

Monument Creek Watershed Landscape Assessment

a Legacy Resource Management Program Project



Monument Creek Watershed Landscape Assessment

prepared for:

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31 January 2002

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Cover photo: Panorama of Pikes Peak and the Rampart Range (the western boundary of the Monument Creek Watershed) from Palmer Park. Photograph by J. Armstrong.

**Funding provided by the Legacy Resource Management Program,
administered by the US Army Corps of Engineers.**

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acknowledgements

Planning is typically a collaborative process: this effort is not an exception. The authors wish to thank the following people, whose support, expertise, guidance and good cheer lent well to a planning project spanning the better part of two years:

The landscape assessment was funded by the **Legacy Resource Management Program**. The project was administered by **Robert Johnson** (US Army Corps of Engineers).

Dr. Doug Ripley (US Air National Guard) and **Jim McDermott** (US Air Force Academy) for getting the ball rolling; **Lee Grunau** (Colorado Natural Heritage Program) and **Chris Pague** (The Nature Conservancy) for getting the project off the ground.

Many thanks to planning team members for enduring a long planning process, for guidance and expertise: **Vic Eklund** (Colorado Springs Utilities); **Chuck Kostecka** (Colorado State Forest Service); **Trina Lynch** (Colorado Division of Wildlife); **Jim McDermott** (US Air Force Academy); **Brian Mhlbachler** (US Air Force Academy); **Andy Schlosberg** (Colorado State Forest Service); **Steve Tapia** (US Forest Service); **John Valentine** (Natural Resources Conservation Service).

Dr. Merrill Kaufmann (USDA-USFS Rocky Mountain Experiment Station) provided important fire history and reference condition information, led a two-day workshop and provided much guidance and expertise. His support of the project is much appreciated.

The US Air Force Academy Natural Resources staff: **Greg Speights**, **Steve Wallace**, **Josh Kellar**; US Air Force resource managers on the national level: **Kevin Porteck** (USAF Department for Environmental Excellence).

Local stakeholder provided information about planning issues and desired future conditions: **Norman Armentrout**, **Scott Campbell**, **Dan Cleveland**, **Lynn Engle**, **John Hanlon**, **Mike Isele**, **George Maentz**, **Paul Magnuson**, **Cynthia Nicholos**, **Josh Osterhoud**, **Bob Overman**, **Sally Riley**, **Carl Schueler**, **Ruth Anne Steele** and **Monica Young**.

Leah Davis (Colorado Springs Pioneer Museum); **Brett Gracely** (URS Corporation), **Rich Muzzy** (Pikes Peak Region Council of Governments), **Dan Fosha** (Sierra Club), **Bruce Rosenlund** (US Fish and Wildlife Service), **Seth McClean** (Colorado Division of Wildlife), **David Theobald** (Natural Resource Ecology Laboratory) and **Diane Strohm** (US Forest Service).

CNHP staff members contributed directly (and indirectly) to this effort including: **Jodie Bell**, **Laine Johnson**, **Rob Allen**, **Amy Lavender**, **Alison Loar**, **Adam Carheden**, **Drew Redfield**, **Mary Klein** and **Dr. Boyce Drummond**.

Many thanks to document reviewers: **Jim McDermott** (USFA), **Steve Tapia** (USFS), **Trina Lynch** (CDNR-CDOW), **Georgia Doyle** (CNHP), **Andy Schlosberg**, (Colorado State Forest Service), **Laura Stone** (Colorado State University) and **Suzanne Nayduch** (Colorado State University).

All photographs by **J. Armstrong** (CNHP) unless otherwise noted.







introduction

project history

The Monument Creek Watershed Landscape Assessment was initiated by the United States Air Force Academy with funding from the Legacy Resource Management Program (administered by the Army Corps of Engineers). The goal of the project is to document the current and historic condition of the area and to provide the foundation for multi-jurisdictional, ecological management within and adjacent to the landscape area.

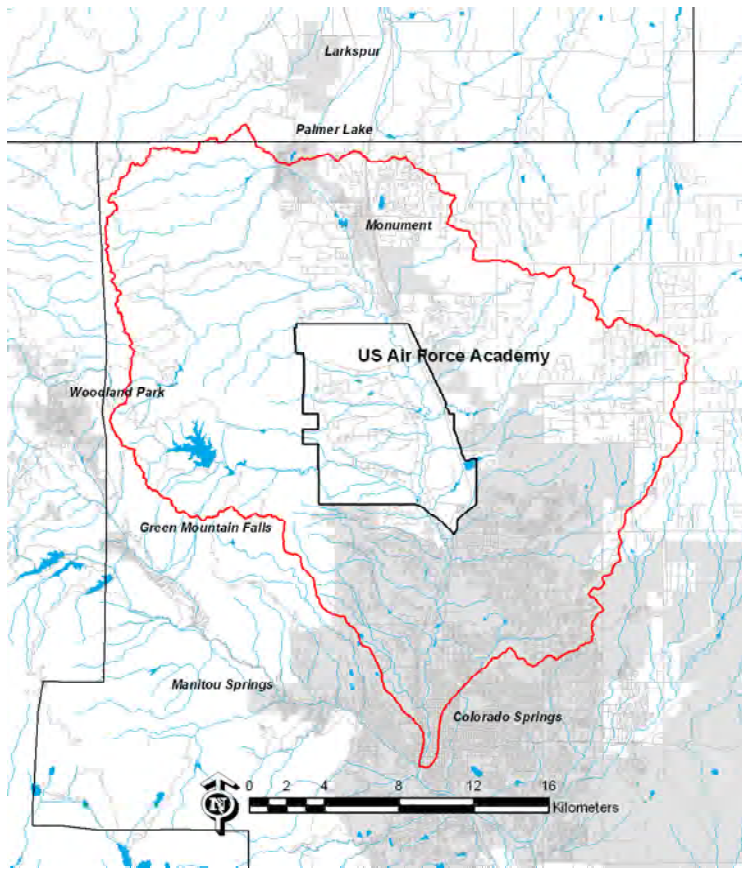
Photograph 1: The Farish Memorial Recreation Area is administered by the US Air Force Academy. A portion of the recreation area is managed for recreation opportunities while the remainder is managed as wildlife habitat and open space. The Farish property is one of the largest openings in the densely forested Rampart Range and is important habitat for a notable herd of elk. Air Force Academy natural resource managers are currently conducting monitored aspen regeneration projects in the area.

background

As areas across the nation continue to urbanize, Department of Defense (DoD) installations formerly on the periphery of developed areas are under increased pressure to plan and manage for a diverse set of issues as development encroaches on their administrative boundaries. In order to meet goals and objectives associated with a facility's military mission and to be appropriately engaged within the larger community, installations are increasingly viewing themselves from within the context of larger regional planning goals and management objectives, including growth, transportation, natural resources and the potential need for multi-jurisdictional planning efforts.

The US Air Force Academy (USAFA) falls into this category of DoD installations once located on the periphery of an urban area, now nearly surrounded by residential development or National Forest. Increased development and associated population growth brings with it demands





Map 1: The United States Air Force Academy is located in the “heart” of the Monument Creek Watershed (depicted here in red). Major urban communities within the watershed include: Colorado Springs, Monument, Palmer Lake and Woodland Park.

for access to lands, complaints about noise, impacts to USAFA management efforts from land use adjacent to the Academy and the expectation that the USAFA will be a working partner in the planning process.

The landscape assessment project represents a multi-jurisdictional planning effort with planning team members from the following agencies and organizations: United States Air Force Academy, US Forest Service, Natural Resources Conservation Service, Colorado Division of Wildlife, Colorado State Forest Service, El Paso County, Colorado Springs Utilities and the Colorado Natural Heritage Program (Colorado State University). The project was facilitated by the Colorado Natural Heritage Program.

the military mission

The United States Air Force Academy balances a complex mission of training future military leaders and the management of natural resources and ecological systems within the jurisdictional boundaries of the installation. The landscape assessment effort is designed to help the USAFA fulfill its mission by providing a basis for ecologically based multi-jurisdictional planning and resource management.

USAFA management goals and mandates are complicated by regional growth that puts pressure on the Academy to respond to community concerns that may occur outside its managed areas; this same growth has also impacted the Academy’s ability to manage its internal resources as upstream users impact downstream inhabitants or administrators including the USAFA. These dynamics give additional legitimacy to multi-jurisdictional planning efforts and the concept of ecological management as relationships between watershed systems are clarified. Clearly, a useful tool in the management of shared resources lies in the ability to “think like a watershed” and to better understand the complex relationships among the many systems that comprise the local landscape.

assessment overview

A **landscape assessment** is primarily a reference document that helps to guide and provide background for intra-jurisdictional planning efforts. A landscape assessment is not a management plan, but rather a reference tool designed to be used as foundational material for

planning processes, to characterize and prioritize further management action and to identify data and information gaps before a more formal planning process takes place and to provide broad brush planning pathways or recommendations.

The Monument Creek Landscape Assessment (MCWLA) contains three main components: a **reference condition** (Chapter 4), a **current condition** (Chapter 3) and a **desired future condition** (Chapter 7).

This assessment was developed under the theoretical framework of **ecological management** or the basic belief that intact ecological systems tend to be more sustainable, more resilient to disturbance and require fundamentally fewer management inputs than those systems for which essential ecological processes have been disrupted. Thus, much attention has been given to historic systems and reference conditions to be used as guides for the development of ecologically based planning recommendations.

An effort was also made to cross-reference the document to avoid redundancy and to reinforce the relational effort of landscape level planning and the complex relationships among component biological, physical and social systems. Thus, readers are guided to other related sections of the document as appropriate.



Photograph 2: The Rampart Range and the US Air Force Academy are dominant landscape features as seen from the Northgate area (east-central watershed).

planning team

The planning team with members from the **United States Air Force Academy, US Forest Service, Natural Resources Conservation Service, Colorado Division of Wildlife, Colorado State Forest Service, El Paso County, Colorado Springs Utilities** and the **Colorado Natural Heritage Program** (Colorado State University) provided guidance and expertise to the project, reviewed documents and served as administrative liaisons between respective agencies and organizations.

Initially, monthly meetings were held to ensure the effort started with a firm foundation in place. As the project progressed into Phase 2, planning team participation became slightly more sporadic and individual team members were called upon or consulted as appropriate.

methodology

Although the goal of the MCWLA is not the creation of a management document, the planning process utilized to generate the assessment is based upon two planning models that are particularly effective at



guiding ecological and landscape scale planning. Marsh (1998) describes the landscape planning process as one which combines three major planning related disciplines: decision making, technical and design.

While these areas of planning are often regarded as distinct, landscape planning emphasizes the relationship between the three areas and the importance of recognizing that a planning process lacking one or more of the areas will likely be incomplete. Much of the work in this document falls within the technical aspects of planning that is the process of assembling pertinent information, analyzing that information, making inferences and understanding how the information

informs other areas of inquiry. Design is addressed on a gross scale in the form of general recommendations or “planning pathways” (see page 117), providing a sense of direction for subsequent planning processes.

Decision making is not represented within the scope of this project. As a reference document, the MCWLA provides a foundation for planning efforts in the area by collecting baseline information on the systems contained within the project area, pointing out areas where current conditions deviate significantly from what is believed to be the historic condition, and coarse recommendations from which to proceed; therefore, regional resource managers, including private landowners, will need to design and implement courses of action using the assessment as a foundation.

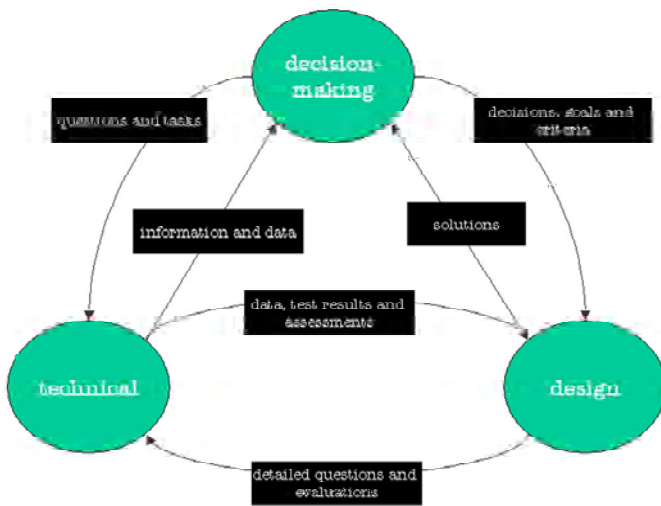


Figure 1: The Landscape Planning Model (from Marsh 1998).

The ecological planning model follows similar assumptions, but places particular importance upon education and citizen participation (Steiner 1991). The process used to develop this assessment concentrated on the first six steps of the model (and to some extent the eighth), again leaving the development and implementation of an actual planning process to local land managers and stakeholders.

Both models are adaptations of the rational planning model utilized in many conventional planning processes. Common to both are feedback loops or the assumption that the process is iterative and that it might be necessary to revisit steps based upon outcomes along the way.

The MCWLA was developed from existing data sources, including: digital spatial data (GIS), reports, journals, interviews, internet sources, etc. Data were incomplete or missing for some systems, even those of critical importance to maintain watershed health and integrity.

Identified data gaps are addressed in detail in the recommendations section (see page 117). The lack of appropriate data in some cases affected the ability of the assessment to properly document system conditions and functions, but attempts were made to find surrogates or in other ways make the most effective use of available information.

The assessment document is comprised of three main components:

1. current condition
2. reference condition
3. desired future condition

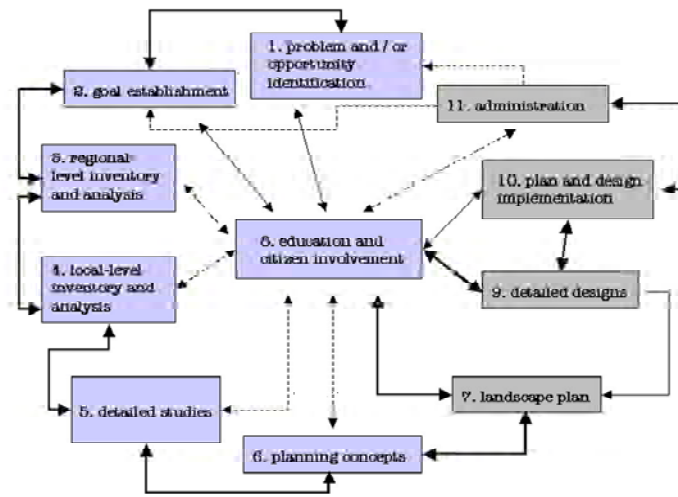


Figure 2: The Ecological Planning Model (from Steiner 1991).

The **current condition** is a detailed summary of the planning context, documenting existing information on systems contained within three broad categories or **domains**:

1. **biological** (vegetation, wildlife, significant biological resources)
2. **physical** (topography, elevation, slope, aspect, soils, geology, hydrology)
3. **social** (population, settlement patterns, demographics, land use, land ownership, recreation)

The current condition is designed to be a snapshot of the current status of the watershed, a summary of the fundamental interactions among component systems and a general "state of the watershed" report.

The **reference condition** or historic condition attempts to portray the project area as it existed before intense human settlement or accelerated land use change. Based upon settlement patterns in the project area, the reference condition for this particular project is regarded as the period before 1860 (when the first intense, permanent settlement began). The goal here is not pick a static point in history but rather generalize the historic conditions in such a way that we can document change over time, using the current condition as a basis for comparison. The fundamental characteristics of change are useful for the establishment of a thoughtful and informed **desired future condition**.

Information to document the reference condition is gathered from a wide variety of sources and includes both quantitative and qualitative information. Data that we would assume to be useful today may not have been gathered 150 years ago. In fact, much of what we know is acquired through inference and oral history. These sources might include: journals, letters, survey expedition notes, legal records, local history and interviews. Contemporary research also helps portray the watershed of years ago. Current fire history research, for instance, uses tree cores and measurement of fire scarring to build a long-term



ecological history of an area. Other research including geological and geographical efforts also lend to the establishment of a reference condition.

A **desired future condition (DFC)** provides a direction for future planning processes. Derived from conclusions made from differences between the reference and current conditions, input from local stakeholders and an analysis of issues, opportunities and constraints, the desired future condition documents future goals and management directions. Development of the DFC is useful as a guide to management efforts and helps coalesce the landscape assessment in a succinct manner.

It should not be assumed that the desired future condition will simply restate the reference condition, although ecological functions may be developed as management goals. Clearly, some changes in the watershed have been profound and rather than view the past as a “golden era” we can use history and our ability to understand change to ensure that the future condition occurs within established social and ecological parameters.

To effectively develop a DFC, the differences between the reference and current conditions are systematically analyzed. The key aspects of change over time are synthesized and assembled in a way that the nature of this change can be summarized and used to better understand the current condition and to influence the development of the DFC. Characteristics of change that will be analyzed include: causal factors (what caused the change), rates of change (when the change occurred or over what periods of time), the spatial distribution of change (where change occurred), what systems changed the most, and characteristics of change that describe why change occurred.

project area boundary

The planning team determined that adopting an ecologically based project boundary would better allow for the analysis and description of ecological systems. Watershed boundaries, though largely diffuse, provide an opportunity to plan across jurisdictional boundaries, to emphasize landscape scales and place into context essential ecological relationships among systems that comprise the landscape. The Monument Creek Watershed (a 5th-level or 10-digit HUC) also fits well into the regional context where landscape assessments have been compiled for the Upper South Platte Watershed and the Pikes Peak Region. This combination of landscape level efforts provides managers, planners and citizens of the region additional tools upon which to base decisions about their environment.

Sub-watersheds (in this case 6th-level or 14-digit HUCs) are used to prioritize management recommendations and provide for a slightly finer scale characterization and analytical unit, providing a more tangible approach to the assessment of the landscape. Sub-watersheds are addressed in more detail in the “Watershed Prioritization” chapter beginning on page 105.



a note about units, scale and accuracy

Much of the watershed characterization in this assessment was developed using a **geographic information system (GIS)**, utilizing existing datasets from a wide variety of sources (see the Digital Data Sources section on page 133). A GIS gives the impression of nearly limitless precision, often calculating areas to two or more decimal places even if such precision is not warranted. Given the nature of the datasets and their original scales, such calculations can be misleading given the landscape scale of this effort. Many of the landscape systems have been characterized by calculating the percentage of total area of a given characteristic.

For example, Colorado Division of Wildlife Basinwide vegetation data (CDOW 1999a) were used to develop the relative percentage of vegetation cover within the watershed (see page 51 for more information). These data were originally derived from Landsat satellite data and classified into 25 meter grids. Using a GIS, areas were calculated in square meters and converted to hectares (**ha**) to develop to the total percentage of each class of vegetation of the total watershed area. According to this analysis, ponderosa pine comprises 28.44% of the total landscape area, representing 17,411.888 ha. The resulting figures are deceptively precise. This precision is even more misleading given that the assumptions used to develop the data are not explicit. For example, the dataset does not include a category for Douglas-fir, although it is a significant species on the watershed landscape. Although percentages have been rounded off in this assessment, all figures should be used as general guides, rather than precise figures for policy development, planning or land management. It is likely that to develop sound management efforts, additional local scale surveys will be required.

Most data and analyses were collected and conducted on the 6th-level watershed scale. Thus of primary relevance to this planning effort were large scale disturbance events, structure, species and systems of landscape-scale significance and other issues that occur and relate on those scales. In some cases, local scale events are noted or addressed as appropriate, particularly if that issue or system is indicative or representative of landscape-scale processes.

Metric units are used throughout the assessment as possible. Conversions to English units are generally provided for convenience. See Appendix 1 for metric to English conversions and additional information on units, scales and cartographic projections.



Map 2: The Monument Creek Watershed (in red) drains approximately 446 km (280 mi) of stream reach. Watershed boundaries can be effective planning boundaries as they capture essential ecological processes and provide a frame of reference upon which ecological management objectives can be placed.

terminology

landscape

A **landscape** is simply defined as the composite of natural and human features that characterize the surface of the land or perhaps a little more specifically a “mosaic where the mix of local ecosystems or land uses is repeated in similar form over a kilometers-wide area (Forman 1995); a **landscape assessment** is a reference report that documents the historic, current and desired future conditions, assessing the biological, physical and social systems of a landscape.

A landscape represents a basic “form-function” or “form-process” relationship: much of our understanding of the processes that operate within it comes from observing forms that are present (Marsh 1998). This is a useful distinction to make as a planning effort of this nature is unable to undertake the on-the-ground scientific surveys and inventories to fully understand the processes underlying the function of the landscape. We then learn to read observed forms whether via observation, maps or digital information and rely on understanding the processes that produce form and how these relationships manifest change over time.

Several common misperceptions regarding landscapes limit our ability to understand and plan for change: landscapes are not static, nor are they comprised of solely of “ancient” features; rather, they represent, for the most part, the sum of processes that currently exist there. As



Photograph 3: Looking west from the Air Force Academy to the Rampart Range, the Monument Creek Watershed landscape is remarkably diverse and includes the impacts of anthropogenic effects over time: displaced natural vegetation, roadways, and structures.

systems in flux, there is a certain level of balance between forces of change and forces of resistance in landscapes. Only when events occur outside the historic range of variability do we have change on a massive scale (slope failure, large scale erosion, etc.). Thus, landscape change can be regarded as incremental but is more often defined by “events” that can be measured in terms of frequency and magnitude. Events that result in the most amount of change in the long-term are moderately large events of moderately low frequency. These types of events might include: seasonal flooding (or flooding that occurs every two or three years), insect outbreaks, or perhaps small scale fire.

To better understand a landscape’s stability it is important to address both the intensity and frequency of events but also how resistant the landscape is to these processes. There is a certain balance within the landscape referred to as **critical balance**. It is usually when the forces of

change outweigh a landscape's ability to resist that we see massive change.

Likewise, landscapes regarded as **conditionally stable** are those that maintain a sensitive balance based upon a key ecological variable. For example, in landscapes with extreme slopes or highly erosive soils, somewhat specialized vegetation may in fact hold the entire landscape together, without which even a relatively minor event could lead to profound changes such as slope failure or stand replacing forest fires.

This document will explore the issue of critical balance within the project area and use existing information to determine whether the landscape is characterized by conditional stability and if so, identifying the ecological systems or factors that are key to long-term stability of the system.

project area overview and planning context

The assessment area encompasses the Monument Creek Watershed located in northwestern El Paso County, Colorado. The project area encompasses approximately 61,200 ha (151,300 ac) of the Fountain Creek Watershed. The minimum elevation within the project area is approximately 1,800 meters (6,000 feet) and the maximum is 2,965 meters (9,727 feet) at the top of Ormes Peak in the Rampart Range. The Monument Creek Watershed is part of the Arkansas River drainage, Colorado's largest river basin, draining 62,011 square km (24,904 square miles) of land area (Colorado State University 2001).

The project area is characterized by a complex land ownership pattern, representing a myriad of potential uses and relationships. The land status break down is as follows (CDOW 1998b):

- **Private** (which includes land managed by local government) - 58% or 35,360 ha (87,377 acres)
- **Forest Service** - 29% or 17,900 ha (44,232 acres)
- **Department of Defense** - 12% or 7,473 ha (18,466 acres)
- **State of Colorado** - 1% or 500 ha (1,228 acres)
- **Bureau of Land Management** - < 1% or 3 ha (6 acres)

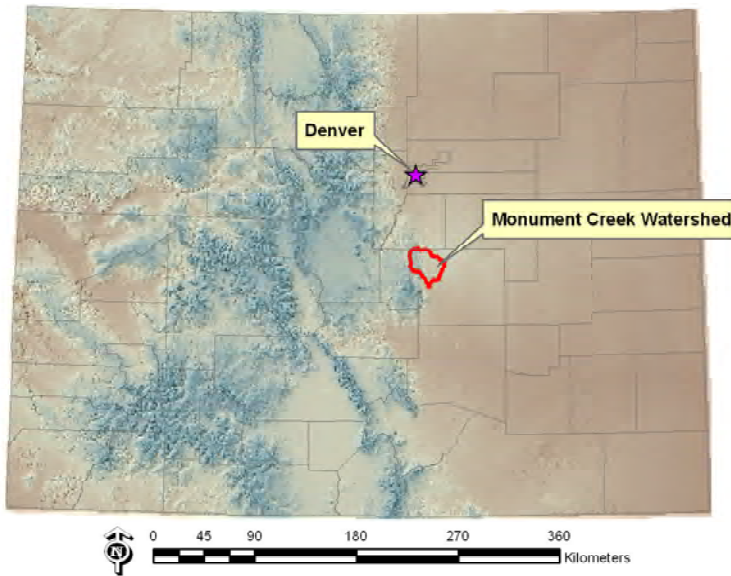
The project area is comprised of three predominant vegetation groups that are strongly correlated to elevation, precipitation and soils: mixed coniferous forest, shrublands and grasslands. Regional vegetation is less regulated by long-term ecological processes than anthropogenic effects. As a result, natural disturbance regimes have been altered due to land use change, fire exclusion, the spread of invasive and exotic species and other impacts.

Climate is complex in the project area, largely dependent on elevation and topography. The mountainous portions of the project area receive over 64 cm (25 inches) of precipitation per year. Lower elevations within the watershed receive less precipitation, averaging just over 41 cm (16 inches) per year (Colorado State University 2000). Precipitation generally occurs during the summer months as part of seasonal



monsoon cycles and during the winter in the form of snow. Unpredictable weather patterns can occur within the watershed. Notable is the Monument Hill area of the Palmer Divide. Many reaches of the Monument Creek Watershed are prone to seasonal flash flooding.

The watershed is highly urbanized: the Colorado Springs metropolitan area dominates the southern portion of the watershed. Other watershed communities include: Monument, Palmer Lake and Black Forest.



Map 3: The Monument Creek Watershed is located primarily in El Paso County, Colorado, approximately 100 km (60 miles) south of Denver.

According to US Census Bureau data (2000), nearly 200,000 people inhabit the project area, close to half of the entire population of El Paso County. Population is concentrated in the north Colorado Springs area (Lower Monument Creek and Douglas Creek sub-watersheds; see page 23 for more information on 6th level watersheds), along the I-25 corridor and former ranch lands east of the Air Force Academy.

Between 1930 and 2000, the population of El Paso County grew by nearly 950%, from just over 49,000 residents to over 500,000 residents (US Census Bureau 2001). Between 1990 and 1998 alone, the county grew by 24%. While neighboring Douglas County grew faster during this period (over 140% growth between 1990 and 1998), more people migrated to El Paso

County than any other county in the state (over 95,000) (Colorado Division of Local Government 2000).

El Paso County is expected to continue growing. Between 1990 and 2025, the county is expected to grow by another 85%, with nearly 340,000 new residents. It is expected that the population of El Paso County will surpass that of Denver County in 2005 (and perhaps sooner), becoming the most populous county in the state.

The economic base of county has changed dramatically over the last 100 years. Formerly a regional health center and once driven by resource extraction and support for mining and timber industries, the region's economy is now dominated by federal installations, a burgeoning high tech sector and higher education. The region possesses one of the highest concentrations of non-profit organizations in the country.

other regional assessments

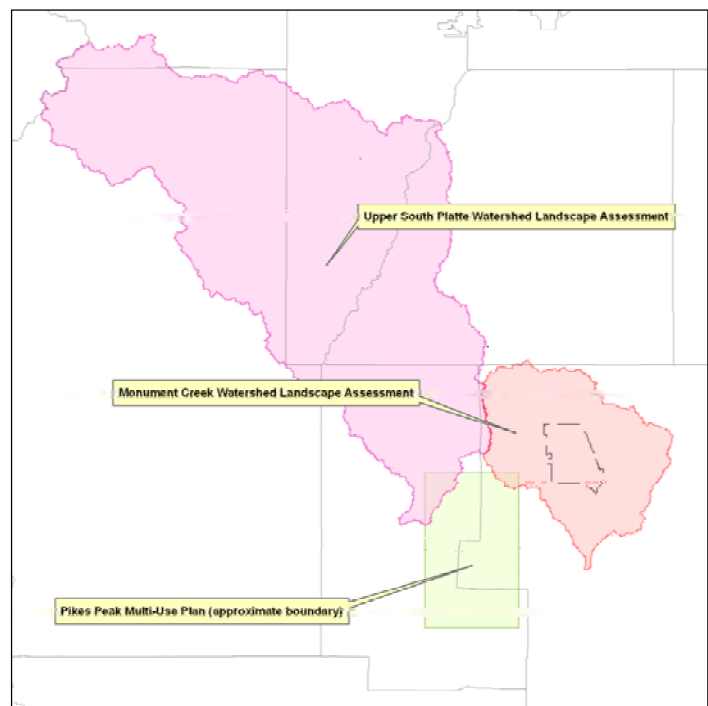
The Monument Creek Watershed Landscape Assessment (MCWLA) is one of several landscape assessments that have been completed in the region. In 1999, the US Forest Service developed a landscape assessment of the Upper South Platte Watershed that shares a boundary with the Monument Creek Watershed. This effort was largely undertaken as a result of catastrophic flooding following the Buffalo Creek fire of 1996. The assessment prioritized sub-watersheds for additional planning work and management efforts.

Also in 1999, the *Pikes Peak Multi-Use Plan* was completed. This planning process followed an extensive public input process designed to measure and integrate the needs and desires of a diverse stakeholder group into a management plan largely built around recreation. The project area encompasses the Pikes Peak region and the area immediately to the south of the Monument Creek Watershed.

Currently (winter of 2001), the Fountain Creek watershed initiative is addressing watershed issues (including to some extent, the Monument Creek drainage). This effort differs slightly in scale and emphasis but both projects have areas of overlap.

The MCWLA, then, fills a regional need by assessing the area that includes north Colorado Springs, the eastern portion of the Rampart Range, the United States Air Force Academy, the Palmer Divide and the quickly developing Black Forest area.

Unique to this particular effort is the diversity of the project area which includes forest and grasslands, urban areas and a federal military installation. This diversity translates into a unique and multi-layered project but also portends to complex relationships of competing values and needs, and ownership patterns. Assessing such a diverse landscape also presents problems not typically encountered in similar efforts: a **general lack of information** on key watershed systems (this point will be addressed throughout the assessment and in the recommendations section); **datasets that lack continuity** (across multi-jurisdictional boundaries) or are otherwise incomplete; **large urbanized areas** (north Colorado Springs) and **rapidly developing, mixed-density residential development**. The pace of change is so rapid, that during the two years that the landscape assessment was under development, several sections have needed periodic updating to remain current.



Map 4: The Monument Creek Watershed Landscape Assessment is one of several landscape-scale planning efforts that have occurred in the region. In 1999, the USFS completed a landscape assessment of the Upper South Platte Watershed and Colorado Springs Utilities and the USFS completed the Pikes Peak Multi-Use Plan. A plan for the Fountain Creek Watershed is also being written and is expected to be completed in late 2001 or early 2002.





watershed characterization

A watershed characterization provides a more detailed discussion of fundamental systems that comprise the landscape area. These include foremost those systems that are “foundational” or those systems that in turn influence other systems but in themselves have undergone very little structural change since the reference condition period (circa 1860). This chapter is in part a convenience to separate those systems for which a reference condition has been established from those where one does not exist or data did not support an establishment of one. Thus, the watershed characterization and the current condition discussed in the following chapter are closely aligned. This chapter provides both the detailed planning context and further discussion of landscape concepts.

Photograph 4: The confluence of Monument and Fountain creeks is located near the intersection of Interstate 25 and US Highway 24. The Monument Creek Watershed is a very diverse watershed with a large urbanized component. This diversity underscores the complex relationships among ecological systems and suggests that greater emphasis be placed on understanding these systems and taking into account the relational nature of watersheds and cumulative impacts.

a landscape

A landscape can be regarded as part of a spatial hierarchy that describes the planet: the broadest (most coarse) spatial category is biosphere or planet, the finest spatial category in the hierarchy is local ecosystems or land uses.

There are several ways to define a landscape. For the purposes of this report, a **landscape** has been defined as a “mosaic where the mix of local ecosystems or land uses is repeated in similar form over a kilometers-wide area” (Forman 1995). McGarigal (2002) points out that landscapes are not necessarily defined by size but rather the spatial pattern of interacting mosaics *relevant to the phenomenon under consideration*. The key then is understanding the spatial pattern (and the

unity provided by this pattern) and the interaction of these patterns as ecological processes. By treating the Monument Creek Watershed as a landscape, definite and repeating ecological patterns emerge that emphasize interrelationships, dependencies, trends and characteristics of significance to land use planning in the area (Map 5).

The landscape mosaic is comprised of three main spatial elements: **patch**, **corridor**, and **matrix**. Landscape elements (spatial elements on landscape scales) can be the result of anthropogenic effects (e.g. land use), different ecosystems, successional stages or community types (Forman 1995). A temporal component is also present in varying scales. The generalized **space-time** principle presupposes that most short-duration changes affect small areas and long-duration change affect larger areas (Forman 1995). It follows that fine-scale events (short duration) are more variable and less stable than coarse scale (long-duration) events which tend to be more persistent over time. **Grain** refers to the texture

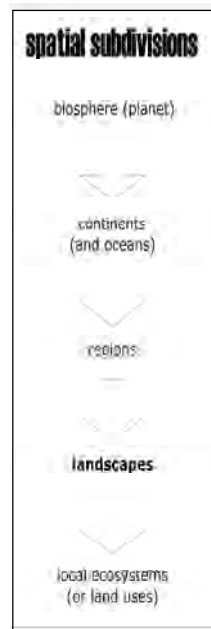
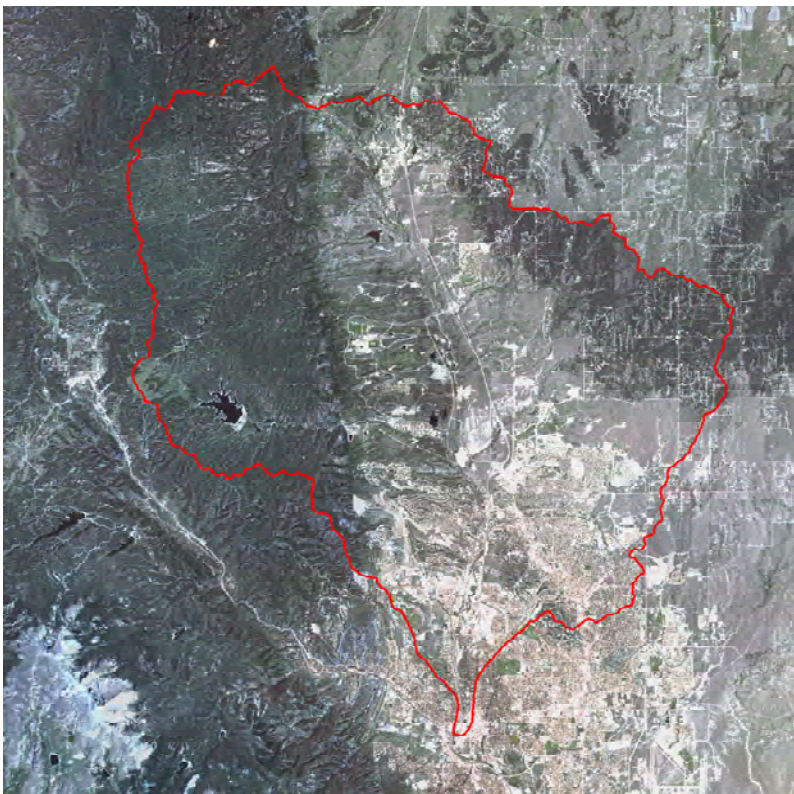


Figure 3: Spatial subdivisions regard the planet at five spatial scales. The landscape scale is useful for regional planning.

of the landscape elements and describes the nature or character of the assemblage of patches, corridors and matrices. Grain is measured by the relative size of the patches: fine-grained landscapes are primarily comprised of small patches and coarse-grained landscapes, larger patches (Forman 1995).

Patches are regarded as somewhat distinct areas or timeframes where environmental conditions are relatively homogenous. Patch boundaries are defined by changes in structure, composition, etc. that are relevant to the species or ecological process being considered (McGarigal 2002). Patch boundaries can vary from simple to complex. Boundaries are measured in terms of **edge**.

From an ecological perspective, patches represent relatively discrete areas (spatial domain) or periods (temporal domain) of relatively homogeneous environmental conditions. Patch boundaries are



Map 5: A Landsat composite image of the Monument Creek Watershed shows a distinct landscape mosaic: including the Rampart Range to the west, the Black Forest to the east, the Palmer Divide to the north and the Colorado Springs metropolitan area to the south. (Landsat data, September 1997, courtesy of the USFS).



distinguished by differences in environmental character from their surroundings, relevant to the organism or ecological phenomenon under consideration.

Landscape ecology focuses on composition, structure and relationships inherent in the core systems and how the landscape functions in the larger regional context. Landscape ecology focuses on three main characteristics of the landscape:

- structure
- function
- change

It is based upon the assumption that the landscape mosaic in the form of patches strongly influences ecological processes.

the Monument Creek Watershed landscape

The Monument Creek Watershed area is a complex mosaic of ecological relationships. These relationships can be expressed in terms of basic landscape metrics or values that describe the landscape structure.

The use of remotely sensed digital data greater aids our ability to characterize and understand the landscape as a whole. Landsat data can be used to classify differences in reflectivity in the landscape and a GIS can be used to discern and quantify relationships.

A 25 meter cell vegetation classification developed by the Colorado Division of Wildlife (1999a)

for the Fountain Creek Watershed served as the basis for landscape metric calculations. This classification breaks vegetation into classes based upon the CDOW Colorado Vegetation Classification Project (CVP) Scheme and the BLM Cover Type Codes and Names. The latter was used in this analysis for consistency and correspondence with grid values. The Monument Creek Watershed was clipped from the Fountain Creek Watershed dataset to define the area of analysis.

Patch Analyst 2.0 (a FragStats front-end for ArcView GIS) was used to develop an array of landscape and class statistics useful for characterizing the landscape. Seventeen cover types are present in the Monument Creek Watershed. Table 4 lists these types by area (in hectares) and % of total landscape area. To effectively quantify and characterize the landscape, the FragStats model generates metrics that define the num-

Table 1: Vegetation Classification Codes by Area and Percentage of Total Area (Data source: CDOW 1999a)

<i>class/code</i>	<i>area (ha)</i>	<i>% total area</i>	<i>BLM name</i>
0	179.750	0.294	not defined
1	5534.250	9.038	urban / built up
2	611.312	0.998	agriculture
6	4095.500	6.689	barren land (<10% veg)
8	1273.875	2.080	riparian
9	406.062	0.663	water
11	777.438	1.270	commercial
15	15386.312	25.129	grass / forb rangeland
43	507.562	0.829	sagebrush community
48	39.625	0.065	pinon-juniper
49	8242.250	13.461	gambel oak
51	1075.062	1.756	mountain shrub mix
57	1568.312	2.561	aspen
59	17411.875	28.437	ponderosa pine
60	79.312	0.130	englemann spruce / fir mix
63	85.375	0.139	ponderosa pine / gambel oak
64	2977.000	4.862	ponderosa pine / aspen mix
79	979.000	1.599	grass / cholla / misc cactus mix



ber of patches, their size, patch complexity, the distribution of patches on the landscape, the amount of edge, proximity to other patches of similar type and so on.

