and plant communities. A thorough analysis of the human context and potential stresses has not been conducted.** However, CNHP's conservation planning staff are available to assist with these types of analyses where conservation priority and local interest warrant additional research.

Off-Site Considerations

Frequently, all necessary ecological processes cannot be contained within a PCA of reasonable size. For example, taken to the extreme, the threat of ozone depletion could expand every PCA to include the entire planet. The boundaries described in this report indicate the immediate, and therefore most important, area to be considered for

protection. Continued landscape level conservation efforts are necessary as well, which will involve regional efforts in addition to coordination and cooperation with private landowners, neighboring land planners, and state and federal agencies.

Ranking of Potential Conservation Areas

CNHP uses element and element occurrence ranks to assess the overall biological diversity significance of a PCA, which may include one or many element occurrences. Based on these ranks, each PCA is assigned a **biological diversity rank** (or B-rank):

B1 Outstanding Significance (irreplaceable):

- Only known occurrence of an element
- A-ranked occurrence of a G1 element (or at least C-ranked if best available occurrence)
- Concentration of A- or B-ranked occurrences of G1 or G2 elements (four or more)

B2 Very High Significance:

- B- or C-ranked occurrence of a G1 element
- A- or B-ranked occurrence of a G2 element
- One of the most outstanding (for example, among the five best) occurrences rangewide (at least A- or B-ranked) of a G3 element
- Concentration of A- or B-ranked G3 elements (four or more)
- Concentration of C-ranked G2 elements (four or more)

B3 High Significance:

- C-ranked occurrence of a G2 element
- A- or B-ranked occurrence of a G3 element
- D-ranked occurrence of a G1 element (if best available occurrence)
- Up to five of the best occurrences of a G4 or G5 community (at least A- or B-ranked) in an ecoregion (requires consultation with other experts)

B4 Moderate Significance:

- Other A- or B-ranked occurrences of a G4 or G5 community
- C-ranked occurrence of a G3 element
- A- or B-ranked occurrence of a G4 or G5 S1 species (or at least C-ranked if it's the only state, provincial, national, or ecoregional occurrence)
- Concentration of A- or B-ranked occurrences of G4 or G5 N1-N2, S1-S2 elements (four or more)
- D-ranked occurrence of a G2 element
- At least C-ranked occurrence of a disjunct G4 or G5 element

- Concentration of excellent or good occurrences (A- or B-ranked) of G4/S1 or G5/S1 elements (four or more)

B5 General or State-wide Biological Diversity Significance: good or marginal occurrence of common community types and globally secure S1 or S2 species.

Protection Urgency Ranks

Protection urgency ranks (P-ranks) refer to the timeframe in which it is recommended that conservation protection occur. In most cases, this rank refers to the need for a major change of protective status (for example agency special area designations or ownership). The urgency for protection rating reflects the need to take legal, political, or other administrative measures to protect the area. Protection urgency ranks are as follows:

P1 Very High Urgency. Protection actions needed immediately. It is estimated that current stresses may reduce the viability of the elements in the PCA within 1 year.

P2 High Urgency. Protection actions may be needed within 5 years. It is estimated that current stresses may reduce the viability of the elements in the PCA within this approximate timeframe.

P3 Moderate Urgency. Protection actions may be needed, but probably not within the next 5 years. It is estimated that current stresses may reduce the viability of the elements in the PCA if protection action is not taken.

P4 Low Urgency. No protection actions are needed in the foreseeable future.

P5 Low Urgency. Land protection is complete and no protection actions are needed.

A protection action involves increasing the current level of legal protection accorded one or more tracts within a potential conservation area. It may also include activities such as educational or public relations campaigns, or collaborative planning efforts with public or private entities, to minimize adverse impacts to element occurrences at a site. It does not include management actions. Situations that may require a protection action are as follows:

- Forces that threaten the existence of one or more element occurrences at a PCA. For example, development that would destroy, degrade or seriously compromise the long-term viability of an element occurrence; or timber, range, recreational, or hydrologic management that is incompatible with an element occurrence's existence;

- The inability to undertake a management action in the absence of a protection action; for example, obtaining a management agreement;

- In extraordinary circumstances, a prospective change in ownership or management that will make future protection actions more difficult.

Management Urgency Ranks

Management urgency ranks (M-ranks) indicate the timeframe in which it is recommended that a change occur in management of the element or PCA. This rank refers to the need for management in contrast to protection (for example, increased fire frequency, decreased grazing, weed control, etc.). The urgency for management rating focuses on land use management or land stewardship action required to maintain element occurrences at the potential conservation area.

A management action may include biological management (prescribed burning, removal of exotics, mowing, etc.) or people and site management (building barriers, rerouting trails, patrolling for collectors, hunters, or trespassers, etc.). Management action does not include legal, political, or administrative measures taken to protect a potential conservation area. The following codes are used to indicate the action needed to be taken at the area:

M1 Very High Urgency. Management actions may be required within one year or the element occurrences could be lost or irretrievably degraded.

M2 High Urgency. New management actions may be needed within 5 years to prevent the loss of the element occurrences within the PCA.

M3 Moderate Urgency. New management actions may be needed within 5 years to maintain the current quality of the element occurrences in the PCA.

M4 Low Urgency. Current management seems to favor the persistence of the elements in the PCA, but management actions may be needed in the future to maintain the current quality of the element occurrences.

M5 Low Urgency. No management needs are known or anticipated in the PCA.

WETLAND DEFINITIONS, REGULATIONS, AND FUNCTIONAL ASSESSMENTS

Wetland Definitions

The federal regulatory definition of a jurisdictional wetland is found in the regulations used by the U.S. Army Corps of Engineers (Corps) for the implementation of a dredge and fill permit system required by Section 404 of the Clean Water Act Amendments (Mitsch and Gosselink 1993). According to the Corps, wetlands are "those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstance do support, a prevalence of vegetation typically adapted for life in saturated soil conditions." For Corps programs, a wetland boundary must be determined according to the mandatory technical criteria described in the Corps of Engineers Wetlands Delineation Manual (Environmental Laboratory 1987). In order for an area to be classified as a jurisdictional wetland (i.e., a wetland subject to federal regulations), it must have **all** three of the following criteria: (1) wetland plants; (2) wetland hydrology; and (3) hydric soils.

The U.S. Fish and Wildlife Service defines wetlands from an ecological point of view. In *Classification of Wetlands and Deepwater Habitats of the United States* (Cowardin et al. 1979) the definition states that "wetlands are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water." Wetlands must have *one or more* of the following three attributes: (1) at least periodically, the land supports predominantly hydrophytes (wetland plants); (2) the substrate is predominantly undrained hydric soil; and/or (3) the substrate is non-soil and is saturated with water or covered by shallow water at some time during the growing season of each year. This definition only requires that an area meet one of the three criteria (vegetation, soils, and hydrology) in order to be classified as a wetland.

CNHP prefers the wetland definition used by the U.S. Fish and Wildlife Service, because it recognizes that some areas display many of the attributes of wetlands without exhibiting all three characteristics required to fulfill the Corps' criteria. Additionally, riparian areas (riverine corridors), which often do not meet all three of the Corps criteria, should be included in a wetland conservation program. Riparian areas perform many of the same functions as do wetlands, including maintenance of water quality, storage of floodwaters, and enhancement of biodiversity, especially in the western United States (National Research Council 1995).

Wetland Regulation in Colorado

Wetlands in Colorado are currently regulated under the authority of the Clean Water Act. A permit issued by the Corps is required before placing fill in a wetland (e.g., building up a site before constructing a home), and before dredging, ditching, or channelizing a wetland. The Clean Water Act exempts certain filling activities, such as normal agricultural activities.

The 404(b)(1) guidelines, prepared by the Environmental Protection Agency in consultation with the Corps, are the federal environmental regulations for evaluating

projects that will impact wetlands. Under these guidelines, the Corps is required to determine if alternatives exist for minimizing or eliminating impacts to wetlands. When unavoidable impacts occur, the Corps requires mitigation of the impacts. Mitigation may involve creation or restoration of similar wetlands in order to achieve an overall goal of no net loss of wetland area.

The U.S. Fish and Wildlife Service has conducted inventories of the extent and types of our nation's wetlands. The Cowardin et al. (1979) classification system provides the basic mapping units for the U.S. National Wetlands Inventory (NWI). The NWI drew maps for most of El Paso and Pueblo counties based on 1:80,000 scale black and white photos taken between 1974 and 1976. A few maps are based on color infrared photography flown in the 1980s. Photo-interpretation and field reconnaissance was used to refine wetland boundaries according to the wetland classification system. The information is summarized on 1:24,000 maps.

The NWI maps provide important and accurate information regarding the location of wetlands. They can be used to gain an understanding of the general types of wetlands in the county and their distribution. The NWI maps cannot be used for federal regulatory programs that govern wetlands for two reasons. First, the U.S. Fish and Wildlife Service uses a definition for a wetland that differs slightly from Corps, the agency responsible for executing federal wetland regulations. Secondly, there is a limit to the resolution of the 1:24,000 scale maps. For example, at this scale, the width of a fine line on a map represents about 17 feet (5 m) on the ground (Mitsch and Gosselink 1993). For this reason, precise wetland boundaries must be determined on a project by project basis. Colorado's state government has developed no guidelines or regulations concerning the management, conservation, and protection of wetlands, but a few county and municipal governments have, including the City of Boulder, Boulder County, and San Miguel County.

Wetland Functions and Values

Wetlands perform many functions beyond simply providing habitat for plants and animals. It is commonly known that wetlands act as natural filters, helping to protect water quality, but it is less well known that wetlands perform other important functions. Adamus et al. (1991) list the following functions performed by wetlands:

- Groundwater recharge--the replenishing of below ground aquifers.
- Groundwater discharge--the movement of groundwater to the surface (e.g., springs).
- Floodflow alteration--the temporary storage of potential flood waters.
- Sediment stabilization--the protection of stream banks and lake shores from erosion.

- Sediment/toxicant retention--the removal of suspended soil particles from the water, along with toxic substances that may be adsorbed to these particles.

- Nutrient removal/transformation--the removal of excess nutrients from the water, in particular nitrogen and phosphorous. Phosphorous is often removed via sedimentation; transformation includes converting inorganic forms of nutrients to organic forms and/or the conversion of one inorganic form to another inorganic form (e.g., NO_3^- converted to N_2O or N_2 via denitrification).

- Production export--supply organic material (dead leaves, soluble organic carbon, etc.) to the base of the food chain.

- Aquatic diversity/abundance--wetlands support fisheries and aquatic invertebrates.

- Wildlife diversity/abundance--wetlands provide habitat for wildlife.

Adamus and Stockwell (1983) include two items they call "values" which also provide benefits to society:

- Recreation--wetlands provide areas for fishing, birdwatching, etc.

- Uniqueness/heritage value--wetlands support rare and unique plants, animals, and plant communities.

"Values" are subject to societal perceptions, whereas "functions" are biological or physical processes that occur in wetlands, regardless of the value placed on them by society (National Research Council 1995). The actual value attached to any given function or value listed above depends on the needs and perceptions of society.

Wetland Functional Assessment

For this project, CNHP utilized a qualitative, descriptive functional assessment based on the best professional judgment of CNHP ecologists while incorporating some of the principles of the hydrogeomorphic (HGM) assessment method. Each wetland was classified according to both the Cowardin et al. (1979) and hydrogeomorphic (HGM) (Brinson 1993) classification systems and twelve categories (listed below) were used to assess each wetland. Using the HGM method, wetland functions are evaluated or compared only with respect to other wetlands in the same subclass, because different subclasses often perform very different functions. For example, a montane kettle pond may provide habitat for rare plant communities never found on a large river but provides little in the way of flood control, while wetlands along a major river perform important flood control functions but may not harbor rare plant species. Thus, the category, **Overall Functional Integrity**, was included in the functional assessment to provide the user of some indication of how a particular wetland is functioning in comparison to its natural capacity, as opposed to comparing it to different wetland types.

The functional assessment assigns to each of the functions a value rating of "low", "moderate", or "high". The following functions were evaluated for most of the sites profiled in this report:

- Overall functional integrity
- Flood attenuation and storage
- Sediment/shoreline stabilization
- Groundwater discharge/recharge
- Dynamic surface water storage
- Elemental cycling
- Removal of imported nutrients, toxicants, and sediments
- Habitat diversity
- General wildlife habitat
- General fish/aquatic habitat
- Production export/food chain support
- Uniqueness

Overall Functional Integrity

The overall functional integrity of each wetland is a rating indicating how a particular wetland is functioning in comparison to wetlands in its same hydrogeomorphic class and/or subclass (see discussion below). For example, mineral soil flats (salt meadows) do not typically function as high wildlife habitat but do have high capacity for storing surface/groundwater. Thus, a mineral soil flat that is given a low rating for General Wildlife Habitat, General Fish Habitat, and Production Export/Food Chain Support does not necessarily indicate that the wetland is not functioning to its capacity. These ratings may just reflect that mineral soil flats, because of their landscape position and soil chemistry, naturally perform fewer functions than a depressional wetland. However, this particular wetland may be functioning the 'best' that could be expected from a mineral soil flat. The Overall Functional Integrity rating would reflect this by giving this particular wetland a 'Functioning at Potential' rating, based on the best professional judgment of CNHP ecologists. In summary, a mineral soil flat wetland having more "low" ratings than a depressional wetland does not necessarily mean that it is functioning improperly. However, if this particular mineral soil flat was given an Overall Functional Integrity rating of 'Functioning Below Normal', then it could be assumed that the wetland is not functioning to the capacity that it should (relative to other mineral soil flat wetlands).

Flood Attenuation and Storage

Many wetlands have a high capacity to store or delay floodwaters that occur from peak flow, gradually recharging the adjacent groundwater table. Indicators of flood storage include: debris along streambank and in vegetation, low gradient, formation of sand and gravel bars, high density of small and large depressions, and dense vegetation. This field assesses the capability of the wetland to detain moving water from in-channel flow or overbank flow for a short duration when the flow is outside of its channel.

Sediment/Shoreline Stabilization
Shoreline anchoring is the stabilization of soil at the water's edge by roots and other plant parts. The vegetation dissipates the energy caused by fluctuations of water and prevents streambank erosion. The presence of woody vegetation and sedges in the understory are the best indicator of good sediment/shoreline anchoring.

Groundwater Discharge/Recharge
Groundwater recharge occurs when the water level in a wetland is higher than the surrounding water table resulting in the movement (usually downward) of surface water (e.g., floodwater retention). Groundwater discharge results when the land surface is lower than the surrounding water table, resulting in the movement (usually laterally or upward) of groundwater (e.g., springs, seeps, etc.). Groundwater movement can greatly influence some wetlands, whereas in others it may have minimal effect (Carter and Novitzki 1988).

Both groundwater discharge and recharge are difficult to estimate without intensive data collection. Wetland characteristics that may indicate groundwater recharge are: porous underlying strata, irregularly shaped wetland, dense vegetation, and presence of a constricted outlet. Indicators of groundwater discharge are the presence of seeps and springs and wet slopes with no obvious water source.

Dynamic Surface Water Storage
Dynamic surface water storage refers to the potential of the wetland to capture water from precipitation and upland surface (sheetflow). Sheetflow is nonchannelized flow that usually occurs during and immediately following rainfall or a spring thaw. Wetlands can also receive surface inflow from seasonal or episodic pulses of flood waters from adjacent streams and rivers that may otherwise not be hydrologically connected with a particular wetland (Mitsch and Gosselink 1993). Spring thaw and/or rainfall can also create a time-lagged increase in groundwater flow. Wetlands providing dynamic surface water storage are capable of releasing these episodic pulses of water at a slow, stable rate thus alleviating short term flooding from such events. This function is applicable to wetlands that are not subject to flooding from in-channel or overbank flow (see Flood Storage and Attenuation). Indicators of potential surface water storage include flooding frequency, density of woody vegetation (particular those species with many small stems), coarse woody debris, surface roughness, and size of the wetland.

Elemental Cycling
The cycling of nutrients, or the abiotic and biotic processes that convert elements from one form to another, is a fundamental ecosystem process that maintains a balance between living biomass and detrital stocks (Brinson et al. 1985). Disrupting nutrient cycles could cause an imbalance between the two, resulting in one factor limiting the other. Thus, impacts to aboveground primary productivity or disturbances to the soil, which may cause a shift in nutrient cycling rates, could change soil fertility, alter plant species composition, and affect potential habitat functions. Indicators of wetlands with intact nutrient cycling need to be considered relative to wetlands within the same hydrogeomorphic class/subclass. Such indicators include high aboveground primary

productivity and high quantities of detritus, within the range expected for that particular hydrogeomorphic class of wetlands.

Removal of Imported Nutrients, Toxicants, and Sediments

Nutrient retention/removal is the storing and/or transformation of nutrients within the sediment or vegetation. Inorganic nutrients can be transformed into an organic form and/or converted to another inorganic form via microbial respiration and redox reactions. For example, denitrification, which is a process that is mediated by microbial respiration, results in the transformation of nitrate (NO_3^-) to nitrous oxide (N_2O) and/or molecular nitrogen (N_2). Nutrient retention/removal may help protect water quality by retaining or transforming nutrients before they are carried downstream or are transported to underlying aquifers. Particular attention is focused on processes involving nitrogen and phosphorus, as these nutrients are usually of greatest importance to wetland systems (Kadlec and Kadlec 1979). Nutrient storage may be for long-term (greater than 5 years) as in peatlands or depressional marshes or short-term (30 days to 5 years) as in riverine wetlands. Some indicators of nutrient retention include: high sediment trapping, organic matter accumulation, presence of free-floating, emergent, and submerged vegetation, and permanently or semi-permanently flooded areas.

Sediment and toxicant trapping is the process by which suspended solids and chemical contaminants are retained and deposited within the wetland. Deposition of sediments can ultimately lead to removal of toxicants through burial, chemical break down, or temporary assimilation into plant tissues (Boto and Patrick 1979). Most vegetated wetlands are excellent sediment traps, at least in the short term. Wetland characteristics indicating this function include: dense vegetation, deposits of mud or organic matter, gentle sloping gradient, and location next to beaver dams or human-made detention ponds/lakes.

Habitat Diversity

Habitat diversity refers to the number of Cowardin wetland classes present at each site. Thus, a site with emergent, scrub/shrub, and forested wetland habitat would have high habitat diversity. The presence of open water in these areas also increases the habitat diversity at a site.

General Wildlife and Fish Habitat

Habitat includes those physical and chemical factors that affect the metabolism, attachment, and predator avoidance of the adult or larval forms of fish, and the food and cover needs of wildlife. Wetland characteristics indicating good fish habitat include: deep, open, non-acidic water, no barriers to migration, well-mixed (high oxygen content) water, and highly vegetated. Wetland characteristics indicating good wildlife habitat are: good edge ratio, islands, high plant diversity, and a sinuous and irregular basin.

Production Export/Food Chain Support

Production export refers to the flushing of relatively large amounts of organic material (both particulate and dissolved organic carbon and detritus) from the wetland to downstream ecosystems. Production export emphasizes the production of organic

substances within the wetland and the utilization of these substances by fish, aquatic invertebrates, and microbes. Food chain support is the direct or indirect use of nutrients, carbon, and even plant species (which provide cover and food for many invertebrates) by organisms that inhabit or periodically use wetland ecosystems. Indicators of wetlands that provide downstream food chain support are: an outlet, seasonally flooded hydrological regime, overhanging vegetation, and dense and diverse vegetation composition and structure.

Uniqueness

This value expresses the general uniqueness of the wetland in terms of relative abundance of similar sites occurring in the same watershed, size, geomorphic position, peat accumulation, mature forested areas, and the replacement potential.

Hydrogeomorphic (HGM) Approach to Wetland Functional Assessment

In an effort to provide a more consistent and logical basis for regulatory decisions about wetlands, a new approach to assessing wetland functions--the *hydrogeomorphic* approach is being developed. In Colorado, the hydrogeomorphic, or HGM, approach to wetland function assessment is being developed by the Colorado Geological Survey, with help from the U.S. Army Corps of Engineers, other government agencies, academic institutions, the Colorado Natural Heritage Program, and representatives from private consulting firms (Colorado Geological Survey et al. 1998).

This approach is based on a classification of wetlands according to their hydrology (water source and direction of flow) and geomorphology (landscape position and shape of the wetland) called "hydrogeomorphic" classification (Brinson 1993). There are four hydrogeomorphic classes present in Colorado: riverine, slope, depression, and mineral soil flats (Table 1). Within a geographic region, HGM wetland classes are further subdivided into subclasses. A subclass includes all those wetlands that have essentially the same characteristics and perform the same functions.

One of the fundamental goals of HGM is to create a system whereby every wetland is evaluated according to the same standard. In the past, wetland functional assessments typically were on a site by site basis, with little ability to compare functions or assessments between sites. HGM allows for consistency, first through the use of a widely applicable classification, then through the use of *reference wetlands*. Reference wetlands are chosen to encompass the known variation of a subclass of wetlands. A subset of reference wetlands is a *reference standard*, wetlands that correspond to the highest level of functioning of the ecosystem across a suite of functions (Brinson and Rheinhardt 1996).

HGM assumes that the highest, sustainable functional capacity is achieved in wetland ecosystems and landscapes that have not been subject to long-term anthropogenic disturbance. Under these conditions, the structural components and physical, chemical, and biological processes in the wetland and surrounding landscape are assumed to be at a dynamic equilibrium that allows maximum ecological function (Smith et al. 1995). If a wetland is to be designated a reference standard for a given subclass of wetlands, it must

meet these criteria. The need to locate reference wetlands is compatible with CNHP's efforts to identify those wetlands with the highest biological significance, in that the least disturbed wetlands will often be those with the highest biological significance.

Table 3. Hydrogeomorphic Wetland Classes in Colorado (Cooper 1998 as cited in Colorado Geological Survey et al. 1998).

Class	**Geomorphic setting**	**Water Source**	**Water Movement**	**Subclass**	**Examples**
Riverine	In riparian areas along rivers and streams	Overbank flow from channel	One-directional and horizontal (downstream)	R1-steep gradient, low order streams R2-moderate gradient, low to middle order R3-middle elevation, moderate gradient along small/mid-order stream R4-low elevation canyons or plateaus R5-low elev. Floodplains	Herbaceous subalpine plant community. Willow shrublands along a montane creek Greenhorn Creek at Rye Yampa River in Dinosaur N.M. Big Sandy Creek at Calhan; Arkansas River
Slope	At the base of slopes, e.g., along the base of the foothills; also, places where porous bedrock overlying a non-porous bedrock intercepts the ground surface.	Groundwater	One-directional, horizontal (to the surface from groundwater)	S1-alpine and subalpine fens on non-calcareous substrates. S2-subalpine and montane fens on calcareous substrates S3-wet meadows at middle elev. S4-low elevation meadows	Big Meadows in Rocky Mtn. N.P. High Creek Fen in Park County Wet meadows Judge Orr Road wet meadows
Depressional	In depressions cause by glacial action (in the mountains) and oxbow ponds within floodplains. Lake, reservoir, and pond margins are also included.	Precipitation and shallow groundwater	Generally two-directional, vertical: flowing into and out of the wetland in the bottom and sides of the depression	D1-mid to high elevation basins with peat soils or lake fringe without peat D2-low elevation basins that are permanently or semi-permanently flooded D3-low elevation basin with seasonal flooding D4-low elevation basins that are temporarily flooded D5-low elevation basins that are intermittently flooded	Kettle ponds Cattail wetlands at Nepesta on Arkansas River Mishak Lake in San Luis Valley Abandoned beaver ponds. Playa lakes.
Mineral Soil Flat	Topographically flat wetland	Precipitation and groundwater	Two directional	F1-low elevation with seasonal high water table	Greasewood flats at Boone Creek

PROJECT BACKGROUND

Location and Physical Characteristics of Study Area

El Paso and Pueblo counties are located along the convergence of the high plains and the Rocky Mountains in south central Colorado (Figure 1). El Paso County encompasses 2,128 square miles (551,000 ha) and ranges in elevation from 5,230 feet (1,594 m) on the shortgrass prairie in the southeast corner to 14,110 feet (4,300 m) at Pikes Peak. Pueblo County encompasses 2,396 square miles (621,000 ha) and ranges in elevation from 4,320 feet (1,317 m) where the Arkansas River flows into Crowley and Otero counties to 12,347 feet (3,763 m) at Greenhorn Mountain in the Wet Mountains. Counties that surround El Paso and Pueblo counties include Crowley, Otero, Las Animas, Huerfano, Custer, Fremont, Teller, Douglas, Elbert, and Lincoln.

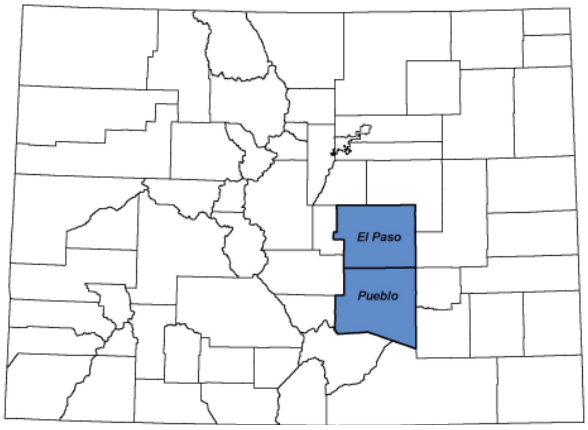


Figure 1. Location of El Paso and Pueblo Counties in Colorado

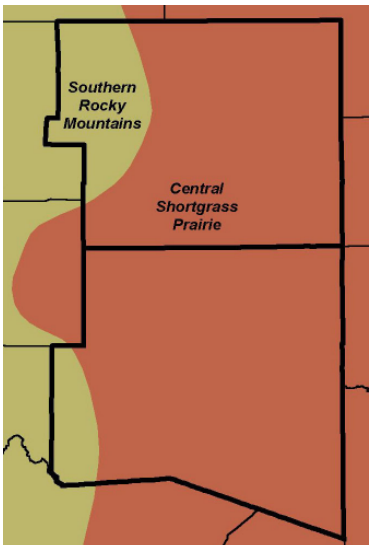


Figure 2. Ecoregions of El Paso and Pueblo Counties

The principal mountainous features located within El Paso and Pueblo counties include the Rampart Range, Pikes Peak, and the Wet Mountains. Foothills form the transition between the mountains and the plains. Other physiographic features within the counties include the Black Forest in northern El Paso County and the Arkansas River Valley in western Pueblo County.

El Paso and Pueblo counties are located within the Southern Rocky Mountains and Central Shortgrass Prairie ecoregions as defined by The Nature Conservancy (modified from Bailey (1994)) (Figure 2). The Central Shortgrass Prairie ecoregion is characterized by rolling plains and tablelands dissected by streams, canyons, badlands, and buttes, and is dominated by shortgrass, mixed-grass, and sandsage prairie (The Nature Conservancy 1998). Small

patches of remnant tallgrass prairie occur along the base of the foothills and in other areas where the soils and moisture regime are appropriate.

The principal drainage within the counties is the Arkansas River (Figure 3). However, the extreme northern portion of El Paso County is within the South Platte River watershed. The principal tributaries to the Arkansas River include Fountain Creek, Black Squirrel Creek, Chico Creek, Big Sandy Creek, Saint Charles River, and Huerfano River.

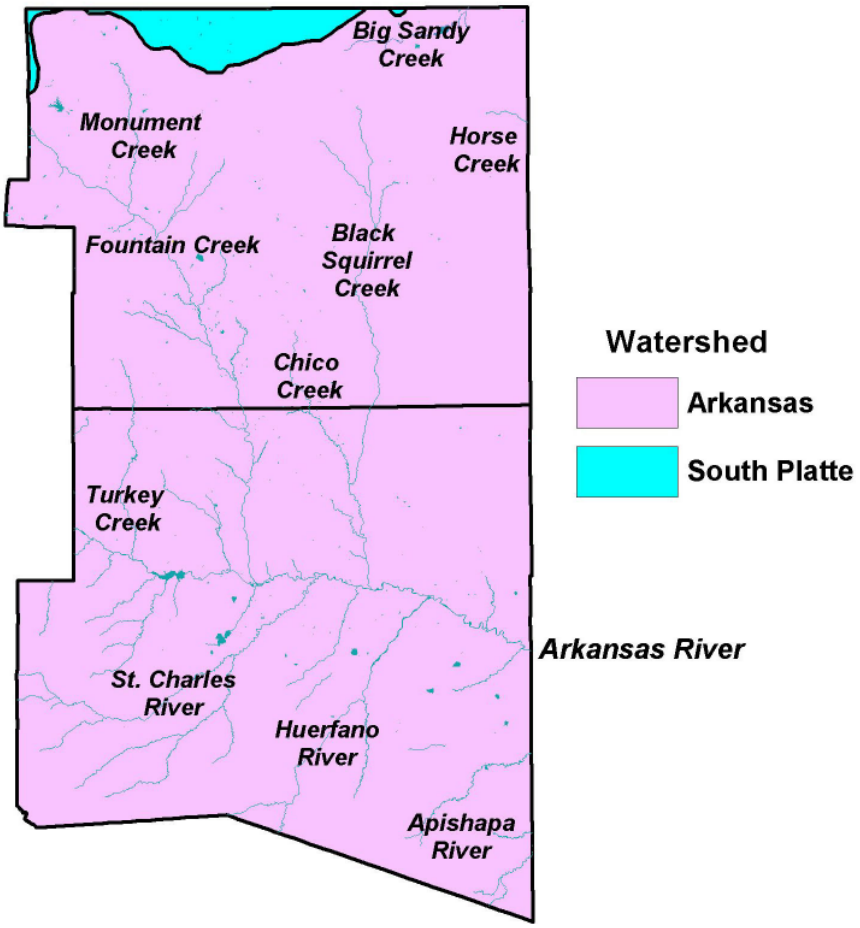


Figure 3. Major Drainages in El Paso and Pueblo Counties

The climate within the counties varies greatly with elevation. Average annual precipitation within the region ranges from less than 12 inches (30.5 cm) per year in eastern Pueblo County to over 30 inches (76 cm) per year at Greenhorn Mountain in western Pueblo County (Figure 4). The wettest (highest rainfall) months are July and August when the rain often falls in severe, localized thunderstorms (Western Regional Climate Center 2001). July is the hottest month; Colorado Springs and Pueblo have mean maximum temperatures of 84.5 and 92.4 degrees F (29.2 and 33.6 degree C) respectively. January is the coldest month with mean low temperatures of 16.3 and 13.8 degrees F (-8.7 and -10.1degree C) in Colorado Springs and Pueblo respectively (Western Regional Climate Center 2001).

El Paso and Pueblo counties are experiencing rapid human population growth. Between 1990 and 2000, the populations in El Paso and Pueblo counties have increased by 30.2 and 15.0 percent respectively (U.S. Census Bureau 2001). Current population estimates for El Paso and Pueblo counties are 516,929 and 141,472 respectively (U.S. Census Bureau 2001). The primary population centers are Colorado Springs and Pueblo (Figure 5). In both counties, development is spreading west into the foothills, east onto the plains, and north and south along the foothills/Front Range/Wet Mountains corridor. Residential development is occurring at all scales including high-density subdivisions and 35-acre ranchettes.

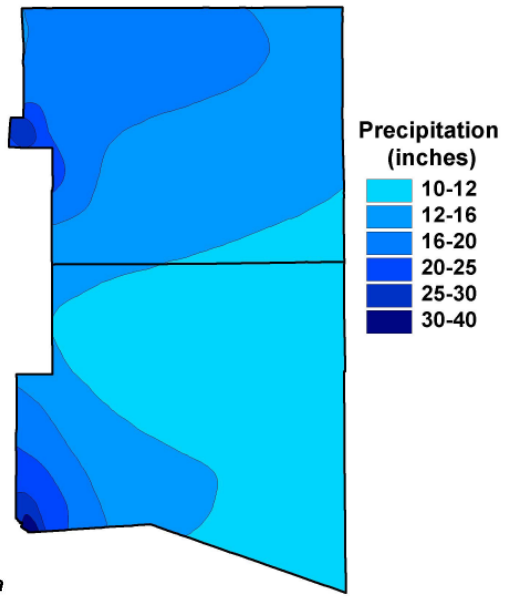


Figure 4. Average Annual Precipitation in El Paso and Pueblo Counties

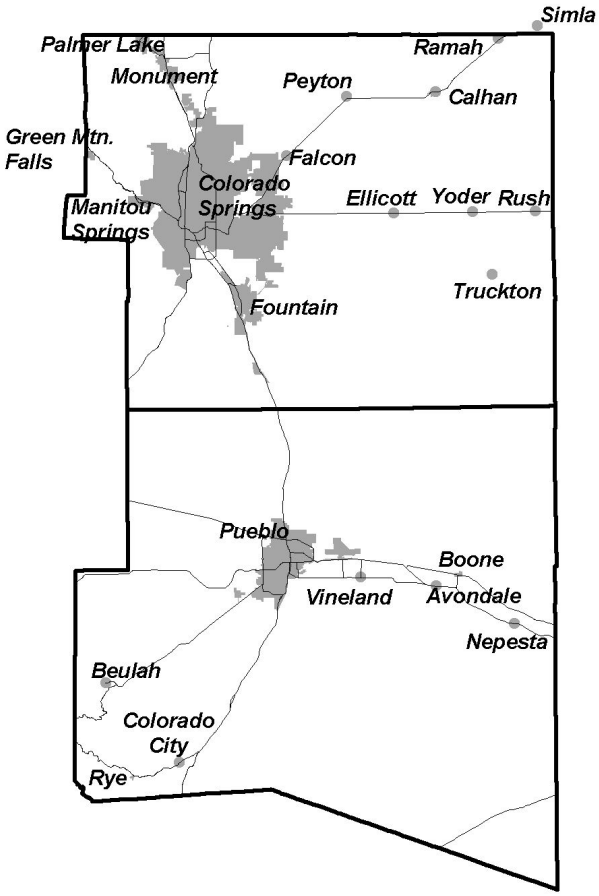


Figure 5. Municipalities and Major Towns in El Paso and Pueblo Counties

More than 75 percent of the land within the counties is privately owned (Figure 6) (Colorado Division of Wildlife 1998). The Colorado State Land Board owns about 14 percent, primarily in a contiguous area in south-central El Paso County and north-central Pueblo County (Note: the coverage of state-owned land shown in Figure 6 is not current.

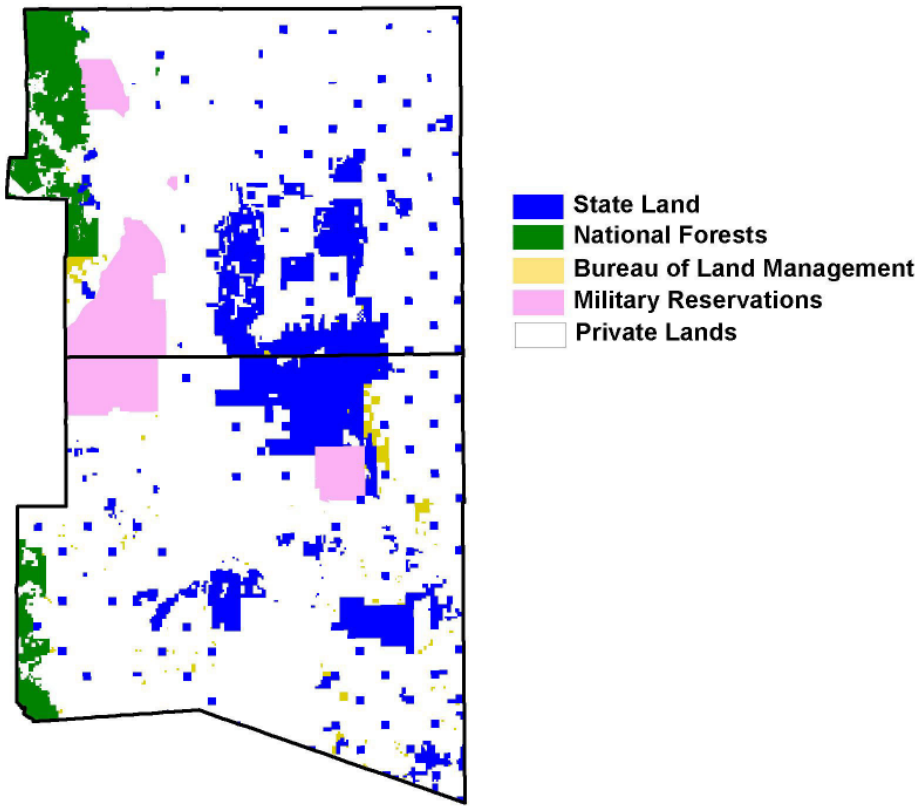


Figure 6. Land Ownership in El Paso and Pueblo Counties

Additional lands within the central portion of El Paso County that were recently purchased by the state are not reflected on the map). The Department of Defense (Fort Carson Military Reservation, the U.S. Air Force Academy, Farish Recreation Area, Peterson Air Force Base, Schriever Air Force Base, and Pueblo Chemical Depot) is the third largest ownership category with 6 percent. The U.S. Forest Service owns and manages the Pike National Forest in El Paso County and the San Isabel National Forest in Pueblo County. The San Isabel National Forest in Pueblo County includes a portion of the Greenhorn Mountain Wilderness Area. Two state wildlife areas managed by the Colorado Division of Wildlife, Ramah Reservoir in El Paso County and Lake Pueblo in Pueblo County, are also included within the study area.

Geology and Hydrology

The geologic features of the counties range from quaternary alluvial deposits to Precambrian rocks exposed at Pikes Peak and the Wet Mountains (Figure 7) (Green 1992). Throughout much of the study area, the bedrock is covered by alluvial (carried by water) and eolian (wind blown) deposits except along the flanks of deeply cut streams (Romero 1992). The northern portion of El Paso County is underlain by deposits of the Denver Basin (Dawson, Denver, Arapahoe, Laramie-Fox Hills). These formations form a large bowl centered around the city of Denver with the southern end extending to Colorado Springs (Figure 8). The Denver Basin is tapped by Denver and other Front Range cities as a significant water source. Underlying the Denver Basin formations is the relatively impermeable Pierre Shale, the bedrock formation beneath parts of Colorado

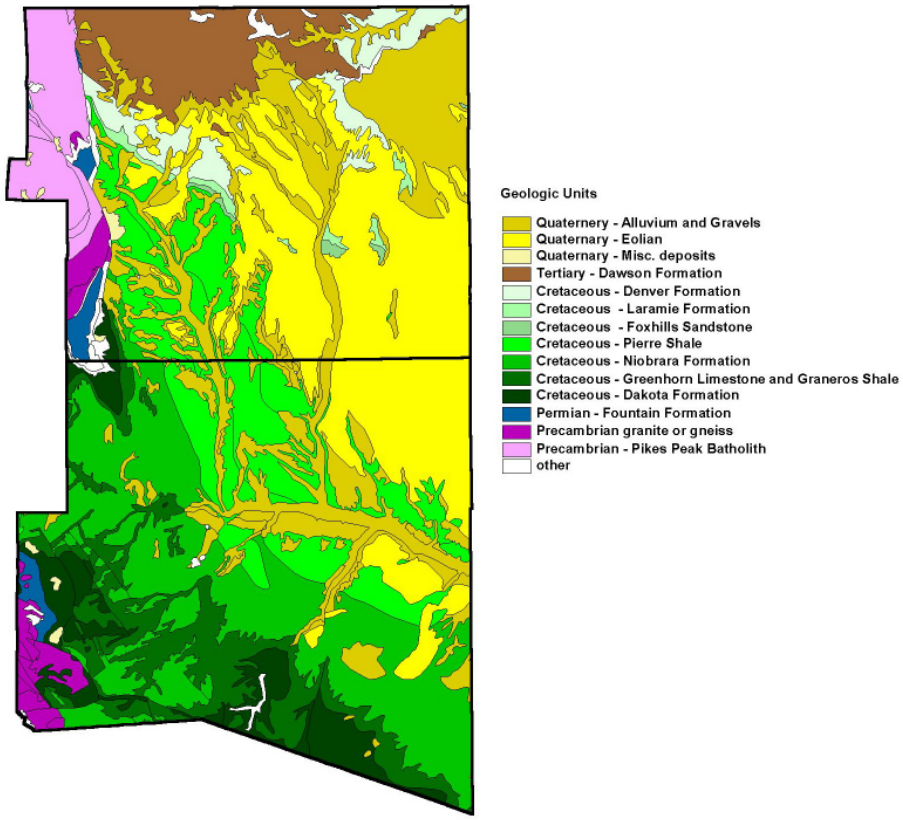


Figure 7. Geology of El Paso and Pueblo Counties (simplified from Green 1992 and Tweto 1979)

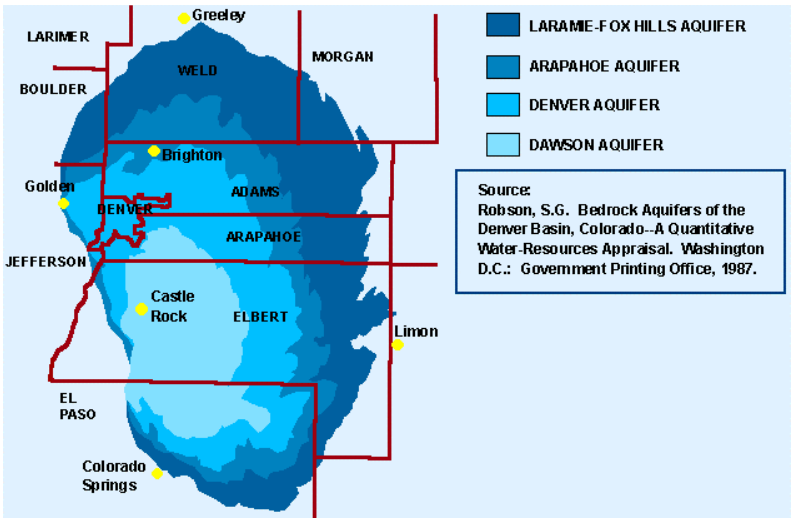


Figure 8. Bedrock Aquifers of the Denver Basin
(map from CSU WaterKnowledge website)

Springs (Chronic 1980) and Pueblo County. Beneath the Pierre Shale is the Niobrara Shale, a series of interbedded limestones and shales, which outcrops in the Arkansas River Valley in Pueblo County. Beneath the Niobrara Formation is the Dakota Sandstone, the formation making up the Dakota Hogback, the intermittent ridge that can be traced along the edge of the mountains from Wyoming to New Mexico (Chronic 1980). Dakota Sandstone forms the walls of strikingly beautiful canyons along portions of the St. Charles and Huerfano rivers in Pueblo County.

The mountains are comprised of Precambrian granites and gneisses. Pikes Peak granite makes up Pikes Peak and the core of the Rampart Range (including Cheyenne Mountain, which is the southern extent of the Colorado Front Range (Chronic 1980)). The Wet Mountains in Pueblo County also have a Precambrian granitic core.

Soils

Soils in the counties are highly variable. Mountain soils are normally rocky and shallow, except in areas where groundwater discharges or slope wetlands occur. These areas often form organic soils (e.g., peat or muck) due to organic matter production, persistent soil saturation and the resultant anaerobic conditions, and cool year-round temperatures. Along drainages, both in the mountains and on the plains, wetland plant communities occur on alluvial soils. Detailed soil survey information is available through the Soil Conservation Service (Larsen et al. 1979, Larsen 1981).

Observations on Major Threats to Wetland Biodiversity

General threats to a particular species or site are identified in the Potential Conservation Area profiles. Some general threats to biodiversity were not observed specifically at Potential Conservation Areas (PCAs) in El Paso and Pueblo counties but instead affect biodiversity on a larger, landscape-level scale. These threats are discussed below.

Hydrological Modifications

River impoundment in the form of lakes and reservoirs and irrigation ditches or canals can affect aquatic dependent plants and animals (Chien 1985, Friedman et al. 1998). Annual flooding is a natural ecological process that can be severely altered by the construction of dams, reservoirs, and other water diversions. These water diversions and impoundments have altered the normal high peak flows that were once a part of the natural hydrological regimes of many large tributaries of the Arkansas River, and of many of the smaller tributaries. These periodic floods are necessary for continued viability of most riparian vegetation. For example, many plants can only reproduce with flooding events, e.g., cottonwood trees (Rood and Mahoney 1993). As plant composition changes in response to alterations in the flooding regime, the composition of the aquatic and terrestrial fauna may also change.

In addition to river impoundment, rivers have also been altered by stream bank stabilization projects (e.g., channelization) (Rosgen 1996). Most streams and rivers are dynamic and inherently move across the land. Stabilizing or channelizing stream banks forces the river to stay in one place and often leads to changes in riparian ecology and more serious destruction downstream. It is also well known that different plant

communities require different geomorphologic settings. For example, point bars are required for some species of willows to regenerate, terraces are required for mature cottonwood/shrubland forests, and old oxbow reaches may eventually provide habitat for many wetland communities. By stabilizing a river, the creation of these geomorphic settings is often eliminated. Thus, the plant communities that require such fluvial processes are no longer able to regenerate or survive. In general, the cumulative effects from dams, reservoirs, and channelization on plant communities, have caused a gradual shift from diverse multi-aged riparian woodlands to mature single aged forest canopies.

Many wetlands not associated with fluvial processes have been altered by irrigation practices, water diversions, and well pumping. Many historical wetlands, such as seeps and springs, have been lost or altered due to water "development" projects, such as water diversions or impoundments. The biodiversity significance of a manmade pond with minimal edge habitat is generally less than the biodiversity significance of extensive intact seep and spring wetlands or naturally occurring ponds.

Development

Residential development is increasing in El Paso and Pueblo counties, especially along the I-25 corridor, in the foothills, and along Highway 24 between Colorado Springs and Calhan. Development creates a number of stresses, including habitat loss and fragmentation, introduction of non-native species, fire suppression, and predation and disturbance from domestic animals (dogs and cats) (Oxley et al. 1974 and Coleman and Temple 1994). Habitat loss to development is considered irreversible. Since development tends to occur adjacent to watercourses, wetland and riparian habitats are highly susceptible to development.

Livestock Grazing

Domestic livestock grazing has been a traditional livelihood in El Paso and Pueblo counties since the late 1800s (Whittemore 1967) and has left a broad and sometimes subtle impact on the landscape. Many riparian areas in El Paso and Pueblo counties are used for rangeland. Because there is little surface water available in the counties, riparian areas often serve as the only available water. Additionally, riparian areas are often areas of the highest production of grasses and forbs. Long-term, incompatible livestock use of wetland and riparian areas can potentially erode stream banks, cause streams to downcut, lower the water table, alter channel morphology, impair plant regeneration, establish non-native species, shift community structure and composition, degrade water quality, and diminish general riparian and wetland functions (Windell et al. 1986). Depending on grazing practices and local environmental conditions, impacts can be minimal and largely reversible (slight shifts in species composition) to severe and irreversible (extensive gullying, introduction of non-native forage species).

Logging

Most logging operations require a network of roads. The impacts from roads can result in threats to biodiversity (see "Roads" below for more detailed discussion). The Forest Service monitors logging closely; nonetheless, problems can still occur.

Recreation
Recreation, once very local and perhaps even unnoticeable, is increasing and becoming an increasing threat to natural ecosystems in El Paso and Pueblo counties. Different types of recreation (i.e., motorized versus non-motorized activities) typically have different effects on ecosystem processes. ATV's can disrupt migration and breeding patterns, and fragment habitat for native resident species. This activity can also threaten rare plants found in non-forested areas. ATV's have also been identified as a vector for the invasion of non-native plant species.

Non-motorized recreation, mostly hikers but also some mountain biking and rock climbing, presents a different set of issues (Cole and Knight 1990; Knight and Cole 1991, Miller et al. 1998, 2001). Wildlife behavior can be significantly altered by repeat visits of hikers/bicyclists. Alpine areas, mountain lakes, and riparian zones are routes and destinations for many established trails. Thus, impacts to native vegetation (mainly trampling) in these areas can be high.

Roads
There is a complex, dense network of roads in many parts of El Paso and Pueblo counties due primarily to livestock activities and past timber harvests. Expansion of the existing road network in some areas will detrimentally affect the natural heritage values of the region. Roads are associated with a wide variety of impacts to natural communities, including invasion by non-native plant species, increased depredation and parasitism of bird nests, increased impacts of pets, fragmentation of habitats, erosion, pollution, and road mortality (Noss et al. 1997).

Roads function as conduits, barriers, habitats, sources, and sinks for some species and populations of species (Forman 1995). Road networks crossing landscapes can increase erosion and alter local hydrological regimes. Runoff from roads may impact local vegetation via contribution of heavy metals and sediments. Road networks interrupt horizontal ecological flows, alter landscape spatial patterns, and therefore inhibit important interior species (Forman and Alexander 1998).

Effects on wildlife can be attributed to road avoidance (a species avoids crossing a road) and occasionally roadkill. Traffic noise appears to be the most important variable in road avoidance, although visual disturbance, pollutants, and predators moving along a road are alternative hypotheses as to the cause of avoidance (Forman and Alexander 1998). Songbirds appear to be sensitive to remarkably low noise levels, even to noise levels similar to that of a library reading room (Reijnen et al. 1995).

Non-native Species
Although non-native species are mentioned repeatedly as stresses in the above discussions, because they may be introduced through so many activities they are included here as a general threat as well. Non-native plants or animals can have wide-ranging impacts. Non-native plants can increase dramatically under the right conditions and essentially dominate a previously natural area (e.g., scraped roadsides). This can generate secondary effects on animals (particularly invertebrates) that depend on native

plant species for forage, cover, or propagation. Effects of non-native fishes include competition that can lead to local extinctions of native fishes and hybridization that corrupts the genetic stock of the native fishes.

Fragmentation and Edge Effects

Edges are simply the outer boundary of an ecosystem that abruptly grades into another type of habitat (e.g., edge of a conifer forest adjacent to a meadow) (Forman & Godron 1986). Edges are often created by naturally occurring processes such as floods, fires, and wind and will recover naturally over time. Edges can also be created by human activities such as roads, timber harvesting, agricultural practices, rangeland, etc. Human induced edges are often dominated by plant and animal species that are adapted to disturbance. As the landscape is increasingly fragmented by large-scale, rapid anthropogenic conversion, these edges become increasingly abundant. The overall reduction of large landscapes jeopardizes the existence of specialist species, may increase non-native species, and may limit the mobility of species that require large landscapes or a diversity of landscapes for their survival (e.g., large mammals or migratory waterbirds).

METHODS

Focusing on private lands, site selection was based on the objective of visiting every wetland type at various geomorphic positions within El Paso and Pueblo counties. The highest quality occurrences of each wetland type were targeted during the field season. Wetland types were defined using plant associations. CNHP classifies wetland and riparian plant associations or communities, not wetland types. Plant communities reflect the broad nature of wetlands in the study area (e.g., cottonwood riparian forest, sedge meadow, willow carr), while also mirroring the local nature of wetlands in the watershed. Most other classifications applied to wetlands in Colorado, and across the nation, discriminate wetlands based primarily on the physiognomy (physical structure) of the vegetation. Broad structural classes, however, do not recognize the relative rarity of the plant species or communities found in El Paso and Pueblo counties.

The methods for assessing and prioritizing conservation needs over a large area are necessarily diverse. The Colorado Natural Heritage Program follows a general method that is continuously being developed specifically for this purpose. The Natural Heritage Inventory described in this report was conducted in several steps summarized below. Additionally, input from a committee of individuals representing local public and private interests was sought at all stages.

Collect Available Information

CNHP databases were updated with information regarding the known locations of species and significant plant communities within El Paso and Pueblo counties. A variety of information sources were searched for this information. The Colorado State University museums and herbarium were searched, as were plant and animal collections at the University of Colorado, Colorado College, Rocky Mountain Herbarium, and local private collections. The Colorado Division of Wildlife provided extensive data on a wide variety of species including native fishes and Preble's meadow jumping mouse. Both general and specific literature sources were incorporated into CNHP databases, either in the form of locational information or as biological data pertaining to a species in general. Such information covers basic species and community biology including range, habitat, phenology (reproductive timing), food sources, and substrates.

Identify Rare or Imperiled Species and Significant Plant Communities with Potential to Occur in El Paso and Pueblo Counties

The list of plant communities thought to occur in El Paso and Pueblo counties was derived from the ongoing Colorado Statewide Wetland Classification and Characterization (CSWCC) project, which is based on the U.S. National Vegetation Classification (USNVC) (Anderson et al. 1998), the accepted national standard for vegetation. The CSWCC utilizes and integrates previously collected data (e.g., CNHP Riparian Classification, CNHP Wetland Inventories, Colorado State University). The CSWCC incorporates all these data on riparian and other wetlands collected during the past 10 years as well as data from other researchers to minimize duplication of effort.

The information collected in the previous step was used to refine the potential element list and to refine our search areas. In general, species and plant communities that have been recorded from El Paso or Pueblo counties, or from adjacent counties, are included in this list. Species or plant communities which prefer habitats that are not included in this study area were removed from the list.

A list of elements includes those elements currently monitored by CNHP that were thought to potentially occur in El Paso and Pueblo counties and were therefore targeted in CNHP field inventories.

Identify Targeted Inventory Areas

Survey sites were chosen based on their likelihood of harboring rare or imperiled species or significant plant communities. Previously documented locations were targeted, and additional potential areas were chosen using available information sources. Precisely known element locations were always included so that they could be verified and updated. Areas with potentially high natural values were selected using aerial photographs, geology maps, vegetation surveys, personal recommendations from local experts, and numerous roadside surveys by our field scientists. Aerial photography is perhaps the most useful tool in this step of the process. High altitude infrared photographs at 1:40,000 scale (National Aerial Photography Program 85) were used for this project and are well suited for assessing vegetation types and, to some extent, natural conditions on the ground.

Using the biological information stored in the CNHP databases, these information sources were analyzed for areas having the highest potential for supporting specific elements. General habitat types can be discerned from aerial photographs. Those chosen for survey sites appeared to be in the most natural condition. In general, this means those sites that are the largest, least fragmented, and relatively free of visible disturbances such as roads, trails, fences, quarries, etc.

The above information was used to delineate over 100 survey areas that were believed to have relatively high probability of harboring significant natural heritage resources. These areas included all major habitat types in the study area. A targeted inventory analysis conducted by CNHP in 1996 for El Paso County and was used for this project.

Roadside surveys were useful in further resolving the natural condition of these areas. The condition of grasslands is especially difficult to discern from aerial photographs, and a quick survey from the road can reveal such aspects as weed infestation or heavy grazing.

Because of the overwhelming number of potential sites and limited resources, surveys for all elements were prioritized by the degree of imperilment. For example, the species with Natural Heritage ranks of G1-G3 were the primary target of our inventory efforts. Although species with lower Natural Heritage ranks were not the main focus of inventory efforts, many of these species occupy similar habitats as the targeted species, and were searched for and documented as they were encountered.

Contact Landowners

Obtaining permission to conduct surveys on private property was essential to this project. Once survey sites were chosen, land ownership of these areas was determined using records at local assessor's offices. Landowners were then either contacted by phone or in person. If landowners could not be contacted, or if permission to access the property was denied, this was recorded and the site was not visited. **Under no circumstances were properties surveyed without landowner permission.**

Conduct Field Surveys

Survey sites where access could be obtained were visited at the appropriate time as dictated by the phenology of the individual elements. It is essential that surveys take place during a time when the targeted elements are detectable. For instance, breeding birds cannot be surveyed outside of the breeding season, and plants are often not identifiable without flowers or fruit that are only present during certain times of the year.

The methods used in the surveys vary according to the elements that were being targeted. In most cases, the appropriate habitats were visually searched in a systematic fashion that would attempt to cover the area as thoroughly as possible in the given time. Some types of organisms require special techniques to document their presence. Some of these are summarized below:

Amphibians: visual or with aquatic nets
Mammals: Sherman live traps
Birds: visual or by song/call, evidence of breeding sought
Insects: aerial or aquatic net
Fishes: electroshocking, seining, barbless fly fishing, observation
Plants: visual
Wetland plant communities: visual, collect qualitative or quantitative composition, soil, hydrological, and function data

When necessary and permitted, voucher specimens were collected and deposited in local university museums and herbaria.

When a rare species or significant plant community was discovered, its precise location and known extent was recorded on 1:24,000 scale topographic maps. Other data recorded at each occurrence included numbers observed, breeding status, habitat description, disturbance features, observable threats, and potential protection and management needs. The overall significance of each occurrence, relative to others of the same element, was estimated by rating the quality (size, vigor, etc.) of the population or community, the condition or naturalness of the habitat, the long-term viability of the population or community, and the defensibility (ease or difficulty of protecting) of the occurrence. These factors are combined into an element occurrence rank, useful in refining conservation priorities. See the previous section on the Natural Heritage Ranking System for more about element occurrence ranking.

Field surveys also included a wetland functional evaluation. Some of the sites profiled in this report were not visited by the author but rather by previous CNHP ecologists. For these sites, only a descriptive paragraph of the potential functions of that site (based on ecological information collected by the previous CNHP scientist) is given. For those sites visited by the author, a wetland functional evaluation, using the Montana based evaluation method (Berglund 1996), is detailed in the site profile. Site visits and assessments were conducted on the following two levels:

(1) **Roadside or adjacent land assessments.** Many of the sites could be viewed at a distance from a public road. While on the ground the field scientist can see, even from a distance, many features not apparent on maps and aerial photos. The road assessments determined the extent of human and livestock impacts on the targeted inventory area (TIA), which included ditching, adventive plant species, plant species indicative of intensive livestock use, stream bank destabilization, major hydrologic alterations, excessive cover of non-native plant species, or new construction. Sites with one or more of these characteristics were generally excluded as potential conservation areas and no extensive data were gathered at these areas.

(2) **On-site assessments**. On-site assessment was the preferred method, as it is the only assessment technique that can yield high-confidence statements concerning the known or potential presence of rare and imperiled elements or excellent examples of common communities. On-site assessments are also the most resource intensive because of the effort required to contact landowners. In a few cases where on-site assessments were desired, they could not be conducted because either field personnel were denied access to the property by the landowner, or CNHP was unable to contact the landowner during the time frame of this study.

The following information was collected for the sites in this report:

General Field Information

- list of all plant associations in the wetland complex, including the amount of wetland area covered by that community. In almost all cases, plant associations were immediately placed within CNHP's Statewide Wetland Classification. However, on rare occasions a plant association was encountered which could not be easily classified based on the stands that had been previously sampled.
- vegetation data for each major plant association in the wetland were collected using visual estimates of species cover in a representative portion of the plant association.
- sketch of the site layout, with distribution of community types indicated (this was generally done on the 7.5' USGS topographic map)
- elevation (from 7.5' USGS topographic map)
- current and historic land use (e.g., grazing, logging, recreational use) when apparent
- notes on geology and geomorphology
- reference photos of the site
- indicators of disturbance such as grazing, flooding, etc.

Natural Heritage Information

- list of elements present or expected at the site
- element occurrence (EO) ranks or information that will lead to EO Rank
- proposed conservation area boundaries

General Wetland Information

- proposed HGM Class and Subclass
- Cowardin System and Subsystem
- water source
- hydroperiod
- general soils description (these are based on either a detailed description of a soil profile in the field (i.e., horizons, texture, color, cobble size, percent mottling) or from information from the county soil surveys.

Qualitative Functional Assessment

- hydrological functions (e.g., groundwater recharge/discharge, flood storage, shoreline anchoring)
- biogeochemical functions (e.g., elemental cycling, sediment trapping, and toxicant retention/removal)
- biological functions (e.g., production export/food chain support, fish and wildlife habitat, habitat diversity)

Restoration Potential

- cause of disturbances, if any (e.g., alteration of hydrology, peat removal, fill material, presence of non-native species, etc.)
- feasibility of rectifying the disturbance (re-establishing natural hydrological regime, remove fill material, plant native species, etc.)
- discussion of possible methods for restoration.

Delineate Potential Conservation Areas

Finally, since the objective for this inventory is to prioritize specific areas for conservation efforts, Potential Conservation Area (PCA) boundaries were delineated. Such a boundary is an estimation of the minimum area needed to ensure persistence of the element. In order to ensure the preservation of an element, the ecological processes that support that occurrence must be preserved. The preliminary conservation planning boundary is meant to include features on the surrounding landscape that provide these functions. Data collected in the field are essential to delineating such a boundary, but other sources of information such as aerial photography are also used. These boundaries are considered preliminary and additional information about the PCA or the element may call for alterations to the boundaries.

Delineate Proposed Networks of Conservation Areas

Occasionally a landscape area will encompass many Potential Conservation Areas that share similar species or natural communities and ecological processes. For example, in South Park there are numerous extreme rich fens that are physically isolated from one

another, yet they all contain the same types of rare plants and plant communities. Each of the isolated fens has been included in its own PCA. Yet, when considering the "big picture" of the overall landscape, these fens probably interact with each other and influence each other on a larger scale. In order to capture this repeating pattern and higher-level interactions on the landscape scale, a **Network of Conservation Areas** (NCA) is delineated.

NCAs include unoccupied or unsurveyed areas that are within the same ecological system that is required by the species or natural communities of the PCAs and contain PCAs with an obvious repeating pattern (the same species or natural communities are in each included PCA). Most NCAS are drawn at a regional scale that may be best represented on a state-wide map.

RESULTS

CNHP ecologists identified 25 wetland and riparian Potential Conservation Areas (PCAs) in El Paso and Pueblo counties (Table 5 and Figure 9). These areas include, in our opinion, the best quality wetlands and riparian areas from a natural plant community perspective. Also included are PCAs that may be degraded from a natural plant community perspective but support rare or declining wetland/riparian associated plant or animal species. Future surveys will almost certainly locate additional biologically significant wetland/riparian areas, especially in undersurveyed areas such as the foothills canyons in El Paso County, USFS lands, and Fort Carson.

All wetland and riparian areas are significant on a local level due to the functions they perform, especially in arid landscapes such as eastern El Paso and Pueblo counties. However, an exhaustive survey of all wetlands in the two counties was beyond the scope of this project. Several rivers and creeks visited did not meet CNHP ranking criteria for natural plant communities or wetland-dependent animals. For example, the Arkansas River, Fountain Creek, Turkey Creek, and Huerfano River are heavily infested with non-native plants including tamarisk and Russian olive. These riparian areas still perform many important functions (e.g., wildlife corridor, flood attenuation, etc.), but are not included within PCAs for plant communities because they represent degraded examples of an apparently globally secure (G4? S3) community (Plains cottonwood with peachleaf willow and coyote willow (*Populus deltoides* ssp. *monilifera-(Salix amygdaloides)/Salix exigua*)). Additionally, other areas have undergone extreme hydrologic modification (e.g., downstream portions of St. Charles River and Greenhorn Creek) and are therefore not included within PCAs.

There is a discrepancy between the number of PCAs in El Paso County (16 PCAs) versus Pueblo County (9 PCAs). The El Paso County wetland/riparian inventory was conducted as part of a larger CNHP biological survey (CNHP 2001) which included field surveys by a CNHP zoologist, botanist, and upland ecologist. PCAs identified by the zoologist and botanist as supporting wetland/riparian-associated species (e.g., Preble's meadow jumping mouse, Bald Eagle, plains ambrosia) are included within this report. A similar CNHP biological survey will be conducted in Pueblo County during 2001 and 2002 and will likely identify additional wetland/riparian PCAs.

Table 4 presents CNHP elements of biological significance known to occur in or associated with wetlands and riparian areas in El Paso and Pueblo counties. Occurrences of all elements are archived in the CNHP Biological Conservation Data System.

Table 4. List of Known Elements of Concern for El Paso and Pueblo Counties by Taxonomic Group. Detailed descriptions of the elements listed below can be found in the Natural History section.

Element	Common Name	Global Rank	State Rank	Federal and State Status
Plants				
Ambrosia linearis	Plains ambrosia	G3	S3	FS
Juncus brachycephalus	Small-headed rush	G5	S1	
Ptilagrostis porteri	Porter's feathergrass	G2	S2	FS, BLM
Plant Communities				
Abies concolor-Picea pungens-Populus angustifolia/Acer glabrum	Montane riparian forest	G2	S2	
Alnus incana/mesic graminoid	Montane riparian shrubland	G5Q	S3	
Alnus incana-Cornus sericea	Thinleaf alder-red-osier dogwood riparian shrubland	G3G4	S3	
Buchloe dactyloides-Ratibida tagetes-Ambrosia linearis	Buffalograss playa	G3	S3	
Carex lanuginosa	Montane wet meadow	G3?	S3	
Carex nebrascensis	Wet meadow	G4	S3	
Carex praegracilis	Clustered-sedge wetland	G3	S2	
Corylus cornuta	Lower montane forest	G3	S1	
Distichlis spicata	Salt meadow	G5	S3	
Eleocharis palustris	Emergent wetland	G5	S4	
Juncus balticus var. *montanus*	Wet meadows	G5	S5	
Pascopyrum smithii-Eleocharis spp.	Playa grassland	G2	S2	
Phragmites australis	Marsh	G4	S3	
Populus angustifolia/Alnus incana	Montane riparian forest	G3?	S3	
Populus angustifolia/Prunus virginiana	Narrowleaf cottonwood/ common chokecherry	G2G3	S1	
Populus angustifolia/Salix exigua	Narrowleaf cottonwood riparian forest	G4	S4	
Populus deltoides ssp. *monilifera-(Salix amygdaloides)/Salix exigua*	Plains cottonwood riparian woodland	G4?	S3	
Populus deltoides/Pascopyrum smithii-Panicum obtusum	Plains cottonwood/western wheatgrass-vine mesquite	G2Q	S1S2 Q	
Populus deltoides/Sporobolus airoides	Plains cottonwood/Alkali sacaton	G3	S2	
Pseudotsuga menziesii/Betula occidentalis	Montane riparian forest	G3?	S3	
Salix amygdaloides/Carex lanuginosa	Peachleaf willow alliance	G3	SU	
Salix eriocephala var. *ligulifolia*	Montane willow carr	G2G3	S2S3	
Salix exigua/mesic graminoid	Coyote willow/mesic graminoid	G5	S5	
Salix lucida ssp. *caudata*	Montane riparian shrubland	G3Q	S2S3	
Sarcobatus vermiculatus/Sporobolus airoides	Saline bottom shrublands	G3?	SU	
Scirpus pungens	Bulrush	G3G4	S3	
Scirpus tabernaemontani-Scirpus acutus	Great Plains marshes	G3	S2S3	
Spartina pectinata	Prairie slough grass	G3?	S3	
Sporobolus airoides	Great Plains salt meadow	G3Q	S3	

Symphoricarpos occidentalis	Snowberry shrubland	G4G5	S3	
Typha angustifolia-Typha latifolia	Cattail marsh	G5	S3	
Amphibians				
Rana blairi	Plains leopard frog	G5	S3	SC, BLM
Birds				
Haliaeetus leucocephalus	Bald Eagle	G4	S1B, SN	LT, T
Fish				
Etheostoma cragini	Arkansas darter	G3	S2	C, T, FS
Oncorhynchus clarki stomias	Greenback cutthroat trout	G4 T2T3	S2	LT,T
Mammals				
Zapus hudsonius preblei	Preble's meadow jumping mouse	G5T2	S1	LT, T, FS

Sites of Biodiversity Significance

The 25 wetland and riparian PCAs documented in El Paso and Pueblo counties are profiled with biodiversity ranks in this section (Table 5 and Figure 9). These PCAs include the wetlands with the highest biodiversity significance, as well as the best examples of types present in the study area. One Network of Conservation Areas (NCA), representing series of riparian communities along West Bijou Creek, is included.

The PCAs are organized in ascending order according to their Biodiversity Rank (e.g., B1 to B5). The NCA follows the PCAs.

Each Potential Conservation Area (PCA) and NCA is described in a standard site profile report that reflects data fields in the CNHP Biological Conservation Data (BCD) System. The contents of the profile report are outlined and explained below.

Site Profile Explanation

Biodiversity Rank: B#
The overall significance of the site in terms of rarity of the Natural Heritage resources and the quality (condition, abundance, etc.) of the occurrences. Please see *Natural Heritage Ranking System* section for more details.

Protection Urgency Rank: P#
A summary of major land ownership issues that may affect the long-term viability of the site and the element(s).

Management Urgency Rank: M#
A summary of major management issues that may affect the long-term viability of the site and the element(s).

Location: General location.

Legal Description: USGS 7.5-minute Quadrangle name(s) and Township Range Section(s).

Size: Expressed in acres and hectares.

Elevation: Expressed in feet and meters.

General Description: A brief narrative of the topography, hydrology, vegetation, and current use of the potential conservation area.

Biodiversity Rank Comments: A synopsis of the rare species and significant plant communities that occur within the proposed conservation area. A table within the area profile lists each element occurrence found in the site, global and state ranks of these elements, the occurrence ranks and federal and state agency special designations. See Table 2 for explanations of ranks and Table 3 for legal designations.

Boundary Justification: Justification for the location of the proposed conservation area boundary delineated in this report, which includes all known occurrences of natural heritage resources and, in some cases, adjacent lands required for their protection.

Protection Rank Comments: Discussion of major land ownership issues that may affect the long-term viability of the site and the element(s).

Management Rank Comments: Discussion of major management issues that may affect the long-term viability of the site and the element(s).

Soils Description: General descriptions of soil are generally provided.

Wetland Functional Assessment: A summary of the functions and the proposed HGM classification, Cowardin system, and the plant community derived from CNHP's Statewide Wetland Classification for the wetlands occurring within each Potential Conservation Area. (Note: Some of the sites profiled in this report were not visited by the author but rather by previous CNHP ecologists. For these sites, a descriptive paragraph of the potential functions of that site (based on ecological information collected by the previous CNHP scientist) is given. For those sites visited by the author, a wetland functional evaluation is detailed in the site profile.)

Restoration Potential: A brief summary describing the feasibility of restoring ecosystem processes at each site.

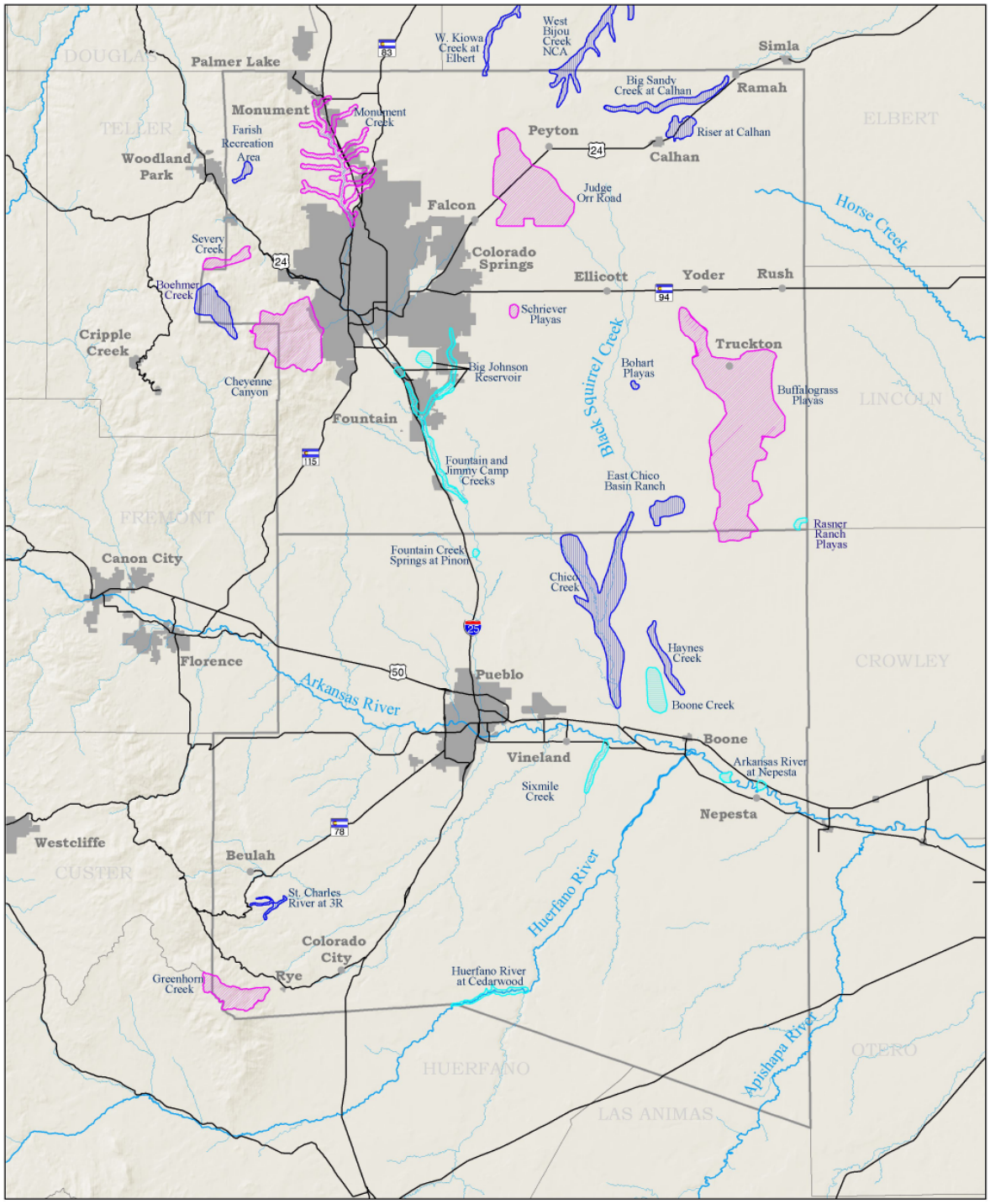
Table 5 displays all 25 wetland and riparian PCAs and one Network of Conservation Areas in the El Paso and Pueblo counties study area. All of these sites merit protection, but it is recommended that available resources be directed first toward the higher B-ranked sites (e.g., B2 and B3 sites). These sites alone do not represent a complete wetland conservation program; they represent only the rare and imperiled elements. In addition, inventory efforts were focused on private lands and due to time limitations, a comprehensive inventory of public lands (e.g., U.S. Forest Service) was not conducted nor were all private lands visited.

Table 5. Wetland and Riparian Potential Conservation Areas and Network of Conservation Areas identified in El Paso and Pueblo Counties, arranged by Biodiversity Rank (B-rank).

Potential Conservation Area
B2
Buffalograss Playas
Cheyenne Canyon
Greenhorn Creek
Judge Orr Road
Monument Creek
Schriever Playas
Severy Creek
B3
Big Sandy Creek at Calhan
Boehmer Creek
Bohart Playas
Chico Creek
East Chico Basin Ranch
Farish Recreation Area
Haynes Creek
Riser at Calhan
St. Charles River at 3R
West Kiowa Creek at Elbert
B4
Arkansas River at Nepesta
Big Johnson Reservoir
Boone Creek
Fountain and Jimmy Camp Creeks
Fountain Creek Springs at Pinon
Huerfano River at Cedarwood
Rasner Ranch Playas
Sixmile Creek

Network of Conservation Areas
West Bijou Creek (B3)

CNHP Wetland and Riparian Potential Conservation Areas in El Paso and Pueblo Counties

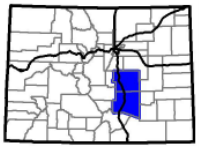


Colorado Natural Heritage Program

Colorado State University
Dept of Fish and Wildlife Biology
254 General Services Bldg
Fort Collins, CO 80523

Map Date: 14 June 2001
GIS Dept: gad

Location in Colorado



Potential Conservation Areas by Biodiversity Significance

- B2: Very High Significance
- B4: Moderate Significance
- B3: High Significance

Base Data

- Highways
- Major Rivers
- Counties
- Municipalities

Digital Elevation Model (DEM) produced by the U.S. Geological Survey, 1996

Disclaimer

The data are provided on an as-is, as-available basis without warranties of any kind, expressed or implied, including (but not limited to) warranties of merchantability, fitness for a particular purpose, and non-infringement. CNHP, Colorado State University and the State of Colorado further expressly disclaim any warranty that the data are error-free or current as of the date supplied.

Buffalograss Playas

Biodiversity Rank: B2 (Very high significance)
This PCA contains the best known playa habitat for the globally vulnerable (G3 S3) plains ambrosia (*Ambrosia linearis*). It also includes the best known occurrences of a globally vulnerable (G3 S3) buffalograss playa community (*Buchloe dactyloides–Ratibida tagetes–Ambrosia linearis*). Over 300 playas occur within this PCA, most of which are in good condition. It is unique to find a high concentration of playas in relatively unaltered condition. Many playas in other playa lake regions have been plowed or otherwise altered.

Protection Urgency Rank: P2 (High urgency)
Protection actions may be needed within five years primarily due to residential development pressures.

Management Urgency Rank: M4 (Low urgency)
Current management appears excellent for maintenance of the element occurrences. If development occurs, management issues will likely become more serious.

Location: Southeastern El Paso County. Extends south from near the town of Yoder through the towns of Truckton and Edison to south of the El Paso/Pueblo county line.

Legal Description: USGS 7.5 minute quadrangles: Big Springs Ranch, Yoder, Rush, Truckton, Truckton NE, Edison School, Truckton SE. T14S R61W Sections 19, 20, and 28-34; T15S R60W Sections 7-10, 15-21, and 28-33; T15S R61W Sections 3-6, 8-10, 13-17, 20-28, and 33-36; T16S R60W Sections 3-11, 14-22, and 28-33; T16S R61W Sections 1, 2, 11-15, 22-27, 34-36; T17S R60W Sections 5-8, 17-20, and 30-32; T17S R61W Sections 1-3, 10-15, 22-27, and 34-36; T18S R60W Sections 5 and 6; T18S R61W Sections 1-3 and 11.

Size: 55,332 acres (22,392 hectares).

Elevation: 5,315 to 6,070 feet (1,620 to 1,850 meters).

General Description: In southeastern El Paso County, between the many low rolling hills of shortgrass prairie, are small flat-bottomed depressions. There are no surface channels draining the area, instead rainfall and runoff collect in these basins forming ephemeral wetlands. It is not clear whether these depressions are wind deflated playas (Bolen et al. 1989) or remnants of buffalo wallows (Uno 1989, F. Knopf, USGS, pers. comm.), both of which develop clay bottoms and collect runoff after heavy rainstorms. We have chosen to refer to these depressions as playas, fully acknowledging that their origin is not well understood. The area outlined by the PCA is estimated to contain over 300 playas, an average density of about three playas per square mile. The playas are generally circular to oval-shaped, oriented roughly north south, and range in size from about 0.5 to 10 acres (0.2 to 5 ha).

These basins remain dry throughout most of the year and collect water only after heavy rainfall. In southeastern El Paso County, the heavy rains generally occur in the late summer and in many cases a series of storms are required in order for the playas to retain water (Weathers 2000, G. Paul, local landowner, pers. comm.). Runoff collecting in a dry playa infiltrates cracks in the clay bottom of the playa and swells the clay, effectively sealing the playa bottom (Zartman et al. 1994). After the clay has been wetted, subsequent storms can result in playa filling. The playas may hold water for periods ranging from days to weeks, depending on the size of the drainage basin and intensity of the rainstorm (Weathers 2000). In some cases, these playas may hold water from May to August (G. Paul, pers. comm., landowner) or in dry years may remain dry year round.

The vegetation in the playas is shorter than the surrounding blue grama (*Bouteloua gracilis*) shortgrass prairie and consists of different species. The dominant species in the playas is the perennial warm-season grass buffalograss (*Buchloe dactyloides*). Growing with the buffalograss are the perennial forbs plains ambrosia (*Ambrosia linearis*) (G3 S3) and short-ray prairie coneflower (*Ratibida tagetes*).

The vegetation in the playas generally occurs in bands where the outermost rim often supports the highest density of plains ambrosia and coneflower. Other plants growing in the playas include a dryland sedge (*Carex eleocharis* ssp. *stenophylla*), prostrate vervain (*Verbena bracteata*), frog-fruit (*Phyla cuneifolia*), spreading yellow cress (*Rorripa sinuata*), greenthread (*Thelesperma megapotamicum*, *T. filifolium*), curly cup gumweed (*Grindelia squarossa*), and Russian thistle (*Salsola iberica*). Interestingly, buffalograss submerged during the growing season has been known to withstand more than five weeks of inundation (Porterfield 1945). In the playas that remain wet the longest, there may be a small bare ground portion in the center with very sparse cover that could include western wheatgrass (*Pascopyrum smithii*), spikerush (*Eleocharis palustris and E. acicularis*), goosefoot (*Chenopodium* sp.), or weedy annuals. Plains ambrosia is a shortgrass prairie species that is restricted to an area of about 100 miles by 50 miles (primarily in El Paso and Lincoln counties). Plains ambrosia requires a little more moisture than most upland plants and as such, the playas appear to be their native habitat as the clay soils of the playas retain moisture longer than the upland soils. Roadsides also appear to provide the extra moisture required by the plains ambrosia and, as such, plains ambrosia is very prevalent on the sides of many unpaved roads in the area. The playas in El Paso County are the best known occurrences for this species.

