

**Biological Survey of
the Upper Purgatoire Watershed
Las Animas County, CO**



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Table of Contents

TABLE OF CONTENTS.....	ii
FIGURES.....	iv
TABLES.....	v
EXECUTIVE SUMMARY.....	1
INTRODUCTION.....	2
Overview of the Study Area.....	2
Climate.....	2
Geomorphology.....	2
Soils.....	3
Vegetation.....	3
THE NATURAL HERITAGE NETWORK.....	5
COLORADO’S NATURAL HERITAGE PROGRAM.....	6
THE NATURAL HERITAGE RANKING SYSTEM.....	7
Protection Urgency Ranks.....	9
Management Urgency Ranks.....	9
Element Occurrence Ranking.....	10
POTENTIAL CONSERVATION SITE PLANNING BOUNDARIES.....	12
Off-Site Considerations.....	12
Ranking of Potential Conservation Sites.....	13
METHODS.....	14
Information collection.....	14
Designate Target Inventory Areas (TIAs).....	14
Landowner Contact.....	15
Field Surveys.....	15
Assign Potential Conservation Site Boundaries.....	16
RESULTS.....	17
Upper Purgatoire River Watershed Conservation Site Profiles.....	17
Bar NI Ranch.....	20
Vermejo Park.....	23
Potato Patch.....	26
Chavez Ranch.....	29
Guajatoyah Creek Slopes.....	32
The Island.....	35
Tercio Ranch.....	38

Widow Woman	41
Plant Alliances	44
<i>Populus tremuloides</i> Alliance	45
<i>Danthonia parryi</i> Alliance	47
<i>Pinus edulis</i> Alliance	48
<i>Pinus ponderosa</i> Alliance	50
<i>Pseudotsuga menziesii</i> Alliance	52
<i>Quercus gambelii</i> Alliance	54
<i>Populus angustifolia</i> Alliance	56
CONCLUSION	58
LITERATURE CITED	59

Figures

Figure 1. Upper Purgatoire River watershed and target inventory areas surveyed during 1997 field season. From USGS 1:100,000 scale topographic map (1982).	Error! Bookmark not defined.
Figure 2. Upper Purgatoire River watershed potential conservation sites. From USGS 1:100,000 scale topographic map (1982).	Error! Bookmark not defined.
Figure 3. Bar NI Ranch conservation site boundary Las Animas County, CO. From USGS 1:100,000 scale topographic map (1982).	22
Figure 4. Vermejo Park conservation site boundary Las Animas County, CO. From USGS 1:24,000 topographic map, 7.5 minute series (1971).	25
Figure 5. Potato Patch conservation site boundary Las Animas County, Colorado. From USGS 1:24,000 topographic map, 7.5 minute series (1971).	28
Figure 6. Chavez Ranch conservation site boundary Las Animas County, Colorado. From USGS 1:24,000 topographic map, 7.5 minute series (1971).	31
Figure 7. Guajatoyah Creek Slopes conservation site boundary Las Animas County, Colorado. From USGS 1: 24,000 topographic map, 7.5 minute series (1971).	34
Figure 8. The Island conservation site boundary Las Animas County, Colorado. From USGS 1:24,000 topographic map, 7.5 minute series (1971).	37
Figure 9. Tercio Ranch conservation site boundary Las Animas County, Colorado. From USGS 1:24,000 topographic map, 7.5 minute series (1971).	40
Figure 10. Widow Woman conservation site boundary Las Animas County, Colorado. From USGS 1:24,000 topographic map, 7.5 minute series (1971).	43

Tables

Table 1. Definition of Colorado Natural Heritage Rarity Ranks	8
Table 2. Sites of Biodiversity Significance in the Upper Purgatoire River Watershed, arranged by biodiversity rank.	17
Table 3. Natural Heritage elements located on Bar NI Ranch.....	21
Table 4. Natural Heritage elements at Vermejo Park site.....	23
Table 5. Natural Heritage elements at Potato Patch site.....	27
Table 6. Natural Heritage element on Chavez Ranch.....	30
Table 7. Natural Heritage elements within Guajatoyah Creek slopes.	33
Table 8. Natural Heritage elements located at the Island.	36
Table 9. Natural Heritage elements located at Tercio Ranch.	38
Table 10. Natural Heritage elements located at Widow Woman site.....	41
Table 11. Cover data for a representative <i>Populus tremuloides</i> -dominated stand.	46
Table 12. Cover data for a representative <i>Pinus edulis</i> -dominated stand.....	49
Table 13. Cover data for representative <i>Pinus ponderosa</i> -dominated stand.	50
Table 14. Cover data for representative <i>Pseudotsuga menziesii</i> -dominated stand.....	53
Table 15. Cover data for representative <i>Quercus gambelii</i> -dominated stand.....	54
Table 16. Cover data for representative <i>Populus angustifolia</i> -dominated stand from Upper Arkansas River Basin (Kittel et al. 1995).....	57

Executive Summary

The Colorado Natural Heritage Program (CNHP) was contracted by the Conservation Fund and The Nature Conservancy (TNC) in 1997, to conduct a rapid ecological assessment of the Upper Purgatoire River watershed as part of the Upper Purgatoire Watershed Planning project. The objective was to locate rare and imperiled plant and animal species and excellent examples of common plant communities. Potential conservation site boundaries were drawn based on the presence of rare and imperiled plants, animals, and significant plant communities.

The assessment revealed several plant communities and two vertebrate species of biodiversity significance. Nine plant communities, two of which are globally rare, and two vertebrates were identified. Two globally rare plants were known to occur from previous surveys in the watershed. Eight potential conservation sites are profiled in this report.

The Upper Purgatoire Watershed Planning project resulted from 1996 Colorado Division of Wildlife (CDOW) elk management meetings for the Purgatoire River watershed. The CDOW meetings focused on elk issues such as the expanding elk population, reducing elk-human conflicts, and minimizing big-game habitat fragmentation. The planning project has expanded into a broader conservation planning effort that includes evaluating wildlife habitat, scenic and visual resources, identifying rare and imperiled plant and animal species, recreational opportunities, and potential development zones. During a July 21, 1997 meeting organized by The Conservation Fund and The Nature Conservancy, local land owners and ranch managers explicitly articulated the ultimate goals of the planning effort: preserve habitat and ranch lands before residential subdivision occurs while fostering economic growth in Las Animas County.

This report is intended to assist The Nature Conservancy in developing a Watershed Conservation Master Plan that incorporates all aspects of the project. Partners cooperating on the Master Plan include Las Animas County, Colorado Division of Wildlife, the Habitat Partnership Program, The Conservation Fund, The Nature Conservancy, plus several landowners.

Introduction

The Colorado Natural Heritage Program (CNHP) was contracted by The Conservation Fund and The Nature Conservancy (TNC) to conduct a rapid ecological assessment for the Upper Purgatoire River watershed. The assessment targeted areas with known natural heritage elements and areas likely to support natural heritage elements. Natural heritage elements are defined as rare, or imperiled plants, animals, and plant communities as well as excellent examples of common plant communities that are tracked by the Colorado Natural Heritage Program. In addition to locating and identifying rare or imperiled species and plant communities, the ecological condition of each surveyed area was assessed and described. The Nature Conservancy will incorporate the results into a Watershed Conservation Master Plan.

An overview of the study area is first presented, followed by an outline of CNHP's mission and methodology. Finally, plant alliances and corresponding plant associations plus potential conservation sites are identified.

Overview of the Study Area

The Upper Purgatoire River watershed study area (Figure 1) covers nearly 600 square miles or approximately 384,000 acres, and corresponds closely to the actual watershed, which extends farther east than the study site. Study site boundaries are delineated by physical and political distinctions: the western boundary is the Sangre de Cristo mountain range; the eastern boundary is the city of Trinidad and U.S. Interstate 25; the southern boundary is the Colorado-New Mexico state line; the northern boundary is defined by the watershed boundary of the Purgatoire River and its tributaries. The Purgatoire River headwaters begin in the Sangre de Cristo Mountain range near 3,962 m (13,000 ft). Headwater streams flow east and near the town of Weston, at 1,828 m (6,000 ft) where two main forks join and form the Purgatoire River.

Climate

Climate is dry and characteristic of the Southern Rockies. Average precipitation is 38 cm, with most moisture falling during August. July is typically the warmest month with a mean temperature of 29.4 °C (84.9 °F). January is the coldest month with a mean temperature of -6.3 °C (20.6° F) (Colorado Climate Center 1980).

Geomorphology

Topography, from west to east, ranges from over 3,900 m at the top of the Sangre de Cristo range to 1,800 m, near the city of Trinidad. The many Purgatoire River tributaries that cut through the study site experience ephemeral stream flow.

The study area consists of three major bedrock types. The Sangre de Cristo Formation, Permian period (240-280 million years before present), located in the west, is a conglomerate of sandstone, siltstone, shale, and gray limestone. Poison Canyon Formation, Tertiary period (approximately 60 million years before present), comprised of arkosic conglomerate and sandstone rock occurs in areas centrally located within the study site. Raton Formation, comprised of sedimentary rock from the Tertiary period, dominates the eastern portion of the study site. Light colored sandstone, dark siltstone, shale and coal are components of the Raton

Formation (Johnson 1969). Rich coal deposits common east of the town of Stonewall were heavily mined from the late 19th century into the 20th century. Noticeable but less extensive components of the area's geology include dikes of intrusive igneous rock emanating from Spanish Peaks (to the north and out of the study area), and the Stonewall comprised of Dakota Sandstone from the Mesozoic era bent up steeply by the rising Sangre de Cristo Range (Chronic 1980).

Soils

Soils in the study area are highly variable. Some soil types within the watershed have never before been identified or described (Jim Hamilton, NRCS, *personal communication* 1997). A soil survey for Las Animas County is being prepared by the Natural Resource Conservation Service Soil Survey and only preliminary data are available. In general, soils with larger particles (rocks, cobble and gravel) occur at higher elevations in the western portion of the study area, while soils with finer particles (sands and loams) are lower in the study site and to the east (Natural Resource Conservation Service 1996).

The Sangre de Cristo Formation is overlain by three soil types. Scandard-Leadville-Rock Outcrop Complex is colluvium and residuum from sandstone with a surface of cobbly sand loam. Leadville-Hierro Complex is alluvium and colluvium from sandstone with a surface of stony to very stony sandy loam. Collegiate Sandy Loam is a sandy loam found on gently sloping stream terraces (Hallock 1996).

Vegetation

The Upper Purgatoire River watershed falls within two of Bailey et al. (1994) ecoregions. The eastern portion and the bulk of the study area is Temperate Steppe Division, Great Plains-Palouse Dry Steppe Province Arkansas Tablelands, and the western portion is Temperate Steppe Regime Mountains, Southern Parks and Rocky Mountain Ranges. Exemplary or rare communities found here (detailed descriptions are in the Results section) include aspen forests, montane grasslands, Gambel-oak woodlands, riparian woodlands, ponderosa pine forest, and piñon-juniper woodlands. Mixed-conifer forests and alpine communities also occur in high country of the Upper Purgatoire River watershed. Most drainages have been heavily grazed or converted to hay meadows (The Nature Conservancy 1986).

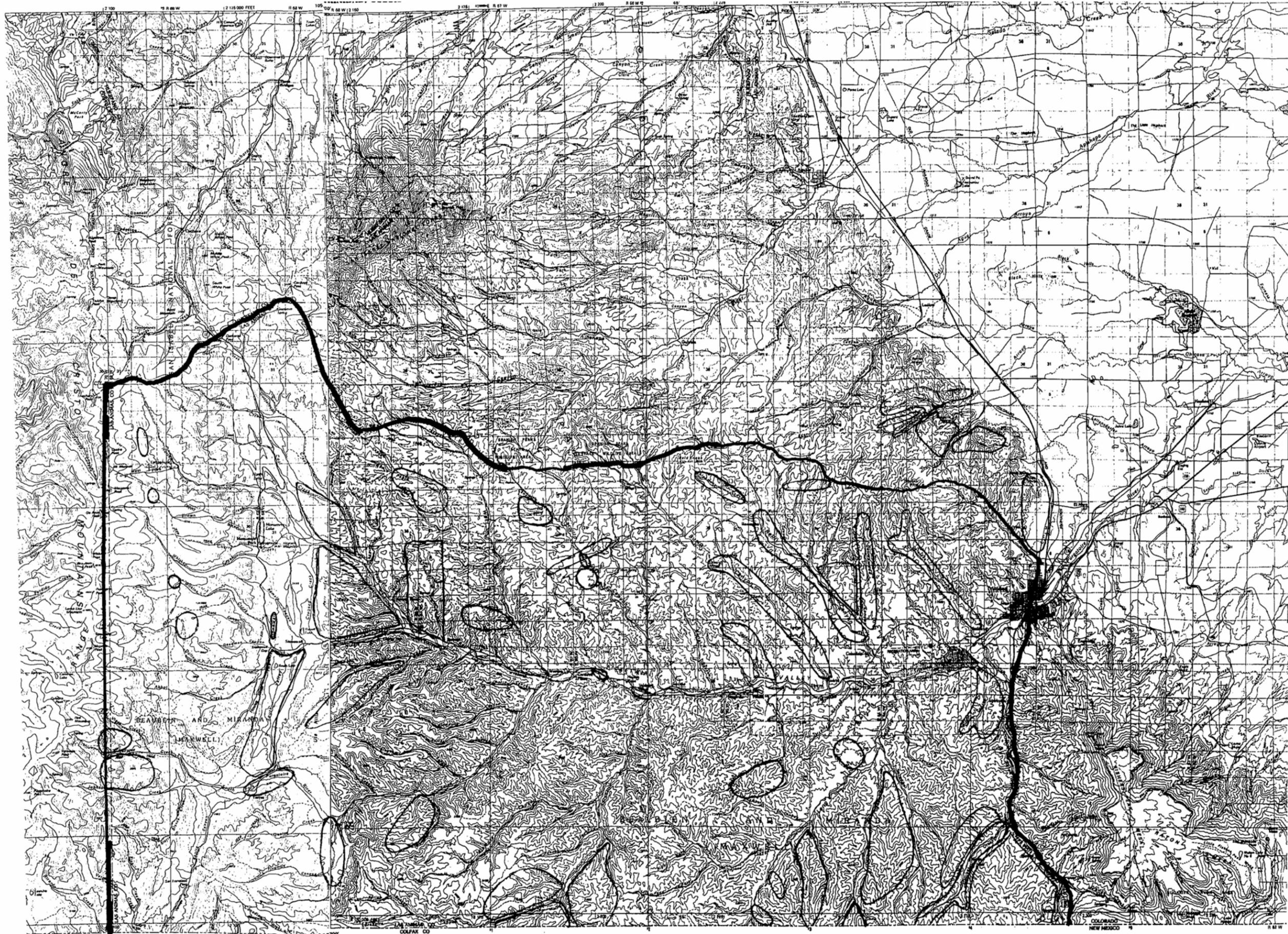


Figure 1. Upper Purgatoire River watershed and target inventory areas surveyed during 1997 field season. From USGS 1:100,000 scale topographic map (1982).

