Lowry Range Biological Survey
2010 Update

Natural Heritage Program
COLORADO

Colorado State University

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Note regarding capitalization of species' common names: All common names for birds are capitalized according to the standard established by the American Ornithologists' Union. As no comparable standard exists for other taxonomic groups, the traditional English standard of capitalizing only proper names is followed for groups other than birds.

Cover photograph: Big bluestem within the Lowry Range (*photo by Renée Rondeau*)
Inset 1: Black-tailed prairie dog at burrow opening (*photo by Michael Menefee*)
Inset 2: Pronghorn on the Piedmont Grassland of the Lowry Range (*photo by John Sovell*)

EXECUTIVE SUMMARY

The 26,000-acre (10,500 ha) Lowry Range (The Range) is located at the southeastern edge of the greater metropolitan Denver area, and is bordered by the City of Aurora and the Aurora Reservoir on its western boundary.

The Colorado State Board of Land Commissioners (SBLC) holds The Range in trust for the State of Colorado. The SBLC would like to maintain significant portions of The Range south of Quincy Road in its current state as a matrix of piedmont grassland with some short-to-mixed grass prairie. They have approved a conceptual plan for the property that includes open space and conservation plans, contained development, and water resource development. The discovery of available oil and gas in the Niobrara shale layer that underlies much of the Range has prompted the SBLC to reconsider management options for the area. The Colorado Natural Heritage Program (CNHP) conducted a biological assessment of The Range during late spring and the summer of 2005, and again in late summer of 2010. The purpose of the 2010 assessment was to focus attention on the piedmont grassland and pocket gopher areas originally documented in the 2005 inventory that intersect with potential water and energy development areas. In 2010, CNHP re-mapped the pocket gopher area and gathered distribution information on the piedmont grassland. This report is an update to the original 2006 report, and incorporates all of the findings from both 2005 and 2010 surveys. Both inventories identified significant biological values of The Range (especially occurrence of species in need of conservation), and evaluated the health of the ecological systems. The results of these assessments will assist the SBLC in determining how potential conservation easement and development scenarios may impact the biological resources.

The Natural Heritage inventory described in this report was conducted in the following steps:

1. All available and pre-existing information was collected at the outset of the project.
2. A list of the rare, imperiled, and vulnerable species, and all the ecological systems with potential to occur on The Range was created.
3. The entire area was searched for the target species in 2005, and a more focused area was surveyed in 2010.
4. Input from representatives of the SBLC and long-term lessees of The Range were incorporated into the inventory process.

During summer 2005, every area of The Range was visited once, and in some cases multiple times, to search for rare animals and record the type and condition of ecological systems present on The Range. Survey sites were visited at the appropriate time as dictated by the seasonal occurrence (or phenology) of the individual animal species. It was essential that surveys took place during a time when the targeted animals were detectable. During August 2010, a more focused search for rare animals and piedmont grassland was completed.

The results of The Range surveys confirm that there are 12 uncommon and rare species of animals. Three highlights from the surveys are: 1) an excellent quality occurrence of one of Colorado's rarest small mammal subspecies, **the northern pocket gopher**, 2) a good quality occurrence of one of Colorado's rarest grassland types, the **foothills-piedmont tall grass prairie**, and 3) a fair quality occurrence of a **prarie riparian system**. The northern pocket

gopher *macrotis* subspecies (*Thomomys talpoides macrotis*), may require conservation of its population on The Range to help prevent its extinction. The global distribution of this subspecies is limited to southwestern Arapahoe, northern Douglas, and possibly extreme northwestern Elbert counties, and the recent distribution appears to be limited to six populations in Douglas and Arapahoe counties. Five of these populations occur outside of The Range and face multiple imminent threats. Conservation of the northern pocket gopher population on The Range is essential to conserving this subspecies within its three county range. In addition, The Range supports a fair sized complex of black-tailed prairie dogs along with the associated predators and other animals they attract, including Ferruginous Hawk, Bald Eagle, Prairie Falcon, Burrowing Owl, and swift fox, among others (see Table 7 for a complete list of these priority species). In all, 61 different animal species were recorded from The Range. Other species of interest on The Range include pronghorn and Lark Bunting, which are still wide-ranging and common, but are in decline or under threat of declining in Colorado.

The ecological systems on The Range include the Western Great Plains Foothill and Piedmont Grassland system, the Western Great Plains Riparian Woodland, Shrubland and Herbaceous system, and wetlands associated with the Coal Creek and Box Elder Creek drainages. The Western Great Plains Foothill and Piedmont Grassland ecological system is represented by a mosaic of grassland types including tallgrass, mixedgrass, and shortgrass prairie. The tallgrass prairie is one of Colorado's rarest grassland types, and has been documented in very few places in Colorado. Big bluestem and little bluestem were abundant and widespread in 2010, and benefited from the elimination of cattle grazing in combination with adequate summer rains. Grassland birds on The Range were abundant and their populations were in good condition in 2005. The 2010 survey date was too late for an adequate bird assessment. In 2005, the riparian woodland and shrublands of both Box Elder and Coal Creeks were degraded by leafy spurge and cheatgrass, invasive plants that dominate the herbaceous understory and competitively eliminate native forbs and grasses. Except in areas along Coal Creek disturbed by mining, the overstory of both creeks was a healthy mix of mature cottonwoods and peachleaf willow, which grow within the wide floodplain. However, regeneration of young cottonwood and willow within the woody understory of both creeks was sparse in 2005, probably as a result of grazing by cattle, which feed on the saplings when grazing. CNHP did not revisit the riparian communities in 2010.

We have delineated two Potential Conservation Areas (PCA) and three Sites of Local Significance (SLS) on The Range where conservation is a desirable priority (Figure 24). These areas include the land occupied by the *macrotis* subspecies of the northern pocket gopher, piedmont grasslands, parts of Coal Creek and all of Box Elder Creek within The Range. In addition, an area is delineated that identifies the largest and healthiest black-tailed prairie dog colonies, including all locations documented in 2005 and 2010. These areas together support the rare pocket gopher, woodland birds (including Bullock's Oriole, Bald Eagle, Loggerhead Shrike, Yellow Warbler, White-breasted Nuthatch, Black-headed Grosbeak, Western Wood-pewee, and American Goldfinch), a diverse community of five amphibian species (northern leopard frog, plains spadefoot, Woodhouse's toad, western chorus frog, and tiger salamander), and abundant grassland birds (including Short-eared Owl, Burrowing Owl, Mountain Plover, Ferruginous Hawk, Prairie Falcon, Northern Harrier, Lark

Bunting, and Western Meadowlark), as well as pronghorn, swift fox, prairie dogs and the other animals they attract. The PCAs and SLSs presented in this report are in good condition with the natural hydrology still intact, and plant communities supporting an abundance of wildlife, including species of conservation priority.

The prairie grasslands and their associated riparian areas are among the most imperiled ecological systems in Colorado (Rondeau, et al. 2011, in prep). The SLBC has the opportunity to conserve and manage the biological values of the Range, but this goal could be incompatible with removal of the underlying energy resources. Careful design of energy and water development projects, as well as appropriate restoration of disturbed lands, will be necessary to protect the biological values that The Range supports. We suggest that, at a minimum, the abundance and quality of the northern pocket gopher occurrence and the distribution and condition of the piedmont grasslands be considered indicators for the health of the Range. These resources are the highest conservation priorities, and should be significant factors when considering development projects as well as habitat restoration.

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INTRODUCTION

The Lowry Range (The Range) is located east of the City of Aurora's southeastern boundary and east of the Aurora Reservoir. The Colorado Natural Heritage Program (CNHP) was contracted to perform a biological assessment of The Range in 2005 and a focused update to that inventory in 2010. Conservation planning conducted jointly by SBLC and CNHP in 2005 used the information generated in the 2005 inventory to develop conservation goals for The Range, and to identify areas suitable for conservation of biological values (Grunau, et al. 2006).

CNHP uses the Natural Heritage Network Ranking System to prioritize conservation actions. The purpose is to identify areas with high quality occurrences of rare or uncommon biological resources, and to then focus attention on those sites that have the greatest chance of conservation success. Based on current knowledge, the Potential Conservation Areas and Sites of Local Significance in this report represent areas CNHP recommends for protection and management in order to conserve the natural heritage of The Range.

The Natural Heritage Network and Biodiversity

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. 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 Bell's twinpod (a wildflower), the greenback cutthroat trout, 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 species exist 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 and protection 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 1970s.

Recognizing that rare and imperiled species are more likely to become extinct than common species, 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 rarity 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 realized that plant communities are equally important as individual species, this methodology has 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. NatureServe, the umbrella organization of this international network, and its member programs are a leading source for information about rare and endangered species and threatened ecosystems. The 85 Natural Heritage Network data centers are located in each of the 50 U.S. states, 11 Canadian provinces and territories, and many countries and territories in Latin 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 organisms 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 many are important for the well being of humans.

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

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.

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

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 of or even restricted to an area.

Landscape Diversity — the type, condition, pattern, and connectedness of plant communities. A landscape consisting of a mosaic of plant 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 plant communities all result in a loss of biological diversity for a region.

The conservation of biological diversity should 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 and the results of their activities are also closely linked to all levels of this hierarchy and are integral parts of most landscapes. 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 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.

All Natural Heritage Programs house data about imperiled species and are implementing use of the Biodiversity Tracking and Conservation System (BIOTICS) developed by NatureServe. This database includes taxonomic group, global and state rarity ranks, federal and state legal status, observation source, observation date, county, township, range, watershed, and other relevant facts and observations. BIOTICS also has an ArcView based mapping program 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 like the following:

- 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 are these priority species or communities found?
- What is the species' 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 may be threatening the biodiversity at 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 cooperative and 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 gathering information and conducting inventories. 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. The cornerstone of Natural Heritage methods is the use of a ranking system to achieve the 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, more detailed information is needed. Because of these species' rarity, gathering comprehensive and detailed population data can be less daunting than gathering similarly comprehensive information on more abundant species.

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 are the size of the geographic range, the number of individuals, the trends in both population and distribution, identifiable threats, and the number of protected occurrences.

Element imperilment ranks are assigned both in terms of the element's degree of imperilment within Colorado (its State-rank or S-rank) and the element's imperilment over its entire range (its Global-rank 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 five current locations in Colorado, is ranked G5

S1 (globally-secure, but critically imperiled in this state). The Rocky Mountain Columbine, which is known only in Colorado from about 30 locations, is ranked a G3 S3 (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 G1 S1 (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 (specificity of habitat requirements), 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 A-1.

This single rank system works readily for all species except those that are migratory. Those 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 A-1, 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.

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 residents.
SNR	Not yet ranked.
SNA	Not Applicable. A conservation status rank is not applicable because the species is not a suitable target for conservation activities.
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 actual rank of the element is uncertain, but falls within the stated range.

Legal Designations for Rare Species

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 either by 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 A-2 defines the special status assigned by these agencies and provides a key to abbreviations used by CNHP.

Table 2. Federal and State agency special designations for rare species.

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.
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.
PDL	Proposed for delisting.
XN	Nonessential experimental population.
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.
4. State Status:	
The Colorado Division of Wildlife has developed categories of imperilment for non-game 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 Occurrences and their 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. 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). This factor for an occurrence is evaluated relative to other known, and/or presumed viable, examples.

Condition/Quality – an integrated measure of the composition, structure, and biotic interactions that characterize the occurrence. This includes measures 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 rank and D representing a poor rank. These ranks for each factor 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 (for extant) is assigned. EO-Ranks and their definitions are summarized in Table A-3.

Table 3. Element occurrence ranks and their definitions.

A	Excellent viability.
B	Good viability
C	Fair viability.
D	Poor viability.
H	Historic: known from historical record, but not verified for an extended period of time.
X	Extirpated: extinct within the state.
E	Extant: the occurrence does exist but not enough information is available to rank.
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 PCA is designed 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 PCA 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 is available to assist with these types of analyses where conservation priority and local interest warrant additional research.

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 that may extend far beyond PCA boundaries are necessary as well. This 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

Biological Diversity Rank

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). See Table A-4 for a summary of these B-ranks.

Table 4. Natural Heritage Program biological diversity ranks and their definitions.

B1	Outstanding Significance (indispensable): 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 G1 or G2 elements)
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 range wide (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 is 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 Rank

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. Table A-5 summarizes the P-ranks and their definitions.

Table 5. Natural Heritage Program protection urgency ranks and their definitions.

P1	Protection actions needed immediately. It is estimated that current stresses may reduce the viability of the elements in the PCA within 1 year.
P2	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	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	No protection actions are needed in the foreseeable future.
P5	Land protection is complete and no protection actions are needed.

A protection action involves increasing the current level of 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 may include the following

- 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 Rank

Management urgency ranks (M-ranks) indicate the timeframe in which it is recommended that a change occur in management of the 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, re-routing 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. Table A-6 summarizes M-ranks and their definitions.

Table 6. Natural Heritage Program management urgency ranks and their definitions.

M1	Management actions may be required within one year or the element occurrences could be lost or irretrievably degraded.
M2	New management actions may be needed within 5 years to prevent the loss of the element occurrences within the PCA.
M3	New management actions may be needed within 5 years to maintain the current quality of the element occurrences in the PCA.
M4	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	No management needs are known or anticipated in the PCA.

The PCA Profile

The following information is summarized for each Potential Conservation Area.

Biodiversity Rank (B-rank): The overall significance of the PCA in terms of rarity of the Natural Heritage resources and the quality (condition, abundance, etc.) of the occurrences. Please see Table A-4, for rating criteria for the biodiversity ranks.

Protection Urgency Rank (P-rank): An estimate of the timeframe in which conservation protection should occur. This rank generally refers to the need for a major change of protective status (e.g., ownership or designation as a natural area). Please see Table A-5, for the definitions of the ranks.

Management Urgency Rank (M-rank): An estimate of the timeframe in which conservation management should occur. Using best scientific estimates, this rank refers to the need for management in contrast to protection (legal, political, or administrative measures). See Table A-6, for the definitions of the ranks.

Location: General location and specific road/trail directions.

Legal Description: U.S.G.S. 7.5-minute quadrangle name and Township, Range, and Section(s).

General Description: A brief narrative describing the topography, vegetation, current use, and size of the potential conservation area. Common names are used along with the scientific names.

Biodiversity Comments: A synopsis of the rare species and significant plant communities that occur in the PCA. A table within the PCA profile lists the element occurrences found within the PCA, their rarity ranks, the occurrence ranks, federal and state agency designations, and the last observation date. See Table A-1, for explanations of global and state imperilment ranks and Table A-2 for legal designations.

Boundary Justification: Justification for the location of the preliminary conservation planning 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 Comments: A summary of major land ownership issues that may affect the PCA and the element(s) in the PCA.

Management Comments: A summary of PCA management issues that may affect the long-term viability of the PCA.

Project Background

The 26,000-acre (10,500 ha) Lowry Range is located at the southeastern edge of the greater metropolitan Denver area, and is bordered by the City of Aurora and the Aurora Reservoir on its western boundary. The Range is part of the former 100,000-acre (~40,500 ha) Lowry Bombing and Gunnery Range. The Range is held in trust for the State of Colorado by the Colorado State Board of Land Commissioners (SBLC) and is a property of the State's School Trust. School Trust lands are managed by the SBLC to generate revenue for the School Trust, and are therefore typically used by specific lessees but are not open to the general public. Currently the SBLC leases The Range for oil and gas production, concrete and asphalt pavement recycling, mining (sand and gravel extraction), grazing, and recreation (model airplanes, gliders, hunting, and horseback riding). The remainder of The Range is predominantly undeveloped. The SBLC would like to maintain significant portions of The Range south of Quincy Road in its current natural state (Colorado State Board of Land Commissioners 2005), and has approved a conceptual plan for the property that includes open space and conservation plans, contained residential development, and water resource development.

Purpose of the Project

The purpose of this assessment was to identify significant biological values of The Range (especially occurrence of species in need of conservation), and to evaluate the health of the ecological systems. The 2010 biological survey was focused on the area most likely to undergo water and energy development in the near future. The results of this assessment will assist the SBLC in evaluating potential conservation easement scenarios and energy and water development projects, as well as improve understanding of how development might affect the existing biological resources of The Range. The goals of the project included:

- identification of potential conservation targets (i.e., sensitive species and ecological systems), and
- evaluation of species' viability and stresses that may adversely affect viability.

The results of the biological assessment presented in this report identify the conservation targets (i.e., species and ecological systems) present on The Range.

Study Area

The Range is located on the southeastern edge of the Denver metropolitan area (Figure 1). It encompasses approximately 40 square miles, or 25,854 acres (10,463 ha) of rolling prairie grassland. Elevation ranges from 5,659 feet (1,725 m) in the northwestern corner where Coal Creek flows from The Range, to 6,165 feet (1,879 m) near the south-central boundary of The Range.

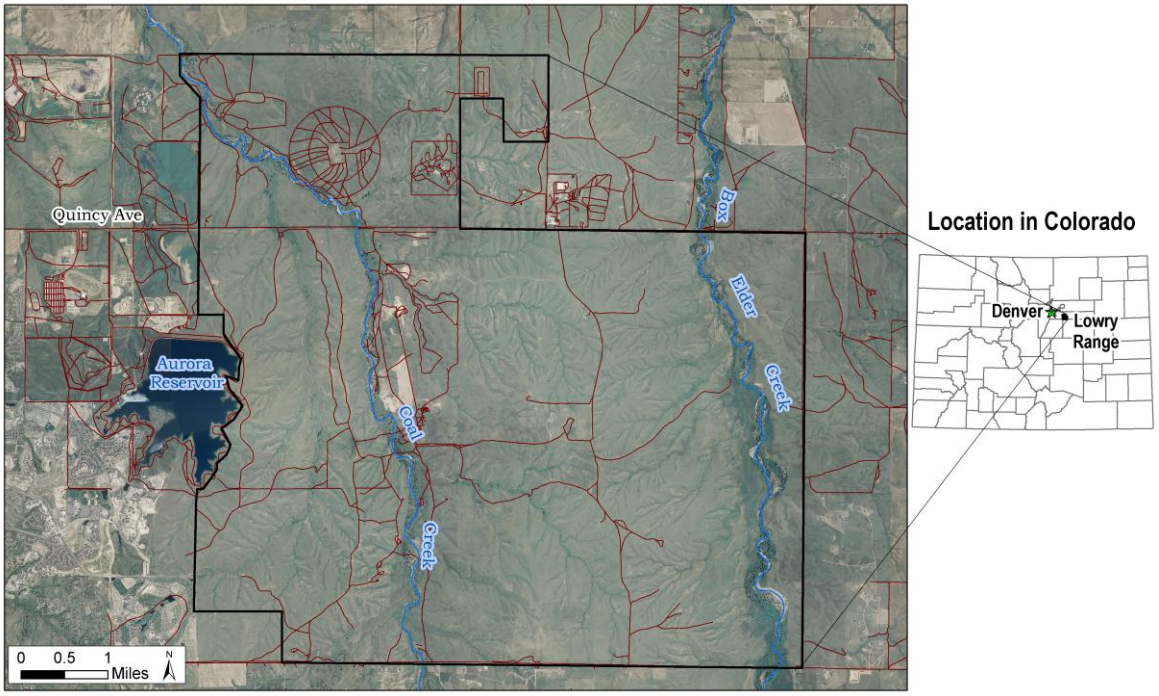


Figure 1. Location of the Lowry Range in Arapahoe County, Colorado.

Ecoregion

The Range is located within the Central Shortgrass Prairie ecoregion (Bailey 1994, modified by The Nature Conservancy) (Figure 2). The Central Shortgrass Prairie ecoregion is characterized by rolling plains and tablelands dissected by streams, canyons, badlands, and buttes, and dominated by shortgrass, mixed grass, and shrublands (The Nature Conservancy 1998). Small patches of remnant foothills and piedmont grasslands occur along the foothills and in areas where the soils and moisture regime are appropriate.

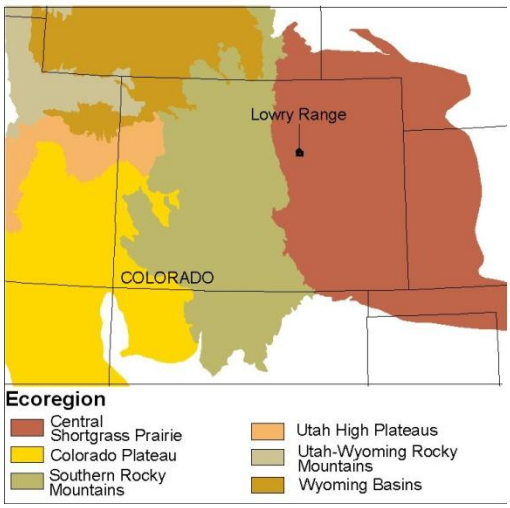


Figure 2. Ecoregions of Colorado (modified from Bailey 1994).

Hydrology

Two prairie streams bisect The Range from south to north. Coal Creek flows through the west side of The Range, and Box Elder Creek is near the eastern boundary (Figure 1). The Range lies within the South Platte River watershed. Box Elder Creek is a direct tributary of the South Platte, while Coal Creek joins with Toll Gate Creek to form Sand Creek before entering the South Platte River.

Climate

Climate data from the Parker weather station three miles south of The Range is fairly typical of Colorado's eastern plains. Annual precipitation ranges from 12-16 inches (30-40 cm). Most of the annual precipitation (70 to 80 percent) falls during the growing season from April through September (Western Regional Climate Center 2005). Mean temperatures during July (the hottest month) are highs of 86º F (30º C) and lows of 55º F (13º C), while January (the coldest month), experiences mean highs of 43º F (6º C) and lows of 15º F (-9º C) (Western Regional Climate Center 2005).

Geology

The geology of The Range is defined by the Denver Basin, which is a huge depression that underlies most of northeastern Colorado, including Denver (Foutz 1994). Geologically, the basin is defined by alluvium washed down from the mountains with eolian sand and silt deposited by winds, which overlie sedimentary sandstones, shales, mudstones, and claystones deposited by an ancient sea (Figure 3) (Chronic 1980). The basin has a great economic value in oil and gas. Production of these resources occurs on The Range, particularly along on the southern half of The Range east of Coal Creek.

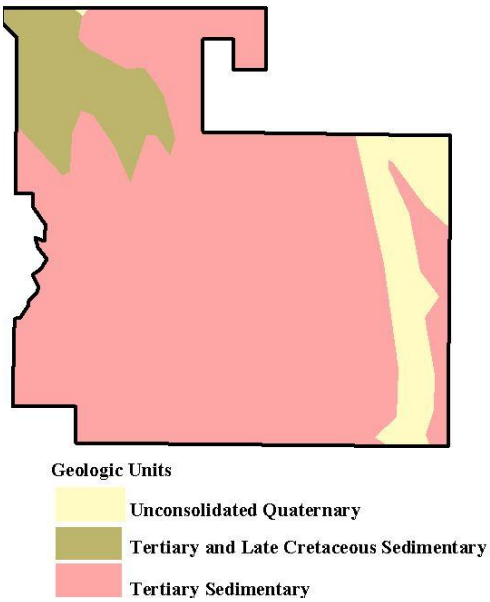


Figure 3. Generalized geology of the Lowry Range (adapted from Green 1992).

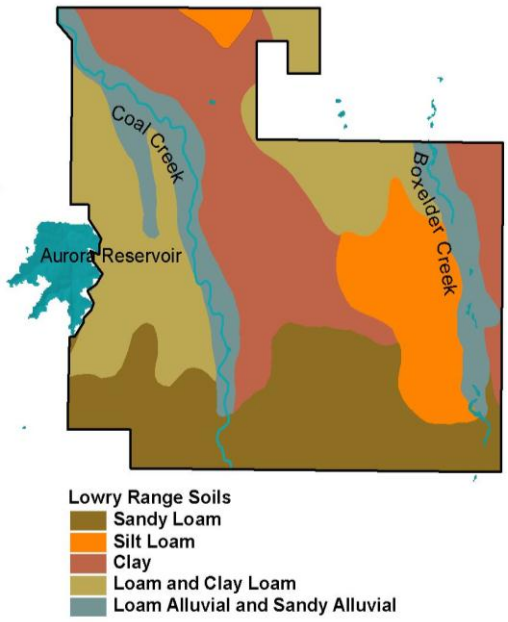


Figure 4. Generalized soils of the Lowry Range (U.S.D.A. Soil Conservation Service 1994).

Soils

Soils on The Range were formed from weathered sedimentary substrates, including hard shale and sandstones, alluvial sediments, and loose material deposited by wind. Soils are characterized as sandy loam, silt loam, clay, loam, clay loam, loamy alluvial, and sandy alluvial deposits (Figure 4) (U.S.D.A. Soil Conservation Service 1971).

Vegetation

The Range is comprised of prairie grasslands and plains riparian systems. Classification of the grasslands is complicated. Based on NatureServe's[1] ecological systems definitions, there are three ecological systems present on The Range: Western Great Plains Foothill and Piedmont Grasslands, Western Great Plains Shortgrass Prairie, and Western Great Plains Riparian Forest, Shrubland, and Herbaceous (Figure 5). The species composition of the grasslands is consistent with

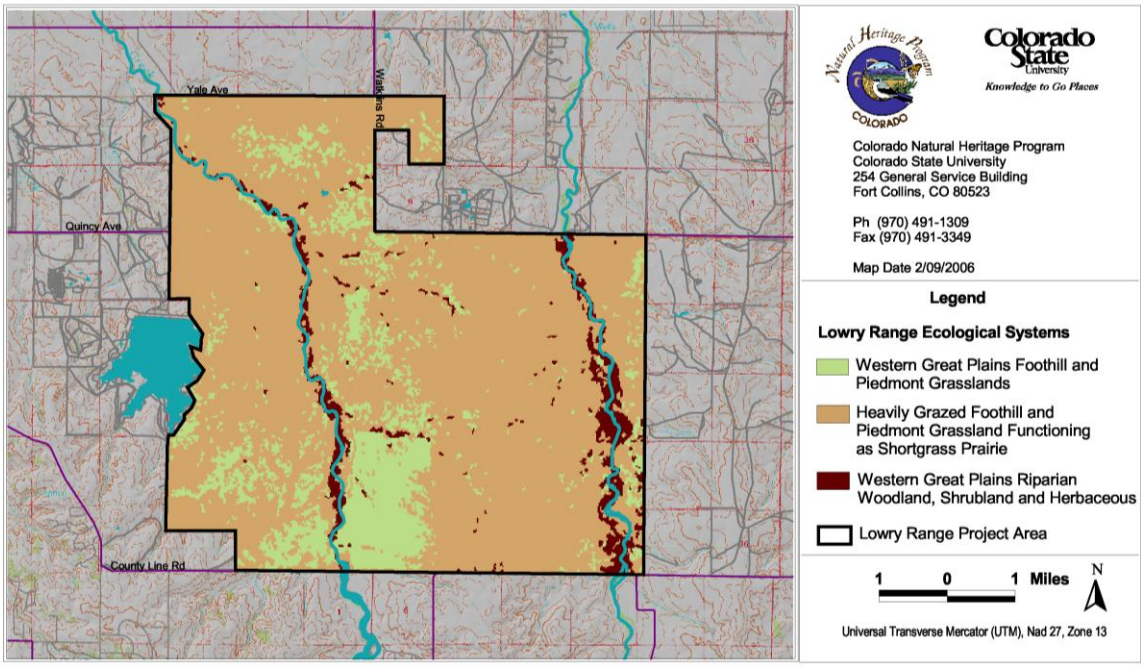


Figure 5. Ecological systems of The Lowry Range (USGS GapAnalysis Program 2004).

