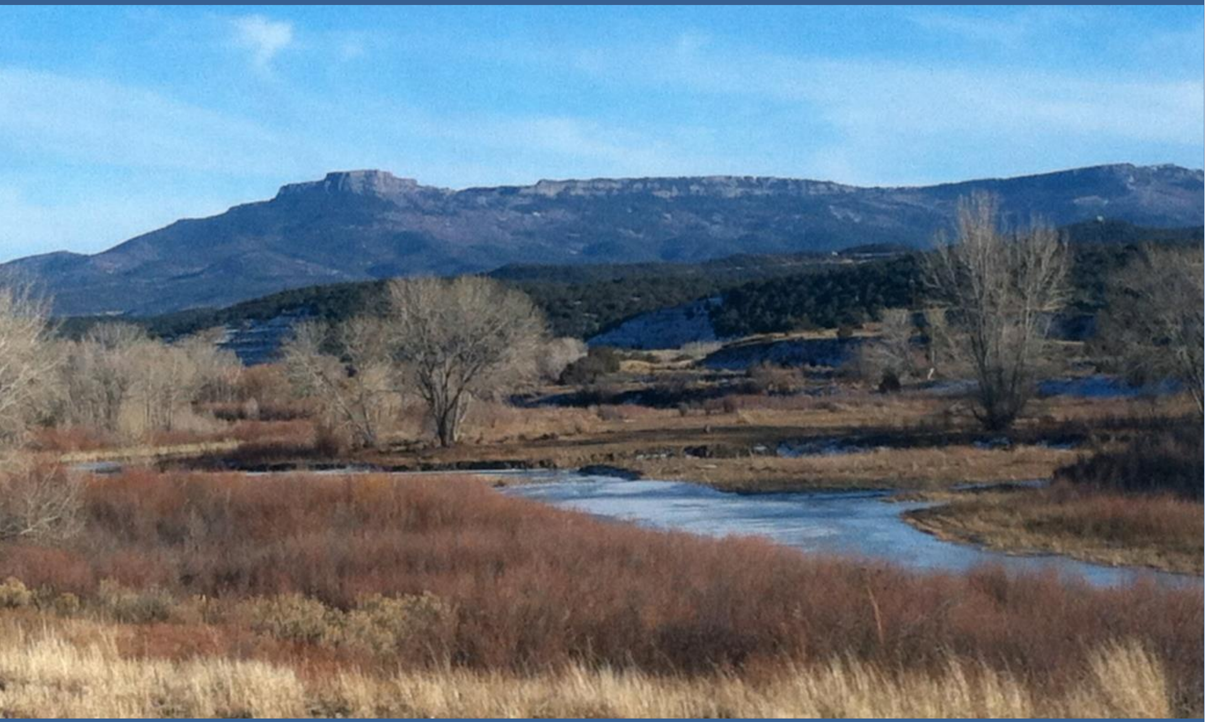
Purgatoire River Watershed Plan



Purgatoire Watershed Partnership

2014

Trinidad, Colorado

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Acronyms

AFY – Acre Foot per Year
AET- Actual Evapotranspiration
ARCA- Arkansas River Compact Administration
BLM – Bureau of Land Management
BMP – Best Management Practice
BOR- Bureau of Reclamation
CBM- Coal Bed Methane
CFS – Cubic Feet per Second
CDOW- Colorado Division of Wildlife
CDPS- Colorado Discharge Permit System
CDPHE- Colorado Department of Public Health and the Environment
CNHP – Colorado Natural Heritage Program
COGCC- Colorado Oil and Gas Conservation Commission
CO-WRAP- Colorado Wildfire Risk Assessment Portal
CPW- Colorado Parks & Wildlife
CSFS- Colorado State Forest Service
CSU- Colorado State University
CRA- Common Resource Areas
CRB- Central Raton Basin
CRCC- Culebra Range Community Coalition
CWA- Colorado Watershed Assembly
CWCB – Colorado Water Conservation Board
CWMP- Cooperative Watershed Management Plan
DMR – Discharge Monthly Report
DAU- Data Analysis Unit
DNR- Department of Natural Resources
DRMS - Division of Reclamation, Mining and Safety
ET- Evapotranspiration
FEMA – Federal Emergency Management Agency
FMCRC – Fire Mountain Canal and Reservoir Company
FERC – Federal Energy Regulation Commission
GIS- Geographic Infomration System
GMU- Game Management Unit
gpd- Gallons per Day
gpm- Gallons per Minute
HFRA- Healthy Forests Restoration Act
HUC - Hydrologic Unit Code
in/yr- Inch(es) per Year
IPM- Integrated Pest Management
ISF – Instream Flow
M&I – Municipal and Industrial
M&E- Monitoring and Evaluation
Mg/L - Milligram per Liter
mgd- Million Gallons per Day
NCNA – Non-Consumptive Needs Assessment
NGO- Non-Governmental Organization
NOAA- National Oceanic and Atmospheric Association
NPDES- National Pollutant Discharge Elimination System
NPS – Non-Point Source Pollution
NRCS – Natural Resources Conservation Service
NWS- National Weather Station
PCA- Potential Conservation Areas
PCMS- Piñon Canyon Maneuver Site
PET- Potential Evapotranspiration
PWC- Parks & Wildlife Commission
PRWCD- Purgatoire River Water Conservancy District
PWP- Purgatoire Watershed Partnership
RCMAP – Reconfigured Channel Monitoring and Assessment Program
SDWA- Safe Drinking Water Act
SEO- State Engineers Office
SWSI - Statewide Water Supply Initiative
TDS – Total Dissolved Solids
TMDL – Total Maximum Daily Load
TNC- The Nature Conservancy
TSS – Total Suspended Solids
WBID – Water Body Identification
WEI- Wind Erodability Index
WFRR- Wild Fire Risk Reduction
WQCC – Water Quality Control Commission
WQCD – Water Quality Control Division
WRA- Wildfire Risk Assessment
WUI- Wildland- urban Interface
WWTP – Waste Water Treatment Plant
USACE – United States Army Corps of Engineers
USBOR – United States Bureau of Reclamation
USDA – United States Department of Agriculture
USEPA – United States Environmental Protection Agency
USFS – United States Forest Service
USGS – United States Geological Survey

Executive Summary

A. The Watershed

The Purgatoire River Watershed is located in southeastern Colorado and stretches from the New Mexico border northeast to the town of Las Animas, Colorado. Originating in the Culebra Range of the Sangre de Cristo Mountains, the Purgatoire River traverses 196 miles before it drains into the Arkansas River. The total area of the Purgatoire River Basin is 2,206,204 acres. The elevation of the Watershed averages 6,008 feet above sea level, with a maximum elevation of 13,962 feet and a minimum elevation of 4,321 feet.

The geographic boundary of this watershed plan is the Purgatoire River Watershed and is identified by the United States Geographical Survey (USGS) as a medium sub-basin of the Arkansas River with the Hydrological Unit Code (HUC) 11020010. The Purgatoire River drains an area of 3,449 square miles (8,930 km^2). The majority of the Watershed, 96.4 percent, is located in Colorado and the remaining 3.6 percent lies in New Mexico. The Purgatoire River Watershed is located within the geographically defined Arkansas River Basin and the western region of the Watershed is also situated—in part—over the geologic Central Raton Basin (CRB) formation.

River flows in the Purgatoire River are highly variable depending on the season and the location. Snowmelt from the headwaters largely contributes to the water supply in the basin area. The Trinidad Dam at Trinidad Lake State Park controls much of the river flows and therefore the flow regimes in the river are substantially different between the upstream and downstream reaches of the Dam. The Dam is used for both storage of irrigation water and flood control. The outlet gates at the Dam are shut outside of the irrigation season for storage, generally between mid-October and mid-April. Average flows into the reservoir are highest during the spring snowmelt runoff months of May and June. Major flooding also occurs during spring runoff when rapidly melting snow is augmented by rain or during summer torrential thunderstorms. The average annual precipitation in the Purgatoire Watershed ranges from 43 inches per year at the headwaters to 13 inches per year at the lower end of the Watershed. More often than not, water scarcity and climate change present great concern in the river basin. Drought in this area is a result of low precipitation, which has led to increased water supply shortfalls.

B. The Purgatoire Watershed Partnership

The Purgatoire Watershed Partnership (PWP) is a stakeholder watershed group comprised of local citizens who are compelled to address and rectify ongoing natural resource concerns within the Purgatoire River Watershed. The Spanish Peaks-Purgatoire River Conservation District is currently the fiscal sponsor for the PWP, providing the group with the support and guidance necessary to become a financially independent and sustainable entity. The Partnership is led by a Board of Directors and governed by established bylaws. The mission of the PWP is to actively maintain a watershed-wide stakeholder partnership aimed at the assessment, restoration, protection & improvement of all aspects regarding the Purgatoire River Watershed. Upon establishment of the PWP, a primary goal of the organization was to develop a watershed plan following the Environmental Protection Agency's *watershed approach*. This approach includes stakeholder involvement and management actions supported by sound science and appropriate technology.

A Water Quality Assessment (Section 4) was completed for the Purgatoire Watershed to address existing water quality studies, water quality standards, water quality assessment, water quality monitoring, permitted water discharges and source water protection areas. From the data compiled in the assessment, data gaps and water quality monitoring recommendations were determined. The assessment will guide the PWP in project designs and implementation in the future.

Water scarcity, water related activity and various stakeholder interests generated several issues of concern throughout the Watershed, which are summarized in the table below.

Table A. Identified Issues of Concern

Issue	Description
1. Water Quality	Water quality includes a broad range of concerns, beyond simply contaminants. There is also a need for a water quality monitoring plan to identify areas lacking data. As projects are developed and data gaps are revealed through more extensive research, more data may need to be collected and more specific maps generated.
2. Water Quantity	Drought in the Purgatoire River Watershed has led to increased shortfalls of water supply. Agricultural water demands are over-appropriated in the Basin. Improved surface water irrigation may lead to material depletion or injury to water rights downstream due to the Arkansas River Compact.
3. Forest and Rangeland Health	Forest health throughout the Purgatoire Watershed, due to fire repression, lack of timbering, dense understory growth and drought, has caused forests to become extremely susceptible to insect diseases and wildfire. Rangeland health concerns include providing livestock water to underutilized areas, among other topics.
4. Invasive Species	Invasive species are prevalent in the Watershed and affect available water, agricultural crops, riparian ecosystems, rangeland and biodiversity.
5. Stream and Habitat Restoration	Due to multiple issues, such as water quality, sedimentation, erosion, invasive species, land use practices, water storage and water diversions, among others, stream banks and riparian areas, as well as other Watershed ecosystems, need to be addressed and improved following best management practices for restoration.
6.Recreational Use and Access to the River	Not only do outdoor recreational activities associated with the River invigorate the regional economy but they also provide opportunities for healthy living. Improving access to the River also provides more recreational pursuits and increases Watershed awareness.
7. Awareness and Knowledge of Watershed Issues	Education and outreach are essential for generating awareness of issues in the Watershed and fostering stewardship of a watershed system. Furthermore, the Purgatoire watershed is part of the Arkansas Basin. Therefore it is important that goals and priorities of the Arkansas Basin Roundtable, and thus the State Water Plan, align with the priorities, goals, programs and projects developed by the PWP.
8. Stakeholder Participation and PWP Sustainability and Publicity	A broad range of participation and increased numbers of participants are essential to the success of the PWP and implementing the Watershed Plan. The PWP cannot survive without consistent stakeholder input, volunteer involvement, donations and external funding.

In order to address issues of concern in the Watershed, goals and objectives (see Section 6) were determined and a set of projects and strategies (see Section 7) were also proposed during multiple PWP public board meetings. In Table B below, similar to the issues of concern, goals, objectives and projects or strategies are not listed or ranked by a particular level of importance and will be addressed and implemented as resources become available.

Table B. Issues of Concern Aligned with Goals, Objectives and Projects and Strategies

Issues of Concern	Goals	Objectives	Projects & Strategies
1. Water Quality	1. Improve Water Quality	1.1 Assess Water Quality 1.2 Address Selenium and Mercury Impaired Waters 1.3 Reduce Sediment Loading, Bacteria & Erosion 1.4 Assess Sodium & Bicarbonate Levels in Lower Purgatoire 1.5 Implement Water Quality Monitoring Programs 1.6 Address Nutrient Loading 1.7 Protect Upper Watershed Municipal Supply	1.1.a Water Quality Assessment Analysis Project 1.2.a Study Selenium and Mercury and Implement Control Efforts 1.2.b Ditch Lining for Selenium Reduction 1.3.a Study Sediment Loading and Bacteria 1.3.b Conduct Targeted Sediment Studies and Sediment Control Efforts 1.3.c Stream Bank Erosion Projects: Purgatoire River and its Tributaries 1.4.a Research and Address Sodium-Bicarbonate Effects on Agriculture Production 1.5.a Water Quality Monitoring Priorities: Purgatoire River from Trinidad Reservoir to the confluence with Van Bremer Arroyo and Purgatoire River from Nine Mile Dam to the confluence with the Arkansas River 1.6.a Implement Non-Point Source Pollution Mitigation 1.7.a Source Water Protection Plan
2. Water Quantity	2. Increase Water Quantity	2.1 Improve Ditch Diversion Infrastructure 2.2 Identify Methods for Long-term Water Storage 2.3 Determine Strategies for Water Re-use	2.1.a Assessment and Improvement of Existing Irrigation Diversions 2.1.b Chilili Ditch Diversion and Improvement Project 2.1.c Ditch Lining - Water Conservation Projects 2.2.a Water Storage: Arkansas River Compact Water Storage Study 2.2.b Augmentation Water Storage 2.3.a Uses for Coalbed Methane Produced Water
3. Forest and Rangeland Health	3. Manage Healthy Forests, Shrublands and Grasslands	3.1 Develop a Community Wildfire Protection Plan (CWPP) 3.2 Investigate Wood Markets 3.3 Address Eastern Watershed Region Needs	3.1.a Implement Stonewall Fire Protection District CWPP and Develop CWPP's for Other Communities 3.2.a Economic Benefits of Wildfire Protection 3.3.a Review and Develop as Necessary Rangeland, Shrubland & Grassland Management Plans

4. Invasive Species	4. Mitigate Invasive Species	4.1 Reduce Tamarisk, Russian-olive & Other Invasive Species 4.2 Study & Reduce Aquatic Invasive Species	4.1.a Tackling Tamarisk on the Purgatoire (TTP) and Russian-olive Removal 4.1.b Noxious and Invasive Species Reduction and Control 4.2.a Research Aquatic Invasive Species Conditions and Mitigation Methods
5. Stream and Habitat Restoration	5. Improve Riparian and other Watershed Ecosystems	5.1 Improve Trout Habitat 5.2 Maintain Existing Riparian and Wetland Habitats 5.3 Identify Wildlife Corridors and Opportunities for Habitat Restoration 5.4 Protect Environmentally Sensitive Areas	5.1.a Purgatoire River Reaches 3, 4, 5 and 6 Trout Habitat Projects 5.1.b Research In-stream Flow Potentials 5.2.a Assess and Restore Degraded Riparian Areas, Wetlands and Streambanks 5.3.a Collaborate with Habitat Planning Efforts 5.3.b. City of Trinidad Trail and Greenway Master Plan 5.4.a Assess Lower Purgatoire River Fishery
6. Recreational Use and Access to the River	6. Enhance Recreational Opportunities	6.1 Increase Non-consumptive Water Use 6.2 Provide Diverse Recreational Activities	6.1.a Improve Recreational Access to River 6.2.a Establish Trails in the Boulevard Addition Nature Park
7. Awareness and Knowledge of Watershed Issues	7. Educate the Public Regarding Water Issues	7.1 Increase Focus on Student Population 7.2 Create Multiple Outreach Strategies for Reaching the Public 7.3 Create Direct Learning Opportunities 7.4 Provide Opportunities for Water Rights, Arkansas Basin and Compact Awareness	7.1.a Create and implement curriculum in schools within the watershed around the Trinidad water festival 7.2.a Website, social media, and news releases 7.2.b Printed educational materials 7.3.a Field tour of water infrastructure and watershed projects 7.4.a Presentations at monthly meetings and public venues.
8. Stakeholder Participation and PWP Sustainability	8. Maintain an Active Watershed Stakeholder Group	8.1 Collaborate with Multiple Agencies & Interest Groups 8.2 Secure Funding and Support to Maintain the Purgatoire Watershed Partnership	8.1.a Communicate and Work With Government, Non-Profits, Education and Conservation Groups, Industry, and Local and Regional Water Agencies 8.1.b Participate in Arkansas Basin Implementation Plan Efforts 8.2.a Apply for Grant Funding 8.2.b Expand Publicity, Membership and Participation

EPA Nine Elements of a Watershed Plan

Although watershed plans are useful for all watersheds to protect and restore water resources, as well as to meet other community resource goals, they are critical for impaired or threatened bodies of water. According to the Environmental Protection Agency, a body of water is ***impaired*** if it does not attain state water quality standards. **Threatened** waters are those that meet standards but exhibit a declining trend in water quality such that they will likely exceed standards. Although water quantity, oil & gas impacts, development pressures, habitat protection, wetland restoration/creation, sediment reduction, wildfire mitigation, source water protection and other components are included in this watershed plan, the United States Environmental Protection Agency (EPA) has identified a minimum of nine elements that are critical for achieving improvements in water quality. The EPA requires all implementation, demonstration, and outreach-education projects funded under Section 319 of the federal Clean Water Act to be supported by a Comprehensive Watershed Plan, which includes the nine elements listed below. Although this project is not funded by the 319 Program, it strives nonetheless to address these important water quality elements and qualify for future 319 funding if deemed necessary. The nine EPA required elements, and the location of the Plan component addressing these elements are listed below.

Element a: Identification of causes of impairment and pollutant sources or groups of sources that need to be controlled to achieve needed load reductions, and any other goals identified in the watershed plan.
Three segments in the watershed are currently on the 303(d) list for selenium impairment. The impairments are due to exceedance of the chronic dissolved selenium standard. Currently, the assigned priority for TMDL development on these segments is low (WQCD, 2012). The dissolved selenium assessment (section 4.5.1) details the existing data set available for each segment in the Purgatoire River Watershed. On each of the listed segments, additional data collection and analysis is needed to identify selenium sources and characterize the nature and extent of selenium impairment.

On segment COARLA07, the Purgatoire River below I-25 to the confluence with the Arkansas River, the existing water quality data suggests that selenium sources may be located on both the upper and lower portions of the segment. These areas have been identified as monitoring priorities. Additional characterization will be used to more specifically identify sources of selenium, which are likely a combination of natural and anthropogenic sources. Local geology and soils may be a source of natural selenium. While certain land uses, particularly irrigation and water delivery systems, may increase anthropogenic selenium loading. Given the size of the segment, over 150 river miles, and the lack of water quality and flow data it is not practical to determine load reductions at this time. Additional data collection on the lower Purgatoire River will support TMDL development.

Segment COARLA09a includes the mainstems of Chacuacho, San Francisco, Trinchera Creeks and Van Bremer Arroyo in the Purgatoire River Watershed and other streams outside of the watershed. Segment COARLA09a was added to the 303(d) list in 2002 based on data collected from Horse and Willow creeks which are located outside of the Purgatoire River Watershed. To date, 7 samples have been collected from the portions of segment COARLA09a in the Purgatoire River Watershed. Dissolved selenium concentrations were below both the chronic and acute selenium standards (Section 4.5.1). It may be possible to use the existing data set to revise the 303(d) listing to Horse and Willow creeks rather than the entirety of segment COARLA09a.

On segment COARLA09b the data used to establish the 303(d) listing was collected from portions of the segment located outside of the Purgatoire River Watershed. To date, the portions within the Purgatoire River Watershed have not been sampled. Data collection should occur in Smith Canyon, Frijole and San Isidro Creeks, and Luning and Blackwell arroyos. Without data it is not possible to determine whether these portions of segment COARLA09b are impaired for selenium and whether load reductions are required. Baseline water quality characterization should occur on this segment.

The Purgatoire Watershed Partnership plans to simultaneously implement projects alongside the data collection efforts discussed above. The PWP has outlined priority project topics in the following four categories: watershed education (Section 6.1), agricultural water (Section 6.2), community wildfire protection plans (Section 6.3) and watershed improvements (Section 6.4).

Element B: An estimate of the load reductions expected from management measures.
Ditch lining and water conservation will lead to load reductions. Specific projects and funding sources have been discussed in the Priority Project Section (See 6.3 Agricultural Water and 6.4 Watershed Improvements). Additional field data collection is needed in these area and load reduction estimates are not known at this time.

Element C: A description of the nonpoint source management measures that will need to be implemented to achieve load reductions, and a description of the critical areas in which those measures will be needed to implement this plan.
Nonpoint source management measures that can be employed for the projects listed in 6.3 and 6.4 include ditch lining, an assessment of ditch diversions and recommended water quality projects (as recommended in Section 4). Existing data sets were used to assign priority reaches in the selenium assessment (Section 4.5.1). Additional data collection and analysis will be used to refine the priority reaches and better identify critical areas. These efforts will be used to inform the implementation measures outlined in the plan.

Element D: Estimate of the amounts of technical and financial assistance needed, associated costs, and/or the sources and authorities that will be relied upon to implement this plan.
The PWP is comprised of stakeholders willing to collect data voluntarily. The River Watch program will be solicited to analyze data in new areas identified for monitoring. The group plans to apply for future Colorado Department of Health and the Environment's Nonpoint Source (319) Program and the Colorado Water Conservation Board's Water Supply Reserve Account Program for load reduction and conservation projects based on data results. See Section 6 for outlined funding sources associated for each identified priority project.

Element E: An information and education component used to enhance public understanding of the project and encourage their early and continued participation in selecting, designing, and implementing the nonpoint source management measures that will be implemented.
In addition to the completion and distribution of the Watershed Plan, the PWP informs the public through newsletters, website updates, stakeholder meetings, and educational events (See Section 6.1).

Element F: Schedule for implementing the nonpoint source management measures identified in this plan that is reasonably expeditious.
The PWP must first collect data before planning the implementation of nonpoint source management measures. Colorado RiverWatch and other voluntary efforts should first be employed over a two to three year period. After data collection is complete then Department of Health and the Environment's Nonpoint Source (319) Program and/or the Colorado Water Conservation Board's Water Supply Reserve Account Program can be applied for to implement load reduction measures such as ditch lining.

Element G: A description of interim measurable milestones for determining whether nonpoint source management measures or other control action are being implemented.
This plan calls for additional water quality characterization to improve understanding of nonpoint source pollutant sources in the watershed. Data management, analysis and sharing are major milestones associated with the characterization effort. Sampling analysis project plans will be developed for each project and data sharing, via the Colorado Data Sharing Network, will occur following each data collection effort. These efforts will assure that quality data is collected and available for use by WQCD in standards assessments or other regulatory matters.

Water quality data collection will likely take place over the next three years. Ditch lining will occur for several years after the planning. Additional monitoring to show reduction will follow implementation.

Element H: A set of criteria that can be used to determine whether loading reductions are being achieved over time and substantial progress is being made toward attaining water quality standards.
The criteria used to determine load reductions will be the water quality standards set by the Colorado Water Quality Control Commission.

Element I: A monitoring component to evaluate the effectiveness of the implementation efforts over time, measured against the criteria established in element H.
Monitoring will continue for a minimum of 5 years beyond the implementation of load reduction projects to determine the rate of success (see Table C below)..

Table C. Water Quality Improvement Tasks

Tasks	**Task 1: Monitoring in Lower Purgatoire River Watershed**	**Task 2: Implementation of Best Management Practices**	**Task 3: Documentation of Loading Reductions**
Milestones	Choose appropriate monitoring site locations	Design projects	To be determined (TBD)
	Recruit volunteers to monitor	Implement projects	TBD
	Coordinate with the WQCD	Create a general monitoring strategy for each if the implementation projects	TBD
	Collect samples (once a month for three years)		TBD
Timeline	**3 years (2015-2017)**	**6 years (2018-2023)**	**5 years (2024-2028)**

Section 1 Purgatoire Watershed Partnership

1.1 Introduction and Background

The Purgatoire Watershed Partnership (PWP) is a stakeholder watershed group that functions out of Trinidad, Colorado. Local citizens, compelled to address and rectify ongoing natural resource concerns within the Purgatoire River Watershed (see Figure 1: Purgatoire Watershed below), formed the group. They are comprised of stakeholders with diverse interests who have come together to form a cooperative partnership to work towards the assessment, conservation, and enhancement of their watershed's health.

The PWP had been a goal of many stakeholders in the area for several years. In November 2011 the Colorado Watershed Assembly (CWA) was invited by local citizens to help establish a cooperative community organization focused on the enhancement of local natural resources within the Purgatoire River Watershed. The CWA was responsible for and assisted with many tasks, including: coordinating stakeholders; organizing speakers and presentations in the Watershed, such as The Colorado Water Conservation Board, the District Water Commissioner and the Arkansas River Compact; facilitating meetings; identifying and participating in grant proposals, including the Cooperative Watershed Management Program; researching watershed issues; and providing staff assistance, part-time for approximately one year, in the form of a VISTA Volunteer. The first official Watershed group meeting was held at the Trinidad State Junior College on November 3, 2011.

The various stakeholders involved in the partnership planning process included landowners, local businesses, ditch companies, students, local attorneys, county commissioners, oil and gas operators, environmental consultants, USDA, NRCS, Trout Unlimited, Purgatoire Water Conservancy District, the Colorado Watershed Assembly, Trinidad Community Foundation, Southern Colorado Environmental Council, Piñon Canyon Maneuver Site, and the Culebra Range Community Coalition.

Once the group was able to secure a source of funding through the Bureau of Reclamation's Cooperative Watershed Management Grant Program (Section 1.4) they began to draft, finalize and submit their Articles and Bylaws necessary for gaining Incorporated Status. At the January 9, 2013, monthly meeting the group adopted Bylaws, established their membership base, and swore in an official Board of Directors. Subcommittees including both Board Members and PWP members were created to begin working on targeted initiatives. The actions taken provide the group with the structure, stability and legal guidelines necessary for future growth. The Spanish Peaks-Purgatoire River Conservation District provides the group with the support and guidance necessary to become their own entity.

Throughout the past several months PWP members have met to discuss various informative topics of interest to the community. Many feature guest speakers including Jeff Montoya the Water Commissioner for the Purgatoire watershed, Jeris Danielson from the Purgatoire Water Conservancy District, Steve Witte the Division Engineer from Division 2, Eve McDonald from the Attorney General's Office, Wendy Ryan from the Colorado Climate Center, Taryn Finnessey with the Colorado Water Conservation Board, Dean Oatman from the CSU Extension Office, and Kevin Reidy from the Drought Planning office of the Colorado Conservation Board. Guest speakers have addressed topics such as water rights, the history and current state of the watershed, the Kansas Compact and its effect on the river, climate and drought updates, weeds in the Purgatoire watershed, and water conservation initiatives. Presentations provide the group with insight on the watershed, which are valuable resources that will guide the group to make informed decisions in the future.

During subsequent meetings, the PWP Board of Directors and members outlined a number of concerns in the Watershed and priorities to address, including but not limited to the following topics: education and outreach, agricultural water, conservation, restoration, wildfire protection plans, water quality, quantity and assessment, land use, recreation and invasive species. Table B above presents these topics in more detail.

1.2 Mission Statement

The Purgatoire Watershed Partnership's mission is to actively maintain a watershed-wide stakeholder partnership aimed at the assessment, restoration, protection and improvement of all aspects regarding the Purgatoire River Watershed.

1.3 Operating Structure and Funding Mechanisms

The PWP is led by a Board of Directors and governed by established bylaws. The PWP also offers membership to any interested individual for a $10 annual fee. Minutes are recorded for every meeting, which are held monthly. The length of term for each director position is laid out in the bylaws, which are in accordance with 501(c)(3) requirements. The bylaws specify that the Board of Directors will represent different stakeholder groups within the watershed as evenly as possible. The bylaws also specify the purpose of the partnership, as well as membership and Board of Directors requirements and voting procedures.

In July 2012, in collaboration with the Spanish Peaks-Purgatoire River Conservation District who agreed to act as the PWP's fiscal sponsor, the PWP applied for a Cooperative Watershed Management Water Smart Grant through a Bureau of Reclamation (BOR) program open to 17 states in the Western United States. The Water Smart grant was awarded in September of 2012. This grant allowed the organization to hire a local watershed coordinator, and simultaneously, a watershed consultant to organize and develop the watershed plan. Watershed coordinator tasks include determining watershed management project concepts, increasing stakeholder involvement, implementing the Watershed Plan, developing a community education program, and allowing as many voices of the Watershed to be heard as possible. The Spanish Peaks-Purgatoire River Conservation District continues to support the efforts of the PWP and provide its fiscal sponsorship. The Partnership, however, is in the process of obtaining 501(c)(3) status and working towards sustainability.

1.4 Purpose of the Watershed Plan

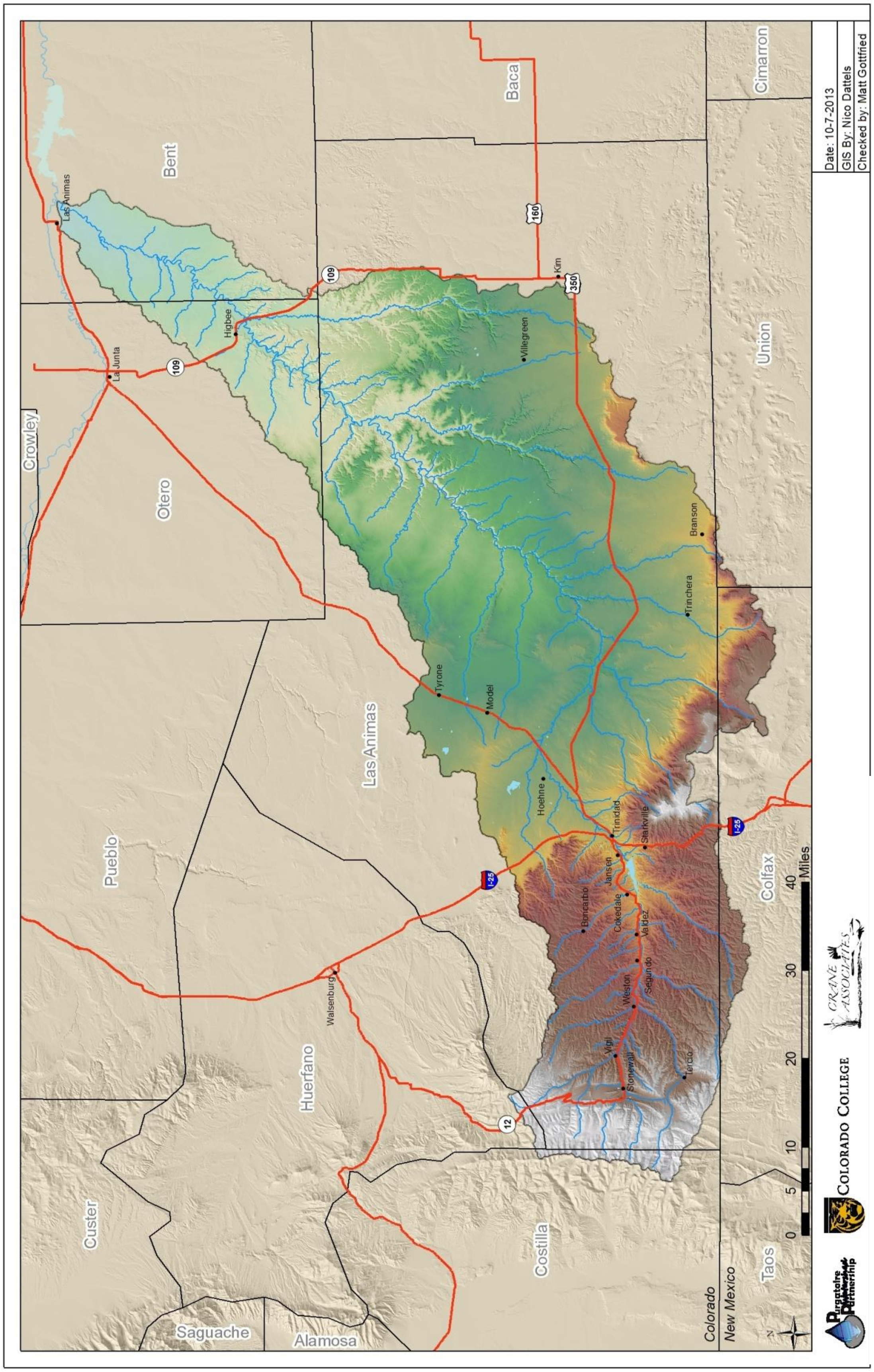
Since the late 1980s, watershed organizations, tribes, and Federal and state agencies have moved toward managing water resources by using a watershed approach. According to the United States Environmental Protection Agency's *Handbook for Developing Watershed Plans to Restore and Protect Our Waters*, "a *watershed approach* is a flexible framework for managing water resource quality and quantity within specified drainage areas, or watersheds. This approach includes stakeholder involvement and management actions supported by sound science and appropriate technology. The *watershed planning process* works within this framework by using a series of cooperative, iterative steps to characterize existing conditions, identify and prioritize problems, define management objectives, develop protection or remediation strategies, and implement and adapt selected actions as necessary. The outcomes of this process are documented or referenced in a watershed plan. A *watershed plan* is a strategy that provides assessment and management information for a geographically defined watershed, including the analyses, actions, participants, and resources related to developing and implementing the plan."

> A **watershed** is the land area that drains to a common waterway, such as a stream, lake, estuary, wetland, or ultimately the ocean.

"Using a watershed approach to restore impaired bodies of water is beneficial because it addresses the problems in a holistic manner and the stakeholders in the watershed are actively involved in selecting the management strategies that will be implemented to solve the problems." A watershed plan is used where concerns span across a given watershed and involve numerous landowners and stakeholders. Concerns usually are the result of landscape scale processes and require the efforts of many individuals working in unison. The purpose of the Plan is to improve awareness through educating stakeholders on the issues affecting their watershed's health and encouraging them to participate. It coordinates community actions through the development of a common vision. Communities can then coordinate their activities and work towards common goals. Local participation is used to put the planning process in the hands of local communities and ensure their concerns are fully integrated. Involving a broad representation of stakeholders ensures that a diverse range of goals and values are represented in the Plan. The Plan also works to target resources, focusing on manpower and funding to address the important issues identified by the community. The partnerships formed establish working relationships, improving communication, and allowing information to be shared. Furthermore, these partnerships minimize conflict and promote cooperation, while leveraging resources. Talents, expertise, funding and time are combined amongst many individuals, organizations, and agencies, proving a workforce to achieve large-scale goals. Efficiency is increased by reducing the duplication of efforts through teamwork and providing information for others to utilize and build upon.

The local planning group is charged with adopting a planning process to help manage complex issues and achieve their goals. Frameworks established by the EPA, NRCS and other sources pertaining to the planning process can be used to develop a watershed plan on the basis of ecological, economic, and social considerations. This process may be used regardless of the expected outcome, scope, size of the watershed, complexity of the issues, or sources of funding.

Figure 0-1: Purgatoire Watershed



Source: Colorado College, 2013. Prepared by Nico Dattels.

Section 2 Characteristics of the Purgatoire Watershed

2.1 Watershed History

Native Americans originally inhabited the Purgatoire River Watershed. Historic Indian tribes who traversed and utilized the River, its tributaries and the surrounding landscape included the Ute, Jicarilla Apache, Arapahoe, Cheyenne, Pawnee, and Comanche. The Spaniards, the first known Europeans to explore this area, named the valley's river *El Rio de Las Animas Perdidas en Purgatorio*, which translates to "The River of Lost Souls in Purgatory." The name arose when a few of the expedition's explorers were killed by Wichita Indians near the Arkansas River, and because the group was traveling without priests the dead were unable to receive "last rites." Eventually French trappers truncated and translated the River's name to the "Purgatoire," which to incoming Anglos sounded like the word "picketwire." Although the River today retains its French spelling, sometimes it is still referred to by its misheard moniker. In fact one of the canyons in the Watershed was permanently named Picketwire Canyon.

The Raton Basin, a geologic structural basin, encompasses much of the western half of the Watershed and was a frontier region for early settlers for hundreds of years. In the southern half of the Central Raton Basin, in present day New Mexico, lived Pueblo Indians. Initially the Utes lived in the mountains in the western region of the Watershed and the Jicarilla Apaches dominated the plains in the eastern Watershed. The Spanish Peaks, which lie to the north of the Purgatoire Watershed, were considered Pueblo territory and Pueblo Indians also lived along the rivers in the Watershed. Apaches moved into the Raton Basin from the north in the 1500's. At this time Spanish explorers came over the mountain passes to trade with the Apaches and Utes, allowing both tribes to acquire horses to trade, carry and hunt over a larger range, and as a result the rate of trade and conflicts quickly escalated. From 1650 to 1725 the Apaches dominated the area. In the mid 1700's, after securing guns through trading with the French, the Comanche moved into these Apache territories. Throughout the 1800's, the Spaniards, other European-Americans, Indians and Mexicans considered the land in the western—and eastern—Watershed their own. Throughout the 1820's and 1830's North American fur trappers and traders also inhabited the Watershed.

Throughout the mid 1800's, the Watershed region continued to be traversed by Native Americans and Hispanics, as well as the United States Cavalry and travelers on the Mountain Route of the Santa Fe Trail. Just beyond the notheastern edge of the Watershed, some travelers passed through Bents Fort, followed the Purgatoire River and then crossed the Raton Pass into New Mexico Territory. In 1848 the Treaty of Guadalupe Hidalgo was signed between Mexico and the United States and the region became US property, which brought many more Anglo settlers to the area. Despite all of the activity along the Purgatoire River, it wasn't until 1861 that Trinidad was actually settled. Led by Felipe and Delores Baca, twelve Hispanic families from the Mora Valley of New Mexico moved to the valley to establish sheep ranching and farming operations, as well as a new town. In 1876 the City of Trinidad was officially incorporated, the same year that Colorado received its statehood. Trinidad's economy grew due to include bottling and brick making industries and became a prominent railroad town.

The western Purgatoire River Basin is well known historically as being a source of coal. In the early Twentieth Century many immigrants were attracted to Trinidad and the surrounding region for the work it offered in its rich coal mines. During the first half of the 1900's money generated from coal revenue was used to expand Trinidad. However, by mid-century the local demand for coal dissolved and a wealthy community became poverty stricken over the coming decades. Las Animas County's population declined from 40,000 to 15,000 and the unemployment rate increased 15 percent. Most recently, in the winter of 2012, there was talk of the New Elk Mine reopening, which brought hope to many citizens of the region. Situated upriver from Trinidad, the mine began hiring employees from the local workforce but it never did become fully operational and most of its new staff was released. The Basin today is better known for its production of natural gas from coalbed methane but the Watershed itself is still dominated by an agrarian economy.

2.2 General Physical Environment

The total area of the Purgatoire River Watershed is 2,206,204 acres (3,449 square miles). The elevation of the Watershed averages 6,008 feet above sea level with a maximum elevation of 13,962 feet and a minimum elevation of 4,321 feet. Over half of the Purgatoire Watershed consists of grassland and herbaceous cover at 55.7%. The next two largest landcovers in the Watershed are shrub/scrub with 20% cover and evergreen forest with 18.4% cover. The remaining 5.9% of landcover in the Purgatoire Watershed consists of deciduous forest, cultivated crops, woody wetlands, mixed forest, developed open space, emergent herbaceous wetlands, barren land, pasture and hay, developed low intensity, open water, and developed medium intensity.

The upper Purgatoire River Watershed is located in the southern Front Range of the Rocky Mountains, almost but not quite entirely north of the Colorado-New Mexico border. The upper Purgatoire—the western half of the Watershed—is one of the few places in Colorado with large areas of privately held, unfragmented forest, grassland, shrubland and riparian systems. This region is an intact mosaic of alpine tundra, gamble oak and mountain mahogany shrublands, piñon/ juniper woodlands, ponderosa pine, savanna and montane grasslands, riparian areas, and high elevation forests containing mixed conifers, spruce-fir and aspen. The area contains a rich diversity of rare and common plants, plus outstanding elk range and other wildlife habitat.

The eastern Watershed region is much different than its higher elevation counterpart. After leaving the Rocky Mountains and connecting mesas, the Purgatoire River and its tributaries eventually meet the western edge of the Great Plains, where they traverse piñon-juniper shrublands, grasslands and canyonlands. The eastern Watershed is bisected by the Purgatoire River, which forms the remarkable Picketwire Canyon, where a world-class dinosaur track-way illustrates that the area has been biologically significant for many millions of years. Side streams have dissected their own smaller canyons. This region includes a complex of mesas and canyons, with hidden gems like Red Rock Canyon, where red sandstone formations have been revealed by not only the Purgatoire River but its tributaries, such as the Chacuaco River. Rising from these canyon floors to the tops of the surrounding plateaus are river terraces of various sizes and steep, rocky canyon walls and cliff faces. The floodplains of the Chacuaco and Purgatoire Rivers are broad and mostly dominated by weedy herbaceous vegetation, cholla cactus and some small patches of cottonwood trees. Livestock has heavily utilized the main canyon, while the side canyons are often relics of time prior to Euro-American occupation of the landscape.

2.2.1 Watershed Boundaries and Tributaries

The headwaters of the Purgatoire River are located in the Culebra Range of the Sangre de Cristo Mountains. Snowmelt from the headwaters contributes to the water supply in the basin area. Technically the Purgatoire River itself originates at the confluence of the North Fork and Middle Forks of the Purgatoire River near Weston, Colorado, located in Las Animas County. Flowing together these forks form the main stem of the Purgatoire River. The River travels in a general east to northeast direction for approximately 196 miles (315 km) to its confluence with the Arkansas River at John Martin Reservoir. John Martin Reservoir, also a State Park, is located near the Town of Las Animas in central Bent County, Colorado. The Purgatoire River is a fourth-order perennial stream dominated by snowmelt and is a principle tributary to the Arkansas River. To clarify, a perennial stream has year round flow and fourth-order streams are medium-sized rivers with three levels of streams that begin, merge and merge again before forming the next lower—or fourth—stream. The Purgatoire River drains an area of 3,447 square miles (8,930 km^2). 96.4% of the Watershed area is located in Colorado in the counties of Las Animas, Otero, Bent, and Costilla. The remaining 3.6% of the watershed lies within New Mexico in Colfax and Union Counties. The land is diverse and ranges from the Southern Rocky Mountains High Mountains in the west to Central Great Plains Grassland in the east.

The main tributaries that supply water to the Watershed include; Lorencito Canyon, Widow Women Canyon, Wet Canyon, Sarcillo Canyon, Valdez Canyon, Burro Canyon, Riley Canyon, Longs Canyon, Raton Creek, Frijole Creek, San Francisco Creek, San Isidro Creek, Trinchera Creek, Trementina Creek, Chacuaco Creek, Smith Canyon, Chicosa Canyon, Leitensdorfer Arroyo, Luning Arroyo, Van Bremer Arroyo, Taylor Arroyo, Lockwood Canyon, Bent Canyon, Red Rock Canyon, Welsh Canyon, Doss Canyon, Alejandro Canyon, Beaty Canyon, Chacuaco Canyon, Vose Canyon, Jack Canyon, Baker Canyon, Rock Arroyo and Tarbox Arroyo.

As mentioned above, the Watershed boundaries are primarily within Colorado's Bent, Costilla, Las Animas and Otero Counties (shown in Table 2-1 below), though for the purpose of this Watershed Plan, the Watershed areas in Costilla County and the New Mexico counties will not be assessed in the study area due to their minimal inclusion in the Purgatoire River Watershed.

Table 2-1: Percent of Colorado Counties in the Watershed

County	Total Acres	Acres in Watershed	% of County in Watershed	% of Watershed
Bent	986,170	129,926	13.2%	6
Costilla	787,109	10,291	1.3%	.5
Las Animas	3,054,954	1,854,720	60.7%	84
Otero	811,808	127,383	15.7%	5.9

Source: NRCS (2007). Rapid Watershed Assessment

Figure 2-1: Chacuaco Canyon, Eastern Watershed

Source: PWP

2.2.2 Topography

The Purgatoire River Watershed contains several different ecosystems as it traverses from high alpine mountains with an elevation of just under 14,000 feet above sea level to the undulating rolling plains of the Arkansas River Valley at an elevation of less than 4,000 feet. Many tributaries that cut through the Purgatoire River Watershed experience ephemeral stream flow. The transition from the Southern Rocky Mountain Foothills to the Upper Arkansas Valley Plains is considered the boundary between the upper and the lower watersheds and is often delineated by the Interstate-25 corridor.

2.2.3 Climate

Station Information

The Trinidad weather station, officially named TRINIDAD, was established in August 1877. The station housed liquid-in-glass thermometers in a cotton- region shelter with a standard rain gage and was located at 6,300 feet in elevation. The station was relocated and the observer changed in the following years: 1898, 1909, 1911, 1922, 1936, 1940, 1942 and 1954. In May 1934, there was an observer change without a station move. There is a data gap from February 1949 to February 1954, at which time the City of Trinidad re-established the station. In June 1972, the location of the station was the Trinidad Municipal Power Plant. In May 1973, the National Weather Station (NWS) added a recording Fischer Porter gage to accompany the standard gage and liquid-in-glass thermometers (owned by the City). However, the standard gage measurements remain as the official records for the Colorado Climate Center.

Climate Trends
A monthly climate summary from July 1, 1898 to March 31, 2013 recorded at TRINIDAD Station 058429 indicates that the climate at the station remains relatively mild year round with the lowest average minimum temperatures at 18.9 degrees Fahrenheit (F) in the month of January (see Table 2-2 below). The highest average maximum temperature for the station is recorded for the month of July, averaging 86.8 degrees F. The average total precipitation recorded annually is 15.55 inches and snowfall is 50.8 inches, indicating that the climate is semi-arid and the greatest amount of moisture is generated from snowfall. U.S. Climate Change Science Program studies suggest that climate in Colorado and other western states are being affected more than any other states within the U.S., with the exception of Alaska. The West has experienced an average temperature increase over the last five years, 70 percent greater than the rest of the world.

Table 2-2: Monthly Climate Summary from July 1, 1898 to March 31, 2013 at TRINIDAD Station 058429

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	48.5	51.1	56.9	64.9	73.5	83.1	86.8	84.7	79.1	69.3	56.8	49.0	67.0
Average Min. Temperature (F)	18.9	21.6	27.3	34.8	43.7	52.5	57.3	55.9	48.8	37.8	27.0	20.1	37.1
Average Total Precipitation (in.)	0.46	0.64	1.03	1.49	1.88	1.57	2.47	2.29	1.27	1.11	0.75	0.60	15.55
Average Total SnowFall (in.)	6.5	8.6	9.6	6.6	1.2	0.0	0.0	0.0	0.2	2.3	6.7	9.0	50.8
Average Snow Depth (in.)	1	1	1	0	0	0	0	0	0	0	1	1	0

Percent of possible observations for period of record.
Max. Temp.: 90.1% Min. Temp.: 90.1% Precipitation: 90.1% Snowfall: 84.8% Snow Depth: 82.4%
Source: WRCC (2013). Retrieved from http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?co8429

The coldest day at the TRINIDAD Station according to data generate by the Western Regional Climate Center, listed in Table 2-3 below, was recorded on January 1, 1997 with a low of -32 degrees F. The highest temperatures on record occurred on June 26, 1994 and July 20, 2005 both reaching 101 degrees F.

Table 2-3: Period of Record General Climate Summary From 1898 to 2012 at TRINIDAD Station 058429

Monthly Averages					Daily Extremes		Monthly Extremes	Max. Temp.		Min. Temp.		
	Max.	Min.	Mean	High	Date	Low	Date		>= 90 F	<= 32 F	<= 32 F	<= 0 F
	F	F	F	F	dd/yyyy or yyyy/mm/dd	F	dd/yyyy or yyyy/mm/dd	Year	# Days	# Days	# Days	# Days
January	48.5	18.9	33.7	78	01/1997	-32	12/1963	1979	0.0	2.9	28.7	1.7
February	51.1	21.6	36.3	83	23/1905	-21	07/1933	1903	0.0	2.0	25.2	1.1
March	56.9	27.3	42.1	88	01/1928	-15	01/1922	1965	0.0	1.1	22.2	0.3
April	64.9	34.8	49.9	89	21/1919	-6	04/1945	1973	0.0	0.2	11.6	0.0
May	73.5	43.7	58.6	96	30/2000	22	07/1978	1917	0.3	0.0	2.2	0.0
June	83.1	52.5	67.8	101	26/1994	29	02/1919	1903	6.2	0.0	0.0	0.0
July	86.8	57.3	72.1	101	20/2005	42	04/1903	1906	10.3	0.0	0.0	0.0
August	84.7	55.9	70.3	99	01/1938	37	17/1979	1915	6.0	0.0	0.0	0.0
September	79.1	48.8	63.9	99	26/1938	23	29/1984	1912	1.3	0.0	0.6	0.0
October	69.3	37.8	53.6	90	09/1926	-3	29/1917	2009	0.0	0.1	7.4	0.0
November	56.8	27.0	41.9	87	08/1927	-15	28/1976	1929	0.0	1.0	22.4	0.3
December	49.0	20.1	34.5	82	16/1964	-26	09/1919	1983	0.0	3.0	28.3	1.2
Annual	67.0	37.1	52.1	101	1994/06/26	-32	19630112	1912	24.1	10.3	148.6	4.6
Winter	49.5	20.2	34.9	83	1905/02/23	-32	1963/01/12	1984	0.0	7.9	82.2	4.0
Spring	65.1	35.3	50.2	96	2000/05/30	-15	1922/03/01	1917	0.3	1.3	35.9	0.3
Summer	84.9	55.2	70.0	101	1994/06/26	29	1919/06/02	1915	22.5	0.0	0.0	0.0
Fall	68.4	37.9	53.1	99	1938/09/26	-15	1976/11/28	1929	1.3	1.2	30.5	0.3

Table above updated on Oct 31, 2012 . For monthly and annual means, thresholds, and sums: Months with 5 or more missing days are not considered. Years with 1 or more missing months are not considered. Seasons are climatological not calendar seasons. Therefore Winter= Dec., Jan., and Feb. Summer= Jun., Jul., and Aug. Spring= Mar., Apr., and May. Fall= Sep., Oct., and Nov.

Source: WRCC (2012). Retrieved from http://www.wrcc.dri.edu/cgi-bin/cliGCStT.pl?co8429

The plains region of Colorado, which dominates over half of the Purgatoire River Watershed, is characterized with having dry winters with occasional wind-blown snow and days alternating from very cold to surprisingly cold. Springtime is windy, with occasional blizzards or gentle soaking wet snow or rain, large temperature fluctuations and variable weather conditions. Summers have hot days and comfortable nights, low in humidity with prevalent thunder and hail storms.

Much of the Purgatoire Watershed's agriculture economy is directly affected by the climate. Table 2-4 below shows monthly Growing Degree Days computed as the difference between the daily average temperature and the base temperature. (Daily Average Temperature-Base Temperature.) One unit is accumulated for each degree F that the average temperature is above the base temperature and negative numbers are discarded. For example if the high temperature for the day is 95 degrees F and the low temperature is 51 degrees F, the base 60 degrees F heating degree day unit is ((95 + 52) / 2)) – 60 = 13. This is equation is used to compute each day of the month and then summed. When analyzing Corn Growing Degree Days, the units have the limitations that the maximum daily temperatures greater than 86 degrees F are set to 86 degrees F and minimum temperatures less than 50 degrees F are set to 50 degrees F. Days missing more than five (5) days are not considered and years with one (1) or more missing month are not considered.

Table 2-4: Period of Record General Climate Summary- Growing Degree Days From 1948 to 2006 at TRINIDAD 058429

Station:(058429) TRINIDAD													
From Year=1948 To Year=2006													
Growing Degree Days for Selected Base Temperature (F)													
Base	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
40 M	45	66	159	332	596	841	999	936	724	434	144	54	5331
40 S	45	111	270	602	1199	2040	3039	3975	4699	5133	5276	5331	5331
45 M	13	23	77	209	445	691	844	781	575	292	67	17	4033
45 S	13	36	113	322	766	1458	2301	3082	3657	3949	4016	4033	4033
50 M	2	6	27	108	299	542	689	626	428	167	22	3	2918
50 S	2	8	35	143	442	984	1672	2298	2726	2893	2915	2918	2918
55 M	0	1	6	41	172	394	534	471	285	73	4	0	1981
55 S	0	1	7	48	220	614	1147	1618	1904	1977	1980	1981	1981
60 M	0	0	1	9	76	252	379	317	156	21	0	0	1211
60 S	0	0	1	10	86	338	717	1034	1190	1211	1211	1211	1211
Corn Growing Degree Days													
50 M	60	78	144	248	389	537	650	609	467	312	131	67	3692
50 S	60	138	282	529	918	1455	2106	2715	3182	3494	3625	3692	3692
M = Monthly Data										S - Running sum of monthly data.			

Source: Western Regional Climate Center, 2006: http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?cotrin

Most recently the Watershed experienced extreme climate conditions that resulted in almost ten years of intense drought. Some farmers and ranchers sold their cattle and/or their property and permanently retired from their agricultural careers, a decision which for many ended a livelihood that had endured for generations. Others decreased their product inventory and yields and some farmers changed from large crop to smaller produce production. In any agrarian region climate plays a significant and at times a detrimental role, not only in the economy but in individual lives.

2.2.4 Geology

The Purgatoire River Watershed geology is primarily dominated by two physiographic formations or regions. Approximately two thirds of the Watershed, the eastern region, lies in the Dakota-Cheyenne aquifer. The majority of the western portion of the Watershed is located in the geologic formation known as the Central Raton Basin (CRB), yet a small portion of the Watershed's geology includes the Vermejo formation, which is adjacent to the CRB. At the time of publication of the Plan most of the geologic data available concerns the Raton Basin.

Major Structural Features

The Raton Basin is an asymmetrical trough, meaning a long and narrow structural depression, with the north-south trending La Veta Syncline forming the structural axis and its boundary defined by the Trinidad Sandstone outcrop. Within the central region of the Raton Basin, the CRB, the axis of the basin is split by a plunging anticline located between Wet and Sarcillo Canyons. This basin is bounded by the steeply rising Sangre de Cristo Mountains on the western edge, the Sierra Grande Uplift to the southeast, and the Apishapa Arch on the northeast. The major structural features are shown in Figure 2-4 below.

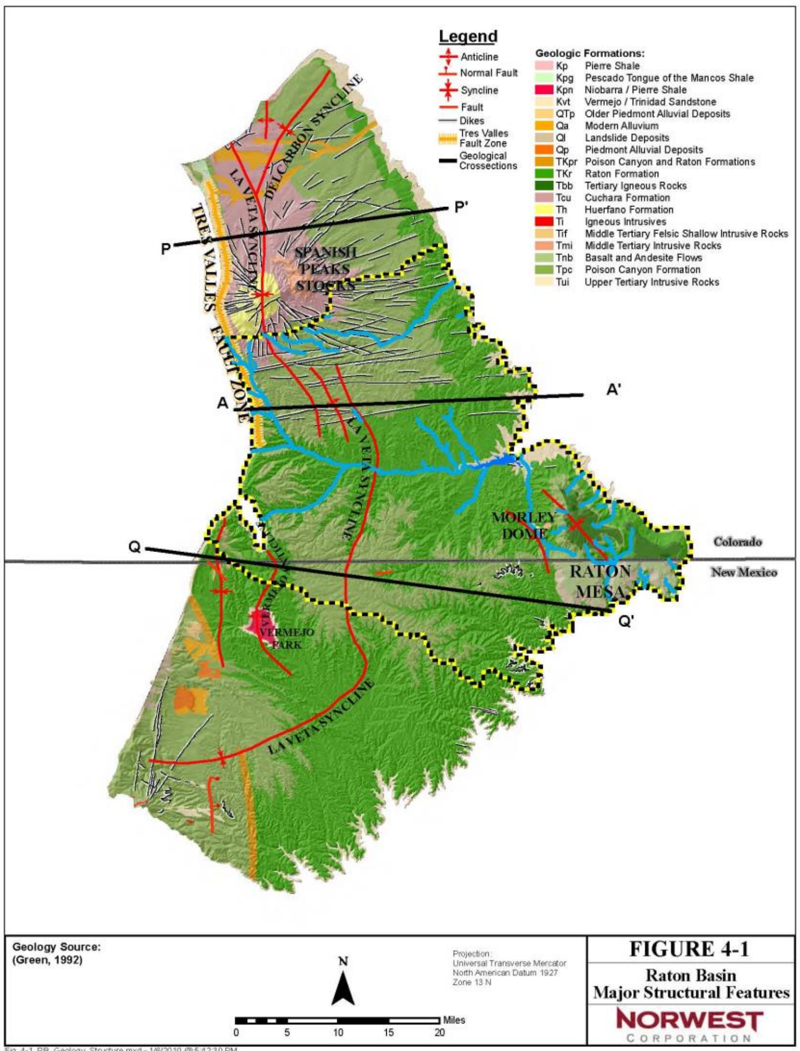


Figure 2-2: Raton Basin

Large-scale igneous activity during the Tertiary and early Quaternary time periods produced stocks, plugs, and sills related to fracturing and faulting of basin sedimentary layers. Prominent geological features include the Spanish Peaks and White Peak in the northwest, the Vermejo Park and Tercio Anticlines in the west central part of the basin, the Ojo Anticline in the northwest, and the Morley Dome in the east central portion of the basin. The Vermejo and Tercio Anticlines reveal Pierre Shale at the surface in the western part of the CRB and the Morley Dome exposes the Vermejo Formation southeast of Trinidad. A radial dike system exists proximal to the West Spanish Peak and enters through weakened areas created by deformation. Dikes in the area of the Spanish Peaks form vertical walls and typically dissect the sedimentary units at right angles. A set of parallel dikes oriented perpendicular to the basin axis occurs throughout this geologic basin.

The CRB surficial geology is shown in Figure 2-5. The Raton and Vermejo Formations are the major coal-bearing units in the CRB. The Raton and Vermejo Formations occupy approximately 2,140 square miles (1,369,600 acres) within the entire CRB and contain over 13.6 billion tons of coal defined as available for surface mining.

Source: Norwest Corporation (2010).CRB Groundwater Modeling Project

The Vermejo Formation mainly crops out only at the periphery of the Raton Basin. It is unconformably overlain by the Raton Formation, and underlain by the Trinidad Sandstone and the Pierre Shale. The Poison Canyon Formation overlies portions of the Raton Formation throughout the basin. The Cuchara Formation is present in limited areas in the northern portion of the CRB. Basalt formations, such as the Raton Mesa, are located in the southeastern portion of the CRB.

Figure 2-3: CRB Surficial Geology

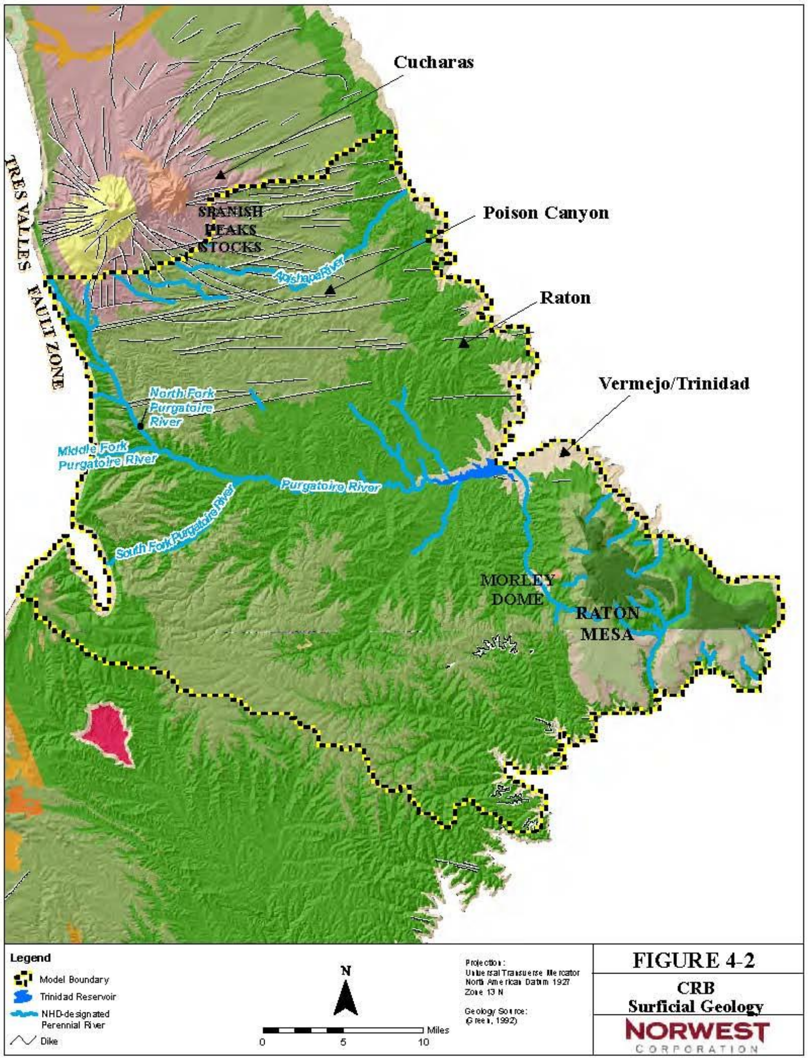


Fig_42_RB_Geology_around_model.mxd 12/23/2009 @ 9:46:18 AM

Source: Norwest Corporation (2010). CRB Groundwater Modeling Project

Thrust faults during the Late Cretaceous to Late Paleocene Laramide orogeny (40 to 70 million years ago) west of the Raton Basin uplifted the western portion of the basin creating the Sangre de Cristo Mountains, deforming the Raton Basin. The uplift resulted in the regression of the Cretaceous sea and development of the depositional environment for the Pierre Shale, Trinidad Sandstone, Vermejo, and Raton Formations. The Vermejo and Raton Formations were formed during late Upper Cretaceous and Paleocene Periods, 65 to 71.3 million years ago, giving an upper age bound for connate water. The Poison Canyon Formation was deposited later at the surface from erosional processes, which were increasing due to uplift during late Paleocene Laramide orogeny, approximately 54.8 to 65 million years ago.

The Pierre Shale, Trinidad Sandstone, and Vermejo Formation together represent a near shore marine to deltaic environment, and successively form an off lapping sequence due to the fluctuating shoreline of the Cretaceous Western Interior seaway. The Trinidad Sandstone was deposited in the west and northwestern portion of the basin as the shoreline retreated and the Pierre Shale was formed in the offshore marine shelf. Further west and inland, the clays, coals, and sands of the Vermejo Formation accumulated in a swamp and floodplain environment.

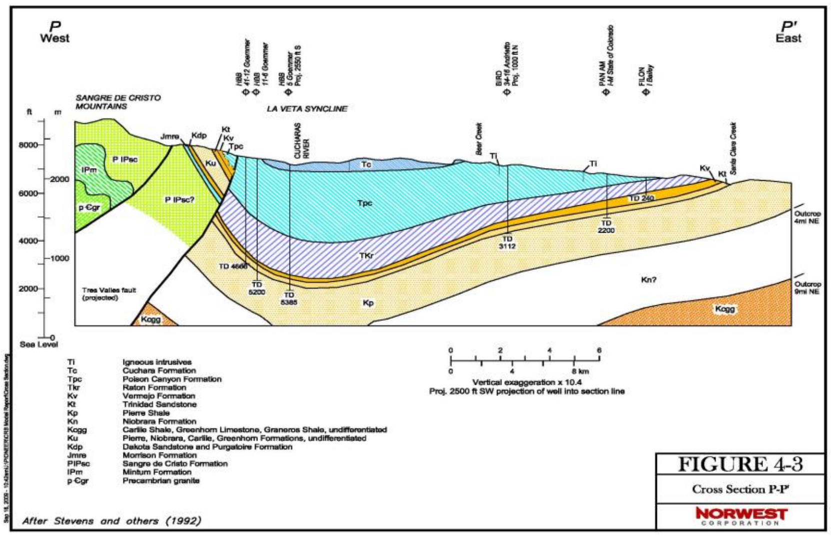
By the end of the Laramide orogeny the sedimentary units were tilted nearly vertical near the western edge, where they dip gently from the east, westward into the basin. The upper Raton Formation is comprised of alluvial and colluvial fan deposits from the uplifted Sangre de Cristo Mountains. The alluvial and colluvial deposits of the Raton Formation formed a conglomeratic layer followed by deposition of fine-to coarse-grained arkose, greywacke and quartzose sandstone beds with siltstone, silty shale and coal beds formed in swamps and flood plains.

The Raton and Vermejo Formations are large-scale fining-upward sequences, consisting of alternating siltstone and shales, with interbedded coal and sandstone units. The basal coals are typically thicker than stratigraphically higher coal beds, which are thinner and more discontinuous both vertically and laterally. Hydraulic conductivity is conventionally considered to be orders of magnitude higher in the coal units than in the shale units, so that the overall transmissivity of these formations is mainly attributed to the coal beds. This is particularly the case when data from coalbed methane (CBM) production wells are used to test Vermejo Formation transmissivity, as these wells are typically only perforated adjacent to the main coal units.

Stream alluvium within the CRB is present in the river and tributary valleys at a localized scale. Geldon (1989) reported alluvial thickness of 12 to 41 ft in the Purgatoire River valley. In tributary canyons the alluvium is usually less than 50 ft thick. The width of the alluvium in the mainstem of the Purgatoire River varies, ranging from 1,000 ft near Stonewall (Powell, 1952) to more than 4,000 ft near Trinidad, Colorado. The alluvium is predominantly sand and gravel when located in the Poison Canyon or Cuchara Formations and gravelly clay or silt where canyons are cut into the Raton and Vermejo Formations. The exception is modern channels and flood plains where the alluvium is largely sand and gravel (Geldon, 1989).

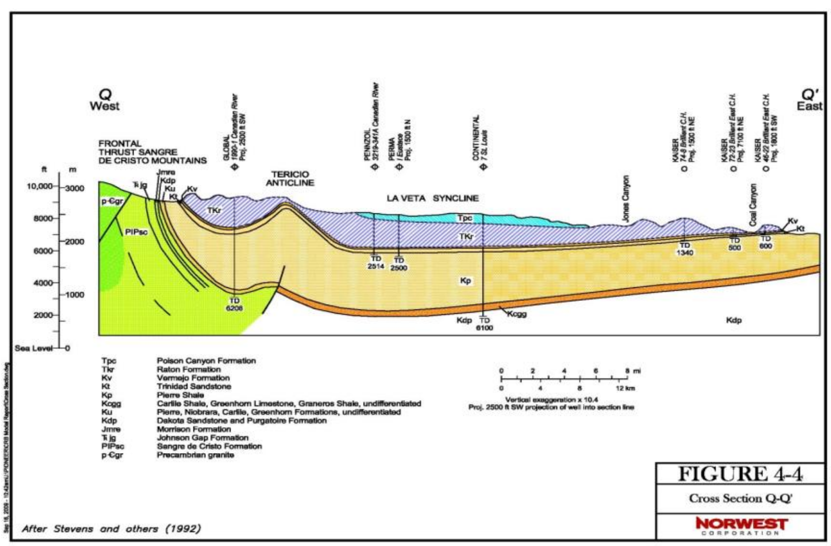
The Purgatoire River is incised through the uppermost sedimentary formations, and as a result it is in contact with the near-surface horizons of the Raton Formation. Unconsolidated material and localized alluvium exist under the river. The river flows over the Vermejo Formation for a short distance before entering Trinidad Reservoir and the reservoir itself is located on the Vermejo Formation. Connection between the Purgatoire River and the deeper Raton Formation horizons and the Vermejo Formation is likely impeded for most of the river's length due to the low vertical hydraulic conductivity, created by the large percentage of low permeability shale and siltstone throughout both formations. The three cross-section diagrams below, Figures 2-6, 2-7 and 2-8, display the layers of the formation in more detail. See Figure 2-4 above for the location of each cross-section.

