STATE OIL & GAS
REGULATORY EXCHANGE

PEER
Assessment 2019
Well Integrity

Colorado Department of Natural Resources
Oil & Gas Conservation Commission

Preface

States First is a state-led initiative aimed at facilitating multi-state collaboration and innovative regulatory solutions for oil and natural gas producing states.

Governors, regulators, and policy leaders from oil and gas producing states across the country have partnered with the Interstate Oil and Gas Compact Commission (IOGCC) and Ground Water Protection Council (GWPC) in this endeavor. This joint initiative allows a unique mix of regulatory experts, state policy and technical staff from across the country to come together and to share the way they do business, review internal operations and opens opportunities for extrapolating effective practices from one state to another.

Looking forward, the states remain committed to excellence and to providing the regulatory leadership necessary for a sound energy future. As leaders, the states recognize the need to continuously improve and to develop innovative solutions to emerging regulatory challenges. Through States First programs, state regulatory agencies are collaborating and communicating with one another in an ongoing effort to keep current with rapidly changing technology, as well as to share the very best and innovative regulatory procedures from state to state.

The **State Oil and Gas Regulatory Exchange** (SOGRE) is an outreach program created under the States First initiative. The mission of the SOGRE is to assist states to continually improve state oil and gas regulatory programs by providing member states consultation and program assessment services targeted to their specific needs.

Ground Water Protection Council

The GWPC is a nonprofit 501(c)6 organization whose members consist of state ground water regulatory agencies, which come together within the GWPC organization to mutually work toward the protection of the nation's ground water supplies. The purpose of the GWPC is to promote and ensure the use of best management practices and fair but effective laws regarding comprehensive ground water protection.

The mission of GWPC is to promote the protection and conservation of ground water resources for all beneficial uses, recognizing ground water as a critical component of the ecosystem. The organization provides an important forum for stakeholder communication and research to improve governments' role in the protection and conservation of ground water.

Interstate Oil & Gas Compact Commission

The IOGCC, comprised of 38 oil and gas producing states, is a multi-state government entity that promotes the conservation and efficient recovery of domestic oil and natural gas resources while protecting health, safety and the environment.

The Commission, acting through member-state governors, assists states to maximize oil and natural gas resources through sound regulatory practices. As the collective voice of member governors on oil and gas issues, the IOGCC advocates for states' rights to govern petroleum and natural gas resources within their borders.

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Acronyms

AAC – Alaska Administrative Code

Act – Colorado's Oil and Gas Conservation Act

AOR – Area of Review

APD – Approving a drilling permit

API – American Petroleum Institute

ASTM – American Society for Testing and Materials

BLM – United States Bureau of Land Management

BMP – Best Management Practices

COA – Conditions of Approval

COGCC – Colorado Oil and Gas Conservation Commission

C.R.S. – Colorado Revised Statutes

CWR – Division of Water

EDF – Environmental Defense Fund

FIT – Formation Integrity Test

GIS – Geographic Information System

GPS – Global Positioning System

GWPC – Ground Water Protection Council

IOGCC – Interstate Oil & Gas Compact Commission

MI – Mechanical Integrity

MIT – Mechanical Integrity Tests

MRF – Model Regulatory Framework for Hydraulically Fractured Hydrocarbon Production Wells

Ohio AC – Ohio Administrative Code

SOGRE – State Oil and Gas Regulatory Exchange

SPE – Society of Petroleum Engineers

TAC – Texas Administrative Code

TX RRC – Texas Railroad Commission

TIPRO – Texas Independent Producers & Royalty Owners Association

UIC – Underground Injection Control

WQCC – Water Quality Control Commission

State Oil and Gas Regulatory Exchange

Peer Assessment Report 2018
COLORADO Oil and Gas Conservation Commission

SOGRE Colorado: Well Integrity Assessment Team

Leslie Savage, P.G., Chief Geologist, Railroad Commission of Texas
Assessment Team Lead

Leslie Savage is the Assistant Director for Technical Permitting for the Oil and Gas Division of the Railroad Commission of Texas. Over her 34 years of employment with the Commission, Ms. Savage helped develop and/or supervised the Commission's programs for underground injection control (UIC), surface waste management, hazardous oil and gas wastes, naturally occurring radioactive material, waste minimization, and geologic storage of carbon dioxide. Ms. Savage currently is responsible for managing the Groundwater Advisory, Engineering, UIC, and Environmental Permitting Units, as well as coordinating rulemaking for the division, coordinating with federal and other state agencies, and water quality certification of federal permits.