Table 2: Summary of Monument Creek Watershed landscape metrics

Total Area (ha):	61229.875
Largest Patch Index(%):	12.727
Number of patches:	61033
Patch Density (#/100 ha):	99.678
Mean Patch Size (ha):	1.003
Patch Size Standard Dev (ha):	52.694
Patch Size Coeff of Variation (%):	5252.468
Total Edge (m):	14170975.000
Edge Density (m/ha):	231.439
Landscape Shape Index:	143.172
Mean Shape Index:	1.275
Area-Weighted Mean Shape Index:	22.989
Double Log Fractal Dimension:	1.495
Mean Patch Fractal Dimension:	1.044
Area-Weighted Mean Fractal Dimension:	1.291
Total Core Area (ha):	61229.875
Number of Core Areas:	61475
Core Area Density (#/100 ha):	100.400
Mean Core Area 1 (ha):	1.003
Core Area Standard Dev 1 (ha):	52.694
Core Area Coeff of Variation 1 (%):	5252.468
Mean Core Area 2 (ha):	0.996
Core Area Standard Dev 2 (ha):	52.504
Core Area Coeff of Variation 2 (%):	5233.559
Total Core Area Index (%):	100.000
Mean Core Area Index (%):	100.000
Mean Proximity Index:	0.000
(MPI threshold = 1,000)	
Shannon's Diversity Index:	2.045
Simpson's Diversity Index:	0.821
Modified Simpson's Diversity Index:	1.719
Patch Richness:	18
Patch Richness Density (#/100 ha):	0.029
Shannon's Evenness Index:	0.708
Simpson's Evenness Index:	0.869
Modified Simpson's Evenness Index:	0.595
Interspersion/Juxtaposition Index (%):	65.237
Contagion (%):	46.558

While there are several ways to characterize a landscape, it is important to develop a consistent set of assumptions that clearly recognizes that landscape structure consists of both composition and configuration and that the various landscapes metrics represent landscape structure separately or in combination. In other words, landscape metrics must be regarded within the context of other metrics, as a single metric may not be characteristic of the landscape as a whole, but rather characteristic of one of its components. Thus, for these values to be of the greatest use, a valid analytical target should be developed that can be used as a basis for comparison. Given the rather broad goals of this assessment, analytical targets were not determined. Therefore, as the analysis lacks such a target, the values calculated for the watershed will be of limited use, other than simply to characterize the watershed as a whole landscape. With those assumptions in mind, the Monument Creek Watershed landscape is summarized in Table 2.

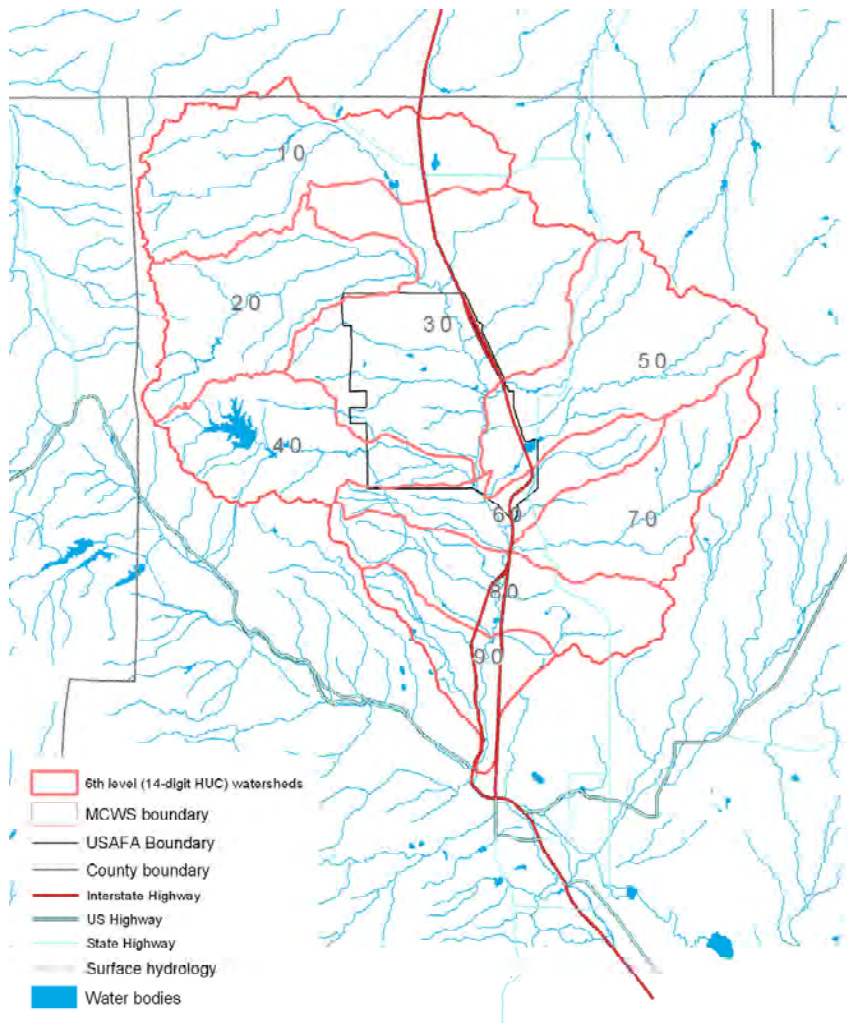
These numbers raise questions as to the characterization of the watershed: are there optimal numbers of patches for certain landscapes? Optimal amount of edge? How should patches be distributed? What is an optimal patch shape (e.g. simple versus complex) and size? Answers to questions such as these depend solely upon the nature and purpose of the analysis. In the case of a landscape assessment, the rationale can be rather diffuse as the goal is to assess the

character of the landscape as a whole and how that relates to numerous component systems. Thus, issues of landscape will be related directly to component systems as relevant, including but not limited to: vegetation, wildlife, endemic, threatened or endangered species, open space, hydrology (specifically watershed management). The relevance of these metrics or the use of them to establish targets will largely depend on management needs and specific planning goals developed to address issues within the watershed. Conversely, the model may be run under a targeted set of assumptions.

watershed landscape regions

Several distinct regions emerge from the watershed landscape that are useful to distinguish as they characterize topological and ecological relationships. Monument Creek roughly bisects the watershed into two





Map 6: 6th level (14 digit HUC) sub-watersheds of the Monument Creek Watershed. These units are useful for the prioritization of management and planning efforts and as analytical units or management zones.

halves, a western region dominated by the Rampart Range and the eastern portion which is comprised of the high plains and the Black Forest. The northern boundary of the watershed is formed by the Palmer Divide, which separates the South Platte and Arkansas River watersheds. Each of these sub-regions can be characterized differently and it is useful to do so if only to point out sharp contrasts present in the watershed, contrasts that are nearly lost when the watershed is treated as a whole. The major unit of analysis for this assessment is, however, the watershed. As mentioned previously, the next level of analysis is sub-watersheds, which will be used primarily for management prioritization and to emphasize the spatial distribution of ecological relationships across the landscape.

The Monument Creek Watershed is comprised of nine, 6th level (14-digit HUCs or hydrologic unit code) watersheds that are used in this assessment as potential management areas. The sub-watersheds are as

follows (names have been assigned for convenience -these are *not* official designations; the analytical unit in this case is the watershed id, or the final two digits of the 14 digit HUC (Map 6):

- 10 North Monument Creek (8,177 ha)
- 20 Beaver Creek (6,849 ha)
- 30 Jackson Creek (12,986 ha)
- 40 West Monument Creek (5,847 ha)
- 50 Kettle Creek (8,225 ha)
- 60 Pine Creek (3,654 ha)
- 70 Cottonwood Creek (5,716 ha)
- 80 Douglas Creek (5,728 ha)
- 90 Lower Monument Creek (3,051 ha)

The sub-watersheds receive detailed treatment in the watershed prioritization section beginning on page 105.

regional history

The establishment of an historical context is an important component of a landscape assessment as it sets the stage for better understanding the current condition and better informed recommendations or conclusions. History also provides background into the establishment of the reference condition. Included in this section are brief discussions of the region's history and early post-European settlement patterns.

Like much of the Front Range, at one time the Monument Creek Watershed was submerged under a shallow sea, the newly formed Rampart Range comprised of sediments left behind by even older oceans.

The Monument Creek Watershed region has long been home to humans. The area was inhabited seasonally by several indigenous groups. The Utes, Comanches, Kiowas, Cheyennes, Arapahoes and Sioux were known to have inhabited the area at one time (Carter 1956). Present-day US Highway 24 occupies what was known as the Ute Trail, the natural pass that provided access to the rich hunting grounds of South Park. As late as 1878, Utes were still establishing encampments at Garden of the Gods and along Monument Creek despite ongoing conflicts with increasing numbers of white settlers (Hall 1891).

Spanish forays into the region were infrequent. In 1779, Juan Bautista de Anza led an expedition against the Comanche, making his way through the San Luis Valley and the Arkansas River Valley before traversing the Ute Pass, passing through the region.

Zebulon Pike led an expedition in search of the headwaters of the Arkansas and South Platte Rivers in 1806 as part of the post Louisiana Purchase expeditionary phase (Carter 1956). Although it is unlikely Pike explored the Monument Creek Watershed although expedition notes suggest his northern-most foray was south of Cheyenne Mountain enroute to a short-lived attempt to climb the "Grand Peak" (later named Pikes Peak).



The Long expedition explored the region in 1820, the team's surgeon making the first recorded ascent of Pikes Peak (Carter 1956). The expedition camped on Monument Creek, just south of present-day Palmer Lake (Ripley 1994).

El Paso County was one of the original 17 counties formally recognized when the Territory of Colorado was organized in 1861.

The first recorded inhabitant of the region of European descent was Jimmy Hayes who built a small cabin on the banks of what is now Jimmy Camp Creek (a tributary of Fountain Creek, southeast of the Monument Creek Watershed) in 1833. A trader, Jimmy was killed by bandits soon after. In 1858, a group of settlers from Kansas set up camp near the Garden of the Gods on Camp Creek. The camp was destroyed during a flood in July of 1858.

Soon after, the first incorporated town in El Paso County was formed. The first recorded deed from Colorado City is dated, 13 August 1859. The city was incorporated on 1 November 1859 and within a year, 300 buildings has been erected (Hall 1891). Colorado City was located on the western edge of present-day Colorado Springs on the banks of Fountain Creek (Colorado City has since been subsumed by Colorado Springs). Colorado City was named the first territorial capital in 1861; however, it soon lost this status to Denver (Hall 1891). By 1863, a system of water rights was in development and agriculture began in earnest. By 1868, three flour mills were in operation.

Colorado Springs was established in 1871 by the enigmatic General Palmer as part of the "Fountain Colony," a corporation based in Pennsylvania (Colorado Springs would in essence be part of the Pennsylvania based corporation until the National Land and Improvement Company reorganized as a Colorado based corporation in 1883) (Hall 1891). Upon his first visit to the region, Palmer came upon the "amphitheatre of mountain and mesa, pine and plain" to find that the grassland mesa had recently burned "with the devastation that a prairie fire leaves in its wake" (Hall 1891).

Sited on the east bank of Monument Creek, Colorado Springs was built upon a foundation of land speculation and early covenants that ensured the town developed according to a carefully laid out plan. Undesirable settlers and businesses were excluded as newcomers were required to possess "good moral character and strict temperance habits" and \$100 cash to join the colony. Within four months of purchase, the new owner was required to improve the land with a residence or business (Hall 1891).

27th November 1806, Thursday - Arose hungry, dry and extremely sore, from the inequality of the rocks, on which we had lain all night, but were amply compensated for toil by the sublimity of the prospects below. The unbounded prairie was overhung with clouds, which appeared like the ocean in a storm; wave piled on wave and foaming, whilst the sky was perfectly clear where we were. Commenced our march up the mountain, and in about an hour arrived at the summit of this chain: here we found the snow middle deep; no sign of beast or bird inhabiting this region. The thermometer which stood at 9 degrees above 0 at the foot of the mountain, here fell to 4 degrees below 0. The summit of the Grand Peak, which was entirely bare of vegetation and covered with snow, now appeared at the distance of 15 or 16 miles from us, and as high again as what we had ascended, and would have taken a whole day's march to have arrived at its base, when I believe no human being could have ascended on its pinnacle.

Figure 4: Zebulon Pike explored the Pikes Peak region in 1806, in search of the Arkansas River headwaters. This journal entry most likely described the area surrounding Blue or Black Mountain, south of Colorado Springs, between Turkey and Little Fountain Creeks (from Carter 1956).



The early development of Colorado Springs differed from most settlements of the west as the founders offered inducements based upon class (to those who could pay as opposed to opportunism) and prohibition assumed a certain level of societal development not typically associated with so-called frontier towns. It has been said that in most frontier towns, the first building built was the saloon. Furthermore, Colorado Springs was founded under the auspices of railroad development rather than beforehand, simply waiting for the railroad to jump-start development. In many ways, early Colorado Springs resembles planned communities of today that rely on careful resource and economic planning to best use limited resources rather than reactive, yet more organic evolution.

The first town boundaries measured 1.5 miles long (north to south) and 0.5 miles wide and consisted of 48 city blocks. Within two months, 32 additional blocks were added to the town. Early inhabitants and visitors described Colorado Springs as “feel[ing] lost upon a boundless prairie” (Hall 1891). Nevada Avenue was planned for residential construction (the widened, landscaped median persists to this day) and commercial construction was to occur on Cascade Avenue. A fire in 1876 destroyed the business district on Cascade Avenue which was rebuilt with “handsome residences because of its uninterrupted view of the mountains.” Businesses were relocated to Tejon Street.

Seven thousand cottonwood trees were planted in the town and a six mile canal was built to bring water from Fountain Creek to the new town. Severe penalties applied to those who dumped refuse into the canals.

The Denver & Rio Grande Railroad was completed between Denver and Colorado Springs during the summer of 1871. The railroad was planned before Colorado Springs had existed, designed to support the burgeoning regional mining industry.

The Town of Monument came into existence during the middle 1860s as ranchers homesteaded the area in earnest. The first ranchers settled just northwest of the Monument Reservoir. The Mountain Ute were still using encampments along Monument Creek during this period. By 1867 the first large-scale saw mills appeared responding to recent settlement and a seemingly endless supply of “beautiful forests throughout [the] region” (Horgan 1920). Mount Herman burned intensely in 1870, thick smoke “obscuring the sun for days” (Horgan 1920).

Large scale flooding occurred in 1864 on Monument, Cheyenne and Sand Creeks. Property was destroyed and thirteen lives were lost in waters deep enough to “float a steamboat” (Hall 1891). Additional flooding occurred on Monument Creek in 1884, again destroying property (including portions of Colorado Springs, still a young town) (Hall 1891).

By 1880, Colorado Springs had grown to 5,000 residents and El Paso County was known for two things: sheep and health. Although some



cattle grazing occurred on the grassy plains east of Colorado Springs, it was the sheep that would occupy the land and the minds of the locals. In 1878, a March blizzard dumped 11 feet of snow on the area, killing thousands of sheep (Hall 1891).

The Pikes Peak and White River National Forests were the first to be established in Colorado. In 1892 the Pikes Peak and Plum Creek Timber Reserves were established that included 184,320 acres and 179,000 acres, respectively (Horgan 1920). The reserves were consolidated to form the Pike National Forest in 1907.

Between 1917 and 1945 the size of Colorado Springs remained constant. Following the war boom and the resulting diversification of the region's economy, Colorado Springs grew in area by 25% between 1945 and 1956.

As early as 1948, local leaders made plans to host what would become the US Air Force Academy (Carter 1956). The Academy was completed in 1958.

biological systems context

It is common to break the landscape into component systems to better characterize complex relationships that occur on the landscape level. These are represented by three primary domains: **biological** (see also page 51), **physical** (see pages 30 and 64) and **social** (see pages 40 and 67). Important, however, in a landscape assessment is to determine to what level the landscape functions as a whole. This aspect of the assessment will be accomplished in the "Landscape Synthesis" chapter beginning on page 99.

Note that the system characterizations that follow might also be considered part of the **current condition** (see the following chapter). They have been included in the Watershed Characterization chapter for consistency (see also the Reference Condition and Landscape Synthesis chapters).

biologically significant species and communities

Thirty-nine rare or imperiled species and 12 natural communities are known from the Monument Creek Watershed area (CNHP 2001) (see **Note 2** on page 127), distributed among the following taxonomic groups:

- birds – 4 species
- insects – 5 species
- mammals – 3 species
- plants – 27 species
- natural communities – 12 community types

"[The creation of the National Forest system] is only an example of government asininity or possibly the creation of a 'Job' for some favorite and is an outrage on the hardy pioneers who have entered that desert country with a desire to open up and develop resources much more valuable than these trees, which should be left open to appropriation and use of the 'present', not the future generation.

But such things as this are convincing to a student of political economy that the Forest Service is the theoretical and entirely unreliable bureau as at present constituted. It is a political play to the grandstand, a bait set to catch the Socialist vote."

Denver Republican, 24 May 1908

Figure 5: Creation of the forest reserve system and the subsequent national forests were met with less than positive reactions by some residents (Carter 1956).

Three species are federally listed under the Endangered Species Act administered by the US Fish and Wildlife Service: **Preble’s meadow jumping mouse** (Threatened, also regarded as a species of special concern, CDOW), **Mexican Spotted Owl** (Threatened), and **Mountain Plover** (candidate, also a state candidate species, CDOW); several additional species are listed as sensitive species by the Forest Service and / or Bureau of Land Management including: **golden columbine** (BLM), **plains ragweed** (or **plains ambrosia**) (USFS), **Selkirk violet** (USFS), **Townsend’s big-eared bat** (BLM and USFS), and **Brandagee wild buckwheat** (BLM and USFS).

Colorado Natural Heritage Program Biological Significance Ranks (B-Ranks)

- B1 - Outstanding
- B2 - Very high
- B3 - High
- B4 - Moderate
- B5 - General

The Colorado Natural Heritage Program has designated four **Potential Conservation Areas (PCA)** within the watershed. PCAs are not regulatory boundaries but rather planning boundaries that estimate the area needed to protect the ecological processes that support a given species or natural community of significance. PCAs are assigned a biological significance rank (or B-Rank) using a numerical system from 1 to 5, with 1 being the most biologically significant and 5 being the most generally significant. CNHP PCAs within the watershed include:

- Monument Creek (B2 or very high biological significance)
- Farish Recreation Area (B3 or high biological significance)
- Black Forest (B4 or moderate biological significance)
- Monument Southeast (B4 or moderate biological significance)

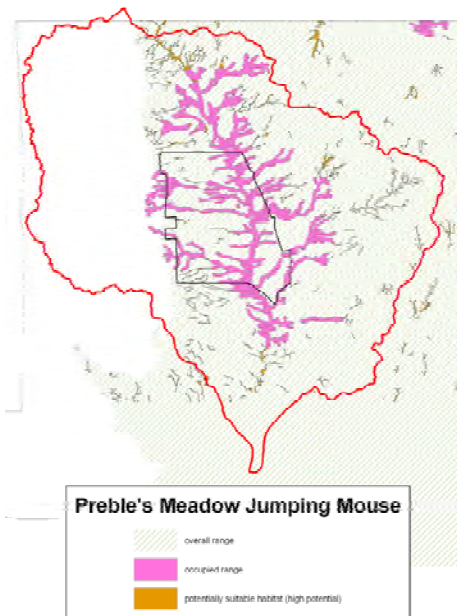
Figure 6: The Colorado Natural Heritage Program (located at Colorado State University) is a member of an international network of Conservation Data Centers and uses standardized methodology to track imperiled and / or rare species and natural communities in the state of Colorado. Potential Conservation Areas are non-regulatory planning boundaries designed to help resource managers, planners and land owners better understand the ecological processes necessary to conserve elements of Colorado’s rich natural heritage.

The **Monument Creek PCA** extends from the Town of Monument to the northern edge of Colorado Springs and encompasses several Monument Creek tributaries (Doyle et al. 2001). The PCA was drawn primarily for important populations of Preble’s meadow jumping mouse (*Zapus hudsonius preblei*), the globally rare, federally (Threatened) and state listed subspecies that is found only in certain types of riparian habitats of the Colorado Front Range and southern Wyoming. Other species found within the PCA include several butterflies, the Moss’s elfin (*Callophrys mossii schryverii*) and the Hops feeding azure (*Celastrina humulus*); several plants: the Southern Rocky Mountain cinquefoil (*Potentilla ambigens*) and the New Mexico cliff fern (*Woodsia neomexicana*) and several riparian plant communities: Montane riparian shrubland (*Alnus incana* / mesic graminoid), Thinleaf alder – red-osier dogwood riparian shrubland (*Alnus incana* – *Cornus sericea*), Narrlowleaf cottonwood riparian forest (*Populus angustifolia* / *Salix exigua*), Coyote willow / mesic graminoid (*Salix exigua* / mesic graminoid) and Snowberry shrubland (*Symphoricarpos occidentalis*).

Of all the rare species in the watershed, perhaps the most profoundly important on a landscape scale is the Preble’s meadow jumping mouse (*Zapus hudsonius preblei*) given the quality of the population inhabiting the Monument Creek drainage, generally known as the best occurrence in the Arkansas River drainage (Doyle et al. 2001).

Preble’s meadow jumping mouse is a riparian specialist, occupying lush riparian vegetation along stream reaches, marshes and wet meadows. Jumping mice hibernate during the winter, usually in upslope areas





Map 7: One of the most significant populations of the Preble's meadow jumping mouse occurs in the Monument Creek drainage. This sub-species is federally (threatened) and is considered threatened across its range. The species is known only from Front Range riparian systems in Colorado and Wyoming (CDOW 1999b).

from riparian areas. They forage on seeds, fruits, fungi and insects (Doyle et al. 2001).

Effects of urban development are the most likely stresses to this area, though the precise impacts from development to the Preble's meadow jumping mouse in particular are not yet known (Doyle et al. 2001). Other concerns include noxious weeds and the introduction of other exotic plants.

A disjunct part of the US Air Force Academy, the Farish Recreation Area is known for its broad expanse of grassland surrounded by aspen and Englemann spruce / subalpine fir forest. The **Farish Recreation Area PCA** was drawn for several globally rare plants and natural communities. The

only known population of Porter's feathergrass (*Ptilagrostis porteri*) from El Paso County has been observed near Leo Lake in the Recreation Area. This Colorado endemic is known from only three counties: El Paso, Park and Summit and favors hydric soils with very high organic content (Doyle et al. 2001). Other significant species known from this area include: a high quality population of a dryland sedge (*Carex oreocharis*) and a globally significant montane grassland comprised of Parry's oatgrass (*Danthonia parryi*), Idaho fescue (*Festuca idahoensis*), fringed sage (*Artemisia frigida*), three-nerved fleabane (*Erigeron subtrinervis*) and hairy aster (*Heterotheca villosa*). As discussed elsewhere in this assessment, the Farish Recreation Area comprises one of the largest openings in the forest mosaic in the southern Rampart Range, providing diverse habitat for a multitude of animal and plant fauna.

Known for its physiographic and biological significance (particularly forest vegetation and structure), the **Black Forest PCA** encompasses habitat for several globally vulnerable or state rare plants including: the Southern Rocky Mountain cinquefoil (*Potentilla ambigens*), Richardson alum root (*Heuchera richardsonii*), Selkirk's violet (*Viola selkirkii*), Birdfoot violet (*Viola pedatifida*) and Prairie goldenrod (*Unamia alba*). In addition to stresses associated with changing land use, particularly residential development, plants in this area are sensitive to



Photograph 5: The Farish Recreation Area is managed by the US Air Force Academy. Though the precise origins of this large opening are not known, it is believed that the historic watershed landscape would have included openings of this size in greater abundance across the landscape. Most of the Farish property is managed as wildlife habitat in its natural state.

competition from noxious weeds, particularly yellow toadflax (*Linaria vulgaris*).

Located southeast of the Town of Monument, the **Monument Southeast PCA** is designed to capture the ecological processes that support several colonies of Gunnison's prairie dog (*Cynomys gunnisoni*). These colonies are located on the eastern-most edge (and nearly the northeastern-most extent) of this species' distribution (Doyle et al. 2001). Most of these colonies occur on private land and are stressed by land use changes and cultural norms towards this genus.

physical systems context

physiography

The Monument Creek watershed region is comprised of varied and diverse topography and physiographic systems. These systems are important factors of change within the landscape.

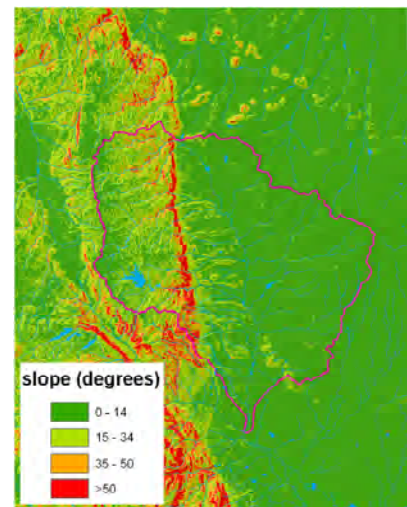
elevation and topography

Elevation is a fundamental determinant of climate, vegetation, habitat, hydrology, etc.

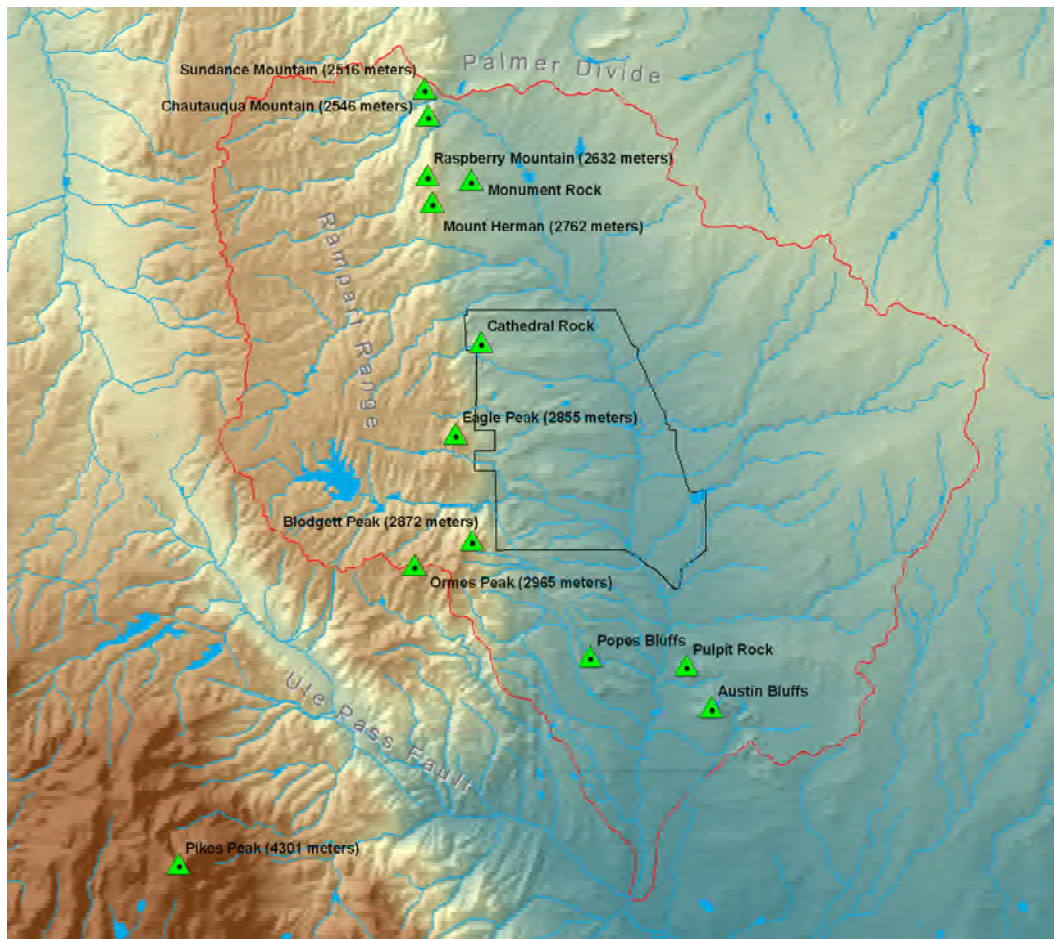
Elevation within the watershed varies from approximately 1,800 meters (6,000 feet) at the pour point with Fountain Creek to 2,965 meters (9,727 feet) at the top of Ormes Peak in the Rampart Range. The Palmer Divide extends eastward into the plains averages approximately 2,200 meters (7,220 feet) above sea level across its extent. The Ute Pass Fault forms the southern boundary of the Rampart Range and is drained by Fountain Creek.

slope

Given the susceptibility of the region's soils to erosion and the regional climate patterns (particularly the temporal attributes of precipitation), slope is of profound importance in the watershed. Slopes of greater than 18 degrees (33%) are regarded as critical for planning purposes both in terms of land use suitability and in regards to management prioritization (the likelihood of catastrophic soil loss, property or resource damage is significantly higher on slopes of more than 18 degrees). This figure falls within the "severe" category for erosion hazard ratings (see page 37 for more information).



Map 8: Steep slopes characterize the dramatic east slope of the Rampart Range. Given the sensitivity of most of the region's soils, it is important to consider localized slopes, particularly drainages, when planning for landscape scales. Data source: USGS 30 meter digital elevation model.



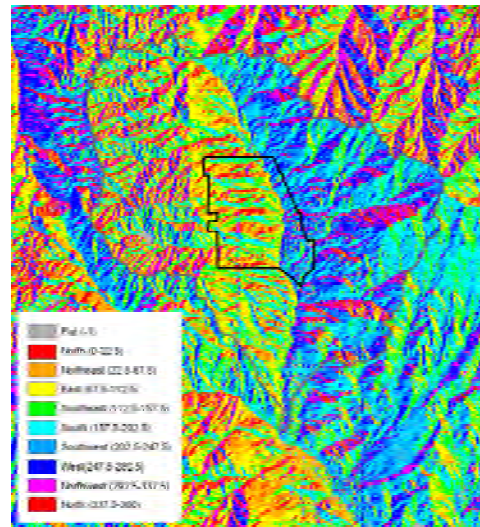
Map 9: The Rampart Range, the Ute Pass Fault and the Palmer Divide are the dominant landforms of the Monument Creek Watershed landscape. The dramatic Front Range backdrop of the Rampart Range includes Ormes Peak (2,965 meters or 9,727 feet), Blodgett Peak (2,872 meters or 9,423 feet), Eagle Peak (2,855 meters or 9,368 feet) and Mount Herman (2,762 meters or 9,063 feet). The imposing Pikes Peak rises 4,301 meters (14,110 feet) above sea level, but occurs outside the Monument Creek Watershed.

Slope is central to understanding erosion and the role of soil loss as a landscape disturbance regime. Erosion hazard ratings are developed and discussed in the soils section, beginning on page 32. Serious erosion is not, however, limited to areas of extensive extreme slopes. Localized soil loss has landscape scale implications as cumulative sedimentation in regional stream reaches magnifies the scale of slope.

Using 30 meter digital elevation models, slope was calculated for the watershed region, then clipped to the watershed boundary. Based on these data, approximately 94% of the watershed is characterized by slopes from 0 to 18 degrees and 6% of the watershed is characterized by slopes from 19 to 51 degrees. On a landscape scale, extreme slopes typify the east slope of the Rampart Range and perhaps most importantly, stream reaches throughout the watershed.

aspect

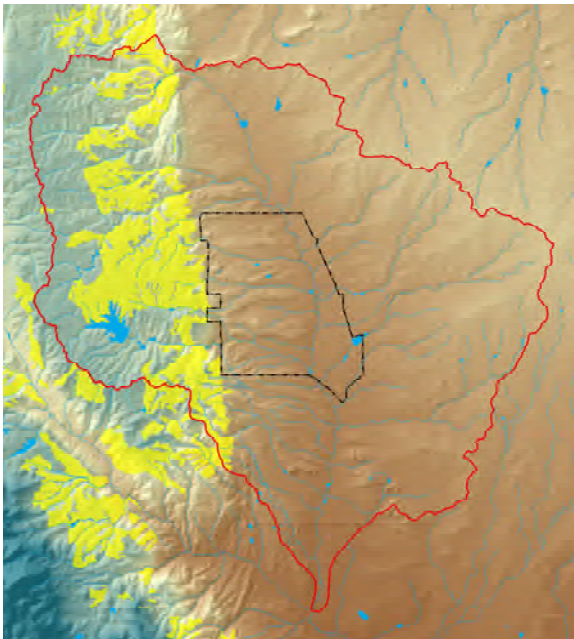
Aspect, or the direction in which slope faces, is of profound importance to a landscape, having a strong influence on vegetation patterns and thus soil loss, habitat, socio-economic values and so on. Aspect often mimics climatic patterns or suggests narrower and larger elevational ranges. Certain aspects in certain areas harbor small populations of narrowly adapted plant or animal fauna. On a landscape level there is a strong correlation between aspect and the presence of certain types of vegetation. As noted in the section on the region's forests, this correlation is particularly strong with ponderosa pine and other species that have particular climatic and soil moisture requirements .



Map 10: Aspect, or the direction a slope faces, affects vegetation, soil formation and temperature. The Monument Creek Watershed boundary is clearly visible based upon differences in aspect.

soils

Soil development is a complex function of parent material (based upon geology and vegetation), organic interaction (decomposition), hydrology (presence or absence of water) and time. It is estimated that in humid regions of the world it can take upwards of 1,000 years to



Map 11 - Soil Map Unit 46: Sphinx-Rock Outcrop complex, 15 to 80% slopes (12% of Total Landscape Area)

location: mountainous regions, north and east aspects of mountain sides and ridges
elevation range: 6,000 - 8,000 feet
annual precipitation: 15 - 20 inches
composition: 60% Sphinx gravelly coarse sandy loam, cool and 25% rock outcrop (Pikes Peak granite which is also this soil's parent material)
drainage characteristics: well drained, rapid permeability, low available water capacity
erosion potential: severe
vegetation: Sphinx soil component is 40 – 65% vegetated (forest and tree litter); ponderosa pine is dominate but soil also supports fir and aspen
suitability: wildlife habitat, watershed, limited timber production (constraints include: slope, susceptibility to erosion and rock outcrop component, which supports no vegetation)
K factor: 0.11

develop 2.5 cm (1 inch) of topsoil (Pimental 1993). As the foundation of agriculture, of building and vegetation, soils are a fundamental component of the landscape and their loss, through erosion or land use change, is of profound significance to the landscape.

Soils are characterized based upon their physical properties, topological characteristics and amount of development (largely based upon time). These characteristics determine appropriateness of land use activity and their sensitivity to erosive processes from water and wind.

Soils that typify grassland ecosystems tend to be finely textured loams that are reasonably well developed and support a diversity of potential habitats for vegetation and other species. While grasses and other plants tend to favor habitat with these types of soils, the plants also play a role in the development of the soil, thus soils affect vegetation and

**Map 12 - Soil Map Unit 62541: Kettle Loamy Sand, 8
- 40% Slopes (11% of Total Landscape Area)**

location: sandy arkosic deposits on uplands
elevation range: 7,000 - 7,700 feet
annual precipitation: 18 inches
average temperature: 43 degrees F; approximate frost-free period, 120 days
composition: unit include small areas of Elbeth sandy loam, 8 to 15% slopes; Pring coarse sandy loam, 8 to 15% slopes; Tomah-Crowfoot loamy sands, 8 to 15% slopes; "a few" rock outcrops
drainage characteristics: rapid permeability; available water capacity is low to moderate; surface runoff is medium
erosion potential: moderate
vegetation:
suitability: woodland, grazing, habitat, recreation, residential development
limitations: erosion potential and slope
K factor: 0.17



vegetation affects soils. The same holds true for forested lands. Ponderosa pine, for example, is generally found in areas with coarse, granitic soils that lack substantive soil development. These soils tend not to support significant grassland populations; however, other ecological processes affect these relationships. Forested areas may be cleared by fire and grasses may eventually move into the area as the soil's physical properties may have been altered somewhat with fresh inputs of essential nutrients and new opening in the forest canopy. Over time, formerly forested grasslands may occur in areas where the soils are profoundly different providing suitable characteristics for growth of other plant species including trees. As noted previously (see the vegetation section beginning on page 51 for more information), the converse can also occur, with encroachment of trees into grassland regions.

As is noted in the **hydrology** section (see page 64 for more information), water is perhaps the most effective process shaping the landscape. Related to this central process is the relationship of water to soils in the

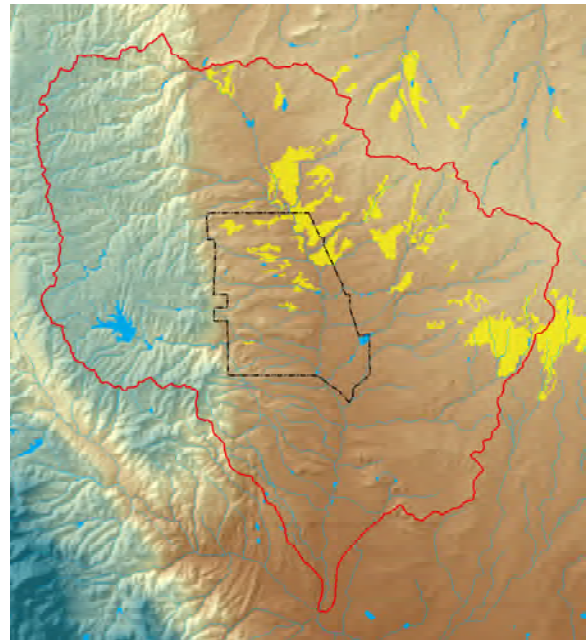


Map 14 - Soil Map Unit 62571: Pring coarse sandy loam, 3 – 8% slopes (6% of Total Landscape Area)

location: valley side slopes and uplands, formed in sandy sediment derived from arkosic sedimentary rock
elevation range: 6,800 – 7,600 feet
annual precipitation: 17 inches
average temperature: 43 degrees F; approximate frost-free period, 120 days
composition: non-calcareous unit includes small areas of Alamosa loam, 1 - 3% slopes along drainageways; Crockton sandy loam, 1 – 9% slopes; Peyton sandy loam, 1 – 5% slopes; Peyton sandy loam, 5 – 9% slopes; Tomah-Crowfoot loamy sands, 3 – 8% slopes
drainage characteristics: well drained; rapid permeability; available water capacity is moderate; surface runoff is medium
erosion potential: moderate; eolian erosion potential exists
vegetation: mountain muhly, little bluestem, needle and thread grass, Parry oatgrass, junegrass
suitability: range and grazing, residential development
limitations: erosion potential, particularly eolian
K factor: 0.17

Map 13 - Soil Map Unit 6258: Blakeland loamy sand, 1 – 9% slopes (7% of Total Landscape Area)

location: upland areas, formed in alluvial and eolian materials derived from arkosic sedimentary rock
elevation range: NA
annual precipitation: 15 inches
average temperature: 47 degrees F; approximate frost-free period, 135 days
composition: unit includes small areas of Bresser sandy loam, 0 – 3% slopes; Bresser sandy loam, 3 – 5% slopes; Truckton sandy loam, 3 – 9% slopes; Stapleton sandy loam, 3 – 8% slopes
drainage characteristics: somewhat excessively drained; permeability is rapid; available water capacity is low to moderate; surface runoff is slow
erosion potential: moderate; eolian erosion potential is severe
vegetation: western wheatgrass, side-oats grama, needle and thread grass
suitability: wildlife habitat, range and grazing, urban development
limitations: erosion potential, particularly eolian
K factor: 0.20



form of erosion or soil loss. Some have suggested that “soil erosion may be the most serious land management problem facing humanity today” (Marsh 1998). Indeed, evidence of this problem is present within the Monument Creek Watershed: flooding and resulting sediment loading and bank failure; slope failure following catastrophic fire; decline in agricultural productivity; structural damage and loss and unspecified impacts to downstream systems and inhabitants.