Where the playas are most concentrated, the density can exceed 10 playas per square mile. The playas provide heterogeneity within a sea of shortgrass prairie which is important biologically to provide for the needs of a wide range of species (Knopf 1996a, Hoagland and Collins 1997). Other factors affecting grassland environmental and compositional heterogeneity include fire, soils, grazing, and prairie dogs. Because fire and grazing are heavily managed and prairie dogs have been greatly reduced in numbers, playas may serve as the primary source of heterogeneity in the region (Hoagland and Collins 1997).

In late summer 2000, Mountain Plover (*Charadrius montanus*) (G2 S2B,SZN) were observed gathering for migration in dry playas. Mountain Plover is a declining shortgrass prairie species that is known to inhabit areas with low vegetation and a high percentage of bare ground such as prairie dog towns and heavily grazed shortgrass prairie (Knopf 1996b). Observations of concentrations of Mountain Plover exceeding 50 birds in the playas in late summer may indicate that playas may be another habitat attractive to Mountain Plover because of the low-growing vegetation. In addition, a breeding location for another shortgrass prairie bird that prefers low-growing vegetation, McCown's Longspur (*Calcarius mccownii*) (G5 S2B, SZN), was noted in the vicinity of playas (A. Versaw, pers. comm.). This may be the southernmost known current breeding location in Colorado for McCown's Longspur (Kingery 1998).

In the U.S., the area typically described as the playa lakes region includes approximately 140,000 square miles (36.2 million ha) of southwestern Kansas, southeastern Colorado, the panhandle of Oklahoma, eastern New Mexico, and the panhandle and Southern High Plains of Texas (Haukos and Smith 1997). El Paso County is northwest of this area and its playas appear to differ from those further south. The El Paso County playas are smaller and are inundated at different times than the more southern playas. The more southern playas fill with rainwater during late winter and early spring and may remain flooded through summer and fall and as such are considered critical to the maintenance of waterfowl and shorebirds on the central flyway (Guthrey and Bryant 1982, Batt 1996). Though the El Paso County playas can fill during wet springs, they are more often inundated late in the summer and are dry during spring migration. Finally, most of the more southern playas are within areas of intense agricultural use and many have been plowed for crops, modified for collection of irrigation or feedlot runoff, or otherwise altered (Guthery and Bryant 1982, Bolen et al. 1989, Haukos and Smith 1994). The El Paso County playas are primarily rangeland with little alteration by agriculture. The most common disturbance in the El Paso County playas is roads.

The most common explanation for the origin of playas is deflation (wind erosion) though theories on playa formation are controversial (Osterkamp and Wood 1987). The consistent north-south orientation of the playas in southeastern El Paso County suggests deflation influenced their formation. As previously mentioned, these playas are also consistent with descriptions of buffalo wallows. Wallows are formed by bison pawing the ground, creating patches of bare ground in which to dust bathe (Uno 1989), or perhaps mud bathe to protect against biting insects or aid in shedding their heavy fur (Hornaday, 1887, F. Knopf, pers. comm. USGS). Active wallows range from 3 to 5 meters in diameter and merging of adjacent wallows can create wallows larger than about 0.5 acre (1,400 square meters) (Uno 1989, Knopf 1996a). Bison were extirpated from the area by 1875 (Hornaday 1889) but evidence of their wallows can remain evident on the landscape for more than a hundred years (Knopf 1996a). Perennial grasses invade wallows not used by bison (Uno 1989). It is possible that the southeast El Paso County playas result from of a combination of factors including deflation and buffalo wallowing.

The land within the PCA is primarily privately owned and used for cattle grazing. About 10 percent of the area is tilled for crops or developed for rural housing. Most of the southeast El Paso County playas have not been plowed and retain their native vegetation

for the most part. The most common modifications of the playas are unpaved roads passing through or excavation of the center of the playa to retain water longer for livestock watering. More recently, development pressure is increasing and land is being subdivided, usually into 35-acre parcels. Within these subdivided properties, in some cases homes have been placed adjacent to or within playas.

Biodiversity Rank Comments: This PCA contains the best known playa habitat for the globally vulnerable (G3 S3) plains ambrosia (*Ambrosia linearis*). It also includes most of the known extent of the globally vulnerable (G3 S3) buffalograss playa community (*Buchloe dactyloides-Ratibida tagetes-Ambrosia linearis*). The landscape included within this PCA is fragmented by roads and some agriculture but remains largely intact. Hundreds of playas remain in good to excellent condition in the PCA. Plains ambrosia, though locally abundant, has a very limited global range (about 50 miles by 100 miles) and almost all of the habitat is privately owned.

Natural Heritage element occurrences at the Buffalograss Playas PCA.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	Federal Sensitive	EO* Rank	Last Observed
Plants								
Ambrosia linearis	**Plains ambrosia**	**G3**	**S3**			**FS**	**A**	**2000-07-19**
Ambrosia linearis	**Plains ambrosia**	**G3**	**S3**			**FS**	**A**	**2000-07-13**
Ambrosia linearis	**Plains ambrosia**	**G3**	**S3**			**FS**	**A**	**2000-07-12**
Ambrosia linearis	Plains ambrosia	G3	S3			FS	B	2000-09-12
Ambrosia linearis	Plains ambrosia	G3	S3			FS	B	2000-07-13
Ambrosia linearis	Plains ambrosia	G3	S3			FS	B	2000-07-12
Ambrosia linearis	Plains ambrosia	G3	S3			FS	B	2000-06-30
Ambrosia linearis	Plains ambrosia	G3	S3			FS	C	2000-07-18
Ambrosia linearis	Plains ambrosia	G3	S3			FS	C	1993-07
Ambrosia linearis	Plains ambrosia	G3	S3			FS	C	1993-07
Ambrosia linearis	Plains ambrosia	G3	S3			FS	C	1993-07
Plant Communities								
Buchloe dactyloides-Ratibida tagetes-Ambrosia linearis	Buffalograss playa	G3	S3				B	2000-09-12
Buchloe dactyloides-Ratibida tagetes-Ambrosia linearis	Buffalograss playa	G3	S3				B	2000-07-19
Buchloe dactyloides-Ratibida tagetes-Ambrosia linearis	Buffalograss playa	G3	S3				B	2000-07-19

Buchloe dactyloides-Ratibida tagetes-Ambrosia linearis	Buffalograss playa	G3	S3				B	2000-07-13
Buchloe dactyloides-Ratibida tagetes-Ambrosia linearis	Buffalograss playa	G3	S3				B	2000-07-13
Buchloe dactyloides-Ratibida tagetes-Ambrosia linearis	Buffalograss playa	G3	S3				B	2000-07-13
Buchloe dactyloides-Ratibida tagetes-Ambrosia linearis	Buffalograss playa	G3	S3				B	2000-07-12
Bouteloua gracilis-Buchloe dactyloides	Shortgrass prairie	G4	S2?				B	2000-11-18

*EO = Element Occurrence Note: Element occurrences responsible for the B-rank are shown in bold typeface.

Boundary Justification: The site boundary for El Paso Playa includes the densest concentration of playas in El Paso County. Playas continue for many miles north, south, and east of this PCA but not in the concentrations found within it. The entire PCA is underlain by Dwyer soils. Roadside occurrences of plains ambrosia extend for many miles beyond the boundary but these are not included because they are of lower conservation value.

Protection Rank Comments: All land within this PCA is either privately owned or leased from the State Land Board for grazing. Historically, grazing has been the dominant land use in the area, varying in intensity from light to heavy. Increasingly, grazing lands are being subdivided and sold as 35-acre or larger parcels and residential development is progressing rapidly, mostly in the form of mobile homes on small plots.

Six sections within the PCA are owned by the State Land Board and leased for grazing. Limited areas are currently cultivated at present, but when the land was initially homesteaded there were many small cultivated areas, probably one per section or more. Most of these areas have not been farmed for many years but the areas that were once plowed still do not exhibit a typical shortgrass prairie flora.

Management Rank Comments: The current management appears appropriate for maintaining the element occurrences. Grazing regimes that maintain the natural mosaic nature of the shortgrass prairie should be encouraged. Introduction of additional pet animals (primarily dogs and cats) with increased residential development may negatively impact shortgrass prairie birds dependent on the playa area for breeding or brood rearing.

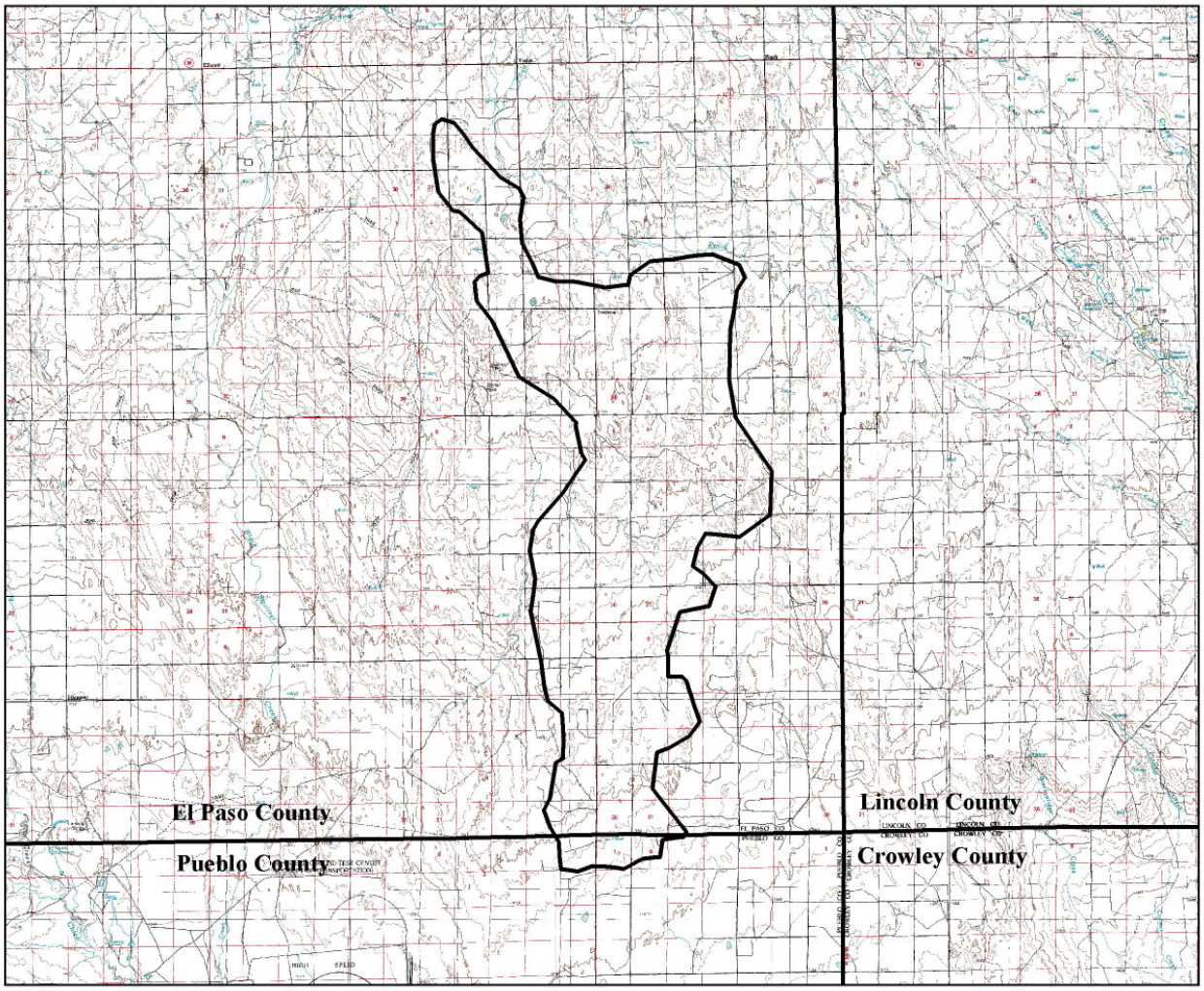
Soils Description: The soils in the playa bottoms are fine-textured sandy clay, silty clay, or clay with 5-10% mottles.

Wetland Functional Assessment for the Buffalograss Playas PCA:
Proposed HGM Class: Depression Subclass: D5
Cowardin System: Palustrine.
CNHP's Wetland Classification: *Buchloe dactyloides-Ratibida tagetes-Ambrosia linearis*.

Function	Rating	Comments
Overall Functional Integrity	At potential	
Hydrological Functions		
Flood Attenuation and Storage	N/A	These ephemeral wetlands are not on stream channels.
Sediment/Shoreline Stabilization	N/A	These ephemeral wetlands are not on stream channels.
Groundwater Discharge/ Recharge	Yes	Groundwater recharge probably occurs prior to playa filling and swelling of the clay bottom. Zartman et al. (1994) have documented playas in other regions as sources of significant groundwater recharge, especially at the playa margins.
Dynamic Surface Water Storage	High	The playas are depressions that collect surface flow after heavy precipitation events. There are no surface water channels in the PCA and the playas act as the water collection system.
Biogeochemical Functions		
Elemental Cycling	Low	These ephemeral wetlands are dry most of the time. Elemental cycling is probably unique from that which occurs in nearby uplands due to the fine-textured soils and periodic saturation of those soils. The playas are therefore, likely providing important local biogeochemical functions. Compared to other wetland types, the quantity of nutrients cycled in playas is probably lower.
Removal of Imported Nutrients, Toxicants, and Sediments.	Low	The playas collect sediment and surface runoff which may contain excess nutrients from cattle. Whether this retention benefits downstream water quality depends on a better understanding of whether and/or how much groundwater recharge is occurring in the playas
Biological Functions		
Habitat Diversity	Low	The playas contain surface water only intermittently and generally consist of shortgrass.
General Wildlife Habitat	Moderate	Apparently, Mountain Plover use playas for foraging and staging.
General Fish/Aquatic Habitat	N/A	The playas are generally dry. Seasonally wet playas may support frog/toad populations and aquatic invertebrates associated with temporary pools.
Production Export/Food Chain Support	Low	There is probably minimal export from the playas. During periods of saturation, the playas may support populations of invertebrates.
Uniqueness	High	Playas occur sporadically throughout the plains but rarely in the concentration found within this PCA. Many playas rangewide have been altered by agricultural use or other human uses. The playas within this PCA have been used as rangeland for a century and not planted with or invaded by non-native vegetation. These playas support plains ambrosia, a plant with a very limited global range.

Restoration Potential: Many of the playas within the PCA are in relatively natural condition (not excavated, no roads, relatively free of non-native vegetation). The need for restoration of these playas is minimal because ecological functions appear intact. Other playas are encroached by roads or non-native vegetation or have been excavated. These are probably performing many of their ecological functions but restoration activities could include control of non-native species or possibly filling of excavations.

Buffalograss Playas
Potential Conservation Area



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The Colorado Natural Heritage Program
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Fax: (970) 491-3349

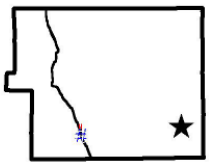
map date: 10 May 2001
GIS department: db

PCA Boundary

U.S.G.S. 30x60 Minute Quadrangle*
Colorado Springs, 38104-E1

*Digital Raster Graphics (DRGs) produced by the U. S. Geological Survey, 1996

Location in Project Area



Cheyenne Canyon

Biodiversity Rank: B2 (Very high significance)
This PCA contains excellent (A-ranked) examples of a globally critically imperiled plant subspecies (*Aquilegia chrysantha* var. *rydbergii*).

Protection Urgency Rank: P4 (Low urgency)
There is mixed ownership between USFS and private.

Management Urgency Rank: M1 (Very high urgency)
Recreation impacts are of concern.

Location: El Paso and Teller counties. West of Colorado Springs, including Bear Creek and North Cheyenne Canyon.

Legal Description: USGS 7.5 minute quadrangles: Manitou Springs, Colorado Springs, Mount Big Chief, and Cheyenne Mountain. T14S R67W Sections 15-17, 19-22, and 27-35; T14S R68W Sections 23-26 and 34-36; T15S R67W Sections 2-11 and 14-22; T15S R68W Sections 1-3 and 10-13.

Size: 18,520 acres (7,495 hectares).

Elevation: 6,260-12,000 feet (1,908 to 3,658 meters)

General Description: The Cheyenne and Bear Creek drainages lie in the foothills west of Colorado Springs and below the Pikes Peak summit. Snowmelt and springs feed the creeks within the PCA. Granite cliffs, outcrops and boulders are dominant features of the landscape in this area. The upland communities consist of mixed conifers dominated by ponderosa pine (*Pinus ponderosa*), oak *(Quercus* ssp.), Douglas-fir (*Pseudotsuga menziesii*) and lodgepole pine (*Pinus contorta*), and spruce-fir (*Picea-Abies*) at the higher elevations. The drainages are filled with Douglas-fir, hazelnut (*Corylus cornuta*), narrowleaf cottonwood (*Populus angustifolia*), river birch (*Betula occidentalis*), chokecherry (*Prunus virginiana*), Rocky Mountain maple (*Acer glabrum*), aspen (*Populus tremuloides*), and willow (*Salix* ssp.). The site covers a large area between 6,260-12,000 feet in elevation.

North Cheyenne and Bear Creek (and likely South Cheyenne Creek) support a plant variety that is endemic to Colorado and is the basis for this site. Rydberg's golden columbine (*Aquilegia chrysantha* var. *rydbergii*) is currently known only from Cheyenne Mountain and Cheyenne/Bear Canyons. This endemic variety is found along the creeks and side drainages in moist areas.

In addition to this globally rare variety, there are 10 other significant plants, animals and plant communities found within this site.

Biodiversity Rank Comments: This site includes a large occurrence of Rydberg's golden columbine (*Aquilegia chrysantha* var. *rydbergii*), a variety endemic to Colorado. Rydberg's golden columbine has only been documented from three other locations worldwide, two of which are known only historically and are probably extirpated. (The full species, *Aquilegia chrysantha,* is known from Arizona, New Mexico, Texas and Mexico, and there is some debate by the experts as to the validity of the variety in Colorado.) In addition to this globally significant variety there are six other rare plant species reported from this site. Three globally rare riparian plant communities and one globally rare bird also occur within this area.

Natural Heritage element occurrences at the Cheyenne Canyon PCA.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	Federal Sensitive	EO* Rank	Last Observed
Plants								
Aquilegia chrysantha var rydbergii	**Golden columbine**	**G4T1Q**	**S1**			**BLM**	**A**	**1998-07-08**
Aquilegia chrysantha var rydbergii	**Golden columbine**	**G4T1Q**	**S1**			**BLM**	**E**	**1994-06-12**
Aquilegia chrysantha var rydbergii	**Golden columbine**	**G4T1Q**	**S1**			**BLM**	**A**	**1998-07-20**
Aquilegia chrysantha var rydbergii	Golden columbine	G4T1Q	S1			BLM	H	1914-07-99
Telesonix jamesii	James' telesonix	G2G3	S2?				B	2000-06-27
Aquilegia saximontana	Rocky mountain columbine	G3	S3				B	1998-07-06
Botrypus virginianus ssp europaeus	Rattlesnake fern	G5	S1				H	1901-07-03
Cypripedium calceolus ssp parviflorum	Yellow lady's-slipper	G5	S2					1990-99-99
Cypripedium calceolus ssp parviflorum	Yellow lady's-slipper	G5	S2				H	1978-06-15
Pellaea atropurpurea	Purple cliff-brake	G5	S2S3				H	1895-07-09
Carex leptalea	Bristle-stalk sedge	G5	S1				H	1956-06-23
Plant Communities								
Corylus cornuta	Lower montane forest	G3	S1				B	1995-08-24
Populus angustifolia/ Prunus virginiana	Narrowleaf cottonwood/ Common chokecherry	G2G3	S1				B	1995-07-24
Pseudotsuga menziesii/Betula occidentalis	Montane riparian forest	G3?	S3				B	1995-06-26

Animals								
Falco peregrinus anatum	American peregrine falcon	G4T3	S2B, SZN				B	1996-07-19

*EO = Element Occurrence Note: Element occurrences responsible for the B-rank are shown in bold typeface.

Boundary Justification: Boundaries encompass riparian canyon bottoms and upland slopes which support rare plant species and riparian plant communities. The immediate watershed is included because the occurrences within this site depend on mesic to wet conditions for survival.

Protection Rank Comments: Mixed land ownership between USFS and private. This is a large site with multiple owners and users.

Management Rank Comments: Bear Creek is less used and developed than North Cheyenne Canyon, and it also supports a much larger population of Rydberg's golden columbine. Due to these factors, Bear Creek is an ideal location to implement strong protective measures for Rydberg's golden columbine. The Bear Creek trail is becoming widened with use and is eroding in a stretch below the falls. Actions addressing these problems would likely go a long ways towards protecting the columbines. Restricting this trail from recreation other than hikers should be considered. Future trails, roads, picnic grounds and other developments should not be constructed in the riparian zones.

The riparian areas should be the top priority for management actions. The rare plant communities and the globally significant golden columbine rely on these riparian areas. Recreation along Cheyenne Creek is heavy (hiking, picnicking, biking and rock climbing). Recreation on the south side of the creek should be restricted. Impacts from the road, picnic areas and parking areas are expanding into the riparian zone. This will be detrimental to the rare plants. Bear Creek is less disturbed and only accessed by a trail. Trail expansion and associated increase in use could also impact the rare plants at this site. The large yellow flower attracts attention and may be in danger of being picked excessively by passers-by. "No flower picking" or informational signs about rare plants in the area may help to control hikers from trampling or disturbing the plants. The upland areas are also important but are not as easily impacted by recreation.

Trail 701 at the upper end of North Cheyenne Creek is currently open to motor bikes. This type of recreation is causing the granite gravel trail to erode to form a gully. This trail should be stabilized or closed to motor vehicles; mountain bikes may be acting in a similar way. A globally rare plant species (*Aquilegia saximontana*) is growing directly adjacent to this trail and should be worked around very carefully.

Management for the peregrine falcon seems to be adequate. The area around the nest is closed during breeding season.

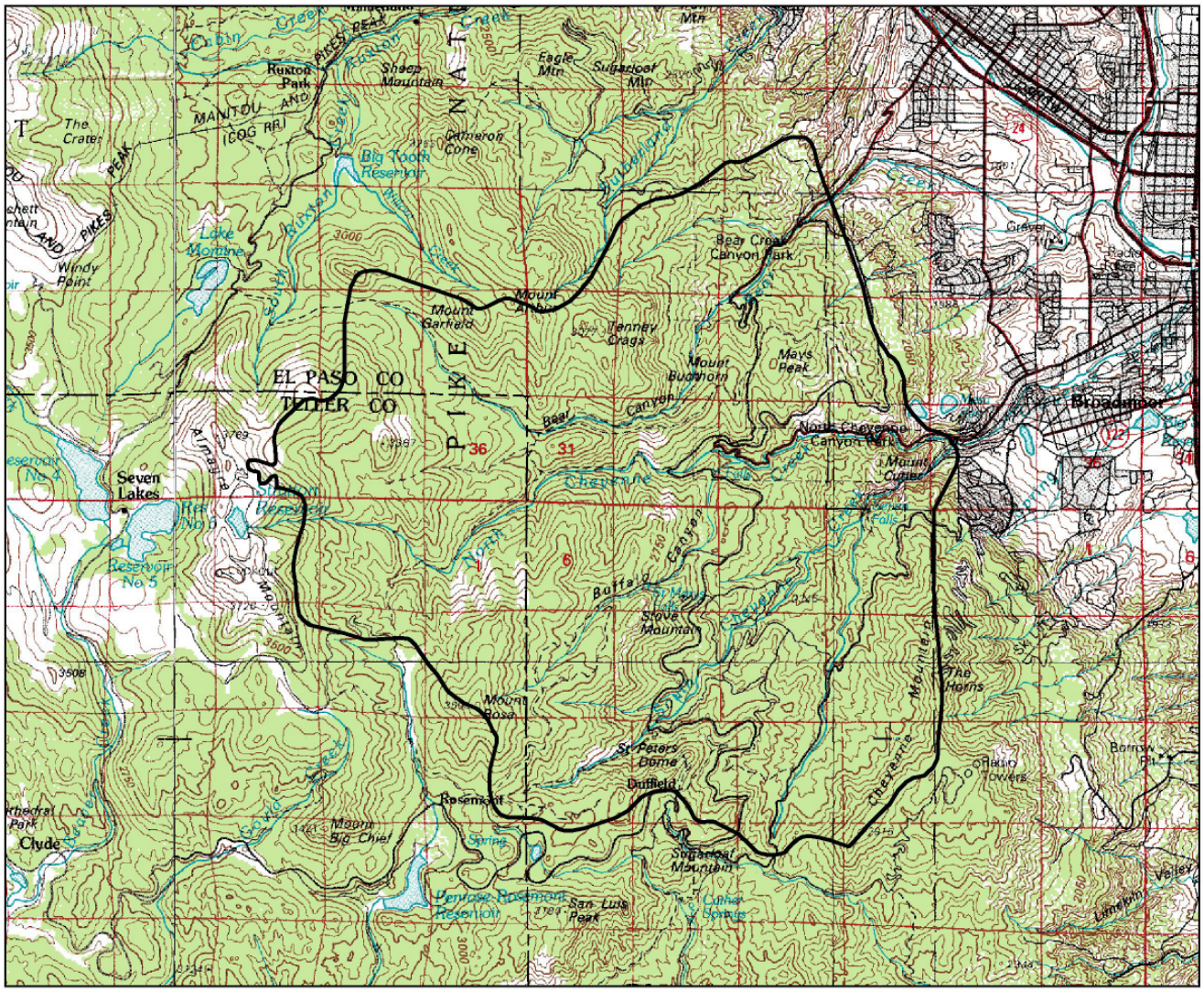
Soils Description: Soils consist of coarse alluvium.

Wetland Functional Assessment: This site was not visited by a CNHP wetland ecologist during the 2000 field season. The following functional assessment comments are based upon notes from other investigators.

The riparian area is likely providing good fish habitat as indicated by the presence of a perennial water source, no alteration of upstream flow, and a diversity of shrubs along the creek. However, heavy recreation may be causing excess erosion. Structural characteristics of the riparian vegetation are diverse, thus providing good avian habitat. Given the proximity to a road and the high amount of recreation in the area, there are potentially high amounts of excess sediments being contributed to the stream.

Restoration Potential: Management and/or eradication of non-native species would benefit the ecological health of the area. Highly eroded areas, caused by excessive recreation, could be revegetated with native species to reduce erosion potential. Trail stabilization could potentially benefit the rare plant and riparian community occurrences.

Cheyenne Canyon
Potential Conservation Area



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Fax: (970) 491-3349

map date: 10 May 2001
GIS department: db

PCA Boundary

U.S.G.S. 30x60 Minute Quadrangles*
Colorado Springs, 38104-E1

*Digital Raster Graphics (DRGs) produced by the U. S. Geological Survey, 1996

Location in Project Area

Greenhorn Creek

Biodiversity Rank: B2 (Very high significance)
This site contains a good (B-ranked) occurrence of a globally imperiled (G2 S2) montane riparian forest community, white fir with blue spruce, narrowleaf cottonwood, and rocky mountain maple *(Abies concolor-Picea pungens - Populus angustifolia/Acer glabrum*). Additionally, a fair (C-ranked) occurrence of greenback cutthroat trout (*Oncorhynchus clarki stomias*) (G4T2T3 S2) occurs in Greenhorn Creek.

Protection Urgency Rank: P4 (Low urgency)
All but the lowermost mile of the PCA are part of the San Isabel National Forest. The lowermost mile is either privately owned or part of Rye Mountain Park. The southern half of the PCA is within the USFS Greenhorn Mountain Wilderness Area.

Management Urgency Rank:M3 (Moderate urgency)
Timber sales on USFS property have the potential to affect the greenback cutthroat trout population. The current management appears appropriate for maintaining the riparian occurrences.

Location: The Greenhorn Creek PCA is located in southwestern Pueblo County, upstream from the town of Rye, and includes the southern tip of Custer County.

Legal Description: USGS 7.5 minute quadrangles: San Isabel and Rye. T24S R68W Sections 29-36; T24S R69W Sections 24, 25, and 36; T25S R68W Sections 2-10.

Size: 6,430 acres (2,602 hectares)

Elevation: 7,200 to 12,237 feet. (2,195 to 3,730 meters)

General Description: Greenhorn Creek begins in the Wet Mountains in Custer County and flows east into Pueblo County and eventually to the Saint Charles and Arkansas rivers. The Greenhorn Creek PCA encompasses the headwaters of the creek and about six miles downstream to Rye Mountain Park. The lower two miles of the site supports good examples of two montane riparian forest communities: white fir with narrowleaf cottonwood and Rocky Mountain maple (*Abies concolor-Picea pungens-Populus angustifolia/Acer glabrum*) (G2 S2) and narrowleaf cottonwood with alder (*Populus angustifolia/Alnus incana*) (G3? S3). The diversity of plant species is high within the communities and includes willows (*Salix monticola, S. irrorata, S. bebbiana*), chokecherry (*Padus virginiana*), red raspberry (*Rubus ideaus*), bush honeysuckle (*Lonicera involucrata*), river birch (*Betula occidentalis*), and beaked hazelnut (*Corylus cornuta*).

Greenhorn Creek is a steep gradient, perennial stream with a rocky/bouldery bed and abundant woody debris. The woody debris provides habitat for a variety of aquatic

insects including stoneflies, mayflies, and caddisflies. Groundwater seepage in side channels and in the main channel creates marshy areas with dense vegetation.

The Colorado Division of Wildlife reintroduced Greenback cutthroat trout (*Oncorhynchus clarki stomias*) (G4T2T3 S2) to the upper reach of Greenhorn Creek in 1988 (U.S. Fish and Wildlife Service 1998). The natural reproduction rates are currently being monitored by CDOW and the population is not currently considered stable but may be within the next couple of years (Poliky et al. 1999).

The surrounding mountains in the lower reaches are forested with ponderosa pine and Douglas fir with patches of aspen. The mountains in the higher reaches support spruce fir forests.

There is little evidence of human-caused alteration of the hydrological processes upstream of the occurrence and within the watershed. The stream undergoes flooding as is evidenced by debris in the riparian vegetation. The upstream watershed is forested and managed by the U.S. Forest Service. The southern half of the PCA is included wihtn the 22,040-acre Greenhorn Mountain Wilderness Area, so designated in 1993. The wilderness area includes Greenhorn Mountain, the highest peak in the Wet Mountains (12,347 feet).

Downstream from the PCA, the majority of flow in Greenhorn Creek is diverted to Lake Beckwith to supply the water needs of the town of Colorado City. The diversion occurs near the confluence with Cold Spring Creek (about two miles east of Rye). Lake Beckwith was built in the 1950's and there are currently plans to expand the reservoir (D. Crawford, pers. comm., CDOW).

Biodiversity Rank Comments: This site contains a good (B-ranked) example of a globally imperiled (G2 S2) montane riparian forest: white fir with blue spruce, narrowleaf cottonwood, and Rocky Mountain maple (*Abies concolor-Picea pungens-Populus angustifolia/Acer glabrum*). The plant association is known from about ten documented occurrences in Colorado and possibly occurs in New Mexico. The site also contains a good (B-ranked) example of a globally vulnerable (G3? S3) montane riparian woodland, narrowleaf cottonwood/thinleaf alder (*Populus angustifolia/Alnus incana*). The plant association is known from Colorado and New Mexico and is expected to occur throughout the range of narrowleaf cottonwood in the Southern Rocky Mountains ecoregion. There are about 40 documented occurrences in Colorado.

Greenback cutthroat trout (*Oncorhynchus clarki stomias*) (G4T2T3 S2) were reintroduced to the upper reach of Greenhorn Creek in 1988 (U.S. Fish and Wildlife Service 1998). The natural reproduction rates are currently being monitored by CDOW and the population is not currently considered stable but may be within the next couple of years (Poliky et al. 1999).

Natural Heritage element occurrences at the Greenhorn Creek PCA.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	Federal Sensitive	EO* Rank	Last Observed
Fish								
Oncorhynchus clarki stomias	Greenback cutthroat trout	G4T2T3	S2	LT	T		C	1998-09-05
Plant Communities								
Abies concolor-Picea pungens - Populus angustifolia/Acer glabrum	**Montane riparian forest**	**G2**	**S2**				**B**	**2000-08-17**
Populus angustifolia/Alnus incana	Montane riparian forest	G3?	S3				B	2000-08-17

*EO = Element Occurrence Note: Element occurrence responsible for the B-rank is shown in bold typeface.

Boundary Justification: The boundary includes the riparian community and the upstream watershed to encompass the headwaters of the stream and the known extent of the greenback cutthroat trout population. The upstream watershed is included to account for continued surface flow and periodic flooding that are necessary for the maintaining the ecological functions and the viability of the occurrences. The boundary was designated using the hydrologic unit GIS coverage (Natural Resources Conservation Service 2000) and the 1:100,000 scale USGS topographic map. The entire upstream watershed of Greenhorn Creek needs to be considered when developing a plan for the long-term viability of this site.

Protection Rank Comments: The majority of the land within the PCA is owned and managed by the USFS. A portion is included within the Greenhorn Mountain Wilderness Area.

Management Rank Comments: The current management appears appropriate for maintaining the element occurrences. A timber sale within the watershed in 1998 resulted in skid trails on the upper reaches of the North Fork of Greenhorn Creek (Melby 1998). USFS personnel reacted quickly to stop the sale and work to repair the damage and it is unknown whether or not there will be any long-term damage to the greenback cutthroat trout population (Melby 1998). Maintenance of the element occurrences depends on appropriate management in the upper watershed to maintain the natural flooding regime and ecological processes. A small amount of leafy spurge (*Euphorbia esula* ssp. *uralensis*) was noted in Rye Mountain Park campground and weed management efforts are strongly recommended.

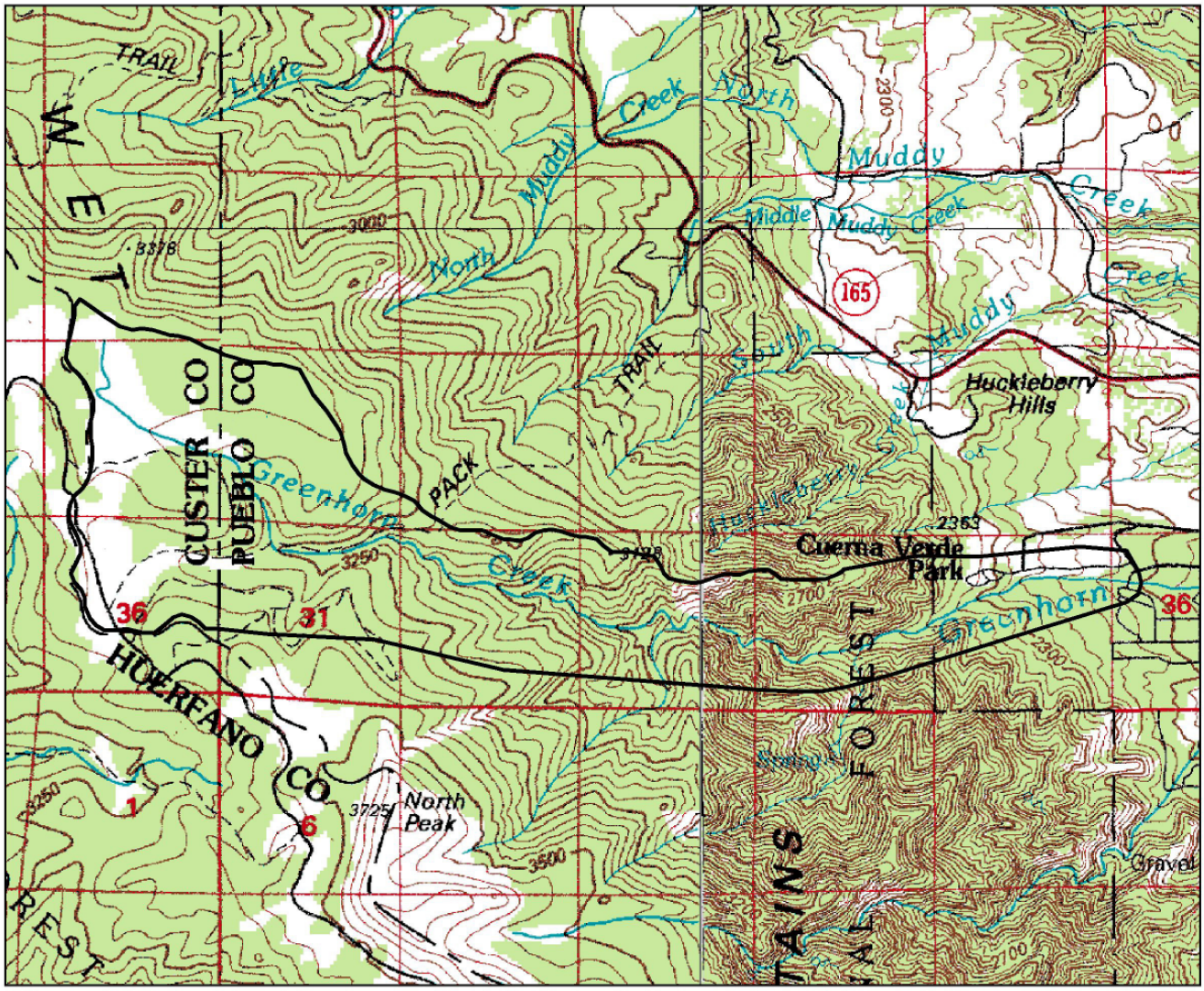
Soils Description: Soils in the riparian area consist of coarse alluvium.

Wetland Functional Assessment for the Greenhorn Creek PCA:
Proposed HGM Class: Riverine Subclass: R3
Cowardin System: Palustrine.
CNHP's Wetland Classification: *Abies concolor-Picea pungens - Populus angustifolia/Acer glabrum* and *Populus angustifolia/Alnus incana*.

Function	Rating	Comments
Overall Functional Integrity	At potential	
Hydrological Functions		
Flood Attenuation and Storage	High	A high density of woody and herbaceous vegetation on the floodplain dissipates stream flow and provides high potential for flood attenuation. The upstream hydrologic regime is intact and flooding probably occurs seasonally.
Sediment/Shoreline Stabilization	High	High vegetative cover along perennial source of water. Streambed is boulders and stones.
Groundwater Discharge/ Recharge	Yes	Stream probably receives groundwater discharge via springs.
Dynamic Surface Water Storage	N/A	Flooding at this site is primarily due to overbank or in-channel flow.
Biogeochemical Functions		
Elemental Cycling	High	Given the diversity of plant species and thus diverse types of litter inputs, and areas with saturated soils, there is likely a stable and persistent cycling of nutrients (as opposed to a quick 'flush'). Thus, important, local biogeochemical functions are likely occurring at this site.
Removal of Imported Nutrients, Toxicants, and Sediments.	Moderate	High vegetative cover provides opportunity for sediment retention. Coarse stream sediments likely provide little nutrient removal.
Biological Functions		
Habitat Diversity	High	Habitat types include rocky and unconsolidated stream bottom, and emergent, scrub-shrub, and forested wetlands.
General Wildlife Habitat	High	There is good vegetative structure associated with the riparian area. Wildlife within the canyon includes elk, deer, and a variety of songbirds.
General Fish/Aquatic Habitat	High	Greenback cutthroat trout were reintroduced to the creek in 1988. The population is considered "potentially stable" by the Colorado Division of Wildlife. Overhanging banks and woody and leaf debris in the creek create excellent fish and aquatic invertebrate habitat. Mayflies, stoneflies, and caddisflies were observed.
Production Export/Food Chain Support	Moderate	High potential to export a diverse composition of litter downstream for use by a variety of organisms. Downstream from the PCA the creek is diverted to Lake Beckwith, thereby disturbing the natural downstream export of litter and nutrients. Locally, the diverse array of plant species and habitat provide good food chain support.
Uniqueness	Moderate	Riparian systems similar to this site are common at similar elevations, but limited within Pueblo County. Greenhorn Creek is not impacted by water diversions at this elevation. Part of the watershed is located within the Greenhorn Mountain Wilderness Area.

Restoration Potential: Efforts to manage and/or eradicate the population of leafy spurge and any other non-native species would benefit the ecological health of the site.

Greenhorn Creek
Potential Conservation Area



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The Colorado Natural Heritage Program
Colorado State University
254 General Services Bldg
Fort Collins, CO 80523
Fax: (970) 491-3349

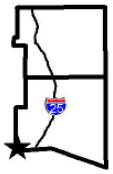
map date: 4 May 2001
GIS department: db

PCA Boundary

U.S.G.S. 30x60 Minute Quadrangles*
Blanca Peak, 37105-E1
Walsenburg, 37104-E1

*Digital Raster Graphics (DRGs) produced by the U. S. Geological Survey, 1996

Location in Project Area



Judge Orr Road

Biodiversity Rank: B2 (Very high significance)
This PCA contains a good (B-ranked) example of a globally imperiled (G2 S2) tallgrass community, big bluestem–little bluestem (*Andropogon gerardii-Schizachyrium scoparium*). The PCA also contains several good (B-ranked) examples of globally vulnerable (G3) to globally secure (G5) wetland plant communities.

Protection Urgency Rank: P2 (High urgency)
The town of Falcon and associated housing subdivisions are encroaching on the grasslands and wetlands within the PCA. The PCA is comprised of private lands and one State Land Board parcel of ¾ square mile. The private lands could easily find development a viable option.

Management Urgency Rank: M4 (Low urgency)
Current management appears appropriate for maintenance of the element occurrences. If development continues to proceed at a rapid rate, water management may become the primary management issue.

Location: Judge Orr Road PCA is located in El Paso County both north and south of Highway 24 between the towns of Falcon and Peyton. The wetlands occur throughout the PCA but are more prevalent south of Highway 24 along Judge Orr Road.

Legal Description: USGS 7.5 minute quadrangles: Eastonville, Falcon, Haegler Ranch, and Peyton. T11S R64W Sections 33 and 34; T12S R63W Sections 18-20 and 29-34; T12S R64W Sections 2-4, 8-11, 13-17, 20-29, and 32-36; T13S R63W Sections 3-9 and 16-18; T13S R64W Sections 1-4 and 8-16.
Size: 25,026 acres (10,128 hectares).

Elevation: 6,420 to 7,200 feet (1,957 to 2,195 meters)

General Description: Low rolling hills of tallgrass, midgrass, and shortgrass prairie with swales containing wet meadows and small ephemeral drainages form a relatively intact landscape in north-central El Paso County. Located south and west of the Black Forest, the PCA encompasses the upper watershed of Black Squirrel Creek and its tributaries.

Remnants of tallgrass prairie occur in Colorado as disjuncts from the historic tallgrass prairie that made up the eastern third of the Great Plains. Historically, tallgrass prairie occupied approximately 60 million hectares, but today less than 2 percent of that remains (Samson and Knopf 1994). Most tallgrass prairie has been converted to cropland or other uses. In Colorado, tallgrass prairie remnants are limited to the plains adjacent to the Front Range where the rainfall and soil is appropriate. As you move further east of the Front Range the rainfall diminishes and shortgrass prairie dominates. Very few large patches of tallgrass prairie remain in Colorado.

Tallgrass prairie is present in scattered patches in El Paso County both along the foothills and out into the plains in the northern portion of the county. Within the Judge Orr Road PCA, two grassland communities have been described. The first is south of Highway 24 and along both sides of Judge Orr Road where a fairly large occurrence of a big bluestem little bluestem western Great Plains tallgrass prairie (*Andropogon gerardii-Schizachyrium scoparium*) (G2 S2) is present. The community occurs in patches within about a five square mile area. The occurrence appears to be in good condition with relatively few weeds and sustainable grazing practices. Other grasses present include blue grama (*Bouteloua gracilis*), prairie sandreed (*Calamovilfa longifolia*), and scattered Indian grass (*Sorghastrum nutans*).

Associated with tallgrass prairie are at least five species of skippers (butterflies in the family Hesperiidae) known to rely on big bluestem as their primary host plant (Opler and Wright 1999). These eastern Great Plains skippers occur, like tallgrass prairie, as disjunct populations along the Colorado Front Range. Though we have no current records of these species within the Judge Orr Road PCA, three skippers tracked by CNHP have been documented in El Paso County (Opler et al. 1995, Colorado Natural Heritage Program 2001a). These include the Dusted Skipper (*Atrytonopsis hianna*) (G4G5 S2), Crossline Skipper (*Polites origines*) (G5 S3), and Ottoe Skipper (*Hesperia ottoe*) (G3G4 S2). Future surveys may reveal populations of these rare butterflies.

North of Highway 24 is another relatively intact grassland. The dominant species appear to be little bluestem, blue grama, and mountain muhly (*Muhlenbergia montana*). The community is described as little bluestem with sideoats grama (*Schizachyrium scoparium-Bouteloua curtipendula*) (G3 S2), a globally vulnerable midgrass prairie community.

Perhaps the most striking aspect of the prairie along Judge Orr Road is the abundance of creeks and wetlands. These creeks and wetlands are supported by regional shallow groundwater resulting from groundwater recharge in the Black Forest to the north. The land gently slopes to the southeast forming the headwaters of Black Squirrel Creek. Many small drainages flow from the area and can form wide wet meadows of up to 40 acres in size. Along Judge Orr Road, the many drainages and wet meadows support a mosaic of wetland communities including Baltic rush (*Juncus balticus* var. *montanus*) (G5 S5), Nebraska sedge (*Carex nebrascensis*) (G4 S3), Clustered sedge (*Carex praegracilis*) G3 S2), Woolly sedge (*Carex lanuginosa*) (G3? S3), three-square bulrush (*Scirpus pungens*) (G3G4 S3), and saltgrass (*Distichlis spicata*) (G5 S3). Another prevalent species is the European pasture grass redtop (*Agrostis gigantea*). These communities can form monotypic stands or intermingle with adjacent types.

The drainages and associated ponds support small fishes (unidentified species), abundant northern leopard frogs (*Rana pipiens*) (G5 S3) (a species on CNHP's "watchlist"), and a variety of aquatic invertebrates. Birds observed within the PCA wetlands include Common Snipe, American Coot, Pied-billed Grebe, and Northern Harrier. Aquatic vegetation in the ponds and drainages includes pondweed (*Potamogeton* sp.), hornwort (*Ceratophyllum demersum*), duckweed (*Lemna minor*), and arrowhead (*Sagittaria* sp.).

Small-headed rush (*Juncus brachycephalus*) (G5 S1), a common wetland in parts of the eastern US and Canada, occurs as a disjunct in Colorado. Streams draining the Black Forest and their associated wet meadows are the only known current Colorado locations for this plant. Small-headed rush has been documented on Black Squirrel Creek and a tributary.

Development pressures are intense in this portion of the county. The primary land use within the PCA is cattle grazing but with increasing encroachment of the town of Falcon. Falcon occurs within the described wetland complex and is in a period of rapid expansion. Water diversion structures have been constructed and wetlands dredged and filled to allow for residential and commercial development. Drainage and diversion structures have the potential to alter the hydrologic regime supporting the larger wetland complex.

Biodiversity Rank Comments: This site contains a good (B-ranked) occurrence of a globally imperiled (G2 S2) big bluestem little bluestem tallgrass prairie community (*Andropogon gerardii-Schizachyrium scoparium*). Large occurrences of this community type are rarely encountered and no A-ranked occurrences remain in Colorado. The PCA also includes good example of many globally vulnerable to common wetland communities but the biodiversity rank is not dependent on these occurrences.

Natural Heritage element occurrences at the Judge Orr Road PCA.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	Federal Sensitive	EO* Rank	Last Observed
Plants								
Juncus brachycephalus	Small-headed rush	G5	S1				E	2000-09-06
Juncus brachycephalus	Small-headed rush	G5	S1				E	1997-09-03
Plant Communities								
Andropogon gerardii-Schizachyrium scoparium	**Xeric tallgrass prairies**	**G2**	**S2**				**B**	**2000-10-23**
Schizachyrium scoparium-Bouteloua curtipendula	Great Plains mixed grass prairies	G3	S2				B	2000-11-22
Carex praegracilis	Clustered sedge wetland	G3	S2				B	2000-10-23
Carex lanuginosa	Wet meadow	G3?	S3				B	2000-10-23
Scirpus pungens	Bulrush	G3G4	S3				B	2000-10-23
Carex nebrascensis	Wet meadow	G4	S3				B	2000-10-23
Distichlis spicata	Salt meadow	G5	S3				B	2000-10-23
Juncus balticus var. *montanus*	Wet meadow	G5	S5				B	2000-10-23

*EO = Element Occurrence Note: Element occurrence responsible for the B-rank is shown in bold typeface.

Boundary Justification: The boundary encompasses the tallgrass prairie and midgrass prairie element occurrences. The boundary also encompasses the wetlands and riparian

areas and a portion of the upstream watershed to account for continued surface flow and periodic flooding. These processes are necessary for the viability of the occurrence and maintenance of ecological functions. The PCA could be expanded to include a greater proportion of the upstream watershed to ensure maintenance of the ecological and hydrological processes. The wetlands and grasslands extend beyond the boundary of the PCA; the boundary includes the largest known grasslands/wetlands in good condition with relatively unfragmented ownership. Further investigation might extend the occurrences east of Peyton.

Protection Rank Comments: The land is privately owned in parcels ranging up to about 8,000 acres (3,240 ha). The primary land use in the PCA is cattle grazing; however, development pressures are extremely high as the town of Falcon grows south and east.

Management Rank Comments: The current management appears appropriate for maintaining the element occurrences. Alteration of the hydrologic regime associated with encroaching developments (e.g.,surface water diversions, groundwater withdrawls) will likely be the primary management issue in the area. Management of non-native plants within the wetlands would improve their ecological health.

Soils Description: The soil in the channels is variable but generally includes a thin organic layer (< 5 cm) overlying silty clay loam (<5 cm) overlying sand.

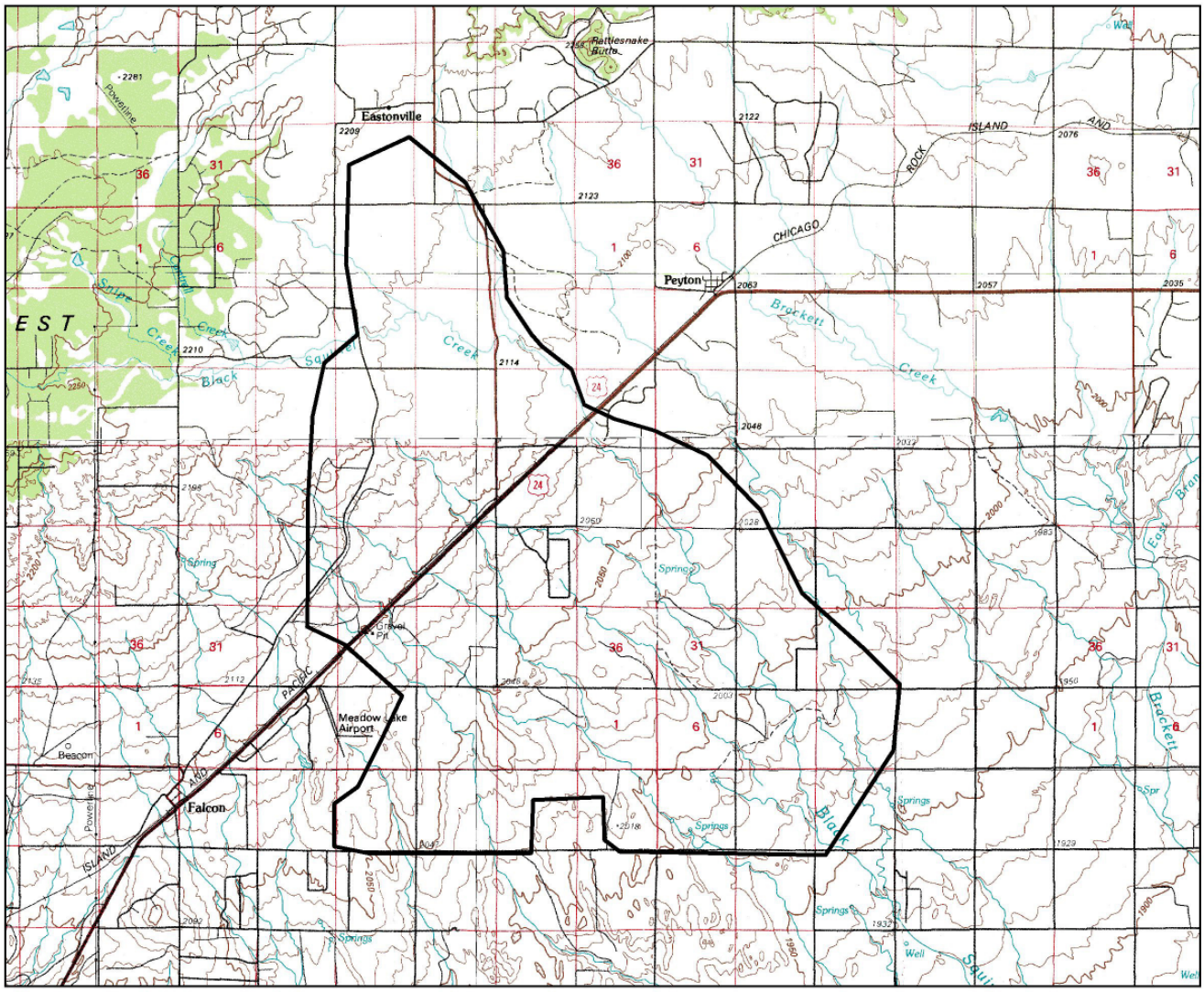
Wetland Functional Assessment for the Judge Orr Road PCA:
Proposed HGM Class: Slope Subclass: S4
Cowardin System: Palustrine.
CNHP's Wetland Classification: *Juncus balticus, Carex nebrascensis, C. praegracilis, C. lanuginosa, Scirpus pungens,* and *Distichlis spicata*.

Function	Rating	Comments
Overall Functional Integrity	At potential	
Hydrological Functions		
Flood Attenuation and Storage	High	Highly vegetated small channels (some entrenched) between the rolling hills and associated wet meadows have the potential to attenuate floods and store overbank flow.
Sediment/Shoreline Stabilization	High	Dense cover of emergents creates good sediment and shoreline stabilization potential.
Groundwater Discharge/ Recharge	Yes	Groundwater discharge supports the wetlands. This region is the headwaters for Black Squirrel Creek.
Dynamic Surface Water Storage	N/A	The wetlands probably flood via overbank flow.
Biogeochemical Functions		
Elemental Cycling	High	Some organic soils are present, surface water is perennial in some sections, and vegetative cover is high – all indicating elemental cycling is functioning normally.
Removal of Imported Nutrients, Toxicants, and Sediments.	High	The fine-grained sediments and dense vegetative cover probably have the potential to remove nutrients and sediments from the surface water. Cattle grazing occurs within the wetlands which likely contributes excess nutrients.
Biological Functions		
Habitat Diversity	Moderate	Habitat types include emergent and small open water wetlands.
General Wildlife Habitat	Moderate	The dense emergent vegetative cover provides great cover for common snipe (many observed). Also observed in ponds were American Coot and Pied-billed Grebe. Greater Sandhill Cranes were observed circling overhead and have been documented using the nearby wetlands during fall migration.
General Fish/Aquatic Habitat	Moderate	Numerous northern leopard frogs and small fishes (unidentified) were observed in small ponds and flowing stream sections. Mayflies, damselflies, water striders observed.
Production Export/Food Chain Support	Moderate	The perennial surface water and dense emergent vegetation and stream outlets indicate a downstream flow of organic material is probable.
Uniqueness	Moderate	This type of wetland is globally common and locally common in the vicinity of Falcon and Peyton. However, it is rare to find a wetland of such large acreage within a relatively intact landscape on the plains. Development pressures are high and many wetlands have been irreversibly altered. Also, the tallgrass prairie uplands contribute to the uniqueness of this wetland.

Restoration Potential: Control of non-native species present within the wetlands would benefit the site.

Judge Orr Road

Potential Conservation Area



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The Colorado Natural Heritage Program
Colorado State University
254 General Services Bldg
Fort Collins, CO 80523
Fax: (970) 491-3349

map date: 10 May 2001
GIS department: db

PCA Boundary

U.S.G.S. 30x60 Minute Quadrangles*

Colorado Springs, 38104-E1
Castle Rock, 39104-A1

*Digital Raster Graphics (DRGs) produced by the U. S. Geological Survey, 1996

Location in Project Area

Monument Creek

Biodiversity Rank: B2 (Very high biodiversity significance)
The Monument Creek site supports an excellent (A-ranked) and a fair (C-ranked) occurrence of the globally and state imperiled (G5T2 S2) Preble's meadow jumping mouse (*Zapus hudsonius preblei*), a species designated as sensitive (Forest Service), as federally threatened, and as a species of special concern (State of Colorado).

Protection Urgency Rank: P2 (High urgency)
It is estimated that stresses may reduce the viability of the Preble's meadow jumping mice in the potential conservation area if protection action is not taken.

Management Urgency Rank: M3 (Moderate urgency)
New management actions may be needed within five years to maintain the current quality of the jumping mouse occurrences.

Location: This conservation area is located approximately 12 miles north of the city of Colorado Springs. It extends from the town of Monument to the northern border of Colorado Springs. It encompasses the length of Monument Creek plus all eastern tributaries and most western tributaries including Beaver Creek, Deadmans Creek, Lehmans Run and West Monument Creek.

Legal Description: USGS 7.5 minute quadrangles: Palmer Lake, Monument, Cascade, Pikeview. T11S R66W Sections 17, 19, 20, 30, 32, and 33. T11S R67W Sections 14, 15, 22-28, 33-36; T12S R66W Sections 4-9, 16-21, and 28-32; T12S R67W Sections 1, 2, 9-16, 21, 23-28, and 33-36; T13S R66W Sections 5-8, 17, and 18; T13S R67W Section 1.

Size: 12,709 acres (5,143 hectares)

Elevation: 6,260 to 7,440 feet (1,908 to 2,268 meters)

General Description: Monument Creek flows southward from the Monument Divide through the U.S. Air Force Academy (Academy) and into the city of Colorado Springs. The potential conservation area begins at the town of Monument and extends to the northern edge of the city of Colorado Springs. This site is centered around Monument Creek and includes the tributaries of Beaver Creek, Deadmans Creek, Lehman Run and West Monument Creek to the west and Dirty Woman Creek, Jackson Creek, Smith Creek, Monument Branch, Black Squirrel Creek, and Kettle Creek to the east. The floodplain is composed of gravel and silt and is defined by steep, eroding sandstone cliffs and gentle terraces. Monument Creek meanders broadly through some stretches, particularly the Academy where periodic flooding events have created substantial deposits of silt and debris. The riparian vegetation is dominated by coyote willow (*Salix exigua*), peachleaf willow (*Salix amygdaloides*), and crack willow (*Salix fragilis*) with scattered stands of narrowleaf cottonwood (*Populus angustifolia*). Also found in these mesic habitats are snowberry (*Symphoricarpos occidentalis*), wild plum (*Prunus americana*), and Russian olive (*Elaeagnus angustifolia*). Stream banks retain native

graminoid vegetation in the form of sedges (*Carex* spp.) and rushes (*Juncus* spp.). Surrounding uplands are generally midgrass prairie that is composed of smooth brome (*Bromopsis inermis*), cheatgrass (*Bromus tectorum*), big bluestem (*Andropogon gerardii*), needle-and-thread (*Stipa comata*), and little blue stem (*Schizachyrium scoparium*). Ponderosa pine (*Pinus ponderosa*) and Gambel's oak *(Quercus gambelii*) occur in patches on either side of Monument Creek and its tributaries.

Prior to the establishment of the U.S. Air Force Academy, the area was used for logging and ranching operations since settlement in the 1860s (Ripley 1994). Within the Academy, logging has not occurred since 1915 and cattle grazing has not occurred since the purchase of the area by the Air Force in 1915 (Ripley 1994). Cattle grazing and smaller ranching operations still exist north of the Academy. South and east of the Academy the system is quickly being encroached by residential and commercial development.

Biodiversity Rank Comments: This potential conservation area is of high global significance because it is one of the best-known occurrences of a globally-rare subspecies (Schorr 2001). Also, this conservation area is the best-known occurrence of Preble's meadow jumping mice in the Arkansas River drainage. The population of jumping mice from within the Academy has shown persistence since 1994 and has shown resilience to severe flooding in 1999. This potential conservation area that incorporates Monument Creek and the associated tributaries provides protection from stochastic events that may affect portions of the Monument Creek population or segments of the population within tributaries. This complex of mainstem waterway and tributaries lends a degree of protection from such stochastic events that might jeopardize a more homogenous population that is susceptible to site-specific catastrophic events. This potential conservation area includes the habitat parameters that are likely critical to Prebles' jumping mouse persistence: dense herbaceous and shrub riparian communities and upland grassland communities free from urban impacts.

Natural Heritage element occurrences at the Monument Creek PCA.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	Federal Sensitive	EO* Rank	Last Observed
Mammals								
Zapus hudsonius preblei	**Preble's meadow jumping mouse**	**G5T2**	**S1**	**T**	**SC**	**FS**	**A**	**2000-09-99**
Zapus hudsonius preblei	Preble's meadow jumping mouse	G5T2	S1	T	SC	FS	C	2000-09-99
Butterflies								
Callophrys mossii schryveri	Moss's elfin	G3G4 T3	S2S3				B	1994-05-03
Celastrina humulus	Hops feeding azure	G2G3	S2				C	1995-06-27
Celastrina humulus	Hops feeding azure	G2G3	S2				C	1995-07-12

Plant Communities								
*Alnus incana/*mesic graminoid	Montane riparian shrubland	G5Q	S3				B	1995-07-25
*Alnus incana/*mesic graminoid	Montane riparian shrubland	G5Q	S3				C	1995-09-22
Alnus incana-Cornus sericea	Thinleaf alder–red-osier dogwood riparian shrubland	G3G4	S3				B	1995-09-22
Populus angustifolia/ Salix exigua	Narrowleaf cottonwood riparian forest	G4	S4				B	1995-09-22
*Salix exigua /*mesic graminoid	Coyote willow/mesic graminoid	G5	S5				B	1995-09-21
*Salix exigua /*mesic graminoid	Coyote willow/mesic graminoid	G5	S5				B	1995-09-22
*Salix exigua /*mesic graminoid	Coyote willow/mesic graminoid	G5	S5				BC	1995-09-21
*Salix exigua /*mesic graminoid	Coyote willow/mesic graminoid	G5	S5				B	1995-09-22
Symphoricarpos occidentalis	Snowberry shrubland	G4G5	S3				BC	1995-09-21
Symphoricarpos occidentalis	Snowberry shrubland	G4G5	S3				C	1995-09-22
Plants								
Potentilla ambigens	Southern rocky mountain cinquefoil	G3	S1S2				B	1993-08-11
Woodsia neomexicana	New Mexico cliff fern	G4?	S2				E	1989-99-99
Woodsia neomexicana	New Mexico cliff fern	G4?	S2				E	1989-99-99

*EO = Element Occurrence Note: Element occurrence responsible for the B-rank is shown in bold typeface.

Boundary Justification: The boundaries of this conservation area were defined based on the presence of Preble's meadow jumping mice throughout the system. In five of the last six years, systematic sampling for Preble's meadow jumping mice has occurred within the U.S. Air Force Academy. Outside of the Academy, jumping mice have been documented in Beaver Creek, Kettle Creek, Deadmans Creek, Jackson Creek, Smith Creek and Dirty Woman Creek. The boundary includes 300 meters on either side of the associated creek. This is designed to include the riparian vegetation and associated upland grass communities that have been documented as part of Preble's meadow jumping mouse habitat (Schorr 2001). The distance of 300 meters was intended to be conservative, likely including a greater amount of upland community than most mice will utilize, but sufficient in all circumstances to ensure persistence of jumping mice. A better approximation of this potential conservation area would be the area that includes the 100-year floodplain and an additional 100 meters of adjacent upland habitat. Until these data layers are available for all areas within the conservation area, this conservation boundary should provide the persistence of the subspecies in this area.

Protection Rank Comments: Likely the biggest threat to this conservation area is the encroachment of urban impacts. Although the impacts of development are unclear, Preble's meadow jumping mice are not found in great numbers or simply do not occur,

near urban settings. This potential conservation area is well protected within the U.S. Air Force Academy, but may be subject to a host of potential impacts outside of the Academy boundaries. Since the likelihood of increased urbanization east and north of the Academy is high, it is important to use these conservation area boundaries to plan for the long-term conservation of this significant Preble's meadow jumping mouse population.

Since much of the Monument Creek potential conservation area is housed within the U.S. Air Force Academy it is likely that much of the area will be protected as long as the Academy maintains the present habitat management strategy. However, much of this potential conservation area is located on private and local government land. Depending on the management strategies in place on these properties, it may be more difficult to ensure long-term persistence of this potential conservation area off Academy lands. Within the Academy the riparian communities and associated uplands are some of the healthiest along the Front Range. Although the presence of exotic, invasive plant species may compromise the value of this conservation area, it currently does not impact the persistence of Preble's meadow jumping mice. Further investigations are necessary to determine the conservation impact weedy plants have on jumping mouse biology. Outside the Academy current habitat management strategies may be problematic to the value of this potential conservation area. In particular, the increase in development adjacent to riparian systems in the eastern and northern sections of this conservation area may jeopardize the persistence of jumping mouse populations. To date there have not been studies associating increased development and jumping mouse declines, but anecdotal evidence (Compton and Hugie 1993, Ryon 1996) suggests that they may be incompatible. In some areas along the northern section of Monument Creek and the associated tributaries current management may not jeopardize jumping mouse populations, but also may not allow populations to expand considerably. For the most part, the tributaries in this area are surrounded by small to medium ranches that may house a few head of livestock. It is believed that jumping mice and livestock grazing are compatible, but depending on the level of impact to riparian systems these ranches may preclude expansion of jumping mouse populations.

Management Rank Comments: Current management within the Academy restricts human access to Monument Creek and some of the associated tributaries within this potential conservation area. This management strategy likely contributes to the high-quality habitat that persists today. North and south of the Academy the level of grazing and ranching may not jeopardize the population, but also may restrict the degree to which it can expand. Grazing and ranching can restrict the expanse of riparian shrub communities and thus, restrict the ability for Preble's meadow jumping mice to utilize the area. However, mild grazing pressure may not affect the population.

Of the utmost importance to ensuring the persistence of the jumping mouse populations within this conservation area is the continued management of habitats within the U.S. Air Force Academy. The current management strategy, which limits activities within riparian corridors, has provided habitat for one of the healthiest populations of Preble's meadow jumping mouse known. Outside of the Academy, it is essential to ensure that development in and around riparian corridors provide both riparian and upland habitat for

jumping mice. Jumping mice have been documented using upland habitats and it is possible that habitats that only include riparian communities will not be sufficient for jumping mouse persistence. Current management strategies on ranches may be sufficient to maintain jumping mouse populations at their current level; however, restricting impacts such as excessive grazing and compaction of soils near riparian systems will likely increase jumping mouse populations.

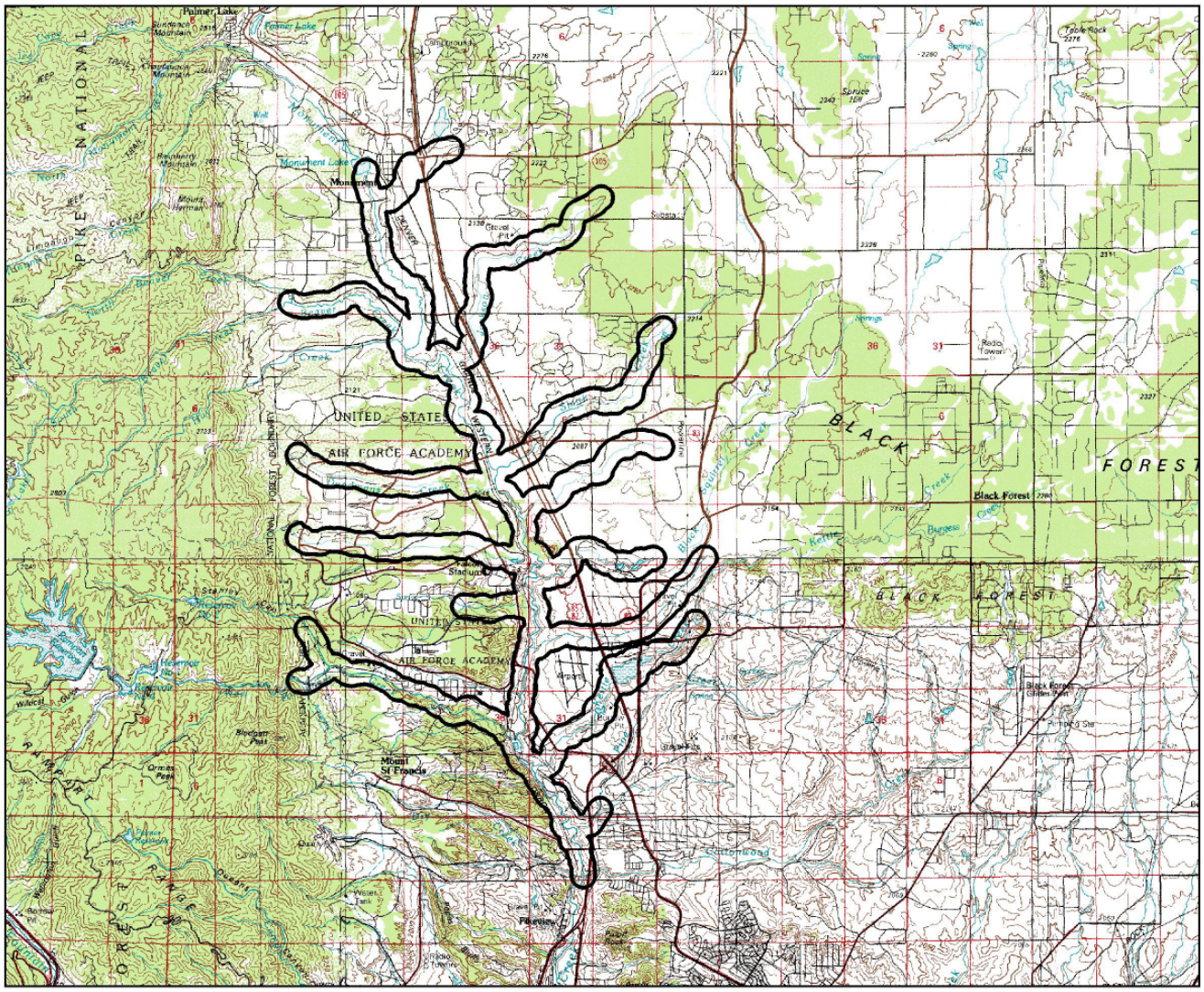
Soils Description: Soils were not described at this site.

Wetland Functional Assessment: This site was not visited by a CNHP wetland ecologist during the 2000 field season. No functional assessment was conducted at this site.

Restoration Potential: No evaluation of restoration potential was conducted at this site.

Monument Creek

Potential Conservation Area



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Fax: (970) 491-3349

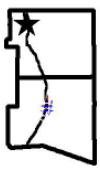
map date: 10 May 2001
GIS department: db

PCA Boundary

U.S.G.S. 30x60 Minute Quadrangles*
Pikes Peak, 38105-E1
Castle Rock, 39104-A1

*Digital Raster Graphics (DRGs) produced by the U. S. Geological Survey, 1996

Location in Project Area



Schriever Playas

Biodiversity Rank: B2 (Very High Significance)
This PCA contains a good (B-ranked) occurrence of a globally imperiled (G2 S1) playa grassland community (*Pascopyrum smithii – Eleocharis* spp.).

Protection Urgency Rank: P2 (High urgency)
Protection actions may be needed within five years primarily due to residential development pressures. Two of the playas are on property owned by Schriever Air Force Base and will likely remain undeveloped.

Management Urgency Rank: M4 (Low urgency)
Current management appears adequate for maintenance of the element occurrence. Mechanical disturbance of the playas should be avoided and weed management considered.

Location: Central El Paso County. Schriever Air Force Base, south of Highway 24 and west of Enoch Road.

Legal Description: USGS 7.5 minute quadrangle: Corral Bluffs. T14S R64W Sections 22 and 27.

Size: 514acres (208 hectares).

Elevation: 6,320 to 6,380 feet.

General Description: Scattered playas occur within the rolling hills of shortgrass prairie in central El Paso County. Schriever Playas PCA contains four of these small, periodically inundated, closed basins. The playas support stands of western wheatgrass with mixed species of spikerush (*Pascopyrum smithii-Eleocharis* spp.) (G2 S1), a plant community previously documented in only a few playas in Wyoming (G. Jones, pers. comm., Wyoming NHP).

The vegetation in the playas occurs in two zones, resulting from differences in the period of inundation. The lowest part of the stand, which is inundated most often and for the longest time, is dominated by spikerush (*Eleocharis acicularis* and *E. palustris*) and bare ground; the higher part of the stand is dominated by western wheatgrass (*Pascopyrum smithii*), a cool-season perennial.

These basins remain dry throughout most of the year and collect water only after heavy rainfall. Heavy rains generally fall in the late summer and in many cases a series of storms are required in order for the playas to retain water (Weathers 2000). Runoff collecting in a dry playa infiltrates cracks in the clay bottom of the playa and swells the clay effectively sealing the playa bottom (Zartman et al. 1994). After the clay has been wetted, subsequent storms can result in playa filling. The playas may hold water for

periods ranging from days to weeks, depending on the local topography and intensity of the rainstorm (Weathers 2000). In dry years, the playas may remain dry year round.

The most common explanation for the origin of playas is deflation, or wind erosion, though theories on playa formation are controversial (Osterkamp and Wood 1987). These playas are also consistent with descriptions of buffalo wallows which are formed by bison pawing the ground, creating patches of bare ground in which to dust bathe (Uno 1989), or perhaps mud bathe to protect against biting insects or aid in shedding their heavy fur (F. Knopf, pers. comm., USGS). Active wallows range from 3 to 5 meters in diameter and merging of adjacent wallows can create wallows larger than about 0.5 acre (1,400 square meters) (Uno 1989, Knopf 1996a). Bison were extirpated from the area by 1875 (Hornaday 1889) but evidence of their wallows can remain evident on the landscape for more than a hundred years (Knopf 1996a). Perennial grasses invade wallows not used by bison (Uno 1989). It is possible that the playas result from of a combination of factors including deflation and buffalo wallowing.

The land within the PCA is owned and managed by Schriever Air Force Base, State Land Board, or private owners. The area has historically been used for cattle grazing. Limited cattle grazing probably continues, but housing developments are increasingly encroaching from the west.

Biodiversity Rank Comments: This PCA contains a good (B-ranked) occurrence of a globally imperiled (G2 S1) playa grassland community (*Pascopyrum smithii - Eleocharis* spp.).

Natural Heritage element occurrences at the Schriever Playas PCA.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	Federal Sensitive	EO* Rank	Last Observed
Plant Communities								
Pascopyrum smithii – Eleocharis spp.	Playa grassland	G2	S2				B	2000-10-27

*EO = Element Occurrence

Boundary Justification: The site boundary includes four playas and most of the surrounding lands acting as the catchment basin for the playas. The catchment basin boundary was roughly delineated using the 1:24,000 scale USGS topographic quadrangle. Scattered playas occurring within a few miles of these playas were not surveyed and are not included within the PCA.

Protection Rank Comments: About 40 percent of the PCA, including the two largest playas, is owned and managed by Schriever AFB as a buffer for the developed portion of the AFB. The remainder of the PCA is State Land Board property or privately owned. Schriever AFB natural resources staff is aware of the playas and reports that the property east of Enoch Road will likely continue to be used as an undeveloped buffer for the AFB (R. Mitchell, pers. comm., Schriever AFB). The two playas on Schriever AFB have been designated as jurisdictional wetland (U.S. Army Corps of Engineers 1991) and as such are regulated under the Clean Water Act.

Management Rank Comments: The current management appears appropriate for maintaining the element occurrences. One of the playas on Schriever AFB has been fenced to exclude grazing (R. Mitchell, pers. comm., Schriever AFB). Some weedy species are present in the playas and in the surrounding uplands and weed management activities should be considered.

Soils Description: The soils in the playa bottoms are silty clay (10YR 3/3) with mottles.

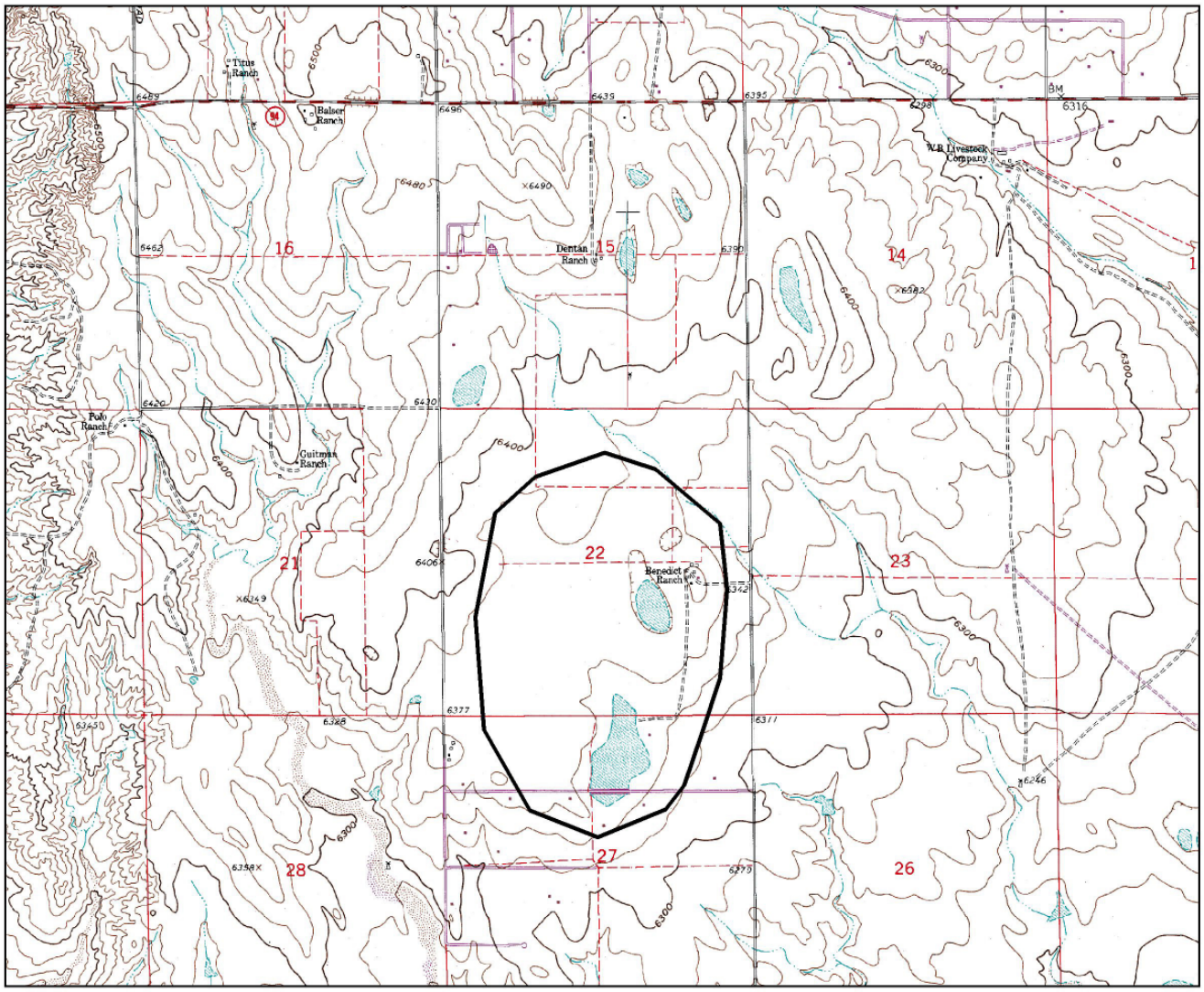
Wetland Functional Assessment for the Schriever Playas PCA:
Proposed HGM Class: Depression Subclass: D5
Cowardin System: Palustrine.
CNHP's Wetland Classification: *Pascopyrum smithii-Eleocharis* spp.