Seth Pelepko, P.G., Environmental Program Manager, Pennsylvania Department of Environmental Protection

Seth Pelepko is an environmental professional with more than 20 years of experience as a project scientist or manager, including both private and public sector work as a geologist. Mr. Pelepko has an extensive background reviewing, interpreting and applying state and federal environmental regulations and laws, and construction specifications to ensure compliance and material performance, respectively. He has completed multi-disciplinary work analyzing datasets to support process development and improvement, and advanced successfully from a staff geologist to division manager responsible for providing regulatory oversight of exploration and production activities and managing the legacy well plugging program in Pennsylvania.

Mr. Pelepko currently serves as the Well Plugging and Subsurface Activities Division Manager for the Pennsylvania Department of Environmental Protection's Bureau of Oil and Gas Planning and Program Management. He has worked in this capacity for over three years and has been with the Office of Oil and Gas Management for almost eight years. His areas of expertise include stray gas migration casework, gas and oil well integrity, and legacy well issues. He previously worked as a petrographer responsible for evaluating construction aggregate and engineering structures and as a hydrogeologist for both the Commonwealth of Pennsylvania and for a private consulting firm. He received a B.S. degree in Earth Sciences in 1998 from the Pennsylvania State University and M.S. degree in Geology from the University of Delaware. He has been a licensed professional geologist in Pennsylvania since 2004.

Additional Resources

Mark Layne, Ph.D., Technical Director, Ground Water Protection Council

Project Facilitator – Staff

Mark Layne received his Doctor of Engineering, specializing in Petroleum Engineering from Missouri University of Science and Technology (formally University of Missouri – Rolla) in 1996. He also holds Bachelor ('85) and Masters ('87) of Science degrees in Petroleum Engineering. He is a retired Professional Engineer in the State of Oklahoma and has been a member of the Society of Petroleum Engineers since 1981. Dr Layne is currently working as the Technical Director for the Water GWPC. In this capacity, he is responsible for management of projects related to data management and regulatory issues dealing with underground injection control. He is working with several state agencies directly with their Oil & Gas Regulatory Data Management Systems, coordinating/performing SOGRE reviews, providing direct support and direction on the "FracFocus Chemical Disclosure" system, and participating in several other initiatives GWPC currently has ongoing.

Prior to joining GWPC, Dr. Layne was a founding partner of ALL Consulting in Tulsa, Ok. There he managed/designed/developed numerous projects dealing with development of data management systems, most notably: the Risk Based Data Management System and FracFocus. Mark also worked on numerous client projects that required Petroleum Engineering, Environmental, and Regulatory support as part of their business.

Scott Kell, Assistant Chief, Ohio DNR: Division of Oil and Gas Resources

Commenter

Scott Kell is the Assistant Chief with the Ohio Department of Natural Resources, Division of Oil and Gas Resources Management (DOGRM). Mr. Kell has over 34 years of oil and gas regulatory experience and has overseen a variety of regulatory programs including Field Inspections and Enforcement, Underground Injection Control, Idle and Orphan Wells, and developed the program for investigating citizen complaints alleging contamination of groundwater. Mr. Kell was elected to the Board of Directors of the national Ground Water Protection Council (2000-2010) including two years as President. During his term as President, Mr. Kell had opportunity to present testimony before the United States House Committee on Natural Resources regarding state water resource protection and shale gas development. Mr. Kell has also worked with the Atlantic Council to present information about state water resource protection regulations and practices to European nations that are considering development of shale gas resources. As a geologist, Mr. Kell continues to assist the DOGRM in the ongoing development of the regulatory framework for the Utica-Point Pleasant Play. Mr. Kell earned a B.S. in Geology from Mount Union College and a M.S. in Geology from Kent State University.

Introduction

The Colorado Oil and Gas Conservation Commission (COGCC or Commission) is responsible for oversight of the development of Colorado's oil and gas natural resources in a manner to ensure the protection of public health, safety, and welfare. This includes the protection of the environment and wildlife resources of the State. To better accomplish these goals, the agency actively solicits participation from, and maintains working relationships with, the State's stakeholders having an interest in Colorado's oil and gas natural resources.

The COGCC has developed a robust regulatory platform to address the needs of the State and the Industry operating in the state. Some of the elements included in the platform are:

- **Enforcement:** A robust enforcement program has been developed to ensure operator compliance.
- **Hearings:** The Agency's Commissioners meet roughly ten times annually to manage the business of the COGCC. These meetings include discussions of important regulatory issues, votes on proposed rules, and reviews of applications and orders before the COGCC.
- **Operator Guidance, Orders & Policies:** The COGCC provides detailed and timely information to operators through various means with regards to the rules, regulations, policies, and relevant forms currently in effect. This information is readily available from the COGCC's website and offices.
- **Rules:** The COGCC provides rules and regulations to establish operational standards and requirements for industry activity in the state.

