

## **Appendix 4**

Report from Stratus Consulting, Inc.

An Assessment of the Potential Benefits Associated with the  
Proposed Rules

# Memorandum

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**To:** David Neslin, Acting Director Colorado Oil and Gas Conservation Commission

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**Subject:** Assessment of the potential benefits associated with the proposed revisions to the  
*Draft Rules for Oil and Gas Development in Colorado (HB 1298 & 1341)*

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## 1. Introduction

Colorado has a bounty of commercially exploitable oil and natural gas resources. Developing these resources requires temporarily modifying landscapes to install wells, tanks, and other production-related equipment. The state plays a unique role in this process as it seeks to implement regulations that will provide a balance between the development of these resources with competing demands and values from humans and wildlife.

Over the past decade, Colorado has experienced unprecedented growth in oil and gas production. This increase can be measured in part by the number of applications for permits to drill (APDs) approved by the Colorado Oil and Gas Conservation Commission (COGCC), which rose sharply from 1,157 in 1998 to 6,368 in 2007 (COGCC, 2008c). The associated escalation in drilling and production activity has led to growing public concern for the effects these activities have on human health and the environment.

In 2007, the Colorado General Assembly passed House Bills (HB) 07-1298 and 07-1341, which call for increased protection of public health, safety, and welfare, including wildlife habitat, against potential adverse impacts resulting from increased oil and gas development. In response to this legislation, COGCC met with representatives from the Colorado Division of Public Health and Environment (CDPHE) and the Colorado Division of Wildlife (CDOW) to identify ways to implement changes that would allow for the continuation of oil and gas development, while affording the citizens of Colorado necessary protections against the potential adverse impacts from that development. The draft rules were developed through a regulatory process that included statewide public hearings, consideration of several regulatory alternatives, and the development of a series of pre-draft rules, which were made available for public comment.

## 1.1 Draft Rules

On March 31, 2008, COGCC released the draft rules. The draft rules revise, amend, and expand upon current rules governing the oil and gas industry, while striving to maintain a balance between continuing resource development and minimizing potentially adverse impacts from that development.<sup>1</sup> The draft rules are organized in the 12 series shown in Box 1. A brief overview of the most significant changes to each series follows.

- ▶ 100 Series: Definitions are revised, added, or deleted as necessary to account for changes to the 11 subsequent series.
- ▶ 200 Series: Operators must develop, maintain, and regularly update a chemical inventory. Further, operators in the Piceance Basin must complete and retain a Pollution Prevention Checklist. In addition, operators are encouraged to consider landscape level planning for future development by preparing Comprehensive Drilling Plans (CDPs).
- ▶ 300 Series: Operators must supply additional information on a revised version of Form 2A. The draft rules also allow for increased notice and opportunities for comment on APDs. The draft rules explicitly call for greater participation from CDPHE, CDOW, and the general public in the permitting process. In addition, further precautions are required to avoid contamination of sources of drinking water, and increased monitoring is required to prevent fluid loss during well stimulation.
- ▶ 400 Series: No changes or additions were made to this series.

**Box 1. Draft Rules for Oil and Gas Development in Colorado Series Titles**

*100:* Definitions  
*200:* General Rules  
*300:* Drilling, Development, Producing and Abandonment  
*400:* Unit Operations, Enhanced Recovery Projects, and Storage of Liquid Hydrocarbons  
*500:* Applicability of Rules of Practice and Procedure  
*600:* Safety Regulations  
*700:* Financial Assurance  
*800:* Aesthetic and Noise Control Regulations  
*900:* E&P Waste Management  
*1000:* Reclamation Regulations  
*1100:* Pipeline Regulations  
*1200:* Protection of Wildlife Resources

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1. All proposed changes and additions to the existing rules are listed in order in the appendix. In some cases, minor editorial changes were made to clarify language, update terminology, or correct grammatical errors. Rules where such changes were made are not discussed in the main document because they have no impact on potential benefits of the proposed regulation. In addition, the schedule of fines associated with the rules is adjusted. We assume for the purposes of this analysis that all operators are in compliance with the rules and thus these adjustments will neither have associated benefits nor costs. These rules are listed in the appendix only.

- ▶ 500 Series: The list of parties that can request a hearing on a drilling permit is expanded to include the operator, the surface owner, the local government, CDPHE, and CDOW. In addition, operators can request a hearing to expedite the processing of APDs. Additions to this series also include a provision for the development of Geographic Area Plans by COGCC, and Memorandums of Agreement (MOAs) between COGCC and local governments to harmonize state and local regulations.
- ▶ 600 Series: The draft rules mandate and provide technical specifications for berms, water pits, and equipment related fired vessels and heater-treaters. In addition, the draft rules require operators to identify existing coalbed methane (CBM) and other wells around a proposed CBM site and assess them for risk.
- ▶ 700 Series: The draft rules contain several proposed increases in the level of financial assurance required for centralized waste facilities, single wells, and groups of wells run by a single operator.
- ▶ 800 Series: Under the draft rules, site-specific mitigation practices to protect aesthetic and visual resources may be required. In addition, the draft rules mandate the control of fugitive dust, prohibit excessive odor emissions, require emission control equipment in certain circumstances, and require green completion practices to be utilized in certain circumstances.
- ▶ 900 Series: Requires that all drilling, production, reserve, and special-purpose pits be lined and maintained to control for bacteria growth, overtopping, and accidental entry by wildlife. The draft rules also require that stormwater controls be established for centralized waste management facilities. In addition, the allowable concentrations and levels for pollutants in soil and water are revised to conform to the cleanup standards for impacted resources used by the CDPHE.
- ▶ 1000 Series: Operators must develop a stormwater program for the operation phase of oil and gas activities. Certain program elements must be specifically addressed and best management practices for the facility to prevent negative impacts to nearby surface waters and to protect other beneficial uses of these waters, must be identified.
- ▶ 1100 Series: Requires membership in the Utility Notification Center of Colorado and participation in Colorado's One Call notification system by all pipeline operators.
- ▶ 1200 Series: This is a new series which contains guidelines and standards intended to minimize adverse impacts to wildlife resources affected by oil and gas operations and ensures the proper reclamation of wildlife habitat during and following such operations as mandated in HB 1298. The draft rules include the establishment of timing restrictions for

operations in areas that are of particular importance to wildlife, and spatial buffers for a limited number of wildlife species where possible.

## 1.2 Analytical Requirements for Rulemakings in Colorado

Colorado Revised Statute (C.R.S.) 24-4-103(4.5)(d) requires Colorado state agencies to issue a regulatory analysis of a proposed rule upon request of any person. This analysis was formally requested from COGCC by the oil and gas industry. The regulatory analysis must contain the following:

- ▶ A description of the classes of persons who will be affected by the proposed rule, including classes that will bear the costs of the proposed rule and classes that will benefit from the proposed rule
- ▶ To the extent practicable, a description of the probable quantitative and qualitative impact of the proposed rule, economic or otherwise, upon affected classes of persons
- ▶ The probable costs to the agency and to any other agency of the implementation and enforcement of the proposed rule and any anticipated effects on state revenues
- ▶ A comparison of the probable costs and benefits of the proposed rule to the probable costs and benefits of inaction
- ▶ A determination of whether there are less costly methods or less intrusive methods for achieving the purpose of the proposed rule
- ▶ A description of any alternative methods for achieving the purpose of the proposed rule that were seriously considered by the agency and the reasons they were rejected in favor of the proposed rule.

Further, each regulatory analysis must include quantification of the data to the extent practicable and take account of both short-term and long-term consequences.

## 1.3 Purpose

This memorandum is prepared to help support a regulatory analysis of the draft rules as called for by C.R.S. 24-4-103(4.5)(d). The goal of this memorandum is to provide a summary of the potential incremental benefits of the COGCC's *Draft Rules for Oil and Gas Development in Colorado* (COGCC, 2008a). In this summary, benefits to mutually exclusive parties are identified and discussed. It is critical to note that this memorandum only considers the benefits associated with the revisions to existing rules and that it is not intended to provide a

comprehensive summary of the benefits of the entire body of COGCC rules governing oil and gas development in Colorado.

## 1.4 Contents

The memorandum is structured as follows:

- ▶ Section 2, *Methodology*, describes the analytical methods employed for this analysis
- ▶ Section 3, *Parties Affected by the Draft Rules*, identifies and defines the affected parties
- ▶ Section 4, *Benefits*, provides a qualitative and, where possible, quantitative and monetized summary of the draft rules' potential benefits
- ▶ Section 5, *Conclusions*, summarizes the findings
- ▶ *References*
- ▶ The *appendix* provides a summary and categorization of the potential benefits for rules that have been revised and new rules proposed as part of this rulemaking process.

## 2. Methodology

### 2.1 Qualitative analysis

The first step in the benefits assessment is to prepare a qualitative summary of actions mandated in the draft rules, and their associated benefits. This is based on a review of the draft rules; information gained from staff involved with the rulemaking at COGCC, CDOW, and CDPHE; and available summaries of the draft rules. Potential benefits of the draft rules are summarized in the following four broad benefit categories:

- ▶ Information
- ▶ Financial
- ▶ Public health, safety, and welfare
- ▶ Natural resources (including wildlife and the environment).

The changes to the existing rules are summarized in terms of these four potential benefits categories throughout the memorandum. A detailed list of existing rules with changes and new proposed rules is included in the appendix along with an indication of the categories where potential benefits may be realized.