Function	Rating	Comments
Overall Functional Integrity	At potential	
Hydrological Functions		
Flood Attenuation and Storage	N/A	These ephemeral wetlands are not on stream channels.
Sediment/Shoreline Stabilization	N/A	These ephemeral wetlands are not on stream channels.
Groundwater Discharge/ Recharge	Yes	Groundwater recharge probably occurs prior to playa filling and swelling of the clay bottom. Zartman et al. (1994) have documented playas in other regions as sources of significant groundwater recharge, especially at the playa margins.
Dynamic Surface Water Storage	Low	The playas are depressions that collect surface flow after heavy precipitation events. The drainage basins for these few playas is relatively small.
Biogeochemical Functions		
Elemental Cycling	Low	These ephemeral wetlands are dry most of the time. Elemental cycling is probably unique from that which occurs in nearby uplands due to the fine-textured soils and periodic saturation of those soils and thus provide important local biogeochemical functions. Compared to other wetland types, the quantity of nutrients cycled in playas is probably lower.
Removal of Imported Nutrients, Toxicants, and Sediments.	Low	The playas collect sediment and surface runoff which may contain excess nutrients from cattle. Whether this retention benefits downstream water quality depends on a better understanding of whether and/or how much groundwater recharge is occurring in the playas
Biological Functions		
Habitat Diversity	Low	The playas contain surface water only intermittently and generally consist of shortgrass.
General Wildlife Habitat	Low	Shortgrass prairie fauna.
General Fish/Aquatic Habitat	N/A	The playas are generally dry. Seasonally wet playas may support frog/toad populations and aquatic invertebrates associated with temporary pools.
Production Export/Food Chain Support	Low	There is probably minimal export from the playas. During periods of saturation, the playas may support populations of invertebrates.
Uniqueness	High	Playas occur sporadically throughout the plains. Many playas rangewide have been altered by agricultural use or other human uses. The playas within this PCA have historically been used as rangeland and not planted with or invaded by non-native vegetation.

Restoration Potential: Considering that most of the site is good condition and ecological functions appear intact, restoration potential is minimal.

Schriever Playas

Potential Conservation Area



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map date: 10 May 2001
GIS department: db

PCA Boundary

U.S.G.S. 7.5 Minute Quadrangle*
Corral Bluffs, 38104-G5

*Digital Raster Graphics (DRGs) produced by the U. S. Geological Survey, 1996

Location in Project Area

Severy Creek

Biodiversity Rank: B2 (Very high significance)
This site contains one of two stable, native historic populations of greenback cutthroat trout (*Oncorhynchus clarki stomias*) (G4T2T3 S2) in the Arkansas River watershed.

Protection Urgency Rank: P3 (Moderate urgency)
All but the lower portion of the creek are within Pike National Forest. No special Forest Service designation is known, hence the rank of P3.

Management Urgency Rank: M3 (Moderate urgency)
Activities with the potential to affect the greenback cutthroat trout population include recreational fishing with potential introduction of whirling disease and non-native fish, timber operations, and road building/maintenance.

Location: The Severy Creek PCA is located in El Paso and Teller counties about two and a half miles north of the summit of Pikes Peak.

Legal Description: USGS 7.5 minute quadrangles: Woodland Park, Pikes Peak, Cascade. T13S R68W Sections 21, 22, and 27-33; T13S R69W Sections 25, 35, and 36; T14S R69W Section 1.

Size: 2,264 acres (916 hectares)

Elevation: 8,200 to 12,300 feet. (2,500 to 3,750 meters)

General Description: Severy Creek is a steep gradient, high-elevation, perennial stream draining tundra and spruce fir forested slopes on the north slope of Pikes Peak. The creek flows into Cascade Creek before joining Fountain Creek. The Colorado Division of Wildlife discovered a native population of greenback cutthroat trout (*Oncorhynchus clarki stomias*) (G4T2T3 S2) in this high elevation stream in 1998. Genetic testing showed the population to be "pure" (Policky et al. 1999).

Greenback cutthroat trout is the only trout endemic to the headwaters of the South Platte and Arkansas River drainages. By the early 1900's, the subspecies was believed extinct due to over-harvest, introduction of non-native trout species, and habitat alteration (U.S. Fish and Wildlife Service 1998). Since then, ten native populations of greenback cutthroat trout have been discovered, seven in the South Platte watershed and three in the Arkansas watershed (U.S. Fish and Wildlife Service, 1998, Policky et al. 1999). Two of these historic Arkansas watershed populations are considered stable: Severy Creek in El Paso County and South Apache Creek in Huerfano County (Policky et al. 1999).

Recovery efforts by Colorado Division of Wildlife have reintroduced the species in the South Platte and Arkansas drainages and 25 waters within the Arkansas drainage are currently managed for greenback cutthroat trout (Policky et al. 1999). Of the 25, two

native populations (Severy and South Apache) and one reintroduction site (Boehmer Reservoir) are currently considered stable and 21 others are considered potentially stable.

The Pikes Peak Highway passes Severy Creek at its confluence with Cascade Creek and loops around to pass the headwaters as it ascends the peak.

Biodiversity Rank Comments: This site contains one of two stable, native historic populations of greenback cutthroat trout (*Oncorhynchus clarki stomias*) (G4T2T3 S2) in the Arkansas drainage and one of only six stable native historic populations rangewide (U.S. Fish and Wildlife Service 1998). The population was discovered by Colorado Division of Wildlife in 1998 and determined to be "pure" based on genetic testing (Policky et al. 1999).

Natural Heritage element occurrences at the Severy Creek PCA.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	Federal Sensitive	EO* Rank	Last Observed
Fish								
Oncorhynchus clarki stomias	Greenback cutthroat trout	G4T2T3	S2	LT	T		A	1999

*EO = Element Occurrence

Boundary Justification: The entire watershed of Severy Creek is included within the PCA. The watershed boundary was roughly delineated using 1:100,000 scale USGS topographic maps. The entire watershed is included because it is small and any activities within it could potentially affect the fish population. The boundary includes the entire reach of the stream considered occupied habitat by the Colorado Division of Wildlife (Colorado Division of Wildlife 2001a).

Protection Rank Comments: The PCA is within the Pike National Forest and includes about 160 acres of private land in the lower reach.

Management Rank Comments: Colorado Division of Wildlife proposes to remove non-native brook trout from the lower two kilometers of the system and make small yearly transplants of greenbacks above a natural barrier within the stream (Policky et al. 1999). Other potential management issues are recreational fishing and the potential for spreading of whirling disease or introduction of non-native fish, timber operations, and road building/maintenance.

Soils Description: Soils were not described at this site.

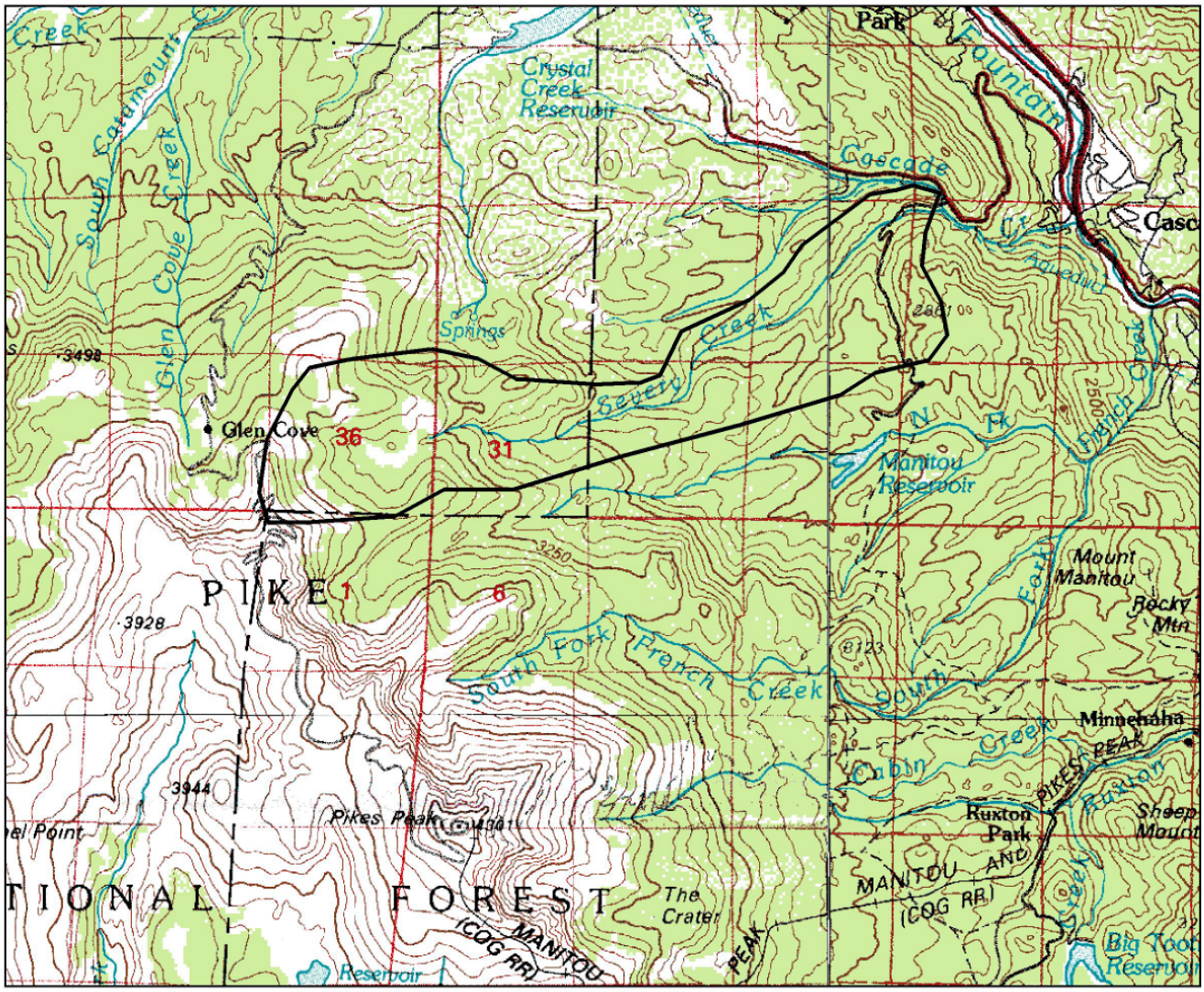
Wetland Functional Assessment: This site was not visited by a CNHP wetland ecologist during the 2000 field season. The following functional assessment comments are based upon notes from other investigators.

This riparian wetland is providing excellent fish and aquatic habitat as indicated by the native population of greenback cutthroat trout that occupies Severy Creek. The wetland

is also likely providing sources of carbon and nutrients to downstream areas and likely supports a healthy population of invertebrates.

Restoration Potential:. Removal of non-native brook trout from the lower portion of the creek would assist in successful restoration efforts of the native trout population.

Severy Creek
Potential Conservation Area



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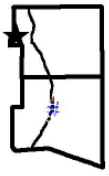
PCA Boundary

U.S.G.S. 30x60 Minute Quadrangle*
Pikes Peak, 38105-E1

*Digital Raster Graphics (DRGs) produced by the U. S. Geological Survey, 1996

Location in Project Area



Big Sandy Creek at Calhan

Biodiversity Rank: B3 (High significance)
This PCA contains a good (B-ranked) example of the globally vulnerable (G3 S2) Arkansas darter (*Etheostoma cragini*).

Protection Urgency Rank: P2 (High urgency)
The land within the PCA is privately owned with the exception of Ramah Reservoir State Wildlife Area. Given the proximity to Colorado Springs, this area could be targeted for increased development, groundwater withdrawals, and flood control structures. Maintenance of the natural hydrologic regime, including flooding, is important in maintaining the Arkansas darter population above the reservoir.

Management Urgency Rank: M4 (Low urgency)
Current management appears excellent for maintenance of the element occurrences.

Location: Big Sandy Creek at Calhan PCA is located in northeastern El Paso County about 3 miles north of Calhan.

Legal Description: USGS 7.5 minute quadrangles: Peyton, Calhan, Ramah South. T11S R61W Sections 1, 2, 9-12, and 14-18; T11S R62W Sections 13-15 and 19-24; T11S R63W Section 24.

Size: 4,342 acres (1,757 hectares).

Elevation: 6,100 to 6,600 feet (1,859 to 2,011 meters).

General Description: Big Sandy Creek begins at the eastern edge of the Black Forest in El Paso County and joins the Arkansas River east of Lamar in Prowers County some 150 miles later. This PCA encompasses the headwaters of the creek and continues downstream to two miles below Ramah Reservoir. This reach of the creek supports Arkansas darter (*Etheostoma cragini*) (G3 S2), a small eastern plains fish native to streams in the Arkansas River basin (Nesler et al. 1999; Colorado Division of Wildlife 2001b). These little plains fish are classified as a threatened species in the state of Colorado (Colorado Division of Wildlife 2001c). Arkansas darter are known to inhabit small, shallow, clear streams that are often spring-fed and have sandy substrates, slow current, cooler water, and aquatic vegetation (Nesler et al. 1999). Other small plains fishes that occur in Big Sandy Creek include plains killifish (*Fundulus zebrinus*) and fathead minnow (*Pimephales promelas*) (Colorado Division of Wildlife 2001d).

Big Sandy is typical of many plains streams, with high flood peaks of short duration. Late spring and summer thunderstorms produce about 70 percent of the annual precipitation (Labbe et al. 1996). Infiltration of floodwaters into the alluvium recharges the alluvial aquifer that sustains the interrupted spring-run habitats where Arkansas darter are most abundant (Labbe et al. 1996).

Plains cottonwood (*Populus deltoides* ssp. *monilifera*) occurs in patches within the PCA and is most developed along an approximate 1½ mile reach a few miles above Ramah Reservoir. In this reach, the cottonwood grows with peachleaf willow (*Salix amygdaloides*) and has a dense understory of coyote willow (*Salix exigua*) and native sedges, rushes, and grasses. The plains cottonwood/coyote willow plant community (*Populus deltoides* ssp. *monilifera-(Salix amygdaloides)/Salix exigua*) is globally common (G4? S3) but rarely encountered in good condition, primarily due to colonization by invasive non-native species (e.g., tamarisk and Russian olive) and elimination of the flooding required for cottonwood regeneration. This reach is significant in that these invasive species were not noted and there is a wide range of native species present in the understory. Bare sandbars, a wide range of age classes of cottonwood (saplings to mature), and vegetative debris suspended 8 feet up in the willows indicate a natural flooding regime. According to the landowner, the channel can be ¼- to ½- mile wide during large floods (G. Fosha, pers. comm.).

The active stream channel is narrow (less than 2 feet) and meandering. The floodplain is generally over 100 feet wide and wider where the channel braids. The stream gradient is low and the bottom is sandy. In September, the stream channel was dry in some areas and wet in others with thick stands of softstem bulrush (*Schoenoplectus lacustris),* and cattail (*Typha* sp.) in the wettest areas. Woolly sedge (*Carex lanuginosa*) occurs in small pure stands intermixed with stands of Nebraska sedge (*Carex nebrascensis*), common threesquare (*Scirpus pungens*), common spikerush (*Eleocharis palustris*), and Baltic rush (*Juncus balticus*). Prairie cordgrass (*Spartina pectinata*) and switchgrass (*Panicum virgatum*) also occur as small patches. American licorice (*Glycyrrhiza lepidota*) occurs in patches on higher banks with cottonwood.

Songbirds are abundant in the riparian area and bird use is heavy during migration times (G. Fosha, pers. comm.). Dragonflies, damselflies, and waterstriders are abundant and an aquatic turtle was present in a pond.

The cattle grazing regime in the occurrence for at least the past 50 years has been to winter the cattle in the riparian area and rest the riparian area during the growing season (G. Fosha, pers. comm). The owner is considering extending this management regime downstream of the occurrence.

The adjacent uplands are rolling hills of shortgrass prairie with patches of tallgrass prairie. Within the watershed, some of the uplands are dryland hayed and have been seeded with alfalfa (*Medicago sativa*) and smooth brome (*Bromus inermis*), both non-native species. Other areas support primarily native grasses including blue grama, little bluestem, and in isolated patches, prairie sandreed (*Calamovilfa longifolia*) and big bluestem (*Andropogon gerardii*).

Big Sandy has a long history of human use. The creek was used by Plains Indians as a travel route from the plains to the Springs at Manitou and Ute Pass (Whittemore 1967). The earliest ranch on the Big Sandy near Calhan was established in 1863 (Whittemore

1967) and Big Sandy Creek at Calhan was a stagecoach stop by 1876 (Scott 1999). Ramah Reservoir is owned and managed by Colorado Division of Wildlife as Ramah State Wildlife Area.

Downstream from this PCA there are two documented occurrences of plains cottonwood with switchgrass (*Populus deltoides/Panicum virgatum*), a globally imperiled (G1G2 S1) riparian community. These occurrences are in Elbert and Cheyenne Counties. Maintaining the natural hydrologic processes in the headwaters of Big Sandy Creek may help maintain these downstream occurrences. However, Ramah Reservoir potentially alters the downstream flooding regime enough to make the upstream hydrology irrelevant to the downstream occurrences.

Biodiversity Rank Comments: This site contains a good (B-ranked) occurrence of a globally vulnerable (G3 S2) fish, the Arkansas darter (*Etheostoma cragini*). The site also contains a good example of an apparently secure (G4? S3) plains cottonwood riparian woodland, plains cottonwood with peachleaf willow and coyote willow (*Populus deltoides* ssp. *monilifera-(Salix amygdaloides)/Salix exigua*). Good examples of this plant community are rarely encountered.

Natural Heritage element occurrences at the Big Sandy Creek at Calhan PCA.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	Federal Sensitive	EO* Rank	Last Observed
Fish								
Etheostoma cragini	**Arkansas darter**	**G3**	**S2**	**C**	**T**	**FS**	**B**	**1999**
Plant Communities								
Populus deltoides ssp *monilifera–(Salix amygdaloides) Salix exigua*	Plains cottonwood riparian woodland	G4?	S3				B	2000-09-25

*EO = Element Occurrence Note: Element occurrence responsible for the B-rank is shown in bold typeface.

Boundary Justification: The boundary encompasses the creek upstream and downstream from Ramah Reservoir which is considered occupied Arkansas darter habitat by the Colorado Division of Wildlife (Colorado Division of Wildlife 2001b). The boundary also encompasses the riparian community and its floodplain located upstream from Ramah Reservoir and a portion of the upstream watershed to account for continued surface flow and periodic flooding. These processes are necessary for the viability of the occurrence and maintenance of ecological functions. The PCA could be expanded to include a greater proportion of the upstream watershed to ensure maintenance of the ecological and hydrological processes.

Protection Rank Comments: The land is privately owned in acreages ranging from about 300 to 1500 (120 to 600 ha). The primary land use in the watershed is haying and cattle grazing. Given the proximity to Colorado Springs, this area could be targeted for increased development. Additionally, maintenance of the natural flooding regime is important in recharge to the alluvial aquifer that supports the creek and spring-fed ponds sustaining the Arkansas darter.

Management Rank Comments: The current management appears appropriate for maintaining the element occurrences. The riparian area within the occurrence is grazed by cattle in the winter and rested in the growing season. This management regime has occurred over the past 50 years and appears to greatly benefit the riparian plant community. In other reaches of the creek the riparian vegetation is not in as good a condition and modification of grazing and haying regimes could be considered.

Soils Description: The soils along the riparian area vary according to channel processes and the velocity of stream flow in the area of deposition. Soils are sandy and undeveloped in areas of recent deposition and silty clay overlying gleyed loamy sand and sand in other places. Oxidized rhizospheres are present in the uppermost 8 inches of these soils.

Wetland Functional Assessment for the Big Sandy Creek at Calhan PCA:
Proposed HGM Class: Riverine Subclass: R5
Cowardin System: Palustrine.
CNHP's Wetland Classification: *Populus deltoides* ssp. *monilifera-(Salix amygdaloides)/Salix exigua* plus numerous emergent wetlands.

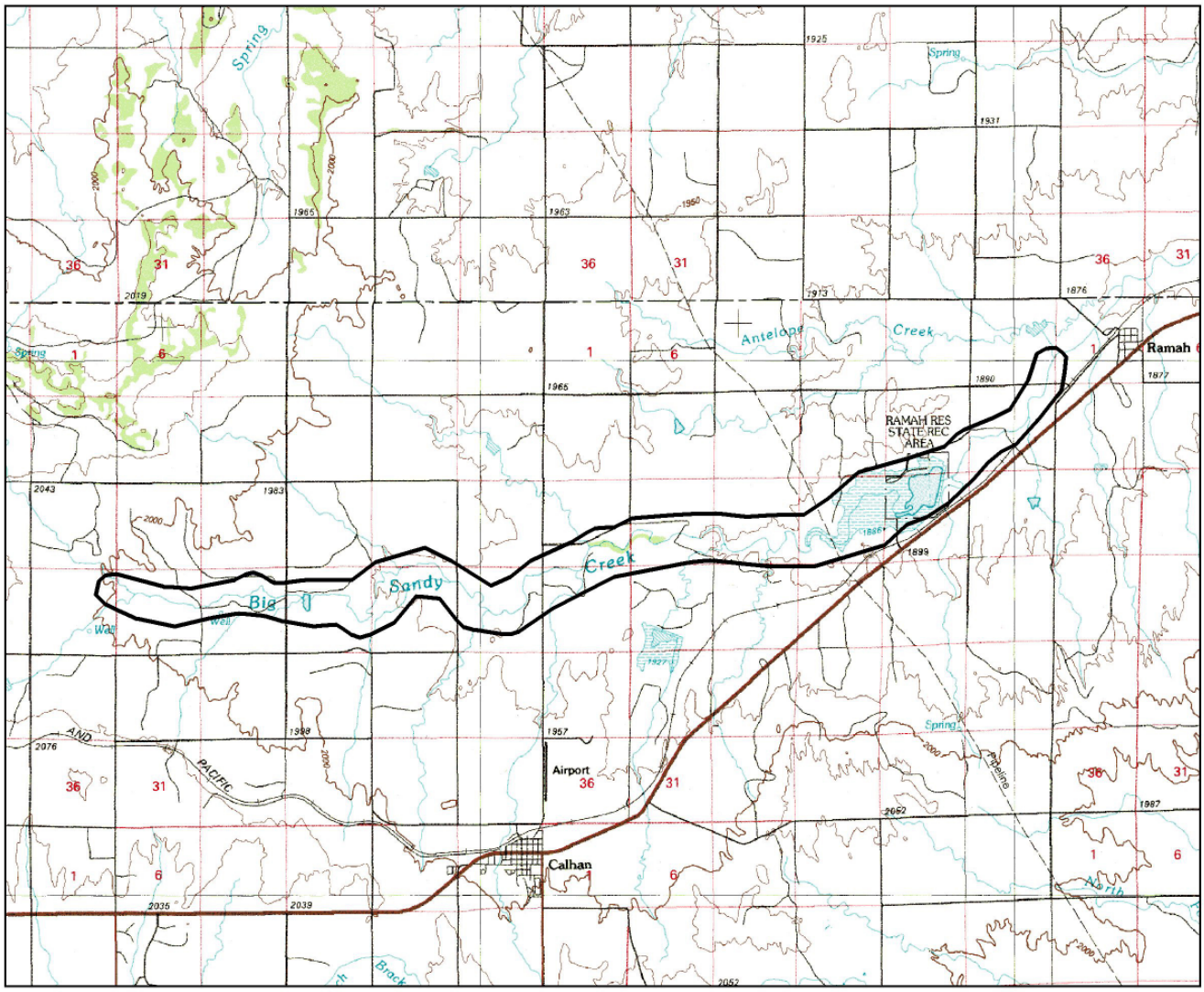
Function	Rating	Comments
Overall Functional Integrity	At Potential	
Hydrological Functions		
Flood Attenuation and Storage	High	The floodplain is wide and not entrenched indicating high flood storage potential. The landowner indicates the channel can be ½ mile wide during big floods. Flood debris suspended in the woody vegetation indicates flooding occurs. High density of woody and herbaceous vegetative cover along the creek dissipate the velocity of stream flow thereby allowing floodwaters to infiltrate into the soil.
Sediment/Shoreline Stabilization	High	Perennial stream with dense cover of woody and herbaceous vegetation along indicates good soil stabilization potential.
Groundwater Discharge/ Recharge	High	The spring-fed perennially ponded portions of the stream and the population of Arkansas darter indicate that groundwater discharge is a vital component of stream flow.
Dynamic Surface Water Storage	N/A	Flooding at this site is primarily due to overbank or in-channel flow.
Biogeochemical Functions		
Elemental Cycling	High	Given the diversity of plant species and thus diverse types of litter inputs, the presence of aerated water (the stream), and areas with saturated soils, there is likely a stable and persistent cycling of nutrients (as opposed to a quick 'flush'). Thus, important, local biogeochemical functions are likely occurring at this site.
Removal of Imported Nutrients, Toxicants, and Sediments.	Low	Imported nutrients and sediments are probably partially removed from the streamflow in this reach because of the density of vegetation in the floodplain, which slows stream flow and allows sediment to settle. Additionally, occasional ponded reaches provide potential soil settling basins.
Biological Functions		
Habitat Diversity	High	There are woodland, shrubland, and open water (associated with the creek) wetland habitats.
General Wildlife Habitat	High	High density of shrubs/trees provide good avian habitat. A Great Blue Heron and a variety of songbirds were observed utilizing the area. An aquatic turtle was noted in a pond and deer use the riparian area.
General Fish/Aquatic Habitat	High	High vegetation cover, large woody debris, and spring-fed perennial pools make this stream reach excellent habitat. Excellent Arkansas darter population documented by Colorado Division of Wildlife. Darter probably occupy the pools during the dry season. Aquatic invertebrates are present in the stream.
Production Export/Food Chain Support	Moderate	A permanent water source and high quantities of allochthonous organic substrates provide carbon and nutrients for downstream ecosystems. Ramah Reservoir alters the downstream flow of organic material. The reservoir probably limits production export, however the diversity of structural vegetation classes provide a variety of habitats for invertebrate populations thus providing excellent food chain support at this site.

Uniqueness	High	The development of the cottonwood community and the lack of tamarisk make this plains stream very special.

Restoration Potential: The reach of Big Sandy with the described cottonwood community may be an appropriate reference site for riverine wetlands on the plains. Other reaches of the stream are hayed to the edge of the stream and establishment of haying/grazing buffer zones could serve as restoration activities.

Big Sandy Creek at Calhan

Potential Conservation Area



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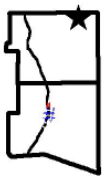
PCA Boundary

U.S.G.S. 30x60 Minute Quadrangle*
Castle Rock, 39104-A1

*Digital Raster Graphics (DRGs) produced by the U. S. Geological Survey, 1996

Location in Project Area



Boehmer Creek

Biodiversity Rank: B3 (High significance)
This site contains a stable, reintroduced population of greenback cutthroat trout (*Oncorhynchus clarki stomias*) (G4T2T3 S2). It is one of three stable populations in the Arkansas watershed.

Protection Urgency Rank: P4 (Low urgency)
The creek occurs on the Pike National Forest and has watershed protection.

Management Urgency Rank: M4 (Low urgency)
Due to this being a water source for Colorado Springs, all but a small portion of this PCA is closed to the public.

Location: The Boehmer Creek PCA is located in El Paso and Teller counties on the south flank of Pikes Peak.

Legal Description: USGS 7.5 minute quadrangle: Pikes Peak: T14S R68W Sections 7, 17-20, and 29-33; T14S R69W Sections 11-14 and 23-26; T15S R68W Sections 4 and 5.

Size: 5,688 acres (2,302 hectares)

Elevation: 10,880 to 14,110 feet (3,316 to 4,300 meters).

General Description: Boehmer Creek, the headwaters of Middle Beaver Creek, is a steep-gradient, perennial stream draining the tundra and spruce fir forested south flank of Pikes Peak. The Boehmer Creek watershed is owned by the Colorado Springs Utilities because the creek and reservoirs along the creek provide a portion of the city's water supply. A tunnel conveys water from East Fork West Beaver Creek, another headwater stream draining the south flank of Pikes Peak, to Boehmer Creek to augment the water supply. Public access to the Boehmer and upper East Fork West Beaver Creek watershed is restricted to maintain the excellent water quality.

In 1985, the Colorado Division of Wildlife introduced greenback cutthroat trout (*Oncorhynchus clarki stomias*) (G4T2T3 S2) to Boehmer Creek and its reservoirs (U.S. Fish and Wildlife Service 1998). The greenback cutthroat trout population is currently the only reintroduced population in the Arkansas basin considered stable by the Colorado Division of Wildlife (Policky et al. 1999). This population is used as a source population for stocking in the state.

Greenback cutthroat trout is the only trout endemic to the headwaters of the South Platte and Arkansas River drainages. By the early 1900's, the subspecies was believed extinct due to over-harvest, introduction of non-native trout species, and habitat alteration (U.S. Fish and Wildlife Service 1998). Since then, ten native populations of greenback cutthroat trout have been discovered, seven in the South Platte watershed and three in the

Arkansas watershed (U.S. Fish and Wildlife Service 1998, Policky et al. 1999). Recovery efforts by Colorado Division of Wildlife have reintroduced the species and 25 waters within the Arkansas drainage are currently managed for greenback cutthroat trout (Policky et al. 1999).

The Pikes Peak Highway accesses the peak from the north. A reservoir maintenance road along Boehmer Creek is not open to the public.

Biodiversity Rank Comments: This site contains one of three stable populations of greenback cutthroat trout (*Oncorhynchus clarki stomias*) (G4T2T3 S2) in the Arkansas drainage (U.S. Fish and Wildlife Service 1998, Policky et al. 1999). This population was reintroduced to Boehmer Creek and reservoirs in 1985.

Natural Heritage element occurrences at the Boehmer Creek PCA.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	Federal Sensitive	EO* Rank	Last Observed
Fish								
Oncorhynchus clarki stomias	Greenback cutthroat trout	G4T2T3	S2	LT	T		A	1998-07-02

*EO = Element Occurrence

Boundary Justification: The PCA boundary includes the watershed of Boehmer Creek including Reservoirs #2 and #4 and upper East Fork Middle Beaver Creek including Reservoirs #7 and #8. East Fork Middle Beaver Creek is included within the PCA because the creeks are connected via a tunnel and water quality issues in East Fork Middle Beaver Creek could affect the greenback cutthroat trout in Boehmer Creek. The watershed boundary was delineated using hydrologic unit GIS coverage (Natural Resources Conservation Service 2000) and the 1:100,000 scale USGS topographic map. The entire watershed is included because it is small and any activities within it could potentially affect the fish population and degrade water quality.

Protection Rank Comments: The land within the PCA is owned and managed by Colorado Springs Utilities and the Pike National Forest.

Management Rank Comments: The south slope of Pikes Peak is closed to recreation and unlikely to be developed as long as the land is used as Colorado Springs water supply. The headwaters of the creeks include the summit of Pikes Peak and the Pikes Peak Highway. Recreation and erosion and runoff from the highway and road maintenance are potential management issues. Opening of the area to fishing could potentially introduce whirling disease to the greenback cutthroat trout population.

Soils Description: Soils were not described at this site.

Wetland Functional Assessment for the Boehmer Creek PCA:
Proposed HGM Class: Riverine Subclass: Not enough information to determine
Cowardin System: Palustrine.

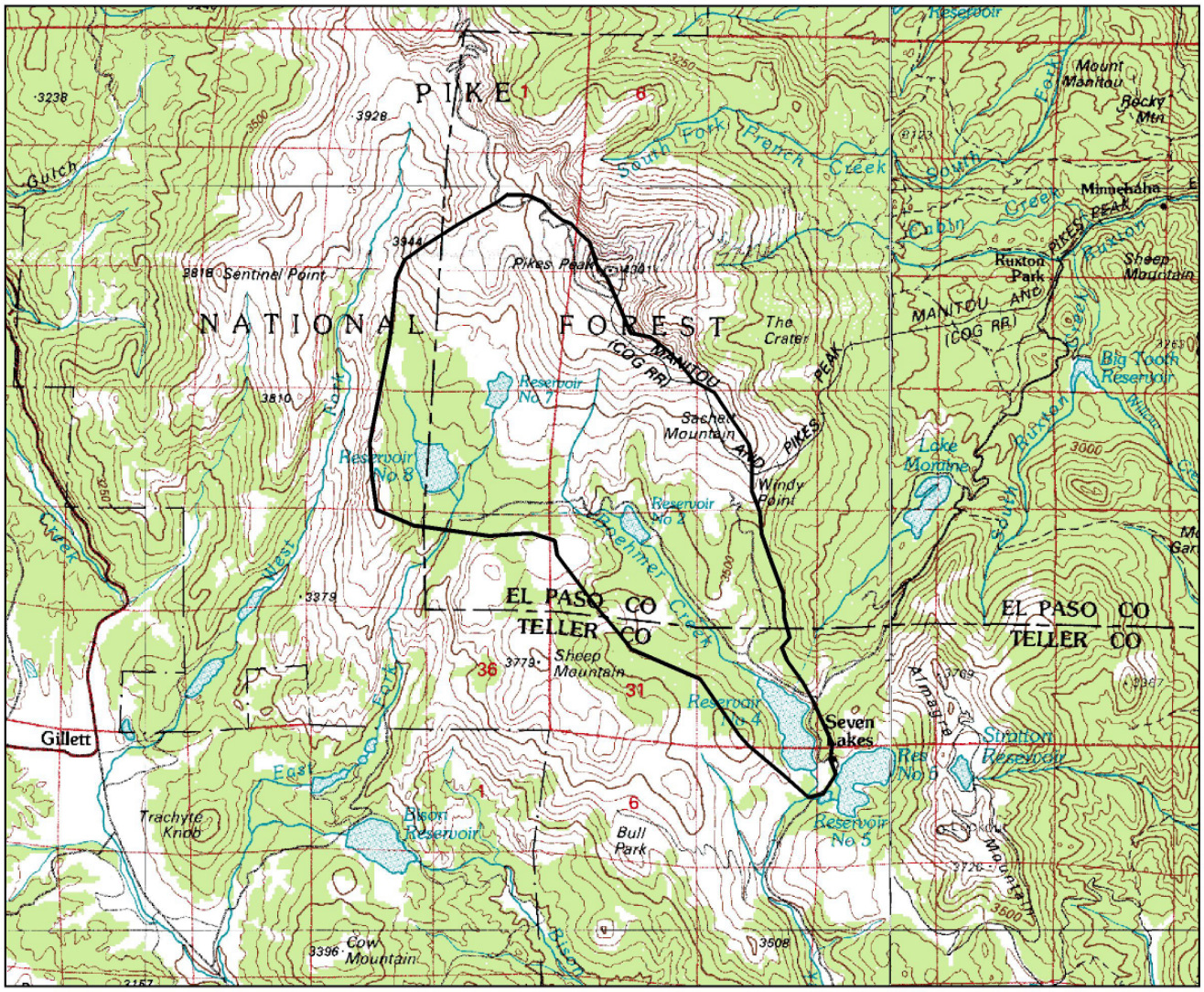
This site was not visited by a CNHP wetland ecologist during the 2000 field season. The following functional assessment comments are based upon notes from other investigators.

This riparian wetland provides excellent fish habitat as indicated by the stable population of the native greenback cutthroat trout. However, the natural hydrological regime has been altered by the numerous reservoirs situated along the creek and the excess water inputs from East Fork Middle Beaver Creek.

Restoration Potential: Most of the site is in great condition due to the remoteness and restricted access of the area. However, the reservoirs have altered typical ecosystem functions associated with flooding and production export. Restoring these areas to natural hydrological flow is likely not feasible given their contribution to Colorado Springs water supply.

Boehmer Creek

Potential Conservation Area



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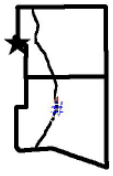
map date: 10 May 2001
GIS department: db

PCA Boundary

U.S.G.S. 30x60 Minute Quadrangle*
Pikes Peak, 38105-E1

*Digital Raster Graphics (DRGs) produced by the U. S. Geological Survey, 1996

Location in Project Area



Bohart Playas

Biodiversity Rank: B3 (High significance)
This PCA contains an excellent (A-ranked) occurrence of a globally vulnerable (G3 S3) plant, plains ambrosia (*Ambrosia linearis*).

Protection Urgency Rank: P4 (Low urgency)
Land managed as part of 48,000-acre cattle ranch on State Land Board land leased by The Nature Conservancy. The Nature Conservancy has a 25-year lease on the property.

Management Urgency Rank: M4 (Low urgency)
Current management appears excellent for maintenance of the plains ambrosia and it's associated playas.

Location: Southeastern El Paso County. On the Bohart Ranch about eight miles south of the town of Ellicott and two miles east of Ellicott Highway.

Legal Description: USGS 7.5 minute quadrangle: Hanover NE. TRS 15S 62W Section 28.

Size: 235 acres (95 hectares).

Elevation: 5,780 to 5,820 feet (1,762 to 1,174 meters).

General Description: A few scattered playas occur within the sandsage prairie on the Bohart Ranch in southeastern El Paso County. The Bohart Playas PCA contains two small (0.5 to 3 acre)(0.2-1.2 ha) playas. The small, flat-bottomed depressions occur between rolling hills. No surface channels drain the area and rainfall and runoff collects in these basins forming ephemeral wetlands. These playas are about five miles west of the greater concentration of playas found in the vicinity of Truckton (Buffalograss Playas PCA). The two playas on the Bohart Ranch are presented as a PCA because of their excellent landscape context - they occur within 48,000 acres (19,425 ha) of State Land Board property leased to The Nature Conservancy.

These basins remain dry throughout most of the year and collect water only after heavy rainfall. In southeastern El Paso County, the heavy rains generally fall in the late summer and in many cases a series of storms are required in order for the playas to retain water (Weathers 2000). Runoff collecting in a dry playa infiltrates cracks in the clay bottom of the playa and swells the clay effectively sealing the playa bottom (Zartman et al. 1994). After the clay has been wetted, subsequent storms can result in playa filling. The playas may hold water for periods ranging from days to weeks, depending on the local topography and intensity of the rainstorm (Weathers 2000). In dry years the playas may remain dry year round.

The upland plant community around the playas is sandsage prairie (*Artemisia filifolia/Andropogon hallii*) (G3 S2). Interestingly, even though the upland plant community is different in the playas to the east (shortgrass prairie versus sandsage prairie), the vegetation in the playas is the same. The dominant species in the playas is the perennial warm-season grass buffalograss (*Buchloe dactyloides*). Growing with the buffalograss are the perennial forbs plains ambrosia (*Ambrosia linearis*) (G3 S3) and short-ray prairie coneflower (*Ratibida tagetes*).

The vegetation in the playas occurs in bands where the outermost rim supports the highest density of plains ambrosia and coneflower. Other plants growing in the playas include a dryland sedge (*Carex eleocharis* ssp. *stenophylla*), blue grama (*Bouteloua gracilis*), purple three-awn (*Aristida purpurea*), prostrate vervain (*Verbena bracteata*), frog-fruit (*Phyla cuneifolia*), and Russian thistle (*Salsola iberica*). Buffalograss submerged during the growing season has been known to withstand more than five weeks of inundation (Porterfield 1945).

Plains ambrosia is a shortgrass prairie species that is endemic to an area of about 100 miles by 50 miles primarily in El Paso and Lincoln counties. It requires a little more moisture than most upland plants and as such, the playas appear to be their native habitat as the clay soils of the playas retain moisture longer than the upland soils. Roadsides also appear to provide the extra moisture required by the plains ambrosia and, as such, plains ambrosia is very prevalent on the sides of many unpaved roads in the area. The Bohart playas may be the westernmost playa-occurrence of plains ambrosia.

The playas occur within a mosaic of sandsage prairie providing added heterogeneity to the landscape. Heterogeneity is important biologically to provide for the needs of a wide range of species (Knopf 1996a, Hoagland and Collins 1997).

Playas are often considered deflated, or wind-eroded, depressions though theories on playa formation are controversial (Osterkamp and Wood 1987). Additionally, these playas are consistent with descriptions of buffalo wallows. Wallows are formed by bison pawing the ground, creating patches of bare ground in which to dust bathe (Uno 1989), or perhaps mud bathe to protect against biting insects or aid in shedding their heavy fur (Hornaday 1887, F. Knopf, pers. comm., USGS). Active wallows range from 10 to 15 feet (3 to 5 meters) in diameter and merging of adjacent wallows can create wallows larger than about 0.5 acre (0.2 ha) (Uno, 1989, Knopf, 1996a). Bison were extirpated from the area by 1875 (Hornaday 1889) but evidence of their wallows can remain evident on the landscape for more than a hundred years (Knopf 1996a). Perennial grasses invade wallows not used by bison (Uno 1989). It is possible that the playas result from of a combination of factors including deflation and buffalo wallowing.

Biodiversity Rank Comments: This PCA contains an excellent (A-ranked) occurrence of the globally vulnerable (G3 S3) plains ambrosia (*Ambrosia linearis*) and a good (B-ranked) example of a globally vulnerable (G3 S3) buffalograss playa grassland (*Buchloe dactyloides-Ratibida tagetes-Ambrosia linearis*). The landscape context of the playas is excellent. Plains ambrosia, though locally abundant, has a very limited global range (about 50 miles by 100 miles) and almost all of the habitat is privately owned.

Natural Heritage element occurrences at the Bohart Playas PCA.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	Federal Sensitive	EO* Rank	Last Observed
Plants								
Ambrosia linearis	**Plains ambrosia**	**G3**	**S3**			**FS**	**A**	**2000-06-24**
Plant Communities								
Buchloe dactyloides-Ratibida tagetes-Ambrosia linearis	Buffalograss playa	G3	S3				B	2000-07-26

*EO = Element Occurrence Note: Element occurrence responsible for the B-rank is shown in bold typeface.

Boundary Justification: The site boundary for Bohart Playas includes two playas and the surrounding sandsage prairie uplands.

Protection Rank Comments: All the land within this PCA is owned by the State Land Board and leased to The Nature Conservancy for cattle grazing. Livestock grazing is the dominant land use in the PCA.

Management Rank Comments: The current management appears appropriate for maintaining the element occurrences.

Soils Description: The soils in the playa bottoms are fine-grained (soil profile 7 inches of clay loam (10YR 4/2) underlain by 10 inches of silty clay (10YR 4/2), underlain by clay (10YR 3/1)) with little organic matter accumulating on the soil surface and no mottling noted.

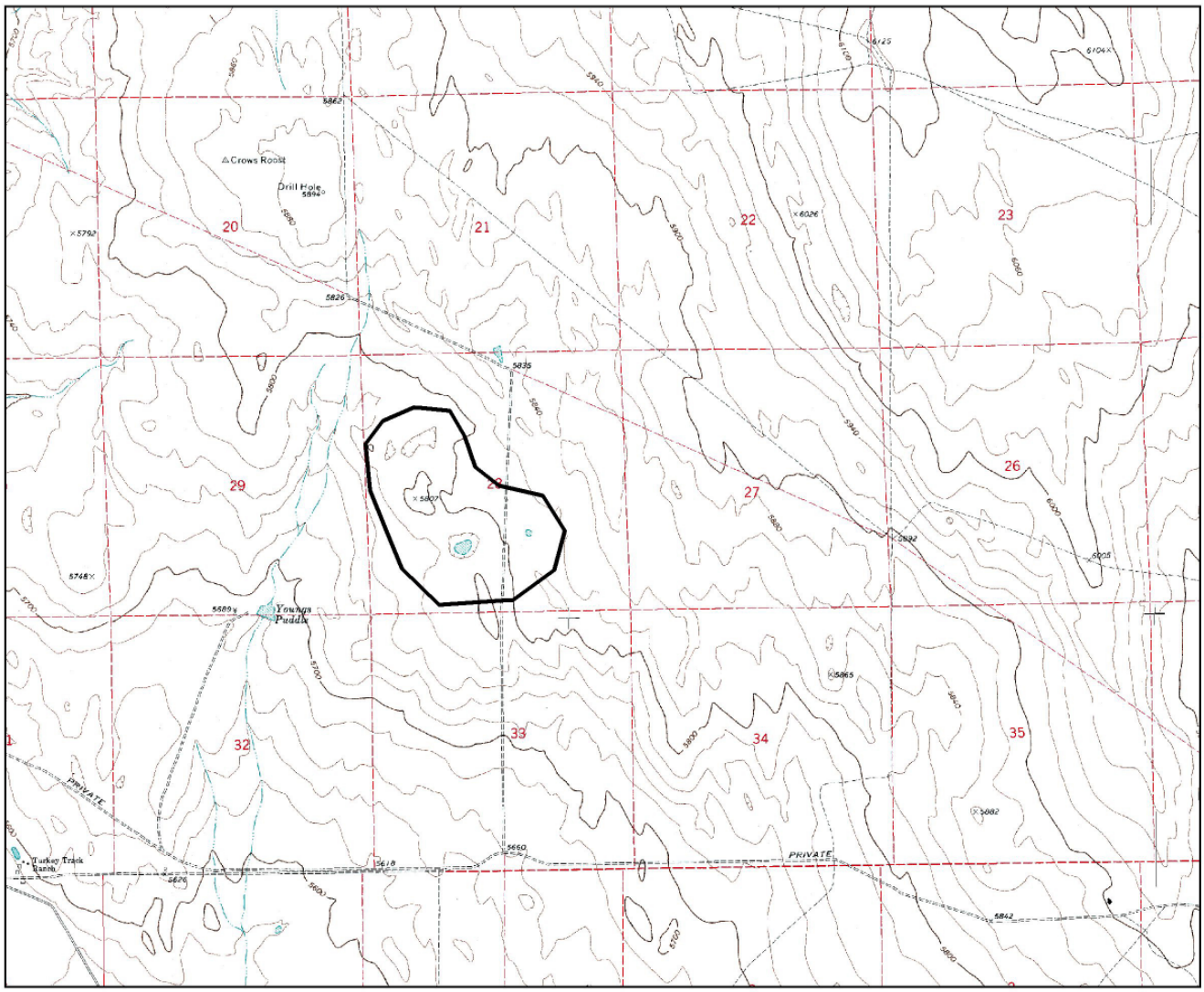
Wetland Functional Assessment for the Bohart Playas PCA:
Proposed HGM Class: Depression Subclass: D5
Cowardin System: Palustrine.
CNHP's Wetland Classification: *Buchloe dactyloides-Ratibida tagetes-Ambrosia linearis*.

Function	Rating	Comments
Overall Functional Integrity	At potential	
Hydrological Functions		
Flood Attenuation and Storage	N/A	These ephemeral wetlands are not on stream channels.
Sediment/Shoreline Stabilization	N/A	These ephemeral wetlands are not on stream channels.
Groundwater Discharge/ Recharge	Yes	Groundwater recharge probably occurs prior to playa filling and swelling of the clay bottom
Dynamic Surface Water Storage	Low	The playas are depressions that collect surface flow after heavy precipitation events. The drainage basins for these two playas is relatively small.
Biogeochemical Functions		
Elemental Cycling	Low	These ephemeral wetlands are dry most of the time. Elemental cycling is probably unique from that which occurs in nearby uplands due to the fine-textured soils and periodic saturation of those soils and thus provide important local biogeochemical functions. Compared to other wetland types, the quantity of nutrients cycled in playas is probably lower.
Removal of Imported Nutrients, Toxicants, and Sediments.	Low	The playas collect sediment and surface runoff which may contain excess nutrients from cattle. Whether this retention benefits downstream water quality depends on a better understanding of whether and/or how much groundwater recharge is occurring in the playas
Biological Functions		
Habitat Diversity	Low	The playas contain surface water only intermittently and generally consist of shortgrass.
General Wildlife Habitat	Low	Shortgrass prairie fauna.
General Fish/Aquatic Habitat	N/A	The playas are generally dry. Seasonally wet playas may support frog/toad populations and aquatic invertebrates associated with temporary pools.
Production Export/Food Chain Support	Low	There is probably minimal export from the playas. During periods of saturation, the playas may support populations of invertebrates.
Uniqueness	High	Playas occur sporadically throughout the plains. Many playas rangewide have been altered by agricultural use or other human uses. The playas within this PCA have been used as rangeland for a century and not planted with or invaded by non-native vegetation. These playas support plains ambrosia, a plant with a very limited global range.

Restoration Potential: Considering that most of the site is good condition and ecological functions appear intact, restoration potential is minimal.

Bohart Playas

Potential Conservation Area



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N

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Fax: (970) 491-3349

map date: 10 May 2001
GIS department: db

PCA Boundary

U.S.G.S. 7.5 Minute Quadrangle*
Hanover NE, 38104-F3

*Digital Raster Graphics (DRGs) produced by the U. S. Geological Survey, 1996

Location in Project Area

Chico Creek

Biodiversity Rank: B3 (High significance)
This PCA contains a good (B-ranked) occurrence of the globally vulnerable (G3 S2) Arkansas darter (*Etheostoma cragini*), good (B-ranked) occurrences of two globally vulnerable (G3) wetland communities (*Spartina pectinata* and *Carex praegracilis*), and a fair (C-ranked) occurrence of a globally imperiled (G2Q S1S2Q) cottonwood riparian woodland (*Populus deltoides/Pascopyrum smithii-Panicum obtusum*). The large acreage and wide range of wetland communities present in the PCA are unusual for the central shortgrass prairie.

Protection Urgency Rank: P3 (Moderate urgency)
Protection actions are needed to secure long-term conservation. Currently, most of the land within the PCA is owned by the State Land Board and managed with conservation in mind.

Management Urgency Rank: M3 (Moderate urgency)
Current management appears appropriate for maintaining the element occurrences; however, various management options could improve their quality. Chico Basin Ranch is working with the Colorado Division of Wildlife to develop a small fishes management plan. Land managers are considering management of non-native species including tamarisk on Chico Creek. Of larger-scale concern is maintenance of the hydrologic regime necessary to support the wetland communities and Arkansas darter.

Location: Chico Creek PCA is located in north central Pueblo County and extends into El Paso County on Black Squirrel Creek. The PCA extends south along Chico Creek onto the Pueblo Chemical Depot.

Legal Description: USGS 7.5 minute quadrangles: Hanover, Hanover SE, Bar JH Ranch, North Avondale NE, Devine, North Avondale. T17S R62W Sections 28, 29, 31, and 32; T18S R62W Sections 5-8, 17-20, and 29-32; T18S R63W Sections 3-5, 8-10, 13-17, 21-27, and 33-36; T19S R62W Sections 5-7, 18, 19, and 29-32; T19S R63W Sections 1-4, 10-14, 23-25, and 36; T20S R62W Sections 5-7, 18, and 19; T20S R63W Sections 1, 12, and 13.

Size: 21,580 acres (8,732 hectares)

Elevation: 4,580 to 5,200 feet. (1,396 to 1,585 meters).

General Description: The Chico Creek watershed reaches from the Black Forest to the Arkansas River, encompassing over 580 square miles in El Paso and Pueblo counties. Chico Creek and its tributary, Black Squirrel Creek, are ephemeral throughout most of their length and surface flow reaches the Arkansas River only after heavy precipitation events. In the southern portion of the watershed, various seeps and springs create an extensive Great Plains wetland and riparian complex with perennially ponded portions.

Surface water is extremely rare in the basin and the wetlands formed by these seeps and springs are the most significant hydrologic feature of the entire basin (Romero 1992). The Chico Creek PCA encompasses these wetlands and riparian areas.

The range of wetland and riparian plant communities supported by the seeps and springs is extensive. The largest wetland complex covers about 2,700 acres in the Black Squirrel Creek basin. Within the surrounding community of greasewood with alkali sacaton (*Sarcobatus vermiculatus/Sporobolus airoides*) (G3? S2) occur wetter portions vegetated with a mosaic of wetland communities including Nebraska sedge (*Carex nebrascensis*) (G4 S3), spikerush (*Eleocharis palustris*) (G5 S4), softstem bulrush and hardstem bulrush (*Scirpus tabernaemontani–Scirpus acutus*) (G3 S2S3), clustered sedge (*Carex praegracilis*) (G3 S2), and prairie cordgrass (*Spartina pectinata*) (G3? S3).

Another interesting wetland complex occurs as a broken band of seeps along bluffs above the eastern bank of Chico Creek. The vegetation on the seeps varies considerably but generally includes common threesquare (*Scirpus pungens*) (G3G4 S3) at up to about 20 percent cover. Other portions of the seeps support a community of alkali sacaton (*Sporobolus airoides*) (G3Q S3). Other plants present on the seeps include mixed sedges (*Carex nebrascensis, C. praegracilis, C. lanuginosa, C. hystericina*), spikerush (*Eleocharis palustris, E. acicularis, E. quinqueflora*), rushes (*Juncus balticus*), cattail (*Typha latifolia*), bulrush (*Schoenoplectus acutus*), and western wheatgrass (*Panicum virgatum*). Certain small areas of the seeps have unstable histic soil horizons floating on discharging groundwater that gives the wetlands a spongy feel. Two species of lobelia, not previously known from Pueblo County (*Lobelia cardinalis* ssp. *graminea and L. siphilitica* var. *ludoviciana*) were common on the southern seeps during the 2000 field season. In some areas, the bluff top above the seeps has a white crust of alkaline salts with sparse cover of saltgrass (*Distichlis spicata*).

Portions of Chico Creek support cottonwood riparian woodlands. Unfortunately, tamarisk (*Tamarix ramosissima)*, an exotic invasive shrub, has colonized much of Chico Creek crowding out native species. However, many native species are still present including coyote willow (*Salix exigua*), alkali sacaton (*Sporobolus airoides*), western wheatgrass (*Pascopyrum smithii*), and vine mesquite (*Panicum obtusum*). The riparian plant community can be characterized as cottonwood/alkali sacaton (*Populus deltoides/Sporobolus airoides*) (G3 S2) with patches of cottonwood/western wheatgrass-vine mesquite (*Populus deltoides/Pascopyrum smithii-Panicum obtusum*) (G2Q S1S2Q). Control of tamarisk would greatly improve the quality of these occurrences and is being considered by the land managers. The creek undergoes natural flooding regimes as evidenced by the presence of cottonwood saplings and flood debris suspended in the riparian vegetation. A large flood in April/May 1999 resulted in scouring of the channel and subsequent sprouting of cottonwood seedlings. On the Pueblo Chemical Depot, the April/May 1999 flood resulted in widening of the Chico Creek stream channel by three times (M. Canestorp, pers. comm., PCD).

Spring-fed pools in Black Squirrel Creek and a spring-fed tributary to Chico Creek support Arkansas darter (*Etheostoma cragini*) (G3 S2), a small plains fish listed as

threatened in the state of Colorado (Colorado Division of Wildlife 2001c). These populations were discovered by Colorado Division of Wildlife in 1998 (Colorado Division of Wildlife 2001c). Arkansas darters are native to small clear streams tributary to the Arkansas River and can survive in scattered pools that undergo evaporative concentration, high temperatures, and low dissolved oxygen concentrations (Nesler et al. 1999). The fish likely distribute between perennial portions of the creeks during high flow events (G. Dowler, pers. comm., CDOW) therefore, it is likely that all the perennial reaches and pools are potential habitat for this fish. Other native fishes present in the creeks include white sucker (*Catostomus commersoni*), fathead minnow (*Pimephales promelas*), red shiner (*Cyprinella lutrensis*), sand shiner (*Notropis stramineus*), plains killifish (*Fundulus zebrinus*), and stoneroller (*Campostoma anomalum*) (Melby 1998).

Some tributaries to Chico Creek in the northern portion of the PCA have surface impoundments for irrigation and recreational use. The population of Arkansas darter on Chico Creek occurs above an impoundment on a tributary (Melby 1998). The ponds likely result in a decrease of native fishes in the drainage by decreasing the amount of available water in the creek (evaporation and agricultural use) and reducing the native fish habitat (Melby 1998). Non-native fishes introduced to the Chico Creek ponds for recreational fishing include large-mouth bass (*Micropterus salmomides*), and bluegill (*Lepomis macrochirus*), both potential predators on native fish populations. Large-mouth bass have also been collected downstream on the Pueblo Chemical Depot portion of Chico Creek (M. Canestorp, pers. comm., CDOW).

Other wildlife observed within Black Squirrel and Chico Creek wetlands include plains leopard frogs (*Rana blairi*) (G5 S3), northern leopard frogs (*Rana pipiens*) (G5 S3), Red-winged Blackbirds, and Common Snipe. The pools also support a wide range of aquatic invertebrates. Sampling of pools on Black Squirrel Creek and the adjacent Burnt Creek resulted in collection of over 45 species of aquatic insects including 26 species of aquatic beetles (Durfee and Kondratieff 2000).

Wildlife noted using Chico Creek riparian area include typical shortgrass prairie species including pronghorn antelope, white-tailed deer, mule deer, coyote, desert cottontail, jackrabbit, American Kestrel, Horned Lark, Lark Bunting, Lark Sparrow, Sage Thrasher, Great Horned Owl, western rattlesnake, and Woodhouse's toad. Also noted were big brown bat, common porcupine, northern leopard frog, Red-tailed and Swainson's Hawks, Northern Flicker, Western Kingbird, and Tree Swallow (Gionfriddo 2001). Small mammal trapping on Chico Creek revealed white-footed mice (*Peromyscus leucopus*), deer mouse (*P. maniculatus*), Ord's kangaroo rat (*Dipodomys ordii*), western harvest mice (*Reithrodontomys megalotis*), silky pocket mouse (*Perognathus flavus*), hispid cotton rat (*Sigmodon hispidus*), woodrat (*Neotoma* sp.), and voles (*Microtus* sp.) (Schorr 1999, Gionfriddo 2001). Two beaver (*Castor canadensis*) were relocated to the PCD portion of Chico Creek in 1997. Non-native bullfrogs (*Rana catesbeiana*) have been present on the PCD portion of Chico Creek (M. Canestorp, pers. comm., PCD).

Hydrologic investigations by Romero (1992) indicate that the water discharging from the seeps and springs and supporting the perennial pools in the creeks is shallow alluvial

groundwater recharged by precipitation over the entire watershed. According to water balance calculations, about 90 percent of precipitation falling on the basin evaporates or is transpired by plants and the remaining 10 percent infiltrates and becomes shallow alluvial groundwater (Romero 1992). The groundwater moves southward toward the Arkansas River and discharges as a broken band of seeps along about five miles of the bluff above the east bank of Chico Creek and as seeps and springs within Chico and Black Squirrel Creeks. The groundwater discharges where the creek has removed the alluvium and the underlying impermeable Pierre Shale bedrock is exposed. Similar seeps that are part of the same system but not included in this PCA occur along Boone Creek on the Pueblo Chemical Depot and south of Pueblo Chemical Depot on bluffs east of the town of North Avondale.

The wetlands and creeks are surrounded by large expanses of relatively natural lands. Upland vegetative communities include sandsage prairie (*Artemesia filifolia/Andropogon hallii*) and blue grama shortgrass prairie (*Bouteloua gracilis-Hilaria jamesii*) (see Signal Rock Sandhills, Olney Prairie, and Midway Prairie PCAs). Bird surveys by Rocky Mountain Bird Observatory tally over 200 species on the 86,000-acre Chico Basin Ranch (S. York, pers. comm., Chico Basin Ranch). Mountain Plover, a shortgrass prairie species that is proposed for federal listing as a threatened species, is known on and around the Chico Creek PCA, generally associated with black-tailed prairie dog colonies. The size and context of the natural landscape suggest that species assemblages are relatively complete and natural ecological processes are intact or restorable.

An area of over 300 square miles– reaching from the northern boundary of the Bohart Ranch in El Paso County to the southern boundary of Pueblo Chemical Depot and including the Chico Creek PCA – is managed by just five parties. These units include the 86,000 acre Chico Basin Ranch, 48,000 acre Bohart Ranch, 33,000 acre Transportation Technology Center, 23,000 acre Pueblo Chemical Depot, and one privately-owned ranch. The Chico Basin Ranch is leased from the State Land Board by Duke Phillips and operated as a cattle ranch. Similarly, the Bohart Ranch is leased from the State Land Board by The Nature Conservancy and operated as a cattle ranch. The Transportation Technology Center is leased from the State Land Board and operated as a railroad technology development and test facility. Pueblo Chemical Depot is a Department of Defense facility built in 1942 for storage of ammunition and general supplies.

The area has historically been used primarily for livestock grazing. The Chico Basin Ranch, Bohart Ranch, and private ranch are actively grazed. Portions of the 23,000 acre Pueblo Chemical Depot have not been grazed by cattle since the land was purchased in 1942 with grazing continuing on 7,700 acres through June 1998. Limited grazing occurs on portions of Chico Creek located on PCD and the private ranch (M. Canestorp, pers. comm., PCD). The Transportation Technology Center (TTC) has not been grazed by cattle since the facility began operation in the early 1970's (G. Spons, pers. comm., TTC).

The hydrological processes of the basin appear to be relatively unaltered with the most important process being recharge to the shallow alluvial aquifer. Recharge supporting

the wetlands and riparian areas occurs in both Pueblo and El Paso counties. Processes that might result in decrease in infiltration (e.g., increase in hard surfaces/paving), or increase in water consumption within the basin (more pumping for domestic and agricultural uses), could decrease the amount of water discharging from the seeps and springs. Additionally, factors that might result in a decrease in water quality including increase in use of septic systems and non-point source pollution from roads and other sources, could result in a degradation of water quality discharging from the seeps and springs.

Biodiversity Rank Comments: This site contains a good example of Arkansas darter (*Etheostoma cragini*), a globally vulnerable eastern plains fish native to small streams in the Arkansas River drainage. The site also includes a fair (C-ranked) occurrence of a globally imperiled (G2Q S1S2Q) cottonwood riparian woodland (*Populus deltoides-Pascopyrum smithii-Panicum obtusum*).

Natural Heritage element occurrences at the Chico Creek PCA.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	Federal Sensitive	EO* Rank	Last Observed
Fish								
Etheostoma cragini	**Arkansas darter**	**G3**	**S2**	**C**	**T**	**FS**	**B**	**2000-05-20**
Etheostoma cragini	Arkansas darter	G3	S2	C	T	FS	E	1998
Amphibians								
Rana blairi	Plains leopard frog	G5	S3		SC	BLM	E	2000-07-26
Plant Communities								
Populus deltoides / Pascopyrum smithii – Panicum obtusum	**Plains cottonwood/ western wheatgrass-vine mesquite**	**G2Q**	**S1S2Q**				**C**	**2000-07-13**
Carex praegracilis	**Clustered sedge wetland**	**G3**	**S2**				**B**	**2000-08-28**
Carex praegracilis	Clustered sedge wetland	G3	S2				C	2000-07-26
Scirpus tabernaemontani - Scirpus acutus	**Great Plains marsh**	**G3**	**S2S3**				**B**	**2000-08-28**
Populus deltoides/Sporobolus airoides	Plains cottonwood/ alkali sacaton	G3	S2				C	2000-07-26
Sarcobatus vermiculatus / Sporobolus airoides	Saline bottom shrubland	G3?	SU				C	1997-04-03
Spartina pectinata	**Prairie slough grass**	**G3?**	**S3**				**B**	**2000-08-28**
Spartina pectinata	Prairie slough grass	G3?	S3				C	2000-07-26

Scirpus pungens	Bulrush	G3G4	S3				C	2000-09-09
Sporobolus airoides	Great Plains salt meadows	G3Q	S3				C	1997-04-03
Carex nebrascensis	Wet meadow	G4	S3				B	2000-08-28
Phragmites australis	Marsh	G4	S3				C	1997-04-03
Eleocharis palustris	Emergent wetland	G5	S4				B	2000-08-28

*EO = Element Occurrence Note: Element occurrences responsible for the B-rank are shown in bold typeface.

Boundary Justification: The boundary encompasses the northerly extent of the Black Squirrel Creek Arkansas darter population documented by the Colorado Division of Wildlife (2001b) and the wetland and riparian communities supported by the seeps and springs. Although this PCA boundary incorporates the element occurrences, management at the watershed scale is important for their persistence. Conservation attention could include a greater proportion of the groundwater recharge area believed necessary to maintain the seeps and springs supporting the Arkansas darter population and the wetland and riparian plant communities.

Protection Rank Comments: There are definable threats, but none expected to be critical in the next five years. Small lots to the north (near Colorado Springs) are being sold for residential development and continued suburban expansion may threaten the likelihood that large-scale ecological processes such as fire, herbivory, flooding, and groundwater recharge will function naturally. Additionally, development of water supplies for housing subdivisions (e.g., groundwater) could alter the hydrologic regime supporting the wetlands and fishes.

Over 98 percent of the land contained within the PCA is owned by the State Land Board and the Department of Defense. Chico Basin Ranch signed a 25-year lease with the State Land Board in 1999. A longer-term issue is the possibility of the State Land Board selling the property to maximize their return on the land. Increases in land value resulting from growth of Colorado Springs may cause this to be a real concern down the road.

At the Pueblo Chemical Depot, all missions, except storage of chemical munitions, were terminated in 1994 and environmental restoration of the installation is one of the depot's highest priorities. Pueblo Chemical Depot is studying various options for transferring the property to a new owner, potentially a conservation agency or organization willing to manage for native ecosystem values

Management Rank Comments: From the perspective of natural heritage elements on the PCA, current management appears appropriate for maintaining the element occurrences. Management actions being considered that could improve the quality of the element occurrences include improvement of native small fishes habitat, non-native species management, and grazing management. Chico Basin Ranch land managers will be working with Colorado Division of Wildlife to develop a small fishes management plan (Melby 2000). Control of tamarisk on Chico Creek has the potential to greatly improve the quality of the riparian element occurrences and is being considered by the

land managers. Chico Basin Ranch is considering altering the grazing regime in the Chico Creek riparian area. Black Squirrel Creek wetlands on the Transportation Technology Center include large patches of Canada thistle (*Breea arvensis*) and other potentially noxious weeds and could benefit from weed control efforts.

Soils Description: The soils in the Black Squirrel Creek basin and the lower part of the Chico Creek basin are mainly deep, somewhat poorly drained to well drained fine sandy loams and silty clays that formed in alluvium on floodplains (the Las Animas-Glenberg-Apishapa association). Within the larger soil matrix are inclusions of very poorly drained soils, including small pockets of very alkaline peaty (histic) soils. Some of the wetlands are alkaline, to the point where some of the springs are coated with alkali deposits and nearly devoid of vegetation.

Soils on Black Squirrel Creek are loamy sand (10YR 5/1) with mottles.

Wetland Functional Assessments for the Chico Creek PCA:
Proposed HGM Class: Riverine Subclass: R5
Cowardin System: Palustrine.
CNHP's Wetland Classification: *Populus deltoides/Sporobolus airoides* and *Populus deltoides/Pascopyrum smithii-Panicum obtusum.*

Function	Rating	Comments
Overall Functional Integrity	At potential	Tamarisk and small water retention dams on Chico Creek alter the natural functioning of the riverine wetlands; however, overall, the system is probably functioning at or near potential.
Hydrological Functions		
Flood Attenuation and Storage	Moderate	Some stretches of Chico Creek and Black Squirrel Creek are not entrenched and are densely vegetated. These reaches have high flood attenuation and storage potential. However, most of Chico Creek is deeply incised in the alluvium and/or sparsely vegetated. These reaches have lower flood attenuation and storage potential.
Sediment/Shoreline Stabilization	Moderate	Some reaches of the creeks have high shoreline stabilization potential (>30% rooted vegetation, permanent surface water), other reaches have low potential (<10% rooted vegetation, ephemeral surface water).
Groundwater Discharge/ Recharge	Yes	Portions of Chico Creek and Black Squirrel Creek receive groundwater discharge via seeps and springs. Lower reaches of the creeks likely recharge the local aquifer (losing streams).
Dynamic Surface Water Storage	N/A	Flooding at this site is primarily due to overbank or in-channel flow.
Biogeochemical Functions		
Elemental Cycling	Moderate	The dry, sandy portions of the creeks probably support little elemental cycling. The perennially flooded portions adjacent to springs and with dense vegetation probably function higher. The dense cover of tamarisk on Chico Creek is probably disrupting the natural nutrient cycles via salinization of the soil.
Removal of Imported Nutrients, Toxicants, and Sediments.	Moderate	Black Squirrel and Chico Creeks are dry throughout most of their reach and have permanent water and dense emergent vegetation only near slope wetland springs. In these areas the potential for removal of nutrients and sediments is high.
Biological Functions		
Habitat Diversity	High	Chico Creek has forested, scrub-shrub, emergent, and open water (isolated pools) habitat. Black Squirrel Creek has emergent habitat.
General Wildlife Habitat	High	Birds are abundant in the cottonwood forest along Chico Creek and in the dense marshes on Black Squirrel Creek. Plains leopard frog were noted on Chico Creek and northern leopard frog on Black Squirrel Creek. A wide diversity of aquatic insects indicative of a healthy plains ecosystem were collected from ponds on Black Squirrel and Burnt Creeks.
General Fish/Aquatic Habitat	High	One of the best known populations of Arkansas darter, a globally vulnerable fish, was discovered in Black Squirrel Creek in 1998. The springs and seeps on Chico and Black Squirrel Creek support the darter habitat.
Production Export/Food Chain Support	Low	The creeks have no outlet except during flood events.

Uniqueness	High	It is rare to encounter extensive wetlands such as these in an arid landscape. The cottonwood community on Chico Creek has been invaded by tamarisk, a common non-native shrub/tree on plains streams, thus decreasing the uniqueness.

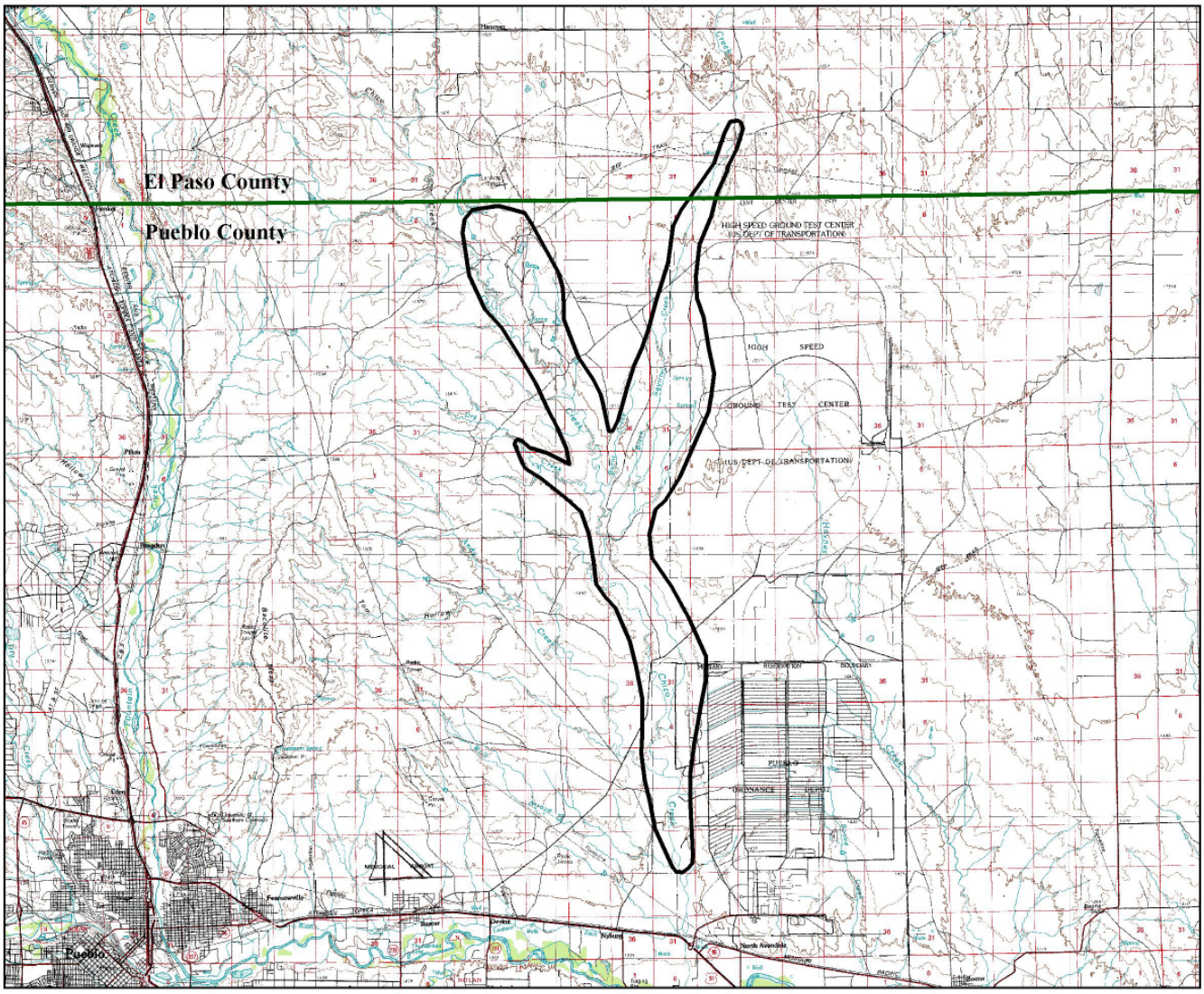
Proposed HGM Class: Slope Subclass: S4
Cowardin System: Palustrine.
CNHP's Wetland Classification: *Carex nebrascensis, C. praegracilis, Spartina gracilis, Eleocharis palustris, Scirpus tabernaemontani-Scirpus acutus*, and other emergent vegetation.

Function	Rating	Comments
Overall Functional Integrity	At potential	
Hydrological Functions		
Flood Attenuation and Storage	Moderate	Some of the slope wetlands are within the floodplain and channel of Black Squirrel Creek and contribute to flood attenuation and storage.
Sediment/Shoreline Stabilization	Moderate	Some of the slope wetlands are within the floodplain and channel of Black Squirrel Creek and have high shoreline stabilization potential (>30% rooted vegetation, permanent surface water).
Groundwater Discharge/ Recharge	Yes	The slope wetlands represent discharge of regional shallow alluvial groundwater.
Dynamic Surface Water Storage	N/A	
Biogeochemical Functions		
Elemental Cycling	High	Slope wetlands on the bluff east of Chico Creek support organic soils in places and are densely vegetated. These areas are likely providing unique and important local biogeochemical functions. Some areas of the seeps have been impacted by heavy grazing and elemental cycling has probably been altered.
Removal of Imported Nutrients, Toxicants, and Sediments.	Low	The slope wetlands are densely vegetated and have high potential for removal of nutrients and sediments
Biological Functions		
Habitat Diversity	Moderate	The slope wetlands are primarily emergent habitat.
General Wildlife Habitat	High	Birds noted in slope wetlands in the dense bulrush included Red-winged Blackbird and Common Snipe. The greasewood shrublands on Black Squirrel Creek provide cover and habitat for another range of species.
General Fish/Aquatic Habitat	High	The slope wetlands hydrologically support the ponded portions of Black Squirrel Creek and the tributary to Chico Creek that support Arkansas darter, a globally vulnerable fish.
Production Export/Food Chain Support	Moderate	Outflow from the slope wetlands supplies the creeks downstream with sources of particulate and soluble carbon.
Uniqueness	High	Seep wetlands such as along Chico Creek are rarely encountered. This is the largest wetland complex in Pueblo County.

Restoration Potential: Control of tamarisk on Chico Creek has the potential to greatly improve the quality of the riparian element occurrences and is being considered by the land managers. A weed coop is present in the area with tamarisk removal already occurring on the adjacent Bohart Ranch. Chico Basin Ranch is considering altering the grazing regime in the Chico Creek riparian area. Also, control of non-native species along Black Squirrel Creek would benefit the ecological health of the riparian area. Colorado Division of Wildlife is working with the Chico Basin Ranch to develop a small fishes management plan. Their efforts may involve restoration activities.

Chico Creek

Potential Conservation Area



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The Colorado Natural Heritage Program
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Fax: (970) 491-3349

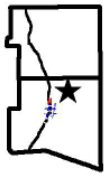
map date: 4 May 2001
GIS department: db

PCA Boundary

U.S.G.S. 30x60 Minute Quadrangles*
Colorado Springs, 38104-E1
Pueblo, 38104-A1

*Digital Raster Graphics (DRGs) produced by the U. S. Geological Survey, 1996

Location in Project Area



East Chico Basin Ranch

Biodiversity Rank: B3 (High significance)
This PCA contains excellent (A-ranked) examples of a globally vulnerable plant species (*Ambrosia linearis*).

Protection Urgency Rank: P4 (Low urgency)
Most of the PCA occurs within leased State Land Board property.

Management Urgency Rank: M4 (Low urgency)
Control non-native species.

Location: El Paso County on the Chico Basin Ranch. South of Meyers Road, approximately 10 miles east-southeast of the main entrance to the Chico Basin Ranch on the Peyton Highway.

Legal Description: USGS 7.5 minute quadrangle: Hanover SE. T17S R61W Sections 18, 19, and 30; T17S R62W Sections 13, 22-27, 34, and 35.

Size: 3,118 acres (1,262 hectares).

Elevation: 5,220 to 5,320 feet (1,591 to 1,622 meters).

General Description: This PCA includes islands of shortgrass prairie surrounded by rolling sandhills and sand sage prairie. These islands are poorly drained and relatively flat, though not as flat as the playas to the north and east. Soils are less sandy than in the surrounding area and support vegetation similar to that of playas, with buffalograss (*Buchloe dactyloides*) as the dominant species, and prairie coneflower (*Ratibida tagetes*) also prevalent. Overall, the shortgrass prairie areas have the appearance of extremely large playas due to the similar physiography and vegetation, but may be functionally different from other playas in El Paso County.

This area supports two large, excellent (A-ranked) occurrences of the globally vulnerable (G3 S3) plains ambrosia (*Ambrosia linearis*) in the shortgrass basins of the PCA. The western occurrence is located in a basin at the terminus of an ephemeral drainage visible on satellite imagery. This is the largest known natural occurrence of plains ambrosia, with an estimated population size of at least 20,000 individuals. Cover of plains ambrosia throughout the occurrence ranges from nearly 0 to 25 percent throughout most of the occurrence in unaltered areas. Cover exceeds 50 percent in the vicinity of the road, corral, and water tank area within the occurrence, where plains ambrosia is co-dominant with kochia (*Bassia sieversiana*), an annual weed. Such areas, however, make up a very small portion of the occurrence.

To the east is another excellent (A-ranked) occurrence of the plains ambrosia, in an extremely large playa basin. The plains ambrosia is concentrated around the rim of the

playa and in a small slight depression in the center. Small patches of buffalograss are also found here but with large areas of bare ground and patchy blue grama (*Bouteloua gracilis)* and three awn (*Aristida purpurea*).

Other plant species observed in the PCA were yucca (*Yucca glauca*), rocky mountain bee plant (*Cleome serrulata*), alkali sacaton (*Sporobolus airoides*), snakeweed (*Gutierrezia sarothrae*) and locoweed (*Oxytropis* sp.) and a native thistle (*Cirsium* sp.).

A large prairie dog town also resides in the western basin, and may be excellent Mountain Plover breeding habitat. Mountain Plovers have been observed within the PCA.

Biodiversity Rank Comments: This PCA contains two excellent (A-ranked) occurrences of the globally vulnerable (G3 S3) plains ambrosia (*Ambrosia linearis*).

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	Federal Sensitive	EO* Rank	Last Observed
Plants								
Ambrosia linearis	**Plains ambrosia**	**G3**	**S3**				**A**	**2000-09-12**
Ambrosia linearis	**Plains ambrosia**	**G3**	**S3**				**A**	**2000-09-26**

Boundary Justification: The boundary of the PCA encompasses the known occurrences of plains ambrosia in the Chico Basin Ranch and the surrounding area. Additional surrounding area is included due to the presence of apparently suitable habitat and topography for the plains ambrosia.

Protection Rank Comments: This PCA is entirely included within the Chico Basin Ranch, which is owned by the State Land Board. It is currently leased to managers who are sensitive to the biodiversity significance of this area.

Management Rank Comments: The current management and grazing regime appears to favor the persistence of the plains ambrosia within the PCA. Weeds are present and present some threat to the elements in the PCA, but appear to be limited at this time primarily to roads, corrals, and water tanks in the PCA. Kochia and Russian thistle (*Salsola iberica*) are the two most common weeds in the PCA.

Soils Description: Soils were not described at this site.

Wetland Functional Assessment:
Wetland Functional Assessment for the East Chico Basin Ranch PCA:
Proposed HGM Class: Depression Subclass: D5
Cowardin System: Palustrine.