The Natural Heritage Network

Colorado is well known for its rich diversity of geography, wildlife, plants, and plant communities. However, like many other states, Colorado is losing much of its flora and fauna. This decline in biodiversity is also a global trend resulting from human population growth, development, and subsequent habitat loss. Globally, the loss in species diversity has become so intense that Wilson (1988) compared the phenomenon to the great natural catastrophes at the end of the Paleozoic and Mesozoic eras.

For decades the scientific community has recognized the need to minimize any loss of biodiversity. Still, many conservation efforts made in the United States were not based upon preserving biodiversity; instead, they focused on preserving game animals, scenery, and locally favorite open spaces. Robert Jenkins, in conjunction with The Nature Conservancy, developed the Natural Heritage Methodology in 1978 to provide a science-based approach to preserving diversity.

Natural Heritage Methodology ranks species according to their rarity or degree of imperilment. The fundamental basis for biodiversity ranks is the assumption that rare and imperiled species are more likely to become extinct than common species. The ranking system is scientifically based upon the number of known locations of the species as well as its biology and known threats to the species. Using established ranks for the relative rareness or imperilment of a species, the quality of its populations, and the importance of associated conservation sites, this methodology directs conservation efforts by placing highest priority on the rarest and most imperiled species. Rare plant communities and the best examples of common communities have also been ranked and preserved using this methodology.

The Natural Heritage Methodology is used by Natural Heritage programs throughout North, Central, and South America that form an international database network. Natural Heritage Network data centers are located in each of the 50 United States, five provinces of Canada, and 13 countries in South and Central America and the Caribbean. This network enables scientists to monitor the status of species with state, national, and global perspective. It also helps conservationists and natural resource managers to make informed, objective decisions when establishing priorities and directing conservation efforts.

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 principal comprehensive biological diversity data center, gathering information and field observations to help develop statewide conservation priorities. After operating in Denver, Colorado for 14 years, the Program was relocated from the State Division of Parks and Outdoor Recreation to Boulder, and the University of Colorado Museum in 1992, and more recently to the College of Natural Resources at Colorado State University in Fort Collins.

The multi-disciplinary team of scientists and information managers gathers comprehensive information on 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. Information management staff carefully plot the data on 1:24,000 scale USGS maps and enter it into the Biological and Conservation Data System. The Element Occurrence database can be accessed by many categories, including taxonomic group, global and state rarity rank, federal and state legal status, source, observation date, county, quadrangle map, watershed, management area, township, range, and section, precision, and conservation unit.

CNHP is part of an international network of conservation data centers that use the Biological and Conservation Data System developed by The Nature Conservancy. CNHP works closely with several state and federal agencies, including the Colorado Natural Areas Program, Colorado Department of Natural Resources and the Colorado Division of Wildlife, the U.S. Environmental Protection Agency, and the U.S. Forest Service. Numerous local governments and private entities also coordinate efforts with CNHP. Use of the data by many different individuals and organizations, including Great Outdoors! Colorado, encourages a proactive approach to development and conservation thereby reducing the potential for conflict. Information collected by Natural Heritage Programs around the globe aids in protecting species before the need for legal endangerment status arises.

The Natural Heritage Ranking System

Information is gathered by CNHP on Colorado's plants, animals, and plant communities. Each of these species and plant communities is considered an **element of natural diversity**, or simply an **element**. Each element is assigned a rank that indicates its relative degree of imperilment on a five-point scale (e.g., 1 = extremely rare/imperiled, 5 = abundant/secure). The primary criterion for ranking elements is the number of occurrences, i.e., the number of known distinct localities or populations. This factor is weighted more heavily 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, trends in both population and distribution, identifiable threats, and the number of already protected occurrences.

Element rarity ranks are assigned both in terms of the element's degree of imperilment within Colorado (its State or S-rank) and the element's imperilment over its entire range (its Global or G-rank). Taken together, these two ranks give an instant picture of the degree of imperilment of an element. CNHP actively collects, maps, and electronically processes specific occurrence information for species elements considered extremely imperiled to vulnerable (S1 - S3). Plant or animal species ranked S3S4 are "watchlisted", meaning that specific occurrence data are collected and periodically analyzed to determine whether more active tracking is warranted. All plant communities in BCD are tracked. Common plant communities, i.e. G4G5-S4S5, are tracked only if the community is considered an excellent condition occurrence or the best know occurrence within a study site. A complete description of each of the Natural Heritage ranks is provided in Table 1.

This single rank system works 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 instances, it is necessary to distinguish between breeding, non-breeding, and resident species. As noted in Table 1, ranks followed by a "B", e.g., S1B, indicate that the rank applies only to the status of breeding occurrences. Similarly, ranks followed by an "N", e.g., S4N, refer to nonbreeding status, typically during migration and winter. Elements without this notation are believed to be year-round residents within the state.

Table 1. Definition of Colorado Natural Heritage Rarity Ranks.

Global rarity ranks are based on the range-wide status of a species. State rarity ranks are based on the status of a species in an individual state. State and Global ranks are denoted, respectively, with an "S" or a "G" followed by a

G/S1	Critically imperiled globally/state because of rarity (5 or fewer occurrences in the world/state; or very few remaining individuals), or because of some factor of its biology making it especially vulnerable to extinction.
G/S2	Imperiled globally/state because of rarity (6 to 20 occurrences), or because of other factors demonstrably making 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).
G/S4	Apparently secure globally/state, though it might be quite rare in parts of its range, especially at the periphery.
G/S5	Demonstrably secure globally, though it may be quite rare in parts of its range, especially at the periphery.
GX	Presumed extinct.
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 not verified for an extended period, usually.
G#T#	Trinomial rank (T) is used for subspecies or varieties. These taxa are ranked on the same criteria as G1-G5.
S#B	Refers to the breeding season imperilment of elements that are not permanent residents.
S#N	Refers to the non-breeding season imperilment of elements that are not permanent residents. Where no consistent location can be discerned for migrants or non-breeding populations, a rank of SZN is used.
SZ	Migrant whose occurrences are too irregular, transitory, and/or dispersed to be reliably identified, mapped, and protected.
SA	Accidental in the state.
SR	Reported to occur in the state, but unverified.
S?	Unranked. Some evidence that species may be imperiled, but awaiting formal rarity ranking.

Protection Urgency Ranks

Protection urgency ranks (P-ranks) refer to the time frame in which conservation protection must occur. In most cases, this rank indicates the need for a major change in protective status (e.g., agency special area designations or ownership), and reflects the necessity of legal, political, or other administrative actions to alleviate threats related to land ownership or designation. The following codes are used to indicate the rating which best describes the urgency to **protect** the area:

- P1** Immediately threatened by severely destructive forces, within 1 year of rank date; protect now or never!
- P2** Threat expected within 5 years.
- P3** Definable threat, but not in the next 5 years.
- P4** No threat known in foreseeable future.
- P5** Land protection complete or adequate reasons exist not to protect the site; do not act on this site.

A protection action involves increasing the current level of legal protection accorded one or more tracts at a potential conservation area. Also included may be 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. Not included are management actions, e.g., any action requiring stewardship intervention. Threats that may require a protection action are as follows:

- 1) Anthropogenic forces that threaten the existence of one or more element occurrences at a site; e.g., development that would destroy, degrade or seriously compromise the long-term viability of an element occurrence and timber, range, recreational, or hydrologic management that is incompatible with an element occurrence's existence.
- 2) The inability to undertake a management action in the absence of a protection action; e.g., obtaining a management agreement.
- 3) In extraordinary circumstances, a prospective change in ownership management that will make future protection actions more difficult.

Management Urgency Ranks

Management urgency ranks (M-ranks) indicate the time frame in which a change in management of the element or site must occur. Using best scientific estimates, this rank refers to the need for management in contrast to protection (e.g., increased fire frequency, decreased herbivory, weed control, etc.). The urgency for management rating focuses on land use management or land stewardship action required to maintain element occurrences at the potential conservation area.

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

- M1** Management action required immediately or element occurrences could be lost or irretrievably degraded within one year.
- M2** New management action will be needed within 5 years to prevent the loss of element occurrences.
- M3** New management action will be needed within 5 years to maintain current quality of element occurrences.
- M4** Although not currently threatened, management may be needed in the future to maintain the current quality of element occurrences.
- M5** No serious management needs known or anticipated at the site.

Element Occurrence Ranking

Actual location of elements, whether they be 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. In order to prioritize element occurrences for a given species, an element occurrence rank (EO-Rank) is assigned according to their ecological quality whenever sufficient information is available. This ranking system is designed to indicate which occurrences are the healthiest and most ecologically viable, thus focusing conservation efforts where they will be most successful. The EO-Rank is based on four factors:

- Quality** The representativeness of the occurrence as compared to element occurrence (EO) specifications including maturity, size, and numbers.
- The element occurrence specifications are set by a consensus of experts regarding the element in question.
- Condition** How much has the site and EO been damaged or altered from its optimal condition and character.
- Viability** The long term prospects for continued existence of this occurrence.
- Defensibility** The extent to which the occurrence can be protected from extrinsic human factors that might otherwise degrade or destroy it.

Each of these factors are rated on a scale of A through D, with A representing an excellent grade and D representing a poor grade. These grades are then averaged to determine an appropriate EO-Rank for the occurrence. If there is insufficient information available to rank

an element occurrence, an EO-Rank is not assigned. Possible EO-Ranks and their appropriate definitions are as follows:

- A** The occurrence is relatively large, pristine, defensible, and viable.
- B** The occurrence is small but in good condition, or large but removed from its natural condition and/or not viable and defensible.
- C** The occurrence is small, in poor condition, and possibly of questionable viability.
- D** The occurrence does not merit conservation efforts because it is too degraded or not viable.

Potential Conservation Site Planning Boundaries

Once the presence of rare or imperiled species or significant plant communities is confirmed, the first step towards their protection is delineation of a conservation site boundary. In general, the potential conservation site planning boundary includes land that harbors the rare elements as well as a larger area where ecological processes operate that allow species or communities to persist. In developing such boundaries, CNHP staff consider a number of factors including, but not limited to:

- the extent of current and potential habitat for the elements present;
- the ecological processes necessary to maintain or improve existing conditions;
- species movement and migration corridors;
- maintenance of surface water quality within the site and the surrounding watershed;
- maintenance of the hydrologic integrity of the groundwater, e.g., by protecting recharge zones;
- land intended to buffer the site 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 here delineate ecologically sensitive areas where land-use practices should be carefully planned and managed to ensure that they are compatible with protection goals for natural heritage resources and sensitive species. All land within the potential conservation site boundary should be considered an integral part of a complex economic, social, and ecological landscape that requires wise land-use planning at all levels.

Off-Site Considerations

Frequently, all relevant ecological processes cannot be contained within a site of reasonable size. Examples of ecological processes that may influence a potential conservation site from outside the proposed boundaries include: fire, changes in hydrology, or interference with wildlife corridors. An extreme example is the threat of ozone depletion which could expand every site to include the entire planet. The boundaries illustrated in this report signify the immediate, and therefore most important, area in need of protection. Landscape level conservation will require county-wide efforts in coordination with private landowners, neighboring land planners, plus state and federal agencies.

Ranking of Potential Conservation Sites

CNHP uses element and element occurrence ranks together, to assess the overall biodiversity significance of a site, which may include one or many element occurrences. Knowing the relative significance of a site helps direct conservation resources to the highest priority sites. Based on these ranks, each site is assigned a **biodiversity (or B) rank**:

- B1** Outstanding Significance: only site known for an element or an excellent occurrence of a G1 species.
- B2** Very High Significance: one of the best examples of a community type, good occurrence of a G1 species, or excellent occurrence of a G2 or G3 species.
- B3** High Significance: excellent example of any community type, good occurrence of a G3 species, or a large concentration of good occurrences of state rare species.
- B4** Moderate or Regional Significance: good example of a community type, excellent or good occurrence of state-rare species.
- B5** General or Local Biodiversity Significance: good or marginal occurrence of a community type, S1, or S2 species.

Methods

Colorado Natural Heritage ecological assessments occur in several phases. Phase one focuses on gathering existing information for the study site. Phase two is the cataloging of potential rare or imperiled species and significant plant communities for the study site. Identification of targeted inventory areas occurs during phase three. Phase four consists of landowner contacts. Field surveys are conducted in phase five. The sixth and final phase is potential conservation site boundary delineation.

Information collection

Existing ecological information was collected from a variety of sources and used to help designate target inventory areas. CNHP's Biological Conservation and Data System (BCD) was used to generate a list of known element occurrences in the study area. For some portions of the study site, known element occurrences were gathered from easement documentation of a 28,000 acre tract in the watershed and a report by TNC for CDOW. Colorado Natural Areas Program and Colorado State Land Board information were also used to identify element occurrences.

Tracked species and plant communities recorded from Las Animas, Huerfano, and Costillo counties were included in the list of elements obtained from BCD. Species and plant communities which occurred in habitat not found in the Upper Purgatoire River watershed were removed from the list. Omissions were generally associated with grasslands and undisturbed riparian areas.

Designate Target Inventory Areas (TIAs)

TIAs contained all known and historical element occurrences identified through the search described above. Other areas with potentially high natural values were selected using aerial photographs. United States Geological Survey high-altitude color infrared photographs (1:24:000, NAPP) from August and September, 1988-1992, were analyzed to assess vegetation types, and where possible, landscape condition. TIAs selected from aerial photos generally met several criteria; the largest, least fragmented, and relatively undisturbed (few to no roads or structures) sites qualified as TIAs. Robust and dense vegetation plus the presence of flowing water designated a preliminary TIA. Potential habitat for rare and imperiled species and what appeared to be the best examples of all major vegetation types also qualified as TIA's.

After preliminary TIA identification, roadside surveys helped confirm natural conditions of an area. Quick roadside surveys can reveal features such as weed infestation, overgrazing, or structures built subsequent to the aerial photographs. Highly disturbed preliminary TIAs or those obviously ill-suited for containing natural heritage elements were disqualified. Remaining TIAs were investigated further during field surveys described below. Figure 2 shows all TIAs visited during the 1997 field season.

Landowner Contact

Landowner permission was obtained before conducting field surveys of all targeted inventory areas. Ownership was determined using records from the Las Animas County assessor's office. Nearly the entire study area is privately owned, and much of the land is under absentee ownership. Often, the assessor's records were out of date or inaccurate. Mr. Stanley Barron, a long time resident and former surveyor, and Bob Holder, District Wildlife Manager for the Colorado Division of Wildlife, helped piece together ownership information. The Conservation Fund also helped locate absentee owners. Landowners were contacted by phone or in person. Under no circumstances were properties surveyed without landowner permission.