Figure 2-4: Cross Section P-P



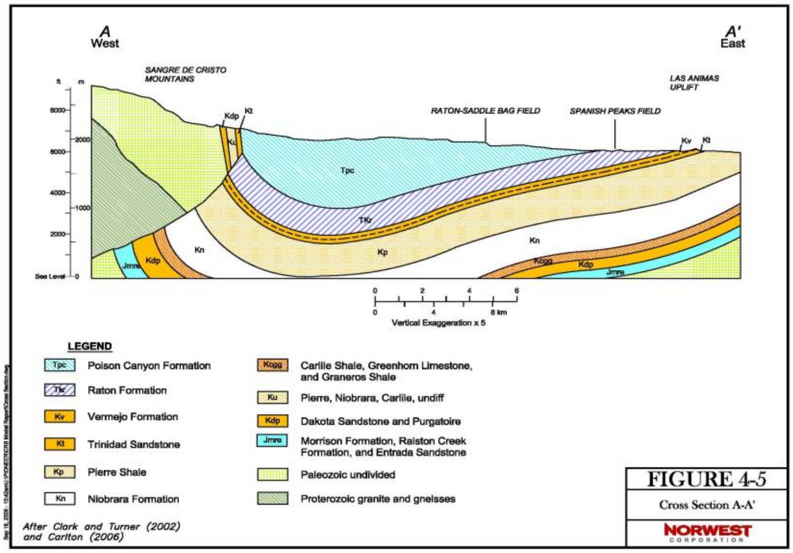
Source: Norwest Corporation (2010). CRB Groundwater Modeling Report

Figure 2-5: Cross Section Q-Q



Source: Norwest Corporation (2010). CRB Groundwater Modeling Report

Figure 2-6: Cross Section A-A

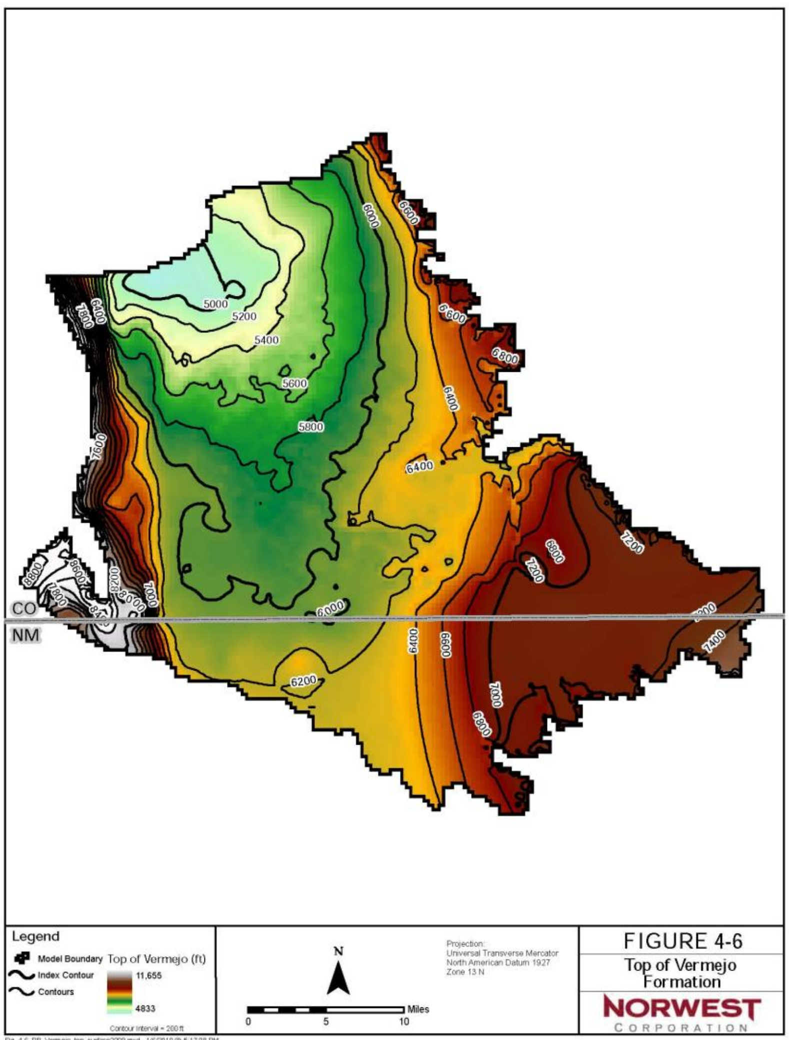


Source: Norwest Corporation (2010). CRB Groundwater Modeling Project

Figure 2-8 is the cross section through Pioneer's Spanish Peaks and Raton-Saddle Bag fields (from Clark and Turner). This is a highly generalized cross-section and it does not show the heterogeneity within each formation.

Structural maps were prepared for the top of the Raton and Vermejo Formations and the top of the Trinidad Sandstone (base of Vermejo). Previously published structure maps were modified using additional elevation control points, taken from USGS (Watts, 2006a) digital elevation model (DEM) coverage where mapped formations crop out, and formation tops provided by Pioneer and XTO. The top of the Vermejo Formation, presented in Figure 2-9 below, was used as the primary control surface for the construction of the numeric model.

Figure 2-7: Top of Vermejo Formation



Alluvium is not noted in the CRB on the USGS 1:500,000 scale Colorado geology maps. However, stream alluvium is present in the river and tributary valleys at a localized scale. Geldon (1989) reported alluvial thickness of 12 to 41 ft in the Purgatoire River valley and a maximum alluvial thickness of 45 ft in the Apishapa River valley with alluvium deposited by these rivers transmitting water more readily than alluvial deposits in tributary canyons. In tributary canyons the alluvium is usually less than 50 ft thick.

The width of the alluvium in the mainstem of the Purgatoire River varies, ranging from 1,000 ft near Stonewall (Powell, 1952) to more than 4,000 ft near Trinidad, Colorado. The alluvium is predominantly sand and gravel when located in the Poison Canyon or Cuchara Formations and gravelly clay or silt where canyons are cut into the Raton and Vermejo Formations. The exception is modern channels and flood plains where the alluvium is largely sand and gravel (Geldon, 1989). The report by Powell (1952) indicates the presence of clay stringers within the Purgatoire River alluvium, which impede groundwater interaction between the bedrock aquifer and the alluvium.

Source: Norwest Corporation (2010). CRB Groundwater Modeling Project

The Purgatoire River is incised through the uppermost sedimentary formations, and as a result it is in contact with the near-surface horizons of the Raton Formation. Unconsolidated material and localized alluvium exist under the river. In the Purgatoire River Valley, the alluvium ranges in thickness from 12 to 41 ft (Geldon, 1989). The river flows over the Vermejo Formation for a short distance before entering Trinidad Reservoir and the reservoir itself is located on the Vermejo Formation. Connection between the Purgatoire River and the deeper Raton Formation horizons and the Vermejo Formation is likely impeded for most of the river's length due to the low vertical hydraulic conductivity, created by the large percentage of low permeability shale and siltstone throughout both formations.

The coal-bearing Raton and Vermejo Formations are extremely heterogeneous with interbedded shales, siltstones, sandstones and coals with the majority of the formations consisting of siltstones and shales. The more permeable coals and sandstones are lenticular and discontinuous. The coal units are laterally persistent up to 3,000 ft on average. Coal thickness may be upwards of 10 ft in the Vermejo Formation, and less than that in the Raton Formation. The transmissive coals and sands govern the horizontal hydraulic conductivity (Kh), while the less transmissive siltstones and shales govern the vertical hydraulic conductivity (Kv). Due to the dominance of the essentially impermeable shales and siltstone, Kv is a small fraction of Kh.

Although the Raton Basin does not represent the majority of the Watershed, it plays a significant role due to its economic value in the oil and gas industry. Water often functions in direct relationship to geology, whether surface or ground water. Although data about the geology of the eastern Watershed is lacking here, a brief summary of the Dakota-Cheyenne aquifer is presented in Section 3 and the Partnership intends to conduct further research regarding the geology—as well as soils—of the region and how geology interacts with and affects water activity and resources.

2.3 Demographics, Economics and Growth Trends

As previously mentioned in Section 2.2.1, the Purgatoire Watershed primarily spans three counties in southern Colorado, with the majority of the Watershed lying within Las Animas County. This region, like Southeastern Colorado in general, is one of the most economically depressed areas of the State. For example, according to Census data, the annual per capita income in Southeastern Colorado consistently falls approximately $20,000 less than the State average for annual income.

Las Animas County

Population: According to the 2010 census, the population of Las Animas County is 15,507, which breaks into 6,341 households. The Las Animas County seat, Trinidad, has a population of 8,763. The median age of people in the county is 44 years old, with 54.4% of the population being White/non-Hispanic, 40.6% of the population Latino or Hispanic, and 5% consider themselves as other races including American Indian, African American, Asian, or two or more races.

*Economics and Industry***:** Las Animas County has a total of 7,098 individuals in the labor force. 550 people are unemployed and 5,553 are over the age of 16 and are not in the labor force. Traditional industries make up 1,697 of jobs, which includes agribusiness, mining, manufacturing, and government. The per capita income is $22,357 with the median family income at $52,513. A total of 1,679 people in the county receive some sort of government or public assistance. 18.1% of people in the county are at or below the poverty line. The rich history of mining is experiencing resurgence in coal bed methane and coal mining and exploration. The city of Trinidad is a boom and bust community. It became a railroad town as industries were established and grew into a coal mining community, which then diminished. It is speculated that the reduction in coal production was tied to the decline in steel production in Pueblo, Colorado, primarily from the 1950's to 1970's. Eventually the community transitioned into an oil and gas-centered economy, which is now also beginning to fade.

Bent County

*Population***:** The total population of Bent County is 6,499, which translates into 1,832 households. The Bent County Seat, Las Animas, has a population of 2,410. The median age in the county is 39.8 years old. 59% of residents are White/non-Hispanic, 30.4% are Hispanic or Latino, 7% are African American, and 3.6% consider themselves other races including American Indian, Asian, or two or more races.

Economics and Industry: Bent County has a total of 2,212 people in the labor force. 275 people are unemployed and 3,003 over 16 years of age and are not in the labor force. Traditional industries account for 1,002 of jobs, which includes agribusiness, mining, manufacturing, and government. The per capita income is $15,390 with the median family income being $40,750. A total of 691 people in the county receive some sort of government or public assistance. 20.8% of the people in the county are at or below the poverty line. Bent is a mostly rural county, which still relies heavily on farming and ranching as its main economic engine. Rural living is one of the attractions that have drawn many newcomers to the county in recent years.

Otero County

*Population***:** The total population of Otero County is 18,831, which translates to 7,729 households. The Otero County seat, La Junta, has a population of 7,077. The median age of Otero County is 40.9 years. 56.5% of the population is White/non-Hispanic, 40.3% is Hispanic or Latino, and 3.2% consider themselves other races including African American, American Indian, and Asian.

Economics and Industry: Otero County has a total of 8,398 individuals in the labor force. 1,065 are unemployed and 6,332—over the age of 16—are not in the labor force. Traditional industries account for 2,095 of jobs, which includes agribusiness, mining, manufacturing, and government. The per capita income is $17,396, with the median family income being $39,811. A total of 2,205 individuals receive some sort of public or government assistance. 25.7% of the individuals in the county are at or below the poverty line.

(County information source: http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml)

2.4 Land Use and Ownership

2.4.1 General Land Use and Ownership

Unlike many watersheds in Colorado, the majority of land in the Purgatoire River watershed is privately owned, accounting for 1,353,931.5 acres or 61.3%. Large private landowners own most of the forests in the upper watershed. Coal companies in the early years of statehood bought most of the land west of I-25 for mining operations. Agriculture is the dominant use of land east of I-25, consisting primarily of cattle ranches and grass feed production. A breakdown of land use per total acre in the watershed can be found in Table 2-7 below.

Table 2-5: Land Use/Ownership in the Purgatoire Watershed

Land Use/Ownership	Total Area (ac)	% of Watershed
Private Property	1,353,931.5	61.3
Piñon Canyon Maneuvering Site	259,978.3	11.8
State Lands	224,845.2	10.2
Comanche National Grasslands	205,644.8	9.3
State Wildlife Areas (CPW)	75,733.9	3.4
San Isabel National Forest (USFS)	69,962.8	3.2
Trinidad Lake	9,617.3	0.4
Bureau of Land Management	7,737.2	0.4
Total Watershed	**2,207,451**	**100**

Maxwell Land Grant

The Maxwell Land Grant, also known as the Beaubien-Miranda Land Grant, was a 1,714,765-acre Mexican land grant in Colfax County, New Mexico and part of adjoining Las Animas County, Colorado. This grant was one of the largest contiguous private landholdings in the U.S., as large as twice the size of Rhode Island. It is the primary reason for large land holdings in the upper Purgatoire Watershed.

Before white settlement, the land was an undisputed territory of the Apache and Ute Indians, and later the Comanches. In 1841, five years before the U.S. Army arrived Charles Beaubien and Guadaloupe Mirando of Taos, New Mexico applied to Governor Manuel Amijo for the grant, promising to encourage new settlers to come to the area and utilize its resources. Carlos Beaubien was a French-Canadian trapper who became a Mexican citizen. His partner, Gaudaupe Miranda was the secretary to the Governor Manuel Armijo in Sante Fe. Beaubien and Miranda were awarded the grant though did not receive it for two years after it has been issued. On February 13, 1843, they asked the Taos, New Mexico Justice of the Peace to sign an order promising them possession of the land, making them in full possession.

Lucien Bonaparte Maxwell, a fur trapper from Illinois, was working as a guide, where he often worked on the Beaubien-Miranda ranch. Maxwell married one of Beaubien's six daughters and was hired to manage Carlos Beaubiens interests. He increased herd numbers and by 1864, after the death of his father-in-law, was able to buy all shares of the ranch, and made the 1,714,765 acres his own, renaming the property the Maxwell Land Grant.

Maxwell sold the land in 1870, and six months later it was sold again to a Dutch Firm in 1872. The new grant owners wished to remove all squatters (farmers and miners) who had settled on the land. Grant officials, in league with lawyers, politicians and businessmen joined forces to form a group known as the Santa Fe Ring. They began making false allegations against locals and tried to force the squatters off the land. This quickly led to what became known as the Colfax County War. On August 25, 1888, several people were killed during a violent incident at Stonewall, Colorado. Eventually, after many disputes, ranchers, loggers, and private organizations gradually subdivided the land throughout the 1900s.

2.4.3 **Military Land Use**

Piñon Canyon Maneuver Site

The Piñon Canyon Maneuver Site (PCMS) is a 235,896-acre (955 square kilometers) U.S. Army base lies within the Purgatoire River Watershed near its eastern boundary and the town of Thatcher, Colorado. At PCMS the Purgatoire River flows in a 300-400 feet deep canyon and its tributaries have cut steep arroyos into the terrain. The Site functions as an active military training post servicing Fort Carson and other Army installations to accommodate a full range of maneuver training, including brigade-level used for both small arms weapons qualification and convoy deployment. The primary mission of the PCMS is to conduct live fire exercises on weapons training ranges and tactical vehicle maneuver operations for all assigned combat brigades.

Prior to becoming a maneuver site in the 1980's, this region was devoted to ranching and livestock grazing. The Federal government acquired the land in 1983, and since many landowners were unwilling to sell, the Army used eminent domain to obtain 75% of the area. Half of the land was acquired through *eminent* domain, 25% was acquired through *friendly* domain at the request of legal representation of some ranchers, 15% was a transfer of public land, and the remaining 10% was private sales. On-site facilities include a cantonment area, a railhead, helipads, and an airstrip, which are used for training purposes.

2.4.4 **Agricultural Land Use**

The NRCS Rapid Watershed Assessment done for the Purgatoire Watershed found Las Animas to have the greatest acres of county land in farms and ranches within the watershed, encompassing 2,304,766-acres (Table 2-8). Though there are more farms and a greater number of county acres associated with agriculture in Las Animas County, Otero County has the greatest number of cattle and calves, with 65,000 animals.

Table 2-6: County Agricultural Characteristics

Characteristic	Bent County	Las Animas County	Otero County
Farms (number)	265	567	488
Land in farms/ ranches (acres)	735,826	2,304,766	546,396
Average size farm/ ranch acres	2,777	4,065	1,120
Median size farm (acres)	580	1,000	170
Average age of farmer or rancher	53.9	57.6	52.3
Net cash return from ag sales ($1,000)	5,898	1,798	2,935
Cattle and calves number	45,000	47,000	65,000

Source: *NRCS (2007). Rapid Watershed Assessment*

2.4.5 **Recreational Land Use**

Tourism

A number of recreational sites draw tourists to the area and offer residents year-round outdoor activities. For example, the Trinidad K-T Boundary Natural Area, designated by Colorado Parks and Wildlife (CPW), encompasses 180 acres of Trinidad Lake State Park and is known for significant evidence of asteroid impacts, which may have occurred 65 million years ago at the end of the Cretaceous Period. Named for the Cretaceous- Tertiary (K-T) surface boundaries, the K-T Boundary Natural Area contains authentic evidence of dinosaurs, as does the Picketwire Cayonlands located on Comanche National Grasslands . Additional attractions in Picketwire Canyon include Indian rock art that decorates Dakota Sandstone with petroglyphs ranging from 375 to 4,500 years in age. An abandoned mission, cemetery and the Rourke Ranch can also be explored in Picketwire Canyon which is located in the northeast end of the Watershed and can be reached from Colorado Highway 109, via county roads, to the Withers Canyon Trailhead.

Other notable attractions found within the Watershed, and proximate to John Martin Reservoir, include the Comanche National Grasslands (Otero, Baca and Las Animas Counties), Bent's Old Fort National Historic Site (Otero County), the Kit Carson Museum (Las Animas County), and Boggsville National Historic Site (Las Animas County).

Trinidad Lake State Park is a destination itself and offers trails, camping and interpretive programs. Up the Highway of Legends (State Highway 12) from the Park, near Stonewall, is the historic Monument Lake Resort. The Resort is the site of a Works Projects Administration -built Fish Hatchery and Zoo, as well as rustic Santa Fe-style adobe structures, including a lodge and cottages. Nearby are primitive campgrounds and trails that access the Culebra Range Mountains as well as the Spanish Peaks. Along the same highway is access to the Bosque del Oso and the Spanish Peaks State Wildlife Areas.

Recreation

The Purgatoire River Watershed provides many recreational opportunities for the outdoor enthusiast. While much of the watershed is not available to the public, there are still many areas where local citizens and visitors to the community can enjoy leisure and sport. (See also Table 2-9 below.)

One of the greatest resources providing information about state owned land available to the public is "2013 Colorado State Recreation Lands," distributed by CPW. The brochure includes state parks, state wildlife areas, and state land trusts. Another great resource for recreation in the watershed and surrounding areas is the Trinidad Outdoor Club (see Appendix A: Resources). Founded recently in 2013, the Trinidad Outdoor Club offers an informal way for outdoor enthusiasts to gather for excursions, from bird walks to peak climbs to downhill skiing, that are planned by members and posted by E-mail.

Some recreation activities available in the Watershed include:

<u>Bicycling</u>

Road biking is a popular sport and can be done on any public road with the exception of Interstate Highways. Local regulations should be consulted before planning a trip. Mountain biking or trail riding is available at Trinidad Lake State Park and the Comanche National Grasslands.

<u>Bird Watching</u>

Bird and Nature watching can be done just about anywhere, anytime, and with minimal expense. For more information see the bird list for southeastern Colorado and the Southern Colorado Audubon Society web page (Appendix A).

<u>Boating</u>

There are three (3) public lakes that will allow boating. Both North Lake and Monument Lake allow small boats that can be powered with electric trolling motors. No gas motors are allowed in the lakes because they are also sources of drinking water. Trinidad Lake State Park allows boats with gas motors and has a nice boat ramp. Boats are inspected for invasive species at the park. Boating on the Purgatoire River itself is limited due to access and the amount of flow. Much of the river passes through private land, limiting access. Flows of enough volume to facilitate canoeing or kayaking the river are limited to the demand of the agricultural industry.

<u>Camping</u>

Camping is available at the Purgatoire Campground, Bosque Del Oso State Wildlife Area, Monument Lake, San Isabel National Forest "Potato Patch" and Trinidad Lake State Park, among other areas.

<u>Cross Country Skiing</u>

Trinidad Lake State Park is available for cross-country skiing when conditions permit.

Dinosaur Tracks

Mentioned above, for the amateur paleontologist, a short hike in the Picketwire Canyonlands will take the curious to a stunning and nationally known site of dinosaur tracks. See Appendix A for more information on Picketwire Canyon and geological history of the Great Plains.

Fishing

Public access allows anglers to fish for brook, brown and rainbow trout, as well as catfish, chubs, suckers and smallmouth bass. Access to the Purgatoire River is available at the Purgatoire Campground, Bosque del Oso, Trinidad Lake State Park, Monument Lake, North Lake and in Downtown Trinidad along the River Walk and in Central Park. Trinidad Reservoir has brown and rainbow trout, channel catfish, bass, crappie, and strippers. Ice fishing is available when conditions permit. State fishing regulations can be found online as well as more information about the local Trout Unlimited chapter (see Appendix A).

Geocaching

According to the Geocaching website, geocaching is “a worldwide game of hiding and seeking treasure. A geocacher can place a geocache in the world, pinpoint its location using GPS technology and then share the geocache’s existence and location online. Anyone with a GPS unit can then try to locate the geocache.” Inside a geocache container is a logbook for participants to sign. Seven geocache sites are located on Trinidad State Park property. Coordinates may be obtained by visiting www.geocaching.com or by picking up a geocache brochure at the Park Visitor Center where GPS units may also be rented.

Hiking

Hiking is available on all public lands including Trinidad Lake State Park, Comanche National Grasslands, and the Pike and San Isabel National Forests.

Horseback Riding

Horseback riding is permitted at Trinidad Lake State Park. There are also non-motorized trails accessible from the Purgatoire Campground run by the USDA Forestry Department. The Comanche National Grasslands also provide opportunities for horseback riding as well as the Pike and San Isabel National Forests. Special groups are sometimes allowed to ride at the Bar N-I Ranch, Vermejo Park and the Stonewall Guest Ranch.

Hunting

Hunting is available on private lands through outfitters and ranchers, as well as on public lands. Game species available are deer, elk, black beer, mountain lion, pronghorn, turkey, waterfowl, and small game such as rabbits and squirrels. Public lands include those maintained by CPW, such as Trinidad Lake State Park, Hill Ranch, Purgatoire Wildlife Ranch, Rimrock Ranch, and Bosque de Oso (special regulations apply). There are two tracts of land that are in the Pike and San Isabel National Forest that allow hunters access to game. Both of these tracts are located just northwest of Stonewall, CO and are accessible from CO Highway 12. There are numerous private ranches in the watershed that provide hunts, usually with an outfitter for deer, elk, and pronghorn. State hunting regulations can also be found online (see Appendix A).

Mushrooming

Public lands located in higher altitudes often provide better mushrooming and other plant foraging opportunities. More information can be found through the Colorado Mycological Society (see Appendix A).

Nature Studies

There are plenty of opportunities to have a first-hand experience with wildlife in any of the public lands located in the Watershed. Such opportunities include orienteering and picnicking, which most popularly are done at Trinidad Lake State Park, Purgatoire Campground, North Lake, Monument Lake and Comanche National Grasslands. Nature studies, including bird watching, is also available on the Piñon Canyon Maneuver Site through a permission process.

Water Skiing

Trinidad Lake State Park has water skiing available seasonally when conditions permit.

See Table 2-7 below for a summary of recreational activities available at various sites in the Watershed.

Table 2-7: Recreation by Location for the Purgatoire Watershed

Site	Bicycling	Bird & Wildlife Viewing	Boating	Camping	Cross Country Skiing & Snow Shoeing	Fishing	Hiking	Horse–Back Riding	Hunting	Mushroom Hunting	Picnicking
Purgatoire Camp Ground	X	X		X	X	X	X	X	X	X	X
Trinidad Lake SP	X	X	X	X	X	X	X	X	X	X	X
Bosque De Oso	X	X		X		X	X	X	X	X	
Comanche National Grassland	X	X		X			X	X			X
Hill Ranch									X		
Purgatoire Ranch									X		
Rimrock Ranch									X		
North Lake SWA		X	X			X	X				X
Monument Lake		X	X			X	X				X
Higbee Canyon STL		X					X		X		
Sakariason STL		X					X		X		
Setchfield SWA		X					X		X		X

Source: Mark Hanson (2013)

2.5 Common Resource Areas and Descriptions

Common Resource Areas (CRAs) are defined by the Natural Resources Conservation Service (NRCS) as a geographic area where resource concerns, problems or treatment needs are similar. Common Resource Areas identified within the Purgatoire watershed are the Central Great Plains, Southern Part; Northern New Mexico Highlands; Southern Rocky Mountain Foothills; Southern Rocky Mountains High Mountains and Valleys; and the Upper Arkansas Valley Rolling Plains (shown in Figure 2-10). The CRA covering the greatest amount of the watershed is the Upper Arkansas Valley Rolling Plains. The CRA with the least acreage throughout the watershed is the Northern New Mexico Highlands. These areas are important to the watershed, as they guide future management treatments and strategies.

Central Great Plains, Southern Part

The Central Great Plains, Southern Part Common Resource Area (CRA) is characterized by broad, undulating to rolling plains that are dissected by streams and rivers (shown in Figure 2-12). Soils are deep and made up of alluvial and eolian materials. Nearly all of this area is fallow cropland rotations or range- land. Some cropland areas are irrigated. Local relief is measured in tens of feet on the plains. Before settlement in the area, vegetation was composed of short-grass prairie.

Northern New Mexico Highlands

This CRA is characterized by broad, rolling plains segmented by closed basins and drainageways that have smooth-shaped valley floors. Rugged breaks are common in the northern part of the area. Piñon and juniper trees and shrubs can be found in higher elevations and on the breaks. In the lowlands native vegetation is mid- to short-grass prairie. Soils were formed in weathered sedimentary rocks of Cretaceous age and igneous rocks of Tertiary and Quaternary age. These areas refer to the mesa system north of Fisher’s Peak.

Southern Rocky Mountain Foothills

The Southern Rocky Mountain Foothills are generally marked as the transition between the Great Plains and the Southern Rocky Mountains. The moisture regime is ustic and the temperature regime is mesic or frigid. Native vegetation ranges from grasslands and shrubs to ponderosa pine and Rocky Mountain Douglas fir forest.

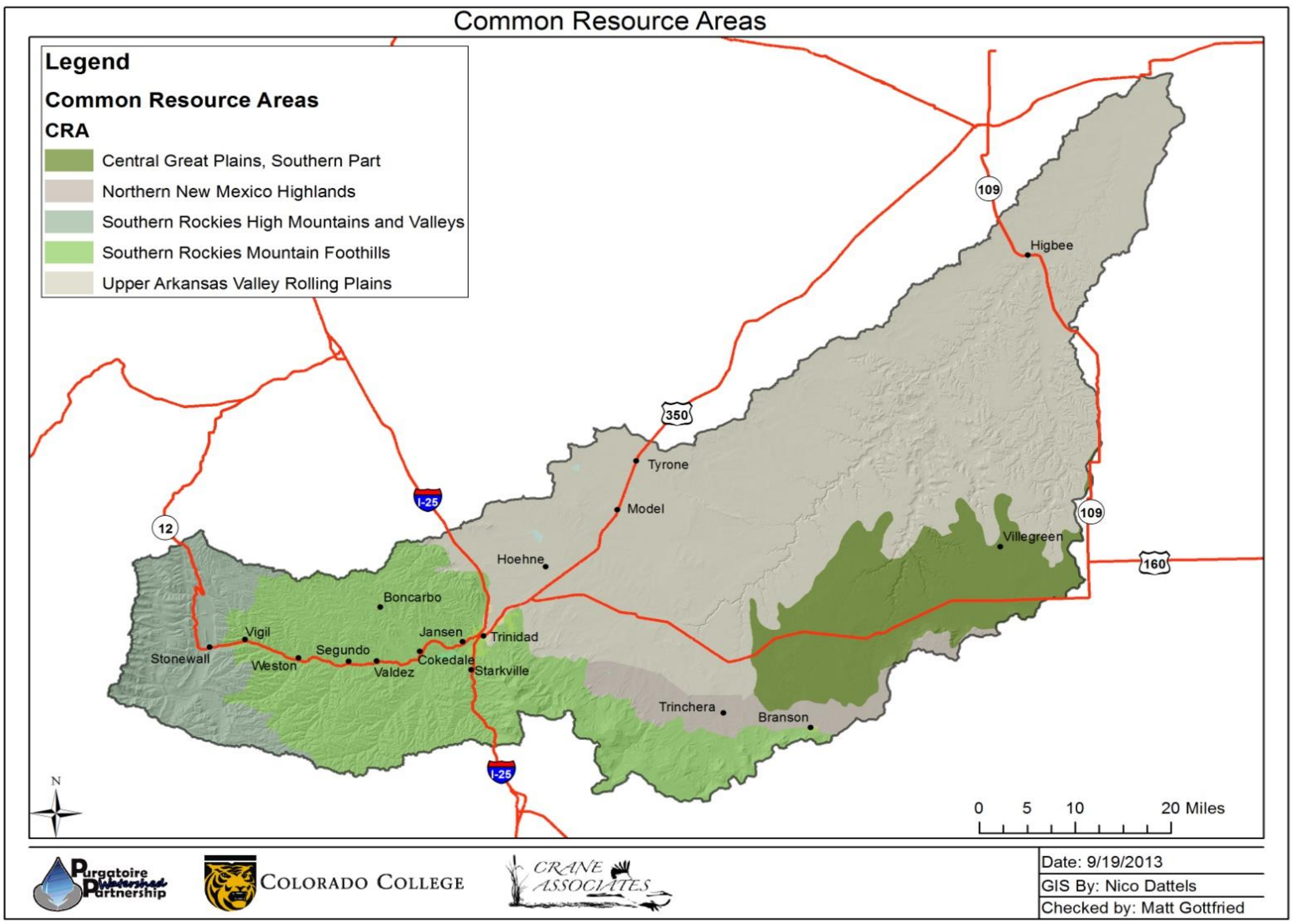
Southern Rocky Mountains High Mountains and Valleys

This CRA is best described by steep, high mountain ranges and associated mountain valleys. Moisture regimes are mostly ustic and udic; temperature regimes are mostly cryic and frigid. Sage brush-grass makes up the vegetation in low elevations. As elevation increases coniferous forest to alpine tundra make up the vegetation.

Upper Arkansas Valley Rolling Plains

The Upper Arkansas Valley Rolling Plains CRA is broad, undulating to rolling shale plains found along the upper tributaries of the Arkansas River. Local relief reaches 200 feet. Short-grass prairies and piñon and juniper stands found on the stony and rocky soils were the vegetation types pre-settlement. Now almost all of this area is rangeland with small areas of irrigated cropland along the terraces and floodplain. Soils are shallow to deep and formed in eolian, alluvial, outwash and loess materials.

Figure 2-8: Common Resource Areas in the Purgatoire Watershed



Source: Colorado College (2013). Prepared by Nico Dattels

2.6 Environmental Resources

2.6.1 Forests and Grasslands

The lower Purgatoire River Watershed is quite exemplary of a largely intact and untilled landscape within the Central Shortgrass Prairie Ecoregion. Due to its biodiversity values and threats, this site has been identified as a *priority conservation area* by The Nature Conservancy in Colorado (see also Section 2.7: Colorado Natural Heritage Program Conservation Areas below).

The lower Watershed is dominated by rolling grasslands with hills of juniper that also contain occasional stands of piñon pine. Vegetation in the canyons is approximately 46% piñon - juniper, 28% grassland or mixed grasses/forbs/cacti, 21% shrubland or shrubs mixed with grass and juniper, and 4% greasewood. This area of the Watershed also contains trace amounts of open water, riparian corridors and agricultural lands.

2.6.2 Wetlands and Riparian Zones

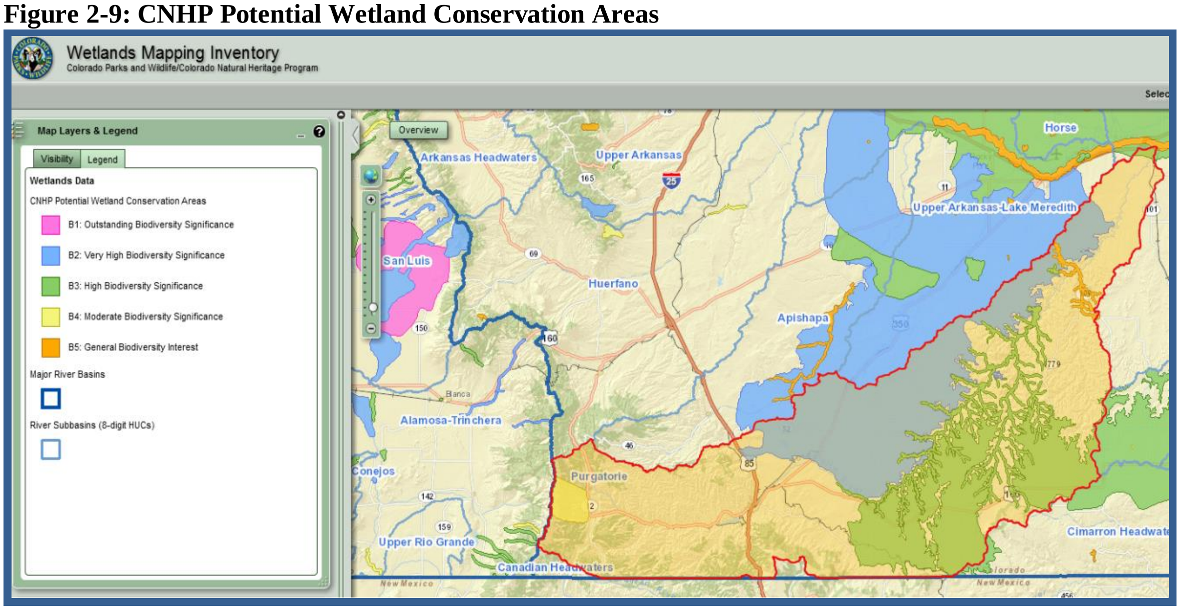
Wetlands are important elements within an ecosystem for a number of reasons. Wetlands have the ability to provide multiple economic, social and ecological benefits through fish, wildlife and plant habitat. Wetlands act as nurseries for many freshwater, saltwater and shellfish species of importance to recreational and commercial needs. A wetland can hold and slowly release flood water and snowmelt, recharge groundwater, provide recreation and wildlife viewing havens, and recycle nutrients throughout a landscape.

Colorado Natural Heritage Program

Although digital wetland mapping in Colorado is limited, the Colorado Natural Heritage Program (CNHP) has created an online database which includes a Colorado Wetlands Inventory Mapping Tool. The Tool allows users to view the status of several major wetland mapping efforts and actual mapped polygons based on datasets generated by a number of entities, such as the National Wetlands Inventory (NWI), Colorado Parks and Wildlife, Rocky Mountains Bird Observatory, local governments (Boulder and Summit Counties), and other various parties. Datasets produced by the CNHP found in the mapping tool are Potential Conservation Areas (PCAs) and Modeled Intensity of Wetland Stressors.

Using the Mapping Tool to analyze the CNHP Potential Wetland Conservation Areas in the Purgatoire River watershed revealed that the greatest area within the basin with data generated for it is rated with a B3: High Biodiversity Significance. The rating system goes from B1 to B5 with B1 as the greatest potential or more "Outstanding Biodiversity Significance." A smaller area within the upper Purgatoire watershed was rated as a B5: General Biodiversity Interest, the lowest potential rating (Figure 2-11). The CNHP has created PCA ratings by collecting data on imperiled and rare species, subspecies and natural communities in Colorado. The data represents an estimate of the primary area supporting the long-term survival of the targeted species, subspecies and natural communities.

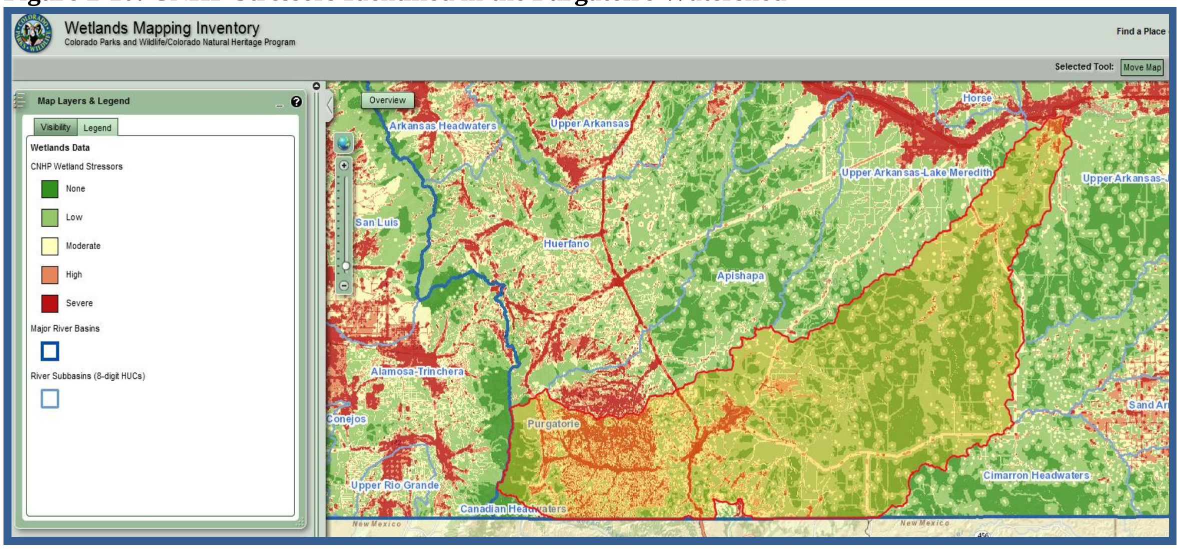
Figure 2-9: CNHP Potential Wetland Conservation Areas



Source: CNHP (2013). Retrieved from http://ndismaps.nrel.colostate.edu/wetlands/

The Wetland Stressor layer showed that the majority of the Purgatoire River was found to have none to a low rating of wetland stressors. However, the lower southwestern portion of the Watershed, closer to the New Mexico border, had the most continuous area affected by a high number of stressors primarily due to oil & gas development (Figure 2-12). CNHP has created a statewide landscape integrity model, specific to wetlands and used to reflect the impact to wetlands from map-able, cumulative, anthropogenic changes made to the water and the land. The model generated numbers of severity based on a number of inputs: Density of Dams & Diversions; Mining Hydrological Modification; Land use & Development; Housing and Commercial Development; Agriculture; Energy; Development/ Extraction; Roads; Reservoir Storage as a proportion of mean annual flows; Altered Flows as a proportion of mean annual flows; Tamarisk Infestation; Oil & Gas Wells; Water Wells; and Wind Turbines.

Figure 2-10: CNHP Stressors Identified in the Purgatoire Watershed



Source: CNHP (2013). Retrieved from <u>*http://ndismaps.nrel.colostate.edu/wetlands/*</u>

2.6.3 Fisheries

According to Colorado Parks and Wildlife there are several cold and warm water fisheries available to the public located in the Purgatoire Watershed. More information of fisheries can be found on the Colorado State University website (see Appendix A). The following table, Table 2-8, identifies lakes reservoirs and streams found in the area. Fish species and special fishing regulations are also listed for the Purgatoire Watershed by specific area and water body. The most abundant fish species found is the Rainbow trout, which have been located in all but one water body.

Table 2-8: Lakes, Reservoirs and Streams

Name of Water body	Specific Area	Fish Species Found	Special Fishing Regulations
Purgatoire River, Middle Fork	Within the Bosque del Oso State Wildlife Area	* Trout: Brook * Trout: Cutbow * Trout: Rainbow	* Fishing is by artificial flies and lures only. * All fish must be returned to the water immediately upon catch.
Purgatoire River, South Fork	Within the Bosque del Oso State Wildlife Area	* Trout: Brook * Trout: Cutbow * Trout: Rainbow	* Fishing is by artificial flies and lures only. * All fish must be returned to the water immediately upon catch.
Monument Reservoir	City of Trinidad - Monument Lake Resort	* Salmon: Kokanee * Trout: Brown * Trout: Cutbow * Trout: Rainbow	* Snagging of kokanee salmon is permitted from October 1 through December 31.

North Lake	North Lake SWA	* Salmon: Kokanee * Splake * Trout: Brook * Trout: Brown * Trout: Cutbow * Trout: Rainbow	* Snagging of kokanee salmon is permitted from October 1 through December 31.
Trinidad Central Park Lake	Trinidad Central Park	* Bass: Largemouth * Catfish: Channel * Bluegill * Trout: Rainbow	* Youth only.
Trinidad Reservoir	Trinidad Lake State Park	* Bass: Largemouth * Bass: Smallmouth * Wiper * Catfish: Channel * Crappie: Black * Perch: Yellow * Saugeye * Walleye * Bluegill * Trout: Brown * Trout: Cutbow * Trout: Rainbow	* The minimum size for largemouth, smallmouth, and spotted bass is 15 inches in length. * The bag and possession limit for walleye and saugeye is five fish in the aggregate. * No more than one walleye or saugeye in the aggregate greater than 18 inches in length may be taken per day. * Underwater spearfishing may be used as a method of fishing in accordance with regulations issued by Colorado Parks and Wildlife. Underwater spearfishing is prohibited within 100 feet of any marina, boat ramp, swim beach or dam infrastructure.

Source: CPW (2013). Retrieved from http://ndismaps.nrel.colostate.edu/fishingatlas/

Species of game fish are stocked in Trinidad Lake and include spotted bass, largemouth bass, small mouth bass, saugeye, walleye, channel catfish, wipers, yellow perch, bluegill and crappie.

2.6.4 Wildlife

Much of the landmass located within the Purgatoire Watershed is covered by shortgrass prairie. This area is significant in Colorado because it accounts for much of the state's agricultural productivity and ecological diversity. Productive grasslands able to raise livestock and a variety of wildlife species led many early settlers to this area. Livestock production still remains high though many of the original species ranging from herds of American bison to mountain plover populations have suffered and much of the once diverse landscape has been fragmented, as a result of grazing management. At present, the Purgatoire watershed elk range remains outstanding, and areas recognized specifically for other game species.

Just two miles south of the town of Las Animas, the Purgatoire River State Wildlife Area (SWA) is identified as Game Management Unit (GMU) 130. This area is accessible from Highway 50 and County Road 10.75. The GMU is approximately 913-acres and a minimum of 3,890 feet to a maximum of 3,972 feet in elevation. Species hunted within the Unit include deer, rabbit, squirrel, bobwhite quail, pheasant, scaled quail, dove, turkey, and waterfowl.

Throughout the Purgatoire drainage basin, in Bent, Otero and Las Animas Counties, there are fourteen (14) GMU's regulated by Colorado Parks and Wildlife (CPW). GMUs 125, 126, 129, 130, 133, 134, 135, 136, 137, 141, 142, 143, 146, and 147 are identified as partially or fully included in the watershed boundary. Wildlife populations found within these Units are composed of turkey, pronghorn, mule deer, elk and bighorn sheep.

Colorado Division of Wildlife Deer Management Plan for Trinidad Data Analysis Unit D-32, Summary of Findings

Background
A Deer Management Plan was completed in April 2007 for Trinidad Data Analysis Unit (DAU) D-32 focusing on GMU's 85, 140 & 851 by the Colorado Division of Wildlife (CDOW). Within these units landownership is composed of 85% Private, 6% State, 5% USFS, and 2% BLM. The Current post-hunt population objective for these areas fell between 9,800-10,800, greater than the 2006 estimate of 5,900 species. The previous (1987) post-hunt population objective was 12,000 deer. The deer population has declined since the previous 1987 post-hunt population. Antlerless harvest has been confined to

private land only in GMU's 85 and 140 because winter concentration of deer damaged habitat and caused game damage to private lands. In 2005 the limited amount of antlerless licenses once available were removed, and none have been available since. The current post-hunt sex ratio (bucks/ 100 does) objective was 25-29 bucks, and the previous post-hunt sex ratio (bucks/ 100 does) objective was 40, which was adopted in 1987. In 2006 the post-hunt sex ratio observed was 44, though 30 bulls were modeled. 40 bucks to 100 would allow for "trophy" management within the DAU, though the Wildlife Commission did not make that classification and therefore the DAU is not eligible for "trophy" management and the sex ratio objective will be reduced to a level below 29 bucks per 100 does.

Deer populations have been declining since 1985. Since 1998, less than 45 antlerless licenses are available for the DAU, a very low number for the entire area. Low postseasons fawn/doe ratios in previous years indicates that recruitment into the yearling class is low, which essentially slows population increases which are expected from the elimination of antlerless harvests. In 2005 the fawn/ doe ratio remarkably improved, indicating the habitat had changed, though it is too soon to determine if it was a one-time increase or the beginning of an increasing deer herd.

Current management practices limiting the availability of buck licenses should continue and antlerless harvest should remain restricted. In general, sportsmen are concerned about the decline in deer population and are in support of reducing the population objective to the level expressed in option number 2.

Population changes are a result of land use changes, habitat maturation, methane development, weed competition, a large increase in elk population, and housing development, which all effect habitat quantity and quality and lower the carrying capacity within the DAU. To increase populations there must be a reduction in forage competition and an increase in habitat quality to promote fawn survival. The loss of habitat to private property and methane production may not be offset by habitat improvement projects alone. Additionally, since 2002, multiple large fires have burned through the DAU including the Mericio Canyon Fire and the James M John Fire which burned over 36,000 acres within Colorado and New Mexico. A slight increase in deer populations in these areas are slightly increasing in comparison to the rest of the DAU.

Significant Issues

Findings from a public input process showed a concern for the decline in deer populations and the reduction of deer habitat as a result of methane and housing development. A public survey also identified private land access as another voiced concern. A list of all issues and concerns identified include:

<u>Declining deer population</u>**-** Though declining deer population is a significant concern throughout the DUA, the cause of decline is unknown at this time, though likely a result of many factors; habitat maturation, increasing elk herds competing for available forage; nutritional deficiencies; starvation; increased natural mortality due to predation, and other potential causes.

<u>Housing development</u>**-** The DAU within the last decade has seen a rapid increase in housing developments and ranch sub-division where deer rangeland once was. These changes have permanently altered habitats or have completely eliminated them, including the direct loss of habitat and the effective loss of habitat due to pet and human harassment on deer herds.

<u>Methane development</u>**-** Beginning in the late 1980's, methane development began in the DAU, but did not cause a substantial impact on deer habitat until the late 1990's when extraction techniques improved, and since that time the development has also increased drastically within the area. Wells are drilled on an average density of six wells per section with corresponding maintenance, drilling and human activity that have increased in response to these development needs. Additional road densities, causing fragmentation have increased significantly to service methane operations.

<u>Private land access</u>- The greatest area of land within the DAU is in Private ownership hunter access, which is a continuing concern. The CDOW purchased 38,000 acres, leasing 6,314 since 1987 when the DAU Management Plan was written to help hunters access the area.

Additionally, there is public concern specifically related to predators and habitat quality and quantity.

CDOW Recommendation to the Wildlife Commission Population Objective

The CDOW recommends that deer populations are managed within the range of 9,800- 10,800 species representing an 18% decline in the previous population objective. This decrease results in 3,900 or 40% of species below the current estimated population. The current long term population objective for the DAU is 12,000 species. Landowners and the public support the decline in the population objective. The herd in D-32 has slowly been increasing with very conservative management strategies, and the population is currently about 51% below the 1987 objective of 12,000 and 40% below the new objective. The post-season fawn/ doe ratios in the last several years have been low, averaging 51.5 from 1992-2002, though ratios have been improving, and averaging 78.6% from 2003-2006. This increase is most likely a result of habitat quality caused by large fires burning critical deer winter habitat.

Two substantial problems that managers must work through include habitat loss and maturation. Before deer population can reach an objective of 10,800 species, habitat improvement projects must be used to offset habitat loss. The CDOW recommends a long-term population objective ranging from 9,800- 10,800, balancing public desires to increase the population and to improve recruitment and survival efforts.

Sex Ratio Objective
The recommendation is to manage the sex ratio objective within a range 25-29 bucks per 100 does. Over the past several years sex ratio models have used this range, finding that maintenance at this level would not require license number reductions.

Management Strategy
The DAU management strategy recommendation is status quo. The current management practices which limit available buck licenses should continue and antlerless harvest should remain restricted, however if populations begin to increase above the new population objective there is potential to offer a limited amount of antlerless harvest and allow flexible damage situations.

Colorado Division of Wildlife Elk Management Plan for Trinchera Data Analysis Unit, Summary of Findings

Background
An Elk Management Plan was completed in April 2007 for Trinchera DAU E-33 focusing on GMU's 83, 85, 140, and 851 by the CDOW. Within these units landownership is composed of 89% Private, 3.3% USFS, 1.5% BLM, and 2.4% CDOW. The Current post-hunt population objective for these areas fell between 14,000- 16,000, and the current post- hunt estimate is 16,200 animals. The previous post-hunt population objective was 22,500 elk in 1987, greater than the 2006 estimate of 18,100. In 1987 the population was nearly 15,800. The current post-hunt sex ratio (bulls/ 100 cows) objective is 35-40 and the previous post-hunt sex ratio (bulls/ 100 cows) objective was 50, which was adopted in 1987. The highest observed post-hunt sex ratio occurred in 2003, with 53 bulls/ 100 cows. The 2006 observed post-hunt sex ratio was 35, while 43 bulls were modeled. Efforts to reduce population in recent years had led to an increased antlerless harvest.

Elk population modeling was difficult due to herds moving across New Mexico and Colorado state lines and different survey methodologies preventing states from sharing information on specific parameters such as sex and age ratios and harvest data. However, game managers from both states discussed findings and both estimated population for the DUA at 33,000 elk despite different methodologies. At this time the states decided that though there were definite interchanges across the border, these interchanges were estimated at equal levels in both directions; therefore Colorado elk population could be monitored as a separate entity. It was determined that within the DAU a minimum population of 14,000 elk was the current level, though it an intensive population classification would be done to determine population ratios for planning and modeling processes.

Significant Issues
A public input process was done for the DAU and revealed issues and concerns within the area. A main concern is balancing and maintaining elk populations while development and demands on elk resources increases. A list of all issues and concerns identified include:
Housing development- The DAU within the last decade has seen a rapid increase in housing developments and ranch sub-division where deer rangeland once was. These changes have permanently altered habitats or have completely eliminated them, including the direct loss of habitat and the effective loss of habitat due to pet and human harassment on deer herds.
Methane development- Beginning in the late 1980's, methane development began in the DAU, but did not cause a substantial impact on deer habitat until the late 1990's when extraction techniques improved, and since that time the development has also increased drastically within the area. Wells are drilled on an average density of six wells per section with corresponding maintenance, drilling and human activity that have increased in response to these development needs. Additional road densities, causing fragmentation have increased significantly to service methane operations.
Maintaining high bull/cow ratios- It is important to a large portion of the public to manage the quality of trophy opportunities on public and private lands within E-33. The CDOW's objective however, is to maintain the DAU as a highly productive elk population able to support harvest similar to what it has supported in the past. It is difficult to achieve maintenance population levels accepted by society and in balance with the habitat.
Private land access- 89% of E-33 is in Private ownership hunter access, which is a continuing concern. Issues with trespassing and private landowner rights are an identified problem for GMU's 83, 140 and 851, and hunter access to elk populations especially for antlerless harvests is an increasing concern. The CDOW has purchased 38,000 acres, leasing 6,314 to help with hunter access since the completion of the DAU plan in 1987.

Management Alternatives
Currently the elk population is approximately 18,100 animals, which has been acknowledged as too many elk for the DAU. The CDOW does not recommend managing more than 16,000 elk because of concerns in regard to damage and habitat. Three post-season population objective alternatives proposed include (1) 16,000- 18,000 (2) 14,000- 16,000 (3) 12,000- 14,000.

Managing for more than 40 bulls per 100 cows is not within the realm of possibility for the DAU. Current

CDOW Recommendation to the Wildlife Commission

Population Objective
Managing elk population within the range of 16,000- 18,000, representing a 21% increase from the previous population objective of 14,000, and a 32% reduction from the 1987 objective of 22,500 is the recommendation of the CDOW. This number maximizes opportunity without compromising habitat or agricultural producers' productivity. The management objective also takes into consideration private property issues, game damage issues, and competition for forage with cattle. Sportsmen favor an increased population object greater than what is being recommended.

Sex Ratio
Recommendations made by the CDOW suggest that the sex ratio objective is managed within a range of 35-40 bulls for 100 cows. This represents a 36% decrease in the current estimate. However, the CDOW realizes this may be a difficult to achieve with the current availability of unlimited bull licenses in the 2nd and 3rd season.

Management Strategy
The DAU management strategy recommendation is status quo. Unlimited antlered licenses are available during the 2nd and 3rd seasons, though the 1st and 4th seasons offer limited antlered and antlerless licenses. Antlerless hunts in the past have achieved management objectives, including early and late season PLO licenses, Either-sex licenses for the first and fourth seasons, along with game damage and dispersal hunts.

Colorado Parks and Wildlife Pronghorn Management Plan for Thatcher Herd, Summary of Findings

Background
In July 2012 a Pronghorn Management Plan for DAU PH-7 Thatcher Herd composed of GMU's 128, 129, 133, 134, 135, 140, 141, 142, and 147 was prepared for Colorado Parks and Wildlife (CPW). Within PH- 7 land ownership is 74% Private, 14% Federal (USFS or DOD), 10% State Land Board, 2% CPW, and <1% other. The DAU contains a large pronghorn population in southeaster Colorado, with higher concentrations in the western and south- central portions. CPW estimated the pronghorn herd population in 2008 to greater than 2,500 animals, exceeding the long-term population size objective. That December CPW increased the number of license available throughout the DAU. Since 2009, pronghorn harvests have increased substantially resulting in a decrease in the estimated population size. The post-hunt population previous objection was 6,500, estimating 8,106 in 2011. The approved new objective is 8,000 (7,800- 8,800). The post-hunt sex ratio previous objective was 37, and the 2011 pre-hunt estimate was 40. The 2011 post-hunt modeled 37 and approved 35 (30-40) as the new objective.

Population Objectives
The CPW completed an extensive public involvement process including online surveys, public meetings, a 30-day comment period, in addition to many other outreach and information gathering procedures. Finding include:
Population Objectives
Alternative #1- 8,000 (7,200- 8,800) pronghorn estimated 2011 post-hunt population size. This alternative would be reduced to hold the population at the new population size by increasing harvest pressure.
Alternative #2- 6,500 (5,500- 7,500) pronghorns, representing a 25% reduction in the number of animals from the current modeled population size. This number is also the current long-term population objective.
Alternative #3- 9,000 (8,000- 10,000) pronghorn encompasses 20% increase from the current modeled population size.
Sex Ratio Objectives
Alternative #1- 35 (35-30) bucks per 100 does represents the current sex ratio objective and encompasses the long-term average sex ratio for the population.
Alternative # 2- 30 (25-35) bucks per 100 does would reduce the current sex ratio objective by approximately 20%.
Alternative #3- 45 (40-50) bucks per 100 does would increase the current observed sex ratio by approximately 15%.

Approved Alternatives
Post-hunt population objective range= 7,200- 8,800
74% of the DAU is owned by private landowners; therefore it is necessary to balance the needs of landowners. However, the public involvement process revealed that the group was evenly split in their alternative preferences, but 19 out of 29 landowners preferred a population objective at or above the 2011 post-hunt population level composed of approximately 8,100 pronghorn. Hunters were evenly split on the current population level remaining the same verses increasing. The alternative chosen (objective range 7,200- 8,800) was decided as a compromise between increasing the objective, and also considers the concerns of landowners that did not want an increase in the long-term objective. Low production and increased

harvest in 2011 have resulted in reduced licenses to allow the population to reach the approved alternative level, though alternative strategies may be used in the future to target harvest in areas with a high potential for game damage.

Post-hunt sex ratio objective range= 30-40 bucks per 100 does
Utilizing this alternative maintains the current sex ratio objective for the population and was favored by most hunters and land owners within the DAU. It will continue to provide a high level of opportunities for hunters and landowners to draw hunting licenses.

Trinidad Lake State Park Draft Environmental Assessment and Findings of No Significant Impact for the Trinidad Lake State Park Fuels Management Project, 2013

AMEC Environmental & Infrastructure, Inc. in cooperation with CPW and the U.S. Army Corps of Engineers put together a *Draft Environmental Assessment and Finding of Significant Impact for the Trinidad Lake State Park Fuels Management Project in Las Animas County, Colorado*. The report was concluded on May 2013, and provides up to date information about wildlife species occurring within the Trinidad Lake State Park:

Wildlife species occupying the Trinidad Lake State Park (LSP) are those commonly found in sagebrush shrublands in the transition zone between the Great Plains and the Rocky Mountains, and piñon/ juniper. Mule deer, white-tailed deer, coyote and bob cat are among the large mammals found in the Park. In higher elevations Rocky Mountain elk, mountain lion, and black bear are occasionally seen. North American beaver, piñon mouse, desert cottontail, Mexican woodrat, Botta's pocket gopher, and gray fox, in addition to seven bat species, two of which are considered rare found within the Park. Reptile species found include bullsnake, prairie rattlesnake, Texas horned lizard, red-lipped plateau lizard, collared lizard, and prairie racerunner often found. The piñon/ juniper woodlands, rock outcrops and abandoned mines in the Park create good habitat for reptiles and bats alike. Amphibians in the park are Plains spadefoot, tiger salamander, New Mexico spadefoot, and Woodhouse's toad.

Residential and migratory bird species can be found in the Trinidad LSP. Migratory birds often do not nest or breed in the Park, though use it as a resting stop while migrating. Occurring species include shorebirds, waterfowl, gulls, great blue heron, black-crowned night heron, Clark's grebe, and Forster's tern. Shrublands and forested areas support piñon jays, cliff swallows, mountain bluebirds, and the common raven. Bald eagle, golden eagle, osprey (raptors), northern harrier, prairie falcon, shark shinned hawk, red-tailed hawk, Swainson's hawk, ferruginous hawk and Cooper's hawk. Resident bird species and migratory song birds rely on shrubland and riparian habitat on the Purgatoire River for food, shelter and nesting areas.

Colorado Parks and Wildlife Bosque Del Oso State Wildlife Area
The Bosque Del Oso State Wildlife Area (SWA) is located in the Watershed approximately 25 miles west of Trinidad on Colorado State Highway 12. Purchased in 1998 with hunting license dollars, the 30,000 acre Bosque del Oso is the largest State Wildlife Area in Colorado. The Bosque del Oso now protects critical habitat for elk, black bear, turkey, deer, and bald and golden eagles. When the SWA was purchased all mineral rights and surface property rights were severed because surface and mineral interests belonged to different parties. A surface agreement was therefore developed between Pioneer Natural Resources, an oil and gas company, and the State. Stipulations in the agreement provide for seasonal and daily restrictions on construction and maintenance operations, which limit industry vehicle traffic to six hours during the day. Agreements such as this between partners allow for economic activities to continue while simultaneously considering the well-being of wildlife, at times a necessary partnership on public lands.

2.6.5 Species of Concern

There are nineteen (19) Colorado *species of concern* in the Purgatoire Watershed (see Table 2-12 below). Species of concern is a term that commonly refers to species that are declining or appear to be in need of concentrated conservation actions. The term commonly refers to species that are declining or appear to be in need of concentrated conservation actions. Many agencies and organizations maintain lists of these at-risk species.

State by state various organizations take on the task of documenting and storing information about species of concern. One such entity in Colorado is the Colorado Natural Heritage Program (CNHP), a non-profit scientific organization established in 1979 and affiliated with the Warner College of Natural Resources at Colorado State University. The CNHP is Colorado's only comprehensive source of information on the status and location of species of concern, or more specifically Colorado's most threatened and rare species and plant communities. The CNHP tracks and ranks these imperiled species and habitats to provide scientific and expert-generated information, and in turn promotes conservation. The Program shares information with a wide range of stakeholders in partnerships that work to ensure that Colorado's biodiversity resources are not diminished.

CNHP has an enormous impact on conservation in Colorado through these partnerships. More information on the CNHP can be found on the internet (see Appendix A).

Table 2-9: Species of Concern

Common Name (Scientific Name)	Status
Western Narrow-mouthed Toad (Gastrophryne olivacea)	Colorado species of concern
Plains Leopard Frog (Lithobates blairi)	Colorado species of concern
Ferruginous Hawk (Buteo regalis)	Colorado species of concern
Mountain Plover (Charadrius montanus)	Colorado species of concern
American Peregrine Falcon (Falco peregrinus anatum)	Colorado species of concern
Bald Eagle (Haliaeetus leucocephalus)	Colorado threatened
Long-billed Curlew (Numenius americanus)	Colorado species of concern
Suckermouth Minnow (Phenacobius mirabilis)	Colorado endangered
Flathead Chub (Platygobio gracilis)	Colorado species of concern
Townsend's Big-eared Bat (Corynorhinus townsendii pallescens)	Colorado species of concern
Black-tailed Prairie Dog (Cynomys ludovicianus)	Colorado species of concern
Black-footed Ferret (Mustela nigripes)	Federally and Colorado endangered
Swift Fox (Vulpes velox)	Colorado species of concern
Meadow Jumping Mouse (Zapus hudsonius luteus)	ESA candidate
Colorado Checkered Whiptail (Aspidoscelis neotesselata)	Colorado species of concern
New Mexico thread snake (Leptotyphlops dissectus)	Colorado species of concern
Texas Horned Lizard (Phrynosoma cornutum)	Colorado species of concern
Roundtail Horned Lizard (Phrynosoma modestum)	Colorado species of concern
Massasauga (Sistrurus catenatus)	Colorado species of concern

Source: CNHP (2013). Retrieved from http://www.cnhp.colostate.edu/

Threatened Species
Threatened species are any species which are vulnerable to endangerment in the near future. The threatened species found within the Purgatoire Watershed are the burrowing owl and the bald eagle.

Endangered Species
There are a number of endangered species, classified as either state or federally endangered species, occurring within the Purgatoire River Watershed. The only amphibian considered endangered is the boreal toad. Birds include the whooping crane, least tern, southwestern willow flycatcher, and plains sharp-tailed grouse. Fish species include the, Rio Grande sucker, lake chub, Plains minnow, suckermouth minnow, northern redbelly dace, and southern redbelly dace. Mammals include the gray wolf, black-footed ferret, grizzly bear, lynx, wolverine, and kit fox.

Future identified projects may require U.S. Fish and Wildlife Service review before implementation.

2.7 Colorado Natural Heritage Program Conservation Areas

Similar to documenting species of concern, within the Purgatoire Watershed twenty-eight (28) Potential Conservation Areas (PCA) have been reported and mapped by the CNHP. In order to successfully protect populations, as well as document species occurrences, it is necessary to delineate conservation areas. The 28 PCAs identified focus on capturing the ecological processes that are necessary to support the continued existence of a particular element of natural heritage significance. PCAs may include a single occurrence of a rare element, such as a plant, animal or habitat niche, or a suite of rare elements or significant features.

The goal of the PCA process is to identify a land area that can provide the habitat and ecological system upon which a particular element or suite of elements depends for their continued existence. The best available knowledge of each species' life history is used in conjunction with information about topographic, geomorphic and hydrologic features, vegetative cover, as well as current and potential land uses. The proposed boundary does not automatically exclude all activity. It is hypothesized that some activities will cause degradation to the element or the process on which they depend, while others will not. Consideration of specific activities or land use changes proposed within or adjacent to the preliminary conservation planning boundary should be carefully considered and evaluated for their consequences to the element on which the conservation unit is based. Table 2-10 below shows all PCAs mapped for the Purgatoire watershed by CNHP site code and latitudinal/ longitudinal location. Each PCA can give specific restoration objectives to potential projects in these areas.

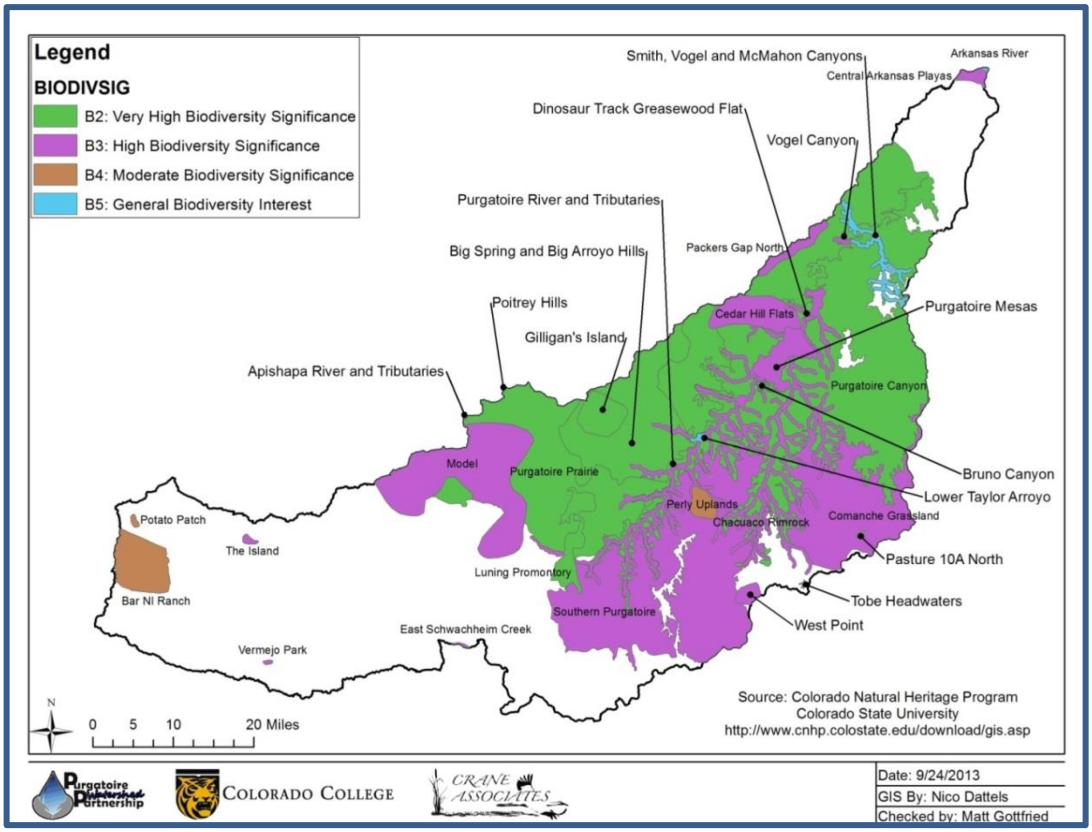
Table 2-10: PCA's Mapped for the Purgatoire Watershed

PCA Name	CNHP Site Code	Location (Lat/Long)
Bar NI Ranch	S.USCOFO*50	37.11.28N/ 105 06 14W
Big Spring and Big Arroyo Hills	S.USCOHP8*3282	37.29.07N/ 104.00.29W
Bruno Canyon	S.USCOHP*28135	37.29.59N/ 103.41.46W
Cedar Hill Flats	S.USCOHP*26874	37.37.48N/ 103.43.05W
Central Arkansas Playas	S.USCOHP*25350	38.18.42N/ 103.25.48W
Chacuaco Rimrock	S.USCOHP*27094	37.15.22N/ 10.342.18W
Comanche Grassland	S.USCOHP*25491	37.28.47N/ 102.51.00W
Dinosaur Track Greasewood Flat	S.USCOHP5*174	37.37.14N/ 103.35.38W
East Schwachheim Creek	S.USCOHP*8788	37.01.32N/ 104.23.10W
Gilligan's Island	S.USCOHP*26603	37.27.10N/ 104.03.50W
Lower Taylor Arroyo	S.USCOHP*27154	37.24.29N/ 103.50.53W
Luning Promontory	S.USCOHP*27118	37.13.27N/ 104.07.59W
Model	S.USCOHP*038	37.19.01N/ 104.30.07W
Packers Gap North	S.USCOHP*9568	37.44.48N/ 103.38.31W
Pasture 10A North	S.USCOHP*9564	37.13.49N/ 103.29.06W
Poitrey Hills	S.USCOHP*26601	37.37.06N/ 104.07.55W
Potato Patch	S.USCOHP*10607	37.15.48N/ 105.07.16W
Purgatoire Canyon	S.USCOHP*1289	37.28.44N/ 103.33.47W
Purgatoire Mesas	S.USWRO1*1279	37.32.50N/ 103.39.11W
Purgatoire Prairie	S.USCOHP*25152	37.41.06N/ 103.56.20W
Purgatoire River and Tributaries	S.USCOHP*27134	37.23.46N/ 103.39.40W
Smith, Vogel and McMahon Canyons	S.USCOHP*28119	37.44.01N/ 103.25.37W
Southern Purgatoire	S.USCOHP*25151	37.12.40N/ 103.56.20W
The Island	S.USCOHP*10610	37.13.48N/ 104.51.36W
Tobe Headwaters	S.USCOHP*27116	37.08.27N/ 103.36.58W
Vermejo Park	S.USCOHP*10603	37.00.28N/ 104.49.19W
Vogel Canyon	S.USCOHP*3894	37.4.548N/ 103.31.01W
West Point	S.USCOHP*27122	37.07.32N/ 103.44.28W

Source: *CNHP (2013). Retrieved from* http://www.cnhp.colostate.edu/download/gis/pca_reports.asp

Figure 2-11 below identifies the locations of each of the PCA's and their biodiversity significance. Much of the eastern Watershed has been classified as high to very high biodiversity significance primarily because of the unfragmented nature of its ecosystems. A complete report of each PCA can be found in Appendix B: Level 4 Potential Conservation Area Report.