[1] NatureServe is a non-profit conservation organization representing an international network of biological inventories—known as natural heritage programs or conservation data centers—operating in all 50 U.S. states, Canada, Latin America and the Caribbean. NatureServe and its member programs are the leading source for information about rare and endangered species and threatened ecosystems.

piedmont grasslands. Prior to removal of cattle from The Range in 2007, however, the piedmont grassland was biologically and structurally functioning as a shortgrass prairie in some areas. We believe this was due to previous grazing practices, and that reduction in grazing pressure would alter the grassland composition to more closely resemble the piedmont grassland ecological system. See Results for additional discussion of this issue.

Shortgrass prairie is very common in eastern Colorado, while piedmont grasslands are more limited and threatened.Threats are very high for the piedmont system and therefore, protecting occurrences of this system is a high conservation priority. Refer to the Results section of this report for additional discussion on ecological systems.

Land Use

The Clovis culture, and later Folsom man, occupied the area approximately 10,000 yea4rs ago (Cushing 2004). They were followed by Native Americans (Arapahoe, Comanche, Kiowa and Plains Apache), who hunted the bison (*Bison bison*), pronghorn (*Antilocapra americana*) and other ungulates that grazed Colorado's plains prior to European settlement. Europeans have occupied areas in eastern Colorado since the early 1800s, but it wasn't until gold was discovered in 1858 along the banks of Cherry Creek that Europeans began settlement of the area that includes The Range in earnest. By 1863, livestock ranchers and farmers predominated in the area surrounding The Range. Overuse of grassland and soil resources, in conjunction with the drought of the 1930s, led to economic depression in the area and abandonment of ranches and farms. In 1938, in an attempt to stimulate the economy after acquiring The Range and surrounding property from numerous private owners, the City of Denver sold the land to the War Department, which established the Lowry Bombing and Gunnery Range (Cushing 2004). The Range was used for active bombing maneuvers during World War II, and again until 1958 during the Korean War, with an intermittent period between wars when The Range was leased as pasture for livestock grazing. Unexploded ordnance still present at former bombing target sites spread throughout The Range are remnants of past military activity. In the 1960s, the SBLC received lands, including what is now The Range, from the federal government in exchange for other state managed School Trust lands. Since then, the major use of The Range has been ranching, but the site still supports active training of helicopter pilots by the military (primarily helicopter flyovers). In 2008, all cattle were removed.

METHODS

2010 Animal, Plant, and Plant Community Surveys

Systematic ground searches were conducted by CNHP biologists John Sovell and Renée Rondeau in the summer of 2010. The entire portion of the Range south of Quincy Avenue was targeted for surveying. The ground searches consisted of driving a four-wheel-drive vehicle off road in a systematic fashion to thoroughly cover the entire survey area (Figure 6). Binoculars and spotting scopes were used to perform a 360 degree scan for species, plant communities, and animal sign at high points that afforded a wide-ranging view of the landscape below. The majority of the time was spent driving slowly through the landscape while remaining alert for potential sightings of plants, animals, plant communities, suitable habitat (e. g. wetlands for frogs), and animal sign (prairie dog mounds, pocket gopher diggings, pronghorn, and Burrowing Owl).

Data collected included UTM Coordinates in NAD 83, Zone 13 for all sighting of species and plant communities that were of biological significance; the UTMs in the same coordinates for the boundaries of all the observed plant communities and black-tailed prairie dog (*Cynomys ludovicianus*) towns; observer name; and the date of the observation.

2005 Animal, Plant, and Plant Community Surveys

The natural heritage inventory completed in 2005 was conducted in several steps summarized below. Additionally, input from representatives of the SBLC and long term lessees on The Range was incorporated into the inventory process.

Collect Available Information

The Colorado Division of Wildlife provided data on swift fox (*Vulpes velox*), pronghorn, and Burrowing Owl (*Athene cunicularia*). In addition, the scientific literature was searched for information on species' life history and locations of occurrence. These data were entered into CNHP databases and used to identify areas of potential habitat.

Identify Rare or Imperiled Species and Ecological Systems with Potential to Occur at The Range

The information collected in the previous step was used to refine a list of potential species and ecological systems, and to refine our search areas. In general, species previously recorded from Arapahoe County or from adjacent counties were included in the list. Species preferring habitats that are not found on The Range were removed from the list. In all, 33 species were identified as potentially occurring on The Range. These species were considered to be a priority for inventory because of their conservation status (G1 to G3 or S1 to S3) (see Natural Heritage Network Ranking System section of this report for definitions), and/or because they are known to occur in areas that are subject to various development pressures, such as hydrological alterations and conversion to residential uses. In addition, the

ecological systems present on The Range were assessed for condition and viability because of their importance in maintaining integrity of the animal community, and integrity of surface and ground water flows.

Identify Targeted Inventory Areas

Given the moderate size of The Range, we were able to search the entire area for the target species. Sub-areas, identified as target inventory areas (TIAs), were identified for increased survey effort based on their likelihood of harboring rare or imperiled species. Sub-areas were those areas presumed to have highest quality habitats based on aerial photographs, geology maps, vegetation surveys, personal recommendations from knowledgeable local biologists and residents, and roadside surveys by our field scientists. Targeted inventory areas visited by field biologists are displayed on Figure 6.

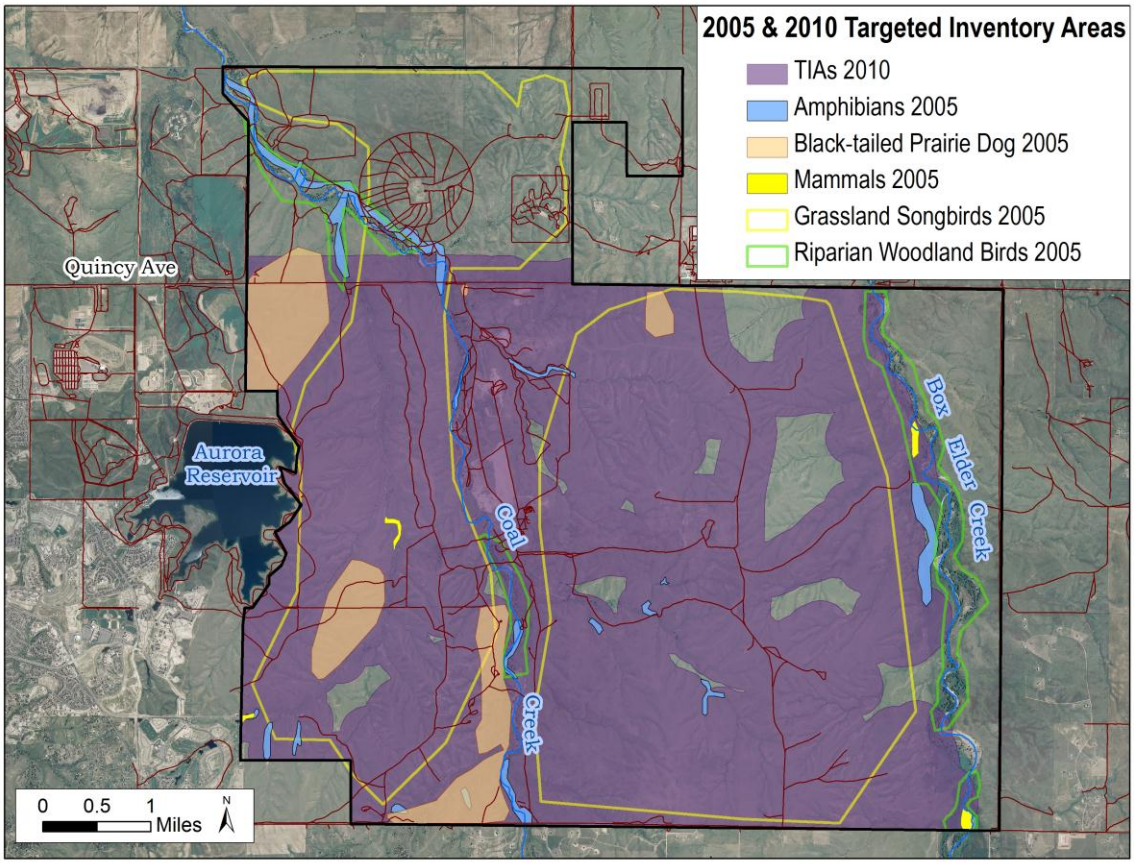


Figure 6. Target inventory areas on the Lowry Range

Conduct Field Surveys

TIAs were visited at appropriate times, as dictated by the seasonal occurrence (or phenology) of the individual species. It was essential that surveys took place during a time when the targeted species were detectable. For instance, breeding birds cannot be surveyed outside of

the breeding season, and plants are often not identifiable without flowers or fruit, which are only present during certain times of the year.

Survey methods varied according to the species for which surveys were conducted. In most cases, the appropriate habitats were visually searched in a systematic fashion to cover the area as thoroughly as possible in the given time. Some types of organisms require special techniques to document their presence. Species that require methods other than visual search were:

- Amphibians: visual observation and capture using aquatic dip nets;
- Mammals: live traps;
- Birds: visual observation or identification by song or call; and
- Fish: capture using aquatic dip nets.

When a rare species was discovered, its precise location and known extent of occupied habitat was recorded with a global positioning system (GPS) unit. Other data recorded for each occurrence included numbers observed, breeding status, habitat description, disturbance features (e.g., overgrazing, damming or diversion of natural water flows, and presence of invasive plant species), observable threats, and potential protection and management needs.

Identify Conservation Needs and Opportunities

Once the biological inventory has identified species, plant communities, and ecological systems in the study area, it is necessary to interpret these data from a conservation planning standpoint. In order to do this, CNHP has developed methods to delineate the local geographic areas that are necessary to maintain long-term persistence of the species and plant communities of interest. Potential Conservation Areas (PCAs) are delineated to focus attention on species and plant communities of highest conservation priority at global and statewide levels (see The Natural Heritage Ranking Method section of this report for details on PCA methods). In addition, Sites of Local Significance (SLSs) are identified in order to emphasize biological resources that are not among the highest priorities for conservation at a statewide level, but are nonetheless very significant to supporting species at the local level. SLSs contribute to the character of the local area and the overall local diversity of plants and communities present, and therefore warrant conservation consideration.

RESULTS AND DISCUSSION

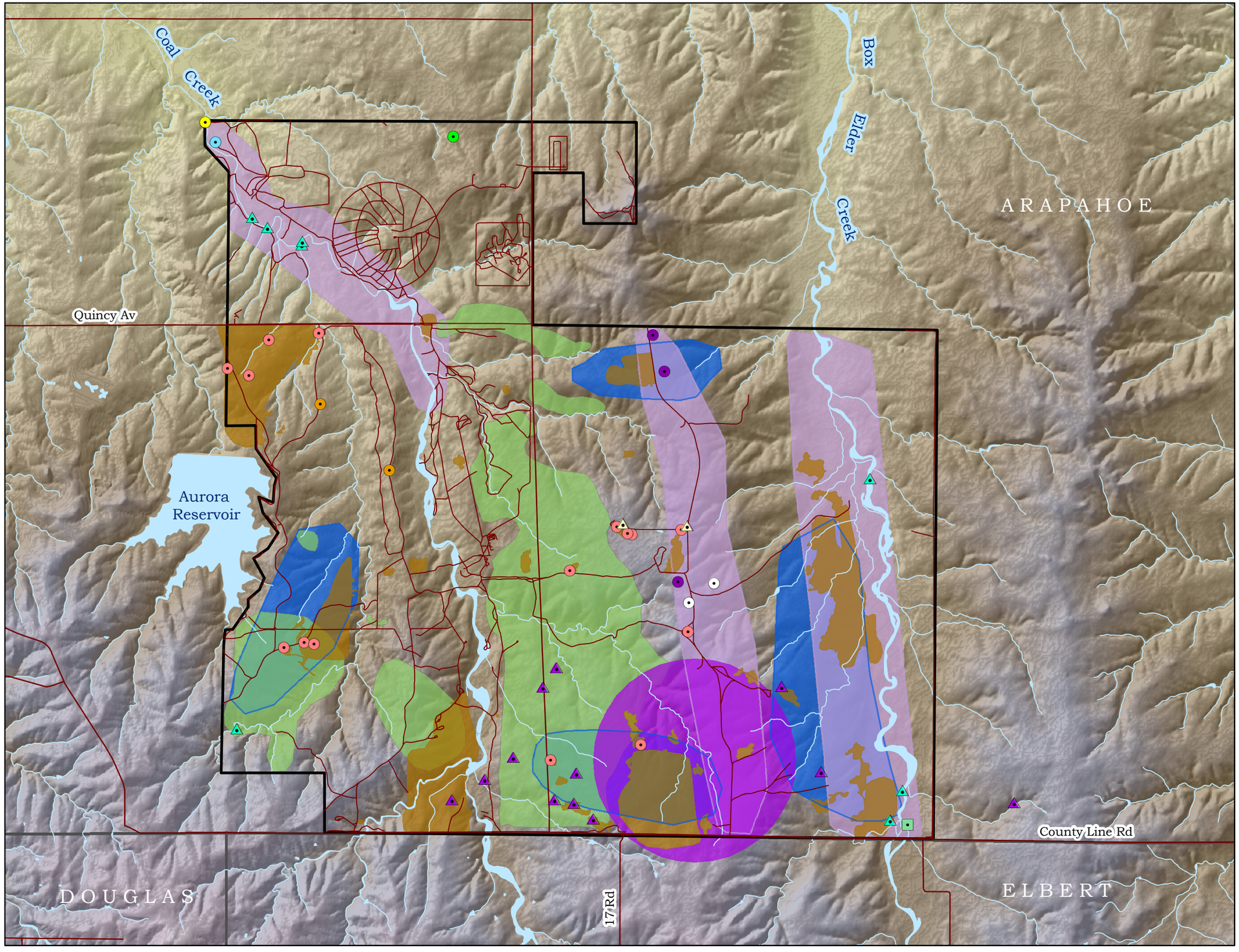
Animals

Results of the 2005 and 2010 surveys confirm that there are numerous species of conservation priority present on The Range, and that the ecological systems on The Range are in fair condition. Altogether, 12 animals that are rare, imperiled or vulnerable globally or within the state of Colorado were documented throughout The Range (Table 7, Figure 7). The 2005 and 2010 surveys identified an additional 50 common animal species at The Range, resulting in a total of 62 species observed on The Range (Table 8). A list of all the plant species documented on The Range can be found in Appendix A.

Table 7. Vertebrate species of conservation priority observed at the Lowry Range during summer 2005 and 2010.

Element	Common Name	Global Rank[1]	State Rank[1]	Federal and State Status[1]
AMPHIBIANS				
Rana pipiens	northern leopard frog	G5	S3	FS, BLM, SC
BIRDS				
Asio flammeus	Short-eared Owl	G5	S2B	FS
Athene cunicularia	Burrowing Owl	G4	S4B	FS, ST
Buteo regalis	Ferruginous Hawk	G4	S3B	FS, BLM, SC
Charadrius montanus	Mountain Plover	G2	S2B	FS, BLM, SC
Circus cyaneus	Northern Harrier	G5	S3B	FS
Falco mexicanus	Prairie Falcon	G5	S4B	
Haliaeetus leucocephalus	Bald Eagle	G5	S1B	FS, BLM SC
Lanius ludovicianus	Loggerhead Shrike	G4	S3S4B	FS
MAMMALS				
Cynomys ludovicianus	black-tailed prairie dog	G3G4	S3	FS, SC
Thomomys talpoides macrotis	northern pocket gopher *macrotis* subsp.	G5T1	S1	SC
Vulpes velox	swift fox	G3	S3	FS, SC

[1] See Table 1 for explanations of global and state imperilment ranks and Table A-2 for legal designations.



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Map Date: 02/28/2011

Legend

Significant Biological Resources

Amphibians
- Northern Leopard Frog

Birds
- Bald Eagle
- Burrowing Owl
- Ferruginous Hawk
- Mountain Plover
- Northern Harrier
- Prairie Falcon
- Short-eared Owl
- Loggerhead Shrike

Communities
- Mesic Tallgrass Prairie

Mammals
- Northern Pocket Gopher Subsp*
- Swift Fox
- Black-tailed Prairie Dog
- Northern Pocket Gopher Subsp*
- Pronghorn

Plants
- broodfruit burreed

**macrotis* subspecies

Base Data
- Lowry Range
- Counties
- Major Roads
- Lowry Local Roads
- Lakes, Reservoirs
- Streams, Creeks

10m Digital Elevation Model Produced by the USGS

Location in Colorado

0 0.5 1 Miles

N

Figure 7. Significant biological resources documented at the Lowry Range.

Table 8. Common animal species observed at the Lowry Range during summer 2005.

Element	Common Name	Global Rank[1]	State Rank[1]
AMPHIBIANS			
Ambystoma tigrinum	tiger salamander	G5	S5
Bufo woodhousii	Woodhouse's toad	G5	S5
Pseudacris triseriata	western chorus frog	G5	S5
Spea bombifrons	plains spadefoot	G5	S5
BIRDS			
Agelaius phoeniceus	Red-winged Blackbird	G5	S5
Anas platyrhynchos	Mallard	G5	S5
Aquila chrysaetos	Golden Eagle	G5	S3S4B
Ardea herodias	Great Blue Heron	G5	S3B
Bubo virginianus	Great Horned Pwl	G5	S5
Buteo jamaicensis	Red-tailed Hawk	G5	S5B
Buteo swainsoni	Swainson’s Hawk	G5	S5B
Calamospiza melanocorys	Lark Bunting	G5	S4
Carduelis tristis	American Goldfinch	G5	S5
Cathartes aura	Turkey Vulture	G5	S4B
Charadrius vociferus	Killdeer	G5	S5
Chordeiles minor	Common Nighthawk	G5	S5
Colaptes auratus	Northern Flicker	G5	S5
Contopus sordidulus	Western Wood-pewee	G5	S5
Corvus brachyrhynchos	American Crow	G5	S5
Cyanocitta cristata	Blue Jjay	G5	S5
Dendroica coronata	Yellow-rumped Warbler	G5	S5
Dendroica petechia	Yellow Warbler	G5	S5
Eremophila alpestris	Horned Lark	G5	S5B
Euphagus cyanocephalus	Brewer’s Blackbird	G5	S5B
Falco sparverius	American Kestrel	G5	S5B
Icterus bullockii	Bullock's Oriole	G5	S5
Icterus spurius	Orchard Oriole	G5	S4B
Melospiza melodia	Song Sparrow	G5	S5
Molothrus ater	Brown-headed Cowbird	G5	S5
Pheucticus melanocephalus	Black-headed Grosbeak	G5	S4B
Pica hudsonia	Black-billed Magpie	G5	S5
Pooecetes gramineus	Vesper Sparrow	G5	S5
Quiscalus quiscula	Common Grackle	G5	S5B
Sitta carolinensis	White-breasted Nuthatch	G5	S5B
Stelgidopteryx serripennis	Northern Rough-winged Swallow	G5	S5
Sturnella neglecta	Western Meadowlark	G5	S5
Sturnus vulgaris	European Starling	G5	SNA
Tachycineta bicolor	Tree Swallow	G5	S5
Troglodytes aedon	House Wren	G5	S5
Turdus migratorius	American Robin	G5	S5
Tyrannus tyrannus	Eastern Kingbird	G5	S5B
Tyrannus verticalis	Western Kingbird	G5	S5B
Zenaida macroura	Mourning Dove	G5	S5
FISH			
Pimephales promelas	fathead minnow	G5	S5

Element	Common Name	Global Rank[1]	State Rank[1]
MAMMALS			
Antilocapra americana	pronghorn	G5	S4
Canis latrans	coyote	G5	S5
Geomys bursarius	plains pocket gopher	G5	S5
Microtus pennsylvanicus	meadow vole	G5	S5
Peromyscus maniculatus	deer mouse	G5	S5
Sylvilagus audubonii	desert cottontail	G5	S4
REPTILES			
Thamnophis radix	plains garter snake	G5	S5

[1] See Table 1 for explanations of global and state imperilment ranks and Table 2 for legal designations. None of these species have state or federal legal status.

Animal Species Surveyed in 2005 and 2010

Amphibians

Northern Leopard Frog (Rana pipiens)

The northern leopard frog occurs throughout Colorado from the plains to the mountains up to 12,000 feet (3,700 m). Northern leopard frogs are currently ranked by NatureServe as secure globally (G5) and vulnerable in Colorado (S3). In summer, northern leopard frogs commonly occupy wet meadows and fields, and natural and irrigation-created wetlands.

Northern leopard frogs are declining throughout their North American range. The exact cause of the decline is unknown and needs further investigation (Hammerson 1999), but threats include habitat loss, commercial overexploitation, and, in some areas, probably competition or predation from introduced species. Part of the statewide decline in Colorado may be due to predation by the increasingly abundant bullfrog (*Rana catesbiana*), which is native to the eastern U.S. but not Colorado. No bullfrogs were seen or heard at The Range. If bullfrog populations become established on The Range in the future, immediate steps should be taken to eradicate those populations.

2005 Inventory Results

In 2005, northern leopard frogs were recorded in the Coal and Box Elder Creek drainages, in pools of the creek channel fed by rainwater runoff, and in wetlands associated with the drainages but fed by groundwater seepage (Figure 8, Table 9).

2010 Inventory Results

A new location for the northern leopard frog was discovered at The Range in 2010. Four frogs were observed at a spring within a tributary of Coal Creek near the southwest boundary of The Range. This newly found population added to the three documented in 2005 increases the total number of populations at The Range to four.

Table 9. Northern leopard frog (*Rana pipiens*) observations at the Lowry Range (UTM in NAD83 Zone 13).

				Number Observed	
Record No.	**UTM E**	**UTM N**	**Observation Date**	**Adult**	**Tadpoles**
1	529555	4389374	6/17/2005	1	0
2	529794	4389211	6/17/2005	1	0
3	530339	4388942	6/17/2005	5	0
4	530348	4388998	6/17/2005	1	0
5	539856	4380309	6/23/2005	3	0
6	539343	4385238	6/02/2005	1	0
7	539663	4379840	7/13/2005	2	0
8	529310	4381284	8/17/2010	4	0

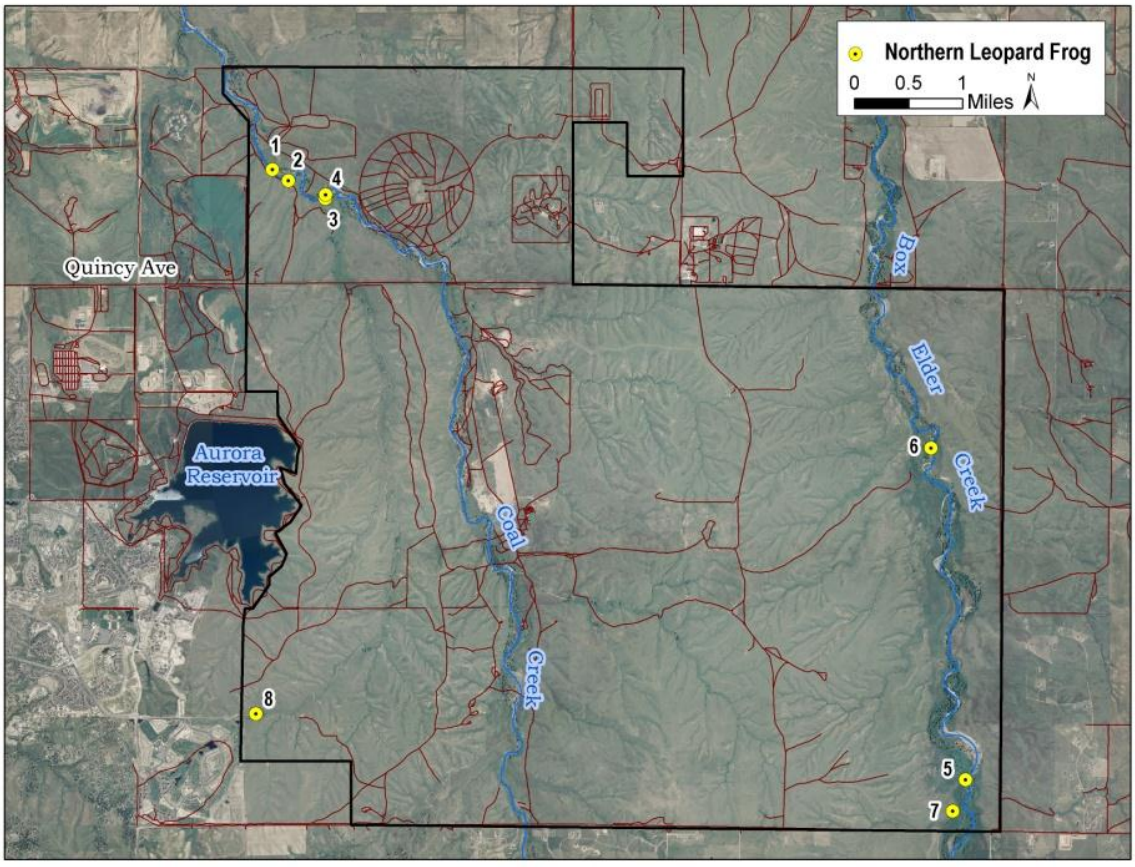

Figure 8. Locations of northern leopard frog (*Rana pipiens*) recorded from the Lowry Range.

Photo 1. Northern leopard frog found at a natural spring during the 2010 survey.