Field Surveys

Qualitative and quantitative data were collected at each targeted inventory area visited. Ideally, surveys occur when targeted elements are discernible. However, due to time constraints, phenology of targeted elements did not always correspond to field visits.

Methods used for field surveys depended on the elements of interest. A list of organisms and the generalized survey techniques follows:

Amphibians	Observation or capture with aquatic nets.
Reptiles	Observation or capture with nets.
Small Mammals	Capture with sherman live traps or gopher traps.
Birds	Identification by song/call, observation, and nests.
Fish	Observation and line-intercept capture.
Insects	Capture with aerial net.
Plants	Observation, collection and identification with Colorado Flora: Eastern Slope (Weber and Wittman, 1996).
Natural Communities	Collection of quantitative composition data and qualitative condition information.

Plant communities tracked by CNHP were sampled. Tracking status of a plant community was determined using BCD and Bourgeron and Engelking (1994). Quantitative data for woody species and herbaceous species were collected to help describe plant communities. Canopy cover by woody species was measured using the line-intercept method. A 30 m tape was stretched through a representative portion of the plant community. The length of each intercepted plant part is measured. The length of line and total length intercepted by vegetation are used to estimate percentage cover (Bonham 1989). The percentage of total intercept per individual species determines dominance in the canopy.

Cover data and species composition for herbaceous species were determined using rectangular frames that delineate 0.10 m². Plot frames were marked along percentage intervals to allow for more objective estimates (Bonham 1989). Plots were located every third meter along the transect used for woody vegetation sampling. Percent cover by herbaceous plant species was estimated to the nearest 10% in the following cover classes: 5-15%, 16-25%, 26-35%, 36-45%, 46-55%, 56-65%, 66-75%, 76-85%, 86-95% and >95%. Plant cover of 5% or less was further delineated from two categories, <1% and 1-5%.

Other data recorded during field surveys included: numbers of individuals observed, breeding status, habitat description, disturbance features, observable threats, plus potential protection and management needs.

The overall significance of each occurrence, relative to other occurrences of the same element, was estimated by rating the condition (size and degree of disturbance) of the population or community, the landscape context (degree to which natural processes and species interaction and migration can occur), the long-term viability of the population or community, and the defensibility (ease or difficulty of protection) of the occurrence. These factors are combined into an element occurrence rank (see Table 1).

When rare species or significant plant communities were discovered, the precise locations and known extents were recorded on 1:24,000 scale USGS topographic maps.

Assign Potential Conservation Site Boundaries

Assignment of potential conservation boundaries was subjective and intended to include features on the surrounding landscape that maintain ecological processes essential for preserving element occurrences. A potential conservation site boundary is an estimate of the minimum area needed to assure survival of the element. Following initial boundary delineation from the ground, the entire study area was surveyed from the air to reconcile and adjust boundaries. A buffer against changes in adjacent land use was regularly included in site boundaries in order to protect against off-site threats to the element.

Results

Upper Purgatoire River Watershed Conservation Site Profiles

Conservation resources should be directed to the sites profiled in this section. Table 2 lists eight designated potential conservation sites in order of their biodiversity rank. Seven plant alliances are represented by the potential conservation site boundaries. The seven plant alliances are: *Danthonia parryi*, *Pinus edulis*, *Pinus ponderosa*, *Populus angustifolia*, *Populus tremuloides*, *Pseudotsuga menziesii*, and *Quercus gambelii*. The delineation of conservation planning sites does not confer any regulatory protection.

Table 2. Sites of Biodiversity Significance in the Upper Purgatoire River Watershed, arranged by biodiversity rank.

SITE NAME (approximate size in acres)	BIODIVERSITY RANK
Bar NI Ranch (28,000)	B2
Vermejo Park (200)	B3
Potato Patch (640)	B3
Chavez Ranch (3,900)	B4
Guajatoyah Creek Slopes (1,500)	B4
The Island (900)	B4
Tercio Ranch (250)	B5
Widow Woman (3,000)	B5

Each site is described in a standard site report which reflects data fields in CNHP's Biological and Conservation Data System. Site description contents are outlined and explained below.

BIODIVERSITY RANK: The overall significance of the conservation site in terms of imperilment of the natural heritage resources and the quality (health, abundance, etc.) of their occurrences. As discussed in Section 2, these ranks range from B1 (Outstanding Significance) to B5 (General Biodiversity Significance).

PROTECTION URGENCY RANK: The time frame in which conservation protection must occur. In most cases, this rank refers to the need for a major change of protective status (e.g., agency special area designations or ownership). The ranks range from P1 (immediate urgency; within a one year time frame) to P5 (no known urgency).

MANAGEMENT URGENCY RANK: The time frame in which a change in management of the element or site must occur. Using best scientific estimates, this rank refers to the need for management in contrast to protection (e.g., increased fire frequency, decreased herbivory, weed control, etc.). The ranks range from M1 (immediate urgency, within one year) to M5 (no known urgency).

LOCATION: General location, followed by the USGS 7.5' quadrangles and the township, range, and section that include the potential Conservation Site.

GENERAL DESCRIPTION: A brief narrative picture of the topography, general location, vegetation, and current use of the site. Common names are used along with the scientific names.

BIODIVERSITY RANK JUSTIFICATION: A synopsis of the rare species and significant natural communities that occur on the site. The Natural Heritage elements are listed alphabetically according to genera. The species or community that is the primary element appears in bold typeface within the table. See Table 1 for explanations of ranks.

BOUNDARY JUSTIFICATION: The potential conservation site boundaries include all known occurrences of natural heritage resources and, in some cases, adjacent lands required for their protection.

PROTECTION AND MANAGEMENT CONSIDERATIONS: A summary of the major issues and factors that are known or likely to affect the protection and management of the conservation site.

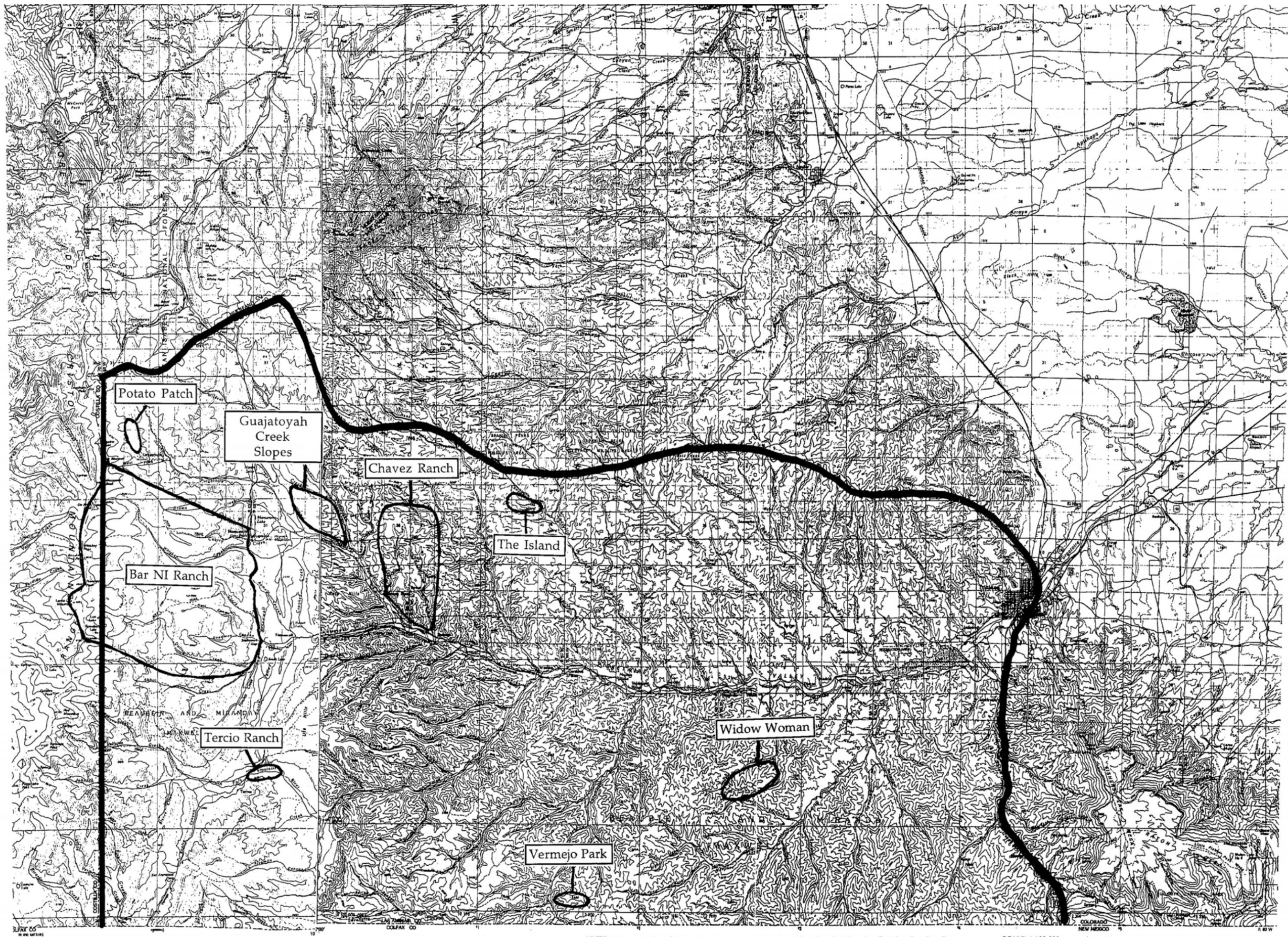


Figure 2. Upper Purgatoire River watershed potential conservation sites. From USGS 1:100,000 scale topographic map (1982).

Bar NI Ranch

Biodiversity Rank: B2

Very high significance. This site contains an excellent example of a globally imperiled community. There are four elements of natural heritage significance on this site; two of these occur in more than one location.

Protection Urgency Rank: P5

Land protection complete. Conservation easements are in place for this site.

Management Urgency Rank: M4

Not currently threatened, but management may be needed in the future to maintain current quality. Condition of rare plant populations and species composition of rare plant community should be monitored.

Location: South and west of Stonewall off Highway 12.

U.S.G.S. 7.5 min. quadrangle (s): Stonewall

Legal Description: Site is located within the Maxwell Land Grant.

General Description: Bar NI ranch is nearly 28,000 acres, covering elevation from 2439 m (8,000 ft) to over 3963 m (13,000 ft). This site contains alpine tundra, alpine shrublands, subalpine plant communities, montane grasslands and mixed-conifer forests, riparian forests, piñon-juniper woodlands, and wetlands. The ranch contains a rich diversity of rare and common plants, plus outstanding elk range and other wildlife habitat. Detailed information available in two conservation easement documentation reports from the Colorado Field Office of The Nature Conservancy.

Biodiversity Rank Justification: There are a total of four elements of natural heritage significance on this site, two globally imperiled (G2) and two state imperiled (S2). The site supports an excellent (A-ranked) example of a globally imperiled (G2/S2) foothills piñon-juniper woodland (*Pinus edulis/Quercus x pauciloba*). Adjacent land is in good condition, though logging operations have started in some areas. This site is very defensible because the entire ranch is under conservation easement.

Table 3. Natural Heritage elements located on Bar NI Ranch.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	Federal Status	*EO Rank
<i>Cypripedium pubescens</i>	yellow lady's slipper	G5	S2				#
<i>Danthonia parryii</i>	montane grasslands	G2?	S2?				C
<i>Pinus edulis</i> / <i>Quercus x pauciloba</i>	foothills piñon-juniper woodlands	G2?	S2				A
<i>Goodyera repens</i>	dwarf rattlesnake plantain	G5	S2				#

*EO = Element Occurrence # = original researcher did not assign rank; EO was not re-evaluated.

Boundary Justification: The site boundary contains all of the natural heritage elements of concern and an extensive matrix of associated species and plant communities. While the site is largely defined by the border of the Bar NI Ranch, it extends beyond the ranch to include a large area, representative of the upper reaches of the Purgatoire River, that is highly viable and defensible. The boundaries extend as far as the Stonewall, a natural geologic feature that likely acts as a defense against invasion of weedy species common in the overgrazed Stonewall valley immediately to the east.

Protection Considerations: The Nature Conservancy holds conservation easements on the Bar NI Ranch.

Management Consideration: Current management is adequate. Bar NI managers are developing wildfire and prescribed burning management plans. If elements are disturbed or altered, a decision will need to be made whether to allow natural processes to proceed unhampered or maintain elements in a desired state.

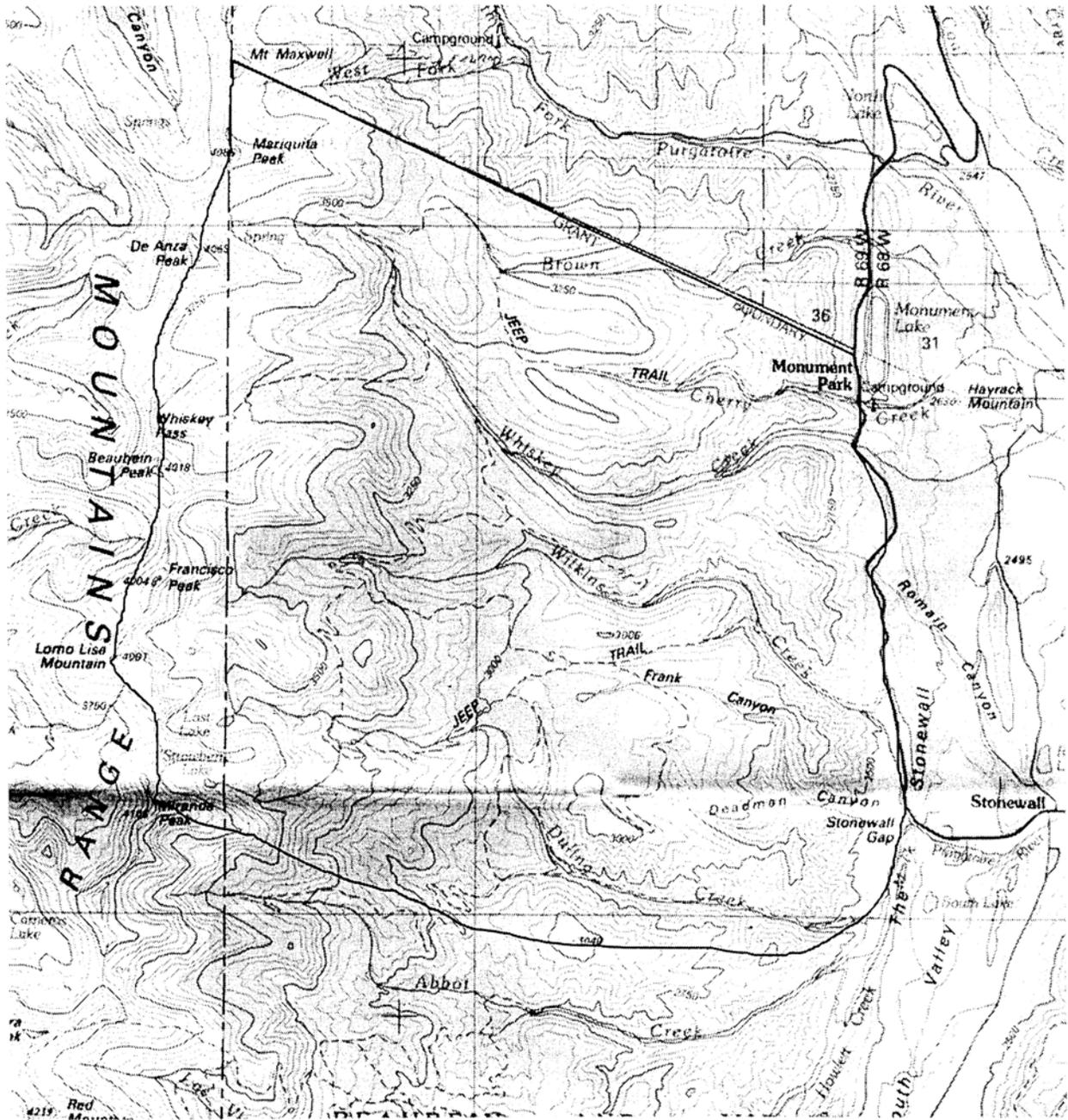


Figure 3. Bar NI Ranch conservation site boundary Las Animas County, CO. From USGS 1:100,000 scale topographic map (1982).