Information on the COGCC's current regulatory program can be found here: https://cogcc.state.co.us.

Brief History of Oil and Gas in Colorado

Development of oil and gas in Colorado has a rich and long history with initial exploration beginning as early as 1864 near Canon City. In the 1990s, gas production began an increase, while oil production was steady from the 1980s through 2007. From 2007 to 2011, crude oil and gas production were both on the increase. The development of oil and gas is dependent upon several factors, including geology, the cost of extraction and distribution, and commodity prices.

Oil and gas development in Colorado has been on the rise in recent years. The combination of hydraulic fracturing, horizontal drilling technologies, and oil prices had made the extraction of resources in the state economically attractive. This growth has led to a need to better understand oil and gas development and the effectiveness of current practices, spurring a review of rules and regulations to assure that the resource and environment are being protected. In the past decade, many revisions have been made, as can be seen in the document: A Decade of Change: COGCC Policy, Regulation, Transparency - 2007-2017.

SOGRE Assessment

The Commission requested the SOGRE conduct a peer assessment of the Commission's Well Integrity regulations and other topics. Through this peer assessment by the SOGRE Assessment Team ("SOGRE Team"), the Commission sought to obtain the perspective of other state oil and gas regulators on Colorado's regulatory regime. Specifically focusing on insights into best practices and leading edge thought among state oil and gas regulators from around the country. The COGCC requested that the review team identify any perceived regulatory gaps or inefficiencies, insights into other states' approaches to regulating the same or similar topics and suggested modifications to existing or addition of new rules.

The COGCC requested that SOGRE conduct a Peer Assessment of several specific topics within COGCC's existing rules. The scope is such that multiple SOGRE teams were needed, one for each specified topic. Topics were prioritized by the COGCC and each team has autonomy to complete its assigned topic separately. Each group will provide a report for distribution to the COGCC upon completion. A comprehensive report may be generated for finalization of assessment upon approval of all topic reports by COGCC and SOGRE Board. The topics requested include:

- Wellbore integrity regulations;
- Idle well regulations;
- Natural gas storage regulations; and
- Venting and flaring regulations.

Background Materials Evaluated

Each member of the SOGRE Team was supplied the following materials relating to the COGCC's Well Integrity regulatory regime:

1. Colorado Rules and Regs located at: http://cogcc.state.co.us/reg.html#/rules, and specifically:
    a. 300 Series: Drilling, Development, Producing and Abandonment
    b. 200 Series: General Rules
    c. 600 Series: Safety Regulations (BOP, etc.)
2. COGCC Guidance Documents
3. COGCC Policy Documents
4. COGCC Forms
5. Well Integrity Regulatory Elements for Consideration, GWPC 2016[1], document generated to provide a topical outline that a regulator may find useful when updating rules and policies, and it was used in the Excel Crosswalk performed by COGCC and Environmental Defense Fund (EDF).
6. A crosswalk created by EDF and shared with COGCC on the Colorado rules vs. the Well Integrity Regulatory Elements for Consideration, GWPC, 2016 paper.
7. Model Regulatory Framework for Hydraulically Fractured Hydrocarbon Production Wells, EDF 2014.[2]
8. Surface Casing Pressure As an Indicator of Well Integrity Loss and Stray Gas Migration in the Wattenberg Field, Colorado, Published in Environmental Science & Technology.[3]
9. Society of Petroleum Engineers (SPE)-181680-MS - A Continued Assessment of the Risk of Migration of Hydrocarbons or Fracturing Fluids into Fresh Water Aquifers in the Piceance, Raton, and San Juan Basins of Colorado, SPE 181680-MS, SPE 2016[4].

Process

In the course of its deliberations, the review committee consulted a crosswalk prepared by the EDF (which had previously been shared with COGCC staff) that analyzed how Colorado's well integrity rules and policies relate to the GWPC's 2016 "Well Integrity Regulatory Elements for Consideration."

In May 2018, SOGRE Team members Leslie Savage and Seth Pelepko, along with Mark Layne, spent a full day in Austin, TX, reviewing the crosswalk and COGCC's Rules and Regulations. That meeting resulted in the development of a process for reviewing the information provided and developing recommendations specific to Well Integrity. After that meeting, the same team met in a series of 4, 2-hour, conference calls to complete reviewing the information relevant to this report. During their meetings the SOGRE Team consulted with Scott Anderson, Adam Peltz, and Jim Bolander, of EDF, to gather their thoughts on the information contained in the crosswalk. From the meetings many of the recommendations presented in this document were developed.