Birds

Burrowing Owl (Athene cunicularia)

The Burrowing Owl inhabits the eastern plains of Colorado, the San Luis Valley of south-central Colorado, and the Grand Valley in Mesa County, Colorado (Kingery 1998). The Colorado Division of Wildlife lists the Burrowing Owl as a Threatened species in Colorado. NatureServe considers both the global population and the breeding population in Colorado apparently secure (G4/S4), but reductions in the numbers and distributions of prairie dogs and ground squirrels have caused range contractions and decreased abundance of Burrowing Owl throughout the Great Plains (Johnsgard 1979). In Colorado, Burrowing Owls are declining in abundance and distribution, and they have been extirpated from some areas (Andrews and Righter 1992). On the eastern plains of Colorado, the species remains a locally uncommon to fairly common summer resident and a casual winter resident (Andrews and Righter 1992). Habitat fragmentation and loss (Sheffield 1997, Warnock and James 1997), pesticide use for insect control (James and Fox 1987, Fox *et al*. 1989), poisoning of rodent colonies (Sheffield 1997, Desmond *et al*. 2000), plague outbreaks in rodent colonies (Sheffield 1997), shooting (Butts 1973, Wedgwood 1978), collisions with vehicles (Haug and Oliphant 1987, Millsap and Bear 1988), and losses on wintering grounds (McDonald *et al.* 2004) have all contributed to the observed declines. Human disturbance at nest and roost sites may significantly reduce Burrowing Owls' reproductive success (Thomsen 1971, Millsap and Bear 1988). Burrowing Owls occupy dry, open, treeless grasslands where they typically nest in burrows of prairie dogs or ground squirrels (Butts and Lewis 1982, Haug *et al.* 1993, Kingery 1998). Burrowing Owls will abandon areas where plague or poisoning has eliminated most burrowing rodents and the vegetation has grown more than a few inches tall (MacCracken *et al.* 1985, Plumpton and Lutz 1993).

2005 Inventory Results

Burrowing Owls were found at four sites on The Range, all on black-tailed prairie dog towns (Figure 19, Table 10).

2010 Inventory Results

Burrowing Owls were found at The Range again in 2010. Owls were found at 11 separate locations; 37 individuals were counted, including four juveniles. This represents an increase in numbers from 2005, when five individual Burrowing Owls were documented at four different locations. This increase in Burrowing Owls may reflect an increase in the number of suitable black-tailed prairie dog burrows available to owls for nesting. In eastern Colorado, Burrowing Owls typically nest in the abandoned burrows of prairie dogs and ground squirrels. As discussed below, compared to 2005 in 2010 there was a large decline in the number of acres occupied by prairie dogs at The Range. This decline in prairie dogs has left a large number of unoccupied burrows. The Burrowing Owls may be exploiting this sudden increase in suitable nesting sites. If the increase in owls is related to the prairie dog decline, it exemplifies the dynamic nature of ecological interactions taking place at The Range. As prairie dogs decline in number, raptors such as Ferruginous Hawks that prey upon them suffer, while species like the Burrowing Owl that exploit their empty burrows benefit, at least temporarily. The abundant population of Burrowing Owls occupying The Range is important as this species is declining in Colorado and is extirpated from part of its historical range in the State (Andrews and Righter 1992).

Table 10. Burrowing Owl (*Athene cunicularia*) observations at the Lowry Range (UTM in NAD83 Zone 13).

				Number Observed	
Record No.	**UTM E**	**UTM N**	**Observation Date**	**Adult**	**Juvenile**
1	530393	4382651	8/11/2005	1	0
2	535583	4384354	6/23/2005	2	0
3	529176	4386986	2005	unknown	0
4	529622	4386069	2005	unknown	0
5	535516	4384370	2005	unknown	0
6	535344	4384477	8/10/2010	4	0
7	536365	4384426	8/10/2010	4	0
8	534602	4383783	8/10/2010	3	2
9	536473	4382821	8/11/2010	1	0
10	535723	4381033	8/12/2010	4	0
11	534297	4380786	8/12/2010	2	2
12	530621	4387544	8/16/2010	1	0
13	529831	4387431	8/16/2010	4	0
14	529515	4386875	8/16/2010	4	0
15	530070	4382568	8/17/2010	5	0
16	530545	4382620	8/17/2010	1	0

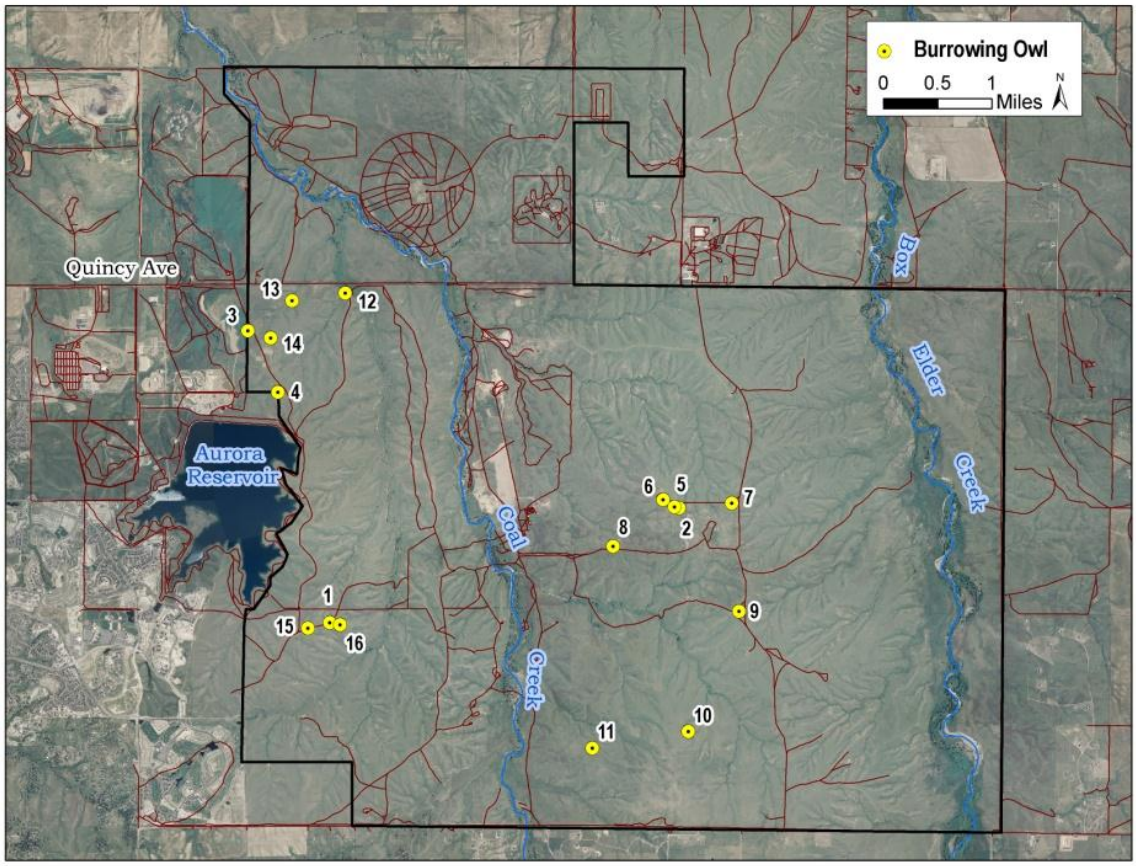

Figure 9. Locations of Burrowing Owl (*Athene cunicularia*) recorded from the Lowry Range.

Bald Eagle (Haliaeetus leucocephalus)

Since the 2005 survey was completed, a nesting pair of Bald Eagles was documented at The Range by SBLC staff (Figure 10, Table 11). The breeding pair is nesting in Coal Creek, north of Quincy Avenue, in a cottonwood gallery forest at the northeast boundary of The Range. The eagles expanded an old Ferruginous Hawk nest that was already present. The eagles were first observed constructing the nest in December of 2008, and brooding was documented in February 2009. The fledged young were observed foraging in prairie dog towns on the Lowry Range until September of 2009, at which time they left the area. No sign of the eagles was observed in 2010. The Colorado Division of Wildlife lists the Bald Eagle as a Species of Special Concern in Colorado. NatureServe considers the global population to be demonstrably secure (G5), while the breeding population in Colorado is considered extremely rare (S1).

In the early-mid 20th century, Bald Eagle populations declined in size due to pesticides (primarily DDT), human disturbance, and loss of trees for nesting habitat (Franson et al. 1996, Fraser et al. 1996, Montopoli and Anderson 1991). Consequently, in 1995 the Bald Eagle was placed on the Endangered Species List. With the ban of the pesticide DDT and protection of nesting habitat, Bald Eagle populations have significantly recovered. By 2007,

there were almost 10,000 bald eagles nesting in the lower 48 states and they were delisted from Endangered Species Act protection. In Colorado, Bald Eagles are found throughout much of the state during both the summer and winter, often near large reservoirs and along major rivers. In grasslands, the Bald Eagle is often found near prairie dog towns. There are about 120 known nests in the State. A buffer of 500 meters around nests maintained from November 15th to July 31st is considered adequate to prevent disturbance from human activity (Fraser 1985).

Table 11. Bald Eagle (*Haliaeetus leucocephalus*) observations at The Range (UTM in NAD83 Zone 13).

				Number Observed	
Record No.	**UTM E**	**UTM N**	**Observation Date**	**Adult**	**Juvenile**
1	528823	4	2009	2	2

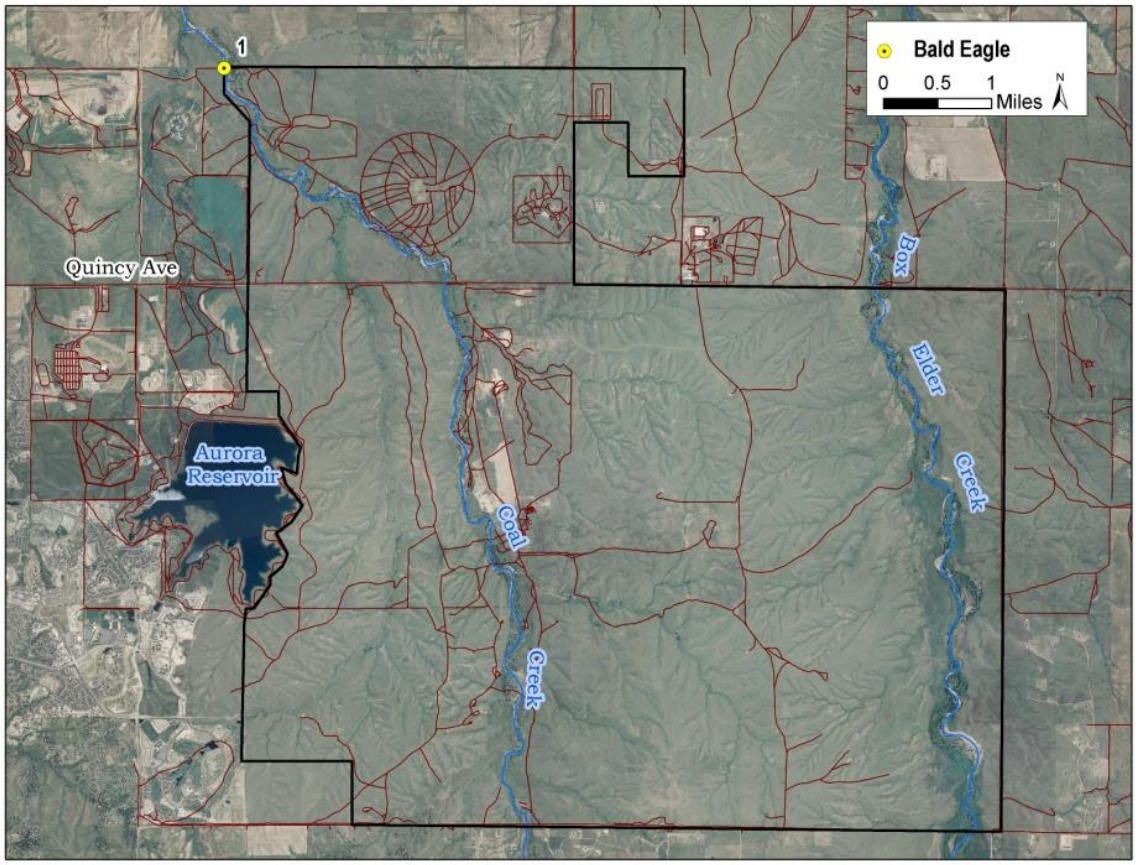

Figure 10. Location of Bald Eagle (*Haliaeetus leucocephalus*) recorded from the Lowry Range.

Mammals

Black-tailed Prairie Dog (Cynomys ludovicianus)

In Colorado, black-tailed prairie dogs occupy the eastern 40 percent of the state (Fitzgerald *et al.* 1994). Throughout its range, the species occurs in much lower densities and in smaller colonies than it did historically (Fitzgerald *et al.* 1994, Hoogland 1996). NatureServe ranks this species as secure to vulnerable across its range (G3G4), and vulnerable in Colorado (S3). Rangewide, the area prairie dogs occupy has declined dramatically, from about 110 million acres (45 million ha) historically to about 1.4 million acres (0.56 million ha) - a decline of about 99 percent (U.S. Fish and Wildlife Service 2002). Approximately 37 percent of the historical habitat has been converted to cropland, and is now generally unavailable as habitat due to continuous disturbance. In the metropolitan Denver area, populations of prairie dogs have also declined dramatically, as once suitable prairie has been converted to industrial and residential development and cropland. In urban areas, harassment and predation by domestic pets can be a problem. In addition, outbreaks of plague (caused by the bacillus *Yersinia pestis* and transmitted by fleas) continue to reduce or even eliminate some colonies (Barnes 1982). Through their foraging behavior and their clipping of tall plants, black-tailed prairie dogs significantly change the composition of plant communities throughout their range (Hoogland 1996). In addition, the presence of prairie dog towns greatly increases the zoological diversity of prairie ecosystems by attracting predators and many other animals (Clark *et al.* 1982, Hoogland 1995). The population on The Range is one of the few healthy and comparatively large black-tailed prairie dog complexes still remaining in close proximity to Denver.

2005 Inventory Results

In 2005, The Range supported a complex of black-tailed prairie dog towns scattered across the east and west sides of The Range (Figure 11). The 10 existing towns occupied approximately 1,700 acres (690 ha). We observed hundreds of prairie dogs, but observations were conducted in less than 1-hour periods at each town, and more individuals than were counted probably occupied The Range.

Photo 2. Black-tailed prairie dog town on The Range, observed during the 2010 survey.

2010 Inventory Results

The black-tailed prairie dog complex documented in 2005 was re-surveyed during the 2010 field season (Figures 11 and 12). Prairie dogs were absent from many areas that were occupied in 2005. Many of the large expansive towns documented in 2005 had fragmented into multiple smaller towns interlaced with uninhabited spaces that in 2005 were occupied. Also, numerous new towns were documented during the 2010 survey. These towns may have been present but missed during the 2005 field work, or they could represent towns newly established since 2005. In comparison to the newly documented towns, a far greater number of towns declined in size from 2005 to 2010. The net result was a 50% decline in surface area occupied by prairie dogs from 1,700 acres in 2005 to 825 acres in 2010. The reason for this decline is unknown, but an epizootic of sylvatic plague (*Yersinia pestis*) is one plausible explanation. While the number of acres occupied by prairie dogs declined, because of town fragmentation the actual number of individual towns increased from 10 in 2005 to 47 in 2010.

The dramatic decline in area occupied by prairie dogs between 2005 and 2010 at The Range indicates that conserving the remaining prairie at The Range is important. Large areas supporting expansive prairie dog populations are required so that during downturns, subpopulations can survive that will then replenish numbers after the decline. This is particularly important for isolated populations such as that found on The Range, which cannot rely on recolonization from adjacent unaffected populations. Consequently, maintaining a viable population of prairie dogs at The Range will require conserving the remaining native prairie and protecting it from fragmentation related to urban, commercial, or energy development.

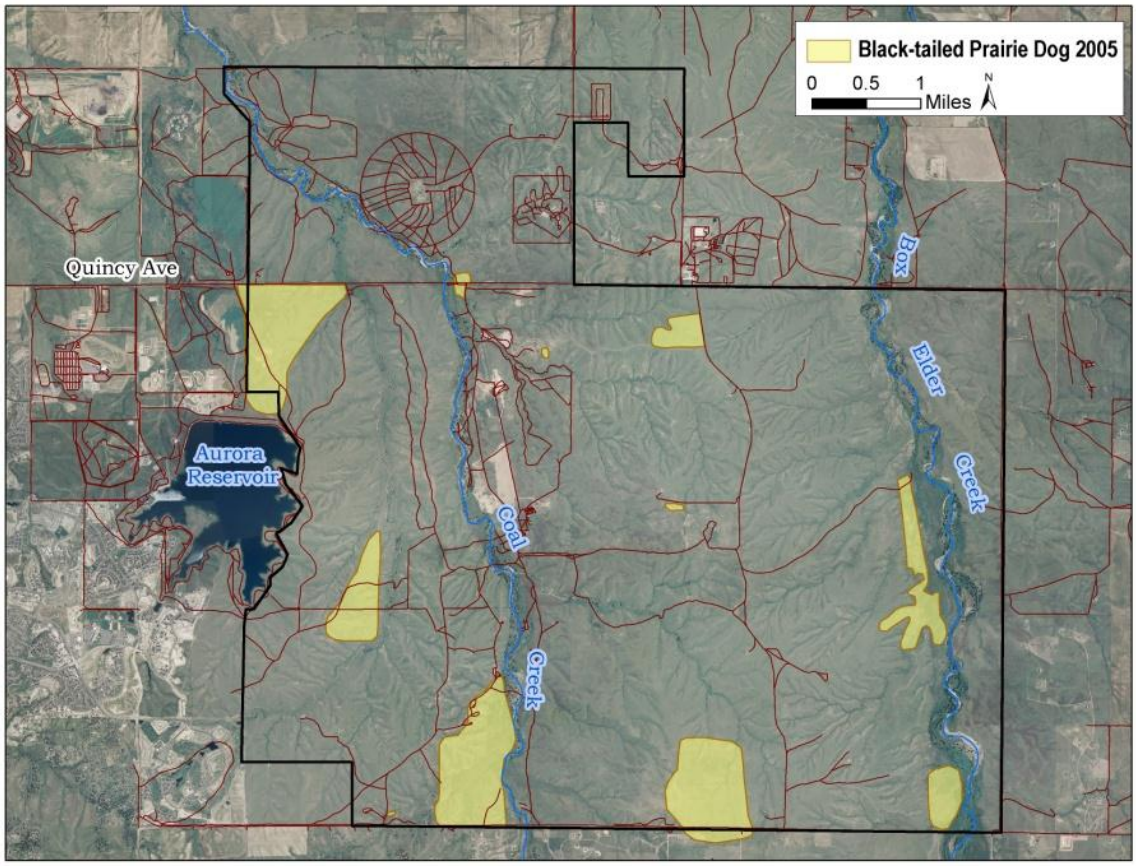

Figure 11. Locations of black-tailed prairie dog (*Cynomys ludovicianus*) towns recorded from the Lowry Range in 2005.

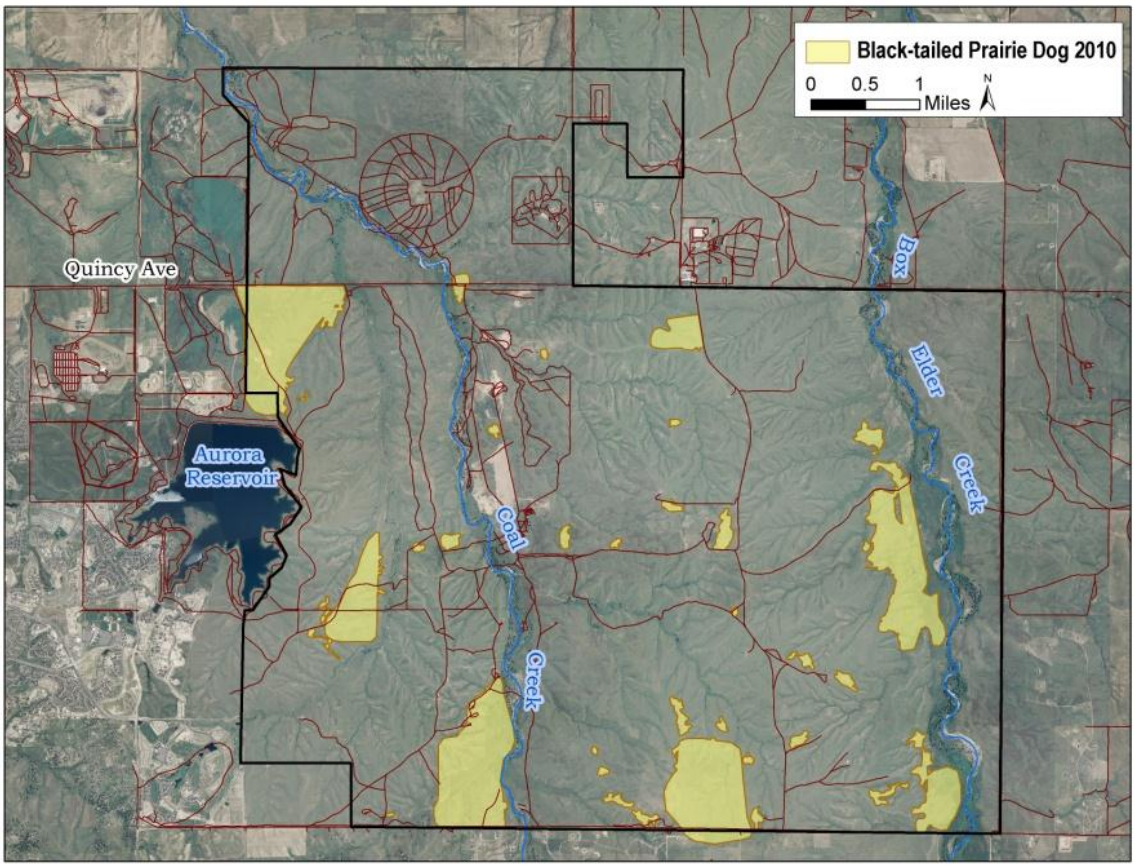

Figure 12. Locations of black-tailed prairie dog (*Cynomys ludovicianus*) towns recorded from the Lowry Range in 2010.

Northern Pocket Gopher macrotis Subspecies (*Thomomys talpoides macrotis*)

The historic distribution of the *macrotis* subspecies of the northern pocket gopher is very narrow, with a range of only 40 to 385 square miles (100-1,000 sq km) (Colorado Division of Wildlife 2000). This range includes southwestern Arapahoe, northern Douglas, and possibly extreme northwestern Elbert counties (Armstrong 1972, Center for Native Ecosystems *et al.* 2003, CNHP 2005). The current distribution of *macrotis* appears to be limited to 16 populations in Douglas and Arapahoe counties. NatureServe ranks this subspecies of the northern pocket gopher as critically imperiled both globally and in Colorado (G5T1/S1). The Colorado Division of Wildlife characterizes population trends of this subspecies as unknown, but asserts that the subspecies is probably declining due to the effects of urban development (Center for Native Ecosystems *et al.* 2003). The global population size in CNHP's Biodiversity and Tracking Conservation System (BIOTICS) is small, with 16 known populations, three of which are historic.

2005 Inventory Results

Old inactive and fresh active diggings of the northern pocket gopher *macrotis* subspecies are sparsely scattered throughout the upland habitat on the east side of The Range (Figure 13,

Table 12). All known populations outside of The Range face multiple imminent threats (Center for Native Ecosystems *et al.* 2003). All are on private land and some are in highly developed areas (one occupies the E470 right-of-way), and as such their continued viability is questionable. The SLB has an outstanding opportunity to support the continued viability of this population by preserving the prairie grassland in its present state (e.g., free of surface disturbance from recreation or residential and commercial development). The Range provides all of this subspecies' ecological requirements, including a large enough area of suitable habitat with proper soils, drainage, soil moisture content, and forage availability. The prairie grassland inhabited by this population is in fair condition.

Photo 3. Northern pocket gopher digging on The Range – new digging adjacent to old dig mound.

2010 Inventory Results

The *macrotis* subspecies of the northern pocket gopher is abundant on The Range. Surveys in 2010 documented 31 distinct point locations with fresh gopher diggings, over four times the seven locations documented in 2005 (Figure 13). One of the most abundant populations of *T. t. macrotis's* known is found at The Range. Furthermore, the population at The Range is the only one that occupies an unfragmented landscape. All 15 of the other populations exist in suburban and exurban landscapes fragmented by roads and residential or commercial development. The population at The Range affords the best opportunity for conserving a high quality viable population of the gopher, as summarized under 2005 results below, and protection of this population is vital to securing the global conservation of this rare subspecies.

Table12. Northern pocket gopher (*Thomomys talpoides macrotis*) observations at the Lowry Range (UTM in NAD83 Zone 13).

Record No.	UTM E	UTM N	Observation Date	Number Observed Adult	Juvenile
1	541628	4380115	9/22/2002	1 (specimen collected)	0
2	536578	4380786	7/14/2005	3 (specimens collected)	0
3	537944	4381955	8/11/2010	0 (fresh excavations)	0
4	538571	4380605	8/11/2010	0 (fresh excavations)	0
5	534376	4382254	8/12/2010	0 (fresh excavations)	0
6	534163	4381943	8/12/2010	0 (fresh excavations)	0
7	534691	4380587	8/12/2010	0 (recent excavations)	0
8	534345	4380159	8/12/2010	0 (recent excavations)	0
9	534653	4380105	8/12/2010	0 (old excavations)	0
10	534957	4379858	8/12/2010	0 (fresh excavations)	0
11	533691	4380835	8/13/2010	0 (recent excavations)	0
12	533239	4380483	8/13/2010	0 (recent excavations)	0
13	532720	4380159	8/18/2010	0 (fresh excavations)	0

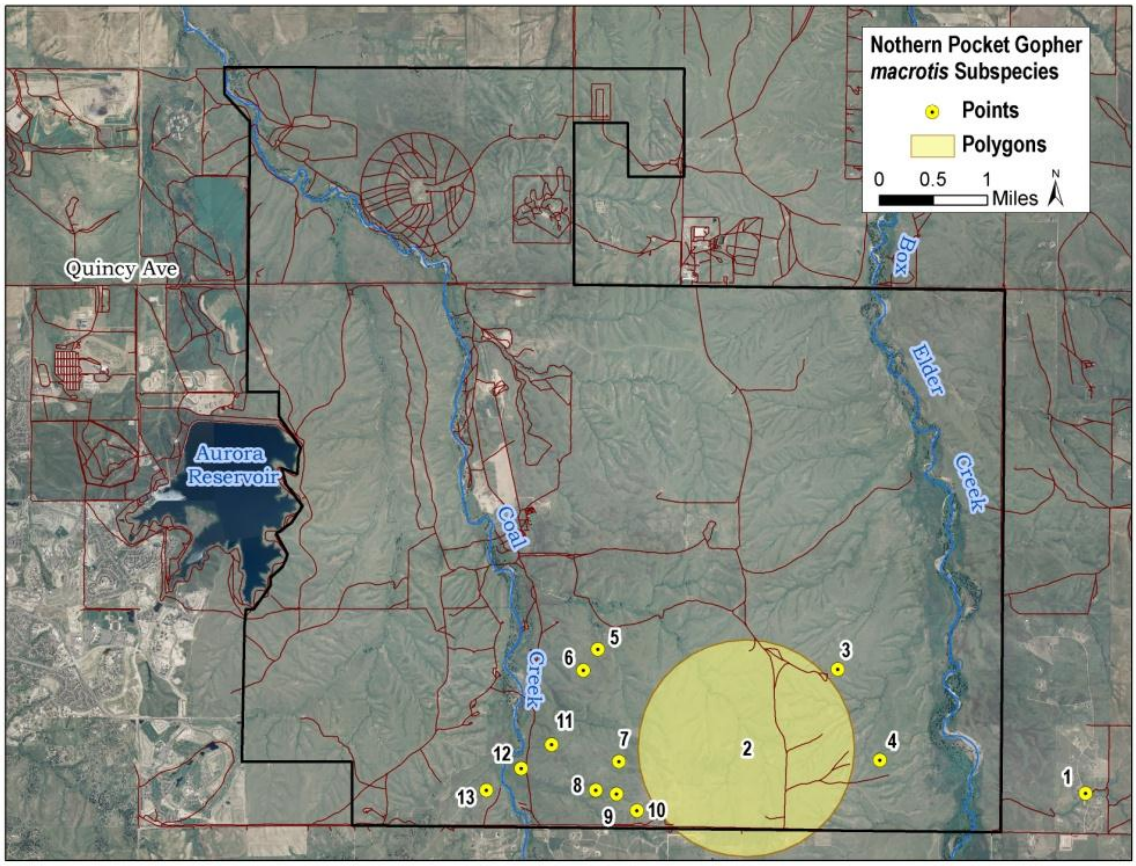

Figure 13. Locations of northern pocket gopher (*Thomomys talpoides macrotis*) recorded from the Lowry Range.