The analysis is structured this way to facilitate capturing the collective impact of multiple draft rules that are focused on a specific issue or resource (e.g., wildlife protections in the new 1200 series rules). We believe these benefits categories are mutually exclusive and capture the full range of beneficial impacts the draft rules are likely to generate. Finally, we believe a categorical assessment of potential benefits is consistent with the regulatory requirements for a regulatory costs-benefit assessment in Colorado [C.R.S. 24-4-103(4.5)(d)].

## 2.2 Quantitative analysis

From the qualitative summary, we attempted to develop a quantitative summary of potential benefits whenever possible. Potential quantitative measures that could be considered for this effort include the following:

- ▶ Acres of various types of habitat
- ▶ Miles of waterways
- ▶ Population level impacts to various species
- ▶ Acre-feet of groundwater that could experience reduced contamination or a reduced risk of contamination
- ▶ Changes in ambient air quality (e.g., particulate matter and ozone concentrations).

The draft rules, if enacted, will affect activity over a number of years. At the same time, the future actions of the oil and gas industry are subject to several factors in addition to the COGCC's governing regulations, including changing market dynamics, additional regulations required by other agencies (e.g., CDPHE), and flexibility within the draft rules (e.g., often regulations have an option to request variances or different compliance alternatives). The analyses in this memorandum that attempt to project future benefits of the draft rules require various assumptions about the timing, scale, and nature of the industry in the future. These assumptions are clearly presented and efforts are made to incorporate the associated uncertainty into the final results. In all cases, it was difficult to develop quantitative estimates of benefits because of resource constraints and lack of quantitative information on both baseline conditions under the present rules and the expected changes due to the draft rules.

### **2.3 Monetization of benefits**

Where possible and appropriate, quantitative impact estimates conceivably could be monetized using the economic technique of benefits transfer. This technique is performed by first reviewing available valuation estimates to identify those that most closely resemble the specific resource, the impact, and/or the location being valued in the current study. Additional considerations in identifying potentially useful valuation studies include the date of the study and technical robustness of the original study design and analysis. Estimates are widely available in the peer-reviewed literature for the monetary value of preserving some lands from development, protecting various species, and avoiding or remediating groundwater contamination. In addition, there is a well-established process for valuing potential changes in concentrations of ambient air pollutants such as ozone and particulate matter.

Monetized benefits estimates established using the benefits transfer technique are generally presented in ranges of values to reflect both the uncertainty in the underlying quantitative estimates and the variation in the available economic estimates. While the benefits of the draft rules have not been monetized due to complications associated with quantifying benefits, monetary values for some of the specific benefit categories can be established based on current literature. These monetary values are included in each section to provide an indication of the potential magnitude of some values based upon prior studies. If benefits were quantified in the future, then this would enable some monetization of benefits.

## **3. Parties Affected by the Draft Rules**

The draft rules have the potential to generate benefits for three distinct, mutually exclusive, parties: the oil and gas industry, state and local agencies, and the public. These groups are defined below.

### **3.1 Oil and Gas Industry**

The oil and gas industry encompasses the firms and individuals involved with activities related to the exploration, development, and production of oil and natural gas resources in the State of Colorado. More narrowly, for this analysis, this party consists of the individuals whose actions are effectively regulated by the draft rules or who will be responsible for complying with requirements imposed by the draft rules.

### **3.2 State and Local Agencies**

State and local agencies include elected and appointed members of committees, boards, and agencies, and the staff of any public institution (e.g., state, county, municipal). In the context of this analysis, state and local agencies include COGCC, CDOW, CDPHE, county boards, and other elected or appointed officials that are given a specific role in the implementation and enforcement of the draft rules.

### **3.3 The Public**

The public consists of residents of Colorado and nonresidents whose health, safety, and welfare can be adversely affected by oil and gas exploration, development, and production activities. The nonresident group includes both nonresidents who visit Colorado (or plan to visit Colorado) and those with other concerns regarding oil and gas development in the state (e.g., habitat loss and fragmentation).

## **4. Benefits**

Benefits refer to increases in the anticipated quality and/or quantity of natural resources, human health and welfare, or the ability of the state and local governments to satisfy their regulatory obligations (including funding); or decreases in costs for industry operations, holding all else equal. Benefits are generated when actions mandated by the draft rules result in changes in current, or anticipated future, practices. If enacted, the draft rules are anticipated to cause several behavioral changes. First, the draft rules will alter aspects of how firms in the oil and gas industry operate in the exploration, development, and production phases of their work. Second, the draft rules are likely to influence how these firms interact with state and local agencies (including regulators), the general public, and each other. It is important to note that the draft rules may generate benefits even in cases where the overall net impact on a resource from oil and gas development is negative. In these cases, benefits can accrue for the draft rules if the decline would have been more severe and/or protracted without enacting the draft rules.

Moreover, it is likely that the draft rules will change relevant behavior over multiple time periods. Predicting changes over different time periods is critical for accurately summarizing anticipated benefits. However, developing a time sensitive summary is complicated by the need to account for largely independent trends (e.g., projections of the overall number of Colorado residents). It is also important to recognize the possibility that some trends and behaviors may be indirectly attributable to the draft rules (e.g., projections of where future Colorado residents may live).

## 4.1 Information Benefits

### 4.1.1 Origin of potential benefits

The draft rules seek to increase availability and accessibility of information to assist state and local agencies, the regulated community, and the general public to better understand the potential risks to human health and the environment. Table 1 provides a summary of the relevant draft rules that are likely to generate information benefits. These draft rules pertain to the accessibility of information, the collection and dissemination of information that would allow for a better understanding of risks, and the permitting process.

**Table 1. Draft rules that could generate information benefits**

<b>Nature of the action associated with the draft rule</b>	<b>Relevant draft rule</b>
Improved access to information and/or improved quality of information	205, 206, 210, 215, 216 303, 341
Increased understanding of surface impacts of new oil and gas locations	303
Regional planning	216 508, 513, 521
Notice and comment on drilling permit applications	305 508, 509, 511, 512
Consultation with CDPHE and CDOW on drilling permit applications	305, 306 513
Hearings on drilling permit approvals	501, 503, 508, 509

### 4.1.2 Summary of potential information benefits

Benefits derived from increased information may be examined as normative, substantive, and instrumental (Beierle, 2003).

- ▶ Normative benefits are derived from communities' and individuals' rights-to-know about risks they are subjected to. These benefits are generally accrued by the public. Publishing of accepted CDPs under Rule 216 and Form 2A under Rule 305 on the COGCC website are examples of actions that result in normative benefits.
- ▶ Substantive benefits are derived from gaining a better understanding of a problem that allows for the subsequent identification of remedies to address it. These benefits accrue to the regulated party, government agencies, and the general public. For instance, regulated parties might identify environmental and operational problems as they collect additional information, government agencies may make better decisions with increased information,

and the general public is better informed when trying to resolve problems with the regulated parties. These benefits may be captured in subsequent sections, which discuss other benefit categories such as public health, safety, and welfare, or wildlife and natural resources.

Examples of draft rules with substantive benefits include Rules 205, 210, 216, 303, 508, 509, and 513. Rule 205 requires companies to maintain specific, current chemical inventory lists for their operations to be readily available for COGCC or CDPHE review. In this example, substantive benefits are derived by the state when investigating alleged impacts of oil and gas activities on public health, safety, and welfare, including environment and wildlife. Rule 210 requires labeling of tanks to help identify the hazards of a material(s) involved in an emergency incident and assists emergency responders in reacting appropriately. Rule 216 allows for the development of CDPs, which provide substantive benefits to the general public, state agencies, and industry by facilitating discussions about potential impacts of intended oil and gas drilling activities, and identifying measures to minimize adverse impacts from such activities. Further, Rule 303 requires a pre-drilling assessment to ensure that production and waste sites are restored to as close to their original condition as possible. Consultations with CDPHE and CDOW, such as under Rules 305, 306, and 513, also help improve an understanding of the potential risks to human health and the environment. Amendments to the draft rules on hearings related to the permits also accrue substantive benefits to public health, safety, and welfare, including the environment and wildlife resources, since the list of issues to be raised at public hearings have been expanded to include these (Rules 508, 509). These benefits are further discussed in Sections 5.3 and 5.4.

- ▶ Instrumental benefits are realized when companies improve their environmental performance as a result of information collection and provision. These benefits may also be captured in other benefit categories, such as public health, safety, and welfare, or wildlife and natural resources. Studies of the Toxics Release Inventory (TRI) program provide numerous examples where companies have improved their performance by reducing toxic releases as a result of collecting information (Kennedy et al., 1994; Khanna et al., 1998; Case, 2001). Other TRI studies that indicate company environmental performance has been improved due to the reaction of financial markets to environmental information include Hamilton (1995), Konar and Cohen (1997), and Jeffords and Gorte (2006). An example of a draft rule with instrumental benefits is Rule 206, which requires a pollution prevention checklist in the Piceance Basin that ensures compliance and results in decreased adverse impacts.

## 4.2 Financial Benefits

### 4.2.1 Origin of potential benefits

The draft rules increase the financial assurance requirements (including bonding requirements) for operators of less than 100 active wells, and the operators of record for inactive wells and centralized exploration and production (E&P) waste management facilities. Table 2 provides a summary of the relevant draft rules that have the potential to generate financial benefits.