Vermejo Park

Biodiversity Rank: B3

High significance. Vermejo Park contains a fair occurrence of a globally rare woodland community.

Protection Urgency Rank: P3

Definable threat, but not within five years. The land has high recreation and development value plus moderate logging value. Currently, private owners do not have plans for any of these activities.

Management Urgency Rank: M4

Management may be needed in the future to maintain current quality of element occurrence. Non-native plant species composition should be monitored and controlled.

Location: South of Highway 12 near the southern end of Lorencito Canyon.

U.S.G.S. 7.5 min. quadrangle (s): Little Pine Canyon

Legal Description: Site is located within the Maxwell Land Grant.

General Description: This site is a dry, flat bench at the top of north and south facing slopes, dominated by ponderosa pine (*Pinus ponderosa*) with small openings containing big bluestem (*Andropogon gerardii*). Adjacent north facing slopes are Douglas-fir (*Pseudotsuga menziesii*) forests. South facing slopes are characterized by Gambel oak (*Quercus gambelii*) thickets. Soil is sandy and well drained. Bedrock consists of the Raton Formation. Slope bases are degraded by livestock grazing, but upland areas are in good condition. North-facing slopes show evidence of logging. This site covers approximately 200 acres.

Biodiversity Rank Justification: This site contains a C-ranked occurrence of a G2 plant community. The plant community is in fair condition and the surrounding area is relatively undisturbed, compared to much of the study area. This is the best occurrence of this community identified in the Upper Purgatoire River watershed study area west of Trinidad, Colorado during the 1997 field season.

Table 4. Natural Heritage elements at Vermejo Park site.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	Federal Sens.	EO* Rank
<i>Pinus ponderosa</i> / <i>Cercocarpus montanus</i> / <i>Andropogon gerardii</i>	foothills woodland	G2	S2?				C

*EO = Element Occurrence

Boundary Justification: This site is naturally delineated by the ridge top it occupies. Boundaries enclose the flat area plus gentle slopes that form the perimeter of the site. These

boundaries may allow for the use of fire for thinning the forest to preserve the community; fire spreads less easily on flat terrain than on steep slopes. Selective cutting that reduces fuel loads on adjacent slopes may be a useful precursor to any prescribed burning. Boundaries extend downslope to help protect against changes in plant species composition following disturbance to adjacent slopes.

Protection Considerations: No foreseeable threat within the next five years. North facing slopes have been logged in the past and still have valuable timber potential. The ranch manager did not indicate that logging is likely.

Management Considerations: Current management policy appears adequate for maintaining site integrity. Weedy species such as gumweed (*Grindelia squarrosa*) and foxtail barley (*Critesion jubatum*) are common at the bottom of the slopes forming boundaries for the element occurrence. These and other weedy species should be monitored.

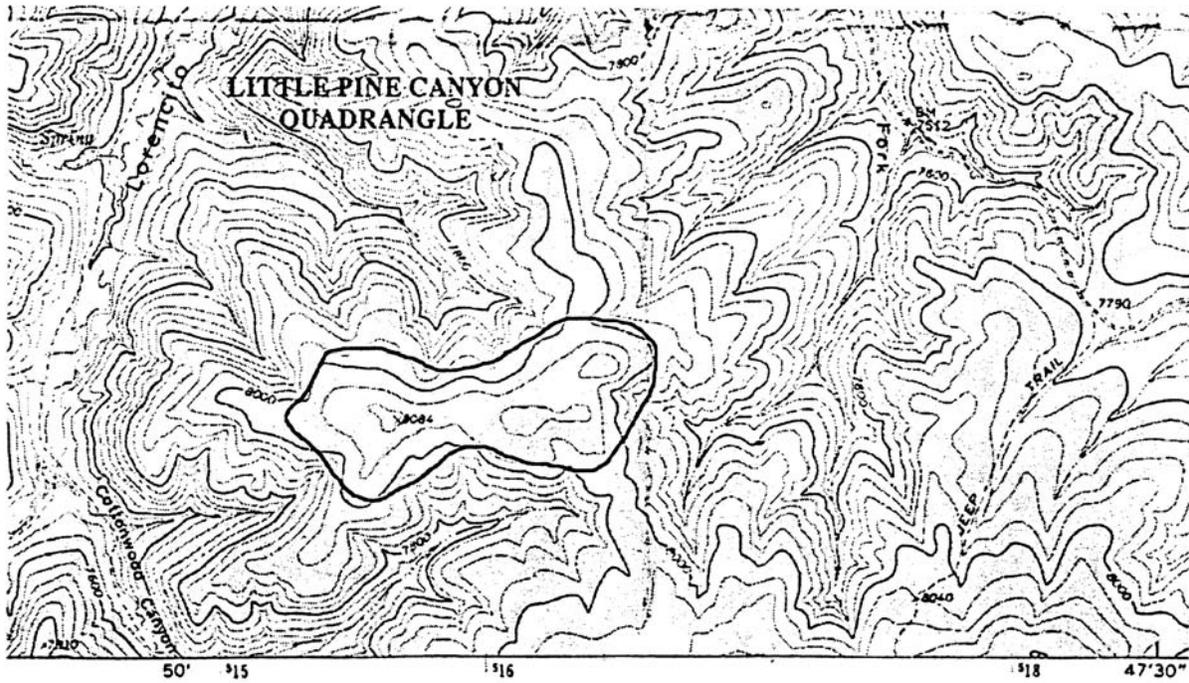


Figure 4. Vermejo Park conservation site boundary Las Animas County, CO. From USGS 1:24,000 topographic map, 7.5 minute series (1971).

Potato Patch

Biodiversity Rank: B3

High significance. This site supports an excellent example of a common plant community.

Protection Urgency Rank: P4

Definable threat, but not within five years. Site is within San Isabel National Forest. Grazing and logging are potential threats.

Management Urgency Rank: M3

Ongoing, recurrent management action must continue to maintain current quality of element occurrences. Cattle should be excluded and heavy off-trail recreational use should be discouraged.

Location: San Isabel National Forest near Potato Patch campground, west of trail to Blue Lake campground.

U.S.G.S. 7.5 min. quadrangle (s): Cucharas Pass

Legal Description: T 32 south, R 69 west.

General Description: Potato Patch is an aspen grove containing two ponds. A striking paucity of rooted aquatic vegetation occurs in the lower of the two ponds. The water is crystal clear and approximately 4 feet deep. Major understory components change with elevation. Higher elevation understory is co-dominated by kinnikinnick (*Arctostaphylos uva-ursi*), wild rose (*Rosa woodsii*), golden banner (*Thermopsis montana*), and juniper (*Juniperus communis*). With decreasing elevation, ericaceous species become less common and juniper drops out entirely. Moisture gradient of the loamy soil changes with elevation: near 3758 m (10,700 ft) the soil is shallow and well-drained. Closer to 3,704 m (10,000 ft) the soil is deeper and mesic. Bedrock is assorted shales and Sangre de Cristo formation from the upper Cretaceous and Permian periods respectively.

Small headwater streams are also common in these forests. The wet areas within the site contain orchids (*Goodyera oblongifolia*) and other montane species. Because these streams flow into areas at lower elevations, protecting this site will defend against ecological degradation down slope.

Potato Patch is excellent elk habitat. Black bear are also common.

Biodiversity Rank Justification: This site contains an excellent example (A-ranked) of a globally common (G4S4) persistent aspen forest (*Populus tremuloides/Juniperus communis*). The site has experienced minimal logging according to the U.S. Forest Service. Though cattle have grazed throughout the site for years, there is no lasting impact at this elevation. Within the Upper Purgatoire watershed survey area this site is very significant. Aspen and other upper montane plant communities are relatively rare within the Upper Purgatoire watershed and contain species with narrow habitat requirements. In most places where they occur, timber harvest is ongoing.

Table 5. Natural Heritage elements at Potato Patch site.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	Federal Sens.	EO* Rank
<i>Populus tremuloides/ Juniperus communis</i>	Persistent aspen forests	G4	S4				A

*EO = Element Occurrence

Boundary Justification: The proposed site boundary encompasses the contiguous aspen forest where it is in excellent condition. The boundary may need to be expanded in the future as we learn more about the ecosystems components and processes necessary for long term maintenance of aspen stands and their associated flora and fauna.

Protection Considerations: The site is within San Isabel National Forest.

Management Considerations: Current management appears adequate, but changes in land use such as logging or livestock grazing, will require immediate and commensurate changes in management policy that protect the plant community found here.

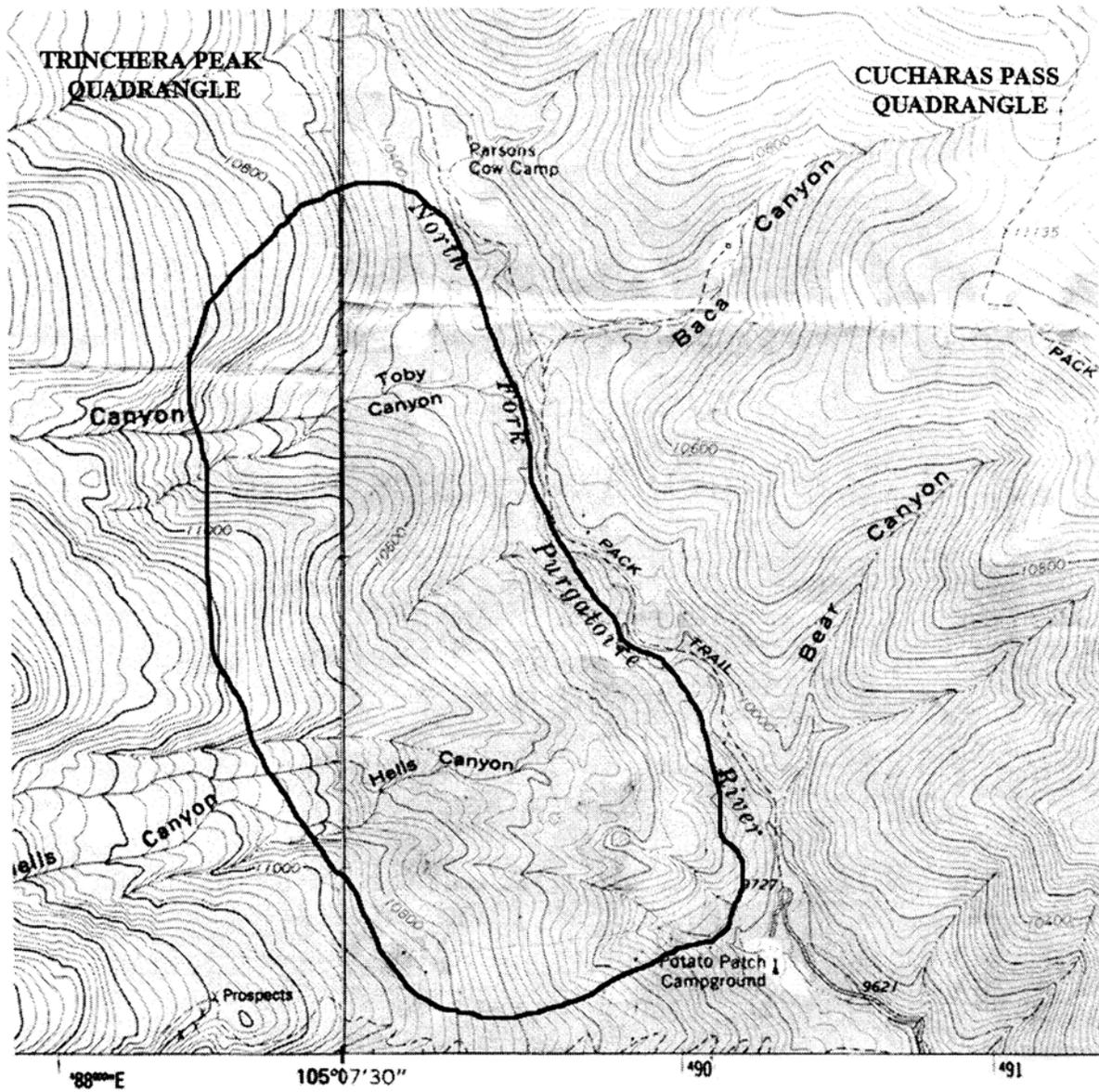


Figure 5. Potato Patch conservation site boundary Las Animas County, Colorado. From USGS 1:24,000 topographic map, 7.5 minute series (1971).

Chavez Ranch

Biodiversity Rank: B4

Moderate significance. The site contains a state significant reptile, Las Animas County's first record.

Protection Urgency Rank: P2

Threat expected within 5 years. The site is privately owned. The owner is intent on leaving the property to family. Land adjacent on three of the four sides is developing into residential lots.

Management Urgency Rank: M3

New management needed within 5 years. Management will be needed to minimize changing plant species composition following development on adjacent parcels. Logging would alter hydrology within the two watersheds.

Location: Santistevan Canyon Road North of Highway 12.

U.S.G.S. 7.5 min. quadrangle (s): Vigil

Legal Description: T 32 south, R 67 west, section 31

T 32 south, R 68 west, section 36

T 33 south, R 67 west, sections 6,7,18,19

T 33 south, R 67 west, sections 1,12,13

General Description: Chavez Ranch covers approximately 4,400 acres, with elevation ranges from 2255 m (7,400 ft) to 2548 m (8,360 ft). This site contains the headwaters of two small watersheds. The majority of Parras Canyon and part of Santistevan Canyon fall within the site boundaries. The narrow drainages contain exposed sandstone bedrock (Raton formation) and experience ephemeral stream flow.