Map 15 - Soil Map Unit 62538: Jarre-Tecolote complex, 8 – 65% slopes (5% of Total Landscape Area)

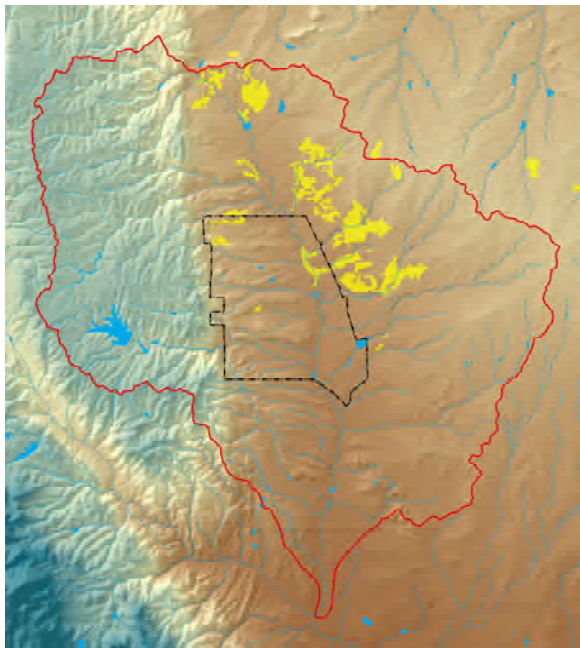
location: alluvial fans, formed in sandy sediment (Jarre component) and acidic igneous rocks (Tecolote component)
elevation range: 6,700 – 7,500 feet
annual precipitation: 18 inches
average temperature: 43 degrees F
composition: the Jarre component comprises about 40% of this unit, the Tecolote component 30% and other soils about 30%; included within complex are areas of Jarre gravelly sandy loam, 1 – 8% slopes; Kettle gravelly loamy sand, 8 – 40% slopes; Kutch clay loam, 5 – 20% slopes; Chaseville gravelly sandy loam, 8 – 40% slopes; large amount of surficial stones and cobbles, and some large boulders
drainage characteristics: *Jarre component:* deep and well drained; permeability is moderate; available water capacity is moderate; surface runoff is medium to rapid | *Tecolote component:* deep and well drained; permeability is moderate; available water capacity is low to moderate; surface runoff is medium
erosion potential: *Jarre component:* moderate to high | *Tecolote component:* moderate
vegetation: mountain muhly, little bluestem, needle and thread grass, Parry oatgrass, junegrass
suitability: wildlife habitat, woodland, range and grazing, recreation, residential development
limitations: erosion potential, particularly eolian
K factor: 0.02

Soil loss is not limited to erosion by water, however. Some soils, particularly loamy soils that typify the gently sloping areas of the middle watershed, are particularly sensitive to eolian (wind) erosion.

Map 16 - Soil Map Unit 47: Sphinx, warm-rock outcrop complex, 15-80% slopes (5% of Total Landscape Area)

location: south and west aspects of mountainsides and ridges
elevation range: 6,700 – 7,500 feet
annual precipitation: 18 inches
average temperature: 43 degrees F
composition: 60% Sphinx gravelly coarse sandy loam, warm and 25% rock outcrop (again, Pikes Peak granite)
drainage characteristics: Sphinx component is regarded as somewhat excessively drained, permeability is rapid and water capacity is low; runoff is rapid
erosion potential: **severe** (Sphinx component)
vegetation: component is typically 40 – 65% vegetated, primarily with Ponderosa pine forests; Sphinx soil component also supports Douglas fir, aspen, juniper, forbs and grasses
suitability: wildlife habitat, watershed and limited timber production
limitations: rock crop component of this soil supports no vegetation and is of limited suitability for timber production; also limiting this soil's suitability for timber production is aspect, slope and susceptibility to erosion
K factor: 0.11





Map 18 - Soil Map Unit 42: *Sphinx gravelly coarse loam*, 15 – 40% slopes (3% of Total Landscape Area)

location: north and east aspects of mountainsides, drainageways and ridges
elevation range: 6,000 - 8,000 feet
annual precipitation: 15 - 20 inches
average temperature: 46 degrees F
composition: unit is formed from weathered Pikes Peak granite. 5% of soil unit is included in areas of Garber very gravelly coarse sandy loam and 10% of unit is comprised of soil layers darker than the Sphinx component
drainage characteristics: shallow soil considered to be somewhat excessively drained and is comprised of weathered material from Pikes Peak granite; permeability is regarded as rapid, water capacity is low, run off rapid
erosion potential: moderate (very susceptible to erosion if the vegetative cover is removed or disturbed)
vegetation: 40 – 65% vegetative cover, including forest litter.; dominate vegetation type is Ponderosa pine although it also supports fir, aspen
suitability: wildlife habitat, watershed, recreation and limited timber production
limitations: high erosion potential, low natural fertility and shallow depth to bedrock
K factor: 0.15

Map 17 - Soil Map Unit 62593: *Tomah-Crowfoot loamy sands*, 8-15% slopes (4% of Total Landscape Area)

location: alluvial fans, hills and ridges
elevation range: 7,300 to 7,600 feet
precipitation: 17 inches
average temperature: 42 degrees F; approximate frost-free period, 120 days
composition: Tomah component comprises 50%, Crowfoot component 30%, other soils (including Elbeth sandy loam, 8-15% slopes; Peyton-Pring complex, 8-15% slopes; Kettle gravelly loamy sand, 8-40% slopes), 20%.
drainage characteristics: *Tomah component:* deep and well drained, permeability is rapid; available water capacity is moderate and surface run off moderate | *Crowfoot component:* deep and well drained; permeability is moderate as is its available water capacity; surface runoff is characterized as medium
erosion potential: *Tomah component:* moderate | *Crowfoot component:* moderate
vegetation: mountain muhly, little bluestem, needle and thread grass, blue grama and mountain brome
suitability: range, recreation, habitat and residential development
limitations: for urban uses, limitations include potential frost-action and slope
K factor: 0.10



Sensitivity to erosion is expressed by **K factors**. K factors generally range from 0 to 0.6 with the larger number being regarded as more sensitive to erosive processes. K factors are key data in the calculation of soil loss rates using the Universal Soil Loss Equation (USLE) or Modified Soil Loss Equation (MSLE), both of which are regarded as



Photograph 6: Localized erosion can have landscape level implications. This yard located near Kettle Creek (central watershed) is adding to already high levels of sedimentation that contribute to flood damage downstream on Monument and Fountain creeks.

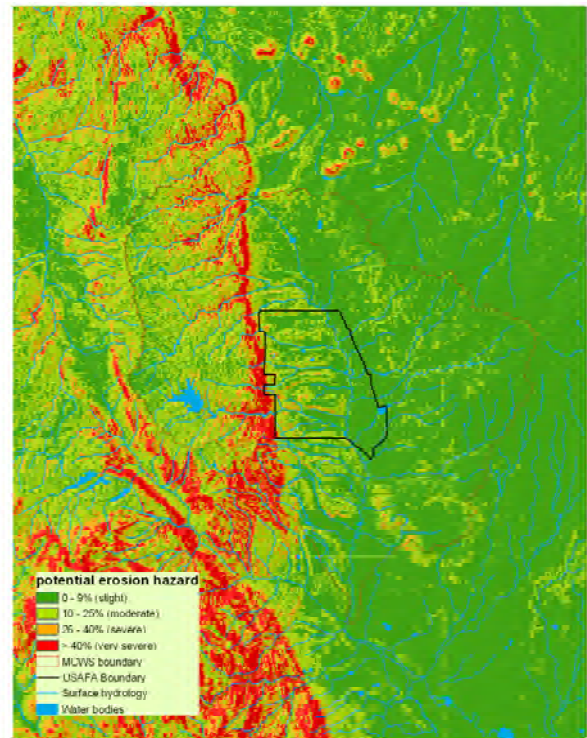
inappropriate for watershed scale landscapes. Thus, though K factors are just one part of the erosion process they are useful for indicating areas of general sensitivity. The character of the region's slope, vegetation and land use would also be important to consider (and are addressed to some extent in the soil loss equations).

soil types and taxonomy

The Monument Creek Watershed is comprised of two soils surveys. The US National Forest surveys Forest Service lands and the Natural Resources Conservation Service (formerly the Soil Conservation Service or SCS) surveys all other federal, state, local government and private lands. The two surveys are slightly inconsistent in soil unit names, physical descriptions and management recommendations. Of importance here are the physical characteristics (associated slope, composition, sensitivity to erosion, predominate vegetative cover) rather than the soil unit itself. Maps 11 through 18 summarize and show regional distribution of those soils that comprise more than 3% of the total landscape area. Soil map unit codes beginning with 625 are NRCS mapped soils, those without the 625 prefix are USFS mapped soils; all descriptions were summarized from USFS 1992 or SCS 1981.

erosion hazard ratings

Erosion is a function of slope, a soil's physical properties, ground cover and potential for precipitation and / or wind. Several models exist that allow for the modeling of soil loss based upon several factors. These analyses, however, are not appropriate for landscape level planning with diverse and heterogeneous vegetative structures. These models include the USLE, MSLE, etc. The Natural Resources Conservation Service has developed broad guidelines for the determination of erosion hazard ratings based upon the distribution of K factors (or a soil's inherent susceptibility to erosion, generally measured on a scale from 0 to 0.6) and the categorization of slopes based upon those factors. According to the NRCS National Forestry Manual (1998) the following slope categories are used for areas where the range of K factors includes those greater than 0.35: slight (0-9%); moderate (10-25%); severe (26-40%) and very severe (>



Map 19: Erosion hazard ratings from the Monument Creek Watershed landscape show high ratings for the Rampart Range area as expected. It is also important to consider the cumulative impacts of localized erosion and sedimentation as evidenced in the catastrophic flooding on Monument and Fountain creeks in 1999.

40%). The distribution of erosion hazard ratings based upon this classification suggests that on a landscape scale, areas of the highest erosion hazard are those on the east face and toe slopes of the Rampart Range and along drainages.

geology

A landscape's geology determines (or is related to): soils, hydrology, land use patterns, vegetation, aesthetics, wildlife habitat and other physical characteristics (particularly related to geologic age). The complex geologic pattern gives rise, in part, to the diverse physical, biological and social structures present today.

The Rampart Range is the dominant geologic structure within the watershed. It runs roughly north-south, extending from west of Castle Rock to Colorado Springs (at the southern edge of Cheyenne Mountain) and is separated from the main Front Range by a series of faults, the most striking of which forms the Ute Pass, a fault at least 60 miles in length (where present day US Highway 24 is located) (Chronic 1994).

The Rampart Range is a faulted anticline comprised of late Paleozoic sedimentary rocks composed of sediment washed from the Ancestral Rocky Mountains (formed 300 million years ago before the present day Rocky Mountains existed). Precambrian Pikes Peak granite forms the core of the range (and is regarded as the parent material for the range's predominantly granitic soils) (Chronic 1994). The summit of the range is a Tertiary era pediment, regarded as "well preserved" (Chronic 1994). Paleozoic and Mesozoic sedimentary rocks comprised of sediment washed from the Ancestral Rockies, line the fault, visible in places through the forest canopy on the dramatic eastern slope of the Rampart Range. These same rocks are present at the Garden of the Gods, just south of the watershed.



Photograph 7: Precambrian Pikes Peak granite forms the core of the Rampart Range and is the parent material for many of the region's coarse, granitic (and highly erosive) soils.

The monument at the Town of Monument (and the origin of the town's name), is a result of weathered Tertiary sandstone. These formations were formed after the uplift of the current Rocky Mountains, thus they are younger than the formations at the Garden of the Gods or Red Rocks, to the north. The Air Force Academy is located on a bench of Pleistocene pediments, which is younger than the Rampart Range pediments (Chronic 1994). South of the Air Force Academy, Paleozoic limestone (also sedimentary) was historically quarried for use in concrete and road building material.

The eastern portion of the Monument Creek watershed is bounded by hills composed of Cretaceous and Tertiary sandstone. Many of the older portions of Colorado Springs along the banks of Monument Creek were built on Pierre shale formed during the Cretaceous period (Chronic 1994). This formation was deposited by

a sea that stretched from the Arctic to the present-day Gulf of Mexico (Chronic 1994).

climate

Climate plays an important role within the watershed landscape: it influences precipitation, the amount and the frequency, and form; it affects hydrologic regimes, land use, and simply the desirability of the region for recreation and inhabitation.

precipitation and temperature

Precipitation in the form of rain is a particularly important system within the watershed. As described previously, water is regarded as one of the most profound agents of change on the landscape. Water as an agent of change occurs on several scales, all of which are pertinent to landscapes although they vary in terms of magnitude, frequency and amount of change.

Climate in the landscape area varies largely by topography and specifically by elevation. There are two main climate stations within the watershed: Monument and Colorado Springs. While not capturing the full elevation range, these two stations do represent some of the elevational and climatological variation in the landscape. The town of Monument is located at 2,160 meters (7,080 feet) above sea level.

Summary of climate data from Monument (station 55734) (years 1988-1999) (Colorado State University 2000):

- Average yearly temperature: **45.1 degrees F**
- Average maximum monthly temperature: **58.4 degrees F**
- Highest average monthly temperature: **86.9 degrees F** (July 1997)
- Average minimum monthly temperature: **31.8 degrees F**
- Lowest average monthly temperature: **10.1 degrees F** (February 1989)

- Average yearly precipitation: **24.89 inches** (most falls during April through August)
- Maximum monthly precipitation: **12.34 inches** (April 1999)
- Minimum monthly precipitation: **0.05 inches** (October 1997)

- Average yearly snowfall: **114.6 inches** (most falls October through April)
- Maximum monthly snowfall: **63.0 inches** (October 1997)
- Minimum monthly snowfall: **0.0 inches** (May, June, July, August, September, October, multiple years)



Photograph 8: Most precipitation within the watershed occurs in intense events of short duration, varying widely by season. Increased levels of hard-surface development (streets and driveways) within the watershed, and the presence of highly erosive soils, have resulted in increased levels of sedimentation in regional stream reaches. Smith Creek (above, a tributary of Monument Creek to the east) carries sediment to Monument Creek after an early spring rain shower.

Summary of climate data from Colorado Springs (station 51778) (for years 1948-1999) (Colorado State University 2000):

- Average yearly temperature: **48.7 degrees F**
- Average maximum monthly temperature: **62.0 degrees F**
- Highest average monthly temperature: **90.3 degrees F** (July 1964 and other years)
- Average minimum monthly temperature: **35.3 degrees F**
- Lowest average monthly temperature: **6.6 degrees F** (January 1979)

- Average yearly precipitation: **16.4 inches**
- Maximum monthly precipitation: **7.99 inches** (July 1965)
- Minimum monthly precipitation: **0.0 inches** (January, February, September, November, December, multiple years and several other months at **0.01 inches**: March, April and October)

- Average yearly snowfall: **42.8 inches** (most falls October through April)
- Maximum monthly snowfall: **28.7 inches** (January 1987 but note that **27.9 inches** for September 1959)
- Minimum monthly snowfall: **0.0 inches** (all months over multiple years)

social systems context

The role of social systems is typically left out of natural resource planning efforts, instead concentrating on the physical and biological processes that obviously interact in natural systems. Increasingly, the understanding of social processes is being integrated into ecological planning efforts to underscore the importance of anthropogenic effects on the landscape. Equally important, this understanding is being utilized to design better management options and sustainable management approaches that take into consideration complex natural systems relationships and socio-economic structures that inform, determine or limit the ability to manage shared resources.

From this standpoint, the inclusion of social systems in the assessment process can be regarded as an attempt to ensure that subsequent planning processes occur within existing social constraints or from the point of view that social systems are also in essence functioning ecological systems that need to be assessed in order to fully understand the landscape.

land use

Land use within the watershed region is appropriately complex, reflecting complex social structures, resource distribution, topography, vegetation and other environmental determinants. Land use is an intrinsically socially defined system. While largely determined by physical and biological systems, land use is influenced by socio-political



considerations and changes over time in response to ever changing political climates and economic needs.

Land use describes how land is, and will be used, thus *time* is an inherent variable in the discussion of land use. This is often reflected in its current (for example agriculture) and its potential (forested areas for resource extraction) uses. It is important to distinguish land's use value or how the land can be potentially utilized. As communities increase in

land use	hectares	percent
evergreen forest	24982	40.77
herbaceous rangeland	10382	16.98
shrub and brush rangeland	8337	10.36
transitional areas	5202	8.49
residential	5171	8.44
mixed rangeland	3653	5.97
commercial	2362	3.86
mixed forest	1093	1.78
infrastructure	784	1.26
other urban	593	0.97
reservoirs	250	0.41
mines	137	0.22
cropland and pasture	95	0.15
industrial	82	0.13
mixed urban	65	0.11
other ag land	30	0.05
not classified	18	0.03
rock	19	0.03

Figure 7: The distribution of land use types indicates a watershed that is still primarily comprised of forest, although given the age of the actual data, development uses are expected to be higher. Data source: USGS 1990.

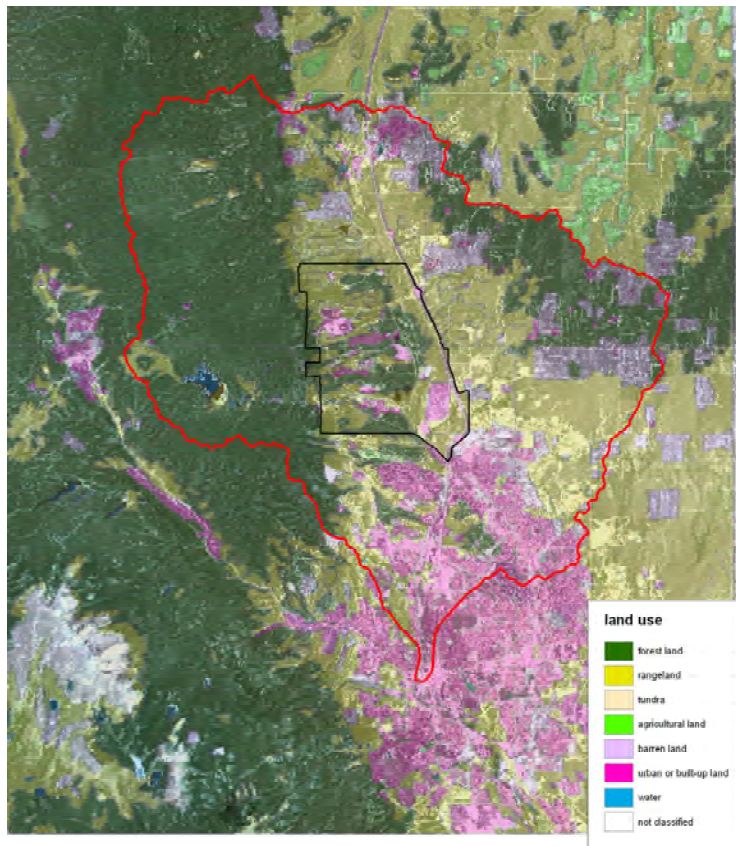
complexity (usually in response to population growth), the notion of land use changes in kind, reflecting current social attitudes: how people view their environment and ever-evolving attitudes towards resources and the environment. For example, forest land as a land use type traditionally described land suitable for timber production or harvest. More recently, forest land describes something that has a multitude of uses including recreation, watershed, habitat, visual amenity and potential for fire. Timber production is regarded in a more limited fashion, primarily for fuels reduction, forest health or forest restoration or very selective cutting.

Given the complexity of land use and the somewhat intrinsic nature of its associated political dimension, it is worth understanding as it relates to other systems within the watershed. Like other systems, land use can cross jurisdictional boundaries: this both emphasizes the importance of a relational view and underscores its potential as another foundation for multi-jurisdictional planning and management.

The most recent comprehensive land use data known from the project area are included in the land use / land cover data series developed by the United States Geologic Survey (1990) and processed by the Environmental Protection Agency. These spatial data were developed in 1990 with information gathered during the mid-1970s through early 1980s. Though they lack currency, they are still useful to discern general land use trends and perhaps even more useful as a measure of change over time (even if the time period is only 25 years). Land use categories were developed by Anderson, et al. (see Appendix 2, page 139 for a full list of the Anderson codes and the hierarchical classification system used to categorize land use) (USGS 1990).

Because land use often follows biological and physical systems the land use pattern across the landscape is similar to the vegetation pattern (see page 51 for more information on the vegetative structure of the landscape). A coarse breakdown of land use by percentage of total





Map 20: Many types of regional land use closely follow vegetation types, notably forested areas. These land use data were obtained during the late 1970s and early 1980s and clearly show land conversion, particularly from range to urban (note north Colorado Springs). Land use data have been overlaid on Landsat data for clarity. Data source: USGS 1990.

landscape area shows that, similar to vegetative cove, the watershed is comprised of similar percentages of forest and range or grassland (see Figure 7 for a more detailed breakdown of land use types):

forest land:	43%
range land:	33%
urban / built:	15%
barren land:	9%
water:	< 1%
agricultural:	< 1%
not classified:	< 1%

Forest land is predominantly used for watershed, wildlife habitat, viewshed, recreation, livestock grazing and increasingly limited timber production. This land use type is of particular significance given the amount of forested land, forest health and the change in values associated with forested land.

Most of the forested areas within the watershed were last logged in the 1950s, following the timber boom of the late 1800s associated with the mining industry, a burgeoning railroad system and providing building material for rapidly developing urban area in Colorado Springs (for more information on the historic context, see page 24).

Since that period, the forested lands of the watershed have seen little systematic logging and aside from the occasional small-scale (yet semi-catastrophic) fire or thinning effort, the forest of today is the result of controlled ecological processes, products of decisions made 50 to 100 years ago.

The suppression of fire has resulted in landscape-scale changes in the watershed. The exclusion of fire has led to increased tree densities, limiting growth of stands in some areas, leading to encroachment of shade tolerant species, such as Douglas fir. Ironically, fire suppression, the build-up of fuels and residential building within forested areas has resulted in an increased likelihood of catastrophic (i.e. property and resource damaging) fire. The end result of more than 100 years of landscape-scale fire suppression in watershed forests are areas that have been profoundly altered from their historic condition, compounding or creating new management issues.

In response to changing cultural attitudes, imports of timber products, development of new technologies and the lack of profitability in small diameter timber products, forest land within the watershed is more

often regarded as an amenity. The densely forested Rampart Range forms a dramatic backdrop to the Monument Creek Valley. Increasing importance is being placed on aesthetic values including *viewsheds*. Increased ecological awareness in the populace has also led to viewing forested lands as important for habitat and watershed. There are increasing demands for recreational opportunities and places to escape from the ever-growing urban population of Colorado Springs. The forested areas of the watershed under federal management are under increased pressure to provide access to hikers, equestrians, cyclists and off-road vehicles, which bring with them associated stresses to systems present in these areas.

Remaining tracts of **range land** are still used for forage, wildlife habitat, de facto open space and low density development. Arguably, the range land portions are undergoing the highest rates of conversion (to urban / built) within the watershed. Other areas categorized as range include the oak scrub community found in the transitional area between the grassland and forest communities (see the vegetation section beginning on page 51 for more information about these communities and their relationship to urbanization and land use conversion). These areas are also seeing increased levels of development in fairly low-density patterns. Converted areas also contribute to the burgeoning wildland / urban interface and are therefore considered to be at high risk for catastrophic fire and subsequent potential property damage.

Urban and built-up land use within the watershed is increasing at rapid rates pressuring forest and range areas. According to county planners, nearly all range land within the watershed has been platted, meaning that development is planned in the near to mid future (Schueller 2000). Thus, despite the appearance of ample amounts of open land in the eastern watershed, it is likely that most of these lands will be developed within the next 5 to 20 years.

While range land can be argued to be an inefficient use of land supporting an inefficient method of producing food, this land use type supports other systems and uses. Range land also provides habitat for prairie and shrub community specialists, open space, community separators, watershed, viewshed and other uses.

Urban or **built** areas are used for housing, commerce, manufacturing and transportation. Within this somewhat opportunistic (at least on the watershed scale) system is placed the system of zoning or how site-specific development is to occur. Definite



Photograph 9: Much of watershed's range land is being converted to other land uses including residential development. Range land continues to provide forage for livestock, community and development separators and de facto open space. This photo is indicative of the eastern portion of the watershed with the Rampart Range and US Air Force Academy in the background (and Pikes Peak).

patterns evolve within these systems of environmental and social constraints, community desires, economics, politics and time.



Photograph 10: At least 15% of the Monument Creek Watershed is urbanized. The southern portion of the watershed encompasses densely developed Colorado Springs. Much of the development in the east watershed is regarded as ex-urban or relatively low-density development. This photograph depicts a residential development on the edge of the Black Forest occupying converted rangeland. The Rampart Range is in the background.

Density is an important consideration as to the potential of land to be used in the future. While the urban areas in the southern portion of the watershed are fairly dense, the development pattern in the north and eastern areas of the watershed are considerably less dense. While the likelihood that some of this urbanized land may be useful for a diversity of land uses (including wildlife habitat and open space), it is more likely that the fragmented nature of this type of development will result in low-quality habitat (particularly for larger species or those requiring movement corridors or possessing larger home ranges). This type of development will ultimately require more land to house fewer people; result in increased utility costs (higher transmission and infrastructure costs); result in an increased reliance on personal transportation and a decrease in open space, community separators, viewshed and watershed.

Barren land tends to refer to rock outcrop, low-density vegetation or more likely to areas that have been cleared for development. The broad group of barren land also includes mines, which according to these data comprise less than 1% of the landscape area. This figure has stayed relatively constant over the past 25 years as quarries have closed and mined areas have been restored. Of particular interest within the watershed is the “Scar” or Queen’s Quarry. Currently under restoration (via revegetation and erosion control efforts), the quarry is important habitat for a herd of bighorn sheep. This is an excellent example of the complexities of land use and the potential opportunity for mixed or varied use across jurisdictional boundaries and across traditional uses of land. Current management efforts are aimed at establishing a travel corridor to connect other regional populations to encourage movement, genetic diversity and discourage disease and isolation (see the wildlife section, page 59 for more information on the local bighorn sheep population).

Other types of barren land, including “transitional areas,” should be regarded with some level of suspicion given the amount of time that has passed since these data were collected. Transitional tends to refer to lands that are in the process of converting from one land use to another. It is probably safe to assume that these lands have long since converted, suggesting that this figure in particular might be regarded as erroneous.

Agricultural land, that is, mechanical agriculture, as opposed to range or grazing use, is clearly a small percentage of the watershed landscape. Grazing has always played a larger role than traditional agriculture within the watershed and aside from the production of forage, agricultural use is still in decline. This is not to suggest that agriculture is not an important land use in the region, where it plays a larger role in the land use mosaic, but within the watershed it has either been less profitable or efficient or has been displaced in favor of other types of land use.

As agricultural profitability decreases and the value of land for development increases, the amount of land devoted to agriculture declines. This trend is clearly apparent in many communities along the Front Range.

land status

Land status or land ownership is a purely political system defined by private ownership and public management influenced land patterns. While most of the landscape area is privately owned, the fact that nearly half of the watershed is under public ownership (and managed by a multitude of federal and local agencies) suggests a complex and inherently political ownership pattern.

Within the watershed, there is a sharp correlation between physiography, vegetation and land status. Most of the mountainous, forested areas of the west are under federal management, as part of the Pike National Forest. Most of the Black Forest, the forested portion of the east watershed, is privately owned (although this figure includes land management by local government and specifically in this area, parks managed by El Paso County) as is most of the rest of the watershed. As previously noted, the US Air Force Academy occupies the virtual center of the watershed and is bordered to the west by National Forest and all other sides by private land.

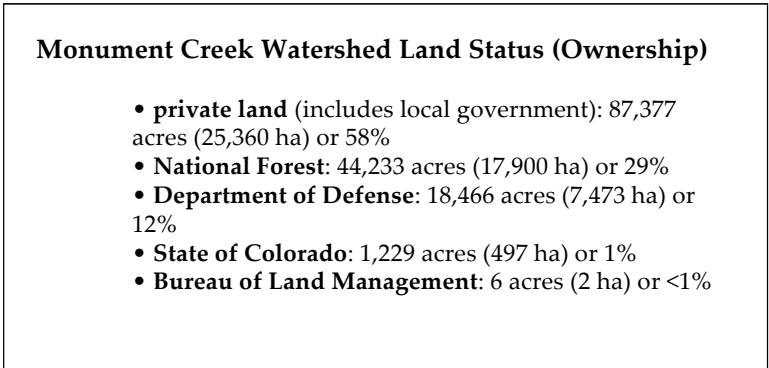
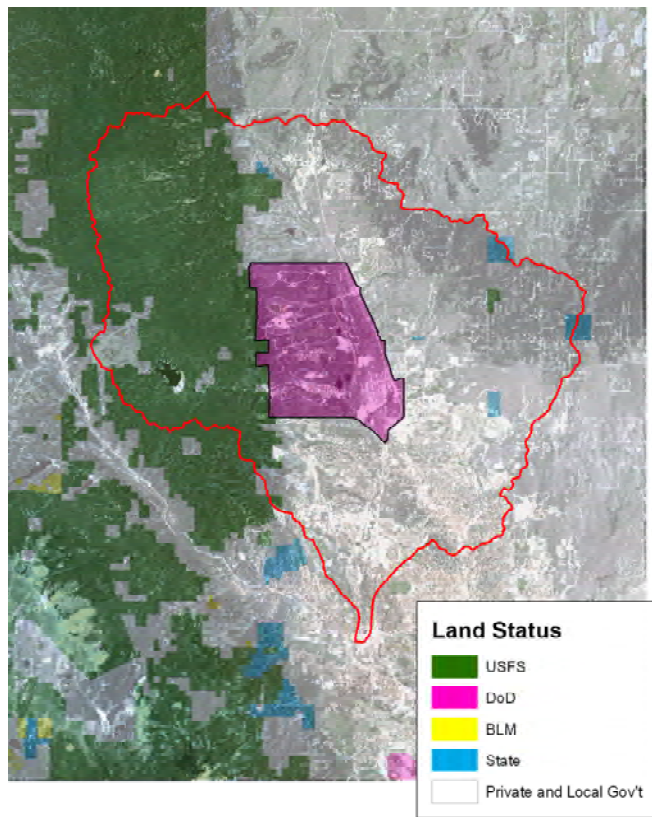


Figure 8: Monument Creek Watershed land status by percentage of total area. Data source: CDOW 1998b.

Private land: Much of the watershed is comprised of low-density, ex-urban development, although portions of the watershed are characterized by dense urban and relatively dense suburban development. North Colorado Springs (southern watershed) is increasingly dense, characterized by increased levels of impervious development (streets, parking lots, etc.). The central watershed is currently converting from agriculture / ranching to suburban development with varying levels of density.





Map 21: Most of the land within the Monument Creek Watershed is owned or managed privately or by local government. Nearly 18,000 ha is National Forest and the Department of Defense manages close to 7,500 ha or 12% of the watershed. Data source: CDOW 1998b.

Within the broad category of private land ownership exists the increasingly complex system of specific ownership patterns that are ever shifting but all important on a landscape level as they relate back to land use and opportunities to manage for other systems. The section on development and population goes into more detail about how development patterns, in part, determine opportunities and constraints for the management and understanding of other systems.

National Forest: The Pike National Forest is part of the Pike / San Isabel / Comanche National Grassland. Within the forest are several private inholdings, road and access easements. The Forest Service is under increasing pressure to manage shared resources for multiple uses. As suggested elsewhere, this emphasizes the need for multi-jurisdictional approaches to management and decision-making. The task is increasingly difficult as many of the management goals are somewhat contradictory and self-defeating (managing for off-road recreation and balancing the needs of hikers or other users while maintaining suitable watershed or wildlife habitat).

Department of Defense: All DoD administered lands within the watershed are part of the US Air Force Academy which includes the core campus and satellite units (Farish Recreational Area). The Air Force Academy is managed

under a diverse set of rules that underscore the military mission while balancing the environmental responsibilities of effectively managing natural resources for the good of the Department of Defense, the local community and American public. While this has been remarkably successful to date, the USAFA is under increased pressure from regional community members to provide community access and recreational opportunities. Furthermore, impacts associated with other land ownership patterns affect the Academy's ability to manage its resources. For example, rapidly developing areas along tributaries to Monument Creek are increasing amounts of sediment and altering hydrology to extents that place stress on the Monument Creek mainstem.

It is increasingly obvious to USAFA resource managers that administration of resources is only possible in a multi-jurisdictional and collaborative process in which stresses placed on systems elsewhere are identified and mitigated within a watershed context. This approach might help avoid downstream impacts to the Academy and other owners or managers situated close to water ways. This provides an excellent rationale as to the importance of a watershed perspective in resource management and the usefulness of landscape scale

assessments that help put these types of relationships into a useful perspective.

State of Colorado: The State Land Board administers several parcels within the watershed on behalf of Colorado schools. These lands are subject to disposal or leasing arrangements designed to maximize benefit from these lands.

Bureau of Land Management: The BLM administers a very small parcel of land east of Woodland Park comprising far less than 1% of the total watershed area.

recreation

Influenced heavily by burgeoning urban populations in Colorado Springs and surrounding communities, the watershed area receives heavy recreational use. The Pike National Forest provides established opportunities for camping, hiking, day-use, hunting, back country cycling and off-road vehicle use. Other lands, including those managed by the DoD / Air Force receive heavy use from hikers and cyclists (via the Monument Creek trail for example). Several regional parks (including the east watershed, Black Forest area) provide additional recreational opportunities in generally concentrated areas. While regarded as relatively benign, the cumulative impacts from recreation affects other system within the watershed stressing physical, biological and social properties of the landscape area.

Informal recreation occurs throughout the watershed but is particularly heavy in the Rampart Range area where any number of off-road activities take place. Some of these activities have placed enormous stress on the forest's ecological systems by exacerbating soil loss, causing fragmentation, disturbing wildlife and creating noise. Illegal shooting ranges are also common, creating dangerous situations for other recreationists, resulting in illegal refuse dumping and outright resource destruction. The Forest Service has engaged in an effort to mitigate damage to systems through education and exclusion with varying levels of success (Tapia 1999).

economics

Economics can be regarded as the base of the human dimension, influencing all component systems grouped under the social systems category. The project area is, in a sense, the intersection of several levels of economy or exchange of resources.

The region's economic history mirrors that of its settlement patterns. Early economic systems were driven by resource extraction and harvest including trapping, mining and logging. After the arrival of the railroad and the founding of Colorado Springs in the 1870s, the economy began to diversify. The



Photograph 11: The Rampart Range Road receives heavy traffic from informal (outside developed recreation areas) recreationists. To minimize impacts to the forest from off-road vehicles and shooting ranges, the Forest Service has embarked on an ambitious task of education and exclusion to protect against soil loss, resource destruction and illegal dumping. This photograph, taken from the Rampart Range Road, shows impacts from off-road vehicle use and shooting ranges (note the tree in the foreground).



region has long derived a substantial amount of economic activity from the service sector predominantly centered on recreational and tourism related activities.

By 1956, the Colorado Springs area supported upwards of 200 light manufacturing companies (in part due to the war-time efforts of the Chamber of Commerce to recruit small-scale manufacturing), although tourism was still regarded as the second most important economic activity after the military related investment in the area (Carter 1956). In fact, by the late 1950s, there were three primary economic bases: tourism, light industrial plants and military facilities (Carter 1956).

These economies can be grouped into several large classes, partially dependent upon location and clearly interrelated. Like other systems within the project area, these economies follow similar bio-geographical lines of other systems. The southern portion of the watershed is heavily urbanized containing a concentration of residential, commercial and industrial development. This represents a diverse economy based upon services, manufacturing, education and high-tech endeavors. Within the western portion of the watershed is a concentration of recreational activity and resource extraction in forested, public lands of the Rampart Range and the Pike National Forest. The prairie ecosystems of the eastern watershed are prime areas for development but still retain elements of the land-based economies of agriculture and ranching.



Photograph 12: The Manitou Experimental Forest (just north of Woodland Park) is part of the USFS Rocky Mountain Research Station and focuses on the ecology of Front Range Forests. Experimental thinning and forest health projects, such as the one shown here, help guide regional forestry efforts.

forest economics

Although in steady decline since the 1950s, regional forest economics are of utmost importance within the watershed. Integral to sustainable forest health projects are markets for small-diameter timber products (resulting from thinning projects) and local sources to thin forest stands and to remove material.

Recent studies from the Upper South Platte Watershed (adjacent to the Monument Creek Watershed, see map on page 17 for more information) suggest that given the lack of processing facilities in the region and the lack of market for small-diameter timber, selective thinning projects are not economically sustainable (revenues recovered from sales of extracted timber do not cover thinning or transport costs), requiring to some extent subsidies to merely break even (Lynch 2000). For the three units thinned in the 2000 study, costs associated with thinning (equipment, labor and transportation) were always roughly double the revenues recovered from sales of the extracted timber, although some variation occurred due to differences in terrain, slope and access.

Local thinning projects are expensive as transportation costs tend to be high given the lack of local processing facilities. Wood resulting from thinning efforts in the Upper South Platte Watershed was transported to

Olathe, Colorado for processing. This facility has recently closed, following the regional trend of mill closures.

Further, potential uses for ponderosa pine (the predominant wood resulting from thinning projects) are few. Though potentially a source as fuel-wood for local residents still burning wood as a source of heat, ponderosa pine is regarded as a poor source for building studs and marginal for oriented strand board. While adequate as pulp material, to-date there exist no pulp processing facilities on the Front Range, let alone the local region.

Colorado as a whole utilizes a large amount of wood products for everything from building materials, animal bedding, poles and fencing. Upwards of 90 to 100% of this material is imported from outside the state and an increasing amount is imported from outside the country (Lynch and Mackes 2001). Given the increase in shipping costs, it is likely that material resulting from local thinning efforts could be processed efficiently in a value-added process that extended some economic benefits to the local community.





current condition

The **current condition** represents what we know about the project area. This chapter builds upon the watershed characterization documented in the previous chapter, providing a detailed summary of the current state of the ecological systems within the watershed. This information might be useful for land managers and local stakeholders engaged in planning processes and management efforts. It is assumed that the landscape is the sum interaction between the systems considered under these broad headings.

biological systems

Biological systems include plant and animal fauna (vegetation and wildlife) and significant species (including plants, animals and natural communities, and those regarded as rare or threatened). Documented in additional detail are vegetative patterns, composition and structure; exotic plants and noxious weeds; dominant and key wildlife; plants and animals that are significant to the region or those that are regarded as rare globally or within the state.

Photograph 13: The Rampart Range (from Palmer Park) forms the western boundary of the Monument Creek Watershed. The US Air Force Academy occupies the virtual "heart" of the watershed (the small assembly of buildings in the middle, left third of the image).

vegetation

A landscape's vegetation is in part determined by climate, soils, elevation, slope, aspect, and anthropogenic effects, including historic land use. The vegetative structure of the Monument Creek Watershed is remarkably complex, with a diversity of species and structures that reflects the effect of other complex systems (see topography on page 30, soils on page 32 and land use on page 40) and historic land use patterns.