**Table 2. Draft rules that could generate financial benefits**

<b>Nature of the action associated with the draft rule</b>	<b>Relevant draft rule</b>
Bonding and financial assurance	304 704, 706, 707, 710, 711, 712 908
Streamlining the review process	216 303, 306 521

Benefits in this category are accrued through changes in the relative allocation of funds devoted to addressing sites where proper closure and abandonment processes ultimately are not followed.

Financial benefits are also accrued by regulated parties by draft rules seeking to streamline the permitting process.

### 4.2.2 Summary of the potential financial benefits

The state ultimately guarantees that proper site closure standards are achieved at wells and centralized E&P waste management facilities. If an operator fails to meet the appropriate standards, financial assurance is revoked and used to initiate the work needed to properly close the site. Any shortfall in funding for the project work is initially provided by the state through one of several funding mechanisms (e.g., an emergency allocation request or withdrawal from the environmental response fund). However, the state ultimately recoups the initial funding commitment at these sites through adjustments to a mill levy that is assessed on all operators based on the value of their in-state oil and gas production.

Increasing the financial assurance amounts will increase the portion of funding for appropriate site closure that is drawn from the site operator, thereby decreasing the portion that is funded by the overall industry through the mill levy. Reducing this burden to the industry (as opposed to the operator) is viewed as a benefit based on both efficiency and equity considerations. The

efficiency gains are realized by making those responsible for a site bear the expenses associated with their own actions, thereby taking financial burden off of those other industry entities that leave their sites better protected. This also creates equity benefits insofar as a “polluter pays” approach to site closure and remediation is considered more fair and thus socially desirable.

It is important to note that a distinction must be made between those directly responsible for site closure and all other operators to realize this benefit. Absent this distinction, the draft rules identified in Table 2 are not expected to change the overall future burden on the oil and gas industry.

The potential magnitude of this benefit over time is difficult to predict because of the uncertainty surrounding both the number of sites where the state will need to revoke a financial assurance guarantee, and the associated project costs.

Examples of draft rules that result in financial benefits from streamlining the permitting process include developing MOAs between COGCC and local governments to clarify, coordinate, and harmonize the relationship between the Commission’s rules and the local government’s regulations or ordinances (Rule 521); reducing the time operators need to wait for approval of applications and creating fixed deadlines by which certain actions will be taken by COGCC (Rule 216); and providing means for the regulated party to request expedited hearings (Rule 303). Collectively, such actions could help improve the oil and gas industry’s ability to efficiently schedule projects and the associated labor and equipment more efficiently generating a cost-savings benefit.

Similarly, it is difficult to estimate the potential cost savings the oil and gas industry could realize with the establishment of firm permit review and action periods. The magnitude of these benefits will depend in large part on the future scale of operations. Cost savings will be larger with the assumption made that permitting activity continues to increase, thereby increasing the amount of permit review required of COGCC, and relatively small if it is assumed permitting activity remains constant or decreases.

### **4.3 Public Health, Safety, and Welfare Benefits**

#### **4.3.1 Origin of potential benefits**

One of the main goals in developing the draft rules was to increase the protection of public health, safety, and welfare (COGCC, 2008a). A summary of the draft rules that are likely to generate public health benefits is presented in Table 3.

**Table 3. Draft rules providing potential public health, safety, and welfare benefits**

<b>Nature of the action associated with the draft rule</b>	<b>Relevant draft rules</b>
Protection of drinking water supply areas	306, 317 902, 908, 910
Management of odors and fugitive dust	306 805 1003
Lining of waste pits	317 904
Assessment of coal-bed methane (CBM) wells	608
Develop and maintain a Pollution Prevention Checklist	206
Improved information of field practices, operations, and impacts	205, 206, 210 303, 306 602, 608 1002
Increased opportunities to address public, health, safety, and welfare concerns	210 306 508, 509, 513 603, 604 905 1204
Human welfare protection/improvement	804 901, 902, 906, 910, 912 1102

The draft rules identified in Table 3 incorporate a mix of direct and indirect measures to generate public health, safety, and welfare benefits.

Direct public health and safety benefits are likely to result when the draft rules produce any of the following outcomes:

- ▶ A reduction in human exposure to pollutants that have recognized associations to adverse health impacts, at the individual or population level (i.e., pollutants with recognized concentration-response functions)
- ▶ A reduction in the frequency and/or severity of exceedences of maximum allowable chemical concentrations, as established by regulations or documented minimum concentration values below which there is no evidence of adverse effects to humans
- ▶ A change in standard practices that allows for a more timely and/or effective response to spills and releases.

Several of the draft rules are likely to produce direct health and safety benefits, including requirements for:

- ▶ Lining or elimination of waste pits (Rules 317, 914)
- ▶ Exclusion zones around public water supply sources (Rule 317)
- ▶ Risk assessments for CBM operations (Rule 608)
- ▶ A chemical inventory and pollution prevention checklist (Rule 205)
- ▶ Signs and markers on production and development tanks and facilities (Rule 210).

The draft rules also are expected to generate welfare benefits in this category by reducing the extent to which oil and gas exploration and development activities interfere with the use and enjoyment of other resources. Specifically, changes in Rule 804 are intended to reduce the visual and aesthetic impacts of production facilities and Rule 805 focuses on reducing the odors and dust associated with development and production activities. Finally, Rule 513 provides the opportunity to minimize any potentially adverse human health, safety, or welfare impacts that begin to emerge and are beyond remedy by the limitations imposed by other rules through the implementation of Geographic Area Plans.

#### **4.3.2 Summary of the potential health, safety, and welfare benefits**

At this time, estimates of the reduced volume or weight of pollutant releases attributable to the draft rules have not been developed. However, several key benefits of the draft rules to human health and welfare are discussed below.

Estimates of reduced health impacts from reductions in ground and surface water contamination require a large volume of site-specific information, which is not currently available. In addition, to produce the necessary estimates of avoided health outcomes, the site-specific information would need to be combined with assumptions about the size and composition of the exposed populations, the pollutants involved, the duration and levels of exposure, and potential lags from exposure to onset of illness.

Similar challenges exist for estimating health and welfare benefits associated with changes in air pollutant emissions. However, the supporting documentation for this rulemaking strongly suggests that the reduction in emissions of volatile organic compounds (VOCs) that is likely to be achieved as a result of Rule 805 could result in reductions in ambient ozone concentrations. Specifically the *Proposed Statement of Basis, Specific Statutory Authority, and Purpose* (COGCC, 2008b, p. 38) states that:

airsheds of Colorado and neighboring states are directly impacted by concentrated oil and gas activities. For instance: (1) the Front Range region is presently violating the 8-hour ozone national ambient air quality standard, and oil and gas

activities are a major contributor of emissions that form ozone; (2) southwestern Wyoming has experienced high levels of ozone pollution during winter months in an area where oil and gas activities dominate the landscape; (3) numerous reports and complaints of noxious odors and deteriorating public health are lodged in Garfield County by residents in close proximity to oil and gas operations; and (4) northwestern New Mexico and southwestern Colorado experience elevated ozone concentrations and impaired visibility in pristine national parks and wilderness areas that are directly attributed to concentrated coal-bed methane production.

If CDPHE were to complete photochemical modeling to estimate if and how the anticipated VOC emissions reductions would affect ambient ozone concentrations within the state, it would be possible to develop quantitative estimates of the health impacts for the changes anticipated as part of Rule 805. These quantitative estimates would be based on the estimated location, timing, and magnitude of the changes in ambient ozone concentrations combined with information on resident populations, widely accepted concentration response functions, and baseline incidence rates. Assuming the VOC emissions reductions result in reduced ambient ozone concentrations, estimates of avoided health outcomes that range in severity from premature death to days with acute respiratory symptoms could be produced (see table 6.1 of U.S. EPA, 2008). To the extent these air quality changes could be forecast over multiple years, a time series of health benefits could be estimated.

Similarly, a range of site-specific information would be needed to estimate the potential public welfare benefits for the draft rules. There is some evidence of the scale and potential significance of the welfare benefits. Specifically, an analysis of COGCC data on complaints received found that, since 2006, 24% of 496 complaints involved oil and gas related odors. Thus, one could conclude that a significant share of those who are being adversely affected by oil and gas operations could realize welfare improvements from Rule 805. In addition, while this work has not been completed, facility location information could be used, for example, to attempt to estimate the number of households expected to experience significant odor reductions as a result of Rule 805 or the number of individuals that could experience improved landscape viewing as a result of Rule 804.

### **Monetized benefits**

Without estimates of how the incidence of adverse health outcomes is expected to change over time, it is not possible to monetize potential public health benefits. However, it is worth noting that the economic literature in this area is particularly well developed. This body of literature has been applied to support monetary estimates of the potential health impacts of a number of rules focused on improving water quality and air quality (e.g., U.S. EPA, 2008). The majority of the monetized benefits of improvements in ozone concentrations are associated with estimated

reductions in premature mortality. This value is in excess of \$6.6 million per mortality, depending on how far in the future the reduction in mortality occurs. In contrast, the monetary estimates associated with other ozone-related health outcomes range from roughly \$10,000–\$25,000 for different categories of hospital admissions to tens of dollars for minor activity restrictions.