Around 2255 m, weedy species such as bindweed (*Convolvulus arvensis*), salsify (*Tragopogon dubius*), wild lettuce (*Lactuca tatarica*), and gumweed (*Grindelia squarrosa*) are common. Sub-surface gas and mineral exploration plots have been re-seeded with a seed mixture dominated by crested wheat grass (*Agropyron cristatum*). Mid-elevations are characterized by a mixture of ponderosa pine (*Pinus ponderosa*) and Douglas-fir (*Pseudotsuga menziesii*) with one-seeded juniper (*Juniperus monosperma*). Dry drainages at mid-elevation also contain white fir (*Abies concolor*). The highest elevations are dominated by piñon pine (*Pinus edulis*) and Gambel oak (*Quercus gambelii*).

Stream channel conditions improve with increasing elevation. Lower elevations show the most prominent signs of disturbance within the site. Moderate to heavy grazing has occurred along the lower portions of several drainages compromising portions of the stream banks. Cattle currently graze the lower portion of the ranch. An old windmill and pump house exist at approximately 2408 m. Mid to high elevations of Chavez Ranch contain stumps plus snags with burn scars and charcoal, indicating fire and logging have occurred. No signs of very recent anthropogenic disturbance exist at or near the ridge top.

Deer and coyote scat are common at higher elevations. Black-bear tracks are common and bear are often seen by the land owner. Least-chipmunks and rock squirrels are abundant.

Western garter snakes and fence lizards are common. Spotted towhee, pine siskin, violet-green swallows, stellar’s jays and white-breasted nuthatches also inhabit the site.

Biodiversity Rank Justification: A good (B-ranked) example of a state rare (S3) element, the many lined-skink, was found on this site establishing a new county record and range extension within Colorado. Piñon-juniper forests and mesic Gambel-oak thickets supported here are very good quality examples of common plant communities in Las Animas County. Placed in the context of the highly altered plant communities along the Front Range they are important common occurrences.

Table 6. Natural Heritage element on Chavez Ranch.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	Federal Sens.	EO*
<i>Eumeces multivirgatus</i> ssp. <i>gaigeae</i>	Many-lined skink	G5	S3				B

*EO = Element Occurrence

Boundary Justification: The boundaries include small drainages with rocky sandstone outcrops. These outcrops contain important microhabitat for the many-lined skink. Boundaries also include good quality Gambel oak thickets that house numerous bird species and several small mammals. Development is in progress on the north and east sides. According to the landowner, land adjacent to the west side is privately owned with development possible. The southern and shortest boundary is formed by Highway 12.

Protection Considerations: Development of adjacent property may facilitate spread of adventitious, weedy plant species. Development of upland areas may also threaten the drainages and the habitat they provide for the lizard.

Management Considerations: Grazing management on the lower portions needs to be reviewed. New roads on the upper portions should be discouraged. Any plans for logging should consider the good quality mosaic of plant communities.

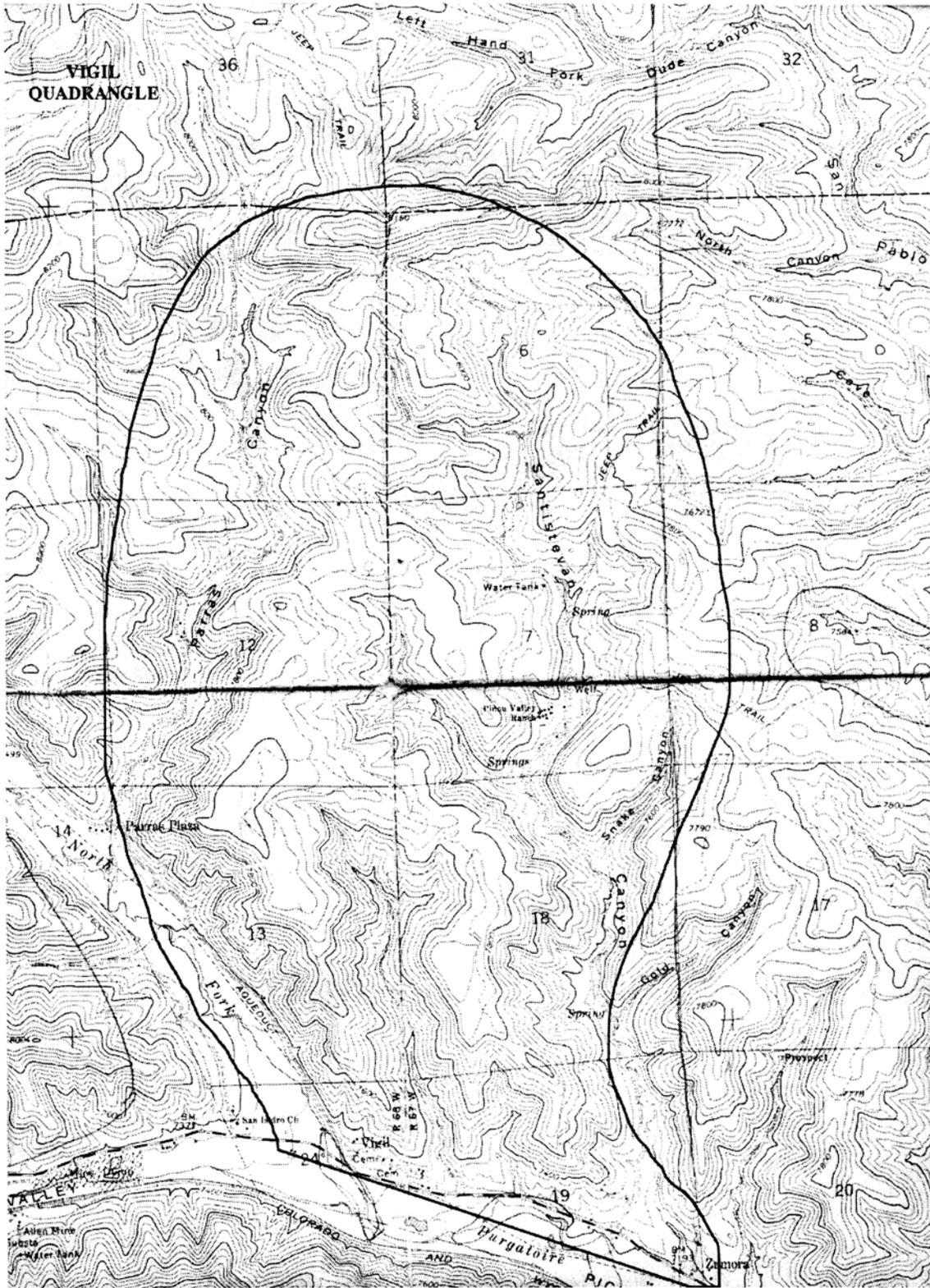


Figure 6. Chavez Ranch conservation site boundary Las Animas County, Colorado. From USGS 1:24,000 topographic map, 7.5 minute series (1971).

Guajatoyah Creek Slopes

Biodiversity Rank: B4

Moderate significance. Guajatoyah Creek Slopes contain good extensive examples of locally significant woodlands.

Protection Urgency Rank: P3

Definable threat, but not within five years. This site is privately owned and no known threats exist from current owners. The hay meadows adjacent to the west and the undeveloped land to the north and east may pose a threat in the future.

Management Urgency Rank: M3

Recurrent management action must continue within five years to maintain current quality of element occurrences.

Location: County Road 21.6, approximately 7 miles north from Vigil.

U.S.G.S. 7.5 min. quadrangle (s): Vigil and Stonewall.

Legal Description: T 32 south, R 68 west, sections 28, 29, 33, 34.

General Description: A series of north and south facing slopes comprise this nearly 1,500 acre site along with four small drainages that flow into Guajatoyah Creek, one of the Purgatoire River tributaries. The banks of Guajatoyah Creek are moderately incised. Cattle graze the base of the slopes along the creek. Evidence of fire and logging exists on the north slopes.

Mesic piñon-juniper woodlands containing piñon pine (*Pinus edulis*) and mountain mahogany (*Cercocarpus montanus*) dominate the south-facing slopes. Common herbaceous understory species are nodding brome (*Bromus anomalus*), mountain muhly (*Muhlenbergia montana*), side-oats grama (*Bouteloua curtipendula*), big bluestem (*Andropogon gerardii*), and wild buckwheat (*Eriogonum jamesii*). Sandy, well-drained soil and exposed bedrock are common on slopes with southern aspect.

Ponderosa pine (*Pinus ponderosa*) woodlands with Gambel's oak (*Quercus gambelii*) dominate north-facing slopes. Ponderosa pine occurs in assorted sizes along with Douglas-fir (*Pseudotsuga menziesii*) and white fir (*Abies concolor*) saplings. The understory of north facing slopes is in good condition with pasqueflower (*Pulsatilla patens*), meadow-rue (*Thalictrum fendleri*), pine dropseed (*Blepharoneuron tricholepis*), and bottle gentian (*Pneumonanthe bigelovii*) present.

Biodiversity Rank Justification: Guajatoyah Creek slopes support extensive locally significant plant communities. Disturbance is minimal. Few weedy or invasive plant species occur here. Nearly 80% of the area is adjacent to undeveloped land. This location is among the best examples of this community in the Upper Purgatoire watershed.

Table 7. Natural Heritage elements within Guajatoyah Creek slopes.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	Federal Sens.	EO* Rank
<i>Pinus ponderosa/ Quercus gambelii</i>	foothills ponderosa pine scrub woodland	G5	S4				B
<i>Pinus edulis/ Cercocarpus montanus</i>	mesic western slope woodlands	G5	S4				B

*EO = Element Occurrence

Boundary Justification: The eastern edge of Guajatoyah Creek and the western bank of the North Fork create natural boundaries for this site. County Road 21.6 forms the western boundary and distinguishes Guajatoyah Creek slopes from Coal Creek Flat on the western boundary. These borders also provide buffers from the hay meadows to the west and future land use changes on neighboring parcels.

Protection Considerations: Hay meadows are adjacent to the site. Future land use plans on adjacent property are unknown.

Management Considerations: Livestock grazing should be minimized, especially along the creek banks. Logging and residential development will compromise the natural communities.

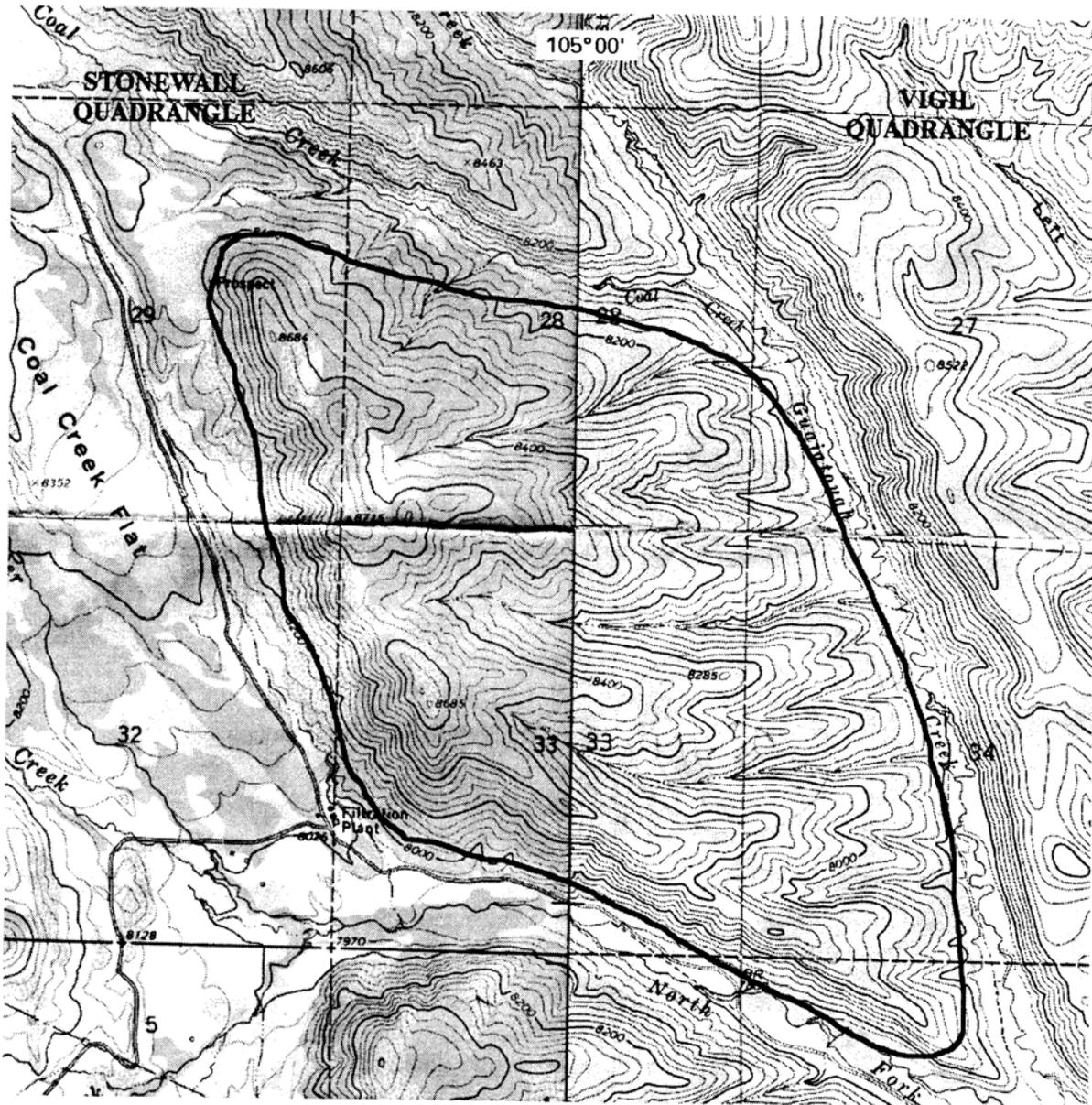


Figure 7. Guajatoyah Creek Slopes conservation site boundary Las Animas County, Colorado. From USGS 1: 24,000 topographic map, 7.5 minute series (1971).

The Island

Biodiversity Rank: B4

Moderate significance. This site contains good quality examples of representative plant communities that have not previously been recorded in Las Animas County.

Protection Urgency Rank: P3

Definable threat, but not within 5 years. There are no signs of impending development. Oil pumps are common nearby and drilling in this site should be discouraged.

Management Urgency Rank: M3

New management action will be needed within 5 years. Livestock grazing may alter species composition within the communities identified. Drilling on or near the site could adversely affect the plant communities and associated species.