Figure 9: Landscape vegetation (percent of total watershed area in descending order). Data source: CDOW 1999a):

- Ponderosa pine 28% (17,411 ha)
- Grass / forb rangeland 25% (15,386 ha)
- Gambel oak 13% (8,242 ha)
- Urban / built-up 9% (5,534 ha)
- Barren land 7% (4,096 ha)
- Ponderosa pine / aspen mix 5% (2,977 ha)
- Aspen 3% (1,568 ha)
- Riparian 2% (1,274 ha)
- Mountain shrub mix 2% (1,075 ha)
- Grass / cholla cactus mix 2% (979 ha)
- Commercial 1% (777 ha)
- Agriculture 1% (611 ha)
- Sagebrush community 1% (508 ha)
- Water 1% (406 ha)
- Ponderosa pine / Gambel oak <1% (85 ha)
- Englemann spruce / fir mix <1% (79 ha)
- Piñon-juniper <1% (40 ha)

Notably, current vegetative structure reflects intense anthropogenic effects sustained over the past 140 years including: fire suppression, logging, land use conversion, development, infestation of exotic species (weeds), and insect outbreaks, among others.

The project area can be characterized by three main types of vegetative cover, largely determined by elevation, aspect and moisture. The western and northeastern portions of the watershed are typified by coniferous mixed forest above about 6,500 feet. This montane zone is dominated by the Rampart Range on the west, a north-south oriented range of mountains that extends from Castle Rock in the north to Cheyenne Mountain to the south (see geology section on page 38 and the topography section on page 30 for more information about the Rampart Range). The Black Forest is located on the Palmer Divide a roughly east-west ridge comprising the northern and northeastern edge of the watershed. The transition area between mixed montane forests and prairie grasslands is

dominated by oak shrub and mixed shrubland communities. These areas are found on the toe-slopes of the Rampart Range and edges of the Black Forest. Grasslands comprise much of the central part of the watershed, occurring at slightly lower elevations than the forest and shrub components. The shrub and grassland communities have been historically amenable to development. Increasingly, development is encroaching upon the oak shrub and forested areas, adding fears that building in the “Red Zone” might result in substantial loss of property if the region were to experience a catastrophic fire.

The ponderosa pine (*Pinus ponderosa*), Douglas-fir (*Pseudotsuga menziesii*) forest that typifies approximately 28% of the project area is similar to other Front Range forests: relatively young, homogenous and dense (generally more so than before European settlement). These forests are generally regarded to be less regulated by long-term or historic ecological processes, particularly fire, tending to be prone to impacts from extreme events.

A breakdown of landscape vegetation, again showing the percentage of cover within the watershed is included in Figure 9.

forests

Forests within the watershed are part of a much larger forest mosaic that comprises portions of the Southern and Middle Rocky Mountains, stretching from Arizona and New Mexico in the south to Wyoming and western South Dakota in the north (Montana and Idaho are considered part of the Northern Rocky Mountains).



While the distribution of trees is strongly influenced by moisture patterns and temperature (often determined by elevation and / or aspect), five distinct forest types or zones are recognized within the Rocky Mountain region (Barrett 1995):

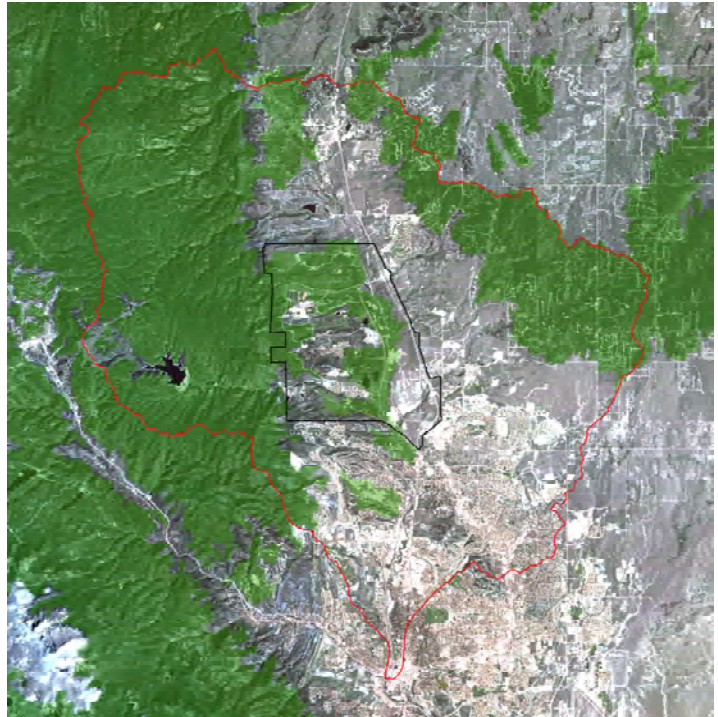
- **Oak-mountain mahogany zone**
- **Piñon-juniper zone**
- **Ponderosa pine zone**
- **Douglas-fir zone**
- **Engelmann spruce-subalpine fir zone**

Of these zones, the first four are found within the watershed to some extent. Zones are a classification scheme based on climax vegetation, in absence of catastrophic disturbance, named for the dominant species. While it is useful to categorize forested areas in this manner, these areas are rarely discrete, homogenous units. Rather they tend to vary along environmental and ecological gradients (Barrett 1995). Identifying these gradients is important to better understanding the structure of the forest systems, how they have changed over time, how they respond to disturbance and how forests relate to larger vegetative patterns.

A rough breakdown of the percentage of zone representation within the watershed, indicates that most of the watershed falls within Ponderosa pine and Oak-mountain mahogany zones, which given the elevational range (and not really taking into account localized instances of aspect variation and moisture levels), is fairly constant (CDOW 1999a; see **Note 1**, page 127).

- **Oak-mountain mahogany zone** 29% (8,242 ha)
- **Piñon-juniper zone** <1% (40 ha)
- **Ponderosa pine zone** 71% (20,474 ha)
- **Douglas-fir zone** 0% (0 ha) (or 16% using USFS data, see below)
- **Engelmann spruce-subalpine fir zone** <1% (79 ha)

While useful for landscape level characterization, these figures fail to reflect forest composition which includes an ever increasing percentage of Douglas-fir encroachment in ponderosa pine stands (see **Note 1**, page 127). USFS data suggest that upwards of 50% of the National Forest within the Monument Creek Watershed is comprised of Douglas-fir (or 16% of the entire watershed), while ponderosa pine covers 25% (USFS 2000). CDOW Basinwide data (1999a) for the same area documents no



Map 22: Approximately 40% of the Monument Creek Watershed is forested, including portions of the Palmer Divide known as the Black Forest. Ponderosa pine and Douglas-fir are dominant species in watershed forests. Data source: CDOW 1999a.



Photograph 14: Much of the forested areas of the Monument Creek Watershed are characterized by dense stands of even aged and sized timber, thought to be in excess of sustainable ecological condition. Increased likelihood of catastrophic fire, disease and other forest health issues result. This particularly dense stand of ponderosa pine and Gambel oak occurs near Mount Herman, west of Monument.

Douglas fir and 47% ponderosa pine coverage. It is also doubtful that Englemann spruce occurs in the watershed (Schlosberg 2002).

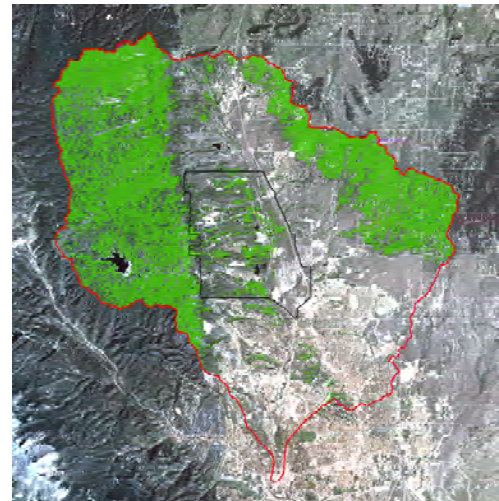
forest composition

Watershed forests are comprised of several dominant species of trees: ponderosa pine (*Pinus ponderosa*), Douglas-fir (*Pseudotsuga menziesii*), quaking aspen (*Populus tremuloides*), and blue spruce (*Picea pungens*). Other less common species include limber pine (*Pinus flexilis*), white fir (*Abies concolor*), and bristlecone pine (*Pinus aristada*).

As the predominant species within a heavily forested watershed, ponderosa pine types are the center of the ecologically complex landscape system. As elsewhere on the Front Range, this forest type has been greatly stressed by logging as a source of fuel and building material, and has seen a great effort to suppress naturally occurring and

fundamentally integral disturbance cycles, including fire. Ponderosa pine types are the dominant community type along the eastern slope of the Rampart Range above about 2,000 meters (6,500 feet) and below about 3,000 meters (10,000 feet). Ponderosa pine forest extends eastward across the Palmer Divide, comprising much of the Black Forest, generally regarded as the lowest elevational and most plains dominant ponderosa pine forest in Colorado (McGinnies et al. 1991).

Paleoecological evidence suggests that the range of ponderosa pine forests has increased significantly since the last ice age, spreading from relatively isolated populations over the last 6,000 – 8,000 years. This change may in part suggest why this species is not present in ecologically similar and suitable areas and why taxonomic confusion persists (Barrett 1995).



Map 23: Ponderosa pine is the predominant species of tree in a heavily forested watershed. The ponderosa pine stands comprising the Black Forest are regarded as the lowest elevational and most plains dominant in the state of Colorado. Data source: CDOW 1999a.

Ponderosa pine generally comprises pure or mixed-conifer forests at mid-level elevations (6,500 – 10,000 feet). Suppression of grassland fires has led to encroachment of ponderosa pine into grassland communities in some areas, particularly the lower foothills and margins of the Black Forest. Ponderosa pine is relatively tolerant of hot, dry habitat, and therefore tends to occur on ridgetops and south and east facing slopes. Its relative effectiveness in controlling water loss is important given climatic conditions and the poorly formed granitic soils that typify the mountainous areas of the region (see the soils section beginning on page 32 for more information about the region's soils). This species is not as tolerant to heavy freezing and snow as other coniferous species, thus other species tend to dominate north facing slopes and other localized regions where ponderosa pine would otherwise be found (Livingston 1949).

Presently, ponderosa pine stands within the watershed are characterized by dense, relatively even-aged timber resulting in large part from decades of fire suppression and livestock grazing following heavy logging. Though historically ponderosa pine forests would be expected to contain numerous openings and a diversity of age classes, few large openings exist aside from the Farish Recreation Area (a disjunct parcel owned and managed by the US Air Force Academy), and rocky outcrops occurring primarily on the eastern flank of the Rampart Range. A high percentage of crown closure, the alteration of ecological processes and persistent patterns of disturbance have resulted in an accumulation of fuels, increasing the likelihood of catastrophic, stand replacing crown fires in the region. In portions of the forested areas where logging and fire suppression have been most active, the resulting forest structure includes few openings, or mixed-density stands, and include a higher percentage of Douglas-fir (Kaufmann et al. 1999). These forests are particularly susceptible to catastrophic, stand replacing fire and post-fire impacts including: property loss, soil loss, habitat loss, etc.



Photograph 15: Changes in landscape disturbance regimes, notably the exclusion of fire, as lead to changes in forest structure including increased percentage of Douglas-fir. The forest visible from the Rampart Range road (here facing south) is indicative of Douglas-fir forests within the watershed.

Like other ponderosa pine – Douglas-fir forests of the lower montane zone (1,830 to 2,350 meters or 6,000 to 7,700 feet), stands on south facing slopes and ridge tops tend to be comprised of pure ponderosa pine with an herbaceous understory. Stands on north facing slopes are usually more dense, with occasional Douglas-fir with less understory except in openings (Brown et al. 1999).

US Forest Service Resource Inventory System (RIS) data for the federally managed forests within the watershed are incomplete (80% of federally managed forest stands in the watershed lack habitat structure



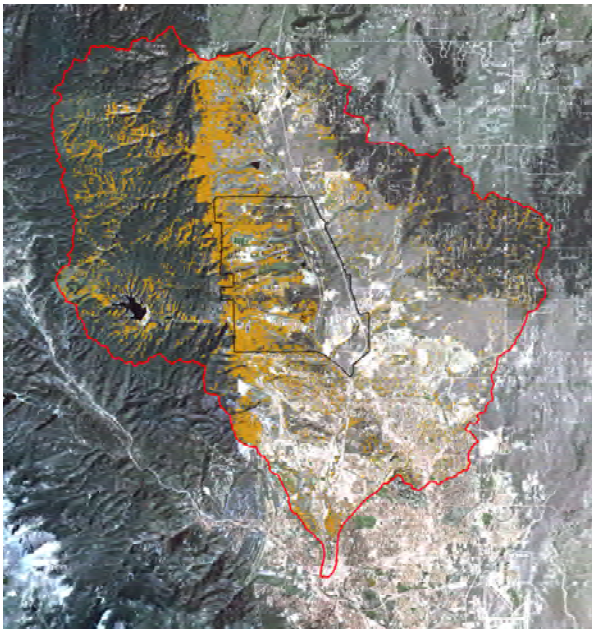
information), but the data that do exist suggest that much of the forest is regarded as mature with moderate to high rates of crown closure (USFS 2000). Less than 1% of the surveyed stands are characterized as old growth.

The existence of ponderosa pine stands along the Palmer Divide in the Black Forest has long been the subject of scientific inquiry (Livingston 1949). Forest stands are not correlated solely to elevation as mixed prairie vegetation also occurs at the summit of the divide. Rather it is believed that soils and geology are perhaps a stronger determinant, as xeric conditions associated with coarse granitic soils (similar to those of the Rampart Range) create conditions hospitable to the recruitment of ponderosa pine and less so for mixed prairie vegetation (Livingston 1949).

As in the stands that typify the Rampart Range, ponderosa pine stands occurring on private and state lands in the Black Forest region (northeast watershed) are also characterized as dense, even-aged and structurally homogenous: “90 to 120 year old trees with some Douglas fir” (Schlosberg 2001). There is also a high level of dwarf mistletoe (*Arceuthobium vaginatum*) infestation that places increasing levels of stress on trees and stands. Upwards of 20% of Front Range ponderosa pine forests are infested with mistletoe (Veblen and Lorenz 1991).

While structurally similar to forest stands in the Rampart Range, the Black Forest is strikingly different in terms of land use and potential for ecologically-based management. Given the high percentage of private

land ownership in the area, landscape level management is difficult at best, requiring a particularly high level of coordination among private sector players (for more information on land ownership in the watershed, see the “land status” and “land use” sections beginning on page 40).



Map 24: The majority of watershed shrublands are found along foothill slopes, in the transition between prairie grasslands and lower montane forests. Gambel oak is a dominant species. Data source: CDOW 1999a.

shrublands

Shrublands in the watershed are located primarily in a narrow band along the lower foothills slopes at the transition from the prairie grasslands zone to the foothills-montane zone, and as a fringe at the transition to the Palmer Divide plateau (Black Forest). They consist of several different associations dominated by Gambel oak (*Quercus gambelii*). These shrublands form a discontinuous band intermingled with openings of mixed grasses and small wooded areas.

The range of the communities dominated by Gambel oak includes much of western and southwestern Colorado. In the eastern portion of the state, the range of Gambel oak (*Quercus gambelii*) extends north in a narrow strip along the lower Front Range foothills and ends just south of Denver. With the exception of a narrow band along the Colorado-New Mexico border, the Front Range foothills represent the easternmost

extent of its range. Throughout its Front Range foothills habitat, Gambel oak forms a transitional ecotone between the prairie grasslands and the montane forests.

The foothills shrubland band dominated by Gambel oak (*Quercus gambelii*) extends from below Colorado Springs in the south to well above the El Paso County line and the northern limit of the watershed in the north. As can be expected, the character of these shrublands changes from the southern-most to the northern-most reaches of the range; however, within the watershed very little difference exists.

Aspect and slope, through the effect they have on moisture and temperature, are important factors in determining the distribution of the different community associations on the landscape. Dense oak shrublands are typically found on the south facing slopes, while oak shrub communities on the north facing slopes typically also include a tree overstory. Associations in the valley bottoms are usually either dominated by grassy meadows, or open oak shrublands with a grassy understory.

Moisture and temperature conditions of a site are important factors in determining the distribution of oak shrublands on the landscape. Historically, the frequency and severity of the natural fire regime played an important role in restricting the extent of the oak shrublands to specific sites.

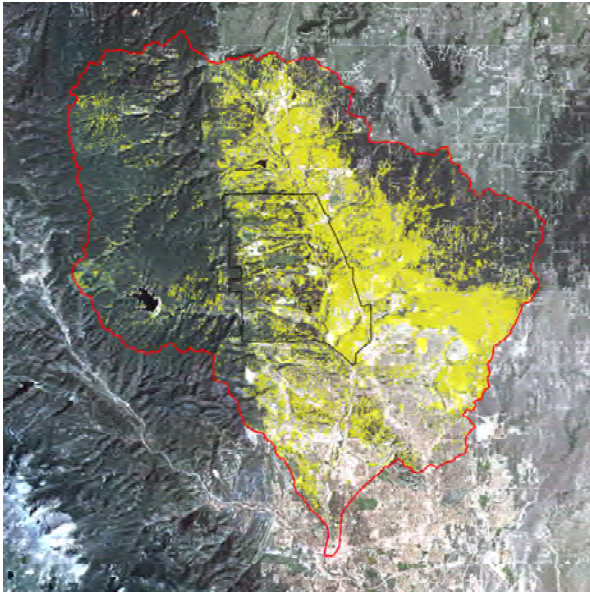
shrubland composition

The shrublands within the watershed are all dominated by Gambel oak (*Quercus gambelii*) in association with skunkbrush (*Rhus trilobata*), mountain mahogany (*Cercocarpus montanus*), and to a lesser degree wax current (*Ribes cereum*), yucca (*Yucca* sp.), and Rocky Mountain maple (*Acer glabrum*) (Kelso 2001). Plant associations of Gambel oak occur as savanna shrublands interspersed with short- and mid-height grasslands, as pure shrublands with a mix of mountain mahogany and skunkbush, or as the understory shrub in woodlands of ponderosa pine (*Pinus ponderosa*), piñon pine (*Pinus edulis*), and Rocky Mountain juniper (*Juniperus scopulorum*), and forests of Douglas-fir (*Pseudotsuga menziesii*) and blue spruce (*Picea pungens*).

In the area of the lower foothill slopes and valleys at the north end of the Air Force Academy, the south facing slopes tend to be dominated by a dense association of Gambel oak (*Quercus gambelii*) and mountain mahogany (*Cercocarpus montanus*), while the valley bottoms support more open associations of Gambel oak (*Quercus gambelii*) and mixed



Photograph 16: Gambel oak occurs in the foothills of the Rampart Range and along the Palmer Divide forming an ecotone between watershed grasslands and montane forests.



Map 25: Grasslands (depicted in yellow) within the Monument Creek Watershed are under continual pressure as prairie is converted to other uses including agriculture and urban development. Data source: CDOW 1999a.

grasses. The north facing slopes and east facing ridges typically have an open overstory of ponderosa pine and juniper with a dense understory of Gambel oak (*Quercus gambelii*). This pattern is typical of the shrublands on the lower foothills throughout the watershed. On the fringe of the Palmer Divide plateau and Black Forest, Gambel oak (*Quercus gambelii*) occurs less frequently with mountain mahogany (*Cercocarpus montanus*) and is interspersed with mixed grass openings before it grades into a ponderosa pine (*Pinus ponderosa*) woodland.

grasslands

Grasslands in the watershed are limited to mixed grass prairie grasslands of the lower elevations and mesic montane meadows of the higher elevations. Mixed grass prairie grasslands are located primarily in the main valley of Monument Creek and on some of the rolling hills that border it. Smaller areas of this grassland type also occur interspersed within the shrublands as openings between the shrubs and on the bottoms of tributary valleys.

The mixed grass prairie grasslands found on the lower elevations along the main Monument Creek drainage tend to be dominated by short and mid height species, while the smaller meadows on the upper slopes and in the openings between the shrublands tend to include a higher proportion of mid height and tall species.

grassland composition

Mixed grass prairie grasslands contain a wide diversity of short-, mid-height, and tall species. Common tall and mid-height species found in the opening between shrubs and on some of the more mesic slopes and valleys include little bluestem (*Schizachyrium scoparium*), big bluestem (*Andropogon gerardii*), Canada wild rye (*Elymus canadensis*), mountain muhly (*Muhlenbergia montana*), prairie sandreed (*Calamovilfa longifolia*), needle and thread (*Stipa comata*), western wheatgrass (*Pascopyrum smithii*), and sleepygrass (*Stipa robusta*). Typically the short grass species include blue grama (*Chondrosium gracile*) and buffalo grass (*Buchloe dactyloides*). Numerous non-native species may also be present in these areas. These include cheatgrass (*Bromus tectorum*),



Photograph 17: Mixed grass prairie occurs in watershed lowlands, forest openings and transition areas. Watershed grasslands are under increased pressure from development and other land use changes, including the introduction of non-native species.

smooth brome (*Bromus inermis*), timothy (*Phleum pratense*) and crested wheatgrass (*Agropyron cristatum*).

Grasslands in the region have been severely altered due to grazing, fire suppression, and introduction of non-native species and pasture grasses. The biggest threat to preservation and maintenance of functioning grasslands systems is the conversion from native prairie to agricultural or urban uses. As stated in Risser (1996), grasslands originally covered 370 million hectares of North America, but since European settlement have been reduced to less than 130 million hectares. In Colorado similar trends have occurred. Many parts of the vast grasslands of the eastern portions of the state have been converted to agricultural and urban purposes, while the less prevalent ecotonal grasslands in and near the foothills have been largely converted to urban uses.

The role of fire in maintaining foothills grassland ecosystems is uncertain, particularly when considering that the original stature of the areas we reviewed is uncertain. The role and effect of fire in grassland ecology depends upon the stature and character of the grassland. Weaver et al. (1996) reviewed literature on the role of fire in shortgrass prairie ecosystems and found the evidence inconclusive as to its role in excluding sagebrush, pine, and other woody species. In the mixed grass prairies, Bragg and Steuter (1996) found that fire is an important ecological process in all areas of mixed grass prairie (northern mixed grass, sandhill mixed grass, and southern mixed grass).

weeds

Several noxious weed species are being tracked that pose a serious management issue to area land managers and owners. Efforts are being made to map populations and develop strategies to mitigate potential impacts from these species on other populations of plants. El Paso County is tracking and mapping the following weed species (occurring on the Colorado State Weed List) in the watershed (note these data are only collected from private and county land or along public roadways, thus they are not necessarily representative of the weed distribution in the watershed) (El Paso County Department of Forestry 2000):

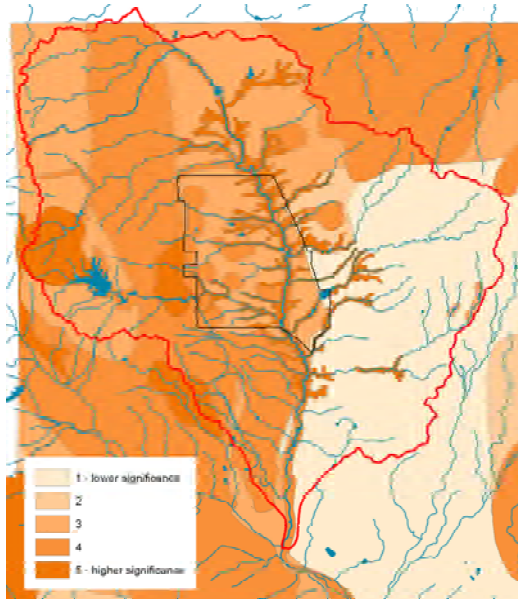
- Canada thistle (*Cirsium arvense*)
- Diffuse knapweed (*Centaurea diffusa*)
- Leafy spurge (*Euphorbia esula*)
- Musk thistle (*Carduus nutans*)
- Russian knapweed (*Acroptilon repens*)
- Spotted knapweed (*Centaurea maculosa*)

Other introduced species stress local systems and present management concerns to local resource managers.

wildlife

The diverse physiographic and vegetative nature of the project area lends to diverse habitat and likewise animal fauna. This section addresses the type of species known to inhabit the area, those that are





Map 26: CDOW Significant Wildlife Habitat mapping indicates areas of significant habitat and those areas at risk for adverse impacts due to land use change or other anthropogenic effects. According to these data, the Rampart Range, Black Forest and the Monument Creek drainage are highly significant areas within the Monument Creek Watershed. Data source: CDOW 2000.

expected to inhabit the area and those that have the potential to inhabit the area (see also the section on “significant biological resources” on page 27 for more information).

There are several groups of wildlife, useful to understanding how a landscape functions within the context of human social systems. Species of economic significance include those that are hunted or generate other types of revenue (including viewing, etc.); species of concern are those that are tracked due to their biological significance or regulatory protection; there are still other species that don’t fall neatly into either category including insects, some fishes, amphibians, etc. It is not uncommon to have certain species tracked by several agencies or organizations.

Given the coarse filter approach to assessing wildlife implied on a landscape scale, keystone species and those with landscape scale ranges, impacts or potential for pressure from the effects of other systems are given priority in this section.

Habitat significance data compiled by the Colorado Division of Wildlife suggests that habitat found in the Rampart Range, Monument Creek drainage, Black Forest and several disjunct areas (including some within the USAFA boundary) are regarded as high significance in terms of habitat

priority and potential for adverse impacts (CDOW 2000 and CDOW 1999b).

mammalian species

Upwards of 70 species of mammals (of 125 known from the state of Colorado) have been observed from the US Air Force Academy alone (Ripley 1994). Of these, several are of importance on a landscape scale due to habitat requirements, abundance and associated management issues. Of particular importance is the population of Preble’s meadow jumping mouse (*Zapus hudsonius preblei*) known from the Monument Creek drainage. This species is discussed in more detail in the “Biologically Significant Species and Natural Communities” section; see page 27 for more information.

Bighorn sheep (*Ovis canadensis*)

While populations of bighorn sheep within the watershed are not extensive, they are nonetheless important. The herd occupying the former quarry at Queen’s Canyon has received much attention from local resource managers and concerned stakeholders. The herd is currently being treated for lungworm by Colorado Division of Wildlife personnel as part of a long-term management program (Lynch 2002).

Bighorn sheep are relatively common in rocky portions of the Rocky Mountains. They are known for their site fidelity which may affect expansion of herds (Fitzgerald et al. 1994).

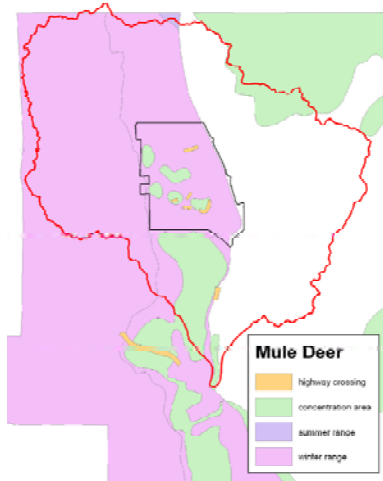
The populations of bighorn sheep within the watershed are relatively isolated and there is concern that continued isolation may make the herds more susceptible to disease and genetic homogeneity. Therefore, a management priority is the re-establishment of migration corridors between the Rampart Range populations and other regional herds. Bighorn sheep are known to migrate seasonally from 5 to 15 kilometers or 3 to 9 miles (and as far as 60 kilometers or 37 miles) (Fitzgerald et al. 1994).

As of late 2001, a ram tagged as a yearling in 1995 made its way to Queen's Quarry from the Dome Rock area (near Mueller State Park, approximately 20 kilometers or 15 miles from Queen's Quarry). It is hoped that such contact will bring much needed genetic diversity to the resident herd (Lynch 2002).

The US Forest Service also plans to clear dense Gambel oak thickets north of the quarry to provide additional habitat for bighorn sheep within the watershed (Lynch 2002).

Mule deer (*Odocoileus hemionus*) and White-tailed deer (*Odocoileus virginianus*)

Mule deer are one of the most common mammalian species in the western portion of the Monument Creek Watershed, potentially inhabiting all forested areas of the watershed, including the Rampart Range and Black Forest (CDOW 1999b). During the late 1980s and early 1990s, populations were generally believed to be in excess of carrying capacity resulting in management concerns ranging from over-browsing (of native and domesticated vegetation), and vehicle altercations in portions of the

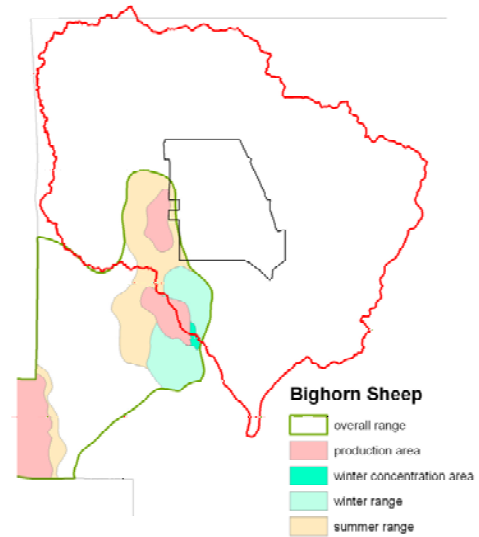


Map 28: Important mule deer concentration areas are located within the United States Air Force Academy boundaries, portions of the Black Forest and in the Rampart Range. Data source: CDOW 1999b.

watershed (Ripley 1994). These are populations are now believed to be stable (at least locally) (McDermott 2002). Although, mule deer are open to huntings seasons (including those managed by the Air Force Academy), overpopulation has resulted in changes to habitat (particularly as the result of urbanization) and the lack of natural predation (Ripley 1994).

Mule deer are regarded as generalists, typically occurring in a wide range of habitat types. Habitat has been altered significantly due to development and land use changes.

The widest ranging member of the deer family in North America, White-tailed deer are known to inhabit several habitats, primarily riparian woodlands or irrigated plains areas (Fitzgerald et al. 1994). Within the



Map 27: The small population of Rocky Mountain bighorn sheep within the watershed represents an important example of the interaction between wildlife and social systems. The complex relationships implicit in these interactions includes the role of resource managers in the conservation of species and habitat. Note the location of the bighorn herd at the Queen's Canyon Quarry, shown on this map production area and winter concentration area. Data source: CDOW 1999b.

Monument Creek Watershed, white-tailed deer have traditionally occurred east of Interstate 25. However, recent surveys in January of 2002 suggest that populations are moving westward with confirmed observations by Colorado Division of Wildlife personnel on the western edge of the US Air Force Academy (Lynch 2002). Similar westward movement of white-tailed deer has also been observed in southern Colorado Springs, near the Broadmoor Hotel (Lynch 2002).

Black bear (*Ursus americanus*)

The black bear is relatively common within the watershed and is regarded as Colorado's largest carnivore (still extant in the state) (Fitzgerald et al. 1994). Black bears are able to survive in nearly any habitat with appropriate food supplies although they generally inhabit montane shrublands and forests (Fitzgerald et al. 1994). Black bears are omnivorous and somewhat opportunistic depending on the season. Bears forage primarily on grasses and forbs during the spring and berries and fruits during the summer and fall and are supplemented with small animals, carrion and occasionally large animals (Fitzgerald et al. 1994). Black bears will also forage in urban areas, searching for food in garbage cans and cars. Conflicts between bears and humans are increasing due to increasing urbanization in the watershed and subsequent habitat replacement or encroachment and seasonal fluctuation of typical food sources. Food supplies are particularly important as the animals come out of hibernation (which can last upwards of 200 days) (Fitzgerald et al. 1994).

Most of the forested areas of the Monument Creek Watershed are included in the black bear's overall range (CDOW 1999b). Concentration areas vary by season. Several "bear / human conflict areas" exist within the watershed including the southern portion of the US Air Force Academy and the Palmer Lake Area (CDOW 1999b).



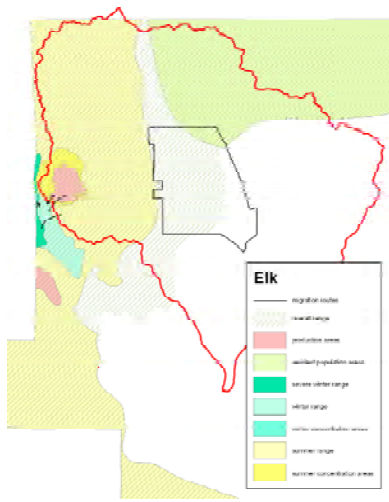
Photograph 18: Browsing pressure from elk is known to negatively affect aspen regeneration and stand health. Elk have been excluded from several clear cut aspen stands in the Farish Recreation Area by US Air Force Academy natural resource managers to promote aspen regeneration.

American Elk (*Cervus elaphus*)

Although elk are generally believed to have inhabited portions of the Great Plains, current populations tend to inhabit forested areas with established openings or forest edges (Fitzgerald et al. 1994).

Most of the Rampart Range is regarded as summer range with concentration areas occurring in and near the Farish Memorial Recreation Area administered by the Air Force Academy. This area is also an important production areas (CDOW 1999b). Winter range and concentration areas occur just west of Woodland Park in the Fountain Creek Watershed. The summer and winter concentration areas are connected by well established migration corridors (CDOW 1999b). In general, elk are moving eastward suggested by the resident population at the Air Force Academy that is currently under management including a small hunting program (McDermott 2002).

Elk both graze and forage and subsist on a varied diet of grasses, shrubs, and forbs depending somewhat on the



Map 29: Much of the Rampart Range is regarded as summer range for elk while summer concentration areas occur in and near the Farish Recreation Area. A resident population of elk occurs on the Air Force Academy. Data source: CDOW 1999b.

season (Fitzgerald et al. 1994). Elk have been known to heavily browse aspen stands, feeding on twigs, seedlings and bark. The heaviest pressure comes during the fall and winter months when other food sources are scarce or obscured by snow. Browsing has been known to negatively affect aspen regeneration and stand health (Fitzgerald et al. 1994). Such browsing pressure has occurred in the Farish area and USAFA resource managers are currently erecting fences to exclude elk from selected aspen stands that have been clearcut to promote aspen regeneration (McDermott 2002).

Pronghorn antelope (*Antilocapra americana*)

Once common in the grassland areas of the eastern watershed, persistent populations of pronghorn are now isolated due to land use change, fencing and habitat conversion

(particularly via residential development). Although home ranges vary by season, habitat quality and population, they range from approximately 165 to more than 2,300 ha (410 to 5,700 acres) (Fitzgerald et al. 1994).

It is estimated that 2 million pronghorn existed in Colorado in the early 1800s. By 1900, few remained pressured by hunting and land use change. Conservation and limited hunting seasons have had a tremendous impact on this species' ability to recover from near extinction (Fitzgerald et al. 1994).

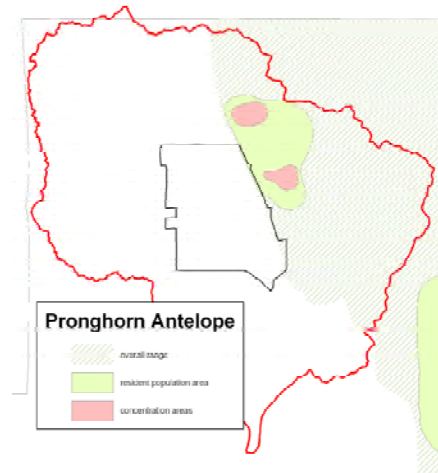
avian species

Several species of birds are of importance on a landscape scale either due to regulatory issues or habitat requirements.

Mexican Spotted Owl (*Strix occidentalis lucida*)

Critical habitat for the Mexican Spotted Owl was designated 1 February 2001 and included much of the Rampart Range where it meets the Great Plains. This designation is currently being re-negotiated because in Colorado Spotted Owls occur in narrow, shady, cool canyons and sandstone slickrock. This aspect of the owl's habitat is missing along the designated critical habitat.

A 1919 historic record from the Queen's Canyon exists but contempo-



Map 30: Recovering from near extinction in the early 1900s, pronghorn antelope inhabit grasslands in the eastern watershed. Data source: CDOW 1999b.

rary surveys in Queen's Canyon, Williams Canyon, Ormes Peak, West Monument Creek, Stanley Canyon, Hay Creek, Hell Creek and South Beaver Creek resulted in no contacts for Mexican Spotted Owl (Tapia 2002).

Peregrine Falcon (*Falco peregrinus*)

A Peregrine Falcon "hacking" program was conducted by the Colorado Division of Wildlife in the mid to late 1980s. The hack site was located on Eagle Peak (also known as North Peak) west of the US Air Force Academy visitor center. Several birds were released during this time, however no nests were established in the vicinity of the planning area. There are no known falcon eyries (nests) within the Monument Creek Watershed (Tapia 2002).

aquatic species

Greenback Cutthroat Trout (*Oncorhynchus clarki stomias*)

There are no known populations of Greenback cutthroat trout within the Monument Creek Watershed. The closest known population inhabits drainages in the Pikes Peak area. Much of the watershed is, however, regarded as potential habitat (CDOW 1999b).

wildlife and the urban environment

Due to the proximity of habitat to urbanized areas, issues related to wildlife are numerous. Better understanding of the regional aspects of wildlife needs and movement in the context of an ever growing urban-wildland interface is central to long-term planning strategies that attempt to address these complex issues and ecology and management.

physical systems

hydrology

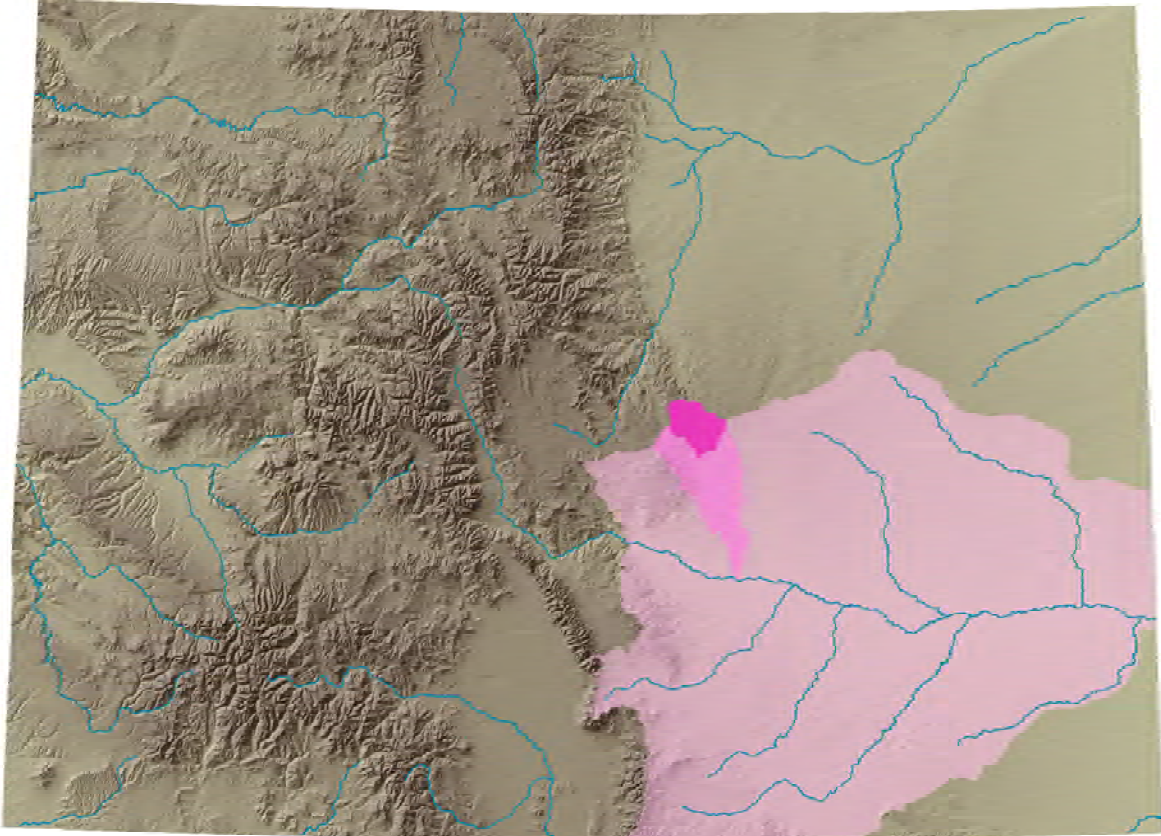
In the arid west, water is of historic importance and often a determinant of whether a community prospered or failed. As part of a landscape, water is regarded as perhaps the most profound of the elements of change, indeed it is regarded as the most effective process shaping the landscape (Marsh 1998). Evidence of this change is often readily apparent: seasonal flooding or soil erosion but often times change is subtle or indirect in the case of appropriation of water rights or intra-basin water transfers to support a growing urban region. The hydrologic systems within the Monument Creek Watershed form complex relationships between climate, geology, soils, land use and politics.