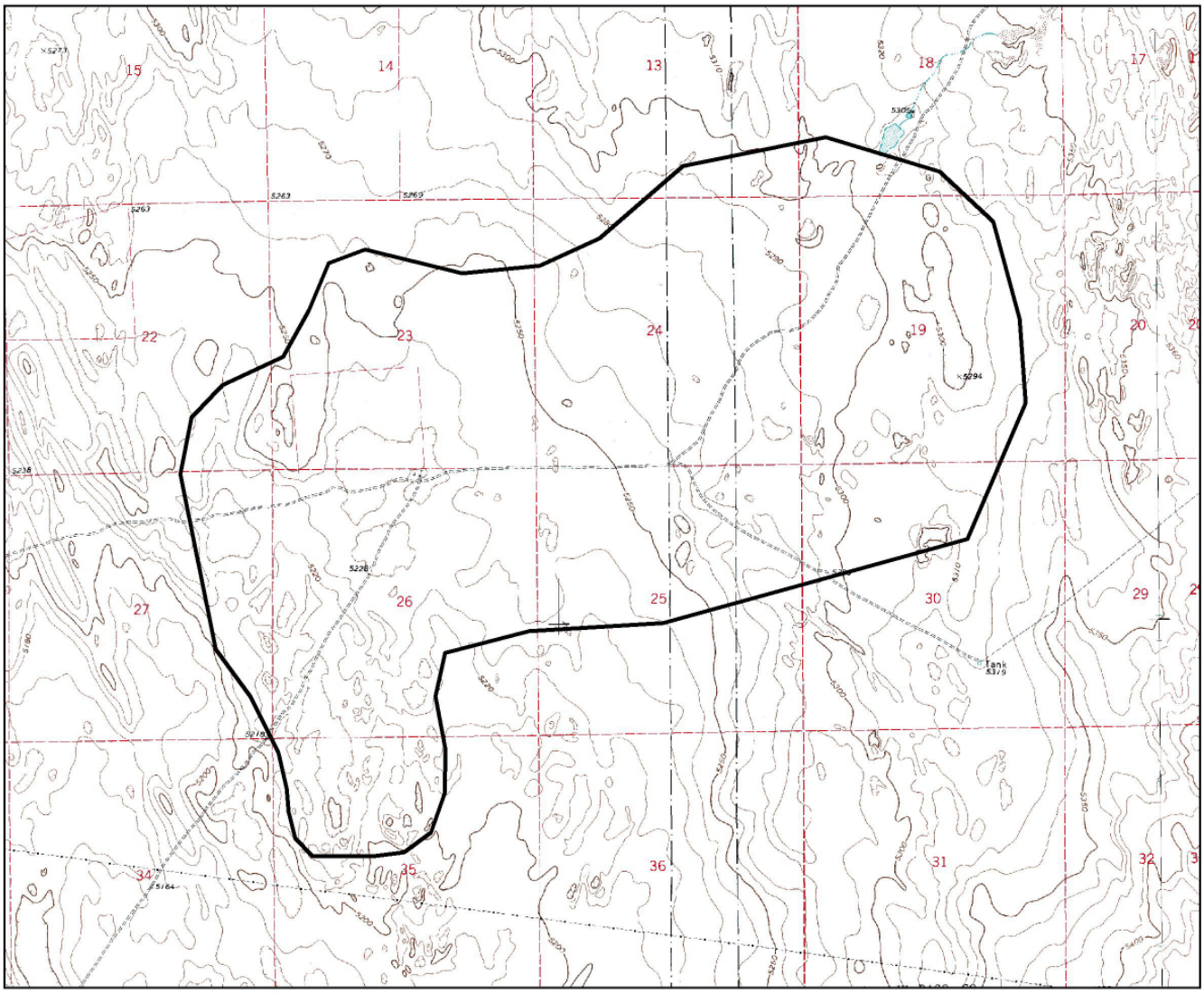
This site was not visited by a CNHP wetland ecologist during the 2000 field season. The following functional assessment comments are based upon notes from other investigators.

This area is probably functioning at potential as a collection basin for surface runoff during large storm events. Also potentially acts as a groundwater recharge area due to infiltration of surface water following isolated storms. Successive storms probably result in swelling of the clay soil basin bottoms and inhibiting infiltration. Elemental cycling is probably unique from that which occurs in nearby uplands due to the fine-textured soils and periodic saturation of those soils and thus provide important local biogeochemical functions. Seasonally wet playas may support frog/toad populations and aquatic invertebrates associated with temporary pools.

Restoration Potential: Control non-native species.

East Chico Basin Ranch

Potential Conservation Area



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Fax: (970) 491-3349

map date: 10 May 2001
GIS department: db

PCA Boundary

U.S.G.S. 7.5 Minute Quadrangle*
Hanover SE, 38104-E3

*Digital Raster Graphics (DRGs) produced by the U. S. Geological Survey, 1996

Location in Project Area

Farish Recreation Area

Biodiversity Rank: B3 (High significance)
This PCA contains a fair (C-ranked) example of the globally imperiled (G2 S2) Porter's feathergrass (*Ptilagrostis porteri*), a good occurrence (B-ranked) of a globally vulnerable (G3 S1) dryland sedge (*Carex oreocharis*), and a good (B-ranked) occurrence of a globally vulnerable (G3 S3) Parry's oatgrass (*Danthonia parryi*) montane grassland.

Protection Urgency Rank: P4 (Low urgency)
Most of the PCA is currently owned by the U.S. Air Force Academy.

Management Urgency Rank: M3 (Moderate urgency)
Control non-native species.

Location: El Paso County, northeast of the town of Woodland Park.

Legal Description: USGS 7.5 minute quadrangles: Woodland Park, Cascade, and Palmer Lake. T12S R68W Sections 15, 16, 20-22, 28, and 29.

Size: 752 acres (304 hectares).

Elevation: 9,050 to 9,440 feet (2,758 to 2,877 meters).

General Description: This PCA includes much of the Farish Memorial Recreation Area. The landscape within this PCA is diverse, with the steep rugged topography typical of the Rampart Range. The steep slopes of the area are studded with countless large, rounded granite boulders, giving the slopes a striking lumpy appearance. These uplands support subalpine forests dominated by Engelmann spruce (*Picea engelmannii*) and quaking aspen (*Populus tremuloides*). Among the steep ridges and slopes are mesic meadows, streams, and willow carrs. Several streams have been dammed in the recreation area to create Sapphire Lake, Leo Lake, and Grace Lake. During the summer, afternoon rain showers occur almost daily. West facing slopes are drier that other slopes. The PCA is used heavily by elk in the fall and winter.

This PCA contains the only known occurrence of Porter's feathergrass (*Ptilagrostis porteri*) in El Paso County. This species is a Colorado endemic, known currently from only three counties (Park, El Paso, and Summit). The occurrence is located south of Leo Lake in the Farish Memorial Recreation Area. The plants are found in a limited area in deep, peaty soils in a willow carr/sedge meadow peatland. The plants are growing in clumps in a hummocky area, with tufts of the grass growing on top of the hummocks. The dominant species are willows, including planeleaf willow (*Salix planifolia*), shortfruit willow (*S. brachycarpa* ssp. *brachycarpa*), and possibly mountain willow (*S. cf. monticola*). Shrubby cinquefoil (*Pentaphylloides floribunda*) is also common with the Porter's feathergrass. Other associated taxa include sedges (*Carex utriculata, C. aquatilis, C. simulata, C. lanuginosa*), hairgrass (*Deschampsia caespitosa*), Canadian

reedgrass (*Calamagrostis canadensis*), foxtail grass (*Alopecurus aequalis*), and rosecrown (*Clementsia rhodantha*).

The montane grassland community in the southern portion of the PCA occupies one of the largest openings in the Rampart Range. The grassland community is Parry's oatgrass (Danthonia parryi) (G3 S3) with Idaho fescue (*Festuca idahoensis)*, fringed sage (Artemisia frigida), three-nerved fleabane (*Erigeron subtrinervis*), and hairy aster (*Heterotheca villosa*). A globally vulnerable (G3 S1) dryland sedge (*Carex oreocharis*) occurs within the Parry's oatgrass meadow.

Biodiversity Rank Comments: This PCA contains a fair (C-ranked) occurrence of Porter's feathergrass, a globally imperiled (G2 S2) species, a good (B-ranked) occurrence of the globally vulnerable (G3 S1) *Carex oreocharis*, and a good (B-ranked) occurrence of the montane grasslands plant community that is vulnerable on a global scale (G3 S3).

Natural Heritage element occurrences at the Farish Recreation Area PCA.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	Federal Sensitive	EO* Rank	Last Observed
Plants								
Ptilagrostis porteri	**Porter's feathergrass**	**G2**	**S2**			**FS, BLM**	**C**	**2000-09-13**
Carex oreocharis	**A dryland sedge**	**G3**	**S1**				**B**	**2000-07-26**
Plant communities								
Danthonia parryi	**Montane grassland**	**G3**	**S3**				**B**	**1996-08-28**

*EO = Element Occurrence Note: Element occurrences responsible for the B-rank are shown in bold typeface.

Boundary Justification: The boundary encompasses the occurrences and adjacent similar habitat that is not known to be impacted at this time. Open meadows to the north of the Parry's oatgrass montane grassland have been planted with smooth brome and Kentucky bluegrass, while meadows to the south have several roads or trails within them. Both areas have been excluded from the site. The site itself would not include all necessary processes (especially fire) for survival of the montane grassland occurrence, but they could be simulated at a smaller scale. The watershed of the creek that supports the occurrence of Porter's feathergrass within the PCA was included to delineate the area needed to ensure the persistence of the proper hydrologic regime for this species.

Protection Rank Comments: Most of the site is currently owned by the Air Force Academy and operated as Farish Recreation Area. The site extends onto Pike National Forest.

Management Rank Comments: Management to control exotic species may be needed within five years to maintain the current quality. Recreation activities could potentially impact the site. A road/campground runs along the boundary of the willow carr/sedge meadow potentially serving as a conduit for non-native species.

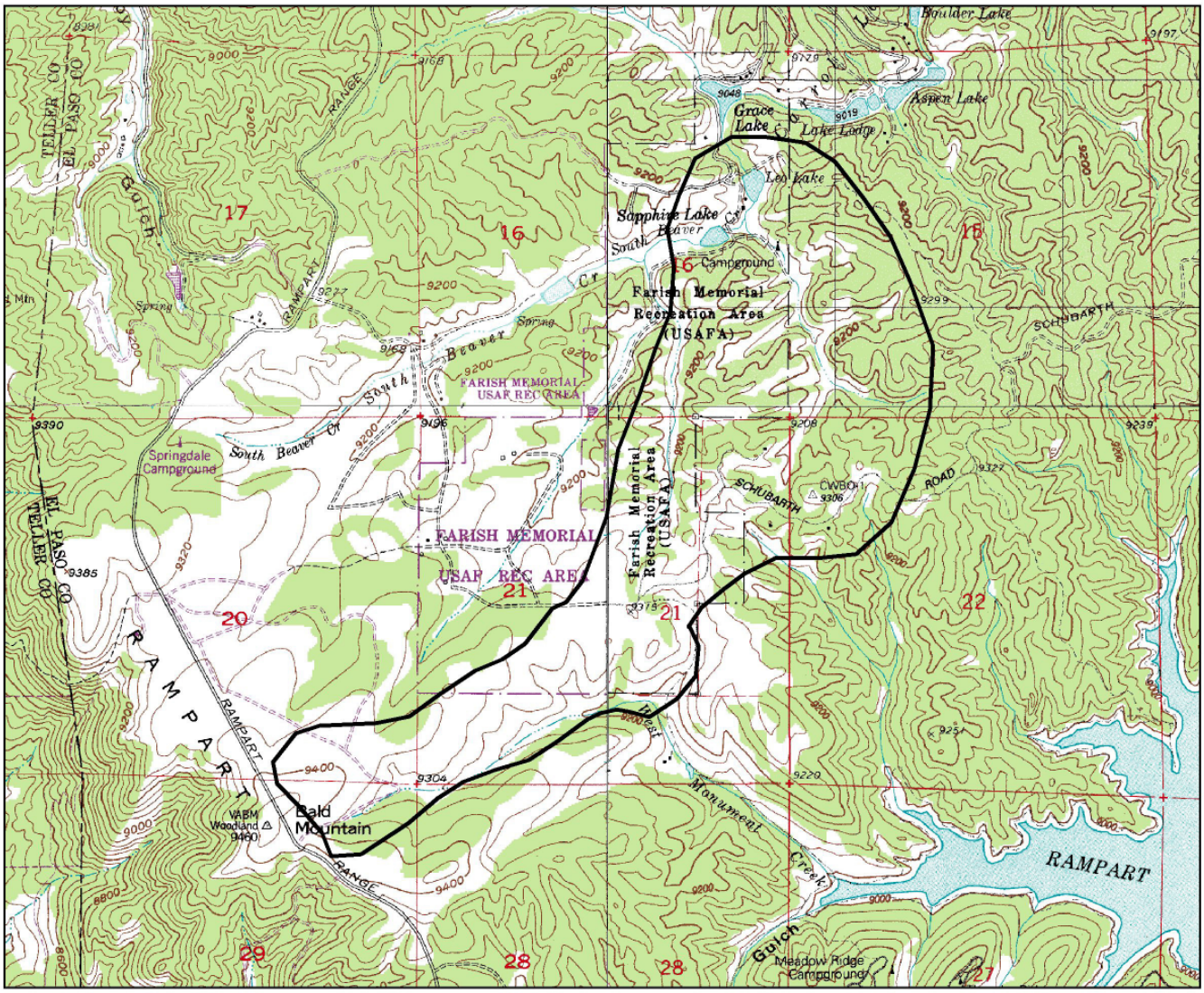
Soils Description: Soils within the willow carr/sedge meadow supporting the Porter's feathergrass are peat (over 30 centimeters deep).

Wetland Functional Assessment:
Proposed HGM Class: Slope
Cowardin System: Palustrine
This willow carr/sedge meadow has a high capacity to store water. The peat provides organic matter (energy) for microbes to use in nutrient mineralization and immobilization processes.

Restoration Potential: The willow carr/sedge meadow appears to be functioning at potential. The size may have decreased due to the construction of Leo Lake at the downstream end.

Farish Recreation Area

Potential Conservation Area



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Fax: (970) 491-3349

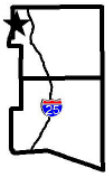
map date: 10 May 2001
GIS department: db

PCA Boundary

U.S.G.S. 7.5 Minute Quadrangles*
Cascade, 38104-H8
Woodland Park, 38105-H1
Palmer Lake, 39104-A8

*Digital Raster Graphics (DRGs) produced by the U. S. Geological Survey, 1996

Location in Project Area



Haynes Creek

Biodiversity Rank: B3 (High significance)
This PCA contains a good (B-ranked) occurrence of a globally vulnerable (G3G4 S3) riparian community (*Scirpus pungens*) on a small plains stream. The non-weedy and non-entrenched condition is unusual for the plains.

Protection Urgency Rank: P2 (High urgency)
The PCA is located on Department of Defense property and private property owned by one landowner. The Department of Defense is considering options for transferring their property to another entity, potentially with conservation intentions.

Management Urgency Rank: M4 (Low urgency)
Current management appears adequate to maintain the element occurrences.

Location: Haynes Creek PCA is located in north central Pueblo County on the eastern boundary of the Department of Defense Pueblo Chemical Depot. The PCA extends upstream and downstream onto private property.

Legal Description: USGS 7.5 minute quadrangles: North Avondale, North Avondale NE,. T19S R62W Sections 14, 15, 22, 23, 26, 27, 35, and 36; T20S R62W Sections 1, 2, 12, and 13; T20S R61W Sections 7 and 18.

Size: 2,600 acres (1,052 hectares)

Elevation: 4,600 to 4,850 feet (1,402 to 1,478 meters).

General Description: Haynes Creek is a small, meandering, ephemeral, Great Plains stream occurring within a mosaic of shortgrass prairie, sandsage prairie, and greasewood shrubland. The landscape context of the creek is relatively intact. The creek originates at springs on the Transportation Technology Center and private property and flows through the eastern undeveloped portion of Pueblo Chemical Depot (PCD) then back to private property and towards the Arkansas River. The potential conservation area (PCA) encompasses the Haynes Creek springs, the PCD reach of the creek, and the reach downstream from PCD for about a mile.

On the Pueblo Chemical Depot, the width of the creek supporting riparian vegetation ranges from about 5 to 50 feet. The vegetation is a mosaic of threesquare bulrush (*Scirpus pungens*) (G3G4 S3) and saltgrass (*Distichlis spicata*) (G5 S3) communities. Along two miles of the occurrence, the creek has no entrenchment, is completely vegetated, and is relatively free of non-native species. Saltgrass is the dominant species in this reach with some patches of common spikerush (*Eleocharis palustris*) in the wider areas. Near the IL Road crossing, the channel is entrenched and the vegetation is mainly threesquare bulrush with small patches of common spikerush, Baltic rush (*Juncus balticus*), and alkali bulrush (*Bolboschoenus maritimus*). In this lower reach, saltgrass is

the dominant plant in the floodplain. Weedy species in the channel include curlycup gumweed (*Xanthium strumarium*), dock (*Rumex* sp.), and a few scattered tamarisk (*Tamarix ramosissima*).

Terrestrial insects abundant in Haynes Creek and surrounding uplands are robber flies, grasshoppers, and wasps. Aquatic insects collected from a temporary pond on the creek include predaceous diving beetles (*Agabus disintegratus* and *Hygrotus nubilis*), water boatmen (*Corisella tarsalis* and *Sigara alternata*), and midge larvae (*Chironomus* sp. and *Procladius* sp.) (Kondratieff and Durfee 1999). Birds observed in the vicinity include Killdeer, Western Kingbird, Lark Bunting, Western Meadowlark, Northern Harrier, and Ferruginous Hawk. Mountain Plover use the adjacent shortgrass uplands.

Small mammal trapping in the shortgrass prairie surrounding Haynes Creek resulted in the following species: deer mouse (*Peromyscus maniculatus*), kangaroo rat (*Dipodomys ordii*), western harvest mouse (*Reithrodontomys megalotis*), silky pocket mouse (*Perognathus flavus*), northern grasshopper mouse (*Onychomys leucogaster*), hispid pocket mouse (*Chaetodipus hispidus*), and spotted ground squirrel (*Spermophilus spilosoma*) (Colorado Natural Heritage Program 2001b).

Hydrologic investigations by Romero (1992) indicate that Haynes Creek is part of the larger Chico Creek/Black Squirrel Creek system and creek discharge is from shallow groundwater recharged by precipitation over the entire watershed (Pueblo and El Paso counties). The hydrologic regime of the creek appears to be nearly intact. The springs at the headwaters are developed and a small retention dam was built to supply a privately owned ranch residence and headquarters. The retention pond likely alters the hydrologic regime by moderating flows and increasing evaporative losses. Only two roads cross the creek within the PCA, the Department of Transportation (DOT) Highway near the headwaters and the IL Road along the eastern boundary of PCD.

The land history of the depot property is complex. From at least the early 1900's to 1941, the depot property was a mixture of private and state owned parcels with ranching as the primary use. In 1941, the Department of Defense acquired the land and by 1942 had built a munitions storage facility. In 1994, all but a small portion of the munitions were removed. Though bunkers and other buildings were constructed over most of the depot, the Haynes Creek portion was never developed and remains in relatively intact condition.

Grazing has been excluded from the PCD portion of the PCA since 1998 (M. Canestorp, pers. comm., PCD) and fire is suppressed throughout the region.

Biodiversity Rank Comments: This site contains a good example (B-ranked) of a globally vulnerable/apparently secure (G3G4 S3) threesquare bulrush (*Scirpus pungens*) plant community on a small, intact Great Plains stream.

Natural Heritage element occurrences at the Haynes Creek PCA.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	Federal Sensitive	EO* Rank*	Last Observed
Plant Communities								
Scirpus pungens	**Bulrush**	**G3G4**	**S3**				**B**	**2000-09-09**
Distichlis spicata	Salt meadow	G5	S3				B	2000-09-09

*EO = Element Occurrence Note: Element occurrence responsible for the B-rank is shown in bold typeface.

Boundary Justification: The boundary encompasses the springs at the headwaters of the creek and a portion of the surrounding uplands. The PCA could be expanded to include a greater proportion of the groundwater recharge area necessary to maintain the springs and seeps supporting the riparian plant communities along Haynes Creek.

Protection Rank Comments:. The Pueblo Chemical Depot is scheduled for closure in future years. The Department of Defense is studying various options for transferring the property to a new owner, potentially one with conservation intentions. The ranch to the north has been operating for decades and ranch practices appear compatible with maintenance of the good condition of the element occurrences.

Management Rank Comments: From the perspective of natural heritage elements on the PCA, current management appears appropriate for maintaining the element occurrences. Elimination of tamarisk on Haynes Creek is recommended because the species currently forms less than one percent cover and would be relatively easy to eradicate. The potential for reestablishment of naturally-occurring large scale ecological processes such as fire and herbivory should be considered in management plans.

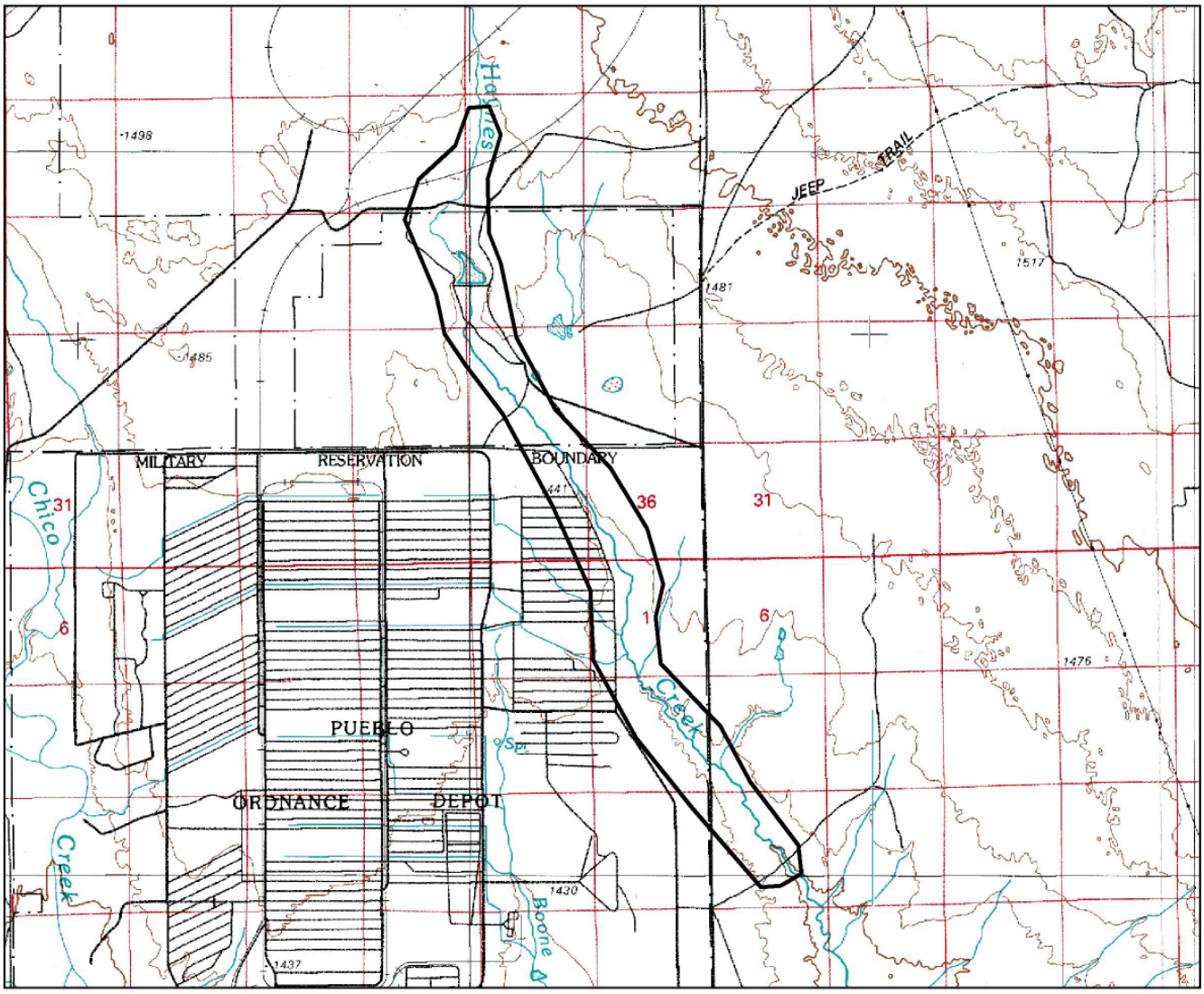
Soils Description: Soils in the dry stream channel are silty clay and clay loam (10YR 3/2) with some mottling. In some areas bare ground in the channel is covered with a white alkali crust. The crust forms when evaporation of soil moisture leaves a concentrated amount of salts (calcium sulfate, calcium carbonate, and/or magnesium carbonate) from the soil solution, which eventually results in precipitate (salt crusts) forming on the soil surface.

Wetland Functional Assessment for the Haynes Creek PCA:
Proposed HGM Class: Riverine Subclass: R5
Cowardin System: Palustrine.
CNHP's Wetland Classification: *Scirpus pungens* and *Distichlis spicata*.

Function	Rating	Comments
Overall Functional Integrity	At potential	
Hydrological Functions		
Flood Attenuation and Storage	High	Dense, nearly continuous cover of herbaceous cover in the stream channel provides high potential for flood attenuation. Storage potential is also offered by small ponded sections of the stream.
Sediment/Shoreline Stabilization	Moderate	Stream banks and the floodplain are densely vegetated providing high ability to stabilize banks and minimize erosion. In the downstream section, streambanks are entrenched in some places.
Groundwater Discharge/ Recharge	Yes	The stream originates from spring discharge. The majority of the creek probably flows only during precipitation events.
Dynamic Surface Water Storage	N/A	Flooding at this site is primarily due to overbank or in-channel flow.
Biogeochemical Functions		
Elemental Cycling	High	There is little perennial water in the creek but high vegetative cover provides a continual supply of carbon. The fine-textured and seasonally wet soil provide an environment for dynamic nutrient cycles Although, seasonally wet, this area provides important biogeochemical functions that the surrounding dry upland areas do not offer.
Removal of Imported Nutrients, Toxicants, and Sediments.	Low	Dense herbaceous cover and fine sediment indicate potential for sediment and nutrient removal/retention but upstream inputs are minimal.
Biological Functions		
Habitat Diversity	Low	Habitat types include emergent wetland and bare ground. There are limited ephemeral pools.
General Wildlife Habitat	Moderate	Upland wildlife using the creek include antelope, rabbits, rodents, coyote, raptors, and songbirds – species representative of shortgrass prairie.
General Fish/Aquatic Habitat	Low	There is no permanent surface water and therefore no fish. Aquatic insects in temporary ponds include aquatic beetles, water boatmen, and midges.
Production Export/Food Chain Support	Low	The creek is ephemeral.
Uniqueness	High	It is rare to find plains streams in good condition. Haynes Creek is relatively weed-free, not entrenched, and occurs within a relatively intact landscape.

Restoration Potential: Control and eradication of non-native species, including the small amount of tamarisk would benefit the site. Additional restoration tools include prescribed burning to reestablish periodic fire disturbance.

Haynes Creek
Potential Conservation Area



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Fax: (970) 491-3349

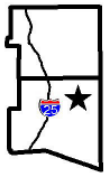
map date: 4 May 2001
GIS department: db

PCA Boundary

U.S.G.S. 30x60 Minute Quadrangle*
Pueblo, 38104-A1

*Digital Raster Graphics (DRGs) produced by the U. S. Geological Survey, 1996

Location in Project Area



Riser at Calhan

Biodiversity Rank: B3 (High significance)
The Riser at Calhan PCA supports two good (B-ranked) occurrences of plains ambrosia (*Ambrosia linearis*), a globally vulnerable (G3 S3) plant species.

Protection Urgency Rank: P3 (Moderate urgency)
This PCA may become increasingly threatened by expanding residential development when US 24 is widened.

Management Urgency Rank: M3 (Moderate urgency)
Current management may be congruent with the persistence of the plains ambrosia at this location. Management that promotes natural hydrologic conditions is likely to ensure the persistence of this element in this PCA.

Location: El Paso County, northeast of Calhan. The PCA is bisected by US Highway 24 and the Chicago Rock Island and Pacific Railroad line.

Legal Description: USGS 7.5 minute quadrangles: Calhan and Ramah South. T11S R61W Sections 28-32; T11S R62W Sections 25 and 36; T12S R61W Sections 5 and 6; T12S R62W Section 1.

Size: 2,564 acres 1,038 hectares).

Elevation: 6,300 to 6,700 feet (1,920 to 2,042 meters).

General Description: The Riser at Calhan PCA is located within a mile northeast of the incorporated area of Calhan, and continues north and northeast for approximately three miles. All of the area within the PCA is privately owned except for the right of way areas. The area is near the upper elevational extent of shortgrass and midgrass prairies in El Paso County, approaching 6,600 feet at its southeastern boundary. Ostensibly, this area includes the highest of the high plains in El Paso County. The landscape is topographically diverse in this area, with high rolling hills in the eastern portion overlooking the bottomlands upslope from an unnamed reservoir at the northwestern edge of the PCA. Numerous drainages flow in a generally northern direction from the PCA towards Big Sandy Creek.

The PCA includes two good (B-ranked) occurrences of plains ambrosia (*Ambrosia linearis*). The habitat for the plains ambrosia in this area is somewhat different than that further south, where this species inhabits playas (dry lakes). In the Riser at Calhan PCA this species is found in shallow draws and in a depression in a pasture. These occurrences also mark the upper elevational limit of occurrences known to be extant at this time. Plains ambrosia is also common on the roadsides within this PCA, including US Highway 24 and Harrisville Road.

Biodiversity Rank Comments: Two good (B-ranked) occurrences of the globally vulnerable (G3 S3) plains ambrosia (*Ambrosia linearis*) are present within the PCA. These occurrences are ecologically significant because the plant is found at high elevation and in slightly different habitat than elsewhere in El Paso County.

Natural Heritage element occurrences at the Riser at Calhan PCA.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	Federal Sensitive	EO* Rank	Last Observed
Plants								
Ambrosia linearis	**Plains ambrosia**	**G3**	**S3**			**FS**	**B**	**1989**
Ambrosia linearis	**Plains ambrosia**	**G3**	**S3**			**FS**	**B**	**1989-07-27**

*EO = Element Occurrence Note: Element occurrences responsible for the B-rank are shown in bold typeface.

Boundary Justification: The boundary encompasses the two known occurrences of plains ambrosia in the area and additional suitable habitat in draws and bottomlands around the occurrences. The roadside occurrences of the species are also included in the PCA, although it was not drawn specifically to include these occurrences.

Protection Rank Comments: With the exception of right of way areas, all of the land within this PCA is privately owned. Residential development is already occurring in the vicinity of this PCA. It is likely to increase rapidly in the future as Colorado Springs grows and US 24 is upgraded to a four lane road. Currently most of the land within the site is used for cattle grazing.

Management Rank Comments: Management needs may arise if further hydrological alterations are implemented within the PCA. Weeds such as musk thistle (*Carduus nutans*) and white top (*Cardaria draba*) have the potential to negatively impact the occurrences of plains ambrosia here.

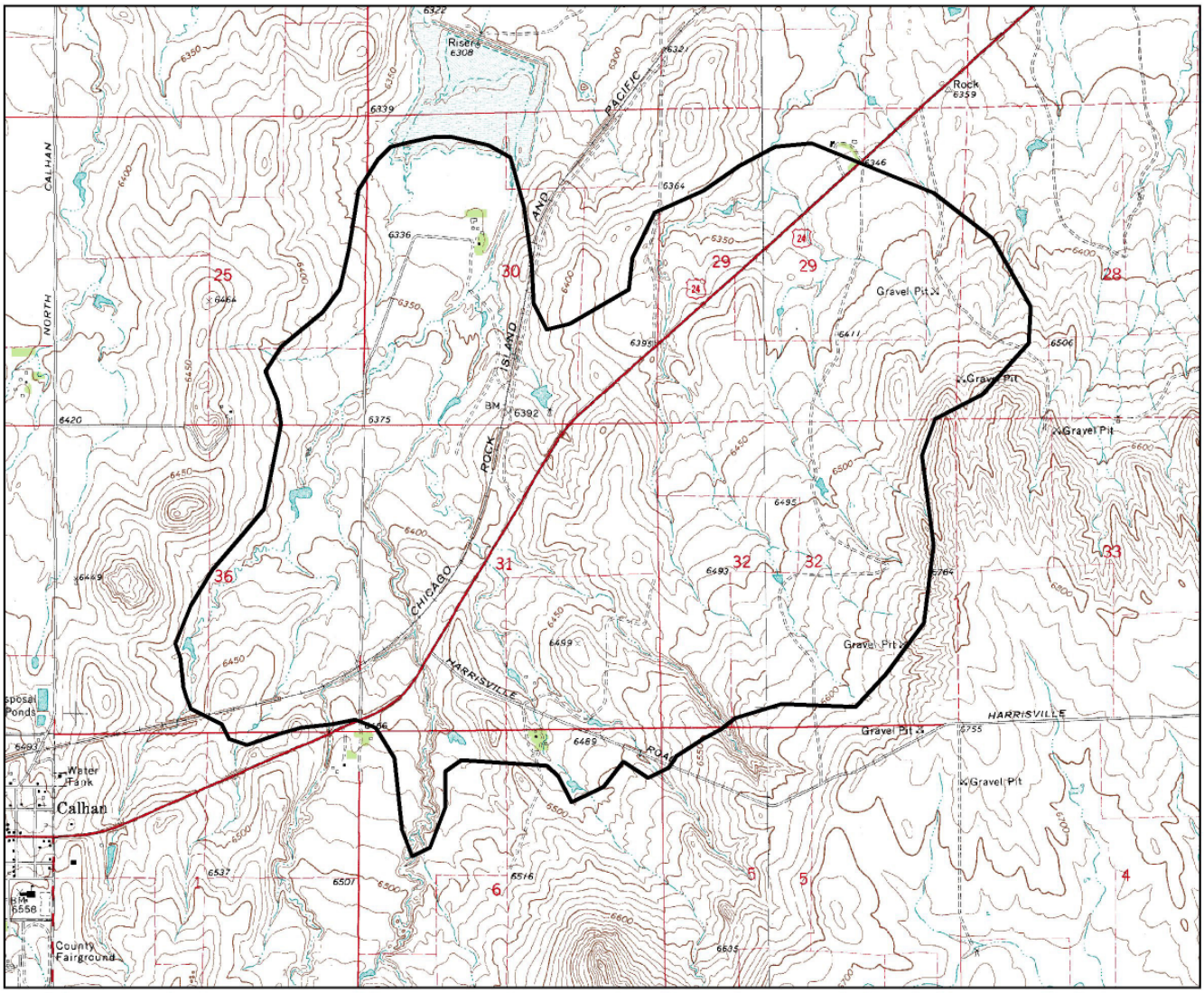
Soils Description: Soils were not described at this site.

Wetland Functional Assessment: This site was not visited by a CNHP wetland ecologist during the 2000 field season. No functional assessment was performed at this site.

Restoration Potential: Control non-native species.

Riser at Calhan

Potential Conservation Area



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map date: 10 May 2001
GIS department: db

PCA Boundary

U.S.G.S. 7.5 Minute Quadrangles*
Ramah South, 39104-A2
Calhan, 39104-A3

*Digital Raster Graphics (DRGs) produced by the U. S. Geological Survey, 1996

Location in Project Area

St. Charles River at 3R

Biodiversity Rank: B3 (High Significance)
This site contains a good (B-ranked) occurrence of a vulnerable (G3? S3) montane riparian forest plant community, narrowleaf cottonwood/alder (*Populus angustifolia/Alnus incana*).

Protection Urgency Rank: P3 (Moderate urgency)
The land is privately owned and its primary use is cattle grazing. Due to its proximity to Pueblo, this area could be targeted for increased development.

Management Urgency Rank: M5 (Low urgency)
The current management appears appropriate for maintaining the element occurrence.

Location: St. Charles River at 3R is located about 20 miles southwest of Pueblo, south of Highway 78 on the Three R Road.

Legal Description: USGS 7.5 minute quadrangle: Beulah. T23S R67W Sections 18 and 19; T23S R68W Sections 13, 14, and 22-26.

Size: 807 acres (328 hectares)

Elevation: 6,060 to 7,100 feet (1,847 to 2,164 meters).

General Description: The St. Charles River begins in the Wet Mountains and flows northeast toward Pueblo and the Arkansas River. The site encompasses the riparian area in the lower montane zone. In the lower portion of the site, the river cuts a narrow canyon through some 100 feet of Dakota sandstone creating impressive towering cliffs. The stream is perennial and the bed is coarse alluvium with large boulders. The plant community in this lower montane portion of the canyon is primarily narrowleaf cottonwood (*Populus angustifolia*) with alder (*Alnus incana*) and coyote willow (*Salix exigua*). In the narrower portions of the canyon, narrowleaf cottonwood is absent and alder and coyote willow dominate. Other tree and shrub species within the riparian zone in the canyon include Rocky Mountain juniper (*Juniperus scopulorum*), one-seeded juniper (*J. monosperma*), ponderosa pine (*Pinus ponderosa*), peach-leaf willow (*Salix amygdaloides*), Gambel's oak (*Quercus gambelii*), lead plant (*Amorpha fruticosa*), bluestem willow (*Salix irrorata*), and snowberry (*Symphoricarpos* sp.). The grass and forb understory is a mixture of native and pasture species. Native species include field horsetail (*Equisetum arvense)*, scouring-rush (*Hippochaete* sp.), various rushes (*Juncus* spp.) and sedges (including *Carex lanuginosa* and *C. simulata*). Pasture species include orchardgrass (*Dactylis glomerata*), Kentucky bluegrass (*Poa pratensis*), redtop (*Agrostis gigantea*), timothy (*Phleum pratense*), clover (*Trifolium* spp.), and alfalfa (*Medicago sativa*).

The stream has overhanging vegetation in many reaches and duckweed (*Lemna minor*) and speedwell (*Veronica* sp.) are common on gravel bars in the channel. Small fishes are present in ponded areas and aquatic insects noted include mayfly and caddisfly larvae, water striders, and water boatmen. Songbirds including Cliff Swallow and Canyon Wrens are abundant in the canyon and raptors soar overhead. Large mammals using the canyon include mountain lion, black bear, and deer.

The canyon walls are vegetated primarily with one-seeded juniper, ponderosa pine, Gambel's oak, mountain mahogany (*Cercocarpus montanus*), and blue grama (*Bouteloua gracilis*). The benches above the canyon walls are irrigated pasture used for haying and cattle grazing on the south bench and primarily non-irrigated grazing land on the north bench.

The land use in the area is primarily agricultural and cattle grazing. The ranch owners on the south bench practice "holistic resource management" where the entire herd is kept as a unit and pastures are grazed intensively but for a very short period. For example, the riparian area and canyon bottom are grazed once or twice a year for a few days each (B. Brown, pers. comm., landowner).

There is little evidence of human-caused alteration of the hydrological processes upstream of the occurrence and within the watershed. The stream undergoes flooding as is evidenced by debris in the riparian vegetation and a wide range of age classes for narrowleaf cottonwood. Most of the upstream watershed is forested and managed by the U.S. Forest Service. Lake Isabel occurs near the headwaters at an elevation of 8,474 feet, and an irrigation ditch conveying water to the 3R Ranch diverts a portion of the flow at the 3R Road.

Upstream from the potential conservation area, breeding Mexican spotted owl (*Strix occidentalis lucida*) occur on U.S. Forest Service property in forests of Engelmann spruce (*Picea engelmannii*), white fir (*Abies concolor*), Douglas fir (*Pseudotsuga menziesii*), and quaking aspen (*Populus tremuloides*) (Johnson 1977). Mexican spotted owls are classified as a federally threatened species and are generally found in steep canyons with old growth conifers.

Biodiversity Rank Comments: This site contains a good (B-ranked) example of a globally vulnerable (G3? S3) lower montane riparian woodland, narrowleaf cottonwood/thinleaf alder (*Populus angustifolia/Alnus incana*). The plant association is known from Colorado and New Mexico and is expected to occur throughout the range of narrowleaf cottonwood in the Southern Rocky Mountains ecoregion. There are about 40 documented occurrences in Colorado.

Natural Heritage element occurrences at the St. Charles River at 3R PCA.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	Federal Sensitive	EO Rank*	Last Observed
Plant Communities								
Populus angustifolia/ Alnus incana	Montane riparian forest	G3?	S3				B	2000-09-08

*EO = Element Occurrence

Boundary Justification: The boundary encompasses the riparian community and adjacent benches in the lower end and a portion of the upstream watershed to account for continued surface flow and periodic flooding. These processes are necessary for the viability of the occurrence and maintenance of ecological functions. A much larger area including the full upstream watershed of St. Charles River needs to be considered when developing a plan for the long-term viability of this site.

Protection Rank Comments: The land is privately owned with the majority comprising one large cattle ranch. Upstream from the PCA on the mainstem of the river is a 230-acre parcel of BLM land that is adjacent to Pike-San Isabel National Forest that continues to the headwaters at the continental divide. The primary land use in the lower portion of the stream is cattle grazing with haying and rotational grazing on the bench tops. There are homes scattered along the Three R Road. Given the proximity to Pueblo, this area could be targeted for increased development.

Management Rank Comments: The current management appears appropriate for maintaining the element occurrence. The riparian area is grazed by cattle only once or twice a year for a few days each ("holistic resource management"). Portions of the creek not included in the element occurrence experience year-round grazing and support lower plant species diversity. Although the PCA does not include the entire watershed, maintenance of the element occurrence depends on appropriate management in the upper watershed to maintain the natural flooding regime.

Soils Description: The soils consist of mixed alluvium along the riparian area.

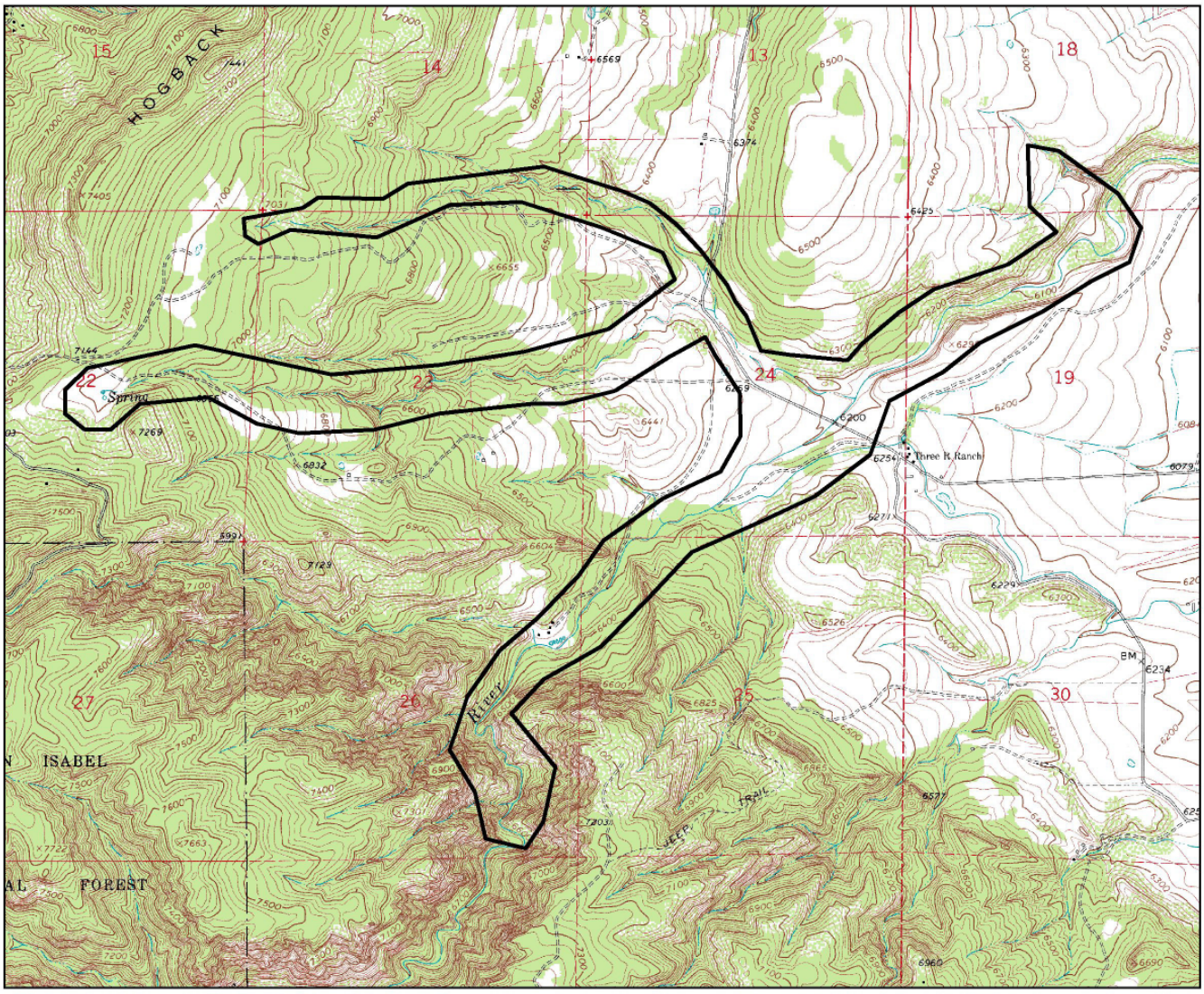
Wetland Functional Assessment for the St. Charles River at 3R PCA:
Proposed HGM Class: Riverine Subclass: R3
Cowardin System: Palustrine.
CNHP's Wetland Classification: *Populus angustifolia/Alnus incana,* plus numerous emergent wetlands.

Function	Rating	Comments
Overall Functional Integrity	At potential	
Hydrological Functions		
Flood Attenuation and Storage	Moderate	The canyon is fairly narrow and thus there is low flood storage potential. High density of woody and herbaceous vegetative cover along the creek creates good flood attenuation potential. Flood debris suspended in the woody vegetation indicates flooding occurs.
Sediment/Shoreline Stabilization	High	Perennial stream with dense cover of woody and herbaceous vegetation along indicates good soil stabilization potential.
Groundwater Discharge/ Recharge	High	Occasional springs and seeps were encountered along the stream. The perennial nature of the stream indicates that groundwater discharge is a vital component of stream flow.
Dynamic Surface Water Storage	N/A	Flooding at this site is primarily due to overbank or in-channel flow.
Biogeochemical Functions		
Elemental Cycling	High	Given the diversity of plant species and thus diverse types of litter inputs, the presence of aerated water (the stream), and areas with saturated soils, there is likely a stable and persistent cycling of nutrients (as opposed to a quick 'flush'). Thus, important, local biogeochemical functions are likely occurring at this site. Downstream, disturbances have likely disrupted nutrient cycling.
Removal of Imported Nutrients, Toxicants, and Sediments.	Moderate	Imported nutrients, toxicants, and sediments are probably minimal. Additionally, occasional ponded reaches provide potential soil settling basins.
Biological Functions		
Habitat Diversity	Moderate	There are woodland, shrubland, and open water (associated with the creek) wetland habitats. The canyon walls provide habitat for birds.
General Wildlife Habitat	Moderate	Avian habitat is good with songbirds including Cliff Swallows and Canyon Wren using the cliffs and raptors soaring overhead. Large mammals using the area include bear and deer.
General Fish/Aquatic Habitat	High	Nice pool/riffle complex, overhanging vegetation, and presence of large woody debris provides great fish and aquatic invertebrate habitat. Observed small fishes in the pools. Observed aquatic invertebrates included mayflies, caddisflies, and hemipterans.
Production Export/Food Chain Support	High	A permanent water source and high quantities of allochthonous organic substrates provide carbon and nutrients for downstream ecosystems. The diversity of structural vegetation classes also provide a variety of habitats for invertebrate populations.
Uniqueness	Moderate	The canyon at this elevation appears to be relatively unique for the area. Other drainages nearby may have similar riparian vegetation.

Restoration Potential: Currently, most of the site is in relatively good condition, thus restoration opportunities are minimal. However, those portions of the creek where grazing occurs year-round could be targeted for implementation of different grazing regimes that benefit the ecological health of the riparian area.

St. Charles River at 3R

Potential Conservation Area



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map date: 10 May 2001
GIS department: db

PCA Boundary

U.S.G.S. 7.5 Minute Quadrangle*
Beulah, 38104-A8

*Digital Raster Graphics (DRGs) produced by the U. S. Geological Survey, 1996

Location in Project Area

West Kiowa Creek at Elbert

Biodiversity Rank: B3 (High Significance)
This PCA contains a good (B-ranked) example of a globally vulnerable (G3Q S2S3) riparian willow community and two fair (C-ranked) examples of globally imperiled (G2) riparian willow communities.

Protection Urgency Rank: P2 (High urgency)
The occurrences are directly threatened by development in the towns of Kiowa and Elizabeth. Alteration of the hydrologic regime in Black Forest in El Paso County can affect the occurrences in Elbert County.

Management Urgency Rank: M2 (High urgency)
Sections within the PCA boundary are severely degraded but recoverable.

Location: Elbert and El Paso Counties. West Kiowa Creek PCA is located primarily in Elbert County. The stream originates within the Black Forest in El Paso County.

Legal Description: USGS 7.5 minute quadrangles: Elbert, Eastonville. T9S R64W Sections 34 and 35; T10S R64W Sections 2-4, 8-11, 16, 17, 31, and 32; T11S R64W Sections 5 and 6.

Size: 1,742 acres (705 hectares).

Elevation: 6,720 to 7,200 feet (2,048 to 2,195 meters)

General Description: This PCA encompasses a foothills ephemeral stream with meanders and pockets of thick willows and stands of plains cottonwood (*Populus deltoides* ssp. *monilifera*). This is a high quality low elevation riparian area. Only a small portion of the site lies within El Paso County; however, El Paso County comprises the headwaters of the creek and is therefore very important to the lower reaches of the creek.

Natural Heritage element occurrences at the West Kiowa Creek at Elbert PCA.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	Federal Sensitive	EO Rank*	Last Observed
Plant Communities								
Salix amygdaloides/ Carex lanuginosa	Peachleaf willow alliance	G3	SU				C	1995-07-01
Salix eriocephala* var. *ligulifolia	**Willow carr**	**G2G3**	**S2S3**				**C**	**1995-07-02**
Salix lucida* ssp. *caudata	**Montane riparian shrubland**	**G3Q**	**S2S3**				**B**	**1995-07-01**
Populus deltoides ssp. *monilifera-(Salix amygdaloides)/Salix exigua*	Plains cottonwood riparian woodland	G4?	S3				E	1995-06-29

*EO = Element Occurrence Note: Element occurrences responsible for the B-rank are shown in bold typeface.

Biodiversity comments: This PCA contains a good (B-ranked) example of a globally vulnerable (G3Q S2S3) riparian willow community and a fair (C-ranked) example of globally imperiled/vulnerable (G2G3 SU) riparian willow community.

Boundary Justification: The alluvial floodplain and riparian area is constricted by roads. The downstream boundary of the PCA is the town of Elbert. The upstream boundary marks the start of compatible management. Further upstream the creek bottom is severely degraded.

Protection Rank Comments: Threatened by development in the towns of Kiowa and Elizabeth.

Management Rank Comments: Sections within boundaries are severely degraded but recoverable.

Soils Description: Soils consist of sandy alluvium.

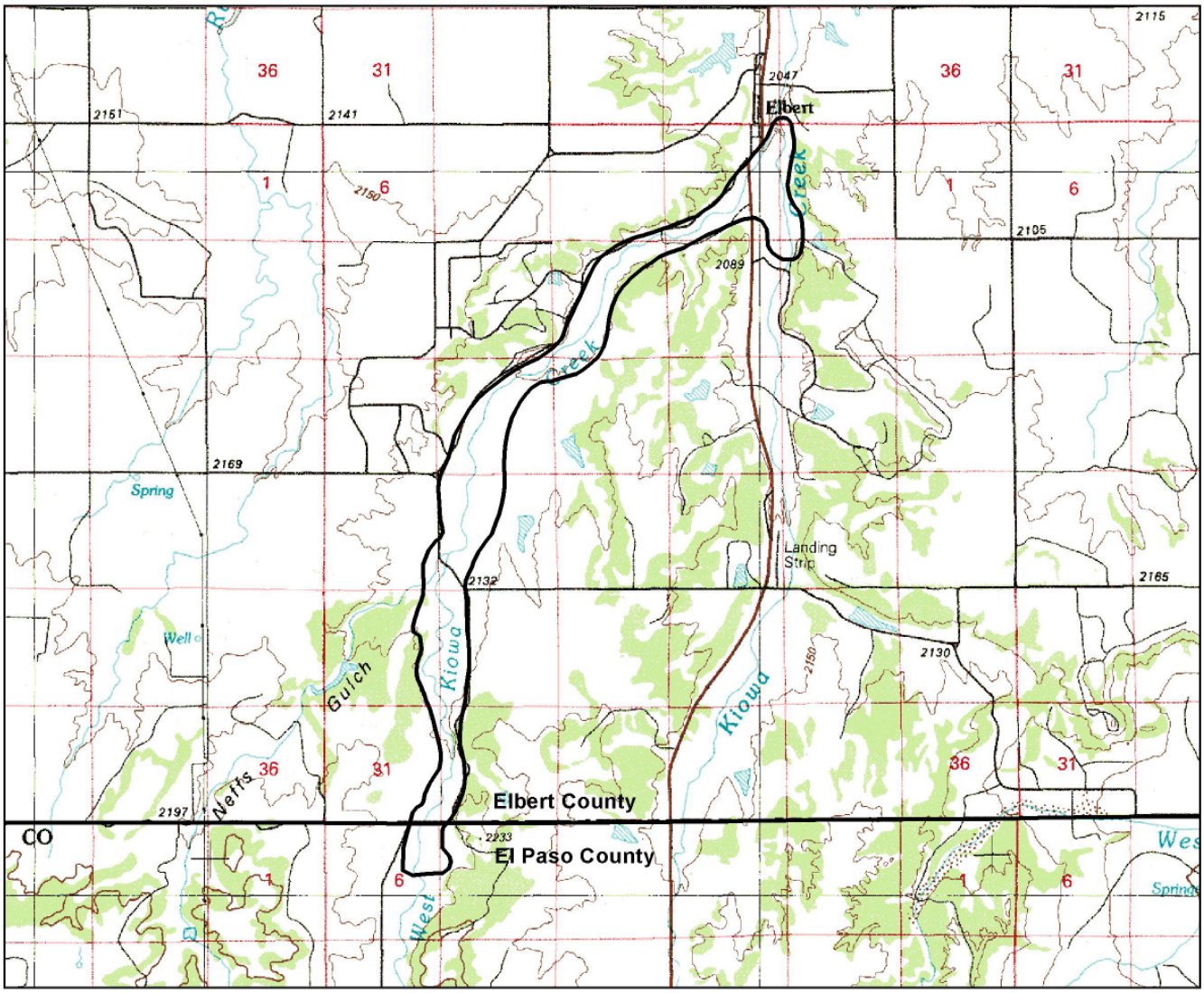
Wetland Functional Assessment: This site was not visited by a CNHP wetland ecologist during the 2000 field season. The following functional assessment comments are based upon notes from previous investigators.

This area maintains uninterrupted hydrological flow for downstream reaches of West Kiowa Creek.

Restoration Potential: Degradation, resulting from upstream roads and development, could be abated using created wetlands to intercept stormwater runoff prior to it draining into West Kiowa Creek. Non-native species should be controlled.

West Kiowa Creek at Elbert

Potential Conservation Area



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Fax: (970) 491-3349

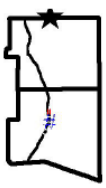
map date: 10 May 2001
GIS department: db

PCA Boundary

U.S.G.S. 30x60 Minute Quadrangle*
Castle Rock, 39104-A1

*Digital Raster Graphics (DRGs) produced by the U. S. Geological Survey, 1996

Location in Project Area



Arkansas River at Nepesta

Biodiversity Rank: B4 (Moderate significance)
This PCA contains a good (B-ranked) example of a globally secure (G5 S3) cattail marsh community (*Typha angustifolia – Typha latifolia*). This is the best known occurrence of this common wetland community in Pueblo County.

Protection Urgency Rank: P2 (High urgency)
The wetlands are privately owned.

Management Urgency Rank: M3 (Moderate urgency)
The presence of mosquitofish at the Nepesta wetland could be investigated and control measures attempted if they are present. Removal of pumps from the other cattail stand may help restore natural ecological functions.

Location: Arkansas River at Nepesta PCA is located in eastern Pueblo County. The site includes two separate wetlands within the Arkansas River floodplain.

Legal Description: USGS 7.5 minute quadrangle: Nepesta. T21S R61W Sections 22, 23, 26, and 27; T21S R60W Sections unsurveyed.

Size: 455 acres (184 ha) and 375 acres (152 ha).

Elevation: 4,440 to 4,460 feet and 4,360 to 4,420 feet.

General Description: This PCA contains two good examples of cattail wetlands (*Typha angustifolia – Typha latifolia*) (G5 S3) within meander bends of the Arkansas River. One is located on the north bank of the river near the mouth of Kramer Creek at Nepesta. The other is located about three miles upstream on the south bank of the river

The cattail marsh near Nepesta is the larger of the two covering about 150 acres (61 ha). Typical of a cattail stand, the vegetation within the stand is very homogeneous. The uplands north of the stand are greasewood shrublands intermixed with shortgrass prairie. Mosquitofish (*Gambusia affinis*) were introduced to the marsh in an attempt to control mosquito larvae (J. Dillon, pers. comm., landowner). Mosquitofish are native to southeastern U.S. and have been introduced worldwide. Almost everywhere introductions have been made, mosquitofish have gradually eliminated or reduced populations of small native fishes (Minkley and Deacon 1968).

The other cattail marsh occupies about 70 acres (28 ha). It has been drained via pumping of wells in the past to allow haying of the cattails. The pumps have been inactivated due to water agreements with Kansas concerning flow in the Arkansas River. The cattail stand has small patches of bulrush (*Scirpus acutus*) within and a few scattered peach-leaf willow (*Salix amygdaloides*). Birds including Green Heron and Great Blue Heron were observed perching in the trees. Northern leopard frogs (*Rana pipiens*) were also observed

in the wetland. The uplands are rolling hills of shortgrass prairie with rabbitbrush (*Chrysothamnus nauseosus*), cholla (*Cylindropuntia imbricata*), and scattered sand sage (*Artemisia filifolia*).

Natural Heritage element occurrences at the Arkansas River at Nepesta PCA.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	Federal Sensitive	EO Rank*	Last Observed
Plant Communities								
Typha angustifolia-Typha latifolia	**Cattail marsh**	**G5**	**S3**				**B**	**2000-09-26**
Typha angustifolia-Typha latifolia	**Cattail marsh**	**G5**	**S3**				**B**	**2000-09-26**

*EO = Element Occurrence Note: Element occurrences responsible for the B-rank are shown in bold typeface.

Biodiversity comments: This site contains a good (B-ranked) occurrence of a globally common (G5 S3) cattail wetland (*Typha angustifolia – Typha latifolia*). These cattail marshes are unusually large.

Boundary Justification: The boundary encompasses the wetland and a small amount of the surrounding uplands. The groundwater recharge areas for the wetlands are not encompassed within the PCA. Recharge areas probably include the entire Arkansas River drainage and the adjacent uplands draining toward the Arkansas River.

Protection Rank Comments: The lands are privately owned.

Management Rank Comments: The presence of mosquitofish at the Nepesta wetland could be investigated and control measures attempted if they are present. The pumps designed to drain the more western cattail stand could be removed to ensure long-term maintenance of the local natural hydrologic regime.

Soils Description: Standing water portions of the wetland have an organic-rich black soil with strong sulfur odor overlying silty clay. The drier portions have silty clay with oxidized rhizospheres and gleying.

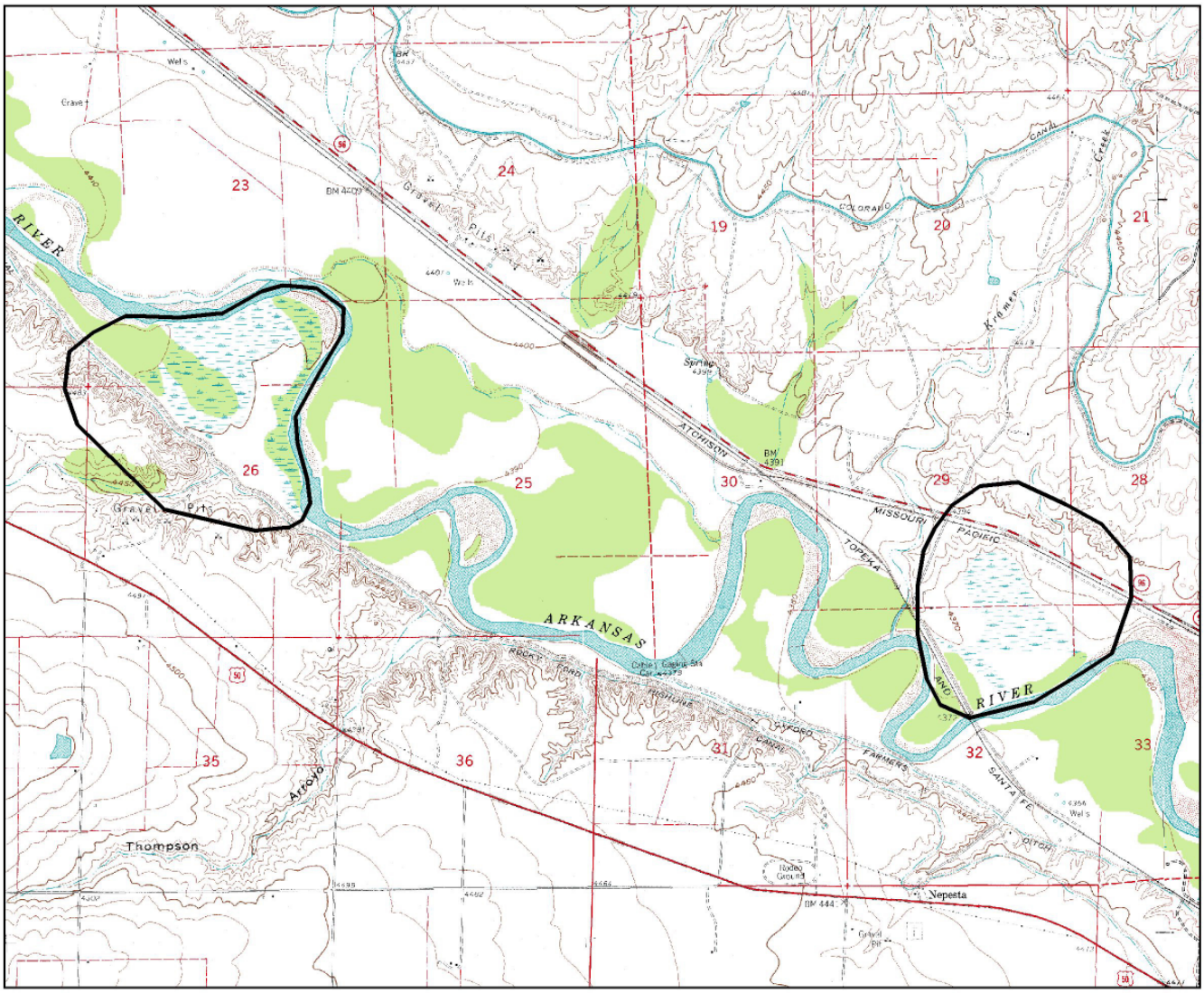
Wetland Functional Assessment for the Arkansas River at Nepesta PCA:
Proposed HGM Class: Depressional Subclass: D2
Cowardin System: Palustrine.
CNHP's Wetland Classification: *Typha angustifolia – Typha latifolia*

Function	Rating	Comments
Overall Functional Integrity	At potential	
Hydrological Functions		
Flood Attenuation and Storage	High	These wetlands occur within the floodplain of the Arkansas River. The dense vegetative cover and restricted outlet provide a high potential for flood storage and attenuation. These wetlands are inundated during high flow events on the Arkansas River. It should be noted that upstream alterations in hydrology (e.g., dams, channelization) have drastically affected the flooding cycle of the Arkansas River.
Sediment/Shoreline Stabilization	N/A	Does not occur on a channel.
Groundwater Discharge/ Recharge	Yes	Wetlands are part of the Arkansas River floodplain and hydrologic system. Wetland likely intercepts groundwater discharge headed toward the Arkansas River.
Dynamic Surface Water Storage	High	Can receive runoff from surrounding uplands. Good potential for surface water storage. Permanent inundation of a large area
Biogeochemical Functions		
Elemental Cycling	Moderate	High aboveground primary productivity and detritus and organic soil horizon indicate that nutrient cycles are intact.
Removal of Imported Nutrients, Toxicants, and Sediments.	Moderate	High capacity to trap sediments during high flow events on the Arkansas River. Fine-grained sediments and decomposing organic matter indicate nutrient removal potential.
Biological Functions		
Habitat Diversity	Moderate	Habitat types include emergent wetlands (extensive area) and open water. (small area). The wetland is adjacent to the Arkansas River riparian corridor with cottonwood, Russian olive, and tamarisk.
General Wildlife Habitat	Moderate	Large size provides good bird nesting habitat. May be too wet for predators (e.g., coyote, raccoon) to access. Observed northern leopard frogs, Green Heron, and Great Blue Heron in the more western cattail stand.
General Fish/Aquatic Habitat	Low	Gambusia fish were introduced to the more eastern cattail stand and it is not known whether they have become established. It is likely that they did establish and subsequently alter native faunal composition. The landowner indicates there are carp are in the pools.
Production Export/Food Chain Support	Moderate	High vegetative cover, moderate habitat diversity, and perennial surface water contribute to a diverse array of organic substances and nutrients that potentially transport downstream during high flood events on the Arkansas River or via groundwater flow.
Uniqueness	Low	Though these two cattail stands are the largest noted on the Arkansas River in Pueblo County, this community type is very common and larger, better quality stands probably exist elsewhere. These occurrences are locally significant. Large-scale, hydrologically unaltered (other than changes to flood regime on Arkansas River), native vegetation wetlands are not common on the plains.

Restoration Potential: Removal of the pumps from the western occurrence would help ensure long-term maintenance of the natural local hydrologic regime. Attempts to eliminate mosquitofish populations from the eastern occurrence (if present) could benefit native fish, amphibian, and invertebrate populations.

Arkansas River at Nepesta

Potential Conservation Area



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The Colorado Natural Heritage Program
Colorado State University
254 General Services Bldg
Fort Collins, CO 80523
Fax: (970) 491-3349

map date: 10 May 2001
GIS department: db

PCA Boundary

U.S.G.S. 7.5 Minute Quadrangle*
Nepesta, 38104-B2

*Digital Raster Graphics (DRGs) produced by the U. S. Geological Survey, 1996

Location in Project Area

Big Johnson Reservoir

Biodiversity Rank: B4 (Moderate biodiversity significance)
The Big Johnson Reservoir site supports 3 fair (C-ranked) occurrences of the apparently globally secure (G4) but locally restricted or vulnerable wintering (S1B, S3N) Bald Eagle (*Haliaeetus leucocephalus*). The Bald Eagle is classified as a threatened species by both the federal government and the state of Colorado.

Protection Urgency Rank: P2 (High urgency)
Protection actions may be needed within five years. It is estimated that within five years, stresses may reduce the viability of the population of Bald Eagles wintering at the Big Johnson Reservoir site.

Management Urgency Rank: M3 (Moderate urgency)
New management actions may be needed within five years to maintain the current quality of the Bald Eagle occurrence at the Big Johnson Reservoir site.

Location: This site consists of three discrete areas. The first area encompasses Big Johnson Reservoir and a strip of land (0.25 miles in width) surrounding the reservoir. The second area includes a 1.3-mile-long stretch of Fountain Creek located to the west of the city of Widefield, Colorado. The third area lies along an approximately 3.5-mile-long stretch of Jimmy Camp Creek and is located to the east and south of the intersection of Marksheffel Road and Link Road.

Legal Description:

A. Big Johnson Reservoir area
USGS 7.5 minute quadrangles: Elsmere, Fountain
T15S R65W Sections 7, 8, 9, 16, 17, 18.

B. Fountain Creek area
USGS 7.5 minute quadrangle: Fountain
T15S R66W Sections 13, 14, 23, 24.

C. Jimmy Camp Creek area
USGS 7.5 minute quadrangle: Fountain
T15S R65W Sections 26, 27, 28, 33, 34.

Size: 2,395 acres (969 hectares)

A. Big Johnson Reservoir area:	1,008 acres	(408 hectares)
B. Fountain Creek area:	435 acres	(176 hectares)
C. Jimmy Camp Creek area:	952 acres	(385 hectares)

Elevation: 5,590 - 5,900 feet (1,704 - 1,798 meters)

A. Big Johnson Reservoir area:	5,720 - 5,900 feet	(1,743 - 1,798 meters)
B. Fountain Creek area:	5,640 - 5,800 feet	(1,719 - 1,768 meters)
C. Jimmy Camp Creek area:	5,590 - 5,720 feet	(1,704 - 1,743 meters)

General Description: The Big Johnson Reservoir site includes 3 discrete areas that are used by wintering Bald Eagles for roosting and feeding. The first area consists of Big Johnson Reservoir and a 0.25-mile-wide strip of shoreline (buffer zone) surrounding the reservoir. The reservoir is situated in a large, open expanse of shortgrass prairie that supports scattered *Yucca glauca*. A stand of large cottonwood (*Populus deltoides* ssp. *monilifera*) trees and several clusters of medium-sized trees are located at the western edge of the reservoir. Bald Eagles use these trees for roosting and for hunting perches from which they swoop down on fishes at the water's surface. The Big Johnson Reservoir area is used by a variety of avian species including wintering Lapland Longspurs (*Calcarius lapponicus*) (R. Bunn, pers. comm., Fort Carson). The area also serves as a stopover point for numerous migratory birds of many species (R. Bunn, pers. comm., Fort Carson).

The second portion of the Big Johnson Reservoir site includes a 1.3-mile-long stretch of Fountain Creek, located to the west of the city of Widefield. This area lies immediately to the south of the sewage treatment ponds and to the north of the gaging station at Fountain Creek. Riparian vegetation, including mature cottonwood trees, grows along the creek. Bald Eagles use the cottonwood trees for roosting and for hunting perches from which they attack black-tailed prairie dogs and other prey.

A 3.5-mile-long stretch of Jimmy Camp Creek constitutes the third portion of the Big Johnson Reservoir site. Riparian vegetation growing along Jimmy Camp Creek includes mature cottonwood trees that are used by Bald Eagles. Jimmy Camp Creek flows intermittently.

Arkansas Darters (*Etheostoma cragini*) (globally vulnerable (G3), imperiled in Colorado (S2), and threatened (State of Colorado), and as a candidate for listing as a federally threatened/endangered species) inhabit Jimmy Camp Creek within the Big Johnson Reservoir site. (See the Fountain and Jimmy Camp Creeks Potential Conservation Area for a description of the Arkansas Darter occurrence.) In addition, black-tailed prairie dogs (G4 S4) occur on or near each of the 3 discrete portions of the site.

Biodiversity Rank Comments: At least 3 fair (C-ranked) occurrences of the apparently globally secure (G4) but locally restricted or vulnerable (S1B, S3N) wintering Bald Eagle are known within the Big Johnson Reservoir site.

Natural Heritage element occurrences at the Big Johnson Reservoir PCA.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	Federal Sensitive	EO* Rank	Last Observed
Birds								
Haliaeetus leucocephalus	**Bald Eagle**	**G4**	**S1B, S3N**	**LT**	**T**		**C**	**2000-03-99**
Haliaeetus leucocephalus	**Bald Eagle**	**G4**	**S1B, S3N**	**LT**	**T**		**C**	**2000-03-99**
Haliaeetus leucocephalus	**Bald Eagle**	**G4**	**S1B, S3N**	**LT**	**T**		**C**	**2000-03-99**

*EO = Element Occurrence Note: Element occurrences responsible for the B-rank are shown in bold typeface.

Boundary Justification: The boundaries encompass the 3 known Bald Eagle wintering sites and include a 0.25-mile-wide buffer strip surrounding each wintering site. Such buffer strips are recommended as a means of restricting human activity within a 0.25-mile radius of winter roosts between November 15 and March 15 each year (Craig 1997). In cases where there is a direct line of vision from the roost to the location of the human activities, restrictions on some activities are recommended within 0.5 miles of Bald Eagle winter roosting sites (Craig 1997). Bald Eagles often forage over vast areas many miles from their roosts (see the Bald Eagle species characterization abstract for details and references).

Protection Rank Comments: The City of Colorado Springs recently purchased 650 acres of land surrounding Big Johnson Reservoir which will be preserved as open space (C. Leiber, pers. comm., City of Colorado Springs). The segment of Jimmy Camp Creek that lies within the site is privately owned and is bordered by residential subdivisions to the north and the south. Additional land development is currently underway in the vicinity.

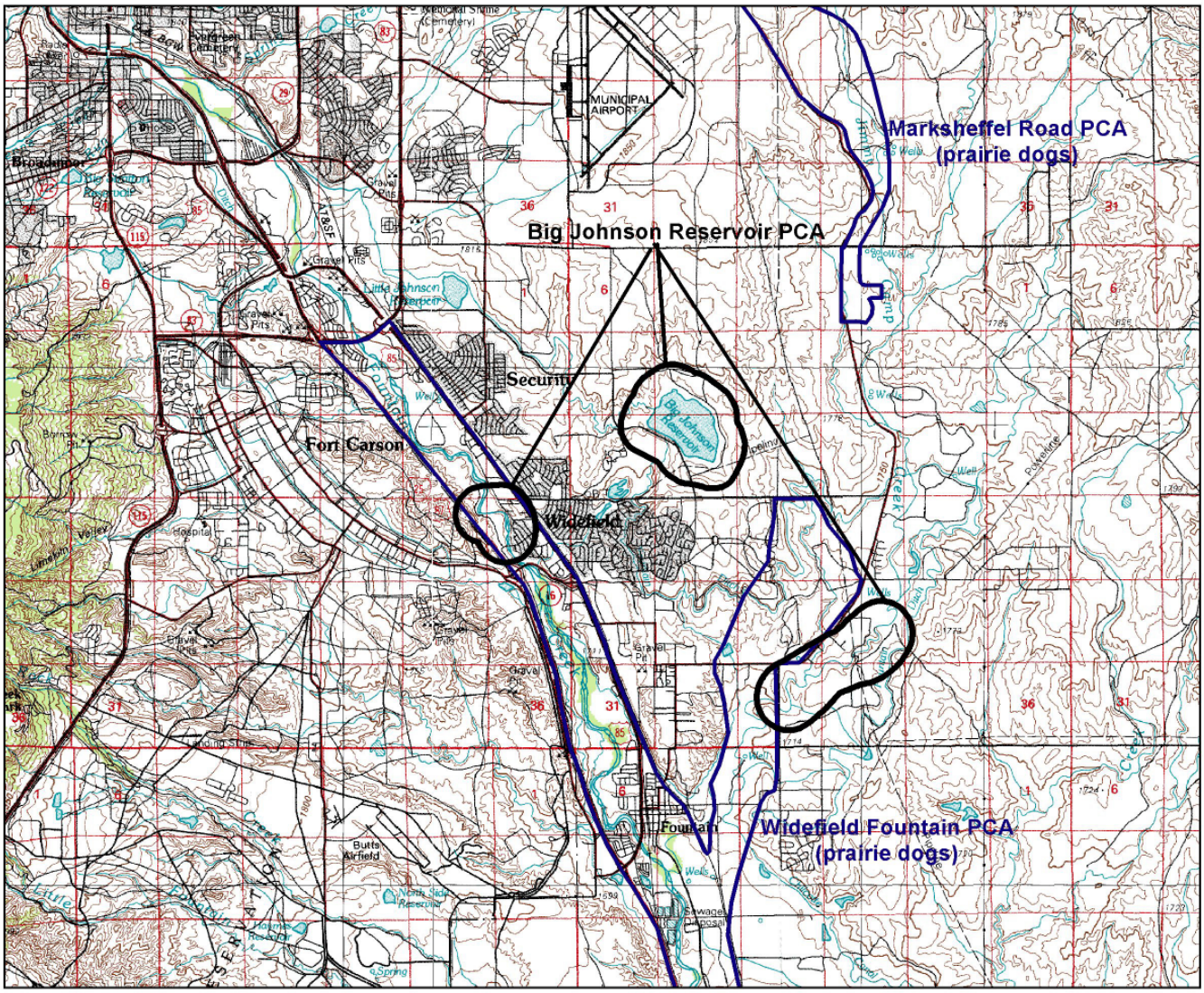
Management Rank Comments: Future management actions that may be needed to maintain the current quality of the Bald Eagle occurrences include the restriction of human access to the areas near eagle roosting and feeding sites (via the delineation of appropriate buffer zones). Another potential management action is the local protection of black-tailed prairie dogs, fishes, and other prey upon which the eagles depend.

Soils Description: Soils were not described at this site.

Wetland Functional Assessment: This site was not visited by a CNHP wetland ecologist during the 2000 field season. No functional assessment was performed at this site.

Big Johnson Reservoir

Potential Conservation Area


Marksheffel Road PCA
(prairie dogs)
Big Johnson Reservoir PCA
Security
Fort Carson
Widefield
Widefield Fountain PCA
(prairie dogs)
Fountain
MUNICIPAL AIRPORT
Butts Airfield
Big Johnson Reservoir
Little Johnson Reservoir
Jimmy Camp Creek
Little Fountain Creek
Sewage Disposal
Gravel Pits
Hospital
Limekiln
Valley
Spring
Well
Wells
Pipeline
Powerline
Canal
Ditch
Creek
Cemetery
Shrine
Bridge
Reservoir
Broadmoor
Colorado Springs
Municipal
Airport
Gravel Pit
Gravel Pits
Sewage Disposal
Butts Airfield
North Side Reservoir
Hanna Reservoir
Limekiln
Valley
Hospital
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North Side Reservoir
Hanna Reservoir
Big Johnson Reservoir
Little Johnson Reservoir
Jimmy Camp Creek
Little Fountain Creek
Sewage Disposal
Gravel Pits
Hospital
Limekiln
Valley

Boone Creek

Biodiversity Rank: B4 (Moderate significance)
This PCA contains a fair (C-ranked) occurrence of a globally vulnerable (G3? SU) greasewood flats community (*Sarcobatus vermiculatus–Sporobolus airoides*).

Protection Urgency Rank: P2 (High urgency)
The PCA is located on Department of Defense property. The Department of Defense is considering options for turning their property over to another entity.

Management Urgency Rank: M3 (Moderate urgency)
Decommissioning activities on Pueblo Chemical Depot should consider maintaining existing intact portions of the greasewood occurrence in their current condition.

Location: Boone Creek PCA is located in north central Pueblo County within the Department of Defense's Pueblo Chemical Depot.

Legal Description: USGS 7.5 minute quadrangle: North Avondale. T20S R62W Sections 2, 3, 10, 11, 14, 15, and 22-27.

Size: 3,700 acres (1,498 hectares)

Elevation: 4,600 to 4,770 feet (1,400-1,455 meters).

General Description: The Boone Creek PCA contains over 1,550 acres (627 ha) of greasewood–alkali sacaton shrubland (*Sarcobatus vermiculatus/Sporobolus airoides*) occurring within a mosaic of shortgrass and sandsage prairie. The greasewood-alkali sacaton occurrence is a linear system occupying a wide shallow drainage associated with Boone Creek. Only after heavy rains will surface water be present; an alkaline salt crust occurs on the soil surface where water ponds after floods. Other vegetation occurring within the shrubland include rabbitbrush (*Chrysothamnus nauseosus*), cholla (*Cylindropuntia imbricata*), blue grama (*Bouteloua gracilis*), and galleta grass (*Hilaria jamesii*). On average, there is about 25 percent bare ground.

Small mammal trapping in the greasewood shrublands at Boone Creek resulted in the following species: deer mouse (*Peromyscus maniculatus*), kangaroo rat (*Dipodomys ordii*), western harvest mouse (*Reithrodontomys megalotis*), northern grasshopper mouse (*Onychomys leucogaster*), hispid cotton rat (*Sigmodon hispidus*), and woodrat (*Neotoma* sp.) (Colorado Natural Heritage Program 2001b). Four globally common species of tiger beetles present in the alkaline flats include *Cicindela circumpicta johnsonii, C. fulgida, C. nigrocoerulea*, and *C. punctulata* (P. Pineda, pers. comm., CSU).

Another significant ecological feature within the PCA is a bermed spring pond adjacent to Boone Creek. Vegetation around the pond includes cattail (*Typha* sp.) and bulrush (*Scirpus acutus*), surrounded by salt flats with saltgrass (*Distichlis spicata*), Baltic rush

(*Juncus balticus*), and foxtail barley (*Hordeum jubatum*). The spring and surrounding area has been invaded by non-native plant species including tamarisk (*Tamarix ramosissima*) and kochia (*Bassia sieversiana*). Wildlife using the spring includes native species (e.g., tiger salamander (*Ambystoma tigrinum*), painted turtle (*Chrysemys picta*), plains garter snake (*Thamnophis radix*), Red-winged Blackbird, Killdeer, damselflies and dragonflies) and non-native (e.g., bullfrogs (*Rana catesbeiana*)) (J. Gionfriddo, pers. comm. Colorado NHP).