[1] Well Integrity Regulatory Elements for Consideration, GWPC Aug. 2016, accessed 7/9/2018, http://www.gwpc.org/sites/default/files/Well%20Integrity%20-%20Full%20Publication%202016.pdf.
[2] Model Regulatory Framework for Hydraulically Fractured Hydrocarbon Production Wells, EDF, 2014, accessed 7/9/2018, http://www.edf.org/mrf.
[3] Surface Casing Pressure As an Indicator of Well Integrity Loss and Stray Gas Migration in the Wattenberg Field, Colorado, Environ Sci Technol. 2017 Mar 21;51(6):3567-3574. doi: 10.1021/acs.est.6b06071. Epub 2017 Mar 1.
[4] A Continued Assessment of the Risk of Migration of Hydrocarbons or Fracturing Fluids into Fresh Water Aquifers in the Piceance, Raton, and San Juan Basins of Colorado, SPE 181680-MS, SPE Annual Technical Conference and Exhibition, 26-28 September, Dubai, UAE, SPE 2016.

SOGRE TEAM FINDINGS

A. Statutory Authority and Implementing Regulations

1. Colorado's Oil and Gas Conservation Act (the "Act"), C.R.S 34-60-101 to 34-64-107, current through 2017, provides the Commission with essential jurisdiction and authority necessary to effectively regulate oil and gas exploration and production in the State.
    a. The Act was originally based on IOGCC Model Act. Many oil and gas producing states' conservation acts are also consistent with the IOGCC Model Act.
    b. The Act creates the Colorado Oil and Gas Conservation Commission ("Commission") and provides the Commission with broad general authority to regulate development of Colorado's oil and gas natural resources. C.R.S. 34-60-104.
    c. The Act further provides the Commission authority to regulate many specific aspects of oil and gas exploration and production operations in the state. An outlined listing of specific statutory authorities granted to the Commission is included in Appendix 1.
2. The Commission has adopted comprehensive implementing rules and regulations. The SOGRE Team evaluated these rules and regulations and several guidance and policy publications available on the COGCC website relative to well integrity.

The COGCC's regulations govern several substantive topics. An index of the COGCC's implementing statutes is included in Appendix 2 and rules in Appendix 3.

B. SOGRE Team Recommendations on Well Integrity Regulations

The following recommendations have been developed based on the review of the background information presented. The recommendations are presented in two sections. First, a section on General Recommendation/Observation based on the review performed of COGCC's regulations; and second, individual recommendations based on evaluating the "Well Integrity Regulatory Elements for Consideration" document against COGCC's regulations.

In general, the review team found that the Colorado regulatory framework, respective of well integrity, is strong and includes the main elements necessary to support COGCC's mission related to conservation and environmental protection. However, COGCC should evaluate its rules and regulations to determine whether the program could benefit from more clarity and cohesiveness in certain areas, codification of certain guidance, policy, and field rules, and collection of certain data elements to support Commission data needs and performance standards.

1. General Recommendation/Observation

Recommendation: COGCC should consider a review of regulations where the language references standards, such as American Petroleum Institute (API) and American Society for Testing and Materials (ASTM), to determine if updates are needed to specify the use of the most recent available standards and best management practices (BMPs).

2. The following recommendations are based on the document "Well Integrity Regulatory Elements for Consideration". Where an element is not shown, COGCC's program met the element.