The project boundary traces the Monument Creek Watershed or the area within the landscape that drains to a common point (or the pour point, in this case at Fountain Creek, underneath the junction of Interstate 25 and US Highway 24). As a hydrologic unit, the Monument Creek Watershed is part of the Fountain Creek Watershed, which in turn is part of the Arkansas River Watershed. The northern boundary of the Monument Creek Watershed follows the Palmer Divide which is also the southern boundary of the Platte River Watershed. The Palmer



Divide is a major bio-geographic boundary separating the north from the south.

There are approximately 420 kilometers (260 miles) of stream reach in El Paso County (based upon 1:100,000 scale digital hydrographic data).



-  Monument Creek Watershed
-  Fountain Creek Watershed
-  Arkansas River Watershed

Map 31: The Arkansas River Basin (Colorado's largest) drains 62,011 square km (24,904 sq miles) of Colorado stream reach including Fountain and Monument Creeks (see page 15). Water is regarded as a fundamental agent of landscape change. Understanding the relationships of hydrology to other watershed systems is integral to characterizing and understanding the watershed landscape.

streamflow and precipitation (including flooding)

Between 1930 and 2000, the population of El Paso County increased by nearly 950% (from approximately 50,000 to nearly 520,000 residents). There has been a 30% increase in county population since 1990 alone (as of 2000) representing nearly 120,000 additional inhabitants in the county (see page 68 for more information on population growth). As population increases, the amount of impervious surface area also increases (streets, driveways, parking lots, etc.). As the amount of impervious surface area increases, infiltration decreases which causes runoff to increase resulting in a quicker hydrologic response resulting in exacerbated streambank erosion (Stogner 2000).

As discussed in detail in the climate section (see page 39 for more information), precipitation is highly variable within the watershed. Most (70-80%) precipitation events occur at less than 0.6 cm (0.25 inches). Precipitation events greater than 0.6 cm generally occur during the summer months (July through September) and these tend to be of short, intense durations resulting in large variations in annual precipitation over short distances (Stogner 2000). Recent research suggests that between 1977 and 1999, precipitation levels were generally above historic averages, although no increasing trends were detected from the Monument Creek Watershed (and only slight increasing precipitation trends were detected in the southern portion of the Fountain Creek Watershed at Ruxton Park and Pueblo).

Streamflow also shows wide variation across the watershed and correlates strongly with seasonal changes. Three predominant flow regimes are present in the Monument Creek and Fountain Creek Watersheds: base flow (September through early October), snow melt (mid-April through mid-June) and summer flow (mid-June through mid-September). Streamflow is fairly uniform during the base flow period and varies somewhat during the snow melt period depending on temperature and snowfall levels. Streamflow increases significantly during the early part of the snow melt period and decreases quickly after peaking in mid-May. Streamflow during the summer flow period is highly variable, affected by seasonal thunderstorms and precipitation events (Stogner 2000).

Figure 10 shows mean daily discharge data (in cubic feet per second or cfs) for the station at Monument Creek at the North Gate of the US Air Force Academy for 1998 (arbitrarily picked as a typical year). The

seasonality of the flows is apparent: flows average between the beginning of the year and mid-March are fairly constant at around 10 cfs, not exceeding 20 cfs until the last week of March. Discharge rates increase dramatically through the spring, finally peaking in early May at 131 cfs. By late July, the mean daily discharge rate has returned to less than 20 cfs, although the summer precipitation patterns cause variation from nearly 0 to 20 cfs into the early fall, which is relatively constant until the snows come in late fall and early winter. This pattern is relatively constant throughout the measurement period of 1985 through 1998, although several extremes occurred: in 1987 the high mean daily discharge rate reached 232 cfs (7 May) and in 1995 it reached 219 (21 May). In April of 1999, however, the mean daily discharge rate reached 1,250 cfs, while the May peaks reached 228 cfs early in

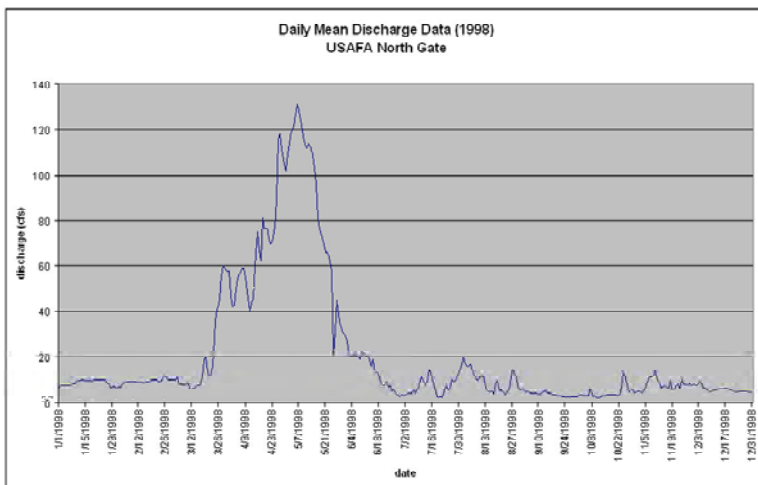


Figure 10: Daily mean flow data for Monument Creek (at USAFA North Gate) depicts wide seasonal fluctuation which is largely dependent on precipitation cycles, most of which occurs during the spring and summer months (Colorado State University 2000).



the month and 293 cfs later in the month (Colorado State University 2000). This event caused major property damage and contributed to bank and slope failures on Monument and Fountain Creeks (Figure 11).

A significant increasing trend in annual peak streamflow was detected at Pikeview to Nevada Street in Colorado Springs since the mid-1970s. Given precipitation trends for the same area, this trend suggests that changes in land use (predominantly rangeland to urban) over the past quarter century have altered the hydrologic response and increased storm run off.

On a watershed scale, the effects of land use change are compounded by political realities. Waste water effluent from the Colorado Springs Waste Water Treatment Plant is discharged into Fountain Creek, noticeably affecting streamflow. Further, intra-basin water transfers have also influenced streamflow, enforced by the Fountain Creek transbasin return-flow decree which maintains that Colorado Springs can return intra-basin transfers to other locations in the Arkansas River Watershed.

Efforts to move water from the West Slope began during the 1950s as the region's population grew significantly following World War II. The first phase of a massive effort to transport water from the Blue River drainage was completed in 1953. Water was transported through the Hoosier Tunnel into the Middle Fork of the South Platte River and stored at the Eleven Mile Canyon Reservoir near Lake George (Carter 1956). Storage facilities were also constructed on West Monument Creek, a small tributary of Monument Creek forming the Rampart Reservoir which is part of the Colorado Springs water system, managed by Colorado Springs Utilities.

Some have suggested that the flood of April 1999 was exacerbated by land use change and regulatory means (transfers and effluent discharge) causing much damage to property downstream but effectively influenced by systems and processes operating upstream.

social systems

Social systems are those that comprise the human dimension of the project area. These systems include: population, development and settlement, demographics, economics, transportation systems, recreation, land use and land ownership. Human influence on the

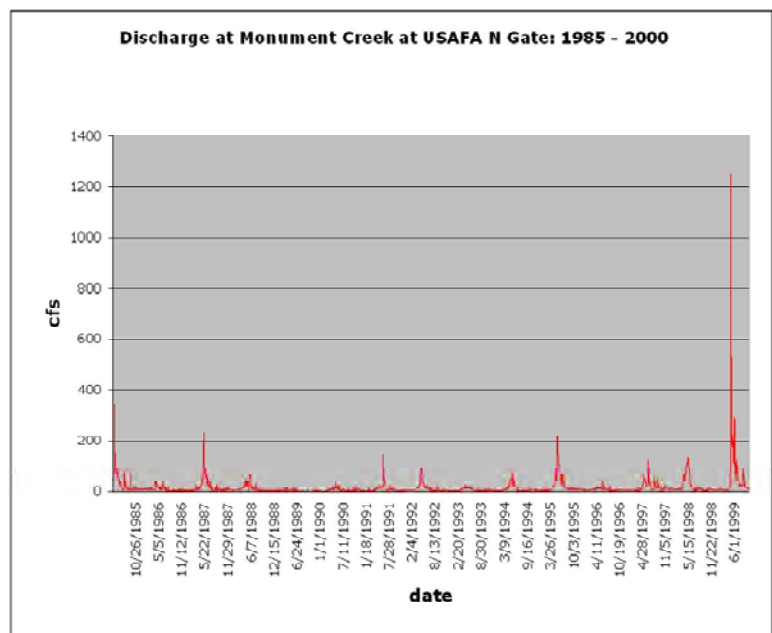
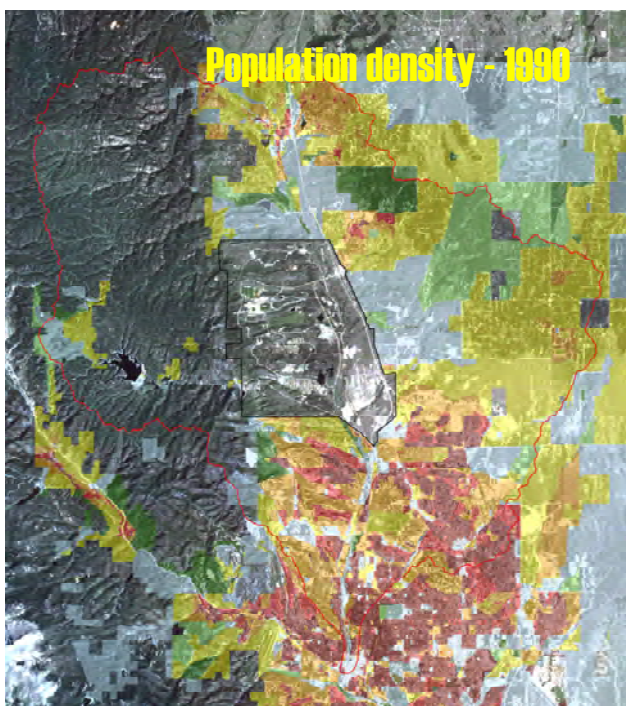
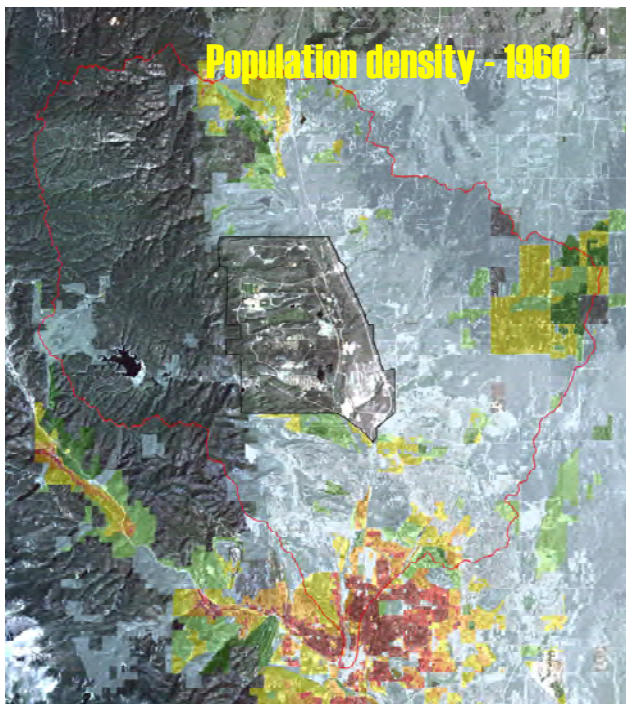


Figure 11: Over a 15 year period, Monument Creek flows resemble those of 1985, with higher flows during the spring and summer months. In April 1999, however, the mean daily discharge rate reached 1,250 cfs (sharp spike towards right of figure) during a flood on Monument Creek which contributed to damage and bank failures on Monument and Fountain creeks (Colorado State University 2000).



Population Density

- Vacant
- Rural
- Rural (1 per 40 to 80 ac)
- Exurban (1 per 5 to 40 ac)
- Suburban (1 per 1 to 5 ac)
- Urban (1 to 2 per ac)
- Urban (>2 per ac)



landscape can be profound and yet it is difficult if not impossible to assess a landscape without regarding the human dimension as part of the region's ecology. Given this influence, understanding the complex set of dynamics that make up the human dimension is an important part of long-term planning.

A landscape assessment is an appropriate place to look in detail at the relationship of social systems to other systems within the landscape. The goal is not simply look at "impacts" from human influence, but to better understand admittedly complex relationships between the systems. In essence there is a synergy of sorts, that results in change over time. A better grasp of the nature and characteristics of this change can lend important insight into how a community attains planning goals over watershed level scales.

population / settlement patterns / development

El Paso County is one of the fastest growing counties in Colorado. In terms of numbers of people moving to the county, it is ranked number one in the state. The county is home to nearly 500,000 people and will soon challenge Denver County as the most populous in the state. Between 1930 and 2000, the county grew by nearly 950%. Between 1990 and 2000, the county grew by an additional 30% (Colorado Division of Local Government 2000). Most of this growth occurred in the Colorado Springs metropolitan area, but increasingly development is occurring in former agricultural areas and in forested portions of the watershed. This development tends to be less dense, producing a fragmented landscape.

Maps 32 and 33: El Paso County is one of the fastest growing counties in Colorado. Between 1930 and 2000, county population grew by nearly 950%. Most of this growth occurred in the Colorado Springs metropolitan area, including portions of the Monument Creek Watershed. Much of the growth within the watershed between 1960 and 1990 was exurban development (low-density, 1 dwelling per 5 to 40 acres) that some believe may be detrimental to the conservation of wildlife habitat. Data source: Theobald 1998.

Population density models suggest several general growth patterns over time. Using census data, the model show historic changes in density between 1960 and 1990 (Theobald 1998). Maps 31 and 32 show the changes in density between 1960 and 1990. Increased density in already urbanized areas is expected to continue and is in the form of infill or development of vacant land surround by urbanized areas.

These areas are typified by the lands in the southern watershed or northern Colorado Springs. Significant change is also occurring, however, in areas east of the Air Force Academy. This part of the project area, in addition to areas north and south of the Academy are currently receiving the most intense development pressure. Development in this area is often regarded as exurban or low-density development (1 dwelling per 5 to 40 acres) that some believe to be more detrimental to the conservation of biological diversity and species richness than clustered or higher density development approaches designed to maximize open spaces and movement corridors (Berwyn 2002).





reference condition

Reference conditions describe the characteristics of a landscape at some time in the past and provide a point from which to consider existing and future ecosystem characteristics. A reference condition is generally regarded as a point in time in which ecological processes were largely free of human influence (Kaufmann et al. 1998). When attempting to characterize reference conditions for an area, it is important to consider the objective of the study and define the temporal and spatial range of interest. Because ecosystem characteristics naturally change over time and space and can have variable scales, a single estimate of the reference condition only represents the state of the ecosystem at one point in time and space. For the purpose of this study we chose to look at the reference condition as that which existed just prior to the mass movement of European settlers into the interior west in and after the 1860s. Prior to that time, the landscape was influenced to a lesser degree by smaller numbers of settlers, Spanish explorers and settlers, and Native Americans than has been the case since that time.

Photograph 19: In 1880, Colorado Springs was a young town of 5,000 inhabitants. Founded on the plains adjacent to Monument Creek, the community would grow to 360,890 residents in 2000. Accompanying this population increase has been dramatic change to natural systems, the social fabric and the landscape as a whole.

The reference condition is the historic context used to compare the current condition against the desired future condition (DFC). In order to establish the DFC, it is useful to better understand how the landscape has changed over time and how these changes might be characterized.

As discussed in the methodology section (see page 10 for more information), 1850 was used as a target date to establish the reference condition period. This time period was chosen due to its proximity to the intense

settlement period which began during the 1860s. It is assumed that prior to 1850, ecological systems were functioning within expected ranges of variability. This assumption is made despite the well documented human populations living and utilizing the region during and prior to this period. It is also understood that native populations influenced their environment, using fire and manipulating plant and animal populations. Therefore, 1850 is a target, subject to a wide variation of time periods documented in existing datasets and not necessarily assumed that the environment of this time period was pristine or uninfluenced by humans.

The reference condition chapter attempts to document the historic condition of landscape systems that have undergone measurable change over the evaluation period. Thus systems documented in this section possess an analog in the current condition section. Although reference

systems are certainly related to those documented in the watershed characterization portion of this assessment, there is no reference condition analog as a reference condition could not be established or the system doesn't change in an appropriately short time period (e.g. geology which clearly is a dynamic system but changes occur on a fundamentally different temporal scale). The rationale for this approach will become more apparent in the landscape synthesis section which follows.

Numerous methods are available for estimating reference conditions. They are based on identifying and analyzing cultural and biological evidence of historical conditions. Biological evidence can include studies of dendrochronology, palynology, packrat middens, soils, geomorphology, hydrology, and phytolithology. Cultural evidence can be collected from archeological, paleoecological, ethnobotanical, and sociological studies (Whitney and DeCant 2001). For the purpose of this study, we sought a reference condition that represents the distribution and character of the MCWS plant communities prior to large scale modifications caused by European settlement. Fortunately, information regarding the characteristics of the vegetation prior to,

Township No. 11 South Range No. 08 West of the Sixth Principal Meridian.

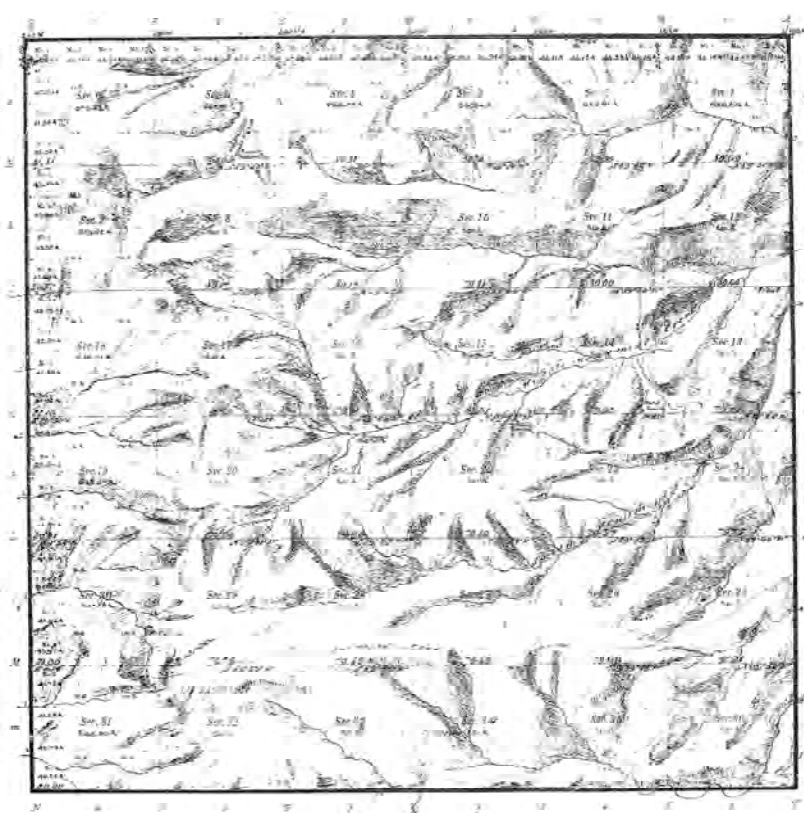


Figure 12: The Monument Creek Watershed was surveyed by the General Land Office during the 1860s and 1870s as part of the Public Land Survey (PLS). Historic information, such as PLS notes are useful in the determination of the reference condition or the period before intense settlement occurred in the region or when ecological systems were believed to be functioning within historic ranges of variability. The Public Land Survey notes from the watershed region are summarized on page 83.

or concurrent with, European settlement is available in the form of the Public Land Survey (PLS) notes of the General Land Office (GLO). The Land Ordinance of 1785 established the rectangular system of survey as the Federal Government standard, and resulted in the use of township, range, and section by the GLO in completing the PLS. PLS information gathered from the Monument Creek Watershed landscape during the 1860s is summarized by township beginning on page 83.

historic biological systems

Prior to about 1850 and the arrival of large numbers of European settlers, human impacts to Front Range ecosystems likely remained relatively constant for long periods. Changes in the frequency, distribution and scale of human impacts were likely small and gradual, and were unlikely to have significantly eliminated one or more ecosystem processes over large areas. With the arrival of large numbers of European settlers, historical patterns of ecosystem disturbance changed abruptly. The frequency, distribution, and scale of ecosystem disturbances increased significantly, and resulted in elimination or significant modification of large-scale ecosystem processes. Practices associated with settlement and which have changed the natural structure and composition of prairie, foothill and montane ecosystems include logging, fire suppression, water storage and diversion, cultivation and cattle grazing.

As important habitat, ground cover and resources, vegetation plays a fundamental role in the functioning of the watershed. Understanding how these systems have changed over time is useful in the development of contemporary management strategies that attempt to balance functioning ecological systems and the need for resources.

vegetation and fire ecology / history

The vegetation of Front Range ecosystems has been modified from its original character due to the land use and management practices employed since European settlement. Land uses which have altered the character and distribution of vegetation types include cultivation of previously undisturbed soils, sustained high intensity grazing of domesticated livestock, suppression of natural fires and initiation of anthropogenic fires, timber logging, land clearing, and water storage and diversion.

As part of the larger landscape assessment, a localized review of the distribution, characteristics and status of the vegetation types that occur within the Monument Creek watershed was conducted. The review included a search of the literature to identify information on the historical extent and characteristics of plant associations in the area, as well as reconnaissance of the area to identify the general extent and distribution of those communities currently.

forests

Information on the historic condition of regional forests comes from a variety of sources, that together comprise a reasonably coherent picture of forest landscape of 150 years ago. Contemporary fire ecology /



history research is useful for determining the frequency of fire events and the forest structure that is responsive to these cycles. In turn historic forest structure information is useful for the development of appropriate silvicultural treatment both for the mitigation of catastrophic fire and in support of ecological management goals.



Photograph 20: The Cheesman Lake area is part of the Upper South Platte Watershed, approximately 35 km (20 mi) northwest of Woodland Park. As part of the municipal water supply for the City of Denver, some of the forested areas surrounding Cheesman Lake have never been logged and have been excluded from grazing activities since the early 1900s, providing a unique perspective into the historic landscape of Front Range ponderosa pine forests.

Survey data gathered during the land surveys of the 1860s provide remarkably detailed and lucid accounts of the vegetative structure before settlements were widespread in the area. Historic photographs corroborate all the historic data sources, suggesting that the vegetation pattern has changed drastically during the past 150 years.

Ponderosa pine forests in the watershed (including both Rampart Range and Black Forest forests) were generally complex and heterogenous, typified by mixed density, mixed age stands, with frequent, persistent openings and well-developed ground cover consisting of grasses and some shrubs. Data gathered from the Cheesman Lake area (Upper South Platte Watershed) suggests the mean fire interval (MFI or the average number of years between fire events) was approximately 50-60 years (Kaufmann et al. 1999). Longer intervals resulted in a mixed-severity fire regime that included a substantial stand-replacing component (Kaufmann et al. 1999). Higher MFIs are expected at lower elevations and in areas where ponderosa pine forests begin at the edge of grasslands. Though comprehensive data are lacking for Front Range ponderosa pine forests, other studies suggest that MFIs in the lower portion of the watershed may be as short as 5 to 12 years (Veblen and Lorenz 1991).

Fire cessation (either directly via fire suppression techniques or indirectly due to logging efforts, grazing or fragmentation due to road building), particularly the exclusion of frequently occurring, episodic, low-intensity fires (i.e. the historic condition) in ponderosa pine – Douglas-fir forests within the watershed has resulted in a dramatically altered forest structure and “historically unprecedented increases in tree densities” (Brown et al. 1999). As a result of changes to landscape vegetation patterns and altered ecological processes, many of these forests are regarded as being outside their historical range of variability and likely unsustainable in the long term (Brown et al. 1999).

A comprehensive fire history has not been conducted within the project area (see recommendations, page 117, for more information regarding the need for such a study), but data from the Cheesman Lake area (Upper South Platte watershed; see regional map on page 17 for more information) obtained fire scar data from trees in the ponderosa pine dominant forest covering a period from 991 CE (“common era”) to 1996, represent a fire history spanning from 1197 CE to 1963 that is useful as a

rough guide to the historic condition of some of the forested areas of the Monument Creek Watershed (Brown et al. 1999). The spatial extent of these fires included very localized fires, burning less than 0.1 ha to landscape scale fires burning more than 4,000 ha. Though these data were gathered from an adjacent watershed, it is suggested that large regional fires burned in 1587, 1631 and 1851, based upon similar studies to the north and south of the Cheesman Lake study area. Instead of suggesting that these fires were single events, it is more probable that regional climatic conditions resulted in fuel loads that supported multiple fires across the region (Brown et al. 1999).

The length of time between fire events in this area varied widely on multiple scales. Some areas burned every 1 to 10 years while others saw more than 100 years between events. No extensive fires have occurred on the Cheesman Lake landscape since 1851 due in large part to fire suppression activities on and around the study area. The MFI for the Cheesman Lake project area on the landscape level (using data between 1285 and 1963) is 9.2 (with a standard deviation of 7.0). Taking into account wide-spread fires only, the MFI is 59.2 (sd = 36.1) (Brown et al. 1999). Fires burned throughout the growing season.

Historically, fires burned with mixed severity. It is noted that overstory mortality occurred in larger fires that burned in the Cheesman Lake area, either due to crown fires or to particularly intense surface fires. Loss of overstory was both localized or occurred over larger areas due to prevailing conditions of fuel loads and climatic conditions.

Ponderosa pine forests have shown to be sensitive to long-term climate changes. These changes, particularly prolonged periods of cooler temperatures and high levels of precipitation result in “pulses,” which are particularly favorable for tree growth resulting, over time, in increased tree densities and fuel loads. These pulses lasted approximately 10 years, coinciding with landscape-scale fires or periods of increased fire severity (Kaufmann et al. 1999). This trend has been observed in ponderosa pine forests in the Southwestern United States as well as other portions of Colorado’s Front Range. This set of dynamics, including the spatial and temporal variability of tree recruitment (leading to forestation of openings), existing (or surviving) openings and forest structure resulted in a complex landscape structure and one in continual flux: some openings would have persisted for long periods of time (from tens of years to over 100), particularly those occurring on south facing slopes (see section on aspect for more information). The resulting stands varied widely in terms of density (Kaufmann et al. 1999).

It has been estimated that approximately 10-20% of the historic forest landscape would have consisted of openings (based on data gathered from the Upper South Platte watershed) (Foster Wheeler Environmental Corporation 1999).

It is generally agreed that historic fire regimes in ponderosa pine forests in the Southern Rocky Mountains consisted of relatively frequent, low-severity surface fires that lead to open mixed-aged forests. This is regarded as generally true for Front Range forests as well, although it is



suggested that the frequency interval was longer due to climactic conditions, elevation, soil development and anthropogenic effects (the possibility of additional ignition sources) (Brown et al. 1999). This pattern also included a more varied fire regime with a greater frequency of stand-replacing fires, reflected in a diverse forest structure. Though insects and parasitic plant species contributed to landscape-level

disturbance regimes, it is generally believed that fire was the most significant of landscape disturbance factors in forested systems.

"If the department were not so given to 'Grandstand' talk it would behoove the citizens of Colorado Springs to bring an injunction suit against the government, which threatens to plant millions of trees per year until twenty million are planted on the Pikes Peak 'Reserve.' Water is scarce enough at Colorado Springs at present conditions, but if the government is going to attempt to water twenty million trees in addition to the trees now absorbing water, I can assure the citizens that in twenty years there would only be water for the trees and none for the city.

It would increase the water supply of Colorado Springs materially if every tree was cut from Pikes Peak. If these men expect to raise trees without using up water they propose to reverse nature.

These so-called timber reserves originated in fraud and are continued in iniquity, and should be reduced to the hunting and fishing preserves which originally was intended."

Denver Republican, 28 June 1908.

The last landscape level fires burned in the watershed before 1860, although Mount Herman burned intensely around 1870 (Horgan 1920) and several high level, but small-scale events have occurred since, including the Monument fire in 1989. High rates of tree recruitment were observed in much of the South Platte Basin during the 40 year period following 1875, when intense logging efforts began (Kaufmann et al. 1999). This resulted in a dense, even-aged, homogenous forest structure, primarily consisting of ponderosa pine but with a higher percentage of Douglas-fir (Kaufmann et al. 1999). Openings that may have persisted were reforested due to reduced competition by ground cover, understory vegetation during periods of heavy grazing and fire suppression and forest reforestation efforts.

Small-scale logging began in the Monument Creek Watershed region during the early 1860s, supporting small mining and ranching efforts. Landscape scale logging first occurred with the arrival of the railroads, roughly 1882 to 1890 (Horgan 1920). The western slope of the Rampart Range was logged heavily during this period, cutting roughly 100,000 board feet, milled in Woodland Park (Horgan 1920).

Figure 13: Local reforestation efforts were met with strong local resistance (as was the creation of the reserve system and subsequent national forests).

Following the establishment of the Pike National Forest in 1907, an ambitious program of "reforestation" began (it is unclear from the record if the goal of the effort was to reforest disturbed timber lands or simply to increase density and presumably yield of existing stands) in the region to increase timber yield from the newly created system of reserves. The reforestation efforts included seeding and transplanting seedlings raised at local nurseries. Early results were mixed as most reforestation projects failed within the watershed due to poor experimental design or inadequate understanding of local conditions. Direct seeding efforts were, for the most part, abandoned by 1912 in favor of transplanting nursery stock, which after appropriate guidelines were developed resulted in the planting of more than 2 million trees between 1912 and the early 1920s (Horgan 1920).



The planting of seedlings continued well into the 1930s as part of the Civilian Conservation Corps program: “millions of seedlings were planted by the CCC boys and rangers in many denuded areas of the Pike National Forest” (Carter 1956).

shrublands

The shrubland communities found in the watershed are generally regarded as slow to change over time, suggesting both resiliency and the difficulty of shrubland communities to re-establish themselves after disturbance events (McGinnies et al. 1991).

grasslands

The predominant grassland components of the watershed were described as late as the 1940s as primarily as mixed prairie association. Within the association occurred relict grassland communities commonly associated with true prairie typically found in the north-central United States (Livingston 1952). Relict species occurring in the transition zone between grassland and forest ecotones (particularly true in the Black Forest region) included: prairie dropseed (*Sporobolus heterolepis*) and needle and thread grass (*Stipa spartea*). At lower elevations, mixed prairie associations included: prairie dropseed (*Sporobolus heterolepis*), little bluestem (*Schizachyrium scoparium*) and indiangrass (*Sorghastrum nutans*) (Livingston 1952). It was noted that relict communities were not determined by climatic or evaporative patterns, rather that they were able to survive in areas where soil types and soil moisture were “unusually favorable.” These conditions were related to topographic features (including aspect) and overall vegetative structure (proximity to forest openings or edge) or by the level of the water table. It was unclear to what extent anthropogenic effects had encouraged communities associated with true prairie via migration routes from Nebraska or the planting of seed. It was more likely that relict populations were remnants of former climax grass communities, left behind after the southward movement of communities in response to the last ice age. Most of these true prairie communities disappeared following the glacial retreat.

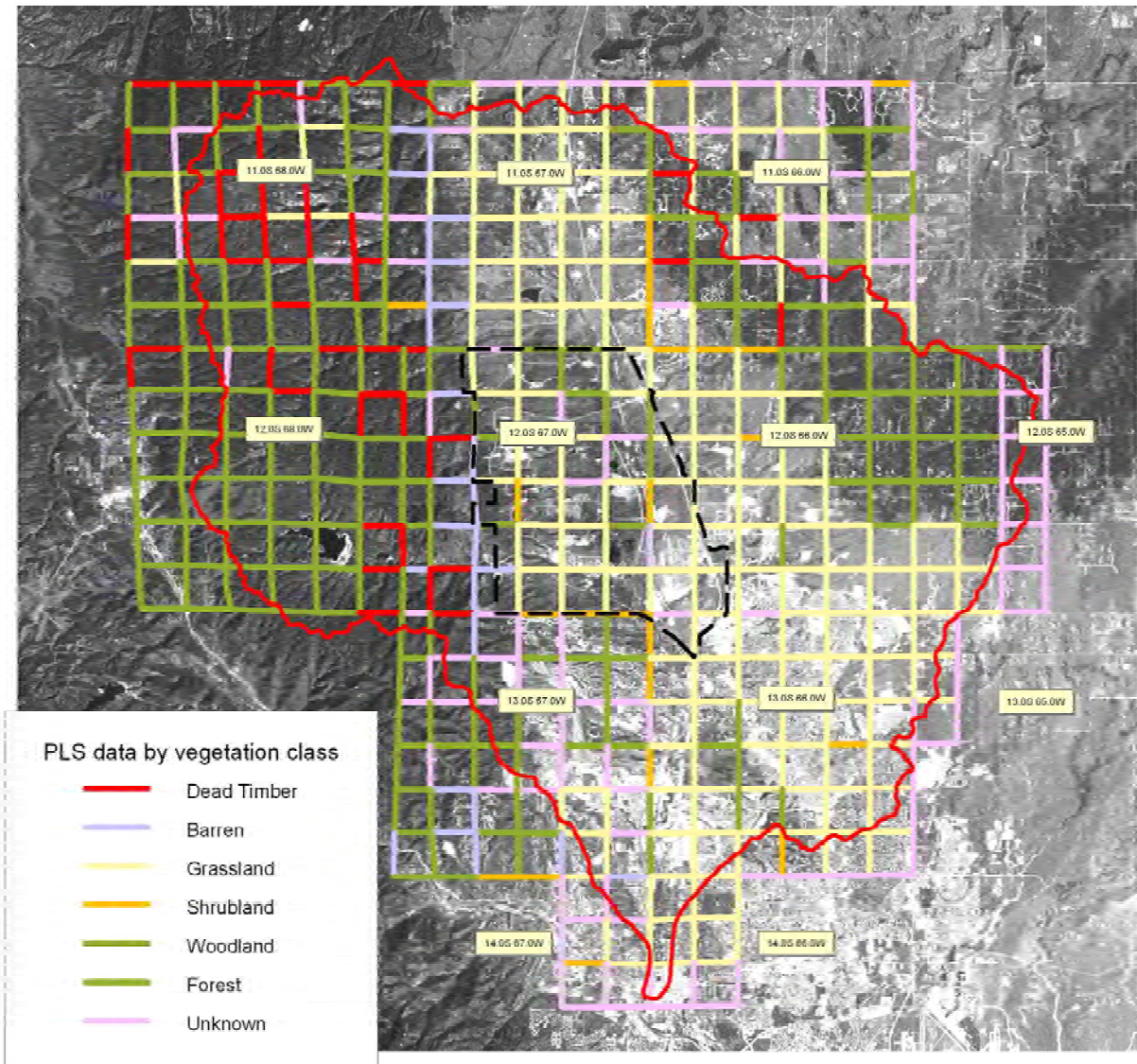
Public Land Survey summary

Copies of original PLS journal entries were obtained from the Bureau of Land Management (which currently houses the General Land Office) for the following townships that fall within the Monument Creek Watershed.

The PLS notes include the measurements for all the section lines in each township, as well as a brief description of the vegetation and soil characteristics encountered along each line. Vegetation and soil descriptions were originally collected as part of the PLS in the interest of identifying valuable natural resources. In addition to noting swamps, creeks, prairies and groves, the survey instructions required the crews to note the tree species encountered (in descending order of abundance) and the kinds of grasses and their amount of cover (Galatowitsch 1990). Because the surveys were typically completed prior to settlement or large-scale modification, they have become a



Public Land Survey Data Summary by Vegetation Class



Map 34: The Monument Creek Watershed landscape has changed significantly since the region was intensely settled, beginning in the 1860s. Public Land Survey data gathered from this period describes the vegetation and other natural features of the watershed during the 1860s and 1870s, providing a unique perspective on landscape level change over time.

valuable resource to ecologists and historians for determining landscape characteristics prior to settlement.

To estimate the pre-settlement vegetation of the MCWS, the original PLS notes were evaluated for all areas of the watershed. This included townships: T11S R66W, R67W, R68W; T12S R66W, R67W, R68W; and T13S R66W, R67W; and portions of T12S R65W, T13S R65W, T14S R66W and T14S R67W. The townships that comprise the MCWS were all surveyed between the years of 1864 and 1870.

While not quantitative, the vegetation notes provide a general picture of the dominant vegetation that occurred along each section line.

Occasionally, the notes included an indication as to the different community types that occurred along a single line by mentioning, for example, “leave trees, enter prairie,” or “forest (first half), barren, rocky, few trees (second half).” More frequently, however, the notes simply indicated a single cover type for the entire length of a section line (1 mile). These are often very brief and only describe one or a few of the dominant species, such as “pine, cedar, and oak underbrush,” “prairie,” “bunchgrass.” Other descriptions were incomplete or ambiguous such as, “rolling prairie, undergrowth of oak, hawe, and cherry.” Alternative to noting the vegetation cover, some of the section line descriptions indicated the occurrence of disturbance, the lack of vegetation, or, in some cases, failed to provide any indication whatsoever.

Given the qualitative and sometimes uncertain nature of the vegetation descriptions, we were able to establish broad cover type categories based on the growth form of the vegetation and assign each section line to a category. The cover type categories we established include “grassland,” “shrubland,” and “forest,” as well as “barren,” “dead timber,” and “unknown.”

The following sections describe each of the cover type categories and provide additional information regarding the characteristics of the section lines allocated to it. The percentages given are based on the number of section lines evaluated and do not represent the coverage for the entire watershed.

grasslands

Approximately 42% of the descriptions we evaluated were placed into the grassland category. With few variations, grassland types had two basic descriptions; these were either some variation of “prairie” or “bunch grass.” Areas described as prairie often included terms such as “open,” “high,” or “rolling,” which tend to suggest that these areas were what would presently be termed shortgrass prairie. The grass species blue grama (*Bouteloua gracilis*) and buffalo grass (*Buchloe dactyloides*) typically dominate areas considered shortgrass prairie. Blue grama is the most common and widespread of the shortgrass prairie species. It covers an immense expanse of the western high plains and is the dominant species of the shortgrass prairie. Buffalo grass is similarly widespread in the shortgrass prairie but is not typically the dominant or co-dominant species. Other species commonly present in shortgrass prairie areas include the grasses purple three-awn (*Aristida purpurea*), galleta grass (*Hilaria jamesii*), sand dropseed (*Sporobolus cryptandrus*), needle and thread (*Stipa comata*), and others.