Similarly, it is possible that the reduction in odor and dust controls combined with improved visual aesthetics could improve residential values for those who live near relevant oil and gas production facilities. The monetary value of these potential improvements could be determined with survey-based research, and would likely be subject to a number of factors such as the nature and extent of the disruption (e.g., odors versus visual disruption) and the relative value of the housing stock in affected areas. For perspective, a limited list of calculated losses in property value resulting from various types of industrial activity are presented in Table 4.

**Table 4. Percentage effects of hazardous waste sites on nearby residential property values**

Study	Geographic area	Site characteristics	Percentage value lost
Adler et al. (1982)	New Jersey	Hazardous waste site	6% to 22%
Freshwater Foundation (1989)	Five Minnesota cities	Groundwater contamination, including VOCs at one site	10% or less
Ihlanfeldt and Taylor (2004)	Atlanta, Georgia	Twenty-three hazardous waste sites	12% to 36%
Nelson et al. (1992)	Ramsey County, Minnesota	Nuisance issues (e.g., noise, smell, traffic) from solid waste landfill	6% to 12%
Ozog et al. (1990)	Denver, Colorado	Industrial site with groundwater plumes contaminated soils and surface water	13%
Rowe et al. (1985)	Eagle, Colorado	Metals contamination from mining	35%
Schulze et al. (1986a)	West Covina, California	Groundwater contamination and methane gas releases from a landfill	5% to 10%
Schulze et al. (1986b)	Suburban Los Angeles, California	Groundwater contamination and methane gas releases from a landfill	2.5% to 5%

#### 4.4 Potential Natural Resource Benefits

Increasing the protection for the environment and wildlife resources is one of the key goals of the draft rules (COGCC, 2008b). The draft rules include a new series, the 1200 series, titled *Protection of Wildlife Resources*. In addition, a number of the changes to other series in the draft rules could provide natural resource benefits. A summary of these draft rules is presented in Table 5.

**Table 5. Draft rules providing potential natural resource benefits**

Nature of the action associated with the draft rule	Relevant draft rules
Provisions to protect wildlife resources	216 306 503, 508, 509, 513, 523 603, 604, 608 902, 906, 910 1001, 1002 1201, 1203, 1204, 1205, 1206, 1207, 1208, 1209
Wildlife-based activity restrictions	306 1208, 1209
Restoration of disturbed lands	306 1002, 1003
Improve/increase information on timing, nature, and extent of any chemical releases, spills	608 905, 906
Improve quality or quantity of natural resources (air, and surface and ground water)	209 317, 319 902, 904, 905, 906, 908, 910 1002, 1003, 1004 1206
Improve information on the nature and extent of wildlife resources present in project areas	216 608 1202

#### 4.4.1 Origin of the potential benefits

Benefits to natural resources result in part from increasing the awareness of, and providing additional information pertaining to, natural resources that are vulnerable to aspects of oil and gas operations, as discussed in Section 5.1. In addition, the draft rules implement a series of controls designed to increase the protection of these resources.

The draft rules require actions that are intended to directly improve the quality and quantity of natural resources compared to current regulations. These changes and their associated benefits are summarized in terms of the five general resource categories: air, surface water, groundwater, surface vegetation, and wildlife resources.

## **Air**

As noted in Section 5.3, improvements in air quality are expected as a result of additional requirements for control of VOC emissions near most occupied structures, and additional emphasis placed on controlling fugitive dust (Rule 805). The VOC controls are intended to reduce noxious odors emitted from the targeted facilities (COGCC, 2008b; Tourangeau and King, 2008), however, this control may also improve air quality by reducing ambient ozone concentrations. As previously noted, the photochemical modeling required to quantify this benefit has not been completed (COGCC, 2008b).

## **Surface water**

The draft rules include a number of provisions specifically targeted at protecting and improving surface water quality. The draft rules specifically are intended to reduce potential sources and volumes of pollutants that enter these waterways and control the spread of invasive species.

For example, the proposed changes to Rule 1002 require the development and implementation of a stormwater management plan for the operation phase of oil and gas activity. This plan would focus on minimizing erosion and loading of sediment and other pollutants that are carried to surface waters in stormwater runoff. Currently, stormwater best management practices are only required in the construction phase. Similar controls mandated by Rule 908 are likely to improve stormwater management and prevent pollutant loading from centralized E&P waste facilities.

In addition, draft Rule 317 would likely limit the impact of oil and gas operations on surface waters that influence public water supply springs or groundwater wells by prohibiting operations within a 500-ft exclusion zone around the springs or wells. The 500-ft exclusion zone would be in effect for a distance of 5 miles upstream of public water intakes from surface waters. Finally, this draft rule mandates performance standards for operations that occur within one half-mile of any public water sources. This draft rule would ultimately limit the impact of any release from oil and gas operations on surface water by increasing the physical buffer around the resource, and thus increasing the time available for contamination prevention activities (COGCC, 2008b). Similarly, Rule 604 requires secondary containment structures on crude oil, condensate, and produced water tanks and is intended to reduce the impacts on surface water and other resources in the event of a spill.

Finally, surface water benefits would result from draft Rule 1206, which identifies requirements for disinfecting equipment used in one waterway before it can be re-used in a different waterbody. This draft rule is intended to control the spread of invasive species (e.g., zebra mussels, New Zealand mud snails) and organisms associated with illnesses in aquatic organisms (e.g., whirling disease), both of which could adversely affect both water quality and associated human and wildlife uses.

## **Groundwater**

Benefits to groundwater are anticipated as a result of draft rules that are intended to reduce the potential for contaminant releases to groundwater and reduce allowable contaminant concentrations in groundwater.

Rule 317 (noted in the Surface Water section) is intended to limit impacts to surface waters that influence groundwater supplies. In addition, the new requirements, such as Rules 904 and 908 for lining pits used in the oil and gas E&P process (e.g., drilling pits, production pits, skim pits) and for E&P waste storage, are expected reduce contaminant releases to groundwater (Johnson, 2008). Moreover, revisions to the allowable contaminant concentrations incorporated in draft Rule 910 would provide additional groundwater benefits because they reduce allowable concentration levels. These draft rules notably reduce the allowable concentration of TPH (total petroleum hydrocarbons), a summary measure of oil and gas contamination; and specify maximum allowable concentrations for the main toxic constituents of concern in hydrocarbon solutions. The reduction in allowable concentrations is likely to minimize the extent and severity of future groundwater contamination.

## **Surface vegetation**

Rules 1003 and 1004 address the reclamation of surface areas disturbed by oil and gas activities. These draft rules establish explicit criteria for reclamation based on plant density if applicable. Interim restoration of all disturbed areas no longer in use is considered complete if a uniform vegetative cover has been established with an individual plant density of at least 70% of the pre-disturbance vegetation levels, excluding noxious weeds, at the development site or at previously identified reference areas. These draft rules, in combination with the requirements for on-site weed control, will benefit wildlife and the public by decreasing erosion and encouraging the growth of native wildlife species in previously disturbed sites, while at the same time controlling the spread of invasive species.

Potential surface vegetation benefits could also be derived from the development and submission of CDPs, as specified in Rule 216. The explicit purpose of these plans is to concentrate development and thereby minimize adverse impacts from oil and gas exploration and development activities. The use of these plans is expected to minimize the habitat fragmentation that can result from resource development.

## Wildlife resources

The new 1200 series of rules focus on increasing the protection for wildlife resources in Colorado. The new rules include provisions for:

- ▶ Identifying and mapping wildlife prior to development operations (Rule 1202)
- ▶ Minimizing new road development (Rule 1203)
- ▶ Controlling mosquito-breeding grounds and discouraging bear activity (Rules 1204 and 1205, respectively)
- ▶ Preventing the spread of invasive, nonnative, and noxious aquatic and vegetative species (Rule 1206)
- ▶ Providing suitable movement corridors for wildlife during construction activities (Rule 1207)
- ▶ Timing restrictions on development operations during sensitive times of the year (Rule 1208)
- ▶ Restricted surface occupancy areas for sensitive species (Rule 1209).

In general, various species are likely to benefit from restrictions that prevent activity at certain times of the year when the animals are most vulnerable, or prevent activity altogether in certain areas for sensitive species (e.g., those incorporated in the Federal listings of threatened and endangered species). Additionally, wildlife benefits are likely to result from draft rules designed to reduce physical injuries resulting from entry into production-related equipment or facilities. Such equipment include heater-treaters (Rule 604), pits (Rule 902), and pipeline trenches (Rule 1207).

A list of specific species addressed by the 1200 series of draft rules is presented in Table 6.

In addition, Rule 513 provides the ability to address and potentially minimize adverse impacts to natural resources and the environment by allowing for enactment of Geographic Area Plans to address issues beyond the scope of other rules.