<table>
<tr><th colspan="3">B. Plan Elements</th></tr>
<tr><td></td><td colspan="2">1. Well Spacing</td></tr>
<tr><td>4</td><td>a) Owner identifies zones that may be tested and stimulated by hydraulic fracturing.</td><td rowspan="4">Recommendation: COGCC should consider codifying existing "Horizontal Offset – Statewide Interim Policy" relating to fracture characteristics in the development area/reservoir for all wells in the State with opportunity for variances based on a supporting technical demonstration and consider a requirement to notify adjacent operators in the "area of review" (AOR).</td></tr>
<tr><td>5</td><td>b) Owner identifies the proposed location of the well relative to unit boundaries.</td></tr>
<tr><td>6</td><td>c) Owner identifies and/or regulator evaluates the distance to offset wells that penetrate the target-producing zone or impacted strata within the "area of potential impact", to determine if proximal wellbores are potential conduits for out-of-zone migration of stimulation fluids, and to implement corrective action when necessary.</td></tr>
<tr><td>7</td><td>d) Owner attests, and/or regulator affirms, that there are no known pathways (natural or wellbore) to convey stimulation fluids or gas from "impacted strata" into protected groundwater based upon an assessment of the area of potential impact.</td></tr>
<tr><td colspan="3">References for consideration: COGCC Guidance – Stimulation at Depths 2,000 Feet or Less & Alaska 20 AAC 25.283 (10) & (11)</td></tr>
<tr><td>8</td><td>e) Establish standards for conducting wellbore deviation and inclination surveys.</td><td>Recommendation: COGCC should consider whether inclination surveys should be required in certain circumstances, including "vertical" wells. Further, COGCC should consider enhancing rule language as necessary to accomplish the COGCC's goal of mapping 3D wellbore locations digitally. Such rules would assist in: AOR implementation (i.e., accurately knowing locations of wells to mitigate risk associated with hydraulic fracturing communication incidents), plotting well locations accurately, and avoiding potential collisions.</td></tr>
<tr><td colspan="3">Reference for consideration: MRF 4.9</td></tr>
<tr><td></td><td colspan="2">2. Wellbore Construction</td></tr>
<tr><td>10</td><td>b) Owner provides and/or regulator approves a casing and cementing plan that addresses how anticipated hazards will be addressed.</td><td>Recommendation: COGCC should consider reviewing regulations to determine whether additional requirements should be codified with respect to drilling near a coal mine.</td></tr>
</table>

Reference for consideration: MRF 4.9		
	3. Well Stimulation	
13	c) Owner attests, or regulator affirms, that the intervening zone contains adequate confining layer(s) to prevent migration of pumped stimulation fluids or gas into a source of protected water.	**Recommendation:** See items 4-7 above
Reference for Consideration: MRF 2.3(a)(xiv)		
C. Regulator Authority/Responsibilities		
14	1. Regulator identifies aquifers that must be protected or establishes criteria for identifying protected groundwater.	**Recommendation:** COGCC should confirm that Water Quality Control Commission (WQCC) is using all available data present at COGCC to set protected groundwater depths including, but not limited to, well logs.
15	2. Regulator maintains data and provides information to the industry regarding the depth or basal elevation of protected groundwater, and wellbore depths and locations.	
16	3. Regulator determines or approves the depth of the deepest protected groundwater.	
17	4. Regulator may require sampling and testing, or logging to determine the deepest protected aquifer in areas where it is unknown.	
18	5. Regulator defines and establishes more stringent standards for wells that may be stimulated by hydraulic fracturing when there are questions about the adequacy of confining layer(s).	
References for consideration: WQCC Groundwater quality classifications and standards: Regulation 41 and Regulation 42		
III. Well Control		
	B. Elements	
20	1. Establishes requirements for blowout preventers, control heads and accumulators capable of controlling the maximum anticipated pressure that may be encountered during drilling operations.	**Recommendation:** See General Recommendation on Standards in Section SOGRE Team Findings B. 1. above.
22	3. If drilling with a mud system establishes standards for fluid properties necessary to maintain well control.	**Recommendation:** See General Recommendation on Standards in SOGRE Team Finings Section B.1. above
23	4. Establishes requirements for continual or regular monitoring of the fluid system.	
Reference for Consideration: MRF Section 4.2(d), (e) and (h).		
27	8. Establishes requirements for Formation Integrity Tests where necessary to assess	**Recommendation:** COGCC should consider adding requirements for formation integrity tests in areas where