Figure 2-11: PCA's and Biodiversity Significance



Source: Colorado College (2013). Prepared by Nico Dattels

2.8 The Nature Conservancy Conservation Plan for the Purgatoire Watershed

The Nature Conservancy (TNC) functions as an environmental resource for the Purgatoire River Watershed. This agency can also assist interested Watershed stakeholders with conservation projects. The following is a summary of TNC's values and goals specific to the Watershed.

The Purgatoire River - Conserving Natural Resources in a Working Community

Background

Flowing 196 miles from the crest of the Culebra Range to its confluence with the Arkansas River, the Purgatoire River crosses one of Colorado's largest and most unfragmented natural areas. Primarily privately owned, the Purgatoire River basin contains, across a range of elevations, unfragmented forest, grassland, canyonland, woodland, shrubland, aquatic and riparian systems. Pressured by a range of stresses, including altered fire regimes, wildlife disease, invasive species, changing demographic and economic patterns of land ownership and management, the Purgatoire River has been identified by The Nature Conservancy as a priority landscape for its conservation efforts. This document describes the work the Conservancy in partnership with private landowners and public agencies is doing to conserve this important region.

What TNC Wants to Conserve

The most significant features of the Purgatoire River Conservation Area are its sheer size, intactness and generally good condition. This tremendous area supports intact ecological systems and plant communities that, in turn, support a wide variety of native plant and animal species at healthy population levels. The scale of the landscape is sufficient to allow the natural processes that govern this arid area to function, and, with the lack of fragmentation and generally good land management, help maintain robust populations of native species.

TNC's Conservation Vision

In the Purgatoire River Basin, as around the world, The Nature Conservancy believes that successful and lasting conservation respects and supports local communities and culture. Science guides our understanding of ecological systems and the stresses effecting them, but practical considerations of traditions, economics and relationships has an equal role in determining goals and appropriate strategies to achieve ecological conservation. In southeast Colorado, rich traditions of private land ownership and agriculture have supported both the human and natural communities for generations; those same traditions have a vital role in achieving and maintaining the long-term conservation vision outlined here.

The long term vision for the Upper Purgatoire River area is to maintain an intact landscape, composed of high quality native shrublands, high elevation forests, ponderosa pine woodlands, montane grasslands and riparian communities. These systems will support shrubland birds, Gunnison's prairie dogs and wide-ranging mammals. In addition, the fire regime will be restored especially in the ponderosa pine woodlands. This vision also includes increasing the awareness, appreciation and support for conservation.

The vision for conservation in the Lower Purgatoire River area is to maintain an intact area of shortgrass prairie and canyon ecosystems large enough so that natural processes and land management can continue to support native plant and wildlife communities. These systems include restored and maintained rivers and streams, a balance between woodlands and grasslands historically maintained by fire, and healthy and productive grasslands. The systems will continue to support declining grassland birds, a diverse and largely native fish community, wildlife communities associated with Black-tailed prairie dogs, and wide ranging mammals. Again, this vision also includes increasing the awareness, appreciation and support for conservation.

TNC's Conservation Objectives

The following conservation objectives were originally identified in planning efforts undertaken 7 to 10 years ago. New information and opportunities, as well as resources and time limitations, regularly alter day-to-day priorities. The listed objectives highlight important conservation issues identified by biologists and ecologists for the areas, but the Conservancy is not working on all issues currently.

Upper Purgatoire River:

- Permit the safe implementation of managed fire on the Ponderosa pine woodlands leading to the restoration of fire in the ponderosa pine system.
    - Strategy: Assist in watershed-scale Forest Restoration Planning.
    - Strategy: Create infrastructure to annually burn the needed area of ponderosa pine woodlands to safely sustain the system (i.e. assist in development of local expertise and resources for proactive fire management).
- Protect key parcels from sub-development and fragmentation.
    - Strategy: Work with interested landowners to establish easements.
    - Strategy: Support partner organizations on priority easement projects.
    - Strategy: Highlight significance of area for continued conservation funding support from relevant public and private funders.
- Create a habitat reserve for Gunnison's prairie dog adequate to support associated species.
    - Strategy: Identify and work with private landowner(s) to permanently protect 3,000 acres of Gunnison's prairie dog colonies. Preserve flexibility for control and/or compensation to manage boundary issues with non-participants.

Lower Purgatoire River:

- Protect key parcels from sub-development and fragmentation.
    - Strategy: Work with interested landowners to establish easements, preferably connected to or in close proximity to other protected lands.
    - Strategy: Develop conservation tools that also address economic challenges to agricultural economic viability.
    - Strategy: Highlight significance of area for increased conservation funding support from relevant public and private funders.
- Functionally remove tamarisk and Russian-olive from the Purgatoire River system such that native riparian vegetation dominates the watershed.

- Strategy: Continue financial and resource support for ongoing woody invasive project through local conservation districts.
    - Strategy: Assist in creation of locally based and supported weed management entities to address long-term removal and management of invasive species, working with southeast Colorado counties and agricultural associations.
- Reverse encroachment by woody vegetation (piñon and juniper) from shallow soils and steep slopes into deep soil areas historically dominated by shortgrass prairie.
    - Strategy: Evaluate relative resource and economic costs/benefits of piñon-juniper management strategies and provide recommendations and resources to implement.
    - Strategy: Create infrastructure to manage piñon-juniper expansion with combination of mechanical and fire management (i.e. assist in development of local expertise and resources for proactive fire management).
- Create a habitat reserve for Black-tailed prairie dog adequate to support associated species (examples include burrowing owl, mountain plover, etc.).
    - Strategy: Identify and work with private landowner(s) to permanently protect sufficient acres of Black-tailed prairie dog colonies. Preserve flexibility for control and/or compensation to manage boundary issues with non-participants.
    - Strategy: Utilize regulatory safeguards to benefit surrounding community (i.e. potential use of CCAA to create regulatory shield for all non-participating landowners in larger area [county, conservation district, etc.]).

Again, The Nature Conservancy piece above represents its findings which followed professional research and analysis.

2.9 Las Animas County Master Plan

The Las Animas County Master Plan (See Appendix A) was completed in May 2001 through a participatory process including a series of community workshops. The plan was developed by identifying issues, understanding existing conditions, developing plan options, preparing a draft plan, preparing the final plan, and plan adoption. The plan is considered an advisory document and provides the basis for regulatory measures, such as updating codes and establishing development review recommendations. Various sections of the Master Plan contain information that directly relates to the Purgatoire Watershed. Sections in the Las Animas County Plan pertaining to the Watershed include Environment and Natural Resources; Concepts, Policies and Implementation Actions; and Listing of Issues by Town. Below is a brief overview of each of these sections.

Environment and Natural Resources

Mineral Resources

Coal, bituminous coal, sandstone, gypsum, limestone, and clay are found throughout Las Animas County. In 1992 the EPA's Mineral Availability System from the U.S. Bureau of Mines, found 224 mines in Las Animas County, most of which are underground (168), though 52 are surface mines and 4 are unknown. Several abandoned mines exist within the County.

Water Resources

The majority of the County falls within the Purgatoire watershed, which flows to the northeast and drains into the Arkansas River downstream of La Junta.

Timber Resources

Most timbering is conducted on private lands because there are fewer federal lands that make up the County. Dochter Lumber and Sawmill Company (out of Trinidad) was the main logging company in Las Animas in 2001, when this report was conducted. Also at this time, timbering was considered to be the most underutilized and poorest managed resource in the county, causing major concerns about overall forest health, fire repression and a lack of timbering over the course of many years causing the understory to become dense and forests to become susceptible to disease (from insects) and fire. More about this topic can be found in Section 5.6.

Major Wetlands

The Las Animas County Master Plan found the majority of major wetlands in Las Animas County to be located within the Piñon Canyon Maneuver Site, and additional wetland areas surrounding the Model Reservoir on the Purgatoire River.

Concepts, Policies and Implementation Actions

Concept 9 and 10 within the Las Animas County Master Plan are directly related to water resources within the Purgatoire Watershed and have been summarized below.

<u>Concept 9. Protect County Watersheds</u>

Policy CW 11:

Watersheds in the county shall be protected from contamination. Watershed water quality will be monitored using existing federal and state laws and stands used by the CDPHE.

Action(s): Work with the Colorado Oil and Gas Conservation Commission (COGCC) and the CDPHE to obtain Las Animal County water quality

Time frame: *Short-term*

Consider adopting watershed protection regulations to protect groundwater from contamination.

Time frame: Mid-term

Policy CW 12:

The County shall work to ensure there is adequate water supply for agricultural and domestic purposes in the county.

<u>Concept 10. Protect Surface Water</u>

Policy CW 13:

Contamination of surface water in the county shall be minimized. Surface water quality will be monitored using existing federal and state laws and standards used by the CDPHE.

<u>Listing of Issues by Town</u>

Town issues were identified throughout the County and ranked as high, medium or low priority. Hoehne listed water as a high priority along with fire protection. The Town of Branson listed water as a medium priority and Kim listed water as a low priority.

2.10 City of Trinidad Comprehensive Plan

The City of Trinidad Comprehensive Plan was completed in 2008 in accordance with Colorado State statues. As stated in the City's Plan, a comprehensive plan is tool for "guiding and accomplishing a coordinated, adjusted, and harmonious development of the municipality and its environs." It is viewed as an advisory document and is not binding regarding the zoning discretion of Trinidad. The Plan, however, can function as the basis for establishing regulatory measures. Trinidad's Comprehensive Plan serves as the foundation for establishing future intergovernmental agreements, planning capital improvements, developing programs and conducting studies. Various sections of Trinidad's report contain information that relates to the Purgatoire Watershed and is evident in this Watershed Plan. Sections of the City Plan pertaining to the Watershed include Environment and Natural Resources; Population and Land Use; and Recreation and Community Resources. The Plan will be updated again in 2014/2015 through a Department of Local Affairs grant. The full report can be found on the City of Trinidad website (see Appendix A).

Section 3 Water and Water Use

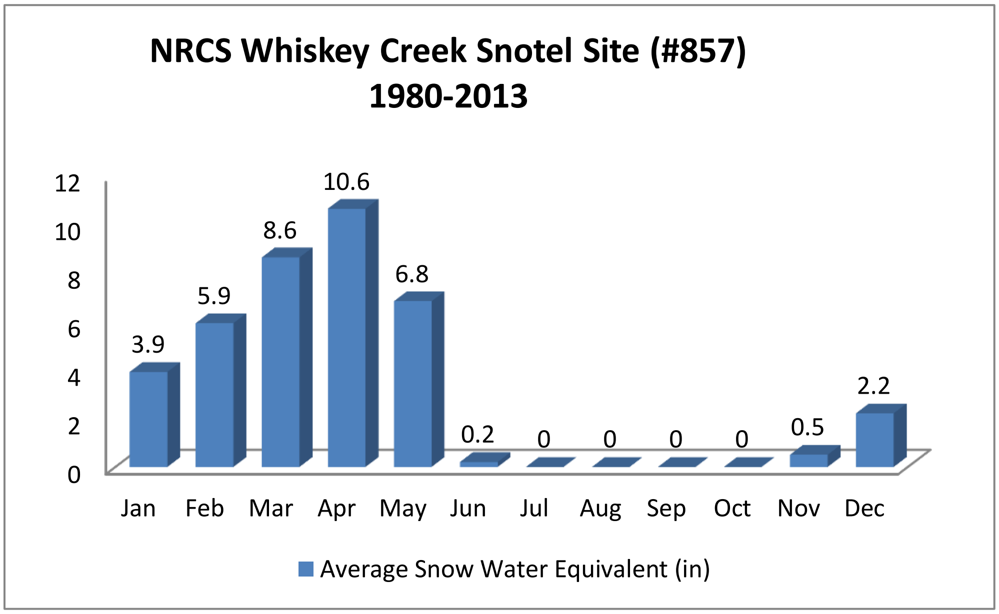
3.1 Hydrology

This section describes the hydrology of the Purgatoire River Watershed. The information within this section provides a description of the area's surface and groundwater resources as well as snowpack, in-stream flows and diversions. The majority of this information comes from a report done on the Central Raton Basin geologic formation located within the western third of the Purgatoire River Watershed.

3.1.1 Snowpack

Approximately 80% of Colorado's water supply comes from melting snow. The Snow Telemetry (SNOTEL) program collects data on snow depth, snow water equivalent, and year-to-date precipitation. Snow water equivalent (SWE) is the amount of water contained within the snowpack and is a valuable tool for stream flow forecasting. Since 1980, the National Water & Climate Center has collected SWE data on Whiskey Creek (#857). The Whiskey Creek SNOTEL site is located in Las Animas County west of Monument Lake and east of De Anza Peak in the Culebra Range within hydrological unit code 110200100102. This SNOTEL site is located in the western region of the Purgatoire River Watershed. It is situated at Latitude 37.21 and longitude -105.12 at 10,220 feet. Figure 3-1 shows the average monthly SWE at Whiskey Creek. SWE can be thought of as the depth of water that would theoretically result if you instantaneously melted the entire snowpack. Average monthly snowpack is greatest in April.

Figure 3-1: Average Monthly Snowpack at Whiskey Creek



Source: NRCS (2013). Retrieved from http://www.wcc.nrcs.usda.gov/snotel/Colorado/colorado.html

Annual snowpack varies from year to year. Earlier spring snowmelt can cause reservoirs to fill ahead of schedule and require water to be released for flood control, deprive soils from retaining moisture, and cause vegetation to dry out earlier, which increases the risk of forest fire. Accelerated spring snowmelt can result from increased temperatures and dust on snow events. Research has shown that winter and spring depositions of desert dust from the Colorado Plateau onto Colorado's mountain snowpacks can dramatically reduce snowcover albedo, advance snowmelt timing, enhance snowmelt runoff intensity, and decrease snowmelt runoff yields. The presence of both the Colorado Plateau and mountains within the watershed makes this an important issue.

3.1.2 Surface Streamflows

The Purgatoire River is a fourth-order perennial stream dominated by snowmelt that drains approximately 3,447 square miles in the upper Arkansas River basin. The Purgatoire River is a major tributary of the Arkansas River. The headwaters of the Purgatoire are located in the Culebra Range of the Sangre de Cristo Mountains and are formed by the confluence of the North Fork and Middle Fork of the Purgatoire River near Vigil, about 29 miles west of Trinidad, at an approximate elevation of 7,600 feet. The UGGS hydrological unit code for this watershed is 11020010.

The mainstem of the Purgatoire River is generally classified by the Level II Rosgen Classification system as a C4 stream type. Individual stream reaches will have somewhat different classifications throughout the length of the river but in general the river will fall into this category. A C4 stream type is a slightly entrenched, meandering, gravel dominated, riffle/ pool channel with a well-developed floodplain. This stream type is found in U-shaped glacial valleys bordered by glacial and Holocene terraces and in very broad, coarse alluvial valleys that are typical of plains areas. These stream channels have gentle gradients of less than 2%, display a high width/ depth ratio, are slightly more sinuous and have a higher meander width than steeper gradient channels. The average riffle/ pool sequence for this type of stream is usually 5 to 7 bankfull channel widths in length. The streambanks are generally composed of unconsolidated, heterogeneous, non-cohesive, alluvial materials that are finer than the gravel-dominated bed material. Consequently, the stream is susceptible to accelerated bank erosion. Rates of lateral adjustment are influenced by the presence and condition of riparian vegetation. Sediment supply is moderate to high, unless streambanks are in a very low erodibility condition. This stream type is characterized by the presence of point bars and other depositional features; is very susceptible to shifts in both lateral and vertical stability caused by direct channel disturbance; and changes in the flow and sediment regimes of the contributing watershed.

Selected stream flows in the Purgatoire watershed are continuously measured at a number of real-time flow gaging stations. Table 3-1 lists four (4) of the active real-time flow gages, period of record, and mean annual stream flow in the Purgatoire.

Table 3-1: Stream Gages

Gage Number	Station Name	Period of Record	Mean Annual Stream Flow (CFS)
07124200	PURGATOIRE RIVER AT MADRID, CO.	1972 - current	**68.5**
07124410	PURGATOIRE RIVER BELOW TRINIDAD LAKE, CO.	1977 – current	**72.9**
07126300	PURGATOIRE RIVER NEAR THATCHER, CO.	1966 - current	**59.9**
07128500	**PURGATOIRE RIVER NEAR LAS ANIMAS, CO**	**1922 – current**	**60.4**

Source: USGS (2013). Real-time Stream Gage

River flows in the Purgatoire are highly variable depending on the season and the location. The dam at Trinidad Lake controls the river flows and therefore the flow regimes in the Purgatoire River are substantially different between the upstream and downstream reaches of the dam. The impoundment at Trinidad Lake is used for both storage of irrigation water and flood control. The outlet gates at the dam are shut outside of the irrigation season, generally between mid-October and mid-April. Average flows into the reservoir are highest during spring snowmelt runoff months, May and June (Table 3-2). Major flooding also occurs during spring runoff when rapidly melting snow is augmented by rain or during summer torrential thunderstorms.

Table 3-2: Mean Monthly Discharge (cfs)

Month	Madrid **Gage #07124200 Lat 37°07'46" Long 104°38'22"**	Below Trinidad Lake **Gage #07124410 Lat 37°08'38" Long 104°32'50"**	Thatcher **Gage #07126300 Lat 37°21'23" Long 103°53'59"**	Las Animas **Gage #07128500 Lat 38°02'03.2" Long 103°12'05.1"**
January	20	2.5	26	28
February	21	3.1	28	29
March	24	3.0	37	41
April	52	32	95	99
May	146	169	115	118
June	184	199	83	90
July	115	164	72	64
August	109	144	119	117
September	54	106	48	42
October	32	25	33	35
November	26	4.5	29	32
December	22	2.1	26	26
Annual	805 cfs	854.2 cfs	711 cfs	721 cfs
Annual Runoff	582,793 ac-ft	618,413 ac-ft	514,740 ac-ft	521,980 ac ft

Source:USGS

The Las Animas gage recorded the greatest peak flow occurred in July 1927 before the dam was constructed at 49,000 cfs (Table 3-3). A more recent July 20, 2012 reading at the Las Animas station recorded the minimum flow to be 0.24 cfs.

Table 3-3: Maximum and Minimum Flows

Gage	Drainage Area (sq mi)	Peak Flow (cfs)	Minimum Flow (cfs)
Madrid #07124200	505	14,300 cfs, recorded on July 20, 1976	2.1 cfs, recorded July 20, 2002
Below Trinidad Lake #07124410	673	1,260 cfs, recorded on Aug 6, 2004	3.5 cfs, recorded July 20, 2002 (For period of record between Mar 21 and Sep 21 2002)
Thatcher #07126300	1,914	47,700 cfs, recorded on Jun 18, 1965 (prior to the dam at Trinidad Lake)	0 cfs, recorded multiple times
Las Animas #07128500	3,441	49,000 cfs, recorded on Jul 21, 1927 (prior to the dam at Trinidad Lake)	0.24 cfs, recorded July 20, 2012

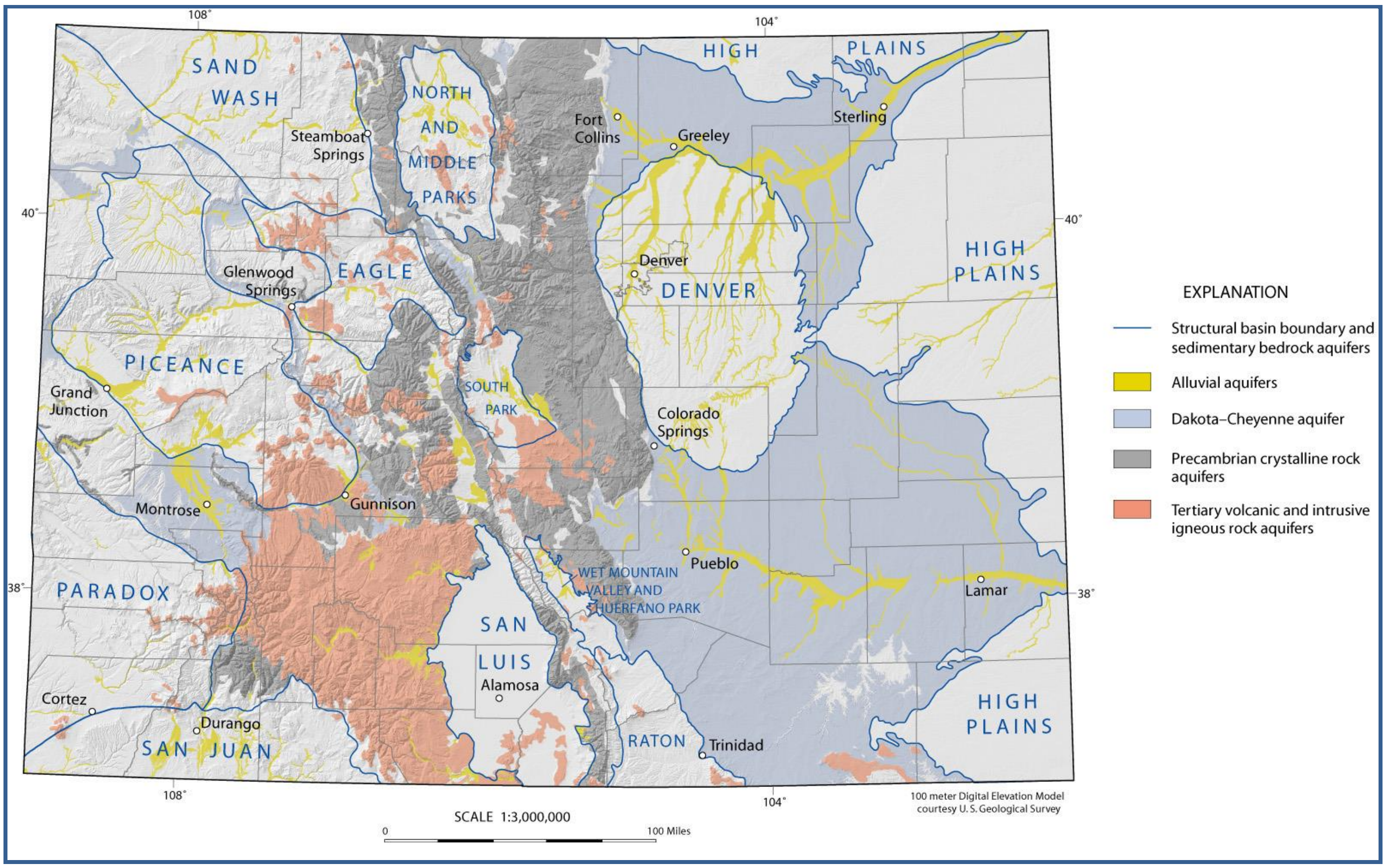
3.1.3 Groundwater

Ground water is the water that is found beneath the earth's surface. Below the top layer of dirt on the earth's surface are layers of solid rock. Each of these layers has many small spaces and cracks filled with water. Ground water moves slowly as it finds its way from space to space in the rock. This water is accessed through wells and groundwater tapping. Groundwater is used to supplement surface water supply for both consumptive and non-consumptive use throughout the Purgatoire River Watershed.

The Purgatoire River Watershed lies on top of the Raton Basin in the western area of the Watershed. The Raton Basin includes groundwater resources. The Raton Basin generates limited recharge to the groundwater system due to low precipitation and high evapotranspiration that occurs above ground in the Purgatoire River Watershed. The limited recharge moves through the formations at several scales, namely through shallow and deep flow aquifer systems. Flow is generally west to east, with localized variations due to topographic influences. Most recharge water is present in the shallower flow system with comparatively quick discharge to intermittent or ephemeral drainages where it is consumed by evapotranspiration with a small amount of groundwater discharge to surface water.

The central and eastern area of the Watershed is located within the Cheyenne-Dakota aquifer (see Figure 3.2 below). Unlike the Central Raton Basin area, extensive studies of the Cheyenne-Dakota aquifer have not been conducted within the Purgatoire River Watershed. The Cheyenne-Dakota aquifer is comprised of sedimentary bedrock, and the water table is located an average of 300 feet below the surface (Colorado Foundation for Water Education). The groundwater within this aquifer is primarily used for irrigation or domestic purposes. Since the 1960s, people have been extracting more water from this aquifer than has been returned (Colorado Foundation for Water Education). Aquifer recharge comes mostly from local precipitation – but the region receives relatively little precipitation and experiences high rates of evaporation. More research is required to understand groundwater availability within the eastern area of the Purgatoire River Watershed. (See Appendix A: Resources for links to additional information.)

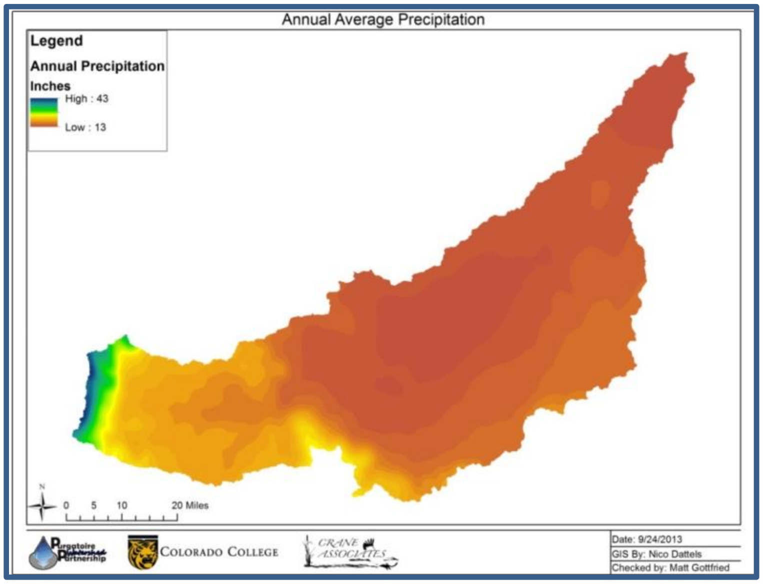
Figure 3.2: Principal Aquifers and Structural Basins of Colorado



Source: Colorado Geological Survey *Ground Water Atlas of Colorado* (2014), http://coloradogeologicalsurvey.org/apps/wateratlas/images/fig1_2hi.jpg

Precipitation, Evapotranspiration and Recharge

Figure 3-3: Annual Average Precipitation



Source: Colorado College (2013). Prepared by Nico Dattels

Average annual precipitation in the Purgatoire Watershed ranges from 43 inches per year at the headwaters to 13 inches per year in the eastern portion of the Watershed (Figure 3-2). Almost half of the precipitation (47.9%) falls within the 15-17 inches per year range, with 88.7% of precipitation in the Purgatoire Watershed under 21 inches per year. Precipitation amounts are higher as the elevation within the watershed increases, with the highest rates proximate to dominant topographic features, such the Sangre de Cristo Mountain range on the western portion of the Purgatoire River Basin. The lowest annual precipitation occurs in the valleys of major drainages. Rainfall is greatest in late spring and in summer, characterized by torrential thunderstorms during the monsoon season.

The climate of the Watershed is mainly semiarid. In 1985, a study titled “Effects of Climate, Vegetation, and Soils on Consumptive Water Use and Groundwater recharge to the Central Midwest Regional Aquifer System, Mid-Continent United States” was completed as a USGS Water-Resources Investigation Report. Through this report the potential evapotranspiration (PET), the loss of water that would occur from the soil (evaporation) and through plants (transpiration) was estimated for southeastern Colorado. Findings showed a mean annual PET greater than 60 in/yr with around 80% of the PET occurring during the warm season of April through September. This PET is reflective of a pan evaporation rate, whereas actual evapotranspiration (AET) would be less. AET is the proportion of the PET that is actually evapotranspired under the existing soil moisture supply. The value for AET that is most appropriate for the CRB based on similar precipitation zones and plant communities is 36 in/yr.

Recharge is defined as the amount of precipitation that reaches the water table. In evaluating groundwater resources, determination of the rate of recharge is one of the most difficult to derive with certainty. Estimates of recharge are typically prone to large uncertainties and spatial and temporal variability. Recharge estimates from studies of the southwestern U.S., mostly in Colorado and New Mexico, range from less than 1% to values of 30%. 2002 reports estimate the average recharge rates over large areas ((15-144,000 square miles (9,600-92,160,000 acres)) ranging from 0.008 in/yr to 1.38 in/yr, representing 0.1–5% of long-term mean annual precipitation. The Rio Grande Decision Support System done in 2004 in Central New Mexico and the San Luis Valley, reported recharge values of 3%. The precipitation for both of these areas is well below the average annual precipitation for the CRB. The mean annual precipitation for the San Luis Valley is 7 in/yr.

In 2010 the Norwest Corporation completed a Central Raton Basin Groundwater Modeling Project. Research conclusions found by Dr. Buchanan, working on the Modeling Project, indicated that approximately 5% of mean annual precipitation in the CRB, which equates to 0.92 in/yr on average, moves into the groundwater system as recharge. The majority of recharge moves through the shallow aquifer system and is consumed by groundwater evapotranspiration while a small amount, on the order of 1%, recharges the deep bedrock aquifers. The other approximately 95% of precipitation is consumed through evapotranspiration or leaves the basin as runoff. The Pierre Shale acts as a boundary to groundwater flow both into and out of the CRB on the west and east sides.

Groundwater moves from areas of recharge to areas of discharge. In the CRB, the majority of recharge discharges as groundwater evapotranspiration with a small percent discharging as baseflow (or net aquifer contribution to river flow). Bedrock aquifers are replenished by precipitation in outcrop areas and by seepage from alluvium in stream valleys.

Generally, in the CRB, groundwater flows regionally from west to east. However, local flow from stream divides to valleys intercepts much of the water in regional circulation. The remaining water moves sluggishly and is highly mineralized from prolonged contact with shale and coal. Groundwater discharges to streams and springs, usually corresponding to topographic lows or contact points between bedrock and alluvium, and where bedrock crops out.

Springs

A spring is a water resource formed when the side of a hill, a valley bottom or other excavation intersects a flowing body of groundwater at or below the local water table, below which the subsurface material is saturated with water. A spring is the result of an aquifer being filled to the point that the water overflows onto the land surface.

In the CRB, springs discharge from the alluvium where the underlying bedrock is near the surface or where dikes and sills cross the channels. Many of the springs are located between the Cuchara-Poison Canyon and Raton-Vermejo-Trinidad aquifers; most others are located on the slopes of volcanic-capped mesas, and along dikes and sills. In the CRB, approximately 189 springs with decreed water rights were identified according to the State Engineers Office (SEO). These springs are located primarily in the northern portion of the CRB, at the contact between the Poison Canyon Formation and the less transmissive Raton Formation. Minimal data exists to determine the source or flow rate of the springs. Fifteen (15) flowing springs have been identified in the CRB, Eleven (11) of which were alluvial springs and four (4) were bedrock springs. When Norwest completed the Groundwater Modeling Report for the CRB in 2010, they utilized a high resolution aerial photo to look for indications of springs that may be flowing continually at rates high enough to exhibit signs of flow, either through channelization, erosion, enhanced vegetation growth, or flowing water. This was done further delineate the presence of springs; approximately 80 springs fell within the extent of the aerial photo and less than 50% of the springs within the aerial photo area showed evidence of flow. This exercise suggested that although a spring may be identified in the SEO database, this does not confirm the presence of a continual flowing spring, nor does it indicate it is a bedrock spring.

Baseflow

Baseflow (also called drought flow, groundwater recession flow, low flow, low-water flow, low-water discharge and sustained or fair-weather runoff) is the portion of stream flow that is not runoff and results from seepage of water from the ground into a channel slowly over time. Baseflow is the primary source of running water in a stream during dry weather. Baseflow is an important statistic so that a watershed can assess water availability for agriculture, domestic, and industrial use. Baseflow can be estimated by measuring the gains or losses in stream flow between points after accounting for changes due to surface water inflow or outflow. Intermittent streams do not receive sufficient groundwater inflow to maintain year round flows; hence they are not connected to the groundwater system. The Purgatoire River is perennial but also receives surface water inflows (run-on) coming into the CRB via the North, Middle, and South Forks. Baseflow estimates for the Purgatoire River are presented based on average stream flow records from the USGS gauging stations on the Purgatoire River at Stonewall and Madrid, Colorado and compared with the baseflow estimates presented by from a gain-loss study conducted in 1989 by Geldon for work on a USGS Water-Supply Paper (2288).

Baseflow was estimated from the daily flow records for the months of November, December, January, and February. These months are outside the irrigation season, have low rainfall amounts, and precede spring runoff. The average daily flow in the Purgatoire River for these months is shown in Table 3-4. This table shows that the Purgatoire River has an average gain of approximately 13.3 cfs between the USGS gauging station at Stonewall and the one at Madrid. Sources of this gain are run-on to the basin via the North and South Forks, potentially some overland flow, and gains from groundwater (baseflow).

Table 3-4: Purgatoire River Baseflow Calculation

Month	Average Monthly Flow (cfs)		Gain (cfs)*
	Stonewall (11/1978 to 2/1981)	**Madrid** (11/1978 to 2/1981)	
November	6.3	22.1	15.8
December	5.4	19.7	14.3
January	4.6	15.0	10.4
February	4.9	17.6	12.7
Average	5.3	18.6	13.3

*Note: Statistical evaluation shows the annual average baseflow at Madrid from 11/1978 to 2/1981 is not statistically significantly different that the annual average baseflow at Madrid from 11/1978 to 12/2006.

Source: Norwest (2010). CRB Groundwater Modeling Project

Geldon conducted a gain-loss study on the Purgatoire River between Stonewall and Madrid, CO., on November 17 and 18, 1982 with a total of 35 sites measured along a 22-mile stretch of river. This study showed that the run-on flow from the North, Middle, and South Forks into the Purgatoire River was upwards of 16 cfs and that the Purgatoire River was primarily a gaining stream.

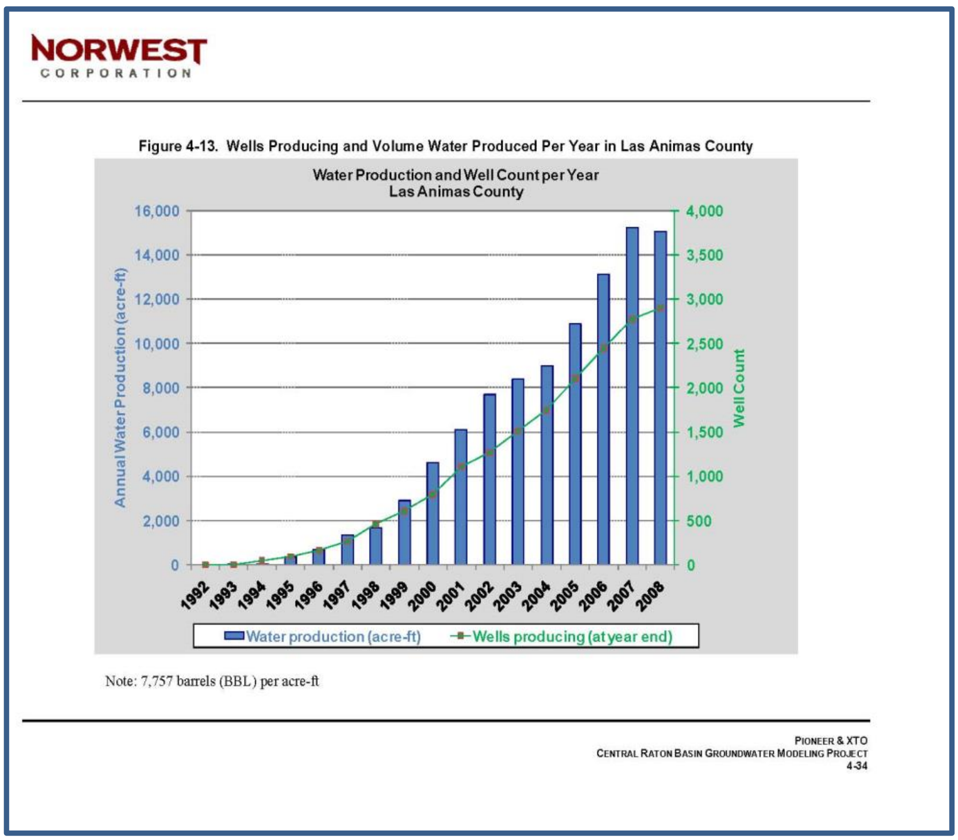
The USGS gaging station at Stonewall measures the run-on flow that comes into the Purgatoire River via the Middle Fork, which was 5.3 cfs on average during baseflow conditions. Using this flow data from the Stonewall station, the run-on per watershed size was estimated. This “run-on per watershed” value was applied to the North and South Fork watersheds. The run-on flow from the North Fork is approximately 5.3 cfs and from the South Fork is 5.5 cfs. The total run-on flow from the three forks is 16.1 cfs. This estimate, which is based on the watershed size of three forks, agrees with the flow rates measured by Geldon. Subtracting the run-on flow (16.1 cfs) to the Purgatoire River from the flow at the Madrid Station (18.6 cfs) demonstrates a net gain to the Purgatoire River from groundwater of 2.5 cfs. This gain is primarily derived from the upper Raton Formation because it crops out along the Purgatoire River. There is a component of flow that occurs through the alluvium, however it is anticipated to be very small compared to the flow in the river.

The Vermejo Formation of the Raton Basin crops out downstream of the Madrid Station with the Purgatoire River crossing a short stretch of the Vermejo Formation between the station and Trinidad Reservoir. Trinidad Reservoir lies on the Vermejo Formation outcrop. The Purgatoire River and Trinidad Reservoir are considered to be the primary discharge points for groundwater flowing through the Vermejo Formation. Using the chloride mass balance the estimated recharge to the Vermejo Formation is on the order of 2.4 cfs (0.1% of mean annual precipitation). Of this 2.4 cfs, some percentage would turn into groundwater evapotranspiration, spring flow, or leakage, leaving the rest for discharge. The 2.4 cfs can be considered an upper limit for the discharge from the Vermejo Formation to the Trinidad Reservoir.

Coalbed Methane Produced Water

Annual water production from coalbed methane (CBM) has been increasing within the Purgatoire River Watershed. The total CBM associated produced water was approximately 15,200 acre-ft in 2008. Figure 3-3 shows the water production and number of producing wells per year in Las Animas County, where the CRB is located.

Figure 3-4: Wells Producing and Volume Water Produced Per Year in Las Animas County



Source: Norwest Company (2010). CRB Groundwater Modeling Report

3.1.4 Flooding and Drainage

The majority of flood-producing storms over the Purgatoire River Basin occurs during the spring and summer months of April through August. Because of the topography and geographic location, with respect to the path of invading air masses, the basin is subject to several storm types and combinations of storms. These storms may be divided into two classifications; the frontal storm resulting from frontal activity of two or more air masses, and the thunderstorm resulting from orographic or convective lifting. Each of these may cover a large area. Frontal storms generally produce moderate precipitation intensities. During thunderstorms, precipitation intensities may be high at random locations within the storm area. Thunderstorms in the area are most active during July and August. Available records indicate that snowmelt has seldom contributed to flood occurrences, except when augmented with heavy rainfall. The physical features of the stream basins, notably the highly erosive clay-sand soils, are all conducive to a rapid concentration of runoff resulting in flash flooding, characterized by high peak flows, moderate volumes and short durations.

Major floods have occurred in the Purgatoire Watershed throughout its history, but historical records of various events are primarily focused on the Trinidad area because its population has comprised more than 60% of the Watershed's population. Large magnitude floods swept the Trinidad vicinity on at least three occasions, including November 1866, the summer of 1883, and July 1886. Definitive information is generally lacking but it is certain that flood damages increased with each flood event, paralleling the growth of Trinidad and the continuing settlement in the rural Purgatoire River Valley.

Among the major flood occurrences since 1896, the September 1904 flood was the highest of record on the Purgatoire River at Trinidad, but the May 1955 flood (ranking fourth in terms of peak discharge) reportedly caused the greatest devastation. The most significant recorded floods on the Purgatoire River at Trinidad occurred in 1904, 1925, 1942, and 1955 when discharges of 45,000 cfs, 33,000 cfs, 35,000 cfs and 28,000 cfs respectively, were recorded at the Trinidad gaging station. However, the highest flood of record on the Purgatoire River was recorded at the Las Animas gage near its confluence with the Arkansas River on July 21, 1927 with a discharge of 49,000 cfs (Table 3.3 Maximum and Minimum Flows, above).

Flood problems in the area have not only been the result of rare storm events but also improper floodplain development. Visual accounts of floods have noted the debris which was picked up by the floodwaters: natural debris of trees, rock and soil but mostly items foreign to the floodplain like houses, bridges, autos, heavy equipment, lumber, house trailers, propane tanks and other flotsam. With these items blocking bridges and culverts, flood levels rise and cause more extensive damage. Oftentimes property that was not structurally damaged by flood depths and velocities experienced substantial damage and clean-up costs related to mud and silt deposition and property erosion.

Peak discharge-frequency for floods of the 10, 50, 100 & 500-year recurrence intervals were computed in 1976 using the Plains Region equations established by the USGS (Table 3-5, below).

Table 3-5: Flood Frequency Interval Flows for the Purgatoire River near Trinidad (1976)

Frequency Interval (years)	Flow (cfs)
10	6,500
50	15,500
100	21,500
500	41,000

Source: *Flood Insurance Study for Las Animas County (1977)*

3.2 Rapid Watershed Assessment

In September 2007 the National Resources Conservation Council (NRCS) in conjunction with the United States Department of Agriculture (USDA) conducted a Rapid Watershed Assessment (see Appendix A) for the Purgatoire River watershed (HUC 11020010). The report was completed to increase the speed and efficiency of information generated to guide conservation implementation, and put these efforts into the hands of local decision makers. The assessment provides initial estimates of where conservation investments would best address local conservation districts, community organizations, stakeholders, and landowner concerns, priorities and the best actions to achieve conservation goals. Rapid assessments generally provide less detailed results than full studies and plans; however, they are time and cost efficient.

Areas of study included: County acres within the watershed; Common Resource Areas; Elevation; Land Ownership; Vegetation; Precipitation; Ecological Sites; Land Capability Classification; Wind Erodibility Index (WEI); 303(d) Stream Impairments; Natural Resource Concerns; Wildlife Information; Social and Economic Data; Selected Conservation Application Data; Conservation Systems to Address Major Resource Concerns; General Effects; and Impacts and Estimated Costs of Application of Conservation Systems.

3.3 Water Rights

Colorado water law is based on the doctrine of prior appropriation or "first in time – first in right." The system gives older or senior water rights priority over newer or more junior water rights. Water rights can be established for both surface and groundwater and are administered by the Colorado State Engineer. The system is designed to protect holders of senior water rights from injury by holders of more junior water rights. Injury to senior water rights can be mitigated by stopping diversions of surface water or replacing out of priority surface water depletions caused by pumping groundwater.

A water right may be held by any legal entity, including an individual, group of individuals, organization, corporation, government agency, etc. The only restriction on who can hold a water right concerns instream flow rights which can only be held by the Colorado Water Conservation Board. In Colorado beneficial uses include agricultural, domestic, industrial, groundwater recharge and municipal uses.

Beneficial uses for water rights in the Purgatoire watershed include augmentation, commercial, domestic, federal reserved, fire, fishery, household use only, industrial, irrigation, minimum streamflow, municipal, recharge, recreation, snow making, stock, storage, wildlife, and other. With such diverse uses of water rights, protection of both surface and groundwater is important to all stakeholders in the Purgatoire River Watershed.

The City of Trinidad's existent water rights provide approximately 5,746 acre-feet of water a year from mountain supply sources. The Lower Purgatoire supplies 2,000 acre-feet per year. However, potable uses from the Lower Purgatoire require an exchange of the Lower Purgatoire Supply back up the river to either North Lake or Monument Lake, or the construction of a new treatment plant below Trinidad Reservoir.

3.3.1 Arkansas River Compact

History

At the turn of the 20th century, conflicts between Kansas and Colorado over use of the Arkansas River led to the 1907 U.S. Supreme Court decision in Kansas v. Colorado that first laid out the doctrine of equitable apportionment of interstate rivers, eventually leading to the development of the John Martin Reservoir in 1936.

After years of dispute and 17 meetings of the Arkansas River Compact Commission over a three-year period, the commissioners signed the Arkansas River Compact, which was ratified by the legislatures of both states and approved by Congress in 1949. The Compact's purpose is to (1) settle existing disputes and remove causes of future controversy between Colorado and Kansas, and (2) equitably divide and apportion waters of the Arkansas River between Kansas and Colorado, along with arising benefits of the John Martin Reservoir. The compact established the Arkansas River Compact Administration (ARCA) to administer its provisions of the compact and sets procedures; it is composed of Colorado and Kansas state agencies, and federal representatives charged with the administration of water rights within in each state. The ARCA also has the power to investigate compact violations.

However, in 1985 Kansas filed *Kansas v. Colorado*, No.105, originally to enforce the compact's terms. In 1995 it was determined by the Supreme Court that Colorado had violated Article IV-D of the compact for post-compact well pumping in Colorado, because of groundwater development in Colorado that has reduced flows at the border between the states. As a result Colorado paid Kansas more than $34 million for violating the compact from 1950 to 1999. Colorado also paid Kansas more than $1.1 million for costs related to litigating this case before the Supreme Court. In the future, Colorado will make up depletions in water instead of money.

Kansas and Colorado developed a decree containing several appendices including the hydrologic- institutional model and accounting procedures to determine if Colorado is in compliance with the compact. This judgment and decree was incorporated in the special master's fifth and final report, which was entered by the Court in March 2009. An appendix to the judgment and decree was adapted in 2009 as a result of an evaluation of the replacement requirements for Colorado well users along the Arkansas River between Pueblo, Colorado, and the Colorado-Kansas state line. The states submitted the adapted appendix to the Court in August 2009, ending the active litigation before the court. Kansas and Colorado are now working closely together to monitor well pumping and replacement of well depletions, with frequent meetings and monthly data exchanges. The water accounting for the prior 10-year period is reviewed each year. The two states also cooperate in the operation of a complex computer model to determine compact compliance. Colorado has been in compliance for each of the 10-year compliance periods reviewed to date and the two states have agreed on an out-of-court dispute resolution procedure they hope will prevent future litigation.

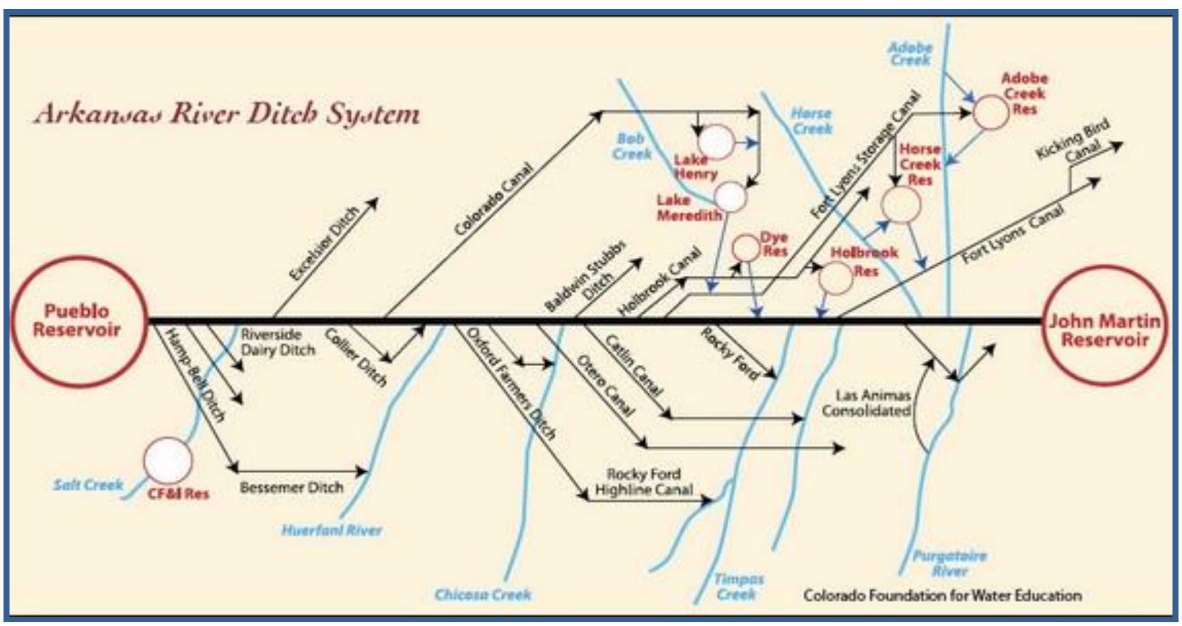
Impacts to the Basin

In 1936, Congress authorized the John Martin Reservoir project to provide flood control and storage for Colorado and Kansas to facilitate sharing of the waters of the Arkansas River. John Martin Dam impounds the Arkansas River downstream from its confluence with the Purgatoire River, roughly 60 miles upstream from the Colorado-Kansas state line. The reservoir is operated by the U.S. Army Corps of Engineers.

The Compact does not appropriate water from the River between the two states in specific amounts or as a percentage of river flows. It instead protects the existing water uses in the states from depletion from future development, without quantifying those uses. The Compact itself, allows future additional water uses in the Arkansas River Basin in Colorado and Kansas only if the waters of the Arkansas River "shall not be materially depleted in usable quantity or availability for use in the water users in Colorado and Kansas." Additionally, groundwater users in the Arkansas River Basin are required to provide replacement water for depletions to surface water rights in Colorado and Kansas for depletions to usable state line flows.

Even with storage in John Martin Reservoir, the Compact recognized that there were some available flood flows and winter flows not yet appropriated in 1948. This allows for future appropriations of available water in either state as long as existing water users rights are protected. Only "waters of the Arkansas River" or waters originating upstream from the Colorado-Kansas state line are allocated through the Compact, excluding a significant amount of water that is imported from the Western Slope into the Arkansas River. A visual of the Arkansas River Ditch system is depicted in Figure 3-4 below.

Figure 3-5: The Arkansas River Ditch System



Source: CFWE (2013) Retrieved from: http://coyotegulch.wordpress.com/category/colorado-water/arkansas-basin/lower-arkansas-valley-water-conservancy-district

Conservation

Development of another set of compact rules have been designed by the Colorado State Engineer's Office to proactively address Kansas' concern that certain improvements to surface water uses (as opposed to groundwater uses e.g. pumping) in Colorado may violate the compact. Kansas' representatives expressed concerns on recent trends toward improved surface water irrigation system efficiency. The systems divert surface water from the Arkansas River in Colorado to increase crop water consumption and reduce historical seepage and return flows owed to Kansas under the "no material depletion" standard of the compact.

Drafted irrigation improvement rules are designed to evaluate the effect of proposed improvements of irrigation technology on return flows to provide irrigations multiple options for maintaining their historical seepage and return flows to the Arkansas River. In September 2009, the new proposed rules were submitted to the Colorado Water Division 2 Court for approval, and were approved by the Court in October 2010. The rules were developed with a basin-wide Advisory Committee alongside the State Engineer. The rules lay out how Colorado will evaluate the effect of irrigation system improvements on return flows and provide irrigators with a number of options for maintaining their historical seepage and return flows to the Arkansas River even after irrigation systems are improved. The Final Arkansas River Irrigation Improvement Rules went into effect on January 1, 2011.

3.4 Consumptive Uses

Consumptive water use removes water from the environment and future uses. Consumptive uses include evaporation, transpiration, incorporation into products or crops, or human and livestock consumption.

3.4.1 Agricultural

Agriculture is the heart of the Purgatoire River Watershed economy. Without the construction and maintenance of multiple irrigation diversions, agriculture would be severely limited. In addition to Colorado water law, the Purgatoire River Water Conservancy District manages water use in conjunction with the Water Commissioner to distribute irrigation water in pursuant with Colorado water law.

Purgatoire River Water Conservancy District

The Purgatoire River Water Conservancy District (PRWCD) was created pursuant to Colorado Revised Statutes, Title 37, Article 45, paragraph 101, December 2, 1960. The purpose for the formation of the District was to provide a legal entity capable of contracting with the United States for repayment of the irrigation, municipal and industrial component assigned to the Trinidad Project and to provide a management entity to oversee the Project. The PRWCD Board of Directors is appointed by the Chief Judge for the 3rd Judicial District. They are appointed for varying terms, each director representing a different reach of the project.

Other responsibilities of the PRWCD include: surveying existing water resources and basin rivers, taking actions necessary to "secure and insure an adequate supply of water - present and future", constructing water reservoirs, entering into contracts with other water agencies (such as the Bureau of Reclamation), organizing special assessment districts, providing for instream flows for fisheries and other legal responsibilities needed by the District to fulfill its purposes.

On February 10, 1967, the District executed a repayment contract with the United States whereby it assumed a debt of $6,465,600.00, which is to be repaid over a 70-year period.

The main feature of the Trinidad Project is Trinidad Dam, located three miles west of the City of Trinidad, on the Purgatoire River in Las Animas County, Colorado. The dam, which was constructed by the Army Corps of Engineers, is of the earth-fill type of construction, and has a height of 208 feet above the stream bed and crest elevation of 6,298 feet above mean sea level.

The reservoir created by the dam has a total capacity of 125,967 acre feet, which is allocated to the following uses:

Flood Control:	**51,000 Acre Feet**	**Permanent Recreation & Fishery:**	**15,967 Acre Feet**
Irrigation & M&I:	**20,000 Acre Feet**	**Joint Use & Sediment Pool:**	**39,000 Acre Feet**

The irrigation and Joint Use Pools (allocations of various water use within Trinidad Reservoir) located in Trinidad Reservoir are utilized to provide storage for ten (10) project ditches for irrigation up to 19,499 acres in the project area, and for municipal use by the City of Trinidad. Each of the participating ditches has a repayment contract with the District whereby annual payments are made based upon available water during the year. In 1960 the Purgatoire River Water Conservancy District (PRWCD) was organized under the Colorado Water Conservancy Act to manage the project ditches. The 10 ditches (Table 3-6) were created to own the Model Storage Right for the benefit of the users of the ditches, to contract with the U.S. in connection with the construction and operation of the Trinidad Project, and to direct the distribution among the ditches of all their direct flows, in addition to PRWCD storage rights. Historically, the Model Land and Irrigation Company owned the Model Reservoir, which was decreed an annual storage of 20,000 acre-feet taken from the Purgatoire River through diversions below the Trinidad Dam. The allocated Model Storage Right was given its priority on January 22, 1908. Through the Trinidad Project the Model Storage Right was transferred to the PRWCD and its associated water was then stored in the Trinidad Reservoir. Table 3-7 displays the agricultural water use within the Purgatoire River Watershed ditches, and table 3-8 displays the direct flow water rights to 10 project ditches.

Table 3-6: Project Ditches & Irrigated Areas

Project Ditch	2013 Irrigated Acres
Baca	306
Burns & Duncan	88.1
Chilili	300
El Moro	164
Enlarged Southside	5850
Hoehne	1200
John Flood	2170
Llewelling McCormick	411
Model	6177
Picketwire	2100
Total	**18766.1**

Table 3-7: Agricultural Water Use within the Purgatoire River Water Conservancy District

Purgatoire River Water Conservancy District — **Composite Report** — **YEAR TO DATE**

2013 Irrigation Season
All Units in Acre Feet
Season Opened: 4/15/2013 — Season closed: 10/15/13
Total Claimed Acres: 18766.10
10/16/12 Reservoir Content: 10014.00

Ditch:	Demand AF	Share of Inflow	Project Water Diverted	Priority Water Diverted	Total Diversions	Cumulative Use - AF/AC
Baca	0.00	119.15	66.47	1107.07	1173.54	3.84
Burns & Duncan	0.00	0.00	22.00	347.43	369.43	4.19
Chilili	0.00	106.14	28.10	1258.83	1286.93	4.29
El Moro	0.00	63.63	77.40	328.98	406.38	2.48
Enlarged Southside	0.00	2277.99	3191.31	4918.07	8109.38	1.38
Hoehne	1465.81	492.59	2787.13	2519.86	5307.00	4.42
Johns Flood	139.58	1316.20	827.96	4733.86	5561.82	2.56
Llewelling McCormick	0.00	85.76	144.04	1569.37	1713.41	4.13
Model	19.84	1472.51	3782.30	0.00	3782.30	0.61
Picketwire	0.00	838.88	1024.91	2400.87	3425.78	1.62
		TOTALS:	**11951.62**	**19184.33**	**31135.96**	

Source: PRWCD (2013)

The Hoehne and Model allocations are made before any storage allocations are made to the other ditches. Once Hoehne and Model allocations are made, the remaining storage in the irrigation allocation of Trinidad Lake is divided up by the percentage of irrigated acres each ditch has relative to the remaining storage. In 2013 there was no storage water remaining for any of the other ditches after Hoehne and Model received their allocations.

Table 3-8: Direct Flow Water Rights to Project Ditches

Priority Number	Priority Date	Contracted Amount (cfs)	Running Total (cfs)	Contracting User
3	11/30/1861	4.000	4.000	Baca
3	11/30/1861	2.000	6.000	Picketwire
5	03/20/1862	4.000	10.000	Johns Flood
7	04/30/1862	7.000	17.000	Chilili
8	11/15/1862	1.550	18.550	El Moro
8	11/15/1862	2.180	20.730	El Moro
9	01/01/1863	1.280	22.010	Johns Flood
9	01/01/1863	4.720	26.730	Hoehne
12	06/30/1863	0.500	27.230	Southside
13	01/01/1864	1.250	28.480	Johns Flood
13	01/01/1864	3.750	32.230	Llewelling McCormick
15	04/10/1864	5.100	37.330	Johns Flood
15	04/10/1864	0.800	38.130	Hoehne
15	06/01/1865	0.847	38.977	Llewelling McCormick
19	10/07/1865	4.000	42.977	Llewelling McCormick
20	10/07/1865	7.350	50.327	Johns Flood
20	01/01/1866	16.650	66.977	Hoehne
21	02/01/1866	3.250	70.227	Llewelling McCormick
22	05/31/1866	1.340	71.567	Llewelling McCormick
27	05/31/1866	2.250	73.817	Johns Flood
27	05/31/1866	0.750	74.567	Llewelling McCormick
40	04/30/1868	1.400	75.967	Southside
64	04/01/1873	2.400	78.367	Johns Flood
73	11/01/1875	6.000	84.367	Southside
74	02/17/1876	34.000	118.367	Southside
75	12/25/1876	4.000	122.367	Southside
77	03/11/1877	1.300	123.667	El Moro
77	03/11/1877	2.7	126.367	El Moro
80	04/07/1877	18.6	144.967	Southside
93	12/15/1882	4.000	148.967	Southside
95	11/04/1883	14.390	163.357	Picketwire
96	11/23/1883	16.840	180.197	Southside
98	04/30/1884	60.000	240.197	Southside
103	03/21/1886	14.73	254.927	Picketwire
104	10/21/1886	10.000	264.927	Llewelling McCormick
106	03/12/1887	15.000	279.927	Picketwire
108	02/15/1888	9.700	289.627	Southside
109	03/01/1888	8.000	297.627	Southside
145	10/20/1902	100.000	397.627	Johns Flood
168	01/22/1908	200.000	597.627	Model
242 1/2	06/12/1920	45.560	643.187	Picketwire

Source: PRWCD (2013)

The Purgatoire River Water Conservancy District has ranked various Watershed concerns in order of how important they are to the District, with number one representing the highest importance:

1. Protect water rights and users
2. Improve Watershed health
3. Improve bank stabilization
4. Understand impacts of oil and gas
5. Reduce/ Remove invasive species
6. Preserve/ Promote healthy forests
7. Promote water conservation and understand CO-KS compact
8. Protect land and wildlife
9. Decrease nutrient loading
10. Education
11. Improve land values

Water management in Colorado is divided into surface flows and storage rights. Water rights are appropriated to store water in certain storage facilities, which also have a right for the quantity of water that can be legal stored, which is measured in acre feet, whereas surface flows that supply water are measured in cubic feet per second.

3.4.2 Storage

On average 49,000 acre-feet of water from the Purgatoire River basin is produced annually. From the total produced the City of Trinidad is allocated over 7,700 acre-feet, sufficiently accommodating double the existing population of 15,000 (number based on recent water trends). The water supply system for the City consists of multiple surface water supplies comprised of 5,746 acre-feet a year from mountain supply sources and 2,000 acre-feet per year from the Lower Purgatoire. Supply sources to the water system for consumptive use are from diversions from the North Fork of the Purgatoire River- stored in North Lake and Monument Lake Reservoir; Diversions from Whiskey Creek, Cherry Creek, and Brown's Creek- stored in North Lake and Monument Reservoirs; Diversions from the Purgatoire River via the Johns Flood and Model Irrigation Ditches- stored in Trinidad Reservoir. Monument and North Lakes are located near the decreed surface water rights and their points of diversion in western Las Animas County.

North Lake

North Lake has the ability to store 1,227,835,000 gallons or 3,768.34 acre-feet of raw water supply (Table 3-9). The Lake is located about 40 miles west of Trinidad, north of Monument Lake.

Table 3-9: Water System Accounting: City of Trinidad's Water System Profile 2011

Raw Water Supply	Gallons	Acre-feet
North Lake	1,227,835,000	3,768.34
North Lake Peak Flow (mgd)	6.420	19.70
North Lake Low Flow (mgd)	1.720	5.28
Finished Water Supply		
Water Filtration Plant	905,122,000	2,777.91
Average Water Treatment Plant (mgd)	2.480	7.61
Peak Flow (mgd)	4.727	14.51
Low Flow (mgd)	1.266	3.89
End Use		
Consolidated Billing	720,948,623	2,212.66
Non-Account Uses (Land & Utilities.)	184,173,378	565.25
TOTALS	**905,122,001**	**2,777.91**

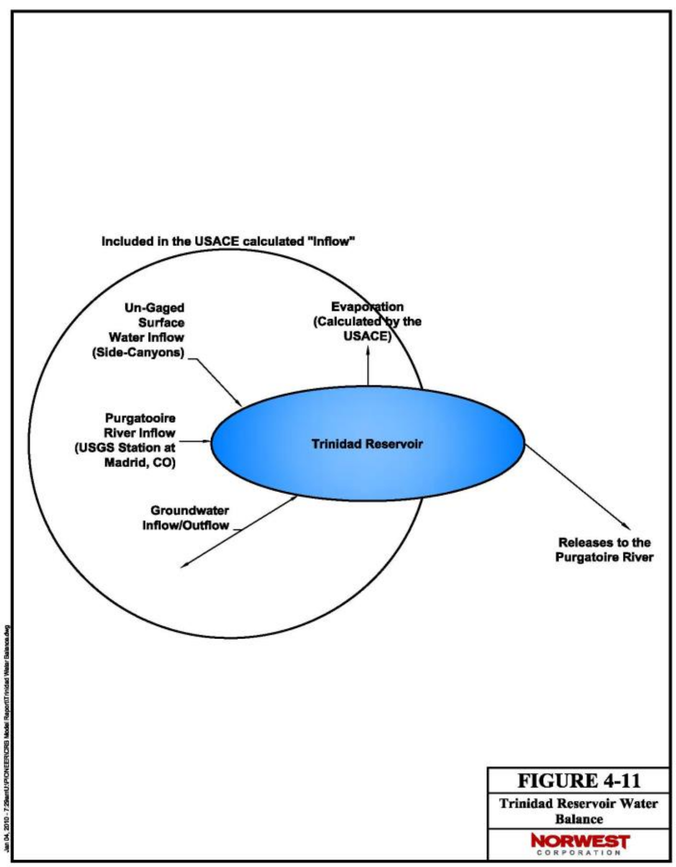
Source: RJH (2012). City of Trinidad, Colorado Water Conservation Plan

Monument Lake

Monument Lake is controlled by senior water rights and is located approximately 40 miles west of the City of Trinidad. It provides raw water storage for the City and is ancillary storage.

Figure 3-6: Trinidad Reservoir (September 24 1999), 63,609 Acre Feet

Source: U.S. ACE (1999)



Trinidad Lake/ Reservoir and Trinidad Dam

Located three miles southwest of the City of Trinidad is the manmade 900 acre Trinidad Lake built by the Army Corps of Engineers and completed in 1977. The Trinidad Lake and Dam project displaced—over time—an estimated 400 to 800 residents of six former coal communities: Jerryville, Piedmont, Sopris, Sopris Plaza, St. Thomas and Upper St. Thomas. Three cemeteries were also relocated. Figure 3-5 shows the reservoir and dam in September 1999 holding 63,609 acre-feet. The reservoir was built for irrigation, sediment control, flood control and recreation. The Lake's water level rises and falls with irrigation usage and the fluctuation of rainfall and snowpack.

Figure 3-6 above provides a schematic of the reservoir water balance components.

Figure 3-7: Trinidad Reservoir Water Balance
Source: Norwest Company (2010). CRB Groundwater Modeling Report

The inflows include flow measured at the USGS Madrid Station, flow from canyons entering the Purgatoire River below the Madrid Station, and, at times, groundwater influx. Outflow from the reservoir includes releases to the Purgatoire River downstream of the edge of the Raton Basin, evaporation, and loss to groundwater. Generally, data suggests there is a small positive contribution from groundwater to the Trinidad Reservoir. However, deriving an accurate estimate of the groundwater contribution is very difficult due to the high variability in rainfall received in the catchments that discharge to Trinidad Reservoir, fluctuations in the groundwater table near Trinidad Reservoir, and the contribution of water from ungaged ephemeral canyons like Reilly Canyon and Longs Canyon (after 1989) below Madrid, and uncertainties in the rainfall-runoff relationship used to estimate flow.