Location: Approximately 11 miles north of Highway 121 on County Road 33.4.

U.S.G.S. 7.5 min. quadrangle (s): Weston

Legal Description: T 32 south, R 67 west, sections 25(SW4), 26, 27.

General Description: The Island is a small knoll surrounded on all sides by flat grazed meadows. The area covered by this site is approximately 900 acres. North-facing slopes have gradual pitch and are dominated by Douglas-fir (*Pseudotsuga menziesii*) with patches of Gambel's oak (*Quercus gambelii*) in the understory. On well-shaded, north-facing slopes, the soil is moist, sandy loam. Bedrock outcrops (Poison Canyon Formation of sandstone, yellow siltstone and shale) provide microhabitat for lizards and pack rats. Evidence of bear, elk and deer is abundant. Dry and arid south-facing slopes contain sandy soil. South-facing slopes are dominated by Gambel's oak mixed with patches of mountain mahogany (*Cercocarpus montanus*). Mountain muhly (*Muhlenbergia montana*) is the most common herbaceous component that together with little bluestem (*Schizachyrium scoparium*) forms grassy patches between clumps of shrubs. This mosaic continues across the meadow, west along Pawley Canyon and also along the south facing slopes of Dry Canyon.

Biodiversity Rank Justification: Two good (B-ranked) examples of plant communities (one G5S3S4, the other GUSU) occur within this site. Both occurrences are relatively small, however, the entire site is in good condition with few exotics and little signs of disturbance. Hay meadows and pastures that are interspersed through the site contain weedy species and exotics.

Table 8. Natural Heritage elements located at the Island.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	Federal Sens.	EO* Rank
<i>Pseudotsuga menziesii</i> / <i>Quercus gambelii</i>	Lower montane forests	G5	S3S4				B
<i>Quercus gambelii</i> – <i>Cercocarpus montanus</i> / <i>Muhlenbergia montana</i>	Mesic oak thickets	GU	SU				B

*EO = Element Occurrence

Boundary Justification: Boundaries encompass the north edge of the Island plus the north slopes of Pawley Canyon and Dry Canyon. These boundaries allow for the aspect-specific communities to grow in a fairly extensive continuous area. Wildlife migration between the communities is more feasible within the boundaries proposed than between small, disconnected parks. Ideally, this site should cover enough area and contains enough individuals to withstand widespread disease or recover from a major burn. The site boundary may have to be expanded as more is learned about maintaining the ecological integrity of the component plant communities.

Protection Considerations: It does not appear that development or threatening changes in current land use are imminent. Land use plans for adjacent property are unknown.

Management Considerations: Cattle that graze at the base of the slopes should be monitored and excluded from the plant communities identified.

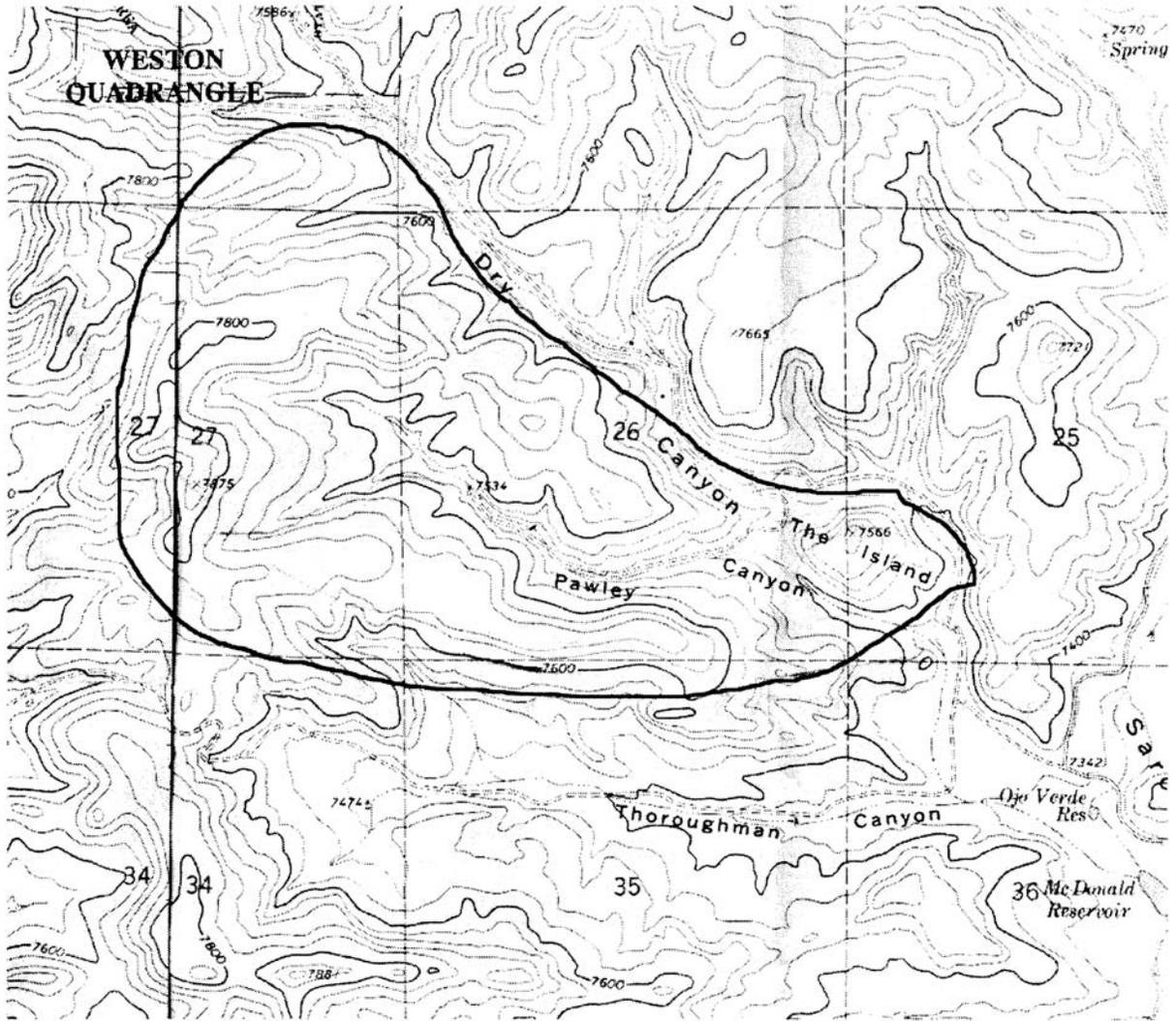


Figure 8. The Island conservation site boundary Las Animas County, Colorado. From USGS 1:24,000 topographic map, 7.5 minute series (1971).

Tercio Ranch

Biodiversity Rank: B5

General Biodiversity Significance. This site contains a fair occurrence of a Gunnison prairie dog community.

Protection Urgency Rank: P3

Definable threat, but not within 5 years. Changes in ownership are unlikely.

Management Urgency Rank: M2

New management action will be required within five years to prevent loss of element occurrences. Heavy cattle in the riparian area and hay production adjacent to the stream threaten the ecological integrity of the site.

Location: Follow County Road 13 approximately 5 miles south from Highway 12.

U.S.G.S. 7.5 min. quadrangle(s): Torres

Legal Description: Site is located within the Maxwell Land Grant.

General Description: Tercio Ranch contains a riparian system on the south fork of the Purgatoire River with a mixture of willow (*Salix* sp.) at the east end. The west portion is dominated by narrow leaf cottonwood trees (*Populus angustifolia*) with a diverse herbaceous understory. The stream bank is artificially reinforced in some areas. Natural hydrological processes are intact. Adjacent land contains hay meadows and pasture for cattle. Hay meadows separate the riparian area from the Gunnison prairie dog town. The entire site covers approximately 250 acres. No exposed bedrock occurs within the site. Soils are mesic loam near the stream and well drained, xeric, sandy loam upland.

Biodiversity Rank Justification: The site contains a fair (C-ranked) occurrence of that Gunnison prairie dog (*Cynomys gunnisoni gunnisoni*). This occurrence is exposed and vulnerable to predation or hunting. Tercio Ranch also contains a common riparian plant community type (*Populus angustifolia/mesic graminoids*), but this is the best example of a narrow-leaf cottonwood system within the upper Purgatoire watershed.

Table 9. Natural Heritage elements located at Tercio Ranch.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	Federal Sens.	EO* Rank
<i>Cynomys gunnisoni gunnisoni</i>	Gunnison prairie dog	G5T3	S3				C

*EO = Element Occurrence

Boundary Justification: Boundaries are based on the extent of the Gunnison prairie dog town and the vegetation affiliated with the riparian system. Establishing boundaries beyond the immediate edge of both element occurrences allows for expansion of the cottonwood community, which is likely if hydrological processes in the stream are maintained or improved. Placing the boundary as far west as possible will allow the highly disturbed area to recover. This

will benefit downstream areas by improving water quality, reducing water temperature, and mitigating flood effects.

Protection Considerations: Tercio Ranch is privately owned. The owner is committed to maintaining the property for hunting and small scale livestock operations.

Management Considerations: Cattle currently graze in and around the stream. Cattle exclusions should be constructed around the riparian area. Non-native grasses may be better controlled if haying does not occur so close to the stream. Re-introduction of beavers would have a positive effect on important riverine processes such as channel build-up, pond formation, and flood mitigation.

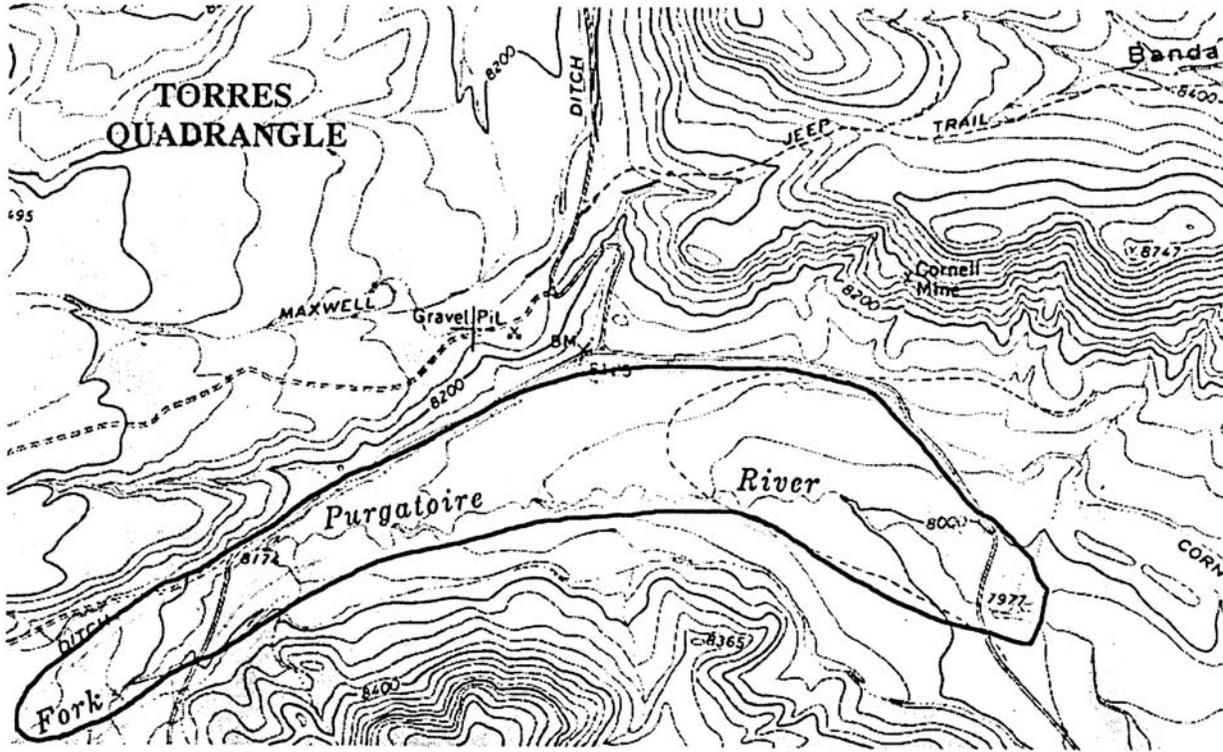


Figure 9. Tercio Ranch conservation site boundary Las Animas County, Colorado. From USGS 1:24,000 topographic map, 7.5 minute series (1971).

Widow Woman

Biodiversity Rank: B5

General biodiversity significance. Widow Woman contains an extensive, representative woodland plant community in good condition.

Protection Urgency Rank: P1

Immediately threatened. The early stages of residential development are in progress.

Management Urgency Rank: M2

New management priorities are needed or the natural communities located here will be irretrievably degraded within one to five years.

Location: At Valdez (Jane’s West Side Tavern) on Highway 12, follow Widow Woman Canyon Road south approximately 3 miles. Head west at intersection with Middle Fork.

U.S.G.S. 7.5 min. quadrangle (s): Valdez

Legal Description: T 34 south, R 65 west, section 24

T 34 south, R 66 west, sections 16, 17, 19, 20, 21.

General Description: Widow Woman site, approximately 3000 acres, contains the Middle Fork watershed and is characterized by a series of moderate to steep north- and south-facing slopes. The many south-facing slopes are extensive high quality piñon-oak communities. Shrubs such as Gambel’s oak (*Quercus gambelii*), mountain mahogany (*Cercocarpus montanus*), and skunk bush (*Rhus trilobata*) provide dense cover on south-facing slopes. The area is in good condition with few weedy or adventive species. Rattlesnakes and lizards are common as well as numerous bird species. Black bear and mule deer are also present.

Bedrock is primarily Raton Formation with fingers of Arkosic conglomerate and shale. Ridge tops commonly contain rocky outcrops. Loose gravel of assorted sizes covers exposed portions of south-facing slopes.

Biodiversity Rank Justification: This site contains extensive pine/oak woodlands that are in good condition (B-ranked G5S5). This community is highly representative of the Upper Purgatoire, and is among the best examples of this community in the area. Disturbance is minimal and a healthy forb component exists with a few weeds. The surrounding landscape is also in good condition except near existing roads. While this occurrence is ranked B, it should be noted that no A-ranked occurrences have been reported in Colorado.

Table 10. Natural Heritage elements located at Widow Woman site.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	Federal Sens.	EO* Rank
<i>Pinus edulis/Quercus gambelii</i>	Foothills piñon-juniper woodland	G5	S5				B

*EO = Element Occurrence

Boundary Justification: The proposed site boundary encompasses an extensive area of the piñon pine/Gambel oak community. It also contains the Middle Fork Watershed and the upper portion of Widow Woman Canyon. Protecting an area containing two watersheds will provide a wildlife corridor between the two streams and increase the opportunity for species interaction and migration. The likelihood of good quality downstream habitat is increased if headwaters are protected. The boundary may have to be expanded in the future as more is learned about the requirements for maintaining the viability of these shrubland communities and their component species.