	breakdown pressure of strata beneath the surface and intermediate casing seats.	the fracture gradient is unknown in appropriate circumstances.
References for Consideration: MRF language - 4.4(f) - surface casing and 4.5(f) - intermediate casing.		
29	10. Establishes standards for wellhead assemblies.	**Recommendation:** COGCC should consider adding a reference to API specification 6A and specifying that all annuli should be capable of being monitored (i.e., surface casing and deeper).
30	11. Establishes standards for emergency response planning.	**Recommendation:** COGCC should consider establishing standards or formalized agreements for emergency response planning for incidents that could pose immediate threats to human health and safety, including, but not limited to, first responder coordination and coordination on blowouts, spills, fires, and uncontained releases.
References for Consideration: MRF language 4.2(v) and Ohio Emergency Operations and Response Section		
IV. Drilling-Well Construction		
	A. Performance objectives; examples:	
33	3. Isolate corrosive zones.	**Recommendation:** COGCC should consider whether additional language is needed to better define which zones should be isolated (e.g., flow zones).
34	4. Isolate flow zones capable of over-pressurizing the surface casing annulus or adversely affecting the cement job.	
Reference for Consideration: 16 Tex. Admin Code (TAC) §3.13		
35	5. Isolate potentially productive zones including the target-producing zone.	**Recommendation:** COGCC should consider reviewing isolation requirements between the area below the surface casing and 200 feet above the shallowest productive zone to clarify zones that can cause known problems (i.e., impairment of cement jobs), those characterized by sustained flows, those that could damage other well construction materials or those that are overpressured. In lieu of requirements, COGCC should consider options for publishing information relating to zones that are potentially problematic.
	C. Drilling Fluids	
41	1. Establishes types of fluids and additives that may be used while drilling through protected groundwater in an uncased wellbore.	**Recommendation:** COGCC should consider whether to codify the COGCC's standards for types of fluids (e.g., air, freshwater, or freshwater-based muds) used during drilling through protected groundwater in an uncased wellbore and prohibiting the use of additives that would be detrimental to the quality of the water zones being drilled.
References for Consideration: MRF Section 4.2(h) and 16 Tex. Admin, Code (TAC) §3.13		
	D. Appropriate casing and casing equipment quality standards	
42	1. Establishes criteria for casing quality (new and/or reconditioned) based on well depth and other anticipated completion	**Recommendation:** COGCC should consider enhancing standards for casing quality. See General

	factors, including an appropriate safety factor.	Recommendation on Standards in Section SOGRE Team Findings B. 1. above.
References for Consideration: MRF Section 4.2 and 16 Tex. Admin Code (TAC) §3.13(a)(6)(C)(iii).		
44	3. Establishes or references quality standards for centralizers.	**Recommendation:** COGCC should consider referencing API specifications for centralizers and requiring casing centralization plans that facilitate effective standoff, cement circulation, and casing installation.
References for Consideration: API Spec 10-D, MRF Section 4.2 and 16 Tex. Admin, Code (TAC) §3.13		
	E. Appropriate cement quality standards	
45	1. Establishes or references standard methods for manufacture of cements.	**Recommendation:** COGCC should consider including baseline standards for cement quality in rules.
References for Consideration: API Spec 10-D, MRF Section 4.2 and 16 Tex. Admin Code (TAC) §3.13		
46	2. Establish quality standards for preparation of slurry.	**Recommendation:** COGCC should consider including mix water quality standards for cement in rules. (see Element #48 below)
References for Consideration: API Standards (RP 10A), MRF Section 4.2, and 16 Tex. Admin Code (TAC) §3.13		
47	3. Establishes or references testing standards for consideration of cement slurries for which published data is unavailable, prior to cementing.	**Recommendation:** COGCC should consider including test standards for cement slurries in rules, when there are no published data.
References for Consideration: API Standards, MRF Section 4.2 and 16 Tex. Admin Code (TAC) §3.13		
48	4. Establishes standards for mix water quality.	**Recommendation:** COGCC should consider including mix water quality standards for cement in rules. (see Element #46 above) See General Recommendation on Standards in Section SOGRE Team Findings B. 1. above.
References for Consideration: API Standards(RP 10A), MRF Section 4.2, and 16 Tex. Admin Code (TAC) §3.13		
49	5. Establishes authority to require specific blends to isolate problematic zones (such as corrosive H2S-bearing zones).	**Recommendation:** COGCC should consider clarifying current policy in rule to require specific cements to isolate problem zones, such as flow zones. COGCC should consider enhancing regulations to include chemically protective cements, and cement standards, where necessary.
50	6. Establishes or references standards for cement slurries circulated to effectively isolate natural gas flow zones.	
References for Consideration: API RP 65-2, BLM Order 6, and COGCC's Reporting H2S		
	F. Wellbore circulation and conditioning	
51	1. Establishes standards for proper conditioning of the wellbore prior to cement emplacement.	**Recommendation:** COGCC should consider codifying standards for wellbore conditioning to kill gas flow, foster adequate cement displacement, and ensure a good bond between cement and the wellbore. See General Recommendation on Standards in Section SOGRE Team Findings B. 1. above.
References for Consideration: MRF Section 4.2, Ohio AC 1501.9-1-08(I) and 16 Tex. Admin Code (TAC) §3.13		
52	2. Establishes standards for wellbore circulation prior to commencement of cementing, if technically feasible.	**Recommendation:** COGCC should consider codifying more specific standards for wellbore conditioning and circulating prior to cementing in the regulations. See General Recommendation on Standards in Section SOGRE Team Findings B. 1. above.