City of Trinidad Water Supply and Demand

Existing treated water demands for the City of Trinidad average 2.96 million gallons per day (mgd) with a maximum demand of 7.40 mgd. Projected water demands for 2020 assuming a low annual growth rate of 2% is 4.19 mgd average and a maximum of 10.48 mgd. Projected water demands for 2020 assuming a high annual growth rate of 3.5% is 5.32 mgd average and a maximum of 13.30 mgd. The maximum day water demands (the highest water demands during any one 24-hour period) to average day water demand ratio is 2.5 mgd based on historical City water usage.

Water production at the water treatment facility has exceeded water billing (consumption) by between 35 to 40 percent based on records from 1995 to 2000. Normal losses in a water distribution system can usually account for up to approximately 15 percent due to water system leaks, pressure testing, and other unmetered uses. The high rate of loss for Trinidad is of concern and may be due to overflows at the Jansen tank.

The available firm yield (reliable yield during a dry year) of the City's mountain water supply is 4.47 mgd (5,000 acre-feet/year) is sufficient to supply existing water demands. However, an additional 0.85 mgd (950 acre-feet/year) will be needed to supply the projected 2020 water demand for the high growth scenario. The additional supply may be available from the John's Flood supply (Trinidad Reservoir), which has a firm yield of 1.79 mgd (2,000 acre-feet/year).

The existing City's storage capacity of 9.46 million gallons is sufficient to supply operating, emergency and firefighting needs through the projected demands of 2020.

3.4.3 Municipal

Trinidad is the largest city in the Purgatoire River Watershed and as a result eighty five percent (85%) of Las Animas County gets their domestic water from the City of Trinidad. Trinidad's water service area consists of the City of Trinidad, approximately 34 rural water associations/connections serving small communities or areas surrounding Trinidad, and approximately 538 residential customers outside the City limits. The existing service area within the City boundaries is 6.6 square miles. The projected 202 service area will include an additional 8.83 square miles. The rural water connections include service to the US Army Piñon Canyon Maneuver Site (30 miles northeast of Trinidad) and the Colorado Department of Corrections Trinidad Correctional Facility along Highway 160. Trinidad delivers water to approximately 10,000 people within the existing City boundaries consisting of approximately 3,100 residential accounts and 513 business accounts. Water is provided to 23 water associations and the City of Trinidad. Trinidad's drinking water is provided by the North Lake Reservoir, which has the capacity to provide 4,300 acre-feet of water to the city. The city's secondary water source comes from Monument Lake which has the capacity to provide 1,400 acre feet of water to the city per year. In 2011 Trinidad consumed approximated 2,800 acre-feet of water.

The City of Trinidad's water treatment facility is approximately 2 miles downstream from North and Monument Lakes at an elevation of 8,000 feet. It is located at the intersection of County Road 21.6 and County Road 13 (Lat N 37-12'-40", Long W 105-0'-40"). The treatment facility has the capacity to treat 8.4 mgd. Potable water is piped through an underground transmission line from the treatment facility to four potable water storage tanks that have a combined storage capacity of 8.4 million gallons. From this series of tanks water is distributed to customers.

The existing water system consists of the following key components:

- Water Supply
  - Mountain Supply (North Lake and Monument Lake)
  - Lower Purgatoire Supply
- 1 – Water Treatment Facility
- 1 – 30-mile long Treated Water Transmission Pipeline
- 3 – Treated Water Pumping Stations
  - North Pump Station
  - South Pump Station
  - Allendale Pump Station
- 4 – Treated Water Storage Reservoirs
  - North Tank
  - South Tank
  - Allendale Tank
  - Jansen Tank
- Water Distribution System (6 inch to 24 inch diameter mains)

A telemetry system allows the City to monitor and control operations of the facilities. The impact of current and proposed Safe Drinking Water Act (SDWA) regulations on the operations of the Trinidad Water Treatment facility was evaluated in 2012 and the City met all of the applicable SDWA requirements.

Table 3-10 shows the Consumptive History of water use for the City of Trinidad's Water System Profile from 2011. The greatest consumptive use of water for the Trinidad Water System is Urban Residential customers using 1,017.63 acre-feet, followed by Urban Commercial customers using 551.82 acre-feet. The least consumptive uses are from fire hydrants that average zero acre-feet per year followed by the U.S. Army's consumptive use of 9.84 acre-feet per year.

Table 3-10: Annual Water Use: City of Trinidad's Water System Profile 2011

Customer Category	Number of Customers	Annual Consumption (cubic feet)	Annual Consumption (gallons)	Annual Consumption (Acre feet)
Urban Residential	3,250	44,327,819	332,458,643	1,017.63
Rural Residential	469	5,311,219	39,834,143	121.93
Urban Commercial	542	24,037,378	180,280,335	551.82
Rural Commercial	70	14,050,941	105,382,058	322.57
Re-sale	2	1,169,126	8,768,445	26.84
Fire Hydrants	15	0	0	0.00
U.S. Army	1	428,413	3,213,098	9.84
Department of Corrections	1	6,801,587	51,011,903	156.14
TOTALS	**4,350**	**96,126,483**	**720,948,623**	**2,207**

Source: RJH (2012). City of Trinidad, Colorado Water Conservation Plan

Growth Trends in Terms of Water Use

The City of Trinidad provides 85% of Las Animas County with water accounting for the majority of the population within the Purgatoire watershed. The City of Trinidad has projected high and low growth trends within the municipality's service area displayed in Tables 3-11 and 3-12 below. High growth trends project a potential increase of 5,700 mgd to the service areas project population from 2005 to 2020. However, low growth scenario trends indicate 3,100 mgd to the service area project population from 2005 to 2020.

Table 3-11: Projected Water Demands (mgd): High Growth Scenario

Year	Service Area Projected Population	Average Day	Maximum Day	Maximum Hour
2000	10,400	2.96	7.40	11.10
2005	15,000	4.05	10.13	15.20
2020	20,700	5.32	13.30	19.95
Buildout of 2020 Service Area	29,700	7.12	17.80	26.70

Source: RJH (2012). City of Trinidad, Colorado Water Conservation Plan

Table 3-12: Projected Water Demands (mgd): Low Growth Scenario

Year	Service Area Projected Population	Average Day	Maximum Day	Maximum Hour
2000	10,400	2.96	7.40	11.10
2005	12,400	3.35	8.38	12.57
2020	15,500	4.19	10.48	15.72

Source: RJH (2012). City of Trinidad, Colorado Water Conservation Plan

The City expects a Low Growth Scenario, meaning rising slowly over time, as the projected outcome, resulting in an insignificant increase in water demand for the 2012-2019 planning period based on the usage between 2000 and 2010. The current demand is 2,200 acre-feet per year and the City does not expect it to be greatly altered unless Trinidad experiences unexpected rapid growth. Currently, Trinidad's water supply will be sufficient to meet demand for the next 50 years.

City of Trinidad's Water Conservation Goals

The CWCB defines five levels of conservation practices defined in the 2010 Statewide Water Supply Initiative. Conservation Levels are ranked 1 through 5, with Level 1 representing minimal conservation efforts (i.e. passive conservation measures including plumbing and fixture ordinances of the National Energy Policy Act) and Level 5 represents the most significant conservation efforts made by a water provider to establish intensive conservation programs and measures (i.e. eliminating all customer leakage and high water use landscapes).

The City of Trinidad is the largest municipal water provider in the Purgatoire watershed supplying water to 85% of Las Animas County. Current water conservation activities the City is pursuing fall under Conservation Levels 2 and 3 as defined by the CWCB, typical of many Front Range communities. Activities include metering all potable water supplies for each customer, demonstration projects, a rate structure tying sewer charges directly to water usage, and other water saving measures. Many factors must be considered when quantifying water saved and therefore it is hard to calculate the total water saved from current activities.

In 2012 the City developed a Water Conservation Plan outlining these five conservation goals:

- Maintain the currently low average annual per capita water usage of 110 gallons/ person/ day through 2019.
- Continue the current level of 300 to 400 acre-feet/ year of reclaimed (reused treated effluent water) use through 2019 for the Cougar Canyon Golf Course Irrigation (at the time of publication the Cougar Canyon Golf Course is closed).
- Reduce water use by 5% on all existing city irrigated parks and landscaping by 2019 and optimize irrigation efficiency on any new city irrigated parks and landscaping.
- Implement conservation measures and programs that are compatible with the community.
- Establish a monitoring system that collects a sufficient amount of data to effectively measure the success of conservation programs on an annual basis.

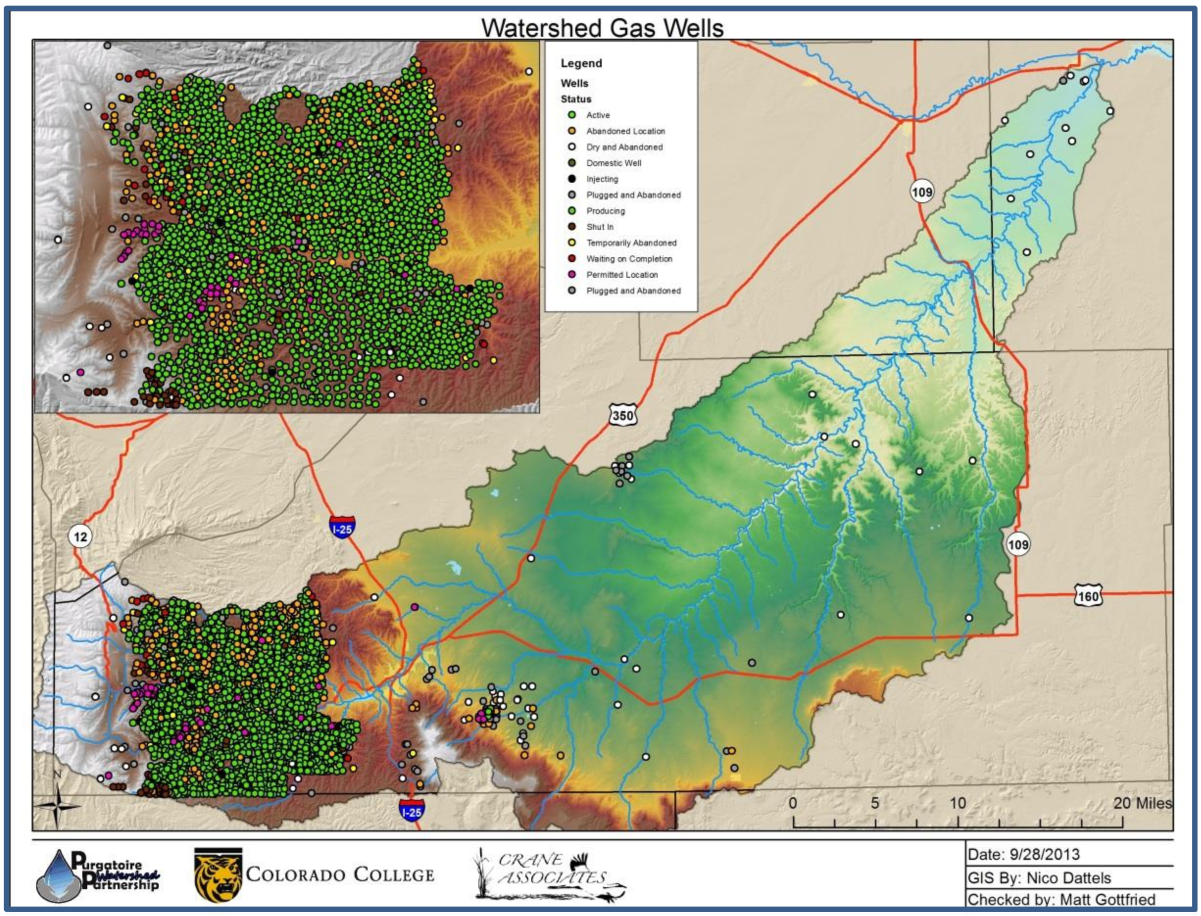
3.4.4 Industrial

Oil and Gas

The western Purgatoire River Watershed has a long history of coal mining, dating back to the 1800's. Mining operations included the production of water and venting of coalbed methane gas. In the 1970's and 1980's some oil and gas exploration occurred in the basin, but it was not until the mid-1990s that the production of coalbed methane proved economic. In the 1990's there were about a dozen companies developing coalbed methane in the Central Raton Basin. Eventually some projects were abandoned and ownership of others consolidated. Today, three companies account for all of the production of coalbed methane in the basin. Pioneer Natural Resources USA, Inc. is the largest producer in the Raton Basin.

With approximately 2,300 wells, Pioneer produces about 200 million cubic feet of natural gas (methane) and about 125,000 barrels (or 5.2 million gallons) of water per day. Approximately 60-70% of this water is surface discharged under permits issued by the State of Colorado.

Figure 3-8: Coalbed Methane Production Sites



Source: Colorado College (2013). Prepared by Nico Dattels.

Figure 3-8 represents the density of coalbed methane production sites found in the Purgatoire Watershed.

Coalbed Methane Water

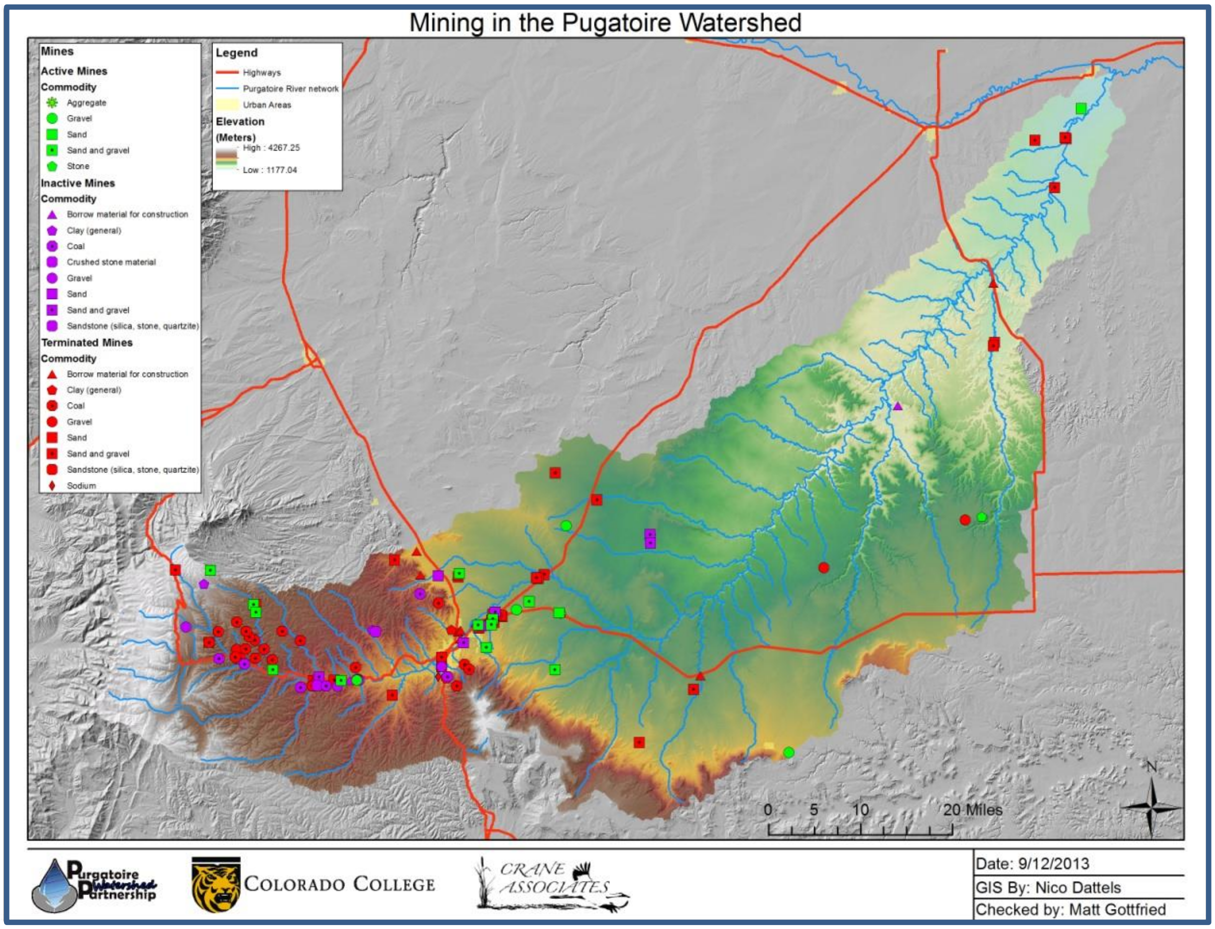
Water produced by coalbed methane operations and discharged under permits issued by the State of Colorado becomes part of State waters. The produced water from coalbed methane production is suitable for stock watering in accordance with the NPDES permit Blended with natural runoff, this byproduct water is considered suitable for irrigation and other uses by the

EPA. In recent years, low prices of natural gas coupled with less pressure in formations, has resulted in less produced water from coalbed methane operations in the Raton Basin leading to less produced water within the Purgatoire River Watershed.

Coal Mining

Coal mining in the Watershed, especially in the Trinidad community and surrounding areas, has a strong historical legacy, tradition and cultural value. The Raton Basin was one of Colorado's major metallurgical coal fields and at the time of Trinidad's city incorporation (1876), it soon after became the supply and transportation center for the region's coal mines. Coal mining became Trinidad's major industry as Trinidad became a wealthy commercial center. However, there are no current operating coal production facilities left in the Watershed. There are no records indicating hard rock mining occurred in the watershed basin. The only mining on record includes coal and gravel production.

Figure 3-9: Mining in the Purgatoire Watershed



Source: Colorado College (2013). Prepared by Nico Dattels.

3.4.5 Military

Piñon Canyon Maneuver Site (PCMS)

PCMS is located within the Purgatoire River Watershed and uses the Purgatoire River as the main source of freshwater. The City of Trinidad Provides the U.S. Army in the area with 9.84 acre-feet of water annually.

In 1983 the USGS documented ninety-five (95) wells throughout the 235,896 acres occupied by the PCMS located in Model, Colorado. Wells were originally powered by wind, solar and electrical sources, which were installed by ranchers throughout the 1950's to the early 1980's in an effort to provide water to their livestock. By 2011, most wells were found to be in disrepair and no longer functional for a number of reasons, including leaky tanks, damaged windmill heads, a lack of water, broken pipes and broken sucker rods. From 2011 to 2013 the Army invested approximately $200,000 to restore twenty-one (21) wells, which have mostly been upgraded by converting wind to solar powered wells. Some of these wells also provide water for wildlife.

PCMS has repaired many water pipeline systems, including Red Rocks, Hill Ranch and High Point, that are valuable to several species of wildlife. Over the past few years many of the float chambers along the pipelines have been replaced with PVC sleeves. Cracked tanks have been sealed or replaced as needed by PCMS wildlife personnel, and sections of leaking pipes have also been replaced. In addition, wildlife biologists have installed several stand-alone tanks in areas where wells are not present. These tanks are hand-filled in the summer and are primarily located on short-grass prairie land and benefit pronghorn antelope species. In general these efforts reduce stress on animals and may support more wildlife in the future. Barbed wire fences surrounding many of the wells have been removed, as well, to allow safer and easier wildlife access to water. Installing game cameras at the wells has provided photo evidence capturing various wildlife species drinking from the tanks. Animals photographed include birds, snakes, mule deer, foxes, pronghorn antelope and elk. Resident aquatic species including the spade-foot toad, tiger salamanders and aquatic insects have been found utilizing the tanks, some for reproduction.

Future goals of the PCMS include the installation of automatic shut-off devices placed on many of the solar wells. This will ensure that wildlife always has access to full water tanks. The automatic shut-off device will limit the cost of fuel and staff time currently required to continually turn wells on and off. Old solar panels will also be replaced with more efficient panels. Other projects include repairing leaky tanks on the Red Rocks and High Point pipelines, setting new tanks in the ground so they are accessible to additional species of wildlife, and acquiring funding to power the Stineman pipeline.

3.5 Nonconsumptive Uses

Nonconsumptive water uses include environmental, recreational, and hydropower generation. Environmental and recreational water needs are generally in-channel and flow-based.

3.5.1 Environment and recreation

The Colorado Water Conservation Board (CWCB) recognizes the need to correlate activities of mankind with reasonable preservation and improvement of the natural environment, and has done so with the responsible appropriation, acquisition, protection, and monitoring of instream flow (ISF) and natural lake level water rights. The CWCB exclusively makes instream water rights, which are noncomsumptive, in-channel or in-lake uses of water for minimum flows between specific points on a stream or levels in natural lakes. The state's water right priority system administers instream water rights to preserve and improve the natural environment to a reasonable degree.

Table 3-13 below displays all instream flow water rights that the CWCB has appropriated or applied since the inception of the Instream Flow and Natural Lake Level Program in 1973 for the North Fork Purgatoire River (Case Number 2-77W4632), South Fork Purgatoire River (Case Number 2-09CW088) and the Purgatoire River (Case Number 2-09CW090). All of these stretches are located within the HUC 11020010, in Water District nineteen (19) under Water Division two (2). Currently, the Purgatoire and the South Fork are being challenged by oil and gas companies and have not yet been decreed by water court.

Table 3-13: Instream Flow Rights in the North Fork Purgatoire River

Stream Name	Upper Terminus	Lower Terminus	County	Appropriation Date	Segment Length (miles)	Instream Flow Recommendation	Fish Species Present	Public Lands
North Fork Purgatoire River	Headwaters in vicinity of lat 37 17 07N long 105 09 25W	Inlet Trinidad North Lake in SE SE S 24 T32S R69W 6PM	Las Animas	1/19/1977	7	5 cfs (1/1- 12/31)	No Records	None
South Fork Purgatoire River	Confluence unnamed tributary at lat 37 03 49N long 104 58 60W	Confluence Torres Canyon at lat 37 05 40N long 104 52 47W	Last Animas	1/27/2009	7.7	3 cfs (10/16- 4/30) 9.6 cfs (5/1- 5/31) 18 cfs (6/1- 6/30) 13 cfs (7/1- 8/15) 5 cfs (8/16- 10/15)	No Records	None
Purgatoire River	Confluence M/N Fork Purgatoire River at lat 37 09 26N long 104 56 27W	Confluence Lopez Canyon at lat 37 08 25N long 104 52 45W	Las Animas	1/27/2009	4.8	7 cfs (12/1- 4/14) 8.4 cfs (4/15- 5/14) 21 cfs (5/15- 8/15) 15 cfs (8/16- 9/15) 8.4 cfs (9/16- 11/30)	No Records	None

Source: CWCB: http://cwcb.state.co.us/technical-resources/instream-flow-water-rights-database/pages/main.aspx

There are no instream channel diversions for boating (e.g., kayak park) in the watershed. Recreation includes fishing, made possible by ISF and existing water rights in upper watershed, allowing water to move downward to the Trinidad Reservoir to fulfill downstream water rights.

3.5.2 Hydropower

The City of Trinidad has discussed potential for hydropower generation at the water treatment plant located near Northlake, as well as potentially capturing hydropower through the transmission pipes that carry the drinking water from Northlake to the city limits. These projects have the potential to generate enough electricity to power the plant itself, as well as generate excess power that could be sold. However, the City of Trinidad must work with local power companies in order to create a plan to transmit the generated electricity to customers.

Furthermore there have been discussions to add hydropower to the Trinidad Reservoir Dam. Because The Trinidad Reservoir Dam only releases water May through October, hydropower may not be a feasible option for this site. No current plans to construct a hydropower facility at this site are underway.

Section 4 Water Quality

This section presents existing water quality studies, water quality standards, water quality assessment, water quality monitoring, permitted water discharges and source water protection areas.

4.1 Reports and Studies

The western third of the Purgatoire River Watershed is located within the central area of the Raton Basin. The Raton Basin is a geologic structural basin in southern Colorado and northern New Mexico. In extent, the Raton Basin is approximately 50 miles (80 km) east-west, and 90 miles (140 km) north-south, in Huerfano and Las Animas Counties, Colorado, and Colfax County, New Mexico. The headwaters of the Purgatoire River Watershed are west and up-gradient of the Raton Basin. The Purgatoire River flows east to exit the Raton Basin, where it eroded through Trinidad Sandstone, and drains much of the Las Animas Uplift. The presence of the Raton Basin within the Purgatoire River is important because the Raton Basin has economically viable reserves of coal and coal bed methane (CBM).

Coal bed methane producers in the Purgatoire River Watershed operate about 3,000 wells that extract natural gas from coal seams in the Vermejo and Raton Formations within the Raton Basin (Tetra Tech, 2010). The process of CBM extraction yields natural gas (methane) and unaltered groundwater, referred to as produced water.

Following widespread CBM development and associated produced water management, the Purgatoire River Watershed (PRW) Monitoring Program was established by Tetra Tech, in April 2010. The program seeks to evaluate water quality data in areas of the Purgatoire River Watershed where coal bed methane operations occur in the Raton Basin. Two strategies are commonly used to manage produced water in the Raton Basin. A portion of the produced water is re-injected into deep geologic formations in accordance with Underground Injection Control (UIC) permits issued by the Colorado Oil and Gas Conservation Commission (COGCC; Tetra Tech, 2010). The majority of the produced water is discharged to tributaries of the Purgatoire River in accordance with permits issued by the Colorado Department of Public Health and Environment (Section 4.2). Collectively, CBM producers are permitted to discharge up to 10.45 million gallons per day (MGD), or approximately 11,700 acre-feet annually, of CBM produced water into tributaries of the Purgatoire River (Tetra Tech, 2010). The quality of produced water varies, and depends largely upon the characteristics of the formation from which it originated. Produced water is typically classified as a sodium bicarbonate enriched water. In Las Animas County, the median concentrations were 1910 mg/L, 710 mg/L and 69 for total dissolved solids, sodium and SAR, respectively for samples collected prior to 2009 (COGCC, 2009).

The study area includes about 640 square miles in the portion of the Purgatoire River Watershed west of Interstate 25. Stream flow and water quality characteristics (pH, temperature, electrical conductivity, and chloride collected with in-situ probes) are measured continuously at nine stations. On a monthly basis, water quality samples are collected from 27 other stations. The analysis suite includes major ions, nutrients, dissolved and total metals. The analysis interval is monthly for most water quality parameters and quarterly for selected metals. The locations referred to as upstream are above permitted discharge points (CBM outfalls), rather than all CBM development. The report is better suited to characterize the effect of CBM produced water discharges, rather than the cumulative, and possibly secondary effects, of CBM development (i.e. pads, roads and other features constructed to support extraction activities). Monitoring results from 2010, 2011 and 2012 have been summarized in three annual reports (Tetra Tech, 2011, 2012 and 2013).

The water quality data from PRW Monitoring Program is incorporated into the water quality assessment discussion. However, the data is not included in the PWP dataset (the PRW data is only available in PDF, rather than Excel format). In 2013, the WQCC revised the segment descriptions in Regulation 32. Due to the revision, the segments referenced in the Annual Reports for the PRW Monitoring Program are no longer current. This document presents the PRW data according to the current version of Regulation 32, effective date December 31, 2013 (see Section 4.3 below).

4.2 Point Source Permits

A point source is a localized and stationary source where water pollution is being discharged directly into a water body. National Pollution Discharge elimination System (NPDES) permits are used to manage point source discharges throughout the United States under the Clean Water Act (CWA) of 1972. The national water pollution control permitting program is administered by the United States Environmental Protection Agency (EPA) and implemented through state agencies. In Colorado, the Colorado Department of Public Health and Environment (CDPHE) is the agency responsible for implementing and managing these permits. As of 2014, there are 27 active NPDES permitted facilities within the Purgatoire River Watershed (see Figure 4-1 and Table 4-1 below). A permit is specifically tailored to an individual facility. Once a facility submits their application, the permitting authority develops a permit for that particular facility based on the information contained in the permit application, such as activity, nature of discharge, and receiving water quality. The water quality of the receiving waters is incorporated into the permit criteria to assure that the designated uses of the receiving water are protected. The agency then issues a permit to the facility that allots discharge limits for water quality, quantity and duration based on the information gathered in the permitting process.

The primary focus of the NPDES permitting program is municipal and non-municipal (industrial) direct dischargers. Within these major categories of dischargers there are a number of more specific types of discharges that are regulated under the NPDES Program.

<u>Municipal Sources</u>
Municipal sources are publicly owned treatment works (POTWs) POTWs that receive primarily domestic sewage from residential and commercial customers. Larger POTWs will also typically receive and treat wastewater from industrial facilities (indirect dischargers) connected to the POTW sewerage system. The types of pollutants treated by a POTW will always include conventional pollutants, and may include non-conventional pollutants and toxic pollutants depending on the unique characteristics of the commercial and industrial sources discharging to the POTW. The treatment provided by POTWs typically includes physical separation and settling (e.g., screening, grit removal, primary settling), biological treatment (e.g., trickling filters, activated sludge), and disinfection (e.g., chlorination, UV, ozone). These processes produce the treated effluent (wastewater) and a biosolids (sludge) residual, which is managed under the Municipal Sewage Sludge Program.

Specific NPDES program areas applicable to municipal sources are:

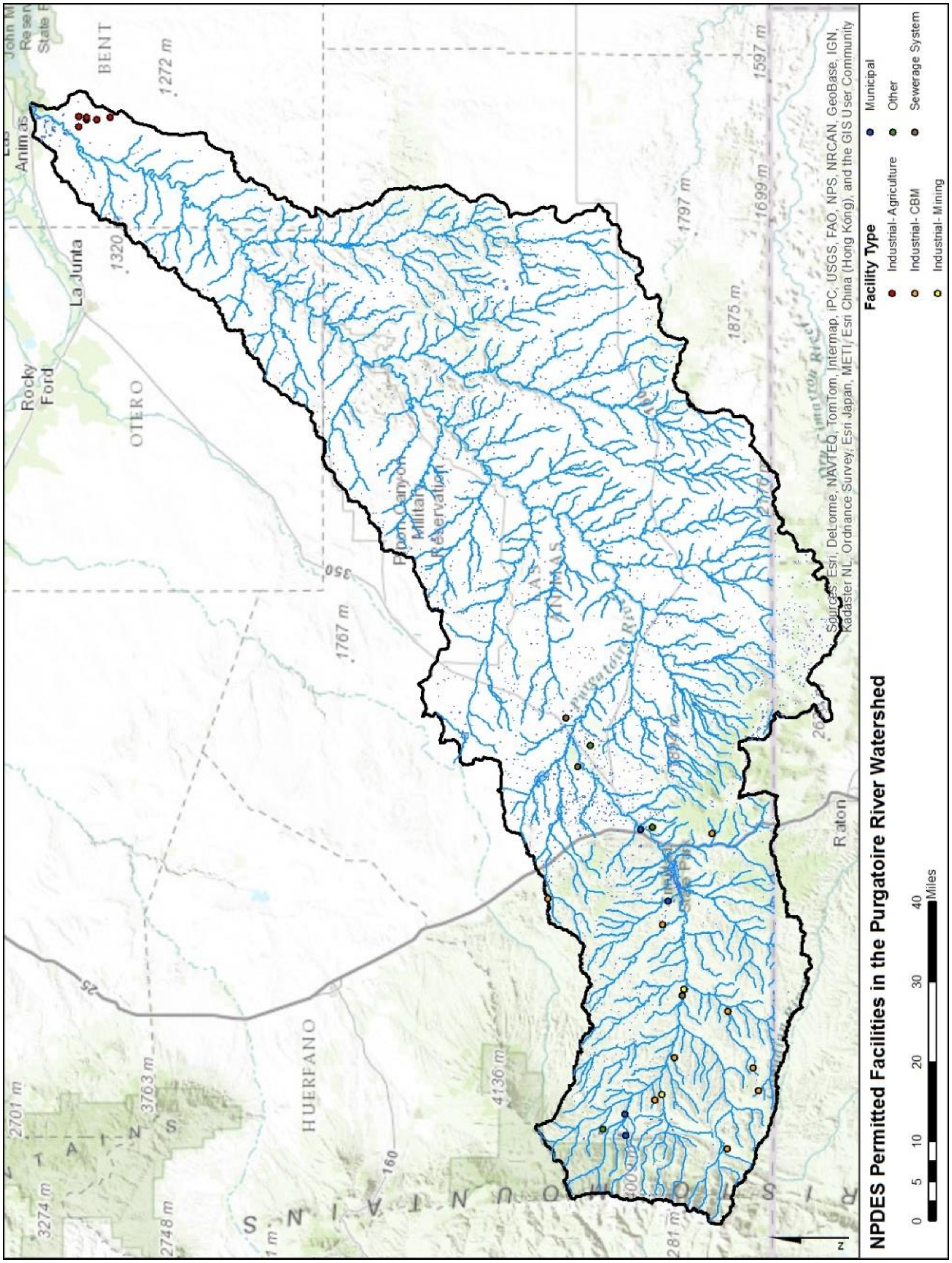
- the National Pretreatment Program
- the Municipal Sewage Sludge Program
- Combined Sewer Overflows (CSOs)
- the Municipal Storm Water Program

<u>Non-municipal Sources</u>
Non-municipal sources, which include industrial and commercial facilities, are unique with respect to the products and processes present at the facility. Unlike municipal sources, at industrial facilities the types of raw materials, production processes, treatment technologies utilized, and pollutants discharged vary widely and are dependent on the type of industry and specific facility characteristics. The operations at industrial facilities are generally carried out within a clearly defined plant area; thus, the collection systems are typically less complex than those for POTWs. Industrial facilities may have storm water discharges contaminated by manufacturing activities, contact with raw materials or product storage activities, and may have non-process wastewater discharges such as non-contact cooling water. The NPDES Program addresses these potential wastewater sources for industrial facilities. Residuals (sludge) generated by industrial facilities are not currently regulated by the NPDES Program.

Specific NPDES program areas applicable to industrial sources are:

- Process Wastewater Discharges
- Non-process Wastewater Discharges
- the Industrial Storm Water Program

Figure 4-1: NPDES Permitted Facilities by Type in the Purgatoire River Watershed



Source: EPA ECHO. Alpine Environmental Consultants LLC, 2014.

Table 4-1: Summary of NPDES Permitted Facilities in the Purgatoire River Watershed

Facility Name	City	Facility Type
COKEDALE WWTF	COKEDALE	Municipal
E SPANISH PEAKS	LAS ANIMAS COUNTY	Industrial- CBM
EVERGREEN OPERATING CORP.	TRINIDAD	Industrial- CBM
HOEHNE SCHOOL DIST R-3	TRINIDAD	Sewerage System
LORENCITO CANYON COALBED METHANE OPERATION	WESTON	Industrial- CBM
LORENCITO CANYON MINE	WESTON	Industrial- Mining
MOUNTAIN PRAIRIE - ARK RIVER	LAS ANIMAS	Industrial- Agriculture
MOUNTAIN PRAIRIE - BUFFALO RIDGE	LAS ANIMAS	Industrial- Agriculture
MOUNTAIN PRAIRIE - CEDAR POINT	LAS ANIMAS	Industrial- Agriculture
MOUNTAIN PRAIRIE - COYOTE CROSSING	LAS ANIMAS	Industrial- Agriculture
MOUNTAIN PRAIRIE - DEER TRAIL	LAS ANIMAS	Industrial- Agriculture
MOUNTAIN PRAIRIE - EASTERN PLAINS	LAS ANIMAS	Industrial- Agriculture
NEW ELK COAL COMPANY, LLC	WESTON	Industrial- Mining
NORTH LAKE DAM REHABILITATION PROJECT	WESTON	Other
PIONEER CBM LORENCITO	TRINIDAD	Industrial- CBM
PRIMERO RE-2 SCHOOL DISTRICT	WESTON	Sewerage System
RATON BASIN CBM PROJECT	WESTON	Industrial- CBM
TRINIDAD CORRECTIONAL FACILITY	MODEL	Sewerage System
TRINIDAD MUNICIPAL POWER PLANT	TRINIDAD	Other
TRINIDAD, CITY OF	WESTON	Municipal
TRINIDAD, CITY OF	WESTON	Municipal
TRINIDAD, CITY OF	TRINIDAD	Municipal
TRINIDAD/PERRY STOKES AIRPORT	TRINIDAD	Other
UPS TRINIDAD CENTER	TRINIDAD	Industrial- CBM
WEST SPANISH PEAKS COALBED METHANE OPERATION	LAS ANIMAS COUNTY	Industrial- CBM
XTO ENERGY APACHE CANYON	UNKNOWN	Industrial- CBM
XTO ENERGY LORENCITO CANYON	TRINIDAD	Industrial- CBM

Source: Alpine Environmental Consultants LLC, 2014.

4.2.1 Waste Water Treatment Permits

There are four municipal wastewater treatment facilities permits. Three of the permits are held by the City of Trinidad and one is held by Cokedale, a statutory located on Highway 12 and eight miles up-river from Trinidad. Furthermore, three sewerage systems are permitted within the Purgatoire River Watershed and are held by school districts and the Trinidad Correctional Facility. Additional information regarding these permits can be requested from the CDPHE.

4.2.2 Industrial Permits

Coalbed Methane (CBM) operations account for nine of the industrially-permitted facilities, also known as NPDES permits. Six facilities are registered as industrial agriculture permits. Operations classified as mining account for two permits. Additional information regarding these permits can be requested from the CDPHE.

4.2.3 Source Water Protection

NPDES permits are also given to drinking water treatment plants, which discharge waste from the filtration process. The general permit provides coverage for discharges of treated wastewater from water treatment filtration processes (filter backwash, sedimentation/pre-sedimentation wash-down, sedimentation/clarification, or filter-to-waste) to surface waters of the State, when water treatment is the primary function of the facility.

4.3 State Water Quality Standards

Water quality standards are the foundation of the water quality-based pollution control program mandated by the Federal Clean Water Act (CWA). Water quality standards define the goals for a waterbody by designating its uses, setting criteria to protect those uses, and establishing provisions such as anti-degradation policies to protect bodies of water from pollutants. In Colorado, water quality standards are assigned to all bodies of water, including streams, river, lakes and reservoirs. The process of standard setting occurs through a public hearing process conducted by the Colorado Water Quality Control Commission (WQCC) within the Colorado Department of Public Health and Environment (CDPHE). The Water Quality Control Division (WQCD) is the department within CDPHE responsible for the implementation and oversight of WQCC policies and regulations.

It is useful to know the water quality standards and whether or not those standards are being met. Comparing historical and current water quality data to the standards can provide an idea of whether a particular waterbody has historically or is currently experiencing water quality impairments.

Caretakers—and users—of water resources need to be aware of water quality standards and whether or not those standards are being met. Comparing historical and current water quality data to State and Federal standards can provide an idea of whether a particular water system has historically or is currently experiencing water quality impairments.

The PWP Water Quality Analysis Report, in part presented in this section, introduces four key water quality regulations for purposes of comparison when evaluating existing water quality conditions in the Watershed. Each is described in more detail in the subsections that follow.

- Regulation 31 – The Basic Standards and Methodologies for Surface Water,
- Regulation 32 – Classifications and Numeric Standards for Arkansas River Basin
- Regulation 85 – Nutrients Management Control Regulation, and
- Regulation 93 – 303(d) List of Impaired Waterbodies.

4.3.1 Regulation 31: Basic Standards and Methodologies for Surface Water

Regulation 31, the Basic Standards and Methodologies for Surface Water, describes a set of "beneficial uses" for Colorado's water and defines the water quality conditions generally necessary to support such beneficial uses. In addition, it establishes procedures for classifying the waters of the state, for assigning water quality standards, and for periodic review and modification to the classifications and standards. Regulation 31 also relates to instream standards and adds criteria for total phosphorus, total nitrogen and chlorophyll-a.

4.3.2 Regulation 32: Classifications and Numeric Standards for Arkansas River

The Colorado Water Quality Control Commission (WQCC) divides all waterbodies into segments, or discrete pieces, based upon similar characteristics, uses and other factors. The segments are assigned beneficial water uses and specific water quality standards that must be met in order to protect those uses. Water quality standards and classified uses are typically re-evaluated by the WQCC every three years during the Rulemaking Hearing for Regulation No. 32 Classifications and numeric standards for Arkansas River Basin. Regulations 32, Classifications and Numeric Standards for Arkansas River Basin, classifies and assigns beneficial water uses and numeric water quality standards to surface waters located in the Arkansas River Basin, including the Purgatoire River Watershed.

The Purgatoire River Watershed contains 14 segments (Table 4-2; Regulation 32). Streams account for ten of the segments and lakes or reservoirs are grouped into four segments (Table 4-2). The segment descriptions presented in Table 4-2 are identical to the descriptions found in Regulations 32 for waterbodies in the Watershed*. The maps presented in this report show only the portions of segments within the Watershed; parts of the segment may extend beyond the boundary of the Watershed. Figure 4-2 is a map of the water quality segments in the Watershed.

*Note: Other tables presented in the PWP Water Quality Analysis Report may shorten the segment descriptions.

Table 4-2: Water Quality Control Commission (WQCC) Segments in the Purgatoire River Watershed (1 of 3)

Segment	Classifications	Numeric Standards[1,2,3,4,5]						Temporary Modifications and Qualifiers
		Physical & Biological	Inorganic (mg/l)		Metals (ug/l)			
COARLA02a: All tributaries to the Arkansas River, including wetlands, from the Colorado Canal headgate to the Colorado/Kansas border except for specific listings in segments 2b, 2c, 3a through 9b, and Middle Arkansas Basin listings. ***Use Protected***	Aq Life Warm 2 Recreation N Water Supply Agriculture	T=TVS(WS-III) °C D.O. = 5.0 mg/l pH = 6.5-9.0 E.Coli=630/100ml	CN=0.2 NO_2=1.0 S=0.05	B=0.75 NO_3=10 Cl=250 SO_4=WS P=170 ug/l (tot) [C]	As(ch)=0.02-10(Trec) [A] Be(ch)=4.0 (Trec) Cd(ac)=5.0(Trec) CrIII(ac)=50(Trec) CrIII(ch)=TVS CrVI(ac)=50(Trec)	CrVI(ch)=100(Trec) Cu(ch)=200(Trec) Fe(ch)=WS(dis) Pb(ac)=50(Trec) Pb(ch)=100(Trec) Mn(ch)=WS(dis)	Hg(ac)=2.0(tot) Mo(ch)=160(Trec) Ni(ch)=100(Trec) Se(ch)=20(Trec) Ag(ac)=100(Trec) Zn(ch)=2000(Trec)	
COARLA04b: Mainstem of Lorencito Canyon, from the source to the confluence with the Purgatoire River. ***Use Protected***	Aq Life Warm 2 Recreation E Agriculture	T=TVS(WS-II) °C D.O. = 5.0 mg/l pH = 6.5-9.0 E.Coli=126/100ml Chla=150 mg/m^2	NH_3(ac/ch)=TVS CL_2(ac)=0.019 CL_2(ch)=0.011	CN=0.005 S=0.002 B=4.0 NO_2=0.5 NO_3=100 P=170 ug/l (tot)	As(ac)=340 As(ch)=100(Trec) Cd(ac/ch)=TVS CrIII(ac/ch)=TVS CrIII(ch)=100(Trec) CrVI(ac/ch)=TVS	Cu(ac/ch)=TVS Fe(ch)=1000(Trec) Pb(ac/ch)=TVS Mn(ac/ch)=TVS Hg(ch)=0.01(tot) Mo(ch)=160(Trec)	Ni(ac/ch)=TVS Se(ac/ch)=TVS Ag(ac/ch)=TVS Zn(ac/ch)=TVS	Temporary modification type B: Temperature= "current conditions" Expiration date of 6/30/2016.
COARLA05a: Mainstem of the North Fork of the Purgatoire River, including all tributaries and wetlands, from the source to a point immediately below the confluence with Guajatoyah Creek; mainstem of the Middle Fork of the Purgatoire River, including all tributaries and wetlands, from the source to the Bar Ni Ranch Road at Stonewall Gap; Mainstem of the South Fork of the Purgatoire River, including all tributaries and wetlands, from the source to Tercio.	Aq Life Cold 1 Recreation E Water Supply Agriculture	T=TVS(CS-I) °C D.O. = 6.0 mg/l D.O. (sp)=7.0 mg/l pH = 6.5-9.0 E.Coli=126/100ml Chla=150 mg/m^2	NH_3(ac/ch)=TVS CL_2(ac)=0.019 CL_2(ch)=0.011 CN=0.005 S=0.002	B=4.0 NO_2=0.05 NO_3=10 Cl=250 SO_4=WS P=110 ug/l (tot)	As(ac)=340 As(ch)=0.02(Trec) Cd(ac)=TVS(tr) Cd(ch)=TVS CrIII(ac)=50(Trec) CrIII(ch)=TVS CrVI(ac/ch)=TVS	Cu(ac/ch)=TVS Fe(ch)=WS(dis) Fe(ch)=1000(Trec) Pb(ac/ch)=TVS Mn(ac/ch)=TVS Mn(ch)=WS(dis)	Hg(ch)=0.01(tot) Mo(ch)=160(Trec) Ni(ac/ch)=TVS Se(ac/ch)=TVS Ag(ac)=TVS Ag(ch)=TVS(tr) Zn(ac/ch)=TVS	Temporary modification: As(ch)=hybrid Expiration date of 12/31/21.
COARLA05b: Mainstem of the North Fork of the Purgatoire River, including all tributaries and wetlands, from a point immediately below the confluence with Guajatoyah Creek to the confluence with the Purgatoire River. Mainstem of the Middle Fork of the Purgatoire River from the Bar Ni Ranch Road at Stonewall Gap to the confluence with the North Fork of the Purgatoire River. Mainstem of the South Fork of the Purgatoire River from Tercio to the confluence with the Purgatoire River. Mainstem of the Purgatoire River to Trinidad Lake. Mainstem of Long Canyon Creek from the source to Trinidad Reservoir.	Aq Life Cold 1 Recreation E Water Supply Agriculture	T=TVS(CS-II) °C D.O. = 6.0 mg/l D.O. (sp)=7.0 mg/l pH = 6.5-9.0 E.Coli=126/100ml Chla=150 mg/m^2	NH_3(ac/ch)=TVS CL_2(ac)=0.019 CL_2(ch)=0.011 CN=0.005 S=0.002	B=4.0 NO_2=0.05 NO_3=10 Cl=250 SO_4=WS P=110 ug/l (tot) [C]	As(ac)=340 As(ch)=0.02(Trec) Cd(ac)=TVS(tr) Cd(ch)=TVS CrIII(ac)=50(Trec) CrIII(ch)=TVS CrVI(ac/ch)=TVS	Cu(ac/ch)=TVS Fe(ch)=WS(dis) Fe(ch)=1000(Trec) Pb(ac/ch)=TVS Mn(ac/ch)=TVS Mn(ch)=WS(dis)	Hg(ch)=0.01(tot) Mo(ch)=160(Trec) Ni(ac/ch)=TVS Se(ac/ch)=TVS Ag(ac)=TVS Ag(ch)=TVS(tr) Zn(ac/ch)=TVS	Temporary modification: As(ch)=hybrid Expiration date of 12/31/21. Temporary modification Type B: Temperature= "current conditions" Expiration date of 6/30/2016.
COARLA05c: Purgatoire mainstem from Trinidad Lake outlet works to I-25. Mainstem of Raton Creek from the source to the confluence of Purgatoire River.	Aq Life Cold 1 Recreation E Water Supply Agriculture	T=TVS(CS-I) °C D.O. = 6.0 mg/l D.O. (sp)=7.0 mg/l pH = 6.5-9.0 E.Coli=126/100ml Chla=150 mg/m^2	NH_3(ac/ch)=TVS CL_2(ac)=0.019 CL_2(ch)=0.011 CN=0.005 S=0.002	B=2.0 NO_2=0.05 NO_3=10 Cl=250 SO_4=WS P=110 ug/l (tot) [C]	As(ac)=340 As(ch)=0.02(Trec) Cd(ac)=TVS(tr) Cd(ch)=TVS CrIII(ac)=50(Trec) CrIII(ch)=TVS CrVI(ac/ch)=TVS Cu(ac/ch)=TVS	Fe(ch)=WS(dis) Fe(ch)=1000(Trec) Pb(ac/ch)=TVS Mn(ac/ch)=TVS Mn(ch)=WS(dis) Hg(ch)=0.01(tot)	Hg(ch)=0.01(tot) Mo(ch)=160(Trec) Ni(ac/ch)=TVS Se(ac/ch)=TVS Ag(ac)=TVS Ag(ch)=TVS(tr) Zn(ac/ch)=TVS	Temporary modification: As(ch)=hybrid Expiration date of 12/31/21. Temporary modification Type B: Temperature= "current conditions" Expiration date of 6/30/2016.
COARLA06a: All tributaries to the Purgatoire River, including all wetlands, from the source to Interstate 25, except for specific listings in segments 4b, 5a, 5b, 5c and 6b. ***Use Protected***	Aq Life Cold 2 Recreation E Agriculture	T=TVS(CS-II) °C D.O.=6.0 mg/l D.O.(sp)=7.0 mg/l pH=6.5-9.0 E.Coli=126/100ml Chla=150 mg/m^2 [C]	CN=0.2 NO_2=10 NO_3=100	B=4.0 P=110 ug/l (tot) [C]	As(ch)=100(Trec) Be(ch)=100(Trec) Cd(ch)=10(Trec) CrIII(ch)=100(Trec) CrIII(ac/ch)=TVS	CrVI(ch)=100(Trec) Cu(ch)=200(Trec) Pb(ch)=100(Trec) Mo(ch)=160(Trec)	Ni(ch)=200(Trec) Se(ch)=20(Trec) Zn(ch)=2000(Trec)	Temporary modification Type B: Temperature= "current conditions" Expiration date of 6/30/2016.

Source: WQCC Regulation 32. Prepared by Alpine Environmental Consultants LLC, 2014.

Table 4-2: Water Quality Control Commission (WQCC) Segments in the Purgatoire River Watershed (2 of 3)

Segment	Classifications	Numeric Standards[1,2,3,4,5]						Temporary Modifications and Qualifiers
		Physical & Biological	Inorganic (mg/l)		Metals (ug/l)			
COARLA06b: Wet Canyon and all tributaries, including wetlands, from the source to the confluence with the Purgatoire River.***Use Protected***	Aq Life Cold 2 Recreation E Water Supply Agriculture	T=TVS(CS-II) °C D.O.=6.0 mg/l D.O.(sp)=7.0 mg/l pH=6.5-9.0 E.Coli=126/100ml Chla=150 mg/m^2	CN=0.2 NO_2=1.0 NO_3=10 S=0.05	B=2.0 Cl=250 SO_4=WS P=110 ug/l (tot)	As(ch)=0.02-10(Trec) [A] Be(ch)=4.0(Trec) Cd(ac)=5.0(Trec) CrIII(ac)=50(Trec) CrIII(ac/ch)=TVS CrVI(ac)=50(Trec)	CrVI(ch)=100(Trec) Cu(ch)=200(Trec) Fe(ch)=WS(dis) Pb(ac)=50(Trec) Pb(ch)=100(Trec) Mn(ch)=WS(dis)	Hg(ac)=2.0(tot) Mo(ch)=160(Trec) Ni(ch)=100(Trec) Se(ch)=20(Trec) Ag(ac)=100(Trec) Zn(ch)=2000(Trec)	Temporary modification Type B: Temperature= "current conditions" Expiration date of 6/30/2016.
COARLA07: Mainstem of the Purgatoire River from Interstate 25 to the confluence with the Arkansas River.	Aq Life Warm 1 Recreation E Agriculture	T=TVS(WS-II) °C D.O.=5.0 mg/l pH=6.5-9.0 E.Coli=126/100ml	NH_3(ac/ch)=TVS CL_2(ac)=0.019 CL_2(ch)=0.011	CN=0.005 S=0.002 B=0.75 NO_2=0.5 NO_3=100	As(ac)=340 As(ch)=7.6(Trec) Cd(ac/ch)=TVS CrIII(ch)=100(Trec) CrIII(ac/ch)=TVS CrVI(ac/ch)=TVS	Cu(ac/ch)=TVS Fe(ch)=1000(Trec) Pb(ac/ch)=TVS Mn(ac/ch)=TVS Hg(ch)=0.01(tot) Mo(ch)=160(Trec)	Ni(ac/ch)=TVS Se(ac/ch)=TVS Ag(ac/ch)=TVS Zn(ac/ch)=TVS	
COARLA09a: Mainstems of Chacuacho Creek, San Francisco Creek, Trinchera Creek and Van Bremer Arroyo from their sources to their confluences with the Purgatoire River. Segment also includes additional streams not in the Purgatoire River Watershed.	Aq Life Warm 1 Recreation E Water Supply Agriculture	T=TVS(WS-II) °C D.O. = 5.0 mg/l pH = 6.5-9.0 E.Coli=126/100ml Chla=150 mg/m^2	NH_3(ac/ch)=TVS CL_2(ac)=0.019 CL_2(ch)=0.011 NO_2=0.5 NO_3=10	CN=0.005 S=0.002 B=0.75 Cl=250 SO_4=WS P=170 ug/l (tot)	As(ac)=340 As(ch)=0.02(Trec) Cd(ac/ch)=TVS CrIII(ac)=50(Trec) CrIII(ch)=TVS CrVI(ac/ch)=TVS	Cu(ac/ch)=TVS Fe(ch)=WS(dis) Fe(ch)=1000(Trec) Pb(ac/ch)=TVS Mn(ac/ch)=TVS Mn(ch)=WS(dis)	Hg(ch)=0.01(tot) Mo(ch)=160(Trec) Ni(ac/ch)=TVS Se(ac/ch)=TVS Ag(ac/ch)=TVS Zn(ac/ch)=TVS	
COARLA09b: Mainstem of Smith Canyon from the Otero/Las Animas county line to the confluence with the Purgatoire River. Mainstems of Frijole Creek and Luning Arroyo from their sources to their confluences with the Purgatoire River. Mainstem of Blackwell Arroyo from its source to the confluence with Luning Arroyo. Mainstem of San Isidro Creek from the source to the confluence with San Francisco Creek. Segment also includes additional streams not in the Purgatoire River Watershed. ***Use Protected***	Aq Life Warm 2 Recreation E Water Supply Agriculture	T=TVS(WS-II) °C D.O. = 5.0 mg/l pH = 6.5-9.0 E.Coli=126/100ml Chla=150 mg/m^2	NH_3(ac/ch)=TVS CL_2(ac)=0.019 CL_2(ch)=0.011 NO_2=0.5 NO_3=10	CN=0.005 S=0.002 B=0.75 Cl=250 SO_4=WS P=170 ug/l (tot)	As(ac)=340 As(ch)=0.02-10 (Trec) Cd(ac/ch)=TVS CrIII(ac)=50(Trec) CrIII(ch)=TVS CrVI(ac/ch)=TVS	Cu(ac/ch)=TVS Fe(ch)=WS(dis) Fe(ch)=1000(Trec) Pb(ac/ch)=TVS Mn(ac/ch)=TVS Mn(ch)=WS(dis)	Hg(ch)=0.01(tot) Mo(ch)=160(Trec) Ni(ac/ch)=TVS Se(ac/ch)=TVS Ag(ac/ch)=TVS Zn(ac/ch)=TVS	
COARLA15: All lakes and reservoirs tributary to the mainstem of the North Fork of the Purgatoire River from the source to a point immediately below the confluence with Guajatoyah Creek. All lakes and reservoirs tributary to the Middle Fork of the Purgatoire River from the source to the USGS gage at Stonewall mainstem of the South Fork of the Purgatoire River, from the source to Tercio. Monument Lake, North Lake, Trinidad Lake, Long Canyon Reservoir and Lake Dorothey.	Aq Life Cold 1 Recreation E Water Supply Agriculture *Direct Use Water Supply*	T=TVS(CL) °C Trinidad Reservoir T=TVS(CLL) °C D.O. = 6.0 mg/l D.O. (sp)=7.0 mg/l pH = 6.5-9.0 E.Coli=126/100ml Chla=8 ug/l [B]	NH_3(ac/ch)=TVS CL_2(ac)=0.019 CL_2(ch)=0.011 CN=0.005 S=0.002	B=0.75 NO_2=0.05 NO_3=10 Cl=250 SO_4=WS P=25 ug/l (tot) [B]	As(ac)=340 As(ch)=0.02(Trec) Cd(ac)=TVS(tr) Cd(ch)=TVS CrIII(ac)=50(Trec) CrIII(ch)=TVS	CrVI(ac/ch)=TVS Cu(ac/ch)=TVS Fe(ch)=WS(dis) Fe(ch)=1000(Trec) Pb(ac/ch)=TVS Mn(ac/ch)=TVS Mn(ch)=WS(dis)	Hg(ch)=0.01(tot) Mo(ch)=160(Trec) Ni(ac/ch)=TVS Se(ac/ch)=TVS Ag(ac)=TVS Ag(ch)=TVS(tr) Zn(ac/ch)=TVS	*DUWS Applies only to Monument and North Lakes Temporary modification Type B: Temperature= "current conditions" Expiration date of 6/30/2016.

Source: WQCC Regulation 32. Prepared by Alpine Environmental Consultants LLC, 2014.

Table 4-2: Water Quality Control Commission (WQCC) Segments in the Purgatoire River Watershed (3 of 3)

Segment	Classifications	Numeric Standards[1,2,3,4,5]						Temporary Modifications and Qualifiers
		Physical & Biological	Inorganic (mg/l)		Metals (ug/l)			
COARLA16: All lakes and reservoirs tributary to the Purgatoire River from the source to I-25, except for the specific listings in segment 15 and 17. ***Use Protected***	Aq Life Cold 2 Recreation E Agriculture	T=TVS(CL) °C D.O.=6.0 mg/l D.O.(sp)=7.0 mg/l pH=6.5-9.0 E.Coli=126/100ml Chla=8 ug/l [B]	CN=0.2 NO_2=10 NO_3=100	B=0.75 P=25 ug/l (tot) [B]	As(ch)=100(Trec) Be(ch)=100(Trec) Cd(ch)=10(Trec) CrIII(ch)=100(Trec) CrIII(ac/ch)=TVS	CrVI(ch)=100(Trec) Cu(ch)=200(Trec) Pb(ch)=100(Trec) Mo(ch)=160(Trec)	Ni(ch)=200(Trec) Se(ch)=20(Trec) Zn(ch)=2000(Trec)	Temporary modification Type B: Temperature= "current conditions" Expiration date of 6/30/2016.
COARLA17: All lakes and reservoirs tributary to Wet Canyon, from the source to the confluence with the Purgatoire River. ***Use Protected***	Aq Life Cold 2 Recreation E Water Supply Agriculture	T=TVS(CL) °C D.O.=6.0 mg/l D.O.(sp)=7.0 mg/l pH=6.5-9.0 E.Coli=126/100ml Chla=8 ug/l [B]	CN=0.2 NO_2=0.05 NO_3=10 S=0.05	B=0.75 Cl=250 SO_4=WS P=25 ug/l (tot) [B]	As(ch)=0.02-10(Trec) [A] Be(ch)=4.0(Trec) Cd(ac)=5.0(Trec) CrIII(ac)=50(Trec) CrIII(ch)=TVS CrVI(ac)=50(Trec)	CrVI(ch)=100(Trec) Cu(ch)=200(Trec) Fe(ch)=WS(dis) Pb(ac)=50(Trec) Pb(ch)=100(Trec) Mn(ch)=WS(dis)	Hg(ac)=2.0(tot) Mo(ch)=160(Trec) Ni(ch)=100(Trec) Se(ch)=20(Trec) Ag(ac)=100(Trec) Zn(ch)=2000(Trec)	Temporary modification Type B: Temperature= "current conditions" Expiration date of 6/30/2016.
COARLA19: All lakes and reservoirs tributary to the Arkansas River, except for specific listings in segments 10-18 and Middle Arkansas Basin segments 19-28.	Aq Life Warm 1 Recreation E Water Supply Agriculture	T=TVS(WL) °C D.O.=5.0 mg/l pH=6.5-9.0 E.Coli=126/100ml Chla=20 ug/l [B]	NH_3(ac/ch)=TVS CL_2(ac)=0.019 CL_2(ch)=0.011 CN=0.005 S=0.002	B=0.75 NO_2=0.5 NO_3=10 Cl=250 SO_4=WS P=83 ug/l (tot) [B]	As(ac)=340 As(ch)=0.02(Trec) Cd(ac/ch)=TVS CrIII(ac)=50(Trec) CrIII(ch)=TVS CrVI(ac/ch)=TVS	Cu(ac/ch)=TVS Fe(ch)=WS(dis) Fe(ch)=1000(Trec) Pb(ac/ch)=TVS Mn(ac/ch)=TVS Mn(ch)=WS(dis)	Hg(ch)=0.01(tot) Mo(ch)=160(Trec) Ni(ac/ch)=TVS Se(ac/ch)=TVS Ag(ac)=TVS Ag(ch)=TVS(tr) Zn(ac/ch)=TVS	

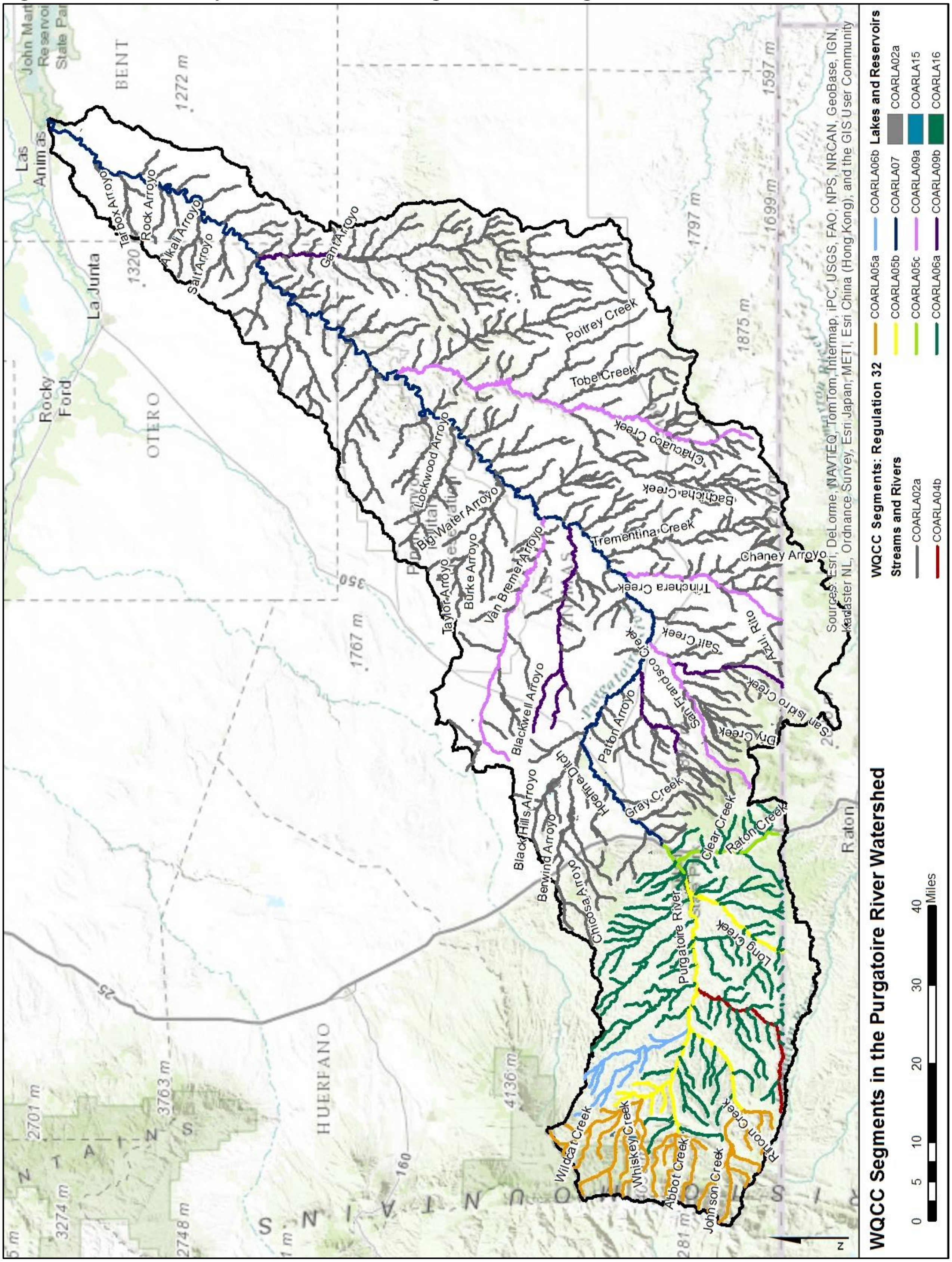
Notes

1. Segments and standards are from the Colorado Water Quality Control Comission Regulation 32: Effective Date 12-31-2013.
2. TVS= Table Value Standard. The value of these standards are hardness-dependent.
3. Ac= Acute, Ch= Chronic, Dis= Dissolved, Sp= Spawning, Tr= Trout, Trec= Total Recoverable, WS= Water Supply, tot= total.
4. Metal concentrations are dissolved, unless otherwise specified.
5. NH_3= Unionized ammonia. The standard relies on both water pH and temperature.

A. Whenever a range of standards is listed and referenced to this footnote, the first number in the range is a strictly health-based value, based on the Commission's established methodology for human health-based standards. The second number in the range is a maximum contaminant level, established under the federal Safe Drinking Water Act that has been determined to be an acceptable level of this chemical in public water supplies, taking treatability and laboratory detection limits into account. Control requirements, such as discharge permit effluent limitations, shall be established using the first number in the range as the ambient water quality target, provided that no effluent limitation shall require an "end-of-pipe" discharge level more restrictive than the second number in the range. Water bodies will be considered in attainment of this standard, and not included on the Section 303(d) List, so long as the existing ambient quality does not exceed the second number in the range.
B. Total phosphorus (TP) and chlorophyll a standards apply only to lakes and reservoirs larger than 25 acres surface area.
C. Total phosphorus and chlorophyll a standards apply only above the facilities listed at 32.5(4).

Source: WQCC Regulation 32. Prepared by Alpine Environmental Consultants LLC, 2014.

Figure 4-2: Water Quality Control Commission Segments in the Purgatoire River Watershed



Source: WQCC Regulation 32. Prepared by Alpine Environmental Consultants LLC, 2014.

Colorado recognizes several beneficial water uses. In the Purgatoire Watershed the water uses of aquatic life, recreation, agriculture and water supply apply to some or all of the segments. Each of these use classifications has specific standards for many water quality parameters. The water use classification with the most restrictive criteria (i.e. lowest value) is applied as the effective standard for each parameter (e.g., pH, temperature or lead). This approach assures that all water uses are protected because the use with the most restrictive criteria is applied as the standard. In the Watershed, the numeric standards associated with aquatic life or water supply are typically the low and are therefore the respective criteria are applied as the numeric standard for many parameters.