Protection Considerations: A portion of this site is in the early stages of development. Residential lots are for sale. Infrastructure such as new roads and power lines are not yet in place.

Management Considerations: Establish new management priorities immediately or natural communities could be irretrievably degraded by residential development within one to five years.

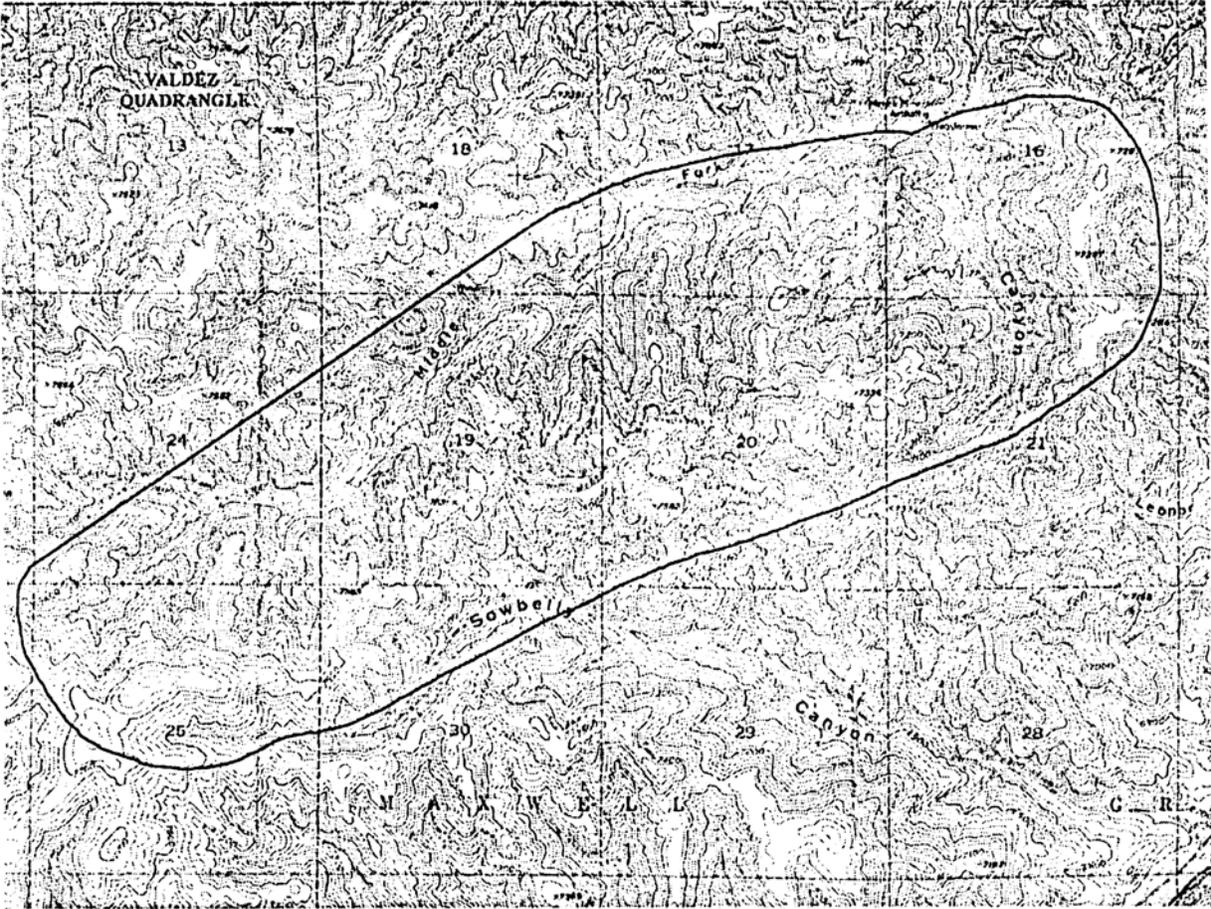


Figure 10. Widow Woman conservation site boundary Las Animas County, Colorado. From USGS 1:24,000 topographic map, 7.5 minute series (1971).

Plant Alliances

Plant alliances are vegetation types defined by one or more diagnostic species in the uppermost vegetation stratum. Within the Upper Purgatoire River watershed, alliances are roughly equivalent to “cover type” or “habitat type.” Plant alliance is one hierarchical level above plant association in The Nature Conservancy’s national vegetation classification. An alliance may contain one or several plant associations. For example, in the Upper Purgatoire watershed, the piñon pine (*Pinus edulis*) alliance contains the following associations: *Pinus edulis/Quercus gambelii*, *Pinus edulis/Juniperus scopulorum*, and *Pinus edulis/Juniperus osteosperma*.

The plant alliance descriptions that follow contain information on distribution of the alliance (geographic range and elevational range), the general appearance of the alliance (habit), soils, vegetation composition, and notes on successional relationships and management. This information is presented here to give land planners and managers a better idea of the various components of the Upper Purgatoire landscape and how these components might be best managed.

Populus tremuloides Alliance

Plant Associations: Aspen forests. *Populus tremuloides*/*Juniperus communis*, *Populus tremuloides*-*Abies concolor*/*Juniperus communis*.

Distribution: Aspen is the most widely distributed native North American tree species (Mutel and Emerick 1992). Johnston (1987) documents this alliance and several *Populus tremuloides* associations from Wyoming to Utah including Shoshone, Medicine Bow, Routt, and Roosevelt National Forests. The Upper Purgatoire watershed contains aspen at 2744 m (9,000 ft) and higher, along the western boundary exclusively.

Elevation: 2,438-3,292 m (8,000-10,800 ft)

Habit: Aspen is one of the few tree species that can grow in all mountain vegetation zones except alpine tundra. In the Southern Rockies aspen forests occur in relatively moist sites. Sites that support major stands of aspen receive more than 25 inches of precipitation annually, experience moderately cold and snowy winters and warm summers, and have comparatively long growing seasons (Benedict 1991). Potato Patch site contains aspen forests with large trees and robust understory, indicating that soils in these stands are moist through the growing season (Mutel and Emerick 1992). Aspen forests occupy slopes with assorted aspect and pitch, and are often found on steep slopes.

Soils: Variable, mesic to dry loamy soils with shallow to moderate depth.

Vegetation: *Populus tremuloides* is the only canopy species at Potato Patch. At higher elevations (approximately 3354 m) *Arctostaphylos uva-ursi* and *Rosa woodsii* are the dominant understory species (50% and 20% respectively). *Juniperus communis* is present. *Thermopsis montana* is also common. With decreasing elevation, soils are less drained and ericaceous species become increasingly uncommon. *Thermopsis montana* remains a dominant (20%) herbaceous component while *Galium septentrionale* and *Rosa woodsii* each account for 10% of aerial coverage near 3049 m.

Succession/Management: Aspen groves occur as successional communities and stable, self-perpetuating stands. Seral aspen forests are best identified by the active replacement of the aspen overstory by coniferous trees. Stable aspen forests exhibit three main attributes: uneven age structure of the aspen overstory, paucity of successional change in understory species composition, and an absence of tree species more shade-tolerant than aspen (Benedict 1991). Aspen forests are utilized for wildlife value, livestock grazing, and forest products as well as attracting tourist dollars every autumn. In the Upper Purgatoire, aspen forests are important summer habitat for the extensive elk herds.

Table 11. Cover data* for a representative *Populus tremuloides*-dominated stand.

Site: **Potato Patch**
Biodiversity Rank: B3

	Canopy Cover
TREES	
<i>Populus tremuloides</i>	60
SHRUBS	
<i>Arctostaphylos uva-ursi</i>	50
<i>Juniperus communis</i>	10
<i>Paxistima myrsinites</i>	10
<i>Vaccinium sp.</i>	3
<i>Rosa woodsii</i>	1
<i>Jamesia americana</i>	1
<i>Mahonia repens</i>	1
GRAMINOIDS	
<i>Bromopsis sp.</i>	1
FORBS	
<i>Thermopsis montana</i>	20
<i>Fragaria virginiana</i>	3
<i>Aster sp.</i>	3
<i>Epilobium latifolium</i>	1
<i>Pseudocymopteris montana</i>	1
<i>Solidago spathulata</i> var. <i>neomexicana</i>	1

*Cover data codes represent the mid-point for the range. For example, 3=1-5%, 10=5-15%, etc.
Cover Code 1 denotes <1%.

***Danthonia parryi* Alliance**

Plant Associations: Montane grasslands. *Danthonia parryi* and *Danthonia parryi*/*Muhlenbergia montana*.

Distribution: *Danthonia parryi* (Parry's oatgrass) associations are documented in Roosevelt, Pike, Medicine Bow and Gunnison National Forests (Johnston 1987). Parts of the Shirley and Laramie basins in Wyoming and Morneo Valley in New Mexico contain this alliance (Benedict 1991). No more than ten known occurrences of Parry oatgrass grasslands exist in Colorado (Neely and Mitchell 1987).

Elevation: 2,957-3,048 m (9,700-10,000 ft)

Habit: Montane meadows or grasslands are found at the upper limits of the montane mixed-conifer forest often growing in deep, fine-textured soils (Mutel and Emerick 1992). Differences between individual mountain grasslands are due to altitude, topographic position, moisture availability, and protection from surrounding vegetation types (Benedict 1991). Duhling Park on the Bar NI Ranch is a flat bench containing ephemeral ponds. The immediate perimeter is formed by aspen trees that separate the grassland from limber pine (*Pinus flexilis*) forest.

Soils: The *Danthonia parryi* grassland located in the Upper Purgatoire watershed occurs on Davtone loam, Davtone-Wichup Variant complex (Hallock 1996).

Vegetation: Dominant vegetation is *Danthonia parryi*. Common species are *Pentaphylloides floribunda*, *Erigeron glabellus*, *Erigeron flagellaris*, *Phleum pratense*, *Poa pratensis*, *Trifolium sp.*, *Festuca arizonica*, *Oxytropis sericea*, *Achillea lanulosa*, and *Antennaria parviflora*.

Succession/Management: Most meadows have been severely altered by grazing and conversion to hay meadows. They are very susceptible to invasion from hay meadow grasses, especially Kentucky bluegrass (*Poa pratensis*). Bluegrass in Duhling Park indicates that livestock have grazed here in the past (Neely and Mitchell, 1987). Currently, this site is grazed by elk which may also facilitate changes in species composition. Preservation of natural montane meadows is probably best accomplished by excluding livestock and maintaining a large buffer between hayed areas and natural meadows.

* No quantitative cover data were collected during the 1997 field season for this alliance within, or near, the study site.

***Pinus edulis* Alliance**

Plant Associations: Foothills Piñon-Juniper woodlands. *Pinus edulis/Quercus gambelii*, *Pinus edulis/Juniperus scopulorum*, *Pinus edulis/Juniperus osteosperma*.

Distribution: In Colorado this alliance is concentrated in the west and south (Mutel and Emerick 1992). Records of the *Pinus edulis* alliance exist for White River, Grand Mesa, Gunnison, Uncompahgre and San Juan National Forests. Along Colorado's Front Range, piñon woodlands occur south of Colorado Springs. Piñon pine woodlands cover over 75,000 square miles in western North America (Benedict 1991).

Elevation: 1,640-2,740 m (5000-9000 ft)

Habit: Moderately flat to steep rocky slopes or gently rolling hills with southwest, south, or southeast aspect. Typically, this alliance is just above a break in slope between foothills and valley floors or on slopes above broad valleys (Johnston 1987). The Upper Purgatoire watershed piñon-juniper woodlands generally occur on exposed, windy, south-facing, xeric sites.

Soils: In the Upper Purgatoire watershed, piñon woodlands occur in shallow well-drained soils commonly over sandstone. Fine sandy loam or rocky sandy soils are affiliated with this alliance.

Vegetation: *Pinus edulis* dominates the canopy, providing 70% of aerial coverage from trees. *Quercus gambelii* is the dominant shrub species with 60% coverage. *Rhus trilobata* and *Sabina scopulorum* are also common. Affiliated species include; *Opuntia polyacantha* and *Pediocactus simpsonii*, *Townsendia eximia* (Las Animas County record), *Oryzopsis hymenoides*, *Andropogon hallii*, *Thalictrum fendleri*, *Linaria vulgaris*, *Artemisia frigida*, *Artemisia ludoviciana*, *Pterogonum alatum*, *Orthocarpus luteus*, *Orthocarpus purpureoalbus*, *Chondrosium (Bouteloua) gracile*, *Eriogonum jamesii*, *Senecio spartioides*, *Plantago patagonica*, *Bouteloua curtipendula*, *Chorispora tenella*, *Agrostis scabra*, and *Penstemon barbatus*.

Succession/management: These plant communities burn well and succession to a piñon climax community requires three hundred years or longer following a major disturbance (Mutel and Emerick 1992). Piñon requires "nurse plants," a small tree, to aid germination and establishment. Following a major disturbance such as fire or chaining, a site is colonized by assorted annual forbs. Grasses become more common, followed by shrubs, then juniper and eventually piñon.

These woodlands are delicate, but can be effectively managed for wildlife habitat and livestock forage. When a piñon-juniper woodland experiences overgrazing, grasses and shrubs in the understory may be decimated and annuals such as Russian thistle and cheatgrass become common (David Buckner, ESCO Associates Boulder, CO, *personal communication*, 1992). Piñon woodlands overgrazed fifty years ago still not have recovered (Mutel and Emerick 1992).

Table 12. Cover data* for a representative *Pinus edulis*-dominated stand.

Site: Widow Woman	
Biodiversity Rank: B4	Canopy Cover
<hr/>	
TREES	
<i>Pinus edulis</i>	20
<i>Sabina monosperma</i>	5
<i>Juniperus scopulorum</i>	5
SHRUBS	
<i>Quercus gambelii</i>	60
<i>Cercocarpus montanus</i>	30
<i>Rhus trilobata</i>	5
<i>Symphoricarpos rotundifolius</i>	1
GRAMINOIDS	
<i>Agrostis scabra</i>	5
FORBS	
<i>Artemisia frigida</i>	5
<i>Achillea lanulosa</i>	5
<i>Eriogonum jamesii</i>	5
<i>Helianthella parryi</i>	5
<i>Artemisia tridentata</i>	3
<i>Fragaria virginiana</i>	1
<i>Pterogonum alatum</i>	1
<i>Opuntia</i> sp.	1

*Cover data codes represent the mid-point for the range. For example, 3=1-5%, 10=5-15%, etc.
Cover Code 1 denotes <1%.

***Pinus ponderosa* Alliance**

Plant Associations: Ponderosa pine forests and scrub woodlands. *Pinus ponderosa/Quercus gambelii*, *Pinus ponderosa/Cercocarpus montanus/Andropogon gerardii*.