References for Consideration: MRF Section 4.2, API RP 65-2, Ohio AC 1501.9-1-08(I) and 16 Tex. Admin Code (TAC) §3.13		
	G. Cement placement and job evaluation	
53	1. Establishes allowable methods for effective cement placement.	**Recommendation:** COGCC should consider clarifying methods for effective cement placement behind intermediate and production casing. General Recommendation on Standards in Section SOGRE Team Findings B. 1. above.
References for Consideration: MRF Section 4. and COGCC 317(f)		
54	2. Establishes standards for mixing and pumping cement slurry (e.g., free water separation and optimum density standards).	**Recommendation:** COGCC should consider establishing baseline standards for mixing and pumping cement slurry (e.g., balance "optimal" free water separation and density). See General Recommendation on Standards in Section SOGRE Team Findings B. 1. above.
References for Consideration: MRF Section 4.2, API RP 65-2, Ohio AC 1501.9-1-08 and 16 Tex. Admin Code (TAC) §3.13		
55	3. Establishes requirements for minimum annular space, between wellbore and casing, or casing and casing, to ensure emplacement of an effective cement sheath that can be verified by test or log.	**Recommendation:** COGCC should consider establishing baseline standards for minimum annular offset between wellbore and casing or casing and casing through codification of existing policy.
References for Consideration: MRF Section 4.2, API Standards, Ohio AC 1501.9-1-08, 25 Pa. Code § 78.83(b), and 16 Tex. Admin Code (TAC) §3.13		
56	4. Establishes standards for centralization of casing.	**Recommendation:** COGCC should consider codifying standards for centralization of casing that facilitates effective standoff, mud removal, cement circulation, and casing installation. General Recommendation on Standards in Section SOGRE Team Findings B. 1. above.
References for Consideration: MRF Section 4.2(t) and API Standards (10D, Spec 10 TR4, RP 10D-2)		
63	11. Establishes operator oversight/responsibility standard.	**Recommendation:** COGCC should consider if there are circumstances when a service company, such as a company performing cementing, should demonstrate competence.
H. Contractor/Service Company Licensing or Approvals		
64	1. Establishes standards for approved cement contractors and service companies.	**Recommendation:** COGCC should consider if there are circumstances when a service company should demonstrate competence.
65	2. Establish criteria for approval of contractors and service companies.	
References for consideration: MRF 4.8 and TX RRC P&A Certification Requirements		
I. Construction standards address performance objectives (By string)		
	2. Surface Casing	
71	e) Establishes standards for casing centralization.	**Recommendation:** See recommendation for Element #56. **In addition:** COGCC should review current requirements for centralization of surface casing and ensuring that all coal-gas interface issues are adequately addressed (i.e.,

		is a separate casing program necessary for coal/mine protection).
References for Consideration: MRF Section 4.2(t) and API Standards (10D, Spec 10 TR4, RP 10D-2)		
	4. Production Casing	
74	a) Establishes a minimum standard for the height of cement above the uppermost perforation of the production casing or top of the production zone, or upper most flow zone.	**Recommendation:** COGCC should determine whether to codify requirements to isolate zones, such as flow zones, corrosive zones, and lost circulation zones.
75	b) Hydrocarbon-bearing zones above the target producing zone, must be isolated if necessary, to prevent annular over-pressurization (if not isolated using intermediate casing).	
References: See elements 31-37 above and in Well Integrity Regulatory Elements for Consideration		
76	c) Establishes additional standards for wells with a limited intervening zone.	**Recommendation:** COGCC should consider codifying existing policy "Stimulation at Depths 2,000 Feet or Less – Practices and Procedures" for wells with limited intervening zones.
Reference for Consideration: MRF Section 4.7		
	J. Assessment of mechanical integrity (MI) after each casing string is emplaced and cemented.	
77	1. Establishes authority to require reporting of defective casing or cement diagnostic work and appropriate corrective action.	**Recommendation:** COGCC should consider exploring ways to improve cohesiveness between all pressure testing/well integrity metric requirements and better defining the pathway for resolution.
78	2. Establishes standard for pressure test prior to drill-out to verify casing integrity and cement displacement.	
79	3. Defines when cement evaluation logs or other approved methods are required to assess integrity.	
References: See elements 58-61 above		
	K. Reports	
82	3. Establishes log and reporting requirements for geologic information (e.g., mud log records, wire line logs, well completion reports) including base of protected water zones, depth and thickness of hydrocarbon bearing flow zones, lost circulation zones, formation voids, the intervening zone, and all zones to be tested or produced.	**Recommendation:** COGCC should review all reporting requirements to determine whether the information is adequate to allow COGCC to ensure well integrity.
V. Well Completion- Hydraulic Fracturing		
	A. Performance Objectives, e.g.	