Pronghorn (*Antilocapra Americana*)

2005 Inventory Results

In 2005, lone individuals as well as groups of a few to more than 15 individuals per group were observed throughout both the east and west sides of The Range. Some areas on The Range where pronghorn were repeatedly observed are shown in Figure 14. Species activity maps from the Colorado Division of Wildlife indicate that the closest pronghorn concentration areas to The Range are three and six miles to the north, and 10 miles to the east (CDOW 2010, Figure 15). The CDOW defines concentration areas as that part of the overall range where densities are at least 200% greater than the surrounding area during a season other than winter. If pronghorn are to remain viable at The Range, it is imperative that undisturbed corridors between The Range and these concentration areas be maintained. This will require that the SBLC work with partners and neighbors to preserve movement corridors in a natural state - a difficult task given pressures of urbanization being exerted on the region.

2010 Inventory Results

Pronghorn were observed throughout The Range in 2010. Eight different groups of pronghorn representing approximately 125 individuals[2] were observed at The Range in 2010. The groups ranged in size from five to approximately 30 individuals. Group sizes tended to be larger than those observed during 2005 surveys; the largest groups observed in 2010 were approximately twice the size of those observed in 2005. The areas where pronghorn were repeatedly observed corresponded with areas where observations were made in 2005, with the exception of south-central portion of The Range. Large groups of from 20 to 30 individuals were consistently observed there in 2010, whereas pronghorn were absent from this area in 2005.

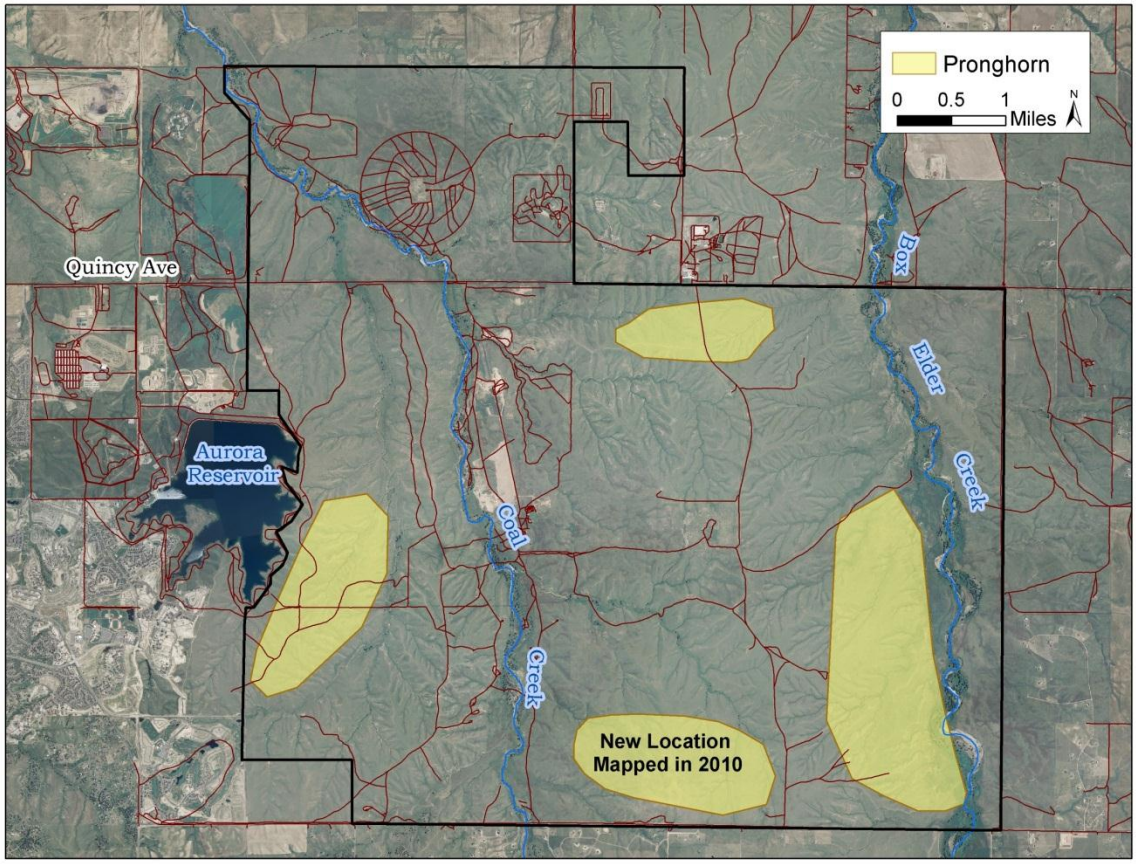

Figure 14. Areas of pronghorn (*Antilocapra americana*) concentration recorded at the Lowry Range.

[2] We do not know whether these individuals were all unique, or whether some animals were observed more than once.

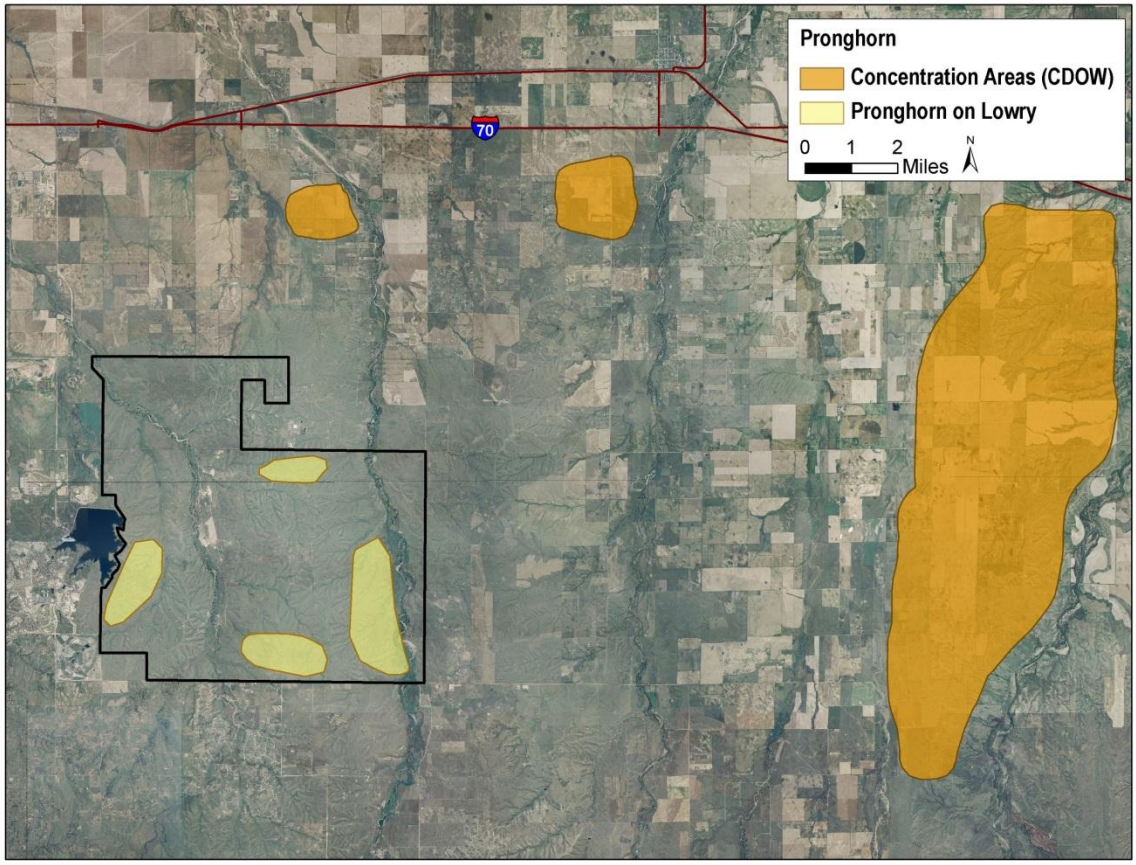

Figure 15. Pronghorn (*Antilocapra americana*) concentration areas in the vicinity of the Lowry Range (CDOW 2005).

Animal Species Surveyed Only in 2005

Rare, Imperiled, and Vulnerable Birds

Short-eared Owl (*Asio flammeus*)

Two Short-eared Owls were observed together in the cottonwood riparian forest along Coal Creek, north of Quincy Road (Figure 16, Table 13). Colorado is at the extreme southern tip of the breeding range, with breeding occurring throughout the northern third of the State and in the San Luis Valley of south–central Colorado (Kingery 1998). The Short-eared Owl migrates seasonally, and Colorado hosts more of this species in the winter than in the summer. The two owls at The Range were observed during the breeding season. If these birds were breeding on, or in the vicinity of, The Range, it would represent one of only a few (10-30) breeding records of this species in Colorado (Kingery 1998). NatureServe ranks the

Short-eared Owl as demonstrably secure globally (G5), but breeding birds are rare

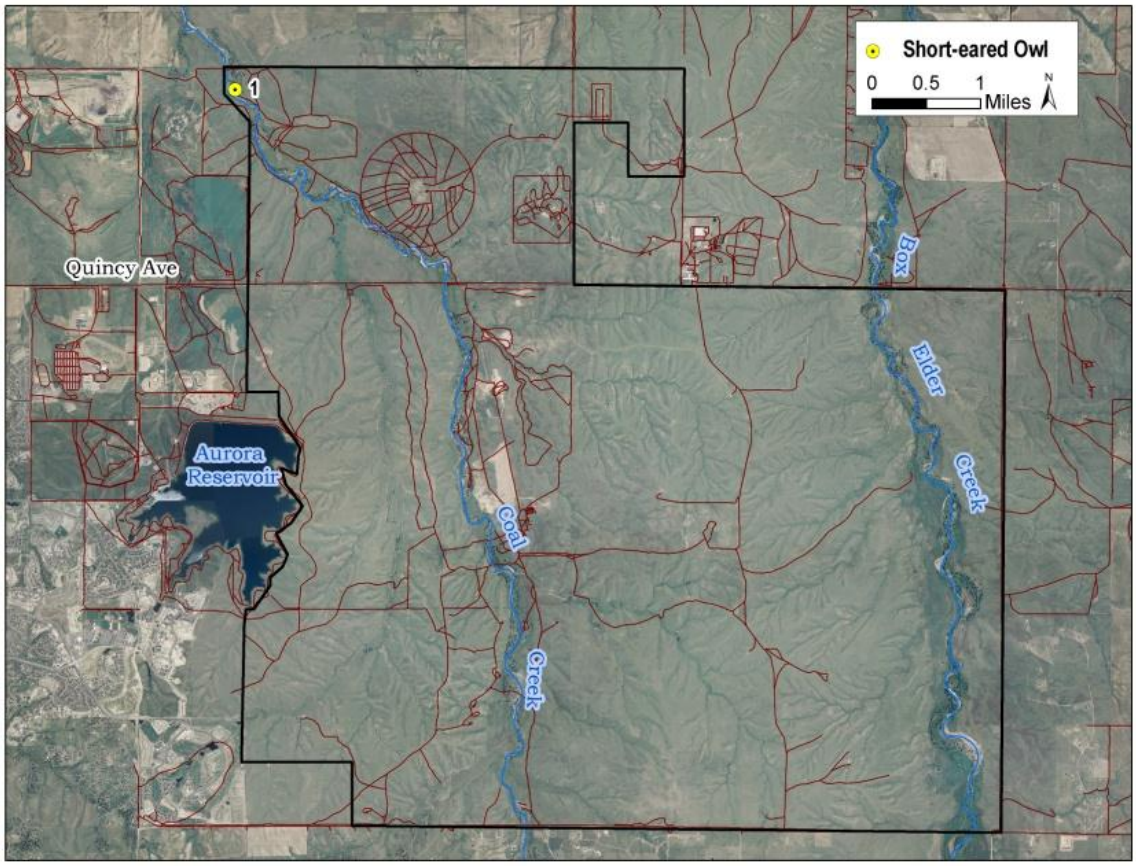

Figure 16. Location of Short-eared Owls (*Asio flammeus*) recorded from the Lowry Range.

in Colorado (S2B). Across their range, Short-eared Owls have experienced declines of between 10 and 30 percent since the 1970s (NatureServe 2005). The decline of Short-eared Owls in Colorado, in part, results from intensive agriculture and urbanization, including the increase of woodlands on the Great Plains due to the plantings of shelterbelts and expansion of riparian forests. This is particularly true near the Front Range (Kingery 1998). Nest predation may also increase when nest-destroying feral dogs and cats, foxes, and skunks proliferate with human settlement (Kingery 1998). In Colorado, Short-eared Owls inhabit prairies and grassy openings with low vegetation, usually near water with emergent vegetation.

Table 13. Short-eared Owl (*Asio flammeus*) observations at the Lowry Range (UTM in NAD83 Zone 13).

				Number Observed	
Record No.	**UTM E**	**UTM N**	**Observation Date**	**Adult**	**Juvenile**
1	428987	4390567	6/16/2005	1	0

Ferruginous Hawk (*Buteo regalis*)

There were three observations of Ferruginous Hawk on The Range, each within the immediate vicinity of prairie dog towns (Figure 17, Table 14). Whether this was the same individual observed multiple times, or observations of three different individuals is unknown. The birds observed on The Range appeared to be foraging individuals hunting prairie dogs. They may have been nesting outside of The Range, but the possibility of their nesting on The Range cannot be discounted.

The Ferruginous Hawk occurs throughout the eastern half of Colorado and in northwestern Colorado from Moffat to Mesa counties (Kingery 1998). NatureServe ranks Ferruginous Hawks apparently secure across their range (G4), but Colorado's breeding population is considered vulnerable (S3B), based on human reduction of the primary winter prey base (prairie dog colonies), small population size, and human encroachment into available habitat. In Colorado, Ferruginous Hawks are fairly common winter residents, but are rare to uncommon summer residents on the eastern plains (Andrews and Righter 1992, Kingery 1998). About 1,200 birds winter in Colorado (Johnsgard 1990), comprising about 20 percent of the total winter population in the United States (Andrews and Righter 1992). North American Breeding Bird Survey data for the U.S. and Canada indicate a relatively stable population from 1990 – 2004 (Sauer *et al*. 2005).

Ferruginous Hawks inhabit grasslands and semidesert shrublands, and are rare in pinon-juniper woodlands. Breeding birds nest in isolated trees, on rock outcrops, on structures such as windmills and power poles, or on the ground. Wintering birds concentrate around prairie dog towns, and their numbers and distribution vary widely with the availability of prairie dogs (Andrews and Righter 1992). Loss of grasslands is likely a long-term threat (Olendorff 1993). Ferruginous Hawks are easily disturbed during the breeding season (February to July 15th) (Bechard *et al.* 1990) and will abandon nests, particularly in the early stages of nesting (White and Thurow 1985).

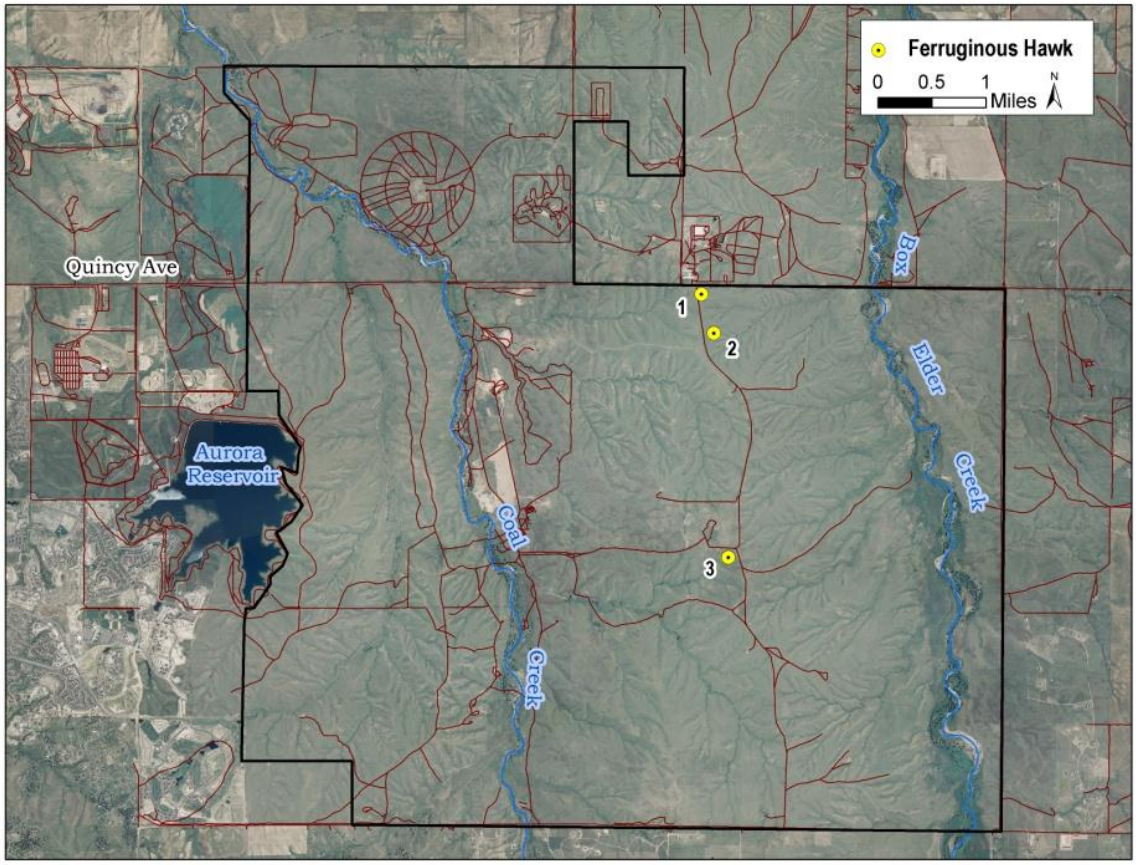

Figure 17. Locations of Ferruginous Hawk (*Buteo regalis*) recorded from the Lowry Range.

Table 14. Ferruginous Hawk (*Buteo regalis*) observations at the Lowry Range (UTM in NAD83 Zone 13).

				Number Observed	
Record No.	**UTM E**	**UTM N**	**Observation Date**	**Adult**	**Juvenile**
1	535916	4387510	7/13/2005	1	0
2	536099	4386933	6/23/2005	1	0
3	536314	4383604	6/02/2005	1	0

Mountain Plover (*Charadrius montanus*)

Four Mountain Plovers were observed on The Range on the same day, approximately one mile apart, within 30 minutes of each other. It may be that they were the same two birds being observed twice (Figure 18, Table 15). Mountain Plovers inhabit the eastern plains of Colorado, the San Luis Valley of south-central Colorado, and South Park in the central mountains of Colorado (Kingery 1998). NatureServe ranks the Mountain Plover rare both globally and in Colorado (G2/S2B). It is unlikely the plover observed on The Range were nesting birds, as the height of the breeding season is May-June (Dreitz 2005), while these birds were observed on August 11th. Since The Range is at the extreme western edge of the breeding distribution on Colorado's eastern plains, it is unlikely that The Range is used by

Mountain Plover for breeding. Breeding Bird Survey data indicate a decline of two-thirds in the continental population during the period 1966-1993 (Knopf 1996). The breeding range of this species has undergone a dramatic long-term contraction, both in Colorado (Andrews and Righter 1992) and throughout the western Great Plains (Graul and Webster 1976). Once widely distributed in eastern Colorado (Sclater 1912), Mountain Plover underwent a dramatic range reduction due to loss of habitat, as native prairie was converted to cropland (see refs. in Andrews and Righter 1992). Breeding Mountain Plovers occupy open habitats with low-growing vegetation, especially shortgrass prairie characterized by the presence of blue grama (*Chondrosum gracile*) and buffalograss (*Buchloe dactyloides*) (Knopf and Miller 1994). In grasslands where vegetation grows taller than approximately three inches in height, Mountain Plovers use intensively grazed areas (Graul and Webster 1976, Knopf 1996) and prairie dog towns (Shackford 1991, Dreitz 2005). Threats to Mountain Plover and their habitat include gas, oil, and mineral extraction, spring plowing (the timing and size of the area plowed) (Shackford 1998), collisions with motor vehicles, and recreation (Underwood 1994). Human disturbance at nest sites may cause nest abandonment (Miller and Knopf 1993).

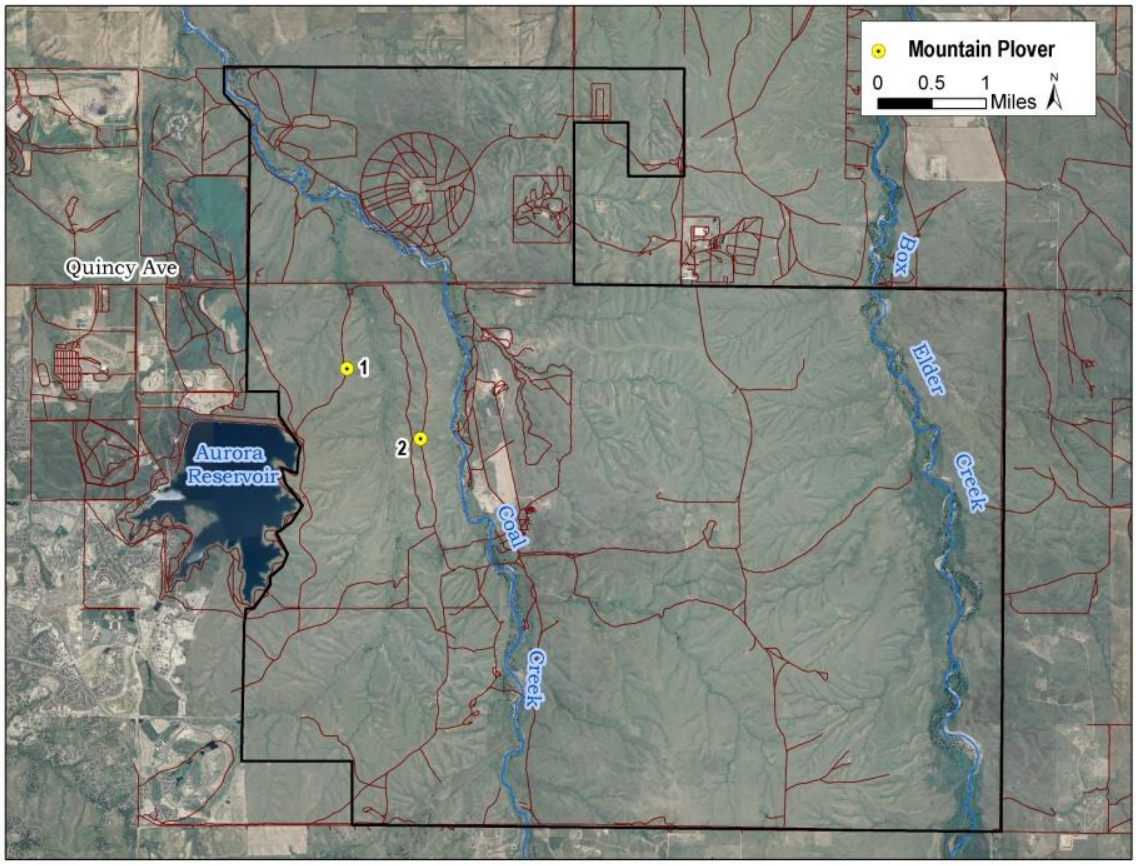

Figure 18. Locations of Mountain Plover (*Charadrius montanus*) recorded from the Lowry Range.

Table 15. Mountain Plover (*Charadrius montanus*) observations at the Lowry Range (UTM in NAD83 Zone 13).

				Number Observed	
Record No.	**UTM E**	**UTM N**	**Observation Date**	**Adult**	**Juvenile**
1	530648	4386417	8/11/2005	2	0
2	531740	4385372	8/11/2005	2	0

Northern Harrier (*Circus cyaneus*)

One Northern Harrier was observed foraging along the northern boundary of The Range (Figure 19, Table 16). NatureServe ranks Northern Harriers as secure globally (G5), but breeding birds are vulnerable in Colorado (S3B). Breeding Bird Survey data for the U.S. and Canada show an annual population decline of 2 percent between 1990 and 2004 (Sauer *et al.* 2005). Where declines have occurred, they have been attributed to habitat conversions such as draining of wetlands, monotypic farming, and urbanization (Evans 1982). Northern Harriers nest in a wide range of open habitats and vegetative associations, including abandoned fields (Serrentino 1992), wetland habitats such as willow (*Salix* spp.) shrubland, native grassland prairies (Genoways and Brenner 1985), and swales and meadows (Hamerstrom and Kopeny 1981).