The land history of the depot property is complex. From at least the early 1900's to 1941, the depot property was a mixture of private and state owned parcels with ranching as the primary use. In 1941, the Department of Defense acquired the land and by 1942 had built a munitions storage facility. In 1994, all but a small portion of the munitions was removed. Ammunition storage bunkers and a network of roads have been constructed through about half of the greasewood occurrence. The bunkers alter the composition and more weeds occur within this portion of the occurrence.

Grazing has been excluded from the bunker portion of the occurrence since 1942 and grazing was excluded from the remainder of the occurrence in 1998.

Biodiversity Rank Comments: This site contains a fair example (C-ranked) of a globally vulnerable (G3? SU) greasewood – alkali sacaton community (*Sarcobatus vermiculatus–Sporobolus airoides*).

Natural Heritage element occurrences at the Boone Creek PCA.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	Federal Sensitive	EO* Rank	Last Observed
Plant Communities								
Sarcobatus vermiculatus–Sporobolus airoides	Saline bottom shrublands	G3?	SU				C	2000-08-26

*EO = Element Occurrence

Boundary Justification: The boundary encompasses most of the greasewood occurrence and a portion of the surrounding shortgrass and sandsage prairie. The northern boundary of the PCA is the G-Block on PCD, where chemical munitions are stored.

Protection Rank Comments: All but a very small portion of Pueblo Chemical Depot is being decommissioned. The Department of Defense is studying various options for transferring the property to a new owner, potentially a conservation agency or organization willing to manage for native ecosystem values.

Management Rank Comments: Significant portions of the greasewood shrublands remain in relatively intact condition. The decommissioning activities of Pueblo Chemical Depot should take into consideration the maintenance of these portions in their intact condition. The potential for reestablishment of naturally-occurring large scale ecological processes such as fire and herbivory should be considered in management plans. A

proposed plant to destroy the chemical munitions is planned for the area east of G-block. Construction and maintenance of the plant may impact the Boone Creek PCA.

Soils Description: The soils are fine-grained and in some areas where surface water ponds an alkaline crust has developed.

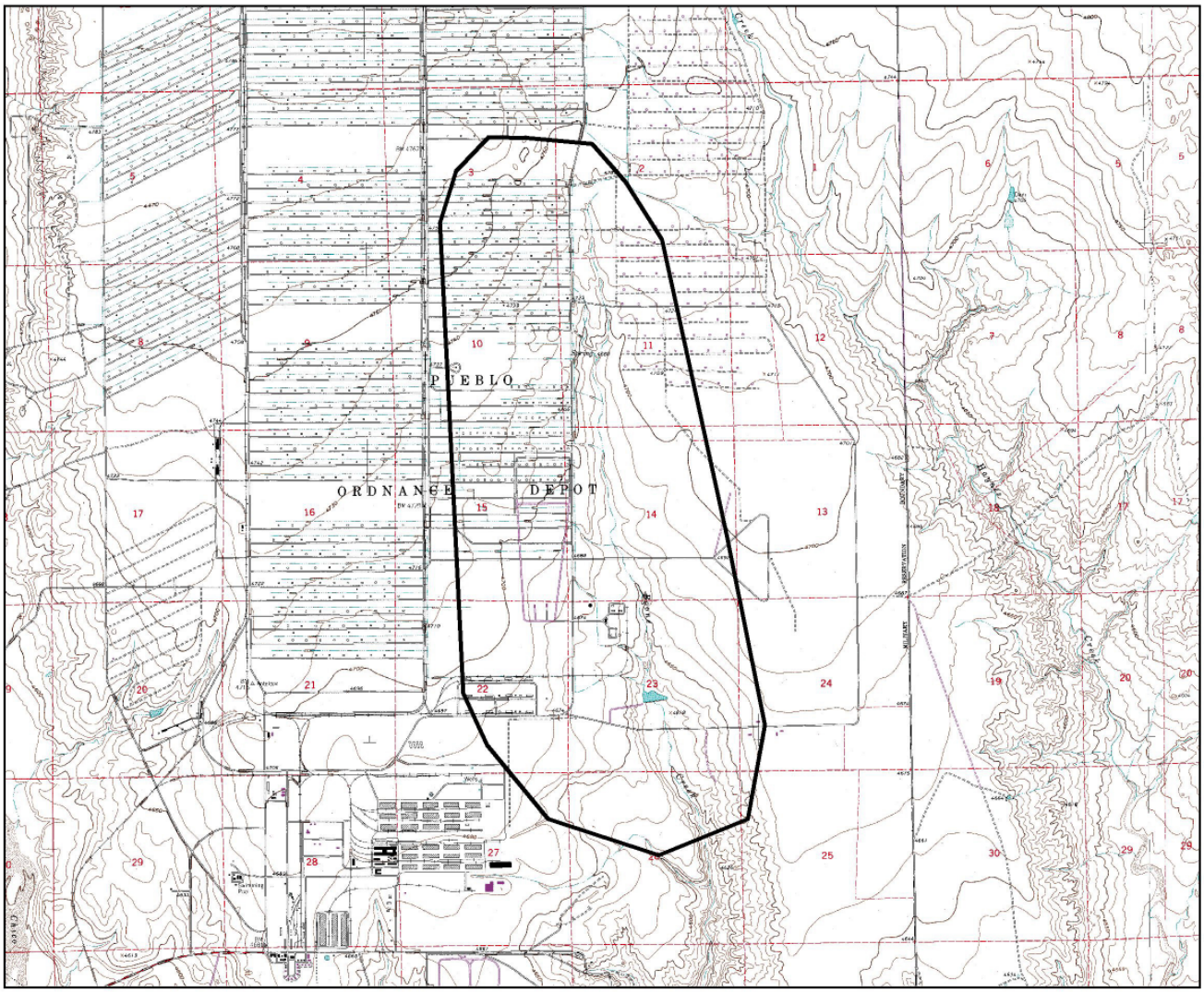
Wetland Functional Assessment for the Boone Creek PCA:
Proposed HGM Class: Mineral Soil Flats Subclass: F1
Cowardin System: Palustrine
CNHP's Wetland and Riparian Classification: *Sarcobatus vermiculatus/Sporobolus airoides*

Function	Rating	Comments
Overall Functional Integrity	At potential	
Hydrological Functions		
Flood Attenuation and Storage	N/A	This wetland is not on a stream channel
Sediment/Shoreline Stabilization	N/A	This wetland is not on a stream channel.
Groundwater Discharge/ Recharge	No	No evidence of groundwater recharge or discharge
Dynamic Surface Water Storage	Moderate	Nonchannelized sheetflow after precipitation events ponds in depressions within the greasewood shrubland.
Biogeochemical Functions		
Elemental Cycling	Normal	Cycling of elements within the wetland is probably low but normal for this type of wetland.
Removal of Imported Nutrients, Toxicants, and Sediments.	Low	Sparse vegetative cover and likely receives little or no input from upstream sources
Biological Functions		
Habitat Diversity	Low	Scrub-shrub wetland.
General Wildlife Habitat	Moderate	Upland wildlife species representative of greasewood shrublands and shortgrass prairie.
General Fish/Aquatic Habitat	N/A	No surface water.
Production Export/Food Chain Support	Low	Export is probably naturally low in greasewood flats.
Uniqueness	Moderate	Greasewood shrublands are globally vulnerable community type. Large stands are not common.

Restoration Potential: Opportunities include restoring large-scale ecological processes such as fire and herbivory and management of non-native species. Removal of storage bunkers and reestablishment of native vegetation would improve the size and quality of the occurrence.

Boone Creek

Potential Conservation Area



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The Colorado Natural Heritage Program
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Fax: (970) 491-3349

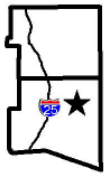
map date: 4 May 2001
GIS department: db

PCA Boundary

U.S.G.S. 7.5 Minute Quadrangle*
North Avondale, 38104-A3

*Digital Raster Graphics (DRGs) produced by the U. S. Geological Survey, 1996

Location in Project Area



Fountain and Jimmy Camp Creeks

Biodiversity Rank: B4 (Moderate significance)
This PCA contains an extant (E-ranked) example of Arkansas darter (*Etheostoma cragini*) a globally vulnerable (G3 S2) fish species.

Protection Urgency Rank: P2 (High urgency)
Changes in the hydrologic regime of Fountain Creek and development on the banks of Fountain and Jimmy Camp creeks have the potential to extirpate Arkansas darter from these reaches.

Management Urgency Rank: M2 (High urgency)
New management actions may be needed to prevent the loss of this species from these stream reaches.

Location: Portions of Fountain Creek and Jimmy Camp Creek in southern El Paso County. Fountain Creek north of the Williams Creek confluence to Fountain Creek Regional Park. Jimmy Camp Creek north from its confluence with Fountain Creek to the Colorado Springs Airport.

Legal Description: USGS 7.5 minute quadrangles: Elsmere, Fountain, Buttes, Fountain SE. T14S R65W Sections 34 and 35; T15S R65W Sections 2, 3, 10, 11, 14, 15, 22, 23, 26-28, and 30-34; T15S R66W Sections 25 and 36; T16S R65W Sections 4-8, 17, 20, 21, 28, 29, 32, and 33; T17S R65W Sections 3, 4, 9-11, 13-15, 23, and 24.

Size: 5,221 acres (2,113 hectares).

Elevation: 5,240 to 5,900 feet (1,597 to 1,798 meters)..

General Description: Fountain Creek Watershed comprises 927 square miles and includes portions within eleven governmental jurisdictions (Monument, Palmer Lake, Fountain, Woodland Park, Manitou Springs, Green Mountain Falls, City and County of Pueblo, Colorado Springs, Teller County, and El Paso County). The Colorado Division of Wildlife has documented Arkansas darter, a globally vulnerable (G3 S2) small plains fish, in two reaches of Fountain Creek. This PCA encompasses the more northerly occurrence of the two Fountain Creek occurrences of Arkansas darter.

Arkansas darter (*Etheostoma cragini*) occur within the riparian corridor of Fountain Creek between Williams Creek north to the between the towns of Widefield and Fountain (Colorado Division of Wildlife 2001b). Additionally, Arkansas darter occur within the Jimmy Camp Creek riparian corridor north to the Colorado Springs Airport (Colorado Division of Wildlife 2001b). Arkansas darter are a small eastern plains fish native to streams in the Arkansas River basin and are known to inhabit small, shallow, clear streams that are often spring-fed and have sandy substrates, slow current, cooler water, and aquatic vegetation (Nesler et al. 1999). In Fountain and Jimmy Camp creeks,

Arkansas darters are probably most abundant in spring-fed marshes adjacent to the creeks. Other fish species that have been documented to occur with the Arkansas darter include fathead minnow (*Pimephales promelas*), flathead chub (*Platygobio gracilis*), longnose dace (*Rhinichthys cataractae*), and brook stickleback (*Culaea inconstans*) (Colorado Division of Wildlife 2001d).

Flooding and streambank erosion along Fountain Creek increased dramatically in recent years probably degrading the Arkansas darter habitat (G. Dowler, pers. comm., CDOW). Factors contributing to increased streamflows include an increase in hard surfaces (e.g., roads, rooftops, parking lots) and an increase in the volume of wastewater treatment plant discharge into Fountain Creek (Pikes Peak Area Council of Governments 1997). Hard surfaces prevent rainfall from soaking into the ground and discharging slowly to the creek. Instead, rainwater is collected in concrete culverts and delivered directly into the creeks. In addition, billions of gallons of water imported from basins west of the Continental Divide to supply demands of a growing population, ultimately discharge to Fountain Creek as treated wastewater. Higher flows translate to increased erosion and flooding, accelerating the loss of wetland habitat. Pikes Peak Area Council of Governments (PPACAG) and Pueblo Area Council of Governments (PACAG) are coordinating preparation of the Fountain Creek Watershed Plan (www.fountain-crk.org) to address issues of watershed health.

Reaches of Fountain Creek support a riparian forest of plains cottonwood with coyote willow. Unfortunately, Russian olive (*Elaeagnus angustifolia*), crack willow (*Salix fragilis*), and tamarisk (*Tamarix ramosissima*), all invasive exotic species, comprise much of the vegetative cover and thus contribute to ecosystem degradation. However, the riparian vegetation provides important habitat for a range of bird species and is an important migration corridor along the Front Range. In fact, Fountain Creek Regional Park, located within the PCA, has been designated by the National Audubon Society as an Important Bird Area (IBA) of Colorado (Cafaro 2000). The IBA designation is based on the area providing essential wetland habitat and resources for resident and migrant species. Observers have recorded over 250 bird species in the park. A Great Blue Heron rookery supporting over 50 pair is located in the riparian area. Also documented as breeding within the Fountain Creek riparian area are Bullock's Oriole and Swainson's Hawk (Cafaro 2000). Other wildlife known in the riparian area include beaver, muskrat, and white-tailed deer. A bike trail runs along portions of Monument and Fountain Creeks and interpretive programs focusing on hands-on environmental education occur within Fountain Creek Regional Park.

Biodiversity Rank Comments: This site contains an extant (E-ranked) occurrence of a globally vulnerable (G3 S2) fish, the Arkansas darter (*Etheostoma cragini*).

Natural Heritage element occurrences at the Fountain and Jimmy Camp Creeks PCA.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	Federal Sensitive	EO* Rank	Last Observed
Fish								
Etheostoma cragini	Arkansas darter	G3	S2	C	T	FS	E	

*EO = Element Occurrence

Boundary Justification: The boundary encompasses the reaches of Fountain and Jimmy Camp creeks considered occupied Arkansas darter habitat by the Colorado Division of Wildlife (Colorado Division of Wildlife 2001b). The PCA could be expanded to include a greater proportion of the upstream watershed to ensure maintenance of the ecological and hydrological processes necessary to support the Arkansas darter population.

Protection Rank Comments: The land is primarily privately owned with a portion managed by El Paso County Parks as Fountain Creek Regional Park. Residential and industrial development is occurring within the watershed and on creek banks at a rapid pace, decreasing the creek's natural ability to accommodate flooding. Recent flooding (e.g., April/May 1999) along Fountain Creek has been known to remove large acreages of wetlands and adjacent riparian habitat. Another issue within the Fountain Creek Watershed is water quality with increased point source and non-point source loading to the creek.

Management Rank Comments: Group efforts at devising management strategies for the Fountain Creek watershed are underway. The principal issues are flooding and streambank erosion, sedimentation, and water quality degradation.

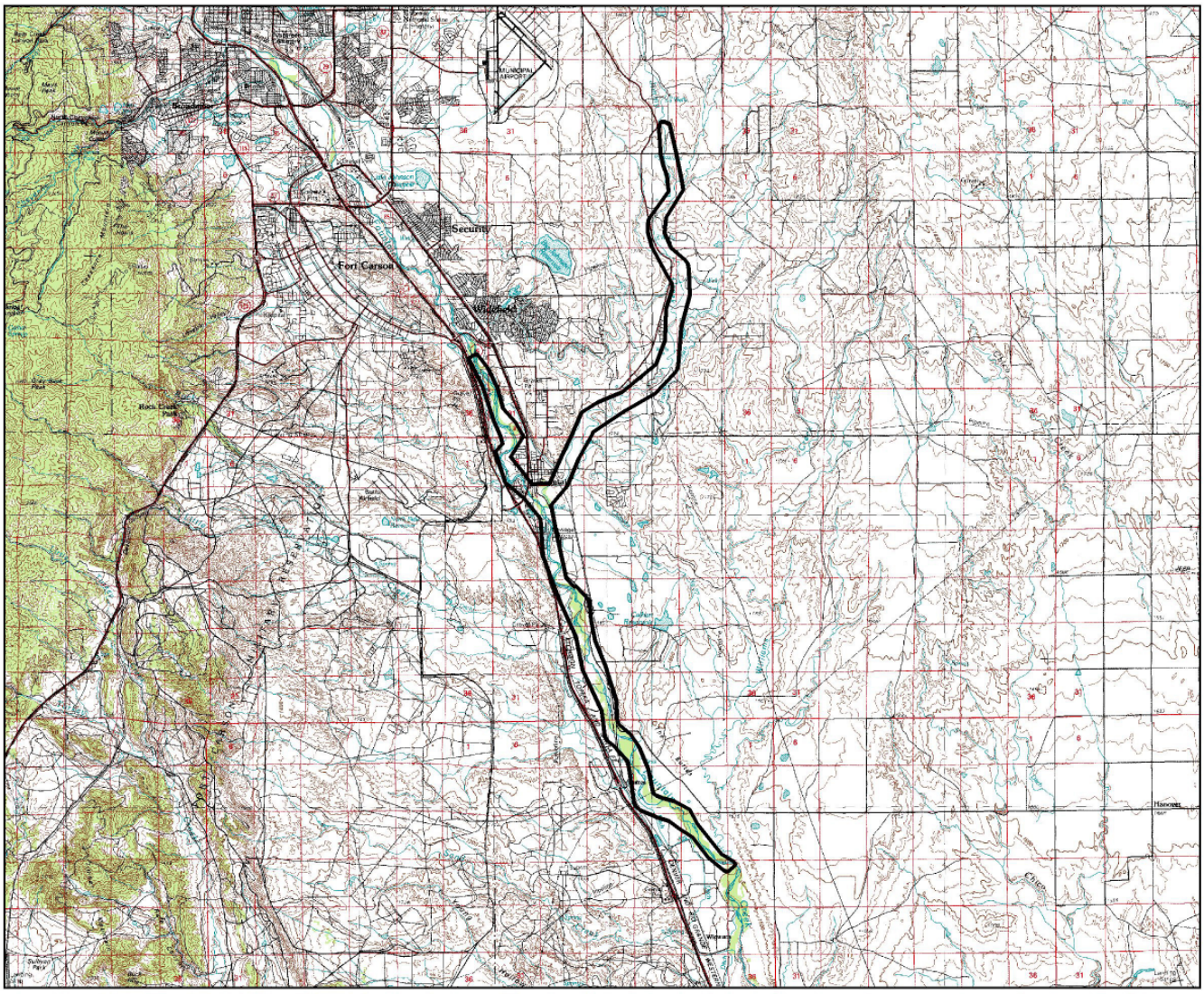
Soils Description: Soils were not described at this site.

Wetland Functional Assessment for the Fountain and Jimmy Camp Creeks PCA:
Proposed HGM Class: Riverine Subclass: R5
Cowardin System: Palustrine.
The creek provides fish habitat as indicated by its ability to support a population of the Arkansas darter. The darter population has likely declined in viability and may continue to decline with increased urbanization and subsequent stormwater runoff and streambank erosion. Increased non-point and point source pollution may also alter nutrient cycles. The area does provide good avian habitat as indicated by the diversity of birds observed here. However, the bird habitat has also likely declined with loss of overstory resulting from bank erosion during floods.

Restoration Potential: Restoration of Fountain Creek to its natural condition would be difficult to attain given the extreme streamflows and the degree of urbanization within the watershed. The Fountain Creek Watershed Plan (www.fountain-crk.org) is identifying critical issues and solution strategies associated with managing the watershed.

Fountain and Jimmy Camp Creeks

Potential Conservation Area



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The Colorado Natural Heritage Program
Colorado State University
254 General Services Bldg
Fort Collins, CO 80523
Fax: (970) 491-3349

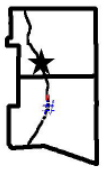
map date: 10 May 2001
GIS department: db

PCA Boundary

U.S.G.S. 30x60 Minute Quadrangle*
Colorado Springs, 38104-E1

*Digital Raster Graphics (DRGs) produced by the U. S. Geological Survey, 1996

Location in Project Area



Fountain Creek Springs at Pinon

Biodiversity Rank: B4 (Moderate significance)
This PCA contains a fair (C-ranked) example of a globally vulnerable (G3 S2S3) Great Plains bulrush marsh community (*Scirpus tabernaemontani – Scirpus acutus*).

Protection Urgency Rank: P2 (High urgency)
The wetlands are privately owned and the landowner is currently considering different management options.

Management Urgency Rank: M3 (Moderate urgency)
The marsh is relatively self-sustaining. Modifications of the wetlands and introduction of non-native plant and fish species should be discouraged.

Location: Fountain Creek Springs at Pinon PCA is located on the west bank of Fountain Creek near the Pinon Rest Stop on Interstate 25.

Legal Description: USGS 7.5 minute quadrangle: Pinon. T18S R64W Sections 7 and 18; T18S R65W Sections 12 and 13.

Size: 207 acres (84 hectares).

Elevation: 5,100 to 5,120 feet (1,550 to1,560 meters).

General Description: A spring-fed marsh on the west bank of Fountain Creek supports about 25 acres of Nebraska sedge (*Carex nebrascensis*) (G4 S3) and 5 acres of bulrush (*Scirpus tabernaemontani – Scirpus acutus*) (G3 S2S3). The bulrush occurs in the wettest area and surrounds small open water ponds. The ponds support small fishes and frogs. Birds observed within the wetland include Mallard, American Avocet, Green Heron, and Red-winged Blackbird. The marsh has been drained in the past to provide pasture for grazing; however, the native community returns despite the attempts at alteration.

The bulrush portion of the wetland also supports cattail (*Typha angustifolia*), spikerush (*Eleocharis* sp.), duckweed (*Lemna minor*), speedwell (*Veronica* sp.), water parsnip (*Berula erecta*). Watercress (*Nasturtium officinale*), generally considered a Eurasian species (CNHP, 2001), also grows in the ponds. The sedge meadow portion of the wetland also supports threesquare bulrush (*Scirpus pungens*), Baltic rush (*Juncus balticus*), spikerush (*Eleocharis* sp.), saltgrass (*Distichlis spicata*), western wheatgrass (*Pascopyrum smithii*), and foxtail barley (*Hordeum jubatum*). The sedge meadow has been seeded in the past to increase the forage value and clover (*Trifolium pratense*) makes up about 5 percent cover in the drier portions of the meadow.

Fountain Creek supports a broken band of plains cottonwood with coyote willow (*Populus deltoides –(Salix amygdaloides)/Salix exigua*) heavily invaded by tamarisk and

Russian olive, two non-native species. Flooding within the creek has changed the riparian vegetation lately, removing some of the cottonwood forest and widening and downcutting the banks. Irrigated agriculture occurs along the creek within about a mile band. Privately operated and maintained ditches divert the creek to the irrigated fields.

Biodiversity Rank Comments: This site contains a fair (C-ranked) occurrence of a globally vulnerable (G3 S2S3) bulrush wetland (*Scirpus tabernaemontani-Scirpus acutus*).

Natural Heritage element occurrences at the Fountain Creek Springs at Pinon PCA.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	Federal Sensitive	EO* Rank	Last Observed
Plant Communities								
Scirpus tabernaemontani-Scirpus acutus	**Great Plains marsh**	**G3**	**S2S3**				**C**	**2000-07-14**
Carex nebrascensis	Wet meadow	G4	S3				C	2000-07-14

*EO = Element Occurrence Note: Element occurrence responsible for the B-rank is shown in bold typeface.

Boundary Justification: The boundary encompasses the wetland and a small amount of the surrounding uplands on the west bank of Fountain Creek. The groundwater recharge area for the creek probably includes the Fountain Creek floodplain and may include Youngs Hollow to the west. The recharge area for the springs is not included within the PCA.

Protection Rank Comments: The land is privately owned by one primary owner.

Management Rank Comments: The landowner runs a small farm/ranch and needs to devise a way to earn income from the wetland. Options under consideration include harvesting wetland plant seed and enhancing the wetland for duck hunting. Funding associated with conservation may be an option considered by the landowner.

Soils Description: The bulrush portion of the wetland has black, sulfurous, organic-rich soils overlying silty clay (10YR 2/2). The sedge meadow portion of the wetland has silty clay soil, with gleying and mottles (10YR 3/3).

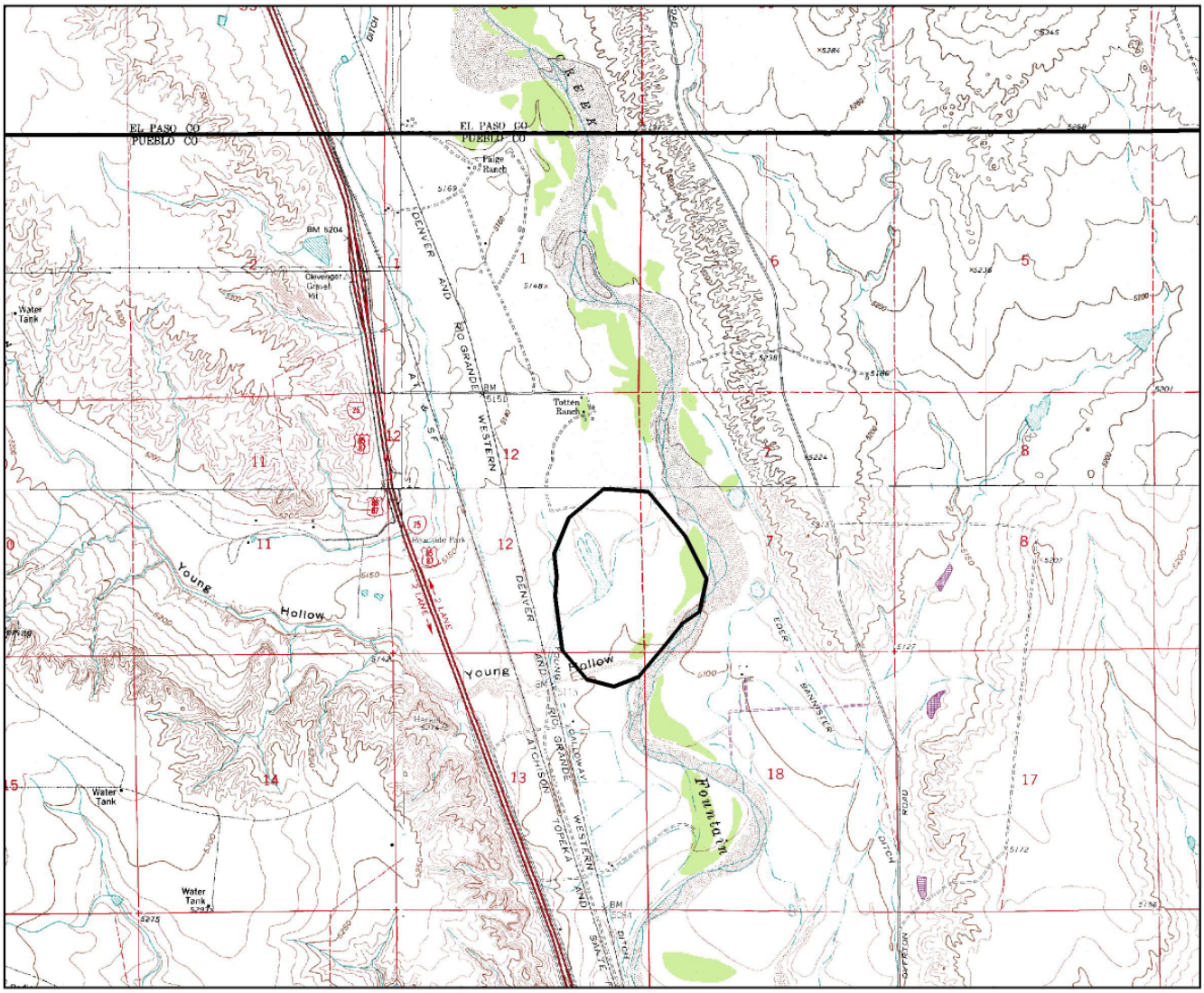
Wetland Functional Assessment for the Fountain Creek Springs at Pinon PCA:
Proposed HGM Class: Depressional Subclass: D2
Cowardin System: Palustrine.
CNHP's Wetland Classification: *Scirpus tabernaemontani-Scirpus acutus* and *Carex nebrascensis*.

Function	Rating	Comments
Overall Functional Integrity	At potential	
Hydrological Functions		
Flood Attenuation and Storage	High	The depressional wetland is within the floodplain of Fountain Creek and floods via overbank flow during extreme high flow events.
Sediment/Shoreline Stabilization	N/A	The wetland is not on a channel.
Groundwater Discharge/ Recharge	Yes	Groundwater discharge zone. Spring discharges to open water ponds and flows towards Fountain Creek.
Dynamic Surface Water Storage	N/A	
Biogeochemical Functions		
Elemental Cycling	Moderate	Sulfurous organic-rich sediments and permanent surface water indicate intact elemental cycling.
Removal of Imported Nutrients, Toxicants, and Sediments.	Moderate	Dense vegetation and fine-grained sediment indicate high potential for removal of constituents, however, input from upstream sources is probably low. Wetland is highly vegetated. Fine-grained sediment.
Biological Functions		
Habitat Diversity	High	Emergent wetland, aquatic bed, and open water habitat. Wetland is within 1000 feet of Fountain Creek and its forested riparian corridor.
General Wildlife Habitat	High	Waterfowl probably use the wetland seasonally. Excellent vegetative cover. Mallard, Green Heron, Red-winged Blackbird, American Avocet, and frogs observed in the wetland. Deer and elk use adjacent Fountain Creek.
General Fish/Aquatic Habitat	Moderate	Observed small fishes in the isolated pools. Dragonflies and damselflies abundant.
Production Export/Food Chain Support	Moderate	Dense vegetation with high sustained productivity indicate food chain support. Production export is probably low as there is no sustained flow to Fountain Creek.
Uniqueness	Moderate	Only large bulrush/sedge wetland noted in El Paso and Pueblo counties. Attempts to modify the wetland (e.g., drain, seed with pasture species) have been unsuccessful and the wetland vegetation reestablishes itself.

Restoration Potential: Control and eradication of tamarisk and Russian olive would benefit the ecological health of the wetland community.

Fountain Creek Springs at Pinon

Potential Conservation Area



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Fax: (970) 491-3349

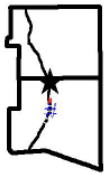
map date: 10 May 2001
GIS department: db

PCA Boundary

U.S.G.S. 7.5 Minute Quadrangle*
Pinon, 38104-D5

*Digital Raster Graphics (DRGs) produced by the U. S. Geological Survey, 1996

Location in Project Area



Huerfano River at Cedarwood

Biodiversity Rank: B4 (Moderate significance)
This PCA contains a good (B-ranked) example of a globally secure (G4? S3) plains cottonwood riparian woodland (*Populus deltoides – (Salix amygdaloides)/Salix exigua*). This is the best Pueblo County occurrence of this riparian community observed during the year 2000 field season.

Protection Urgency Rank: P3 (Moderate urgency)
No threat known for foreseeable future; however, no conservation strategy is in place and development is occurring on adjacent lands.

Management Urgency Rank: M4 (Low urgency)
Current management appears adequate for maintenance of the element occurrence. Issues include maintenance of the upstream hydrology (maintain natural flooding regime) and non-native invasive plant species within the river canyon, specifically tamarisk. The density of tamarisk is currently low within the element occurrence and may increase without management.

Location: Huerfano River at Cedarwood PCA is located about 20 miles south of Pueblo near the Huerfano County line.

Legal Description: USGS 7.5 minute quadrangles: Cedarwood, Graneros Flats. T24S R65W Section 36; T25S R65W Sections 1-3; and unsurveyed Township Range.

Size: 1,850 acres (748 hectares).

Elevation: 5,100 to 5,470 feet (1,554 to 1,667 meters).

General Description: The Huerfano River at Cedarwood PCA encompasses about six miles of the Huerfano River and the surrounding canyon walls near the Huerfano/Pueblo County line. In this reach, the Huerfano is an ephemeral plains stream winding through a canyon cut through about 600 feet of desert varnished Dakota Sandstone. The sandy/gravelly stream channel varies in width from about 15 to 30 feet and the canyon bottom up to 600 feet. Plains cottonwood and coyote willow (*Populus deltoides*-(*Salix amygdaloides)/Salix exigua*) (G4? S3) grow in scattered bands along the stream with a rather continuous band of threesquare bulrush (*Scirpus pungens*) immediately adjacent to the channel. The plains cottonwood rarely forms dense cover and a variety of age classes are represented. In some areas, there is a shrubby band of American licorice (*Glycyrrhiza lepidota*) on the banks. Tamarisk (*Tamarix ramosissima*) and Russian olive (*Elaeagnus angustifolia*), invasive non-native species, are present within the channel but only in small amounts and rarely form dense cover. Side canyons can contain interesting spring-fed pools, some over five feet deep with thick aquatic plants and cattails (*Typha* sp.) on the banks.

In September, the streambed was dry in most sections with some sections of moist sand and others with flowing water emerging and resubmerging further downstream. Flowing water sections and pools contained many small fishes, garter snakes (*Thamnophis radix*), and aquatic insects including mayfly nymphs, dragonfly nymphs, water striders, and toad bugs.

Some of the stream banks are heavily grazed and have thick cover of rabbitbrush (*Chrysothamnus nauseosus*). In other places, shrubs within the riparian zone include skunkbrush (*Rhus trilobata*), golden currant (*Ribes aureum*), snowberry (*Symphoricarpos* sp.), wild grape (*Vitis riparia*), chokecherry (*Padus virginiana*), and mountain mahogany (*Cercocarpus montanus*).

Further downstream, the cover of Russian olive and tamarisk increase as well as other non-native plant species.

The canyon walls are vegetated with one-seeded juniper (*Juniperus monosperma*), pinyon pine (*Pinus edulis*), and mountain mahogany, with ponderosa pine (*Pinus ponderosa*) on the north-facing slope. The mesas atop the canyon walls are a mixture of shortgrass prairie and juniper woodlands.

The PCA is within the 150,000-acre Vigil and St. Vrain PCA, which encompasses several good occurrences of juniper woodlands and shortgrass prairie within a relatively intact landscape. The Huerfano at Cedarwood PCA contains a portion of the Hatchett Ranch, a large ranch that has recently been subdivided into 35-acre ranchettes.

Upstream from the PCA, near Interstate 25, the Huerfano River is used for irrigated agriculture and thick stands of Russian olive and tamarisk occur with the cottonwood. Downstream from the PCA, the cover of Russian olive and tamarisk increase. There are no major dams on the stream.

Biodiversity Rank Comments: The site contains a good (B-ranked) example of an apparently secure (G4? S3) plains cottonwood riparian woodland, plains cottonwood with peachleaf willow and coyote willow (*Populus deltoides-(Salix amygdaloides)/Salix exigua*). Good examples of this plant community are rarely encountered.

Natural Heritage element occurrences at the Huerfano River at Cedarwood PCA.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	Federal Sensitive	EO* Rank	Last Observed
Plant Communities								
Populus deltoides ssp monilifera–(Salix amygdaloides)/Salix exigua	Plains cottonwood riparian woodland	G4?	S3				B	2000-09-10

*EO = Element Occurrence

Boundary Justification: The boundary encompasses the community occurrence and a portion of the river and riparian area upstream and downstream from the occurrence. The boundary could be extended farther downstream; however, the incidence of non-native

invasive plants (e.g., tamarisk and Russian olive) increase downstream. The PCA could be expanded to include a greater proportion of the upstream watershed to ensure maintenance of the ecological and hydrological processes including periodic flooding.

Protection Rank Comments: The land within the PCA is privately owned and is primarily used as cattle ranches. Immediately to the west is part of the Hatchett Ranch and has been subdivided and sold as ranchettes. Given the proximity to Pueblo, this area could be targeted for increased subdivision and development.

Management Rank Comments: The riparian area and canyon are actively grazed by cattle. Grazing management within the canyon could benefit the community element occurrence. Management of tamarisk and Russian olive would improve the riparian plant community from a natural heritage perspective.

Soils Description: Soils along the creek consisted of coarse alluvium with a high density of sand and gravel in the streambed. General soil colors were 10YR 5/4.

Wetland Functional Assessment for the Huerfano River at Cedarwood PCA:
Proposed HGM Class: Riverine Subclass: R5
Cowardin System: Palustrine.
CNHP's Wetland Classification: *Populus deltoides* ssp. *monilifera-(Salix amygdaloides)/Salix exigua*.

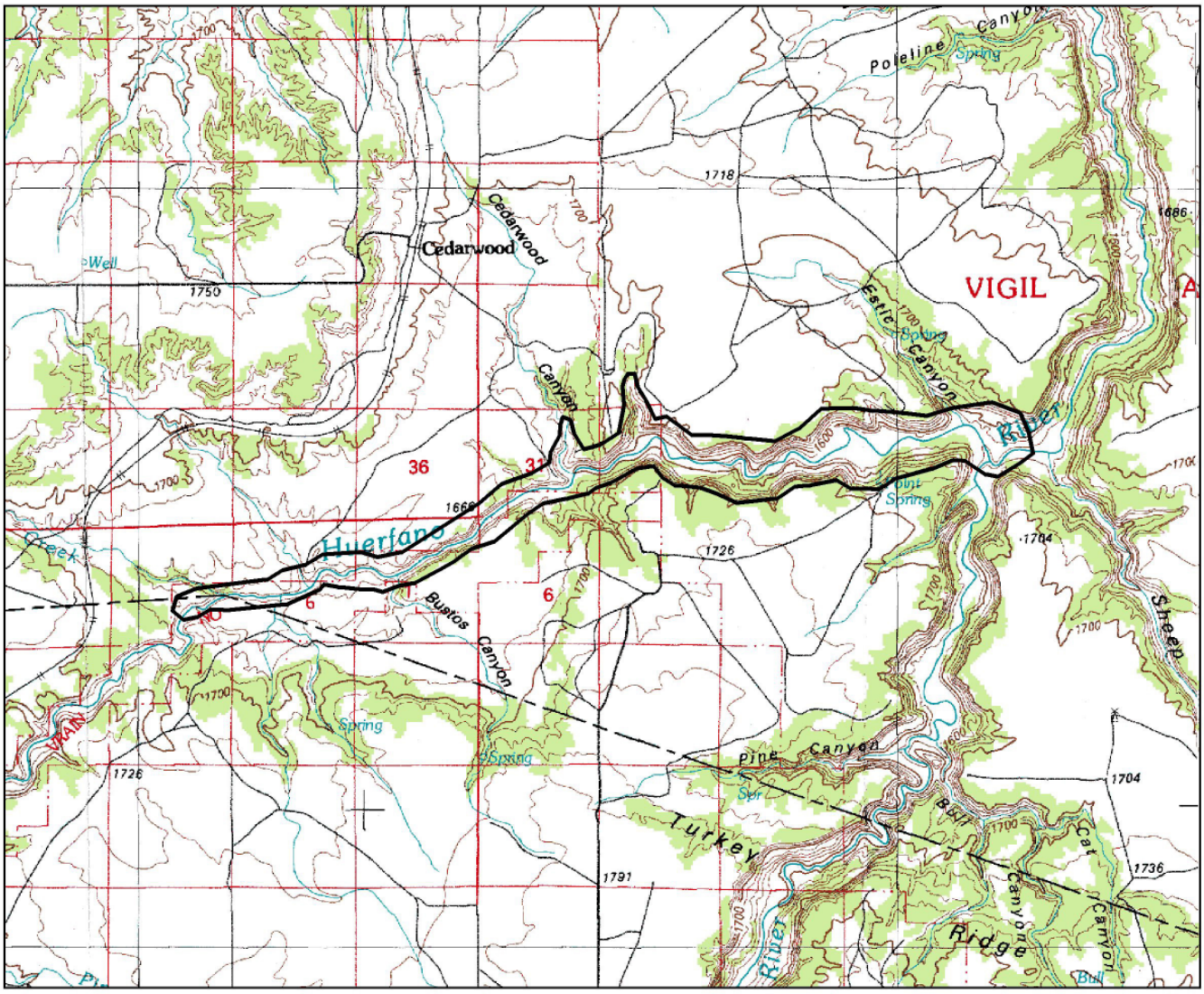
Function	Rating	Comments
Overall Functional Integrity	At potential	
Hydrological Functions		
Flood Attenuation and Storage	Moderate	The canyon is fairly narrow and thus limits flood storage potential. Low density of woody and herbaceous vegetative cover along the river and downcutting of the stream channel also minimize flood attenuation potential.
Sediment/Shoreline Stabilization	Moderate	Some downcutting of stream banks has occurred which probably results in downstream movement of sediment during high flow events. Channel incision has caused some steep banks to develop not allowing vegetation to establish. Other areas appear densely vegetated.
Groundwater Discharge/ Recharge	Yes	Sandy creek bottom recharges local groundwater system during high flow events as indicated by periodic infiltration of the stream into the streambed. Springs in side canyons and intermittent flowing reaches during late summer indicate groundwater discharge occurs.
Dynamic Surface Water Storage	N/A	Flooding at this site is primarily due to overbank or in-channel flow.
Biogeochemical Functions		
Elemental Cycling	Low	This stream has naturally low vegetative cover and sand/gravel stream bottom. Elemental cycling is probably low but functioning at potential for this wetland type. The small amount of tamarisk is probably locally disrupting the natural nutrient cycles via salinization of the soil.
Removal of Imported Nutrients, Toxicants, and Sediments.	Low	Imported nutrients, toxicants, and sediments are probably minimal due to lack of vegetation cover and ephemeral source of water
Biological Functions		
Habitat Diversity	Moderate	There are woodland (cottonwood), shrubland (willow and tamarisk), and open water (very small ponds within channel and in side canyons) wetland habitats.
General Wildlife Habitat	Moderate	The canyon has large areas of relatively low percent cover vegetation. Garter snakes were abundant in ponded portions of the river. Songbirds present in the canyon.
General Fish/Aquatic Habitat	Moderate	Observed small fishes in the isolated pools and deep pools in side canyon. Observed aquatic invertebrates included mayfly nymphs, odonate nymphs, water striders, and toad bugs. Agricultural diversion upstream from the occurrence may decrease water available to fish populations.
Production Export/Food Chain Support	Moderate	The river is ephemeral, has a sandy bottom, and undergoes seasonal flooding thus limiting the potential for export of carbon sources to downstream areas. Local ponded areas support invertebrate populations and thus provide good food chain support

Uniqueness	Moderate	Two similar sized streams in Pueblo County (St. Charles River and Greenhorn Creek) are completely diverted for human uses prior to reaching the plains. This reach of the Huerfano is notable in that there is no upstream dam, agricultural use is the only significant upstream use, and tamarisk does not dominate. Further downstream (closer to the Arkansas River), the Huerfano is heavily infested with tamarisk.

Restoration Potential: Alter grazing management to benefit the ecological health of the riparian area. Fences could be used to keep livestock out of important aquatic areas (e.g., the ponded areas). Control and eradication of tamarisk and Russian olive is necessary to maintain community integrity.

Huerfano River at Cedarwood

Potential Conservation Area



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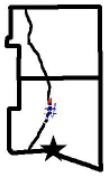
map date: 10 May 2001
GIS department: db

PCA Boundary

U.S.G.S. 30x60 Minute Quadrangle*
Walsenburg, 37104-E1

*Digital Raster Graphics (DRGs) produced by the U. S. Geological Survey, 1996

Location in Project Area



Rasner Ranch Playas

Biodiversity Rank: B4 (Moderate significance)
This PCA contains a fair (C-ranked) example of a globally vulnerable (G3 S3) plant species (*Ambrosia linearis*).

Protection Urgency Rank: P3 (Moderate urgency)
Most of the PCA occurs within leased State Land Board property.

Management Urgency Rank: M3 (Moderate urgency)
One management concern is use of herbicides and its affect on the rare plant.

Location: The extreme southwest corner of El Paso County, northwest of the "four corners" area of Pueblo, Crowley, Lincoln, and El Paso counties on the Rasner Ranch.

Legal Description: USGS 7.5 minute quadrangle: Truckton SE. T17S R60W Sections 25, 35, and 36.

Size: 435 acres (176 hectares).

Elevation: 5,220 to 5,280 feet (1,591 to 1,609 meters).

General Description: This PCA and the surrounding landscape consist of predominantly flat to somewhat rolling shortgrass prairie. Much of the area has been converted to agricultural fields for alfalfa. At least three playas or playa-like depressions are also present within the PCA. One of these was visited on July 19, 2000 and found to contain a fair (C-ranked) occurrence of the plains ambrosia (*Ambrosia linearis*). This playa, in the southwestern portion of the PCA is somewhat large and has not been excavated for watering cattle, unlike many playas in the county. One small portion of the playa contained standing water when visited. Most of the plains ambrosia individuals were found around the margin of this playa, with a few scattered plants on the floor of the playa. 198 plants were counted in 1/2 hour of searching at this location. Associated species include many common playa species such as buffalograss (*Buchloe dactyloides*), prairie coneflower (*Ratibida tagetes*), frog-fruit (*Phyla cuneifolia*), and the non-native verbena (*Verbena bracteata*). Upland species in the surrounding area include three awn (*Aristida purpurea*), old plainsman (*Hymenopappus tenuifolius*), and yellow-spined thistle (*Cirsium ochrocentrum*). This PCA also contains habitat that appears suitable for the Mountain Plover.

The plains ambrosia was also observed on the roadside of the access road running southeast from the ranch compound.

Biodiversity Rank Comments: This PCA contains a fair (C-ranked) occurrence of the globally vulnerable (G3 S3) plains ambrosia (*Ambrosia linearis*). It also includes

suitable habitat for Mountain Plover (*Charadrius montanus*), although this does not affect the biodiversity rank of this PCA.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	Federal Sensitive	EO* Rank	Last Observed
Plants								
Ambrosia linearis	Plains ambrosia	G3	S3			FS	C	2000-07-19

*EO = Element Occurrence

Boundary Justification: The boundary of this PCA is drawn to include the known population of plains ambrosia, as well as additional suitable habitat for this species. These areas also appear suitable for the Mountain Plover.

Protection Rank Comments: Section 36, in which most of the PCA resides, is state land leased for cattle ranching. As such it is currently protected from residential development that has impacted may other playa areas in El Paso County. The surrounding sections are privately owned.

Management Rank Comments: It is uncertain how the plains ambrosia responds to the use of herbicides intended to improve forage quality for cattle grazing. Until research has demonstrated that they do not harm plains ambrosia, it is presumed that aerial spraying may have a negative impact on this species. Avoiding the use of these substances in and around playas may help ensure the persistence of the plains ambrosia in this PCA.

No exotic species appear to threaten the occurrence of plains ambrosia in this PCA at this time. Annual weeds, particularly kochia (*Bassia sieversiana*), yellow sweet clover (*Melilotus officinale*) and Russian thistle (*Salsola iberica*) are common in the PCA. Grazing intensity in the PCA is moderate to heavy.

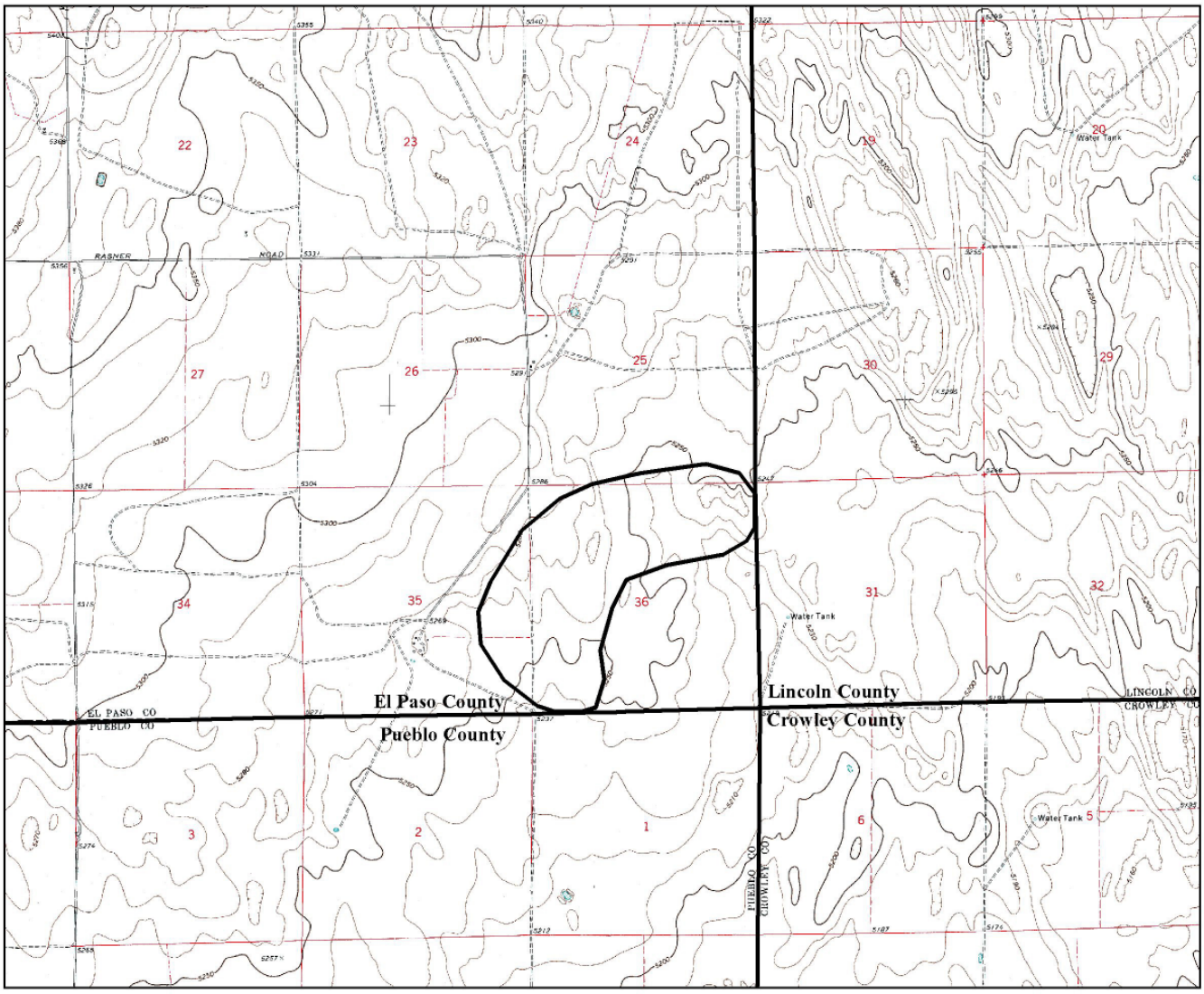
Soils Description: Soils were not described at this site.

Wetland Functional Assessment for the Rasner Ranch Playas PCA:
Proposed HGM Class: Depression Subclass: D5
Cowardin System: Palustrine.
CNHP's Wetland Classification: *Buchloe dactyloides-Ratibida tagetes-Ambrosia linearis*.
The playas collect surface flow after heavy precipitation events and thus provide some surface water storage. Elemental cycling is probably unique from that which occurs in nearby uplands due to the fine-textured soils and periodic saturation of those soils and thus provide important local biogeochemical functions. Seasonally wet playas may support frog/toad populations and aquatic invertebrates associated with temporary pools.

Restoration Potential: Currently most of the site is in relatively good condition. Should continue to monitor the playa for increases in non-native species.

Rasner Ranch Playas

Potential Conservation Area



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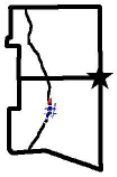
map date: 10 May 2001
GIS department: db

PCA Boundary

U.S.G.S. 7.5 Minute Quadrangle*
Truckton SE, 38104-E1

*Digital Raster Graphics (DRGs) produced by the U. S. Geological Survey, 1996

Location in Project Area



Sixmile Creek

Biodiversity Rank: B4 (Moderate significance)
This PCA contains an extant (E-ranked) population of Arkansas darter (*Etheostoma cragini*) a globally vulnerable (G3) state imperiled (S2) fish species.

Protection Urgency Rank: P1 (Very high urgency)
A sand and gravel mining operation has recently been proposed within a mile of Sixmile Creek. The mining operation could potentially alter the hydrologic regime supporting the fish population and contribute additional sediment load to the creek. The land within the PCA is privately owned and within the belt of irrigated agricultural land along the Arkansas River.

Management Urgency Rank: M3 (Moderate urgency)
Current management appears to be adequate to maintain the element occurrence; however, the population is not well understood and perhaps management actions could benefit the population.

Location: Sixmile Creek PCA is south of the Arkansas River between the towns of Vineland and Avondale.

Legal Description: USGS 7.5 minute quadrangle: Vineland. T21S R63W Sections 1, 11-14, 22-27, 34, and 35

Size: 1,668 acres (675 hectares).

Elevation: 4,520 to 4,700 feet (1,378 to 1,433 meters).

General Description: Sixmile Creek is a tributary to the Arkansas River located between the towns of Vineland and Avondale. The creek has been documented by the Colorado Division of Wildlife to support Arkansas darter (*Etheostoma cragini*) (G3 S2), a globally imperiled small plains fish (Colorado Division of Wildlife 2001b). The Arkansas darter is a small eastern plains fish native to streams in the Arkansas River basin and is known to inhabit small, shallow, clear streams that are often spring-fed and have sandy substrates, slow current, cooler water, and aquatic vegetation (Nesler et al. 1999).

The Arkansas darter have been documented in about a six-mile reach of the creek from the confluence with the Arkansas River upstream about to where Bessemer Ditch crosses the creek. Bessemer Ditch is an irrigation canal transporting Arkansas River water from the base of Pueblo Reservoir to the Huerfano River and supplying farmers along the south bank of the Arkansas River.

The source of the water in the creek is not well understood. Springs may discharge to Sixmile Creek creating the wetland habitat and ponds or the water may be leakage from

Bessemer Ditch. In addition, the Arkansas darter population is also not well understood with few individuals located on multiple sampling events.

Vegetation within a marsh just below the Bessemer Ditch crossing includes threesquare bulrush (*Scirpus pungens*), cattail (*Typha* sp.), Baltic rush (*Juncus balticus*), mixed grasses. Non-native plants within the marsh include Canada thistle *(Breea arvensis*) and Russian olive (*Elaeagnus angustifolia*).

Biodiversity Rank Comments: This site contains an extant (E-ranked) population of a globally vulnerable (G3 S2) fish, the Arkansas darter (*Etheostoma cragini*).

Natural Heritage element occurrences at the Sixmile Creek PCA.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	Federal Sensitive	EO* Rank	Last Observed
Fish								
Etheostoma cragini	Arkansas darter	G3	S2	C	T	FS	E	1994-06-02

*EO = Element Occurrence

Boundary Justification: The boundary encompasses the reach of Sixmile Creek considered occupied Arkansas darter habitat by the Colorado Division of Wildlife (Colorado Division of Wildlife 2001b). The PCA could be expanded to include a greater proportion of the watershed to ensure maintenance of the ecological and hydrological processes necessary to support the Arkansas darter population.

Protection Rank Comments: A sand and gravel mining operation has recently been proposed within a mile of Sixmile Creek. The mining operation could potentially alter the hydrologic regime supporting the fish population and contribute additional sediment load to the creek. The land within the PCA is privately owned and used for irrigated agriculture.

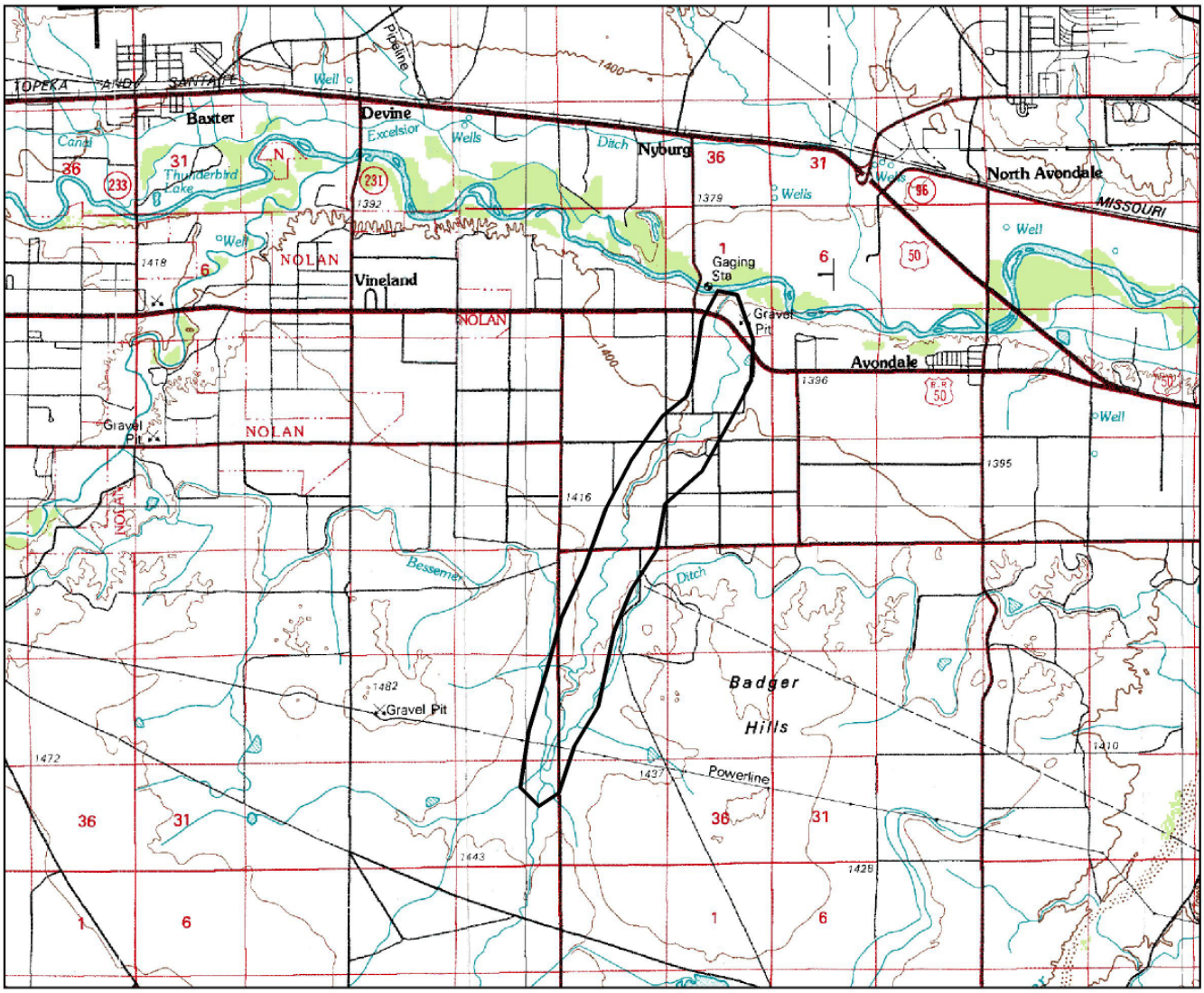
Management Rank Comments: The fish population and source of the water supplying Sixmile Creek are not well understood. Additional information on this fish population is needed to devise management options. Operation of the proposed sand and gravel mine would impose additional management needs.

Soils Description: Soils were not described at this site.

Wetland Functional Assessment: The creek provides fish habitat as indicated by the presence of the Arkansas darter. Additionally, the creek probably provides opportunity for nutrient removal and sediment retention.

Restoration Potential: Potential restoration activities at Sixmile Creek include creating a buffer between the creek and agricultural fields to aid in removal/retaining of excess sediments and nutrients derived from agricultural practices.

Sixmile Creek
Potential Conservation Area



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map date: 11 June 2001
GIS department: gd

PCA Boundary

U.S.G.S. 30x60 Minute Quadrangle*
Pueblo, 38104-A1

*Digital Raster Graphics (DRGs) produced by the U. S. Geological Survey, 1996

Location in Project Area

Network of Conservation Areas
West Bijou Creek

Biodiversity Rank: B4 (Moderate significance)
This network of conservation areas contains one potential conservation area (PCA) of moderate biodiversity significance (B4) and one PCA of general biodiversity significance (B5). The PCAs contain a good (B-ranked) example of a coyote willow riparian shrubland (*Salix exigua*/mesic graminoid) (G5 S5) and fair (C-ranked) examples of plains cottonwood/coyote willow riparian forest communities (*Populus deltoides-(Salix amygdaloides)/Salix exigua*).

Protection Urgency Rank: P3 (Moderate urgency)
The land within the network of conservation areas is privately owned with occasional sections owned by the State Land Board. The occurrences are threatened by groundwater extraction to supply the Denver metropolitan area and subsequent drawdown of the water table

Management Urgency Rank: M3 (Moderate urgency)
Some areas within the network of conservation areas are under excellent management, others are in need of improved management to restore the floodplain vegetation. Control non-native vegetation within the floodplain.

Location: El Paso, Elbert, and Arapahoe Counties. The NCA begins at the headwaters of Bijou Creek at the extreme north end of El Paso County, continues through Elbert County, and ends in Arapahoe County, about two miles south of the Adams County line.

Legal Description: USGS 7.5 minute quadrangles: Peyton, Bijou Basin, Fondis, Big Gulch, Kiowa NE, Strasburg SE, Byers. T4S R61W, T5S R61W, T5S R62W, T6S R62W, T7S R61W, T7S R62W, T8S R61W, T8S R62W, T9S R62W, T10S R62W, T10S R63W, T11S R63W.

Size: 24,190 acres (9,790 hectares).

Elevation: 5,200 to7,060 feet (1,585 to 2,152 meters).

General Description: West Bijou Creek is an ephemeral stream on the Great Plains of eastern Colorado. The stream drains from the Black Forest region of Elbert and El Paso counties. The floodplain and channel are relatively wide. The substrate is sandy and the stream is often dry in the late summer. The northern end of the network of conservation area is surrounded mostly by agricultural land (center pivot irrigation), but the southern end is surrounded by rangeland. Elevations range from 6,520 to 5,190 feet. The floodplain, banks, and terraces of the stream are dominated by fair to good patches of plains cottonwood (*Populus deltoides*) with scattered peach-leaved willow (*Salix amygdaloides*). Coyote willow (*Salix exigua*) is present within the floodplain in varying

quantities, generally dense near the channel, but less so on higher surfaces above the channel. The understory is highly variable. Both native and exotic weeds are common. Other riparian plant associations found along the stream are coyote willow/bare soil, cattail (*Typha latifolia*) and threesquare bulrush (*Scirpus pungens*) wetlands. The creek has a strong gradient of near perennial surface runoff at the upper end, to becoming an intermittent wash at the downstream end. Along the upper reaches, the bedrock is not far from the surface, keeping the stream flow near the surface. About mid-NCA the bedrock is no longer constricting flow, and the stream water flows into a much deeper sandy alluvium. As a consequence, the upper reaches of the stream are a diverse mosaic of riparian and wetland plant associations, while downstream reaches can only support only the cottonwood dominated plant association.

Biodiversity Rank Comments: This NCA contains two potential conservation areas encompassing the riparian vegetation along West Bijou Creek. The PCAs encompass fair examples of the plains cottonwood/coyote willow riparian forest (*Populus deltoides-(Salix amygdaloides)/Salix exigua*) that is apparently secure on a global basis (G4? S3) and a good example (B-ranked) of a demonstrably secure (G5 S5) coyote willow mixed grass riparian shrubland (*Salix exigua*/mesic graminoid).

Natural Heritage PCAs and element occurrences within the West Bijou Creek NCA.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	Federal Sensitive	EO* Rank	Last Observed
West Bijou Creek at 86 PCA (Elbert County)				Biodiversity rank: B4 (Moderate significance)				
Populus deltoides ssp. *monilifera-(Salix amygdaloides)/Salix exigua*	Plains cottonwood riparian woodland	G4?	S3				C	1995-06-28
Salix exigua /mesic graminoid	Coyote willow/mesic graminoid	G5	S5				B	1995-07-03
West Bijou Creek at Byers PCA (Arapahoe County)				Biodiversity rank: B5 (General significance)				
Populus deltoides ssp. *monilifera-(Salix amygdaloides)/Salix exigua*	Plains cottonwood riparian woodland	G4?	S3				C	1994-08-09

*EO = Element Occurrence

Boundary Justification: Boundaries that protect the elements from direct impacts such as weed invasions and physical alterations of the vegetation structure should be considered a minimum. Boundaries should incorporate the major ecological processes that allow the element to survive. These may include but are not limited to channel migration, flooding and sedimentation, fire, and herbivory. Inclusion of the entire floodplain into the site boundaries will allow for natural migration of the channel, allowing the creation of sites for cottonwood regeneration and other vegetation types.

Protection Rank Comments: The entire watershed needs to be monitored. The natural hydrologic flow of the stream and groundwater must be maintained for long-term survival of this riparian ecosystem.

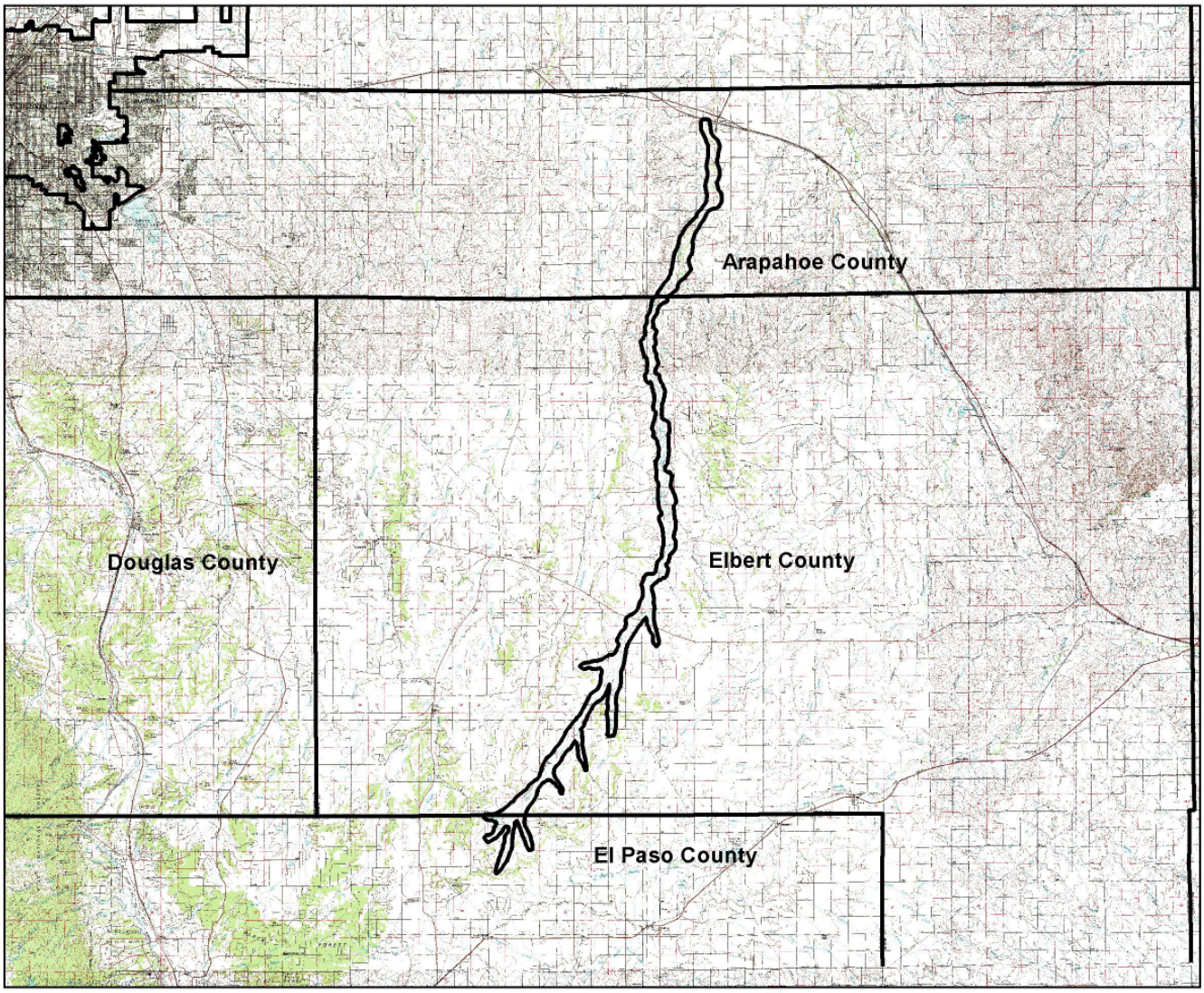
Management Rank Comments: Some areas within the NCA boundaries are under excellent management, (the Bijou Cattle Ranch, for example) with the floodplain showing signs of recovery and an increase in native woody species abundance. Other areas, however, have very poor examples of the riparian plant associations, or none at all, and require improved management techniques to restore the floodplain. Control weeds, allow for continued natural hydrologic regime, avoid groundwater table depletion. Current intensive short-duration grazing (holistic) and re-introduction of beaver appear to be improving the element vigor, reproduction and viability.

Soils Description: Soils along the creek consist of moderately coarse alluvium (mainly sand).

Wetland Functional Assessment: Groundwater recharge is occurring along the lower reach of this site. The diverse mosaic of riparian and wetland communities in the upper section provide good wildlife habitat. Production export is minimal considering that this is a losing stream (stream flow infiltrates into the channel).

Restoration Potential: Control of non-native species would benefit the ecological health of the riparian area.

West Bijou Creek
Network of Conservation Areas



8 0 8 Miles

N

The Colorado Natural Heritage Program
Colorado State University
254 General Services Bldg
Fort Collins, CO 80523
Fax: (970) 491-3349

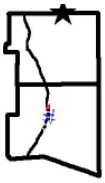
map date: 10 May 2001
GIS department: db

PCA Boundary

U.S.G.S. 30x60 Minute Quadrangles*
Castle Rock, 39104-A1
Denver East, 39104-E1

*Digital Raster Graphics (DRGs) produced by the U. S. Geological Survey, 1996

Location in Project Area



Natural History Information

Rare and Imperiled Plants Dependent on Wetlands in El Paso and Pueblo Counties

Three rare wetland-dependent plant species are known from El Paso County. These plants have been included within PCAs. Descriptions are given for the plants on the following pages.

In the chart below, in addition to scientific and common names and CNHP global and state ranks, the plants' federal legal status under the Endangered Species Act, and their status within federal agencies is given. LE or LT refers to Listed as Endangered or Threatened under the ESA. BLM and FS indicate that the Bureau of Land Management or U.S. Forest Service considers the species to be of special concern. Colorado has no legal state list of threatened and endangered plant species (Buckner and Bunin 1992).

Element	Common Name	Global Rank	State Rank	Federal/ State Status
Plants				
Ambrosia linearis	Plains ambrosia	G3	S3	FS
Juncus brachycephalus	Small-headed rush	G5	S1	
Ptilagrostis porteri	Porter's feathergrass	G2	S2	FS, BLM

Ambrosia linearis (plains ambrosia)

Taxonomy:
Class: Dicotyledoneae
Order: Asterales
Family: Asteraceae
Genus: *Ambrosia*

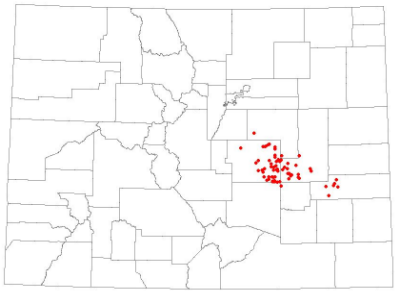
Taxonomic Comments: None.

CNHP Ranking: G3 S3

State/Federal Status: Forest Service Sensitive

Phenology: The inconspicuous flowers appear in June and continue through early August; fruiting continues through September (Spackman et al. 1997).

Habitat Comments: Known primarily from clayey soils, but also from sandy soils in seasonally moist habitats in prairies. Frequently encountered in association with intermittent streams and around the margins of intermittent ponds and playas. Also along roadsides and ditches. Elevation ranges from 4300 to 6700 feet.



Colorado Distribution

Global Range: The plains ambrosia is a restricted endemic to the shortgrass prairie of east central Colorado.

State Range: It is known from Elbert, Lincoln, Cheyenne, Kiowa, Crowley, El Paso, and Pueblo counties.

Distribution/Abundance: In natural occurrences, which are limited to playa and dry creek margin habitats, there are an estimated 50,000 to 100,000 individuals at this time. As this species is common on roadsides within its range, additional hundreds of thousands of individuals are presumed to exist.

Known Threats and Management Issues: Development of land for housing and agriculture poses the greatest threat to this species. Playas and creek banks have been subject to significant disturbance and alteration throughout the range of this species, and further reduction of these habitats is ongoing. Many occurrences are eminently threatened by the rapid subdivision of southeastern El Paso County. Rapidly increasing density of humans, livestock, and infrastructure in east central Colorado is resulting in overall reduced quality of habitat for this species.

Potential Conservation Areas supporting*Ambrosia linearis*:
Buffalograss Playas
East Chico Basin Ranch
Bohart Playas
Riser at Calhan
Rasner Ranch Playas

Juncus brachycephalus (small-headed rush)

Taxonomy:
Class: Monocotyledoneae
Order: Juncales
Family: Juncaceae
Genus: *Juncus*

© USDA, NRCS, 1997 - Northeastern Wetlands Flora USDA Plants Database.

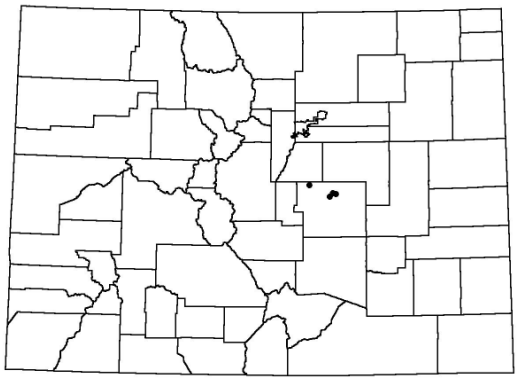
Taxonomic Comments: None.

CNHP Ranking: G5 S1

State/Federal Status: None

Phenology: The flowers appear in July through early August (Great Plains Flora Association 1986).

Habitat Comments: Known primarily from lake and stream marshes (Great Plains Flora Association 1986).



Colorado Distribution

Global Range: The small-headed rush is known to occur throughout the midwest and east (CT, GA, IL, IN, LA, MA, MD, ME, MI, MN, ND, NH, NJ, NY, OH, PA, TN, VA, VT, WI) and eastern Canada (LB, NB, NS, NU, ON, QC) (Nature Serve 2001).

State Range: . In Colorado it is an eastern relic with only five Colorado occurrences, all in El Paso County. The plants occur primarily near the town of Falcon on Black Squirrel Creek, its tributaries, and associated wet meadows.

Distribution/Abundance: There are limited data for the small-headed rush in Colorado. One occurrence reported 300 individuals, another occurrence was reported the plant as not common, and the three remaining occurrences did not contain population data.

Known Threats and Management Issues: Development of land for housing and agriculture poses the greatest threat to this species. Lake and creek banks have been subject to significant disturbance and alteration throughout the range of this species, and further reduction of these habitats is ongoing. Many occurrences are eminently threatened by the rapid subdivision of El Paso County in the vicinity of the town of Falcon. Rapidly increasing density of humans, livestock, and infrastructure in this area is resulting in overall reduced quality of habitat for this species.

Potential Conservation Areas supporting*Juncus brachycephalus*:
Judge Orr Road

Ptilagrostis porteri **(Porter's feathergrass)**

Taxonomy:
Class: Monocotyledoneae
Order: Cyperales
Family: Poaceae
Genus: *Ptilagrostis*

Taxonomic Comments: This taxon is still considered by W.A. Weber (University of Colorado) to be a distinct species (*Ptilagrostis porteri*), but is classified by Kartesz (1994 checklist), following Barkworth (Syst. Bot., 1983), as the subspecies *Ptilagrostis mongholica* ssp. *porteri*. *P. mongholica* is otherwise Asian.

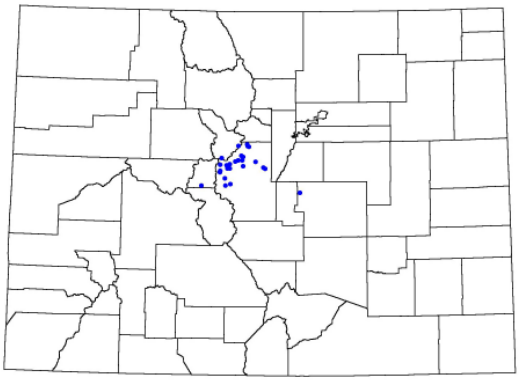
CNHP Ranking: G2 S2

State/Federal Status: Forest Service and BLM Sensitive

Phenology: Fruit maturing from mid-August to early September.

Habitat Comments: Hummocks in fens and willow carrs, at elevations between 9200 and 12,000 feet.

Global Range: Endemic to central Colorado (El Paso, Lake, Park and Summit Counties).



Colorado Distribution

State Range: Endemic to Colorado, see Global Range.

Distribution/Abundance: 27 occurrences have been documented in Colorado for this species, but many of these have likely been extirpated.

Known Threats and Management Issues: Peat mining, wetland ditching, and other hydrological alterations to its habitat pose the greatest threat to this species.

Potential Conservation Areas supporting*Ptilagrostis porteri*:
Farish Recreation Area

Rare and Imperiled Animals Dependent on Wetlands in El Paso and Pueblo Counties

Within the boundaries of El Paso and Pueblo counties there are numerous ecosystems supporting a rich diversity of flora. From this diversity in vegetation comes a diversity in animal life that includes rare Mountain Plovers breeding on the eastern plains to rare greenback cutthroat trout in alpine streams draining Pikes Peak and Greenhorn Mountain. This is truly a unique area with an amazing richness of rare fauna well worth preserving for future generations. Five animal species that are rare or imperiled, globally or in Colorado, and known to depend on wetlands or riparian areas for their survival are known in El Paso and Pueblo counties.

Element	Common Name	Global Rank	State Rank	Federal/ State Status
Amphibians				
Rana blairi	Plains leopard frog	G5	S3	SC, BLM
Birds				
Haliaeetus leucocephalus	Bald Eagle	G4	S1B, SN	LT, T
Fish				
Etheostoma cragini	Arkansas darter	G3	S2	C, T, FS
Oncorhynchus clarki stomias	Greenback cutthroat trout	G4 T2T3	S2	LT,T
Mammals				
Zapus hudsonius preblei	Preble's meadow jumping mouse	G5T2	S1	LT, T, FS

Additionally, northern leopard frogs (*Rana pipiens*) (G5 S3) are scattered throughout the counties. Northern leopard frogs are not actively tracked by CNHP but are a "watchlisted" species. Once common throughout Colorado, the northern leopard frog has become scarce in many areas as local populations have been extirpated (Hammerson 1999). Factors causing the declines in abundance and distribution in Colorado are numerous and complex. Successful reproduction by northern leopard frogs is most likely to occur in wetlands devoid of predatory fishes and bullfrogs (*Rana catesbeiana*). For that reason, the protection of semi-permanent wetlands (in which northern leopard frogs can successfully breed but fishes and bullfrogs cannot) would be likely to help northern leopard frogs persist in areas from which they would otherwise be likely to disappear. PCAs in which northern leopard frogs are present include Judge Orr Road, Chico Creek, and Arkansas River at Nepesta.

Plains Leopard Frog (*Rana blairi*)

Photo by Geoff Hammerson

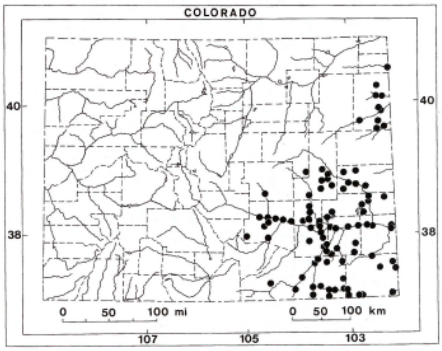
Taxonomy:
Class: Amphibia
Order: Anura
Family: Ranidae
Genus: *Rana*

Taxonomic Comments: Formerly considered part of the *Rana pipiens* species complex; hybridizes with *Rana pipiens* and *Rana sphenocephala.* No subspecies are recognized.

CNHP Ranking: G5 S3

State/Federal Status: Colorado species of special concern.

Habitat Comments: Plains leopard frogs are found in a wide variety of temporary and permanent aquatic habitats, including streams, rivers, ponds, lakes, ditches, and marshes (Degenhardt et al. 1996). They often are found great distances from water and for that reason they sometimes are known as "meadow frogs" (Wright and Wright 1949). Mass movements away from breeding ponds are sometimes undertaken by adults and young after summer rains (Fitch 1958). *Rana blairi* is better adapted to dry conditions than the closely-related *Rana pipiens* (Gillis 1975, 1979) and often uses shallow, muddy waters (Scott and Jennings 1985, Stebbins 1985).