**Table 6. Species addressed by the new 1200 Series of Rules: Protection of Wildlife Resources**

Amphibians including boreal toads	Ferruginous hawk	Peregrine falcon
Bald eagle	Golden eagle	Plains sharp-tailed grouse
Bighorn sheep	Greater sage grouse	Preble's meadow jumping mouse
Black bear	Gunnison sage-grouse	Prairie dog (black-tailed, white-tailed, Gunnison's)
Black-footed ferret	Lesser prairie chicken	Prairie falcon
Black-tailed prairie dog	Mexican free-tailed bat	Pronghorn antelope
Brook trout	Mexican spotted owl	Rainbow trout
Burrowing owl	Mountain plover	Raptors
Columbian sharp-tailed grouse	Mule deer	Southwest willow flycatcher
Elk	Northern goshawk	Swift fox
Fringed myotis	Osprey	Townsend's big eared bat

#### 4.4.2 Summary of the potential natural resource and environmental benefits

It is not currently possible to develop quantitative estimates for most of the natural resource benefits. The primary barriers that prevent development of these estimates include:

- ▶ Lack of necessary data and/or analyses (e.g., the relationship between VOC reductions and potential improvements in ambient ozone concentrations)
- ▶ Lack of information regarding the specific timing, location, and scale of future oil and gas development (e.g., the impact of pit lining requirements on groundwater)
- ▶ Uncertainty over the impacts of the regulations that allow for variance requests (e.g., timing and surface occupancy restrictions for wildlife).

Collectively, these restrictions prevent the development of quantitative estimates of benefits to air, surface water, and groundwater. However, information provided by CDOW regarding the areas that would initially have a designated timing restriction (Rule 1208) or restricted surface occupancy (Rule 1209) can be quantified. These areas can then be linked to areas of likely oil and gas development, which allows for the quantification of potential benefits (for Rules 1208 and 1209) in terms of acres.

Figure 1 depicts the location of the APDs reviewed and approved by the COGCC in 2007 and the production basins that are formally recognized by COGCC.

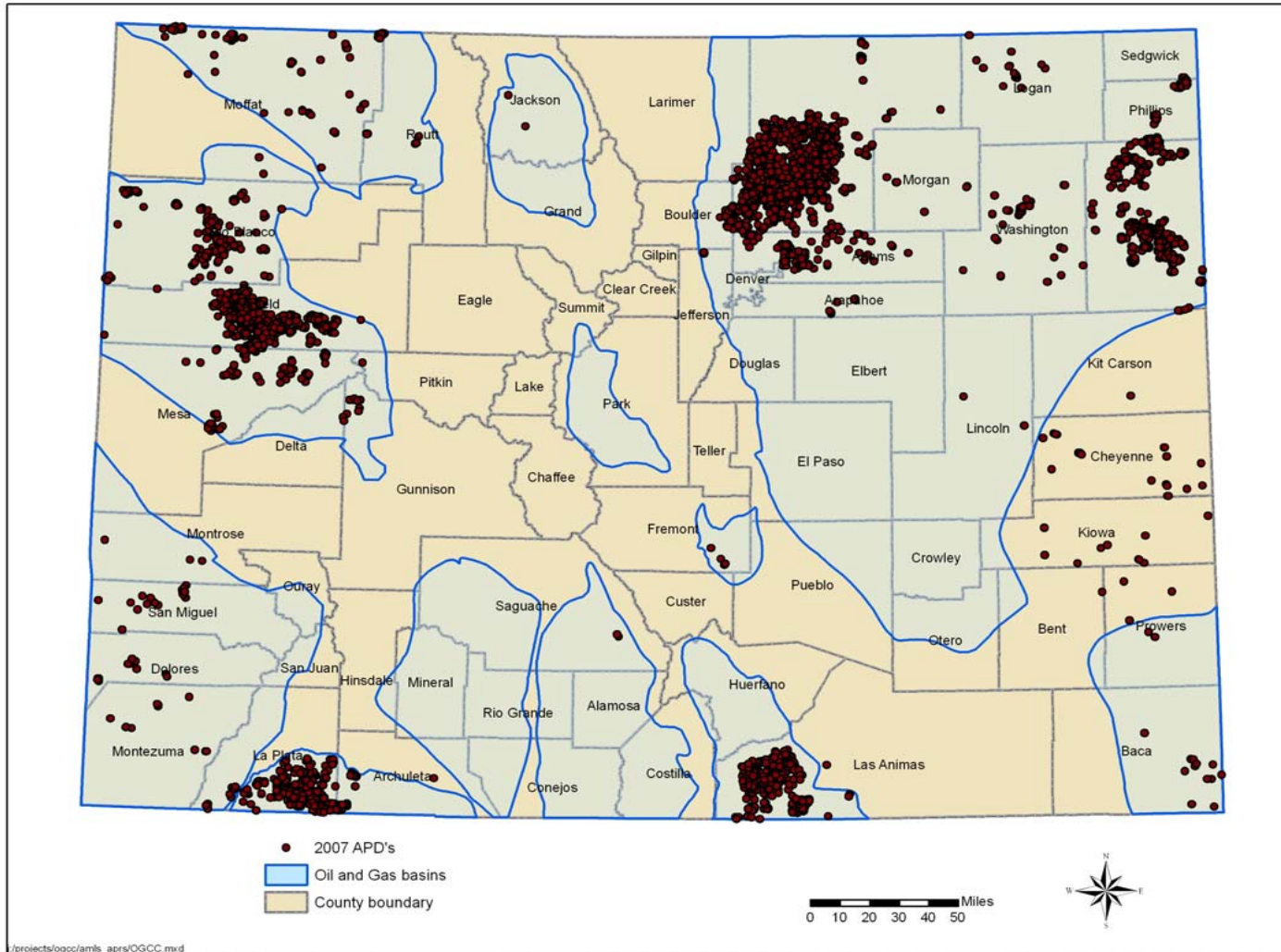


Figure 1. Location of COGCC approved APDs in 2007.

Figure 1 demonstrates that the overwhelming majority of the APDs approved in 2007 fall within COGCC's defined production basins. Therefore, an in-basin, out-of-basin designation is established for comparison with the areas where timing and surface occupancy restrictions apply.

Figure 2 presents the areas in the state covered by a timing restriction for at least one species under Rule 1208. Although information is not available for all species, in total, these areas cover roughly 17.9 million acres of habitat.

Figure 3 presents the areas covered by timing restrictions that fall within the defined production basins. There are roughly 10.7 million acres, or 60% of the total acreage covered by timing restrictions under Draft Rule 1208, which fall within a defined production basin.

The focus of Rule 1208 is not to prevent development activities altogether, but to restrict activities in periods of increased species vulnerability, not to exceed three months. As a result, the draft rule may provide relatively small benefits in terms of habitat protection, but larger benefits in terms of wildlife protection by minimizing adverse impacts, assuming that any habitat fragmentation can be overcome.

A similar acreage comparison and summary can be made pertaining to restricted surface occupancy areas as defined by Rule 1209. Figures 4 and 5, respectively, show these restricted occupancy areas in terms of total state coverage, and the portion of these areas that fall within the defined production basins.

A total of 1.8 million acres are within surface occupancy restricted areas (Figure 4), of this area 39% or roughly 0.7 million acres are within the COGCC defined production basins.

### **Monetized benefits**

The lack of quantitative estimates of the changes in resource quality and/or quantity anticipated as a result of the draft rules prevents a direct monetization of either expected annual or cumulative benefits. However, there is a large body of economic literature that could be used to monetize a number of the anticipated benefits, should these estimates be developed. In addition, this body of literature strongly supports the conclusion that the types of benefits anticipated from the draft rules have a potentially significant monetary value. The following sections present summaries of this evidence as it pertains to each specific resource.