Distribution: Along the Eastern Slope of the Colorado Rockies, Ponderosa pine forests are common from the Wyoming border to the southern end of the Sangre de Cristo mountain range (Benedict 1991). San Isabel, Pike, San Juan, Arapaho, and Roosevelt National Forests each have records of this alliance.

Elevation: 1,700-2,740 m (5600-9000 ft)

Habit: This alliance is confined primarily to lower slopes and ridges. Though ponderosa is shade intolerant, it occurs on all exposures and slopes from gentle to very steep (DeVelice et al. 1986). The Upper Purgatoire River watershed contains this alliance at very different elevations, but typically in flat areas or areas with very moderate slopes.

Soils: Soils are shallow to deep and have loamy to clayey texture with low to high coarse fragment content (DeVelice et al. 1986). Ponderosa forests in the Upper Purgatoire watershed occur on well-drained xeric to deep mesic soils.

Vegetation: In two different sites with Ponderosa woodlands, aerial coverage from ponderosa pine was 60% at both. *Quercus gambelii* is the dominant shrub species at both sites 31% and 12% respectively. *Pseudotsuga menziesii* saplings and *Cercocarpus montanus* are also present. Affiliated herbaceous species include: *Muhlenbergia montana*, *Andropogon gerardii*, *Chondrosium gracile*, *Mariscus fendlerianus*, *Achillea lanulosa*, *Geranium caespitosum*, *Artemisia frigida*, *Oxalis violacea*, *Fragaria virginiana*, and *Campanula robusta*.

Succession/management: Fire is an important ecological agent of succession for this alliance. Following intense fire, *Quercus gambelii* often forms in very dense thickets preventing conifer re-establishment. Fire suppression facilitates dense ponderosa stands with even-aged (often young) trees. Resulting shade and the accumulation of needles limits growth of an herbaceous understory and ponderosa regeneration (DeVelice et al. 1986). In the Upper Purgatoire River watershed, ponderosa woodlands typically occupy gentle slopes with herbaceous and shrubby understory species and experience heavy grazing by livestock and/or big game. The result is open, park-like stands with very sparse understory vegetation.

Table 13. Cover data* for representative *Pinus ponderosa*-dominated stand.

Site: Guajatoyah Creek Slopes

Biodiversity Rank: B4

Canopy Cover

TREES

<i>Pinus ponderosa</i>	30
<i>Pseudotsuga menziesii</i>	1

SHRUBS

<i>Quercus gambelii</i>	10
<i>Symphoricarpos sp.</i>	3

GRAMINOIDS

<i>Mariscus fendlerianus</i>	3
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FORBS

<i>Galium septentrionale</i>	3
<i>Artemisia frigida</i>	3
<i>Erythrocoma triflora</i>	3
<i>Geranium caespitosa</i>	3
<i>Lycurus setosus</i>	3
<i>Pulsatilla patens</i>	3
<i>Campanula rotundifolia</i>	1
<i>Pneumonanthe bigelovii</i>	1
<i>Thalictrum fendleri</i>	1

*Cover data codes represent the mid-point for the range. For example, 3=1-5%, 10=5-15%, etc.
Cover Code 1 denotes <1%.

Pseudotsuga menziesii Alliance

Plant Associations: Lower montane forests. *Pseudotsuga menziesii/Quercus gambelii*.

Distribution: Douglas-fir occurs on both sides of the continental divide and are common throughout Colorado. In western North America, Douglas-fir forests are found from British Columbia south to Central Mexico (Benedict 1991).

Elevation: 1,829-2,743 m (6,000-9,500 ft)

Habit: Douglas-fir and Ponderosa pine co-dominate the canopy in montane forests. In cooler sites and with increasing elevation in the Upper Purgatoire watershed, Douglas-fir tends to replace ponderosa. Eventually, Douglas-fir is replaced by Engelmann spruce and subalpine fir. At lower elevations, Douglas-fir is restricted to ravine bottoms, cold-air drainages, or sheltered north-facing slopes.

Soils: Soils are finely textured and moist. Exposed bedrock and boulders are common in Douglas-fir forests in the Upper Purgatoire.

Vegetation: Line intercept data for aerial coverage of Douglas-fir forest in Upper Purgatoire: *Pseudotsuga menziesii* 55%, *Quercus gambelii* 15%, *Ribes cereum* 5%, *Cercocarpus montanus* 1%. White fir (*Abies concolor*) is present in trace amounts. *Pseudotsuga menziesii* is present in assorted age and size classes, including saplings. *Quercus gambelii* is patchy. Herbaceous understory is sparse but dominated by forbs. The most common forbs are: *Geranium caespitosum*, *Pulsatilla patens*, *Eriogonum jamesii*, *Galium septentrionale*, *Bahia dissecta*. *Bromus anomalus* is the most common grass. Shrub species are represented by *Rosa woodsii* and *Artemisia ludoviciana*.

Succession/Management: Most pristine Douglas-fir communities in the Southern Rockies have been destroyed through lumbering activities. Consequently, mixed conifer forests generally prevail in areas formerly dominated by Douglas-fir (Benedict 1991). Climax Douglas-fir communities change in density, typically becoming less dense as they mature. *Pseudotsuga menziesii* association with *Quercus* sp. is often affiliated with a healthy graminoid component. Collectively, these components create broad possibilities for management ranging from forage utilization to timber production (DeVelice et al. 1986).

Table 14. Cover data* for representative *Pseudotsuga menziesii*-dominated stand.

Site: The Island	
Biodiversity Rank: B4	Canopy Cover
<hr/>	
TREES	
<i>Pseudotsuga menziesii</i>	60
SHRUBS	
<i>Quercus gambelii</i>	15
<i>Cercocarpus montanus</i>	5
<i>Ribes cereum</i>	1
GRAMINOIDS	
<i>Bromus anomalus</i>	10
<i>Chondrosium gracile</i>	1
FORBS	
<i>Pterogonum alatum</i>	3
<i>Allium cernuum</i>	3
<i>Oxalis violacea</i>	3
<i>Lithospermum incisum</i>	3
<i>Thalictrum fendleri</i>	3
<i>Brickellia grandiflora</i>	3
<i>Helianthella parryi</i>	3
<i>Delphinium</i> sp.	3
<i>Galium boreale</i>	3
<i>Ipomopsis aggregata</i>	3

*Cover data codes represent the mid-point for the range. For example, 3=1-5%, 10=5-15%, etc.
Cover Code 1 denotes <1%.

Quercus gambelii Alliance

Plant Associations: Mesic oak thickets and mixed mountain shrublands. *Quercus gambelii*-*Cercocarpus montanus*/*Muhlenbergia montana*.

Distribution: *Quercus gambelii* is one of the most common shrub species in western North America. As recently as 1958, roughly one million acres of nearly pure stands existed in west-central Colorado alone (Brown 1958). Mountain shrublands are still common throughout Colorado and other western states. White River, Gunnison, Routt, San Juan, Mesa Verde, Uncompahgre, and Grand Mesa National Forests all contain this alliance. From Trinidad to Stonewall, this is the most common alliance within the Upper Purgatoire watershed.

Elevation: 2,100-2,621 m (6,900-8,600 ft)

Habit: On gentle slopes, this alliance usually grows in clumps, while on steeper slopes it occurs in thickets (Brown 1958). Within its elevational band, *Quercus gambelii* associations occupy middle valley sides with gentle to steep pitch as well as mesa tops. *Quercus gambelii* associations are also common among rocky outcrops. In the Upper Purgatoire, this alliance typically inhabits south-facing slopes. With increasing elevation Gambel's oak shrublands taper into the mixed-conifer montane forests.

Soils: Soils are well-drained, shallow with coarse texture and a high rock content.

Vegetation: 20 m-square plot data of aerial coverage from shrubs: *Quercus gambelii* 70%, *Cercocarpus montanus* 15%. At mid-elevations in the Upper Purgatoire watershed, this alliance contains more *Muhlenbergia montana* than other herbaceous species. At higher elevations, *Muhlenbergia montana*, *Schizachyrium scoparium*, *Chondrosium gracile*, and *Bouteloua curtipendula* appear to be co-dominants in the understory.

Succession/Management: Fire, logging, and grazing determine the extent and density of Gambel's oak. Fire may have had a greater influence than other disturbances (Brown, 1958). Gambel's oak reproduces by means of suckers and stoolshoots which allow the plant to survive most surface disturbances. Increased sucker growth occurs following disturbance and dense thickets result. When protected from fire or other disturbance, Gambel's oak thickets are less dense. In parts of south-central Colorado, including south of State Highway 12 in this study area, Gambel's oak has spread into large areas of the lower montane region where ponderosa pine has been logged or burned (Benedict 1991).

Table 15. Cover data* for representative *Quercus gambelii*-dominated stand.

Site: **The Island**

Biodiversity Rank: B4

Canopy Cover

TREES

Pinus ponderosa 3

SHRUBS

Quercus gambelii 70

Cercocarpus montanus 40

Ribes cereum 3

GRAMINOIDS

Muhlenbergia montana 10

Chondrosium gracile 3

Schizachyrium scoparium 3

Bouteloua curtipendula 1

Elymus elymoides 1

Lycurus setosus 1

Agrostis scabra 1

FORBS

Campanula rotundifolia 1

Delphinium sp. 1

Galium septentrionale 1

Helianthella parryi 1

Ipomopsis aggregata 1

Liatris punctata 1

Lithospermum incisum 1

Senecio spartioides 1

*Cover data codes represent the mid-point for the range. For example, 3=1-5%, 10=5-15%, etc.
Cover Code 1 denotes <1%.

***Populus angustifolia* Alliance**

Plant Associations: Riparian woodlands. *Populus angustifolia/mesic graminoid*, *Populus angustifolia/Alnus incana* ssp. *tenuifolia*, *Populus angustifolia/Cornus sericea*.

Distribution: This alliance is most common in montane valleys of the Southern Rockies. *Populus angustifolia* associations do occur in Wyoming and Idaho (Baker 1989), but less frequently than Colorado and Utah. The southern boundary is unclear (Kittel et al. 1997).

Elevation: 2,079-2,895 m (5,500-9,500 ft)

Habit: This alliance appears on active floodplains in montane forests and in cool, narrow valleys of lower elevations. *Populus angustifolia/mesic graminoid* association is most common on narrow to moderately wide floodplains (30-130 m), where overbank flow and sediment deposition can occur (Kittel et al. 1995). In the Upper Purgatoire riparian sites are generally overgrazed, with an abundance of non-native grasses, highly altered stream channels and deeply incised stream banks.

Soils: Soils are wet, sandy to silty loam near the stream, and well-drained sandy loam upland.

Vegetation: Line intercept (30 m) aerial coverage data for woody spp.: *Populus angustifolia* 78%, *Salix bebbiana* 30%. Plot data for herbaceous cover: *Poa pratensis* 35%, *Thalictrum fendleri* 13%, *Maianthemum stellatum* 9%, *Thermopsis montana* 8%, *Pedicularis procera* 6%. Adjacent upland vegetation is *Quercus gambelii* shrubland and mixed-conifer forests. In other sites around Colorado, *Alnus incana* and mixed *Alnus incana-Cornus sericea* shrublands may occur adjacent to the floodplain forest on steep-sided banks, and *Salix exigua* stands often occupy point bars and overflow channels (Kittel et al. 1995).

Succession/Management: Riparian areas are greatly altered from human use. The trend is conversion from willow thickets and lush riparian woodlands into hay meadows. Riparian areas attract wildlife and livestock with lush forage and drinking water. Grazing changes herb composition, increasing adventive species concentrations. Trampling and grazing by livestock kills regenerating trees and shrubs, hastens bank erosion and siltation of streams. This alliance requires flooding and fresh alluvial deposits for *Populus* regeneration. Providing a buffer between the stream bank and grazing or hay meadows allows for natural succession of riparian communities and maintenance of natural hydrological processes.

Table 16. Cover data* for representative *Populus angustifolia* dominated stand from Upper Arkansas River Basin (Kittel et al. 1995).

Site: Pueblo Reservoir	Canopy cover
TREES	
<i>Populus angustifolia</i>	45
SHRUBS	
<i>Alnus incana</i> ssp. <i>tenuifolia</i>	30
<i>Salix exigua</i>	30
<i>Salix lucida</i> ssp. <i>caudata</i>	20
GRAMINOIDS	
<i>Poa pratensis</i>	30
<i>Elytrigia repens</i>	10
<i>Carex aquatilis</i>	1
<i>Juncus balticus</i> var. <i>montanus</i>	1
FORBS	
<i>Trifolium repens</i>	10
<i>Taraxacum officinale</i>	5
<i>Clematis ligusticifolia</i>	1
<i>Achillea lanulosa</i>	1
<i>Heracleum sphondylium</i>	1

*Cover data codes represent the mid-point for the range. For example, 3=1-5%, 10=5-15%, etc.
Cover Code 1 denotes <1%.

Conclusion

From Fort Collins to Pueblo, commercial and residential development has altered the landscape resulting in the loss of many natural heritage elements. The majority of the Upper Purgatoire River watershed has remained in large landholdings and was, until now, overlooked by developers because of its remote location and difficult access. It has not experienced overuse from recreation common in other parts of Colorado. As such, the Upper Purgatoire offers an opportunity to protect large tracts of relatively common yet valuable ecosystems while they are still common. Protecting large tracts of all the ecosystem types in the Upper Purgatoire will insure the integrity of these ecosystems while helping to avoid possible future imperilment of species in the region.

This Colorado Natural Heritage Program survey located plants, animals, and plant communities of global and state-wide biodiversity significance. Survey results suggest that the Upper Purgatoire does not contain a large concentration of rare vascular plants and vertebrate animals. However, the region does contain many good to excellent examples of relatively common low-elevation plant communities. Some of the sites in this report are designed around imperiled plants and animal, while several are designed around these plant communities. There is much evidence to suggest that maintaining the long-term viability of these plant communities is the best way to protect the integrity of the Upper Purgatoire's natural heritage.

Of the sites presented in this report, consideration should be given first to sites with the highest Biodiversity Rank. Five sites were ranked B4, indicating moderate biodiversity significance. These sites are far more meaningful than the ranking language suggests. Placed in the context of Colorado's highly disturbed Front Range, they are very important areas. All sites included in this report should be considered as "red flags" when considering proposals for commercial and residential land use changes.

Riparian areas in the watershed are highly degraded. Stream banks are incised as much as 30 feet, exotic plant species thrive, and stream channels are dramatically altered. Planners must consider the effects on already degraded Purgatoire River tributaries when evaluating proposals for water diversions, groundwater development, and other activities that will further compromise these areas.

Several large ranches within the study area have already placed more than 50,000 acres under conservation easement with The Nature Conservancy and The Rocky Mountain Elk Foundation. By emphasizing the areas identified during this survey, planners will preserve Colorado's vanishing natural heritage, help ensure that the Upper Purgatoire River watershed continues to contain some of Colorado's best wildlife habitat, and enhance existing protected areas.

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