Plains leopard frog distribution in Colorado
(from Hammerson 1999)

Distribution: *Rana blairi* ranges westward from Indiana to southern South Dakota and eastern Colorado, and southward to Texas; isolated populations occur in southern Illinois, New Mexico, and Arizona (Stebbins 1985, Brown 1992, Conant and Collins 1998). In Colorado, the range of the plains leopard frog generally is complementary to that of the northern leopard frog (*Rana pipiens*) (Hammerson 1999). *Rana blairi* is found at elevations below 6000 feet in the Arkansas River drainage in southeastern Colorado and in the Republican River drainage of northeastern Colorado (Hammerson 1999).

Important Life History Characteristics: *Rana blairi* breeds from February through October (Pace 1974), with peaks in breeding activity occurring after heavy rains (Gillis 1975, Lynch 1985). Eggs, which hatch into tadpoles within 3 weeks, are laid in large clusters attached to submerged vegetation in shallow water (Degenhardt et al. 1996). Depending upon the timing (month) of egg deposition, the tadpoles may metamorphose into frogs or they may overwinter and then transform during the next spring (Gillis 1975, Scott and Jennings 1985). In the autumn, adult plains leopard frogs dig into the mud and debris on the bottoms of streams and ponds where they overwinter (Collins 1993). Occasionally these frogs are active during warm weather in winter (Fitch 1956). *Rana blairi* adults feed mainly on nonaquatic insects (Hartman 1906, Hammerson 1999). To escape predators, plains leopard frogs tend to leap away from water rather than toward it, in contrast to the responses of many other species of frogs (Degenhardt et al. 1996,

Hammerson 1999). When captured by predators, plains leopard frogs emit characteristic, explosive distress calls (Hammerson 1999). Dispersal distances of 8 km have been recorded for the species (Gillis 1975).

Known Threats and Management Issues *Rana blairi* has become scarce or absent at some locations where non-native bullfrogs have been introduced (Hammerson 1982). *Rana blairi* eggs and young are readily eaten by bullfrog larvae (Ehrlich 1979), and large, overwintered bullfrog larvae could greatly reduce the reproductive success of plains leopard frogs (Hammerson 1999). Moreover, adult bullfrogs consume adult plains leopard frogs (Mackessy 1998).

Potential Conservation Areas supporting Plains Leopard Frog:
Chico Creek

Bald Eagle *(Haliaeetus leucocephalus*)

Photo by Mary Kiesling

Taxonomy:
Class: Aves
Order: Falconiformes
Family: Accipitridae
Genus: *Haliaeetus*

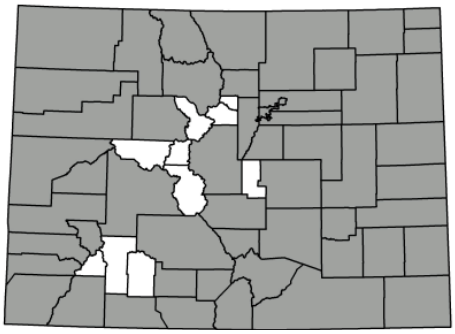
Taxonomic Comments: none.

CNHP Ranking: G4 S1B,S3N

State/Federal Status: Federally threatened

Habitat Comments: Breeding habitat for Bald Eagles consists of forested areas near large bodies of water (Andrew and Mosher 1982, Usgaard and Higgins 1995). Nests typically are placed in tops of tall trees located near suitable foraging habitat (Anthony et al. 1982, Anthony and Isaacs 1989, Kralovec et al. 1992). Factors affecting the quality of foraging habitats include the characteristics of the prey base (Livingston et al. 1990), the structure of the aquatic habitat (MacDonald and Austin-Smith 1989), and the extent of human development and disturbance (McGarigal et al. 1991). Sites used for diurnal perching tend to include tall trees located near shoreline foraging habitat (Steenhof et al. 1980, Chester et al. 1990, Buehler et al. 1992, Canton et al. 1992, Chandler et al. 1995). Winter habitats occur along major river systems and along eastern and western North American coasts (Millsap 1986) and are characterized by the presence of abundant food, protected roost sites, and little or no human disturbance (Steenhof et al. 1980, Keister et al. 1987). Roosting habitat consists of tall trees that offer protection from prevailing winds and are generally located near aquatic foraging areas (Steenhof et al. 1980, Anthony et al. 1982, Keister and Anthony 1983, Grubb et al. 1989, Chester et al. 1990, Buehler et al. 1991*b*). Most roosting sites for Bald Eagles in western North America are in coniferous (or sometimes in riparian) trees (Anthony et al. 1982, Keister and Anthony 1983, Crenshaw and McClelland 1989, Grubb et al. 1989).

Distribution: Bald Eagles breed in suitable habitats throughout much of North America, including Alaska, Canada, all 48 contiguous states in the U.S. except Vermont and Rhode Island, and parts of Mexico (Buehler 2000). No records exist of Bald Eagles breeding outside North America (Buehler 2000). Most wintering areas for Bald Eagles are located in the lower 48 states and in coastal areas of Alaska and Canada, in aquatic habitats where open water persists for foraging (Millsap 1986). Some adult Bald Eagles migrate seasonally as necessary when food becomes unavailable (McClelland et al. 1982, Millsap 1986, Buehler et al. 1991*a*, Harmata and Stahlecker 1993), whereas others remain in the vicinity of their breeding territories throughout the year (Sherrod et al. 1976, Swenson et al. 1986, Garrett et al. 1993, Jenkins and Jackman 1993). Many of the Bald Eagles that winter in Colorado migrate to breeding areas in Saskatchewan and Manitoba in January-March (Harmata and Stahlecker 1993). Bald Eagles breed in northwestern, southwestern, and north-central Colorado (Andrews and Righter 1992).



Bald Eagle distribution (all seasons) in Colorado (adapted from Andrews and Righter 1992)

Important Life History Characteristics Bald Eagles are opportunistic foragers and their diet varies greatly, depending upon the location and the availability of various types of prey (Todd et al. 1982). In most regions Bald Eagles forage in aquatic habitats and prefer fishes (McEwan and Hirth 1980, Knight and Knight 1986, Brown 1993, Stalmaster and Kaiser 1998). Mammals and birds,

however, are important components of the diet at many sites (Bent 1937, Todd et al. 1982, Kralovec et al. 1992). Bald Eagles typically hunt from perches or while soaring, but they also feed on carrion on the ground in areas where they are not disturbed by humans (Buehler 2000). At some wintering sites, ungulate carrion is a critical component of the diet (Houston 1978, Swenson et al. 1986). Bald Eagles often engage in kleptoparasitism or food piracy; typically they steal fishes or other prey items from other Bald Eagles or from Ospreys while in flight or on the ground (Burr 1912, Bent 1937, Todd et al. 1982, Knight and Knight 1983, Stalmaster and Gessaman 1984, Hansen 1986). Bald Eagles use sticks and branches to build large nests which often are reused each year (Buehler 2000). A well-known nest in Ohio was used for 34 years before the tree in which it was located blew down (Herrick 1924). Bald Eagles roost communally (or sometimes solitarily) at traditional winter roosting sites (Anthony et al. 1982, Keister et al. 1987, Crenshaw and McClelland 1989, Grubb et al. 1989), and, in some cases, at post-breeding-season summer roosting sites (Chester et al. 1990). Mated pairs of Bald Eagles defend their breeding territories against encroachments by other Bald Eagles (Gerrard et al. 1992*b*, Buehler 2000). Male and female Bald Eagles exhibit strong fidelity to their mates and to their nest sites (Gerrard et al. 1992*a*, Jenkins and Jackman 1993). A female Bald Eagle in Saskatchewan, for example, used the same territory for 13 years (Gerrard et al. 1992*a*). If one member of a mated pair dies or disappears, the surviving eagle typically continues to occupy the same territory and finds a new mate (Postupalsky and Holt 1975, Grubb et al. 1988, Jenkins and Jackman 1993). Many Bald Eagles also show fidelity (i.e., they return year after year) to their wintering areas (McCollough 1989, Harmata and Stahlecker 1993).

Known Threats and Management Issues: Major threats to the Bald Eagle include the loss of critical habitat components such as nest trees (Weekes 1974), perch sites, and winter roosts (Hansen et al. 1981) to natural or man-induced causes. Throughout the range of the Bald Eagle, loss of critical breeding and wintering habitats is a serious problem (Therres et al. 1993, Shapiro et al. 1982, Wood et al. 1989). Human activities and disturbance can affect populations of Bald Eagles and other birds in many important ways. These factors can alter foraging patterns, distribution, and habitat use (Stalmaster and Newman 1978, Skagen 1980, Knight and Knight 1984, Buehler et al. 1991*b*, Grubb and King 1991, Knight et al. 1991, McGarigal et al. 1991, Brown and Stevens 1997), reduce reproductive success (White and Thurow 1985) and foraging efficiency (Knight and Knight 1986, Knight et al. 1991, Skagen et al. 1991, Stalmaster and Kaiser 1998), and increase energy expenditures (Knight and Knight 1983, Stalmaster 1983) and stress (Fernandez and Azkona 1993). Additional threats to the Bald Eagle include shooting (Hamerstrom et al. 1975, Fraser 1983, Reichel et al. 1984), trapping, electrocution (Smith and Murphy 1972, Hamerstrom et al. 1975), and poisoning by pesticides or lead shot (Hickey and Anderson 1968, Wiemeyer et al. 1978, 1984, Swenson et al. 1986, Anthony et al. 1993, Kramer and Redig 1997).

Potential Conservation Areas supporting Bald Eagle:
Big Johnson Reservoir

**Greenback Cutthroat Trout (*Oncorhynchus clarki stomias*
Taxonomy:
Class: Osteichthyes
Order: Salmoniformes
Family: Salmonidae
Genus: *Oncorhynchus*

Taxonomic Comments: Greenback cutthroat trout are closely related to Colorado River cutthroat trout (*Oncorhynchus clarki pleuriticus*). Greenback cutthroat trout hybridize with various species and subspecies of the genus *Oncorhynchus* and therefore local cutthroat populations can range in appearance from "pure-looking" to obvious hybrids (U. S. Fish and Wildlife Service 1998).

CNHP Ranking: G4T2T3 S2

State/Federal Status: Listed as federally threatened.

Habitat Comments: Inhabits clear, cold, well-oxygenated mountain streams with moderate gradients, rocky to gravelly substrates, and abundant riparian vegetation; also is found in ponds and lakes (Trotter 1987).

Distribution: The exact historical distribution of the greenback cutthroat trout is uncertain because the species declined so rapidly during the 1800s. The species is native to the headwaters of the South Platte and Arkansas river drainages in Colorado and to a short portion of the South Platte drainage in Wyoming (U.S. Fish and Wildlife Service 1998). By the early 1900s, greenback cutthroat trout were thought to be extinct (Greene 1937). Since then, ten native populations of greenback cutthroat trout have been discovered in the South Platte drainage (seven populations) and in the Arkansas River watershed (three populations); two of the three populations in the Arkansas River drainage are considered stable (Severy Creek in El Paso County and South Apache Creek in Huerfano County (U.S. Fish and Wildlife Service 1998, Policky et al. 1999). The Colorado Division of Wildlife has reintroduced greenback cutthroat trout at many sites in the South Platte and Arkansas river drainages, and 25 areas in the Arkansas river watershed are managed for the species (Policky et al. 1999). Twenty (6 historical and 14 reintroduced) populations of greenback cutthroat trout are currently thought to be stable and self-sustaining (U.S. Fish and Wildlife Service 1998).

Important Life History Characteristics: Greenback cutthroat trout spawn in gravel-bottomed areas in running water during the spring when water temperatures reach 5-8°C (41-46°F); the timing of spawning varies with elevation and the age of the fish (U.S. Fish and Wildlife Service 1998). Although female greenbacks in hatcheries produce eggs when two years old, females in small alpine streams in Colorado typically reach sexual maturity when three or four years of age (U.S. Fish and Wildlife Service 1998). An opportunistic feeder, the greenback cutthroat trout consumes a wide range of prey but focuses mainly on invertebrates (Trotter 1987, U.S. Fish and Wildlife Service 1998). Vertebrates such as salamanders and small fishes also are consumed (U.S. Fish and Wildlife Service 1998).

Known Threats and Management Issues: The decline in greenback cutthroat trout populations was caused by several factors related to human activities. The major factor was the introduction of non-native salmonid species (rainbow trout, brook trout, brown trout, and Yellowstone cutthroat trout) into the South Platte and Arkansas river drainages (U.S. Fish and Wildlife Service 1998). Rainbow trout and various cutthroat subspecies readily hybridize with greenback cutthroat trout (Everhart and Seaman 1971, U.S. Fish and Wildlife Service 1998). Introduced brook trout (Behnke and Zarn 1976, Behnke 1979) and brown trout (Wang 1989) tend to outcompete and ultimately displace greenback cutthroat trout. Finally, because cutthroat trout are more easily caught than other salmonid species, harvest by fishermen may have played an important role in reducing greenback cutthroat populations, particularly in waters where non-native species were present with greenbacks (U.S. Fish and Wildlife Service 1998).

Other factors that contributed to the decline of greenback cutthroat trout populations also were associated with the human settlement and development of the Front Range. Exploitation of land, water, minerals,

timber resources, and fisheries adversely affected greenback cutthroat trout and their habitat (U.S. Fish and Wildlife Service 1998). The diversion of streams and the removal of water for irrigation of agricultural lands had major impacts on the ecology and hydrology of waters occupied by greenback cutthroat trout.

Preliminary experiments indicated that greenback cutthroat trout were susceptible to whirling disease (caused by *Myxobolus cerebralis*) and that mortalities among infected greenbacks were higher than those among infected rainbow trout despite the fact that greenbacks showed no overt signs of infection (no skeletal deformities or tail-chasing behavior) (U.S. Fish and Wildlife Service 1998).

Potential Conservation Areas supporting*Oncorhynchus clarki stomias*:
Severy Creek
Boehmer Creek
Greenhorn Creek

Arkansas Darter (*Etheostoma cragini*)

Taxonomy:
Class: Osteichthyes
Order: Perciformes
Family: Percidae
Genus: *Etheostoma*

Taxonomic Comments: *Etheostoma* is the largest (most speciose = contains the most species) genus of North American fishes.

CNHP Ranking: G3 S2

State/Federal Status: Forest Service sensitive; candidate for federal listing as threatened/endangered; threatened in Colorado.

Habitat Comments: Arkansas darters inhabit small, shallow, clear, slowly-flowing streams that are partially overgrown with rooted aquatic vegetation such as watercress; they often are found in pools with substrates of sand, fine gravel, or organic detritus (Miller and Robison 1973, Cross and Collins 1975, Lee et al. 1980). These darters are able to tolerate moderately suboptimal conditions such as water turbidity (Miller 1984), high water temperature (Labbe and Fausch 1997), and low dissolved oxygen availability (Labbe and Fausch 1997).

Distribution: Although the historical distribution of Arkansas darters is unknown because of the paucity of historical records (e.g., only three pre-1979 records exist for Colorado), it is generally agreed that the distribution and abundance of the Arkansas darter have declined substantially due to loss of riparian habitats and reductions in groundwater aquifers that support spring-fed habitats in the region (Colorado Division of Wildlife 2001c). Today, localized populations of Arkansas darters inhabit portions of the Arkansas River drainage in eastern Colorado, southern Kansas, northeastern Oklahoma, and southwestern Missouri (Lee et al. 1980, Colorado Division of Wildlife 2001c). In Colorado, Arkansas darters are known to occur in Elbert, El Paso, Lincoln, Pueblo, Kiowa, and Prowers counties (Woodling 1985, Colorado Division of Wildlife 2001c).

Important Life History Characteristics: Arkansas darters are small fishes (up to 2.5 inches [10 centimeters] in length) that breed in the early spring and deposit their eggs in open areas where organic ooze occurs as a thin layer over sandy substrates (Moss 1981). Young Arkansas darters tend to occupy areas that are relatively open, whereas adults use areas with more aquatic vegetation (Moss 1981, Woodling 1985). Although mayflies are the primary food for Arkansas darters, many other items also are consumed, including dragonflies, caddisflies, dipterans, fish eggs, and small leaves and seeds (Moss 1981). Like most darters, Arkansas darters often sit motionless on the substrate; the name "darter" is based on their habit of occasionally darting about on the bottoms of streams as they forage (Page and Burr 1991).

Known Threats and Management Issues: Several factors have contributed to the declines in distribution and abundance of the Arkansas darter. Since the late 1800s, extensive water diversion and impoundment for irrigating croplands, degradation of stream banks and shallow wetlands due to livestock grazing and human activities, and pollution of streams have probably substantially reduced the availability of habitat suitable for Arkansas darters (Colorado Division of Wildlife 2001c). The major obstacle to the recovery and future persistence of the Arkansas darter is the availability of adequate amounts of suitable habitat. The quality and quantity of freshwater habitats will become increasingly difficult to maintain as the demand for water for human usage (e.g., domestic, agricultural, industrial) continues to increase (Colorado Division of Wildlife 2001c).

Potential Conservation Areas supporting *Etheostoma cragini*:
Big Sandy Creek at Calhan
Big Johnson Reservoir
Chico Creek
Sixmile Creek
Fountain and Jimmy Camp Creeks

Preble's Meadow Jumping Mouse (*Zapus hudsonius preblei*)

Taxonomy:
Class: Mammalia
Order: Rodentia
Family: Zapodidae
Genus: *Zapus*

Taxonomic Comments: Some taxonomists use the family name "Dipodidae" instead of "Zapodidae."

CNHP Ranking: G5T2 S1

State/Federal Status: Forest Service sensitive; federal LT; Colorado species of special concern

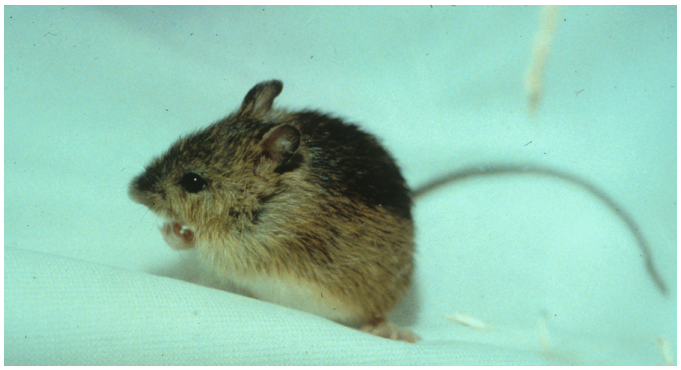
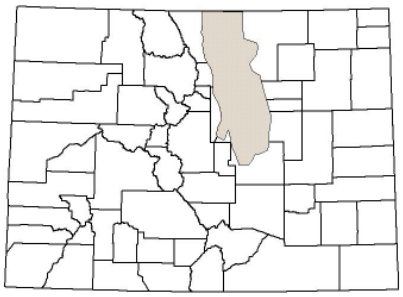


Photo by Parker Schuerman

Habitat Comments: Preble's meadow jumping mouse occurs in areas of lush, rank vegetation along watercourses and in marshy areas and wet meadows (Krutzsch 1954, Whitaker 1972, Fitzgerald et al. 1994). Habitats often are characterized by high species richness and well-developed vegetative cover (Meaney et al. 1997). Hibernacula generally are located upslope (and may be quite distant) from areas used in summer (Hafner 1997).

Distribution: *Z. h. preblei* historically occurred in marshy areas along the upper drainages of the North Platte River in southeastern Wyoming (Long 1965, Clark and Stromberg 1987) and on the western edge of the Colorado piedmont along the South Platte River drainage south to the Denver area (Armstrong 1972). Current distribution is severely restricted and fragmented; habitats are likely to continue to decline both qualitatively and quantitatively (Hafner et al. 1998)



Preble's meadow jumping mouse distribution in Colorado (based on CNHP data from R. A. Schorr)

Important Life History Characteristics:*Zapus hudsonius preblei* hibernates for a longer period than most mammalian hibernators: from September or October through late April or early May each year (Whitaker 1963, 1972). During the 4-6 month period of activity each spring/summer, jumping mice feed on seeds, fruits, fungi, and insects; they do not cache food but store body fat before hibernating (Fitzgerald et al. 1994, Nowak 1999). Jumping mice generally are nocturnal and crepuscular, but they sometimes are active in daylight (Whitaker 1963, Fitzgerald et al. 1994). For protection, jumping mice construct nests of grasses, leaves, or other plant material. Nests are placed in protected locations beneath logs or shrubs and are usually underground but well above the water table (Fitzgerald et al. 1994). When hot summer weather reduces the availability of mesic habitat, Preble's meadow jumping mice sometimes abandon their home ranges and wander widely in search of moist sites (Fitzgerald et al. 1994:291, Nowak 1999).

Known Threats and Management Issues: The replacement of natural wetlands by reservoirs and by agricultural and urban development has severely impacted many populations (Fitzgerald et al. 1994, Garza 1995). Preble's meadow jumping mouse may have been extirpated over most of its former range in Wyoming by extensive overgrazing (habitat loss) and pesticide use (Hafner et al. 1998). Conservation of critical mesic forb-grassland habitats and the dispersal corridors that connect isolated patches of habitat is essential to the continued survival of this subspecies (Hafner 1997).

Potential Conservation Areas supporting Preble's meadow jumping mouse:
Monument Creek

Rare and Imperiled (or good examples of common) Wetland and Riparian Plant Communities in El Paso and Pueblo Counties

The following chart shows wetland and riparian plant communities documented in El Paso and Pueblo counties in the CNHP data system. Note that this is not a complete list of all the communities that occur, but only those that are tracked by CNHP.

Element	Common Name	Global Rank	State Rank	Federal and State Status
Plant Communities				
Abies concolor-Picea pungens-Populus angustifolia/Acer glabrum	Montane riparian forest	G2	S2	
Alnus incana/mesic graminoid	Montane riparian shrubland	G5Q	S3	
Alnus incana-Cornus sericea	Thinleaf alder-red-osier dogwood riparian shrubland	G3G4	S3	
Buchloe dactyloides-Ratibida tagetes-Ambrosia linearis	Buffalograss playa	G3	S3	
Carex lanuginosa	Montane wet meadow	G3?	S3	
Carex nebrascensis	Wet meadow	G4	S3	
Carex praegracilis	Clustered-sedge wetland	G3	S2	
Corylus cornuta	Lower montane forest	G3	S1	
Distichlis spicata	Salt meadow	G5	S3	
Eleocharis palustris	Emergent wetland	G5	S4	
Juncus balticus var. *montanus*	Wet meadows	G5	S5	
Pascopyrum smithii-Eleocharis spp.	Playa grassland	G2	S2	
Phragmites australis	Marsh	G4	S3	
Populus angustifolia/Alnus incana	Montane riparian forest	G3?	S3	
Populus angustifolia/Prunus virginiana	Narrowleaf cottonwood/ common chokecherry	G2G3	S1	
Populus angustifolia/Salix exigua	Narrowleaf cottonwood riparian forest	G4	S4	
Populus deltoides ssp. *monilifera-(Salix amygdaloides)/Salix exigua*	Plains cottonwood riparian woodland	G4?	S3	
Populus deltoides/Pascopyrum smithii-Panicum obtusum	Plains cottonwood/western wheatgrass-vine mesquite	G2Q	S1S2 Q	
Populus deltoides/Sporobolus airoides	Plains cottonwood/Alkali sacaton	G3	S2	
Pseudotsuga menziesii/Betula occidentalis	Montane riparian forest	G3?	S3	
Salix amygdaloides/Carex lanuginosa	Peachleaf willow alliance	G3	SU	
Salix eriocephala var. *ligulifolia*	Montane willow carr	G2G3	S2S3	
Salix exigua/mesic graminoid	Coyote willow/mesic graminoid	G5	S5	
Salix lucida ssp. *caudata*	Montane riparian shrubland	G3Q	S2S3	
Sarcobatus vermiculatus/Sporobolus airoides	Saline bottom shrublands	G3?	SU	
Scirpus pungens	Bulrush	G3G4	S3	
Scirpus tabernaemontani-Scirpus acutus	Great Plains marshes	G3	S2S3	
Spartina pectinata	Prairie slough grass	G3?	S3	
Sporobolus airoides	Great Plains salt meadow	G3Q	S3	
Symphoricarpos occidentalis	Snowberry shrubland	G4G5	S3	
Typha angustifolia-Typha latifolia	Cattail marsh	G5	S3	

Global Scientific Name: *Abies concolor - Picea pungens - Populus angustifolia / Acer glabrum* plant association

Global Common Name: white fir-Colorado blue spruce-narrowleaf cottonwood/Rocky Mountain maple

Wetland System: palustrine

Related Literature and Synonyms:

Baker (1989) first described this community from the San Juan Mountains and notes that it also occurs in northern New Mexico (DeVelice *et al.* 1986). Stands with *Abies concolor* were previously included in the *Populus angustifolia-Picea pungens/Alnus incana* plant association, and the two associations were thought to be synonyms (Kittel *et al.* 1994, 1995, 1996). Further field research has indicated a distinct regional variation of the *Abies concolor*-(*Picea pungens*)-*Populus angustifolia/Acer glabrum* plant association.

Similar Communities:

A closely related type, the *Abies lasiocarpa-Picea engelmannii-Populus angustifolia/Lonicera involucrata* plant association (Baker 1989, Richard *et al.* 1996) consistently lacks *Abies concolor* and *Picea pungens.*

Regional Distribution:

This plant association is known only from southern Colorado (Baker 1989, CNHP 1999) but may occur in northern New Mexico (DeVelice *et al.* 1986).

Distribution in Colorado:

This plant association is known only from the San Juan, Sangre de Cristo, and Wet Mountains of south-central Colorado (CNHP 1999).

Reasons for Global Rank:

This community is only known south-central Colorado. It may occur in northern New Mexico. Additional inventory is needed.

Global Rank:

Global rank is based on the status of a taxon throughout its range. This association is ranked G2, imperiled globally because of rarity (6 to 20 occurrences), or because of other factors demonstrably making it very vulnerable to extinction throughout its range. (Endangered throughout its range).

Reasons for State Rank:

In Colorado, this community is known from less than 20 stands and is probably restricted to the southern mountains. It is threatened by improper livestock grazing, heavy recreational use and stream flow alterations.

State Rank:

State rank is based on the status of a taxon in an individual state. In Colorado, this association is ranked S2, imperiled in state because of rarity (6 to 20 occurrences), or because of other factors demonstrably making it very vulnerable to extirpation from the state. (Endangered or threatened in state).

General Description and Comments:

The *Abies concolor*-(*Picea pungens*)-*Populus angustifolia/Acer glabrum* (white fir-Colorado blue spruce-narrowleaf cottonwood/Rocky Mountain maple) plant association is a diverse, mixed conifer-deciduous forest occurring on active floodplains and streambanks of montane valley floors. The presence of *Abies concolor* distinguishes this community from the more common *Populus angustifolia-Picea pungens/Alnus incana* (narrowleaf cottonwood-Colorado blue spruce/thinleaf alder) plant association, and is indicative of the southern-most mountains in Colorado. Colorado blue spruce (*Picea pungens*) is often an upper canopy

component (64% frequency, when combined with Baker 1989data) but is not present in all stands. This is reflected in the association name by placing *Picea pungens* in parentheses.

Elevation Range in Colorado:

7400-8700 ft. (2300-2700 m).

Site Geomorphology:

This community is located on narrow to moderately wide valleys, 50-300 ft. (15-90 m) on immediate streambanks, floodplains and upper terraces, 1-6.5 feet, 1.5 avg. ft (0.3-2.0, 0.45 avg. m), above the channel high-water level. Streams were classified according to the Rosgen Classification of Natural Rivers (Rosgen 1996). Streams are steep to moderately steep (2-6%, average 4% gradient), straight to moderately sinuous (Rosgen Channel Types: A3, A5, B2-5, C3, C5).

Soils:

The soils are poorly developed, well-drained entisols with shallow sandy loam over coarse alluvium.

Management:

Because regeneration and establishment of new stands of cottonwood are dependent upon flooding events, any alteration to the natural flow regime of a river can affect the cottonwood ecosystem. Upstream dams stabilize stream flows by reducing the frequency and magnitude of floods. This results in fewer flood events that allow cottonwood stand regeneration. Without periodic disturbance by flooding, riparian areas become dominated by late-seral communities. These late-seral communities are dominated by more upland species, such as conifers in montane areas or other, more drought tolerant species in the foothill and plains environments.

Forage productivity for this plant association can be high and very palatable to livestock. Cottonwood seedlings and saplings and the associated shrub species are frequently browsed by cattle. Excessive grazing and browsing will reduce plant vigor and allow non-native plant species to gain a competitive advantage. Cottonwood-dominated riparian areas in Colorado are best grazed moderately for short periods during the growing season or solely during the winter season. This maintains high forage quality and quantity. This plant association also provides excellent hiding and thermal cover for mammals and birds (Hansen *et al.* 1995).

Successional and Ecological Processes:

In Colorado, cottonwood is a pioneer tree species. Seed reproduction is primarily restricted to bare, moist sites (Friedman *et al.* 1995, Moss 1938) and rarely occurs underneath an existing canopy of cottonwood poles or trees (Johnson 1994). Regeneration of cottonwood stands is thus dependent on fluvial disturbances that create bare, moist sites (Bradley and Smith 1986, Friedman *et al.* 1997). These processes include channel migration (meandering and avulsion), channel narrowing, and scour and sediment deposition from episodic floods (Scott *et al.* 1996).

The size and age structure of a specific cottonwood patch are heavily dependent on the time since the last disturbance. Annually disturbed sites at the channel margin may never progress beyond young seedlings (Auble *et al.* 1997). Sites disturbed by an extreme event, or sites that become safe through accretion or channel migration, may support pole and tree size cottonwood (Auble and Scott 1998, Everitt 1968). At a larger spatial scale, the riparian forest comprises a mosaic of patches with different ages of cottonwood and different histories of disturbance.

The future of a mature cottonwood stand depends on future disturbance and moisture conditions. A disturbance may trigger another generation of cottonwood at the patch. On undisturbed sites that are moist enough to support trees, cottonwood may be replaced by co-established species that live longer than the cottonwood, or by secondary species that have become established in the understory (Boggs and Weaver 1994, Hansen *et al.* 1995, Howe and Knopf 1991, Johnson *et al.* 1976, Padgett *et al.* 1989). On drier, undisturbed sites, decadent cottonwood may be replaced by a treeless herbaceous community (Hefley 1937, Lindauer 1983).

The *Abies concolor-Picea pungens-Populus angustifolia/Acer glabrum* plant association is a mid- to late-seral community. High elevations and cool, shaded canyon bottoms create an environment for *Abies concolor* (white fir) and *Picea pungens* (Colorado blue spruce). Here the active channel flooding and sediment deposition allows *Populus angustifolia* (narrowleaf cottonwood) to perpetuate. On higher terraces that no longer experience flooding, *Abies* and *Picea* may become the climax tree species.

Some authors suggest mixed riparian stands will eventually become dominated by conifer species (see Padgett *et al.* 1989, Hansen *et al.* 1995). In Colorado, observations indicate that with continued fluvial processes, cottonwoods will continue to persist on the streambanks and floodplains. The presence of conifer species on an active floodplain is not necessarily an indication of future "climax" dominance.

Vegetation:

The upper canopy is dominated with *Populus angustifolia* (narrowleaf cottonwood) (20-100% cover) and *Abies concolor* (white fir) (5-66% cover) and diverse. Other tree species occurring with 9-45% frequency include: *Picea pungens* (blue spruce) (13-60% cover), *Abies lasiocarpa* (subalpine fir) (10%), and *Pseudotsuga menziesii* (Douglas fir) (3-36%). Shrubs are thickest near the stream channel with *Acer glabrum* (Rocky Mountain maple) being the most commonly encountered and abundant species (82% frequency, 1-62% cover). Other shrubs often present include: *Alnus incana* (thinleaf alder) (5-50% cover), *Betula occidentalis* (river birch) (10%), *Cornus sericea* (redosier dogwood) (18%), *Amelanchier utahensis* (Utah serviceberry) (1-10%), *Jamesia americana* (wax flower) (1-17%), *Lonicera involucrata* (honeysuckle) (1-5%), *Mahonia repens* (Oregon grape) (1%), *Salix bebbiana* (Bebb willow) (10%), *S. drummondiana* (Drummond willow) (5-27%), *S. monticola* (park willow) (20%), *Symphoricarpos* spp. (snowberry) (1-10%), *Ribes* spp. (current) (2-7%), and *Rosa woodsii* (Woods' rose) (1-10%).

The herbaceous undergrowth is variable, depending on site conditions, but is generally low, with less than 20% total cover. No one species is present in all stands. Common forb species include: *Heracleum sphondylium* (cow parsley) (1-30% cover), *Geranium richardsonii* (Richard geranium) (3-6%), *Vicia americana* (vetch) (1%), *Viola* spp. (violet) (1-3%), *Osmorhiza chilensis* (sweet cicely) (1-10%), *Maianthemum stellatum* (false Solomon's seal) (1-5%), *Mertensia ciliata* (chiming bells) (1%). Graminoid species include: *Elymus glaucus* (blue wildrye) (30% cover), *Bromus inermis* (smooth brome (1-5%), and *Equisetum arvense* (field horsetail) (10%).

Adjacent Riparian Vegetation:

This community often is the only association along the river, however smaller patches of *Populus tremuloides* (quaking aspen) forests, *Alnus* (thinleaf alder) and *Salix* (willow) shrublands or meadows of *Carex* (sedges) spp. may be located within the immediate riparian area.

Adjacent Upland Vegetation:

Side canyon slopes are generally dominated by *Pinus ponderosa* (ponderosa pine), *Pinus edulis* (pinyon pine), or *Quercus gambelii* (Gambel's oak) at lower elevations and *Populus tremuloides* (quaking aspen), *Abies concolor* (white fir) and *Pseudotsuga menziesii* (Douglas fir) at higher elevations.

Potential Conservation Areas supporting the *Abies concolor-Picea pungens-Populus angustifolia/Acer glabrum* plant association:

Greenhorn Creek

Global Scientific Name: *Alnus incana* / mesic graminoids plant association

Common Name: thinleaf alder/mesic graminoids

Wetland System: palustrine

Related Literature and Synonyms:

The *Alnus incana*/Mesic Graminoids plant association reported from Nevada, Utah, southeastern Idaho and Wyoming (Jones 1992, Padgett *et al.* 1989, Manning and Padgett 1995) is synonymous with the Colorado *Alnus incana*/Mesic Graminoids plant association.

Similar Communities:

There are three closely related communities. The *Alnus incana* ssp. *tenuifolia-Betula fontinalis*/*Salix* spp. (thinleaf alder-river birch/willow) plant association (Johnston 1987) has significant cover of *Betula fontinalis.* The Closed Tall Shrub Swamp and the Closed Tall Alder Scrub types (Viereck *et al.* 1992) are both found in very wet, swampy areas, an environment different from that of the Colorado stands. *Betula fontinalis* is a synonym for *Betula occidentalis* (Kartesz 1994).

Regional Distribution:

This plant association occurs in Wyoming (Jones 1992), Idaho, Utah (Padgett *et al.* 1989), Nevada (Manning and Padgett 1995) and Colorado (Johnston 1987, CNHP 1999).

Distribution in Colorado:

This plant association occurs in the Routt and San Juan National Forests and the San Miguel, Rio Grande, Arkansas and North Platte River Basins (Kettler and McMullen 1996, Richard *et al*. 1996, Kittel and Lederer 1993, Kittel *et al.* 1999a, Kittel *et al*. 1996, CNHP 1999).

Reasons for Global Rank:

This is a common plant association with many occurrences throughout the Rocky Mountains. However, it is rare to find stands dominated by native species in the undergrowth. This association is threatened by improper livestock grazing and stream impoundments. The community's taxonomy is tentative and stands may not be recognized by the same name across state lines.

Global Rank:

Global rank is based on the status of a taxon throughout its range. This association is ranked G5Q, demonstrably widespread, abundant and secure globally, though it may be quit rare in parts of its range, especially at the periphery. The Q indicates uncertainty about the community's taxonomy.

Reasons for State Rank:

Many stands of this plant association in Colorado are in degraded condition and are threatened by improper livestock grazing and stream impoundments.

State Rank:

State rank is based on the status of a taxon in an individual state. In Colorado, this association is ranked S3, rare in state (21 to 100 occurrences).

General Description and Comments:

The *Alnus incana* ssp. *tenuifolia*/Mesic Graminoids plant association is a dense shrubland of medium-tall deciduous shrubs with a thick herbaceous cover of mostly native forb and grass species and little to no overstory tree canopy. Heavily disturbed stands have abundant non-native grasses. In Nevada, Utah, southeastern Idaho and Wyoming, this type is considered a grazing-induced community derived from the *Alnus incana*/Mesic Forbs type (Padgett *et al.* 1989, Manning and Padgett 1995, Jones 1992). While many

stands in Colorado fit this description, there are also several stands that remain undisturbed where the undergrowth is dominated by native graminoid cover.

Elevation Range in Colorado:

6400-9800 ft. (2000-3000 m).

Site Geomorphology:

This plant association occurs on narrow to moderately wide floodplains, stream benches, frequently flooded pointbars, recently deposited islands and dredged streambanks. It also occurs on isolated hillside seeps. Streams were classified according to the Rosgen Classification of Natural Rivers (Rosgen 1996). Stream channels can be steep and straight to highly sinuous (Rosgen's Channel Type: A3, A4, F3) or moderately steep and sinuous (Rosgen's Channel Type: B2, B3, B4, B6). Where this association occurs on point bars, stream channels are low gradient (<1% gradient) and highly sinuous (Rosgen's Channel Type: C5).

Soils:

Soils are mostly coarse alluvium, but characteristically have silt loams or sandy clay loams at the surface with a high percentage of organic matter. Soils are shallow to moderately deep, 15-30 inches (35-62 cm), and become increasingly skeletal with depth. Most profiles have 10-50% mottles at 7-10 inches (18-25 cm) depth. One profile had gleyed, mineral soils indicating saturated conditions.

Management:

Dense stands of *Alnus incana* ssp. *tenuifolia* (thinleaf alder) hinder livestock access. *Alnus incana* ssp. *tenuifolia* is not particularly palatable to livestock, but can be trampled as animals search for more palatable species (Hansen *et al*. 1995). *Salix* (willow) species are highly palatable to livestock, large mammals and beaver (Kovalchik *et al.* 1988). Open stands may provide moderate forage and shade in the summer (Hansen *et al*. 1995).

Stands of the *Alnus incana*/Mesic Graminoids plant association that are dominated by non-native grasses and grass-like plants in the undergrowth are thought to be grazing-induced stages of the *Alnus incana*/Mesic Forbs association (Hansen *et al.* 1995, Padgett *et al.* 1989, Kittel *et al.* 1996). However, several stands in Colorado have an undergrowth dominated by native grasses including *Calamagrostis canadensis* (bluejoint reedgrass) and several *Carex* (sedge) and *Equisetum* (horsetail) species (Kettler and McMullen 1996). These stands are clearly not disturbed and may represent the potential natural vegetation for stands in similar physical settings with non-native graminoids.

Most fires destroy *Alnus incana* (thinleaf alder) dominated stands resulting in a sparse herbaceous understory and bank destabilization due to root death. *Alnus incana* ssp. *tenuifolia* sprouts quickly when cut at 4-5 year intervals and can be used as pole plantings for restabilizing streambanks. Cutting in spring and winter results in rapidly growing sprouts; cutting in the summer results in fewer, slow-growing sprouts (Hansen *et al*. 1995).

Successional and Ecological Processes:

Alnus incana ssp. *tenuifolia* (thinleaf alder) is a long-lived, early-seral species. It is one of the first species to establish on fluvial or glacial deposits as well as the spoils of placer mining (Viereck 1970, Van Cleve *et al*. 1971, Chapin *et al*. 1994, Hansen *et al.* 1989). After establishment, young stands of *Alnus incana* are continually flooded. As stands mature, the stems can slow flood waters and trap sediment. Fine-textured sediments accumulate on top of the coarser alluvial material and the land surface eventually rises above annual flood levels. Flooding is then less frequent and soils begin to develop (Padgett *et al.* 1989).

Alnus incana is shade-intolerant (Viereck 1970, Chapin *et al*. 1994) and many mature stands in Colorado are restricted to streambank edges, possibly because these are the only sites where light can penetrate the neighboring overstory canopy. *Alnus incana* has been observed on high-gradient streams and is thought to require well-aerated water (Hansen *et al.* 1988, Padgett *et al.* 1989).

Undisturbed *Alnus incana* (thinleaf alder) stands may become dominated by *Salix* (willow) species or conifer stands (Hansen *et al.* 1989). In Alaska, thick stands of alders inhibit succession by competing with spruce for nutrients and light (Chapin *et al.* 1994). In Utah, *Acer negundo* (boxelder) often becomes the dominant canopy species on more xeric sites (Padgett *et al.* 1989).

Alnus incana (thinleaf alder) fixes atmospheric nitrogen through a symbiotic relationship with the bacteria *Frankenia* and increases the ecosystem nitrogen supply with the deposition of nitrogen-rich leaf litter (Binkley 1986). The annual input of nitrogen to soils from alder species ranges from 10 to 150 times the amount deposited by atmospheric precipitation alone (Binkley 1986, Bowman and Steltzer *in press*). Nitrogen-rich detritus is an important source of nutrients for the aquatic ecosystem as well.

In Nevada, Utah, southeastern Idaho, Montana and Wyoming, the *Alnus incana*/Mesic Graminoids type is considered a grazing-induced community, derived from the *Alnus incana*/Mesic Forbs plant association (Padgett *et al.* 1989, Manning and Padgett 1995, Jones 1992). In Colorado, most stands of this plant association appear to be disturbed by improper grazing and have an abundance of non-native graminoid species. A few stands, however, appear undisturbed and have an undergrowth dominated by native grasses.

Vegetation:

Alnus incana ssp. *tenuifolia* (thinleaf alder) dominates the upper canopy with 10-90% cover. Other shrubs occasionally present include: *Rosa woodsii* (Woods' rose) (1-3% cover), *Rubus deliciosus* (delicious raspberry) (1-22%), *Salix bebbiana* (Bebb willow) (8%), *S. drummondiana* (Drummond willow) (8%), *S. exigua* (coyote willow) (6-17%), and *S. monticola* (park willow) (1-16%). Trees are infrequent and may be scattered throughout the shrubland or they may occur along one edge. Tree species include: *Populus deltoides* ssp. *monilifera* (plains cottonwood) (1-22% cover) and *Salix fragilis* (crack willow) (14-20%).

The undergrowth is a thick carpet of grasses. Native graminoids include *Calamagrostis canadensis* (bluejoint reedgrass) (5-65% cover), *Carex utriculata* (beaked sedge) (2-32%), *Glyceria striata* (fowl mannagrass) (2-26%), *Carex aquatilis* (aquatic sedge) (1-20%), *Carex lanuginosa* (woolly sedge) (31%) and *Festuca rubra* (red fescue) (23%). Some stands are dominated by introduced, non-native grasses, including: *Poa pratensis* (Kentucky bluegrass) (2-41% cover), *Agrostis stolonifera* (redtop) (1-25%), and *Bromus inermis* (smooth brome) (3-23%). Forb cover is usually low relative to the amount of graminoid cover in both disturbed and undisturbed stands, but can include a high variety of species, including: *Mertensia ciliata* (chiming bells) (1-11% cover), *Mentha arvensis* (field mint) (1-14%), *Cardamine cordifolia* (bittercress) (1-8%), and *Caltha leptosepala* (marsh marigold) (7-14%).

Adjacent Riparian Vegetation:

Adjacent riparian associations include *Populus angustifolia* (narrowleaf cottonwood) woodlands; *Betula occidentalis* (river birch) and *Salix exigua* (coyote willow) shrublands; and *Calamagrostis canadensis* (bluejoint reedgrass), *Carex aquatilis* (aquatic sedge), *C. utriculata* (beaked sedge), and "Mesic Forbs" meadows.

Adjacent Upland Vegetation:

Pinus ponderosa (ponderosa pine), *Pseudotsuga menziesii* (Douglas fir), and *Pinus edulis* (pinyon pine) woodlands, and *Artemisia tridentata* (sagebrush) shrublands can occur on adjacent hill slopes.

Potential Conservation Areas supporting the *Alnus incana ssp. tenuifolia*-mesic graminoids plant association:

Monument Creek

Global Scientific Name: *Alnus incana* ssp. *tenuifolia-Cornus sericea*

Global Common Name: thinleaf alder-red-osier dogwood

Wetland System: palustrine

Related Literature and Synonyms: The following two communities are synonymous with the Colorado *Alnus incana-Cornus sericea* plant association: the *Alnus incana/Cornus sericea* community type (Padgett *et al.* 1989 and Manning and Padgett 1995) and the *Alnus incana* ssp. *tenuifolia/Swida sericea* plant association (Komarkova 1986). *Swida sericea* is synonym for *Cornus sericea* (Kartesz 1994, Weber and Wittmann 1996a, 1996b).

Similar Communities: Closely related communities include: the *Alnus incana* ssp. *tenuifolia/Ribes hudsonianum* (thinleaf alder/northern black current) community type (Youngblood *et al.* 1985) which has significant cover of *Ribes hudsonianum*, the *Cornus sericea/Galium triflorum* (red-osier dogwood/sweet-scented bedstraw) community type (Youngblood *et al.* 1985) which includes *Alnus* in the canopy, but not consistently, the *Alnus incana/Rudbeckia laciniata* (thinleaf alder/cutleaf coneflower) plant association (Cooper and Cottrell 1990) which has a more diverse forb undergrowth, and the *Alnus oblongifolia-Cornus sericea* (Arizona alder-red-osier dogwood) community type (Durkin *et al.* 1994) which has a different species of *Alnus* and more diverse and dense understory.

Regional Distribution: This plant association occurs in Nevada, Utah (Padgett *et al.* 1989, Manning and Padgett 1995), and Colorado (Johnston 1987, Colorado Natural Heritage Program 2001a).

Distribution in Colorado: This plant association occurs in the Yampa, Colorado, Gunnison, San Juan, Arkansas and Rio Grande River Basins (Johnston 1987, Kittel and Lederer 1993, Kittel *et al.* 1994, Kittel *et al.* 1995, Kittel *et al.* 1996, Richard *et al.* 1996, Kittel *et al.* 1999a).

Global Rank Comments: This plant association is ranked a G3G4. This plant association is widespread throughout the Rocky Mountains. However, all of the occurrences are small and threatened by improper grazing and stream impoundments. The double rank indicates the total number of estimated occurrences is thought to be between 20 and 100.

Reasons for State Rank: This plant association is ranked S3. There are less than 100 stands of this plant association is Colorado. This association is threatened by improper livestock grazing, stream impoundments, and heavy recreational use.

General Description and Comments: The *Alnus incana* ssp. *tenuifolia-Cornus sericea* (thinleaf alder-red-osier dogwood) plant association is a narrow thicket of medium to tall shrubs lining the stream bank. It is an uncommon association restricted to small tributaries and narrow, constricted reaches of larger rivers. Due to heavy shading, there is usually a limited herbaceous understory.

Elevation Range in Colorado: 6400-8600 ft. (2000-2600 m).

Site Geomorphology: This plant association occurs on narrow, rocky banks and benches of small channels as well as narrow, constricted reaches of larger rivers. It can also occur along overflow channels and narrow tributaries. Streams were classified according to the Rosgen Classification of Natural Rivers (Rosgen 1996). Stream channels are steep and narrow (Rosgen's Channel Type: A2, A3, A4), wider and moderately sinuous (Rosgen's Channel Type: B3, B4), or wider and highly sinuous (Rosgen's Channel Type: C2, C3).

Soils: Soils range from loamy sand to sandy clay loam. Mottling is evident at approximately 12 inches (30 cm) and gravel or cobble layers appear at 20-40 inches (50-100 cm) beneath the surface. In the Colorado River Basin, the soils classify as recently buried typic Cryaquolls, sandy typic Cryoborolls, Histisols, typic Cryaquents, loamy to clayey Cryofluvents and fragmental Cryaquents

Vegetation: This plant association is characterized by a dense thicket of shrubs dominated by 10-80% cover each of *Alnus incana* ssp. *tenuifolia* (thinleaf alder) and *Cornus sericea* (red-osier dogwood). *Salix exigua* is often present (42% frequency) with 1-10% cover. A wide variety of other shrub species may be present, but with < 37% frequency, including *Salix eriocephala* var. *ligulifolia* (strapleaf willow) (3-30%) and *Salix lasiandra* var. *caudata* (whiplash willow) (3-30%), *Salix monticola* (mountain willow) (1-20%), *Lonicera involucrata* (honeysuckle) (1-20%), *Rosa woodsii* (woods rose) (1-20%), *Betula occidentalis* (river birch) (3-20%), *Salix bebbiana* (Bebb willow) (8-70%), and *Rubus idaeus* (raspberry) (3-9%). One stand in the Yampa River Basin had 70% cover of *Salix bebbiana.* Tree species are scattered and not consistently present.

Forb cover is highly variable depending on the amount of light that penetrates through the canopy. Forb species include *Rudbeckia laciniata* (cutleaf coneflower) (1-20%) *Heracleum maximum* (cow parsnip) (1-17%), *Maianthemum stellatum* (false Solomon seal) (1-10%) and *Ozmorhiza depauperata* (blunt-fruit sweet cicely) (1-10%), *Ligusticum porteri* (southern ligusticum) (1-3%). Graminoid cover is usually low, but can include *Poa pratensis* (Kentucky bluegrass) (1-45%) and *Equisetum arvense* (meadow horsetail) (1-10%).

Successional and Ecological Processes: *Alnus incana* ssp. *tenuifolia* (thinleaf alder) is a long-lived, early-seral species. It is one of the first species to establish on fluvial or glacial deposits as well as the spoils of placer mining (Viereck 1970, Van Cleve *et al.* 1971, Chapin *et al.* 1994, Hansen *et al.* 1989). After establishment, young stands of *Alnus incana* are continually flooded. As stands mature, the stems can slow flood waters and trap sediment. Fine-textured sediments accumulate on top of the coarser alluvial material and the land surface eventually rises above annual flood levels. Flooding is then less frequent and soils begin to develop (Padgett *et al.* 1989).

Alnus incana is shade-intolerant (Viereck 1970, Chapin *et al.* 1994), and many mature stands in Colorado are restricted to stream bank edges, possibly because these are the only sites where light can penetrate the neighboring overstory canopy. *Alnus incana* has been observed on high-gradient streams and is thought to require well-aerated water (Hansen *et al.* 1988, Padgett *et al.* 1989).

Undisturbed *Alnus incana* (thinleaf alder) stands may become dominated by *Salix* (willow) species or conifer stands (Hansen *et al.* 1989). In Alaska, thick stands of alders inhibit succession by competing with spruce for nutrients and light (Chapin *et al.* 1994). In Utah, *Acer negundo* (boxelder) often becomes the dominant canopy species on more xeric sites (Padgett *et al.* 1989).

Alnus incana (thinleaf alder) fixes atmospheric nitrogen through a symbiotic relationship with the bacteria *Frankia* and increases the ecosystem nitrogen supply with the deposition of nitrogen-rich leaf litter (Binkley 1986). The annual input of nitrogen to soils from alder species ranges from 10 to 150 times that deposited by atmospheric precipitation alone (Binkley 1986, Bowman and Steltzer *in press*). Nitrogen rich detritus is an important source of nutrients for the aquatic ecosystem as well.

In Colorado, the *Alnus incana* ssp. *tenuifolia-Cornus sericea* (thinleaf alder-red-osier dogwood) plant association is tolerant of flooding and requires a high water table each spring. It appears to be a stable, long-lived association where succession to other types can be very slow (Manning and Padgett 1995).

Adjacent Riparian Vegetation: The *Alnus incana* ssp. *tenuifolia-Cornus sericea* (thinleaf alder-red-osier dogwood) plant association is often the only riparian community along a reach. However, *Pseudotsuga menziesii* (Douglas-fir) forests can occur along narrow reaches. *Populus angustifolia* (narrowleaf cottonwood) forests occur on floodplains and stream banks along wider reaches. *Salix exigua* (coyote willow) shrublands also occur along wider reaches on point bars and stream banks.

Adjacent Upland Vegetation: At lower elevations, *Pseudotsuga menziesii* (Douglas-fir) forests occur on north-facing slopes. *Pinus ponderosa* (ponderosa pine) forests and *Quercus gambelii* (Gambel oak) and *Amelanchier* spp. (serviceberry) shrublands occur on steep south-facing slopes. At higher elevations, *Abies lasiocarpa-Picea engelmannii* (subalpine fir-Engelmann spruce) forests and *Populus tremuloides* (quaking aspen) woodlands grow on north-facing slopes.

Management: *Alnus incana* ssp. *tenuifolia* (thinleaf alder) is not particularly palatable to livestock, but can be trampled as animals search for more palatable forb species (Hansen *et al*. 1995). *Cornus sericea* (red-osier dogwood) is considered to be an "ice cream" plant (e.g., it is readily eaten and is a preferred browse species) for livestock and wildlife. However, dense stands of *Alnus incana* ssp. *tenuifolia* and *Cornus sericea* hinder livestock access. Season-long grazing reduces the native forb cover and allows non-native grasses to increase (Padgett *et al.* 1989, Hansen *et al.* 1995).

According to Hansen *et al*. (1995), most fires kill *Alnus incana* (thinleaf alder) dominated stands, resulting in a sparse herbaceous understory and bank destabilization due to root death. *Cornus sericea* can survive all but the hottest fires. After fire, new shoots sprout from the surviving rhizomes (Hansen *et al.* 1995). Frequent fire may sift this community to *Cornus sericea* dominated types.

Both *Alnus incana* ssp. *tenuifolia* and *Cornus sericea* are capable of sprouting and have rhizomatous roots which provide good stream bank stabilization. *Alnus incana* ssp. *tenuifolia* sprouts quickly when cut at 4-5 year intervals. Cutting in spring and winter results in rapid sprouts. Cutting in the summer results in fewer, slow-growing sprouts. The rapid growth following direct seeding or transplanting allows this shrub to quickly establish on streambanks (Hansen *et al*. 1995). *Alnus incana* ssp. *tenuifolia* and *Cornus sericea* may be useful for revegetating higher gradient streams where seasonal, scouring floods occur (Hansen *et al*. 1995)

Potential Conservation Areas supporting the *Alnus incana ssp. tenuifolia-Cornus sericea* plant association:
Monument Creek

Global Scientific Name: *Buchloe dactyloides- Ratibida tagetes – Ambrosia linearis* plant association

Common Name: buffalograss playa

Wetland System: palustrine

Related Literature and Synonyms: This plant association is newly described in 2001. There are no known synonyms.

Similar Communities:

Pascopyrum smithii - Buchloe dactyloides - (*Phyla cuneifolia, Oenothera canescens*) Herbaceous Vegetation is similar but differs in the prevalence of *Pascopyrum smithii. Pascopyrum smithii – Buchloe dactyloides* is dominated by *Pascopyrum smithii* and the *Buchloe-Ratibida-Ambrosia* plant association rarely contains *Pascopyrum* and if present, it is generally at less than 2% cover. In addition, *Ambrosia linearis*, plains ragweed, a Colorado endemic with a range of about 50 miles by 100 miles was consistently documented within this buffalograss playa plant association. The *Pascopyrum smithii-Eleocharis* spp. plant association can occur in the center of some playas (wettest portion) during wet years.

Regional Distribution:

This plant association is only know from southeastern Colorado within the limited range of *Ambrosia linearis.*

Distribution in Colorado:

This plant association is newly described from the El Paso County Wetland Survey. During the field season of 2000, 21 suboccurrences were documented.

Reasons for Global Rank:

This plant association is documented only from Colorado.

Global Rank:

Global rank is based on the status of a taxon throughout its range. This association is ranked G3, either very rare and local throughout its range or found locally, even abundantly, in a restricted range or because of other factors making it vulnerable to extinction throughout its range (20 to 100 occurrences). The global rank of *Ambrosia linearis* is G3.

Reasons for State Rank:

In Colorado, this community occurs within playas on the eastern plains within the limited range of *Ambrosia linearis*. It has been documented only in El Paso County. Few pristine high-quality stands are known and only a few small stands are formally protected.

State Rank:

State rank is based on the status of a taxon in an individual state. In Colorado, this association is ranked S3, rare in state (21 to 100 occurrences).

General Description and Comments:

This plant association is found within playas in El Paso County, Colorado. During the 2000 field season over 50 playas were visited. The playas are generally small (approx. 0.5 – 3 acres) and occur in greatest concentration within a 50 square mile area. Where playas are the most concentrated, over 10 playas can occur within a square mile. Roughly one quarter to one half of the playas have not been altered , the remaining playas have had the center excavated, are impacted by roads, or have undergone cultivation. Nearly all of the playas are used as rangeland.

The buffalograss playa plant association occurs within a matrix of shortgrass prairie (*Bouteloua gracilis* with *Aristida purpurea*). The vegetation in the playas generally occurs in bands where the outermost rim generally supports the highest density of plains ambrosia and coneflower.

The playas provide heterogeneity within a sea of shortgrass prairie which is important biologically to provide for the needs of a wide range of species (Knopf 1996a, Hoagland and Collins 1997). Other factors affecting grassland environmental and compositional heterogeneity include fire, soils, grazing, and prairie dogs. Because fire and grazing are heavily managed and prairie dogs have drastically reduced in numbers, playas may serve as the primary source of heterogeneity in the region (Hoagland and Collins 1997).

Elevation Range in Colorado:
5,300 to 6,100 feet

Site Geomorphology:
This plant association occurs within playas or depressions between the many low rolling hills of shortgrass prairie. There are no surface channels draining the area, instead rainfall and runoff collect in these basins forming ephemeral wetlands. It is not clear whether these depressions are wind deflated playas (Bolen et al. 1989) or remnants of buffalo wallows (F. Knopf, pers. comm., USGS; Uno 1989), both of which develop clay bottoms and collect runoff after heavy rainstorms. The playas are generally circular to oval-shaped, oriented roughly north south, and range in size from about 0.5 to 10 acres (0.2 – 5 ha).

These basins remain dry throughout most of the year and collect water only after heavy rainfall. In southeastern El Paso County, the heavy rains generally fall in the late summer and in many cases a series of storms are required in order for the playas to retain water (G. Paul, landowner, pers. comm., Weathers 2000). Runoff collecting in a dry playa infiltrates cracks in the clay bottom of the playa and swells the clay, effectively sealing the playa bottom (Zartman et al. 1994). After the clay has been wetted, subsequent storms can result in playa filling. The playas may hold water for periods ranging from days to weeks, depending on the size of the drainage basin and intensity of the rainstorm (Weathers 2000). In some cases, these playas may hold water from May to August (G. Paul, landowner, pers. comm.) or in dry years may remain dry year round.

Soils:
The soils in the playa bottoms are fine-textured sandy clay, silty clay, or clay with 5-10% mottles.

Management:
All of the known occurrences of the buffalograss playa plant association are privately owned or on leased State Land Board property. Most are used for cattle grazing. A few have been tilled for crops or developed for rural housing. The most common modifications of the playas are unpaved roads passing through or excavation of the center of the playa to retain water longer for livestock watering. More recently, development pressure is increasing and land is being subdivided into 35-acre parcels. Within these subdivided properties, in some cases homes have been placed adjacent to or within playas.

Successional and Ecological Processes:
The most common explanation for the origin of playas is deflation, or wind erosion, though theories on playa formation are controversial (Osterkamp and Wood 1987). The consistent north-south orientation of the playas in southeastern El Paso County suggests deflation influenced their formation. As previously mentioned, these playas are also consistent with descriptions of buffalo wallows. Wallows are formed by bison pawing the ground, creating patches of bare ground in which to dust bathe (Uno 1989), or perhaps mud bathe to protect against biting insects or aid in shedding their heavy fur (F. Knopf, USGS, pers. comm., Hornaday 1887). Active wallows range from 3 to 5 meters in diameter and merging of adjacent wallows can create wallows larger than about 0.5 acre (1,400 square meters) (Knopf 1996a, Uno 1989). Bison were extirpated from the area by about 1875 (Hornaday 1889) but evidence of their wallows can remain evident on the landscape for more

than a hundred years (Knopf 1996a). Perennial grasses invade wallows not used by bison (Uno 1989). It is possible that the southeast El Paso County playas result from of a combination of factors including deflation and buffalo wallowing.

Vegetation:

The vegetation in the playas is shorter than the surrounding blue grama (*Bouteloua gracilis*) shortgrass prairie and consists of different species. The dominant species in the playas is the perennial warm-season grass buffalograss (*Buchloe dactyloides*). Growing with the buffalograss are the perennial forbs plains ambrosia (*Ambrosia linearis*) (G3 S3) and short-ray prairie coneflower (*Ratibida tagetes*).

The vegetation in the playas generally occurs in bands where the outermost rim generally supports the highest density of plains ambrosia and coneflower. Other plants growing in the playas include a dryland sedge (*Carex eleocharis* ssp. *stenophylla*), prostrate vervain (*Verbena bracteata*), frog-fruit (*Phyla cuneifolia*), spreading yellow cress (*Rorripa sinuata*), greenthread (*Thelesperma megapotamicum*, *T. filifolium*), curly cup gumweed (*Grindelia squarossa*), and Russian thistle (*Salsola iberica*). Interestingly, buffalograss submerged during the growing season has been known to withstand more than five weeks of inundation (Porterfield 1945). In the playas that remain wet the longest, there may be a small bare ground portion in the center with very sparse cover that could include western wheatgrass (*Pascopyrum smithii*), spikerush (*Eleocharis palustris and E. acicularis*), goosefoot (*Chenopodium sp.*), or weedy annuals. Plains ambrosia is a shortgrass prairie species that is restricted to an area of about 100 miles by 50 miles (primarily in El Paso and Lincoln counties). Plains ambrosia requires a little more moisture than most upland plants and as such, the playas appear to be their native habitat as the clay soils of the playas retain moisture longer than the upland soils. Roadsides also appear to provide the extra moisture required by the plains ambrosia and, as such, plains ambrosia is very prevalent on the sides of many unpaved roads in the area. The playas in El Paso County are the best known occurrences for this species.

Adjacent Riparian Vegetation:

Not applicable

Adjacent Upland Vegetation:

Upland vegetation is typically shortgrass prairie matrix dominated by blue grama (*Bouteloua gracilis*).

Potential Conservation Areas supporting the *Buchloe dactyloides-Ratibida tagetes-Ambrosia linearis* plant association:

Buffalograss Playas
Bohart Playas

Global Scientific Name: *Carex lanuginosa* plant association

Common Name: Woolly Sedge

Wetland System: palustrine

Related Literature and Synonyms:

The *Carex lanuginosa* community types documented from Montana (Hansen *et al*. 1988, Hansen *et al*. 1991), Idaho, Oregon, and Utah (Bourgeron and Engelking 1994) are synonymous with the Colorado *Carex lanuginosa* plant association.

Similar Communities:

Closely related communities include two *Carex lanuginosa-Scirpus* spp. (woolly sedge-bulrush) plant associations and the *Carex lanuginosa-Spartina pectinata* (woolly sedge-prairie cordgrass) plant association reported from North and South Dakota, Nebraska, and Kansas (Faber-Langendoen 1996).

Regional Distribution:

This plant association occurs in North and South Dakota, Nebraska, Kansas (Faber-Langendoen 1996), Montana (Hansen *et al*. 1988, Hansen *et al*. 1991), Oregon, Utah, Idaho, and Colorado (Kovalchik 1987, Bourgeron and Engelking 1994, CNHP 1999).

Distribution in Colorado:

This plant association is documented from the Gunnison (Kittel *et al*. 1995), South Platte (Kittel *et al*. 1996, Kittel *et al*. 1997), and Rio Grande River Basins (CNHP 1999).

Reasons for Global Rank:

This community is documented from Oregon east to South Dakota and Montana south to Colorado and Kansas.

Global Rank:

Global rank is based on the status of a taxon throughout its range. This association is ranked G3?, either very rare and local throughout its range or found locally, even abundantly, in a restricted range or because of other factors making it vulnerable to extinction throughout its range (20 to 100 occurrences). This plant association is documented from Colorado and is expected to occur elsewhere. The question mark in the Global rank indicates that the community is suspected to be more abundant, but additional locations have not been documented.

Reasons for State Rank:

In Colorado, this community has increased in abundance along regulated rivers on the Western Slope and may have decreased in abundance on streams on the eastern plains. Few, pristine high-quality stands are known, and no stands are formally protected.

State Rank:

State rank is based on the status of a taxon in an individual state. In Colorado, this association is ranked S3, rare in state (21 to 100 occurrences).

General Description and Comments:

Carex lanuginosa (woolly sedge) is a distinctive wetland-indicator sedge that forms small- to medium-size meadows. It occurs in depressions and swales at the saturated edge of stream channels or in standing water. On the eastern plains of Colorado, it can occur under the canopy of cottonwood trees, forming the *Populus deltoides* ssp. *monilifera/Carex lanuginosa* (plains cottonwood/woolly sedge) plant association.

Elevation Range in Colorado:

5000-7400 ft (1500-2300 m).

Site Geomorphology:

This plant association occurs in very wet conditions, generally at the saturated edge of the stream channel or in standing water. Streams were classified according to the Rosgen Classification of Natural Rivers (Rosgen 1996). Stream channels are sinuous with a moderate gradient (Rosgen's Channel Type: C4, C6).

Soils:

Soils are deep silt loams to clays. Mottling often occurs throughout the profile.

Management:

Carex lanuginosa (woolly sedge) is highly palatable to most livestock when young. Overuse of this plant association may result in the increase of the non-native grass, *Poa pratensis* (Kentucky bluegrass), and compaction of saturated soils. Periods of rest from livestock grazing are necessary in order to maintain the vigor of this association. Due to its long, creeping rhizomes, *Carex lanuginosa* is an effective streambank stabilizer and is resistant to fire damage (Hansen *et al.* 1988).

Successional and Ecological Processes:

The *Carex lanuginosa* (woolly sedge) plant association appears to be a fairly stable community because of its strongly rhizomatous roots and well developed soils (Padgett *et al.* 1989). In Montana, the *Carex lanuginosa* plant association can be associated with large amounts of *Carex lasiocarpa* (slender sedge). With season-long grazing, *Carex lanuginosa* decreases in abundance, shifting dominance towards *Poa pratensis* (Kentucky bluegrass). In Colorado, stands of *Carex lanuginosa* occurring on streambanks with heavy, cohesive clay soils appear to be stable, long-lived communities as long as the water table remains near the surface.

Vegetation:

This plant association is characterized by a nearly monotypic stand of 40-90% cover of *Carex lanuginosa* (woolly sedge). Other graminoid cover is minor, but includes *Phalaris arundinacea* (reed canarygrass) (10%), *Carex nebrascensis* (Nebraska sedge) (2%), *Schoenoplectus pungens* (threesquare bulrush) (1%), *Equisetum arvense* (field horsetail) (1%), *Equisetum hyemale* (scouringrush horsetail) and *Poa pratensis* (Kentucky bluegrass) (8%). Scattered forbs include *Mentha arvensis* (field mint) (8-13%), and *Cirsium arvense* (Canadian thistle) (4%).

Adjacent Riparian Vegetation:

Stands of *Salix amygdaloides* (peachleaf willow) and *Populus angustifolia* (narrowleaf cottonwood) woodlands occur along foothill streams. *Populus deltoides* (eastern cottonwood) woodlands occur along streams on the eastern plains.

Adjacent Upland Vegetation:

Along foothill tributaries, adjacent hill slopes have *Pinus ponderosa* (ponderosa pine) forests. Along eastern plains streams, adjacent hill slopes have *Bouteloua gracilis* (blue grama) shortgrass prairies.

Potential Conservation Areas supporting the *Carex lanuginosa* plant association:

Judge Orr Road

Global Scientific Name: *Carex nebrascensis* plant association

Common Name: Nebraska sedge

Wetland System: palustrine

Related Literature and Synonyms:

The *Carex nebrascensis* (Nebraska sedge) community types from Nevada (Manning and Padgett 1995), Montana (Hansen *et al.* 1995), Idaho, Wyoming (Youngblood *et al.* 1985a, Jones and Walford 1995), Utah (Padgett *et al.* 1989), Colorado (Cooper and Cottrell 1990, CNHP 1999), and New Mexico (Durkin *et al.* 1994, Durkin *et al.* 1995, Bourgeron and Engelking 1994) are synonymous with the Colorado *Carex nebrascensis* plant association.

Similar Communities:

The *Carex nebrascensis/Deschampsia cespitosa* (Nebraska sedge/tufted hairgrass) plant association documented from Wyoming and Idaho (Johnston 1987) and the *Carex nebrascensis/Catabrosa aquatica-Juncus arcticus* (Nebraska sedge/water whorlgrass-arctic sedge) plant association documented from Colorado are also considered synonymous with the Colorado *Carex nebrascensis* plant association.

Regional Distribution:

This plant association occurs in Nevada (Manning and Padgett 1995), Montana (Hansen *et al.* 1995), Idaho, Wyoming (Youngblood *et al.* 1985a, Jones and Walford 1995), Utah (Padgett *et al.* 1989), New Mexico (Durkin *et al.* 1994, Durkin *et al.* 1995, Bourgeron and Engelking 1994), and Colorado (Johnston 1987, Cooper and Cottrell 1990, CNHP 1999).

Distribution in Colorado:

This plant association occurs in the Yampa River Basin (Kittel and Lederer 1993), the White and Colorado River Basins (Kittel *et al.* 1994), the Rio Grande River Basin (CNHP 1999), and the South Platte River Basin (Baker 1982 [as cited in Johnston 1987], Cooper and Cottrell 1990, Kittel *et al.* 1996, Kittel *et al.* 1997).

Reasons for Global Rank:

This is a common community documented from many western states.

Global Rank:

Global rank is based on the status of a taxon throughout its range. This association is ranked G4, apparently secure globally, though it may be quite rare in parts of its range, especially at the periphery.

Reasons for State Rank:

In Colorado, this is a common but declining association. It is threatened by improper livestock grazing, stream flow alterations and heavy recreational use.

State Rank:

State rank is based on the status of a taxon in an individual state. In Colorado, this association is ranked S3, rare in state (21 to 100 occurrences).

General Description and Comments:

Carex nebrascensis (Nebraska sedge) is a widespread species and generally forms small- to medium-size meadows. It forms an open wetland meadow occurring along the margins of streambanks, lakes and seeps on the plains. The soils are generally saturated for much of the growing season and are subject to compaction by livestock.

Elevation Range in Colorado:

4100-7900 ft (1200-2400 m).

Site Geomorphology:

This plant association appears to be restricted to saturated soils of flat floodplains bordering ponds or pools adjacent to stream channels. It can also occur along flat, marshy areas surrounding springs. Streams were classified according to the Rosgen Classification of Natural RiversRosgen 1996). Stream channels are low-gradient (0.5-0.75%), moderately narrow, and sinuous (Rosgen's Channel Type: C6, F6) or very narrow and sinuous (Rosgen's Channel Type: E6).

Soils:

Soils are heavy clays and silty clay loams with high organic matter content. Anoxic conditions often occur within 8 inches (20 cm) of the surface either in the form of a gleyed layer or abundant mottling.

Management:

Carex nebrascensis is highly palatable to livestock in the spring and early summer when stems and leaves are tender. Forage production in this association is high and grazing pressure can be heavy. However, *Carex nebrascensis* can withstand heavy grazing due to its rhizomatous growth. Since the saturated soils of this association are easily compacted by livestock in the spring and early summer, late season grazing is recommended in order to prevent trampling damage to plants and to allow for regrowth (Hansen *et al*. 1995). On the Rio Grande National Forest in south-central Colorado, livestock disperse more readily in the spring, and tend to concentrate on the wetter sites in the late summer, such that less damage occurs with spring and summer grazing on this association (Dean Erhard, pers. comm. [USFS 1997]).

Beaver activity in the vicinity of this plant association is important for maintaining the health of the riparian ecosystem. Beaver dams abate channel down cutting, bank erosion, and downstream movement of sediment. Beaver dams raise the water table across the floodplain and provide year-round saturated soils. Plant establishment and sediment build-up behind beaver dams raise the channel bed and create a wetland environment. Land managers should consider maintaining beaver rather than removing them (Hansen *et al*. 1995).

According to Hansen *et al*. (1995), *Carex nebrascensis* is well-suited to prescribed burning, but livestock need to be removed for a year prior to burning to build up root reserves. Fire will reduce litter accumulation and temporarily increase plant productivity. Fire apparently does not shift the species composition away from dominance by *Carex nebrascensis* (Hansen *et al*. 1995).

Successional and Ecological Processes:

In Montana, the *Carex nebrascensis* (Nebraska sedge) type is considered a grazing-disclimax. Under season-long grazing, *Carex nebrascensis* increases in abundance, replacing former dominant species (Hansen *et al*. 1995). However, under extreme grazing conditions and a resulting drop in the water table, *Juncus balticus* (Baltic rush) or *Poa pratensis* (Kentucky bluegrass) can eventually replace *Carex nebrascensis.* In Nevada, sites dominated by *Carex nebrascensis* are considered the Potential Natural Community (Manning and Padgett 1995), which appears to be the case in undisturbed stands in Colorado.

Vegetation:

Carex nebrascensis (Nebraska sedge) contributes the dominant cover (10-80%) and is the diagnostic species (has 100% constancy) for this type. A wide variety of other graminoids and forbs may be present, depending on the elevation and wetness of the site. Other graminoids species that can be abundant (10-40% cover) include *Eleocharis palustris* (common spikerush), *Carex praegracilis* (clustered field sedge), and *Schoenoplectus tabernaemontani* (softstem bulrush). Forb cover is generally low, but can be high in moist locations. Common forb species include *Ranunculus cymbalaria* (buttercup), *Mentha arvensis* (field mint), *Mimulus glabratus* (monkey flower), and *Melilotus officinalis* (sweetclover). In one very wet site, *Potamogeton* sp. (pondweed) was abundant with 34% cover.

Adjacent Riparian Vegetation:

Populus angustifolia (narrowleaf cottonwood) forests, *Salix exigua* (coyote willow), *S. lasiandra* var. *lasiandra* (Pacific willow), and *S. boothii* (Booth's willow) shrublands, and *Carex praegracilis* (clustered field sedge), *C. utriculata* (beaked sedge), and *Schoenoplectus acutus* var. *acutus* (hardstem bulrush) meadows occur in adjacent riparian areas.

Adjacent Upland Vegetation:

Pinus edulis-Juniperus spp. (pinyon pine-juniper) and *Quercus gambelii* (Gambel oak) woodlands, *Sarcobatus vermiculatus* (greasewood) and *Artemisia tridentata* (big sagebrush) shrublands, and *Bouteloua gracilis* (blue grama) short-grass prairies occur on adjacent hill slopes.

Potential Conservation Areas supporting the *Carex nebrascensis* plant association:

Chico Creek
Judge Orr Road

Global Scientific Name: *Carex praegracilis* plant association

Common Name: clustered sedge

Wetland System: palustrine

Related Literature and Synonyms:

Three closely related communities may be synonymous with the Colorado *Carex praegracilis* plant association. They are: 1) the *Carex praegracilis-Carex aquatilis* (clustered sedge-aquatic sedge) type (Bourgeron and Engelking 1994), 2) the *Juncus balticus-Carex praegracilis* type (Durkin *et al.* 1994), and 3) the *Carex praegracilis* dominance type (Hansen *et al.* 1988). Additional stands dominated by *Carex praegracilis* are found in Utah, Idaho (Jones and Walford 1995), Montana (Hansen *et al.* 1988), eastern Wyoming (Jones and Walford 1995), and in moist swales of the Great Plains (Hermann 1970); however, no quantitative community descriptions are available for comparison.

Regional Distribution:

Plant associations dominated or co-dominated by this species occur in Montana (Hansen *et al.* 1988), Idaho, Utah (Bourgeron and Engelking 1994), Wyoming (Jones and Walford 1995), New Mexico (Durkin *et al.* 1994), and Colorado (CNHP 1999).

Distribution in Colorado:

This association is found along small creeks of the Pawnee National Grassland and is likely to occur throughout the eastern plains, although only one site was sampled during the study (Kittel *et al.* 1997, CNHP 1999).

Reasons for Global Rank:

This association is known from several western states, although few stands have been well documented.

Global Rank:

Global rank is based on the status of a taxon throughout its range. This association is ranked G3, very rare or local throughout its range or found locally in a restricted range (21 to 100 occurrences). Threatened throughout its range.

Reasons for State Rank:

This association is known from only a few locations on the Pawnee National Grassland. More inventory information (stand location, condition, species list) is requested.

State Rank:

State rank is based on the status of a taxon in an individual state. In Colorado, this association is ranked S2, imperiled in state because of rarity (6 to 20 occurrences), or because of other factors demonstrably making it very vulnerable to extirpation from the state. (Endangered or threatened in state).

General Description and Comments:

The *Carex praegracilis* (clustered sedge) plant association forms small meadows in swales and along stream channels on the short-grass prairie in eastern Colorado, and in similar habitats in other Rocky Mountain states.

Elevation Range in Colorado:

5000 ft. (1500 m).

Site Geomorphology:

This plant association occurs along small, shallow drainages, usually no more than 7-16 ft (2-5 m) wide. Streams were classified according to the Rosgen Classification of Natural Rivers (Rosgen 1996). The

streambanks are gentle and flat. Stream channels are wide and flat, with little sinuosity, low gradient (.5-1%), and little to no floodplain development (Rosgen's Channel Type: F6).

Soils:

Soils are deep and range from heavy clays to sandy clay loams with mottling.

Management:

In southwestern Montana, *Carex praegracilis* (clustered sedge) forms large meadows. This sedge is considered to have medium to high forage value for horses and cattle, especially early in the grazing season (Hermann 1970). In Colorado, *Carex praegracilis* never forms extensive meadows and may be limited to more mesic habitats found within riparian areas. Soils of this association are susceptible to compaction if grazed in early spring and summer when saturated.

Carex praegracilis may be an effective stabilizer of degraded, wet meadows. It has long, creeping rhizomes that quickly produce a tall, dense canopy of aboveground shoots (Hansen *et al*. 1988).

Successional and Ecological Processes:

Little is known about the successional pattern of *Carex praegracilis* (clustered sedge) dominated areas.

Vegetation:

In this plant association the vegetation completely covers the ground in narrow bands following the stream bed dominated by *Carex praegracilis* (clustered sedge) (25-30% cover), with associated *Carex nebrascensis* (Nebraska sedge) (8-12%), *Eleocharis palustris* (common spikerush) (11%), and *Equisetum laevigatum* (scouring rush) (<5%). No trees or shrubs are present.

Adjacent Riparian Vegetation:

The *Carex praegracilis* (clustered sedge) plant association often occurs as the only vegetation type along small streams. It can occur with patches of *Carex nebrascensis* (Nebraska sedge) and *Agropyron smithii* (Western wheatgrass) or patches of *Schoenoplectus pungens* (threesquare bulrush) and *Schoenoplectus acutus* var. *acutus* (hardstem bulrush) in adjacent pools within the channel.

Adjacent Upland Vegetation:

The upland is short-grass prairie. In years of high precipitation, large patches of *Descurainia sophia*, a non-native mustard, can also occur.

Potential Conservation Areas supporting the *Carex praegracilis* plant association:

Chico Creek
Judge Orr Road

Global Scientific Name: *Corylus cornuta* plant association

Global Common Name: beaked hazelnut

Wetland System Type: palustrine

Related Literature and Synonyms: The following three communities are synonymous with the Colorado *Corylus cornuta* plant association: 1) the *Corylus cornuta/Viola canadensis* (hazelnut/violet) plant association (Cooper and Cottrell 1990), 2) the *Pseudotsuga menziesii/Corylus cornuta* plant association (Kittel 1994, Kittel *et al*. 1996), and 3) the *Populus tremuloides/Corylus cornuta* plant association (Bourgeron and Engelking 1994, Dorn and Dorn 1977, Alexander 1988)

Similar Communities: Closely related communities include the *Betula papyrifera/ Corylus cornuta* (paper birch/hazelnut) plant association (Johnston 1987) and the *Acer macrophyllum-Pseudotsuga menziesii/Corylus cornuta* (maple-Douglas-fir/hazelnut) plant association (Bourgeron and Engelking 1994).

Classification and Recognition Problems: *Corylus cornuta* (hazelnut) is a relict species in Colorado. It is a common plant in the eastern and northwestern U.S. and occurs in smaller patches across the Great Plains in the US and lower Canada (Weber 1990, Gleason and Conquest 1963). Stands in Colorado may indicate the southwestern boundary of its range. These stands survive in the arid west by growing in cool, mesic canyon ravines (Weber 1990). Because it is a relict species in Colorado, the classification ignores any overstory tree species. The *Corylus cornuta* plant association is therefore considered a shrubland with a tree canopy, even though the amount of tree canopy is abundant enough to be considered a forested community.