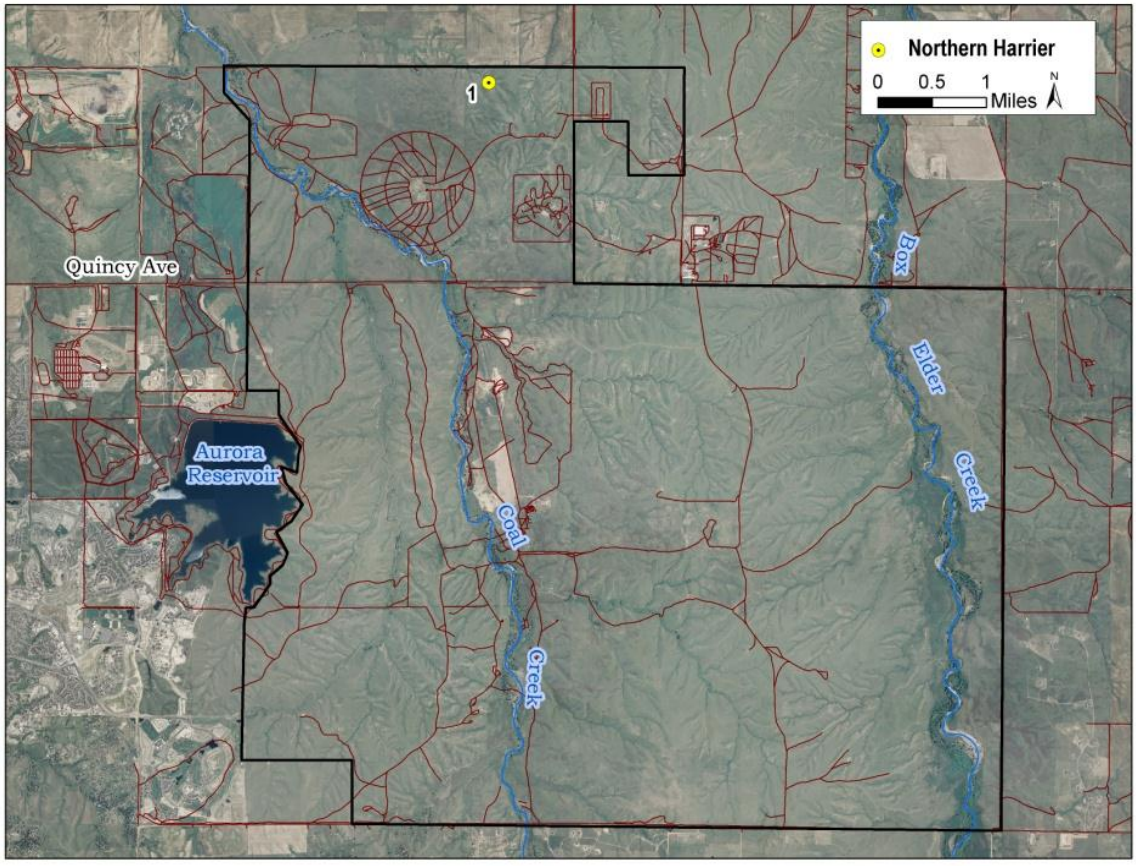

Figure 19. Locations of Northern Harrier (*Circus cyaneus*) recorded from the Lowry Range.

Table 16. Northern Harrier (*Circus cyaneus*) observations at the Lowry Range (UTM in NAD27 Zone 13).

				Number Observed	
Record No.	**UTM E**	**UTM N**	**Observation Date**	**Adult**	**Juvenile**
1	532754	4390650	6/24/2005	1	0

Prairie Falcon (*Falco mexicanus*)

Four Prairie Falcons were observed on The Range. Each observation consisted of two individuals occurring together at two different locations on The Range (Figure 20, Table 17). These may represent two observations of the same individuals, or separate observations of four different individuals. Prairie Falcons nest throughout Colorado (Kingery 1998) where nesting populations are apparently secure (S4B), while globally they are demonstrably secure (G5). Human disturbance has negative effects when it occurs just prior to egg laying (Platt 1974, Boyce 1982). At other times during breeding, human disturbance appears to have no significant effect (Edwards 1973, Holthuijzen 1989). Prairie Falcons appear to be relatively tolerant of oil and gas development in foraging areas when direct human disturbance is not excessive. They are not tolerant of urban development where nest sites are destroyed or direct human disturbance is excessive (Harmata 1991, Squires *et al.* 1993), and harassment and predation by domestic pets can be a problem. Prairie Falcons will nest in potholes or well-sheltered ledges on rocky cliffs, or steep earth embankments, from 30 to more than 325 feet (10 to 100 m) above the surrounding terrain. Since there are no such structures available in the portion of The Range that we inventoried, we suspect that the falcons we observed were probably nesting elsewhere and foraging on The Range. However, the extreme northeast corner of The Range contains higher, more rugged terrain, which we did not access during our survey. It is possible that falcons were nesting there. Large foraging areas that are from 10 to 120 square miles (30 - 310 sq km) in size (NatureServe 2005) require that large-scale landscapes be preserved if Prairie Falcons are to persist in an area.

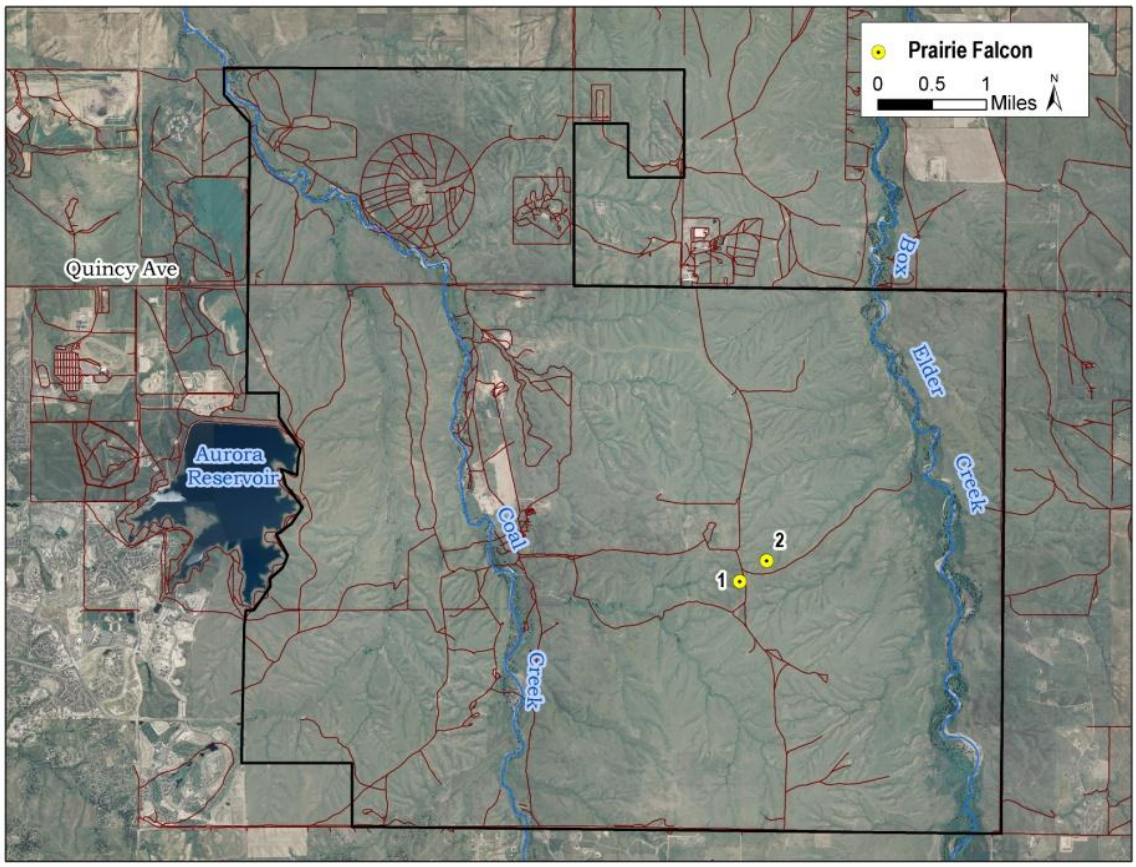

Figure 20. Locations of Prairie Falcon (*Falco mexicanus*) recorded from the Lowry Range.

Table 17. Prairie Falcon (*Falco mexicanus*) observations at the Lowry Range (UTM in NAD83 Zone 13).

				Number Observed	
Record No.	**UTM E**	**UTM N**	**Observation Date**	**Adult**	**Juvenile**
1	536485	4383277	06/24/2005	2	0
2	536884	4383585	07/14/2005	2	0

Loggerhead Shrike (*Lanius ludovicianus*)

Loggerhead Shrikes were often observed perching on fences at The Range, particularly along the eastern access road that runs north-south across The Range from Quincy Road to County Line Road (Figure 21). In addition, an active Loggerhead Shrike nest with at least one fledgling was located on Coal Creek. In Colorado, Loggerhead Shrikes breed on the eastern plains, in the San Luis Valley, the Grand Valley in Mesa County, and Moffat and La Plata counties (Kingery 1998). NatureServe ranks the Loggerhead Shrike apparently secure in Colorado (S3S4) as well as across its range (G4). Breeding Bird Survey data for 1980-2000 indicate ongoing, significant declines, although the rates of these declines may be slowing down for some populations (NatureServe 2005). Rangewide, the decline was 2.2 percent

annually for this 20 year period (Sauer *et al.* 2005). Evidence suggests that habitat loss caused by industrial and residential development and conversion of pasture to cropland have led to declines (Novak 1989, Telfer 1992). Since shrikes are comparatively high on the food chain, pesticides have been implicated as contributing to the decline (Fraser and Luukkonen 1986) by reducing food availability. Significant declines on the Canadian prairies corresponded with dieldrin treatment of grasshoppers, which make up 30-75% of the diet (Yosef 1996). The Loggerhead Shrike nests in numerous types of habitat, including shortgrass pastures, open country with scattered trees and shrubs, savanna, desert scrub, and occasionally, open woodland. All of these habitats, except desert scrub, are available to some extent on The Range.

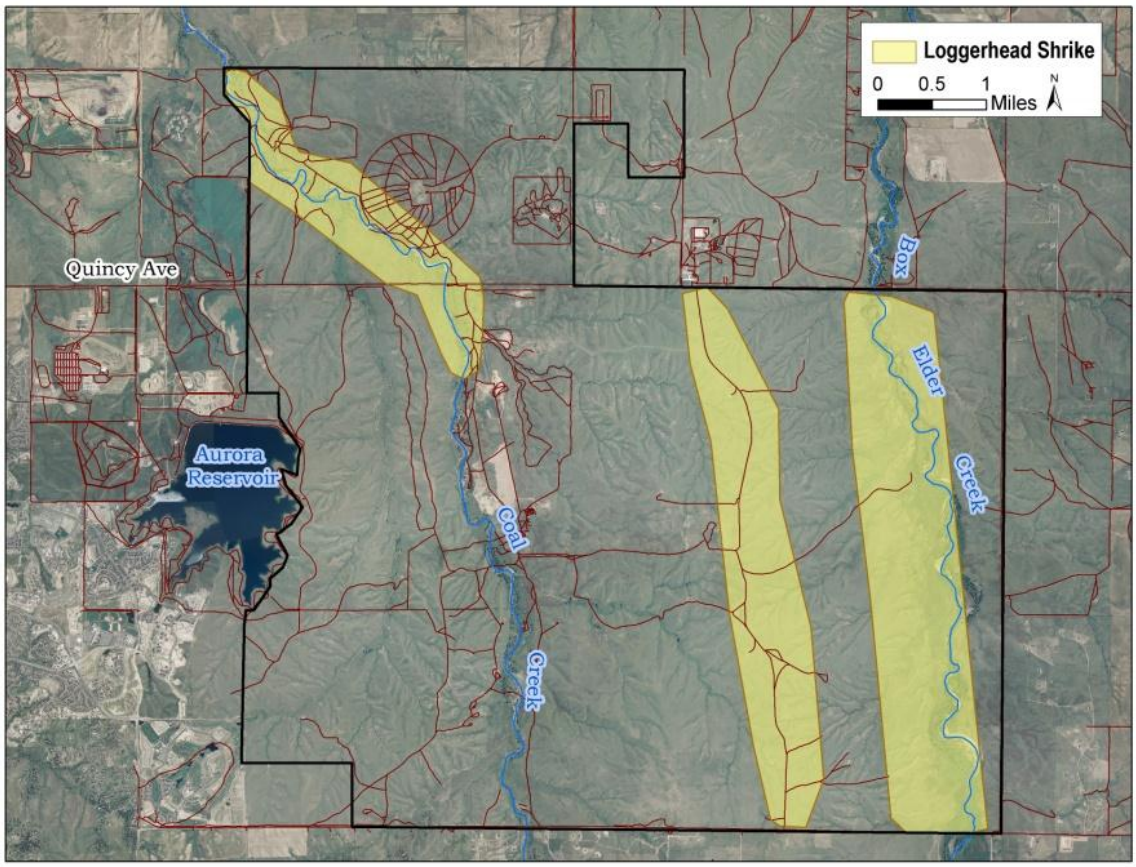

Figure 21. Locations of Loggerhead Shrike (*Lanius ludovicianus*) concentrations on the Lowry Range.

Swift Fox (Vulpes velox)

A breeding population of swift foxes was observed on The Range between June and August, 2005, when one adult and two pups were observed at three different locations (Figure 22, Table 18). In August, only one pup remained at a den where two pups were observed in July. Swift foxes inhabit shortgrass and mixed-grass prairies, where they prefer well-drained, friable soils (Bee *et al.* 1981, Nowak 1999). Dens are excavated on slopes, ridges, or flat areas that afford good views of surrounding lands (Fitzgerald *et al.* 1994), and this was certainly true of the dens located on The Range.

Swift foxes are uncommon residents of Colorado's eastern plains and canyon lands (Fitzgerald *et al*. 1994), where they occur in low densities. NatureServe ranks this species vulnerable both globally and in Colorado (G3/S3). Rangewide, populations of swift fox were severely depleted from the 1830s through the 1950s, and they now occupy only 10 percent of their former range (Smeeton 1993, Allardyce 1995). Populations plummeted during the last half of the 18th century and the early 19th century as a consequence of widespread and indiscriminate poisoning that targeted wolves (*Canus lupus*) (Stephens and Anderson 2005). Factors responsible for current reductions in their distribution and population sizes include habitat loss, attacks by unleashed dogs, predator and rodent control programs, collisions with automobiles, hunting, and trapping (Bailey 1926, Kilgore 1969, Hillman and Sharps 1978). Swift foxes are not as cautious as many other canids, so they are trapped and poisoned relatively easily (Egoscue 1979). In southeastern Colorado, predation by coyotes is a major source of mortality of swift foxes (Andersen *et al.* 1998).

If large portions of The Range are maintained in their current state, particularly in the vicinity of known den sites, swift fox existence on The Range may be preserved. However, swift foxes require large home ranges, from 250 to several thousand acres (100 to several thousand ha) (Harrison 2003). Because The Range has approximately 25,000 acres (10,000 ha) of habitat in total, it cannot afford to lose much area to conversion for recreation and development if swift foxes are to be maintained on The Range. The Arapahoe Hunt Club conducts traditional English fox hunting with hounds, substituting the abundant coyote population on The Range for fox in the hunt. This practice may benefit the swift fox by limiting the population size of a potential predator, the coyote. Due to their predation on swift fox the coyote population needs careful monitoring and management. Also, management should ensure that swift fox locations on The Range are known to the Arapahoe Hunt Club in order to avoid disturbance and/or accidental take of swift fox.

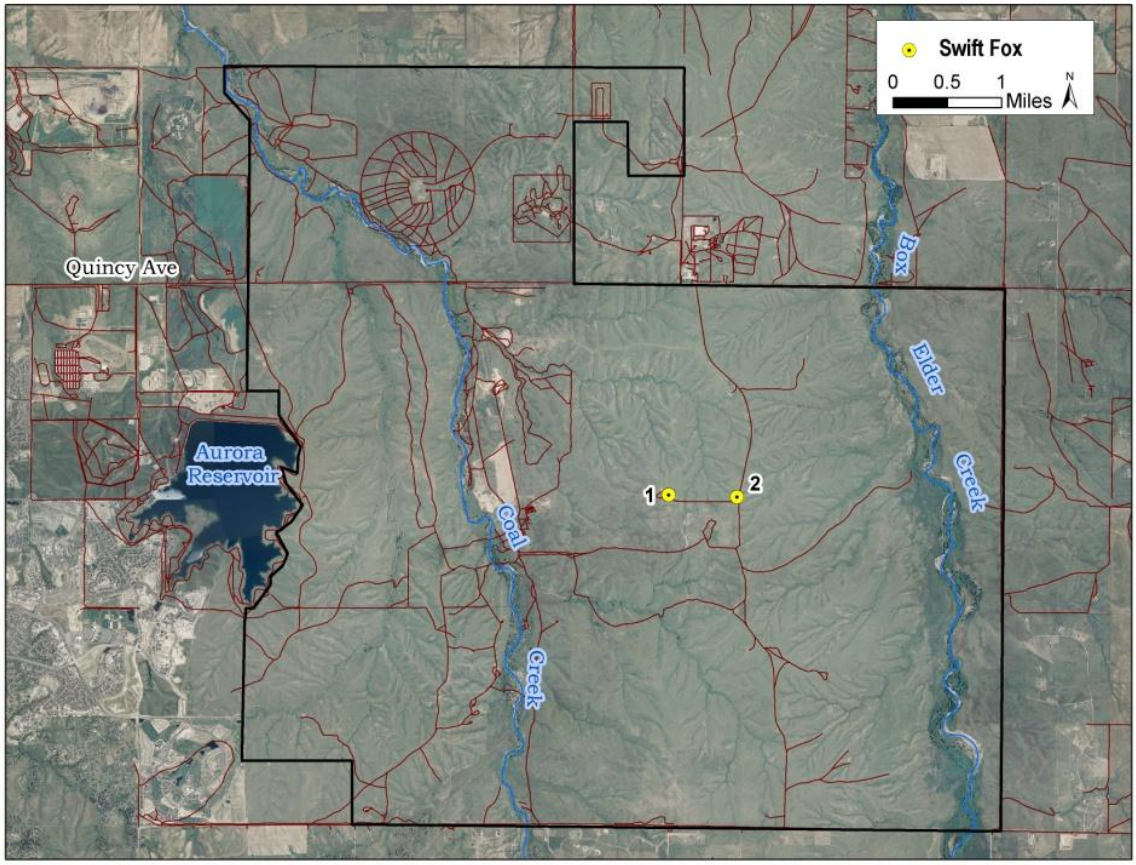

Figure 22. Locations of swift fox (*Vulpes velox*) recorded from the Lowry Range. The original 2005 map showed each individual entrance to the den(s), which may be one den with multiple entrances or a system of closely spaced, but separate dens. This occurrence is currently mapped in CNHP's database as a den system represented by one polygon, plus a second separate den that is about a mile to the east.

Table 18. Swift fox (*Vulpes velox*) observations at the Lowry Range (UTM in NAD83 Zone 13).

				Number Observed	
Record No.	**UTM E**	**UTM N**	**Observation Date**	**Adult**	**Juvenile**
1	535430	4384533	6/16/2005	1	0
2	536445	4384501	7/13/2005	0	2

Photo 4. Swift fox (*Vulpes velox*) pup outside of culvert den at the Lowry Range.

Other Animal Species Documented in 2005

Lark Bunting (*Calamospiza melanocorys*)

A number of grasslands birds were recorded on The Range during the survey (Tables 7 and 8), of which the most notable is the Lark Bunting. The Partner's In Flight (PIF) North American Landbird Conservation Plan considers the Lark Bunting a Stewardship Species of the prairie avifaunal biome, with over 75 percent of their global population in this biome (Rich *et al.* 2004). According to PIF, Lark Buntings merit special conservation action within their core range, within which The Range falls. Population trends are difficult to track for Lark Buntings because of the unstable nature of breeding populations, which exhibit large annual fluctuations in population size as a normal part of their breeding ecology (Hibbard 1965, Wilson 1976). Reliable regional datasets from the Breeding Bird Survey show significant declines of Lark Bunting in the central Great Plains, whereas the species seems to be increasing in the northwest (i.e., Montana) (NatureServe 2005). Significant declines (8.2% annually) have been recorded between 1966 and 1999 in the High Plains Border region (a north-south band across central Kansas and central Nebraska) (NatureServe 2005). Other significant declines from 1966-1999 were recorded in Colorado (2.2% annually) (NatureServe 2005). Lark Buntings are probably threatened most by intensive agricultural

operations that alter or disturb nesting habitat, fragment the landscape, and cause loss of nests to farming operations (NatureServe 2005). Although the Lark Bunting is currently widespread, it will require management or other on-the-ground conservation action to sustain existing populations and to prevent their further decline in the region (Rich *et al.* 2004).

Amphibians

In addition to the northern leopard frogs reported from both Coal and Box Elder Creeks, four other amphibian species were also recorded from The Range, including plains spadefoot (*Spea bombifrons*), Woodhouse's toad (*Bufo woodhousii*), western chorus frog (*Pseudacris triseriata*), and tiger salamander (*Ambystoma tigrinum*) (Table 8). Although none of these species are rare, their occurrence on The Range indicates the natural hydrology of the area is intact (e.g., natural surface water flows arising from snowmelt and rainfall events, and the natural discharge of ground water are both occurring). For a further discussion on hydrology see the "Riparian Hydrology" subsection below within Western Great Plains Riparian Woodland, Shrubland and Herbaceous Ecological System section.

Ecological Systems

Ecological systems at The Range include Western Great Plains Foothill and Piedmont Grassland and Western Great Plains Riparian Woodland, Shrubland and Herbaceous. Most wetlands within the property are associated with Coal Creek or Box Elder Creek, and are discussed below as part of the riparian system. The scattered small wetlands within swales are discussed as part of the grassland system. A partial list of plant species observed on The Range and descriptions of the ecological systems are provided in Appendices B and C, respectively.

Western Great Plains Foothill and Piedmont Grassland Ecological System

In general, the grasslands support a wide range of shortgrass and mixed-grass species, including blue grama (*Boutelous gracilis*), buffalograss (*Buchloe dactyloides*), western wheatgrass (*Pascopyrum smithii*), needle-and-thread (*Hesperostipa comata*), big bluestem (*Andropogon gerardii*), little bluestem (*Schizachrium scoparium*), and prarie sandreed (*Calomovilfa longifolia*). The Gap Analysis Program (USGS National Gap Analysis Program 2004) maps the uplands of The Range as a mosaic of Foothill and Piedmont Grassland and Shortgrass Prairie ecological systems, with the majority designated as Shortgrass Prairie. CNHP classifies much of the property as Foothill and Piedmont Grassland (piedmont grassland) for a variety of reasons discussed below.

The Range, near the northern edge of the Palmer Divide, is within the areal extent where piedmont grasslands can be expected. Remnant mixed-grass species common in piedmont grasslands (e.g., western wheatgrass and needle-and-thread) were noted throughout the property and were dominant in some areas, such as in the southwestern portion of the property in 2005. Livestock management and precipitation (timing and amount) are important attributes in shortgrass/mixed-grass mosaics. In general, piedmont grasslands can be expressed when annual precipitation exceeds 16 inches (40 cm) and grazing is moderate

(Appendix B). Annual precipitation on The Range averages from 12-16 inches (30-40 cm) (Western Regional Climate Center 2005), within the precipitation range that can support piedmont grasslands. In Sovell et al. (2006), we predicted that with a lower intensity cattle grazing operation, the species composition might change from that of shortgrass prairie more towards that of a piedmont grassland, especially during higher than average precipitation years. This prediction proved accurate in 2010. Grazing was eliminated in 2008, rainfall was high in 2010, and the expression of the piedmont grassland was easily discernable and widespread. We recorded an occurrence of big bluestem and prairie sandreed (*Andropogon gerardii/Calomifilva longifolia*) plant association, and delineated Potential Conservation Area for the piedmont grassland (Figure 24). Because the Foothill and Piedmont Grassland system is rarer and more threatened than the Shortgrass Prairie system, we suggest directing management activities on The Range toward the Foothill and Piedmont Grassland system.

In general, especially in the eastern portion of the property, the grasslands are currently relatively homogenous and dominated by blue grama and buffalograss with scattered forbs, including scurfpea (*Psoralidium tenuiflorum*), fringed sage (*Artemisia frigida*), and low daisy (*Erigeron pumilus*), and graminoids including needleleaf sedge (*Carex stenophylla* ssp. *eleocharis*), sixweeks fescue (*Vulpia octoflora*), and junegrass (*Koeleria macrantha*). Mixed-grass species, including needle-and-thread and western wheatgrass, occur scattered throughout the property and dominate in patches. Shrubs are very sparse throughout the property with the exception of yucca (*Yucca glauca*), which occurs rather consistently on hilltops.

Photo 5. Piedmont grassland near southern boundary.

Bird populations on the grassland were in good condition in 2005; there were abundant populations of Horned Lark, Lark Bunting, and Western Meadowlark. Pronghorn and black-tailed prairie dog were also abundant in 2005 and again in 2010.

In general, the grasslands include a matrix of native gasses with weedy patches spread throughout. Weedy patches are dominated by cheatgrass (*Anisantha tectorum*) and scattered musk thistle (*Carduus nutans*). In addition, on the south side of The Range weeds dominate the drainages imbedded within the grassland and that feed Coal Creek. An integrated weed management program would assist with elimination of weedy species and help improve the distribution of native species. In some areas, such as near the radio towers just east of Coal Creek, the uplands are weedy with crested wheatgrass, kochia (*Bassia sieversiana*), prickly lettuce (*Lactuca seriola*), salsify (*Tragopogon dubius*), cheatgrass, sweetclover (*Melilotus officinale*), and mullein (*Verbascum thapsus*). Scattered native plants in the area of the radio towers include gumweed (*Grindelia squarossa*), prairie sunflower (*Helianthus petiolaris*), lupine (*Lupinus* sp.), scurfpea, spiderwort (*Tradescantia occidentalis*), and scarlet globemallow (*Spharalcea coccinea*).

Drainages/Wetlands Within the Grassland System

Most of the ephemeral drainages leading to Coal Creek or Box Elder Creek are dry and support upland vegetation. In some isolated areas, these swales include ponded water and/or very scattered mature plains cottonwood (*Populus deltoides*) and peachleaf willow (*Salix amygdaloides*). Some of the wetter areas support dense wetland vegetation, including native sedges (e.g., *Carex simulata, C. nebrascensis, C. praegracilis*), spikerush (*Eleocharis palustris*), Baltic rush (*Juncus balticus*), and wild licorice (*Glycyrrhiza lepidota*). However, in general, the moist swales are dominated by non-native species, including smooth brome (*Bromopsis inermis*), cheatgrass, Kentucky bluegrass (*Poa pratensis*), leafy spurge (*Euphorbia esula*), and Canada thistle (*Breea arvensis*). These non-natives are generally confined to the swales and immediate surroundings (with the exception of cheatgrass, which occurs in small patches scattered throughout the property). One isolated pond within a swale contained chorus frog tadpoles (*Pseudacris triseriata*), tiger salamander larvae (*Ambystoma tigrinum*), and plains garter snake (*Thamnophis radix*). Presence of these species indicates that the system is healthy, with intact and functional hydrology.

Photo 6. Wetland within piedmont prairie system just south of Yale Ave.

A small wetland immediately south of Yale Avenue (T4S R65W S36 extreme NW corner) supported spikerush (*Eleocharis palustris* and *E. acicularis*), shortawn foxtail (*Alopecurus aequalis*), spreading yellow cress (*Rorippa sinuata*), and sea-blite (*Suaeda* sp.). A tadpole of unidentified species and many aquatic insects (e.g., diving beetles, water boatmen, and backswimmers) were noted in this pond, which is, again, indicative of the system's health and its intact and functioning hydrology.