The areas described as “prairie” were mostly recorded from a narrow NW/SE band in township 11W 66S. This band of “shortgrass prairie” was separated from other grassland areas in the main valley of Monument Creek by similarly narrow NW/SE band of ponderosa pine (*Pinus ponderosa*). Areas to the east of the “prairie” were outside of the township and the watershed and were not evaluated.



Areas described as “bunch grass” were much more numerous in the watershed than were areas described as “prairie.” The areas described as “bunchgrass” occasionally mentioned buffalo grass or less frequently blue grama as components, but gave no other indication as to the dominance of one or another of the species present. As a non-technical term, it is uncertain what the surveyors exactly meant when they described an area as “bunch grass.” Presumably their definition was not significantly different from our general use of the term to describe an area dominated by cespitose species that visually tend to have a “bunchy” growth form. Several “bunch grass” species occur in the watershed presently. The most prominent of these are little bluestem (*Schizachyrium scoparium*), sand dropseed (*Sporobolus cryptandrus*), mountain muhly (*Muhlenbergia montana*), alkali sacaton (*Sporobolus airoides*), and tall dropseed (*Sporobolus asper*).

The areas described as “bunch grass” mostly occurred in a wide NW/SE band along the main valley of the Monument Creek stretching from above the El Paso county line in T11S R67W in the north, to the SE corner of T13S R66W in the southern part of the study area. Scattered line segments of “bunch grass” also occurred as a component of the timbered areas of the Black Forest.

Because the distinction between these two grassland types is not entirely clear, we mapped all lines that indicated “prairie” or “bunch grass” to the single “grassland” category. Of the total 697 section lines we reviewed and the 570 with valid cover descriptions, 238 were categorized as grassland (42%). The grassland category occupied a large area of what is currently the US Air Force Academy and dominated by woodland and shrubland communities.

shrubland

Approximately 4% of the vegetation descriptions were placed into the shrubland category. The shrubland types were identified based on the species listed, or by descriptions that included terms such as “brush,” “scrub,” or “undergrowth.” The species listed typically included oak, cherry, and willow, but also occasionally mentioned “Mexican sumac” and the uncertain term “hawe.”

The oak species referred to is, likely in all cases, Gambel oak (*Quercus gambelii*). This species is common and often dominant along the southern foothills in the area of the USAFA, extending along the Front Range from the New Mexico border, northward to beyond the El Paso County line. It grows on the lower foothill ridges and side slopes, and can form essentially impenetrable thickets. The cherry described is probably the common chokecherry (*Padus virginiana*). Although not a dominant tree in the shrublands here, it is present. Descriptions including willow were most likely referring to points where the section line crossed a stream or creek. References to Mexican sumac were most likely referring to skunkbrush (*Rhus trilobata*), which, in this area, is very common and can be dominant, or co-dominant, on some slopes.

Several line descriptions for shrubland types also mentioned “hawe” as one of the lesser species. It is uncertain what species the surveyor’s were referring to when using this term, but there are several possibilities. In some areas, “haw” is a common term used for any of the species of hawthorn in the genus *Crataegus*. In Colorado, there are several hawthorn species, but none of these is very common in the area of MCWS, and when they do occur they are restricted to the bottoms of the narrower stream canyons. It seems unlikely that the survey notes would identify a poorly represented species such as hawthorn, while omitting other, much more prevalent, species such as mountain mahogany (*Cercocarpus montanus*). As an archaic term, haw was used to describe a hedge of hawthorn or a garden enclosure of shrubs (Merriam-Webster 1993). It also seems unlikely the surveyors would insert this usage into a list of species. Notable in all of the shrubland descriptions is the absence of any mention of mountain mahogany (*Cercocarpus montanus*), which is very common and can be dominant to co-dominant on some sites. Although there is little similarity between the two, it is possible that the surveyors misidentified the mountain mahogany and were calling it hawthorn.

The shrubland communities of the lower foothills are typically dominated by Gambel oak (*Quercus gambelii*), mountain mahogany (*Cercocarpus montanus*), wax current (*Ribes cereum*), and skunkbrush (*Rhus trilobata*). These can occur in dense continuous stands that impede travel completely, or may form patchy mosaics with grassy openings and scattered ponderosa pine (*Pinus ponderosa*) and Rocky Mountain juniper (*Juniperus scopulorum*).

Section line descriptions having tree and shrub species together were typically included into the shrubland category on the assumption that these represent open woodland areas with a low percentage of tree cover and numerous patches of shrubs intermixed with grasses. Of the total 697 section lines we reviewed and the 570 with valid cover descriptions, 24 were categorized as shrubland (4.2%). The shrubland category occupied mostly scattered locations on the eastern and western edges of the valley.

forest

Approximately 41% of the section lines were attributed to the forest category. Forest cover types were identified by the presence of tree species such as pine, cedar (juniper), spruce, red spruce (Douglas-fir), or



Photograph 21: Shrubland communities within the Monument Creek Watershed are dominated by Gambel oak, seen here in the foothills of the Rampart Range above Monument. Increasingly dense shrubland communities also increase the likelihood of catastrophic fire as development occurs in foothill areas.

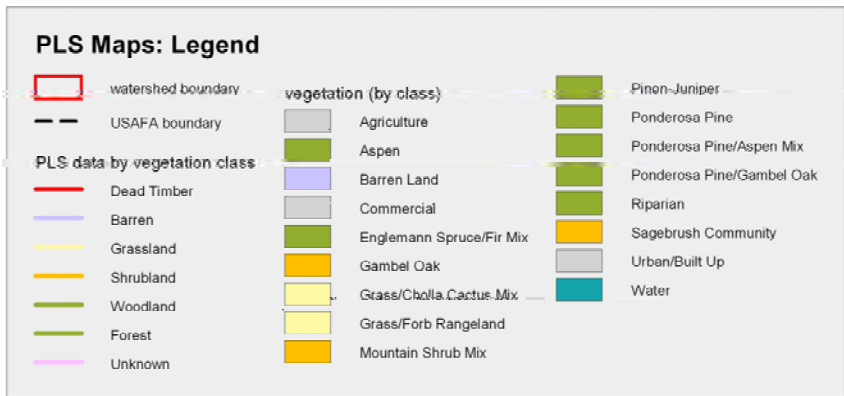


Figure 14: The maps that follow summarize the Public Land Survey journal notes from the survey of the Monument Creek Watershed area of the 1860s and 1870s. Information regarding vegetation was associated with the respective section line (PLS information by vegetation class) and overlaid on current vegetation data (vegetation by class), providing one way of measuring change over time [see page 95-96 for more information on analysis methodology].

the use of terms such as “timber,” “dense,” or “good” in conjunction with tree species names.

Occasionally, the descriptions included terms such as “scattered pine and bunchgrass” or “pine with oak undergrowth” that tended to indicate a low-density tree cover with a shrubby or grassy understory. These are areas that perhaps had less than 25% tree cover and today would probably be called woodland. We combined all areas that potentially were woodlands with areas that were potentially forest since it is impossible to know from the descriptions the percent cover that actually existed along any section line.

Forest areas occurred in two locations: from the upper foothills to lower montane areas on the west side of the watershed, and in the Black Forest area in the northeast portion of the watershed.

Of the total 697 section lines we reviewed and the 570 with valid cover descriptions, 235 were categorized as forest (41%).

dead timber

Approximately 8% of the section lines were described as “dead timber”. These mostly occur in T11S R68W and T12S R67W. In several instances, terms such as “badly burned” or “burned, mostly dead” were given as descriptors. Although uncertain, it is assumed that the timber on all of the section lines described as “dead timber” in these general areas were killed as a result of fire. In fact, the general description for T11S R68W clearly indicates that fire has consumed most of the timber in the area:

“The larger portion of the timber [in this township] has been killed by fire and many hills are entirely bare.”

Other potential sources of tree mortality over a large area such as this could include attack by insects or another forest pathogen, or timber blowdown from a severe wind event.

Of the total 697 section lines we reviewed and the 570 with valid cover descriptions, 47 were categorized as dead timber (8.2%).

barren

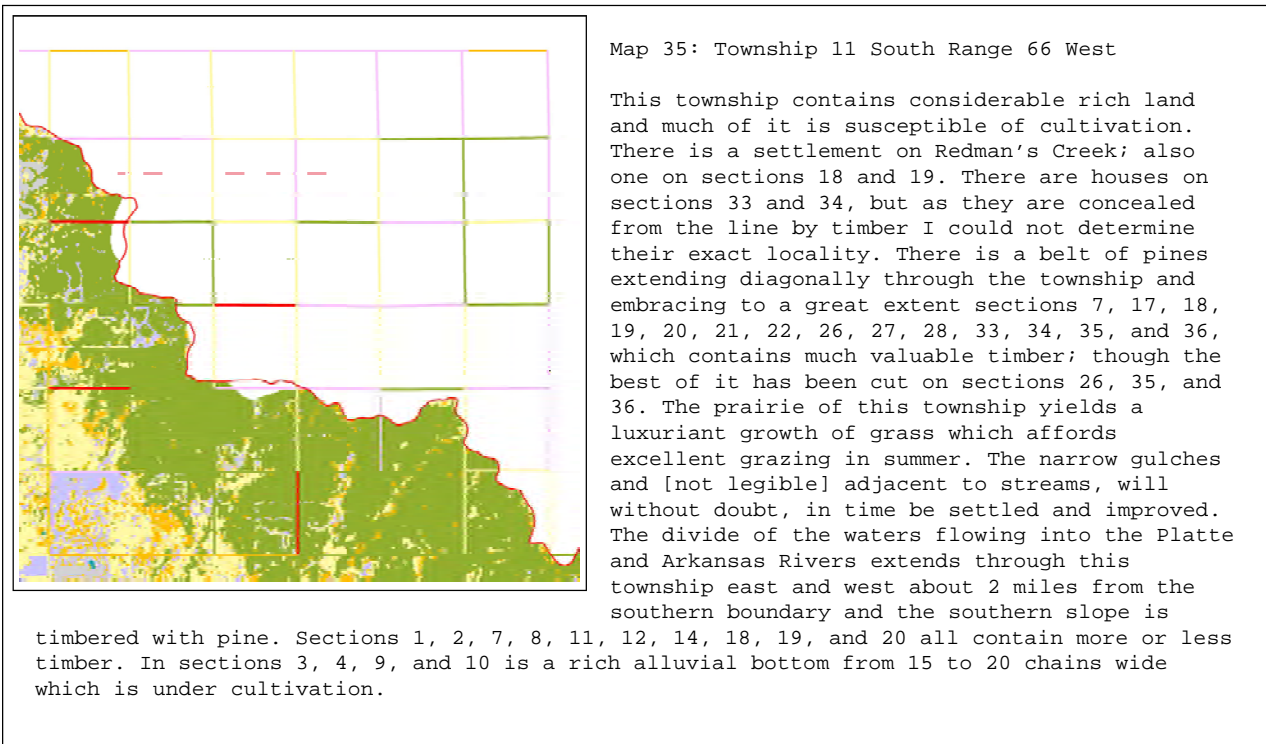
Approximately 5% of the section lines were described as barren. These areas are mostly located along the east face of the foothills and it is not known if these were areas naturally devoid of vegetation due to rock exposed at the surface or were the result of fire, pathogens, or a

blowdown. Occasionally, these included terms such as “rocky” or “broken.” Their proximity to areas that are known to contain dead and burned timber suggests that at least some of these may be the result of fire.

Of the total 697 section lines we reviewed and the 570 with valid cover descriptions, 26 were categorized as barren (4.5%). The barren category occupied a thin band along the face of the mountains on the west side of the valley. Portions of this area are bare today, although these are not classified in the imagery as bare.

unknown

Approximately 18% of the section lines had descriptions that were either too uncertain as to assign to a category, or contained no description at all. Mostly these occurred dispersed throughout the watershed. Of the total 697 section lines we reviewed 127 were categorized as unknown (18%).



original township descriptions

In addition to characterizing the vegetation along each survey line, the surveyors were required to provide a general description of the entire township. These descriptions proved useful to deciding which cover type category to assign the individual section lines to, and for gaining an overall perspective of the character of the township. These descriptions are also valuable in pointing out discrepancies between the perception of the township as a whole, and what the individual section line descriptions indicate. The general township descriptions are

provided below as they were written, and are followed by an interpretation of the important points.

T11S R66W

Interpretation

This township was surveyed in 1866. Its southwestern half lies within the watershed, while the upper reaches of the West Cherry Creek watershed occupy the northeast half of the township. It includes what currently is the western edge of the Black Forest and the northern portions of the main stem of Monument Creek. Based on the description, by 1866 settlers had already begun to log the timber of the Black Forest and convert the floodplains to cultivated agriculture. It is also likely that some small herds of domestic livestock were displacing bison and other traditional grazing animals.

The description clearly indicates the presence of timber in specific sections and identifies the sections where timber has already been cut as well as where fire has burned the trees. Based on the description, the “belt of timber” described appears to be largely in the same area today as it was in 1866. The southern side of the Palmer Divide is identified as “timbered with pine,” which tends to indicate a fairly dense stand as opposed to an open pine savanna. The reference to “prairie that yields a luxuriant growth” describes both the extreme southwest corner of the township (Monument Creek Watershed), as well as the larger northeast corner (West Cherry Creek Watershed).

The section lines shown as burned/dead are not mentioned in the general description, suggesting that these were not catastrophic crown fires over a large area, but perhaps low intensity ground fires with isolated locations of crown destruction.

Comparison of Historic and Current Conditions

The watershed occupies only the southwest portion of the township. In that area, the original section line notes indicate the cover mostly as woodland, but also includes some lines described as grassland. A few of the lines identify burned or dead timber, or were lacking a cover description.

The current cover type map appeared to match the historic section line descriptions very closely. Notable differences include a change from grassland to woodland on several lines in the southeast and southern portions of the area.

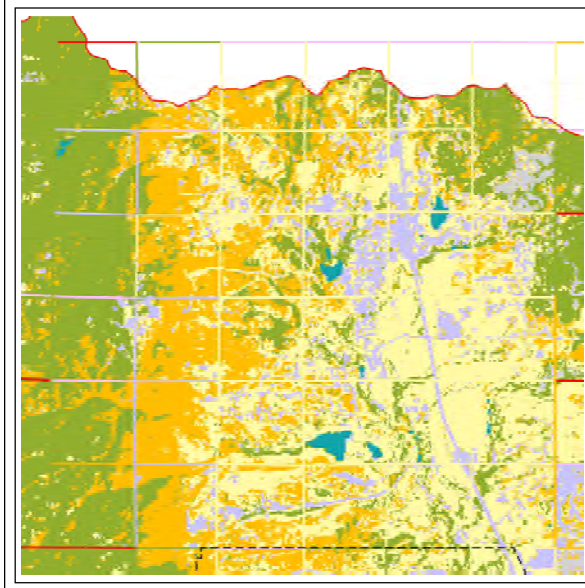
T11S R67W

Interpretation

This township was surveyed between 1864 and 1868. It occupies the north-central portion of the watershed and covers the main stem of the Monument Creek valley headwaters. Although the northeast corner of the township just enters into the Black Forest plateau and the western edge of the township occupies the lower foothills slopes, the majority of the township occupies Monument Creek valley prairies. Although the



township description identifies a “heavy growth of excellent pine timber” in sections 1 and 2, it does not mention any timber in other areas such as along the western edge of the township. This is an indication that there was no timber in those areas at that time, and is corroborated by the typing of the section lines which shows that area to be either “bunch grass” or “barren”.



Map 36: Township 11 South Range 67 West.

The east 2/3 of this township embraces much valuable land and considerable timber. There is already quite a numerous settlement of farmers on Monument Creek and its branches where abundant crops show the quality of the soil. The eastern 1/2 of this township is well watered and much improved by settlers. The east half of sections 1 and 2 contain a heavy growth of excellent pine timber. Monument Creek is the largest running water, I think sufficient for all irrigating purposes. The township contains 38 settlements. The Monument P.O. is in the NE1/4 of section 15. The grass is well adapted to stock grazing.

The description indicates that as early as 1868 the farmers of the area were diverting the streams for irrigation of the floodplain and production of cultivated crops. The statement that the land in the “eastern ½ of the township is well watered” appears to be a reference to a high ground water table and the presence of stream flow and springs and not any suggestion that precipitation patterns are higher. The description of the township to the southeast (T12S R66W) used the same language and included the phrase “...with many springs and streams,” again suggestive of a high water table.

The description also identifies the adaptability of the land to stock grazing, indicating that domestic livestock were likely replacing native grazers before 1868. As of that time, the Town of Monument Creek had already been established and had a post office, which predates the establishment of Colorado Springs by several years.

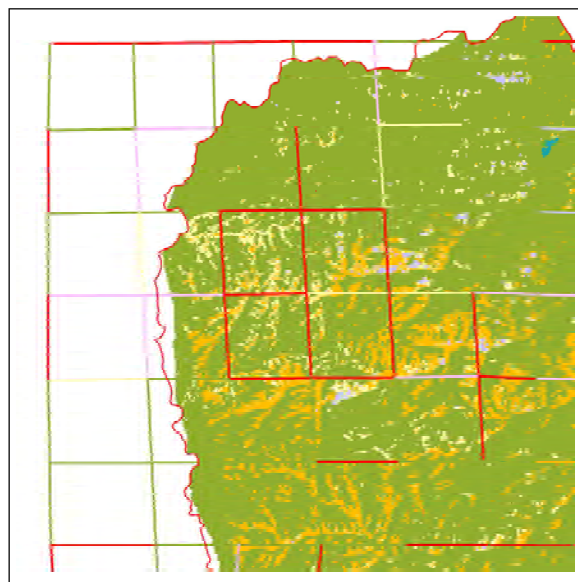
Comparison of Historic and Current Conditions

The watershed covers all areas of the township, with the exception of the upper half of the first row of sections. The original section line notes for this township almost exclusively identify grassland as the cover type. Several of the section lines on the western side of the township were described as barren, while only very few had no description.

In this township the current cover type map identifies much of the area as patchy shrubland or urban. Areas predominantly with grasslands



now occur mostly in the east and southeast portions. This change suggests that a shift from grassland to shrublands has occurred over most of this township.



Map 37: Township 11 South Range 68 West

This township is made up of rugged mountains with deep precipitous canyons between, and in which are rapid mountain streams. The larger portion of the timber has been killed by fire and many hills are entirely bare. So far as I was able to observe I could discover no available timber land in the whole township. This township is very mountainous and rough. The south and west sides are not so rocky as the east and north. The rocks are large boulders with smooth surfaces. The timber is all dead through the middle of the township. On the north and south ends timber pine and spruce is very good. All the water west of the tier of sections that run north of section 32 and south of section 5 run north, on the east side of said tier of sections water runs east. Beaver creek heads in several small ravines about the south boundary of section 33 and 34 and the general census of said sections is about north 55 degrees. There is a divide between South

Monument Creek and Beaver Creek in which there has been a wagon road surveyed and from the town of Monument to Manitou Park. There are several good gulches in the township for stock on [not legible] ranches. The claim of [not legible] Reeser lays in sections 5 and 8 and that of [not legible] Thomas in section 21 NE1/4.

T11S R68W

Interpretation

This township survey was completed in 1869. The eastern edge of the township lies just west of the line of slopes that define the eastern edge of the Front Range foothills. The western and northwestern edges of the township are outside of the watershed and drain north into the South Platte drainage.

This area is contained entirely within the foothills–montane ecological zone and is occupied almost entirely by coniferous forests. The description indicates that fire has destroyed almost all of the timber, particularly through the middle of the township, leaving the hilltops entirely bare. Several of the section line descriptions indicated some variant of “dead timber and bunch grass,” potentially indicating that the fire(s) that killed the timber occurred at least one year, and likely several to many years, prior to the survey in 1869.

Importantly, the location of a surveyed wagon road that runs from Monument to Manitou Park is identified (see township plat map) as are the locations and ownership of several ranches. This tends to indicate that settlers were establishing ranches in the montane zone for the

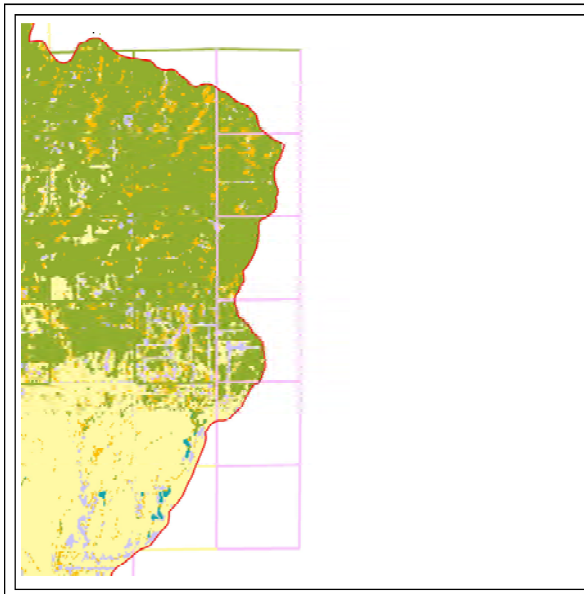
purpose of livestock operations prior to 1869. Although the township is very mountainous and rugged, the description notes that the gulches provide good forage for livestock, indicating the likelihood that the riparian zones of these areas were probably occupied by grasses/forb communities rather than dense shrubs or trees.

Additionally, the description indicates that sections on the east and north edge of the township have a high degree of bare rock and no vegetative cover, however the section line descriptions contradict this.

Comparison of Historic and Current Conditions

The watershed occupies all but the western column of sections in this township. The original section line notes indicate forest was the presettlement vegetation over most of the township. Several of the section lines identified dead or burned timber (the general description of the township is very clear about the extent of burned timber in the area). A few of the section lines were identified as grassland and were probably montane meadows.

In this township the current cover type map identifies most of the area as forest with patchy openings of shrubland and grassland. Except for revegetation of previously burned areas, there does not appear to have been any significant shift in the cover type of this township.



Map 38: Township 12 South Range 65 West

The quality of soil in this township is 2nd and 3rd rate, mostly 2nd rate. About 3/4 of the township is well timbered which alone will make it valuable. Timber consists of pine chiefly. There are several good springs of freshwater and also several small streams in the township affording an ample supply of water for ordinary purposes.

T12S R65W

Interpretation

This township was surveyed in 1861. This township occupies the easternmost portion of the watershed. It straddles the watershed divide and includes the headwaters to several tributary streams. The description indicates that 3/4 of the township is well timbered and this is supported by the survey line descriptions which in the northwest corner

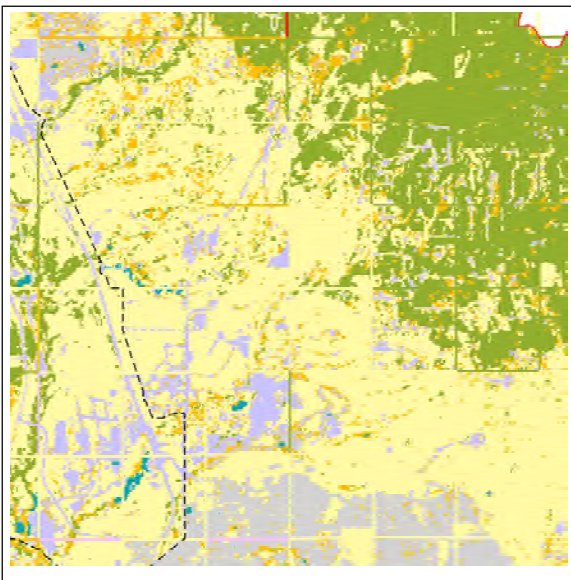


of the township are categorized as forest. The description notes the presence of several good springs and small streams.

Comparison of Historic and Current Conditions

The watershed occupies only the western half of this township. The original section line notes indicate the southern third of this area was grassland, while the northern two thirds were woodland/forest. Several section lines on the east edge are unknown.

The current cover type map also identifies the southern third as grassland and the northern two thirds as woodland/forest. Other than patchy areas that have been converted to urban uses the historical and current conditions appear to be identical.



Map 39: Township 12 South Range 66 West

This township has valuable pine lands, embracing the most of sections 1, 2, 3, 11, 12, 13, 14, and 24. There is a sawmill near the southwest 1/4 of section 2. The quality of land in this township is 2nd and 3rd rate producing good grass. The timber in the northeast portion of the township consists of pine with a fair proportion of good saw timber. In section 2 [not legible] Judd has a saw lath and shingle mill in successful operation. The township is well watered with springs and small streams.

T12S R66W

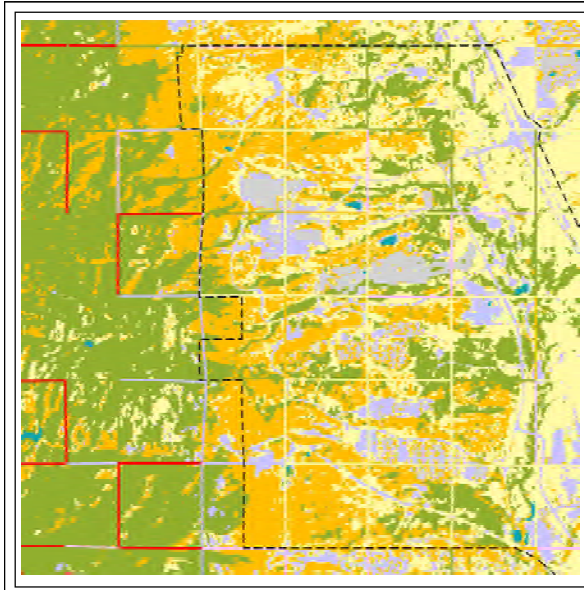
Interpretation

This township was surveyed in 1866. The township occupies the east central portion of the watershed. The northeast corner occupies part of the Black Forest plateau, while the remainder lies in the main valley and side hills of Monument Creek. Most notable, the description indicates the presence and location of an operational sawmill. Given that the mill is "in successful operation," it is likely that it has been established for more than one year and would have to be one of the first mills established in the area. Although Von Ahlefeldt (1979) reviewed and listed the sawmills working in the Black Forest area, the Judd Mill is not listed there. Of the five mills listed as operating in the Black Forest during the 1860s, only two would be located in the Monument Creek watershed.

Comparison of Historic and Current Conditions

The watershed completely covers this township. The original section line notes identify the northeast corner of the township as woodland/forest. The central and southwest portions of the township are identified as grassland.

The current cover type map also identifies the northeast portion of the township as woodland while the remainder is grassland. Other than areas in the south and southwest that have been converted to urban uses, the original and current vegetation appear almost identical.



Map 40: Township 12 South Range 67 West

This township has very little arable land, a narrow tract along Monument Creek and its little tributaries constituting all. There is considerable timber west of Monument Creek and much of it is very good. Cathedral Rock on section 4 is a cluster of elevated turrets of calcareous sandstone, and one of the most interesting of the Natural Monuments in this neighborhood. The eastern part of this township is well-adapted to farming purposes. There is sufficient quantity of water for irrigating purposes. The western portion is very mountainous barren rocky. Sections 6, 7, and 18 are covered with dead and fallen pine timber.

T12S R67W

Interpretation

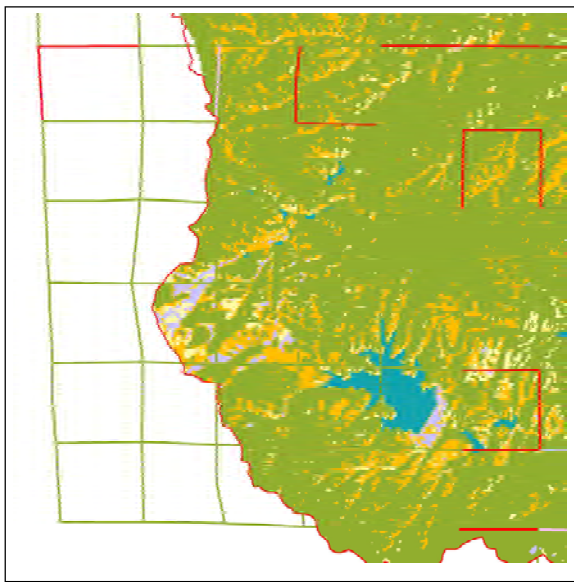
This township was surveyed between 1864 and 1870. This township is located in the west central portion of the watershed and includes much of the western foothill slopes and drainages of the Monument Creek valley. The township also occupies the majority of the land comprising the USAFA. Although the description indicates that there is considerable timber west of the creek, the section line descriptions only bear this out in the area at the far western edge of the watershed. The beginning of the description indicates that the extent of arable land in the township lies within the bottom of the major drainages, the surveyor states later in the description that the eastern portion of the township is well adapted to farming.

Comparison of Historic and Current Conditions

The watershed fully covers this township. This township includes most of the Air Force Academy and some additional sections to the west. The original section line notes identify grasslands over the eastern and

central portions of the township, while the western third is identified as forest. In the western third of the township several section lines were identified as dead/burned timber, or as barren.

The current cover type map identifies a cover of forest in the western third of the township. The remainder of the township is a patchy mosaic of grassland, shrubland, and forest mostly dominated by shrublands. In the northeast corner of the township where the original section lines identified woodland, the current cover is also dominated by a patchwork of woodlands. Over the remaining area of the township a shift from grassland to shrubland appears to have occurred.



Map 41: Township 12 South Range 68 West

This township is well watered except in western tier of fractional quarter Secs. where at present the only settlement in the Township is situated. Their principal supply of water being from a noted spring in the S. W. 1/4 of Sec. 30 called the Silver Spring. Chief production in the settlement being wheat, rye, oats, peas and potatoes. The principal of which are potatoes. The township except the fractional portion above mentioned is hilly and often mountainous and well adapted for pasturage the year round. Timber, pine, spruce and aspen pine in the south slope of the hills and mountainous. Spruce on the north. The aspen, for the most part is an undergrowth that well nigh covers the whole country. The rock is granite red sandstone, and limestone and limestone in place and granite boulders. There is a noted quarry of limestone on the N.W. 1/4 of Sec. 32 from which a superior quality of lime is made. The streams of this Township are small and their general course is South East.

T12S R68W

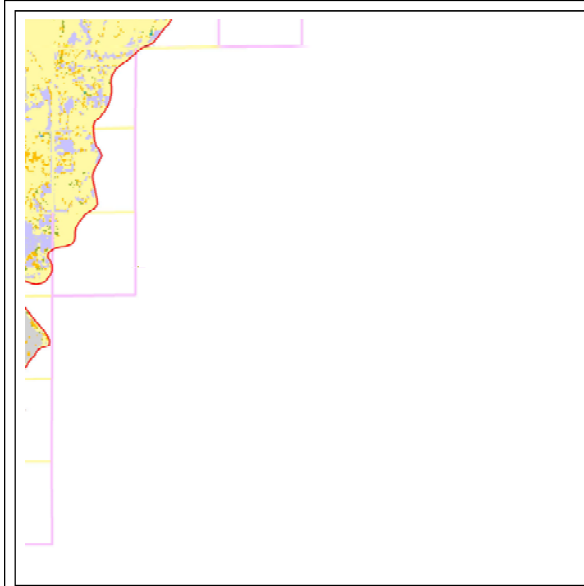
Interpretation

This township was surveyed in 1877-1878. The township occupies the central western edge of the watershed. The description mentions the current day Woodland Park as the only settlement in the township (located in section 30) and notes their dependence on "silver spring" for all of their water. This description describes the type and zonation of timber types in the township and indicates that although the area is mountainous, it provides good pasture indicating the possible presence of numerous openings in the forest cover. The description also indicates that aspen occur as an understory species over the entire township.

Comparison of Historic and Current Conditions

The watershed covers a little more than the eastern half of the township. The original section line notes identify the presettlement cover as exclusively forest, with several section lines of burned or dead timber.

The current cover type map identifies this portion of the watershed as forest with some patches of shrubland. Rampart Reservoir in the southern part of the area, is a large conversion from forest to open water. A significant shift of cover types does not appear to have occurred in this township.



Map 42: Township 13 South Range 65 West

The general character of this township is as follows; sections 35 & 36 are broken, some scattering cedar and pine. The balance is good land on which an abundance of buffalo grass affords a rich pasturage for stock. I am of the opinion coal underlies the whole township though deep. Throughout this whole township the grass is very good and the climate is well adapted for the raising of cattle if one were to judge from the thousands of antelope which we saw while walking the survey.

T13S R65W

Interpretation

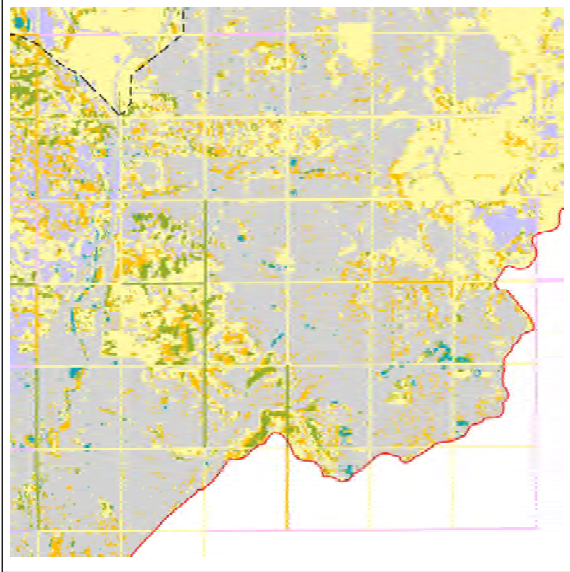
This township was surveyed in 1869. It is located in the southeastern corner of the watershed and includes portions of the watershed in sections 6, 7, and 18. It indicates that the majority of the township is grassland, with the exception of some areas of woodland (“...with some scattering of cedar and pine...”) in the extreme southeast corner of the township (outside the watershed). Interestingly this description is unique in that it mentions wildlife in its statement regarding the “thousands of antelope” observed during the survey.

Comparison of Historic and Current Conditions

The watershed covers only a small part of three sections in the northwest corner of the township. The original section line notes indicate grasslands dominated the historic cover.



The current cover type map shows this area as a mix of grassland and urban uses.



Map 43: Township 13 South Range 66 West

This township has very little land which is available for cultivation. A narrow belt margining the west side of Monument Creek embracing it all. There are indications of coal on S. 19, 9 and 30. Iron ore is found on S. 16. The east part of the township is excellently adapted to growing. The quality of land in this township is on average 2nd rate land. There is a small portion of good farming land along Monument Creek which courses through the western tier of Sections and affords a moderate supply of water for irrigating. The uplands produce a good quality of grass in abundance. There are two or three settlements in the township of Monument Creek. There are several good quarries of sand stone (principally sand) in the sides of the hills. On the line between Secs. 18 and 19 and in the east bank of Monument Creek I discovered a good coal bank.

T13S R66W

Interpretation

This township was surveyed in 1866. It is located in the southeast corner of the watershed and occupies what is now the northernmost reaches of the Colorado Springs urban area. The description indicates that the uplands provide “a good quality of grass in abundance,” which would seem to indicate that this area supported mixed grass prairie as opposed to typical shortgrass prairie. The individual section line descriptions for this township are all categorized as grassland, with the exception of a narrow NW-SE band in the Austin Bluffs area, which is woodland.

Comparison of Historic and Current Conditions

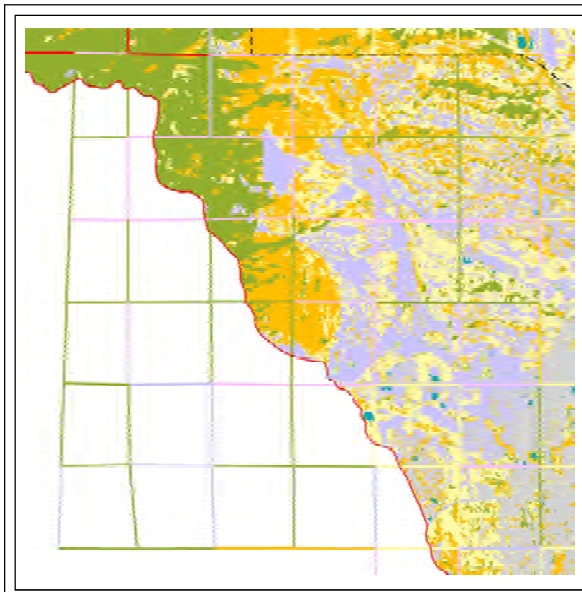
The watershed covers all but a small portion of the southwest and southern edge of the township. The original section line notes identify a small area extending from the west to the south (area of Austin Bluffs) as woodland. The remaining area of the township was identified as grassland.

The current cover type map shows a patchwork of shrub, grass, and woodland types in the Austin bluffs area. Most of the remainder has been converted to urban uses.

T13S R67W

Interpretation

This township was surveyed between 1864 and 1869. It is located in the southwestern corner of the watershed and abuts the south border of the USAFA. The description gives little indication as to the overall vegetative cover of the township, but does mention that the northern areas are covered by considerable amounts of inferior timber. The individual section line descriptions vary and include a large proportion that are of unknown character. The majority of section lines with valid descriptions indicate that the largest part of the township was forested, with some areas of shrubland in the southeastern quadrant. The description does not mention any human settlement of the fertile valley bottoms, which may either be an omission, or an indication that these valleys were not yet settled and cultivated at the time of the survey. Interestingly, the surveys of the township to the south were completed by 1863 and indicate that the valley bottoms are all settled and under cultivation.



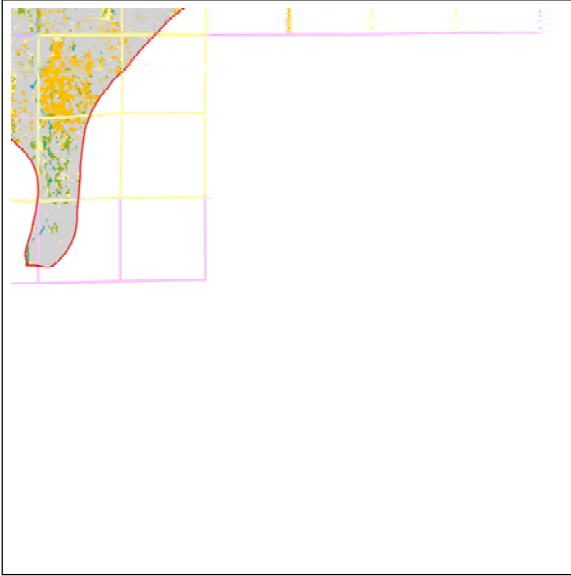
Map 44: Township 13 South Range 67 West

The east half of this township is composed of low rocky hills and ridges separated by narrow and fertile valleys. Two of these open valleys shown on the plats are larger than the others and quite valuable. Monument Park in the north tier of sections and the Gardens of the Gods in section 34 and 27 are wonderful for remarkable scenery. The west half of the township is very mountainous in many places being of the most rugged character, the rocks being for the most part, granite conglomerates and sandstone. The general surface of this township is very rough and broken. It has considerable timber in the north sections, but of an inferior quality.