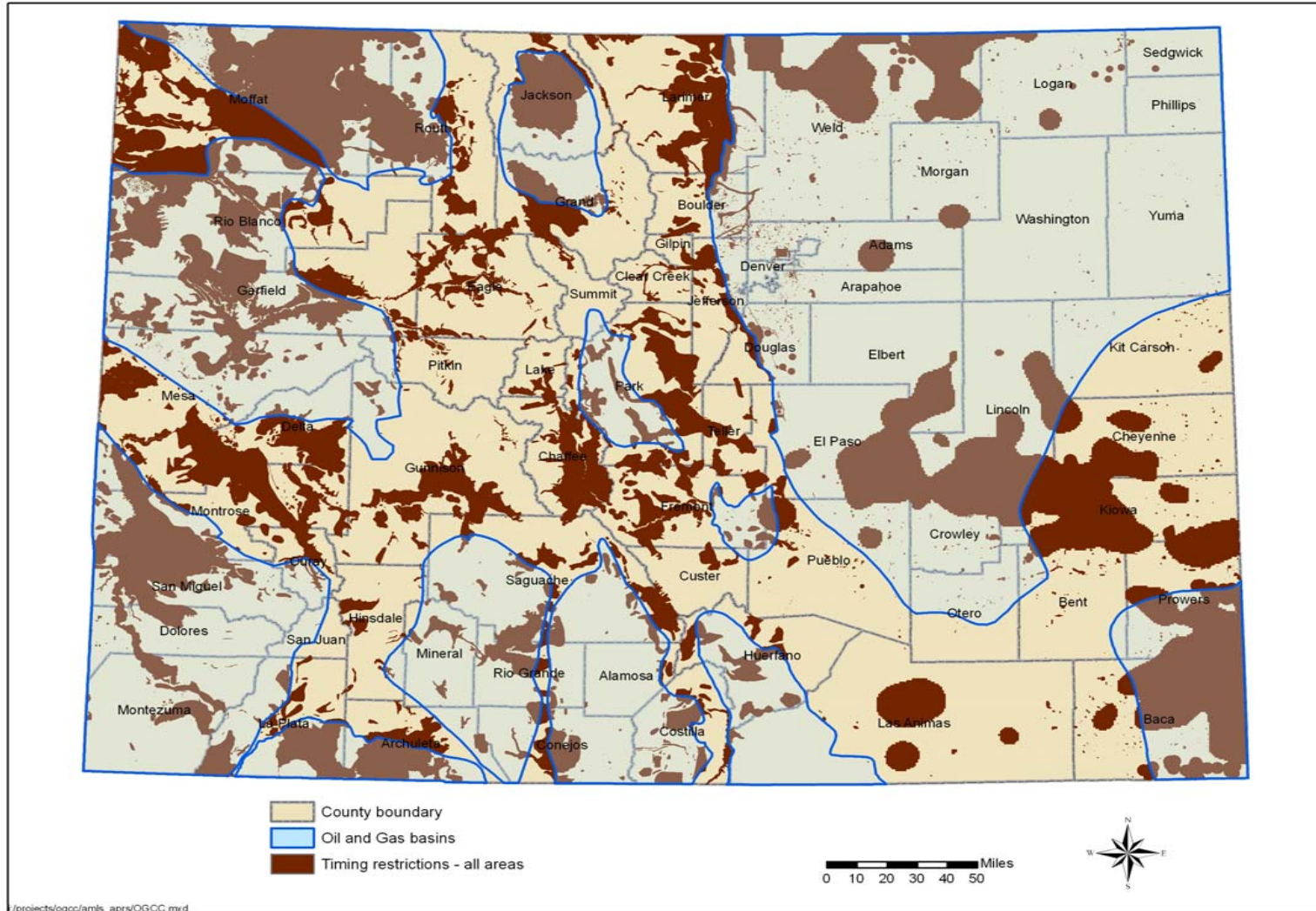


Figure 2. Areas with species-specific timing restrictions identified in Draft Rule 1208.

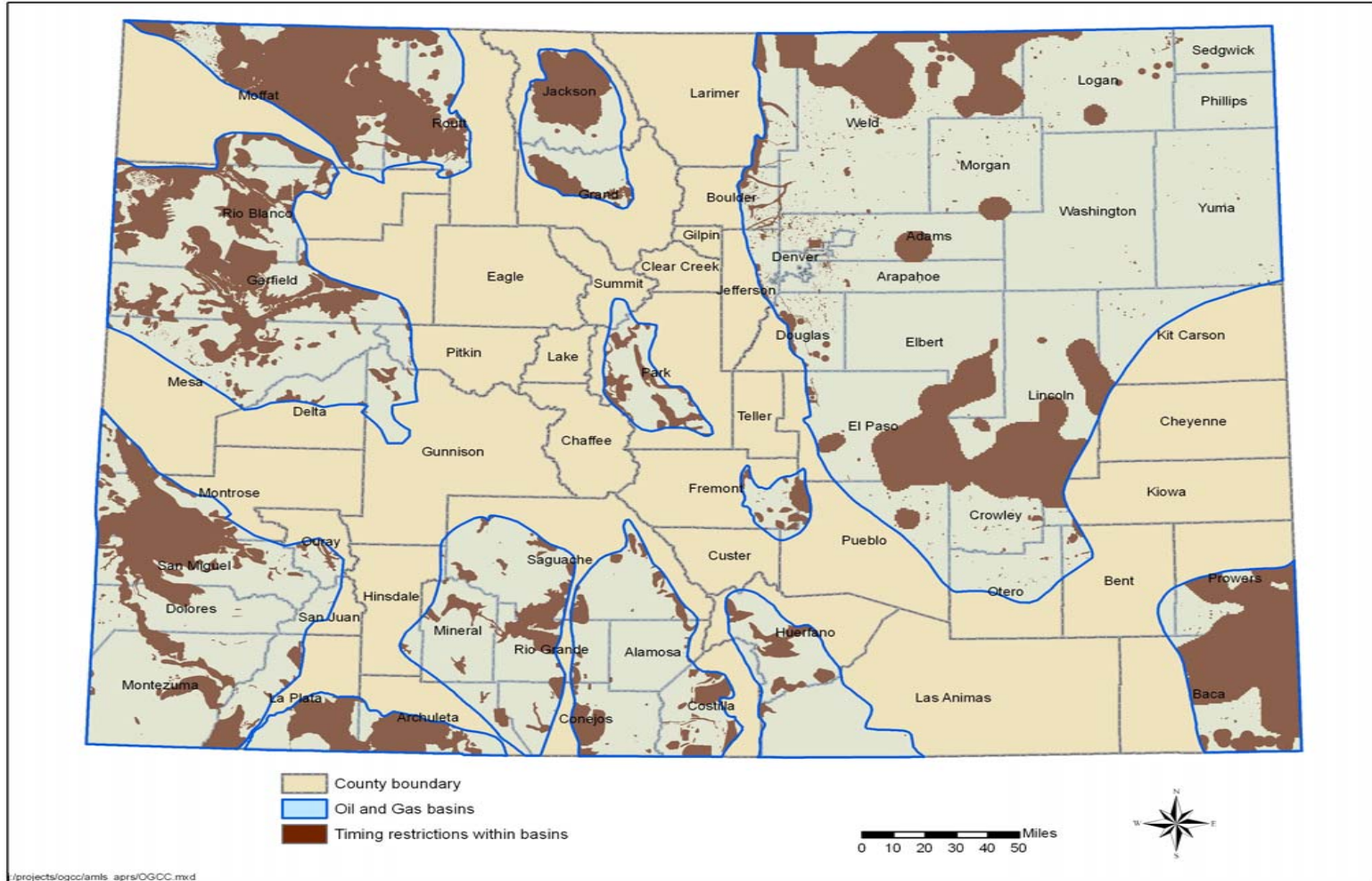


Figure 3. Areas in production basins with a species-specific timing restriction identified in Draft Rule 1208.

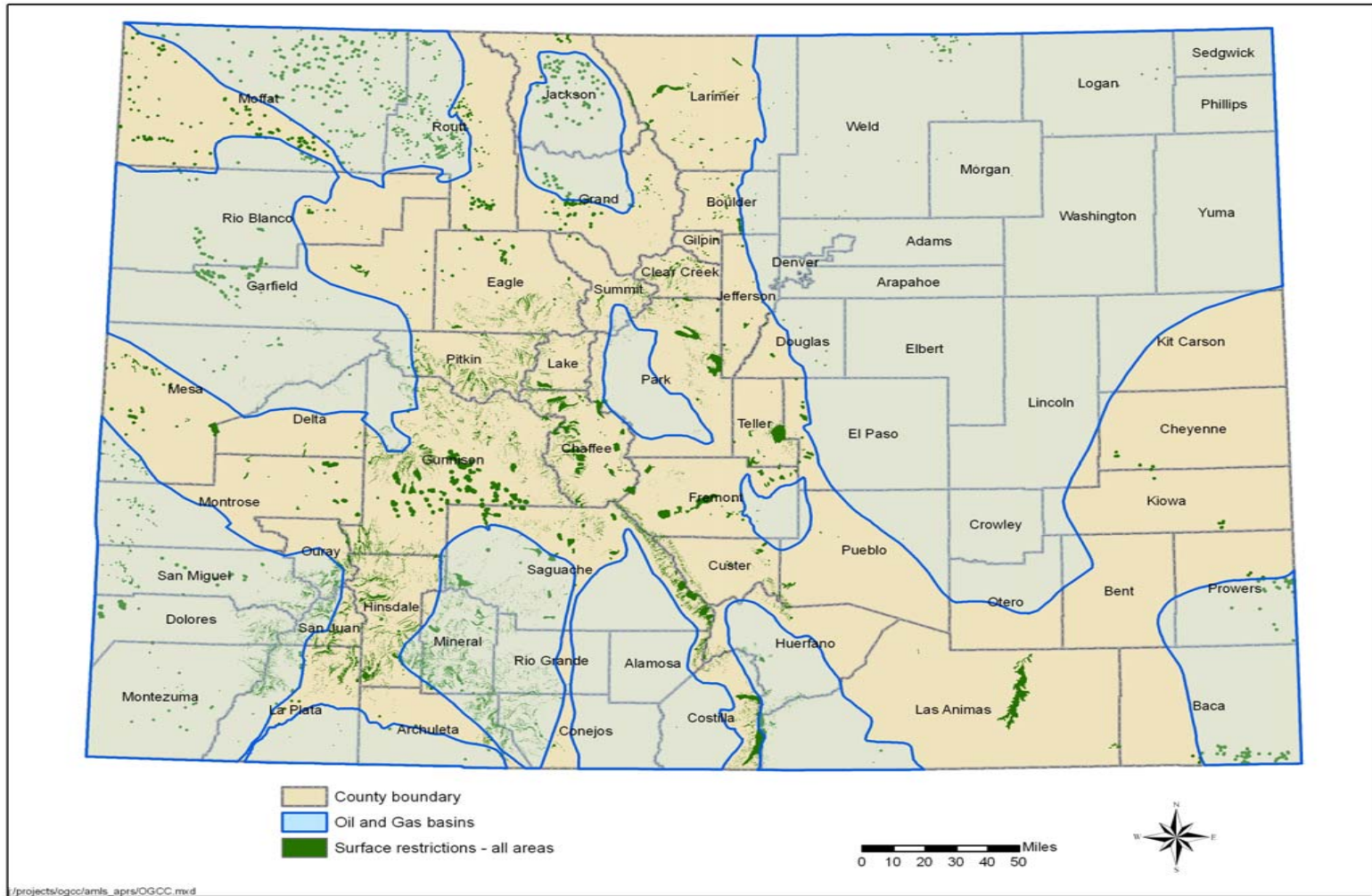


Figure 4. Surface occupancy exclusion areas identified in Draft Rule 1209.