Springs visible from County Line Road support poison ivy (*Toxicodendron rydbergii*), golden currant (*Ribes aureum*), coyote willow (*Salix exigua*), leafy spurge, threesquare bulrush (*Schoenoplectus pungens*), and arrowhead (*Sagittaria* sp.).

Outcrops Within the Grassland System

Rock outcrops or slumping soil faces were inspected for rare plants but none were found. The vegetation was sparser in these settings, but generally consisted of the same species as the surrounding grasslands. The sparse vegetation included Indian ricegrass (*Achnatherum hymenoides*), yucca, prickly pear (*Opuntia* sp.), bastard toadflax (*Comandra umbellata*), white sage (*Artemisia ludoviciana*), ragweed (*Ambrosia psilostachya*), perky sue (*Tetraneuris acaulis*), dogbane (*Apocynum* sp.), prairie clover (*Dalea candida*), poison oak (*Toxicodendron rydbergii*), prairie sunflower, sticky gilia (*Alicellia pinnatifida*), and scurfpea. Non-natives including mullein and salsify were also noted.

Western Great Plains Riparian Woodland, Shrubland and Herbaceous Ecological System

Coal Creek

North from Quincy Road to the radio towers, mature cottonwood and peachleaf willow grow within the wide floodplain of Coal Creek. Most of the creek occurs within an entrenched channel. The meanders of the creek have re-established themselves within the wide entrenched channel. The dry banks of the upper floodplain support upland plants, including scurfpea, needle-and-thread, and western wheatgrass, and non-natives leafy spurge, kochia, cheatgrass, and smooth brome. The dominant species in the herbaceous understory beneath the cottonwood and peachleaf willow are leafy spurge and cheatgrass. A wide range of birds use this cottonwood/ willow overstory, including Short-eared Owl, Bullock's Oriole (*Icterus bullockii*), Loggerhead Shrike, and Western Kingbird (*Tyrannus verticalis*).

Photo 7. Coal Creek with mature cottonwood and dense wetland vegetation.

Photo 8. Coal Creek - shallow pools with tadpoles.

Beginning about one-half mile south of the radio towers and continuing for at least one mile south, there are some reaches with standing water ponds and marshy areas dominated by native wetland vegetation, including threesquare bulrush, bulrush (*S. acutus*), spikerush, Nebraska sedge (*Carex nebrascensis*), clustered field sedge (*Carex praegracilis*), and saltgrass (*Distichlis spicata*). Non-natives include redtop (*Agrostis* sp.), Kentucky bluegrass, cheatgrass, leafy spurge, and rabbitfoot grass (*Polypogon monspeliensis*). This is also the region where tadpoles were abundant in shallow pools and adult northern leopard frogs were found near deeper pools. The tadpoles observed in the shallow pools were likely Woodhouse's toad and plains spadefoot toad. Northern leopard frog tadpoles generally occur in deeper pools such as those found on Coal Creek, but are difficult to see in deep murky water (pers. comm. Brad Lambert, CNHP).

Wetlands next to the treatment plant are dominated by cattail (*Typha* sp.) and bulrush (*Schoenoplectus acutus*), and the open water is covered with duckweed (*Lemna minor*). Peachleaf willow and plains cottonwood occur on the banks with leafy spurge.

In the southern portion of the property (north of County Line Road to Quincy), Coal Creek is generally drier and more degraded. The banks are steeply cut in some areas and the herbaceous understory is dominated by leafy spurge. Mature plains cottonwoods occur scattered along the dry channel. In the vicinity of the sand and gravel mine, the mining has intercepted the water table. One possible result is the interception of groundwater flows to the creek channel resulting in reduced stream flows and a lowering of the water table. Many of the cottonwood trees in the area of the mine are dead or dying, possibly because of an

inadequate water supply induced through changes attributable to the mining. Alternatively, the mining may have directly damaged sub-surface roots of the trees causing their death.

Box Elder Creek

The northern portion of Box Elder Creek (in the vicinity of the corrals) has a wide sandy floodplain with mature cottonwood and peachleaf willow. Most of the creek bed was dry in June, but some areas had flowing water. Leafy spurge and cheatgrass are the dominant understory species in the area of the corrals. Smooth brome, Kentucky bluegrass, and clover (*Trifolium pratense* and *T. repens*) are dominant in other reaches. Native vegetation growing on the dry sandy floodplain includes Baltic rush, needle-and-thread, and sticky gilia. Water flows in a braided sandy channel in some areas; wetland vegetation in these areas includes threesquare bulrush, spikerush, veronica (*Veronica catenata*), and cheatgrass. Northern leopard frog, chorus frog, and Woodhouse toad were all found in this flowing water region. One non-native Russian olive (*Elaeagnus angustifloia*) was noted in the area.

Photo 9. Box Elder Creek - near corrals.

The southern portion of Box Elder Creek (near County Line Road) has a wide sandy floodplain with an overstory of mature plains cottonwood and peachleaf willow and an understory of coyote willow and many non-native grasses and forbs. Smooth brome, clover, Canada thistle, Kentucky bluegrass, timothy, and leafy spurge are common here. Diffuse knapweed (*Acosta diffusa*) was noted adjacent to County Line Road just west of the Box Elder Creek bridge. Native plants within the floodplain and along the creek include Wood's rose (*Rosa woodsii*), snowberry (*Symphoricarpos* sp.), golden currant, nettle (*Urtica gracilis*), and wild licorice. Very close to County Line Road there are off-channel wetlands associated with Box Elder Creek that support open water ponds and a wide range of native wetland vegetation. The marshy area with open water ponds extends about 150 feet. The wetland vegetation includes coyote willow, bulrush, cattail (*Typha latifolia*), veronica, spikerush, mannagrass (*Glyceria grandis*), a buttercup (*Ranunculus* sp.), duckweed, and burreed (*Sparganium eurycarpum*). *Sparganium eurycarpum* is a state rare species (S2?) known from scattered wetlands on the eastern plains, but globally it is demonstrably secure (G5). For purposes of future conservation activity, the burreed was recorded from universal

transverse mercator (UTM) 4379537N 540007E, in NAD 27 Zone 13. Northern leopard frogs are also present in this ponded water portion of Box Elder Creek. In general, non-native grasses and forbs dominate the drier areas along Box Elder Creek and the wetter areas support native vegetation.

Photo 10. Wetlands associated with Box Elder Creek – near County Line Road.

There is much bird activity in this area, including Yellow Warbler (*Dendroica petechia*), White-breasted Nuthatch (*Sitta carolinensis*), Black-headed Grosbeak (*Pheucticus melanocephalus*), Eastern Kingbird (*Tyrannusb tyrannus*), Mourning Dove (*Zenaida macroura*), Western Wood-pewee (*Contopus sordidulus*), American Goldfinch (*Carduelis tristis*), House Wren (*Troglodytes aedon*), American Robin (*Turdus migratorius*), and Red-tailed Hawk (*Buteo jamaicensi*).

Some natural and apparently temporary ponds were noted near Box Elder Creek about 0.4 miles southwest of the corrals. One of the ponds was filled with plains spadefoot tadpoles. Another pond had no tadpoles, but did support predominately native vegetation consisting of hairy pepperwort (*Marsilea mucronata*), spikerush (*Eleocharis palustris* and *E. acicularis*), shortawn foxtail, and spreading yellowcress.

Riparian Hydrology

Maintaining the natural hydrology of The Range will benefit the ecological integrity of Box Elder and Coal Creeks. Water flow, or discharge, within streams of a region will exhibit seasonal patterns influenced by many factors, including precipitation, temperature, runoff from the surrounding landscape, and ground water discharge. Patterns in water flow of streams from the area of The Range exhibit peak volumes of flow in late spring, with a smaller peak in late summer corresponding to the onset of the summer monsoons (Figure 23). Flows during winter are generally low. Alteration in the patterns of natural stream flow can result from water diversion projects such as ground water pumping and the construction of dams, and by changing the quantity and rate of surface water runoff. The effect(s) that alterations within the landscape will have on stream flows depends on the type and number

of alterations, and can include a decline in the volume of peak flow, an increase in peak flow, and/or a change in the timing of peak flows (Figure 21). Changes in the natural patterns of stream flow can have many effects on riparian corridors.

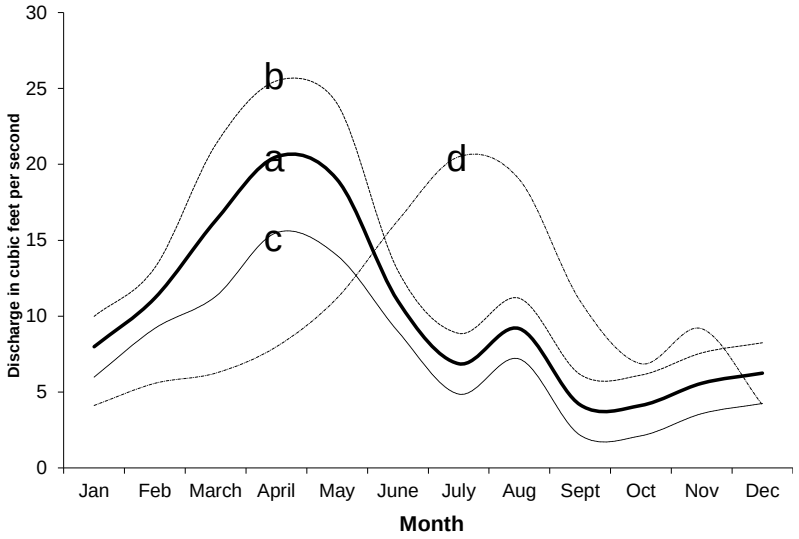

Figure 23. Mean monthly stream flow statistics for Cherry Creek at Parker, Colorado from 1991-2005 (a) (USGS National Water Information System Web Data 2005). Modification to this natural pattern of stream flow could include increasing the volume of peak flows (b), decreasing peak flows (c), or changing the time at which peak flows occur (d).

Urbanization can result in the loss of upland vegetation, leading to more rapid water runoff, elevated stream flows, and increased erosion after rainfall events and during periods of snowmelt (Patten 1998, USDA et al. 1998). Elevated stream flows can lead to channelization and loss of stream meanders and stream braiding, both important for substrate deposition that creates barren bars upon which plant regeneration can occur. Channelization can also disrupt riffle and pool complexes needed at different times in the life cycle of aquatic animals including amphibians, fish, and aquatic invertebrates (USDA et al. 1998). Increased runoff can increase sediment loading, which decreases water quality and compromises survival of aquatic animals (USDA et al. 1998). Increases in water runoff will also lead to a proportional reduction in ground water recharge, leading to a lowered water table, reducing water available to riparian vegetation. Groundwater withdrawal also can cause a drop in the water table, resulting in reduced stream flows and reducing the amount of water available to riparian vegetation, ultimately leading to decline and death of the vegetation. Dams can retain water in spring, during periods of heightened rainfall and snowmelt, causing insufficient spring flows required for seed dispersal and channel scouring (Patten 1998). Scouring leaves barren sandy areas where seeds can implant and germinate. Without these mechanisms, riparian plants such as cottonwood cannot regenerate. The release of water from dams can cause higher than normal summer flows that scour away spring germinating saplings, again resulting in a lack of plant regeneration (Patten1998). Sand and gravel mining intercepts the water table, disrupting runoff and ground water flow into stream channels, and reducing the water available to the riparian corridor (Patten 1998, USDA et al. 1998). This, again, has an impact on the survival of riparian plants and animals. Finally, all of these alterations in seasonal patterns of flow compromise the survival of native plant species

adapted to such conditions and favors establishment of non-native plants (USDA et al. 1998). The effects of these alterations may be detrimental to maintaining the viability and integrity of semi-arid riparian ecosystems like Box Elder and Coal Creeks.

Potential Conservation Areas and Sites of Local Significance

We have delineated two Potential Conservation Areas (PCA) and three Sites of Local Significance (SLSs) on The Range (Figure 24). The East Lowry Range Uplands PCA was delineated for the *macrotis* subspecies of the northern pocket gopher – the rarest and most imperiled species documented on The Range. The Piedmont Grassland PCA was delineated for the piedmont prairie grassland. In addition, Sites of Local Significance were delineated to highlight the Coal Creek and Box Elder riparian corridors, and the largest of the prairie dog communities on The Range. Each PCA and SLS harbors important ecological resources for animals of conservation priority, and requires specific management activities to maintain ecosystem health and the health of the species they support.

East Lowry Range Uplands

Biodiversity Rank - B2: Very High Biodiversity Significance

Protection Urgency Rank - P1: Immediately Threatened/Outstanding Opportunity

Management Urgency Rank - M4: Not Needed Now; No Current Threats; May Need in Future

U.S.G.S. 7.5-minute quadrangles: Watkins SE, Watkins

Size: 8,284 acres (3,352 ha) **Elevation:** 5,820 - 6,190 ft. (1,774 - 1,887 m)

General Description: Old inactive and fresh active diggings of a subspecies of the northern pocket gopher (*Thomomys talpoides macrotis*) are sparsely scattered throughout. The area is characterized by fairly homogenous grassland dominated by blue grama (*Chondrosum gracile / Bouteloua gracilis*) and buffalograss (*Buchloe dactyloides*) with scattered forbs including scurfpea (*Psoralidium tenuiflorum*), fringed sage (*Artemisia frigida*), and low daisy (*Erigeron pumilus*), and graminoids including needleleaf sedge (*Carex stenophylla* ssp. *eleocharis*), six weeks fescue (*Vulpia octoflora*), and junegrass (*Koeleria macrantha*). Midgrass species, including needle-and-thread (*Hesperostipa comata*), western wheatgrass (*Pascopyrum smithii*), and sideoats grama (*Chondrosum curtipendula / Bouteloua curtipendula*) are scattered throughout and become more dominant in small sparsely scattered areas. Although we classified all of Lowry's grasslands within the Foothills and Piedmont Grasslands ecological system, livestock management and grazing intensity has resulted in a grassland complex functioning more as a shortgrass prairie. In general, midgrass prairie can be expressed when annual precipitation exceeds 20 inches and grazing is moderate. Though average annual precipitation at Lowry is lower (about 17 inches), we predict that during higher than average precipitation years, and with a low-intensity cattle grazing operation, the species composition would change more towards that of a midgrass prairie. The midgrass prairie composition would most likely have more diverse grass composition than is currently present. In general, the grasslands are relatively weed-free with the exceptions being scattered patches dominated by cheatgrass (*Anisantha tectorum*), and scattered musk thistle (*Carduus nutans*). Shrubs are very sparse with the exception of yucca (*Yucca glauca*) that occurs rather consistently on hilltops of the site's north end. An important corridor connecting populations of the pocket gopher on the Lowry Range with populations just outside the southeastern boundary travels across Boxelder Creek, which, in general, is dominated by non-native species including smooth brome (*Bromus inermis*), cheatgrass, Kentucky bluegrass (*Poa pratensis*), leafy spurge (*Euphorbia esula*), and Canada thistle (*Breea arvensis*). However, scattered along the drainage are mature plains cottonwood (*Populus deltoides*), peachleaf willow (*Salix amygdaloides*), and areas that support dense wetland vegetation including native sedges (e.g. *Carex simulata, C. nebrascensis, C. praegracilis*), spikerush (*Eleocharis palustris*), Baltic rush

(*Juncus balticus*), wild licorice (*Glycyrrhiza lepidota*), and sandbar willow (*Salix exigua*). Most of the grassland is in good condition and supports abundant grassland birds including Horned Lark (*Eremophila alpestris*), Lark Bunting (*Calamospiza melanospiza*), and Western Meadowlark (*Sturnella neglecta*). Pronghorn (*Antilocapra americana*) and black-tailed prairie dog (*Cynomys ludovicianus*) are also present and species associated with prairie dog complexes were observed within the site including swift fox (*Vulpes velox*), Burrowing Owl (*Athena cunicularia*), Ferruginous Hawk (*Buteo regalis*), and Prairie Falcon (*Falco mexicanus*). Northern leopard frogs (*Rana pipiens*) are present within wetlands associated with the Boxelder Creek drainage and of course *T. t. macrotis*, for which the site was developed, also occupies the area.

Key Environmental Factors: The major factors and environmental variables driving the vegetative structure are annual precipitation and livestock grazing. The distribution of the northern pocket gopher macrotis subspecies on the Lowry Range and within the site is influenced by the distribution of loam soils, soil drainage, forage availability and the presence of prairie dogs and plains pocket gophers (*Geomys bursarius*), which compete with northern pocket gophers.

Climate Description: Climate of the Lowry Range is somewhat characteristic of the High Plains, but is modified by the Rocky Mountains to the west and by the high areas of the Black Forest to the south. Annual precipitation ranges from 15-20 inches, and characteristic of the plains seasonal cycle a large proportion (70 to 80 percent) falls during the growing season from April through September. In July, typically the warmest month, mean maximum highs are 85^{o} F and mean minimums are 56^{o} F. During January, the coldest month, mean maximum highs are 43^{o} F and mean minimums are 15^{o} F.

Land Use History: In 1938, in an attempt to stimulate the economy after acquiring the Lowry Range and surrounding property from numerous private owners, the City of Denver sold the land to the War Department, which established the Lowry Bombing and Gunnery Range. The Lowry Range has been a military installation since 1938 and experienced active bombing maneuvers during World War II and again up until 1958 during the Korean War with an intermittent period between wars where the area of the Range was leased and used as pasture for livestock grazing. In the 1960s the federal government deeded part of the Lowry Range back to the City of Denver and since this time the major use of the range has been ranching, but the site still supports active military training.

Biodiversity Significance Rank Comments (B2): This site supports a good (B-ranked) occurrence of the globally critically imperiled subspecies (G5T1/S1), the northern pocket gopher (*Thomomys talpoides macrotis*). Although not drawn for these species, it also supports other animals of conservation priority including Burrowing Owl, Ferruginous Hawk, Prairie Falcon and colonies of black-tailed prairie dog that are part of a larger prairie dog complex extending across both the west and east halves of the Lowry Range. Multiple dens of a swift fox family, resident on the range

for many years, were also observed and at one such den two pups were noted. Further attesting to the integrity of the grassland and its associated prairie dog complex is the numerous populations of songbirds observed throughout the summer including the Lark Bunting.

Natural Heritage element occurrences at the East Lowry Range Uplands PCA.

Major Group	State Scientific Name	State Common Name	Global Rank	State Rank	Federal Status	State Status	Fed Sens	EO Rank	Last Obs Date
Mammals	Thomomys talpoides macrotis	Northern Pocket Gopher Subsp	G5T1	S1		SC		B	2005-08-12

** The records above are sorted in the following order 1) Major Group 2) Global Rank and 3) Scientific name.

Boundary Justification: The boundary was developed primarily using distribution information from the results of field surveys conducted in 2005 and 2010 identifying both active and inactive diggings where either specimens of *T. t. macrotis* were collected, fresh diggings were observed from areas of old *T. t. macrotis* location records, or from inactive diggings that exhibited conspicuous earthen ridges (casts or eskers) on the surface, characteristic of northern pocket gopher winter activity where subsurface soils are pushed into tunnels in the snow. As snow melts in the spring these garlands of soil are lowered intact to the ground. Given low levels of snowfall in recent years at the Lowry Range, few of these esker-like structures were observed. Many more inactive diggings without the eskers were observed, but could not be attributed to northern pocket gophers with absolute certainty. The boundary includes habitat suitable for the northern pocket gopher as dictated by shallow loam soils, elevation along a low ridge with drainages into both Coal and Boxelder creeks, and absence of the plains pocket gopher (*Geomys bursarius*), a competitor of *T. t. macrotis*, which was common in the Coal and Boxelder creek floodplains. The boundary traverses Boxelder Creek offering a corridor of connectivity with a colony of *T. t. macrotis* just outside the southeast boundary of the Lowry Range. The presence of both prairie dogs and plains pocket gophers in this corridor and the sandy soil characteristic of the floodplain may make it unsuitable for occupancy by *T. t. macrotis*, but it is suitable for *T. t. macrotis* dispersal. This boundary is based on currently available information. Further survey work east and upslope of Boxelder Creek might identify additional populations of *T. t. macrotis* requiring expansion of the boundary to the east along the entire extent of the Lowry Range across Boxelder Creek.

Protection Urgency Rank Comments (P1): There is an outstanding opportunity to eliminate the threats to this population of *T. t. macrotis* if action is taken within one year. The site occupies property owned by the Colorado State Land Board, which is currently developing a management and development plan for the 25,000 acre Lowry Range. Protecting the area of this site as open space in that management and development plan would secure the future viability of the *T. t. macrotis* population.

This area offers the opportunity to protect an area long occupied by *T. t. macrotis*, a globally critically imperiled subspecies in Colorado. Preservation of the prairie grassland in its present state free of surface disturbance from recreation or residential and commercial development will afford continued viability of the *T. t. macrotis* population and all associated animal species. A location where fresh pocket gopher diggings were recorded during this survey effort was reported as a *T. t. macrotis* record in the University of Kansas Museum, date unknown, but it certainly is not a recent record, indicating pocket gophers have occupied this area in its current state for some time.

Management Urgency Rank Comments (M4): Current activities within the site have no potential to degrade the viability of the *T. t. macrotis* population. Small level disturbances from lessees such as model airplane clubs, a hunting enterprise, and livestock grazing are not impacting viability of the *T. t. macrotis* population. However, overutilization for commercial and recreational purposes can degrade and destroy *T. t. macrotis* habitat and intense grazing has modified the grassland structure of the site. Inundation from water projects would result in the loss of *T. t. macrotis* populations. Constructing and maintaining recreational facilities, and residential and commercial development would eliminate suitable habitat, may kill individual gophers, and could increase loss due to harassment and predation from house pets. If this area is protected as open space then proper trail routing and management will be required to prevent disturbance from recreational users. *T. t. macrotis*, occupies an extremely narrow range. Less than 10 populations have been documented, and substantial barriers have been created between these populations. Therefore, *T. t. macrotis* is extremely vulnerable to extinction. Other known populations of *T. t. macrotis* are on private land and some are in highly developed areas, one occupying the E-470 right-of-way, and as such their continued viability is questionable. The population on Lowry occupies State Land Board Property and offers a good, if not the best, opportunity for conservation of *T. t. macrotis*. All of the ecological requirements of *T. t. macrotis* including a large enough area of suitable habitat with proper soils, drainage, soil moisture content, and forage availability are represented by the parts of the site within the Lowry Range. Viability of this population of *T. t. macrotis* could be maintained indefinitely through preservation of this area even if all property outside of Lowry were lost to development.

Exotic Species Comments: There are some small patches of sparsely scattered cheatgrass (*Anisantha tectorum*), but it is not threatening the integrity of the site. The area of the site where it crosses Boxelder Creek is dominated by leafy spurge (*Euphorbia esula*), as is true of the most riparian areas on the range, and removal of this invasive weed is required to restore the ecological integrity of the riparian areas.

Off-Site Considerations: The areas outside of the Lowry Range to the west and south are currently experiencing intense residential and commercial development and the area to the north is currently for sale with Aurora seeking to purchase, annex, and develop the site for residential occupancy. Areas outside of the Lowry

Range further to the north are under tilled agriculture and the area to the east is ranchland with sparsely scattered homesites.

Information Needs: Survey work to the east of Boxelder Creek outside of the Lowry Range is needed to identify the current distribution of *T. t. macrotis* in the area. New records of *T. t. macrotis* east of Boxelder Creek would require modification of the current site boundaries to include both those new populations and corridors connecting current populations on the Lowry Range to the new populations.

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Version Author: Sovell, J.R.

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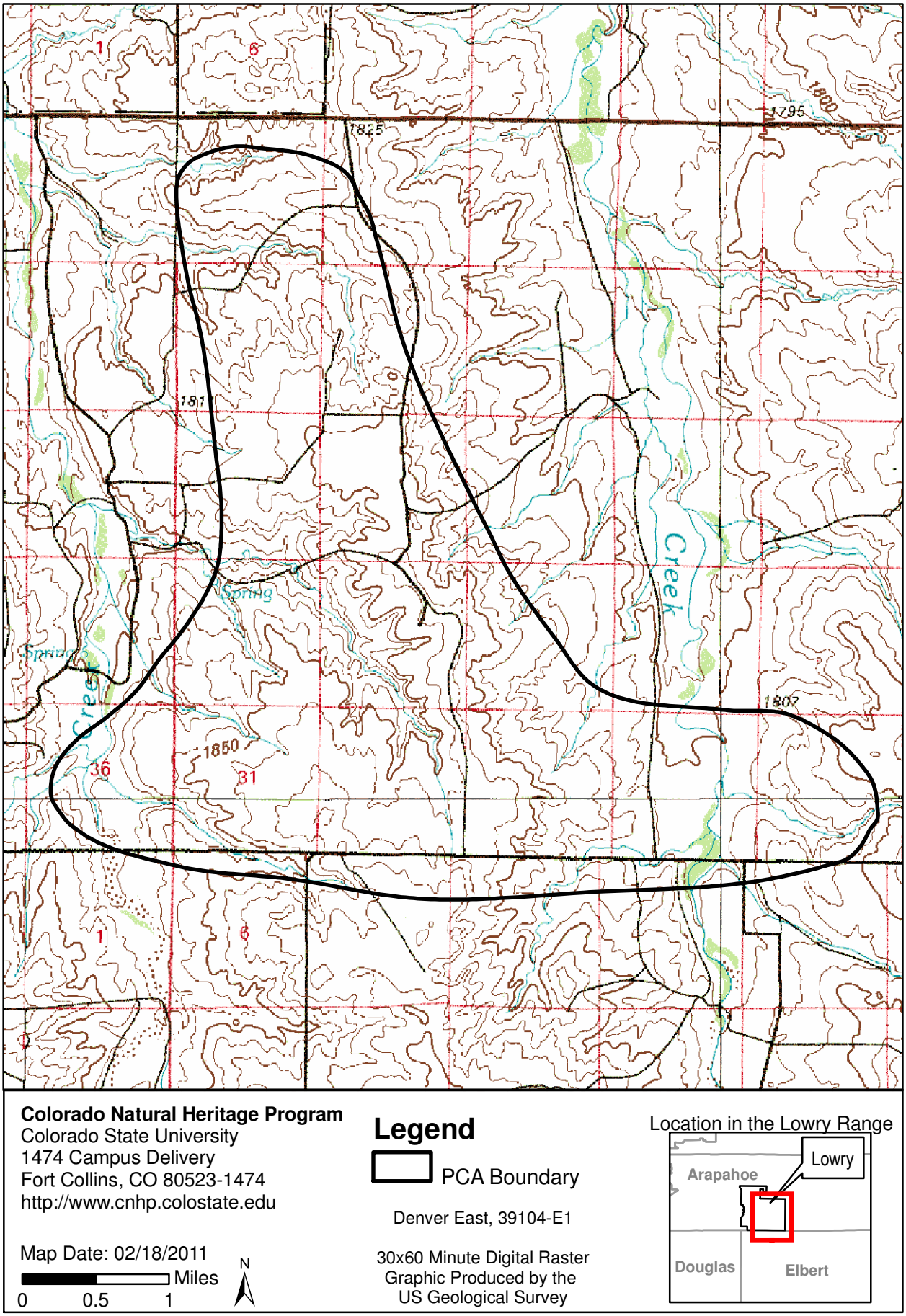

Figure 24. East Lowry Range Uplands Potential Conservation Area, B2: Very High Biodiversity Significance

Lowry Piedmont Grassland

Biodiversity Rank - B2: Very High Biodiversity Significance

Protection Urgency Rank - P2: Threat/Opportunity within 5 Years

Management Urgency Rank - M4: Not Needed Now; No Current Threats; May Need in Future

U.S.G.S. 7.5-minute quadrangles: Watkins SE, Watkins, Piney Creek

Size: 8,039 acres (3,253 ha) **Elevation:** 5,765 - 6,160 ft. (1,757 - 1,878 m)

General Description: The Piedmont grasslands of Lowry are comprised of rolling hills covered in a mosaic of shortgrass, mixed-grass, and tallgrass prairies. For the most part, soils are the driving factor for grassland type; however, grazing animals (e.g., prairie dogs and cattle) share a large role in the condition and type of grassland. This site is specifically drawn for the tallgrass prairie (a.k.a. foothills - piedmont grassland), one of the rarest and most imperiled grassland communities in Colorado. Very few large occurrences of this grassland remain in Colorado of which Lowry Range is one of them. The largest patch at Lowry Range is in the southern portion of Lowry and even within that area it is not a continuous patch but consists of numerous and closely spaced patches. The dominant tall grasses are big bluestem (*Andropogon gerardii*), prairie sandreed (*Calomofilva longifolia)*, and little bluestem (*Schizachryrium scoparium).* During good moisture years and rest from grazing, these grasses will flourish and reach tall heights, as tall as two feet in some places. The tallgrass prairie occupies both ridges and slopes and all aspects as well. Understory species may be diverse. Blue grama (*Bouteloua gracilis*) is the most dominant shortgrass, but other grasses include western wheat (*Agropyron smithii*), needle-and-thread (*Hesperostipa comata*), and purple three-awn (*Aristida purpurea*). Forbs include fringed sage (*Artemisia frigida*), sunflower (*Helianthus* sp.), buckwheat (*Eriogonum* spp.), and more. CNHP visited this site in August 2010, which is a great time for observing the tallgrass species but it is not an ideal time for observing butterflies and skippers (indicator species). Viable populations of Ottoe skipper (*Hesperia ottoe*), cross-lined skipper (*Polites origenes rhena*), Arogos skipper (*Atrytone arogos iowa),* dusted skipper (*Atrytonopsis hianna turneri*), and regal fritillary (*Speyeria idalia*) are indicators of a healthy and functioning foothills - piedmont grassland system. These skippers and butterflies generally require little bluestem or big bluestem as host plants and diverse forbs for adult plants. May - July is the ideal time for surveying for these species.