T14S R66W

Interpretation

This township was surveyed in 1862. It is located in the extreme southeastern portion of the watershed and includes parts of the watershed only in sections 6, 7, and 18. Although the majority of land in this township is outside of the watershed, the description is interesting and pertinent in the perspective it offers on the stage of settlement and level of natural disturbance in the area in 1862. The description seems to make a distinction between the grazing value of the prairie lands in this township, which lies largely in the Fountain Creek watershed, and the land east of the township lying in the



Map 45: Township 14 South Range 66 West

The land in this township available for cultivation, comprises 6 sections lying adjacent to Fountaine qui Bouit, Cheyenne, and Monument Creeks, all of which are occupied by settlers. This land is of good quality and affords profitable returns to the farmer. The uplands have, generally, rich soil but can not be availed of for tillage until some means is devised to supply them with water. They are however invaluable for grazing and already supply numerous herds of cattle. This township contains no timber of any value. Township 14 South Range 66 West is as good a township of land as any in the country. The valleys of the Fountaine qui Bouit, Cheyenne, and Monument creeks are of the best arable land and the divide on the north of the Fountaine qui Bouit is the best grazing land in the country. The township is well settled and the valleys are all under cultivation. The great divide between the Fountaine qui Bouit and the Arkansas on the south and the Platte and Cherry

Creek on the north is all good grazing land. Rain falls in abundance and the land will produce wheat, oats, barley and all small grains. Between the Fountaine qui Bouit and the Arkansas the land is poor consisting of the debris of limestone and is destitute of rain, though near the mountains the grass is good.

Arkansas River basin. It seems as though this may be indicating the prevalence of shortgrass prairie areas in the townships to the east in the Arkansas basin, and the prevalence of midgrass or tallgrass prairie in this township which is closer to the foothills. From the description, it is assumed the majority of the grasslands in the township were midgrass prairie.

Comparison of Historic and Current Conditions

The watershed covers only parts of three sections in the northwest corner of the township. The original section line notes indicate grasslands over this area.

The current cover type map for this area is a patchwork of urban and shrubland types.

T14S R67W

Interpretation

This township was surveyed in 1863. It is located in the extreme southwestern portion of the watershed and includes portions of the watershed in sections 1 and 12. This township includes the confluence of Monument and Fountain creeks and includes the site of the original Colorado City. It interestingly notes demographics for the town and the changes that occurred between 1860 and 1863. As with the description for the previous township, this description indicates the upland areas

are all good grazing land, possibly indicating the majority was occupied by midgrass or tallgrass prairie.

Comparison of Historic and Current Conditions

The watershed covers only parts of three sections in the northeast corner of the township. The original section line notes are unknown for most of this area, but also include some grasslands outside of the watershed boundary.

The current cover type map for this area is a patchwork of urban, shrubland, and grassland types.



Map 46: Township 14 South Range 67 West

The land in this township which is available for cultivation is mainly on its streams and comprises parts of seven or eight sections. There are some twenty five persons and families who are either actually cultivating their "claims" or holding them with a view to their cultivation. The uplands and country adjacent to the mountains afford excellent grazing. Colorado City was organized in 1859 and in 1860 contained 250 buildings, mostly of house logs, and between 300-400 inhabitants. It now contains about 30 buildings including a hotel, two stores, and a good flouring mill, and one hundred inhabitants or there abouts. Most of the buildings of 1860 have been moved to farms along the creek. The town is pleasantly situated and is surrounded by magnificent scenery. Two miles and a half above the town on the Fountaine qui Bouit, are several mineral springs which are much visited.

discussion: characteristics and distribution of the existing vegetation cover types in the study area

As described above, descriptions of pre-settlement vegetation cover types were taken from the GLO survey notes from the period 1864 to 1870. To evaluate the pre-settlement characteristics relative to current conditions, we created a grid of the actual section lines in a Geographic Information System (GIS) and associated the presettlement description with its corresponding section line. The grid was then overlaid onto one of two maps of the existing vegetation to compare existing vegetation with presettlement vegetation.

The maps of existing vegetation included the USGS-GAP coverage (CDOW 1998a), and the Colorado Vegetation Classification Project (CVCP) (CDOW 1999a). Both of these maps were produced from 30 meter LANDSAT Satellite imagery. Because the classification categories in the USGS-GAP map lump structurally similar types together, the polygons tend to be larger and represent several vegetation associations.



The CVCP vegetation cover map also has a spatial resolution of 30 meters, but classifies the vegetation to the plant association level. Because this map separates many structurally similar associations into individual mapping units, the resulting polygons tend to be much smaller, producing a much more detailed map.

conclusions

GLO survey notes can be a valuable tool to assess the pattern of land cover prior to European settlement. The value of the notes for this purpose depends on the date the surveys were completed and the detail of the section line and township descriptions. The GLO notes for the MCWS give fairly detailed descriptions and were completed in the mid to late 1860s, approximately the same time large numbers of settlers were arriving in the area.

Based on the descriptions in the notes, differences in the patterns of the current vegetation and that which existed prior to European settlement can be seen in the distribution of shrublands and grasslands in the main valley of Monument Creek. In that area, the grassland community has been reduced by an expansion of the shrubland and woodland boundaries. These later communities appear to have expanded onto lower elevation slopes and valley floors in the absence of fire. The majority of this cover type change is evident in T11S R67W and T12S R67W. The descriptions of the land cover from the GLO notes indicate that much of the present day Academy property and most of the main valley of Monument Creek was covered by rolling prairie of mixed grasses. Currently, grasslands in these areas are restricted to some of the valley bottoms and openings between areas covered by shrubs.

The survey notes for the watershed did not show a change in the pattern of forest cover over the watershed. It is possible that an expansion of forest cover onto areas previously covered by shrubland and woodland has occurred, but that the descriptions for those areas are not detailed enough to detect this.

Aside from changes in the pattern of forest cover, it is likely given land management practices since the 1860s that the structure of forests within the watershed have changed. Pre-settlement forests are likely to have been characterized as uneven aged with a wide range of density across the watershed. Since European settlement, fire suppression and timber harvesting have generally promoted more even aged forests with a narrower range of densities.

The GLO note clearly identified the occurrence of fire in the watershed. In T11S R68W, the general description notes describe the area as nearly devoid of vegetation and as having all the timber killed by fire. In T11S R66W, which is the portion of the Black Forest that enters into the watershed, only four section lines indicate any evidence of timber killed by fire. These lines were all separated by at least one to two miles of unburned timber.



short-term change: 1958 to 2001

Change is often regarded as a gradual process. The US Air Force Academy was completed in 1958 and although the Academy landscape is often regarded as largely intact, preserved from the immediate and long-term impacts of development and land use change, the site has also seen substantial change since its inception. Historic photos taken during construction suggest that the changes are in fact quite profound.

Much of the Academy site was cleared of vegetation and replanted after recontouring, often with non-native plants such as smooth brome (*Bromus inermis*). Comparisons of photographs taken in 1958 and 2001 suggest that though change has been fairly slow, some systems are clearly altered. Noticeable are thriving shrub communities on the toe slopes of the Rampart Range, presumably dominated by Gambel oak (*Quercus gambelii*) and on the Academy site itself.

wildlife

Much of the information on historic populations of wildlife is anecdotal. Historically, the watershed was populated with a variety of species throughout the different habitat types. Bison, antelope and prairie dogs were prevalent in the grassland regions. Bear, deer and bighorn sheep were common in the mountainous regions.

As early as the 1890s, effects of land use change and conversion were already impacting regional populations. Much of the pronghorn antelope range prevalent in the watershed was during this period, converted to agriculture or range as the region was fenced extensively. This is particularly true of the habitat in the Colorado Springs area (Hall 1891). Other grassland species have either been extirpated (including bison) or experienced increasing stress from development and land use conversion pressures.

Sightings of bear, deer and elk became increasingly uncommon during the later 1890s though mountain lion and lynx were known to visit lower elevations on occasion (but perhaps more to the flanks of Pikes Peak rather than the Monument Creek Watershed proper) (Hall 1891).



Photograph 22: This photograph of the Cadet Area of the US Air Force Academy was taken during the first year of the Academy's operation. Much of the area was cleared of vegetation and replanted with smooth brome and ponderosa pine. Photograph taken by B.C. McLean, Soil Conservation Service (July 1958).



Photograph 23: This matching photograph was taken in 2001 and shows substantial change over a 43 year time period. Notable is the return of Gambel oak and the maturing of planted ponderosa pine. Note that the forest structure of the Rampart Range backdrop appears largely unchanged over this time period, aside from what appears to be increasingly dense oak stands on the toe slopes of the range. Photograph by Greg Speights, USAFA Natural Resources (July 2001).



historic physical systems

hydrologic function

It can be assumed that a lower historic tree density in forested areas would lead to lower evapotranspiration rates resulting in increased streamflow in reaches within the watershed. Anecdotal evidence suggests, however, that streamflow was far more intermittent relying heavily on seasonal cycles: increased flow during the spring due to snow melt, another increase in streamflow during the monsoon cycles of late summer and relatively sporadic flows the remainder of the year. Indeed local residents have described a period in history when the main stem of Monument Creek would cease flowing during certain times of year, although today there is usually enough water to “float a kayak” nearly year-round (Cleveland 2000).



Photograph 24: The Monument Creek (at Bijou Street, Colorado Springs) drainage has a long history of seasonal and at times catastrophic flooding. The drainage has been altered over time to mitigate flooding damage, yet seasonal flooding is part of the creek’s natural cycle.

Flooding was a part of the historic landscape. Large scale flooding occurred in 1864 on Monument, Cheyenne and Sand Creeks. Property was destroyed and thirteen lives were lost in waters deep enough to “float a steamboat” (Hall 1891). Additional flooding occurred on Monument Creek in 1884, again destroying property (including portions of Colorado Springs, still a young town) and drowning the wife of the County Superintendent of Schools (Hall 1891).

The massive Pueblo flood in June of 1921 was exacerbated by the simultaneous arrivals of flood crests from both the Arkansas River and Fountain and Monument Creeks (Carter 1956). Prior to the Big Thompson flood of 1976, the 1921 event was regarded as the state’s most devastating.

The Memorial Day flood of 1935 caused massive damage in downtown Colorado Springs, killing two people (Carter 1956). Heavy rains in the northern portion of the Monument Creek Watershed created an event that destroyed all Monument Creek bridges. Damages were estimated to be in the neighborhood of \$1.8 million (Carter 1956). Following this event, Monument Creek was systematically widened and rip-rapped in an attempt to mitigate future damage but also substantially altering the creek’s hydrologic regime.

historic social systems

historic human populations

Before the incorporation of Colorado Springs in 1871, settlement patterns within the watershed tended to be sparse and low-density. Native Americans lived along the banks of Monument Creek until at least until the late 1860s, tending to live in the region seasonally, following game into the higher country of South Park and beyond.

The Town of Monument incorporated in the mid 1860s following a large influx of homesteaders along Monument Creek. Some of the first homesteaders settled northwest of the Monument Reservoir.

The population of the watershed grew gradually from the founding of Colorado Springs in 1871 (see also history section) through the end of the 1900s. In 1878, Colorado Springs boasted a population of close to 4,000 residents (Horgan 1920). By 1880, 5,000 people lived in the city. Settlements were sporadic throughout the watershed but well distributed throughout the region in ranches and farms (Hall 1891).







l a n d s c a p e s y n t h e s i s

Ecological management is a fundamentally pragmatic approach to the sustained management of shared resources. It involves the reduction of management efforts, mitigating against loss of property or life, assisting in the attempt to leave a legacy for future generations, to provide for a more realistic and sustainable renewable resource base and to better balance needs of human society with those of other species and habitats. Within this context, understanding of the nature of change within the watershed over time aids in the prioritization of management efforts (those areas already exceeding historic ranges of variability or those regions that are particularly prone to instability (intrinsically sensitive systems such as soils and geology or causal systems such as slope, elevation and aspect).

characterization of change over time

It is clear that the Monument Creek Watershed landscape is a complex assemblage of interacting systems that are remarkably resilient in many ways to disturbance patterns, whether they are natural or anthropogenic. These same systems, however, exhibit signs of stress as historic ranges of variability are exceeded.

Photograph 25: Looking east across the Monument Creek Watershed from the Mount Herman Road and the North Beaver Creek drainage, the complex interrelationships among ecological systems is readily apparent. Vegetative systems interact with the human domain, in turn to be affected by seasonal precipitation, by forest cycles, then by varying levels of recreational impacts.

Again, ecological management assumes that systems where essential ecological processes are functioning and within historic ranges of variability (again, taking into account the wide range of potential landscape level and localized disturbance events), result in a more resilient, sustainable and fundamentally more stable landscapes. Thus the goal of ecological management is to ensure (to the extent possible within existing ranges of scientific knowledge and socio-political



constraints, including budgetary) that component systems are operating within historic ranges of variability. It is important to note that the notion of sustainability also extends to management efforts, suggesting that those systems that are most within historic ranges of variability require less management activity and fewer fiscal inputs thus requiring less overall effort and micromanagement over the long term.

Monument Creek Watershed: Summary of Landscape Change Over Time					
system	reference condition	current condition	amount of change	spatial extent of change	causal factors
forest vegetation	heterogeneous; mixed density; diverse age structure; persistent openings; well developed understory; fire events important component of system	homogenous; high density; even aged; few opening; understory inconsistent or lacking; near complete exclusion of fire events (with notable exceptions)	extreme	landscape-wide including most forested areas of watershed including Rampart Range and Black Forest.	exclusion and cessation of fire; land use changes; logging
grassland vegetation	mixed-grass and tall grass; prairie in lowland portions of watershed; matrix of grasslands and shrublands in edge areas; grassland dominant component of reference condition forest understory	tall-grass component nearly missing from landscape with notable exceptions; introduction of exotic species; noxious weeds	extreme	landscape-wide; particularly the central watershed	land use changes including residential and commercial development; grazing; inconsistent management goals
wildlife	lowland grasslands dominated by ungulates including bison and antelope and other prairie specialists including prairie dogs; forested areas ...	very few prairie specialists occur in lowland areas; particularly megafauna; numerous species of wildlife persist in forested areas although in altered, sub-optimal habitat	extreme	landscape-wide but largely determined by habitat type and correlation with causal factors	land use changes including residential, commercial and industrial development; over-hunting; agriculture and grazing; logging; altered habitat structure due to changes in vegetative and hydrologic regimes
hydrology	intermittent drainages; frequent flooding cycles; cyclic sedimentation due to soil loss	primary drainages are perennial; occasional, catastrophic flooding; high levels of sedimentation	extreme	landscape-wide; high levels of sedimentation near residential areas or areas under development; Monument Creek nearly perennial	loss of vegetation due to land use change; increase amounts of impervious development; slope instability; poor environmental oversight
human population / settlement patterns	few permanent populations; few permanent settlements; semi-nomadic; very low-density	county population exceeded 500,000 in 2000; very high density in south watershed; mixed density in central watershed; low density in federally managed west watershed	extreme	landscape-wide; varying levels of density based upon land use; federal lands are not under development pressure but receive impacts from increased recreation and resource extraction	population growth resulting primarily from immigration; changes in local economies drive land use, resulting impacts change over time in response; lack of regional planning efforts, particularly multi-jurisdictional approaches to balance diverse needs across jurisdictional boundaries

Table 3: Summary of landscape change over time.

To better inform land managers of systems that are significant in the formulation of management strategies, it is important to be able to characterize the nature of change over time. To better illustrate change over time, the systems for which a current and reference condition were established, were included in a matrix designed to simply illustrate the magnitude of change, the amount, temporal context and simple causal factors of change. The results of this analysis are discussed in the “landscape trends” section that follows. Other facts and systems summaries are used in conjunction with this analysis to develop the desired future condition and recommendations.

Nearly across the board, changes in the systems are the result of anthropogenic effects altering fundamental ecological processes arguably integral to the functioning of these systems over the long term.



Again, from a standpoint of management pragmatism, understanding the characteristics of change is useful for the determination of future management efforts, aids in the prioritization of these efforts and ultimately provides the basis for more sustainable approaches to the management and perception of the region's natural resources and the ecological processes that support them.

The vegetative structure has been altered significantly from the historic norm, largely the result in land use change, the extraction of resources, development, and the alteration of ecological process, the most profound of which is the exclusion or cessation of fire. The results of which are certainly noticeable on the local scale: forests have increased in density and stands are more often than not characterized by even-aged timber. Species composition has been altered and exotic species have been introduced that has lead to increased competition and fuels accumulation.

The numbers and types of animal fauna have also changed. Again, primarily due to anthropogenic effects, habitat has been severely altered, migration corridors fragmented, home ranges reduced in size and forage isolated. Several species have been extirpated from the area and several more are under regulatory protection as habitat is stressed and as genetic variation is diminished as populations are isolated by development.

Regional hydrology has been altered by way of diversionary structures (including flood control structures), increased development of impervious surfaces, intra-basin transfers and increased population. Land use change and resulting impacts to soils and vegetation has lead to increased levels of soil loss throughout the watershed.

Human population growth is clearly one of the greatest causal factors of landscape level change over the last 100 years. Growth affects systems in several ways, the most rudimentary of which includes population density or how many people occupy a specific area. Growth is more complex than simply increasing numbers of people inhabiting the area. Specific density patterns or how people occupy that space is also important (housing types, the amount of impervious surface, landscaping). A driving force in growth is regional economics, whether they occur on boom-bust cycles or are reflective of more sustainable, long-term economic patterns.

Table 3 summarizes the reference and current conditions in qualitative terms, assigns descriptions of the nature and characteristics of change over time, causal factors in that change and the first stage planning pathways that may help land managers address that change in the future.



Monument Creek Watershed: Summary of Landscape Trends				
trends	causal factors	associated ecological processes	primary affected resource	other affected resources
biological systems				
changes in plant and animal fauna (composition and structure)	fire suppression; introduction of exotic species; land use changes including: development, ranching and agriculture; hunting and overharvesting pressures	cessation of ecological processes: fire, flooding; climate changes	regional forests, grassland and shrubland communities; property (increased risk of catastrophic fire); grassland specialists (mega fauna, birds and rodents)	native plant fauna; viewshed; recreation opportunities; habitat quality
physical systems				
changes to hydrologic regime	increased impervious development; trans-basin transfers	riparian systems	animal and plant fauna; property; drainage systems	recreation; riparian areas; property values
increased erosion	increased impervious development; altered vegetative regime; altered hydrologic regimes	soil formation; hydrology; geology; anthropogenic effects	animal and plant fauna; property; public works; topsoil	vegetation; visual amenities
social systems				
increased human population	immigration; higher birthrate	anthropogenic effects on other systems means human interaction with other systems critical	economic options (agriculture, ranching, logging); quality of life; viewshed	
changes to public perceptions of environment and natural resources	education; economic shifts	anthropogenic effects on other systems means human interaction with other systems critical	management options (generally believed to be more although population also limits options)	
increasing need for collaborative and multi-jurisdictional management	economic constraints; ecological necessity	in a sense all; landscape level ecological management	watershed as a whole; efficacy; efficiency	public confidence and support

Table 4: Summary of landscape trends.

landscape trends

Major landscape level trends were identified and organized according to the three main types of watershed systems: biological, physical and social. To better illustrate the interrelationships between ecological processes over time, the top three trends are identified. This summary compliments the summary of change over time in that it focuses on major relational trends as opposed to the systems themselves. Landscape trends are summarized in Table 4.

results and discussion

The exclusion of fire has led to profound changes across the landscape. In general, fire events are comprised of temporally and spatially discrete events. As a result, increased variability in the temporal and spatial attributes of events is believed to lead to greater diversity and heterogeneity of habitats and resource (or catastrophic event mitigation) across the landscape (and at multiple scales).

Given the current condition of several watershed systems and the amount of change that has occurred since the reference condition, the following systems (and associated ecological processes that may be occurring outside the historic range of variability) have been isolated as key to understanding and assessing the watershed and thus integral to the prioritization of management and planning efforts within the watershed:



- **vegetation composition and structure** (exclusion of fire, land use changes)
- **soils** (erosion, sedimentation, land use changes)
- **human population density and growth** (development, land use changes, habitat fragmentation and loss)
- **slope** (development suitability, soil loss, vegetation growth and structure)

In 1996, the Buffalo Creek fire burned 5,000 ha of ponderosa pine – Douglas fir forest in the Upper South Platte Watershed. The forest structure in this area was typified by dense, homogenous structure that lacked openings typical of historic forests, growing on poorly formed, granitic soils, similar in most ways to the forests that comprise more than a third of the Monument Creek Watershed. The impacts to the landscape as a result of this event were great: in less than a day, near complete overstory mortality occurred in over 3,000 hectares (7,400 acres) of forest. Within weeks, seasonal rains resulted in massive soil loss, severely impacting Denver’s water supply (Kaufmann et al. 1999).

The Hi Meadow and Bobcat Gulch fires of 2000, also burned in ponderosa pine forests similarly characterized by dense, even-aged stands, the result of similar patterns of fire suppression and land use. Also similar was the increased levels of development well within the Red Zone making the likelihood of property loss higher. Portions of these areas have benefitted from the fires (in effect simulating historic ecological processes): increased native grass and ground cover production in burned areas of the Bobcat Gulch fire, for example, and the reduction of persistent noxious weeds (following a dramatic increase in weed populations in response to landscape level disturbance). For the most part, however, the results of the fire, like the Buffalo Creek event, exceeded ranges of historic variability. Overstory and understory loss resulted in massive soil loss, particularly in those areas with excessive slope. In some areas, the fire burned so hot as to sterilize the soil, already poorly formed and largely devoid of nutrients required for revegetation efforts.

The implications for the forested areas of the Monument Creek Watershed are great: given the current condition, the amount of change that has occurred since ecological processes were largely intact (ca. 1850), the amount of development that has occurred within the Red Zone, the similarity to conditions in other watersheds, some of which have already experienced uncontrollable, catastrophic fire events, it seems logical that management efforts might refocus on the issue of forest health, the role of fire and the opportunity to develop ecologically-based management strategies that support the long-term ecological goals of the region but link important corollary social systems (including economics, property loss, insurance rates, loss of life, water quality, etc.) to establish an adequate rationale and basis for landscape-scale planning and most importantly implementation.





watershed prioritization

watershed prioritization analysis

As land managers and local stakeholders address issues within the watershed, it is useful to develop a method by which those areas with the most critical needs receive priority attention. To aid land managers and to better summarize salient points of the landscape assessment, a prioritization method was derived using spatial data to describe those areas in most need of management action based upon selected criteria. These criteria are subjective and land managers may decide to further refine the prioritization process to better fit management priorities or other needs.

Photograph 26: The Rampart Range receives tremendous stress from a multitude of sources including those associated with increasing demands for recreational opportunities. Some forms of recreation pose particular risks to watershed systems, impacts which can have consequences downstream. Management options within the watershed will require a relational approach in order to balance the needs of watershed inhabitants and users with those of the ecological systems occurring in the area.

Sub-watersheds were prioritized for management attention by using factors and considerations derived from the results of the reference and current conditions and the landscape characterization and trends sections. Factors included in this analysis are those that exhibit the most potential for landscape-level change or those systems that have resulted in the greatest difference between reference and current conditions , and thus are assumed to lack conditional stability (see page

14 for more information on conditional stability of landscape systems). These systems include:

- **slope** (erosion hazard ratings);
- **soil erodibility** (K factors)
- **vegetation** (areas exhibiting structure outside the range of historic variability);
- **human population** (population density);
- **sensitive or important habitat** (CDOW Significant Wildlife Habitat mapping and CNHP Potential Conservation Areas)

methods

Six data layers representing the above systems were reclassified into categories generally representing low to high on a numeric scale from 1 to 5 where 1 was the lowest and 5 the highest. The data layers were reclassified as follows:

CNHP PCAs (using biological significance ranks; see page 27)

B2 = 5
B3 = 4
B4 = 3

CDOW Significant Wildlife Habitat Map (using sensitivity codes; see page 59)

5 = 5
4 = 4
3 = 3
2 = 2
1 = 1

Erosion hazard (using erosion hazard classification; see page 37)

40 - 178% (very severe) = 5
25 - 40% (severe) = 4
10 - 25% (moderate) = 3
0 - 9% (low) = 2

K factors (classified using equal intervals excluding 0; see page 32)

0.34769 - 0.4300 = 5
0.26539 - 0.3476 = 4
0.18308 - 0.26539 = 3
0.10078 - 0.18308 = 2
0.01847 - 0.100781 = 1

Forest condition (given lack of data, coniferous forests assumed to be high priority issue and deciduous forests, moderately high priority)

Englemann spruce / fir mix = 5



Pinon-Juniper = 5
 Ponderosa pine = 5
 Ponderosa pine / aspen = 5
 Ponderosa pine / Gambel oak = 5
 Riparian = 5
 Aspen = 2

Population per hectare (derived from 2000 US Census data by census block, classified by quantile)

24.55 - 785.71 = 5
 15.34 - 24.55 = 4
 9.20 - 15.34 = 3
 3.069 - 9.20 = 2
 3.069 - 3.069 = 1

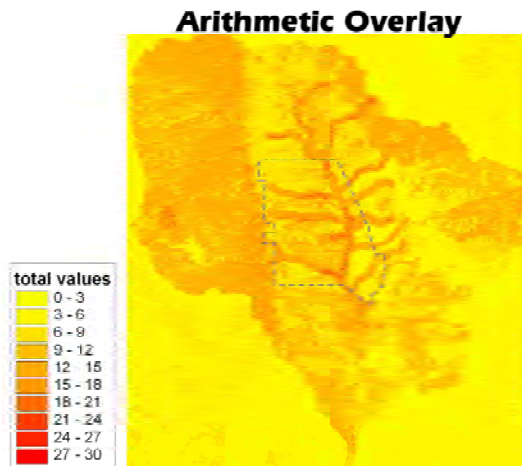
The prioritization model consists of a simple arithmetic overlay, that is all values are equally weighted so that the geographic area that has the highest number of high priority values, is deemed to be the highest priority. For example, an area that receives a priority rank of 30 (the highest possible: $5 \times 6 = 30$) would be an area with a B2 PCA, a CDOW area ranked 5, very severe erosion hazard, sensitive soils, characterized by coniferous forest and a relatively dense population.

The average priority rank was then summarized by watershed, resulting in the watershed prioritization or those watersheds that might receive management attention based upon the presence of the priority factors. The prioritization of watersheds based upon the simple arithmetic model is as follows (Map 47):

- 1 - Middle Monument Creek (ws-30)
- 2 - Pine Creek (ws-60)
- 3 - West Monument Creek (ws-40)
- 4 - Lower Monument Creek (ws-90)
- 5 - Beaver Creek (ws-20)
- 6 - North Monument Creek (ws-10)
- 7 - Douglas Creek (ws-80)
- 8 - Kettle Creek (ws-50)
- 9 - Cottonwood Creek (ws-70)

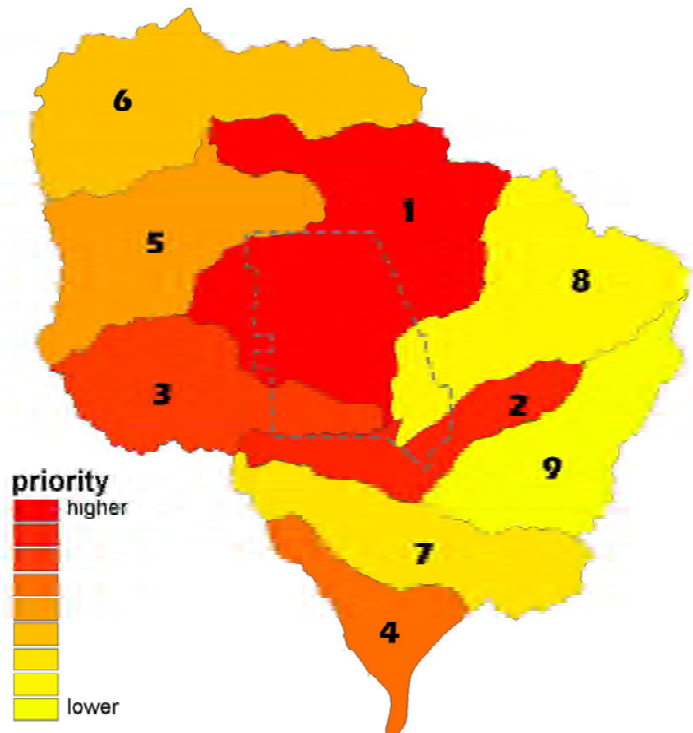
results and discussion

On a landscape scale the results of the prioritization analysis suggest that the central watershed is both an area of ecological significance (given the presence of CNHP PCAs and the importance of habitat as measured by the Colorado Division of Wildlife) and an area that is particularly sensitive to disturbance (susceptibility to erosion). This area is also heavily forested, thus following early assumptions, the central watershed is also prime for forest health issues.



Map 47: The prioritization of watershed activities is facilitated by an arithmetic overlay model, a simple analysis that combines information from several datasets resulting in a map depicting areas of relative management concern based upon pre-defined criteria. Here, areas in red are regarded as more significant (concentration of sensitive values) and those in yellow, less so.

Sub-Watershed Prioritization



Map 48: The sub-watersheds of the highest management concern (based upon the criteria discussed on the preceding pages), are those with the highest concentration of biologically significant areas, soils sensitive to erosion, characterized by steeper slopes and higher relative population density. These areas also correspond with some of the fastest growing parts of the county, but also those with perhaps more planning opportunities: careful multi-jurisdictional planning efforts might be considered to maximize efficiency and effectiveness of the management of shared resources.

Obviously, the prioritization analysis is a simplistic approach to encouraging efficient management action, built upon a rather rudimentary set of assumptions. An effective follow-up for regional land managers would be an effort that added additional weight to individual variables based upon management needs and additional information about the system being measured (relative or comparative sensitivity, for example). Additional refinement of variable classes may also lend well to further developing the model and thus its usefulness in the prioritization of regional management efforts.



desired future condition

Chapters 2, 3 and 4 summarize the current and reference conditions of the Monument Creek Watershed. Chapters 5 and 6 summarize and discuss the dynamics of watershed change. The remaining two chapters directly address ways this information and results can be utilized.

The desired future condition (DFC) is based upon the assumption that if used as a foundation for regional, multi-jurisdictional management, resource integration and sustainability in the Monument Creek Watershed landscape will be ensured and social needs will be met.

In addition to the systems summaries the DFC was developed using input from local stakeholders, including landowners, members of the business community and representatives of local community organizations. This approach reemphasizes the importance of integrating socio-economic information into what are essentially ecological analyses. Using these types of qualitative data helps to ensure that the DFC is a more useful and accurate guide to achieving landscape scale management and planning goals.

Photograph 27: Forest health ranks high among management issues within the watershed. Experimental thinning efforts at the Fox Run Regional Park are designed using information from historic systems, fire ecology and public input. The result is more resilient forest stands that encourage diverse understory structures, create habitat and mitigate against catastrophic and potentially destructive fires.

The DFC should not be regarded as planning strategies, but rather as broad planning goals that are designed to satisfy ecological and social needs and desires. Broad-brush recommendations comprise Chapter 8 and are based directly upon the DFC.

stakeholder input

Edited summaries of responses gathered from local stakeholders are included as Appendix 3, page 141. The fourteen interviews represent a wide range of local stakeholder interests including: local land owners, business owners, local government officials and non-profit organizations. Stakeholders were asked a series of general questions regarding issues and opportunities they believed to be of importance within the watershed.

Several issues were regarded as having nearly universal importance within the watershed including:

- recreation
- open space (the need for more)
- growth (including development, lack of regional planning)
- roads (traffic and associated impacts including habitat fragmentation and erosion)
- forest health (including tree density, insects)
- environmental protection (particularly the need for habitat protection, restoration, designation)
- environmental regulations (need for additional protection and how some regulations produce barriers to other development goals)
- fire (impacts to both natural and human systems)
- multi-jurisdictional planning (the lack of existing efforts and the need for future ones)

issues summary and synthesis

Recreation is recognized as a key issue within the watershed in terms of potential needs and impacts to watershed systems. Though the watershed possesses numerous recreational opportunities, including those found in the Rampart Range area (particularly in the Pike National Forest), the Monument Creek drainageway (trails and limited water sports) and the Black Forest area (several regional parks), it is generally regarded that existing areas and facilities are pressured by increasing population in the Colorado Springs area. This is particularly true in the Rampart Range; the resulting impacts are readily apparent (see the recreation section for more information, page 47). There is a demonstrable demand for additional, appropriate recreational opportunities. Appropriate implies that the recreation type is balanced in regards to potential impacts, access, stress on important habitat, noise, pollution, visual impacts and other needs.

Issues of access are increasingly important as new developments preclude or limit access where rights of way were not established to ensure access over time. This is common where private lands abut public lands, National Forests in particular. Lack of access points can lead to trespassing or concentration of recreational activities in those areas where access is available.

There is growing concern about the associated and cumulative impacts of recreation. Again, the Rampart Range area is receiving increasing stress from recreation resulting in noticeable impacts including resource destruction (informal shooting ranges, off-road vehicle use) and erosion (off-road vehicle use, trail cutting, over use).

Open space is generally regarded as more than simply a visual amenity but rather a required landscape component. As important habitat, community separators, recreation areas, viewsheds and watershed, open space is viewed as a community asset. It is generally believed that there needs to be additional lands set aside as open space across the watershed.

Growth and associated impacts continually rank high in terms of issues state-wide. As one of the fastest growing communities in the state, the Monument Creek Watershed region is no different. Stakeholders were primarily concerned with the rapid rate of development and the perceived loss of habitat, open space, community separators and community. There was a general belief that little if any regional planning efforts were being made and that there needed to be additional efforts to engage in multi-jurisdictional planning efforts on regional (or landscape) scales. Development is generally regarded as reactionary and opportunistic and although stakeholders believe that growth needs to be accommodated to a large extent, there needs to be more attention placed towards appropriate development that takes into account regional impacts.

Other issues commonly associated with growth were identified as key issues. The proliferation of roads in urban, rural and forested areas is of concern due to increased traffic levels and for the role roads play in habitat fragmentation, soil loss and ease of access to sensitive areas (where additional damage is probable).

Issues associated with forest health consistently ranked high among concerns in the stakeholder group. There is increased recognition of the problems associated with dense, homogenous forests including insect outbreaks and catastrophic fire. Other concerns include viewsheds, lack of economic potential in stands comprised of small diameter timber and the persistence of low-quality habitat to ensure of a diverse plant and animal fauna. Some frustration exists in the fact that private land owners are reluctant to cut trees on their property even as fire or insect mitigation strategies.



Photograph 28: Open Space is regarded as an important issue within the watershed according to interviewed stakeholders. Open Space provides important habitat, watershed and viewshed, community separation and recreation. The Austin Bluffs / Palmer Park area provides open space in a very urbanized environment.

In general the stakeholder group believed that the natural resources of the area need additional protection to ensure conservation occurred over the long term. Protection extended to designation or restoration of critical habitat and the management of these habitats for wildlife and plant species.

Some existing environmental regulations were perceived as counterproductive to attaining other goals. Several stakeholders believed that existing Forest Service regulations hinder forest health related management efforts due to limits on cutting within the National Forests. Some concern was also expressed regarding regulations associated with federally listed species (specifically the Preble's meadow jumping mouse) and potential impacts to development options near or adjacent to riparian areas.

Fire was regarded as an important planning issue in its own right. Concern lies primarily with the potential for catastrophic property damage at the urban / wildland interface due to the accumulation of fuels, structural factors including overall density and lack of openings and the general proximity of relatively high density development. Some concern also centered on the high potential for impact of natural systems including habitat, soil loss, water ways and forest structure.

planning issues and opportunities

Planning issues and information salient to the development of the DFC were also gathered from several experts workshops and field trips that occurred within the landscape assessment planning process. Though issues and planning opportunities identified in this manner differ in scale and detail, they closely resemble the results of the stakeholder survey process.

Issues identified in this manner can be assembled into the following groups (see Appendix 4, page 147 for a complete list of planning issues and opportunities identified during the workshop and field trip process):

- fire (fuel loads, lack of preparation or ability to fight large event)
- growth (including urban encroachment, development, hard surface development, extraneous fencing)
- recreation (including access, vandalism, increased use, pollution (air and water), illegal use (off-road vehicles in particular))
- visual amenities (including Front Range back-drop)
- soils (erosion, soil loss)
- wildlife species (including watchable wildlife, species richness, aircraft hazards , loss of habitat, lack of regional connectors)
- forest health (including insects, catastrophic fire, land owner reluctance to cut trees, preconceptions about "healthy" forest, aspen decline in some areas)

- urban / wildland interface
- education (opportunities, need for more)
- military mission
- weeds
- air pollution (smoke agreements, relations to ability to prescribe burn)
- roads (including safety and maintenance)
- water (including quality and altered hydrology)
- forest economics (including lack of market and facilities for small-diameter timber and products)

issues summary and discussion

Similar to the planning issues identified by local stakeholders, those suggested by attendees and presenters at project workshops and field trips fall primarily in general categories of forest health (and associated impacts or causal factors), growth (and by-products of growth), fire (both potential impacts and the need to mitigate against effects of fire), education (both the opportunity and need for additional educational opportunities) and economics (primarily related to the decline of extractive industries).

Of all the issues of concern to regional experts, forest health and related issues are of critical importance. Deviation of regional forests from the historic condition that is generally believed to have existed before the intense settlement and land use altering period began in the 1860s, has resulted in a forest structure that lacks resiliency to disturbance events, provides inadequate habitat to plant and animal fauna, is decreasing in visual aesthetics, provides little or no economic potential, increased likelihood of catastrophic fire due to the accumulation of fuels and the lack of mature understory and a potential inability to appropriately respond to a large scale fire event. Furthermore, the forest health issue is made more complex by the fact that private landowners are often reluctant to cut trees on their land even to mitigate the potential for property loss or damage. There is the general belief that the public as a whole (and some resource managers) possess preconceptions about “healthy” forests that preclude many contemporary management strategies, some of which are accompanied by their own set of issues.

As an ever urbanizing region, the Monument Creek Watershed is already experiencing increased levels of air and water pollution. Regional managers are at times hindered in their efforts to address forest health issues by regulatory and political constraints. There is increasing



Photograph 29: Catastrophic fires, like the Hi Meadow fire that burned in 2000, are of concern to regional resource managers and stakeholders alike.

concern, for instance, that prescribed burning efforts might be greatly affected by both the potential limits on smoke or air pollution or that development will occur in such proximity to the wildland / urban interface as to preclude burning as a risk to property and structures.

Forest economics are another ancillary issue of concern to regional managers and experts. Accompanying the decline in regional timber harvesting is the decline in opportunities to use locally sustainable means to treat timber stands and re-establish properly functioning ecological processes. There are currently few, if any, opportunities to process and add value to the small diameter material commonly removed from forests under treatment for forest health related issues. The lack of processing capability increases the overall cost of treatment, at times making treatment cost prohibitive despite the fact that these same stands are often at high risk of catastrophic fire.

Closely related to issues of forest health are wildlife related issues. As mentioned previously, regional resource managers regard the protection and restoration of wildlife habitat as a critical management issue. Other issues include further developing opportunities for viewing wildlife while mitigating potential side effects including undesirable wildlife / human contact, foraging within the urban / wildland interface, increasing species richness and overall diversity and importantly the lack a regional wildlife corridors.