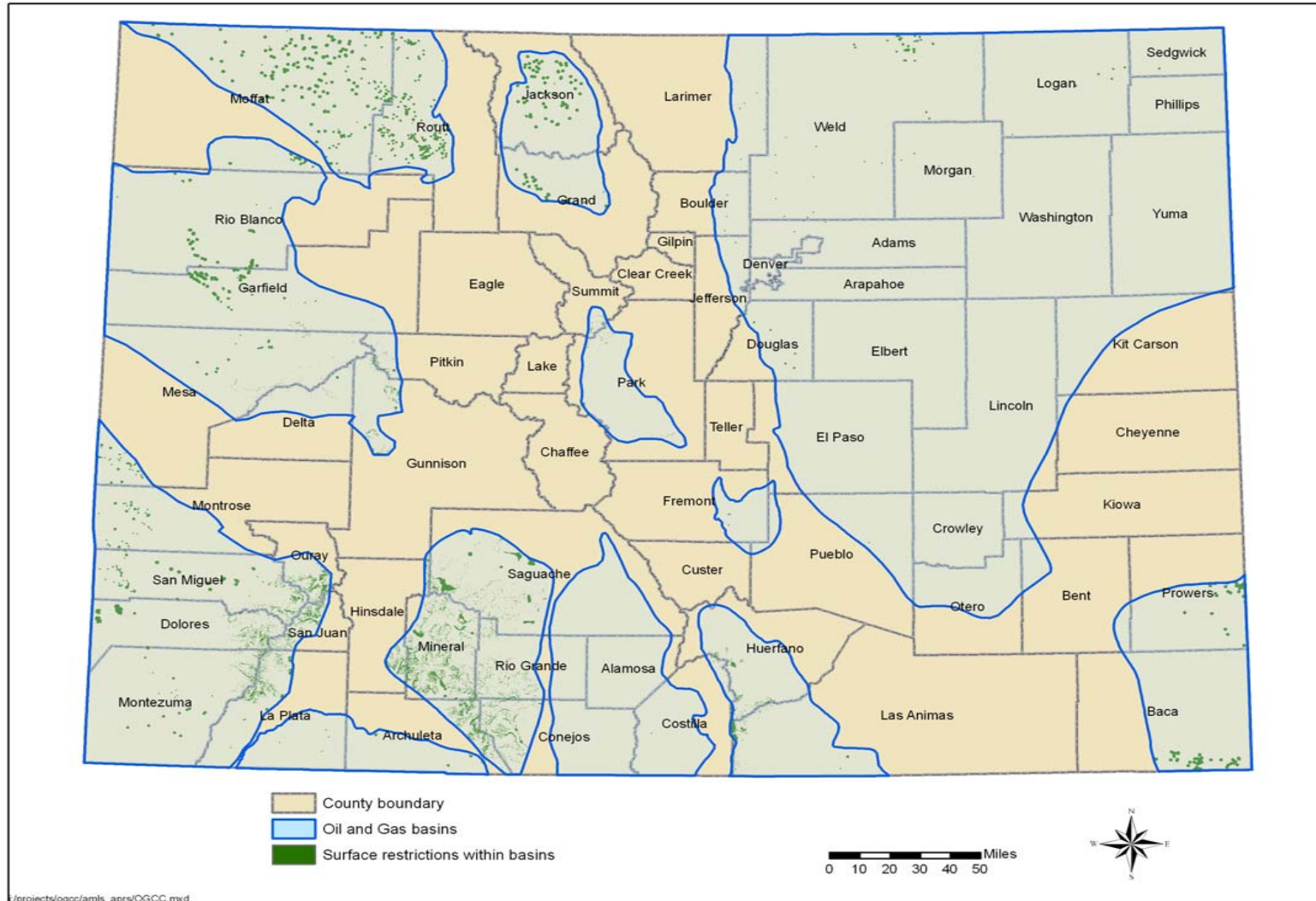


Figure 5. Surface occupancy exclusion areas in production basins identified in Draft Rule 1209.

### *Air*

Evidence of the monetized benefits of reductions in noxious odors has previously been presented. In addition, there is a well-established literature, and an associated set of monetary values, that are used in valuing changes in ambient air quality that result from changes in ambient concentrations of ozone and other pollutants (see Section 5.3).

### *Surface water*

Several of the draft rules focus on reducing the loading of chemical pollutants and sediment, and reducing the probability that invasive species and parasites will be transferred between waterways. These draft rules are likely to reduce the potential degradation of instream habitat and provide benefits to a range of aquatic species. In particular, there may be benefits to highly valued recreational species such as brook and rainbow trout.

Recreational angling is an important activity in the State of Colorado. In-state and out-of-state anglers fished over 6.3 million days and spent an estimated \$540 million in the year 2006 (U.S. DOI et al., 2008). In addition, numerous economic studies have evaluated aspects of anglers' willingness-to-pay (WTP) for recreational fishing through surveys, or estimated the value of the experience using methods such as travel cost models.<sup>2</sup> This suggests that by preventing even a marginal degradation in the quality of recreational angling in Colorado, the draft rules could provide a benefit with a significant equivalent monetary value.

### *Groundwater*

The values households would be willing to pay to avoid or reduce potential groundwater contamination have been well documented in economic survey research. Table 7 presents a selection of estimates of each household's annual WTP when presented with questions focused on groundwater contamination scenarios ranging from ensuring groundwater quality/contamination does not worsen, to essentially eliminating the possibility for exposure to a contaminant in groundwater.

While the values in Table 7 span a large range, the studies consistently found residents were willing to pay to protect groundwater resources. Considering the relative scarcity of water in Colorado, these results suggest state residents may place a significant value on reducing or preventing groundwater contamination.

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2. A search of the Environmental Valuation Reference Inventory (EVRI, 2008), a source for economic valuation estimates that can be used in benefits transfer applications, identified 67 studies that relate to *trout fishing*. While not all of these studies would be relevant for the type of changes that the draft rules could generate, they are indications that such changes are likely to be valued.

**Table 7. Contingent valuation groundwater study results**

<b>Study</b>	<b>Location</b>	<b>Contaminant</b>	<b>Average annual household WTP (2007 dollars)</b>
Barrett et al. (1996) – aquifer protection	56 western Massachusetts towns	Not specified	\$451
Barrett et al. (1996) – private water filter	56 western Massachusetts towns	Not specified	\$402
Bergstrom et al. (2001)	Aroostook County, Maine	Nitrates	\$119
Bergstrom et al. (2001)	Dougherty County, Georgia	Nitrates	\$262
Clemons and Collins (1995)	Martinsburg, West Virginia	Nitrates	\$29
Clemons and Collins (1995)	Martinsburg, West Virginia	VOCs	\$19
Crutchfield et al. (1997)	National (Indiana, Nebraska, Pennsylvania, Washington)	Nitrates	\$890
Poe (1993)	Portage County, Wisconsin	Nitrates	\$403
Powell (1991)	Massachusetts, Pennsylvania, New York	Potential threats of agricultural chemicals, landfills, toxic chemicals, accidental spills, underground storage tanks, and septic tanks	\$103
Shultz and Lindsay (1990)	Dover, New Hampshire	Not specified <sup>a</sup>	\$70

a. At the time of the study, the area recently had two town wells closed for benzene contamination, and surrounding areas had closures from chemicals and toxic wastes from underground storage sites, although these contaminants are not mentioned explicitly in the question.

### *Vegetation*

The monetary value of vegetation benefits could be estimated based on economic studies that estimate the value of wilderness preservation. A study by Walsh et al. (1984) is particularly relevant because Colorado residents were asked to state their annual WTP to establish and maintain 1.2, 2.6, 5, or 10 million acres of wilderness in Colorado. Respondents were informed that this payment would “postpone irreversible economic development,” and established development or wilderness as the alternatives. Separate household values were estimated for a number of the components of total value including preservation (non-use), option (potential

future use), existence (knowing it's there), and bequest (being able to pass to future generations) values. A summary of these household values for a one-time payment for the scenario that would preserve 1.2 million acres is provided in Table 8.

**Table 8. Examples of wilderness preservation values**

Value component	Description of value component	One-time Household WTP (2007 dollars)
Preservation	Associated with non-active use of the resource	\$35.03
Option	Associated with potential future use	\$10.17
Existence	Associated with knowledge the resource exists	\$12.25
Bequest	Associated with knowledge the resource will be available for future generations	\$12.61

These values reflect a historic willingness of Coloradoans to support the preservation of wilderness areas. They are potentially relevant when assessing the value of any acreage that is ultimately preserved from development as a result of the draft rules, especially Rules 1208 and 1209, which seek to protect wildlife species by implementing timing limitations for operations in certain areas and totally restricting operations in other areas.

### *Wildlife*

Colorado's wildlife resources are of considerable value to the state's residents and visitors, as demonstrated by the estimates of expenditures associated with hunting and wildlife watching (where the primary purpose is to observe, feed, or photograph fish and wildlife). A summary of these values for the year 2006 based on survey responses from Colorado residents and visitors is presented in Table 9 based on the results in *2006 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation: Colorado* (U.S. DOI et al., 2008).