Key Environmental Factors: Geology, soil depth, moisture availability, drought, grazing, and fires play a critical role in determining the vegetation species composition. Fires kill woody species and rejuvenate herbaceous growth. Grazing or lack of grazing can easily alter the species composition. Big bluestem is a desirable grass and is sensitive to the amount of grazing (note that this species has evolved

with grazing animals), thus CNHP's 2005 study barely noticed this species due to the heavy grazing that was in practice. However the species must have been present as it was abundant in 2010.

Land Use History: Prior to settlement by European Americans, ungulates including bison (*Bison bison*) and pronghorn (*Antilocapra americana*) grazed the grasses of the range. Native Americans, including the Arapahoe, Comanche, Kiowa and Plains Apache hunted bison and other ungulates on Colorado's plains, while the Clovis culture and later Folsom man occupied the area approximately 10,000 years ago (Cushing 2004). Europeans had occupied areas in eastern Colorado since the early 1800s, but it wasn't until gold was discovered in 1858 along the banks of Cheery Creek that Europeans began settlement of the area that includes the Lowry Range in earnest. By 1863, livestock ranchers and farmers predominated in the area surrounding the Lowry Range. Overuse of grassland and soil resources, in conjunction with the drought of the 1930s, lead to economic depression in the area and abandonment of the ranches and farms. In 1938, in an attempt to stimulate the economy after acquiring the Lowry Range and surrounding property from numerous private owners, the City of Denver sold the land to the War Department, which established the Lowry Bombing and Gunnery Range (Cushing 2004). The Lowry Range was used for active bombing maneuvers during World War II, and again until 1958 during the Korean War, with an intermittent period between wars when the Range was leased as pasture for livestock grazing. In the 1960s, the federal government deeded part of the Lowry Range back to the City of Denver. Since then the major use of the range has been ranching, but the site still supports active military training, oil and gas wells, gravel mining, and other activities. Cattle grazing was eliminated for an undetermined amount of time in 2007.

Cultural Features: Numerous Native American and homesteader artifacts occur throughout the area.

Biodiversity Significance Rank Comments (B2): This site supports a good (B-ranked) occurrence of the state imperiled (GU/S2) *Andropogon gerardii / Calomofilva longifolia* tall grass prairie, a.k.a. foothills - piedmont grassland. Although globally unranked due to the fact that a full assessment has not yet occurred, this is most likely a globally imperiled (G2) community. Only a handful of occurrences are known in Colorado and Lowry supports the second largest occurrence. We recognize this as a B2 site due to the paucity of locations, the size of the Lowry occurrence, and the fact that there are no known "A" ranked occurrences. In addition, this community was probably much more widespread than it is today, making any known occurrence an important conservation area.

Natural Heritage element occurrences at the Lowry Piedmont Grassland PCA.

Major Group	State Scientific Name	State Common Name	Global Rank	State Rank	Federal Status	State Status	Fed Sens	EO Rank	Last Obs Date
Natural Communities	Andropogon gerardii - Calamovilfa longifolia Herbaceous Vegetation	Mesic Tallgrass Prairie	GU	S2				B	2010-08-11

** The records above are sorted in the following order 1) Major Group 2) Global Rank and 3) Scientific name.

Boundary Justification: The boundary is drawn to include the tallgrass prairie and additional connecting lands. The boundary was digitized while referencing a one meter 2009 digital color orthophoto quad, a 1:24,000 digital quad, soils maps, and inferences from on-the-ground assessment.

Protection Urgency Rank Comments (P2): The surface and mineral rights are entirely owned by the Colorado State Land Board and much of the area has been leased to companies for oil, gas, and water development, thus there is no formal protection that specifically excludes surface disturbance. However, the State Land Board and others consider this area an important conservation area and any active leases will be managed to minimize disturbance but to date (2011), no formal plans are in place to adequately protect the rare and imperiled piedmont grassland.

Management Urgency Rank Comments (M4): Management within this ecological zone should promote maintenance and improvement of grassland health, as well as health of the associated animal community. Urban development should be precluded from this ecological zone. However, development of recreational infrastructure such as park buildings and interpretive exhibits are appropriate for this area. Effort should be made to minimize surface disturbance of any such development. Strict leash regulations will be necessary to avoid predation of songbirds and their nests by domestic dogs. Areas around active raptor nests (e.g., Ferruginous Hawk, Swainson's Hawk, Red-tailed Hawk) should have no surface occupancy within ¼ mile (400 m) year round, and no surface occupancy within ½ mile (800 m) from February 1 through July 15 (Craig 1998). Past grazing practices within this zone changed composition of the grassland community and with the elimination of cattle grazing in 2007, the composition in 2010 changed again and big bluestem, prairie sandreed, and little bluestem were abundant. In 2010 The Range appeared lush and in good condition, especially compared to the 2005 (Sovell et al. 2006) and 2006 visits (Natural Resource Options 2006) when big bluestem and little bluestem were hardly mentioned. The tall grass prairie species should be indicators for future grazing plans as the presence and abundance of these species can help establish a healthy grazing regime. Development of water storage within this zone will destroy habitat for grassland animals, including prairie dogs and other terrestrial mammals, raptors, and songbirds. In general, composition of the

grasslands includes a matrix of native gasses with weedy patches spread throughout. Weedy patches are dominated by cheatgrass and scattered musk thistle, and salsify. Although these exotic species are sporadic and at low abundance, they should be carefully monitored so that if they begin to spread additional control can be implemented. Additionally, the desire to extract large quantities of non-renewable energy in the near future and the growth of greater Denver suburbs has the potential to increase the management concerns but as of February 2011, the current management is beneficial to the elements.

Land Use Comments: The land use within or adjacent to the site is mixed and includes gravel mining (just outside the site boundary), oil and gas wells, military training (mostly helicopter fly overs), and the potential for managed cattle or sheep grazing in the future although the cattle operation has not been in existence since 2007. The current use is limited to what leases the Colorado State Land Board maintains. The Range is held in trust for the State of Colorado by the Colorado State Board of Land Commissioners (SBLC) and is a property of the State's School Trust. School Trust lands are managed by the SBLC to generate revenue for the School Trust and typically are used by specific lessees, but are not available to the general public. Currently the SBLC leases The Range for oil and gas production, concrete and asphalt pavement recycling, mining (sand and gravel extraction), and recreation (model airplanes, gliders, hunting, and horseback riding). The remainder of The Range is predominantly undeveloped.

Exotic Species Comments: Non-native species are generally uncommon or less dominant than the natives, however they are present and include Kentucky bluegrass (*Poa pratensis*), cheatgrass (*Bromus tectorum*), and leafy spurge (*Euphorbia esula*), amongst others.

Off-Site Considerations: The landscape surrounding Lowry Range is mixed, with a subdivision adjacent to the southern-most portion, while the other directions are buffered by shortgrass prairie, mostly within the Lowry Range. The Denver suburbs are marching up to the boundaries of Lowry and will pose threats to the grassland system, most likely in the form of invasive species.

Information Needs: Future inventories for rare butterflies could prove fruitful since the host plants are available. Perform field work from May - July to search for skippers and butterflies.

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Version Author: Rondeau, R.J.

Version Date: 03/01/2011

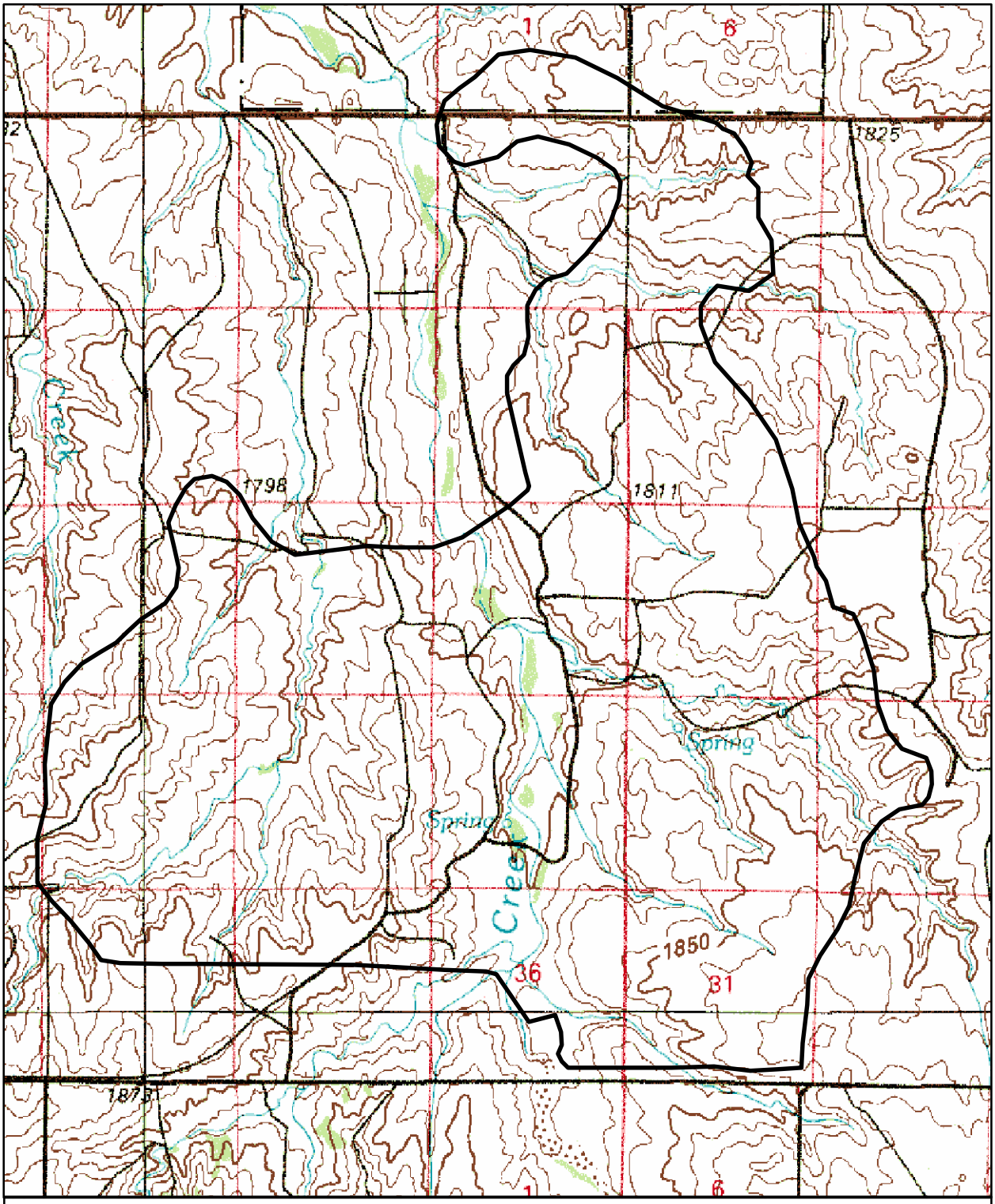
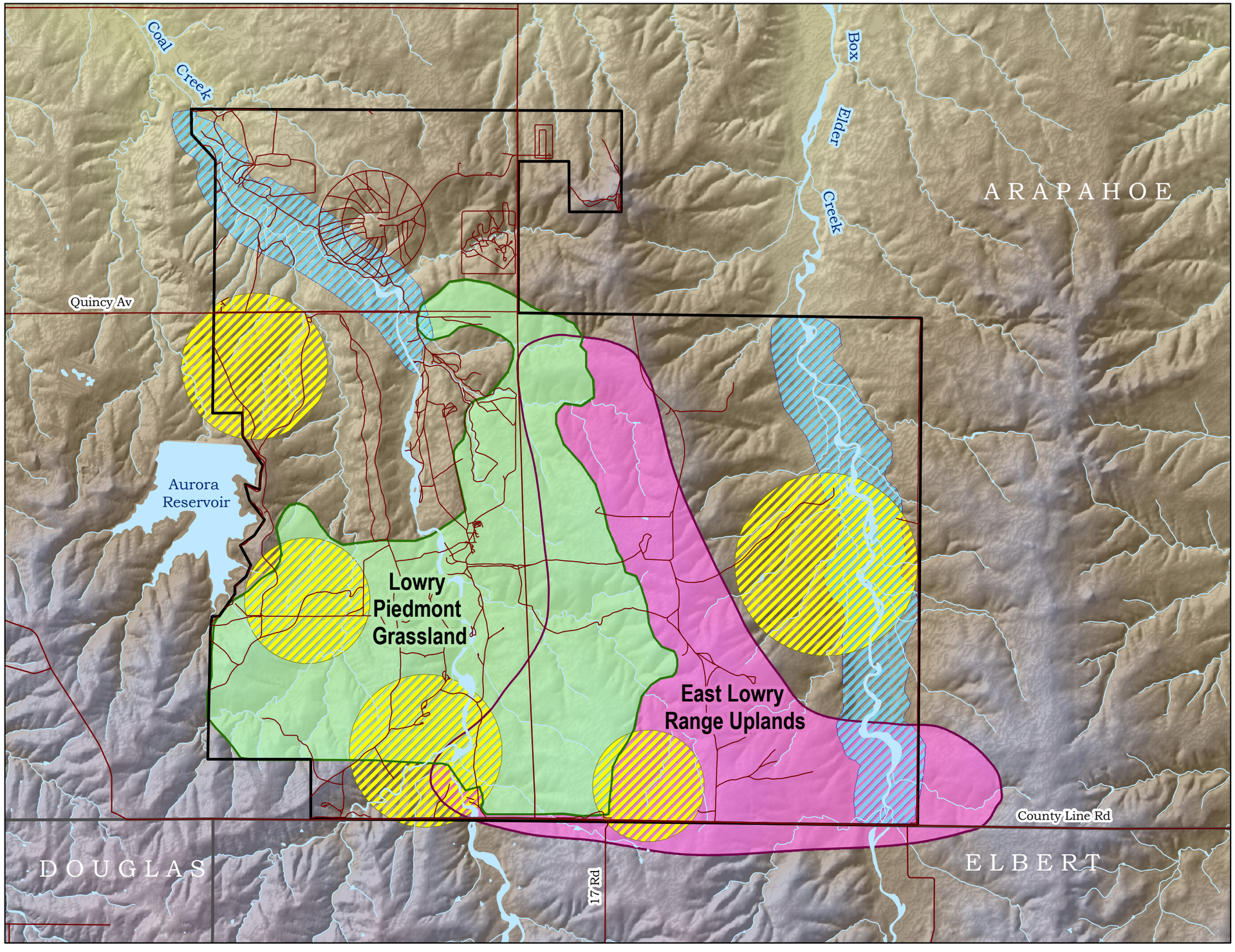


Figure 25. Lowry Piedmont Grassland Potential Conservation Area, B2: Very High Biodiversity Significance



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Map Date: 02/28/2011

Legend

CNHP Potential Conservation Areas (PCAs)
B2: Very High Biodiversity Significance

- East Lowry Range Uplands
- Lowry Piedmont Grassland

Sites of Local Significance

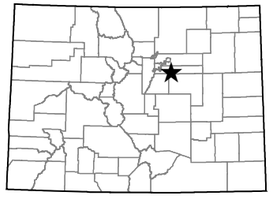
- Prairie Dog Zone
- Riparian Zone

Base Data

- Lowry Range
- Counties
- Major Roads
- Lowry Local Roads
- Rivers, Streams, Creeks
- Lakes, Reservoirs

10m Digital Elevation Model Produced by the USGS

Location in Colorado



PCAs represent CNHP's best estimate of the primary area supporting the long-term survival of targeted species, subspecies and natural communities.

0 0.5 1 Miles

N

Figure 26. CNHP Potential Conservation Areas and Sites of Local Significance.

Box Elder and Coal Creeks Riparian Sites of Local Significance

Boundaries of the Box Elder and Coal Creeks Riparian Sites of Local Significance include the Box Elder Creek and Coal Creek channels and the cottonwood riparian woodland lining the floodplains (Figure 24). The main concerns relative to health of the riparian sites are urban development, recreation, maintenance of an appropriate flooding regime and consequent regeneration of cottonwood, overgrazing, groundwater depletion, and the abundance of exotic species (e.g., smooth brome, cheatgrass, Kentucky bluegrass, leafy spurge, and Canada thistle).

A buffer of approximately 0.3 miles (0.5 km) upslope and on each side of the channel is included within the boundary of these sites. Conservation of lands within these buffers would help protect against direct disturbance such as excavation, urban development, construction of ball fields, or sand and gravel mining near the creek channel that could lead to sedimentation, disruption of groundwater flows, and disturbance to the riparian plant and animal community. Keate (2004) indicates a 0.2 to 0.4 mile (0.3 to 0.6 km) buffer as the distance where impacts to wetland associated wildlife may be minimal. Limiting recreational development within the boundary to discrete trailheads and trails, all situated 0.2 miles (0.3 km) or more from the creek channel, with occasional spur-trails and/or loops accessing the creek channel, should prevent excessive human disturbance to nesting riparian woodland birds.

Management within this zone should include maintaining the cottonwood trees. If grazing is resumed in the future, appropriate management will allow cottonwood regeneration and restoration of the herbaceous understory to occur. Herbaceous vegetation within plains riparian woodlands is variable, but graminoids typical of undisturbed sites include Emory's sedge (*Carex emoryi*), woolly sedge (*Carex pellita*), western wheatgrass, and prairie cordgrass (*Spartina pectinata*).

Periodic disturbance by flooding is necessary to maintain cottonwood woodlands. Cottonwoods are pioneering species that require newly deposited, wet, barren substrates exposed to full sunlight in order to regenerate (Hansen *et al.* 1995). Without such flooding, cottonwood woodlands tend toward stands of older decadent trees. Plains riparian woodlands with appropriate flooding but exposed to overgrazing may still tend towards old decadent stands of cottonwood, because intensive livestock grazing effectively removes all new cottonwood regrowth. Although there is some regeneration of cottonwoods within the floodplain of Box Elder and Coal Creeks, the woodland is dominated by stands of older decadent cottonwoods. Appropriate management of grazing in tandem with normal flooding would assist with cottonwood regeneration, creating a more healthy mix of cottonwood age classes within the floodplain. Once cottonwood saplings become established, the location of the water table becomes important to their survival. In general, maintaining a high water table throughout the growing season enhances survival. Consequently, any removal of groundwater within the ecological zone boundary for recharge of reservoirs or livestock ponds may compromise cottonwood regeneration.

Management is necessary to control and eliminate weeds within the Box Elder Creek and Coal Creek floodplains, which are dominated by exotic species as noted in the previous section of this report. An integrated weed management strategy should be implemented to control exotics. The use of many pesticides is restricted within riparian zones. If chemical controls are used, care should be taken to ensure that the method of application be designed to avoid adverse impacts to native species. Occasional spring burning may also be effective in controlling exotic species. Historically, fires were frequent in plains riparian woodlands and they helped maintain the characteristic open canopy of the woodland. Thus, periodic controlled burns may have the added benefit of maintaining community structure as well as controlling weeds. Finally, overgrazing can stimulate the invasion of exotics. Appropriate management to avoid overgrazing would assist with control of exotic species.

Prairie Dog Site of Local Significance

The boundary of the Prairie Dog Site of Local Significance includes the five largest prairie dog towns on The Range, with a minimal buffer to protect against direct disturbance to adjacent habitat (Figure 24). The main concerns relative to health of this ecological zone are urban development, recreation, overgrazing, and water storage development.

Urban development would degrade and destroy suitable prairie dog habitat, and inundation from water development projects (e.g., reservoirs) would result in the loss of prairie dog habitat. Emphasizing recreational use and trail development in this area is appropriate, but trails should not approach, or cross, existing towns. Leash regulations for dogs should be established and strictly enforced to prevent predation of prairie dogs by domestic dogs, which are known to kill prairie dogs.

CONCLUSIONS

The Range is an incredible landscape with a diverse community of animal and plant species, many of which are important because of their rarity. Well over 150 animal and plant species were documented from The Range during the 2005 and 2010 assessments; 14 of these are highlighted in this report because they are species of conservation concern.

A population of the rare *macrotis* subspecies of the northern pocket gopher occupies the middle portion of The Range's southern half. This population of gophers is a very high conservation priority and should be an important consideration in any future activities planned for The Range. Abundant populations of birds inhabit the grasslands, and the towns of a black-tailed prairie dog complex are scattered across the entire southern half of The Range, spilling over Quincy Avenue to occupy a small portion of The Range's northern area. Activities of the prairie dogs have attracted raptors such as the Ferruginous Hawk, as well as other species adapted to the disturbances prairie dogs exert on the landscape, such as Burrowing Owls. Maintaining the integrity of this abundant community of grassland animals will require protecting the native prairie at The Range from fragmentation and habitat loss related to urban, commercial, or energy development. Pronghorn currently occupy The Range, but their continued viability will require working with outside partners to maintain connectivity between The Range and areas of pronghorn concentration to the east. Riparian

communities within The Range support a native overstory and a non-native ground cover, and sustain a wealth of biological diversity including a diverse community of amphibians and riparian woodland birds, indicating the riparian hydrology is intact and functioning. Maintaining current levels of surface and groundwater flows will be difficult in the face of development occurring outside of The Range and future activities planned within it, but are important for maintaining the health of the riparian corridor and riparian dependent species. Development of the water storage potential of The Range will make this difficult, but not impossible.

Two management activities that could benefit the natural resources of The Range include development of an integrated weed management plan, with appropriate grazing as an important component to control weeds and enhance the native wildlife and plant communities of The Range. An effective weed management program would assist with recovering the native riparian plant community, which would benefit native animals and plants.

Grazing for conservation would also benefit health of the animal and plant communities on The Range. Many native animals and plants do not thrive under intense grazing and tend to become scarce, while others will thrive. Under intense grazing, the composition of grasslands and riparian areas tend to change over time, with the forage plants preferred by livestock being reduced or eliminated. This appears to have occurred on The Range. Currently, the piedmont grassland characteristic to parts of The Range is not being expressed to its full potential, probably because grazing by livestock have caused a decline in the grasses native to this ecological system. Reverting to a less intensive grazing regime could gradually increase the abundance of those species that have declined. Less intensive grazing with lower stocking rates may enable grasses characteristic of piedmont grasslands to recover in The Range. Composition of the herbaceous riparian plant communities on The Range have been extremely degraded through intense grazing, resulting in a change from native plant species to communities dominated by weeds. Restoring the riparian community is more difficult than the grasslands, but management of weeds and grazing, much like for the grassland, will help to recover native herbaceous riparian plants.

Sand and gravel mining destroys riparian vegetation when it occurs directly in the floodplain, and degrades riparian communities by intercepting the water table and disrupting runoff and ground water flow into stream channels. This, in turn, reduces the amount of water available to riparian vegetation, ultimately leading to decline and death of the vegetation. Restoration of stream channels degraded by mining is possible, but requires a lengthy period of time and is resource intensive.

Proper management combined with the appropriate placement of areas developed for commercial, residential, and conservation activities should allow for realization of both the economic and ecological potential of The Range. Information contained in this report will help to accomplish both conservation and economic development goals on The Range. Realization of either goal to the complete exclusion of the other would probably prove detrimental to the greater area, and can hopefully be avoided.