Regional Distribution: This plant association occurs in Wyoming, South Dakota (Bourgeron and Engelking 1994) and Colorado (Colorado Natural Heritage Program 2001a).

Distribution in Colorado: This plant association occurs only in narrow, cool, foothill canyon ravines of the Colorado Front Range (Cooper and Cottrell 1990, Kittel 1994, Kittel *et al*. 1996).

Global Rank Comments: This plant association is ranked G3. This association is documented along the eastern edge of the Rocky Mountains. It may be more abundant in the eastern and northwestern United States.

State Rank Comments: In Colorado, this association (S1) is known only to occur in narrow canyons along the eastern flank of the northern Front Range.

General Description and Comments: The *Corylus cornuta* plant association is thicket of med.-tall (4-6 ft., 1.5-2 m) shrubs. It grows in cool, narrow foothill canyons along the Colorado Front Range. Stands usually have an overstory canopy of trees, such as *Pseudotsuga menziesii* (Douglas-fir) or *Populus tremuloides* (quaking aspen).

Elevation Range in Colorado: 6500-7500 ft. (2000-2300 m).

Site Geomorphology: This plant association occurs on steep, well-defined stream banks in very narrow (<50 m wide) valley bottoms. Streams were classified according to the Rosgen Classification of Natural Rivers (Rosgen 1996). Stream channels are generally quite rocky and steep (5% gradient) with little sinuosity (Rosgen's Stream Type: A2, B2).

Soil: Some soils have a top layer of 40% organic matter, covered with a thick litter layer, and subsurface horizons of loamy sands with many thick roots and gravel. Other soils are moist, dark-colored, sandy loam over cobbles.

Vegetation: This plant association occurs in small stands with an overstory of *Pseudotsuga menziesii* (Douglas-fir), *Populus tremuloides* (aspen) or *Picea pungens* (Colorado blue spruce) (10-45%). One atypical stand has 25% cover of *Populus deltoides* (Plains cottonwood) at 7500 feet (2300 m). The dense shrub layer is dominated by 65-90% cover of *Corylus cornuta* (hazelnut). Stands may include a wide variety of shrubs,

ranging from merely present to co-dominant in abundance, but no one species is consistently present with *Corylus cornuta* (hazelnut). Shrub species include: *Betula occidentalis* (river birch), *Prunus americana* (American plum), *Acer glabrum* (Rocky Mountain maple), *Alnus incana* (thinleaf alder), *Physocarpus monogynus* (ninebark), *Cornus sericea* (red-osier dogwood), *Rubus idaeus* (red raspberry), and *Prunus virginiana* (chokecherry), ranging in cover from 5 to 30%. Few herbaceous species occur in the undergrowth due to the dense shrub cover, thick coniferous litter, and rocky soils.

Successional and Ecological Processes: In the northwestern U.S., *Corylus cornuta* is widespread and grows in large thickets on well-drained soils at lower elevations (Hitchcock and Cronquist 1973). In Wyoming, it occurs in woods and thickets in the northeastern corner of the state (Dorn 1992). In the Great Plains (North Dakota, southeast South Dakota, Minnesota, and the Black Hills), *Corylus cornuta* occurs in upland forests and thickets (Great Plains Flora Association 1986). In Colorado, *Corylus cornuta* is an eastern relict species (Weber 1990) limited to riparian areas in deep, cool canyons that receive more moisture and have a high humidity. These stands appear to be long lived and stable and increase in size under the right growing conditions and lack of disturbance.

Stands dominated by *Pseudotsuga menziesii* (Douglas-fir) in the canopy are considered late seral. Riparian areas dominated by *Pseudotsuga menziesii* are generally considered transitional habitats between moist floodplains and slightly drier uplands. *Pseudotsuga menziesii* is reportedly intolerant of overly wet soils and may be restricted to moist toe slopes, benches, and bottom lands adjacent to streams and rivers (Hansen *et al.* 1988). Most *Pseudotsuga menziesii* riparian communities observed occur adjacent to *Pseudotsuga menziesii* upland communities growing on north-facing slopes. In Montana, this tree species is considered to be the climax species when successfully reproducing (Hansen *et al.* 1995).

Adjacent Riparian Vegetation: Stands of *Pseudotsuga menziesii* (Douglas-fir) or *Populus tremuloides* (quaking aspen) with various shrub understories occur along adjacent stream banks.

Adjacent Upland Vegetation: South-facing slopes have stands of *Pinus ponderosa* (ponderosa pine) woodlands, *Quercus gambelii* (Gambel oak) or *Cercocarpus montanus* (mountain mahogany) shrublands. North-facing slopes usually have stands of *Pseudotsuga menziesii* (Douglas-fir), *Populus tremuloides* (quaking aspen) or *Pinus contorta* (lodgepole pine) forests.

Management: Information on the response of *Corylus cornuta* (hazelnut) to fire, flooding, cutting, and livestock grazing is unknown. However, in the eastern U.S., *Corylus cornuta* can form large, impenetrable thickets that restrict livestock to the edges. Stands dominated by *Pseudotsuga menziesii* (Douglas-fir) benefit from fire. Fire encourages regeneration of *Pseudotsuga menziesii* by creating favorable seed beds and eliminating competition. Mature *Pseudotsuga menziesii* trees are relatively fire resistant, but seedlings and saplings are vulnerable to surface fires.

Stands dominated by *Populus tremuloides* (quaking aspen) may be maintained by infrequent fire or flooding since *Populus tremuloides* resprouts after disturbance. But with livestock grazing, the shrub understory of these stands may shift to more xeric species such as *Symphoricarpos* spp. (snowberry) and *Prunus virginiana* (chokecherry). With severe disturbance, all shrubs may be eliminated and the understory may become dominated by introduced herbaceous species such as *Poa pratensis* (Kentucky bluegrass) (Hansen *et al.* 1995)

Potential Conservation Areas supporting the *Corylus cornuta* plant association:
Cheyenne Canyon

Global Scientific Name: *Distichlis spicata* var. *spicata* plant association

Global Common Name: inland saltgrass

Wetland System Type: palustrine

Related Literature and Synonyms: Synonymous *Distichlis spicata* var. *spicata* community types are documented from the Colorado Front Range (Baker 1984) and Montana (Hansen *et al*. 1995). Closely related communities having various associated species include *Distichlis spicata* var. *spicata-Elytrigia smithii* (inland saltgrass-western wheatgrass) documented from Saskatchewan, Nebraska and northeastern Wyoming and *Distichlis spicata* var. *spicata-Sporobolus airoides-Elytrigia smithii* (inland saltgrass-alkali sacaton-western wheatgrass) documented from Colorado, Wyoming, Nebraska, Kansas, Oklahoma and Utah (Johnston 1987).

Regional Distribution: This plant association and similar types occur in Montana (Hansen *et al*. 1995), Saskatchewan, Wyoming, Nebraska, Kansas, Oklahoma, Utah, and Colorado (Johnston 1987, Baker 1984, Colorado Natural Heritage Program 2001a).

Distribution in Colorado: This association has been documented along the Colorado Front Range (Baker 1984), on the eastern plains (Steve Kettler, *personnel communication*), in the San Luis Valley in south-central Colorado (Colorado Natural Heritage Program 2001a), and in the Yampa, White and Colorado River Basins (Kittel and Lederer 1993, Kittel *et al*. 1994).

Global Rank Comments: This plant association is ranked G5. This is a common association especially in the Intermountain west.

State Rank Comments: This is a common association in Colorado, S3. However, it had declined in abundance since Anglo settlement. Large, pristine stands are virtually unknown. This association is threatened by agricultural conversion and groundwater development.

General Description and Comments: This plant association is characterized by open to thick stands of pure *Distichlis spicata* var. *spicata* (inland saltgrass) growing on alkaline or saline soils in basins, swales or on pond margins.

Elevation Range in Colorado: 5000-7550 ft. (1530-2300 m).

Site Geomorphology: This plant association occurs on alkaline or saline soils; soils that have been formed from the accumulation of bases and soluble salts in poorly drained areas. This association occurs along narrow streams or the margins of playa lakes. Streams were classified according to the Rosgen Classification of Natural Rivers (Rosgen 1996).

Soil: Soils are alkaline and have textures of sandy clay, sandy loams, and sandy clay loams with gravel and cobbles. The soils may be heavily gleyed and can have fine, distinct mottles at a depth of about 20 inches (50 cm). Soils in the Colorado River Basin classify as loamy (calcareous) typic Cryaquents.

Vegetation: This plant association is characterized by almost pure stands of *Distichlis spicata* var. *spicata* (inland saltgrass) with 3-90% cover. Occasionally several stems of *Chrysothamnus nauseosus* (rubber rabbitbrush) or *Sarcobatus vermiculatus* (greasewood) can be present with less than 3% cover. In degraded stands, *Iva axillaris* (poverty weed) can be present with 10-20% cover.

Successional and Ecological Processes: *Distichlis spicata* var. *spicata* (inland saltgrass) is a warm season grass and grows from early summer until fall primarily from rhizomes. *Distichlis spicata* var. *spicata* can tolerate low to moderately alkaline soils and is resistant to trampling by livestock. Cover of *Distichlis spicata* var. *spicata* increases when grazing reduces competition from other plants, but eventually *Hordeum jubatum* (foxtail barley) will take over if heavy grazing persists (Jones and Walford 1995).

Adjacent riparian vegetation: Adjacent vegetation includes meadows of *Triglochin* spp. (arrowgrass), *Eleocharis palustris* (common spikerush), *Juncus balticus* (Baltic rush) and *Carex* spp. (sedge).

Adjacent upslope vegetation: Adjacent uplands vegetation include *Sarcobatus vermiculatus* (greasewood) and *Artemisia tridentata* (big sagebrush) shrublands and *Juniperus osteosperma* (Utah juniper) woodlands

Management: *Distichlis spicata* var. *spicata* (inland saltgrass) is not particularly palatable to livestock and forage production is low in this plant association. With prolonged heavy grazing, *Hordeum jubatum* (foxtail barley) may replace *Distichlis spicata* var. *spicata*. In heavily grazed stands of *Sporobolus airoides* (alkali sacaton), *Distichlis spicata* var. *spicata* will increase significantly. *Distichlis spicata* var. *spicata* can be effective in revegetating degraded saline and alkaline sites due to its rhizomatous growth (Hansen *et al*. 1995).

Potential Conservation Areas supporting the *Distichlis spicata* var. *spicata* plant association:
Haynes Creek
Judge Orr Road

Global Scientific Name: *Eleocharis palustris* plant association

Common Name: common spikerush

Wetland System: palustrine

Related Literature and Synonyms:

The *Eleocharis palustris* (common spikerush) plant association is synonymous with the *Eleocharis palustris* plant association described from Colorado, New Mexico, Utah, Wyoming, Idaho (Kittel and Lederer 1993, Cooper 1993, Cooper and Severn 1992, Durkin *et al.* 1995, Johnston 1987, Padgett *et al.* 1989, Youngblood *et al.* 1985a), and central Oregon (Kovalchik 1987).

Regional Distribution:

The *Eleocharis palustris* (common spikerush) plant association occurs in Oregon (Kovalchik 1987), Idaho, Wyoming (Youngblood *et al.* 1985a), Montana (Hansen *et al.* 1995), Utah (Padgett *et al.* 1989), New Mexico (Durkin *et al.* 1995) and Colorado (CNHP 1999).

Distribution in Colorado:

The *Eleocharis palustris* plant association is common throughout the state and is documented to occur in the Yampa and San Miguel River Basins (Kittel and Lederer 1993), Routt and San Juan National Forests (Kettler and McMullen 1996, Richard *et al.* 1996), near Crested Butte (Cooper 1993), in the Rio Grande and Closed Basins (Cooper and Severn 1992, CNHP 1999), and on the eastern plains in the Arkansas and the South Platte River Basins (CNHP 1999).

Reasons for Global Rank:

This association is known throughout the western states.

Global Rank:

Global rank is based on the status of a taxon throughout its range. This association is ranked G5, demonstrably secure globally, though it may be quite rare in parts of its range, especially at the periphery.

Reasons for State Rank:

This association is a common, if small, component of many streams in Colorado.

State Rank:

State rank is based on the status of a taxon in an individual state. In Colorado, this association is ranked S4, apparently secure in the state with more than 100 occurrences.

General Description and Comments:

The *Eleocharis palustris* (common spikerush) plant association is a conspicuous, if small, common emergent association that occurs in shallow, mostly still water. Most of the sites where it occurs experience water levels that fluctuate to some degree throughout the growing season. It is recognized by the clear dominance, although sometimes sparse cover, of *Eleocharis palustris.* The largest known occurrence consists of broad concentric rings around a series of playa lakes at The Nature Conservancy Mishak Lake Preserve in the San Luis Valley in south central Colorado.

Elevation Range in Colorado:

4600-11,400 ft (1400-3500 m).

Site Geomorphology:

This association occurs on wet sandbars and on finer substrates in backwater areas within the stream channel at low elevations. Streams were classified according to the Rosgen Classification of Natural Rivers(Rosgen 1996). This association usually occurs along narrow, sinuous (Rosgen's Channel Type: E3, E4, E6) headwater rivulets where groundwater flow is lateral, primarily fed from toe slope seeps.

Soils:

High elevation stands consistently occur on organic (highly sapric) soils, or on a thick organic horizon that overlays fine to coarse alluvial material. Lower elevation stands occur on fresh alluvial deposits of fine-textured loamy sands, clays, clay loams, and sandy clays. Two samples from the Arikaree River had considerable organic content in the upper 4-8 in. (10-20 micro-plots (cm). Soils from four plots on San Juan National Forest classified as Cumulic and Histic Cryaquolls.

Management:

The low palatability of *Eleocharis palustris* and seasonally wet soils limit the grazing value of this type for livestock (Hansen *et al.* 1995).

Successional and Ecological Processes:

At lower elevations the *Eleocharis palustris* plant association occurs well within the active channel and is inundated annually. This early-seral community colonizes backwater eddies and shallow edges of slow-moving small and larger rivers. It is probably an ephemeral community, scoured out each year during high spring flows. This association has been described as an early-seral stage by Padgett *et al.* (1989). They describe light colored soils for the sites, indicating an early phase of soil development. At montane elevations, this association occurs in ponded sites on faster moving streams. If siltation occurs, sites may become dominated by *Carex utriculata* (beaked sedge). At higher elevations, this association appears to be stable. It occurs near seeps on soils with deep organic layers, often sapric, and saturated throughout the growing season.

Vegetation:

This community can be very sparse (<5% total vegetative cover) to quite dense (90%), but *Eleocharis palustris* (common spikerush) is always the dominant species (10-90%), and the only species with 100% constancy. Because the *Eleocharis palustris* plant association occurs within a wide elevational range, the species composition can be quite variable, but this community is easy to recognized by its single, low herbaceous canopy cover of bright green, nearly pure stands of *Eleocharis palustris* (common spikerush). Other species, when present, can contribute as much as 40% cover, but never exceed that of the *Eleocharis palustris* cover. On the western slope in low elevation stands, co-occurring species can include: *Phalaroides arundinacea* (common reed) (10%), *Juncus balticus* (Baltic rush) (1%) and *Schoenoplectus americanus* (chairmaker's bulrush) (1%) as well as the introduced *Melilotus officinalis* (sweet clover) and *Bromus inermis* (smooth brome). Forb cover may include: *Sparganium angustifolium* (narrowleaf bur-reed)(1%), *Lemna* spp. (duckweed) and *Potamogeton* spp. (pondweed) (1-3%). On the eastern plains, co-occurring species can include: *Leersia oryzoides* (rice cutgrass) (15-40%), *Schoenoplectus pungens* (threesquare bulrush) (20-30%), *Panicum virgatum* (switchgrass) (10-15%), *Carex lanuginosa* (woolly sedge) (10%), and *Spartina pectinata* (prairie cordgrass) (10%)

At higher, montane elevations other graminoids present include: *Carex aquatilis* (water sedge) (10-30%), *Carex utriculata* (beaked sedge) (1-5%), and *Deschampsia cespitosa* (tufted hairgrass) (1%). Forb cover is typically low, but can be occasionally abundant (30%) in some stands. Common forb species include: *Pedicularis groenlandica* (elephanthead lousewort) (3%), *Rhodiola integrifolia* (king's crown), and *Caltha leptosepala* (marsh marigold) (3-20%).

Adjacent Riparian Vegetation:

At higher elevations *Carex aquatilis* (water sedge) or *Carex utriculata* (beaked sedge) meadows and *Salix wolfii* (Wolf's willow) or *Salix planifolia* (planeleaf willow) shrublands occur within the riparian mosaic. At lower elevations *Schoenoplectus pungens* (threesquare bulrush) and *Schoenoplectus acutus* var. *acutus* (hardstem bulrush) can occur within the stream channel and wet meadow prairies of *Panicum virgatum* (switchgrass) and

Sorghastrum nutans (indiangrass) occupy the immediate streambanks and low floodplains. Stands with *Populus deltoides* (eastern cottonwood) and *Salix amygdaloides* (peachleaf willow) can also be scattered across the floodplain.

Adjacent Upland Vegetation:

Low elevation streams on the Western Slope have *Pinus edulis-Juniperus* spp.(Piñon-juniper) woodlands and *Artemisia tridentata* (sagebrush) or *Sarcobatus vermiculatus* (greasewood) shrublands on adjacent hillslopes. At higher montane and subalpine elevations, *Abies lasiocarpa-Picea engelmannii* (subalpine fir-Engelmann) forests occupy adjacent slopes. On the eastern plains, rolling upland hills are occupied by *Bouteloua gracilis* (blue grama) shortgrass prairie, or *Artemisia* (sandsage) shrublands.

Potential Conservation Areas supporting the *Eleocharis palustris* plant association:

Chico Creek

Global Scientific Name: *Juncus balticus* var. *montanus* plant association

Global Common Name: mountain rush

Wetland System Type: palustrine

Related Literature and Synonyms: The *Juncus balticus* (mountain rush) community types documented from Nevada (Manning and Padgett 1995), Montana (Hansen *et al.* 1995), Idaho, Wyoming (Youngblood *et al.* 1985, Jones and Walford 1995), and Utah (Padgett *et al.* 1989) are synonymous with the Colorado Juncus balticus var. montanus plant association.

Similar Communities: Johnston (1987) describes two closely related communities: the *Juncus arcticus/Distichlis spicata* (mountain rush/inland saltgrass) from Utah, which occurs in lowland alkaline environments, and the *Juncus arcticus/Carex* spp. (mountain rush/sedge) from Oregon, Idaho, Utah, Wyoming, and Colorado, which occurs in more montane habitats with species such as *Carex aquatilis* (water sedge). *Juncus arcticus* ssp. *ater* is a synonym for *Juncus balticus* var. *montanus* (Kartesz 1994).

Regional Distribution: This plant association occurs in Oregon, Nevada (Manning and Padgett 1995), Montana (Hansen *et al.* 1995), Idaho, Wyoming (Youngblood 1985, Jones and Walford 1995), Utah (Padgett *et al.* 1989), and Colorado (Johnston 1987, Colorado Natural Heritage Program 2001a).

Distribution in Colorado: This plant association occurs throughout Colorado. It has been quantitatively sampled in the Yampa (Kittel and Lederer 1993), White and Colorado River Basins (Kittel *et al.* 1994), the Rio Grande and Closed Basin and in the Arkansas River Basin (Colorado Natural Heritage Program 1998) as well as in San Juan National Forest (Richard *et al.* 1996).

Global Rank Comments: This is an abundant community (G5) throughout the western states.

State Rank Comments: This is a common association (S5), increasing in abundance due to improper grazing throughout Colorado.

General Description and Comments: This plant association occurs as small, dense patches on flat stream benches, along overflow channels, and near springs. It is characterized by a dense sward of *Juncus balticus* (mountain sedge) and often minor cover of *Carex* (sedge) species. Forb cover is generally low. This association is often considered to be a grazing-induced community since it increases with disturbance

Elevation Range in Colorado: 6400-11,600 ft (2000-3500 m).

Site Geomorphology: This plant association occurs as small, dense patches on flat stream benches, along overflow channels, and near springs. Streams were classified according to the Rosgen Classification of Natural Rivers (Rosgen 1996). Stream channels are highly variable and can be narrow and deeply entrenched (Rosgen's Channel Type: G5, G6), moderately wide and moderately sinuous (Rosgen's Channel Type: B4), moderately wide and very sinuous (Rosgen's Channel Type: C2,C6), narrow and very sinuous (Rosgen's Channel Type: E6), or braided (Rosgen's Channel Type: D5).

Soils: The soil textures are variable. They range from sandy and well drained, to silty clay loams, to pure organic matter, however most stands occur on coarse-textured sandy loams with a high percentage of cobbles and gravel. Mottles or gleyed horizons are often present. Soils in the Colorado River Basin classified to sandy and clayey typic Cryoborolls, fine-loamy typic Hydraquents, and fine-clayey Aquepts. One stand in San Juan National Forest classified to a Cumulic Haploboroll.

Vegetation: This plant association very easy to recognize with its band of dark green following the channel path. *Juncus balticus* (mountain rush) is the dominated and indicator species for this community. The canopy cover ranges from 3-80%. Because it occurs over a broad elevational and latitudinal range in Colorado, associated species are variable. Some of the more frequently encountered species include *Carex aquatilis* (water sedge) (1-20%), *Carex praegracilis* (clustered field sedge) (10-20%), *Glyceria striata*

(mannagrass) (10-16%) and *Carex utriculata* (beaked sedge) (10-30%), *Distichlis spicata* (salt grass) (10-30%) and *Sporobolus airoides* (alkali sacaton) (10-20%).

Forb cover is usually minor, and may include 1-20% cover of *Viola adunca* (violet), *Achillea millefolium* (yarrow), *Mentha arvense* (field mint) or *Trifolium* spp.(sweet clover). Degraded stands and grazing induced stands of *Juncus balticus* can have high abundance (10-40%) of *Poa pratensis* (Kentucky bluegrass), *Phleum pratensis* (timothy), *Taraxacum officinale* (dandelion). Occasionally, a few tree or shrub seedlings may be present with 3-15% cover, including *Populus angustifolia* (narrowleaf cottonwood), *Pentaphylloides floribunda* (shrubby cinquefoil), and *Salix exigua* (coyote willow).

Successional and Ecological Processes: In low-disturbance areas, this plant association appears to be a stable, climax community. It occupies frequently inundated swales and wet, low- to mid-elevation sites (Kittel and Lederer 1993). However, in some areas, this association is considered to be grazing-induced (Padgett *et al.* 1989). *Juncus balticus* is considered an increaser due to its low forage value and high tolerance to grazing (USDA 1937, Hansen *et al*. 1995). It usually increases in abundance on sites formerly dominated by *Deschampsia cespitosa* (tufted hairgrass) or *Calamagrostis canadensis* (bluejoint reedgrass). Nearly pure stands of *Juncus balticus* (mountain rush) indicate that the site may have been heavily grazed in the past (Hansen *et al*. 1995).

Adjacent Riparian Vegetation:*Salix exigua* (coyote willow) shrublands, *Distichlis spicata* (desert saltgrass) marshes, or *Carex* spp. (sedge) meadows occur in adjacent riparian areas.

Adjacent Upland Vegetation:*Abies lasiocarpa-Picea engelmannii* (subalpine fir-Engelmann spruce), *Pseudotsuga menziesii* (Douglas fir), and *Populus tremuloides* (quaking aspen) forests, *Pinus edulis-Juniperus* spp. (pinyon pine-juniper) woodlands, and *Chrysothamnus nauseosus* (rubber rabbitbrush), *Sarcobatus vermiculatus* (greasewood), and *Artemisia tridentata* (big sagebrush) shrublands occur on adjacent hill slopes

Management: Stands of the *Juncus balticus* (mountain rush) plant association are productive, but forage value is relatively low. Livestock grazing occurs when plants are young and tender, but as*Juncus balticus* matures, its palatability declines. Heavy grazing results in an increase of unpalatable forbs. The rhizomatous roots of *Juncus balticus* (mountain rush) can withstand grazing pressure and is fairly good at stabilizing stream banks (Hansen *et al*. 1995).

Potential Conservation Areas supporting the*Juncus balticus* var. *montanus* plant association:
Judge Orr Road

Global Scientific Name: *Pascopyrum smithii-Eleocharis* spp. plant association

Common Name: Western wheatgrass-spikerush

Wetland System: palustrine

Related Literature and Synonyms: Species composition varies among stands of this type depending on the degree of inundation, but the degree of variation is unknown. More stand data might indicate that this association and the *Pascopyrum smithii-Hordeum jubatum* Herbaceous Vegetation Association should be combined. Other names include: clayey overflow range site (USDA Soil Conservation Service 1986), *Agropyron smithii/Carex filifolia* habitat type (Hansen and Hoffman 1988), *Agropyron smithii* sodgrass steppe (Thilenius et al. 1995), and *Agropyron smithii-Eleocharis acicularis* vegetation type (Paris and Paris 1974, Bergman and Marcus 1976).

Similar Communities: Stands of the *Pascopyrum smithii/Hordeum jubatum* Herbaceous Vegetation Association (CEGL001582) are dominated or codominated by *A. smithii (Pascopyrum smithii*), but *Eleocharis acicularis* is absent and *Hordeum jubatum* is a major species. Stands of that association occur in playas where the subsoils contain higher concentrations of sodium (Paris and Paris 1974, Bergman and Marcus 1976). Holpp (1977) described vegetation from 10 playas in Campbell County, Wyoming that seem very similar to the playas containing this association. His stands generally were dominated by *Pascopyrum smithii* and contained some wetland species (*Juncus balticus, Alopecurus carolinianus*), but they showed no consistency in species composition and none contained *Eleocharis acicularis.*

Regional Distribution:

This association is currently documented only in Wyoming and Colorado. Additional survey work will likely expand the range because *Pascopyrum* and *Eleocharis* are both wide-ranging common species. Playas are little surveyed and may support this association.

Distribution in Colorado:

The only documented occurrences in Colorado are in El Paso County east of Colorado Springs. Future surveys will likely locate additional occurrences as the species are wide-ranging. Playas occur scattered throughout the eastern plains and this plant association may occur within isolated playas.

Reasons for Global Rank:

This association has been described from a small area (ca 250 square miles) in NE Wyoming and apparently on the Montana South Dakota border. The association was documented in a few playas in southeastern Colorado (El Paso County). Future playa surveys may reveal additional occurrences.

Global Rank: G2

Reasons for State Rank:

The association has been recorded only in scattered playas in El Paso County. Additional survey work may reveal additional occurrences.

State Rank: S2

General Description and Comments: This association includes stands of herbaceous vegetation growing in periodically-inundated, closed basins of < 1 ha on the Northern Great Plains. The vegetation typically has two zones, with *Eleocharis acicularis* dominating the inner, lower part of the stand, and *Pascopyrum smithii* dominating the outer, higher part. The species common in the surrounding vegetation are absent from stands of this type, or contribute little cover.

Elevation Range in Colorado: 6,300-6,400 feet.

Site Geomorphology: The small basins supporting this association have standing water during "the wet seasons" (Bergman and Marcus 1976), presumably meaning mainly in the spring and also after heavy summer rains.

Soils: Bidman loam (ponded phase); Fine, montmorillonitic, mesic Ustollic Paleargid (Bergman and Marcus 1976). The A horizon is a friable, granular loam with an abrupt boundary with the clay-rich B horizon below; when the soil is dry, the B horizon forms angular blocks, water infiltrates rapidly, and the A horizon drains readily; but when the soil is wet, the B horizon is nearly impermeable and water ponds (Bergman and Marcus 1976).

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Management: The playas in which this type occurs contain subsurface moisture even in the summer, and livestock ponds have been excavated in many playas (Thilenius et al. 1995).

Successional and Ecological Processes Standing water causes zonation: the lower part of the stand is dominated by *Eleocharis acicularis* and has little litter, and the higher part of the stand is dominated by *Pascopyrum smithii* and contains more litter. Patches of this type occur in a matrix of steppe dominated by *Pascopyrum smithii, Bouteloua gracilis, Carex filifolia*, and *Stipa comata* (*the Bouteloua gracilis-Pascopyrum smithii* association). That vegetation often contains *Artemisia tridentata* ssp. *wyomingensis* (Jones 1997).

Vegetation: This type includes low, herbaceous vegetation growing in closed basins. *Pascopyrum smithii* and *Eleocharis acicularis* generally dominate, and the plants common in the surrounding steppe generally are absent or contribute very little cover. Stands of this type typically include two zones, resulting from differences in the period of inundation. The following information is from two stands surveyed by Jones (1997): the lowest part of the stand, which is inundated most often and for the longest time, is dominated by *Eleocharis acicularis*, and may contain *Hordeum brachyantherum*, *Juncus balticus*, *and Alopecurus aequalis* or *A. carolinianus*, and bare soil accounts for about 75% of the ground surface. The higher part of the stand is dominated by *Pascopyrum smithii* and may contain substantial amounts of *Carex douglasii* and *Festuca octoflora.* According to Thilenius et al. (1995), *Hordeum jubatum* occurs on the margins of the stands. Hansen and Hoffman (1988) apparently include two stands of this association in *their Agropyron smithii/Carex filifolia* habitat type (Table A-5, pp. 42-43, stands 61 and 136) that contain *only Pascopyrum smithii, Eleocharis acicularis*, and *Hordeum jubatum.* The stands in Paris and Paris (1974, Table E-6, pp. IX-E-18 & 19) included *Carex eleocharis.* Patches of this type occur in a matrix of steppe dominated by *Pascopyrum smithii, Bouteloua gracilis, Carex filifolia*, and *Stipa comata* (*the Bouteloua gracilis-Pascopyrum smithii* association). That vegetation often contains *Artemisia tridentata* ssp. *wyomingensis* (Jones 1997).

Adjacent Riparian Vegetation:

Not applicable.

Adjacent Upland Vegetation:

Shortgrass or midgrass prairie. Or shrublands with *Artemisia tridentata* ssp. *wyomingensis* (Jones 1997).

Potential Conservation Areas supporting the *Pascopyrum smithii-Eleocharis* spp. plant association:
Schriever Playas

Global Scientific Name: *Phragmites australis* plant association

Common Name: common reed

Wetland System: palustrine

Related Literature and Synonyms:

The following three community types appear synonymous with the Colorado *Phragmites australis* (common reed) plant association: 1) the *Phragmites australis* (common reed) type documented from northwestern Colorado (Baker 1982), 2) the *Phragmites australis* community type documented from Montana (Hansen *et al*. 1995), and 3) the *Phragmites communis/Carex lacustris* (common reed/hairy sedge) type documented from Nebraska (Johnston 1987). *Phragmites communis* is a synonym for *Phragmites australis* (Kartesz 1994).

Regional Distribution:

This plant association occurs in Montana (Hansen *et al*. 1995), Nebraska (Johnston) and Colorado (Baker 1982, CNHP 1999).

Distribution in Colorado:

This plant association occurs on the western slope in the White and Colorado River Basins (Baker 1982, Kittel *et al*. 1995) and on the eastern plains in the Arkansas River Basin (CNHP 1999).

Reasons for Global Rank:

This association is wide spread and its considered a weedy invader of wetlands in the eastern United States.

Global Rank:

Global rank is based on the status of a taxon throughout its range. This association is ranked G4, apparently secure globally, though it may be quite rare in parts of its range, especially at the periphery.

Reasons for State Rank:

The *Phragmites australis* plant association was once thought to be widespread throughout western Colorado. Now, it occurs only in small, isolated patches where water has become impounded, such as adjacent to raised railroad beds, irrigation ditches, oxbow lakes, and other low-lying swampy areas. It is threatened by stream flow alterations, road building and maintenance.

State Rank:

State rank is based on the status of a taxon in an individual state. In Colorado, this association is ranked S3, rare in state (21 to 100 occurrences).

General Description and Comments:

The *Phragmites australis* (common reed) plant association is a tall (3-5 ft., 1-1.5 m) reed community often growing is small wet patches in seeps and backwater areas of large floodplains, around the fringes of irrigation ponds, ditches, and along railroad embankments that have poor drainage.

Elevation Range in Colorado:

3900-6500 ft. (1200-1980 m).

Site Geomorphology:

This plant association occurs in seeps, along irrigation ditches and outflows, and in oxbow lakes.

Soils:

Soils are deep silty clay loams and sands, often with rich mottling at the level of the fluctuating water table. Soils in the Colorado River Basin classified as coarse-loamy, calcareous typic Cryaquents.

Management:

Phragmites australis (common reed) is highly palatable to livestock and wildlife, especially when the plants are young and growing vigorously. *Phragmites australis* is moderately tolerant of grazing. However, heavy grazing pressure may reduce the size and extent of stands (Hansen *et al*. 1995).

Phragmites australis can be an effective streambank stabilizer due to its rhizomatous growth. The rhizomes hold and stabilize the bank while above ground vegetation traps and filters sediments (Hansen *et al*. 1995).

Successional and Ecological Processes:

Phragmites australis generally requires seasonal flooding in the spring (Johnston 1987). This species has strong rhizomes that allow it to out-compete all but the most aggressive weedy species. With heavy disturbance, however, exotic species such as *Cirsium arvense* (Canada thistle) may invade this plant association (Hansen *et al*. 1995).

Vegetation:

This vegetation is characterized by tall (5-8 feet) grasses in small pockets and stands in marshes and wetlands on broad floodplains. *Phragmites australis* (common reed) is the dominant and diagnostic species, canopy cover ranges from 65-80%. While stands appear to be pure, monotypic stands of the reed, there are almost always a few other, if highly variable, species present. For example, *Salix exigua* (coyote willow) with 1% cover, *Conyza canadensis* (horse weed) with 15% cover, or *Apocynum androsaemifolium* (creeping milkweed) with 1% cover.

Adjacent Riparian Vegetation:

Salix exigua (coyote willow) and *Tamarix ramosissima* (saltcedar) shrublands and *Typha* spp. (cattail) wetlands occur in adjacent riparian areas.

Adjacent Upland Vegetation:

Juniperus osteosperma or *J. monosperma* (Utah or oneseed juniper) and *Pinus edulis* (pinyon pine) woodlands or shortgrass prairie occur on adjacent hill slopes.

Potential Conservation Areas supporting the *Phragmites australis* plant association:
Chico Creek

Global Scientific Name: *Populus angustifolia* / *Alnus incana* plant association

Common Name: narrowleaf cottonwood/thinleaf alder

Wetland System: palustrine

Related Literature and Synonyms:

In Colorado, this plant association is known as *Populus angustifolia/Alnus incana* ssp. *tenuifolia*. It is synonymous with the *Populus angustifolia/Alnus incana* (narrowleaf cottonwood/thinleaf alder) community type described by Durkin *et al.* (1994) but not the *Populus angustifolia/Alnus incana* type described by Walford (1993). Walford's association appears to be more closely aligned with the *Populus angustifolia/Salix exigua* (narrowleaf cottonwood/coyote willow) plant association because it occurs on coarse alluvial point bars and consists of mostly young trees.

Similar Communities:

Two closely related communities have *Populus angustifolia* (narrowleaf cottonwood) and *Alnus incana* (thinleaf alder), but a higher abundance of other shrub species, mainly *Cornus sericea* (redosier dogwood). These community types are the *Populus angustifolia/Cornus sericea* (narrowleaf cottonwood/redosier dogwood) (Padgett *et al.* 1989, Hansen *et al.* 1995) plant association and the *Populus angustifolia/Alnus incana-Cornus sericea* (narrowleaf cottonwood/thinleaf alder-redosier dogwood) plant association (Johnston (1987).

Regional Distribution:

This plant association occurs in New Mexico (Durkin *et al.* 1994) and Colorado (CNHP 1999).

Distribution in Colorado:

This plant association occurs on the West Slope in the Yampa, Gunnison, and San Miguel River Basins, and the San Juan and Rio Grande National Forests (Kittel *et al.* 1994, Kittel *et al.* 1999a, CNHP 1999, Richard *et al.* 1996). It also occurs along the Colorado Front Range in the Arkansas and South Platte River Basins (Kittel *et al.* 1996, Kittel *et al.* 1997).

Reasons for Global Rank:

This association is known from New Mexico and Colorado. Although not well documented from other states, it is expected to occur throughout the range of *Populus angustifolia* (narrowleaf cottonwood) in the Rocky Mountains.

Global Rank:

Global rank is based on the status of a taxon throughout its range. This association is ranked G3?, either very rare and local throughout its range or found locally, even abundantly, in a restricted range or because of other factors making it vulnerable to extinction throughout its range (20 to 100 occurrences). This plant association is documented from Colorado and is expected to occur elsewhere. The question mark in the Global rank indicates that the community is suspected to be more abundant, but additional locations have not been documented.

Reasons for State Rank:

In Colorado, this is a common community along montane streams, but few high-quality examples exist. This association is highly threatened by improper livestock grazing, development, and stream flow alterations.

State Rank:

State rank is based on the status of a taxon in an individual state. In Colorado, this association is ranked S3, rare in state (21 to 100 occurrences).

General Description and Comments:

The *Populus angustifolia/Alnus incana* ssp. *tenuifolia* (narrowleaf cottonwood/thinleaf alder) plant association is characterized by a dense stand of *Alnus incana* lining the streambank and an open to nearly closed canopy of *Populus angustifolia.* Other shrubs may occur, but *Alnus incana* (thinleaf alder) has at least 10-20% cover and is the most abundant of all other shrubs within the stand. It occurs along narrow, fast-moving streams in montane areas.

Elevation Range in Colorado:

6200-8900 ft. (1900-2700 m).

Site Geomorphology:

This plant association occurs on active floodplains in narrow to broad valleys. It forms a narrow, dense band along streambanks and benches. Some of the stands have signs of recent flooding. Stream gradient and channel width are highly variable. Streams were classified according to the Rosgen Classification of Natural Rivers (Rosgen 1996). Some sites occur along steep, narrow channels with little sinuosity (Rosgen's Channel Type: A2-A4). Other sites occur along low gradient, moderately sinuous, broad channels (Rosgen's Channel Type: B2-B5); low gradient, highly sinuous channels (Rosgen's Channel Type: C3, C4); or very narrow and highly sinuous channels (E5, E6).

Soils:

Soils are mostly coarse textured, ranging from deep sands to shallow sandy loams. Some profiles show stratification, with loams to clay loams alternating with sands. Most profiles become skeletal at an average depth of 12 inches (30 cm).

Management:

Because regeneration and establishment of new stands of cottonwood are dependent upon flooding events, any alteration to the natural flow regime of a river can affect the cottonwood ecosystem. Upstream dams stabilize stream flows by reducing the frequency and magnitude of floods. This results in fewer flood events that provide conditions for cottonwood stand regeneration. Without periodic disturbance by flooding, riparian areas become dominated by late-seral communities. These late-seral communities are dominated by more upland species, such as conifers in montane areas or other, more drought tolerant species in the foothill and plains environments.

Forage productivity for this plant association is high and very palatable to livestock. Cottonwood seedlings and saplings and the nitrogen-rich *Alnus incana* (thinleaf alder) leaves are frequently browsed by cattle. Excessive grazing and browsing will reduce plant vigor and allow non-native plant species to gain a competitive advantage. Cottonwood-dominated riparian areas in Colorado are best grazed moderately for short periods during the growing season or solely during the winter season. This maintains high forage quality and quantity (Hansen *et al.* 1995).

Alnus incana is an excellent streambank stabilizer because of its rhizomatous roots. Young stands can re-sprout after flood damage or fire and can tolerate a short duration of standing water (Hansen *et al.* 1995). In addition, alder provides overbank shading and nutrient inputs important for fish and other aquatic fauna.

Successional and Ecological Processes:

In Colorado, cottonwood is a pioneer tree species. Seed reproduction is primarily restricted to bare, moist sites (Friedman *et al.* 1995, Moss 1938) and rarely occurs underneath an existing canopy of cottonwood poles or trees (Johnson 1994). Regeneration of cottonwood stands is thus dependent on fluvial disturbances that create bare, moist sites (Bradley and Smith 1986, Friedman *et al.* 1997). These processes include channel migration (meandering and avulsion), channel narrowing, and scour and sediment deposition from episodic floods (Scott *et al.* 1996).

The size and age structure of a specific cottonwood patch are heavily dependent on the time since the last disturbance. Annually disturbed sites at the channel margin may never progress beyond young seedlings (Auble *et al.* 1997). Sites disturbed by an extreme event, or sites that become safe through accretion or channel migration, may support pole and tree size cottonwood (Auble and Scott 1998, Everitt 1968). At a larger spatial

scale, the riparian forest comprises a mosaic of patches with different ages of cottonwood and different histories of disturbance.

The future of a mature cottonwood stand depends on future disturbance and moisture conditions. A disturbance may trigger another generation of cottonwood at the patch. On undisturbed sites that are moist enough to support trees, cottonwood may be replaced by co-established species that live longer than the cottonwood, or by secondary species that have become established in the understory (Boggs and Weaver 1994, Hansen *et al.* 1995, Howe and Knopf 1991, Johnson *et al.* 1976, Padgett *et al.* 1989). On drier, undisturbed sites, decadent cottonwood may be replaced by a treeless herbaceous community (Hefley 1937, Lindauer 1983).

The *Populus angustifolia/Alnus incana* (narrowleaf cottonwood/thinleaf alder) plant association is considered a mid-seral community (neither the youngest or oldest cottonwood stands within a reach). In the San Luis Valley, stands have high diversity of shrubs, with many willow species also present, although alder is the clear dominant shrub, forming the bulk of the biomass in the understory. With time and without flooding disturbance, the *Populus angustifolia/Alnus incana* stands may become dominated by invading conifers from adjacent upland communities, such as *Pseudotsuga menziesii* (Douglas fir), Juniperus (juniper), or *Picea engelmannii* (Engelmann spruce).

Alnus incana ssp. *tenuifolia* (thinleaf alder) is also adapted to thrive in the floodplain environment. It is one of the first species to establish on fluvial or glacial deposits and even on placer mining spoils (Viereck 1970, Van Cleve *et al.* 1971, Chapin *et al.* 1994, Hansen *et al.* 1989). After establishment, young stands of *Alnus incana* are continually flooded. As stands mature, the stems can slow flood waters and trap sediment. Fine-textured sediments accumulate on top of the coarser alluvial material, and the land surface eventually rises above annual flood levels. Flooding is then less frequent, and soils begin to develop (Padgett *et al.* 1989).

Alnus incana is shade-intolerant (Viereck 1970, Chapin *et al.* 1994), and many mature stands in Colorado are restricted to streambank edges, possibly because these are the only sites where light can penetrate the neighboring overstory canopy. *Alnus incana* has been observed on high-gradient streams and is thought to require well-aerated water (Hansen *et al.* 1988, Padgett *et al.* 1989).

Alnus incana (thinleaf alder) is a nitrogen fixer and increases ecosystem nitrogen supply with the deposition of nitrogen-rich leaf litter (Binkley 1986). The annual input of nitrogen to soils from alder ranges from 16-150 kg/ha/yr, as much as 150 times the annual atmospheric deposition over the same area (Binkley 1986, Bowman and Steltzer *in press*). Nitrogen-rich alder detritus speeds soil development and bank stability. It also provides an important source of nutrients for aquatic invertebrates.

Vegetation:

The dominance of *Populus angustifolia* and *Alnus incana* are the key diagnostic characteristics of this plant association. Several other tree and shrub species may be present, but none equal the abundance of the diagnostic species. The overstory is an open to dense canopy of *Populus angustifolia* (narrowleaf cottonwood), which is always present, if sometimes only as sapling-sized individuals (38% cover). Other tree species that may be present include: *Pseudotsuga menziesii* (Douglas fir) (6% cover), *Juniperus scopulorum* (Rocky Mountain juniper) (4%), *Populus tremuloides* (quaking aspen) (10%), *Pinus ponderosa* (ponderosa pine) (6%), *Populus acuminata* (lance-leaved cottonwood) (48%), *Abies concolor* (white fir) (10%), or *Picea pungens* (Colorado blue spruce) (6%).

The shrub understory is dominated by a dense band of *Alnus incana* ssp. *tenuifolia* (thinleaf alder) (35% cover) lining the streambank. A variety of other shrubs may be present, intermingling with the alder but always less than the total alder cover. Other shrub species include: *Salix bebbiana* (Bebb willow) (6% cover), *S. monticola* (park willow) (7%), *S. drummondiana* (Drummond willow) (11%), *S. eriocephala* var. *ligulifolia* (strapleaf willow) (4%), *S. lasiandra* var. *caudata* (greenleaf willow) (16%), *S. exigua* (coyote willow) (8%), *Cornus sericea* (redosier dogwood) (10%), *Rosa woodsii* (Woods' rose) (3%), *Acer glabrum* (Rocky Mountain maple) (6%), and *Betula occidentalis* (river birch) (13%).

The herbaceous undergrowth is generally sparse. Herbaceous species include: *Poa pratensis* (Kentucky bluegrass) (10% cover), *Taraxacum officinale* (dandelion) (4%), *Equisetum arvense* (field horsetail) (4%),

Rudbeckia laciniata (coneflower) (5%), *Heracleum maximum* (cow parsnip) (4%), *Maianthemum stellatum* (starry false Solomon's seal) (3%), *Trifolium repens* (white clover) (12%), *Calamagrostis canadensis* (Canadian reedgrass) (6%), *Oxypolis fendleri* (cowbane) (3%), and *Cardamine cordifolia* (bittercress) (6%).

Adjacent Riparian Vegetation:

In narrow canyons, the *Populus angustifolia/Alnus incana* (narrowleaf cottonwood/thinleaf alder) plant association is often the only community along streambanks. Along wider stream channels, this association is adjacent to stands of *Pseudotsuga menziesii* (Douglas fir), *Populus angustifolia* (narrowleaf cottonwood), and *Quercus gambelii* (Gambel oak). Younger *Populus angustifolia* stands often occur on adjacent point bars and fresh alluvial deposits. *Carex utriculata* (beaked sedge) meadows or *Alnus incana* (thinleaf alder), *Betula occidentalis* (water birch), or *Salix* (willow) shrublands occur on the floodplain.

Adjacent Upland Vegetation:

At lower elevations, south-facing slopes have *Pinus edulis-Juniperus monosperma* (pinyon pine-oneseed juniper) woodlands. North-facing slopes often have mixed conifer-*Populus tremuloides* (quaking aspen) forests or thick to scattered stands of *Pseudotsuga menziesii* (Douglas fir) and *Quercus gambelii* (Gambel oak). At higher elevations, *Pseudotsuga menziesii*-mixed conifer forests or barren talus are on adjacent slopes.

Potential Conservation Areas supporting the *Populus angustifolia/Alnus incana* plant association:
Greenhorn Creek
St. Charles River at 3R

Global Scientific Name: *Populus angustifolia / Prunus virginiana* plant association

Common Name: narrowleaf cottonwood/chokecherry

Wetland System: palustrine

Related Literature and Synonyms:

The *Populus angustifolia/Prunus virginiana* (narrowleaf cottonwood/chokecherry) community type (Wyoming Natural Diversity Database 1989) is synonymous with the Colorado *Populus angustifolia/Prunus virginiana* plant association. A closely related community, *Acer negundo/Prunus virginiana* (boxelder/chokecherry), plant association (Kittel *et al.* 1994) includes stands that contain some *Populus angustifolia.*

Similar Communities:

Other closely related communities have *Populus deltoides* ssp. *monilifera* (plains cottonwood) in the overstory instead of *Populus angustifolia.* These communities include: 1) the *Populus deltoides/Bromopsis inermis* (eastern cottonwood/smooth brome) plant association (Cooper and Cottrell 1990) with minimal cover of *Prunus virginiana*, 2) the *Prunus virginiana* (chokecherry) dominance type (Hansen *et al.* 1988) with *Populus deltoides* as an overstory component, and 3) stands dominated by *Populus sargentii* (a synonym for *P. deltoides* ssp. *monilifera*) with *Prunus virginiana* near Livermore, Colorado (Knopf 1985).

Regional Distribution:

This plant association is reported from southeastern Wyoming (Wyoming Natural Diversity Database 1989) and Colorado (CNHP 1999).

Distribution in Colorado:

This association is documented along the Colorado Front Range (CNHP 1999).

Reasons for Global Rank:

This association is known only from Colorado and Wyoming.

Global Rank:

Global rank is based on the status of a taxon throughout its range. This association is ranked G2G3, imperiled globally because of rarity (6 to 20 occurrences) or because of other factors demonstrably making it very vulnerable to extinction throughout its range.

Reasons for State Rank:

This association is documented from only two locations in Colorado. A total of five to ten stands are estimated to occur in the state. Additional inventory information (site locations, stand tables, etc.) is needed. This community is threatened by development and stream flow alterations.

State Rank:

State rank is based on the status of a taxon in an individual state. In Colorado, this association is ranked S1, critically imperiled in the state because of extreme rarity (5 or fewer occurrences, or very few remaining individuals), or because of some factor of its biology making it especially vulnerable to extirpation from the state. (Critically endangered in state).

General Description and Comments:

The *Populus angustifolia/Prunus virginiana* (narrowleaf cottonwood/chokecherry) plant association occurs only along low elevation, foothill streams. It is characterized by a thick growth of *Prunus virginiana* with an open overstory of *Populus angustifolia* and occasionally *Populus* x *acuminata* (lanceleaf cottonwood) or

Populus deltoides (eastern cottonwood). *Prunus virginiana* is considered a non-obligate riparian species because it grows on the outer edge of the riparian area.

Elevation Range in Colorado:

5600-8100 ft. (1700-2500 m).

Site Geomorphology:

This plant association occurs on narrow, elevated, or steeply sloping streambanks and benches in narrow to moderately broad valleys, 100-400 feet (30-120 m) wide. Streams were classified according to the Rosgen Classification of Natural (Rosgen 1996). Stream channels are broad, low gradient, and slightly sinuous (Rosgen's Stream Type: B3).

Soils:

Soils are shallow sandy clay loams with many fine layers from fluvial deposition. Soils become skeletal at a depth of approximately 8 inches (20 cm).

Management:

Because regeneration and establishment of new stands of cottonwood are dependent upon flooding events, any alteration to the natural flow regime of a river can affect the cottonwood ecosystem. Upstream dams stabilize stream flows by reducing the frequency and magnitude of floods. This results in fewer flood events that provide conditions for cottonwood stand regeneration. Without periodic disturbance by flooding, riparian areas become dominated by late-seral communities. These late-seral communities are dominated by more upland species, such as conifers in montane areas or other, more drought tolerant species in the foothill and plains environments.

Cottonwood seedlings and saplings are frequently browsed by cattle. However, thick stands of *Prunus virginiana* may preclude use by livestock (Hansen *et al.* 1989). Open stands may provide grazing opportunities, but season-long grazing in open stands increases the abundance and vigor of non-native grasses and, with excessive browsing, may reduce shrub densities. *Prunus virginiana* (common chokecherry) is low to fair in forage quality for livestock, but good for deer and elk (Wasser 1982, Johnson and Nichols 1982 [as cited in Hansen *et al.* 1995]). Eating excessive amounts of *Prunus virginiana* leaves can be poisonous to livestock (Hansen *et al.* 1995). However, livestock will not normally eat fatal quantities, except when other forage is scarce (Wasser 1982, Johnson and Nichols 1982).

This plant association provides thermal cover for fish, livestock, large mammals and upland birds as well as providing fruit for birds and mammals. *Prunus virginiana* (common chokecherry) is tolerant of fire and will usually sprout after fires and grow into even denser stands. The dense growth habit of this shrub species and its ability to propagate by rhizomes make them useful for streambank stabilization (Hansen *et al*. 1995).

Cottonwood-dominated riparian areas in Colorado are best grazed moderately for short periods during the growing season or solely during the winter season. This maintains high forage quality and quantity (Hansen *et al.* 1995).

Successional and Ecological Processes:

In Colorado, cottonwood is a pioneer tree species. Seed reproduction is primarily restricted to bare, moist sites (Friedman *et al.* 1995, Moss 1938) and rarely occurs underneath an existing canopy of cottonwood poles or trees (Johnson 1994). Regeneration of cottonwood stands is thus dependent on fluvial disturbances that create bare, moist sites (Bradley and Smith 1986, Friedman *et al.* 1997). These processes include channel migration (meandering and avulsion), channel narrowing, and scour and sediment deposition from episodic floods (Scott *et al.* 1996).

The size and age structure of a specific cottonwood patch are heavily dependent on the time since the last disturbance. Annually disturbed sites at the channel margin may never progress beyond young seedlings

(Auble *et al.* 1997). Sites disturbed by an extreme event, or sites that become safe through accretion or channel migration, may support pole and tree size cottonwood (Auble and Scott 1998, Everitt 1968). At a larger spatial scale, the riparian forest comprises a mosaic of patches with different ages of cottonwood and different histories of disturbance.

The future of a mature cottonwood stand depends on future disturbance and moisture conditions. A disturbance may trigger another generation of cottonwood at the patch. On undisturbed sites that are moist enough to support trees, cottonwood may be replaced by co-established species that live longer than the cottonwood, or by secondary species that have become established in the understory (Boggs and Weaver 1994, Hansen *et al.* 1995, Howe and Knopf 1991, Johnson *et al.* 1976, Padgett *et al.* 1989). On drier, undisturbed sites, decadent cottonwood may be replaced by a treeless herbaceous community (Hefley 1937, Lindauer 1983).

The *Populus angustifolia/Prunus virginiana* plant association is a late-seral community. With time, the *Populus angustifolia* die, leaving patches of *Prunus virginiana*, which will persist as long as tap roots can reach the water table.

Vegetation:

This plant association is characteristic of ephemeral streams of the Colorado Front Range foothills and of lower elevation western slope streams. The overstory is dominated by *Populus angustifolia* (narrowleaf cottonwood) (8-52%) and *Populus* x *acuminata* (lanceleaf cottonwood) (31%). The shrub layer is thick with *Prunus virginiana* (chokecherry) (3-40%), *Symphoricarpos occidentalis* (western snowberry) (25%), *Alnus incana* (thinleaf alder) (7%), and *Clematis ligusticifolia* (white virgin's-bower) (3%). The herbaceous undergrowth is diverse, depending on local site conditions and amount of past disturbance. Herbaceous species include: *Poa pratensis* (Kentucky bluegrass) (1-39%), *Bromus tectorum* (cheat grass) (32%), *Solidago canadensis* (25%), *Agrostis stolonifera* (13%), and *Carex lanuginosa* (woolly sedge) (8%).

Adjacent Riparian Vegetation:

Adjacent riparian communities include *Populus angustifolia* (narrowleaf cottonwood) woodlands, *Salix exigua* (coyote willow) shrublands, and irrigated hay meadows.

Adjacent Upland Vegetation:

Neighboring hill slopes are vegetated with *Cercocarpus montanus* (mountain mahogany) and *Pinus edulis-Juniperus osteosperma* (pinyon pine-Utah juniper) woodlands.

Potential Conservation Areas supporting the *Populus angustifolia/Prunus virginiana* plant association:

Cheyenne Canyon

Global Scientific Name: *Populus angustifolia* / *Salix exigua* plant association

Common Name: narrowleaf cottonwood/coyote willow

Wetland System: palustrine

Related Literature and Synonyms:

The *Populus angustifolia/Salix exigua* plant association described by Durkin *et al.* (1994, 1995) is synonymous with the Colorado *Populus angustifolia/Salix exigua* plant association.

A closely related community, *Populus angustifolia/*Recent Alluvial Bar (Jones 1990, Jones and Walford 1995, Hansen *et al*. 1995), is not quite synonymous because many stands do not have *Salix exigua* (coyote willow) present. Some Colorado stands (e.g., plot 93RR22) fit the recent alluvial bar description but are listed as *Populus angustifolia/Salix exigua* type due to the ephemeral existence of their alluvial bars (see the Vegetation section for details.)

Similar Communities:

Two closely related communities are the *Populus angustifolia/Salix exigua* habitat type (Hess 1981, Baker 1984), which has significant *Betula occidentalis* cover, and the *Populus angustifolia/Salix exigua-Betula fontinalis* (narrowleaf cottonwood/coyote willow-river birch) plant association (Johnston 1987).

Regional Distribution:

The *Populus angustifolia/Salix exigua* plant association occurs in New Mexico and Colorado (Durkin *et al.* 1994,1995 CNHP 1999).

Distribution in Colorado:

This plant association occurs in the Yampa, White, Colorado, Gunnison, Rio Grande, South Platte, and Arkansas River Basins; and the San Juan and Rio Grande National Forests (Kittel and Lederer 1993, Kittel *et al.* 1994, Kittel *et al.* 1996, Johnston 1987, Richard *et al.* 1996, Kittel *et al.* 1999a).

Reasons for Global Rank:

This is a common, early-seral stage of most *Populus angustifolia* dominated associations. It occurs in New Mexico and Colorado, and is expected to occur in Wyoming and Montana.

Global Rank:

Global rank is based on the status of a taxon throughout its range. This association is ranked G4, apparently secure globally, though it may be quite rare in parts of its range, especially at the periphery.

Reasons for State Rank:

This association is widespread with >100 estimated stands. It is an important indicator of fluvial process and riparian health. It is an early-seral stage of other *Populus angustifolia* communities, many of which are imperiled or vulnerable. Many streams and rivers support this stage of cottonwood regeneration, however, channelization and flood control has curtailed cottonwood growth and stand development beyond this stage.

State Rank:

State rank is based on the status of a taxon in an individual state. In Colorado, this association is ranked S4, apparently secure in the state with more than 100 occurrences.

General Description and Comments:

This is a very common plant association of young seedling and sapling *Populus angustifolia* (narrowleaf cottonwood) intermixed with *Salix exigua* (coyote willow). Stands are open to dense, with little herbaceous undergrowth. The association occupies point bars, gravel bars, benches and low areas that are flooded annually.

Elevation Range in Colorado:

6300-7500 ft. (1900-2300 m).

Site Geomorphology:

This plant association occurs on recently flooded point bars, low terraces, and stream benches. It is usually well within the active channel and immediate floodplain of the stream and does not occur more than 3-6 feet (1-2 m) above the high-water mark. Streams were classified according to the Rosgen Classification of Natural Rivers(Rosgen 1996). Stream channels are wide and slightly sinuous (Rosgen's Channel Type: B3, B4) or wide and moderately sinuous (Rosgen's Channel Type: C3, C4).

Soils:

Soils are skeletal (40% gravel and 10-20% cobbles) and shallow [15 inches (35 cm) deep] sands, sandy loams, sandy clay loams, or silty clays over coarse alluvial material.

Management:

Because regeneration and establishment of new stands of cottonwood are dependent upon flooding events, any alteration to the natural flow regime of a river can affect the cottonwood ecosystem. Upstream dams stabilize stream flows by reducing the frequency and magnitude of floods. This results in fewer flood events that provide conditions for cottonwood stand regeneration. Without periodic disturbance by flooding, riparian areas become dominated by non-obligate riparian, late-seral communities. These late-seral communities are dominated by upland species, such as conifers in montane areas or other, more drought tolerant species in the foothill and plains environments.

Forage productivity for this plant association can be high and very palatable to livestock. Cottonwood and willow seedlings and saplings are frequently browsed by cattle. Excessive grazing and browsing will reduce plant vigor and allow non-native plant species to gain a competitive advantage. Cottonwood-dominated riparian areas in Colorado are best grazed moderately for short periods during the growing season or solely during the winter season. This maintains high forage quality and quantity (Hansen *et al.* 1995).

Salix exigua (coyote willow) is an excellent streambank stabilizer that can be planted as stems or wattles for restoration purposes. However, cattle may browse the young shoots in the winter and kill newly planted poles.

Successional and Ecological Processes:

In Colorado, cottonwood is a pioneer tree species. Seed reproduction is primarily restricted to bare, moist sites (Friedman *et al.* 1995, Moss 1938) and rarely occurs underneath an existing canopy of cottonwood poles or trees (Johnson 1994). Regeneration of cottonwood stands is thus dependent on fluvial disturbances that create bare, moist sites (Bradley and Smith 1986, Friedman *et al.* 1997). These processes include channel migration (meandering and avulsion), channel narrowing, and scour and sediment deposition from episodic floods (Scott *et al.* 1996).

The size and age structure of a specific cottonwood patch are heavily dependent on the time since the last disturbance. Annually disturbed sites at the channel margin may never progress beyond young seedlings (Auble *et al.* 1997). Sites disturbed by an extreme event, or sites that become safe through accretion or channel migration, may support pole and tree size cottonwood (Auble and Scott 1998, Everitt 1968). At a larger spatial scale, the riparian forest comprises a mosaic of patches with different ages of cottonwood and different histories of disturbance.

The future of a mature cottonwood stand depends on future disturbance and moisture conditions. A disturbance may trigger another generation of cottonwood at the patch. On undisturbed sites that are moist enough to support trees, cottonwood may be replaced by co-established species that live longer than the cottonwood, or by secondary species that have become established in the understory (Boggs and Weaver 1994, Hansen *et al.* 1995, Howe and Knopf 1991, Johnson *et al.* 1976, Padgett *et al.* 1989). On drier, undisturbed sites, decadent cottonwood may be replaced by a treeless herbaceous community (Hefley 1937, Lindauer 1983).

Populus angustifolia/Salix exigua (narrowleaf cottonwood/coyote willow) is one of the earliest successional stages of a cottonwood-dominated plant association. *Populus angustifolia* and *Salix exigua* seeds often germinate together on freshly deposited sandbars. If the site becomes more stable and less frequently flooded (i.e., the stream channel migrates away from the site), the *Populus angustifolia* saplings mature, but the *Salix exigua* population eventually declines. The association can become one of several mid- or late-seral floodplain types including *Populus angustifolia/Alnus incana* (narrowleaf cottonwood/thinleaf alder) and *Populus angustifolia/Cornus sericea* (narrowleaf cottonwood/redosier dogwood).

Vegetation:

This plant association represents the early, successional stage of nearly all *Populus angustifolia* (narrowleaf cottonwood) dominated plant associations, and is characterized by an open to dense stand *Populus angustifolia* (narrowleaf cottonwood) young trees (> 12 cm dbh) (20-76% cover), seedlings (< 1.5 m in height) (1-3%), and saplings (< 12 cm dbh) (10-44%) with *Salix exigua* (coyote willow) (3-64%). *Populus* x *acuminata* (lance-leaf cottonwood) may also be present in similar age classes (8-10%). Other, more widely scattered trees may also be present, occurring in less than 20% of sampled stands, and include: *Abies lasiocarpa* (subalpine fir) (1-2% cover), *Pinus ponderosa* (ponderosa pine) (1-17%), and *Picea pungens* (Colorado blue spruce) (6-12%).

The shrub canopy is typically at the same height of the seedling and sapling cottonwood trees, although older, transitional, stands will have taller, more mature trees with *Salix exigua* as an understory. *Salix exigua* (coyote willow) is present with 3-64% cover. Other shrubs that may be present include: *Alnus incana* (thin-leaf alder) (3-10% cover), *Salix lasiandra* var. *caudata* (greenleaf willow) (20%), *S. drummondiana* (Drummond willow) (3-10%), *S. bebbiana* (Bebb willow) (10%), and *S. lasiandra* var. *lasiandra* (Pacific willow) (10%), *S. eriocephala* var. *ligulifolia* (strap-leaf willow) (1-3%).

Some stands are almost pure seedlings of *Populus angustifolia* (narrowleaf cottonwood) with very little or no *Salix exigua* (coyote willow) cover. Stands that fit this description may be more similar to the "recent alluvial bar" community described from Wyoming (Jones and Walford 1995).

The herbaceous undergrowth is generally invasive, non-native and sparse from frequent flooding disturbance. Non-native species include: *Poa pratensis* (Kentucky bluegrass) (1-20% cover), *Trifolium repens* (white clover) (1-40%), *Agrostis stolonifera* (redtop) (1%), *Linaria vulgaris* (butter-and-eggs) (14%), *Taraxacum officinale* (1-20%), *Medicago lupulina* (1-20%), *Phleum pratense* (1-10%), *Melilotus officinalis* (sweet clover) (1-30%), *Dactylis glomerata* (orchard grass) (1-10%), and *Elytrigia repens* (quack grass) (1-10%). Native herbaceous species that can be present include: *Equisetum arvense* (field scouring rush) (1-33% cover), *Achillea millefolium* (yarrow) (1-3%), *Rudbeckia laciniata* (lack-eyed Susan) (1-3%), *Carex microptera* (big head sedge) (1%), *Carex lanuginosa* (woolly sedge) (1-5%), and *Mentha arvensis* (field mint) (1-3%).

Three plots (93RR22, 94JB39, 95AM14) had abundant *Populus angustifolia* seedlings and little to no *Salix exigua* (coyote willow) present and could be considered part of the *Populus angustifolia*/Recent Alluvial Bar association described in Wyoming (Jones 1990, Hansen *et al.* 1995).

Adjacent Riparian Vegetation:

Thick stands of *Salix exigua* (coyote willow) or *Alnus incana* (thinleaf alder) shrublands often occur with *Populus angustifolia/Salix exigua* in the same reach. *Populus angustifolia/Cornus sericea* (narrowleaf

cottonwood/redosier dogwood) and *Populus angustifolia/Amelanchier* spp. (narrowleaf cottonwood/serviceberry) forests occur on higher terraces.

Adjacent Upland Vegetation:

Pinus ponderosa (ponderosa pine) forests, *Pinus edulis-Juniperus monosperma* (pinyon pine-oneseed juniper) woodlands, *Quercus gambelii* (Gambel oak) scrub, and *Artemisia tridentata* (big sagebrush) shrublands occur on adjacent rocky valley slopes.

Potential Conservation Areas supporting the *Populus angustifolia/Salix exigua* plant association:

Monument Creek

Global Scientific Name: *Populus deltoides - (Salix amygdaloides*) / *Salix exigua* plant association

Common Name: eastern cottonwood-(peachleaf willow)/coyote willow

Wetland System: palustrine

Related Literature and Synonyms:

In Colorado, two prior types, the *Populus deltoides* ssp. *wislizenii*/*Salix exigua* (Rio Grande cottonwood/coyote willow) and the *Populus deltoides* ssp. *monilifera*-(*Salix amygdaloides*)/*Salix exigua* (plains cottonwood-(peachleaf willow)/coyote willow) plant associations, are combined into the *Populus deltoides/Salix exigua* plant association.

The following community names are considered synonymous with the Colorado *Populus deltoides/Salix exigua* plant association: 1) the *Populus deltoides* ssp. *monilifera*-(*Salix amygdaloides*)/*Salix exigua* (plains cottonwood-(peachleaf willow)/coyote willow) community described by Jones and Walford (1995), 2) the "mixed community" consisting of *Populus sargentii*, *Salix amygdaloides*, and *Salix interior* described by Christy (1973), 3) the *Populus sargentii/Salix* spp. plant association described by Johnston (1987), and 4) the *Populus deltoides* ssp. *wislizenii*/*Salix exigua* community type in New Mexico described by Durkin *et al.* (1995). Note that *Populus sargentii* and *Salix interior* are synonyms for *Populus deltoides* ssp. *monilifera* and *Salix exigua*, respectively (Kartesz 1994).

Similar Communities:

There are three closely related communities to the Colorado association. The dominant cottonwood of the *Populus fremontii/Salix amygdaloides*/mesic shrub/mesic graminoid-forbs plant association (Dick-Peddie 1993) is different from, but the co-dominant species and environmental setting are similar to, that of the Colorado association. Both the *Populus deltoides/Salix amygdaloides-Salix nigra* (eastern cottonwood/peachleaf willow-black willow) (Faber-Langendoen 1996) and the *Salix amygdaloides-Salix exigua-Salix lucida* ssp. *caudata* (peachleaf willow-coyote willow-greenleaf willow) plant associations (Bourgeron and Engelking 1994) are similar to the Colorado association but have different *Salix* (willow) species in the understory.

Regional Distribution:

This association occurs in Wyoming (Jones and Walford 1995), New Mexico, and Colorado (CNHP 1999). It is expected to occur in Oklahoma, Texas, South Dakota, and Kansas (Faber-Langendoen 1996).

Distribution in Colorado:

In Colorado this plant association occurs along streams and rivers at the base of the Colorado Front Range foothills east to the Nebraska state line (Christy 1973, Johnston 1987, Kittel *et al.* 1996) and along the Colorado and San Juan Rivers and their tributaries west to the Utah and New Mexico state lines (CNHP 1999).

Reasons for Global Rank:

This and similar associations are located throughout the western Great Plains, and on larger, low elevation rivers on the western slope. It was once a patchy type scattered along the South Platte and Platte Rivers. It is more abundant today than is was historically due to the altered hydrologic character of the river. It may decline as the Platte becomes more narrow and entrenched. Also, while this early-seral stage of cottonwoods is common, the late-seral, older cottonwood stands that occur as a result of channel migration, are becoming very rare due to hydrologic manipulation of stream flows. The presence of this early-seral association may be an indication of some resemblance to natural stream flow, but stands must be monitored if all stages of cottonwood riparian communities are to be protected along river corridors.

Global Rank:

Global rank is based on the status of a taxon throughout its range. This association is ranked G4?, widespread, abundant, and apparently secure globally, though it may be quite rare in parts of its range, especially at the periphery (usually more than 100 occurrences). Apparently not vulnerable in most of its range, but may be of long-term concern. This plant association is documented from Colorado and is expected to occur abundantly elsewhere. The question mark in the Global rank indicates that the community is suspected to be more abundant, but additional locations have not been documented.

Reasons for State Rank:

Same as global reasons.

State Rank:

State rank is based on the status of a taxon in an individual state. In Colorado, this association is ranked S3, rare in state (21 to 100 occurrences).

General Description and Comments:

This is an early-seral association with a mix of sapling and pole sized *Populus deltoides*, either subspecies *monilifera* (plains cottonwood) or subspecies *wislizeni* (Rio Grande cottonwood)) intermixed with *Salix exigua* (coyote willow). It is recognized as the younger stage of older plains cottonwood associations that have more widely spaced trees. This association is often located on low streambanks and islands, but can also occur on overflow channels away from the main stream channel. It typically has a fairly dense tree canopy with little herbaceous ground cover.

Elevation Range in Colorado:

3500-6500 ft. (1000-2000 m).

Site Geomorphology:

This plant association occurs on young, alluvial surfaces such as point bars, low streambanks, and overflow areas. It occurs on immediate streambanks and low overflow areas near the main river channel, and on the floodplain of meandering, low to moderate gradient (0.5-3.0%) streams with silt and sand stream beds. Streams were classified according to the Rosgen Classification of Natural Rivers (Rosgen 1996). Channels are broad and braided (Rosgen's Channel Type: C5, D5). Along smaller washes and incised channels (e.g., Kiowa and West Bijou Creeks), the plant association occurs on higher terraces, where periodic summer flash floods disturb the entire floodplain. The washes have flat-bottomed, sandy beds (Rosgen's Channel Type: F5).

Soils:

Soils are typically fresh, alluvial material with little soil development. Textures are predominately loose, friable sands interspersed with narrow bands of clay loams and sandy clays.

Management:

Because regeneration and establishment of new stands of *Populus deltoides* (eastern cottonwood) are dependent upon flooding events, any alterations to the natural flow regime of a river can affect the cottonwood ecosystem. Upstream dams stabilize stream flows by reducing the frequency and magnitude of floods. This results in fewer flood events that would allow for *Populus deltoides* stand regeneration. Without periodic disturbance by flooding, riparian areas become dominated by late-seral communities. These late-seral communities are dominated by more upland species, such as conifers in montane areas or other, more drought tolerant species in the foothill and plains environments.

Along the South Platte River, however, the removal of frequent flooding and ice-flows has encouraged riparian woody growth. Historically, the South Platte River was a wide, shallow braided channel. It experienced significant floods every spring due to spring snowmelt runoff. In addition, the frozen shallow waters of winter would breakup into sheet of ice, flowing downstream in the early spring and damaging any

plant life in their path. Then, in late summer, the flow slowed to a trickle, dropping the water table well below the ground surface of the well-drained, sandy bed material (USDI FWS 1994). This combination of flood, ice-flows and drought kept the South Platte riverbed clear of woody vegetation along ninety-percent of the braided channel and streambanks. The present-day expanse of woody riparian growth along the South Platte River is due to human-caused changes to the hydrologic character of the river.

In addition, it is possible that the increase in woody canopy is a one-time event. Initial hydrological changes that have caused an increase in woody growth will also result in its decline. Continued flood control, especially to the degree exhibited below the confluence with the North Platte River, has limited cottonwood regeneration. With time the riparian forest will narrow as the outer-most trees die and the channel becomes more entrenched, reducing the extent and diversity of habitats within the riparian vegetation mosaic (Friedman *et al*. 1997, Scott *et al*. 1996).

Along the Colorado River, the early-seral cottonwood community has become dis-proportionately more abundant than older cottonwood stands. The Colorado is so regulated today, it is become entrenched and is much less dynamic. Older, mature cottonwood stands on upper terraces will not be replaced as they die out.

Riparian forage can be very productive and palatable to livestock. Cottonwood seedlings and saplings are frequently browsed by cattle. However, thick willow stands of this plant association may actually prevent livestock use. Excessive grazing and browsing will reduce plant vigor and allow non-native plant species to gain a competitive advantage. Cottonwood-dominated riparian areas in Colorado are best grazed moderately for short periods during the growing season or solely during the winter season. This maintains high forage quality and quantity.

Once established, *Salix amygdaloides* is a very good streambank stabilizer and should be protected by managers (Hansen *et al*. 1995). *Salix exigua* is also very useful in streambank stabilization in that it can rapidly colonize and spread on disturbed areas (Hansen *et al*. 1995). It is believed that fire in this type will result in the willow species vigorously sprouting afterward.

Successional and Ecological Processes:

In Colorado, cottonwood is a pioneer tree species. Seed reproduction is primarily restricted to bare, moist sites (Friedman *et al.* 1995, Moss 1938) and rarely occurs underneath an existing canopy of cottonwood poles or trees (Johnson 1994). Regeneration of cottonwood stands is thus dependent on fluvial disturbances that create bare, moist sites (Bradley and Smith 1986, Friedman *et al.* 1997). These processes include channel migration (meandering and avulsion), channel narrowing, and scour and sediment deposition from episodic floods (Scott *et al.* 1996).

The size and age structure of a specific cottonwood patch are heavily dependent on the time since the last disturbance. Annually disturbed sites at the channel margin may never progress beyond young seedlings (Auble *et al.* 1997). Sites disturbed by an extreme event, or sites that become safe through accretion or channel migration, may support pole and tree size cottonwood (Auble and Scott 1998, Everitt 1968). At a larger spatial scale, the riparian forest comprises a mosaic of patches with different ages of cottonwood and different histories of disturbance.

The future of a mature cottonwood stand depends on future disturbance and moisture conditions. A disturbance may trigger another generation of cottonwood at the patch. On undisturbed sites that are moist enough to support trees, cottonwood may be replaced by co-established species that live longer than the cottonwood, or by secondary species that have become established in the understory (Boggs and Weaver 1994, Hansen *et al.* 1995, Howe and Knopf 1991, Johnson *et al.* 1976, Padgett *et al.* 1989). On drier, undisturbed sites, decadent cottonwood may be replaced by a treeless herbaceous community (Hefley 1937, Lindauer 1983).

The *Populus deltoides/Salix exigua* (eastern cottonwood/coyote willow) plant association is an early- to mid-seral stage. With time and tree growth, *Salix exigua* (coyote willow) is shaded by taller cottonwoods, and becomes less important. Christy (1973) suggests that this vegetation type may be transitional between an all *Salix exigua* (coyote willow) dominated association and an all *Populus deltoides* (eastern

cottonwood) dominated association. However, he considers this plant association to be a response to intermediate environmental conditions, namely intermediate soil moisture where *Salix exigua* dominates the wettest soils and *Populus deltoides* dominates the driest.

Salix amygdaloides (peachleaf willow), commonly present in eastern slope occurrences of this association, also requires stream flooding for regenerations. *Salix amygdaloides* is a pioneer species that needs bare, moist alluvium to become established from seed (Johnson 1994 [as cited by Jones and Walford 1995]).

Vegetation:

This association is characterized by seedling, sapling, and pole-sized *Populus deltoides*, either ssp. *monilifera* (plains cottonwood) or ssp. *wislizenii* (Rio Grande cottonwood), mixed with *Salix exigua* (coyote willow) on sandbars, point bars, and other low, frequently flooded areas. Canopy cover of *Populus deltoides* ranges from 1-50%; cover of *Salix exigua* (coyote willow) ranges from 5-50%. The total height of this association is often under 1.5 m (4 ft), but a few stands have near-mature sized cottonwood trees, and represent the last transition to older cottonwood types as the *Salix exigua* (coyote willow) is shaded out by the overstory canopy of cottonwoods. Other sapling and seedling tree species may be present; on the eastern slope, including: *Salix amygdaloides* (peachleaf willow) (2-27%), *Fraxinus pennsylvanica* (green ash) (1-21%), and *Ulmus pumila* (Siberian elm) (32%). Other shrubs that may be present include: *Salix eriocephala* var. *ligulifolia* (strapleaf willow) (1-3%), and *Vitis riparia* (riverbank grape) (8%).

The herbaceous understory is relatively sparse with *Xanthium strumarium* (rough cocklebur) (1-10%), *Melilotus officinalis* (sweet clover) (1-26%), *Poa pratensis* (Kentucky bluegrass) (1-19%), *Bromus inermis* (smooth brome) (2-16%), *Bromus tectorum* (cheat grass) (2-19%).
If the stand is very moist, up to 22% cover may be *Carex* spp. (sedge) with some *Scirpus* spp. (bulrush) and *Eleocharis palustris* (common spikerush) present.

Adjacent Riparian Vegetation:

Older stands of *Populus deltoides* (eastern cottonwood) often occur on higher terraces, while pure stands of other *Salix* (willow) and *Carex* (sedge) species occur within the riparian mosaic of the channel and floodplain. Along the San Miguel River on the western slope, mature stands of older *Populus deltoides* ssp. *wislizenii* (Rio Grande cottonwoods) occur with *Rhus trilobata* (skunk brush) in the understory.

Adjacent Upland Vegetation:

Foothill streams often have stands of *Pinus ponderosa* (ponderosa pine) or *Quercus gambelii* (Gambel oak) shrublands on outcrops. The mainstem of the South Platte River has sand sage, grasslands on adjacent rolling hills, and agricultural fields. Along the San Miguel River on the western slope, uplands have *Artemisia* spp. (sagebrush) and *Chrysothamnus* (rabbitbrush) shrublands and *Pinus edulis-Juniperus* spp. (pinyon pine-juniper) woodlands.

Potential Conservation Areas supporting the *Populus deltoides-(Salix amygdaloides)/Salix exigua* plant association:

Big Sandy Creek at Calhan
Huerfano River at Cedarwood
West Kiowa Creek at Elbert
West Bijou Creek Network of Conservation Areas

Global Scientific Name: *Populus deltoides* / *Pascopyrum smithii* - *Panicum obtusum* plant association

Common Name: eastern cottonwood/western wheatgrass-obtuse panicgrass riparian woodland

Wetland System: palustrine

Related Literature and Synonyms:

This association may be part of the more broadly defined *Populus deltoides/Distichlis spicata* (eastern cottonwood/inland saltgrass) plant association described from the South Platte and Arkansas Rivers in Colorado by Lindauer (1970), Christy (1973), and Crouch (1979a, 1979b). The *Populus deltoides/Pascopyrum smithii-Panicum obtusum* (eastern cottonwood/western wheatgrass-obtuse panicgrass) plant association does contain some *Distichlis spicata.*

Regional Distribution:

This association is documented from eastern Colorado. It is expected to occur in similar habitats in New Mexico, Oklahoma, Kansas, and Nebraska (CNHP 1999).

Distribution in Colorado:

This association is known from rivers and streams east of Pueblo on the mainstem of the Arkansas River and smaller tributaries, the Purgatory River, and on the Cimarron River in the far southeastern corner of Colorado (CNHP 1999).

Reasons for Global Rank:

Known only from sandy floodplains on Colorado's eastern plains rivers. It is expected to occur in New Mexico, Oklahoma, Kansas, and Nebraska.

Global Rank:

Global rank is based on the status of a taxon throughout its range. This association is ranked G2Q, imperiled globally because of rarity (less than 5 documented occurrences with more likely to be located with additional surveys), or because of some factor of its biology making it especially vulnerable to extinction. The Q indicates uncertainty about the community's taxonomy.

Reasons for State Rank:

Known from Chico Creek and the Arkansas, Purgatory, and Cimarron Rivers on the southeastern Colorado plains.

State Rank:

State rank is based on the status of a taxon in an individual state. In Colorado, this association is ranked S1S2Q, critically imperiled in the state because of extreme rarity (5 or fewer occurrences, or very few remaining individuals), or because of some factor of its biology making it especially vulnerable to extirpation from the state. The Q indicates uncertainty about the community's taxonomy.