The criteria to protect aquatic life generally have two standards associated with each parameter: chronic and acute. Chronic conditions cause stress in aquatic organisms during prolonged or repeated exposures resulting in physical abnormalities, impaired growth, reduced survival, and lowered reproductive success. Acute conditions cause extreme stress during instantaneous or brief exposures that can result in sub-lethal and lethal effects on aquatic life. This approach requires an understanding of both the species expected in a given waterbody and the tolerance of those species to various water quality parameters. The chronic and acute standards are designed to protect 95 percent of the genera in a given waterbody (WQCC, 2013). Colorado relies on guidance from Federal, State and local scientists to establish these standards which are frequently reviewed. Because chronic standards are designed to prevent problems associated with long term exposure to parameters, the concentration of a chronic standard is always lower than the concentration of an acute standard, which is designed to prevent lethal effects. If the concentration of a given parameter exceeds the applicable standard, the quality of the water is not protective of the given use. This condition is referred to as an "exceedance".

Waterbodies may be designated as Outstanding Waters if the Water Quality Control Commission (WQCC) determines that existing water quality is very good, that the waters have exceptional recreational or ecological significance and have not been impacted in any significant way, and if the waters warrant additional protection to prevent future degradation. None of the waterbodies in the Purgatoire River Watershed have been designated as Outstanding Waters.

Under certain circumstances the WQCC designates waterbodies Use Protected. Use Protected segments "do not warrant the special protection provided by the Outstanding Waters designation or the antidegradation review process" (WQCC, 2013). Use Protected segments will continue to support existing designated uses. In the Purgatoire River Watershed, 5 stream and 2 lake segments are designated Use Protected (Table 4-2).

Segments not designated as Outstanding Waters or Use Protected are considered Reviewable Waters. This status allows for antidegradation review and other procedures. In the Purgatoire River Watershed, 5 stream and 2 lake segments are designated Reviewable Waters.

4.3.3 Regulation 85: Nutrients Management Control Regulation

In 2012 the WQCC adopted Regulation 85, as a statewide Nutrient Control Regulation in an effort to reduce or avoid eutrophication (i.e., excess nutrients) in Colorado's streams, rivers, lakes and reservoirs. Regulation 85 is the first part of a comprehensive plan for phasing in nutrient controls over the next couple of decades in an effort to reduce phosphorus and nitrogen loading to state waters. As part of a short- and long-term strategy to address current and potential future nutrient loading to Colorado surface waters, the Regulation applies to both point sources and nonpoint sources of nutrients. Point source entities started monitoring in-stream water quality, for specific forms of phosphorus and nitrogen, and flow, in March 2013. Non-regulated entities are strongly encouraged to do the same in an effort to determine source contribution location and magnitude. Where nonpoint source contributions are significant, the Regulation encourages voluntary approaches to nutrient control.

In addition to Regulation 85, Regulation 31 was amended in 2012 to include "interim" science-based numeric water quality goals for phosphorus, nitrogen and chlorophyll for different categories of state waters (Table 4-3). The interim standards are a best estimate of the concentrations required to protect the beneficial uses of the state's waters. These concentrations are intended to be phased in as basic standards starting in 2022, and will likely be more restrictive than the first phase requirements in Regulation 85. As such, many regulated sources across the state will be faced with the need to install new and/or additional nutrient controls in order to meet the basic standards that will apply to streams, rivers, lakes and reservoirs.

Table 4-3: Interim Standards for Total Phosphorus, Total Nitrogren and Chloyrophyll a

Interim Nutrient Standards	Total Phosphorus	Total Nitrogen[6]	Chlorophyll a
Waterbody Characteristics	Concentration (mg/L)		Concentration (ug/L)
Lakes and Reservoirs, cold, > 25 acres[1, 3, 5]	0.025	0.426	8
Lakes and Reservoirs, warm, > 25 acres[1, 3, 5]	0.083	0.91	20
Lakes and Reservoirs, ≤ 25 acres	Reserved	Reserved	Reserved
Rivers and Streams - Cold[2, 4]	0.11	1.25	150 mg/m^2
Rivers and Streams - Warm[2, 4]	0.17	2.01	150 mg/m^2

Notes

1. Summer (July 1- September 30) average Total Phosphorus (mg/L) in the mixed layer of lakes (median of multiple depths), allowable exceedance frequency 1-in-5 years.

2 Annual median Total Phosphorus (mg/L), allowable exceedance frequency 1-in-5 years.

3. Summer (July 1- September 30) average chlorophyll a (ug/L) in the mixed layers of lakes (median of multiple depths), allowable exceedance frequency 1-in-5 years.

4. Summer (July 1- September 30) maximum attached algae, not to exceed.

5. Direct Use Water Supply (DUWS) lakes and reservoirs may not exceed 5 ug/L chlorophyll a.

6. Effective date 5/31/2017.

Source: WQCC Regulation 31-Basic Standards and Methodologies. Prepared by Alpine Environmental Consultants LLC, 2014

4.3.4 Regulation 93: 303(d) List of Impaired Waterbodies

The goal of the Clean Water Act (CWA) is "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters." Under section 303(d) of the CWA, states, territories, and authorized tribes, collectively referred to in the act as "states," are required to develop lists of impaired waters. These are waters for which technology-based regulations and other required controls are not stringent enough to meet the water quality standards set by states. The law requires that states establish priority rankings for waters on the lists and develop Total Maximum Daily Loads (TMDLs), for these waters. A TMDL is a calculation of the maximum amount of a pollutant that a water body can receive and still safely meet water quality standards.

Section 303(d) of the Clean Water Act (CWA) requires that each state prepare a list of waters that do not meet water quality standards. Regulation 93 is used to document the Colorado List of Impaired Waters 303(d) List. The list must describe the waterbody and the parameter for which it is impaired. Typically, these lists are updated and reevaluated every two years; Colorado's next update will be released in 2016 (data compilation and evaluation will occur in 2014 and 2015). In order to assemble the list, the Colorado Water Quality Control Division (WQCD) reviews readily available water quality data, typically collected within 5 years of the assessment period, by segment relative to state water quality standards. When water quality data do not pass the evaluation, the waterbody is added to the 303(d) List. When impairment is in question but the available data is somehow insufficient (typically too few samples), the waterbody is generally added to Colorado's Monitoring and Evaluation (M&E) List.

The Water Quality Control Division has identified the mercury-fish tissue, also referred to as a fish consumption advisory, and dissolved oxygen impairments as high priorities for TDML development (Table 4-4 and Figure 4-3). Mercury cycles on a regional scale through the atmosphere; therefore the TMDL will likely be addressed at a statewide rather than segment level.

The TMDL to address excess selenium on segments COARLA07, COARLA09a and COARLA09b are considered low priority by the WQCD at this time (Table 4-4 and Figure 4-3). The data used to establish the 303(d) listing for segments COARLA09a and COARLA09b were collected from portions of the segments outside of the Watershed. The Purgatoire River Watershed lacks selenium data for segment COARLA09b. The lack of dissolved selenium data for segments COARLA09a and COARLA09b may warrant additional data collection. This data could be used to determine whether the portions of each segment in the Purgatoire River Watershed attain the selenium standard.

Table 4-4: 303 (d) Listed Segments in the Purgatoire River Watershed

WQCC Segment	Segment Description	Portion	Impairment	Priority
COARLA07	Mainstem of the Purgatoire River from Interstate 25 to the confluence with the Arkansas River.	All	Selenium	Low
COARLA15	All lakes and reservoirs tributary to the mainstem of the North Fork of the Purgatoire River from the source to a point immediately below the confluence with Guajatoyah Creek. All lakes and reservoirs tributary to the Middle Fork of the Purgatoire River from the source to the USGS gage at Stonewall mainstem of the South Fork of the Purgatoire River, from the source to Tercio. Monument Lake, North Lake, Trinidad Lake, Long Canyon Reservoir and Lake Dorothey.	Trinidad Lake	Aquatic Life Use (Hg Fish Tissue), D.O. (Temperature)	High
COARLA09a	Mainstems of Chacuacho Creek, San Francisco Creek, Trinchera Creek and Van Bremer Arroyo from their sources to their confluences with the Purgatoire River. Segment also includes additional streams not in the Purgatoire River Watershed.	All	Selenium	Low
COARLA09b	Mainstem of Smith Canyon from the Otero/Las Animas county line to the confluence with the Purgatoire River. Mainstems of Frijole Creek and Luning Arroyo from their sources to their confluences with the Purgatoire River. Mainstem of Blackwell Arroyo from its source to the confluence with Luning Arroyo. Mainstem of San Isidro Creek from the source to the confluence with San Francisco Creek. Segment also includes additional streams not in the Purgatoire River Watershed. *Use Protected*	All	Selenium	Low

Source: Source: WQCC Regulation 93-2012 303(d) and M&E lists; effective date 3/30/12. Prepared by Alpine Environmental Consultants LLC, 2014

4.3.5 TMDL Development

Generally, after a segment is placed on the 303(d) List, an assessment of contaminant sources is completed. The assessment is referred to as a Total Maximum Daily Load (TMDL). TMDL assessments use water quality data and stream flow to determine the amount, or load, of a given parameter than can be in the stream without exceeding applicable water quality standards; plus a margin of safety. The TMDL also documents parameter loads that originate from point and nonpoint sources within the study area. Once this information is available, a plan is developed to address how each of the contributing sources can be reduced in order to meet the allowable load. To date, no TMDL assessments have been completed for impaired waterbodies in the Watershed.

4.3.6 Monitoring and Evaluation Segments

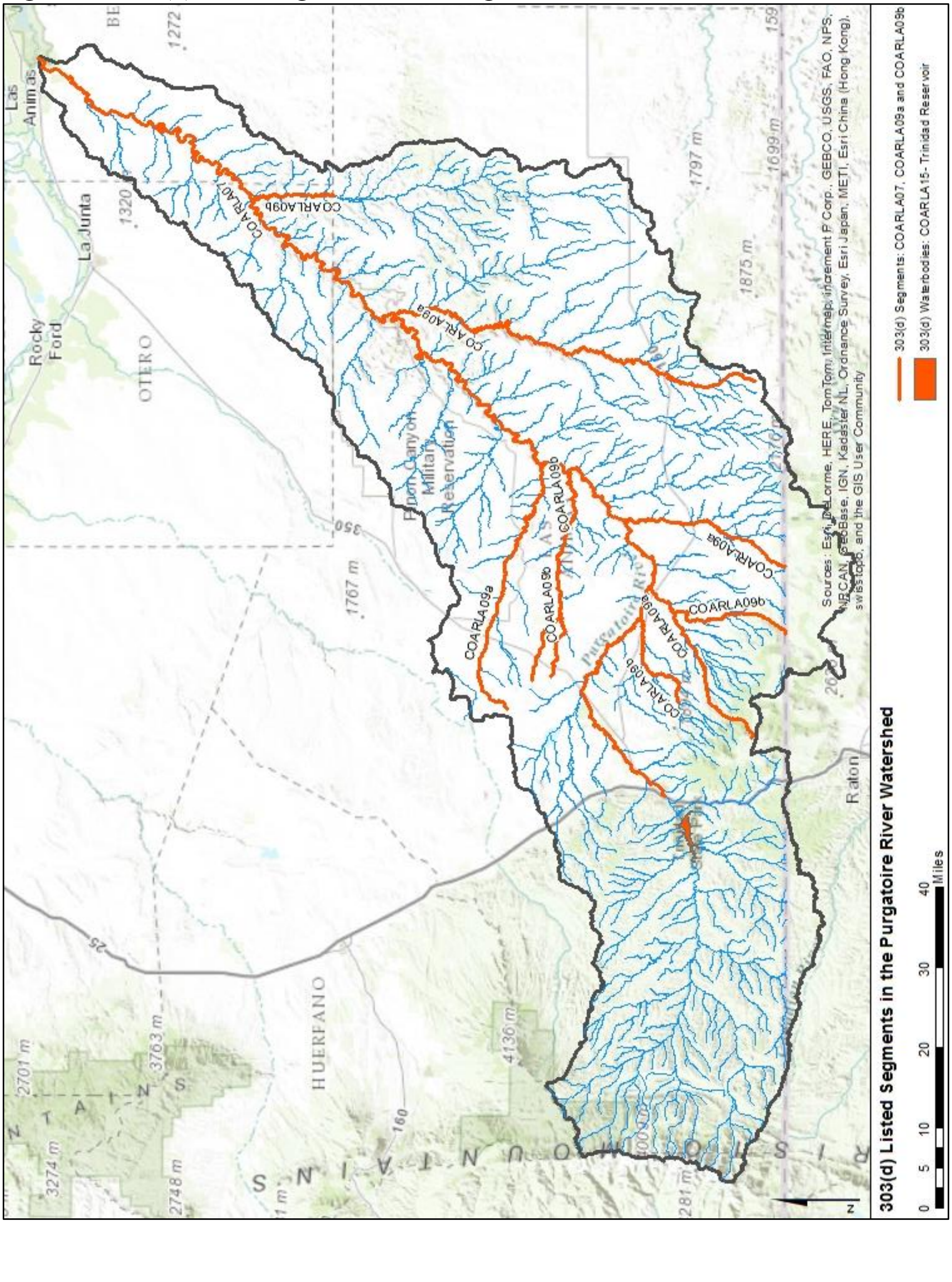
A segment is added to the 303(d) Monitoring and Evaluation List where impairment is suspect but not adequately documented due to an insufficient amount of data, or other issues. The purpose of the M&E list is to highlight where additional monitoring is needed to determine if impairment exists or whether the waterbody is in compliance with standards. Often, the Water Quality Control Division will focus its resources on sampling on these segments or, alternatively, encourage local management agencies to do the same. Segment COARLA07, the Purgatoire River below I-25 to the confluence with the Arkansas River, is on the Monitoring and Evaluation List for excess sediment. Monitoring and Evaluation listing does not initiate the TMDL process.

Table 4-5: Monitoring and Evaluation Segments in the Purgatoire River Watershed

WQCC Segment	Segment Description	Portion	Parameter
COARLA07	Mainstem of the Purgatoire River from Interstate 25 to the confluence with the Arkansas River.	All	Sediment

Source: Source: WQCC Regulation 93-2012 303(d) and M&E lists; effective date 3/30/12 Prepared by Alpine Environmental Consultants LLC, 2014

Figure 4-3: 303(d) Listed Segments in the Purgatoire Watershed.



Note: The data used to determine selenium impairment on segments COARLA09a and COARLA09b were collected from portions of the segments outside of the Purgatoire River Watershed.
Source: WQCC Regulation 93- 2012 303(d) and M&E lists; Prepared by Alpine Environmental Consultants LLC, 2014

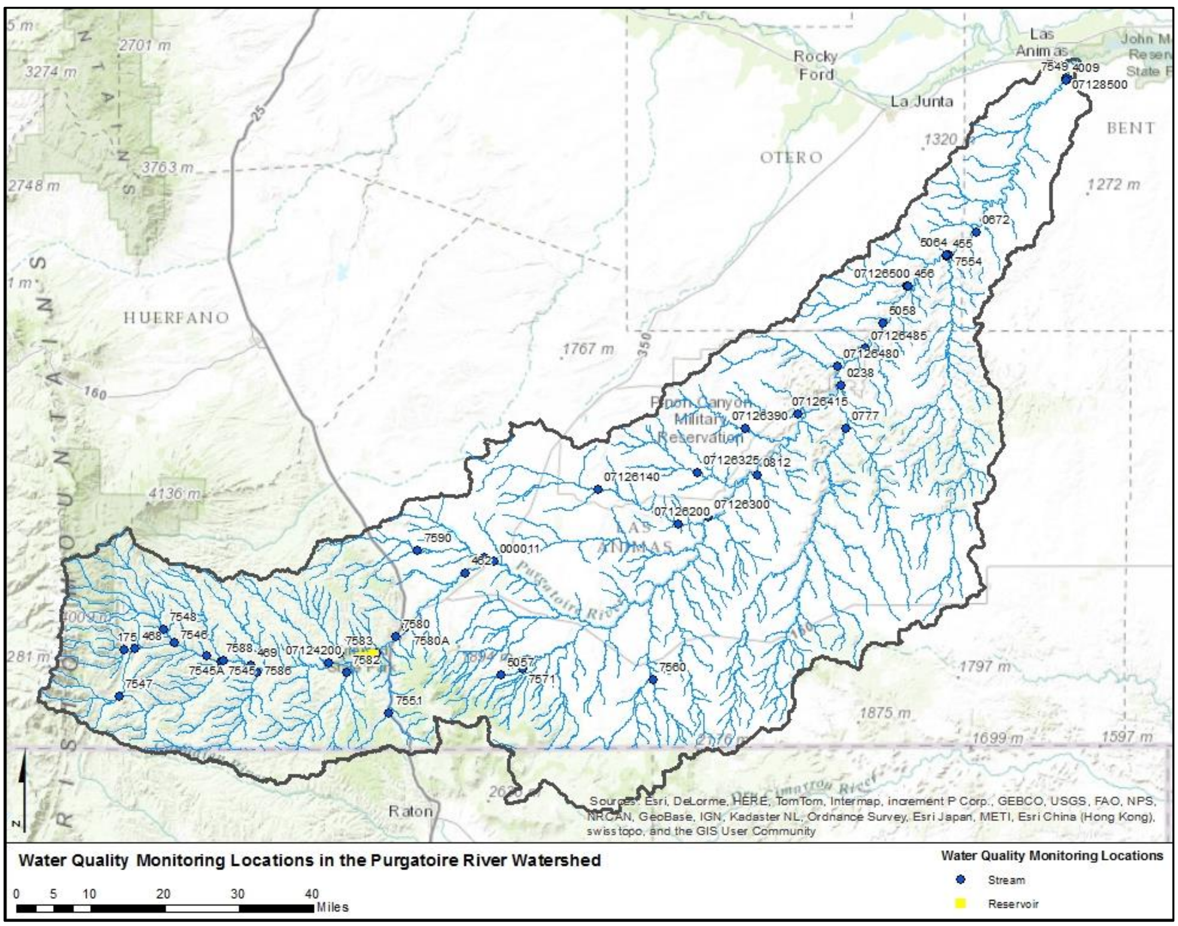
4.4 Water Quality Data Set

The USGS Hydrologic Unit Code (HUC) for the Purgatoire River Watershed (11020010) was used to query the National Water Quality Monitoring Council's Water Quality Portal (WQP). The WQP stores publicly available data from the US Geological Survey (USGS) and the Environmental Protection Agency (EPA) including data available from the following databases: NWIS, WQX and STORET. GIS data was used to assign each location to the correct Water Quality Control Commission (WQCC) segment. The water quality data is referred to as the data set.

There are 51 surface water quality monitoring locations in the Purgatoire River Watershed. 46 of the locations are stream locations. Reservoirs account for 5 of the monitoring locations. The water quality data was collected by USGS, EPA, CDPHE and RiverWatch. 32 of the monitoring locations are on the Mainstem of the Purgatoire River (Figure 4-4). Nineteen of the locations are located in tributary streams (Figure 4-4). The period of record applied to the query was 2000 to 2013.

Water quality data collected as part of the Purgatoire River Watershed Monitoring Program is not included as part of the data set. Report findings and water quality data, as reported in the appendices of the 2010, 2011 and 2012 Annual Reports (Tetra Tech, 2011, 2012, 2013), are incorporated into the water quality discussion that follows. Due to the volume of data collected for the Purgatoire River Watershed Program, the discussion presents the 2011 and 2012 water quality data unless noted otherwise.

Figure 4-4: Water Quality Monitoring Locations in the Purgatoire River Watershed



Source: NWQMC Water Quality Portal. Prepared by Alpine Environmental Consultants LLC, 2014

Table 4-6: Surface Water Quality Monitoring Locations in the Purgatoire River Watershed

Organization	Monitoring Location Name	WQCC Segment	Monitoring Location Description	Location Type
USGS	07124200	COARLA05b	PURGATOIRE RIVER AT MADRID, CO.	Stream
USGS	07124410	COARLA05c	PURGATOIRE RIVER BELOW TRINIDAD LAKE, CO.	Stream
USGS	07126140	COARLA09a	VAN BREMER ARROYO NEAR TYRONE, CO	Stream
USGS	07126200	COARLA09a	VAN BREMER ARROYO NEAR MODEL, CO	Stream
USGS	07126300	COARLA07	PURGATOIRE RIVER NEAR THATCHER, CO.	Stream
USGS	07126325	COARLA02a	TAYLOR ARROYO BL ROCK CROSSING, NR THATCHER, CO.	Stream
USGS	07126390	COARLA02a	LOCKWOOD CANYON CREEK NEAR THATCHER, CO	Stream
USGS	07126415	COARLA02a	RED ROCK CANYON CREEK AT MOUTH NR THATCHER, CO.	Stream
USGS	07126480	COARLA02a	BENT CANYON CREEK AT MOUTH NEAR TIMPAS, CO	Stream
USGS	07126485	COARLA07	PURGATOIRE RIVER AT ROCK CROSSING NR TIMPAS, CO.	Stream
USGS	07126500	COARLA07	PURGATOIRE RIVER AT NINEMILE DAM, NR HIGBEE, CO.	Stream
USGS	07128500	COARLA07	PURGATOIRE RIVER NEAR LAS ANIMAS, CO	Stream
USGS	370831104331101	COARLA16	TRINIDAD LAKE SITE T-1	Reservoir
CDPHE	000011	COARLA07	PURGATOIRE R BLW TRINIDAD @ US HWY 350 BRIDGE	Stream
CDPHE	7541A	COARLA16	TRINIDAD RESERVOIR MID-LAKE UPPER	Reservoir
CDPHE	7541B	COARLA16	TRINIDAD RESERVOIR MID-LAKE LOWER	Reservoir
CDPHE	7544A	COARLA16	TRINIDAD RESERVOIR NR DAM UPPER	Reservoir
CDPHE	7544B	COARLA16	TRINIDAD RESERVOIR NR DAM LOWER	Reservoir
CDPHE	7545	COARLA05b	PURGATOIRE RIVER ABOVE WESTON	Stream
CDPHE	7545A	COARLA05b	PURGATOIRE R. ABOVE WESTON @ HWY 12	Stream
CDPHE	7546	COARLA05b	NORTH FORK PURGATOIRE RIVER NEAR MOUTH	Stream
CDPHE	7547	COARLA05a	SOUTH FORK PURGATOIRE RIVER AT TORRES	Stream
CDPHE	7548	COARLA05b	NORTH FORK PURGATOIRE RIVER NEAR VIGIL	Stream
CDPHE	7549	COARLA07	PURGATOIRE R. @ HWY 101	Stream
CDPHE	7551	COARLA05c	RATON CREEK AT GALLINAS	Stream
CDPHE	7554	COARLA07	PURGATOIRE R. @ HWY 109 SOUTH OF HIGBEE	Stream
CDPHE	7560	COARLA09a	TRINCHERA CREEK BELOW TRINCHERA	Stream
CDPHE	7571	COARLA09a	SAN FRANCISCO CREEK AT BARELA	Stream
CDPHE	7580	COARLA07	PURGATOIRE R. IN TRINIDAD @ CEDAR ST	Stream
CDPHE	7580A	COARLA07	PURGATOIRE R AT KIT CARSON TRAIL IN EAST TRINIDAD	Stream
CDPHE	7581	COARLA02a	CHICOSA ARROYO NR MOUTH AT CR 40	Stream
CDPHE	7582	COARLA05b	LONG CANYON CREEK ABOVE TRINIDAD RESERVOIR	Stream
CDPHE	7583	COARLA06a	REILLY CANYON ABOVE TRINIDAD RESERVOIR	Stream
CDPHE	7586	COARLA04b	LORENCITO CANYON @ MOUTH	Stream
CDPHE	7588	COARLA06b	WET CANYON CREEK @ MOUTH	Stream
CDPHE	7590	COARLA02a	CHICOSA ARROYO AT 75.0 ROAD	Stream
RiverWatch	175	COARLA05a	Bar Ni Ranch	Stream
RiverWatch	4009	COARLA07	CR 101	Stream
RiverWatch	455	COARLA07	Higbee Br	Stream
RiverWatch	456	COARLA07	Nine Mile Dam	Stream
RiverWatch	462	COARLA07	Mincic	Stream
RiverWatch	468	COARLA05b	Stonewall	Stream
RiverWatch	469	COARLA05b	Primero	Stream
RiverWatch	5057	COARLA09a	N of CR 12 Sandoval Ranch	Stream
RiverWatch	5058	COARLA07	Comanche NH Grasslands	Stream
RiverWatch	5064	COARLA07	Abv CO 109	Stream
EPA	0238	COARLA07	PURGATOIRE RIVER	Stream
EPA	0777	COARLA09a	CHACUACO CREEK	Stream
EPA	0812	COARLA07	PURGATOIRE RIVER	Stream
EPA	0672	COARLA07	PURGATOIRE RIVER	Stream

Source: NWQMC Water Quality Portal. Prepared by Alpine Environmental Consultants LLC, 2014

4.5 Water Quality Assessment

This section presents water quality data, analysis and findings for selected priority parameters in the Purgatoire River Watershed. The bulk of the discussion in this section focuses the data that exceeded regulatory standards (i.e. failed to meet criteria). Remember that it is only a portion of the total data set.

Where possible the instantaneous loads are presented for each parameter along with the water quality data. Loads quantify the amount of a parameter that passes through a given point, and are expressed in pounds per day (lbs/day) in this assessment.

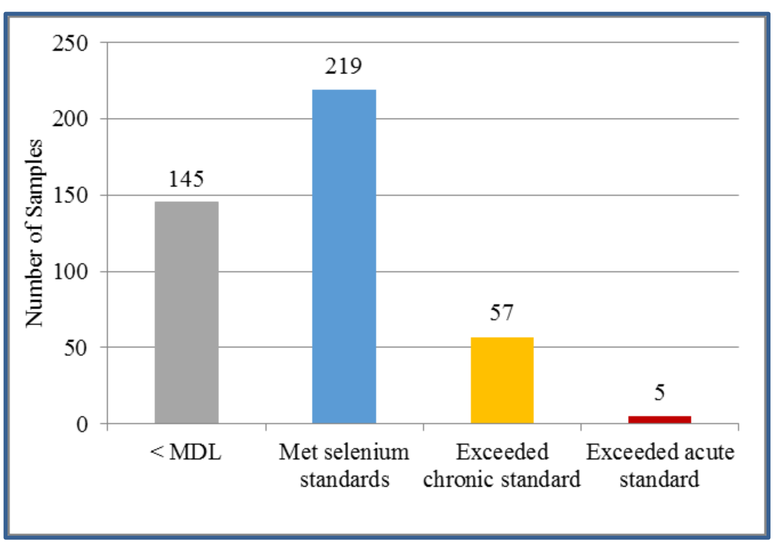
To compute a load, the concentration of a given parameter and the streamflow must be measured during sample collection. The flow and concentration data are multiplied to calculate the load. Both the flow and concentration data are instantaneous, that is to say they only represent the conditions at the specific time the sample was collected. Both stream flows and water quality parameters can vary widely at different time scales (day, month, and year). It is not unusual for peak stream flows to be two to three orders of magnitude larger than low flow conditions. Similarly, the concentration of many parameters, can vary in response to snowmelt, intense precipitation events or due to human activities. Together these factors make characterizing parameter loads difficult, particularly for monthly or annual time frames. Thus, the loads presented in this assessment are instantaneous loads, and references to monthly or annual loads are estimates due to the factors mentioned above. Generally, additional data is needed to improve the veracity of loading estimates, and therefore load reductions, in the Watershed. It is recommended that additional data collection occur as projects identified in the Watershed Plan are implemented to assure that loads are adequately characterized prior to and following the project.

Many of the water quality samples included in the data set lack paired flow measurements, so it is not possible to calculate loads directly. Where appropriate, flow data from adjacent locations is used to estimate the load. In these instances the date range for both the concentration and flow data is provided in the discussion. The load was calculated for parameter concentrations that were below method detection limits, due to the associated uncertainty.

4.5.1 Dissolved Selenium Assessment

Selenium, a nonmetal chemical element, is naturally found in sedimentary rocks. As water infiltrates through these rocks or soils derived from them, selenium can leach from soils and be transported to the nearest waterway, resulting in increased instream concentrations of selenium. Selenium is a bio-accumulative metal; the degree to which it affects organisms varies by species and site-specific variables (WQCC, 2013). Elevated selenium concentrations are particularly detrimental to certain fish and some bird species. Water use practices play a large role in the amount of selenium mobilized due to human activities. Where excess water is applied to soils, regardless of the purpose, selenium can be mobilized. This condition, referred to as deep percolation, can accelerate the rate of natural weathering and groundwater return flows which, in turn, can increase instream concentrations of selenium. Additional pollutants including salts, iron, and others, can also be mobilized in this process. Agricultural, residential, and commercial irrigation, unlined ponds and canals, and other water uses can mobilize large quantities of selenium, particularly if they occur on soils derived from certain selenium-rich shales.

Dissolved selenium concentrations have been measured in 276 samples collected from 41 locations in the Purgatoire River Watershed. Over half of the dissolved selenium concentrations, 149 samples, were collected from locations on segment COARLA07, the mainstem of the Purgatoire River from 1-25 to the Arkansas River (Table 4-7). The upper portions of the Purgatoire River on segments COARLA05a and COARLA05b have been sampled 38 and 48 times, respectively. Collectively, samples collected from the mainstem of the Purgatoire River and named forks (i.e. north, middle and south forks) account for 83 percent of the selenium samples. Other tributaries to the Purgatoire River account for 17 percent of the dissolved selenium samples collected to date. Paired stream flow measurements were completed during 24 of the sample events, which allows for an instantaneous load calculation.



The chronic and acute dissolved selenium standards were met in 219 of 276 samples, or 79% of the evaluations (see Figure 4-5). The chronic dissolved selenium standard was exceeded in 21% of the samples collected from 11 locations (Figure 4-5). An additional 5 of the samples also exceeded the acute dissolved selenium standard. Acute exceedance occurred at 3 locations in the Purgatoire River Watershed.

Figure 4-5: Dissolved Selenium Standards Assessment (n=276)

Source: PWP Water Quality Data Analysis. Prepared by Alpine Environmental Consultants LLC, 2014

Approximately 53 percent, 145 of the samples, of the selenium concentrations were below Maximum Daily Limit (MDL), which ranged from 1-5 ug/L (Figure 4-5). During a standard evaluation, results reported as less than the MDL are treated as a zero. When the MDL is greater than the standard it is not technically suitable to complete a standard evaluation. The MDLs were suitable for the chronic standard evaluation (i.e. MDL < 4.6 ug/L) in samples excluding 26 samples where the MDL was 5 ug/L. The samples were collected by River Watch from 2000 to 2012. Given the dissolved selenium concentrations measured in the Purgatoire River Watershed and the proximity of the unsuitable MDLs, 5 ug/L, to the chronic standard, 4.6 ug/L, it is relatively unlikely that the chronic standard was exceeded in this subset of samples. However, the MDL issue, where the MDL exceeded the chronic standard, is worth noting for future monitoring efforts.

The following paragraphs summarize the dissolved selenium assessment by stream segment. A total recoverable selenium standard of 20 ug/L (chronic) is applied to segments: COARLA02a, COARLA06a, COARLA06b, COARLA16, and COARLA17 (Table 4-8). These segments are discussed in the Total Selenium Assessment (Section 4.5.2).

COARLA04b: Lorencito Canyon

Segment COARLA04b, the mainstem of Lorencito Canyon is classified as Use Protected (Table 4-2) and CBM discharge occurs in the Lorencito Canyon drainage. The data set includes 6 dissolved selenium samples collected from 2 locations. Five samples were collected from site 7586 (Table 4-7 and Figure 4-4). Site 7586 is located near the mouth of Lorencito Canyon and is sampled by CDPHE. Dissolved selenium concentrations ranged from < 1 to 19.0 ug/L in 5 samples (Table 4-9). Dissolved selenium concentrations in 3 samples exceed the chronic standard (Table 4-9); the concentrations in these samples ranged from 16.6 to 19 ug/L. Collectively, 3 in 5 samples exceed the chronic standard and 1 sample exceeds the acute standard (Table 4-9). Flow was not measured at site 7586 and dissolved selenium loads cannot be calculated.

Although three exceedances occurred near the mouth of Lorencito Canyon in 2005 and 2006, data collected more recently suggests that selenium concentrations are below the chronic and acute standards (Table 4-9). The PRW Monitoring Program samples Lorencito Canyon near the mouth, at site LOR-0.2. Dissolved selenium concentrations measured in 24 samples collected from 2010 to 2012, ranged from 0.2 to 1.1 ug/L.

COARLA05a: North Fork and Tributaries above Guajatoyah Creek, Middle Fork and Tributaries above Bar Ni Ranch Road, South Fork and Tributaries above Tercio

Segment COARLA05a includes the headwaters of the Purgatoire River, above the confluence of the North, Middle and South forks. The data set includes 2 locations (Figure 4-4 and Table 4-7). Site 7547, sampled by CDPHE, is located in the South Fork of the Purgatoire River at Torres (Figure 4-4). The site was sampled on one occasion, August 25, 2004. The dissolved selenium concentration was < 1 ug/L. To date, the South Fork of the Purgatoire River has been sampled on one occasion which constitutes a data gap. If possible additional data collection should occur to better characterize selenium concentrations in the South Fork and its tributaries.

Site 175, Middle Fork of the Purgatoire River at Bar Ni Ranch Road, is located at the bottom of segment COARLA05a (Figure 4-4). Site 175 was sampled 37 times from December 2006 to December 2009 by Riverwatch; stream flow was not measured. Dissolved selenium concentrations ranged from < 0.6 to 27.9 ug/L; where 30 of 37 samples were less than MDLs. Selenium concentrations exceeded the chronic standard in 7 samples (Table 4-9). Of those samples, 2 concentrations also exceeded the acute standard (Table 4-9). The 303(d) List previously included segment COARLA05a for selenium. However, 22 samples collected from March 2008 to December 2009 had selenium concentrations less than MDLs, which indicates that the segment attains the selenium criteria and resulted in removal of segment COARLA05a from the 303(d) List (Regulation 93, pg. 88).

The PRW Monitoring Program includes 2 locations on segment COARLA05a. The sites are referred to as NFPR-5.3, North Fork of the Purgatoire River 5.3 miles upstream of the confluence with the Purgatoire River and GUA-0.1, Guajatoyah Creek near the mouth. CBM discharges are located in the Guajatoyah Creek drainage; CBM discharges are not found in areas tributary to the North Fork of the Purgatoire River above Guajatoyah Creek (Tetra Tech, 2011). In 2011 the sites were sampled monthly and in 2012 each site was sampled 4 times. Dissolved selenium concentrations were < 1 ug/L in all of the samples. The available data from the northern portion of segment COARLA05a suggests that the selenium standards are consistently met.

COARLA05b: North (and tributaries), Middle and South Forks of the Purgatoire River below Segment COARLA05a and the Mainstem of the Purgatoire River to Trinidad, and the Mainstem of Long Canyon Creek

Dissolved selenium concentrations have been measured in 48 samples collected from 8 locations on segment COARLA05b. Dissolved selenium concentrations ranged from 0.6 to 37 ug/L on segment COARLA05b. The chronic standard was exceeded in 4 samples, collected from 2 locations; the acute standard was exceeded in 2 samples collected from 1 location (Table 4-7).

The North Fork of the Purgatoire River has been sampled at 2 locations on segment COARLA05b. Site 7548, the North Fork near Vigil, is the upstream of site 7546, the North Fork of the Purgatoire River near the mouth (Figure 4-4). In the only sample collected to date, the dissolved selenium concentration was < 0.6 ug/L at the upper site, 7548. Site 7546, has been sampled 5 times from August 2005 to June 2006. Dissolved selenium concentrations ranged from < 1 to 1.3 ug/L. The PRW Monitoring Program collects samples from the North Fork at one location on segment COARLA05b. The location, referred to as NFPR-0.3, is about 0.3 miles above the confluence with the Purgatoire River. In 2011 and 2012, selenium concentrations were < 1 ug/L in all 16 samples were collected from NFPR-0.3. All three of the locations are downstream of CBM discharges (Tetra Tech, 2011). The North Fork locations did not account for any of the exceedances in segment COARLA05b.

Site 468, the Middle Fork of the Purgatoire River near Stonewall, has been sampled 15 times from April 2004 to October 2006 by River watch. Dissolved selenium concentrations were < 0.6 ug/L in all of the samples. The Purgatoire River has been sampled at two locations, sites 7545 and 7545A, near Weston. CDPHE has collected 6 samples from these locations. Dissolved selenium concentrations ranged from< 1 to 1.4 ug/L. This portion of segment COARLA05b did not account for any of the exceedances on the segment.

The PRW Monitoring Program collects samples from 2 locations on the South Fork of the Purgatoire River. The upstream location, SFPR-12.7, is located near Tercio and the downstream location, SFPR-0.2, is at the mouth of the South Fork. The location near Tercio is upstream of CBM discharges, the location near the mouth of the South Fork is downstream of CBM discharges (Tetra Tech, 2011). Each site was sampled on 16 occasions during 2011 and 2012. Dissolved selenium concentrations were less than 1 ug/L in all samples collected at each site.

Site 469, is located on the mainstem of the Purgatoire River near Primero (Figure 4-9). River watch collected 16 dissolved selenium samples from December 2004 to October 2006. Dissolved selenium concentrations ranged from < 0.6 to 5.7 ug/L; and 81 percent of the concentrations were below MDLs (Table 4-8). One sample, collected on February 21, 2005, exceeded the chronic standard for dissolved selenium. Given that 13 samples collected since February 2005 have met the chronic selenium standard, including additional low flow samples, it does not appear that dissolved selenium concentrations exceed standards on a regular basis. USGS also collected a sample in the vicinity, Purgatoire River at Madrid (Site 07124200; Figure 4-4). The dissolved selenium concentration was < 2 ug/L during a low flow characterization event in August 2002.

CDPHE has collected 4 samples from site 7582, Long Canyon Creek above Trinidad Reservoir in 2005 and 2006. Dissolved selenium concentrations ranged from < 1 to 37.0 ug/L (Table 4-4). Dissolved selenium concentrations exceeded the chronic standard in 3 of the samples and the acute standard in 2 samples (Table 4-9). The PRW Monitoring Program samples Long Canyon Creek about 2.1 miles above the confluence with Trinidad Reservoir. In 2011 and 2012, dissolved selenium concentrations were < 1 ug/L in 16 samples collected from site LNG-2.1 (Tetra Tech, 2012 and 2013). Site 7582 is located immediately above Trinidad Reservoir near Fedora Road which is about 2 miles downstream of site LNG-2.1. CBM discharges do not occur in the Long Canyon Creek drainage; Pioneer re-injects CBM water is this area (Tetra Tech, 2013). It is possible that land uses between the sites, which could be attributed to agriculture or the Fedora Road which parallels the stream, may affect dissolved selenium concentrations between the sites. Alternatively, reservoir inundation near site 7582 may affect soil characteristics and allow for additional selenium mobilization from the sediments.

Flow was not measured at site 7582 during sample collection. The flow data collected at site LNG-2.1 was used to approximate selenium loads near the mouth of Long Canyon Creek; the flow and concentration data are not paired. The lack of paired data limits the veracity of the load estimate. The median flow at LNG-2.1 ranges from 0.031 to 0.68 cfs (Tetra Tech, 2011 and 2013). Given the range of dissolved selenium concentrations measured at site the mouth of Long Canyon Creek, the load at the mouth of Long Canyon Creek ranges from 0.0 to 0.136 lbs/day. The maximum annual load at the mouth of Long Canyon Creek, calculated from the highest median flow (0.68 cfs) and the maximum dissolved selenium concentration (37 ug/L) from the available data, is about 50 lbs/year. Additional sample collection could occur near the mouth of Long Canyon Creek to identify potential selenium sources, better characterize loads, and to determine whether practical mitigation strategies can be employed in this area. Due to very low dissolved selenium concentrations measured at site LNG-2.1, approximately 2 miles upstream of mouth of Long Canyon Creek, and low flows additional monitoring is a low priority.

COARLA05c: The Mainstem of the Purgatoire River from Trinidad Reservoir to I-25, and the Mainstem of Raton Creek

USGS operates site 07124410, the Purgatoire River below Trinidad Reservoir, but dissolved selenium is not measured at the site. However, the PRW Monitoring Program also samples the Purgatoire River below Trinidad Reservoir at site PR-2.8. Dissolved selenium concentrations were < 1 ug/L in 9 samples collected between April and October of 2011 and 2012 (Tetra Tech, 2012 and 2013).

Dissolved selenium concentrations have been measured once at site 7551, Raton Creek at the confluence with Gallinas Creek. The dissolved selenium concentration was < 1 ug/L. Site 7551 is located upstream of the only CBM discharge site, which is located in the Clear Creek drainage (Figures 4-1 and 4-4). Limited CBM development has occurred in the Raton Creek drainage and the area is not included in the PRW Monitoring Program.

COARLA07: Mainstem of the Purgatoire River from I-25 to the Confluence with the Arkansas River

Dissolved selenium was measured in 150 samples collected from 14 locations on the mainstem of the lower Purgatoire River on segment COARLA07 (Table 4-7). The dissolved selenium standard was exceeded in 43 samples, this equates 29 percent of the evaluations, collected from 7 locations (Table 4-7). One sample collected from one location, site 7554, exceeded the acute standard for dissolved selenium (Table 4-9).

At site 7580, the Purgatoire River immediately downstream of I-25, dissolved selenium concentrations have been measured in 12 samples. The dissolved selenium concentrations ranged from < 1.0 ug/L to 13.0 ug/L and 5 of the samples were below the MDL (Table 4-8). The chronic standard was exceeded in 5 samples at site 7580 (Table 4-8). The available data set does not indicate a clear pattern in dissolved selenium concentrations.

At site 7580A, the Purgatoire River near Kit Carson Trail on the east side of Trinidad, 10 dissolved selenium concentrations have been collected. Dissolved selenium concentrations ranged from < 1.0 to 3.0 ug/L. The dissolved selenium concentrations were less than chronic and acute standards in all samples collected to date.

Dissolved selenium concentrations have been measured in 42 samples collected from site 462, the Purgatoire River near Hoehne (about 9 miles northeast of Trinidad). Dissolved selenium concentrations ranged from < 0.6 to 5.7 ug/L; dissolved selenium concentrations were < MDLs in 37 samples (Table 4-8). The chronic selenium standard was exceeded in 3 samples (Table 4-8). The instantaneous load at site 462 ranged from < 0.001 to 0.31 pounds per day in the only 2 flow measurements completed to date.

The Purgatoire River at Highway 350 Bridge (about 13 miles northeast of Trinidad) is sampled at site 000011. In 12 samples collected from 2004 to 2006, dissolved selenium concentrations ranged from < 1 to 12 ug/L (Table 4-8). The dissolved selenium concentration exceeded the chronic standard, 4.6 ug/L, in 3 samples.

The Purgatoire River is sampled near Thatcher, below the confluence with the Van Bremer Arroyo, at site 07126300. Since December 2012, 4 samples have been collected on a quarterly basis. The dissolved selenium concentration ranged from 2.4

to 3.1 ug/L; which is less than the chronic selenium standard. The instantaneous dissolved selenium loads ranged from 0.002 to 0.92 pounds per day.

Site 0238, the Purgatoire River downstream of Chacaucho Creek, has been sampled once. The dissolved selenium concentration was 1.1 ug/L; which is less than the chronic selenium standard.

The Purgatoire River at Rock Crossing near Timpas, site 07126325, was sampled twice in 2013. Dissolved selenium concentrations were 3.7 and 4.1 ug/L in March and August, respectively. The dissolved selenium concentrations were below the chronic standard, 4.6 ug/L. The instantaneous dissolved selenium loads were 0.09 and 1.68 pounds per day in March and August 2013, respectively.

One sample was collected from site 5058, the Purgatoire River south of Withers Canyon Trailhead, in 2009. The dissolved selenium concentration was < 5 ug/L and the instantaneous load was < 0.001 pounds per day.

The Purgatoire River near Nine Mile Dam is monitored at sites 07126500 and 456. In September 2002, during low flow conditions, the dissolved selenium concentration was 1.0 ug/L. Dissolved selenium was not measured at site 456. However, total selenium concentrations have been measured 57 times. Total selenium concentrations ranged from < 0.6 to 16.5 ug/L. Total selenium concentrations, and therefore dissolved selenium concentrations, were less than the acute standard, 18.6 ug/L, in all samples.

The Purgatoire River near Highway 109 is monitored at 3 sites: 455, 5064 and 7554. Dissolved selenium concentrations were measured in 8 samples. Dissolved selenium concentrations ranged from 2 to 88.1 ug/L. The maximum dissolved selenium concentration, 88.1 ug/L collected on November 17, 2005, appears to be an anomaly and was removed from the data set. Six of the dissolved selenium samples were collected after November 2005, following the apparent anomaly. The dissolved selenium concentration in the other 6 samples ranged from 2.0 to 9.30 ug/L. Dissolved selenium concentrations exceeded the chronic standard in 3 samples; the acute standard was not exceeded (Table 4-8).

The Purgatoire River at Highway 101, near Las Animas is sampled by USGS, CDPHE and River watch at 3 adjacent sites: 07128500, 7549 and 4009. Dissolved selenium concentrations have been measured in 57 samples. Dissolved selenium concentrations ranged from 4 to 18 ug/L (Table 4-8). The chronic standard was exceeded in 28 samples, or 49 percent of the evaluations. The dissolved selenium concentrations did not exceed the acute standard in any of the samples. Instantaneous dissolved selenium loads ranged from 0 to 1.91 pounds per day.

Selenium likely originates from both natural and anthropogenic sources in the Lower Purgatoire River. Local geology and soils may be a source of natural selenium. While certain land uses, particularly irrigation and water delivery systems, may increase anthropogenic selenium loading, point source discharges, which include agricultural, industrial and municipal operations (Figure 4-1), may also be a source of selenium. Additional study is required to isolate selenium sources and determine whether the sources are natural or anthropogenic in nature, and the extent to which they may be mitigated.

The Purgatoire River below Trinidad Reservoir, on segment COARLA07, is over 150 miles long. The length of the river and the number of tributaries present a substantial challenge for data collection to support TMDL development. To help manage these challenges, the existing data set was used to identify to priority areas for the lower Purgatoire River.

Further sample collection is recommended for the upper portion of segment COARLA07 in the Purgatoire River from Trinidad Reservoir to Van Bremer Arroyo. Dissolved selenium concentrations intermittently exceeded the chronic, but not acute standard, in this area. Dissolved selenium concentrations exceeded the chronic standard in 11 of 76 samples collected from this portion of the Purgatoire River. The existing data set lacks the resolution to clearly identify potential sources. Thus, sample collection should be designed to isolate all potential sources such as tributaries, stormwater runoff and agricultural return flows. Van Bremer Arroyo was selected as the bottom of the study reach based on data collected by USGS from the mouth of Van Bremer Arroyo and the Purgatoire River below Van Bremer Arroyo. Four samples were collected from each site in 2012 and 2013. Although limited in size, the samples suggest that Van Bremer Arroyo is not a substantial source of dissolved selenium. Dissolved selenium concentrations in the Purgatoire River below Van Bremer Arroyo (site 07126300) and other downstream locations met the chronic standard in all samples collected to date (n= 9).

Additional data collection should occur on the Purgatoire River from Nine Mile Dam to the confluence with the Arkansas River. Selenium concentrations in the Purgatoire River appear to increase between Nine Mile Dam (sites 07126500 and 456) and Highway 109 (sites 455, 5064 and 7554). Potential selenium sources include the Nine Mile and Highland canals, several arroyos and other unnamed tributaries. Future data collection should isolate tributaries, canals and other potential selenium sources; paired flow measurements should also be completed.

COARLA09a: Chacuacho, San Francisco, Trinchera creeks and Van Bremer Arroyo

Dissolved selenium concentrations have been measured in 7 samples collected from 4 locations (Table 4-7). Dissolved selenium concentrations ranged from < 1 to 3.2 ug/L. The chronic or acute standard was not exceeded in any of the samples collected to date. San Francisco Creek has been sampled a 2 locations, sites 5057 and 7571. Dissolved selenium concentrations were < MDLs in the 2 samples collected to date.

Trinchera Creek is sampled at site 7560, Trinchera Creek downstream of Trinchera. Dissolved selenium was 1.5 ug/L in the only sample collected to date. Concentrations were below the MDL in 5 of 7 samples. One sample, collected on July 19, 2005, exceeded the chronic standard but not the acute standard. All of the samples collected following July 2005, were below MDLs.

The Van Bremer Arroyo is sampled near Model, about 4 miles upstream of the confluence with the Purgatoire River at site 07126200 (Figure 4-4). Dissolved selenium concentrations have been measured on 4 occasions. Dissolved selenium concentrations ranged from 0.12 to 3.2 ug/L. Dissolved selenium concentrations were less than the chronic and acute standards.

COARLA15: Lakes and Reservoirs tributary to the Purgatoire River above Trinidad Lake, including Monument, North, Trinidad lakes and Long Canyon Reservoir and Lake Dorothey

To date, Trinidad Reservoir is the only waterbody that has been sampled on segment COARLA15. A total of 12 samples have been collected from 4 locations at various depths in Trinidad Reservoir. The dissolved selenium concentrations ranged from < 1 to 1.3 ug/L; 7 of the sample concentrations were < 1 ug/L. The dissolved selenium concentrations in all samples were less than the chronic and acute standards (Table 4-7).

Dissolved selenium concentrations have not been measured on the following segments: COARLA09b, COARLA16, COARLA17 and COARLA19. Segment COARLA09b includes the lower portion of Smith Canyon, which may be a potential source of dissolved selenium in the lower Purgatoire River, as observed at the sites near Highway 109. The other portions in segment COARLA09b are not considered a priority for water quality characterization. The lakes and reservoirs in the upper portion of the watershed on segment COARLA16 are considered a relatively low priority for water quality characterization, due to generally high quality water in down-gradient streams and rivers. The lakes and reservoirs tributary to Long Canyon are also considered low priority for water quality characterization. The lakes and reservoirs on Segment COARLA19, tributary to the Arkansas River not included on other segments, are a low priority for water quality characterization.

Table 4-7: Summary of Dissolved Selenium Standards and Exceedances in the Purgatoire River Watershed

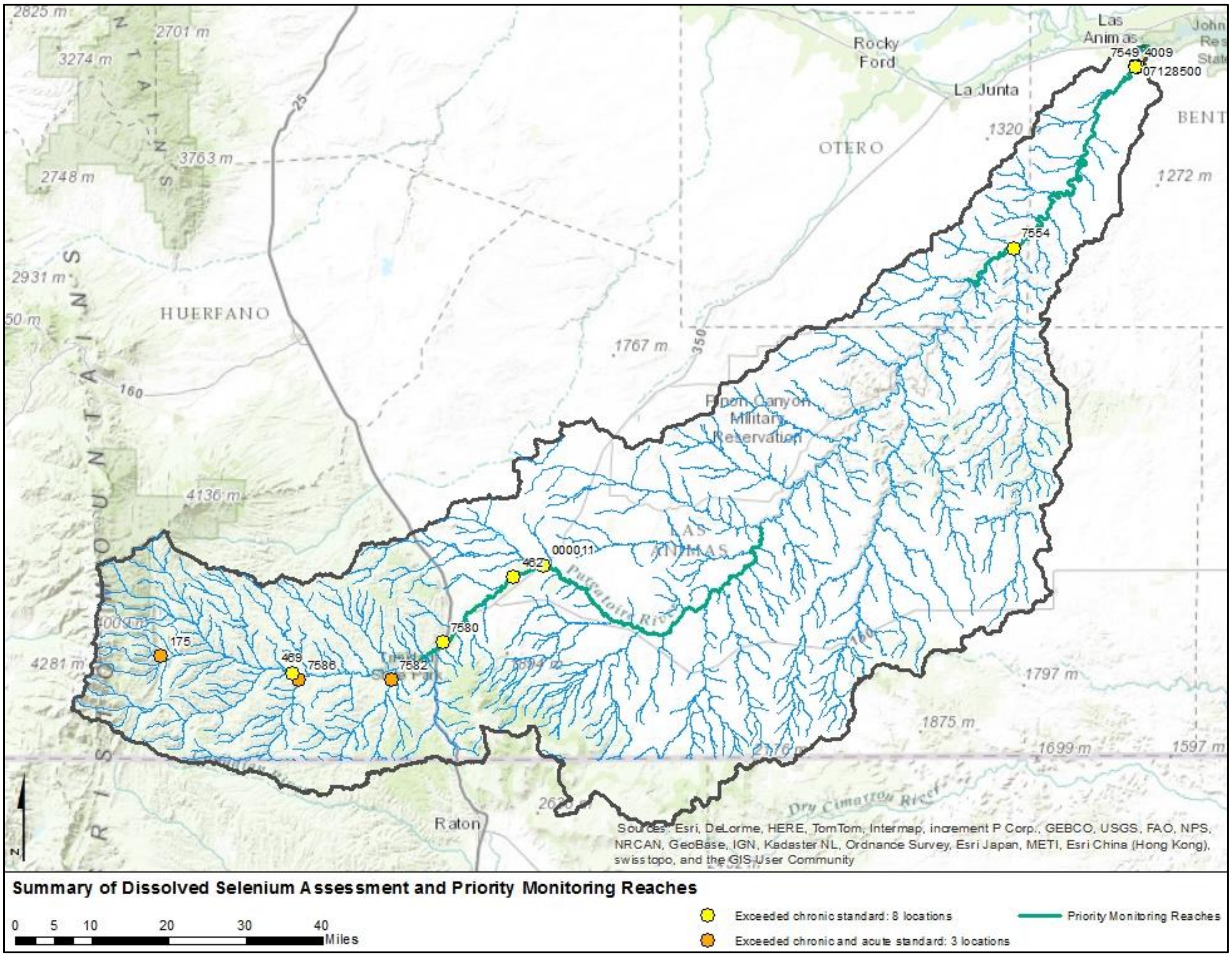
Segment	Segment Description[1]	Selenium Standard (ug/L)		Dissolved Selenium Summary		Chronic Exceedances Summary			Acute Exceedances Summary		
		Chronic	Acute	Number of Samples	Number of Locations	Number of Samples	Percent Exceedances	Number of Locations	Number of Samples	Percent Exceedances	Number of Locations
COARLA02a	All Arkansas River tributaries not included in other segments.	20 (Trec)	NA	6	2	NA	NA	NA	NA	NA	NA
COARLA04b	Mainstem of Lorencito Canyon, from the source to the confluence with the Purgatoire River.	4.6	18.6	5	1	3	60%	1	1	20%	1
COARLA05a	Mainstem of the North Fork of the Purgatoire River,and tributaries, from source to Guajatoyah Creek; mainstem of the Middle Fork of the Purgatoire River, and tributaries, from the source to the Bar Ni Ranch Road; Mainstem of the South Fork of the Purgatoire River, and tributaries, from the source to Tercio.	4.6	18.6	38	2	7	18%	1	2	5%	1
COARLA05b	Mainstem of the North Fork of the Purgatoire River, and tributaries, from Guajatoyah Creek to the the Purgatoire River. Mainstem of the Middle Fork of the Purgatoire River fromStonewall Gap to the North Fork of the Purgatoire River. Mainstem of the South Fork of the Purgatoire River from Tercio to the confluence with the Purgatoire River. Mainstem of the Purgatoire River to Trinidad Lake. Mainstem of Long Canyon Creek from the source to Trinidad Reservoir.	4.6	18.6	48	8	4	8%	2	2	4%	1
COARLA05c	Purgatoire mainstem from Trinidad Lake to I-25. Mainstem of Raton Creek from the source to the Purgatoire River.	4.6	18.6	1	1	0	0%	0	0	0%	0
COARLA06a	All tributaries to the Purgatoire River, and wetlands, from the source to Interstate 25, except for specific listings in segments 4b, 5a, 5b, 5c and 6b.	20 (Trec)	NA	5	1	NA	NA	NA	NA	NA	NA
COARLA06b	Wet Canyon and all tributaries, including wetlands, from the source to the confluence with the Purgatoire River.	20 (Trec)	NA	5	1	NA	NA	NA	NA	NA	NA
COARLA07	Mainstem of the Purgatoire River from I-25 to the confluence with the Arkansas River.	4.6	18.6	150	14	43	29%	7	1	1%	1
COARLA09a	Mainstems of Chacuacho Creek, San Francisco Creek, Trinchera Creek and Van Bremer Arroyo from their sources to their confluences with the Purgatoire River.	4.6	18.6	7	4	0	0%	1	0	0%	0
COARLA09b	Mainstem of Smith Canyon from the Otero/Las Animas county line to the confluence with the Purgatoire River. Mainstems of Frijole Creek and Luning Arroyo from their sources to the Purgatoire River. Mainstem of Blackwell Arroyo from source to Luning Arroyo. Mainstem of San Isidro Creek from source to San Francisco Creek.	4.6	18.6	No data		NA	NA	NA	NA	NA	NA
COARLA15	All lakes and reservoirs tributary to the mainstem of the North Fork of the Purgatoire River from source to Guajatoyah Creek. All lakes and reservoirs tributary to the Middle Fork of the Purgatoire River from source to the USGS gage; mainstem of the South Fork of the Purgatoire River, from the source to Tercio. Monument Lake, North Lake, Trinidad Lake, Long Canyon Reservoir and Lake Dorothey.	4.6	18.6	12	4	0	0%	0	0	0%	0
COARLA16:	All lakes and reservoirs tributary to the Purgatoire River from source to I-25, except for specific listings in segment 15 & 17.	20 (Trec)	NA	No data		NA	NA	NA	NA	NA	NA
COARLA17	All lakes and reservoirs tributary to Wet Canyon, from the source to the confluence with the Purgatoire River.	20 (Trec)	NA	No data		NA	NA	NA	NA	NA	NA
COARLA19	All lakes and reservoirs tributary to the Arkansas River, except for specific listings in segments 10-18.	4.6	18.6	No data		NA	NA	NA	NA	NA	NA

Note

1. The segment descriptions are abbreviated in this table. Official descriptions are available in Table 4-2.

Source: PWP Water Quality Data Analysis. Prepared by Alpine Environmental Consultants LLC, 2014

Figure 4-6: Chronic and acute exceedances and priority reaches for dissolved selenium in the Purgatoire River Watershed



Source: PWP Water Quality Data Analysis. Prepared by Alpine Environmental Consultants LLC, 2014

Table 4-8: Summary of monitoring locations where the chronic dissolved selenium standard was exceeded

Monitoring Location	Location Description	Segment	Number of Samples	Minimum	Median	Maximum	Number of Chronic Exceedances	Date of Exceedance(s)	Comments
469	Purgatoire River near Primero	COARLA05b	16	<0.6	<0.6	5.7	1	2/21/2005	1 of 16 samples exceeded the chronic standard; 0 exceeded the acute standard. 13 samples were <0.6 ug/L. All samples collected since 2/21/2005 were less than the standard, 4.6 ug/L (n= 13)
7580	Purgatoire River at I-25, in Trinidad	COARLA07	12	<1	1.6	13.0	5	8/2005 to 3/2008	5 of 12 samples exceeded the chronic standard; 0 exceeded the acute standard. 5 samples were <1 ug/L. The most recent sample, 3/11/2008, was the maximum measured to date.
462	Purgatoire River near Hoehne	COARLA07	42	<0.6	<0.6	7.4	3	5/27 & 9/30/2004, 5/23/2005	3 of 42 samples exceeded the chronic standard; 0 exceeded the acute standard. 37 samples were <0.6 ug/L. All samples collected since 5/23/2005 were <1 ug/L (n= 31)
000011	Purgatoire River at Highway 350, downstream of Trinidad	COARLA07	12	<1	1.7	5.0	3	8/17 & 10/25/2005, 5/9/2006	3 of 12 samples exceeded the chronic standard; 0 exceeded the acute standard. 4 samples were <1 ug/L. The most recently collected sample, 6/13/2006, was below the chronic standard.
7554	Purgatoire River at Highway 109, south of Higbee	COARLA07	6	2.1	4.4	9.3	3	9/21/2005, 9/25/2006 & 6/7/2007	3 of 6 samples exceeded the chronic standard; 0 exceeded the acute standard. A sample collected on 11/17/2005 was eliminated from the data set as an anomaly.
4009	Purgatoire River at Highway 101, near Las Animas	COARLA07	4	<0.6	7.25	12.6	3	2/10, 5/4 & 11/8/2005	3 of 4 samples exceeded the chronic standard; 0 exceeded the acute standard. 1 sample was <0.6 ug/L.
7549	Purgatoire River at Highway 101, near Las Animas	COARLA07	46	<1	4.5	18.0	23	1/2000 to 10/2007	23 of 46 samples exceeded the chronic standard; 0 exceeded the acute standard. The data set warrants additional sample collection.
07128500	Purgatoire River at Highway 101, near Las Animas	COARLA07	7	<4	4.0	5.0	2	3/16/200, 6/8/2000	2 of 7 samples exceeded the chronic standard; 0 exceeded the acute standard. 2 samples were <4 ug/L. All samples collected since 6/8/2000 were less than 4.6 ug/L (n=4).

Source: PWP Water Quality Data Analysis. Prepared by Alpine Environmental Consultants LLC, 2014

Table 4-9: Summary of monitoring locations where the acute and chronic dissolved selenium standards were exceeded

Monitoring Location	Location Description	Segment	Number of Samples	Minimum	Median	Maximum	Number of Acute Exceedances	Date of Exceedance(s)	Comments
7586	Lorencite Canyon at mouth, above Purgatoire River	COARLA04b	5	<1	16.6	19	1	8/17/2005	1 of 5 samples exceeded the acute standard; 3 of 5 exceeded the chronic standard. 2 of 5 samples were < 1 ug/L including the most recently collected sample, 6/13/2006.
175	Middle Fork of the Purgatoire River at Bar Ni Ranch	COARLA05a	37	<0.6	<0.6	27.9	2	11/15/2007, 2/29/2008	2 of 37 samples exceeded the acute standard; 7 of 37 exceeded the chronic standard. 30 of 37 samples were <0.6 ug/L. The 22 most recently collected samples, 3/2008 to 12/2009, were < 0.6 ug/L.
7582	Long Canyon Creek above Trinidad Reservoir	COARLA05b	4	<1	19.1	37.0	2	10/25/2005, 5/9/2006	3 of 4 samples collected to date exceeded the chronic and or acute standard; however the most recently collected sample, 6/13/2006, had a concentration of < 1 ug/L.

Source: PWP Water Quality Data Analysis. Prepared by Alpine Environmental Consultants LLC, 2014

4.5.2 Total Selenium Assessment

A total recoverable selenium standard of 20 ug/L (chronic) is applied to segments: COARLA02a, COARLA06a, COARLA06b, COARLA16, and COARLA17 (Table 4-2 above). Total recoverable selenium concentrations were not measured at any monitoring locations found on any of the segments where the total recoverable selenium standard is applied. Total selenium concentrations should be analyzed in samples collected from these segments.

Dissolved selenium concentrations can be used as a proxy for total selenium concentrations. If the dissolved selenium concentration exceeds 20 ug/L, the total selenium concentration should also exceed 20 ug/L because the dissolved phase is a fraction of the total selenium concentration (i.e. total selenium = dissolved selenium + suspended selenium). For samples where the dissolved selenium concentration was less than 20 ug/L, it is not possible to make a determination with respect to total selenium concentration. As mentioned earlier, total selenium concentrations should be collected from these segments and the following paragraphs are provided for reference only, as they present dissolved selenium concentrations.

On segment COARLA02a, tributaries to the Arkansas River not included in other segments, 6 dissolved selenium samples were collected from 2 locations. Site 7581 is located near the mouth of Chicosa Arroyo above County Road 40 (Figure 4-4). Dissolved selenium concentrations ranged from 3.4 to 19.0 ug/L in 5 samples. Site 7590 is located in Chicosa Arroyo at County Road 75, which is about 12 miles above the confluence with the Purgatoire River. In the only sample collected to date, the dissolved selenium concentration was 10.6 ug/L. These concentrations do not suggest, however it is possible, that the total selenium concentration has exceeded the chronic standard on segment COARLA02a.

On segment COARLA06a, tributaries to the Purgatoire River above Interstate 25 not included in other segments (Table 4-7), 5 dissolved selenium samples have been collected from site 7583. Site 7583 is located in Reilly Canyon above Trinidad Reservoir north of Cokedale (Figure 4-4). Dissolved selenium concentrations ranged from < 1 to 36 ug/L in 5 samples. Dissolved selenium concentrations exceeded 20 ug/L in 3 samples; this indicates the chronic total recoverable standard was likely exceeded in these samples. Segment COARLA06a is designated as use protected, given the status additional monitoring efforts or implementation projects may be better suited for other areas.

On segment COARLA06b, Wet Canyon and all its tributaries, site 7588 has been sampled for dissolved selenium 5 times. Site 7588 is located at the mouth of Wet Canyon Creek (Figure 4-4). Dissolved selenium concentrations ranged from < 1 to 15 ug/L. These concentrations do not suggest, however it is possible, that the total selenium concentration has exceeded the chronic standard on segment COARLA06b.

In Trinidad Reservoir, segment COARLA15, dissolved selenium concentrations have been measured in 12 samples collected from multiple depths in the reservoir. Dissolved selenium concentrations ranged from < 1 to 1.2 ug/L. These concentrations do not suggest, however it is possible, that the total selenium concentration has exceeded the chronic standard on segment COARLA06b.

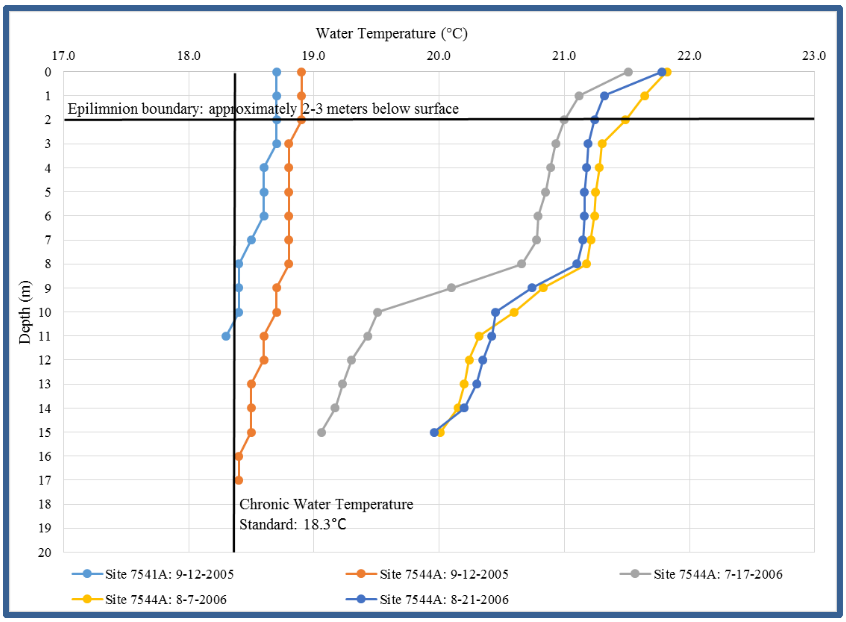
4.6 Dissolved Oxygen Assessment

Like other organisms, aquatic life requires oxygen. In waterbodies, oxygen is dissolved in the water. The amount of dissolved oxygen varies depending on water temperature, turbulence and biological activity, among other factors. Water temperature and dissolved oxygen concentration have an inverse relationship; as the water temperature increases the dissolved oxygen concentration declines. Water temperature change causes daily and seasonal fluctuations in dissolved oxygen concentrations, making temperature a significant factor in dissolved oxygen concentrations, particularly for lakes and reservoirs. Water turbulence, as found in rapids or waves, tends to increase dissolved oxygen concentrations, while stagnant waters tend to lack dissolved oxygen. Biological activity is both a source and sink of dissolved oxygen. Photosynthesis by aquatic plants produces dissolved oxygen, while decomposition of organic materials consumes oxygen in the water column.