Growth and development in the region are also identified as top planning issues. As with the local stakeholders, regional managers and experts also express concern that habitat and natural areas are continually being encroached upon as additional developments occur across the landscape. Associated with this type of growth is increased hard surface or impervious development which can result in altered hydrologic regimes, increased sedimentation and habitat fragmentation. Roads are in themselves at issue as increased ease of access can result in over use of some areas, increased traffic and impacts to habitat via fragmentation or direct mortality. Also related to roadways are maintenance and associated impacts, and safety.

Existing recreation and the potential for additional recreation opportunities are also regarded as important planning issues within the watershed. The Rampart Range area is regarded as a critical management concern due to increasingly serious damage from off-road vehicles in particular and the existence of illegal shooting ranges and dumps. Associated impacts include erosion, soil loss, habitat destruction, air and water pollution, and vandalism. Mitigation attempts to date, although at times quite involved (e.g. using cable or other diversionary structures to block access), have met with limited success as recreationists remain persistent in their attempts to utilize closed areas.

change analysis

Chapter 5 (“Landscape Synthesis”) summarized the nature of change within the MCWS and identified those larger landscape processes that have most deviated from their respective historic condition. Many of the systems falling into this category were also identified as being important planning issues by the stakeholder and resource manager / expert groups. Again, the most significant of these systems include:

- vegetation
- wildlife
- soils
- hydrology
- human population growth

the desired future condition

As were the reference and current conditions, the desired future condition is organized by listing conditions associated with each of the three main landscape domains: biological, physical and social.

future condition of the biological domain

vegetation

1. fundamental structures and ecological processes will be re-established and maintained across landscape
2. plant habitat will be protected and restored
3. plant species composition and populations will be maintained
4. weeds will be controlled to mitigate potential impacts to native systems and habitats

wildlife

5. wildlife habitat will be protected and restored
6. wildlife species composition and populations will be maintained
7. movement corridors and linkages will be established to encourage movement among populations and genetic diversity

rare and / or imperiled plants, animals or communities

8. enhanced efforts will be made to restore imperiled populations or protect critical habitat

future condition of the physical domain

soils

9. efforts to mitigate against soil loss and associated impacts on landscape scale will be made

hydrology

10. fundamental hydrologic regimes and processes will be re-established on watershed scale



slope

11. issues related to slope will be addressed on a watershed scale

future condition of the social domain

12. opportunities for local economic development of sustainable extractive industries will exist

13. viewsheds will be maintained

14. the amount of open space will be increased within the watershed

15. the watershed region will be managed under the auspices of regional and multi-jurisdictional planning efforts that include participation from a broad range of stakeholders, resource managers and public officials

16. development and population growth will occur under a comprehensive understanding of socio-economic needs, the importance of high quality habitat and the needs of the community for the long-term

17. recreational opportunities will be expanded under a system more sensitive to diverse public needs, balanced with needs to conserve resources, maintain wildlife habitat, viewshed, watershed





recommendations

The recommendations that follow are provided as broad-brush strategies to achieve planning or management success based upon the information gathered for this assessment and the analyses performed on those data. Specifically they describe options for meeting goals developed through the desired future condition. Recommendations are presented under headings of the three primary domains addressed in the landscape assessment.

Photograph 30: The management of shared resources within the watershed requires that managers and stakeholders understand the complex interrelationships among ecological systems and that opportunities for multi-jurisdictional and collaborative management are developed and implemented. The US Air Force Academy is clearly a part of a complex mosaic of often conflicting land uses and public desires. The Peregrine Subdivision is located immediately south of the US Air Force Academy.

biological domain

vegetation

Goal 1: *fundamental structures and ecological processes will be re-established and maintained across landscape*

Strategy 1A: Conduct comprehensive fire history study of the south-central Front Range including the Rampart Range and Black Forest

Discussion: In order to make ecologically sound management decisions regarding forest health, a more accurate historic condition must be developed. Proposed here is a study similar to those conducted in the Upper South Platte Watershed, Boulder County and elsewhere in the Rocky Mountain west. Profound



differences between mean fire intervals based upon precipitation, soils, aspect etc. require additional on the ground, landscape specific work to accurately determine forest management strategies to restore the functioning of these ecological systems.

Strategy 1B: Encourage that USFS RIS (Resource Inventory System) databases are completed for National Forest lands within watershed and that analogous studies be conducted on state and private lands within watershed.

Discussion: Similar to the lack of local fire history information, incomplete stand data impact the ability of regional land managers and stakeholders to make informed management decisions regarding watershed forests. Updating these data on even scales across the watershed will move management efforts forward to facilitate multi-jurisdictional and ecological management efforts.

Strategy 1C: Establish regional forest management plan. Using information gathered from the above studies, create a regional forest management plan that implements ecological management goals across all scales of management (site, local and regional). This plan will include suggested openings, patch size and mosaic structure and where spatially these might occur.

Discussion: A regional forest management plan will ensure that efforts to restore forest health occur on a landscape scale. This is important for regional fire mitigation, soil loss prevention and other related efforts. Without regional coordination, localized efforts will be marginalized given the scale on which many of these ecological processes function. This is particularly true for fire mitigation efforts that may be ineffective if thinned stands remain adjacent to fuel loads in dense stands, untreated due to land ownership or jurisdiction issues.

Goal 2: *plant habitat will be protected and restored*

Strategy 2A: Identify existing and potential habitat, and define conservation targets based upon viability specifications.

Discussion: Given the complexity of plant habitat conservation and rehabilitation, it is recommended that targets be developed using viability specifications as a foundation so that appropriate measures of success can also be developed. This approach will help ensure that progress is recognized over time and that communities of plants are conserved while achieving other management objectives including wildlife habitat protection, open space designation, hydrologic regime restoration and enhancing visual quality.



Goal 3: *plant species composition and populations will be maintained*

Strategy 3A: Inventory existing species and prioritize conservation based upon community types and landscape scale ecological processes.

Discussion: The maintenance of species composition and populations requires an enhanced understanding of existing populations, ecological processes required for their persistence and how these populations interact on a landscape scale.

Goal 4: *weeds will be controlled and if possible eradicated to mitigate potential impacts to native systems and habitats*

Strategy 4A: Continue to build upon existing weed inventory efforts to establish a comprehensive understanding of where weeds currently exist, the composition and structure of these populations and vectors that determine distributions patterns.

Discussion: Weeds are increasingly a critical management issue given their ability to negatively impact other systems, even on coarse scales. Existing mapping efforts have been effective at identifying and recording the location of the most high profile populations (particularly those along roadways) but additional efforts will be required to ensure that all known populations are mapped so that control treatments can be developed.

Strategy 4B: Develop community-based plan to manage weeds and invasive plant populations in watershed.

Discussion: Noxious weeds are another good example of a management issue that occurs across jurisdictional lines. Given the high percentage of private property in the watershed, a collaborative approach to weed management that effectively engages landowners and resource managers in a collaborative environment may be the only way in which the spread of weeds can be controlled on a landscape scale.

wildlife

Goal 5: *wildlife habitat will be protected and restored*

Strategy 5A: Identify and prioritize regional habitat of critical importance including mega-fauna.

Discussion: Existing habitat within the watershed is appropriately diverse supporting a multitude of animal fauna; however, this habitat is under increasing pres-



sure from development and potentially incompatible land uses. Identifying and prioritizing habitat on a landscape scale provides another foundation upon which other planning efforts can be built or measured to ensure that long-range planning goals are met.

Strategy 5B: Develop a corollary protection plan to ensure that development (residential, commercial, recreational and transportation) occurs in ways that minimizes impacts to habitat.

Discussion: A protection plan will ensure that habitat is protected in a way that minimizes fragmentation, provides adequate tools so that multiple management objectives can be achieved simultaneously and to guarantees long-term viability of regional populations.

Strategy 5C: Coordinate protection with open space acquisition efforts (see Goal 14) to leverage success from both goals.

Discussion: Coordinating habitat protection and open space acquisition can lead to more strategic, politically expedient and sustainable outcomes for both efforts. Important to this strategy is the understanding and thoughtful consideration of compatible uses. This will require additional knowledge about the natural history or targeted species or systems and how different types of recreation affect habitat or species (at all life stages).

Goal 6: *wildlife species composition and populations will be maintained or increased*

Strategy 6A: Conserve or re-establish animal fauna to all community types in watershed (forest, shrubland and grassland).

Discussion: Reintroduction of species into areas where they have been extirpated is a controversial concept that requires thorough evaluation before implementation. This strategy merely notes options that may have larger benefits on the landscape. In forested areas this might include re-introducing top carnivores into the system; in grassland communities, this might include reintroducing some of the larger ungulates (including bison and antelope) that may also be integral to reaching other management goals.

Goal 7: *movement corridors and linkages will be established to encourage movement among populations and genetic diversity*

Strategy 7A: Identify current and potential corridors and linkages to conserve or establish regional methods of movement to ensure long-term viability of populations and appropriate home ranges.



Discussion: As noted in this assessment, there are several isolated populations of animal fauna that would benefit from the establishment of movement corridors to ensure that the populations remain healthy in the short-term and genetically diverse in the long-term (e.g. the bighorn sheep population at Queen’s Quarry).

rare and / or imperiled plants and animals

Goal 8: *enhanced efforts will be made to restore imperiled populations or protect critical habitat*

Strategy 8A: Using CNHP and CDOW data for the region, prioritize and codify protection or restoration of regional endemic species or those regarded as rare or imperiled.

Discussion: Existing information from both organization is useful in the prioritization and protection of these significant resources. These efforts can also be of use to other planning or management efforts as success in protection can potentially resolve, in part, other regulatory issues (this is particularly true in the case of federally protected species where listing is accompanied by varying types of restrictions).

physical domain

soils

Goal 9: *efforts to mitigate against soil loss and associated impacts on landscape scale will be made*

Strategy 9A: Develop landscape scale model of soil loss for the watershed that can assist regional resource managers in the conservation of soil, water, vegetation and other resources.

Discussion: Though this assessment addressed the issue of soil erodibility through the use of erosion hazard ratings, a comprehensive soil loss model that accounts for variations in slope, ground cover, soil erosion susceptibility, precipitation and other factors would give resource managers additional tools in designing appropriate management strategies. Existing methods (e.g. the ULSE and MSLE) may prove to be inadequate in developing this model (as concluded in this report), suggesting that additional research be conducted. This effort is important given the cumulative impacts of erosion and soil loss from sources as remote as recreation and land use changes to downstream systems and users.



Strategy 9B: Develop strategic plan to control or slow soil loss across landscape.

Discussion: As one of the largest impediments to management success, a systematic approach to controlling soil loss is recommended. This includes erosion patterns associated with hydrologic regimes, open areas, private lands, roadways, recreation areas. Such efforts support other goals of minimizing flood damage, maintaining or restoring hydrologic regimes, minimizing impacts to habitat and property and the maintenance of viewsheds.

hydrology

Goal 10: *fundamental hydrologic regimes and processes will be re-established on watershed scale*

Strategy 10A: Restore ecological systems associated with functioning hydrologic regimes, including vegetative structure and composition, streamflows, and animal fauna.

Discussion: The region's hydrology deviates significantly from the historic condition. Reestablishing fundamental ecological processes supports reaching other management objectives including the mitigation of catastrophic flooding, conservation of critical habitat, restoration of natural vegetative regimes, particularly riparian communities, providing additional recreational opportunities and enhancing visual amenities afforded by healthy stream reaches.

slope

Goal 11: *issues related to slope will be addressed on a watershed scale*

Strategy 11A: Develop finer scale slope data to enhance landscape planning.

Discussion: While existing regional slope data are useful for identifying areas where slope is of a higher, yet still general management issue, well developed slope data will be useful in reaching other management objectives including soil loss modeling, restoration of hydrologic regimes, habitat prioritization, land use determination and the development of appropriate recreation opportunities.



social domain

Goal 12: *opportunities for local economic development of sustainable extractive industries will exist*

Strategy 12A: Conduct economic analyses to ascertain the viability of local timber mills to process and add value to small-diameter timber resulting from thinning efforts

Discussion: Currently, there are no local mills able to process or add value to small-diameter timber resulting from thinning efforts. While such a mill might be difficult to sustain over long periods of time, a major factor in the sustainability and profitability of thinning programs is transportation costs. Minimizing these costs by using local mills would greatly increase cost-benefit ratios, making thinning efforts more economically and socially viable.

Strategy 12B: Ascertain demand or need for local imber products including: chip board, fuel sources, house logs, landscape materials or furniture.

Discussion: As noted in the assessment text, Colorado is a net importer of wood products including, but not limited to, building materials, value-added timber (furniture) and fuel sources. It is conceivable that locally generated sources of timber from thinning or forest management efforts could be processed and utilized within the region reducing transportation costs, adding to local economies, providing markets for extracted timber and adding to revenue streams to ensure forest management activities are sustainable.

Goal 13: *viewsheds will be maintained*

Strategy 13A: Identify regional viewsheds or areas that constitute the region's visual amenities whether historic, contemporary or potential.

Discussion: Viewsheds are designed to represent those areas with significant natural aesthetic qualities. These qualities are often associated with natural features that engender a feeling of place, an important part of a region's identity. The Pikes Peak back-drop is clearly a good example of this. Not only does it provide a dramatic natural back-drop to Colorado Springs and much of the region, it also is an important component of the region's identity. Other portions of the watershed are equally as important. This strategy is designed to identify historic and contemporary visual amenities and to identify those that may no longer exist but could



perhaps be restored (some of the rock quarries may be restoration candidates from an aesthetic perspective).

Goal 14: *the amount of open space will be increased within the watershed*

Strategy 14A: Identify and prioritize the acquisition and protection of open space across watershed landscape.

Discussion: Typically, the acquisition of open space relies on opportunism (having funds to purchase open space as it becomes available). Given other goals implicit within the desired future condition, a more strategic approach may be desirable. Through a public, collaborative process a prioritization for open space acquisition can be developed that takes into account the broad range of locally defined conservation goals including: habitat, community separators, viewshed, recreation and agricultural uses.

Strategy 14B: Engage local government, non-profit organizations and land owners in regional open space plan.

Discussion: Open space acquisition seems to work most efficiently in an arena of public / private partnerships. To work most efficiently on a landscape scale an approach that relies on the efforts of a diverse group of stakeholders including local government (municipal and county), local non-government organizations (including land trusts, open space advocacy groups, local chapters of conservation organizations) and landowners (including members of the ranching and agricultural communities as well as landowners from urbanized areas) can work to find areas of commonality, reduce the burden on a few to provide open space for the regional community.

Goal 15: *the watershed region will be managed under the auspices of regional and multi-jurisdictional planning efforts that includes participation from a broad range of stakeholders, resource managers and public officials*

Strategy 15A: Establish network of watershed councils based upon 6th level watershed boundaries used for watershed prioritization in this assessment.

Discussion: Watershed councils comprised of representatives from the broad range of regional stakeholders can be an effective decision-making, advisory, or monitoring body, helping to facilitate accomplishing landscape scale goals. Watershed councils engender better understanding of essential ecological processes



within the watershed, provide a basis for environmental identity of places where stakeholders live, work or recreate.

Strategy 15B: Explore options for binding multi-jurisdictional management opportunities among regulatory bodies or resource managers.

Discussion: Management agreements between the DoD, USFS, USFWS, BLM, DNR/CDOW, SLB, El Paso County and municipal governments may be useful to codify ecological management efforts across jurisdictional boundaries. Management agreements might be a useful tool to ensure that essential ecological process can be restored across landscape scales and that contradictory or exclusionary regional planning efforts can be avoided.

Goal 16: *development and population growth will occur under a comprehensive understanding of socio-economic needs, the importance of high quality habitat and the needs of the community for the long-term*

Strategy 16A: Utilize sincere, collaborative approaches to regional planning to ensure that diverse needs are met, that sustainability is achieved, and that buy-in occurs.

Discussion: Understanding and dealing with impacts associated with growth and development is difficult on any scale, let alone a watershed scale. This strategy revolves around the systematic attempt to address community needs by building planning processes that engage stakeholders in ways that long-term needs are accounted for while providing avenues for real citizen involvement. This strategy might benefit from using Strategy 15A as a foundation or departure point.

Goal 17: *recreational opportunities will be expanded under a system more sensitive to diverse public needs, balanced with needs to conserve resources, maintain wildlife habitat, viewshed and watershed*

Strategy 17A: Assess current recreational opportunities for environmental appropriateness and develop needs assessment for additional opportunities that address potential for impacts and needs over landscape.

Discussion: While it is clear that some recreation is already seriously affecting the landscape, it is unclear how this pattern of use is distributed throughout the region. Environmental appropriateness assumes the understanding of whether a given activity in a given place is appropriate given the local environmental constraints. The accompanying needs assessment will address lack of opportunities in some areas, issues of



access, what the community needs or expects from recreational opportunities and how these needs can be better balanced with goals to maintain or re-establish functional ecological processes.

Strategy 17B: Engage the larger recreation community in the development of planning processes that collectively mitigate potential impacts to shared resources.

Discussion: Clearly the enforcement of existing regulations is difficult for resource strapped management agencies. Engaging the broad spectrum of recreationists will establish new channels of accountability and ownership of the results of regional planning processes. Without public buy-in from these groups, it is unlikely that the impacts of recreation can be mitigated in the watershed.





notes

1 – Forest Zones: Percentage of project area falling in one of the Forest Zones were developed using the CDNR/CDOW Basinwide Vegetation Map data layer (CDOW 1999a). Using information contained in the “BLM Name” field, non-forest features were removed from the dataset, including: aspen, mountain shrub mix, riparian, sagebrush community, grasslands and non-vegetation related features. The remaining features in the dataset were aggregated to represent Forest Zones as follows:

Photograph 31: Illegal recreation, including illegal shooting ranges, within the watershed, has several unintended consequences including: soil loss, wildlife disturbance, refuse, resource destruction (several trees were destroyed by gunfire in the area where this photo was taken), noise and property

<i>blm_name</i>	<i>zone</i>
Englemann Spruce/Fir Mix	Englemann spruce / fir
Gambel Oak	Oak-mountain mahogany
Pinon-juniper	Pinon-juniper
Ponderosa Pine	Ponderosa pine
Ponderosa Pine/Aspen Mix	Ponderosa pine
Ponderosa Pine/Gambel Oak	Ponderosa pine

2 – CNHP Data Precision: Given data precision methods used by the Colorado Natural Heritage Program, it is difficult to fully estimate presence and absence within the watershed. Included in this section of the assessment were all CNHP Element Occurrence Records that intersected the watershed boundary with respect to precision (not the polygon centroid); therefore, some species may not have actually been observed within the watershed, but certainly within adjacent to the

watershed or in the region. As most species have complex home ranges that usually do not correspond to watershed boundaries (particularly mammalian and avian species), this summary provides a landscape (and thus appropriate) overview of the biologically significant species and natural communities known from the region.





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Photograph 32: The US Air Force Academy is managed under a complex set of guidelines that balances training future military leaders with management of natural resources for the public good.

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Photograph 33: The western edge of the Monument Creek Watershed is bounded by the Rampart Range Road, with views of Pikes Peak to the south.





a p p e n d i c e s

Photograph 34: From the North Beaver Creek drainage in the Rampart Range, the view is dominated by the Palmer Divide and the Colorado high plains.



Appendix 1: Conversions

metric to English units

1 meter = 3.2808 feet
1 kilometer = 0.6214 miles
1 hectare = 2.4711 acres

English to metric units

1 foot = 0.3048 meters
1 mile = 1.6093 kilometers
1 acre = 0.4047 hectares

slope, degrees to percent

$\text{slope [percent]} = \tan(\text{slope [degrees]}) * 100$

slope, percent to degrees

$\text{slope [degrees]} = \text{inv tan} (\text{slope [percent]}/100)$



Appendix 2: Anderson Land Use Codes

- 1 Urban or built-up land
 - 11 Residential
 - 12 Commercial and services
 - 13 Industrial
 - 14 Transportation, communication, utilities
 - 15 Industrial and commercial complexes
 - 16 Mixed urban or built-up land
 - 17 Other urban or built-up land

- 2 Agricultural land
 - 21 Cropland and pasture
 - 22 Orchards, groves, vineyards, nurseries, and ornamental horticultural
 - 23 Confined feeding operations
 - 24 Other agricultural land

- 3 Rangeland
 - 31 Herbaceous rangeland
 - 32 Shrub and brush rangeland
 - 33 Mixed rangeland

- 4 Forest land
 - 41 Deciduous forest land
 - 42 Evergreen forest land
 - 43 Mixed forest land

- 5 Water
 - 51 Streams and canals
 - 52 Lakes
 - 53 Reservoirs
 - 54 Bays and estuaries

- 6 Wetland
 - 61 Forested wetland
 - 62 Nonforested wetland

- 7 Barren land
 - 71 Dry salt flats
 - 72 Beaches
 - 73 Sandy areas not beaches
 - 74 Bare exposed rock
 - 75 Strip mines, quarries, gravel pits
 - 76 Transitional areas

- 8 Tundra
 - 81 Shrub and brush tundra
 - 82 Herbaceous tundra
 - 83 Bare ground
 - 84 Wet tundra
 - 85 Mixed tundra

- 9 Perennial snow or ice
 - 91 Perennial snowfields
 - 92 Glaciers



Appendix 3: Stakeholder Interview Summaries

Glen Eagle area land owner

Open space – Trails/ open space board. “North Gate Open Space” Smith Creek proposed as open space: generated much community support.

Flooding – Smith CR (near mining museum). Developer donated 90 ac to county. Storm holding ponds (2). Both breached (?). Kids grew up in open space, want to keep it that way; may work. GlenEagle has own water district.

Growth – Parks/rec district ballot measure: Northgate Rd to Palmer Divide to CO 83. Approving new developments, out of state/country developers. Wanted to develop business park/ development north of Northgate. Turned down (based on traffic); economic development rampant (Fed-Ex to move).

Roads – Voyager Parkway (four lane to dump into Northgate). Would like to preserve open space and trail linkages to Santa Fe (new) trail. Rush Broshous has population #s 488-0074. Has spoken to major landowners Dick Leech on Black Squirrel Cr. Plans to pass land on to children (son is developer).

county planner

Open space development – No open space demanded as part of regulations. Few big places left: most places already platted. Shifting from unincorporated to cities. Today typically unincorporated but changing. Forest Lakes, clustered development and artificial lakes (north of Academy). Lower density east of freeway, 0.5, 2, 5 ac lots. Higher density along freeway.

Drainage – Drainage Basin master plans. Regional detention ponds. Encouraging impervious surface. “prudent line approach.” Get around floodplain requirements by setting back further. Monument – tends toward onsite.

Mining – Current mines grandfathered; reclamation has begun, no more mines.

Trails – Monument Cr – Palmer Lake to S. Colorado Springs. Monument Cr: historically intermittent. Widefield aquifer, south of Colorado Springs. Upper Black Squirrel aquifer -> center pivot irrigation. Big action = surface, Denver basin. (Fort Collins to Northern Colorado Springs). 5ac lots drill wells and development pattern. Aquifer not recharging, ancient water. City of Colorado Springs not using ground water. Water use controlling factor but not limiting.

Other – County allows urban growth. Special districts: own government. School districts – 17 in county (most in state) 2 in Monument Basin Lewis. Palmer (north) Academy district 20 (?) No concurrency required between development and schools. El Paso – no open space tax; Colorado Springs does. “lifeline” = I25, 6 lanes eventually; Powers Blvd development, Baptist Rd.



director of local non-profit

drainage (development) – Hard surface development = get water out of development ASAP. \$100,000 million damage from flood, damage to trails, sedimentation. Creek side overlay ordinance inc. setback. Currently in public process. 300 ft. 90% permeable.

open space – open space sales tax “TOPs” trails/open space/ parks.

growth – Directed into Fountain Creek, Monument Creek. Large corporations actively recruited, Oracle, Intel. Development of grassroots support for projects = trails, open space.

building – 8 houses condemned, apartment in upper part of household, instability; hillside overlay = developers complain. 31st street drainage out of Garden of the Gods Rd. Balance development with protection creek protection, detention ponds

habitat protection

quality of life “western character”

preserve riparian corridors

no impacts to people downstream

protect resources (trails, etc.)

county resource manager

mistletoe – Mistletoe kills trees then beetles come in. Dry conditions – fire hazard expected to be high. Landowners resistant to management, want to keep trees.

land owner from the Black Forest area

stewardship of natural resources – people moving into forest do not understand ecology

developmental impacts – indiscriminate tree removal

noxious weeds – need to promote public awareness of invading weeds and their impacts

protection of rare and endangered plants

active v. passive recreation – feels too many residential users seek only active recreation at the expense of other values

local business owner

transportation – Lack of planning and changes in plan. Lack of good NS and EW transportation system. Fragmentation caused by lack of public funds for roads.

impacts of PMJM on sites available for building – may have serious economic impacts in the future

lack of adequate planning – not based upon market conditions

local business owner

forest health – poor forest health; forest needs to be thinned and burned; insects on rise

forest industry – small diameter wood: possible market for lodgepole pine; market not good for other conifers; poor market for small diameter firewood <8”; possible market for smallwood: chip and haul to paper

plant, wafer board plant. Need some type of industry that utilizes wood biomass, i.e. chips (Canon City plant uses wood); strong firewood market in region. Burn bans would hurt firewood industry. Haul distances are too high as well. Continue research on potential markets.

wildlife – poor habitat on Rampart Range: too many trees, too little forage; would like to see more opening (created by cutting or burning); as hunter he feels wildlife attracted to opening of all kinds (logging, fire, windthrow, etc.). Can leave brush piles for use by rabbits, rodents, etc.

recreation – Viewsheds being lost to overgrowth of trees. Re-create vistas that are overgrown. ATV use is too much in the area: intrusive to wildlife and people. He feels they should be limited to certain areas. ATVs cause excessive erosion. He feels they should fix the damage they cause. Safety problem for logging trucks coming out of forests. Believes they should leave the resource for future generations in better condition.

fire – Buffalo Creek, for example: fire went around thinned forest, destroyed (??). Thinned areas also resistant to mountain pine beetle; strong advocate for managed forest by thinning and burning to mimic historic fire behavior; if we don't use forest products, trees die and are wasted

history – quartz mining occurred on Rampart (1950s): Ice Cave Creek. Logging (Charlie Hites, horse logger) was common in area. Forest product use for railroads "hi-graded" forest, removing the best trees adding to forest health problems. Logging ended ca. 1940s when railroads died.

management recommendations – Prioritize the forest health needs, involve all landowners in jurisdiction. Start increased forest activities: there are no planned timber sales on Forest Service land for this year! No funding; he feels EAs and other studies cost too much. Has approached Congressman [sic] Ben Campbell to request funding: got negative response. We should look at cutting firebreaks to break up fuels continuity. Forest Service asks way too much for previous timber sales: even the minimum bid is too high

dumping – He thinks it will get worse. Dump station close in Woodland Park = more dumping

anti-logging groups – Earth First!, Friends of the Ancient Forest: does not believe in what they stand for. They are adding to the overall forest health decline and causes increased and elevated forest project costs. Too much paperwork goes into each forest project, increasing costs.

resident, recreationist

trail use (for cycling) – all clients use Rampart Reservoir, 13 mile loop, used for 15 years. Occasionally use Shuberth, no motorized: would like to keep it that way. Rampart only place for folks to go. Dogs OK at Rampart (??). Trails in good shape, trees are cleared quickly: easy for tourists to avoid getting lost. Farish area: would like to see more public use. More trails would be beneficial: reduce pressure on Rampart. Falcon Trail at AFA: public no longer has access due to Peregrine [housing development?]. Against fees. Firewood cutting / burning to protect forest from fire (?). ATV conflicts minimal: ATV damage prevalent in other areas; ATVs need to be limited in forest: high damage.



municipal official

wildlife – no fencing around city due to wildlife movement. Woodland Park doesn't not allow fencing; wants to see fencing restrictions enforced elsewhere.

forest pests – city is taking action to prevent forest pests, including mountain pine beetle. Concerned with forests and weeds migrating into city from adjacent lands (USFS)

noxious weeds – Same issue as forest pests; weed ordinance enforced in city.

ORV use – city does not want ATVs allowed on west face or rim: noise and environmental damage

city planner

fire – fire hazard in urban / wildland interface recognized by chief of fire (Mike Smith) and John Hanlon: not many others

Schubarth Road = underutilized

recreation - #1 concern = unmaintained, undesigned trails; Tubing Hill is example of informal but high use and no maintenance. Disregard for the environment is obvious throughout area. Illegal dumping is prevalent on Rampart Road and side roads. Undesignated camping. Obvious lack of resources to maintain area and not enough law enforcement.

partnerships – Intergovernmental partnerships key to improving area

wildlife – educate folks on urban wildlife

access – need for public, legal access from city to forest (USFS)

youth camp manager

forest health – Not happy with Ormes Peak clearcut. Area cut for sheep habitat but the USFS never burned it or completed clean-up. Need additional coordination with beetle control. Concerned with high fuel loads. Unattended campfires in forest surrounding area: lack of law enforcement.

transportation - Road maintenance did not improve or increase with increased use at Rampart Recreation Area. Loy Creek Road is unsafe: just outside project area. Unauthorized Jeep roads and ATV use: no law enforcement. Favors paving Rampart Range Road if it is maintained and speed limit is enforced.

vandalism / crime - Trash dumping, bodies (!!) dumped, parties, vehicle vandalism, signs vandalized, etc.: no law enforcement: "If you ever leave a vehicle on the Rampart Range Road, there is a 50/50 chance it will be damaged." Target shooting not enforced: shooting range is total mess. Lack of follow-up by law enforcement when crime is reported. Gate to Eagle Lake has been vandalized several times.

signage / communication – Cooperated with USFS to place road signs at Eagle Lake. No communication with FS at night, then they don't respond. Would like to see more direct communication: residents like Lynn are eyes and ears of FS. Communication should be coordinated.

trails permitting – Likes Rampart the way it is. No more designated trails. Outfitter process getting complicated; would like to see it simpli-

fied. Other groups don't get permits, although required: too expensive and cumbersome.

recreation advocate

development – “We need to think about what we are doing; we need to protect environmental integrity.” Residential development requires some type of environmental protection. Concern about groundwater depletion. “We can't shut off growth” but there needs to be caution when accommodating new residents. Concern about industrial development and impacts to environment.

recreation [interviewee relates rec to development] – in light of growth, it will be important that groups work together. New residents need to be “managed” yet still be fair to all users of recreational opportunities. People need to be able to see beyond personal perspective, to work on compromises. Opportunities need to be multi-use to avoid additional specialized trails (motorized only; bike only, etc.). Trail sustainability is possible but facilities will need proper design and maintenance. Joint efforts between all trail user groups has been a good exercise. Planning process needs time: “consensus is a wonderful thing.” AFA, trail questionnaire: what were results of that process and what were they used for? Interviewee mentioned that his group volunteered to repair trails in the stable area (AFA) but that the work required an EA, alienating group (which is grassroots and action oriented).

open space – we need to secure open space corridors in the Peregrine area which is nearly built out.

director of local non-profit

growth and development – Top concern due to impacts to ecology and way of life. Increasing density, how we spread ourselves out on the landscape. Current climate is opportunity driven without regard for consequences (impact on open space, natural values). Interviewee hopes we have the foresight to conserve some of the spaces and ecological processes. Concern is highlighted by loss of wetlands, riparian corridors and drainageways.

recreation – There is a lack of National Forest access along mountain backdrop due to a buffer of private land. Exceptions: Palmer Lake, perhaps area north of AFA. People are forced to drive to NF to access recreational opportunities. As a result, use is concentrated. Situation reflects development pattern along southern Front Range.

“Los Angeles Basin effect” – Lack of community separators (except for DOD installations). Communities growing together: no “green print”

regional planning – [related to growth] lack of regional coordination among plans to better understand relationships. Need to “overlay” plans to understand how they relate using a common base, to see the larger pattern rather than interest group based approaches that focus on one, specific project. This type of planning leads to thinking out of context when what's needed is “larger scale reflection.” We need to be more thoughtful about where and how development occurs.

water – Cumulative impact on downstream users (Monument Cr @



Fountain Cr and below): soil loss, bank cutting and slope failure are big issues. There is a new realization that upstream users affect downstream inhabitants. Increased water use and hard surface development has increased water level in Monument Cr leading to problems in Fountain Cr. These problems are not being effectively addressed. What are consequences of rampant water flow? Loss of native vegetation, alteration of hydrologic regime, structures. What's needed? Diversion structures? Reveg projects? Need unified plan and approach: water is a regional issue.

fire – Maintenance of upslope area of watershed (Monument Cr) due to huge fire concern based on accumulation of fuels: dead standing (beetle kill) timber. “Our day is coming.” Other associated issues: run-off and soil loss.

“community hostility” – Very conservative community. Interviewee is concerned about inability to see need to conserve natural resources beyond realm of their own land (cites PMJM). People tend not to value what is rare or recognizing good stewardship which supports rare species. Community needs ethic of appreciation rather than personal gain. Big education issue.

transportation – Has seen I-25 completely shut down and all traffic diverted to CO 83. There is an isolation in El Paso County: access to north very limited. Can't get in or out. No plans for public transportation but we need better transportation planning and a better understanding of how transportation affects the environment.

local land owner, rancher

wildlife habitat – Would like to see forest managed for wildlife habitat.

private property – Increased impacts from adjacent public use of land: trash dumping, traffic in area, high speed on Rampart Range Rd. Vandalism has occurred: fences cut, cattle shot; elk poaching on property (has ~500 acres)

would like to see – Forest Service grazing permits, more respect for private property, conservation easement on property

local wildlife advocate

big horn sheep – Overall wildlife concerns, particularly loss of habitat due to development. Wildlife need to be monitored. Trespassing a problem at Queen's Quarry. Hikers in area disturb sheep, interfere with behavior and health of herd.

Mined Land Reclamation Board – Was member of committee. Was unaware that sheep were on quarry. Has since worked with the CDOW to improve sheep habitat.



Appendix 4: Planning Issues and Opportunities

Landscape Assessment Field Tour Summary of Planning Issues and Opportunities

8 September 1999

USFS

- urban encroachment
- tourism / recreation
- soils
- visual amenities
- education opportunities

USAFA (slide introduction)

- growth
- species richness
- military mission
- geologic and archaeological sites
- front range back-drop
- recreation
- “watchable” wildlife
- BASH
- forest health
- noxious weeds

Queen’s Quarry

- bighorn sheep habitat
- lack connection to regional wildlife corridors
- smoke / multi-jurisdictional agreements
- quarry may be developed

Fountain Creek watershed

- Woodland Park growth
- hard surface development
- new building restrictions
- erosion / soil loss
- forest history
- urban / wildland interface
- catastrophic fire potential high
- pine beetle
- homeowner reluctance to cut trees
- pre-conceptions of forests / forest health

Eagle Lake

- road safety
- crime
- pine beetle



road maintenance
fire fuel load
not prepared to fight large fire event
low impact outdoors skills taught
extraneous fencing

Rampart Reservoir

public access
recreation
vandalism
concessionaire
increased visitor use
benzene from motors

9 September 1999

Manitou Experimental Forest

acid rain
ohv use
concessionaires
stream sedimentation
beaver
trout habitat
mistletoe
pine beetle
red zone
timber / lumber use and markets
eliminating "fuel ladder"

Farish Property

federal / private / public jurisdictional and access issues
cattle trespass
elk refuge
poaching
private inholdings
aspen decline
fire / forest management
recreation trespass
weed encroachment
exurban development and access

Mount Herman Road

illegal ohv use
serious erosion / soil loss

Monument Fire Center

weeds



altered hydrology (during nursery years): no PMJM

Fox Run County Park

experimental thinning project: forest health and fuel load
reduction
controlled burn needed
education opportunity: defensible space and forest health





Appendix 5: Field Notes

Field notes recorded during visits to the Academy and surrounding areas on 23 September and 27 October 2000.

23 September 2000: USAFA Landscape Assessment - Joe Stevens, Georgia Doyle and Donna Sharrock

Tour of the AFA campus to map oak occurrences. Quads: Black Forest, Monument, Palmer Lake, Cascade and Pikeview. Higher elevation communities are PIPO, PIPU, PSME, QUGA occurs with all of these. Appears that higher you go QUGA becomes a superficial component of the understory and is restricted mostly to south facing slopes. North facing slopes, particularly at higher elevations are almost exclusively PIPO, PIPU and PSME.

At the lower elevations on the AFA, QUGA mixes with PIPO or occurs in pure stands and is associated with CEMO and RHTR. These communities also appear to be variable with respect to slope and aspect. The more southerly slopes tend to be dominated by pure oak or oak mixed with CEMO and / or RHTR.

East of Monument Creek, oak communities occur as an ecotone community between the prairie grasslands of the Monument Creek valley up the woodlands of the Black Forest.

On the AFA, portions of the mid elevation oak communities have been converted to base facilities and irrigated landscape.

On the western edges of the Black Forest, many areas of QUGA have been subdivided and are in private homes.

AFA Landscape Assessment, south of Academy

The oak tallgrass community appears as a mosaic of patches including RHTR, QUGA, PIPO and ANGE, low grasses. Found mainly on the east-west trending ridges and the east facing slopes in the area, from Colorado Springs southern boundary, south along CO Highway 115. Narrow band along foothills. Big blue / little blue occur interspersed with other species, amongst the oaks: yucca, Stipa robust, SCSC, PIED, SANO.

Appears to extend down at least to Table Mountain area. However, along its range many occurrences are degraded, modified or converted. Grazing invasion by mullein and other exotics or seeding of common pasture grasses has impacted much of the community.

Occurs mostly in patchy, open oak woodlands. Never found in the denser oak woodlands or oak forests. Southern limit is the Fremont County line. Really start to notice it in the area between Table Mountain and Aiken Canyon.



27 October 2000: USAFA Landscape Assessment - Site visit to Jacks Valley

- meet Jim McDermott at 900a
- travel to Jacks Valley and meadows at NW end of property (firing range gate)

Area is dominated by mixed-grass meadows on lower slopes and valleys with patchy PIPO-QUGA woodlands above (north facing slopes may be less dense in understory than south facing slopes).

Plant list at lower slope meadow:

Stipa comata
Bouteloua gracilis
Schizachyrium scoparium
Andropogon garardii
Poa pratense
Stipa robusta (?)
Calamovilfa longifolia
Aristida purpurea
Eriogonum effusum
Artemisia frigida
Bromus inermis
Bromus tectorum
Bromus japonicus
Muhlenbergia montanus
mullein sp.

These meadows occur as openings in the PIPO woodland or as meadows extending down the lower slope and across valley bottoms. They are mixed grass character with several tall, mid and short species present. Sometimes small patches of CEMO, RHTR or QUGA shrubs are also present (not often).

Hillsides above meadows

These areas are a woodland of PIPO with a densely patchy understory of QUGA and other shrubby species with some grasses included.

Shrub component is ~95% QUGA, 49% CEMO and 1% RHTR / YUGL.

Grasses in the understory include: MUMO, STSC, SCSC, KOMA and possibly (likely!) *Carex inops* but unable to get positive id. Only identifiable forb at this time is *Linaria vulgaris*, of which there appears to be a lot (widespread).

Travel along North Boundary Rd

North of AFA boundary from hilltop vantage point: community appears to be QUGA-CEMO on south facing slopes with broken QUGA grassland in the valley bottoms.



North facing slopes have PIPO-QUGA woodlands.

At the foot of the mountain slope, narrow bands of QUGA-CEMO extend up toward forest edges. Montane forest of PSME and PIPU extend down these slopes on the north facing sides and in the valleys.