General Description and Comments:

The *Populus deltoides/Pascopyrum smithii-Panicum obtusum* (eastern cottonwood/western wheatgrass-obtuse panicgrass) riparian woodland occurs on silty clay soils along rivers and streams of the eastern Colorado plains. Mature *Populus deltoides* ssp. *monilifera* (plains cottonwoods) provide a nearly continuous overhead canopy. High-quality stands have few shrubs, creating an open, park-like structure. Many stands in Colorado along the lower Arkansas and Purgatory Rivers have a thick subcanopy of *Tamarix ramosissima* (saltcedar), an introduced, non-native invasive shrub.

Elevation Range in Colorado:

3950-4660 ft. (1200-1400 m).

Site Geomorphology:

This association occurs in wide valleys on floodplains and terraces. Stands are located 61-533 ft. (20-175 m) lateral distance from the active channel, although one plot occurred right at the channel edge. Stands are 2-3.5 ft (0.6-1.1 m) above the height of the average annual high water mark, with the exception of one stand, that occurred right at the active channel average high water level. Streams were classified according to the Rosgen Classification of Natural Rivers (Rosgen 1996). Stream channels are wide and meandering with sand and gravel-beds (Rosgen's Channel Type: C5, C4) or wide and braided with sand-beds (Rosgen's Channel Type: D5).

Soils:

Soils are deep silty clay and silty clay loams to over 24 in (60 cm) deep. Some profiles have loamy sands and sands at depth. Mottles occurred from the surface to over 60 cm depth in one profile.

Management:

Regeneration and establishment of new stands of cottonwood are dependent upon flooding events, and any alterations to the natural flow regime of a river can affect the cottonwood ecosystem. Upstream dams stabilize stream flows by reducing the frequency and magnitude of floods. This results in fewer flood events that allow cottonwood stand regeneration. Without periodic disturbance by flooding, riparian areas become dominated by late-seral communities. These late-seral communities are dominated by more upland species, such as conifers in montane areas or other, more drought tolerant species in the foothill and plains environments.

Riparian forage can be very productive and palatable to livestock. Cottonwood seedlings and saplings are frequently browsed by cattle. Excessive grazing and browsing will reduce plant vigor and allow non-native plant species to gain a competitive advantage. Cottonwood-dominated riparian areas in Colorado are best grazed moderately for short periods during the growing season or solely during the winter season. This maintains high forage quality and quantity.

Winter-only grazing by livestock works very well in maintaining the native grass species vigor in cottonwood ecosystems of eastern plains rivers in Colorado. The native grass species are likely to remain if the current management of winter-only grazing is maintained and periodic fire is allowed to occur (Rick Schnider, pers. comm., Nebraska Heritage Program 1998). Other sites in northeastern Colorado that experience season-long grazing have shown a strong reduction in native grass species.

Successional and Ecological Processes:

In Colorado, cottonwood is a pioneer tree species. Seed reproduction is primarily restricted to bare, moist sites (Friedman *et al.* 1995, Moss 1938) and rarely occurs underneath an existing canopy of cottonwood poles or trees (Johnson 1994). Regeneration of cottonwood stands is thus dependent on fluvial disturbances that create bare, moist sites (Bradley and Smith 1986, Friedman *et al.* 1997). These processes include channel migration (meandering and avulsion), channel narrowing, and scour and sediment deposition from episodic floods (Scott *et al.* 1996).

The size and age structure of a specific cottonwood patch are heavily dependent on the time since the last disturbance. Annually disturbed sites at the channel margin may never progress beyond young seedlings (Auble *et al.* 1997). Sites disturbed by an extreme event, or sites that become safe through accretion or channel migration, may support pole and tree size cottonwood (Auble and Scott 1998, Everitt 1968). At a larger spatial scale, the riparian forest comprises a mosaic of patches with different ages of cottonwood and different histories of disturbance.

The future of a mature cottonwood stand depends on future disturbance and moisture conditions. A disturbance may trigger another generation of cottonwood at the patch. On undisturbed sites that are moist enough to support trees, cottonwood may be replaced by co-established species that live longer than the cottonwood, or by

secondary species that have become established in the understory (Boggs and Weaver 1994, Hansen *et al.* 1995, Howe and Knopf 1991, Johnson *et al.* 1976, Padgett *et al.* 1989). On drier, undisturbed sites, decadent cottonwood may be replaced by a treeless herbaceous community (Hefley 1937, Lindauer 1983).

The *Populus deltoides/Pascopyrum smithii-Panicum obtusum* (eastern cottonwood/western wheatgrass-obtuse panicgrass) riparian woodland is a late-seral community of active floodplains. This association occurs only on fine-textured soils in very subtle topographic swales on the floodplain. Large patches of *Sporobolus cryptandrus* (sand dropseed) occur underneath the same cottonwood stand, on the same terrace or floodplain, where pockets of very dry and sandy soils occur on subtle topographic ridges, forming the *Populus deltoides/Sporobolus cryptandrus* (eastern cottonwood/sand dropseed) plant association.

It would appear that the graminoid species in the undergrowth of these cottonwood communities are responding to soil texture, moisture holding capacity, and salinity, while the cottonwoods are well established with much deeper, phreatophytic roots. Subsequent to cottonwood establishment, successive flooding events have unevenly deposited different sediments on the floodplain surface, creating a micro-mosaic of different habitats underneath the cottonwood canopy. All of the aforementioned grass species are rhizomatous, and they form large, near monotypic patches within each micro-habitat.

Vegetation:

Populus deltoides ssp. *monilifera* (plains cottonwood) dominates the overstory canopy with 13-83% cover. *Salix amygdaloides* (peachleaf willow) may be present in small amounts (rarely on transects, but noted in field descriptions). *Ericameria nauseosa* ssp. *nauseosa* var. *glabrata* (rubber rabbitbrush) (1-3%), when present, is the only native shrub. *Tamarix ramosissima* (saltcedar) was frequently abundant (7-76%) although plot selection attempted to avoid it.

The herbaceous undergrowth is dominated by a mix of *Pascopyrum smithii* (western wheatgrass) with 7-50% cover and *Panicum obtusum* (obtuse panicgrass) with 1-79% cover. Other grass species that may be present include: *Distichlis spicata* (saltgrass) (13%), *Panicum virgatum* (switchgrass) (3%), *Muhlenbergia asperifolia* (alkali muhly) (1-4%), *Sporobolus airoides* (alkali sacaton) (1-23%), *Sporobolus cryptandrus* (sand dropseed) (1-4%), *Elymus canadensis* (Canadian wildrye) (1-8%), *Bouteloua gracilis* (blue grama) (1%), and *Bothriochloa laguroides* ssp. *torreyana* (13%).

Adjacent Riparian Vegetation:

Populus deltoides/Sporobolus cryptandrus (eastern cottonwood/sand dropseed) woodlands, *Salix exigua* (coyote willow) and *Tamarix ramosissima* (saltcedar) shrublands, and *Typha* spp. (cattail) and *Scirpus* spp. (bulrush) wetlands occur as part of the surrounding riparian mosaic.

Adjacent Upland Vegetation:

Agricultural fields, *Pinus edulis-Juniperus* spp. (pinyon pine-juniper) woodlands, *Artemisia filifolia* (sand sage) shrublands, *Bouteloua gracilis-Buchloe dactyloides* (Blue grama-buffalograss) shortgrass prairies, and large patches of *Salsola collina* (slender Russian thistle) occur in the surrounding upland landscape.

Potential Conservation Areas supporting the *Populus deltoides/Pascopyrum smithii-Panicum obtusum* plant association:

Chico Creek

Global Scientific Name: *Populus deltoides* / *Sporobolus airoides* plant association

Common Name: eastern cottonwood/alkali sacaton

Wetland System: palustrine

Related Literature and Synonyms:

No synonymous community types or plant associations were found in the literature.. It may be part of the more broadly defined *Populus deltoides/Distichlis spicata* (eastern cottonwood/inland saltgrass) plant association described from the South Platte and Arkansas Rivers in Colorado by Lindauer (1970), Christy (1973), and Crouch (1979a, 1979b). Even though stands of *Populus deltoides/Sporobolus airoides* did not contain any *Distichlis spicata*, they did occur adjacent to similar age stands of the *Populus deltoides/Pascopyrum smithii-Panicum obtusum* (eastern cottonwood/western wheatgrass-obtuse panicgrass) plant association (Kittel *et al.* 1999a) containing some *Distichlis spicata.*

Similar Communities:

The *Sporobolus airoides-Distichlis spicata* Herbaceous Vegetation plant association from New Mexico (Muldavin and Melhop 1992) occurs in a similar habitat with similar herbaceous composition to the Colorado association. It is intermittently flooded but has no cottonwood overstory component.

Regional Distribution:

This association is known from eastern Colorado (CNHP 1999), the Pecos River Basin in southeastern New Mexico, and the middle and lower Rio Grande (Muldavin et al. 2000). It is expected to occur in Oklahoma, Kansas, and Nebraska (CNHP 1999).

Distribution in Colorado:

This association is known only from the Arkansas and Purgatory Rivers in southeastern Colorado (CNHP 1999).

Reasons for Global Rank:

Known from eastern Colorado and New Mexico. It is expected to occur in Oklahoma, Kansas, and Nebraska.

Global Rank:

Global rank is based on the status of a taxon throughout its range. This association is ranked G3, vulnerable globally because of rarity (20 to 100 occurrences) or because of other factors demonstrably making it very vulnerable to extinction throughout its range. Possibly in peril range-wide, but more information is needed.

Reasons for State Rank:

This association is known only from three stands in southeastern Colorado. Chico Creek, a tributary to the Arkansas River, the Arkansas River, and the Purgatory River in the southeastern corner of Colorado.

State Rank:

State rank is based on the status of a taxon in an individual state. In Colorado, this association is ranked S2, imperiled in state because of rarity (6 to 20 occurrences), or because of other factors demonstrably making it very vulnerable to extirpation from the state.

General Description and Comments:

In Colorado, the *Populus deltoides/Sporobolus airoides* (eastern cottonwood/alkali sacaton) riparian woodland is a late-seral, mature *Populus deltoides* ssp. *monilifera* (plains cottonwood) woodland on upper terraces. The woodland is very open with widely spaced trees. The distance between trees is more than twice their canopy widths. Shrubs are few and far between. The ground is covered with thick grasses.

Elevation Range in Colorado:

3400-4400 ft. (1000-1340 m).

Site Geomorphology:

This association occurs on upper terraces. It is located 120-1000 ft. (37-300 m) lateral distance from the active channel, and 3.6-4.1 ft. (1.1-1.25 m) above the channel high water mark. Streams were classified according to the Rosgen Classification of Natural Rivers(Rosgen 1996). Stream channels are wide and meandering with distinct point-bars and cut-banks at curves. The stream gradient is < 1%. Predominant bed material is gravel and sand (Rosgen's Channel Type: C4, C5).

Soils:

Soils are deep loamy sands with silt loam and silty clay textures in the upper layers 2-6 inches (5-15 cm). One profile had distinct mottles starting at 2 inches (5 cm) depth.

Management:

Sporobolus airoides (alkali sacaton) can become an important forage grass in habitats where higher quality grasses are not available.

Regeneration and establishment of new stands of cottonwood are dependent upon flooding events, and any alterations to the natural flow regime of a river can affect the cottonwood ecosystem. Upstream dams stabilize stream flows by reducing the frequency and magnitude of floods. This results in fewer flood events that allow cottonwood stand regeneration. Without periodic disturbance by flooding, riparian areas become dominated by late-seral communities. These late-seral communities are dominated by more upland species, such as conifers in montane areas or other, more drought tolerant species in the foothill and plains environments.

Riparian forage can be very productive and palatable to livestock. Cottonwood seedlings and saplings are frequently browsed by cattle. Excessive grazing and browsing will reduce plant vigor and allow non-native plant species to gain a competitive advantage. Cottonwood-dominated riparian areas in Colorado are best grazed moderately for short periods during the growing season or solely during the winter season. This maintains high forage quality and quantity.

Winter-only grazing by livestock works very well in maintaining the native grass species vigor in cottonwood ecosystems of eastern plains rivers in Colorado. The native grass species are likely to remain if the current management of winter-only grazing is maintained and periodic fire is allowed to occur (Rick Schnider, pers. comm. Nebraska NHP). Other sites in northeastern Colorado that experience season-long grazing have shown a strong reduction in native grass species.

Successional and Ecological Processes:

In Colorado, cottonwood is a pioneer tree species. Seed reproduction is primarily restricted to bare, moist sites (Friedman *et al.* 1995, Moss 1938) and rarely occurs underneath an existing canopy of cottonwood poles or trees (Johnson 1994). Regeneration of cottonwood stands is thus dependent on fluvial disturbances that create bare, moist sites (Bradley and Smith 1986, Friedman *et al.* 1997). These processes include channel migration (meandering and avulsion), channel narrowing, and scour and sediment deposition from episodic floods (Scott *et al.* 1996).

The size and age structure of a specific cottonwood patch are heavily dependent on the time since the last disturbance. Annually disturbed sites at the channel margin may never progress beyond young seedlings (Auble *et al.* 1997). Sites disturbed by an extreme event, or sites that become safe through accretion or channel migration, may support pole and tree size cottonwood (Auble and Scott 1998, Everitt 1968). At a larger spatial scale, the riparian forest comprises a mosaic of patches with different ages of cottonwood and different histories of disturbance.

The future of a mature cottonwood stand depends on future disturbance and moisture conditions. A disturbance may trigger another generation of cottonwood at the patch. On undisturbed sites that are moist enough to

support trees, cottonwood may be replaced by co-established species that live longer than the cottonwood, or by secondary species that have become established in the understory (Boggs and Weaver 1994, Hansen *et al.* 1995, Howe and Knopf 1991, Johnson *et al.* 1976, Padgett *et al.* 1989). On drier, undisturbed sites, decadent cottonwood may be replaced by a treeless herbaceous community (Hefley 1937, Lindauer 1983).

The *Populus deltoides/Sporobolus airoides* (eastern cottonwood/alkali sacaton) riparian woodland is a late-seral community of active floodplains. *Sporobolus airoides* (alkali sacaton) is a salt tolerant plant and is commonly found in low-lying alkaline bottoms and wash banks (Cronquist *et al.* 1977).

Pockets of *Panicum obtusum* (obtuse panicgrass), *Pascopyrum smithii* (western wheatgrass), and *Distichlis spicata* (saltgrass) can also occur on the same terrace, under the same stand of cottonwood trees, but on finer textured soils in very subtle topographic swales. Pockets of *Sporobolus cryptandrus* (sand dropseed) can also occur on drier, sandy soils on minor ridges on the same floodplain surface. It would appear that the graminoid species in the undergrowth of these cottonwood communities are responding to soil texture, moisture holding capacity, and salinity, while the cottonwoods are well established with much deeper, phreatophytic roots. Subsequent to cottonwood establishment, successive flooding events have unevenly deposited different sediments on the floodplain surface, creating a micro-mosaic of different habitats underneath the cottonwood canopy. All of the aforementioned grass species are rhizomatous, and they form large, near monotypic patches within each micro-habitat.

Vegetation:

Large, widely spaced *Populus deltoides* ssp. *monilifera* (plains cottonwood) characterize this association, providing 9-19% canopy cover. There are few native shrubs present, and the non-native introduced shrub, *Tamarix ramosissima* (saltcedar) is unfortunately abundant on both the Purgatory and Arkansas Rivers. This invasive shrub was observed to be quite thick (25-90% canopy cover) in places although plot selection attempted to avoid it (3%).

The herbaceous undergrowth is dominated by *Sporobolus airoides* (alkali sacaton) with 54-61% cover. Other herbaceous species that may be present include: *Kochia scoparia* (fivehorn smotherweed) (23% cover), *Panicum obtusum* (obtuse panicgrass) (5%), *Bouteloua gracilis* (blue grama) (3%), *Aristida purpurea* (purple threeawn) (2%), *Helianthus annuus* (annual sunflower) (1-8%), and *Ambrosia artemisiifolia* (annual ragweed) (1%).

Adjacent Riparian Vegetation:

Populus deltoides/Pascopyrum smithii-Panicum obtusum (eastern cottonwood/western wheatgrass-obtuse panicgrass) woodlands, *Salix exigua* (coyote willow) and *Tamarix ramosissima* (saltcedar) shrublands, and *Typha* spp. (cattail) wetlands occur as part of the surrounding riparian mosaic.

Adjacent Upland Vegetation:

Agricultural fields, *Pinus edulis-Juniperus* spp. (pinyon pine-juniper) woodlands, *Artemisia filifolia* (sand sage) shrublands, *Bouteloua gracilis-Buchloe dactyloides* (Blue grama-buffalograss) shortgrass prairies, and large patches of *Salsola collina* (slender Russian thistle) occur in the surrounding upland landscape.

Potential Conservation Areas supporting the *Populus deltoides/Sporobolus airoides* plant association:
Chico Creek

Global Scientific Name: *Pseudotsuga menziesii / Betula occidentalis* plant association

Common Name: Douglas fir/river birch

Wetland System: palustrine

Related Literature and Synonyms:

One closely related community, the Conifer/*Betula occidentalis* community type (Manning and Padgett 1995), includes stands in the Snake Range, Nevada having *Pseudotsuga menziesii* (Douglas fir) with *Betula occidentalis* (river birch) in the understory.

Regional Distribution:

This plant association occurs in Colorado and Nevada (CNHP 1999, Manning and Padgett 1995).

Distribution in Colorado:

This plant association occurs in narrow foothill canyons of the Colorado Front Range, in the upper Arkansas and South Platte River Basins (Kittel *et al.* 1996, Kittel *et al.* 1997), and in the Rio Grande National Forest (Kittel *et al.* 1999b).

Reasons for Global Rank:

This plant association is documented from Colorado and is expected to occur in Nevada and Utah.

Global Rank:

Global rank is based on the status of a taxon throughout its range. This association is ranked G3?, either very rare and local throughout its range or found locally, even abundantly, in a restricted range or because of other factors making it vulnerable to extinction throughout its range (20 to 100 occurrences). This plant association is documented from Colorado and is expected to occur elsewhere. The question mark in the Global rank indicates that the community is suspected to be more abundant, but additional locations have not been documented.

Reasons for State Rank:

This plant association is limited to foothill tributaries along the Colorado Front Range. It is highly threatened by development, road maintenance and improvements, and heavy recreational use.

State Rank:

State rank is based on the status of a taxon in an individual state. In Colorado, this association is ranked S3, rare in state (21 to 100 occurrences).

General Description and Comments:

The *Pseudotsuga menziesii/Betula occidentalis* (Douglas fir/river birch) plant association occurs in narrow valley bottoms and steep canyons with cold-air drainage. The riparian area is narrow and dominated almost entirely by this one plant association.

Elevation Range in Colorado:

6,600-8080 ft. (2000-2500 m).

Site Geomorphology:

The *Pseudotsuga menziesii/Betula occidentalis* (Douglas fir/river birch) plant association occurs in narrow canyons with small streams and is limited to a narrow band along streambanks. Streams were classified according to the Rosgen Classification of Natural Rivers (Rosgen 1996). Stream channels are steep and narrow with mostly rocky beds (Rosgen's Stream Classification: A2-A3, one B3).

Soils:

The soils, derived from alluvial and colluvial deposits, are fairly shallow (60-135 in, or 25-55 cm) and become skeletal with depth. Surface layers are sandy loams, clay loams, and loams. Subsurface layers are sandy loams with 10-30% cobbles and gravels. Organic matter from accumulated litter appears to be concentrated in the upper layers.

Management:

Pseudotsuga menziesii (Douglas fir) regeneration is favored by fire, which creates seedbeds and eliminates competition. Mature trees are relatively fire resistant, but seedlings and saplings are vulnerable to surface fires due to their thin bark and resin blisters (Hansen *et al.* 1995). The thick shrub cover and multiple vertical canopy layers of this plant association provide excellent wildlife habitat for hiding and thermal cover. Severe disturbance to this plant association may reduce the shrub cover (Hansen *et al.* 1988) and result in a more open, herbaceous understory community of introduced species (Hansen *et al.* 1995).

Successional and Ecological Processes:

The *Pseudotsuga menziesii/Betula occidentalis* (Douglas fir/river birch) plant association appears to be in a late-seral successional stage since *Pseudotsuga menziesii* is successfully reproducing. It also appears that this association is limited to perennial streams where the cold-air drainage and perennial stream flow provide a cool and moist environment to support a diverse shrub canopy.

Vegetation:

This association is characterized by a dominance of *Pseudotsuga menziesii* (Douglas fir) and *Betula occidentalis* (river birch), which are key indicators for this type even if other tree and shrub species are more abundant. The overstory canopy of this plant association is dominated by 20-50% cover of *Pseudotsuga menziesii* (Douglas fir). Other tree species that may be present include: *Populus angustifolia* (narrowleaf cottonwood) (4-19% cover), *Juniperus scopulorum* (Rocky Mountain juniper) (1-20%), *Pinus ponderosa* (ponderosa pine) (2-10%), *Abies concolor* (white fir) (8-36%), *Abies lasiocarpa* (subalpine fir) (13%), *Picea pungens* (Colorado blue spruce) (21%), and *Populus tremuloides* (quaking aspen) (9-38%).

The shrub canopy is fairly thick and diverse with 20-40% cover of *Betula occidentalis* (river birch). Other shrubs that may be present include: *Alnus incana* (thinleaf alder) (5-72% cover), *Acer glabrum* (mountain maple) (1-13%), *Rosa woodsii* (Woods' rose) (3-20%), *Jamesia americana* (wax flower) (1-13%), *Cornus sericea* (5-26%), *Quercus gambelii* (Gambel oak) (10-25%), *Salix bebbiana* (Bebb willow) (2-19%), *S. eriocephala* var. *ligulifolia* (strapleaf willow) (13%), *S. monticola* (park willow) (11%), and *S. irrorata* (sandbar willow) (1-9%).

The herbaceous undergrowth is sparse and limited by heavy shade. Some of the more abundant species that may be present include: *Maianthemum stellatum* (false Solomon's seal) (1-3%), *Equisetum arvense* (field horsetail) (1-15%), *Carex disperma* (soft-leaved sedge) (6-8%), and *Melilotus officinalis* (sweet clover) (10%).

Adjacent Riparian Vegetation:

In general, this is the only riparian community occurring along narrow stream channels. Occasionally, stands of *Betula occidentalis* (river birch) or *Alnus incana* (thinleaf alder) may occur on adjacent stream benches and overflow areas.

Adjacent Upland Vegetation:

Steep colluvial slopes and canyon walls have *Pseudotsuga menziesii* (Douglas fir) and *Pinus ponderosa* (ponderosa pine) forests or *Juniperus monosperma* (oneseed juniper) and *Pinus edulis* (pinyon pine) woodlands mixed with patches of *Quercus gambelii* (Gambel oak).

Potential Conservation Areas supporting the *Psuedotsuga menziesii/Betula occidentalis* plant association:
Cheyenne Canyon

Global Scientific Name: *Salix amygdaloides/Carex lanuginosa* plant association

Common Name: peachleaf willow/woolly sedge

Wetland System: palustrine

Related Literature and Synonyms: This alliance is found in the northwestern Great Plains and northern Rocky Mountain states along streams and rivers where flooding occurs but is of short duration. It has an open canopy dominated by *Salix amygdaloides. Populus deltoides* can also be present. Some stands have a well-developed shrub stratum in which *Salix exigua* is abundant**.**

Similar Communities:
Salix amygdaloides/Salix exigua woodland

Regional Distribution:
This association is documented in Wyoming, South Dakota, Idaho, Montana, and Colorado.

Distribution in Colorado: The community is currently documented in only Douglas and Elbert counties. Future surveys will likely reveal additonal occurrences.

Reasons for Global Rank: The community is ranked as a S3 in Montana and as an S2 in Idaho, and present in Colorado, Wyoming, and South Dakota..

Global Rank: G3

Reasons for State Rank: Insufficient information to assign a state rank.

State Rank: SU

General Description and Comments: Riparian woodland in backwater areas, overflow channels, narrow floodplains, and edges of ponds and lakes.

Elevation Range in Colorado: Stands are found between 500 and 1800 m elevation.

Site Geomorphology:

Soils: Stands occur on a wide range of soil textures with the exception of clay. Soils are classified predominantly as Entisols (Fluvents) or Mollisols (Borolls).

Management:

Successional and Ecological Processes: The vegetation in this plant association occurs in riparian habitats in the Rocky Mountains and the northern Great Plains. Stands are located in backwater areas and overflow channels of large rivers, on narrow floodplains of small creeks, and on the edges of ponds and lakes. The water table is within 1 m of the soil surface during the growing season (Hansen et al. 1995), and the vegetation is tolerant of prolonged flooding. *Salix amygdaloides* is an early-seral species that requires a moist, mineral substrate for seeds to germinate. Seeds can germinate under a sparse canopy of vegetation (Johnson 1992 in Jones and Walford 1995)

Vegetation: The vegetation in this occurs in riparian habitats in the Rocky Mountains and the northern Great Plains. Stands are located near the active channel of large rivers and small creeks, and on the edges of ponds and lakes. The overstory canopy is moderately open and dominated by the small tree *Salix amygdaloides*, *Acer negundo*, *Populus angustifolia*, *Populus deltoides* may be present with low cover

values. One or more willow species may occur in the shrub canopy, including *Salix ligulifolia (= Salix eriocephala* var. *ligulifolia*), *Salix exigua*, *Salix lucida* ssp. *caudata*, and *Salix lutea.* The herbaceous layer is generally dominated by exotic species. *Bromus inermis*, *Cirsium arvense, Melilotus officinalis* (= *Melilotus albus*), *Phalaris arundinacea*, and *Poa pratensis* are the most common non-native species present. *Carex pellita* (= *Carex lanuginosa*), *Glycyrrhiza lepidota*, *Pascopyrum smithii,* and *Poa palustris* are the most common native associates.

Adjacent Riparian Vegetation: Adjacent riparian vegetation includes *Acer negundo*, *Fraxinus pennsylvanica*, and *Populus deltoides* woodlands and *Schoenoplectus pungens* (= *Scirpus pungens*) and *Typha latifolia* herbaceous communities.

Adjacent Upland Vegetation:

Potential Conservation Areas supporting the *Salix amygdaloides/Carex lanuginosa* plant association:
West Kiowa Creek at Elbert

Global Scientific Name: *Salix eriocephala* var. *ligulifolia* plant association
(National Vegetation Classification Name: *Salix ligulifolia* - *Cornus sericea* Shrubland)

Common Name: strapleaf willow

Wetland System: palustrine

Related Literature and Synonyms:

This community is listed as the *Salix ligulifolia – Cornus sericea* plant association in the Terrestrial Vegetation of the United States Volume II (Anderson et al. 1998). In Colorado, it is also known as the *Salix eriocephala* var. *ligulifolia* (strapleaf willow) plant association. Dorn (1995) has combined *Salix ligulifolia* (strapleaf willow) and *S. lutea* (yellow willow), as used in Colorado literature, into *S. eriocephala*. Nearly all Colorado *Salix ligulifolia* and *S. lutea* specimens have been placed into *S. eriocephala* var. *ligulifolia*. *Salix lutea* specimens found in the extreme northwestern part of Colorado (north of Dinosaur National Monument) have been renamed *S. eriocephala* var. *watsonii* (yellow willow); *S. lutea* specimens from extreme northeastern Colorado (along the South Platte River near Julesberg) have been renamed *S. eriocephala* var. *famelica* (plains willow).

Similar Communities:

This plant association has been reported in Colorado by other names: the *Salix eriocephala* var. *ligulifolia*/Mesic Graminoids (strapleaf willow/mesic graminoids) plant association (Kittel *et al.* 1996), the *Salix ligulifolia-Salix monticola* (strapleaf willow-park willow) plant association (Richard *et al*. 1996), and the *Salix ligulifolia-Cornus sericea* (strapleaf willow-redosier dogwood) plant association (Bourgeron and Engelking 1994). Communities containing *Salix eriocephala* var. *ligulifolia* stands mixed with *S. monticola* (park willow), *S. geyeriana* (Geyer's willow), or *S. drummondiana* (Drummond willow), and occurring at montane elevations, are considered synonymous with the Colorado *S. eriocephala* var. *ligulifolia* (strapleaf willow) plant association.

Several closely related *Salix lutea* (yellow willow) dominated community types occur in Montana (Hansen *et al*. 1995), eastern Wyoming and western Idaho (Youngblood *et al.* 1985a), and in Nevada (Manning and Padgett 1995). By applying Dorn's (1995) nomenclature, these communities would be dominated by *Salix eriocephala* var. *watsonii*.

Regional Distribution:

This association occurs in Colorado (CNHP 1999).

Distribution in Colorado:

This association occurs in the South Platte and Arkansas River Basins (Kittel *et al.* 1996), the Rio Grande/Closed Basin watershed (Kittel *et al.* 1999b), and in the San Juan and Rio Grande National Forests (Richard *et al.* 1996, CNHP 1999).

Reasons for Global Rank:

This association is known only from Colorado, but it is expected to occur in New Mexico.

Global Rank:

Global rank is based on the status of a taxon throughout its range. This association is ranked G2G3, imperiled globally because of rarity (6 to 20 occurrences) or because of other factors demonstrably making it very vulnerable to extinction throughout its range.

Reasons for State Rank:

This is a fairly common, if not well documented, plant association in Colorado. At least ten locations are known and an additional 20-50 are expected to occur within its habitat.

State Rank:

State rank is based on the status of a taxon in an individual state. In Colorado, this association is ranked S2S3, imperiled in state because of rarity (6 to 20 occurrences), or because of other factors demonstrably making it very vulnerable to extirpation from the state.

General Description and Comments:

The *Salix eriocephala* var. *ligulifolia* (strapleaf willow) was formerly known as *Salix ligulifolia* and *Salix lutea* in Colorado. The *Salix eriocephala* var. *ligulifolia* (strapleaf willow) plant association is a medium- to tall-willow shrubland occurring on saturated floodplains and streambanks of montane elevations. *Salix eriocephala* var. *ligulifolia* often mixes with *Salix exigua* (coyote willow) and *Salix lucida* (whiplash willow) in the foothills, forming the *Salix exigua-Salix eriocephala* var. *ligulifolia* (coyote willow-strapleaf willow) plant association. In the mountains where it grows in relatively broad valley bottoms, *Salix eriocephala* var. *ligulifolia* mixes with *S. monticola* (park willow) and *S. drummondiana* (Drummond willow).

Elevation Range in Colorado:

6700-10,200 ft. (2000-3100 m).

Site Geomorphology:

This association occurs in moderately wide valleys along low terraces and floodplains, and streambanks of narrower streams. Streams were classified according to the Rosgen Classification of Natural Rivers (Rosgen 1996). The plant association occurs below active beaver ponds where multiple channels create vegetated islands (Rosgen's Channel Type: D3), along slightly sinuous, broad channels (Rosgen's Channel Type: B2, B4), along more sinuous channels with well developed floodplains (Rosgen's Channel Type: C4), and along steep, narrow gullies (Rosgen's Channel Type: G3).

Soils:

Soils are saturated sandy loams and clay loams with a high organic matter content in the upper layers.

Management:

Salix lutea (=*S. eriocephala*) (strapleaf willow) is highly palatable to livestock, therefore, season-long grazing, especially late summer and early fall browsing, should be avoided in order to maintain the vigor of woody species (Hansen *et al.* 1995). Overuse by livestock may cause the site to dry and become dominated by introduced grass species such as *Poa pratensis* (Kentucky bluegrass) or *Bromus inermis* (smooth brome) (Manning and Padgett 1995). With continued overuse, the willow species will decline and eventually become eliminated from the site (Hansen *et al*. 1995).

Beaver are important in maintaining this plant association. Beaver dams raise the water table, which is beneficial to willow and sedge species as well as other hydrophytic plants. Beaver dams also help control bank erosion, channel downcutting, and the loss of sediment downstream (Hansen *et al*. 1995).

Prescribed fires may be useful for rejuvenating *Salix lutea* (=*Salix eriocephala*) (strapleaf willow) since this willow vigorously sprouts after burning, especially in wetter areas (Hansen *et al*. 1995). Willow roots provide streambank stability and should be considered by managers for streambank restabilization projects and revegetation purposes (Hansen *et al.* 1995, Padgett *et al.* 1989).

Successional and Ecological Processes:

This association appears to be long-lived, mid- to late-seral type since they are associated with beaver activity and saturated soils throughout the growing season.

Vegetation:

This association has a canopy dominated by 15-66% cover of *Salix eriocephala* var. *ligulifolia* (strapleaf willow), usually mixed with several other willow species. *Salix eriocephala* var. *ligulifolia* (strapleaf willow) is the key diagnostic species, even though other willows may have equal cover. Other willows that may be present include: *Salix monticola* (park willow) (3-43% cover), *S. geyeriana* (Geyer's willow) (1-12%), *S. bebbiana* (Bebb willow) (3%), *S. lasiandra* var. *lasiandra* (Pacific willow) (1-20%), *S. wolfii* (Wolf's willow) (11%), and *S. planifolia* (planeleaf willow) (8%). Additional shrubs that may be present include *Alnus incana* (thinleaf alder) (6% cover), *Cornus sericea* (redosier dogwood) (21%), and *Pentaphylloides floribunda* (shrubby cinquefoil) (1-10%).

The herbaceous undergrowth can be dense in undisturbed stands with *Carex utriculata* (beaked sedge) (9-40% cover), *C. nebrascensis* (Nebraska sedge) (1-5%), *C. lanuginosa* (woolly sedge) (1-3%), *Juncus balticus* (Baltic rush) (1-20%), and *Calamagrostis canadensis* (bluejoint reedgrass) (1-27%). Forb cover is generally low, but some species are abundant: *Taraxacum officinale* (dandelion) (1-10% cover), *Achillea millefolium* (yarrow) (1-7%), *Thalictrum fendleri* (meadow rue) (1-19%), and *Fragaria virginiana* (wild strawberry) (1-12%).

Adjacent Riparian Vegetation:

This association is often adjacent to, and intermixes with, *Carex aquatilis* (aquatic sedge) or *C. utriculata* (beaked sedge) meadows. *Populus angustifolia* (narrowleaf cottonwood) woodlands may also occur nearby.

Adjacent Upland Vegetation:

Artemisia (sagebrush) shrublands; *Pinus ponderosa* stands; and mixed conifer-*Populus tremuloides* (quaking aspen), and *Abies lasiocarpa-Picea engelmannii* (subalpine fir-Engelmann spruce) forests occur on surrounding hillsides.

Potential Conservation Areas supporting the *Salix eriocephala* var. *ligulifolia* plant association:

West Kiowa Creek at Elbert

Global Scientific Name: *Salix exigua* / mesic graminoids plant association

Common Name: coyote willow/mesic graminoids

Wetland System: palustrine

Related Literature and Synonyms:

The *Salix exigua*/Mesic Graminoids community types (Padgett *et al.* 1989, Jones and Walford 1995) are synonymous with the Colorado *Salix exigua*/Mesic Graminoids plant association.

Regional Distribution:

This plant association occurs in Wyoming (Jones and Walford 1995), Utah, Nebraska, Kansas, Oklahoma (TNC 1996) and Colorado (CNHP 1999).

Distribution in Colorado:

This plant association occurs throughout the western slope: San Miguel/Dolores River Basin (Kittel and Lederer 1993) and on the San Juan National Forest (Richard *et al*. 1996), along the Colorado Front Range (Friedman 1993, Koch 1994, Kittel 1994, Cooper and Cottrell 1990), the mainstem and tributaries of the South Platte River (Christy 1973, Kittel *et al.* 1996, Kittel *et al.* 1997), and in southeastern Colorado on the Comanche National Grasslands (Culver *et al.* 1996).

Reasons for Global Rank:

This is a common association known from Utah to Kansas.

Global Rank:

Global rank is based on the status of a taxon throughout its range. This association is ranked G5, demonstrably secure globally, though it may be quite rare in parts of its range, especially at the periphery.

Reasons for State Rank:

This is one of the most common associations in Colorado, with well over 200 stands estimated to occur.

State Rank:

State rank is based on the status of a taxon in an individual state. In Colorado, this association is ranked S5, demonstrably secure in the state.

General Description and Comments:

Salix exigua (coyote willow) is one of the most common willow species in Colorado. It comprises two associations, the *Salix exigua*/Mesic Graminoids and the *Salix exigua*/Barren. These are easy to recognize as they are nearly pure stands of the willow, with few other species present. An undergrowth of dense grasses and forbs covering at least 30% of the ground falls into the "Mesic Graminoids" type, while an undergrowth of a few, widely scattered forbs and grasses, where exposed cobbles or sand characterizes the ground cover, constitutes the *Salix exigua*/Barren association. *Salix exigua*/Barren association occurs within the annual flood zone of a river on point bars, islands, sand or cobble bars and streambanks, while the *Salix exigua*/Mesic Graminoids association generally occurs along backwater channels and other perennial wet, but less scoured sites, such as floodplain swales and irrigation ditches

Elevation Range in Colorado:

5700-9100 ft. (1750-2700 m).

Site Geomorphology:

This plant association usually occurs within 1 meter vertical distance of the stream channel on point bars, low floodplains, terraces and along overflow channels. It can also occur away from the stream channel in mesic swales or along the margins of beaver ponds. Streams were classified according to the Rosgen Classification of Natural Rivers(Rosgen 1996). Stream channels are broad to narrow meandering with sand or cobble beds (Rosgen's Channel Type: C5).

Soils:

Soils are typically somewhat more developed than the *Salix exigua*/Barren plant association due to a slightly more stable environment and greater input of organic matter. However, the soils are generally thin (<1 m) and skeletal with depth (10-50% cobbles). Textures are typically loamy sands interspersed with layers of silty clays and alternating with coarse sands. Upper layers (10-30 cm) often have 25-30% organic matter.

Management:

Forage production is typically low to moderate in *Salix exigua* stands due to the high densities of stems. The dense overstory may limit livestock movement within the association (Manning and Padgett 1995). Overgrazing by livestock will reduce the vigor of the willows present and may eventually eliminate them from the site. The opening up of *Salix exigua* stands may result in the invasion of introduced and non-palatable native species. However, release from heavy grazing pressure will allow *Salix exigua* to reestablish itself, provided it has not been completely eliminated from the site. Soil compaction is generally not a problem in this association because of the high coarse fragment content of the soils. However, fine-textured soils are subject to compaction when moist (Hansen *et al.* 1995).

The limited information on fire as a management tool in this association indicates that *Salix exigua* vigorously sprouts following fire. Quick, hot fires result in more sprouts than slow fires, which are actually more damaging to willows and tend to result in fewer sprouts (Hansen *et al.* 1995).

Salix exigua is an excellent streambank stabilizer due to its ability to send up individual stems from an underground root system. It also has an excellent capability of re-colonizing and spreading on disturbed areas. Once *Salix exigua* becomes established on disturbed areas, other shrubs and herbaceous species can become established as well. Removal of this association and subsequent streambank exposure can lead to severe degradation and devastating results (Hansen *et al*. 1995).

Salix exigua can be useful for revegetating degraded sites and exposed sand/gravel bars since it will produce many roots along the entire stem. For best results, cuttings should be taken in the spring from dormant 2-4 year old wood, and they should be 12-20 in (30-50 cm) long with a diameter of at least 0.5 in (1 cm). To insure survival, the cuttings should be rooted and grown in a nursery. Roots and shoots can be expected within 10 days of planting (Hansen *et al*. 1995).

Successional and Ecological Processes:

This plant association is typical of recent floodplains and highly disturbed, low, wet areas and is considered early-seral. The amount of herbaceous growth in the understory is an indication of the amount of time since the last scouring (or depositional) flood event. *Salix exigua* (coyote willow) is an excellent soil stabilizer with a deep root system and flexible stems that can withstand flooding. *Salix exigua* reduces erosion potential by increasing the friction of stream flow, trapping sediments and building a protected seed bed for a number of tree and shrub species. The presence of cottonwood seedlings within this association indicates succession to a cottonwood stand (and may represent the *Populus angustifolia* or *Populus deltoides/Salix exigua* plant associations), if seedlings survive subsequent flooding events.

Vegetation:

Salix exigua dominates the canopy of this association with 5-97% cover, giving the association its characteristic grayish-green color. Other shrub species can also be present including: *Rosa woodsii* (Woods' rose) (1-80%), *Salix bebbiana* (Bebb willow) (1-20%), *S. eriocephala* var. *ligulifolia* (strapleaf

willow) (1-23%), *S. monticola* (park willow) (1-13%), *S. lasiandra* (whiplash or Pacific willow) (2-20%), *S. planifolia* (planeleaf willow) (70%), *S. geyeriana* (Geyer's willow) (20%), and *Alnus incana* (thinleaf) (1-20%). The undergrowth has at least 20-35% cover of various graminoid (and sometimes forb) species including: *Poa pratensis* (Kentucky bluegrass) (1-41%), *Juncus balticus* (Baltic rush) (1-38%), *Cirsium* spp. (thistle) (1-20%), *Carex lanuginosa* (woolly sedge) (1-35%), and *Eleocharis palustris* (common spikerush) (1-40%).

Several stands along the Arikaree River had significant amounts of *Panicum virgatum* (switchgrass), *Sorghastrum nutans* (indiangrass), and *Spartina pectinata* (prairie cordgrass) in the undergrowth due their proximity to tall-grass wet meadows. These stands are included as a variation within this plant association.

Forb cover is generally low, but can include a high percentage of non-native species such as *Medicago lupulina* (black medic) (30%) and *Melilotus officinalis* (sweetclover) (1-31%).

Adjacent Riparian Vegetation:

Stands of *Populus angustifolia* (narrowleaf cottonwood) or *Populus deltoides-Salix amygdaloides* (eastern cottonwood-peachleaf willow) woodlands, *Prunus virginiana* (chokecherry) and *Ribes* spp. (currant) thickets, or irrigated hay meadows generally occur on higher terraces and adjacent elevated floodplains. Stands of *Carex aquatilis* (water sedge) can occur in adjacent wet areas and *Symphoricarpos* spp. (snowberry) shrublands occur in drier areas of the floodplain.

Adjacent Upland Vegetation:

Streams cutting through steep rock gullies and canyons often have *Pinus ponderosa* (ponderosa pine) or *Pinus edulis* (pinyon pine) and *Juniperus monosperma* (oneseed juniper) woodlands on the uplands with *Quercus gambelii* (Gambel oak) thickets on lower slopes. *Pseudotsuga menziesii* (Douglas fir) forests can occur on north-facing canyon walls. Irrigated hay meadows and other agricultural crops commonly occur on the immediate uplands of more gentle streams.

Potential Conservation Areas supporting the *Salix exigua*/mesic graminoids plant association:

Monument Creek
West Bijou Creek Network of Conservation Areas

Global Scientific Name: *Salix lasiandra* (var. *caudata* or var. *lasiandra*) plant association

Common Name: greenleaf or Pacific willow

System: palustrine

Related Literature and Synonyms:

In Colorado, this association is called the *Salix lasiandra* (var. *caudata* or var. *lasiandra*) (greenleaf or Pacific willow) plant association. *Salix lucida* ssp. *caudata* and ssp. *lasiandra* are synonyms for *S. lasiandra* var. *caudata* and var. lasiandra, respectively Kartesz 1994). The Colorado plant association is synonymous with the *Salix lasiandra* community type (Hansen *et al.* 1995), the *Salix lasiandra* var. *caudata*/Mesic Graminoids plant association (Kittel and Lederer 1993), and the *Salix lasiandra* slough (TNC 1996)

Similar Communities:

One closely related community, the *Salix lucida* ssp. *caudata-Salix monticola /Calamagrostis canadensis-Equisetum arvense* (greenleaf willow-park willow/bluejoint-field horsetail) plant association (Jankovsky-Jones 1994), differs slightly by having significant cover of *Salix monticola* (park willow) and sparse forb-graminoid cover.

Regional Distribution:

This association occurs in Montana (Hansen *et al.* 1995) and Colorado (CNHP 1999).

Distribution in Colorado:

This is a minor plant association that occurs in the Yampa River (Kittel and Lederer 1993), the South Platte River (Kittel *et al.* 1996), in the Rio Grande/Closed Basin (Kittel *et al.* 1999b), and North Platte River Basins (CNHP 1999).

Reasons for Global Rank:

This association is documented from Montana to Colorado.

Global Rank:

Global rank is based on the status of a taxon throughout its range. This association is ranked G3Q, either very rare and local throughout its range or found locally, even abundantly, in a restricted range or because of other factors making it vulnerable to extinction throughout its range (20 to 100 occurrences). The Q indicates uncertainty about the community's taxonomy.

Reasons for State Rank:

In Colorado, less than ten stands have been documented. An additional five to ten are estimated to occur. It is highly threatened by stream channelization.

State Rank:

State rank is based on the status of a taxon in an individual state. In Colorado, this association is ranked S2S3, imperiled in state because of rarity (6 to 20 occurrences), or because of other factors demonstrably making it very vulnerable to extirpation from the state.

General Description and Comments:

The *Salix lasiandra* (var. *caudata* or var. *lasiandra*) (greenleaf or Pacific willow) plant association is a tall willow community often found within a mosaic of several other riparian communities. It is generally a small patch type on large floodplain ecosystems and is more or less confined to the low montane belt (5,000-8,000 ft) in Colorado.

Elevation Range in Colorado:

5400-8200 ft. (1600-2500 m).

Site Geomorphology:

This plant association occurs in saturated areas, usually adjacent to the channel flow. Streams were classified according to the Rosgen Classification of Natural Rivers (Rosgen 1996). It is found on low point bars and islands, as well as on low streambanks and overflow channels of larger rivers (Rosgen's Channel Type: C6). It also occurs in steep foothill tributary streams (Rosgen's Channel Type: A2).

Soils:

Soils have high organic matter content with reduced conditions.

Management:

Salix lasiandra (greenleaf or Pacific willow) has a moderately high palatability to livestock, large mammals and beaver (Kovalchik *et al*. 1988). In Montana, the *Salix lasiandra* community type is considered to have limited forage value for livestock since there is frequent flooding in those areas (Hansen *et al*. 1995). This may be the case in Colorado as well, since the association is found right along meandering streambanks and in the floodplain. However, the high amount of introduced grass species in one stand indicates that those areas may have been heavily grazed at one time. *Salix lasiandra* is sensitive to fire, but as with most willows, can resprout. *Salix lasiandra* is a good shrub species to plant for streambank stabilization. It establishes easily and forms abundant roots from cuttings approximately 10 days after planting (Platts *et al*. 1987).

Successional and Ecological Processes:

The *Salix lasiandra* plant association establishes on deep alluvial materials and is considered to be early-seral (Hansen *et al*. 1995). It is often associated with abandoned beaver ponds or along steeper reaches below beaver ponds. It appears to colonize areas that have been or are currently filling in with silt. This association will eventually be replaced by slightly drier-site willow species. However, with disturbance such as overuse by livestock, willow cover may decline. With severe disturbance, the willows will completely disappear. This association will then become dominated by *Rosa woodsii* (Woods' rose) and eventually *Poa pratensis* (Kentucky bluegrass) (Hansen *et al*. 1995).

Vegetation:

This association is dominated by *Salix lasiandra*, either var. *caudata* or var. *lasiandra* (greenleaf or Pacific willow), with a canopy cover of 10-82% cover. Stands may consist of one or several willow species. The particular composition of willows is highly variable, depending on the stand's elevation and location. Other willows that may be present include: *Salix eriocephala* var. *ligulifolia* (strapleaf willow) (1-80%), *S. boothii* (Booth's willow) (12%), and *S. geyeriana* (Geyer's willow) (6-10%). Other shrub species that may be present included: *Ribes montigenum* (currant) (20%), *Alnus incana* ssp. *tenuifolia* (thinleaf alder) (10%), and *Betula occidentalis* (river birch) (7%). One higher elevation stand had 15% cover of *Pinus contorta* (lodgepole pine).

The undergrowth is dominated by mesic grasses and sedges including *Calamagrostis canadensis* (bluejoint reedgrass) (8-23%), and several *Carex* (sedge) species (1-10%). Forb cover is insignificant. In degraded stands, the undergrowth includes non-native grasses such as *Agrostis gigantea* (redtop) (10-30%), *Phleum pratense* (timothy) (1-42%), and *Poa pratensis* (Kentucky bluegrass) (1-30%).

Adjacent Riparian Vegetation:

Populus angustifolia (narrowleaf cottonwood) woodlands, *Salix exigua* (coyote willow), and *Salix boothii* (Booth's willow) shrublands, and *Carex aquatilis-Carex utriculata* (aquatic sedge-beaked sedge) wet meadows occur within the surrounding floodplain.

Adjacent Upland Vegetation:

Pinus edulis-Juniperus species (Piñon pine-juniper) woodlands and *Artemisia tridentata* (big sagebrush) and *Quercus gambelii* (Gamble oak) scrub occurs on the surrounding hillslopes.

Potential Conservation Areas supporting the *Salix lasiandra* (var. *caudata* or var. *lasiandra*) plant association:

West Kiowa Creek at Elbert

Global Scientific Name: *Scirpus pungens* plant association

Common Name: threesquare bulrush

System: palustrine

Related Literature and Synonyms:

The *Scirpus pungens* community type from Montana (Hansen *et al*. 1995) and a *Scirpus americanus* wetland from Colorado (Baker 1984) are synonymous with the Colorado *Scirpus pungens* plant association. *Scirpus americanus* is a synonym for *Scirpus pungens* (Kartesz 1994).

Similar Communities:

Closely related communities that have different associated species include: the *Scirpus americanus/Carex* spp. (chairmaker's bulrush/sedge) community from Saskatchewan, Montana, Wyoming, Utah, Colorado, Kansas, and Nebraska (Johnston 1987) and the *Scirpus* spp./*Distichlis spicata* (bulrush/inland saltgrass) from Utah, Kansas, Nebraska, and North Dakota (Johnston 1987).

Regional Distribution:

This plant association occurs in Saskatchewan, Montana, Wyoming, Utah, Kansas, Nebraska, and Colorado (Baker 1984, Johnston 1987, Hansen *et al*. 1995, CNHP 1999).

Distribution in Colorado:

This plant association occurs in the Yampa (Kittel and Lederer 1993), White and Colorado River Basins (Kittel *et al*. 1994), and in the Arkansas River basin (Kittel *et al.* 1999a).

Reasons for Global Rank:

This association has a wide distribution, but few stands have been documented.

Global Rank:

Global rank is based on the status of a taxon throughout its range. This association is ranked G3G4, either very rare and local throughout its range or found locally, even abundantly, in a restricted range or because of other factors making it vulnerable to extinction throughout its range (20 to 100 occurrences).

Reasons for State Rank:

In Colorado, more than 20 stands are documented. Few of these are large or in pristine condition.

State Rank:

State rank is based on the status of a taxon in an individual state. In Colorado, this association is ranked S3, rare in state (21 to 100 occurrences).

General Description and Comments:

The *Scirpus pungens* (threesquare bulrush) plant association forms small low-stature (1-3 ft, or 0.3-1 m) marshes in low-lying swales, abandoned channels, and overflow channels where the soils remain saturated. This association is characterized by pure stands of *Scirpus pungens* and occasionally with a few other graminoid species.

Elevation Range in Colorado:

5400-7750 ft. (1600-2400 m).

Site Geomorphology:

The *Scirpus pungens* (threesquare bulrush) plant association occurs in low-lying swales, abandoned channels, and overflow channels. The water table is generally at or near the surface. This association also occurs on silt and sandbars within the active channel where the water velocity is lowest. Streams were classified according to the Rosgen Classification of Natural (Rosgen 1996).

Soils:

Soils from the Colorado River Basin are black, anoxic, organic soils and gleyed, clay-loam, alkaline soils. The alkaline soils are classified as loamy typic Cryaquents.

Management:

Scirpus pungens (threesquare bulrush) has low to moderate palatability to livestock and is seldom grazed. However, if water levels drop or upland forage is limited, livestock may heavily utilize this plant association (Hansen *et al*. 1995).

Scirpus pungens helps filter sediments to build streambanks. This species is a prolific seed producer but seeds require moist, bare soil for germination. Its rhizomes spread quickly into exposed areas, rapidly colonizing mudflats and drawdown areas (Hansen *et al*. 1995).

Successional and Ecological Processes:

Scirpus pungens (threesquare bulrush) is an early colonizer and is adapted to saturated conditions on streamsides, sandy shores, marshes, and reservoir margins (Johnston 1987, Hansen *et al*. 1995). Because of the wet soil conditions and aggressive growth of *Scirpus pungens*, most other species are precluded from the sites. Disturbance can cause the establishment of increaser species such as *Juncus balticus* (Baltic rush) and *Hordeum jubatum* (foxtail barley). Lowering the water table may dry the site and result in a decrease of *Scirpus pungens*. An increase in salinity may increase alkaline tolerant species.

Vegetation:

This plant association can be pure stands of *Scirpus pungens* (threesquare bulrush) (40-70%) or *Schoenoplectus americanus* (10-50%). Some stands include other graminoids such as *Juncus balticus* (Baltic rush), *Hordeum jubatum* (foxtail barley), *Phragmites australis* (common reed), *Spartina gracilis* (alkali cordgrass), *Muhlenbergia asperifolia* (alkali muhly), and *Eleocharis palustris* (common spikerush). On alkaline soils, *Distichlis spicata* (inland saltgrass) is a common associate.

Note that *Scirpus pungens*, *S. americanus*, and *S. tabernaemontani* are synonyms for *Schoenoplectus pungens*, *S. americanus*, and *S. tabernaemontani*, respectively (USDA NRCS 1997). In addition, in Colorado, plants identified as *Schoenoplectus americanus* belong to *Schoenoplectus pungens* (Weber and Wittmann 1992). Consequently, stands dominated by *S. americanus* are lumped with those dominated by *S pungens*.

Adjacent Riparian Vegetation:

Salix exigua (coyote willow) shrublands and *Eleocharis palustris* (common spikerush) wetlands occur in similar low-lying areas. *Populus* (cottonwood) species and *Acer negundo* (box elder) forests and *Sarcobatus vermiculatus* (greasewood) shrublands occur on higher terraces.

Adjacent Upland Vegetation:

Pinus edulis (pinyon pine) and *Juniperus osteosperma* (Utah juniper) woodlands and *Artemisia tridentata* (big sagebrush) shrublands occur on adjacent hill slopes.

Potential Conservation Areas supporting the *Scirpus pungens* plant association:

Chico Creek
Haynes Creek
Judge Orr Road

Global Scientific Name: *Scirpus acutus* - *Scirpus tabernaemontani* plant association

Common Name: hardstem and softstem bulrush

System: palustrine

Related Literature and Synonyms:

The following three communities are considered synonymous with the Colorado *Scirpus acutus*-*Scirpus tabernaemontani* (hardstem and softstem bulrush) plant association: 1) the *Scirpus tabernaemontani* plant association (Sanderson and Kettler 1996), 2) the *Scirpus acutus* dominance and riparian site types (Hansen *et al.* 1988, Hansen et al. 1989), and 3) the *Scirpus americanus/Carex* spp. (chairmaker's bulrush/sedge) plant association that includes stands of *Scirpus acutus* from North Dakota (Johnston 1987).

Similar Communities:

Closely related communities include the *Scirpus acutus-Eleocharis macrostachya* (hardstem bulrush/common spikerush) community type (Durkin *et al.* 1994) in New Mexico with higher species richness and different associated species; the *Scirpus acutus* (hardstem bulrush) communities reported from Nebraska; and several *Scirpus* spp.-*Typha* spp. (bulrush/cattail) communities reported from the Dakotas, Kansas, and Nebraska (Faber-Langendoen 1996).

Regional Distribution:

This plant association occurs in Montana, South Dakota, North Dakota, and Colorado (Hansen *et al.* 1988, Hansen et al. 1989, Johnston 1987, CNHP 1999).

Distribution in Colorado:

This association has been reported from the Western Slope (Kittel *et al.* 1994, Sanderson and Kettler 1996) and occurs in small patches throughout the eastern edge of the Rocky Mountain front (Johnston 1987).

Reasons for Global Rank:

This association may have declined from historical levels, but has managed to grow in human-made wetland habitats. Few large (>5 acres), natural examples of this community are known to occur.

Global Rank:

Global rank is based on the status of a taxon throughout its range. This association is ranked G3, very rare or local throughout its range or found locally in a restricted range (21 to 100 occurrences). Threatened throughout its range.

Reasons for State Rank:

This association only occurs in small patches below 7,000 ft (2150 m), and is highly threatened by development, agricultural conversion, stream flow alterations, and wetland filling activities.

State Rank:

State rank is based on the status of a taxon in an individual state. In Colorado, this association is ranked S2S3, imperiled in state because of rarity (6 to 20 occurrences), or because of other factors demonstrably making it very vulnerable to extirpation from the state.

General Description and Comments:

The *Scirpus acutus*-*Scirpus tabernaemontani* (hardstem and softstem bulrush) plant association occurs in marshes, along the margins of lakes and ponds, and in backwater areas of rivers in water up to one meter deep.

Elevation Range in Colorado:

4300-7000 ft. (1300-2150m).

Site Geomorphology:

The *Scirpus acutus-Scirpus tabernaemontani* (hardstem and softstem bulrush) plant association occurs in wet swales and overflow channels with standing water. It also occurs at the edges of beaver ponds, ditches, and railroad embankments. One stand occurred on a saturated floodplain where a perched water table emerged from the surrounding bedrock. Streams were classified according to the Rosgen Classification of Natural Rivers (Rosgen 1996). Streams are large and slightly meandering (Rosgen's Stream Type: B3, C3).

Soils:

Soils of this association are deep heavy clays and silty loams with a high organic matter content. Soils remain saturated for most of the growing season and often have an anoxic gleyed layer within 20 in. (50 cm) of the soil surface, although the water table can drop as far as one meter below the surface (Hansen *et al.* 1989).

Management:

Scirpus (bulrush) is not palatable to livestock, and the wet nature of the soils precludes any grazing activities.

Successional and Ecological Processes:

Scirpus spp. (bulrush) stands are generally considered permanent wetland communities. They will remain in place unless the hydrologic regime is severely altered. Stands of *Scirpus* are important to wildlife species, especially birds, for cover and nesting habitat.

Vegetation:

This association is characterized by a near monotypic stand of *Schoenoplectus acutus* var. *acutus* (hardstem bulrush) (80%), with a few aquatic species that may include *Eleocharis palustris* (common spikerush) (30%), *E. rostellata* (beaked spikerush) (20%), *Mimulus guttatus* (yellow monkey flower) (1%), *Sagittaria* ssp. (arrowhead), *Carex* spp. (sedge)and *Nuphar lutea* ssp. *polysepala* (Rocky Mountain pondlily).(Some of these species are from a western slope plot (94JS36C) whose data are not in the stand table).

Note that Scirpus acutus and Scirpus tabernaemontani are synonymous with Schoenoplectus acutus var. acutus and Schoenoplectus tabernaemontani, respectively (USDA NRCS 1997).

Adjacent Riparian Vegetation:

Other emergent wetland vegetation is commonly found with this plant association, such as stands of *Typha* spp. (cattail) and other *Scirpus* spp. (bulrush). Within the riparian zone *Populus deltoides* (eastern cottonwood) and *Salix amygdaloides* (peachleaf willow) may be present on the floodplain. On the open prairies along small streams, adjacent riparian vegetation types include stands of *Carex nebrascensis* (Nebraska sedge) and others.

Adjacent Upland Vegetation:

Along the lower South Platte River adjacent upland vegetation is rangeland dominated by sagebrush or agricultural fields.

Potential Conservation Areas supporting the *Scirpus tabernaemontani-Scirpus acutus* plant association:

Chico Creek
Fountain Creek Springs at Pinon

Global Scientific Name: *Spartina pectinata* plant association

Common Name: prairie cordgrass

System: palustrine

Related Literature and Synonyms:

This association is well documented in the literature with the following community types considered synonymous with the Colorado *Spartina pectinata* (prairie cordgrass) plant association: 1) the *Spartina pectinata* dominance type from Montana (Hansen *et al.* 1988, 1991), the *Spartina pectinata* community from eastern Wyoming (Jones and Walford 1995), 2) hundreds of square miles of bottom land floodplains along the Missouri River and its tributaries covered in *Spartina pectinata* (Weaver 1965), 3) the *Spartina pectinata/Calamagrostis canadensis* (prairie cordgrass/Canadian reedgrass) plant association from north-central Nebraska (Johnston 1987), and 4) several *Spartina pectinata* co-dominated grassland plant associations from Nebraska, North and South Dakota, and Kansas (Faber-Langendoen 1996).

Similar Communities:

Bourgeron and Engelking (1994) list a *Spartina pectinata* (prairie cordgrass) and *Spartina pectinata-Scirpus pungens* (prairie cordgrass-threesquare bulrush) from Colorado and Montana that may be closely related.

Regional Distribution:

The *Spartina pectinata* (prairie cordgrass) plant association occurs in Montana (Hansen *et al.* 1988), Nebraska (Weaver 1965, Faber-Langendoen 1996), Wyoming (Jones and Walford 1995, Johnston 1987) and Colorado (CNHP 1999).

Distribution in Colorado:

In Colorado, the *Spartina pectinata* (prairie cordgrass) plant association is found along the South Platte and Arikaree Rivers and their tributaries in the northeastern corner of the state (Kittel *et al.* 1996, CNHP 1999). Large stands have been observed south of Denver, now threatened by housing and golf course developments (Steve Kettler, pers. comm. Colorado NHP 1995).

Distribution by Watersheds:

The following information is based on only one quantitative plot from the South Platte River Basin (95LS28) (CNHP 1999).

Reasons for Global Rank:

This association once formed large wet meadows on the Platte River. It is now restricted to smaller tributaries. It is highly threatened by stream flow alterations, channel constriction, and development.

Global Rank:

Global rank is based on the status of a taxon throughout its range. This association is ranked G3?, either very rare and local throughout its range or found locally, even abundantly, in a restricted range or because of other factors making it vulnerable to extinction throughout its range (20 to 100 occurrences). This plant association is documented from Colorado and is expected to occur elsewhere. The question mark in the Global rank indicates that the community is suspected to be more abundant, but additional locations have not been documented.

Reasons for State Rank:

This association is limited to the South Platte floodplain and moist floodplain meadows on the eastern plains. It is highly threatened by stream flow alterations, agricultural conversions, development, and improper livestock grazing.

State Rank:

State rank is based on the status of a taxon in an individual state. In Colorado, this association is ranked S3, vulnerable in the state (20 to 100 occurrences).

General Description and Comments:

This is a tall-grass meadow comprised entirely of *Spartina pectinata* (prairie cordgrass). It occurs in small swales on the plains as well as on floodplains of larger rivers. Stands of this grass have been included in other tall-grass prairie plant associations. On large river floodplains, this type occurs as distinct patches and is distinguished from adjacent riparian types by micro-topography and degree of soil saturation. Weaver (1965) reports that historically, large stands of *Spartina pectinata* (prairie cordgrass) occurred on mud flats of the Missouri River. Large stands have been observed south of Denver, now threatened by housing and golf course developments (Steve Kettler, pers. comm. Colorado NHP 1995)

Elevation Range in Colorado:

3400 ft. (1000 m).

Site Geomorphology:

Spartina pectinata (prairie cordgrass) stands occur in low swales and overflow areas of large river floodplains and on moist swales on the plains. The only stand sampled occurs in a shallow overflow area between two slightly raised ridges dominated by linear bands of *Populus deltoides* (eastern cottonwood). Streams were classified according to the Rosgen Classification of Natural (Rosgen 1996). The stand is on a large meandering river with a bed that is mostly sand (Rosgen's Channel Type: C6).

Soils:

The soil is a fine loam to silty clay with mottles abundant (12-69 cm).

Management:

Stands of *Spartina pectinata* (prairie cordgrass) have high production rates, however the rough-edged leaves make for poor forage quality, and it is not readily eaten by livestock or wildlife. Its tall height and thick growth provide shade and cover for wildlife and certain bird species (Hansen *et al.* 1988). Accessible stands can make excellent hay if cut two or three times each growing season, thereby reducing forage coarseness (Weaver 1965, Hansen *et al.* 1988).

Successional and Ecological Processes:

Spartina pectinata (prairie cordgrass) is tolerant of sediment deposition and has sharp-pointed shoots that push their way upward through a foot of new soil (Weaver 1965). On the South Platte River floodplain it appears to be an early colonizer of the fresh sediments laid down by the 1995 flood.

Vegetation:

Spartina pectinata (prairie cordgrass) (69%) co-dominates with *Panicum virgatum* (switchgrass) (30%). Other tall graminoids present include *Andropogon gerardii* (big bluestem) (6%), *Carex praegracilis* (clustered field sedge) (1%) and *Schoenoplectus americanus* (chairmaker's bulrush) (5%). A non-native weed, *Cirsium arvense* (Canadian thistle) (20%), is abundant at the site indicating chronic disturbance.

Adjacent Riparian Vegetation:

Stands of *Populus deltoides* (eastern cottonwood) occur on the adjacent, slightly raised floodplain ridges. *Typha angustifolia* (narrowleaf cattail) stands occur in adjacent, wetter areas.

Adjacent Upland Vegetation:

Upland slopes have mostly *Bouteloua curtipendula* (side-oats grama) shortgrass prairie, pasture lands, and cultivated fields.

Potential Conservation Areas supporting the *Spartina pectinata* plant association:

Chico Creek

Global Scientific Name: *Sporobolus airoides* plant association

Common Name: alkali sacaton

System: palustrine

Related Literature and Synonyms:

The *Sporobolus airoides* (alkali sacaton) plant association (Baker 1984) is synonymous with the Colorado *Sporobolus airoides* plant association. The same type also occurs in New Mexico (Esteban Muldavin, pers. comm. New Mexico NHP 1999).

Similar Communities:

A closely related community, the *Sporobolus airoides*/*Elytrigia smithii* (alkali sacaton/western wheatgrass) plant association, from Kansas, Oklahoma, Colorado, and New Mexico (Johnston 1987), has species not found in the Colorado *Sporobolus airoides* plant association.

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Regional Distribution:

This plant association occurs in Kansas (Steve Kettler, pers. comm. TNC 1998), New Mexico (Durkin *et al.* 1997) and Colorado (Cooper 1986, Johnston 1987, CNHP 1999).

Distribution in Colorado:

This plant association occurs in the Arkansas River Basin (Johnston 1987), in South Park (Cooper 1986), in the San Miguel/Dolores River Basin in western Colorado (Kittel and Lederer 1993).

Distribution by Watersheds:

The following information is based on only one quantitative plot from the San Miguel or Dolores River Basins (91NL22) (CNHP 1999).

Reasons for Global Rank:

This association occurs in small but frequent patches on the eastern plains of Colorado, as well as on the Western Slope (Steve Kettler, pers. comm. [CNHP 1998]).

Global Rank:

Global rank is based on the status of a taxon throughout its range. This association is ranked G3Q, either very rare and local throughout its range or found locally, even abundantly, in a restricted range or because of other factors making it vulnerable to extinction throughout its range (20 to 100 occurrences). The Q indicates uncertainty about the community's taxonomy.

Reasons for State Rank:

This association occurs in small but frequent patches on the eastern plains of Colorado, as well as on the Western Slope (Steve Kettler, pers. comm. [CNHP 1998]). It is highly threatened by improper livestock grazing and stream flow alterations.

State Rank:

State rank is based on the status of a taxon in an individual state. In Colorado, this association is ranked S3, rare in state (21 to 100 occurrences). General Description and

Comments:

This plant association occurs on alkaline or saline soils in floodplain depressions and on sandy streambanks. *Sporobolus airoides* (alkali sacaton) dominates the vegetative cover with a few woody species also present.

Elevation Range in Colorado:
5300-7000 ft. (1600-2100 m).

Site Geomorphology:
This plant association occurs in floodplain depressions and on sandy streambanks. Streams were classified according to the Rosgen Classification of Natural Rivers Rosgen 1996).

Soils:
Soils are alkaline (basic) or saline (contain a high concentration of soluble salts) (Stubbendieck *et al.* 1982).

Management:
Very little management information is available. However, *Sporobolus airoides* (alkali sacaton) is considered to be of poor to good forage value for livestock (Stubbendieck *et al.* 1982). *Distichlis spicata* (inland saltgrass) often increases in this association with heavy grazing (Steve Kettler, pers. comm. Colorado NHP 1998), or with an increase in soil salinity.

Successional and Ecological Processes:
This is an early-seral community that occurs on floodplains and depressions with moderately saline soils (Aldous and Shantz 1924 [as cited in Johnston 1987]). While the stand sampled may be flooded infrequently, other stands of *Sporobolus airoides* (alkali sacaton) are reported to occur on soils not flooded but with often high water tables because of land position. The intermittent flood regime affects soil moisture and salinity which can alter species composition. Sudden increases in salinity will result in a decrease in cover of *Sporobolus airoides* (alkali sacaton). With no change in salinity, this plant association will form hummocks that accumulate sand. Gradually the sites will decrease in salinity and moisture and invasion by other grasses will follow (Ungar 1974a [as cited in Johnston 1987]). Soils are non-saline to moderately saline to usually alkaline. *Sporobolus airoides* (alkali sacaton) will decrease in abundance with increased soil salinity.

Vegetation:
This plant association is characterized by 20-54% cover of a dense, narrow stand of *Sporobolus airoides* (alkali sacaton) lining and overhanging the alluvial streambank or as a monotypic stand in playa lakes. Other grass species that may be present include: *Panicum obtusum* (obtuse panicgrass) (5%), Bouteloua gracilis (blue grama) (3%), *Schizachyrium scoparium* (little bluestem) (10%), and *Sporobolus cryptandrus* (sand dropseed) (2%). A few woody species are present along alluvial rivers, with less than 5% cover including *Populus angustifolia* (narrowleaf cottonwood), *Fraxinus anomala* (singleleaf ash), *Rhus trilobata* (skunkbush), *Amelanchier alnifolia* (Saskatoon serviceberry), and *Salix exigua* (coyote willow). Forb cover is minor.

Adjacent Riparian Vegetation:
Populus angustifolia (narrowleaf cottonwood) forests and *Salix exigua* (coyote willow) shrublands occur in adjacent riparian areas.

Adjacent Upland Vegetation:
Pinus edulis-Juniperus spp. (pinyon pine-juniper) woodlands occur on adjacent hill slopes. In the San Luis valley, uplands surrounding playa lakes are surrounded by *Sarcobatus vermiculatus/Distichlis spicata* shrublands.

Potential Conservation Areas supporting the *Sporobolus airoides* plant association:
Chico Creek

Global Scientific Name: *Symphoricarpos occidentalis* plant association

Common Name: western snowberry

System: palustrine

Related Literature and Synonyms:

No synonyms of the Colorado *Symphoricarpos occidentalis* (western snowberry) plant association occur in the literature.

Similar Communities:

Two closely related communities are the *Symphoricarpos occidentalis* (western snowberry) dominance type (Jones and Walford 1995) that contains a significant amounts of *Fraxinus pennsylvanica* (green ash) and *Acer negundo* (box-elder) saplings and seedlings, and the *Rhus trilobata-Symphoricarpos occidentalis* (skunkbrush sumac-western snowberry) community type (Akashi 1988) that contains a rich diversity of other shrub species.

Regional Distribution:

This association occurs in Colorado (CNHP 1999).

Distribution in Colorado:

This plant association is found east of the Continental Divide where it occurs in rocky draws on the Pawnee National Grassland, on terraces and floodplains of the Cache la Poudre and South Platte Rivers and on toe slopes and stream benches of other foothill streams (Christy 1973, Kittel 1994, Kittel *et al*. 1996).

Distribution by Watersheds:

The following information is based on five quantitative plots: two from the Arkansas River Basin (95GK67, 95GK73) and three from the South Platte River Basin (95GK05, 95GK45, 95GK48) (CNHP 1999).

Reasons for Global Rank:

This association is known only to occur in Colorado.

Global Rank:

Global rank is based on the status of a taxon throughout its range. This association is ranked G4G5, widespread, abundant and apparently secure globally, though it may be quite rare in parts of its range, especially at the periphery (usually more than 100 occurrences). Apparently not vulnerable in most of its range, but may be of long-term concern.

Reasons for State Rank:

In Colorado, this association is known from at least five locations and ten to twenty more are estimated to occur in the state. It is threatened by improper livestock grazing and stream channelization practices.

State Rank:

State rank is based on the status of a taxon in an individual state. In Colorado, this association is ranked S3, rare in state (21 to 100 occurrences).

General Description and Comments:

The *Symphoricarpos occidentalis* (western snowberry) plant association occurs in small draws and on toe slopes within foothill canyons of the Colorado Front Range. Along the South Platte River floodplain, this

association forms large, patchy stands of low to medium height on higher terraces and islands. Generally, few other shrub species are present.

Elevation Range in Colorado:

4000-6600 ft. (1200-2000 m).

Site Geomorphology:

Along the South Platte River, this plant association occurs on higher terraces and open rises of the broad floodplain. Along smaller tributaries, it occurs in draws and on rocky ledges. *Symphoricarpos occidentalis* (western snowberry) can occur in narrow bands or as widely spaced individuals, but is most often found in large, thick patches. Streams were classified according to the Rosgen Classification of Natural (Rosgen 1996).The streams have large braided channels and narrow, steep tributaries (Rosgen's Channel Type: D5, B3, G5).

Soils:

Soils are silty clay loams and silty loams with moderately deep top layers (3-5 feet).

Management:

In Wyoming, the presence of *Symphoricarpos occidentalis* (western snowberry) is considered to be an indication of a lack of grazing (Jones and Walford 1995), while in Montana it is thought to be a grazing-induced community type (Hansen *et al.* 1988). In Colorado, the presence of *Symphoricarpos occidentalis* seems to indicate a lack of grazing. There is a dramatic fence-line contrast between grazed and ungrazed areas along smaller tributaries on the Pawnee National Grasslands. On the grazed side of the fence, *Symphoricarpos occidentalis* is widely spaced and nearly hidden by the tall *Agropyron intermedium* (intermediate wheatgrass). On the ungrazed side of the fence, *Symphoricarpos occidentalis* and *Prunus virginiana* (chokecherry) grow in thick, impenetrable stands.

Successional and Ecological Processes:

The *Symphoricarpos occidentalis* (western snowberry) plant association occupies the driest sites in the riparian area and may be a transitional community between riverine and upland habitats. This plant association is one of the last successional stages of the pioneering floodplain forest of the South Platte River in eastern Colorado. As the older *Populus deltoides* ssp. *monilifera* (plains cottonwood) die and fall over, they leave an open shrubland of *Symphoricarpos occidentalis* (see Christy 1973)**.**

Vegetation:

Symphoricarpos occidentalis (western snowberry) forms a moderately dense shrub layer with 30-90% cover. Other shrub species present in small amounts (0-10% cover) are *Ribes aureum* (golden currant) and *Salix exigua* (coyote willow). The herbaceous undergrowth is sparse.

Adjacent Riparian Vegetation:

This plant association occurs alone in narrow gulches and small draws or with stands of *Alnus incana* (thinleaf alder) and *Populus angustifolia* (narrowleaf cottonwood) on perennial foothill streams. On the broad, open floodplains of the South Platte River of eastern Colorado, this association grades into stands of *Populus deltoides/ Symphoricarpos occidentalis* (eastern cottonwood/western snowberry). In adjacent swales, the *Salix exigua/*Mesic Graminoids (coyote willow/mesic graminoids) plant association occurs.

Adjacent Upland Vegetation:

Pinus ponderosa (ponderosa pine) and *Quercus gambelii* (Gambel oak) grow on hill slopes surrounding foothill streams. Agricultural fields, rangeland and *Bouteloua gracilis* (blue grama) grasslands occur on the uplands of the South Platte River in eastern Colorado.

Potential Conservation Areas supporting the *Symphoricarpos occidentalis* plant association:

Monument Creek, West Kiowa Creek at Elbert

Global Scientific Name: *Typha angustifolia-Typha latifolia* plant association

Common Name: broadleaf cattail

System: palustrine

Related Literature and Synonyms:

In Colorado, this association is also referred to as the *Typha angustifolia-Typha latifolia* (narrowleaf and broadleaf cattail) plant association. It is considered synonymous with the *Typha* spp. dominated wetlands described by Hansen *et al.* (1991), Jones and Walford (1995), Padgett *et al.* (1989), and Faber-Langendoen (1996).

Similar Communities:

A closely related community, the *Typha latifolia/Sagittaria latifolia* (broadleaf cattail/broadleaf arrowhead) plant association, occurs in Nebraska, northeastern Colorado, western Wyoming, eastern Idaho, and North Dakota (Johnston 1987).

Regional Distribution:

This association occurs throughout the northern and central Great Plain states, the Dakotas, Montana, Wyoming (Johnston 1987), Nebraska, Kansas, northern Texas, northwestern Oklahoma (Faber-Langendoen 1996), and Colorado (CNHP 1999).

Distribution in Colorado:

This plant association is not well documented in the literature, but the species is known to occur throughout the plains of eastern Colorado (Weber 1990). During this study the *Typha angustifolia-Typha latifolia* (narrowleaf and broadleaf cattail) plant association was observed throughout its range in Colorado along overflow channels and oxbow lakes of large rivers and in small ponded areas around stock ponds, railroad embankments, and other small depressions where water can pool.

Distribution by Watersheds:

The following information is based on a total of six quantitative plots: three from the White River Basin (92NL17, 92GK20, 92GK44), two from the South Platte River Basin (95GK47, 95GK59), and one from the Rio Grande and Closed Basins (97GK31) (CNHP 1999).

Reasons for Global Rank:

This association is a common wetland community occurring throughout the western and mid-western states.

Global Rank:

Global rank is based on the status of a taxon throughout its range. This association is ranked G5, demonstrably secure globally, though it may be quite rare in parts of its range, especially at the periphery.

Reasons for State Rank:

This association may be declining in Colorado even though it is not uncommon. It is threatened by development, wetland draining, and stream flow alterations. However it is also a natural invader to newly created wetlands, and will appear in newly ponded areas on its own.

State Rank:

State rank is based on the status of a taxon in an individual state. In Colorado, this association is ranked S3, rare in state (21 to 100 occurrences).

General Description and Comments:

The *Typha angustifolia-Typha latifolia* (narrowleaf and broadleaf cattail) plant association is a commonly seen dark green, tall herbaceous community growing in 2-4 feet of standing water. It is found in the shallow edges of ponds and lakes, and can occur in backwaters of larger river floodplains.

Elevation Range in Colorado:

4000-4300 ft. (1,200-1,300 m).

Site Geomorphology:

This plant association occurs in standing water at least 1 ft deep. It is found along the margins of beaver ponds, overflow channels, back water sloughs, floodplain swales, drainage ditches, behind railroad embankments, and anyplace where water collects with sufficient depth for two-thirds of the growing season. Streams were classified according to the Rosgen Classification of Natural Rivers (Rosgen 1996). This association can be found on nearly every type of channel, but typically along meandering, low gradient streams (Rosgen's Channel Type: C5, F5, and D5).

Soils:

Soils are deep, heavy silty clay loam and organic mucks. Some profiles have 10-30% coarse material and are fairly permeable; others remain anoxic throughout most of the year.

Management:

This association does not provide much forage for livestock. It is an important wetland type for many species of birds and waterfowl. It is reported, however, that with heavy livestock use stands can be converted to the *Carex nebrascensis* community type in Montana (Hansen *et al.* 1995).

Successional and Ecological Processes:

Typha angustifolia occupies inundated and disturbed grounds and can tolerate deeper water and higher alkalinity levels than *T. latifolia* (Great Plains Flora Association 1986). *Typha* species are prolific seed producers, spreading rapidly to become the early colonizers of wet mineral soil, and will persist under wet conditions (Hansen *et al.* 1995). Its roots and lower stems are well adapted to prolonged submergence but its germination and establishment requires periods of drawdown to expose bare soil (Hansen *et al.* 1995).

Vegetation:

Typha angustifolia forms near-monotypic (70-85% cover) stands 3-6 ft (1-2 m) tall. Other species include *Potamogeton* spp. (25% cover), *Spartina pectinata* (1%), and *Veronica* spp. (3%).

Adjacent Riparian Vegetation:

Scirpus (bulrush) marshes and *Carex* (sedge) meadows can be found adjacent to the *Typha* spp. (cattail) plant association. Stands of *Populus deltoides* (eastern cottonwood) and *Salix amygdaloides* (peachleaf willow) occur on higher terraces.

Adjacent Upland Vegetation:

On the plains, *Bouteloua gracilis* (blue grama) shortgrass prairies or agricultural fields occur on the uplands.

Potential Conservation Areas supporting the *Typha angustifolia-Typha latifolia* plant association:
Arkansas River at Nepesta

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