**Table 9. Participation and expenditures associated with Colorado wildlife in 2006<sup>a</sup>**

Participants	Hunting		Wildlife watching	
	Participation days	Expenditures (millions)	Participation days <sup>b</sup>	Expenditures (millions)
Colorado residents	1,224,000	\$162.3	7,010,000	\$1,006.0
Colorado visitors	1,152,000	\$281.7	2,394,000	\$381.6
Total (residents and nonresidents)	2,376,000	\$444.1	9,404,000	\$1,387.6

a. The valuation of recreational angling from this study is discussed separately in the section on *Surface Water* benefits.

b. Includes only days more than 1 mile from home.

Source: U.S. DOI et al. (2008).

Table 9 suggests that the draft rules could have a significant monetary benefit if they only slightly improve hunting and wildlife watching in the state.

In addition, a number of the species specifically addressed in the draft rules have been the subject of various economic studies. A brief summary of some of the species and associated studies of WTP for different combinations of species preservation and improvement include:

- ▶ American elk: Kahneman and Ritor (1994), Young (1991)
- ▶ Antelope: Young (1991)
- ▶ Bald eagles: Young (1991), Loomis and White (1996)
- ▶ Bighorn sheep: Young (1991), Brookshire et al. (1992)
- ▶ Black footed ferret: Kahneman and Ritor (1994)
- ▶ Mule deer: Young (1991).

These studies suggest that there would be an associated monetary benefit to the draft rules, to the extent these specific species would be positively affected.

## 5. Conclusions

The draft rules are intended to improve the protection of human health, safety, welfare, and the environment, including wildlife, in anticipation of continued growth of the oil and natural gas industry in Colorado. The draft rules require changes both on the part of the operators and the regulators. These changes are the source of both the incremental benefits associated with the draft rules.

The draft rules have the potential to generate benefits for the oil and gas industry, the public, and public agencies (including industry regulators and other state and local agencies). In general, the potential benefits associated with these draft rules cannot be directly quantified because of a lack of the types of detailed, site- and contaminant-specific data necessary to support suitable analyses. However, there is a substantial body of evidence that demonstrates that the public values the types of changes that the draft rules are likely to provide.

Although there are uncertainties associated with this analysis, we feel that it is robust and that the assumptions and methodology are logical.

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**Appendix. Review and Categorization of Changes to Existing Rules and New Rules in *Draft Rules for Oil and Gas Development in Colorado (HB 1298 & 1341)***

**Table A.1 Summary of proposed changes incorporated in the *Draft Rules for Oil and Gas Development in Colorado (HB 1298 & 1341)* and categorization of associated potential benefits**

Rules with changes	Potential benefits associated with the rule changes				Rules where changes focus on definitions, clarification, and minor edits
	Information	Public health, safety, and welfare	Natural resources	Financial	
<b>100 Series: Definitions</b>					
Definitions					X
<b>200 Series: General Rules</b>					
201A: Effective scope of rules and regulations					X
205: Access to records	X	X			
206: Reports	X	X			
209: Protection of coal seams and water-bearing formations			X		
210: Signs and markers	X	X			
212: Safety					X
215: Global positioning systems	X				
216: Comprehensive drilling plans	X		X	X	
<b>300 Series: Drilling, Development, Producing, and Abandonment</b>					
302: COGCC Form 1. Registration for oil and gas operations					X
303: Requirements for Form 2: Application for a permit to drill, deepen, re-enter, or recompleat and operate Form 2A, oil and gas location assessment	X	X		X	
304: Financial assurance requirements				X	
305: Notices of oil and gas operations	X				
306: Consultation	X	X	X	X	
312: COGCC form 10. Certificate of clearance and change of operator					X
313: COGCC form 11. Monthly report of natural gas processing facilities					X
317: General drilling rules		X	X		
318: Location of wells					X

**Table A.1 Summary of proposed changes incorporated in the *Draft Rules for Oil and Gas Development in Colorado (HB 1298 & 1341)* and categorization of associated potential benefits (cont.)**

Rules with changes	Potential benefits associated with the rule changes				Rules where changes focus on definitions, clarification, and minor edits
	Information	Public health, safety, and welfare	Natural resources	Financial	
<b>300 Series: Drilling, Development, Producing, and Abandonment (cont.)</b>					
319: Abandonment			X		
324: Pollution					
328: Measurement of oil					X
333: Seismic operations					X
341: Bradenhead monitoring during well stimulation operations	X				
<b>400 Series: Unit Operations, Enhanced Recovery Projects, and Storage of Liquid Hydrocarbons</b>					
No changes in series					
<b>500 Series: Rules of Practice and Procedure</b>					
501: Applicability of rules of practice and procedure	X				
502: Proceedings not requiring the filing of an application					X
503: All other proceedings commenced by filing an application	X		X		
505: Requirement of public hearing					X
507: Notice for hearing					
508: Local public forums, hearings on applications for increased well density, public issues hearings, and geographic area plans	X	X	X		
509: Protests/interventions/participation in adjudicatory proceedings	X	X	X		
510: Statements at hearing					
511: Uncontested hearing applications	X				
512: Commission members required for hearings and/or decisions	X				
513: Geographic area plans	X	X	X		
515: Ex parte communications					X

**Table A.1 Summary of proposed changes incorporated in the *Draft Rules for Oil and Gas Development in Colorado (HB 1298 & 1341)* and categorization of associated potential benefits (cont.)**

Rules with changes	Potential benefits associated with the rule changes				Rules where changes focus on definitions, clarification, and minor edits
	Information	Public health, safety, and welfare	Natural resources	Financial	
<b>500 Series: Rules of Practice and Procedure (cont.)</b>					
516: Standards of conduct					X
517: Representation at administrative and commission hearings					X
520: Time of hearings and hearing/consent agenda					
521: Memoranda of agreement with local governments	X			X	
522: Procedure to be followed regarding alleged violations					
523: Procedure for assessing fines			X		
524: Determination of responsible party				X	X
525: Permit-related penalties					X
526: Administrative hearings in uncontested matters					X
527: Prehearing procedures for contested adjudicatory proceedings before the commission					X
528: Conduct of adjudicatory hearings					X
529: Procedures for rulemaking proceedings					
530: Involuntary pooling proceedings					X
<b>600 Series: Safety Regulations</b>					
602: General		X			
603: Drilling and well servicing operations and high density area rules		X	X		
604: Crude oil and condensate tanks		X	X		
608: Coalbed methane wells		X	X		

**Table A.1 Summary of proposed changes incorporated in the *Draft Rules for Oil and Gas Development in Colorado (HB 1298 & 1341)* and categorization of associated potential benefits (cont.)**

Rules with changes	Potential benefits associated with the rule changes				Rules where changes focus on definitions, clarification, and minor edits
	Information	Public health, safety, and welfare	Natural resources	Financial	
<b>700 Series: Financial Assurance and Environmental Response Fund</b>					
704: Centralized E&P waste management facilities				X	
706: Soil protection and plugging and abandonments				X	
707: Inactive wells				X	
708: General liability insurance					X
710: Environmental response fund				X	X
711: Natural gas gathering, and natural gas processing facilities				X	
712: Surface facilities and structures appurtenant to Class II commercial underground injection control wells				X	
<b>800 Series: Aesthetic and Noise Control Regulations</b>					
803: Lighting					X
804: Visual impact mitigation		X			
805: Odors and dust		X			
<b>900 Series: E&amp;P Waste Management</b>					
901: Introduction		X			
902: Pits – general and specific rules		X	X		
903: Pit permitting/reporting requirements					X
904: Pit lining requirements		X	X		
905: Closure of pits, and buried or partially buried produced water vessels		X	X		
906: Spills and releases		X	X		
907: Management of E&P waste					
908: Centralized E&P waste management facilities		X	X	X	

**Table A.1 Summary of proposed changes incorporated in the *Draft Rules for Oil and Gas Development in Colorado (HB 1298 & 1341)* and categorization of associated potential benefits (cont.)**

Rules with changes	Potential benefits associated with the rule changes				Rules where changes focus on definitions, clarification, and minor edits
	Information	Public health, safety, and welfare	Natural resources	Financial	
<b>900 Series: E&amp;P Waste Management (cont.)</b>					
909: Site investigation, remediation and closure		X			
910: Allowable concentrations and sampling for soil and groundwater		X	X		
911: Buried or partially buried produced water vessel...					X
912: Venting or flaring natural gas		X			
<b>1000 Series: Reclamation Regulations</b>					
1001: Introduction			X		
1002: Site preparation and stabilization		X	X		
1003: Interim reclamation		X	X		
1004: Final reclamation of well sites and associated production facilities			X		
<b>1100 Series: Pipeline Regulations</b>					
1102: Operations, maintenance, and repair		X			
<b>1200 Series: Protection of Wildlife Resources</b>					
1201: Purpose			X		
1202: Identification of wildlife species			X		
1203: Transportation planning			X		
1204: Mosquito control		X	X		
1205: Bear control measures			X		
1206: Disinfecting equipment			X		
1207: Wildlife movement during pipeline construction			X		
1208: Timing limitation areas			X		
1209: Restricted surface occupancy areas			X		