Trinidad Reservoir, which is part of segment COARLA15, is on the Environmental Protection Agency's 303(d) List for a lack of dissolved oxygen which is attributed to elevated water temperatures. Water temperature profiles (temperature measured at 1-meter intervals from water surface to bottom) measured in the summer months confirmed that water temperatures in the upper portion (epilimnion- upper layer in a temperature stratified lake; approximately upper 2-3 meters) of the reservoir exceeded the chronic standard for water temperature, 18.3 degrees Celsius. In five profiles at three locations, water temperatures ranged from 18.3 to 21.8 degrees Celsius during sample events completed in September 2005, and July and August of 2006. None of the temperatures measured exceeded the acute standard, 23.8 degrees Celsius.

Figure 4-7: Water Temperature Profiles from Trinidad Reservoir

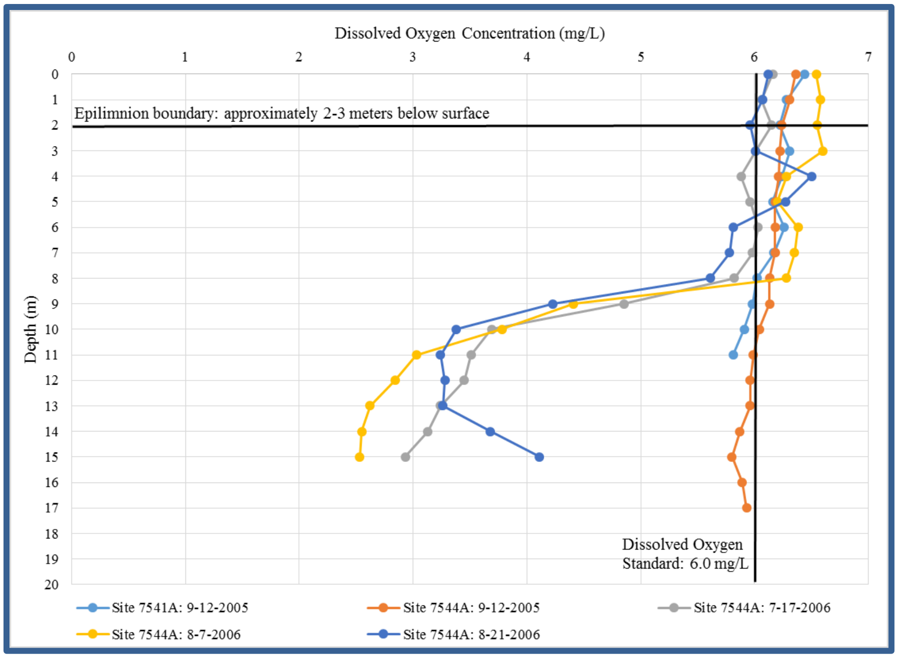
In lakes and reservoirs the primary stressor attributed to elevated water temperatures is a decline in dissolved oxygen concentrations. At depth, cooler water may support higher dissolved oxygen concentrations and provide refuge to aquatic organisms. Thus, when the chronic temperature standard is exceeded in the upper portion of the water body, dissolved oxygen concentrations and water temperature are evaluated at depth to better understand the magnitude of the problem. In the water temperature profiles completed to date, water temperature in Trinidad Reservoir remains near or above the chronic standard at all depths (Figure 4-7). The temperatures profiles from July and August 2006 indicate the reservoir is thermally stratified; while the September 2005 profiles may characterize fall turnover (Figure 4-7).



Source: PWP Water Quality Data Analysis. Prepared by Alpine Environmental Consultants LLC, 2014

Dissolved oxygen profiles, which were collected at the same time as the temperature profiles, suggest that dissolved oxygen concentrations remained above the standard, 6.0 mg/L, in the upper portion of the reservoir, or epilimnion (Figure 4-8). Dissolved oxygen concentrations declined as water depth increased in all samples. In selected profiles dissolved oxygen remained above the standard, 6.0 mg/L, at up 8 meters below the water surface (Figure 4-8). Although, dissolved oxygen concentrations are greater than the standard in some portions of the reservoir, water temperature and dissolved oxygen concentrations may not provide adequate refuge for cold-water dependent species during summer.

Figure 4-8: Dissolved Oxygen Profiles from Trinidad Reservoir



Source: PWP Water Quality Data Analysis. Prepared by Alpine Environmental Consultants LLC, 2014

Dissolved oxygen concentrations have been measured 509 times at 32 stream sites in the PWP Watershed. The stream segments in the watershed are classified as both warm and cold waters (Table 4-2); where the dissolved oxygen standard is 5.0 and 6.0 mg/L, respectively. The stream segments classified as cold waters also include an additional dissolved oxygen standard, 7.0 mg/L, to assure adequate dissolved oxygen for fish spawning (Table 4-2).

On the stream segments classified as warm waters dissolved oxygen concentrations ranged from 3.48 to 15.80 mg/L in 304 measurements. The dissolved oxygen standard was met in 299 of the measurements. Five of the dissolved oxygen measurements, collected from the Purgatoire River downstream of I-25 (segment COARLA07) had concentrations less than the applicable standard, 5.0 mg/L. The water temperatures were typically elevated during these instances and ranged from 14.09 to 28.41 degrees Celsius (Table 4-10). However, the 15th percentile concentrations found at these locations exceeded the standard and indicates that dissolved oxygen concentrations are not typically problematic in the mainstem of the lower Purgatoire River.

On the stream segments classified as cold waters dissolved oxygen concentrations were measured 204 times. The dissolved oxygen concentration ranged from 4.5 to 15.0 ug/L. The dissolved oxygen concentration in 200 of the measurements met both the chronic and spawning criteria. The dissolved oxygen concentration fell below 6.0 mg/L in 5 measurements. The 15th percentile concentrations measured at 3 of these locations exceeded the spawning criteria, 7.0 mg/L (Table 4-10). The 15th percentile dissolved oxygen concentrations at sites 175, 468 and 469 indicate that over the long-term those locations tend to support cold water species throughout the year and during spawning (Table 4-10). The 15th percentile dissolved oxygen concentration, 6.30 mg/L, at site 7582, Long Canyon above Trinidad Reservoir, is supportive of the chronic standard. Based on the existing data set, dissolved oxygen concentrations in Long Canyon at site 7582 are likely supportive of spawning. At site 7583, Reilly Canyon above Trinidad Reservoir, the 15th percentile dissolved oxygen concentration, 5.98 mg/L, was below the standard of 6.0 mg/L (Table 4-10). Dissolved oxygen concentrations at Sites 7582 and 7583 have been measured 4 and 5 times, respectively. The limited number of samples collected to date, constrains the validity of the percentile calculation, so the current percentiles should be interpreted as preliminary in nature. However, paired temperature measurements collected at sites 7582 and 7583 suggest that dissolved oxygen may be limited. There are not locations adjacent to these sites to allow for further comparison. If Reilly or Long canyons support a cold-water fishery, additional data collection may be warranted; otherwise dissolved oxygen concentrations are not a priority at this time.

Table 4-10: Dissolved Oxygen Summary for Selected Steam Sites in the Purgatoire River Watershed

Monitoring Location	Location Description	WQCD Segment	Date	Water Temperature (deg C)	Dissolved Oxygen (mg/L)	Number of Dissolved Oxygen Measurements	15th Percentile D.O. (mg/L)	Dissolved Oxygen Standard (mg/L)	15th Percentile Attains Standard	Dissolved Oxygen Spawning Standard (mg/L)	15th Percentile Attains Spawning Standard
175	Middle Fork of the Purgatoire River at Bar Ni Ranch	COARLA05a	2009-08-31	NM[1]	4.50	36	7.50	6.0	Yes	7.0	Yes
468	Purgatoire River near Stonewall	COARLA05b	2000-12-12	NM	5.00	70	8.10	6.0	Yes	7.0	Yes
469	Purgatoire River near Primero	COARLA05b	2000-04-09	NM	5.90	71	7.85	6.0	Yes	7.0	Yes
7582	Long Canyon above Trinidad Reservoir	COARLA05b	2005-08-17	19.20	5.67	4	6.30	6.0	Yes	7.0	No
7583	Reilly Canyon above Trinidad Reservoir	COARLA06a	2005-08-17	26.65	5.24	5	5.98	6.0	No	7.0	No
000011	Purgatoire River at Highway 350, downstream of Trinidad	COARLA07	2005-05-04	14.09	4.82	12	5.81	5.0	Yes	NA	NA
			2005-08-17	22.05	4.93			5.0	Yes	NA	NA
7549	Purgatoire River at Highway 101, near Las Animas	COARLA07	2000-05-15	23.30	4.83	46		5.0	Yes	NA	NA
			2004-07-20	28.41	3.48		6.74	5.0	Yes	NA	NA
0672	Purgatorie River downstream of Highway 109	COARLA07	2004-05-20	19.40	4.40	1	NA	5.0	Yes[2]	NA	NA

Notes
1. "NM" = not measured, "NA" = not applicable
2. 68 measurements collected from 3 adjacent locations had dissolved oxygen concentrations ranging from 5.3 to 15.8 mg/L.

Source: PWP Water Quality Data Analysis. Prepared by Alpine Environmental Consultants LLC, 2014

4.7 Suspended Sediment Assessment

Landscapes are in a dynamic equilibrium with the prevailing environmental conditions, such as climate, geology, and land use. Streams and rivers are often the most dynamic components of the landscape. As precipitation falls to the land surface a number of outcomes are possible. The water may fall to a stream or river, be stored in the snowpack, infiltrate into soils, or generate runoff and possibly entrain sediment. The vast majority of precipitation falls onto soil and other surfaces, rather than open water, and nearly all water interacts with soil and other materials prior to reaching a waterway. This interaction provides ample opportunity for water to entrain sediment, in a process called erosion. Erosion is a complex process that is heavily dependent upon several factors including climate, precipitation intensity, slope, soil type, geology, vegetation cover, land use, and others. Further, the factors that control erosion are interactive (e.g. removal of vegetation on steep slope generates more erosion than vegetation removal in a flatter area).

Streams and rivers are adept at moving sediment. However, the natural capacity to transport sediment can be overwhelmed during natural episodic events (e.g. landslides, flooding) or due to excess sediment generated by anthropogenic activities. Sediment deposition occurs when the sediment load exceeds the stream's capacity to move or carry the sediment. Like erosion, sediment deposition is controlled by several factors including water velocity, channel form, channel slope, and sediment size.

Sediment deposition can impair aquatic habitat. In rivers and streams with cobble beds deposits of fine sediments (e.g. sand and silt) are the most problematic. Fine sediments can fill the interstitial spaces (e.g. the spaces between rocks) of the stream bed where most macroinvertebrates reside. The sediment reduces both the size and quality of habitat available to macroinvertebrates. Over time, the deposits may decrease diversity and density of the macroinvertebrate community. Fine sediment deposits can also decrease the quality of fish spawning habitat. Sediment deposition occurs in reservoirs, which over time, reduces the storage capacity of the reservoir.

Anthropogenic disturbances can be broadly grouped by proximity to the stream: near or in-channel effects and watershed scale effects. Where near or in-channel disturbance presents a direct sediment source. These disturbances include alteration of the stream channel or banks, removal or decline in the density and quality of riparian vegetation. Watershed scale effects include land use, characteristics of upland vegetation, extent of impervious areas, and other factors. In general, the complexity of erosion and sediment deposition processes make it difficult to attribute sediment to specific sources, whether natural or anthropogenic, without further study.

USGS investigated precipitation, streamflow and suspended sediment load characteristics at the Piñon Canyon Maneuver Site from 1983 to 2007 (Stevens et al., 2008). Piñon Canyon Maneuver Site is located in the lower portion of the watershed; the Purgatoire River forms the eastern boundary of the site. The study evaluated streamflow and sediment loads in five tributaries to the Purgatoire River: Van Bremer Arroyo, Taylor Arroyo, Lockwood Arroyo, Red Rock Canyon and Bent Canyon along with the Purgatoire River above and below the maneuver site. Precipitation was measured at 16 stations in the study area. Data collection occurred from April to October each year, thus the findings refer to this portion of the year only. The lower reach of the Purgatoire River is part of segment COARLA07 and the tributaries are part of segments COARLA02a and COARLA09a. Segment COARLA07 is currently on the Monitoring and Evaluation List for sediment. The key findings from Stevens et al. (2008) are summarized below.

Precipitation Characteristics

- Precipitation is more variable during the summer months, than during the winter months.
- Intense rainfall during July through September produces more runoff and streamflow than winter and spring precipitation.
- From April to October precipitation (> 0.01 inch) tends to fall on 20 percent of the days and the majority of the storms are small (<0.5 inch).
- Monthly precipitation is typically < 1.0 inch per month from November through March. Snow does not tend to accumulate in the study area.
- In Taylor Arroyo, large storms (precipitation > 1.5 inch) accounted for about 73 percent of the suspended sediment load.
- Although small storms (<0.5 inch) accounted for 79 percent of the storms, they only accounted for approximately 3 percent of the sediment load.
- Large storms create substantially more runoff and sediment than small storms, even though large storms occur less frequently.

Streamflow Characteristics

- Taylor Arroyo, Red Rock Canyon and Bent Canyon are ephemeral streams and flow only during storms and immediately following storms.
- Van Bremer and Lockwood Arroyos are intermittent due to irrigation return flows and minimal groundwater inputs. Irrigation return flows may account for up to 40 percent of the annual flow in these tributaries.
- The daily streamflow in all 5 tributaries exceeded 5 percent of the daily streamflow in the Purgatoire River just 3 percent of the time (i.e. flow from the study area is small relative to the Purgatoire River).
- In the tributaries streamflow typically occurred fewer than 20 days per year (April to October).
- Streamflow at Purgatoire Rock Crossing occurred about 99 percent of the time from 1983 to 2007.
- There were not statistically significant temporal trends in streamflow at tributary streamflow stations during the study period. The relatively small number of streamflow events limits the ability to detect trends through time.

Suspended Sediment Loading Characteristics

- Suspended sediment is the portion of the sediment load suspended in the water column and is comprised of clay, silt and fine-grained sand.
- The maximum daily suspended sediment load observed at the tributary sites was just over 12,000 tons at the Taylor station on September 30, 1998. The maximum daily sediment load observed in the Purgatoire River was 160,000 tons and occurred at Rock Crossing on July 9, 1992.
- No sediment transport occurred on 94 percent of the days during 1983 through 2006 because episodic precipitation events were the only source of runoff.
- The lowest annual suspended sediment load, 0.0 tons/year, was observed in 2001 and 2002 in Taylor Arroyo. The arroyo did not flow due to drought conditions and therefore could not transport suspended sediment.
- The maximum annual suspended sediment load at Taylor Arroyo, 33,800 tons/year, was measured in 1998.
- The large degree of variation, five orders of magnitude, in annual sediment loads is attributed to the spatial variability of large storms in the Taylor Arroyo Watershed.

- In the Purgatoire River at Rock Crossing the annual suspended sediment load ranged from 22,300 tons/year in 2003 to 770,000 tons/year in 1986 (however, data were not collected in all years of the study period at this site).
- Approximately 80 percent of the suspended sediment was transported when streamflow exceeded 200 cfs in the Purgatoire River at Rock Crossing; streamflow exceeded 200 cfs only 8 percent of the time.
- Geology affected sediment loading. Watersheds composed of shale created the largest loads, while watersheds composed of sandstone or limestone had the smallest sediment loads.
- Like precipitation and streamflow, it was not possible to detect significant trends in sediment loads during the study period.
- Storm-total sediment yields (tons per acre per square mile) increased from Van Bremer Arroyo to Bent Canyon. Increased sediment yields in the northern portion of the study area were primarily attributed to three watershed characteristics: topography, geology and soil type. The proportion of canyons (or other areas of high topographic relief) increased from south to north. Geologic maps indicate that shale is more common in southern portion of the study area, while sandstone in more common in the northern portion of the study area. Likewise, soil maps showed a decrease in the area occupied by Penrose-Manzanola-Midway group soil types, a readily eroded soil type, northward from Van Bremer to Bent. However, statistical analysis of these and other spatial patterns, including land use and condition, are tenuous.
- Cumulatively, the tributaries in the study area rarely account for a substantial (> 20 percent) portion of the suspended sediment load in the Purgatoire River. The daily sediment load from all five tributaries accounted for more than 20 percent of the load in the Purgatoire River at Rock Crossing just 2 percent of the time during 2000 to 2006.
- Larger, less frequent storms generally contribute much more to sediment transport than smaller, more frequent storms. Storms where precipitation exceeded 1.5 inches accounted for about 73 percent of the suspended sediment load from 1983 through 2006. Storms where precipitation was 0.5 inch or less accounted for less than 3 percent of the sediment load, even though the small storms accounted for 79 percent of the storms.
- Long-term decreases in sediment transport were suggested by a decline in storm-total sediment yield at the Taylor Arroyo and Bent Canyon stations. Such trends indicate that a physical driver, such as streamflow or precipitation, has changed or that other factors like land cover, soil health, or disturbance, have changed. A lack of trend in the streamflow data suggests the decline in sediment load is not attributed to changes in streamflow. Precipitation trends suggest that monthly precipitation and storm magnitude increased during the study. An increase in storm magnitude may increase storm total sediment, so some of the decline in sediment transport may be attributed to changes (improvement) in land cover or condition during the study period.
- On an annual basis the sediment load attributed to the study area was generally small. The annual load from all 5 tributaries ranged from 0.0 in 2001 to 5.7 percent in 2003 of the annual (April to October) suspended sediment load in the Purgatoire River at Rock Crossing. The study area tributaries are 13.9 percent of the total drainage area of the Purgatoire at Rock Crossing.

Suspended sediment is monitored at selected locations on the Purgatoire River. A cursory review of the data suggests that many of the relationships in precipitation, streamflow and suspended sediment load observed in the Piñon Canyon Maneuver Site study (USGS, 2008) may also apply to the entire Purgatoire Watershed. In general, increases in streamflow, which during the summer months are likely attributed to large precipitation events, yield increased suspended sediment loads (Figure 4-4). In the upper portion of the watershed snowmelt may play a larger role in suspended sediment delivery. As watershed area increases the median, maximum and overall sediment load tends to increase (Figure 4-4 and Table 4-11). At the Middle Fork of the Purgatoire River at Stonewall, where the watershed area is smallest, 55 percent of the mean daily sediment loads observed were less than 1 ton per day (Table 4-11). At Rock Crossing the sediment load in the Purgatoire River was less than 1 ton per day in 5 percent of observations (Table 4-11). Suspended sediment concentrations typically declined below Trinidad Lake. The maximum suspended sediment load observed above the lake was 316,000 tons per day while the maximum below the lake was approximately 46,000 tons per day (Table 4-11). The effect of water management practices are apparent in the suspended sediment loads measured immediately below the reservoir (Figure 4-11).

The rate of sediment delivery via tributaries streams is complex and likely episodic since many tributaries to the Purgatoire River are intermittent or ephemeral. Understanding the effect of anthropogenic activities in the context of the watershed is made more difficult by the discontinuous nature of streamflow and sediment delivery. Additional investigation should occur to better delineate natural and anthropogenic sediment sources and to identify priority areas for sediment control efforts. A

GIS analysis that creates a cumulative score or rank for factors such as slope, geology, soil type and proximity to perennial, intermittent and ephemeral waterbodies, and land use or condition, could be applied to identify priority areas for sediment control. However, given the expanse of private lands in the watershed it may be more practical to identify willing partners prior to completing a large-scale analysis. Such an approach would allow for better characterization of sediment source areas, and design and implementation of sediment control measures.

Table 4-11: Mean Daily Suspended Sediment Load, in tons per day, Summary from USGS Stations on the Purgatoire River from 1979 to 2004

Monitoring Location	USGS Station Number	Period of Record		Number of Records	Mean Daily Sediment Load (tons/day)					
		Start	End		Minimum	Median	Maximum	Percent < 1 ton/day[1]	Percent < 10 tons/day	Percent < 100 tons/day
Middle Fork Purgatoire River at Stonewall	07124050	4/1/1979	9/30/1981	366	0.02	0.77	1,160	55%	86%	99%
Purgatoire River at Madrid, above Trinidad Lake	07124200	10/1/1978	9/30/1981	1,095	0.12	5.00	316,000	25%	64%	79%
Purgatoire River below Trinidad Lake	07124410	3/10/1977	9/30/1984	2,350	0.01	4.50	45,700	15%	54%	77%
Purgatoire River near Thatcher, CO	07126300	5/1/1983	9/30/1992	3,321	0.00	7.70	248,000	7%	56%	83%
Purgatoire River at Rock Crossing near Timpas	07126485	8/1/1983	8/27/2004	2,607	0.00	9.70	160,000	5%	52%	77%

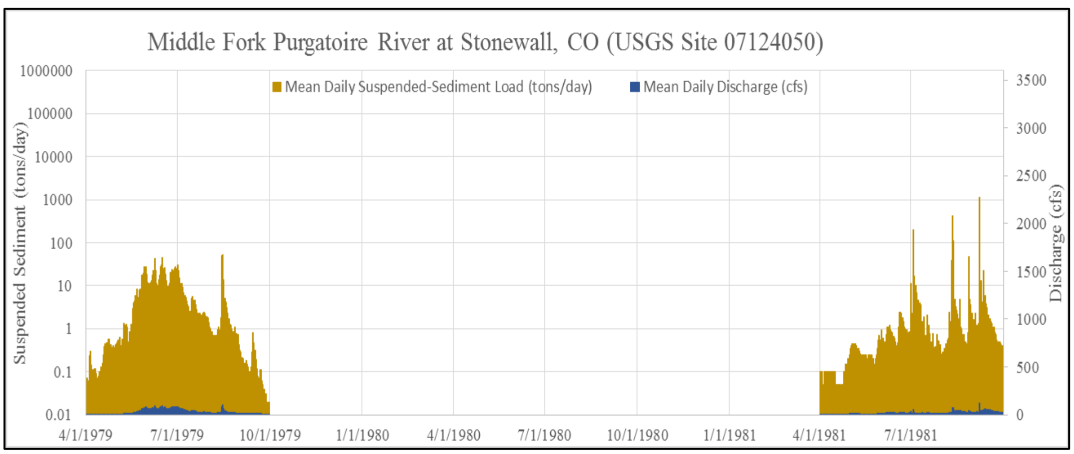
Notes

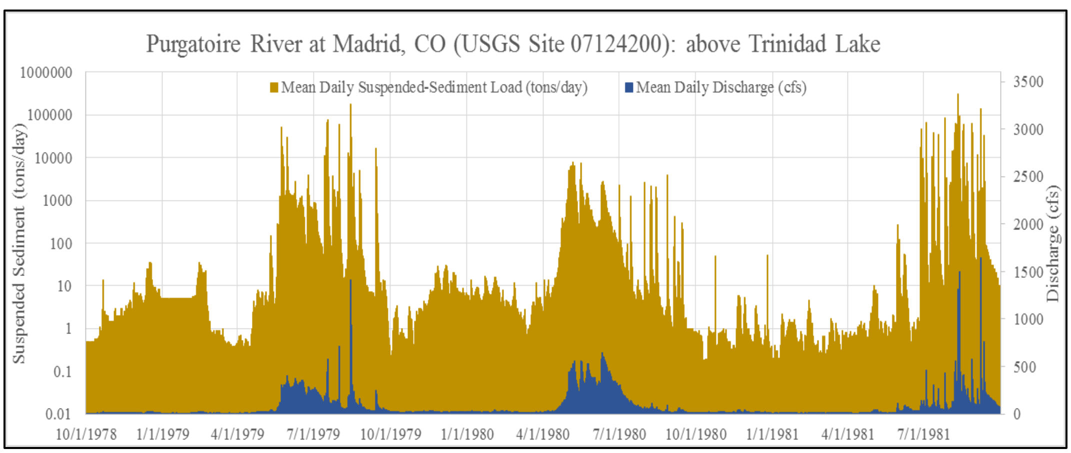
1. The number of results less than the specified quantity expressed as a percent of the total number of results.

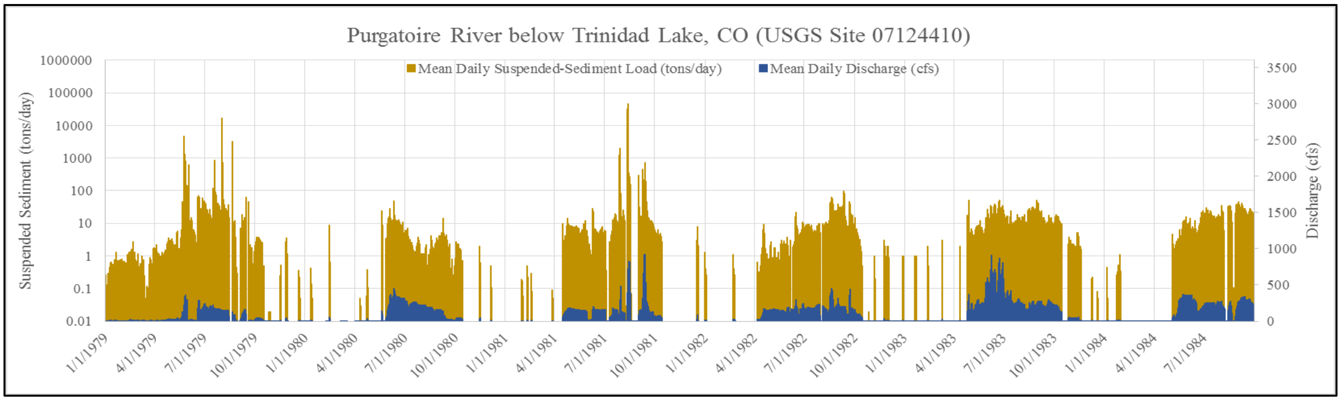
Source: PWP Water Quality Data Analysis. Prepared by Alpine Environmental Consultants LLC, 2014

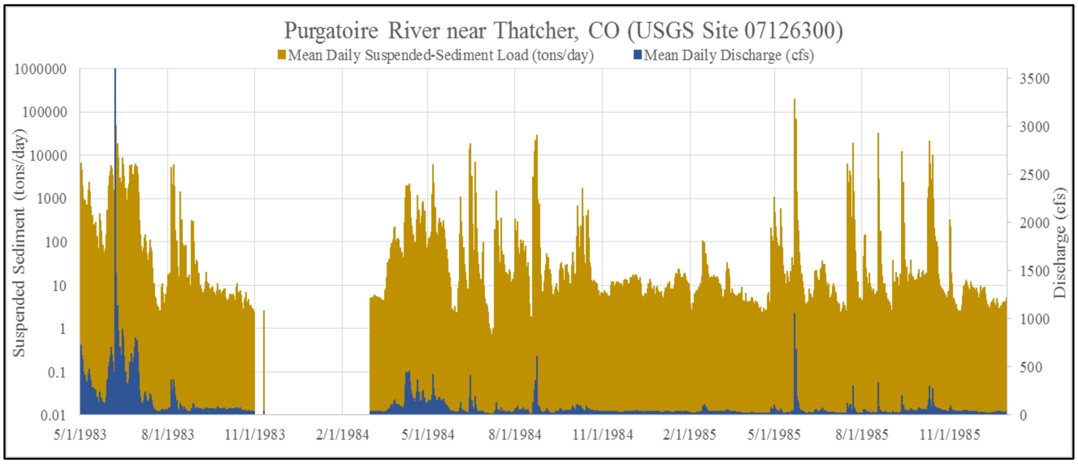
Sediment: Segment COARLA07, the Purgatoire River from I-25 to the confluence with the Arkansas River, is on the M&E list for sediment. The listing was proposed in a Colorado Nonpoint Assessment Report prepared by the WQCD in November 1989. The report included limited information and data has not been collected from the segment. The WQCD and Sediment Work Group are currently finalizing monitoring methods for sediment. After the sediment policy is revised, there will be more clear guidance for large rivers, including the Purgatoire.

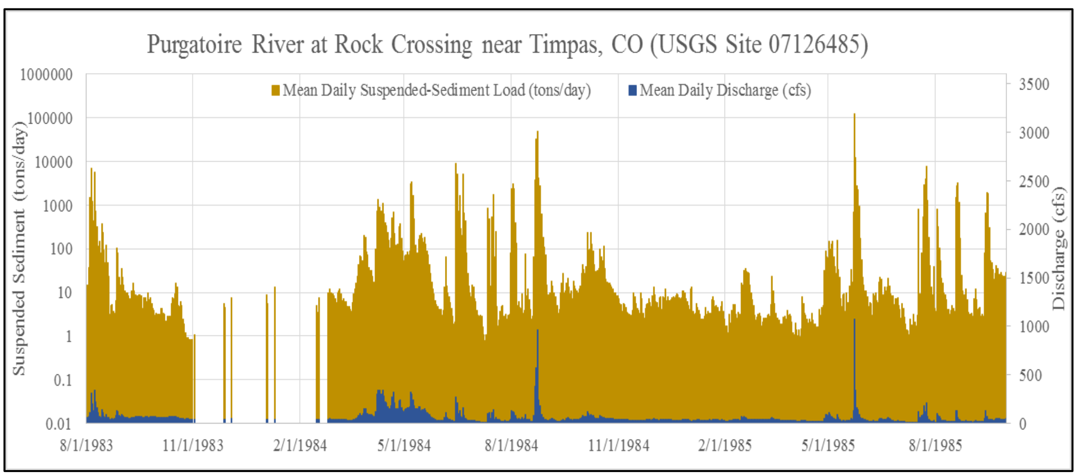
Figure 4-9: Mean Daily Suspended Sediment Load (tons/day) and Mean Daily Discharge (cfs) from USGS Stations on the Purgatoire River from 1979 to 1985











Note: the suspended sediment load is presented on a log-scale.

Source: PWP Water Quality Data Analysis. Prepared by Alpine Environmental Consultants LLC, 2014

4.8 Nutrient Assessment

Three parameters, total phosphorus, total nitrogen, and chlorophyll a, were selected to evaluate the nutrient status of waterbodies in the Watershed. Regulations 31 and 85 outline interim standards for nutrients and will evolve in the next several years to assure that the nutrient status of water bodies remains supportive of designated water uses. Since the standards are new, assessment and monitoring efforts can be used to assure more successful implementation of the new regulation.

Nutrients are required to support life. However, an excess of nutrients can cause eutrophication of waterbodies. Eutrophication is a process where a waterbody acquires an excess of phosphates and nitrates. This process promotes excessive plant and algae growth. As the organic materials are consumed by decomposers, dissolved oxygen concentrations can be severely depleted. This effect has the potential to disturb the aquatic and riparian ecosystems. Eutrophication is most common in warm, slow moving rivers, and shallow lakes or ponds. In excess, nutrients can dramatically alter riverine and riparian habitats. Thus, nutrient control is a priority in supporting overall watershed health.

Common sources of nutrients can include runoff from fertilized areas, especially where fertilizer is over-applied, individual septic disposal systems, concentrated livestock feeding or grazing, and municipal or industrial wastewater treatment facilities.

The paragraphs below describe individual sample results and median annual concentrations for total phosphorus and total nitrogen. Individual sample results are also presented to characterize the range of conditions observed. Median annual concentrations are used to evaluate attainment of the interim standard for total phosphorus (WQCD Regulation 31). Tables 4-12 and 4-13 present minimum, median and maximum concentrations measured at sites where one or more individual samples exceeded the interim standard concentration. These sites are reported to summarize conditions at sites where total phosphorus or total nitrogen may be a potential problem.

4.8.1 Total Phosphorous

Phosphorus gets into water in both urban and agricultural settings. Phosphorus is a common constituent of agricultural fertilizers, manure, and organic wastes in sewage and industrial effluent. Phosphorus tends to attach to soil particles and, thus, moves into surface-water bodies from runoff. Total phosphorus has been measured in 202 samples collected from 36 locations. Total phosphorus concentrations were less than MDLs in 49 samples; MDLs ranged from 0.004 to 0.9 mg/L, although some MDLs were not reported. Total phosphorus concentrations ranged from <0.0037 to 11.70 mg/L in the Purgatoire River Watershed. The interim standard value was exceeded in 15 samples collected from 6 locations (Table 4-12). Seven percent of the samples exceeded the interim total phosphorus criteria; the interim criteria were exceeded at 17 percent of the locations sampled to date. The following paragraphs and Table 4-12 detail where the exceedances occurred.

The Purgatoire River at Highway 101 has been sampled 46 times at site 7549. Total phosphorus concentrations ranged from <0.01 to 1.90 mg/L (Table 4-12). The median concentration at the site for the entire period of record was 0.03 mg/L, which is less than the interim standard, 0.17 mg/L, for cold waters. The annual median total phosphorus concentrations ranged from 0.02 to 0.06 mg/L. The median annual total phosphorus concentration was less than the interim standard in all sample years (2000 to 2008). Although, total phosphorus concentrations are occasionally elevated in the Purgatoire River near Highway 101, median annual concentrations meet the interim criterion.

The Purgatoire River at Thatcher, site 07126300, has been sampled on 5 occasions (Table 4-12). Total phosphorus concentrations ranged from 0.02 to 9.66 mg/L. The maximum concentration was measured on 8/15/2013. Based on the other sample concentrations measured to date, 0.02 to 0.03 mg/L, the maximum concentration may be an anomaly but there is an insufficient number on results to make a final determination. The median annual total phosphorus concentration is 0.03 mg/L.

Table 4-12: Summary of Total Phosphorous Concentrations, in mg/L in the Purgatoire Watershed

Monitoring Location	Location Description	Segment	Number of Samples	Interim Standard (mg/L)	Minimum (mg/L)	Median (mg/L)	Maximum (mg/L)	Number above Interim Value[1]	Date(s)	Comments
7549	Purgatoire River at Highway 101	COARLA07	46	0.17	<0.01	0.03	1.90	7	NA, annual median concentrations < interim standard	Annual median concentrations are below the interim standard without any exceedances on an annual basis.
07126300	Purgatoire River near Thatcher	COARLA07	5	0.17	0.02	0.03	9.66	1	8/15/13	Preliminary results, subject to final review. Continue to review USGS data from these locations to determine whether August 2013 data were anomalous.
07126485	Purgatoire River at Rock Crossing	COARLA07	3	0.17	0.03	0.09	11.70	1	8/16/13	
07126500 456	Purgatoire River at Ninemile Dam	COARLA07	10	0.17	<0.9	0.07	0.52	3	9/4/02, 6/24/03, 5/26/04	4 samples were <MDL. However the MDL, 0.9 mg/L, exceeds the interim standard. Additional monitoring recommended.
7554	Purgatoire River at Highway 109	COARLA07	7	0.17	<0.01	0.02	1.10	1	6/7/2007	Within allowable exceedance frequency at this site.
370831104331101 7544A, 7544B	Trinidad Lake sites sampled by USGS and CDPHE	COARLA15	15	0.025	<0.01	0.01	0.05	2	8/28/02, 8/21/06	Sample collection occurred at multiple depths. Drought conditions in 2002.

Notes
1. The number of samples above the interim standard are reported for reference. However, the standard evaluation is completed using the median annual concentration of total phosphorus.

Source: PWP Water Quality Data Analysis. Prepared by Alpine Environmental Consultants LLC, 2014

Site 07126485, the Purgatoire River at Rock Crossing has been sampled for total phosphorus 3 times. Total phosphorus concentrations ranged from 0.03 to 11.70 mg/L (Table 4-12). The maximum concentration was measured on 8/16/2013. Only 3 total phosphorus concentrations have been collected to date; which prevents calculation of a representative annual median. Given the maximum concentration measured in August 2013, which corresponds with elevated concentrations observed near Thatcher, total phosphorus concentrations should be monitored in this area. USGS will likely measure total phosphorus concentrations at Rock Crossing and Thatcher in 2014. The results should be evaluated to determine whether additional study is warranted in this area.

Total phosphorus concentrations have been measured 15 times at 3 sites, which included depth profiles, in Trinidad Lake (Table 4-12). Total phosphorus concentrations ranged from < 0.01 to 0.05 mg/L. Total phosphorus concentrations exceeded the interim standard, 0.025 mg/L, in samples collected from 2 profiles. The median annual concentration for the most recently sampled year, 2006 was 0.01 mg/L.

There are two monitoring sites in the Purgatoire River near Ninemile Dam, sites 07126500 and 456. Total phosphorus concentrations have been measured 10 times at these sites. Total phosphorus concentrations ranged from < MDL (which is unsuitably high for standard evaluation) to 0.52 mg/L. The interim standard, 0.17 mg/L, was exceeded in 3 samples. The maximum concentration, 0.52 mg/L, was measured on 5/26/2004 (Table 4-12). Using the most recent calendar year data, which includes 3 samples collected during 2004 and 2005 the median annual concentration is 0.14 ug/L. This value is less than the interim standard, but the limited number of samples results limits the confidence attributed to the assessment.

The Purgatoire River at Highway 109 is sampled at site 7554. In 7 samples, total phosphorus concentrations ranged from < 0.01 to 1.10 mg/L (Table 4-12). Although 1 sample concentration exceeded the interim criteria the annual median concentration, 0.04 mg/L, remained below the criterion for total phosphorus, 0.17 mg/L.

4.8.2 Total Nitrogen

Although nitrogen is abundant naturally in the environment, it is also introduced through sewage and fertilizers. Chemical fertilizers or animal manure is commonly applied to crops to add nutrients. Fields have been leveled and also modified to efficiently drain off excess water that may fall as precipitation or from irrigation practices. Total nitrogen concentrations have been measured in 169 samples collected from 30 locations. Total nitrogen concentrations were < MDLs in 93 samples; or 55 percent of the evaluations. Total nitrogen concentrations ranged from < 0.05 to 16.00 mg/L. Total nitrogen concentrations exceeded the interim criteria in 6 samples; or approximately 4 percent of the samples.

The Purgatoire River at Highway 12, site 7545A, has been sampled 6 times to date (Table 4-13). Total nitrogen concentrations ranged from < 0.5 to 1.3 mg/L. One sample exceeded the interim standard, 1.25 mg/L, on 4/26/2006 with a concentration of 1.30 mg/L. The median annual concentration for the 2006 sample year was < 0.5 mg/L (n= 5). Based on the existing data set, site 7545A meets the interim criteria.

Site 7588, the mouth of Wet Canyon, has been sampled 5 times (Table 4-13). Total nitrogen concentrations were <0.5 mg/L in 4 of 5 samples. The only sample, collected to date, that exceeded the MDL had a concentration of 1.90 mg/L which exceeds the interim standard for cold waters. However, all 5 samples were collected within a year (2005-2006) and the annual median concentration was < 0.5 mg/L (Table 4-13). Based on the existing data set, total nitrogen concentrations in Wet Canyon meet the interim criteria.

The Purgatoire River at the Highway 350 bridge has been sampled 12 times (Table 4-13). The maximum result, collected on 1/15/2004, had a total nitrogen concentration of 16.00 mg/L. All the other samples (n =8) collected during the calendar year of 2004 were < 0.5 mg/L, which resulted in a mean annual total nitrogen concentration of < 0.5 mg/L. The Purgatoire River at Highway 350 meets the interim standard.

The Purgatoire River at Thatcher, site 07126300, has been sampled for total nitrogen on 5 occasions (Table 4-13). Total nitrogen concentrations ranged from 0.29 to 6.34 mg/L. The maximum concentration was measured on 8/15/2013. Based on the other sample concentrations measured to date, 0.29 to 0.42 mg/L, the maximum concentration may be an anomaly but there is an insufficient number on results to make a final determination. The median annual total phosphorus concentration is 0.41 mg/L, which is less than the interim standard for warm waters, 2.01 mg/L.

Site 07126485, the Purgatoire River at Rock Crossing has been sampled 3 times. Total nitrogen concentrations ranged from 0.32 to 7.66 mg/L (Table 4-13). The maximum concentration was measured on 8/16/2013. Only 3 nutrient samples have been collected to date; which prevents calculation of a representative annual median. Given the maximum concentration measured in August 2013, which corresponds with elevated concentrations observed near Thatcher, total nitrogen concentrations should be monitored in this area. USGS will likely measure total nitrogen concentrations at Rock Crossing and Thatcher in 2014. Like phosphorus, the results should be evaluated to determine whether additional study is warranted in this area.

Table 4-13: Summary of Total Phosphorous Concentrations, in mg/L in the Purgatoire Watershed (2)

Monitoring Location	Location Description	Segment	Number of Samples	Interim Standard	Minimum	Median	Maximum	Number above Interim Value	Date of Exceedance	Comments
				(mg/L)						
7545A	Purgatoire River at Highway 12 above Weston	COARLA05b	6	1.25	<0.5	<0.5	1.30	1	4/26/06	The most recently collected samples (n= 3) were < 0.5 mg/L
7588	Wet Canyon at Mouth	COARLA06b	5	1.25	<0.5	<0.5	1.90	1	10/25/05	The most recently collected samples (n= 3) were < 0.5 mg/L
000011	Purgatoire River below Trinidad at Highway 350 Bridge		12		<0.5	<0.5	16.00	1	1/15/2004	The most recently collected samples (n= 11) were below the interim standard.
07126300	Purgatoire River near Thatcher	COARLA07	5	2.01	0.29	0.41	6.34	1	8/15/13	Preliminary results, subject to final review. Continue to review USGS data from these locations to determine whether August 2013 data were anomalous.
07126485	Purgatoire River at Rock Crossing		3		0.32	0.40	7.66	1	8/16/13	
7544B	Trinidad Lake sites sampled by USGS and CDPHE	COARLA15	16	0.426	<0.5	<0.5	1.30	1	8/7/06	Sample collection occurred at multiple depths. 12 samples < MDL

Notes
1. The number of samples above the interim standard are reported for reference. However, the standard evaluation is completed using the median annual total nitrogen concentration.

Source: PWP Water Quality Data Analysis. Prepared by Alpine Environmental Consultants LLC, 2014

4.8.3 Chlorophyll a

Chlorophyll, in various forms, is bound within the living cells of algae and other phytoplankton found in surface water. It is measured to enable understanding of the phytoplankton population and its distribution. This information can allows conclusions to be drawn about a water body's health, composition, and ecological status. Chlorophyll a concentrations have been measured 7 times in Trinidad Lake. Each of the samples were composited from a 2 meter interval ranging in depth from 0 to 3 meters below the water surface. Chlorophyll a concentrations ranged from 0.80 to 5.50 mg/L. The maximum concentration was measured during drought conditions on 8/28/2002. Chlorophyll a concentrations were below the 8 mg/L standard for cold lakes and reservoirs. However, Trinidad Lake is also classified as a Direct Use Water Supply (DUWS). Chlorophyll a concentrations in DUWS cannot exceed 5.0 mg/L. It appears that during intense drought conditions, such as August 2002, chlorophyll a concentrations in Trinidad Lake may exceed the DUWS standard. Under more normal hydrologic conditions chlorophyll a concentrations meet the interim criteria for cold waters and DUWS.

4.9 Water Quality Assessment Summary

4.9.1 Non-Point Sources

Pollution is often grouped into two categories point source and nonpoint source pollution. Point-source pollution originates from a specific location, such as an industrial or municipal water treatment system, and is subject to regulation through the NPDES permit system. Nonpoint source pollution generally results from land runoff, precipitation, atmospheric deposition, drainage, seepage or hydrologic modification. The term "nonpoint source" is defined to mean any source of water pollution that does not meet the legal definition of "point source" in section 502(14) of the Clean Water Act. Unlike pollution from industrial and sewage treatment plants, nonpoint source (NPS) pollution comes from many diffuse sources. Common examples of nonpoint source pollution include stormwater runoff from urban areas, agricultural fields, construction sites or disturbed areas (e.g. following a fire). NPS pollution is caused by rainfall or snowmelt moving over and through the ground. As the runoff moves, it picks up and carries away natural and human-made pollutants, finally depositing them into lakes, rivers, wetlands, coastal waters and ground waters. Common nonpoint source pollutants include sediment, salts, metals and nutrients.

Additional data collection and or analysis should occur to refine our understanding of non-point sources in the Purgatoire River Watershed. The existing data set suggests that non-point sources may be more common in the lower portion of the watershed. Although other isolated areas were also identified in the upper portion of the watershed and in Trinidad Reservoir. In general, there is insufficient information to attribute pollutants to specific non-point sources.

4.9.2 Water Quality Monitoring Recommendations

The recommendations provided for additional water quality monitoring prioritize areas where the existing data set suggests there may be a water quality issue, over areas that lack data, which are characterized as data gaps. Additional water quality monitoring should occur in the following areas:

<u>Purgatoire River from Trinidad Reservoir to the confluence with Van Bremer Arroyo:</u> Collect water quality samples to isolate selenium sources on the upper portion of segment COARLA07. The existing data set lacks the resolution to clearly identify potential sources. Thus, sample collection should be designed to isolate all potential sources such as tributaries, stormwater runoff and agricultural return flows. Sample collection should occur at the diversion and return points for irrigation ditches in this area. The irrigation ditches include: Antonio Lopez, Baca-Picketwire, Chilili, Enlarged Hoehne, Johns Flood, Model and South Side. Sampling at both the diversion and return or discharge points for each ditch will help determine whether selenium, which is a natural component of soils that can be mobilized through irrigation, concentrations increase in these areas. Perennial tributaries should also be sampled to determine whether the subwatershed is selenium source. Geologic and soil maps should be consulted to identify other areas where soil or rock type may increase the likelihood of selenium loading. Flow measurement should occur along with any additional sample collection to allow for load calculation.

<u>Purgatoire River from Nine Mile Dam to the confluence with the Arkansas River:</u> Collect water quality samples to isolate selenium, phosphorus and nitrogen sources on the lower portion of segment COARLA07. Potential sources include return flows from canals, tributaries and arroyos in the lower part of the watershed. Ninemile and Highland canals are located on the study reach. Sample collection should occur at the diversion and return points of each canal and any other irrigation ditches. Phosphorus and nitrogen sources are likely anthropogenic, so additional care should be used in study design and location selection to properly isolate potential sources. USGS data from the Thatcher and Rock Crossing locations should be evaluated to determine whether additional monitoring should occur near these sites, prior to selecting the final study reach. The study reach also includes several NPDES permitted dischargers, whose operations are classified as industrial agriculture (Figure 4-1), as such these operations may be a potential source of selenium or nutrients. However, the existing data set lacks

water quality data to characterize the effect of their operations. Flow measurement should occur along with any additional sample collection to allow for load calculation.

A review of the fishery in the Lower Purgatoire River should be completed in conjunction with additional data collection. The review should identify whether selenium sensitive species or endangered fish are present or if suitable habitat exists on the Lower Purgatoire River. The presence or absence of such species will help determine the course of future actions including sample collection or mitigation measures.

Targeted Sediment Studies and Sediment Control Efforts: Mitigate erosion and sediment delivery to local waterbodies using appropriate sediment control measures in a targeted area with appropriate partners.

4.9.3 Data and Information Gaps

Baseline Characterization of un-sampled perennial streams and priority intermittent streams: Complete a baseline assessment of un-sampled tributaries based on streamflow frequency, water quality impairment risk or perceived risk and stakeholder needs. Characterization should include peak flow conditions and storm flow conditions, during irrigation season and or while CBM discharges are underway.

Selenium: Total recoverable selenium standards are applied to four segments in the Watershed. Historically, only the dissolved phase has been measured at sample locations on these segments. Future and on-going sample collection efforts should include total recoverable selenium in the analysis suite. The segments where total recoverable selenium standards are applied are: COARLA02a, COARLA06a, COARLA06b, COARLA16, and COARLA17. Selenium concentrations have not been measured on the following segments where a dissolved selenium standard is applied: COARLA09b, COARLA16, COARLA17 and COARLA19. Collaborate with entities that currently collect water quality data to assure the appropriate type of selenium analysis is completed by the laboratory.

Nutrients: Although very limited in scope, the existing nutrient data set (total phosphorus, total nitrogen and chlorophyll a) does not suggest nutrient concentrations frequently exceed interim criteria. However, nutrient concentrations have been measured at only a portion of the existing sites, so the spatial distribution of this data is more limited than the larger data set. At a minimum, nutrient analysis should be added to existing data collection efforts. Baseline characterization should occur in the mainstem of the Purgatoire River, large tributaries and in areas down gradient of agricultural lands or other lands where fertilizer application may occur. The implementation of Regulation 85 should generate additional nutrient data, as dischargers comply with the new regulations. This data, which includes discharge locations along with up and down gradient sites, should be evaluated to further refine our understanding of nutrient concentrations in the Purgatoire River Watershed.

Source Water: In 2004, the Colorado Department of Public Health and Environment staff prepared screening-level source water protection reports for the towns of Trinidad, Branson and Model and Las Animas County. Additional investigation should occur to determine whether there are sufficient mechanisms in place to protect drinking water supply areas in the Purgatoire River Watershed. The City of Trinidad has plans to develop and implement a Source Water Protection Plan to help mitigate concerns over drinking water supply and quality.

Section 5 Issues of Concern

Stakeholders identified a broad range of issues that need to be addressed in the Purgatoire Watershed. Problems in any watershed often relate to water quality and water quantity, which is why these topics are listed first. Although the issues presented in this watershed plan are not prioritized, water quality and water quantity are dominant and typical concerns and could be considered priorities. Many of the other issues relate to one or both of these concerns as well. The list presented here is not exhaustive, however, and additional topics will be included in future Purgatoire Watershed plans as more information becomes available or other issues arise. The Issues of concern identified throughout the watershed planning process are organized in Table 5-1 below and were also presented in Table A of the Executive Summary.

Table 0-1: Issues of Concern

Issue	Description
1. Water Quality	Water quality includes a broad range of concerns, beyond simply contaminants. There is also a need for a water quality monitoring plan to identify areas lacking data. As projects are developed and data gaps are revealed through more extensive research, more data may need to be collected and more specific maps generated.
2. Water Quantity	Drought in the Purgatoire River Watershed has led to increased shortfalls of water supply. Agricultural water demands are over-appropriated in the Basin. Improved surface water irrigation may lead to material depletion or injury to water rights downstream due to the Arkansas River Compact.
3. Forest and Rangeland Health	Forest health throughout the Purgatoire Watershed, due to fire repression, lack of timbering, dense understory growth and drought, has caused forests to become extremely susceptible to insect diseases and wildfire. Rangeland health concerns include providing livestock water to underutilized areas, among other topics.
4. Invasive Species	Invasive species are prevalent in the Watershed and affect available water, agricultural crops, riparian ecosystems, rangeland and biodiversity.
5. Stream and Habitat Restoration	Due to multiple issues, such as water quality, sedimentation, erosion, invasive species, land use practices, water storage and water diversions, among others, stream banks and riparian areas, as well as other Watershed ecosystems, need to be addressed and improved following best management practices for restoration.
6.Recreational Use and Access to the River	Not only do outdoor recreational activities associated with the River invigorate the regional economy but they also provide opportunities for healthy living. Improving access to the River also provides more recreational pursuits and increases Watershed awareness.
7. Awareness and Knowledge of Watershed Issues	Education and outreach are essential for generating awareness of issues in the Watershed and fostering stewardship of a watershed system. Furthermore, the Purgatoire watershed is part of the Arkansas Basin. Therefore it is important that goals and priorities of the Arkansas Basin Roundtable, and thus the State Water Plan, align with the priorities, goals, programs and projects developed by the PWP.
8. Stakeholder Participation and PWP Sustainability and Publicity	A broad range of participation and increased numbers of participants are essential to the success of the PWP and implementing the Watershed Plan. The PWP cannot survive without consistent stakeholder input, volunteer involvement, donations and external funding.

5.1 Water Quality

There is insufficient data to determine if water quality standards are being met throughout the Watershed. Selenium and sediment are listed as impaired in several reaches of the Purgatoire River and in several tributaries. Section 4.9 above identifies gaps and recommends specific areas in need of monitoring. Once a monitoring plan is in place and existing data gaps are filled, strategies can be implemented to meet current standards and load reductions can be estimated.

Data Gaps

A series of maps have been generated from data collected on the Purgatoire watershed. However, as projects are developed and data gaps are revealed through more extensive research, more data may need to be collected and more specific maps generated. The generation of more maps and the need for greater data to be collected will become projects. Specifically, there is little water quality information or monitoring taking place in the lower or eastern watershed where coalbed methane production is not in operation (i.e. where data is not required to be collected). Water quality within the Purgatoire is generally good, as the only impairments listed are naturally occurring (selenium and iron), though data gaps may lead to projects which focus on the mapping of areas unmonitored or where no water quality data exists, followed by greater monitoring projects as a future priority. Additional data gaps within the watershed that must be assessed or generated before projects can be implemented include a sediment assessment, wildfire plans, the assessments of irrigation diversions and water conservation measures. Potential partners for data collection and project implementation could be land-owners, students, citizens-at-large, municipalities and the oil and gas industry, to name a few.

Oil and Gas Operations

With approximately 2300 wells, Pioneer produces about 200 million cubic feet of natural gas (methane) and about 125,000 barrels (or 5.2 million gallons) of water per day. Approximately 60-70% of this water is surface discharged under permits issued by the State of Colorado. Once surface discharged, this produced water becomes part of the waters of the State. The water produced from coalbed methane wells in the Raton Basin is among the highest quality water ever produced from a commercial natural gas field in the U.S. The water is suitable for stock watering and can be a valuable source of water for wildlife, such as on the Bosque del Oso State Wildlife Area. Blended with natural runoff, the water can be suitable for irrigation, water supply and other uses. In, recent years less pressure in formations has resulted in less produced water from coalbed methane operations in the Raton Basin.

All discharge permits are available to the public through the Colorado Department of Public Health and the Environment's (CDPHE) Colorado Discharge Permit System (CDPS). Fact Sheets are available upon request. (See Appendix A: Resources.)

Coalbed methane produced water can be high in salinity, however there are minimal cases of high salinity levels within the Purgatoire watershed as a result of coalbed methane produced water.

Coal Mining

Coal production can significantly impact water quantity and quality. Water is used to extract, wash and often transport coal. If not managed appropriately water quality can be impacted from coal production. However, in 2014, at the time of publication, no known coal or other hardrock mining practices were taking place in the Watershed. If future mining operations ensue, stakeholders will need to readdress this topic.

5.2 Water Quantity

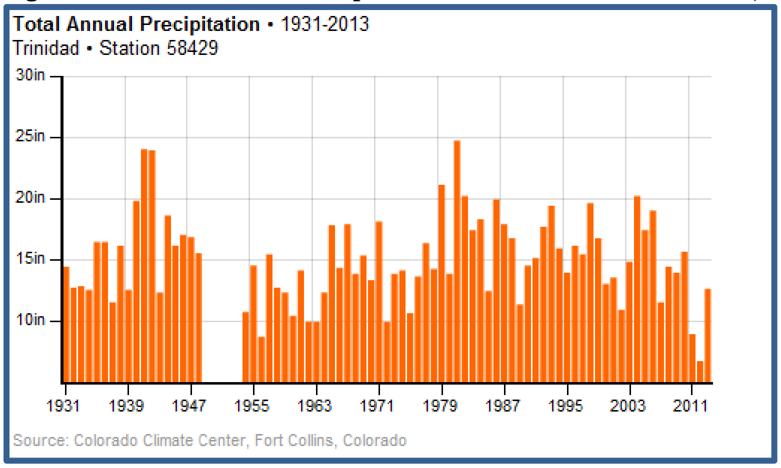
The amount of water in the Watershed is limited based on snowfall in higher elevations that provide the irrigation water to cropland in the watershed and recreation water to Trinidad Lake. Areas above Trinidad Lake rely on the direct flow from the Purgatoire River to provide irrigation water. Trinidad Lake provides storage for downstream-irrigated areas managed by the Purgatoire River Water Conservancy District. Over-appropriation of the resource oftentimes leaves junior water right holders with no water for entire seasons.

Drought

Recent drought in the Purgatoire River watershed has led to increased shortfalls of water supply. As water supply decreases it cannot meet the needs of the ever-growing demand. During the record drought of 2001- 2002, Trinidad's existent mountain supply, which usually yields approximately 5,746 acre-feet per year, only yielded 4,543 acre-feet.

Looking at a summary of climate trends for Trinidad Station 58429, it can be quantified that annual precipitation in the form of snowfall is 50.8 inches and rainfall 15.5 inches on average (Figure 5-1). A variable amount of precipitation has caused drought trends in the past. Only four years within the 82-year study period0 had over 20 inches of rain occurring in 1942, 1943, 1979 and 1981. The average precipitation for 2012 was significantly low with less than five inches of rain, resulting in one of the driest years the Colorado Climate Center has on record, and worst droughts in watershed history.

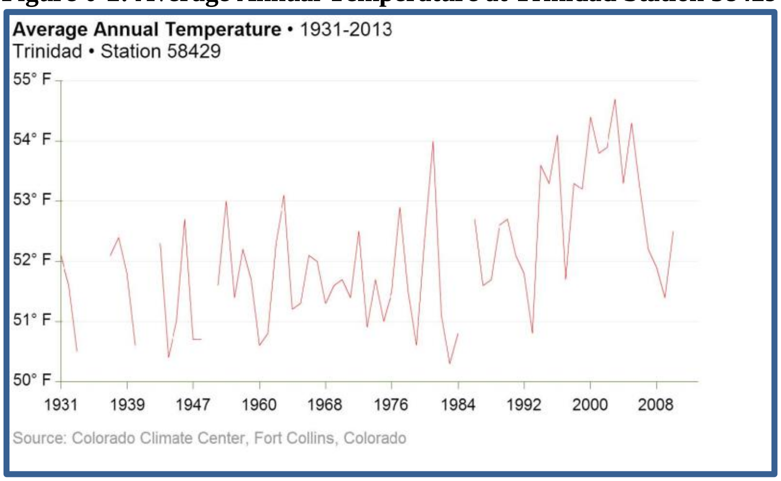
Figure 0-1: Total Annual Precipitation at Trinidad Station 58429 (1931-2013)



Source: Colorado Climate Center (2013)

From 1931 to 2013, there has been an increased temperature trend (Figure 5-2), in addition to variable precipitation trends occurring at Trinidad Station 58429. These trends together indicate that more prevalent drought periods may take place.

Figure 0-2: Average Annual Temperature at Trinidad Station 58429 (1931-2013)



Source: Colorado Climate Center (2013)

On January 15, 2014 Senator Michael Bennet announced that Drought Assistance through the United States Department of Agriculture (USDA) was made available for 15 designated Colorado Counties, found as primary natural disaster areas due to severe drought. These counties include Baca, Bent, Cheyenne, Crowley, El Paso, Kiowa, Kit Carson, Las Animas, Lincoln, Otero, Phillips, Prowers, Pueblo, Sedgwick and Yuma, three of which are found within the Purgatoire Watershed (Bent, Otero and Las Animas). Farm operators in the designated counties are eligible for federal assistance consideration, including emergency loans through the Farm Service Agency. Counties designated as natural disaster areas from U.S. Drought Monitoring data, indicating that they have suffered drought intensity through the growing season of D2 (Severe Drought) for eight (8) or more weeks or are classified as D3 (Drought Extreme) or D4 (Drought Exceptional) regions.

Arkansas Compact

Kansas' representatives have expressed concerns that recent trends toward improved surface water irrigation system efficiency have reduced historical seepage and return flows owed to Kansas under the "no material depletion" standard of the compact. These concerns have triggered the development of another set of compact rules designed by the Colorado State

Engineer's Office to proactively address Kansas' concern that certain improvements to surface water uses (as opposed to groundwater uses e.g. pumping) in Colorado may violate the compact.

Drafted irrigation improvement rules are designed to evaluate the effect of proposed improvements of irrigation technology on return flows to provide multiple options for maintaining their historical seepage and return flows to the Arkansas River. In September 2009, the new proposed rules were submitted to the Colorado Water Division 2 Court for approval and were approved by the Court in October 2010. The rules were developed with a basin-wide Advisory Committee alongside the State Engineer. The rules lay out how Colorado will evaluate the effect of irrigation system improvements on return flows and provide irrigators with a number of options for maintaining their historical seepage and return flows to the Arkansas River even after irrigation systems are improved. The Final Arkansas River Irrigation Improvement Rules went into effect on January 1, 2011.

5.3 Forest and Rangeland Health

There is major concern regarding the overall forest health throughout the Purgatoire Watershed due to fire repression, lack of timbering, dense understory growth, which causes forests to be extremely susceptible to insect diseases and fire, and extreme drought conditions during the past few years. Concerns are most prominent in undeveloped, arid, vegetated hillsides. Whether in the higher elevations of the western Watershed or on the mesas and in the canyons of the central and eastern Watershed, extensive populations of evergreen trees, such as firs, one-seeded juniper, ponderosa pines and piñon pines, have been affected by the recent drought and infestations of pine beetles. These regions now have abnormally high numbers of dead trees, which increases fire danger and therefore demands more immediate mitigation.

In the summer of 2000, the Bosque del Oso and the Piñon Canyon Fire covered approximately 4,000 acres of Las Animas County, that cost approximately $395,000 to fight. Measures are being taken including Wildfire Risk Assessments, Wildfire Protection Plans and other programs developed by the State of Colorado to prevent high frequency and high intensity fires. No structures were lost. In 2002, the Stonewall Fire Department fought the Spring Fire covering 28,000 acres and was the largest in the history of the Purgatoire Watershed. Also in 2002, the James John Fire was approximately 12,000 acres, occurring near the top of Fishers Peak mesa. The two combined 2002 fires cost over $2.18 million dollars, though no structures were lost in either fire. However, sedimentation, siltation, flooding, erosion, mudslides and loss of habitat resulted after the fires. In 2011, Las Animas County experienced the following large fires: Bear Fire, Purgatoire Fire, Calle Marie Fire, Shell Fire, Brice Fire, Mesa de Maya Fire, and Track Fire.

5.3.1 Wildfire Risk Assessment

In 2012 a Colorado Wildfire Risk Assessment (WRA) project was established by the Colorado State Forest Service (CSFS) in response to a growing demand for accurate and up-to-date wildfire risk information, and the results were completed in December of 2012. The goals of the project were to provide consistent and comparable scientific results that would build the foundation for wildfire mitigation and prevention planning throughout the State. The Colorado Wildfire Risk Assessment Portal (CO- WRAP) was created by the CSFS to promote awareness and deploy information seamlessly and quickly. It is the primary mechanism used by the CSFS to relay risk information and generate awareness about wildfire issues to both professionals and residents across the State. CO-WRAP is comprised of a suite of applications, such as data collection tools for determining risk factors, which are tailored to support specific workflow and information requirements for wildland fire managers, government officials, hazard-mitigation planners, private land owners, community groups and the general public. Collectively these applications are able to provide Colorado with baseline information needed to support mitigation and prevention efforts.

Assessment findings can be used to prioritize areas in the state through the use of community interaction, education, tactical analyses, or mitigation treatments to reduce the risks of wildfire. The WRA provides information that can prioritize the following actions:

- Identify areas that may require additional tactical planning, specifically related to mitigation projects and Community Wildfire Protection Planning
- Provide the information necessary to justify resource, budget and funding requests
- Allow agencies to work together to better define priorities and improve emergency response, particularly across jurisdictional boundaries
- Increase communication with local residents and the public to address community priorities and needs
- Plan for response and suppression resource needs
- Plan and prioritize hazardous fuel treatment programs

With the successful completion of the 2012 Colorado Wildfire Risk Assessment project, the CSFS continues to be a national leader in wildland fire management. This latest assessment builds upon and further quantifies and qualifies the West Wide Wildfire Risk Assessment (WWA) results. The WWA was completed in the fall of 2012 and provides baseline risk assessment results for the 17 western states and Pacific Islands. Colorado has analyzed and enhanced these results to reflect priorities and data distributions only within Colorado to better meet Colorado's wildfire planning requirements.

Wildfire Risk Assessment in the Purgatoire River Watershed

The CSFS La Veta District, which serves Las Animas County, prepared a Wildfire Risk Assessment (WRA) Summary report for the Purgatoire River Watershed. Five (5) common resource areas delineated in the Purgatoire Watershed were summarized explicitly for user-defined project area boundaries. The WRA provides a consistent, comparable set of scientific results to be used as a foundation for wildfire mitigation and prevention planning, as well as a list of products generated through the assessment process, each of which is accompanied by a general description, table, chart and/ or map. A list of the products for Colorado is shown in Table 5-2 below, displaying all twenty (20) of the identified products.

Table 0-2: Colorado Wildfire Risk Assessment Products

Colorado WRA Product	Description
Wildland Urban Interface	Depicts where humans and their structures meet or intermix with wildland fuels
WUI Risk Index	Represents a rating of the potential impact of a wildfire on people and their homes in the WUI
Wildfire Risk	Possibility of loss or harm occurring from a wildfire, obtained by combining Wildfire Threat and Fire Effects Index
Wildfire Threat	Likelihood of a wildfire occurring or burning into an area
Values Impacted Rating	Represents an overall rating of the potential impact of a wildfire on all values and assets
Suppression Difficulty Rating	Represents those areas where terrain and vegetation characteristics impede dozer operability
Fire Occurrence	Likelihood of a wildfire starting based on historical ignition patterns
Fire History	Information regarding number of fires, acres suppressed and cause of fires
Characteristic Rate of Spread	Represents the speed with which a fire moves in a horizontal direction across the landscape based on historical percentile weather
Characteristic Flame Length	Represents the distance between the tip and base of the flame based on historical percentile weather
Fire Intensity Scale	Quantifies the potential fire intensity for an area by orders of magnitude based on historical percentile weather
Fire Type – Extreme Weather	Represents the potential fire type under the extreme percentile weather category
Surface Fuels	Description of surface vegetation conditions described by fuel conditions that reflect fire behavior characteristics
Vegetation	General vegetation and land cover types
Drinking Water Importance Areas	Measure of quality and quantity of public surface drinking water categorized by watershed
Drinking Water Risk Index	Measure of wildfire risk to drinking water importance areas
Riparian Assets	Forested riparian areas characterized by functions of water quantity, quality and ecology
Riparian Assets Risk Index	Measure of wildfire risk to forested riparian areas
Forest Assets	Forested lands characterized by height, cover and susceptibility/response to fire
Forest Assets Risk Index	Measure of wildfire risk to forested lands characterized by height, cover and susceptibility/response to fire

Source: CSFS (2013). Colorado Risk Assessment Summary Report

More information can be found in the *Colorado Wildfire Risk Assessment Summary Report: Purgatoire Watershed* document (see Appendix A).

Forest Inventory Analysis for the Culebra Range Community Coalition, 2005

The Culebra Range Community Coalition (CRCC), a collaborative organization of private landowners, local businesses and natural resource professionals dedicated to improving and maintaining the forest and watershed health of headwaters of the

Purgatoire, Apishapa and Cucharas River Watersheds, secured grant funding to complete a forest inventory in the summer of 2005. The inventory took place on forestland west of I-25 in Las Animas County and in a small portion of Costilla County. The inventory area, therefore, is located in a significant portion of the Purgatoire River Watershed headwaters, in addition to parts of the Apishapa and Canadian River Watersheds. The inventory focused on results by forest type. Forest types include: Piñon- Juniper and Oak Woodland (219,427 acres); Ponderosa Pine Vegetation Type (144,779 acres); Douglas-fir Vegetation Type (18,427 acres); Spruce/fir Vegetation Type (48,730 acres); and Aspen Vegetation Type (7,700 acres). An Inventory Summary is displayed in Table 5-3 below.

Table 0-3: CRCC Inventory Summary

Inventory Summary

	Roundwood Net Volume (Tons)	2% growth (Tons)
Ponderosa Pine	522,521	10,450
Douglas-fir	347,905	6,958
White Fir	148,495	2,970
Spruce	245,451	4,909
Limber Pine	19,959	399
Corkbark fir	47,650	953
Aspen	217,481	4,350
	1,549,462	30,989
	Sawtimber Net Volume (MBF)	**2% Growth (MBF)**
Ponderosa Pine	242,366	4,847
Douglas-Fir	102,876	2,057
White Fir	57,783	1,156
Spruce	61,054	1,221
Corkbark fir	15,430	309
Aspen	31,963	639
	511,472	10,229

Cruise Sampling Error – 13.5% at 95% confidence level.