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APPENDIX A – List of Plant Species Documented on Lowry Range

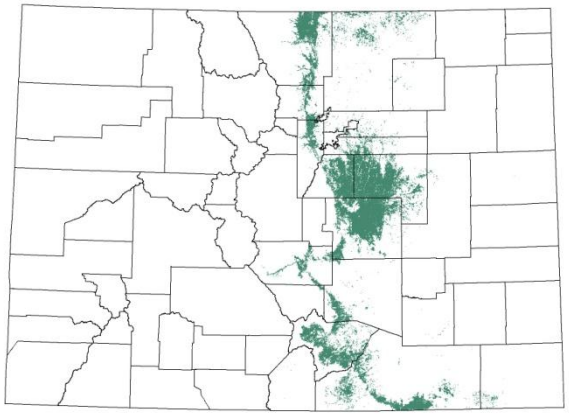
Family	Species	Common name	upland/ dry	riparian/ moist
Agavaceae	*Yucca glauca*	yucca	x	
Alismataceae	*Sagittaria* sp.	arrowhead		x
Alliaceae	*Allium* sp.	onion	x	
Alsinaceae	*Eremogone hookeri*	desert sandwort	x	
Anacardiaceae	*Rhus trilobata*	three-leaf sumac	x	
Anacardiaceae	*Toxicodendron rydbergii*	poison oak	x	
Apiaceae	*Berula erecta*	water parsnip		x
Apiaceae	*Musineon divaricatum*	musineon	x	
Apocynaceae	*Apocynum* sp.	dogbane	x	
Asclepidaceae	*Asclepias speciosa*	milkweed	x	
Asteraceae	*Achillea lanulosa*	yarrow	x	
Asteraceae	*Ambrosia psilostachya*	ragweed	x	
Asteraceae	*Artemisia frigida*	fringed sage	x	
Asteraceae	*Artemisia ludoviciana*	white sage	x	
Asteraceae	*Chrysothamnus nauseosus*	rabbitbrush	x	
Asteraceae	*Cirsium undulatum*	wavy leaf thistle	x	
Asteraceae	*Erigeron pumilus*	low daisy	x	
Asteraceae	*Erigeron vetensis*	fleabane	x	
Asteraceae	*Grindelia squarrosa*	gumweed	x	
Asteraceae	*Gutierrezia sarothrae*	snakeweed	x	
Asteraceae	*Helianthus petiolaris*	prairie sunflower	x	
Asteraceae	*Heterotheca villosa*	hairy golden aster	x	
Asteraceae	*Hymenopapus filifolius*	cream tips	x	
Asteraceae	*Machaeranthera canescens*	tansy aster	x	
Asteraceae	*Nothocalais cuspidata*	false dandelion	x	
Asteraceae	*Packera/Senecio* sp.	groundsel	x	
Asteraceae	*Ratibida columnifera*	coneflower	x	
Asteraceae	*Tetraneuris acaulis*	perky sue	x	
Boraginaceae	*Lithospermum incisum*	puccoon	x	
Boraginaceae	*Mertensia* sp.	bluebells	x	
Boraginaceae	*Onosmodium molle*	marbleseed	x	
Brassicaceae	*Lepidium densiflorum*	peppergrass	x	
Brassicaceae	*Rorippa sinuata*	spreading yellowcress		x
Cactaceae	*Echinocereus viridiflorus*	hen and chickens	x	
Cactaceae	*Opuntia polyacanthus*	prickly pear	x	
Cactaceae	*Opuntia* sp.	prickly pear	x	
Cactaceae	*Pediocactus simpsonii*	ball cactus	x	
Caprifoliaceae	*Symphoricarpos* sp.	snowberry		x
Chenopodiaceae	*Suaeda* sp.	sea-blite		x
Commelinaceae	*Tradescantia occidentalis*	spiderwort	x	
Cyperaceae	*Carex nebrascensis*	Nebraska sedge		x
Cyperaceae	*Carex praegracilis*	clustered field sedge		x
Cyperaceae	*Carex simulata*	analogue sedge		x
Cyperaceae	*Carex stenophylla* ssp. *eleocharis*	needleleaf sedge	x	
Cyperaceae	*Eleocharis acicularis*	spikerush		x
Cyperaceae	*Eleocharis palustris*	spikerush		x
Cyperaceae	*Schoenoplectus acutus*	bulrush		x
Cyperaceae	*Schoenoplectus pungens*	threesquare bulrush		x
Equisitaceae	*Hippochaete laevigata*	horsetail		x
Fabaceae	*Astragalus bisulcatus*	two-grooved milkvetch	x	
Fabaceae	*Astragalus* sp.	milkvetch	x	

Family	Species	Common name	upland/ dry	riparian/ moist
Fabaceae	*Dalea candida*	prairie clover	x	
Fabaceae	*Glycyrrhiza lepidota*	wild licorice		x
Fabaceae	*Lupinus* sp.	lupine	x	
Fabaceae	*Psoralidium lanceolatum*	scurfpea	x	
Fabaceae	*Psoralidium tenuiflorum*	scurfpea	x	
Fabaceae	*Vicia americana*	vetch	x	
Grossulariaceae	*Ribes aureum*	golden currant		x
Juncaceae	*Juncus balticus*	Baltic rush		x
Lemnaceae	*Lemna minor*	duckweed		x
Loasaceae	*Nuttallia* sp.	evening star	x	
Malvaceae	*Sidalcea neomexicana*	checkermallow		x
Malvaceae	*Spharalcea coccinea*	scarlet globemallow	x	
Marsileceae (a fern)	*Marsilea mucronata*	hairy pepperwort		x
Nyctaginaceae	*Abronia fragrans*	prairie snowball	x	
Onagraceae	*Gaura coccinea*	scarlet gaura	x	
Onagraceae	*Gaura mollis*	gaura	x	
Orobanchaceae	*Orobanche ludoviciana*	broom-rape	x	
Papaveraceae	*Argemone* sp.	prickly poppy	x	
Plantaginaceae	*Plantago patagonica*	wooly plantain	x	
Poaceae	*Achnatherum (Oryzopsis) hymenoides*	Indian ricegrass	x	
Poaceae	*Alopecurus aequalis*	shortawn foxtail		x
Poaceae	*Aristida purpurea*	threeawn	x	
Poaceae	*Beckmannia syzigachne*	sloughgrass		x
Poaceae	*Bouteloua curtipendula*	sideoats grama	x	
Poaceae	*Buchloe dactyloides*	buffalograss	x	
Poaceae	*Chondrosum gracile (Bouteloua gracilis)*	blue grama	x	
Poaceae	*Dactylis glomerata*	orchardgrass		x
Poaceae	*Distichlis spicata*	saltgrass		x
Poaceae	*Elymus elymoides*	squirreltail	x	
Poaceae	*Glyceria grandis*	American mannagrass		x
Poaceae	*Hesperostipa comata*	needle-and-thread	x	
Poaceae	*Hordeum brachyantherum*	meadow barley		x
Poaceae	*Hordeum jubatum*	foxtail barley	x	
Poaceae	*Koeleria macrantha*	junegrass	x	
Poaceae	*Pascopyrum smithii*	western wheatgrass	x	
Poaceae	*Schedonnardus paniculatus*	tumblegrass	x	
Poaceae	*Vulpia octoflora*	sixweeks fescue	x	
Polemoniaceae	*Aliciella pinnatifida*	sticky gilia	x	
Polygonaceae	*Eriogonum* sp.	wild buckwheat	x	
Ranunculaceae	*Ranunculus* sp. (tall)	buttercup		x
Rosaceae	*Rosa woodsii*	Wood's rose	x	
Salicaceae	*Populus deltoids*	plains cottonwood		x
Salicaceae	*Salix amygdaloides*	peachleaf willow		x
Salicaceae	*Salix exigua*	coyote willow		x
Santaleaceae	*Comandra umbellata*	bastard toadflax	x	
Scrophulariaceae	*Castilleja* sp.	Indian paintbrush	x	
Scrophulariaceae	*Mimulus* sp.	monkeyflower		x
Scrophulariaceae	*Penstemon albidus*	penstemon	x	
Scrophulariaceae	*Penstemon* sp.	penstemon	x	
Scrophulariaceae	*Veronica*	veronica		x
Sparganiaceae	*Sparganium eurycarpum*	burreed		x
Typhaceae	*Typha latifolia*	cattail		x
Urticaceae	*Urtica gracilis*	stinging nettle		x
Valerianaceae	*Valeriana* sp.	valerian	x	

Family	Species	Common name	upland/ dry	riparian/ moist
Non-native species				
Asteraceae	*Acosta difusa*	diffuse knapweed	x	
Asteraceae	*Breea arvensis*	Canada thistle		x
Asteraceae	*Carduus nutans*	musk thistle	x	
Asteraceae	*Lactuca seriola*	prickly lettuc	x	
Asteraceae	*Taraxacum officinale*	dandelion	x	
Asteraceae	*Tragopogon dubius*	salsify	x	
Brassicaceae	*Alyssum alysoides*	alyssum	x	
Brassicaceae	*Lepidium* sp.	peppergrass	x	
Brassicaceae	*Sisymbrium altissimum*	Jim Hill mustard	x	
Brassicaceae	*Thlapsi arvense*	pennycress	x	
Chenopodiaceae	*Bassia sieversiana*	kochia	x	
Elaeagnaceae	*Elaeagnus angustifolia*	Russian olive		x
Euphorbiaceae	*Euphorbia esula*	leafy spurge		x
Fabaceae	*Medicago lupulina*	black medic	x	
Fabaceae	*Medicago sativa*	alfalfa	x	
Fabaceae	*Melilotus officinale*	sweetclover	x	
Fabaceae	*Trifolium pretense*	clover		x
Fabaceae	*Trifolium repens*	clover		x
Fabaceae	*Vicia villosa*	vetch	x	
Geraniaceae	*Erodium cicutarium*	filaree	x	
Poaceae	*Agropyron cristatum*	crested wheatgrass	x	
Poaceae	*Agrostis* sp.	redtop	x	
Poaceae	*Alopecurus pratensis*	meadow foxtail		x
Poaceae	*Anisantha tectorum*	cheatgrass	x	
Poaceae	*Bromopsis inermis*	smooth brome	x	
Poaceae	*Phleum pratense*	timothy		x
Poaceae	*Poa pratensis*	Kentucky bluegrass		x
Poaceae	*Polypogon monospeliensis*	rabbitfoot grass		x
Polygonaceae	*Rumex crispus*	curly dock		x
Scrophulariaceae	*Verbascum thapsus*	mullein	x	
Verbenaceae	*Verbena bracteata*	verbena	x	

APPENDIX B – Ecological Systems Descriptions

Western Great Plains Foothill and Piedmont Grassland



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ANDROPOGON GERARDII - (SORGHASTRUM NUTANS) HERBACEOUS ALLIANCE
- *Andropogon gerardii - Schizachyrium scoparium* Western Great Plains Herbaceous Vegetation
- *Andropogon gerardii - Sorghastrum nutans* Western Great Plains Herbaceous Vegetation
- *Andropogon gerardii - Sporobolus heterolepis* Western Foothills Herbaceous Vegetation

BOUTELOUA GRACILIS HERBACEOUS ALLIANCE
- *Bouteloua gracilis - Bouteloua curtipendula* Herbaceous Vegetation
- *Bouteloua gracilis - Bouteloua hirsuta* Herbaceous Vegetation
- *Bouteloua gracilis - Buchloe dactyloides* Herbaceous Vegetation
- *Bouteloua gracilis* Herbaceous Vegetation

BOUTELOUA HIRSUTA HERBACEOUS ALLIANCE
- *Bouteloua hirsuta - Bouteloua curtipendula* Herbaceous Vegetation
- *Bouteloua hirsuta - Hesperostipa neomexicana* Herbaceous Vegetation

HESPEROSTIPA COMATA - BOUTELOUA GRACILIS HERBACEOUS ALLIANCE
- *Hesperostipa comata* Colorado Front Range Herbaceous Vegetation

HESPEROSTIPA COMATA BUNCH HERBACEOUS ALLIANCE
- *Hesperostipa comata - Achnatherum hymenoides* Herbaceous Vegetation

HESPEROSTIPA NEOMEXICANA HERBACEOUS ALLIANCE
- *Hesperostipa neomexicana* Herbaceous Vegetation

NASSELLA VIRIDULA HERBACEOUS ALLIANCE
- *Nassella viridula* Herbaceous Vegetation

POLIOMINTHA INCANA SHRUBLAND ALLIANCE
- *Poliomintha incana / Bouteloua gracilis* Shrubland

PSEUDOROEGNERIA SPICATA HERBACEOUS ALLIANCE
- *Pseudoroegneria spicata - Hesperostipa comata* Herbaceous Vegetation
- *Pseudoroegneria spicata - Pascopyrum smithii* Herbaceous Vegetation
- *Pseudoroegneria spicata - Poa secunda* Herbaceous Vegetation
- *Pseudoroegneria spicata* Herbaceous Vegetation

SCHIZACHYRIUM SCOPARIUM - BOUTELOUA CURTIPENDULA HERBACEOUS ALLIANCE
- *Schizachyrium scoparium - Bouteloua curtipendula* Western Great Plains Herbaceous Vegetation

SCHIZACHYRIUM SCOPARIUM BUNCH HERBACEOUS ALLIANCE
- *Schizachyrium scoparium - Muhlenbergia cuspidata* Herbaceous Vegetation

YUCCA GLAUCA SHRUB HERBACEOUS ALLIANCE
- *Yucca glauca / Pseudoroegneria spicata* Shrub Herbaceous Vegetation

Overview: This large patch system typically occurs between 5200-7200 feet (1600-2200 m) in elevation. It is best characterized as a mixed-grass to tallgrass prairie on mostly moderate to gentle slopes, usually at the base of foothill slopes such as the hogbacks of the Rocky Mountain Front Range, where it typically occurs as a relatively narrow elevation band between montane woodlands and shrublands and the shortgrass steppe. The system also extends east on the Front Range piedmont alongside the Chalk Bluffs at the Colorado-Wyoming border, out into the Great Plains on the Palmer Divide, and

on piedmont slopes below mesas and foothills in northeastern New Mexico.

Characteristic species: Usually occurrences of this system have multiple plant associations that may be dominated by *Andropogon gerardii, Schizachyrium scoparium, Muhlenbergia montana, Nassella viridula, Pascopyrum smithii, Sporobolus cryptandrus, Bouteloua gracilis, Hesperostipa comata*, or *Hesperostipa neomexicana*. In Wyoming, typical grasses found in this system include *Pseudoroegneria spicata, Festuca idahoensis, Hesperostipa comata*, and species of *Poa*. Typical adjacent ecological systems include foothill shrublands, ponderosa pine savannas, juniper savannas, as well as shortgrass prairie.

Viable populations of Ottoe skipper (*Hesperia ottoe*), Cross-line skipper (*Polites origenes rhena*), Arogos skipper (*Atrytone arogos iowa*), Dusted skipper (*Atrytonopsis hianna turneri*), and Regal fritillary (*Speyeria idalia*) are indicators of a healthy and functioning foothills grasslands system.

Environment: A combination of increased precipitation from orographic rain, temperature, and soils limits this system to the lower elevation zone with approximately 16 inches (40 cm) of precipitation/year. It is maintained by frequent fire and associated with well-drained clay soils.

Dynamics: This system is one of the most severely altered systems in the Southern Rocky Mountains ecoregion. Alteration is due to fire suppression, housing and water developments, conversion to hay meadows, overgrazing, etc. Fire suppression has allowed for shrub and tree invasion into the grassland and alters the species composition as well (Mast *et al.* 1997, Mast *et al.* 1998). Housing and water developments severely fragment and usually destroy the habitat, while agricultural use has converted tall grass prairies into hay meadows dominated by exotic grasses, e.g., smooth brome (*Bromopsis inermis*). It is very unusual to find excellent occurrences of this system. Threats are very high for this system and therefore, a premium is set on protecting the existing occurrences.

photo by R. Rondeau

Variation: The tallgrass of the foothills and piedmont is disjunct from the Great Plains tallgrass prairie with large expanses of mid-grass and shortgrass prairies in between.

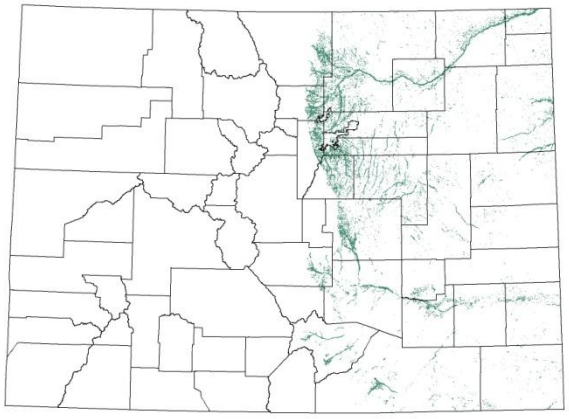
References:

Mast, J. N., T. T. Veblen, and M. E. Hodgson. 1997. Tree invasion within a pine/grassland ecotone: an approach with historic aerial photography and GIS modeling. Forest Ecology and Management 93:181-94.

Mast, J. N., T. T. Veblen, and Y. B. Linhart. 1998. Disturbance and climatic influences on age structure of ponderosa pine at the pine/grassland ecotone, Colorado Front Range. Journal of Biogeography 25:743-755.

Rank:	A	B	C	D
① CONDITION				
Community structure	If trees are present, these are widely scattered and mature. Species richness is often high, and native bunch grasses or sedges (non-increasers) are dominant.	If trees are present, these are widely scattered and mature. Species richness is often high, and native grasses (non-increasers) are dominant.	Trees and shrubs may have seedlings, juveniles, or saplings present. Alteration is extensive but potentially restorable over several decades.	Native grassland species < 10% cover and 20% relative cover. Alteration of vegetation is extensive and restoration potential is low.
Invasive exotics with major potential to alter structure and composition (e.g., non-native thistle, *Euphorbia esula, Bromus tectorum)*	Absent	May be present, but in low abundance	May be prominent but still controllable	
Other non-native spp.	<5%, native species dominant	<10%, native species dominant	>10%	Dominant
Native increaser spp. *(*e.g., *Koelaria macrantha, Guitierizzia sarothrae, and Artemisia frigida)*	< 3%	<10%	Dominant to co-dominant with native species	
Disturbance	Fragmentation from roads and developments are less than 1% of the occurrence.	Fragmentation from roads and developments are less than 5% of the occurrence.	Fragmentation, vehicle use or livestock grazing disturbance, if present, is extensive and significant enough to have notable impact on species composition and soil compaction.	Vehicle use or livestock grazing disturbance, if present, is extensive and significant enough to have notable impact on species composition and soil compaction. System remains fundamentally compromised despite restoration of some processes. Soil compaction and disturbance are extensive throughout the occurrence.
② LANDSCAPE CONTEXT				
Connectivity	Connectivity of adjacent systems allows natural ecological processes (e.g., fire and species migrations) to occur. No unnatural barriers present.	Adjacent systems surrounding occurrence retain much connectivity. Few non-natural barriers present.	Adjacent systems surrounding occurrence are fragmented by alteration with limited connectivity.	Connectivity is severely hampered.
Surrounding land	At least 90% native and unaltered landscape with very little to no urban development or agriculture.	Surrounding landscape composed of at least 75% natural or semi-natural vegetation, with little urban development within or adjacent to the occurrence.	Surrounding landscape is a mosaic of agricultural or semi-developed areas with >50% natural or semi-natural vegetation. Some non-natural barriers are present. Significant disturbance, but easily restorable.	Major human-caused alteration of surrounding landscape. Adjacent systems surrounding occurrence are mostly converted to agricultural or urban uses.
③ SIZE				
Acres (hectares)	>5,000 acres (>2000 ha) Large enough to support A-ranked occurrences of disjunct butterflies and skippers, grassland birds as well as a mosaic of plant associations.	2,000-5,000 (800-2000 ha)	1,000-2,000 (400-800 ha)	< 1,000 (<400 ha)

Western Great Plains Riparian Woodland, Shrubland and Herbaceous



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ARTEMISIA CANA TEMPORARILY FLOODED SHRUBLAND ALLIANCE
Artemisia cana / Pascopyrum smithii Shrubland
COBBLE/GRAVEL SHORE SPARSELY VEGETATED ALLIANCE
Riverine Gravel Flats Great Plains Sparse Vegetation
POPULUS DELTOIDES TEMPORARILY FLOODED WOODLAND ALLIANCE
Populus deltoides - (Salix amygdaloides) / Salix (exigua, interior) Woodland
Populus deltoides - (Salix nigra) / Spartina pectinata - Carex spp. Woodland
Populus deltoides / Carex pellita Woodland
Populus deltoides / Muhlenbergia asperifolia Forest
Populus deltoides / Panicum virgatum - Schizachyrium scoparium Woodland
Populus deltoides / Sporobolus airoides Woodland
Populus deltoides / Sporobolus cryptandrus Woodland
Populus deltoides / Symphoricarpos occidentalis Woodland
SYMPHORICARPOS OCCIDENTALIS TEMPORARILY FLOODED SHRUBLAND ALLIANCE
Symphoricarpos occidentalis Shrubland
SALIX (EXIGUA, INTERIOR) TEMPORARILY FLOODED SHRUBLAND ALLIANCE
Salix exigua / Mesic Graminoids Shrubland
Salix exigua / Barren Shrubland
ANDROPOGON GERARDII - (SORGHASTRUM NUTANS) HERBACEOUS ALLIANCE
Andropogon gerardii - Sorghastrum nutans Western Great Plains Herbaceous Vegetation
CAREX NEBRASCENSIS SEASONALLY FLOODED HERBACEOUS ALLIANCE
Carex nebrascensis Herbaceous Vegetation
CAREX PELLITA SEASONALLY FLOODED HERBACEOUS ALLIANCE
Carex pellita Herbaceous Vegetation
ELEOCHARIS PALUSTRIS SEASONALLY FLOODED HERBACEOUS ALLIANCE
Eleocharis palustris Herbaceous Vegetation
MUHLENBERGIA ASPERIFOLIA INTERMITTENTLY FLOODED HERBACEOUS ALLIANCE
Muhlenbergia asperifolia Herbaceous Vegetation
SCHOENOPLECTUS ACUTUS - (SCHOENOPLECTUS TABERNAEMONTANI) SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE
Scirpus acutus - Scirpus tabernaemontani Herbaceous Vegetation
SCHOENOPLECTUS PUNGENS SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE
Schoenoplectus pungens Herbaceous Vegetation
SPARTINA PECTINATA TEMPORARILY FLOODED HERBACEOUS ALLIANCE
Spartina pectinata Western Herbaceous Vegetation
SPOROBOLUS AIROIDES HERBACEOUS ALLIANCE
Sporobolus airoides Southern Plains Herbaceous Vegetation
TYPHA (ANGUSTIFOLIA, LATIFOLIA) - (SCHOENOPLECTUS SPP.) SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE
Typha (latifolia, angustifolia) Western Herbaceous Vegetation

Overview: This system is found in the riparian areas of medium and small rivers and streams throughout the Western Great Plains. It is likely most common in the Central Shortgrass Prairie and Northern Great Plains Steppe, but extends west into the Wyoming Basins. Dominant vegetation overlaps broadly with portions of large river floodplain systems, but the overall abundance of vegetation is generally lower. Vegetation may be a mosaic of communities that are not always tree or shrub dominated. Communities within this system range from riparian forests and shrublands to tallgrass wet meadows and gravel/sand flats.

Characteristic Dominant species include *Populus deltoides*, *Salix* spp., *Artemisia cana* ssp. *cana*,

species: *Pascopyrum smithii, Sporobolus cryptandrus*, *Schizachyrium scoparium, Andropogon gerardii,* and *Sorghastrum nutans*. Plant associations of the North American Arid West Emergent Marsh ecological system may occur along or adjacent to portions of this system.

Native amphibians and reptiles (e.g., leopard frogs, spadefoot toads, ornate box turtles), and native prairie fishes are indicators of a healthy riparian shrubland and woodland system.

Environment: This system is composed of associations found on alluvial soils in highly variable landscape settings, from deep cut ravines to wide, braided streambeds. Hydrologically, the associated rivers tend to be flashier with less developed floodplain than on larger rivers, and typically dry down completely for some portion of the year.

Dynamics: These areas are often subjected to heavy grazing and/or agriculture and can be heavily degraded. *Tamarix* spp. and less desirable grasses and forbs can invade degraded examples up through central Colorado. Furthermore, groundwater depletion and lack of fire have created additional species changes.

Variation:

Rank:	A	B	C	D
① CONDITION				
Natural hydrologic regime	Intact, including an unaltered floodplain. No or little evidence of alteration due to drainage, flood control, irrigation canals, livestock grazing, digging, burning, vehicle use, etc.	Intact or slightly altered by local drainage, flood control, irrigation canals, livestock grazing, digging, vehicle use, roads, etc. Alteration is easily restorable by ceasing such activities.	Natural hydrologic regime altered by upstream dams, local drainage, diking, filling, digging, or dredging. Alteration is extensive but potentially restorable over several decades.	Not restorable. System remains fundamentally compromised despite restoration of some processes.
Community Structure	Community is composed primarily of native species and has a diverse physiognomic structure.	Although species composition is primarily of native species, the physiognomic structure is less diverse than in A-ranked occurrences.	Noticeably altered by disturbance.	
Non-native species (e.g., *Tamarix ramosissima, Elaeagnus angustifolia*)	If non-native species are present they are less than 3% canopy cover; and have little potential for expansion.	There are few exotic species, and low potential for their expansion if restoration occurs.	May be widespread but potentially manageable with restoration of most natural processes.	May be dominant over significant portions of area, with little potential for control.
Disturbance excessive grazing or other human caused actions e.g., channeling, road construction, vehicle use, etc.	Stream banks are not overly steepened and have not been stripped of vegetation.	Stream banks may show some local deleterious effects.	Stream banks may be severely altered. Disturbance is extensive and significant enough to have notable impact on species composition and soil compaction, causing excessive erosion.	
② LANDSCAPE CONTEXT				
Area hydrology	No evidence of human-caused alteration of hydrology, especially upstream of occurrence and within the watershed. Groundwater pumping is not pervasive in the area, or has not had a detectable impact on hydrologic patterns. Water quality is excellent and supports expected aquatic invertebrates.	Little evidence of human-caused alteration of hydrology, especially upstream of occurrence and within the watershed. Groundwater pumping may be contributing to changes in water availability.	Local or moderate human-caused alteration of hydrology may be present, for example small dams, irrigation ditches, and gravel mines. Groundwater pumping has produced noticeable changes from historic hydrologic patterns.	Major human-caused alteration of hydrology. Large dams and numerous diversions are within watershed. Gravel mining may be extensive.
Surrounding land	Uplands surrounding occurrence and within the watershed are largely unaltered by urban or agricultural uses (>90% natural), and distance to nearest cropped, mowed, or developed land is greater than 1 mile (1.6 km).	Uplands surrounding occurrence and within the watershed are largely unaltered by urban or agricultural uses (60 to 90% natural), but retaining much connectivity, or uplands are not intensively cropped with center-pivot irrigation, dryland farming, or numerous roads.	Uplands surrounding occurrence or upstream watershed are fragmented by urban or agricultural alteration (20 to 60% natural)	Uplands surrounding occurrence mostly converted to agricultural or urban uses. Riparian occurrence may be reduced to narrow strip with much edge effect.
Connectivity & natural processes	Connectivity to habitats allows natural processes and species migration to occur. No unnatural barriers present.		Limited connectivity. Some barriers are present, and natural processes few.	Connectivity and natural processes are nonexistent.
③ SIZE				
Linear miles (km)	>1.5 mile (>2.5 km)	1-1.5 mile (1.5-2.5 km)	0.5-1 mile (0.8-1.5 km)	< 0.5 mile (<0.8 km)