Source: Southwest Environmental Consultants (2005). Forest Inventory Analysis for the CRCC

Findings from the inventory indicate that, based on projected growth, approximately 31,000 tons per year of fuel can be harvested sustainably, and that current over-stocking should be reduced. Fuel refers to flammable materials, such as vegetation or structures, even a wood pile stacked near a house. Under the assumption that approximately 20% of roundwood (cut tree trunks or limbs) volume should be removed to improve stocking, another 300,000 tons are available. If that volume was harvested over a 10-year period, another 30,000 tons would be available annually. There would be approximately 60,000 tons of roundwood available annually for small- diameter industries, in addition to a greater volume of sawtimber (larger logs suitable for cutting into boards) available (under that same assumption). However, the quantity is dependent on the amount of growth reserved to increase sawtimber diameter.

The *Forest Inventory Analysis for the Culebra Range Community Coalition* can be found in Appendix C.

5.3.2 Rangeland Management

Rangeland health concerns include soil compaction due to tillage practices, increased salinization of cropland from irrigation water, wind erosion, and an overall degradation of soil quality. On-going Arkansas River research through Colorado State University has brought awareness to saline high water tables, salt and selenium dissolution in the aquifer, and high water tables under fallow land and invasive phreatophytes. These trends affect agriculture and the environment of the river valley.

5.4 Invasive Species

Noxious weeds and invasive species are an issue of concern identified by many stakeholder groups within the Purgatoire Watershed. In 2004, Las Animas County proposed to complete a Weed Management Plan. Additionally, the NRCS has identified Invasive Species as an area of concern, too, within a Rapid Watershed Assessment conducted in 2007. Details on the Noxious Weed Management Plan for Las Animas County are summarized below (see also Appendix D: Noxious Weed Management Plan for Las Animas County, CO):

Noxious Weed Management Plan for Las Animas County

A Noxious Weed Management Plan for Las Animas County complies with the Colorado Noxious Weed Act of 1996 (HB96-1008) and revisions to the Act made in 2004. The Act requires each county and municipality to adopt a noxious weed management plan and provide for the administration of the plan. This allows for cooperative planning among counties and municipalities. Weeds are classified into several categories by the Colorado Department of Agriculture (C.R.S. 35 – 5.5 – 108). Categories include **List A**: rare noxious weed species that are subject to eradication wherever detected statewide in order to protect neighboring lands and the state as a whole. List A species are designated by the commissioners for eradication; **List B**: noxious weed species for which the commissioners, in consultation with the state weed advisory committee, local governments, and other interested parties, develop and implement state noxious weed management plans designed to stop the continued spread of these species; **List C**: noxious weed species for which the commissioners, in consultation with the state weed advisory committee, local governments, and other interested parties, will develop and implement weed management plans designed to support the efforts of local governing bodies to facilitate effective weed management on public and private land. The plan will provide additional education, research and biological control resources.

An overview of the Weed Management Plan for Las Animas County is as follows:
The plan created by Las Animas County will meet requirements of the Colorado Noxious Weed Act of 1996 and revisions of 2004. The plan will provide policy and guidance for the control and reduction of noxious weeds in the county and will be prepared for the use of all public and private landowners and managers.

The Las Animas County Weed Advisory Board policy is that Integrated Vegetation Management Principles will be used in the control and reduction of noxious weeds, which is defined by the Colorado Noxious Weed Act of 1996 as “the planning and implementation of a coordinated, program utilizing a variety of methods for managing noxious weeds, the purpose of which is to achieve desirable plant communities. Such methods may include, but are not limited to, education, preventative measures, good stewardship and the following techniques: The techniques listed and described are biological, chemical, cultural and mechanical control measures.”

In recent years land management has changed due to development (industry and residential) and absent landowners. These changes have increased soil disturbance and a large increase of non-native plant species (e.g. mullein and thistle).

Weeds identified by Las Animas County’s plan are included in the state noxious weed list. The weeds outlined in Table 5-4 below are a priority for control in the county. Locust Tree and Mexican Locust have also been targeted though are not including below. If additional weeds that are not listed become burdensome in the future, public hearings are required to add these additional weeds to the Plan as needed.

The Weed Control Manager will coordinate noxious weed control efforts among land owners and managers, including federal, county, state, municipal, and private sectors. These include (but are not limited to): Las Animas County Trinidad; PCMS; Farmers; Ranchers; Landowners; School Districts; Irrigation Companies; Recreation Districts; Colorado State Land Board; CDOW; BLM; USFS; CO Department of Transportation; Boy Scouts of America; and Gas and Energy Companies. The Weed Control Manager will complete an educational component by providing materials concerning identification, propagation, and control of noxious weeds. Outreach and educational tools will be communicated through news releases, traveling exhibits, flyers, slide presentations, and field trips. The targeted groups for such education and outreach include recreational groups, individual landowners, schools, farm and ranch organizations, service organizations, and PDA’s.

Herbicides are expected to be the most effective management tool for the control and reduction of noxious weeds. Biological methods will be integrated to lessen the use of chemical management when possible, and will continue to grow as more biological controls are developed. Methods include proper mowing, irrigation, and burning, in addition to properly timed livestock grazing, plowing and seeding. Upon the approval of the plan a mapper will work with individuals and various organizations to create maps using Geographic Positioning Systems and Geographic Information System software to keep maps up to date, available digitally, and able to be overlain with other features.

Table 5-4: Targeted Weeds in Las Animas County

Category A*	Category B	Category C
Yellow Star Thistle *Centurea solistitialis L.* **African Rue *Peganum harmala***	Leafy Spurge *Euphorbia esula* Musk Thistle *Carduss natans* Diffuse Knapweed *Centaura diffusa* Canada Thistle *Circium arvense* Common Mullein *Verbascum Thapsus L.* Houndstongue *Cynoglossum officinale L.* Oxeye Daisy *Chrysantheum leucanthemun* Scotch Thistle *Onopordum acanthium* Bull Thistle *Cirsium vulgare (Savi) Tenore* Russian Knapweed *Centaura repens* Spotted Knapweed *Centaura maculosa* Saltcedar Tamarix *ramosissima Ledeb*	Poison Hemlock *Conium maculatum L.* Common Burdock *Arctium minus* Cheatgrass *Bromus tectorum L.* Yellow Toad Flax *Linaria Vulgaris*

*Mandatory control requirement by the Colorado Weed Management Act = needs to be eradicated
Source: Weed Management Plan for Las Animas County

The 1996 Colorado Noxious Weed Act requires that local noxious weed management plans are reviewed at least once every three years. The Weed Advisory Board can review and update the plan at any time, though County commissioners must approve changes to the plan. Enforcement of the Las Animas Noxious Weed Management Plan will be per Title 35; Article 5.5- 109, requiring the county after notification to provide for and compel the management of noxious weeds on private lands. Land owners not properly controlling weeds will pay the county the cost for inspection and other incidental costs.

5.5 Stream and Habitat Restoration

Riparian Habitats
Riparian habitats are ecosystems that border any type of water way or water body. Riparian areas that most readily deserve consideration for restoration in the Watershed include streams that have experienced erosion and wetlands that would decrease sedimentation in the Purgatoire River and its tributaries. Riparian areas naturally offer habitat for wildlife, as well as shade for livestock, and shade reduces evaporation. Aquatic and riparian vegetation also reduces contaminants in water systems. When plants are used to remove pollutants from water this is known as phytoremediation.

Soil Erosion
Most soils in the Watershed are highly erodible. Data generated through the NRCS through a Rapid Watershed Assessment show the greatest amount of watershed findings to be susceptible to an eighty-six (86) ton per acre per year loss due to wind erosion. The value of tons per acre per year of soil loss is based on a wind erodibility index (WEI) used by the NRCS, which is based on the numerical value associated with soil's susceptibility to wind erosion, or the tons per acre per year that can be expected to be lost to wind erosion, assuming there is no management or vegetative cover. Most soils in the Watershed are considered to be highly erodible. Soil erosion from runoff from well roads is an additional area of concern expressed by several stakeholders within the Watershed, but data is lacking.

5.6 Recreational Use and Access to the River

Recreational access to the Purgatoire River, as well as tributary waters and reservoirs such as Trinidad Lake, North Lake and Monument Lake, contribute to a community's health because they provide venues for engaging in physical activity and enjoying nature, and in turn can raise residents' awareness of watershed needs and thus increase stewardship. Access to the Purgatoire River is limited to the River Walk in the City of Trinidad, but along this path access to the River's edge is often obstructed or unavailable. Access to the River for anglers and other outdoor enthusiasts, or simply trail users, needs to be designed to limit erosion and improve safety. Recreational access to the River could expand beyond City limits, as well, and provide connectivity to other sites, such as Trinidad Lake State Park.

5.7 Awareness and Knowledge of Watershed Issues

Education is essential for understanding a watershed and threats to water quality and quantity, among other issues. Due to the rural nature and small population of the Purgatoire River Watershed, much more information about the Watershed needs to be collected and analyzed. Although some research and reports have been conducted and published, respectively, this information is not always available to multiple stakeholders nor is the content readily accessible. There is a demand to provide more opportunities for residents of the Watershed to become knowledgeable about Watershed issues and become more informed decision makers, as well as become more involved in project implementation and general stewardship. Many mechanisms are in place for improving Watershed awareness, such as collaborative—including professional—partnerships with agencies or groups that can support the PWP as it addresses these issues.

Arkansas Basin Roundtable

One such group, which includes representation from the PWP and is already addressing watershed awareness and needs, is the Arkansas Basin Roundtable. The Arkansas Basin Roundtable was formed as part of a program of the Colorado Water Conservation Board (CWCB). This program is tied to Colorado's new water plan and required the State's river basins (see Figure 5-3 below) to each develop a basin-wide water needs assessments, or a *basin implementation plan*.

Figure 5-3: Colorado Basin Roundtables Map

Source: http://coyotegulch.files.wordpress.com/2010/03/ibccroundtable.jpg

The basin assessment template contains four parts:

1. Non-consumptive water needs (environmental and recreational);
2. Consumptive water needs (agricultural, industrial and municipal);
3. Available water supplies (surface and groundwater): and
4. Analysis of any unappropriated waters with proposed projects or methods to meet any identified water needs and achieve water supply sustainability over time.

The Arkansas Basin—the drainage area of the Arkansas River in Colorado—is home to two large cities, Pueblo and Colorado Springs, which has brought on competition for scarce water resources between urban populations, municipalities, industries and agricultural users. By 2050 water demand in the Arkansas Basin is projected to experience the second largest increase in the state, requiring an increase of between 141,000 acre feet and 195,000 acre feet. Major projects and programs of the Roundtable to date include the Southern Delivery System, Conduit, and the Preferred Storage Option Plan.

The Purgatoire Watershed is part of the Arkansas Basin and therefore it is important that the goals and priorities of the Arkansas Basin align with those of the Purgatoire Watershed as a whole, in addition to the priorities, goals, programs and projects being developed by the PWP. Arkansas Basin Roundtable priorities are to maintain agricultural viability in the lower basin, provide for in-basin augmentation in the upper basin, provide adequate water quality to meet all needs, and to ensure adequate water for future needs in terms of municipal, industrial, agricultural, environmental and recreational needs. Activities and accomplishment to date include the approving of a report describing the Roundtable's significant efforts toward implementing the requirements set forth in the Colorado Water for the 21st Century Act. Since the Roundtable first convened in September 2005, it has worked to determine and examine consumptive and non-consumptive water supply needs and projects or methods to meet water supply availability needs, including a Basin non-consumptive needs assessment. Currently, the Roundtable is finalizing its Basin Implementation Plan, which includes final determinations of project methods for meeting water supply needs, as well as the non-consumptive needs assessment. The Arkansas Basin Roundtable's Goals and Measurable Outcomes can be found in Appendix E. (See also Appendix A for links to more information.)

5.8 Stakeholder Participation and PWP Sustainability

Due to the 97% private ownership of the Watershed's acreage, engaging stakeholders requires diligence, whether a stakeholder rents an apartment in town or owns an expansive ranch. The PWP seeks to continue to involve a variety of stakeholders in improving Watershed health. Stakeholder participation is essential for the PWP to become sustainable as an organization, as well, financially and organizationally.

Section 6 Goals and Objectives

Goals and objectives directly relate to the *Issues of Concern*. Goals for the Purgatoire River Watershed were developed following data collection, research, determining problems in the Watershed, and gathering additional input from stakeholders. Objectives were determined in the same manner and specify actions that need to be pursued in order to reach each goal. Achieving each objective will ultimately lead to the improvement of the health of the Watershed.

6.1 Goals

Goal 1) Improve Water Quality
Goal 2) Increase Water Quantity
Goal 3) Manage Healthy Forests, Shrublands and Grasslands
Goal 4) Mitigate Invasive Species
Goal 5) Improve Riparian and Other Watershed Ecosystems
Goal 6) Enhance Recreational Opportunities
Goal 7) Educate the Public Regarding Water Issues
Goal 8) Maintain an Active Watershed Stakeholder Group

6.2 Objectives

Goal 1: Improve Water Quality

- 1.1 Assess Water Quality
- 1.2 Address Selenium and Mercury Impaired Waters
- 1.3 Reduce Sediment Loading, Bacteria and Erosion
- 1.4 Assess Sodium and Bicarbonate Levels in Lower Purgatoire
- 1.5 Implement Water Quality Monitoring Programs
- 1.6 Address Nutrient Loading
- 1.7 Protect Upper Watershed Municipal Supply

Goal 2: Increase Water Quantity

- 2.1 Improve Ditch Diversion Infrastructure
- 2.2 Identify Methods for Long-term Water Storage
- 2.3 Determine Strategies for Water Re-use

Goal 3: Manage Healthy Forests, Shrublands and Grasslands

- 3.1 Develop a Community Wildfire Protection Plan (CWPP)
- 3.2 Investigate Wood Markets
- 3.3 Address Eastern Watershed Region Needs

Goal 4: Mitigate Invasive Species

- 4.1 Reduce Tamarisk, Russian-olive and Other Invasive Specie
- 4.2 Study and Reduce Aquatic Invasive Species

Goal 5: Improve Riparian Ecosystems and Address Erosion

- 5.1 Improve Trout Habitat
- 5.2 Maintain Existing Riparian Habitats
- 5.3 Identify Wildlife Corridors and Opportunities for Habitat Restoration
- 5.4 Protect Environmentally Sensitive Areas

Goal 6: Enhance Recreational Opportunities

- 6.1 Increase Non-consumptive Water Use
- 6.2 Provide Diverse Recreational Activities

Goal 7: Educate the Public Regarding Water Issues

- 7.1 Focus on Student Population
- 7.2 Create Multiple Outreach Strategies for Reaching the Public
- 7.3 Create Direct Learning Opportunities
- 7.4 Provide Opportunities for Water Rights, Arkansas Basin and Compact Awareness

Goal 8: Maintain an Active Watershed Stakeholder Group

- 8.1 Collaborate with Multiple Agencies and Interest Groups
- 8.2 Secure Funding and Support to Maintain the Purgatoire Watershed Partnership

Section 7 Projects and Strategies

Projects and strategies represent specific tasks, activities and management methods that relate to each objective. They represent the hands-on work that needs to be accomplished in order to improve the health of the Watershed. A set of proposed project topics were identified during PWP meetings. The projects are not listed by an order of priority, or ranked by any particular level of importance, and will be addressed and implemented as resources become available. Project or method topics are listed in Table 7-1 below. This information was also presented in the Executive Summary, Table B.

Table 7-1: Goals, Objectives and Projects and Strategies

Goals	Objectives	Projects and Strategies
1. Improve Water Quality	1.1Assess Water Quality 1.2 Address Selenium and Mercury Impaired Waters 1.3 Reduce Sediment Loading, Bacteria & Erosion 1.4 Assess Sodium & Bicarbonate Levels in Lower Purgatoire 1.5 Implement Water Quality Monitoring Programs 1.6Address Nutrient Loading 1.7 Protect Upper Watershed Municipal Supply	1.1.a Water Quality Assessment Analysis Project 1.2.a Study Selenium and Mercury and Implement Control Efforts 1.2.b Ditch Lining for Selenium Reduction 1.3.a Study Sediment Loading and Bacteria 1.3.b Conduct Targeted Sediment Studies and Sediment Control Efforts 1.3.c Stream Bank Erosion Projects: Purgatoire River and its Tributaries 1.4.a Research and Address Sodium-Bicarbonate Effects on Agricultural Production 1.5.a Water Quality Monitoring Priorities: Purgatoire River from Trinidad Reservoir to the confluence with Van Bremer Arroyo and Purgatoire River from Nine Mile Dam to the confluence with the Arkansas River 1.6.a Implement Non-Point Source Pollution Mitigation 1.7.a Source Water Protection Plan
2. Increase Water Quantity	2.1 Improve Ditch Diversion Infrastructure 2.2 Identify Methods for Long-term Water Storage 2.3 Determine Strategies for Water Re-use	2.1.a Assessment and Improvement of Existing Irrigation Diversions 2.1.b Chilili Ditch Diversion and Improvement Project 2.1.c Ditch Lining - Water Conservation Projects 2.2.a Water Storage: Arkansas River Compact Water Storage Study 2.2.b Augmentation Water Storage 2.3.a Uses for Coalbed Methane Produced Water

3. Manage Healthy Forests, Shrublands and Grasslands	3.1 Develop a Community Wildfire Protection Plan (CWPP) 3.2 Investigate Wood Markets 3.3 Address Eastern Watershed Region Needs	3.1.a Implement Stonewall Fire Protection District CWPP and Develop CWPP's for Other Communities 3.2.a Economic Benefits of Wildfire Protection 3.3.a Review and Develop as Necessary Rangeland, Shrubland & Grassland Management Plans
4. Mitigate Invasive Species	4.1 Reduce Tamarisk, Russian-olive & Other Invasive Species 4.2 Study & Reduce Aquatic Invasive Species	4.1.a Tackling Tamarisk on the Purgatoire (TTP) and Russian-olive Removal 4.1.b Noxious and Invasive Species Reduction and Control 4.2.b Research Aquatic Invasive Species Conditions and Mitigation Methods
5. Improve Riparian and other Watershed Ecosystems	5.1 Improve Trout Habitat 5.2 Maintain Existing Riparian and Wetland Habitats 5.3 Identify Wildlife Corridors and Opportunities for Habitat Restoration 5.4 Protect Environmentally Sensitive Areas	5.1.a Purgatoire River Reaches 3, 4, 5 and 6 Trout Habitat Projects 5.1.b Research In-stream Flow Potentials 5.2.a Assess and Restore Degraded Riparian Areas, Wetlands and Streambanks 5.3.a Collaborate with Habitat Planning Efforts 5.3.b. City of Trinidad Trail and Greenway Master Plan 5.4.a Assess Lower Purgatoire River Fishery
6. Enhance Recreational Opportunities	6.1 Increase Nonconsumptive Water Use 6.2 Provide Diverse Recreational Activities	6.1.a Improve Recreational Access to River 6.2.b Establish Trails in the Boulevard Addition Nature Park
7. Educate the Public Regarding Water Issues	7.1 Increase Focus on Student Population 7.2 Create Multiple Outreach Strategies for Reaching the Public 7.3 Create Direct Learning Opportunities 7.4 Provide Opportunities for Water Rights, Arkansas Basin and Compact Awareness	7.1.a Create and implement curriculum in schools within the watershed around the Trinidad water festival 7.2.a Website, social media, and news releases 7.2.b Printed educational materials 7.3.a Field tour of water infrastructure and watershed projects 7.4.a Presentations at monthly meetings and public venues.
8. Maintain an Active Watershed Stakeholder Group	8.1 Collaborate with Multiple Agencies & Interest Groups 8.2 Secure Funding and Support to Maintain the Purgatoire Watershed Partnership	8.1.a Communicate and Work With Government, Non-Profits, Education and Conservation Groups, Industry, and Local and Regional Water Agencies 8.1.b Participate in Arkansas Basin Implementation Plan Efforts 8.2.a Apply for Grant Funding 8.2.b Expand Publicity, Membership and Participation

7.1 Water Quality

Water Quality Assessment Analysis Project (1.1.a)

This report was completed during the summer of 2014 and the results are presented in Section 4 above. The water quality assessment report compiled surface water quality data in the Purgatoire Watershed and assessed the data relative to priority water quality standards focusing on the 303(d) list of impaired waters, Monitoring & Evaluation Lists, and existing reports. Priority standards were based on parameters identified as problematic in existing reports including the 303(d) and Monitoring

& Evaluation lists. Data was compiled from the CDPHE, Colorado Data Sharing Network, and the USGS, focusing on the surface water quality of the study area. This data set includes the data that promulgated the 303(d) or Monitoring & Evaluation listings. The compilation process included a Quality Assurance- Quality Control review, and the creation of GIS shapefiles and maps to support the water quality assessment. The data analysis included a standards evaluation for priority parameters and employed descriptive statistics to further characterize the data. The analysis identified potential pollutant sources and data gaps where possible. Assessment findings were summarized in the water quality report using tables, figures and maps. Additional studies will be conducted as needed in target areas.

Study Selenium and Mercury and Implement Control Efforts (1.2.a)

Two main water quality concerns in the Purgatoire Watershed are selenium and mercury. Selenium has been detected in most of the Purgatoire River. Additionally, mercury was detected in the fish tissue at the Trinidad Lake near Trinidad, Colorado. A Total Maximum Daily Load (TMDL) is required for selenium impairments. Selenium existing in waterways in elevated levels can cause reproductive failure and deformities in fish and aquatic birds. The PWP has expressed interest in completing a sediment loading assessment for the Purgatoire. Stream reaches requiring assessment have been addressed through the Water Quality Assessment (See Section 4), and are also discussed in *Targeted Sediment Studies and Sediment Control Efforts* below. Funding sources for this assessment can be applied for through the CWCB Healthy Rivers Fund and the CDPHE Nonpoint Source program (see below and Appendix A: Resources).

Ditch Lining for Selenium Reduction (1.2.b)

Conserving water is crucial to agricultural production in the Watershed and some conservation methodologies can have additional benefits, such as reducing contaminants in the water system. Lining irrigation ditches is a technique that has been proven to not only reduce water loss but also reduce selenium concentrations in return flows by reducing infiltration into selenium-rich soils. The Bureau of Reclamation is currently advocating for ditch lining projects through new WaterSmart grant programs. Agriculture in the Purgatoire watershed may qualify for this program. Ditch lining may also qualify for a Nonpoint Source grant from the Colorado Water Quality Control Division for selenium reduction. Although both programs are federally funded and cannot match each other, it is possible to use local in-kind funds as match.

Funding Source

<u>Colorado Department of Health and the Environment, Nonpoint Source Program</u>

Funding opportunities include the State 319 Non-Point Source Program. Non-point source (NPS) is the leading cause of water quality problems in Colorado, which is caused by snowmelt or rainfall moving over and through the ground. As runoff travels, it picks up and carries with it natural and human-made pollutants from many sources, which ultimately are deposited into groundwaters, rivers, wetlands, lakes, and coastal waters.

The Colorado NPS Program (see Appendix A) works to restore waters impaired from NPS pollution, including both surface and groundwater. The program also works to prevent the impairment of Colorado waterways in the future through using an efficient, effective and open process, involving the public and bringing together necessary regulatory and non-regulatory agencies, programs, and authorities. The program offers a source of funding to watershed groups with proven NPS impairments, in an effort to prepare and implement watershed management plans, keeping waterways healthy into the future.

Study Sediment Loading and Bacteria (1.3.a)

Water quality impacts in the Purgatoire Watershed are often from the geologic makeup of the Watershed, causing large amounts of naturally suspended silt to mobilize into drainageways. In many areas of the watershed there are high sediment loads from past wildfire runoff, reduced vegetative cover from drought, roadway construction for drill pads, bare soils, etc. The sediment loads are more prevalent in the spring during snowmelt, and in the summer months during high intensity storms. In the late summer months when the natural flows in the river and creeks are minimal, there are visual indications of higher amounts of bacteria in the water bodies. The PWP has expressed interest in designing and implementing a sediment study. Funding sources for such can be applied for through the CWCB Healthy Rivers Fund and the Nonpoint Source program at the CDPHE Stream restoration on the South Fork of the Purgatoire has been suggested as a potential demonstration project to improve wetlands, reduce iron concentrations and reduce sediment loading from drill roads.

Targeted Sediment Studies and Sediment Control Efforts (1.3.b)

Mitigating erosion and sediment delivery to local waterbodies can be accomplished using appropriate sediment control measures in a targeted area with appropriate partners. An example project which the PWP can use as a case study in project design is the Selenium Control Project: *Loutzenhizer Lateral Piping*. Two Selenium Task Forces, the Gunnison Basin Selenium Task Force and the Grand Valley Selenium Task Force joined together to tackle 303(d) Listed Waters requiring Total Maximum Daily Loads for selenium for the Gunnison River basin and the Colorado River Basin. Working together the groups were able to receive funding from various sources to: study the effects of changing land use, characterize selenium loading sources and mechanisms, test the use of passive selenium bioreactors, develop Best Management Practices for selenium reduction, and demonstrate the use of phytoremediation.

The Selenium Control Project: Loutzenhizer Lateral Piping, is one project in progress by the Task Forces, which may provide guidance for future projects in the Purgatoire watershed. This project was funded by the Colorado NPS Program and the U.S. Bureau of Reclamation Colorado River Basin Salinity Control Program. The goal of the NPS project was to reduce selenium loading to the lower Gunnison and Colorado River system in an effort to bring selenium impaired 303(d) listed segments into compliance with EPA standards. The goal of the Colorado River Basin Salinity Control Program was to reduce salt loading to the Colorado River.

The funding will allow the group to replace six (6) and one-half (1/2) miles of lateral pipe with closed pipe, removing an estimated 171-214 pounds of selenium a year and 2,138 tons of salt per year. The entire Lateral Piping Project will replace approximately 11.9 miles of open ditch laterals with closed pipe, reducing an estimated of 262- 328 pounds of selenium a year and 3,275 tons of salt from the Loutzenhizer Arroyo sub-basin.

Funding Sources

Colorado Department of Health and the Environment, Nonpoint Source Program

Funding opportunities include the State 319 Non-Point Source Program. (See *Ditch Lining for Selenium Reduction* above and Appendix A for more information.)

Colorado Water Conservation Board's Colorado Healthy Rivers Fund

The Colorado Health Rivers Fund grant program (see Appendix A) works to support local watershed organizations to provide clean water, protect habitat and improve recreation and accessibility. It was established by the Colorado Water Conservation Board and the Water Quality Control Commission, in cooperation with the Colorado Watershed Assembly. Locally based watershed protection groups, committed to collaborative approaches to restoration and protection of lands and natural resources within Colorado's watersheds are eligible to apply. Grant money can be used to implement projects or towards project planning. The next application deadline is April 30, 2015.

Stream Bank Erosion Projects: Purgatoire River and its Tributaries (1.3.c)

There are many locations on the Purgatoire River and its tributaries where stream bank erosion may be considered severe. The cause of this erosion has resulted from a number of contributing factors. These may include mismanagement of adjacent land uses; cumulative mismanagement in the upstream drainage area; removal of hydrophytic vegetation along the stream banks, such as willows, due to floods or man-made changes to the stream banks; or adjacent land uses such as irrigation diversions, roads, etc. There is also the slight possibility of geological formations altering tributaries which could result in erosion.

With vegetative and hard engineering practices available, many of these at-risk areas can be treated to reduce erosion and sedimentation in an acceptable limit. The type of work would vary depending on site specifics. Common conservation practices may include bank sloping and the establishment of rock rip rap armoring, rock barbs or J-hooks, which may cause minor changes in the low-water river channels within the flood plain. Along with these type of engineering practices is the vegetative component. Vegetative practices include the native reseeding of grasses, legumes, forbs, shrubs and trees. Native species can be established with many methods of planting, such as the use of seed drills and/or broadcasting of seed, hand planting of potted and bare root stock of shrubs and trees, and pole planting of willow, cottonwoods and other suitable species.

The use of both vegetative and engineered hard structures together is often identified as *soft engineering* and has shown to be effective along stream bank erosion areas, protection of irrigation point of diversion structures, bridges, and other areas.

Research and Address Sodium-Bicarbonate Effects on Agriculture Production (1.4.a)

Sodium, sodium-bicarbonate and other salts can have a negative effect on various agricultural crops, such as alfalfa. If concentrations of sodium or salts are too high in the soil, resulting pH changes can limit crop production. In additional to researching this potential threat to water quality, data gaps regarding the presence of sodium, and other related minerals or nutrients, in the water need to be determined, followed by water quality monitoring, soil testing and developing comprehensive nutrient management plans.

Water Quality Monitoring Priorities: Purgatoire River from Trinidad Reservoir to the confluence with Van Bremer Arroyo and Purgatoire River from Nine Mile Dam to the confluence with the Arkansas River (1.5.a)

The PWP conducted a water quality study on the Purgatoire River. From the study recommendations, additional water quality monitoring areas were prioritized where existing data sets suggest that there may be a water quality issue, over areas that lack data, which are characterized as data gaps. Additional water quality monitoring should occur in the following areas:

Purgatoire River from Trinidad Reservoir to the confluence with Van Bremer Arroyo: Collect water quality samples to isolate selenium sources on the upper portion of segment COARLA07. The existing data set lacks the resolution to clearly identify potential sources. Thus, sample collection should be designed to isolate all potential sources such as tributaries, stormwater runoff and agricultural return flows. Sample collection should occur at the diversion and return points for irrigation ditches in this area. The irrigation ditches include: Lopez, Picketwire, Chicose, Hoehne, Model, and South Side. Sampling at both the diversion and return or discharge points for each ditch will help determine whether selenium, which is a natural component of soils that can be mobilized through irrigation, concentrations increase in these areas. Perennial tributaries should also be sampled to determine whether the subwatershed is selenium source. Geologic and soil maps should be consulted to identify other areas where soil or rock type may increase the likelihood of selenium loading. Flow measurement should occur along with any additional sample collection to allow for load calculation.

Purgatoire River from Nine Mile Dam to the confluence with the Arkansas River: Collect water quality samples to isolate selenium, phosphorus and nitrogen sources on the lower portion of segment COARLA07. Potential sources include return flows from canals, tributaries and arroyos in the lower part of the watershed. Ninemile and Highland canals are located on the study reach. Sample collection should occur at the diversion and return points of each canal and any other irrigation ditches. Phosphorus and nitrogen sources are likely anthropogenic, so additional care should be used in study design and location selection to properly isolate potential sources. USGS data from the Thatcher and Rock Crossing locations should be evaluated to determine whether additional monitoring should occur near these sites, prior to selecting the final study reach. The study reach also includes several NPDES permitted dischargers, whose operations are classified as industrial agriculture (Figure 4-1), as such these operations may be a potential source of selenium or nutrients. However, the existing data set lacks water quality data to characterize the effect of their operations. Flow measurement should occur along with any additional sample collection to allow for load calculation.

Implement Nonpoint Source Pollution Mitigation (1.6.a)

Nonpoint source pollution is a concern for the Purgatoire River Watershed. The three major sources of nonpoint source water pollution within the region are mining operations, agricultural areas and stormwater runoff. The 1987 amendments to the Clean Water Act (CWA) established the Section 319 Nonpoint Source Management Program. Under Section 319, states, territories and tribes receive grant money that supports a wide variety of activities including technical assistance, financial assistance, education, training, technology transfer, demonstration projects and monitoring to assess the success of specific nonpoint source implementation projects. The Purgatoire Watershed Partnership has the opportunity to apply for Section 319 funding and will continue to seek out grants for addressing non-point source projects. Funding opportunities include the. (See *Ditch Lining for Selenium Reduction* above and Appendix A for more information on funding through the State 319 Non-Point Source Program.)

Source Water Protection Plan (1.7.a)

The ultimate purpose of a Source Water Protection Plan (SWPP) is to protect drinking water. The City of Trinidad has partnered with the Purgatoire Watershed Partnership to draft a SWPP and the City has already been partnering with the PWP and the Stonewall Fire Protection District to gather data for this report. Funded in part by the Colorado Rural Water Association, the SWPP endeavor is part of the State's Source Water Assessment and Protection (SWAP) Program, which includes a Source Water Assessment Report provided to Trinidad by the Colorado Department of Public Health and Environment (see Appendix A). The SWPP will not only address how the City can protect its drinking water supply, but it will also, according to the Colorado Rural Water Association, protect public health, reduce contamination risks, reduce or avoid costs associated with water treatment and clean-up, coordinate land use and involve stakeholders, inventory potential issues and provide a plan for mitigating emergencies and threats to source water and implementing goals of the SWAP report.

7.2 Water Quantity

Assessment and Improvement of Existing Irrigation Diversions (2.1.a)

Many ditches in the Watershed are in need of repair and improvement. The Water Commissioner has indicated that there are many irrigation facilities throughout the Watershed that need modifications to improve efficiency, flow measurements and sustainability. In collaboration with the Water Commissioner, the Purgatoire Watershed Partnership will work towards acquiring funding and coordinating an assessment of irrigation facilities to develop a list of priority projects in order to meet both consumptive and non-consumptive needs.

Funding Source

Colorado Water Conservation Board's Water Supply Reservoir Account Grants

A potential funding source to design and implement this project is the Colorado Water Conservation Board's Water Supply Reserve Account Program. Grants or loans are provided to eligible Colorado water users to address critical water supply issues. Funding can be used towards technical assistance regarding permitting, feasibility studies and environmental compliance; studies or analysis of structural, nonstructural, consumptive and nonconsumptive water needs, projects or activities; and structural and nonstructural water projects or activities. Requests for funds must be approved by the Arkansas Basin Roundtable, and then further approved by the CWCB for final funding decisions. Funding from the Basin Account and Statewide funds may be applied for through the Basin Roundtable (see Appendix A).

The PWP can partner with the other local and state entities such as the PRWCD to apply for funding to design and implement this study and subsequent projects.

Chilili Ditch Diversion and Improvement Project (2.1.b)

The Chilili Ditch Diversion and Improvement Project is an example of a collaborative project that is potentially fundable through current State and regional programs. It would be a benefit for both consumptive and non-consumptive uses and would serve as an example to other agricultural water users in the Watershed. The seven-mile-long Chilili Ditch, which is in need of a variety of improvements along its entire length, has senior water rights that have not been fully utilized due to the lack of an effective instream diversion structure and the loss of water through porous ditches. One solution to the ditch headgate would be to install a fish-friendly, low-head diversion structure that would divert a full decree of irrigation water. This structure would control flows to the ditch at the point of diversion, allow for the accurate measurement of water into the ditch, and balance the quantity of water in the River, in turn maintaining fish habitat. Ditch lining would conserve water, irrigate lands that have not had water in many years, reduce selenium loading, and therefore improve the quality of water in the lower Purgatoire River.

The President and other members of the Chilili Ditch Company have expressed interest in participating in a project that can demonstrate new techniques that meet the needs of multiple stakeholders. The diversion site is located in a highly visible location near a bridge in the City of Trinidad and can be easily observed by the community. With local support this project can meet the requirements of the Arkansas Basin Roundtable for Water Supply Reserve Account funding. The PWP will organize and coordinate efforts for design, funding, construction and monitoring of the project. The organization could use this project as an opportunity to educate the community and demonstrate to other funding organizations successful solutions to complicated water resource problems for future projects.

Potential Funding Source

Colorado Water Conservation Board's Water Supply Reservoir Account Grants

A potential funding source to design and implement this project is the Colorado Water Conservation Board's Water Supply Reserve Account Program. (See *Assessment and Improvement of Existing Irrigation Diversions* and Appendix A for more information.)

Ditch Lining - Water Conservation Projects (2.1.c)

As stated in *Section 7.1 Water Quality* above, water conservation is one method available to efficiently utilize the limited water resources available in the Watershed. With agriculture being the primary use of water, the greatest gain could come from improved delivery and water application techniques. One technique that has potential multiple benefits could be ditch lining or piping. Piping projects could conserve water by reducing infiltration into the soil, transpiration by riparian vegetation and evaporation into the atmosphere. (See also *Ditch Lining for Selenium Reduction* in Section 7.1 above.)

Water Storage: Arkansas River Compact Water Storage Study (2.2.a)

Research findings from the City of Trinidad's Water Conservation Plan, completed in 2012, suggest that additional storage of municipal water is not an issue of concern within the Purgatoire basin. The City of Trinidad is the largest municipal water supplier, able to provide and treat more water than currently being demanded by the population. However, there is a chronic shortage of irrigation water and a need for additional storage facilities may or may not help. A study needs be to be performed to determine the feasibility of such a project and if it would meet the requirements of the Arkansas River Compact. It should be noted that Trinidad Reservoir has not filled since 1999 and additional storage may not help the problem of over-appropriation. Augmentation water storage may provide a solution however (see below).

Augmentation Water Storage (2.2.b)
Due to the over appropriation of consumable water (or water rights) and the recent drought, water shortages have been predicted for the future. Following the concerns and goals of the Arkansas Basin Roundtable Basin Implementation Plan (see Appendices G and A—Section 5.7), the Purgatoire Watershed Partnership needs to also address options for augmentation water storage. Augmenting water is the practice of replacing water into a stream when a well or other water resource can no longer provide sufficient water for agricultural or other uses. Through a permitting process, a water user can request the release of water from a reservoir to supplement a specific loss of water. Through its partnerships and by collaborating with other local agencies, such as the Purgatoire River Water Conservancy District, the PWP can analyze augmentation strategies and begin to coordinate and implement programs that will support water shortages throughout the Watershed.

Uses for Coalbed Methane Produced Water (2.3.a)
Due to water scarcity in the Purgatoire River, the PWP has highlighted the use of coalbed methane (CBM) produced water as topic for further investigation. There is a potential for the PWP to work with various stakeholder groups to utilize CBM water in beneficial ways.

Information provided by Pioneer Natural Resources, one of the leading CBM operations within the Raton Basin and Purgatoire watershed, has worked with landowners to provide water for agricultural livestock and ranching operations. These projects primarily make water available in tanks and ponds for livestock and wildlife watering. However, there are no confirmed cases of CBM water being applied to crop land or used as irrigation water within the Raton Basin. This is something that Pioneer has not encouraged. Ultimately, some produced water that is surface discharged from CBM operations in the Purgatoire drainage may mix with run-off and natural surface flow and reach the Purgatoire, in which case this "mixed" water is available for and could be used in irrigation under existing water rights. This would be the case for irrigators along the Purgatoire River. There are real-time monitoring stations along the Purgatoire to demonstrate that the water in those streams remains suitable for irrigation. Data is maintained by Norwest and Tetra-Tech (see Appendix A).

7.3 Forest, Shrubland and Grassland Management

Community Wildfire Protection Plans
Colorado watersheds, especially in areas that suffer from extreme drought, are susceptible to destruction posed by widespread forest fires. The Purgatoire River watershed's forested areas have been mismanaged for decades, and community concerns have unveiled both the need for sustainable forestry practices to be addressed when developing a watershed restoration plan. Healthy forests are a necessary component of a healthy watershed because forested areas are located at the head of the watershed and at its tributaries.
When forested areas are impacted upstream it directly affects downstream areas. There is an exorbitant cost associated with fighting large wildfires and the cleanup in the aftermath. A broad range of stakeholders in the Purgatoire watershed provide likely partners who can address different needs and challenges. Furthermore, the existent Wildfire Risk Assessment outlined in Section 5.2.1 is the first step of developing a Wildfire Protection Plan. The Assessment provides the foundation necessary in the development of future plans.

The creation of a Community Wildfire Protection Plan (CWPP) works to address wildland-urban interfaces (WUI) through solutions that are comprehensive and support the local community. CWPPs were authorized and defined in Title I of the Healthy Forests Restoration Act (HFRA). The HFRA emphasizes a community wildfire protection planning and localized definitions of the WUI boundary. Communities have the opportunity to develop fuel treatment priorities for non-federal and federal surrounding lands. Diverse local interests discuss public safety, natural resources and community sustainability concerns with solutions addressing defensible space, local firefighting capacity, and land management priorities.

Local fire authorities, CSFS representative, governments, federal land management agency representatives, and other non-government partners must be included in the CWPP process, in an effort to address values and risks while prioritizing fuel treatment projects specialized for the community. Plans developed by a county can be used as an umbrella for communities; though cannot be considered a substitute. Components of the Plan should include: A description of the WUI problem areas using a map and a narrative for the community; Information on the community's preparedness to respond to a wildland fire; A community risk analysis that considers, at a minimum, fuel hazards, risk of wildfire occurrence and community values to be protected both in the immediate vicinity and the surround zone where potential fire spread poses a realistic threat; Identification of fuels treatment priorities on the ground and methods of treatment; Ways to reduce structural ignitability; An implementation plan.

Guidelines for CWPP Plan Implementation

1. Establish a core group of local leaders with interest in and commitment to the development of a CWPP.
2. Engage federal and state land managers and enlist their technical assistance, support and participation
3. Contact and seek active involvement from diverse stakeholders that may have an interest in identifying where and how community protection activities occur
4. Create a working map of the community, including populated areas, land ownership, and vegetative conditions
5. Conduct a community risk assessment that looks at local wildfire response capability, fuel hazards, risks of wildfire occurrence, and homes, businesses and other community vales at risk
6. Identify fuels treatment priorities and methods of federal and non-federal land and describe ways that homeowners can reduce their own risks through Firewise building and landscaping. Note: No law requires that CWPP plans are completed for a community, though they are often a grant requirement, and are acknowledged by insurance companies as making communities safer.

Implement Stonewall Fire Protection District CWPP and Develop CWPP's for Other Communities (3.1.a)

The Stonewall Fire Protection District Community Wildfire Protection Plan (CWPP) was completed in November 2014 (see Appendix A). The Purgatoire Watershed Partnership partnered with the SFPD as well as the City of Trinidad, Las Animas County, the Colorado State Forest Service, area landowners and Land Owner Associations and other interested parties to complete the Plan. The Stonewall CWPP is a response to the Healthy Forests Restoration Act of 2003 (HFRA). This legislation established unprecedented incentives for communities to develop comprehensive wildfire protection plans in a collaborative, inclusive process. The legislation also directs the Departments of Interior and Agriculture to address local community priorities in fuels reduction treatments on both federal and non-federal lands. This is the first completed CWPP within the Purgatoire Watershed and therefore will serve as a template for future Community Wildfire Protection Plans done in the area.

Potential immediate partnerships for developing additional CWPP's include the Purgatoire River Volunteer Fire Department, formerly the Longs Canyon Volunteer Fire Department, and the Town of Branson.

Funding Source

Wildfire Risk Reduction Grant Program

The Wildfire Risk Reduction (WFRR) grant program was created under Senate Bill 13-269, and is being administer by the Colorado Department of Natural Resources (DNR) for projects that reduce the risk of fire specifically in areas where forested lands and human development overlap, known as a wildlands/urban interface (WUI). These projects reduce risk to infrastructure, property and water supply damage, in addition to limiting the spread of wildfire into highly populated areas. Groups being accepted for grant funding include local governments, utilities, community groups, non-profits, and state agencies, and all funds will be directed to non-federal lands within the state.

Applications must include identified plans to make use of woody materials removed from the project site and be able to contribute 100 percent matching funds, including in-kind resources for a 50-50 grant-to-match ratio. Proposed projects must be coordinated with county officials to ensure goals of the project align with those of county-level wildfire risk reduction plans. 25 percent of grant funds can be used to purchase equipment if it will increase current and future capacity for hazardous fuel reduction; therefore if equipment is needed it must be identified in the project plan and there must also be an explanation of how it will be used and maintained beyond the scope of the project. Budgets cannot exceed $2 million.

Grant Program Criteria

1. Grant Project Purpose
    - *a. Reduce Hazardous Fuels*
    - *b. Utilize Woody Material*
    - *c. Support Implementation Capacity through Purchase of Equipment (optional)*
2. County Level Coordination
3. Geography Relevant to USFS Lands (informational)
4. Partnerships with Youth Groups (informational)

Goals and objectives and priority projects identified within the Purgatoire Watershed align with those of the Wildfire Risk Reduction Grant (WFRR) Program (see Appendix A), and may be a funding source stakeholders can apply for to get forest health and wildfire reduction projects underway. Project proposals must be received by the DNR by July 13, 2013. This funding round will provide $5.8 million to grants.

Examples of projects being considered include:

- Creation of defensible space around homes and structures (based on CSFS guidelines)
- Construction of fuel breaks (based on CSFS guidelines)
- Fuels reduction beyond defensible space, designed to protect water supplies and/or reduce fire intensity

Economic Benefits of Wildfire Protection (3.2.a)

Use of Woody Materials

Woody materials from forests provide fuel that expands forest fires over greater areas, causing more destruction. It is necessary to remove this fuel to create defensible space and sustain overall forest health. A focus of the Wildfire Protection Plan must be to address areas where wood materials eradicated can be made into a greater use. Benefits of finding beneficial uses for woody materials include job creation through public-private partnerships and energy (biofuels) generated from the beetle-kill (biomass) removed.

Beetle-Kill Converted to Biofuel

On August 9, 2013 the U.S. Forest Service awarded $13.4 million to Confluence Energy in Kremmling and West Range Reclamation in Hotchkiss, both of which are Colorado based companies. The money awarded through stewardship contracts will go towards beetle-kill removal in the White River and Medicine Bow-Routt National Forests, treating about 20,000-acres of public land. This will further support biomass (renewable) energy sources by providing electricity and heat for Eagle Valley Clean Energy in Gypsum and wood pellets for clean and efficient heating at Confluence Energy in Kremmling.

$8.66 million was given to West Range Reclamation in Hotchkiss to remove trees from the White River National Forest susceptible to disease and insect infestations, including lodgepole pine, Douglas fir, subalpine fir, aspen, ponderosa pine, and Englemann spruce species. The company's has partnered with Eagle Valley Clean Energy to provide enough woody material to generate 11.5 megawatts of biomass-fuel to their power plant located in Gypsum, which began operations on December 16, 2013 so far employing 40 employees. The plant burns beetle-kill wood to heat water, which produces steam to power a turbine, that then generates electricity. The Gypsum power plant supplies Holy Cross Energy, which serves 8,000 to 10,000 homes (55,000 customers) in Eagle, Pitkin, Garfield, Mesa and Gunnison counties. In addition to trucking in forested wood (within a 75-mile radius), the plant is also relying on wood waste from the Eagle County Landfill. The remaining $4.75 million of this sustainability contract went to Confluence Energy to remove beetle-killed trees in the Medicine Bow- Routt National Forest.

The contracts are beneficial because they support ecological forest health while creating jobs in rural communities, helping the economy, reducing wildfire risks, protecting water supplies, and promoting human and habitat safety in WUI zones, all by riding the forests of the bark beetle epidemic.

There are some concerns in regards to the biomass plants. Specifically, Gypsum residents have voiced air quality concerns about the 250 tons of wood that will be burned daily. Additionally, the American Lung Association opposes biomass facilities because of their threat on air quality. Although, the CDPHE's Air Pollution Control Division issued a permit for the plant in November 2012 and smokestack filters are expected to remove all smoke with the exception of the equivalence of the smoke of one cigarette.

As Wildfire Plans commence, the PWP can learn from these other projects and be an integral part of project design and implementation for projects incorporating the use of woody materials, providing job opportunities and watershed health throughout the watershed.

Review and Develop as Necessary Rangeland, Shrubland & Grassland Management Plans (3.3.a)

In addition to land management related projects like Community Wildfire Protection Plans (above) and invasive species removal (below), the PWP has expressed concern in other land related projects, such as rangeland and grassland management.

Funding Sources

<u>Natural Resources Conservation Service's Environmental Quality Incentives Program</u>

The Environmental Quality Incentives Program (EQIP) (see Appendix A) provides technical and financial assistance to agricultural produces in order to address natural resource concerns and deliver environmental benefits such as improved water and air quality, conserved ground and surface water, reduced soil erosion and sedimentation or improved or created wildfire habitat. To be eligible applicants must control or own their own land; comply with adjusted gross income limitation provisions; be in compliance with the highly erodible land and wetland conservation requirements; and develop an NRCS EQIP plan of operations.

7.4 Invasive Species

Tackling Tamarisk on the Purgatoire and Russian-olive Removal (4.1.a)
The Tackling Tamarisk on the Purgatoire (TTP) Program promotes land stewardship by providing financial and technical assistance for woody invasive plant control to private agricultural produces and other land owners within the Purgatoire River Watershed.

TTP group information and work that's currently underway, which the PWP may be a partner to, is outlined below:

Mapping and Strategic Planning
Mapping of tamarisk and Russian-olive within the Purgatoire Watershed was completed in 2006. The mapping was funded by the Colorado Water Conservation Board and Purgatoire River Water Conservancy District, and was conducted by the Tamarisk Coalition. Mapping data provided TTP partners with the foundation for targeting control efforts and developing cost estimates for treatment. More accurate project level mapping is utilized as well for specific project sites and monitoring activities.

The TTP Strategic Plan was completed in 2008 and approved by the Colorado Department of Agriculture's State Weed Coordinator. The plan is based on a set of guiding principles that focus on ecological, social-cultural, economic, and research considerations.

Monitoring and Research
TTP partners understand the importance of project monitoring and research, and have partnered with several Universities. Currently, monitoring research and the development of user-friendly monitoring protocols are being conducted in the Purgatoire Watershed by a Denver University team led by Dr. Anna Sher. User-friendly monitoring protocols will be developed for use by private land owners and land managers. These protocols will include effectiveness of control, soil quality, and vegetation response. Funding for this research is being provided by the Colorado Water Conservation Board, The Nature Conservancy, the US Fish and Wildlife Service, and was recently awarded additional funding through the NRCS CIG grant program.

Colorado State University's College of Bioagricultural Sciences and Pest Management is also undergoing research on the mainstem of the Purgatoire focused on using fire as part of an integrated approach for controlling tamarisk. This research is being led by Dr. Scott Nissen, with funding provided by the NRCS CIG grant program.

Project Implementation
Approximately 1,411 acres have been treated within the Watershed since 2005. Annual monitoring and maintenance of project sites is an integral component of project implementation. The project map on page 2 provides an overview of treatment areas from 2005 through 2012.

- **Upper Reaches of Watershed, Trinidad Lake State Park:** ~214 acres have been treated on the Park since 2006.
- **Purgatoire Mainstem, NRCS EQIP Invasives program**: ~96 acres were treated on private lands along the Purgatoire River near the base of Trinidad Reservoir, and near the Town of Hoehne. This served as one of the first TTP demonstration projects.
- **Chacuaco drainage-largest tributary to the Purgatoire**: ~891 acres on private and State lands have been treated since 2008. The Chacuaco drainage is the largest tributary to the Purgatoire River and thus it has been a priority treatment area for TTP.
- **Purgatoire Mainstem, Trinidad River Walk**: ~80 acres were treated in 2010 and 2011 along the Trinidad River Walk, and approximately 69 acres in 2014. This stretch of the Purgatoire is heavily infested with Russian-olive.
- **Upper Purgatoire Mainstem and Tributaries:** ~130 acres have been treated in the upper reaches of the Watershed above the City of Trinidad since 2010.

Biocontrol
Project partners are also working with the CO Department of Agriculture's Insectary to establish tamarisk leaf beetles within the Watershed as part of an integrated management approach. Tamarisk leaf beetles have been released in the Watershed from 2009 through 2012. In 2012, 2013 and 2014 the leaf beetles showed good establishment in the Hoehne area. It is hoped that once populations are fully established, the leaf beetles will serve as the primary control mechanism for tamarisk.

Goals: (ecological, social, economic, etc.):

The purpose of TTP is to improve riparian lands and associated landscapes of the Purgatoire Watershed through the removal and control of the invasive plants tamarisk and Russian-olive. Desired outcomes include improvement of water resources; improvement of native riparian plant and wildlife communities; protection of communities from wildfire and flooding; enhancement of agricultural production; and improvement of hunting and recreational access and opportunities.

Noxious and Invasive Species Reduction and Control (4.1.b)
In 2004, Las Animas County proposed to complete a Weed Management Plan. The PWP can partner with Las Animas County and other groups such as the Tamarisk Coalition to leverage funds and further develop a Noxious Weed Management Plan for Las Animas County. State funding can be applied for through the CWCB Invasive Phreatophyte Control Program.

Funding Sources
<u>Colorado Water Conservation Board's Invasive Phreatophyte Control Program</u>
Grant funding through the Invasive Phreatophyte Control Program (see Appendix A) provides cost share assistants for eligible applicants to control and/or eradicate tamarisk (also known as salt cedar), Russian olive, or other woody riparian invasive phreatohpytes that have degraded Colorado's riparian areas, restricted channel capacity thereby increasing flood risk, and resulted in increased non-beneficial consumptive use of water. This is a completive grant program which requires that no single project and/or entity receive more than $100,000 per grant cycle. The Board reserves the right to negotiate with successful applicants to modify the scope and/or budget of their projects to better meet CWCB objectives and fund availability. Projects will be funded by the CWCB on a cost-share basis and funds may not exceed 50% of the total cost of each individual project.

Applicants must demonstrate a commitment to collaborative approaches that involve locally and/or regionally based diverse interests within the watershed in question, consideration was given to all interested persons in the watershed, there is a broad based involvement in and/or support for the grant application from relevant local, state, or federal governmental entities, and there is an ability to provide the appropriate in-kind or cash match for the activities proposed.

Research Aquatic Invasive Species Conditions and Mitigation Methods (4.2.a)
Trinidad Lake State Park, located within the Watershed, is under the regulation established in 2008 by the State Aquatic Nuisance Species Act. The Act defines aquatic nuisance species (ANS) as exotic or nonnative aquatic wildlife or any plant species that have been determined to pose a significant threat to the aquatic resources or water infrastructure of the State. Seven aquatic animals and eight aquatic plants are identified as an ANS threat in the Act. It makes it illegal to possess, import, export, ship, transport, release, plant, place or cause an ANS to be released. The Act allocated funding to ANS programs in Colorado Parks and Wildlife. It provides authority to qualified peace officers to inspect, and if necessary, decontaminate or quarantine watercraft for ANS. It also provides authority for trained authorized agents to inspect and decontaminate watercraft for ANS. The Purgatoire Watershed Partnership continuously looks for partnership opportunities with Colorado Parks and Wildlife for outreach and education in order to protect the Trinidad Lake State Park from aquatic invasive species.

7.5 Riparian and Other Watershed Ecosystems

Recreational access to the river is very limited in the Purgatoire Watershed. The Purgatoire and most of its tributaries flow primarily through private land. A study on potential additional recreational access to the river could be sponsored by the PWP, as well as projects to mitigate erosion that affects riparian habitats. Erosion is also addressed above in Section 7.1 Water Quality.

Purgatoire River Trout Habitat Projects (5.1.a)
In the summer of 2011, the Purgatoire River Anglers Trout Unlimited Chapter 100 contracted with Fin-Up Habitat Consultants, Inc. to complete an assessment of existing habitat conditions and a feasibility study for a cold water habitat improvement project on a segment of the Purgatoire River within the City of Trinidad, Colorado. Funding Sources included the Trout Unlimited Embrace-A-Stream grant and the Cheyenne Mountain Chapter of TU in Colorado Springs. The assessment results indicated that the severely low winter flows below Trinidad Dam are limiting the potential fishery in the Purgatoire River through the City. Although a self-sustaining population of trout may be difficult to establish in these conditions, there was an opportunity to create a seasonal "put and take" fishery within city limits that would enhance recreation and improve access to the river corridor.

An enhancement project of this nature does not address the limited flow issue, though it provides velocity, shelter and in-channel holding cover for stocked fish during higher flow periods. Such projects can provide seasonal fishing opportunities from April through October, as well as disperse recreational activities and address bank stability issues. From this assessment stemmed implementation projects, which were funded in part through the CWCB's Healthy Rivers Fund. Enhancements to the stream reaches were J-hook vane and boulder vane installation, boulder installation and re-vegetation. Stakeholder groups involved in the trout habitat project included the PWP, PRWCD, City of Trinidad, Purgatoire River Anglers Trout Unlimited Chapter, CPW, Trinidad Community Foundation and Pioneer Natural Resources, Inc. At the time of publication, Reaches 3 and 4 of the Purgatoire River have had trout habitat restored. Recently the City of Trinidad received CPW Fishing Is Fun funds to install trout habitat along Reaches 5 and 6 in the Boulevard Addition Nature Park. (See Appendix A for links to additional information.)

Research In-stream Flow Potentials (5.1.b)
The Purgatoire River's flow regime has been dramatically altered by the Trinidad Project dam and reservoir, which was constructed in 1971 and began operations in 1979. The river hydrology before the project was snow-melt driven, followed by high-intensity, short duration storm events in the summer monsoon season. The river pre-project experienced peak flows from snow melt from May to June and peaks in July and August from monsoon events. The typical base flow was from mid-September to early April. Now, reservoir operations have flattened the annual hydrograph, limiting the peak run-off flows and extending the period of higher than natural flows beginning earlier in the spring through the late summer into fall (irrigation season) below the dam. The only flow in the river downstream of the dam during non-irrigation months is from the Raton Creek and minimal intermittent tributaries.

Assess and Restore Degraded Riparian Areas (5.2.a)
The PWP has expressed interest in completing stream restoration projects on the South Purgatoire. There is already an existent partnership between the PWP and the Purgatoire River Anglers Trout Unlimited Chapter 100, and potential for stream restoration planning in the future. From past stream restoration project successes, it appears the Purgatoire River Water Conservancy District and Fin-Up consultants are also key potential project partners.

Funding Sources
<u>Colorado Water Conservation Board's Colorado Healthy Rivers Fund</u>
The Colorado Health Rivers Fund grant program is a funding option (see Appendix A – Section 7.1).

<u>Colorado Water Conservation Board's Water Supply Reservoir Account Grants</u>
Another potential funding source to design and implement this project is the Colorado Water Conservation Board's Water Supply Reserve Account Program (see Appendix A – Section 7.2).

<u>Colorado Water Conservation Board's Instream Flow Program</u>
The CWCB is responsible for the appropriation, acquisition, protection and monitoring of instream flow and natural lake level water rights to preserve and improve the natural environment to a reasonable degree. The water rights categorized as instream flow are nonconsumptive, in-channel or in-lake uses in natural lakes. These rights are administered within the state's water right priority system to preserve or improve the natural environment to a reasonable degree. Instream flow and natural lake level water rights protect diverse environments in Colorado. Since 1973 the Instream Flow Program (see Appendix A) has appropriated instream flow water rights on more than 1,500 stream segments and completed over 20 voluntary water acquisition transactions.

Through further discussion, the PWP can work with water rights holders, water providers and stakeholders to decide if the instream program is a potential option for keeping water in streams and aquatic habitats healthy.

City of Trinidad Trail and Greenway Master Plan (5.3.a)
In 2014 the City of Trinidad began developing a Trail and Greenway Master Plan that will identify potential land acquisition and trail development opportunities that surround the City. Expanding open space beyond city limits and planning a comprehensive trail system will create connectivity between the region's outdoor recreation sites, such as the River Walk and the Boulevard Addition Nature Park in Trinidad, the mesas to the west of Simpson's Rest, Trinidad Lake State Park, the Old Santa Fe Trail, Fishers Peak and the James M. John State Wildlife Area. Open space provides habitat for wildlife and creates more contiguous corridors for wildlife travel and migration. A plan of this magnitude can also function as a tool for identifying habitat areas that may need restoration or protection. The PWP has partnered with the City in order to broaden the educational reach of this project. PWP's goals with this partnership are to engage youth in outdoor recreation planning and pursuits and to foster stewardship of the environment. The mission of the Trail and Greenway Master Plan has the potential to have a positive effect on the Watershed.

Assess Lower Purgatoire River Fishery (5.4.a)
A review of the fishery in the Lower Purgatoire River should be completed in conjunction with additional data collection. The review should identify whether selenium sensitive species or endangered fish are present or if suitable habitat exists on

the Lower Purgatoire River. The presence or absence of such species will help determine the course of future actions including sample collection or mitigation measures.

7.6 Recreational Opportunities

Improve Recreational Access to River (6.1.a)
As mentioned previously, recreational access, especially pedestrian access, to the Purgatoire River is limited. Through partnerships the PWP can offer assistance with the planning and development of programs that will conscientiously provide residents and visitors alike with safe outdoor activities that interact with the River in meaningful ways. The PWP can utilize resources such as Colorado's Statewide Comprehensive Outdoor Recreation Plan (see Appendix A) in order to align its recreation goals and endeavors with State approved goals and standards.

Establish Trails in the Boulevard Addition Nature Park (6.2.a)
With Great Outdoors Colorado (GOCO) funding the City of Trinidad was able to purchase the remaining private land located in an area of town known as the Boulevard Addition. This land borders the Purgatoire River on both sides and boasts old-growth cottonwood trees. The newly-designated 95 acre urban—yet somewhat wild—park is proximate to the River Walk and surrounds the first segment of the future Old Sopris Trail (see Appendix A). The justification for including this park in the Plan is that it not only borders the River along Reaches 5 and 6 (mentioned above), but it also provides many opportunities for outdoor education, wildlife viewing, hiking and fishing. And not only does the Park need interpretive trails but Russian-olive mitigation as well. Again, this is another partnership between the City of Trinidad and the PWP that represents great potential.

7.7 Education and Outreach

The following Projects and Strategies, for both Goals 7 and 8, are addressed in the Education and Outreach Plan below:

- **Create and implement curriculum in schools within the Watershed around the Trinidad Water Festival (7.1.a)**
- **Website, social media, and news releases (7.2.a)**
- **Printed educational materials (7.2.b)**
- **Field tour of water infrastructure and watershed projects (7.3.a)**
- **Presentations at monthly meetings and public venues (7.4.a)**
- **Communicate and Work With Government, Non-Profits, Education and Conservation Groups, Industry, and Local and Regional Water Agencies (8.1.a)**
- **Expand Publicity, Membership and Participation (8.2.b)**

Education and Outreach Plan

Background Information
One of the intentions of this comprehensive watershed plan is to create an educational component that will be used to enhance public understanding of the Purgatoire Watershed Partnership and encourage early and continued public participation in selecting, designing, and implementing the NPS management measures indicated within the Plan. An outreach plan is important for designing ways to engage all stakeholders within the PWP. By identifying stakeholders and planning ways to engage them, the PWP can better build trust and support for process and outcomes, share the responsibility for decisions or actions, create solutions that will more likely be adopted, enable the creation of better, more cost-effective solutions, forge stronger working relationships, enhance communication and coordination of resources, and help to ensure that any environmental justice concerns are identified. This Education and Outreach Plan is designed to be used as a framework for each individual year of outreach and education planning. This is a living document with the intention of being updated with best practice measures for outreach and education as the PWP grows.

Goals
The health of the Purgatoire Watershed is dependent on stakeholder involvement in protecting water quality. The goal of the Education and Outreach Plan is to assist in reaching the overall goals of the Watershed Plan. Outreach and education are vital to the ability to attain the long term goals for the watershed as it assists with increased awareness and stewardship of the local

watershed. The PWP believes that increasing a sense of understanding and ownership of the Watershed is the best way to achieve improvement in its overall health.

All stakeholders must be engaged in this process in order to ultimately reach goals of changing behavior in order to protect and restore water quality. To build support for the PWP's efforts the PWP will focus on the building of partnerships between stakeholder groups through continual relationships with current active participants as well as a focus on continually broadening the audience that the PWP reaches. The PWP's outreach goal is to be a source of watershed-related information to the public as well as a resource for projects related to improving watershed health.

Outreach and Education Strategies

The Purgatoire Watershed Partnership intends to continue its ongoing practices for education and outreach as well as innovate and implement new ways of communicating watershed information to the various stakeholders within the Watershed. Currently, the PWP holds monthly board meetings which are open to members and the public. Monthly meetings focus on topics specific to watershed needs and concerns. Various speakers from different organizations including the Colorado Water Conservation Board, local conservation districts, Colorado Watershed Assembly, and the Purgatoire River Water Conservation District have spoken on topics ranging from climate change and drought to water rights law. It is a priority to continue having these meetings and bringing in diverse speakers to help educate and collaborate with the PWP.

In 2012 the Culebra Range Community Coalition (CRCC), an environmental stakeholder group within the Purgatoire Watershed, orchestrated the first educational community water event titled the Trinidad Water Festival. In 2013 a total of 1,500 students from kindergarten to twelfth grades attended. The PWP is currently involved in the annual Trinidad Water Festival and prioritizes participation as a pivotal way of demonstrating the importance of the PWP within the Watershed.

Monthly newsletters distributed by the PWP work to improve watershed awareness and keep current members and the public informed about watershed projects, as well as upcoming meetings and events. The PWP plans to keep distributing this newsletter with updated information by the first of the month. The information from the newsletter is also posted on the PWP website: www.purgatoirepartnership.org.

The PWP website is another strategy used to update the general public as well as allow interested stakeholders to learn more about the PWP. The website enables people to learn more about the Purgatoire Watershed, donate to the PWP, and initiate ways for stakeholders to become involved with the PWP. Further online communication goals include establishing a presence on the PWP Facebook Page and other forms of social media.

It is a goal of the PWP to work with schools within the Watershed to develop watershed and environmental education relating directly to the local watershed. The PWP intends to develop curriculum and creative ways of engaging students with the Watershed. This goal includes developing curriculum that can be used in collaboration with the Trinidad Water Festival, enabling students to learn about the Watershed before the Festival, and then receive further education after the Festival has occurred each year.

As part of curriculum development, the PWP intends to work with teachers on how to educate students on watershed related information and issues. The PWP is a small organization, and does not have the ability to individually instill curriculum at each school within the Watershed; therefore, proper workshops and information packages must be developed for teachers.

As part of the educational opportunities created by the PWP, the PWP intends to create the opportunity for students to go on field tours of watershed related facilities and areas. This may include but is not limited to: drinking water facilities, wastewater facilities, riparian zones, state parks, lakes, dams, water distribution facilities, and conveyance system facilities. Through this type of direct learning by any stakeholder group, the PWP enables a better understanding of the watershed.

The PWP is always expanding and improving upon its communication to stakeholder groups. As part of this, a goal is to expand and improve upon printed materials available for stakeholders to learn more about the Watershed. Printed materials may include brochures, flyers, handouts, interpretive signage, etc.

The PWP intends to use the media as a strategy of communication to stakeholders. Media includes newspaper, radio, and television both within and around the Watershed. For example, although the local Trinidad newspaper posts a monthly meeting notice for the PWP in its "The Fine Print" section, the PWP intends to submit press releases to local and regional radio stations, as well as to regional newspapers, in order to inform the watershed community about events and encourage participation in such activities as well as watershed health stewardship.

Target Audiences
Identifying and understanding stakeholders enables recruitment as part of the Education and Outreach Plan. A deeper understanding of stakeholders will enlighten opportunities for more partnerships, as well as create an understanding of what barriers might be faced in the implementation of the Plan. The key audiences within the Purgatoire Watershed Partnership are:

Landowners
The Purgatoire Watershed is comprised of a large percentage of private land. Therefore landowners and their practices have a significant impact on the health of the Watershed. Pollution, degradation, and overall watershed health can be a threat to both property and prosperity within the Watershed.

Farmers/Ranchers/Irrigators/Ditch Companies
Irrigation is an important consumptive use within the Purgatoire Watershed. Private farms and ranches make up a significant amount of the land within the Watershed. Irrigation ditches that support these lands are a concern for watershed health and must be managed in order to prevent watershed degradation.

Oil and Gas Companies
Within the Purgatoire Watershed there are many sites that are used for natural resource development. Both active and inactive sites exist. It is important to understand the best management practices in place which prevent potential impacts within the Watershed and work with operators to sustain watershed health.

BNSF
Trains carrying freight run through the Watershed every day. As a major landowner as well as potential source of contamination Burlington Northern-Santa Fe (BNSF) Railway plays an important role in making sure best management practices are implemented to prevent watershed contamination.

Environmental Groups
Environmental groups within the Watershed can serve as champions for the Purgatoire Watershed Partnership. These groups are already involved in work directly relating to the watershed and serve as important partners in maintaining and improving watershed health.

Recreational Users
Recreation is an important industry for both local citizens and the tourist industry. It is important to keep the Watershed healthy for this group, as well as recognize potential degradation from recreational activity.

Government
Government often serves as the decision makers within a watershed. It is important that these decision makers have a holistic understanding of community viewpoints, watershed science, and best management practices.

Community Members
People within the community engage with the Watershed in many different ways. From drinking water, to runoff, and the land itself, all components are important for a watershed to remain healthy. The PWP will focus on making the connection for local community members and their place and importance within the Watershed .

Youth
It is a goal of the PWP to focus on the youth within the watershed. Youth will be targeted through school curriculum and environmental education. By fostering a connection between students and their watershed at a young age, there can be more long term stewardship of the Watershed.

Partnerships and Collaboration
The Purgatoire Watershed Partnership works closely with organizations within the Watershed to promote watershed health and stewardship. Below are organizations and descriptions of these partnerships that specifically focus on education and outreach strategies within the Watershed.

Two local government conservation districts are a part of the Watershed, the **Branson-Trinchera Conservation District** (B-TCD) and the **Spanish Peaks-Purgatoire River Conservation District** (SP-PRCD). The Conservations Districts specifically identify education and outreach in their long range plans. Conservation Districts reach out to both students and the general public. For example, they conduct tours for the public and plan events for students, such as the Branson-

Trinchera Education Days in Kim and Branson and an annual poster contest for sixth graders in these communities. Conservation Districts offer information and services to landowners on many topics including but not limited to: noxious weeds, wildfire affects, surveying and conservation practices. PWP goals are a natural fit with the endeavors of both the Branson-Trinchera and Spanish Peaks-Purgatoire River Conservation Districts. The SP-PRCD already functions as the PWP's fiscal sponsor and donates office space in its building to the PWP. The PWP intends to collaborate more closely with both the B-TCD and SP-PRCD's annual educational events.

The **Natural Resource Conservation Service** (NRCS) is also a natural partnership for the PWP. The NRCS supports the Conservation Districts and maintains many other partnerships with local and regional agencies and non-governmental organizations (NGO's). The NRCS provides technical assistance to everyone. They go out on the ground and address natural resource concerns related to soil, water, air, plants and animals—both domestic and wildlife—for individuals. The NRCS also participates in the Water Festival and regularly utilizes its watershed "trailer" for teaching students in the region about their watershed. The breadth of the NRCS's educational efforts and services is extensive. This agency provides information and assistance to the PWP, serves on its board of directors and collaborates with the PWP to offer educational opportunities for the communities in the Watershed.

The PWP works closely with the **Culebra Range Community Coalition** (CRCC) and participates in a number of CRCC outreach efforts, including the Trinidad Water Festival, the Network Council and at the Trinidad Community Farmers Market. The CRCC also offers watershed-related educational opportunities, such as the Public Forum on Watershed Health and Protection, Forest Health Community Workshops and an Environmental Scholarship Program. CRCC programs cover the following topics: restoring forest health, reducing the risk of catastrophic wildfire, improving wildlife habitat, and promoting economic utilization of local forest products. Add scholarship.

The **Purgatoire River Anglers Trout Unlimited** (PRATU) **Chapter 100** has been instrumental in organizing River clean-ups, teaching youth about fly fishing and conservation, acquiring grant funding, and implementing river habitat restoration projects along the Purgatoire River in Trinidad. PRATU, a highly active and collaborative local Trout Unlimited chapter, also offers water-related programming at its monthly meetings which are open to the public.

Earth Mountain Education Farm (EMEF) is a small yet highly involved non-profit organization located in the upper Purgatoire River Watershed. EMEF promotes healthy living through on-site educational programs for youth groups, as well as for adults, and has provided programming at Trinidad High School and Trinidad State Junior College. EMEF participated in the establishment of the Trinidad Community Co-Op and the Trinidad Community Gardens and assists with these sites' on-going management. EMEF also runs a Community Supported Agriculture program and promotes best gardening and farming practices.

The **City of Trinidad Tree Board** also collaborates with the PWP and strives to educate the community on tree selection, tree planting and tree care, as well as water-wise gardening. Tree Board members consistently pursue professional education opportunities and are very active in the community and with conservation efforts. The Tree Board works closely with the Colorado State Forest Service foresters to improve the health of the community, the City's tree population and the Watershed itself.

The **Stonewall Fire Protection District** has collaborated with the PWP on managing healthy forests in the western watershed region. The PWP aided in the completion of the Stonewall Fire District Community Wildfire Protection Plan (CWPP) which includes educational components on wildfire risk, wildfire mitigation, and homeowner recommendations for reducing risk. Educational strategies included public meetings, printed material resources, and face-to-face conversations between firefighters and landowners. The PWP plans to use the completed CWPP from stonewall as an example for other fire districts within the watershed.

The PWP will focus on youth for education and outreach. As part of this, the PWP will partner with schools within the watershed to implement curriculum around watershed education. The overall goal is to have this curriculum tie into the **Trinidad Water Festival** to increase understanding and stewardship of the local watershed. By partnering with schools the PWP can reach a large audience within the watershed that can have a lasting impact on the watershed. The following is a list of PreK-12 schools within the watershed:

Table 7-2: Schools

School name	Grades	Address
Eckhart Elementary School	Prek-1	1021 PIERCE STREET, Trinidad, CO 81082
Fisher's Peak Elementary School	2-5	900 MOORE'S CANYON ROAD, Trinidad, CO 81082
Hoehne Junior High School	7-8	19851 COUNTY ROAD 79.1, Trinidad, CO 81082
Trinidad Middle School	6-8	614 PARK STREET, Trinidad, CO 81082
Hoehne High School	9-12	19851 COUNTY ROAD 79. 1, Trinidad, CO 81082
Trinidad High School	9-12	816 WEST STREET, Trinidad, CO 81082
Branson Elementary School	PreK-6	101 Saddlerock Dr, Branson, CO 81027
Branson High School	7-12	101 Saddlerock Dr, Branson, CO 81027
Primero Elementary School	Prek-6	20200 State Hwy 12 , Weston, CO 81091
Primero High School	7-12	20200 State Hwy 12 , Weston, CO 81091
Holy Trinity Academy	K-12	613 Prospect St, Trinidad, CO 81082
G.O.A.L. Academy Trinidad	9-12	105 Main Street, Trinidad, CO 81082
Las Animas Senior High School	9-12	300 Grove Ave, Las Animas, CO 81054
Las Animas Elementary School	PreK-5	530 Poplar Ave, Las Animas, CO 81054
Las Animas Junior High School	6-8	300 Grove Ave, Las Animas, CO 81054
La Junta Primary School	K-2	601 Topeka, La Junta, CO 81050
La Junta Intermediate School	3-6	901 Smithland Ave, La Junta, CO 81050
La Junta High School	7-12	1817 Smithland Ave, La Junta, CO 81050

Table 7-3 Overview of Education and Outreach Plan

Goals	Outreach Strategy	Target Audience
Public Meetings	Monthly board meetings open to the public	All stakeholders
Curriculum Development	Watershed curriculum for 5th grade throughout watershed	Youth
Trainings and workshops	Workshop for teachers: water curriculum	Youth
Demonstrations and Field Tours	Field trip to State parks Field trip to wastewater treatment plant Field trip to drinking water treatment plant	Youth Youth Youth
Special Events	Water Festival Table at Artocade Table at Farmers Market	Youth/Environmental groups Community members Community members
Website and Social Media	Maintain website Facebook page	Community members Youth/community members
Media Releases	Featured stories released to newspaper	Community members
Printed Materials	Create brochures on Watershed	All stakeholders
Newsletter	Monthly newsletter with updates and featured story	All stakeholders

Assessment
This Education and Outreach Plan is intended to serve as a guide for each yearly plan determined by the Purgatoire Watershed Partnership. This Plan outlines many potential options for engaging the public. However the PWP is not limited to only the previously outlined methods of outreach and education and is free to assess and see to the needs of the watershed at the current time. Within each year, it will be important to determine the effectiveness of the strategies and whether or not they are assisting the PWP in reaching its goals.

Periodic evaluation of implementation efforts will be determined by assessing whether each method is on track and being done in a timely manner, whether the project was successful in restoring , protecting, or maintaining water resources or quality, that funds were spent in an effective manner, and through quantifiable results such as participation numbers in events and member increase. Results of projects will be compared over time in order to evaluate each project's success.

7.8 Stakeholders

Participate in Arkansas Basin Implementation Plan Efforts (8.1.b)
The State of Colorado's *Water for the 21st Century Act* motivated the Arkansas Basin Roundtable to act on implementing projects and methods that would address the consumptive and nonconsumptive needs of the Arkansas Basin. The PWP has been participating in these efforts, which includes the planning of the Arkansas Basin Roundtable's Basin Implementation Plan. As a representative of many stakeholders in the Purgatoire River Watershed, and thus in the Arkansas Watershed, it behooves the PWP to continue to support, provide information to and collaborate with the Arkansas Basin Roundtable.

Apply for Grant Funding (8.2.a)
Bureau of Reclamation grant funds made the organization of the Purgatoire Watershed Partnership possible and grant funds will be necessary to keep the PWP functioning and to implement projects. Although the PWP would like to become fully sustainable without grant funds, today non-profits often need to supplement their financial support with donations and monies granted by foundations or grant programs sponsored by governmental agencies. Despite the highly competitive nature of grants a variety of programs exist that fund water, agriculture, conservation, mitigation and education projects that relate to watershed work. Until 2017 the PWP has received support for capacity building from the AmeriCorps VISTA program and grant funds will also be sought for maintaining a part-time or full-time coordinator. The PWP will continue to actively

pursue funding, whether for the PWP itself or for its partners, from a variety of resources in order to reach its goals for the Watershed.

Projects and Strategies Assessment

Implementing projects and strategies will require the application of best management practices, as well as assessment methodologies in order to determine whether, how and to what extent goals are being met. As projects are designed and planned, the Purgatoire Watershed Partnership will develop assessment methods specific to each project, ensure that appropriate standards are followed, and adapt projects as necessary once evaluation results are gathered.

Section 8 References

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Appendices

Appendix A: Resources

Appendix B: Level Four Potential Conservation Area (PCA) Report

Appendix C: Forest Inventory Analysis for the Culebra Range Community Coalition

Appendix D: Noxious Weed Management Plan for Las Animas County

Appendix E: Goals and Measurable Outcomes for the Arkansas Basin Roundtable, 2014

Appendix A: Resources

Section 2.4.5 Recreational Land Use

- Recreation
  - Trinidad Outdoor Club: http://trinidadoutdoorclub.com/
- Birds
  - Southeastern Colorado Bird List: http://www.exploresoutheastcolorado.com/docs/secolobirds.pdf
  - Southern Colorado Audubon Society: http://www.socobirds.org/
- Dinosaur Tracks
  - Picketwire Canyonlands: http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5409581.pdf and http://www.fs.usda.gov/psicc
  - Geological History of the Great Plains: http://library.ndsu.edu/exhibits/text/greatplains/text.html
- Fishing
  - Fishing Regulations: http://wildlife.state.co.us/RulesRegs/HuntFishRegulationsBrochures/Pages/RegulationsBrochures.aspx
  - Purgatoire River Anglers Trout Unlimited Chapter 100: http://pratu.org
- Hunting
  - Hunting Regulations: http://wildlife.state.co.us/RulesRegs/HuntFishRegulationsBrochures/Pages/RegulationsBrochures.aspx
- Mushrooming
  - Colorado Mycological Society: http://www.cmsweb.org/

Section 2.6.3 Fisheries

- State Designated Fisheries: http://ndismaps.nrel.colostate.edu/fishingatlas/

Section 2.6.5 Species of Concern

- Colorado Natural Heritage Program: http://www.cnhp.colostate.edu/

Section 2.9 Las Animas County Master Plan

- Las Animas County Master Plan: http://lasanimascounty.org/

Section 2.10 City of Trinidad Comprehensive Plan

- City of Trinidad Comprehensive Plan: http://trinidad.co.gov/shared/docs/2008%20Comprehensive%20Plan.pdf

Section 3.1.3 Groundwater

- Colorado Foundation for Water Education: http://www.yourwatercolorado.org/
- Colorado Geological Survey Ground Water Atlas of Colorado: http://coloradogeologicalsurvey.org/apps/wateratlas/downloads.html

Section 3.2 Rapid Watershed Assessment

- Rapid Watershed Assessment: http://www.co.nrcs.usda.gov/wps/portal/nrcs/detail/co/technical/?cid=nrcs144p2_062909

Section 5.1 Water Quality

- Oil and Gas Operations
  - Colorado Department of Public Health and the Environment (CDPHE):
    - http://www.chd.dphe.state.co.us/
    - http://www.chd.dphe.state.co.us/topics.aspx?q=Env_Health_Data

Section 5.3.1: Wildfire Risk Assessment

- Wildfire Risk Assessment in the Purgatoire River Watershed
  - *Colorado Wildfire Risk Assessment Summary Report: Purgatoire Watershed*: www.purgatoirepartnership.org

Section 5.7 Awareness and Knowledge of Watershed Issues

- Arkansas Basin Roundtable
  - Basin Implementation Plan: http://www.arkansasbasin.com/
    - http://cwcb.state.co.us/Pages/CWCBHome.aspx

Section 7.1 Water Quality

- Ditch Lining for Selenium Reduction
  - Colorado Nonpoint Source Program: www.npscolorado.com
- Targeted Sediment Studies and Sediment Control Efforts
  - Colorado Healthy Rivers Fund: http://cwcb.state.co.us/LoansGrants/colorado-healthy-rivers-fund-grants/Pages/main.aspx
- Source Water Protection Plan
  - Colorado Rural Water Association and other SWPP and SWAP resources:
    - CRWA: http://coloradoruralwater.sharepoint.com/Pages/SourceWaterProtection.aspx
    - EPA: http://water.epa.gov/infrastructure/drinkingwater/sourcewater/protection/index.cfm
    - CDPHE: https://www.colorado.gov/pacific/cdphe/source-water-assessment-and-protection-swap

Section 7.2 Water Quantity

- Assessment and Improvement of Existing Irrigation Diversions
  - CWCB Water Supply Reservoir Account Grants: http://cwcb.state.co.us/LoansGrants/water-supply-reserve-account-grants/Pages/main.aspx
- Uses for Coalbed Methane Produced Water
  - Norwest and Tetra-Tech Data: http://purgatoirewatershed.org/water.html

Section 7.3 Forests Shrubland and Grassland Management

- Complete Stonewall Fire Protection District CWPP and Develop CWPP's for Other Communities
  - SFPD CWPP: http://www.stonewallfire.us/communitywildfireprotectionplan.html
  - Wildfire Risk Reduction Grant (WFRR) Program: http://www.coemergency.com/2014/01/wildfire-risk-reduction-grant-program.html
- Review and Develop as Necessary Rangeland, Shrubland & Grassland Management Plans
  - NRCS Environmental Quality Incentives Program (EQIP): http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/programs/financial/eqip/?cid=nrcs141p2_022777

Section 7.4 Invasive Species

- Tackling Tamarisk on the Purgatoire and Russian-olive Removal
  - CWCB Invasive Phreatophyte Control Program: http://cwcb.state.co.us/LoansGrants/Documents/IPCP_guidance_October_2013.pdf

Section 7.5 Riparian and Other Watershed Ecosystems

- Purgatoire River Trout Habitat Projects
  - Purgatoire River Anglers Trout Unlimited Chapter 100: http://pratu.org/
  - Trout Unlimited Embrace-A-Stream Program: http://www.coloradotu.org/2012/10/now-is-the-time-to-embrace-a-stream/
  - CWP Fishing Is Fun Program: http://cpw.state.co.us/aboutus/Pages/FishingIsFunProgram.aspx
- Assess and Restore Degraded Riparian Areas
  - CWCB Instream Flow Program: http://cwcb.state.co.us/environment/instream-flow-program/Pages/main.aspx

Section 7.6 Recreational Opportunities

- Improve Recreational Access to the River
  - Statewide Comprehensive Outdoor Recreation Plan: http://cpw.state.co.us/aboutus/Pages/SCORP.aspx
- Establish Trails in the Boulevard Addition Nature Park
  - Old Sopris Trail: http://trinidad.co.gov/pages/planning/Old%20Sopris%20Trail%20Plan.html

Appendix B: Level Four Potential Conservation Area (PCA) Report

Level 4 Potential Conservation Area (PCA) Report

Name Purgatoire River and Tributaries **Site Code** S.USCOHP*27134

IDENTIFIERS

Site ID 2484 **Site Class** PCA

Site Alias Withers Canyon

Network of Conservation Areas (NCA)

NCA Site ID	NCA Site Code	NCA Site Name
-		No Data

Site Relations Contained in Purgatoire Canyon (S.USCOHP*1289). Overlaps Big Spring and Big Arroyo Hills (S.USCOHP8*3282), Bruno Canyon (S.USCOHP*28135), Cedar Hill Flats (S.USCOHP*26874), Chacuaco Rimrock (S.USCOHP*27094), Comanche Grassland (S.USCOHP*25491), Dinosaur Track Greasewood Flat (S.USCOHP5*174), Luning Promontory (S.USCOHP*27118), Perly Uplands (S.USCOHP*27120), Purgatoire Mesas (S.USRWO1*1279), Purgatoire Prairie (S.USCOHP*25152), Southern Purgatoire (S.USCOHP*25151), and Vogel Canyon (S.USCOHP*3894). Shares a boundary and contains Lower Taylor Arroyo (S.USCOHP*27154).

LOCATORS

Nation United States **Latitude** 372346N

State Colorado **Longitude** 1033940W

Quad Code	Quad Name
37104-A1	Trinchera
37103-D8	Rock Crossing
37103-D7	Doss Canyon North
37103-D6	Johnson Canyon
37103-D5	Plum Canyon
37103-E7	Stage Canyon
37103-E6	O V Mesa
37103-E5	Beaty Canyon
37104-C1	Lambing Spring
37103-C8	Painted Canyon
37103-C7	Doss Canyon South
37103-C6	Humbar Spring
37103-C5	Villegreen
37104-B2	Patterson Crossing
37104-B1	Trinchera Cave
37103-B8	Trementina Canyon
37103-B7	Box Ranch
37103-B6	Miners Peak
37103-B5	Tobe
37103-F7	Sheep Canyon
37103-F6	Packers Gap
37103-F5	Riley Canyon

County

Las Animas (CO)

Otero (CO)

Watershed Code	Watershed Name
11020010	Purgatoire

SITE DESCRIPTION

Minimum Elevation	4,345.00	**Feet**	1,324.36	**Meters**
Maximum Elevation	6,380.00	**Feet**	1,944.62	**Meters**

Site Description

The Purgatoire River and Tributaries site includes the Purgatoire Canyon and the side canyons of its tributaries. The canyon system is extensive and the views into the network of red sandstone canyons are often magnificent. Rising from the canyon floor to the top of the surrounding plateaus are river terraces of various size and steep rocky canyon walls and cliff faces. Within this setting are a series of mesas and inter-fluvial plateaus ranging from small to large. Numerous narrow side canyons dissect the mesas and plateaus and extend out away from the main canyons. While the main valley of the Purgatoire and Chacuaco rivers have long been used for human habitation, and now contain a number of non-native species, the deep side canyons are more inaccessible and typically contain communities of mostly native vegetation. The bottoms of the smaller side canyons often consist of exposed sandstone bedrock that support seasonally flooded pools which house numerous populations of the plains leopard frog. Surrounding the pools are open juniper woodlands with an abundance of bedrock and bare ground, cactus, yucca, and various native grasses. The exposed bedrock on the canyon floor, steep canyon sides, and cliffs provides extensive habitat for the rare ferns. The site contains numerous populations, both documented and un documented, of the state-rare ferns, plains leopard frogs, flathead chub, suckermouth minnow, and black-necked gartersnake.

Key Environmental Factors

The natural structure of the exposed bedrock and boulder fields, and the relative lack of non-native species within the smaller side canyons are the key environmental factors sustaining the populations of rare ferns. Although some non-native weedy species can be found in the side canyons, they are not widespread or prevalent. The dry rocky habitat and narrow recessed canyons create extensive habitat for the multiple fern species. The main environmental factor sustaining the plains leopard frog and fish populations is the natural flows of surface and ground waters. These flows are fairly intact, although there are some developed cattle ponds at the head of some canyons within the area and there are, scattered throughout the area, cattle tanks that are pumping ground water for livestock use. However, the canyon pools are still receiving substantial amounts of water, but during periods of drought water use might influence viability of the plains leopards frogs at this location.

Climate Description

The climate is semi-arid with precipitation averaging about 14 inches per year. About half of the yearly precipitation is received during the months of May through August. Winter average minimum temperatures are in the range of 16-20 °F, and summer average maximum temperatures in July and August are near or above 90 °F (HPRCC 2008).

Land Use History

Much of the following information regarding land use history is from Friedman 1985. The area of the Purgatoire Canyon is believed to have been inhabited by people for as long as 5,000 years, and many native tribes lived in or visited the area. The first people of European descent to enter the area were with the Coronado expedition of 1540. Although considered part of Spain, the area remained sparsely populated by Euro-Americans until about 1821 when Mexico received independence from Spain and trade began between Santa Fe and Missouri. Soon thereafter, Spanish émigrés began to colonize the larger canyons. They built small settlements and ranches and raised herds of goats and sheep. The Purgatoire Canyon itself became an alternate trade route, and European settlement increased to a peak of about 400 people in the canyon by the late 1880s. Cattle and sheep ranching dominated the area until around 1909 when dry-land-farming homesteaders fenced the land. In the 1920s and 1930s, the Purgatoire Canyon area was affected by the Dust Bowl and many abandoned their homes, leaving the area to sheep and cattle ranchers. While sheep grazing was mostly discontinued in the 1950s, cattle grazing continued on most private lands. The creation of the Department of the Army's Pinon Canyon Maneuver Site in the 1980s removed grazing from that site, however, cattle grazing continues as the primary land use on adjacent private lands.

Cultural Features

There are numerous archaeological and paleontological sites.

SITE DESIGN

Site Map P - Partial **Mapped Date** 01/25/2010

Designer Sovell, J.R. and J.E. Stevens

Boundary Justification

The site was designed to contain the canyons of the Purgatoire and Chacuaco Rivers and the canyons of their tributaries. It uses a buffer of 300m on each side of the canyon to ensure inclusion of the channel, the canyon bottoms, and the canyon walls. The buffer is intended to protect the physical structure of the canyons that the population of rare ferns depend on, as well as the surface and groundwater flows that the population of plains leopard frogs are dependent upon. Protection of the rivers and their flows is necessary for sustaining the state rare fishes.

Level 4 Potential Conservation Area (PCA) Report

Name Purgatoire River and Tributaries **Site Code** S.USCOHP*27134

Primary Area 103,527.43 **Acres** 41,896.23 **Hectares**

SITE SIGNIFICANCE

Biodiversity Significance Rank B3: High Biodiversity Significance

Biodiversity Significance Comments

The biodiversity rank is based on a good (B-ranked) occurrence of the globally vulnerable (G3/S3) Fendler cloak-fern (*Argyrochosma fendleri*). Multiple occurrences of state rare plants also inhabit the site. These include excellent (A-ranked), good (B-ranked) and fair (C-ranked) occurrences of the state rare (G5/S1) ebony spleenwort (*Asplenium platyneuron*), good (B-ranked) occurrences of the state rare (G5/S1) black-stemmed spleenwort (*Asplenium resiliens*), excellent (A-ranked) and good (B-ranked) occurrences of the state rare (G5?/S2) Eaton's lip fern (*Cheilanthes eatonii*), a good (B-ranked) occurrence of the state rare (G5/S2) southern maiden-hair (*Adiantum capillus-veneris*), a fair (C-ranked) occurrence of the state rare (G4/S1) Standley's cloak fern (*Cheilanthes standleyi*) and a fair (C-ranked) occurrence of the state rare (G5T4?/S2) smooth cliff-brake (*Pellaea suksdorfiana*). In addition, the site supports occurrences of aquatic dependent animals. These include multiple good (B-ranked) to fair (C-ranked) occurrences of the state vulnerable (G5/S3) plains leopard frog (*Lithobates blairi*), an occurrence of the state rare (G5/S2) suckermouth minnow (*Phenacobius mirabilis*) and occurrences of the state vulnerable (G5/S3) flathead chub (*Platygobio gracilis*), which is listed as a species of special concern by the State of Colorado.

Other Values Rank V2 - High values

Other Values Comments

There are many archeological and paleontological sites within the boundary.

LAND MANAGMENT ISSUES

Land Use Comments

The area was historically grazed, especially by cattle, but some sheep grazing also occurred. Some of the side canyons are inaccessible to cattle grazing and disturbance, as seen in the quality of the natural communities in these areas.

Natural Hazard Comments

The juniper uplands include steep slopes and cliffs and safety should be considered when hiking within these areas.

Exotics Comments

The introduction of exotic animals (e.g., fishes, bullfrogs) should be prohibited to prevent exposing the frog population to unnatural levels of predation and competition.

Offsite

No Data

Information Needs

There is a need to understand the historical hydrological regime. The long term effects of water regulation and diversion directly pertain to the viability of the plains leopard frogs.

ASSOCIATED ELEMENTS OF BIODIVERSITY

Element State ID	State Scientific Name	State Common Name	Global Rank	State Rank	Driving Site Rank
17514	*Cheilanthes wootonii*	Wooton's lip fern	G5	S1	No
17514	*Cheilanthes wootonii*	Wooton's lip fern	G5	S1	No
17514	*Cheilanthes wootonii*	Wooton's lip fern	G5	S1	No
17626	*Epipactis gigantea*	helleborine	G4	S1S2	No
20405	*Asplenium platyneuron*	ebony spleenwort	G5	S1	No
20405	*Asplenium platyneuron*	ebony spleenwort	G5	S1	No
20405	*Asplenium platyneuron*	ebony spleenwort	G5	S1	No
20405	*Asplenium platyneuron*	ebony spleenwort	G5	S1	No
20405	*Asplenium platyneuron*	ebony spleenwort	G5	S1	No
20405	*Asplenium platyneuron*	ebony spleenwort	G5	S1	No
20405	*Asplenium platyneuron*	ebony spleenwort	G5	S1	No
20884	*Cheilanthes standleyi*	Standley's cloak fern	G4	S1	No
21047	*Cheilanthes eatonii*	Eaton's lip fern	G5?	S1S2	No

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21047	*Cheilanthes eatonii*	Eaton's lip fern	G5?	S1S2	No
21047	*Cheilanthes eatonii*	Eaton's lip fern	G5?	S1S2	No
21047	*Cheilanthes eatonii*	Eaton's lip fern	G5?	S1S2	No
21047	*Cheilanthes eatonii*	Eaton's lip fern	G5?	S1S2	No
21393	*Asplenium resiliens*	black-stemmed spleenwort	G5	S1	No
21393	*Asplenium resiliens*	black-stemmed spleenwort	G5	S1	No
21393	*Asplenium resiliens*	black-stemmed spleenwort	G5	S1	No
21444	*Phenacobius mirabilis*	Suckermouth Minnow	G5	S2	No
21444	*Phenacobius mirabilis*	Suckermouth Minnow	G5	S2	No
21564	*Asplenium trichomanes-ramosum*	green spleenwort	G4	S1	No
21637	*Lithobates blairi*	Plains Leopard Frog	G5	S3	No
21637	*Lithobates blairi*	Plains Leopard Frog	G5	S3	No
21637	*Lithobates blairi*	Plains Leopard Frog	G5	S3	No
21637	*Lithobates blairi*	Plains Leopard Frog	G5	S3	No
21637	*Lithobates blairi*	Plains Leopard Frog	G5	S3	No
21637	*Lithobates blairi*	Plains Leopard Frog	G5	S3	No
21637	*Lithobates blairi*	Plains Leopard Frog	G5	S3	No
21637	*Lithobates blairi*	Plains Leopard Frog	G5	S3	No
21637	*Lithobates blairi*	Plains Leopard Frog	G5	S3	No
21637	*Lithobates blairi*	Plains Leopard Frog	G5	S3	No
21637	*Lithobates blairi*	Plains Leopard Frog	G5	S3	No
21939	*Pellaea glabella* ssp. *simplex*	smooth cliff-brake	G5T4?	S2	No
22485	*Platygobio gracilis*	Flathead Chub	G5	S3	No
22485	*Platygobio gracilis*	Flathead Chub	G5	S3	No
22485	*Platygobio gracilis*	Flathead Chub	G5	S3	No
22485	*Platygobio gracilis*	Flathead Chub	G5	S3	No
23491	*Adiantum capillus-veneris*	southern maiden-hair	G5	S2	No
24246	*Argyrochosma fendleri*	Fendler cloak-fern	G3	S3	Yes
24856	*Juniperus scopulorum / Cercocarpus montanus* Woodland	Foothills Pinyon-Juniper Woodlands/Scarp Woodlands	G2	S2	No
44140	*Populus deltoides* ssp. *wislizeni* / Disturbed Understory Woodland		GNR	SNR	No

REFERENCES

Reference ID	Full Citation
195120	Friedman, Paul D. 1985. Final Report of History and Oral History Studies of the Fort Carson Pinon Canyon Maneuver Area, Las Animas, Colorado. USDI. National Park Service, Interagency Archaeological Services Branch, Rocky Mountain Regional Office, Denver, CO.
195121	HPRCC. 2008. High Plains Regional Climate Center Web Page. Based on data from automated weather stations operated by Colorado for southeastern Colorado area. High Plains Regional Climate Center Web Page: <http://www.hprcc.unl.edu>
195097	Stevens, J., J. Sovell, D. Culver, K. Decker, L. Grunau, A. Lavender, and C. Gaughan. 2008. Final Report: Southeastern Colorado Survey of Critical Biological Resources 2007. Colorado Natural Heritage Program, Fort Collins, CO.

ADDITIONAL TOPICS

Additional Topics

Original site design by Sovell, J.R. and J.E. Stevens. 2008-02-08.

VERSION

Version Date 01/28/2010

Version Author Sovell, J.R. and J.E. Stevens

DISCLAIMER

Level 4 Potential Conservation Area (PCA) Report

Name Purgatoire River and Tributaries **Site Code** S.USCOHP*27134

Appendix C: Forest Inventory Analysis for the Culebra Range Community Coalition

Forest Inventory Analysis For The Culebra Range Community Coalition

Date: October 2005

Introduction: The Culebra Range Community Coalition (CRCC) is a collaborative organization of private landowners, local businesses and natural resource professionals dedicated to improving and maintaining the forest and watershed health of the headwaters of the Purgatorie, Apishapa and Cucharas River watersheds. Because of a lack of resource data, the CRCC applied for grants to conduct a forest inventory. In the summer of 2005, utilizing funding from grants received from the Colorado Forest Service and Habitat Partnership Program combined with CRCC cost-share funds and donated time from the Colorado Division of Wildlife, Stonewall Fire Department, Colorado Forest Service, and Vermejo Park Ranch, a forest inventory was completed.

Location: The inventory area is commercial forestland west of I-25 in Las Animas County and a small portion in Costilla County. The area is in a significant portion of the headwaters for the Purgatoire River Watershed, along with parts of the Apishapa and Canadian River watersheds.

Objective of Inventory: To collect data on forest vegetation within the designated region of private and state land to evaluate the risk of catastrophic wildfire, assess forest health and estimate the volume distribution by species and diameter class.

Report Description: This report defines general characteristics and associations found during the forest inventory. After describing the inventory design, procedure and general results, inventory data is summarized by forest type. Descriptions include information on stocking levels, fire behavior fuel models, 10-year radial growth, insect, disease and animal damage, and invasive/exotic plant species.

Computer assisted data analysis provided more detailed information regarding volumes and diameter distribution by species. The complexities of wildfire hazard and fire regime will be analyzed by the Nature Conservancy using inventory crown cover and canopy base height measurements combined with fuel model data and tree measurements.

Acreage: ArcView GIS 9.0 and Spatial Analyst were used to determine the acreage in commercial timber types on slopes of less than 40 percent. Based on this analysis, total sampled acreage within the study area is 219,636 acres.

Inventory Design and Point Location: Potential inventory point locations were laid out on the Division of Wildlife Basinwide Vegetation map using an unbiased, systematic sampling design utilizing a 2,000-meter square grid, supplemented by intermediate points on a 2000-meter (north-south) by 3,000-meter (east-west) grid over the study area. Grid intersections falling on mapped commercial timber types (ponderosa pine, Douglas-fir, spruce/fir, and aspen) on slopes less than 40 percent, were selected as sample points, pending landowner access approval.

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Calls were made by CRCC member volunteers to landowners who had potential points on their land. The volunteers described the project and asked for permission for the field forester to access their property and collect inventory data. Landowners provided varying amounts of interaction and information. Some preferred to meet with and accompany the field forester, sometimes providing an ATV or other vehicular transportation assistance. Others said to go ahead and collect the data anytime. Gate combinations, keys and other access information were provided. Some landowners asked the forester to call nearing the time of the inventory to schedule a meeting time or for informational purposes. Points were dropped from the inventory when landowners declined participation in the project, when no recent landowner information was readily available or when landowners were not reachable.

Rachel Wood, certified forester with SEC, Inc. (Southwestern Environmental Consultants) performed the majority of field examination. Vermejo Park Ranch forestry staff examined their forestland using identical criteria and contributed that data to the project.

Field Procedure: A Garmin GPS V was used to locate the point center in the field based on the NAD-27 coordinate system. Point center was identified when the GPS first read zero feet to the programmed destination. USGS topographic maps were used to assist with navigation in the field. A 1-foot piece of rebar was driven into the ground at plot center. At early points, the rebar was left with a few inches sticking above the ground. Later, the rebar was pounded down to ground level and two or more rocks were piled on the stake.

A point consists of three nested plots; two fixed radius plots and one variable radius plot. Point data was recorded on a Stand Examination Cover Card and Plot Card. On the Cover Card basic information such as the project name, exam date, examiner, plot number and GPS coordinates were entered along with the map timber type, actual timber type, percent slope, aspect, seral stage, basal area factor and size of the smaller sapling/seeding fixed plot. Also recorded is information gathered from the larger of the two fixed plots that has a 26.3 foot radius. On the 26.3 foot radius plot, insect/disease/animal damage, tree canopy cover, canopy base height, vegetation canopy cover (of tree, shrub and grass/forb layers), surface fuel model major disturbances, invasive plants, erosion, snag measurements, and digital photograph numbers taken of the four cardinal directions are recorded.

The smaller fixed plot is either 11.8 feet in radius (1/100th acre) for ponderosa pine vegetation map types or 6.8 feet (1/300th acre) for all other vegetation map types. Recorded were size and number of seedlings and saplings under 4.5 inches in diameter at breast height (dbh) for commercial species or diameter at root collar (drc) for noncommercial species.

The variable radius plot used a 10 basal area factor for ponderosa pine map types and a 20 basal area factor for all other vegetation map types (Douglas-fir, spruce/fir and aspen). Precise tree measurements were collected on the variable radius plot and include species, dbh for commercial species or drc for noncommercial species, total height, number of eight foot bolts, total defect, damage or cause of death, mistletoe rating and radial increment. Radial increment measures tree growth in the last ten years at dbh from an increment boring sample. Basal area* is determined by multiplying the number of trees on the variable radius plot by the basal area factor used in selecting trees to measure. A 14-page field procedure manual was developed and provides detailed inventory instructions (copy attached).

**Basal area is: a) the cross-sectional area (in square feet) of a tree trunk at breast height (4.5 feet above the ground). For example, the basal area of a tree that measures 13.5 inches*

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in diameter at breast height is about 1 square foot. (b) the sum basal areas of the individual trees within 1 acre of forest.

For the inventory, standardized surface fire behavior fuel models as described by Anderson (1982), also known as the National Forest Fire Laboratory (NFFL) fuel model classifications are used. The fuel models are classified into four groups which include grass (models 1,2 and 3), shrubs (models 4,5,6 and 7), timber (models 8,9 and 10) and logging slash (models 11,12 and 13). Each model represents the surface fuels in which a fire is most likely to burn and the corresponding fire severity associated with the fuels during the severe period of the fire season. For the purposes of this brief report, only the fuel model is described and a few correlations made from field observations.

General Inventory Results: The total number of points inventoried was 191. Of these points, 138 were mapped prior to field exam as ponderosa pine forest and 50 were Douglas-fir, spruce/fir and 3 aspen. For the most part, the mapped forest types matched the actual forest types. However, nineteen of the ponderosa pine map types were actually pinyon-juniper woodland on the ground and two points were Gambel oak. Recent fires killed all trees on 9 points in the southwest portion of the study area (Spring Fire).

Most areas had zero to light erosion ratings. Medium to high erosion rates were seen on a few areas where roads were recently built and/or where there were recent harvests. Many roads have been and are being built for gas well development.

Inventory Results by Forest Type

Pinyon-Juniper and Oak Woodland – 219,427 acres

These vegetative types are considered noncommercial because based on current markets, they have no commercial value. This vegetation type was not a part of the forest inventory. However, where the twenty-one sample points fell within these types, either as the result of mistyping or as inclusions, data was collected as a ponderosa pine point because there was no way to accurately determine the acreage to be deducted from the ponderosa pine vegetative type. Because of the large acreage in the pinyon-juniper type, it would be an important source of biomass for future industries.

Ponderosa Pine Vegetation Type – 144,779 acres

This type ranged from pure stands of ponderosa pine with high stocking levels to lower stocked ponderosa pine with various amounts of oak, juniper species and pinyon pine. Stocking levels ranged from 0 to 200 square feet of basal area per acre averaging approximately 70. For site conditions generally found in the study area, a basal area of 40 to 50 would be more desirable. Another way to present the data is trees per acre. Table 1 shows the stocking in trees per acre by species and diameter class. An examination of the data reveals a second-growth forest that is over-stocked with smaller diameter classes. This over-stocked condition results in slower growth due to competition between trees for water, increasing their susceptibility to insects, disease and wildfire

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Table 1. Ponderosa Pine Vegetative Type

STAND TABLE (Trees/Acre)

	Sawtimber (10" + dbh)														
	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Total
Ponderosa															
Yellow Pine	-	0.1	-	0.2	0.1	0.1	0.2	-	-	0.1	0.2	-	0.1	-	1.1
Blackjack	9.8	8.6	4.3	3.5	1.9	2.1	0.8	0.4	0.2	0.1	0.2	-	-	-	31.9
Douglas-fir	2.1	1.8	0.9	0.7	0.7	0.2	0.5	0.1	-	-	-	-	-	0.1	7.1
White Fir	0.5	0.5	0.3	0.2	0.1	0.1	-	-	-	-	-	-	-	-	1.7
Limber Pine	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	0.1
Aspen	0.1	-	-	-	-	-	0.1	-		-	-	-	-	-	0.2
Juniper	0.4	0.9	0.9	0.4	0.4	0.6	0.3	0.5	0.2	-	-	-	-	-	4.6
Pinyon	1.5	0.5	0.6	0.2	0.3	0.1	0.2	-	-	-	-	-	-	-	3.4
TOTAL	14.5	12.4	7	5.2	3.5	3.2	2.1	1	0.4	0.2	0.4	-	0.1	0.1	50.1

Roundwood (5-9" dbh)						
	5	6	7	8	9	Total
Ponderosa Pine	10.1	13.7	8.9	9.1	9.5	51.3
Douglas-fir	3.2	2.6	3.5	2.7	3.3	15.3
White Fir	0.5	1.1	0.8	1.7	0.8	4.9
Aspen	1.6	1.1	0.5	0.6	0.2	4
Juniper	2.1	3.7	5.2	2.3	2	15.3
Pinyon	4.8	3	2.4	2.1	1.3	13.6
TOTAL	22.3	25.2	21.3	18.5	17.1	104.4

Saplings (1-4" dbh)	
Ponderosa Pine	33
Douglas-fir	28
White Fir	6
Juniper	8
Pinyon	12
TOTAL	87

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Wildfire hazard increases with overstocking and because of reduced tree vigor, insect and disease activity increases resulting in increased mortality. Canopy base height was low due to the presence of smaller trees of oak, pinyon, juniper and shade-tolerant fir saplings that have branches close to the ground that could carry a ground fire into the ponderosa pine crowns. Ponderosa pine types were most often classified as surface fire behavior model 8 or 9. At low fuel moisture and light wind speeds, rate of fire spread is 1.6 to 7.5 chains per hour with flame length of 1.0 to 2.6 feet. When a shrub layer of oak, and smaller pinyon and juniper existed, the point was classified as a surface fire behavior model 6. This model has a rate of fire spread of 32 chains per hour with a flame length of 6 feet.

Ten-year radial diameter growth at dbh in ponderosa pines averaged 9/20ths of an inch with a range of 4/20ths to 31/20ths with an average of just less than one inch of growth in diameter in ten years. On most trees, the previous 3 years growth was very slow due to drought conditions.

A few areas had drought related mortality of several ponderosa pine trees. Active bark beetle infestations were at three points and seen elsewhere occasionally.

Ten points had low to moderate dwarf mistletoe infections on ponderosa pine. Mistletoe was seen at other times while traversing to a point or near a point. Patches of dwarf mistletoe infection appear throughout the inventory area.

Many ponderosa pines had crooks and forks at 6 to 20 feet that decrease the amount of marketable wood products. These defects are primarily the result of porcupines eating the inner bark and partially girdling the trees.

Douglas-fir Vegetation Type – 18,427 acres

This type primarily consists of Douglas-fir and white fir together with limber pine and aspen. Points in this type averaged 110 square feet of basal area per acre with a range of 30 to 160. Radial growth averaged almost 10/20ths or close to one inch of growth in diameter at breast height in ten years.

Canopy base height is very low due to more downed woody debris, lower limbs and shade tolerant seedlings that can act as ladder fuels. The surface fire behavior model was mostly 8 or 10. Fires under model 10 are at the upper limit of control by direct attack and with more wind or drier conditions could lead to an escaped fire.

Western spruce budworm infestations of low to moderate severity were recorded on white fir and Douglas-fir at five points. Occasional mistletoe infections of low to moderate severity were recorded.

Spruce/fir Vegetation Type – 48,730 acres

Primary species in this vegetation type are Engelman spruce and corkbark fir together with some Douglas-fir, white fir, limber pine, blue spruce, bristlecone pine and aspen. Points in this vegetation type average 142 square feet of basal area per acre with a range of 40 to 310 basal area. These higher stocking levels are typical of this vegetative type and though the type would generally benefit from thinning, the greatest emphasis for treatment is on the drier vegetative types (ponderosa pine and dry site Douglas-fir). However, during severe drought this type is susceptible to stand-replacing fires because of dense trees and heavy downed woody debris.

The surface fire behavior model was most often a 10 that has higher fuel loads than fuel models 8 or 9. Ground fires burn more intensely in fuel model 10 due to heavier dead and down fuels. Individual trees have a higher potential to crown out, spot and torch in this fuel situation making fire control more difficult.

Spruce diameter growth averages 6/10ths of an inch in ten years. Other species in this vegetative type averaged 3/4 of an inch growth in diameter in ten years.

Western spruce budworm infestation is generally common in this vegetative type with periodic severe outbreaks. Species affected are Engelman spruce, white fir and Douglas-fir. A few points had low to moderate broom rust on Engelman spruce which is less of a forest health concern than western spruce budworm and dwarf mistletoe. However, broom rusts can result in dead tops, reduced growth and occasional mortality.

Two patches of dead and dying corkbark fir were seen. The mortality is the result of armillaria root rot that spreads through root grafts from the center of the infestation and was accompanied by western balsam bark beetle activity.

Because of discrepancies in the vegetative type calls, the Douglas-fir and spruce types were combined when processing the data. The basal area averaged 114 which is not abnormally high. However, for the drier Douglas-fir sites, which can be identified during management, basal areas in the 50 to 70 range would be preferable. Table 2 displays the trees per acre stocking levels by species and diameter class.

Table 2. Douglas-fir / Spruce Vegetative Types

STAND TABLE (Trees/Acre)

	Sawtimber (10" + dbh)														
	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Total
Ponderosa	2.2	1.2	0.5	--	--	1.0	--	0.8	0.2	--	--	--	0.2	--	6.0
Douglas-fir	3.7	3.0	2.0	1.3	2.2	1.3	0.3	0.5	0.2	0.6	--	0.2	0.3	--	15.7
White Fir	0.7	1.2	--	1.3	1.9	0.3	0.3	0.8	0.2	--	0.2	0.2	--	0.2	7.3
Limber Pine	0.7	1.2	1.5	0.9	--	0.3	--	--	0.2	--	--	--	--	--	4.9
Aspen	1.5	--	1.5	0.4	1.5	0.7	0.6	0.3	--	0.2	--	--	--	--	6.6
Spruce	2.9	1.8	1.5	2.2	1.1	0.3	0.6	0.3	--	0.4	--	--	--	0.2	11.4
Corkbark Fir	0.7	--	0.5	0.4	0.4	0.3	0.3	--	0.2	--	--	--	--	--	2.9
TOTAL	12.4	8.4	7.5	6.5	7.1	4.2	2.1	2.7	1.0	1.2	0.2	0.4	0.5	0.4	54.6

	Roundwood (5-9" dbh)					
	5	6	7	8	9	Total
Ponderosa	--	2.0	3.0	5.7	1.8	12.6
Douglas-fir	23.5	10.2	6.0	14.9	9.1	63.6
White Fir	8.8	4.1	3.0	5.7	0.9	22.5
Aspen	11.7	12.2	10.5	13.8	2.7	50.9
Spruce	17.6	6.1	13.5	10.3	9.1	56.6
Limber Pine	2.9	2.0	--	3.4	--	8.4
Corkbark Fir	5.9	--	--	1.1	4.5	11.5
Pinyon	--	2.0	1.5	--	1.8	5.3
TOTAL	70.4	38.6	37.5	54.9	29.9	231.4

Saplings (1-4" dbh)	
Ponderosa Pine	12
Douglas-fir	108
White Fir	108
Aspen	72
Spruce	90
Corkbark Fir	36
TOTAL	426

Aspen Vegetative Type – 7,700 acres

Pure aspen stands (found on four points) and aspen in mixed stands often had Cytospora stem cankers. Elk damage was common. Elk damage to the inner and outer bark of aspen provide an entryway for many species of wood-rot fungi. Mortality of aspen was often high. Aspen often had crooks and sweep that decrease marketability though at this time there are limited markets for aspen in the area.

Areas classified as aspen vegetative type, occupy a small portion of the study area. Basal area was 120, which is not unacceptable for this type. Table 3 presents trees per acre by species and diameter class.

The small acreage in aspen is a concern because this is an important vegetative type for elk and other wildlife. As an early seral type that follows major forest disturbance, generally fire, there has been a dramatic reduction in the acres of aspen in Colorado and adjacent states.

Invasive-Exotic Species of Plants: Canada thistle and bull thistle were prolific along many roads and were often seen in other open areas such as mountain meadows and open woodland. It was more common at elevations under 9,000 feet. Fewer thistles were seen west of Highway 12 where it runs north/south and west of South Valley and west of the valley where San Francisco pass is. This could be due to the higher stocked forests of spruce-fir, less traveled roads, elevation and landowner efforts at control. Musk thistle was also recorded in several areas. Yellow toadflax was seen in a few areas south of the Spanish Peaks, generally near Apishapa Road.

Vegetative Mapping versus Actual Vegetative Type

As noted earlier, 21 points that were located in the ponderosa pine vegetative type were actually in pinyon-juniper (19 points) or Gambel oak (2 points). There were also 13 points that were designated spruce/fir, but were identified on-the-ground as aspen (3 points), Douglas-fir (9 points) or ponderosa pine (1 point). These misidentifications of vegetative type has minimal effect on the outputs of the forest inventory, but the ground-truthing by examiners could be valuable information for the producers of the Basinwide Vegetation maps. The results of our ground-truthing is available should it be requested.

Table 3. Aspen Vegetative Types

STAND TABLE (Trees/Acre)

	Sawtimber (10" + dbh)														
	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Total
White Fir	--	--	--	7.2	6.2	--	--	--	--	--	--	--	--	--	13.4
Limber Pine	--	--	--	--	--	--	4.8	--	--	--	--	--	--	--	4.8
Aspen	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TOTAL	--	--	--	7.2	6.2	--	4.8	--	--	--	--	--	--	--	18.2

	Roundwood (5-9" dbh)					
	5	6	7	8	9	Total
Ponderosa Pine	48.9	--	24.9	--	--	73.8
White Fir	48.9	34.0	--	--	--	82.8
Aspen	--	67.9	74.8	56.3	30.2	230.2
Spruce	48.9	--	--	--	--	48.9
TOTAL	146.7	101.9	99.7	57.3	30.2	435.8

Saplings (1-4" dbh)
None

9

Inventory Summary

	Roundwood Net Volume (Tons)	2% growth (Tons)
Ponderosa Pine	522,521	10,450
Douglas-fir	347,905	6,958
White Fir	148,495	2,970
Spruce	245,451	4,909
Limber Pine	19,959	399
Corkbark fir	47,650	953
Aspen	217,481	4,350
	1,549,462	30,989

	Sawtimber Net Volume (MBF)	2% Growth (MBF)
Ponderosa Pine	242,366	4,847
Douglas-Fir	102,876	2,057
White Fir	57,783	1,156
Spruce	61,054	1,221
Corkbark fir	15,430	309
Aspen	31,963	639
	511,472	10,229

Cruise Sampling Error – 13.5% at 95% confidence level.

Summary

Without a detailed analysis, some general assumptions can be made from the inventory data about the volumes that should be harvested to improve forest health. Based on the projected growth, approximately 31,000 tons per year could be sustainably harvested. In addition, the current over-stocking needs to be reduced. Assuming that approximately 20 percent of the roundwood volume should be removed to improve stocking, another 300,000 tons are available. If that volume was harvested over a 10-year period, another 30,000 tons would be available annually. Under those assumptions, there would be approximately 60,000 tons of roundwood available annually for small-diameter industries. In addition, there would be a volume of sawtimber available. That quantity would depend on the amount of growth reserved to increase sawtimber diameter.

Appendix D: Noxious Weed Management Plan for Las Animas County

`NOXIOUS WEED MANAGEMENT PLAN FOR LAS ANIMAS COUNTY, CO.

Background: In 1991 Las Animas County developed and approved a noxious weed management plan, which complied with the requirements of HB 90-1175; The "Colorado Weed Management Act", which was signed into law on May 7, 1990. This plan however; did not get implemented. The 1990 act was superseded by the "Colorado Noxious Weed Act" (HB96-1008) on May 23, 1996. In 2003 the Colorado General Assembly passed and Governor Owens signed into law a number of revisions to the Colorado Noxious Weed Act. Specifically, these revisions directed the Commissioner of Agriculture to restructure the state's noxious weed list, and implement state noxious weed management plans for specific noxious weed species. This Noxious Weed Management Plan for LA County is now written to conform with the 1996 law and to the 2004 revisions of the "Colorado Noxious Weed Act" (' ACT').

Requirements of the Colorado Noxious Weed Act

Among other things, the Colorado Noxious Weed ACT of 1996 requires each county and municipality to adopt a noxious weed management plan. The plan is to address the management of the state noxious weeds "Designated by rule". Each county or municipality may declare additional noxious weeds for inclusion in the plan, but only after a public hearing. The Colorado Department of Agriculture has developed rules pertaining to the 1996 ACT; and has adopted new permanent rules (119 - CR 5
(2003) of 2004) for the administration and enforcement of the' ACT'. The most significant changes made to the' ACT' in 2004 pertains to the classification of noxious weeds into one of several categories (C.R.S. 35 - 5.5 - 108).

1.List A: rare noxious weed species that are subject to eradication wherever detected statewide in order to protect neighboring lands and the state as a whole. All populations of List A species are designated by the commissioners for eradication.

2.List B: noxious weed species for which the commissioners, in consultation with the state weed advisory committee, local governments, and other interested parties, develops and implements state noxious weed management plans designed to stop the continued spread of these species.

3.List C: noxious weed species for which the commissioners, in consultation with the state weed advisory committee, local governments, and other interested parties, will develop and implement weed management plans designed to support the efforts of local governing bodies to facilitate more effective, integrated weed management on public and private lands. The goal of such plans will not be to stop the continued spread of these species, but to provide additional educational, research, and biological control resources to jurisdictions that choose to require management of List C species.

The current State A, B, C, Listed weed species is an addendum to this management plan.

The 1996 Noxious Weed Act also requires that each municipality shall provide for the administration of their weed management plan. The' ACT' allows for cooperative planning and plan administration among counties and municipalities. Additionally, the

'ACT' establishes the position of State Weed Coordinator in the Colorado Department of Agriculture, and creates a State Noxious Weed Management Fund. The Department of Agriculture may make special grants from this fund to local entities for the management of State noxious weeds.

Objectives of this Plan

The main objective of this plan is to meet requirements of the Colorado Noxious Weed Act of 1996 and revisions of2004. This plan provides policy and guidance for the control and reduction of noxious weeds in Las Animas County. This plan is for the use of all landowners and managers, both public and private.

Policy Statement

It is the policy of the Las Animas County Weed Advisory Board that Integrated Vegetation Management principles be used in the control and reduction of noxious weeds. The Colorado Noxious Weed Act of 1996 defines Integrated Vegetation Management as "the planning and implementation of a coordinated, program utilizing a variety of methods for managing noxious weeds, the purpose of which is to achieve desirable plant communities. Such methods may include, but are not limited to, education, preventive measures, good stewardship and the following techniques:

The techniques listed and described are biological, chemical, cultural and mechanical control measures. Of these techniques, chemical control can be most controversial. Therefore, county sponsored herbicide activity will be conducted only by certified public or commercial applicators, as licensed by the State of Colorado for restrictive pesticides.

It is understood that all applicators will carry such liability insurance and/or bonding as is required for certification and further that any chemicals used will be applied strictly according to the manufactures label.

The Las Animas County Weed Advisory Board assumes no liability for the misuse of chemicals, and relies solely upon the integrity and judgment of the applicator to apply herbicides properly.

The Las Animas County Weed Manager will advise landowners of the need and feasibility of weed control. However, only the certified applicator will make recommendations of the suitable chemicals and method of application. Private landowners will be encouraged to do their own herbicide control work where they wish to do so. They will also be advised to strictly follow the manufactures label when applying chemicals herbicides.

2.

History and Current Situation

No documented history. In recent years area land management has changed causing, an increase in soil disturbance due to eg.: gas industry development, 35 acre home sites, absentee landowners, and etc.

In the past few years there has been a large increase in non-native plants species such as mullien, and various thistle species. Some land owners/operators have conducted various plant control methods, many have not.

Targeted Weeds

Weeds covered under this plan are included in the state noxious weed list designated by rule. There are also other weeds listed that are beginning to infest the area. The following weeds will receive priority for control.

Category A*	**Category B**	**Category C**
Yellow Star Thistle *Centurea solstitialis L.*	Leafy Spurge *Euphorbia esula*	Poison Hemlock *Conium maculatum L.*
African rue Peganum harmala	Musk Thistle *Carduss natans*	Common Burdock *Arctium minus*
	Diffuse Knapweed *Centaura diffusa*	Cheatgrass *Bromus tectorum L.*
	Canada Thistle *Circium arvense*	Yellow Toad Flax *Linaria Vulgaris*
	Common Mullein *Verbascum Thapsus L.*	
	Houndstongue *Cynoglossum officinale L.*	
	Oxeye Daisy *Chrysantheum leucanthemun*	
	Scotch Thistle *Onopordum acanthium*	
	Bull Thistle *Cirsium vulgare (Savi) Tenore*	
	Russian Knapweed *Centaura repens*	
	Spotted Knapweed *Centaura maculosa*	
	Saltcedar Tamarix *ramosissima Ledeb*	

Also identified as a targeted weed is Locust Tree or Mexican Locust.

*Mandatory control required by the Colorado Weed Management Act – needs to be eradicated.

If infestations of weeds not included on the list above become a problem, the required public hearings will be held, and weeds will be added to the Las Animas list as needed.

3.

Coordination and Cooperation

The Weed Control Manager will coordinate noxious weed control efforts among various land owners, including private, municipal, county, federal and state land owners and managers. In Las Animas County, this includes, but is not limited to the following:
Las Animas County Trinidad
U S Army Pinon Canyon Maneuver Site (PCMS)
Farmers, ranchers
and landowners
School Districts
Irrigation companies
Recreation Districts
Colorado State
Land Board
Colorado Division
of Wildlife U.S.
Bureau of Land
Management U.S.
Forest Service
Colorado Department of
Transportation Boy
Scouts of America
Gas /Energy companies

Cooperative agreements and memorandums of understanding will be entered into as needed.

Education

The Weed Control Manager will seek out and disseminate educational materials concerning the identification, propagation, and control of noxious weeds. Various outreach and educational tools will be utilized such as news releases, slide presentations, traveling exhibits, flyers in tax statements, and field trips. Target groups include schools, farm and ranch organizations, PDA's, service organizations, recreational groups, and individual landowners.

4.

Biological Management

Biological management of noxious weeds will continue to grow and as more biological controls are developed. The use of biological agents will be integrated with other methods of weed control to lessen the use of chemicals whenever possible.

Chemical Management

The use of herbicides is expected to remain our most effective tool for the reduction and control of noxious weeds. For example there are no biological control agents available at the present time to attack some of the weeds identified on the undesirable species to be controlled in Las Animas County.

Management of these weeds, as well as those subject to biological controls, calls for the sensible application of chemical herbicides.

Cultural and Mechanical Management

Cultural and mechanical control methods of noxious weeds are closely related. In essence, they both call for intensive and constant management ofthe vegetative community. The common key is to create conditions favorable for desirable plants at the expense of undesirable noxious weeds. When properly applied, these methods are effective as control measures as well as preventive measures.

Tools include proper irrigation, mowing, and burning, properly timed livestock grazing, plowing and seeding, to mention a few. In the long run, the intelligent application of these tools can be as effective as biological or chemical control methods.

The implementation of cultural and mechanical control methods is complicated. Many landowners do not understand the complex interrelationships involving plant competition, soil characteristics, climate and land use practices. However, the use of these methods will be encouraged when ever the opportunities arise.

5.

Monitoring and Mapping

Tracking the invasion and control of noxious weeds in Las Animas County will require an effective system of monitoring. Previous efforts have consisted of plotting weed infestations and control activities on various maps as time allowed. The results were minimal.

Upon approval of this plan a part time mapper will be required to work with various organizations and individuals using the Geographic Positioning System (GPS) and Geographic Information Systems (GIS) to create maps. These maps can be easily updated, providing an understandable record of vegetative changes over time. The map information will be stored in a digital format that can be overlaid with other maps that display previous vegetation, roads, streams, land status and other features of interest.

Up to date maps of weed infestations are critical to setting priorities by the Noxious Weed Committee.

Funding

The Las Animas County noxious weed control program can be funded by various entities, including Las Animas County, The Las Animas County Conservation District, Nature/Wild life organizations, PowerlEnergy companies, Trusts, Grants, and landowners. These monies should be deposited in the county "weed fund". Expenditures from this fund are approved by the Las Animas County Commissioners and monitored by both the County Finance Officer and the Chairman of the Las Animas Noxious Weed Advisory Committee.

The Colorado Noxious Weed Act of 1996 has superseded the 1990 Act. The 1996 Act (revised in 2003 & 2004) provides for appropriations by the state legislature "for the purpose of funding noxious weed management projects". The Colorado Department of Agriculture is authorized to award grants from these funds to local weed control agencies.

The Weed Control Manager, at the direction of the Weed Advisory Board and with the consent of the County Commissioners, will apply for such grants. Such monies collected will be used only for the noxious weed control program.

6.

Review and Amendments

The 1996 Colorado Noxious Weed Act requires that local noxious weed management plans be reviewed at least once every three years. Implicit in this language is that the Weed Advisory Board can conduct reviews and updating at any time. The County commissioners must approve and changes to the Noxious Weed Management Plan. Mandatory review of this plan will be conducted yearly while in its early stage.

Enforcement

Enforcement of the Las Animas Noxious Weed Management Plan will be per Title 35; Article 5.5 - 109 which requires the county, after notification etc, to provide for and compel the management of such noxious weeds on private land. Land owners who do not properly control their noxious weeds will pay the county for the total cost for inspection and other incidental costs in connection therewith as outlined in Article 5.5 109.

7.

Appendix E: Goals and Measurable Outcomes for the Arkansas Basin Roundtable, 2014

Goals and Measurable Outcomes for the Arkansas Basin Roundtable, 2014

Storage Goals

Goals	1. Increase surface storage available within the Basin by 70,000 AF by the Year 2020.	2. Develop alluvial and designated basin storage in gap areas within the Basin.	3. Support multiple uses at existing and new storage facilities.	4. Identify storage facilities that can be renovated, restored or enhanced for additional storage.
Actions	1. Implement the IPP called Preferred Storage Option Plan (PSOP). 2. Work with the State Engineers Office of Dam Safety to identify storage projects for restoration, rehabilitation and increased capacity. 3. Support funding, including grant contributions where appropriate, for storage restoration and expansion projects.	1. Quantify alluvial storage opportunities in the sub-regions of the Basin, Upper Ark, Huerfano/Purgatoire, Fountain Creek and Lower Ark. 2. Develop a feasibility study and action plan for storage in designated basins.	1. Support rehabilitation efforts with WSRA funds if the project includes environmental and recreational attributes. 2. Engage Colorado Parks and Wildlife and other stakeholders in project discussions.	1. Conduct an inventory assessment and map candidate facilities in collaboration with the SEO and DWR offices. 2. Support feasibility studies, permitting and construction at these locations with WSRA grant/loan funding in collaboration with CWCB.
Measurable Outcomes	1. Storage capacity and percentage of stored water annually from 2015 to 2020. 2. Annual reporting of projects that have been permitted and/or constructed.	1. Quantify potentially available alluvial storage and cost by Dec, 2015. 2. Annual reporting of projects that have been permitted and/or constructed.	1. Approved WSRA grant requests that incorporate multi-use attributes. 2. Direct feedback from CPW and stakeholders that participation is on-going.	1. Complete an inventory of prospective facilities with an estimate of recoverable storage volume by Dec, 2015. 2. Annual reporting of projects that have been permitted and/or constructed.
Challenges	Federal, state and local permitting requirements; Funding for design and permitting; financing sources.	Regulatory regime, permitting, financing, legal challenges by patent holders.	Complexity of competing stakeholder interests, permitting challenges.	Reluctant ownership, permitting challenges, spillway requirements.

Municipal Goals

Goals	1. Meet the Municipal Supply Gap in each county within the Basin.	2. Support regional infrastructure development for cost-effective solutions to local water supply gaps.	3. Reduce or eliminate Denver Basin groundwater dependence for municipal users.	4. Develop collaborative solutions between municipal and agricultural users of water, particularly in drought conditions.
Actions	1. Determine surplus and deficit sub-regions within each county for collaboration. 2. Project annual supply and demand for water providers who choose to participate in addressing the gap.	1. Complete current regional infrastructure studies. 2. Identify and support new regional studies in gap areas. 3. Support construction of the Arkansas Valley Conduit.	1. Support regional solutions to water supply availability. 2. Identify interim water supply options. 3. Support funding, including grant contributions where appropriate, for collaborative solutions.	1. Continue ATM process of engineering, public policy and pilot projects. 2. Support with WSRA grant/loan funding in collaboration with CWCB.

Measurable Outcomes	1. Generate a study by December, 2015 determining surpluses and deficits within sub-regions/counties. 2. Funds provided in support of collaborative efforts reported annually.	1. Agreements to regional use of identified IPP's such as Southern Delivery System. 2. New WSRA grant request for regional infrastructure studies. 3. Agreements for off-take of Conduit water; Funding of Conduit processes and construction.	1. Presentations by groundwater dependent entities on solutions that have been implemented. 2. Presentations on interim solutions and funding requests to support those solutions. 3. Funds provided in support of collaborative efforts reported annually.	1. Pilot project implemented as reported annually. 2. Engineering template implemented by the Division of Water Resources to expedite temporary transfers at reduced cost.
Challenges	Federal, state and local permitting requirements. Funding for design and permitting; financing sources.	Regulatory regime, permitting, financing, informed decision makers at participating entities.	Complexity of regional agreements, competing stakeholder interests, education, conservation.	Administration of temporary transfers, institutional barriers, permitting, legal challenges.

Agricultural Goals

Goals	**1. Sustain an annual $1.5 billion agricultural economy in the Basin.**	**2. Provide increasing quantities of augmentation water for increased farm efficiencies.**	**3. Develop a viable rotating fallow and/or leasing program between agriculture and municipal interests to address drought and provide risk management for agriculture.**	**4. Sustain recreation and environmental activities that depend on habitat and open space associated with farm and ranch land.**
Actions	1. Establish the Colorado State University economic study as the baseline for agriculture production at $1.5 Billion.	1. Establish long-term sources of augmentation water through leasing, water banks or interruptible supply agreements. 2. Construct recharge facilities to capture and retime fully consumable water supplies.	1. Complete the on-going technical studies and engineering to facilitate temporary transfers. 2. Define and quantify potential third-party impacts to shareholders within a ditch system engaged in a fallow program by providing funding in support of an economic study. 3. Minimize permanent dry-up.	1. Conservation easements to protect habitat values. 2. Financial support for economic development of tourism in historic agricultural communities.
Measurable Outcomes	1. Increase in measured economic productivity by update of CSU Study in 2020.	1. Document the baseline of current augmentation available. 2. Track available storage facilities for augmentation sources.	1. Report on pilot projects underway as of Dec, 2015. 2. Completion and presentation of the report by Dec, 2015. 3. Survey of permanently retired acreage as of the Year 2020.	1. Measure the economic contribution of tourism to the basin economy within the CSU 2020 update. 2. Change of status for "protected" attributes as measured by nonconsumptive projects and methods in SWSI 2016 report.
Challenges	Farm commodity prices; climate and weather.	Storage availability, legal challenges, administration of new decrees or substitute water supply plans.	Legal challenges, modifications of the statute by the Colorado General Assembly, disputes over application of the technical platform.	Climate and weather, impacts of reduced irrigation if rotating fallowing is successful, dust control, economic development funding availability.

Non-consumptive Goals

Goals	1. Maintain or improve native fish populations	2. Maintain, improve or restore habitat for fish species	3. Maintain or improve recreational fishing opportunities	4. Maintain, or improve boating opportunities, including rafting kayaking and other non-motorized and motorized boating.	5. Maintain or improve areas of avian (including waterfowl) breeding, migration and wintering.	6. Maintain or improve riparian habitat, and restore riparian habitat that would support environ-mental features and recreational opportunities	7. Maintain or improve wetlands, and restore wetlands that would support environmental features and recreational opportunities	8. Improve water quality as it relates to the environment and/or recreation.
Actions This section to be completed between Aug, '14 and Dec, '14.								
Measurable Outcomes This section to be completed between Aug, '14 and Dec, '14.								
Challenges This section to be completed between Aug, '14 and Dec, '14.								

Source: http://www.arkansasbasin.com/draft-basin-implementation-plan.html