87	4. Integrity failures are addressed and corrective actions affirmed by test prior to commencement of hydraulic fracturing operations.	**Recommendation:** COGCC should consider adding an appropriate safety factor to the test pressure, depending on the objective of the test.
Reference for Consideration: MRF Section 5.2(a)		
	B. Pre-Stimulation Testing	
88	1. Specifies when an owner is required to notify regulator prior to commencement of testing and stimulation.	**Recommendation:** COGCC should consider adding an appropriate safety factor to the test pressure, depending on the objective of the test.
89	2. Establishes standard for wellbore MI verification before commencement of hydraulic fracturing operations.	
Reference for Consideration: MRF Section 5.2(a)		
90	**3. Establishes standard for surface equipment integrity verification before commencement of hydraulic fracturing operations.**	**Recommendation:** Although not directly related to wellbore integrity in all cases, COGCC should consider codifying standards for determining surface equipment integrity before hydraulic fracturing operations.
Reference for Consideration: MRF Section 5.2(c)		
	C. Hydraulic Fracturing Operations	
91	1. Specifics which casing strings may be perforated for stimulation purposes.	**Recommendation:** COGCC should consider codifying the requirement for a dual string configuration of surface casing and production casing for any well that is hydraulically fractured.
Reference for Consideration: MRF Section 4.5(i)		
92	2. Establishes criteria for continuous monitoring of wellbore integrity throughout the hydraulic fracturing operation.	**Recommendation:** COGCC should consider codifying requirements for annular monitoring during hydraulic fracturing.
93	3. Identifies injection parameters that should be continuously monitored and recorded during the hydraulic fracturing operation.	**Recommendation:** COGCC should consider requiring continuous monitoring and recording, and reporting upon request, of injection parameters, such as surface injection pressure, slurry rate, and annular pressures.
Reference for Consideration: MRF Section 5.3(b)		
94	4. Establishes criteria for terminating hydraulic fracturing operations if there is evidence of MI failure or breach.	**Recommendation:** COGCC should consider establishing criteria for terminating hydraulic fracturing operations when there are indications of failure (wellbore integrity or formation integrity), and criteria under which operations can resume after such failures. Further, COGCC should consider setting thresholds for parameters that indicate the failure of the job.
References for Consideration: MRF Section 5.3(d) and API 100		

95	5. Establishes conditions for notifying regulator if failure symptoms are observed.	**Recommendation:** COGCC should consider establishing thresholds for notifying the Commission of failure symptoms (e.g., wellbore integrity or formation integrity) for other test parameters. Further, COGCC should consider including timeframes for when Commission notifications occur and establishing protocols for when resumption of activities can occur.
Reference for Consideration: MRF Section 5.3(d)		
	D. Reports	
97	2. Establishes report types and minimum data elements for wellbore construction reports (e.g., perforation reports, pumping charts, job summary reports, well completion reports, etc.).	See Recommendation for element 8
	E. Hydraulic Fracturing Service Company Licensing or Approvals	
99	1. Establishes authority to require use of approved service companies.	See Recommendation for elements 64 and 65
100	2. Establishes criteria for approval of hydraulic fracturing service companies.	
Reference for Consideration: MRF Section 5.5		
VI. Production Operations		
	A. Objectives, e.g.	
106	2. Maintain wellbore integrity.	**Recommendation:** COGCC should consider expanding bradenhead monitoring requirements to all wells in the State. COGCC should also consider whether different or more specific protocols for bradenhead pressure testing are needed. Further, COGCC should consider establishing a threshold pressure at which a bradenhead pressure test and submission of Form 17 is required. Finally, COGCC should consider when additional testing should be required and if routine, periodic monitoring (e.g., pressures, leaks/flows, and corrosion) and reporting should be required.
References for Consideration: MRF Section 6.2(e), API 90-2 Section 8, Tex. Admin. Code §3.17; (TIPRO Guidance), and PA Mechanical Integrity Assessment process.		
	B. Elements	
108	1. Establishes standard for monitoring of wellbore integrity during the production phase of E&P operations (e.g., Post-completion tubing, casing, and bradenhead pressures are monitored to detect MI failures and potential annular over-pressurization).	**Recommendation:** COGCC should consider the data and frequency of monitoring, testing, and reporting requirements to determine whether these data are providing adequate information concerning well integrity.
References for Consideration: MRF Section 6.2, see Recommendation on Element 106		

109	2. Identifies when owner must notify Regulator if MI failures and/or annular over-pressurization are detected.	See Recommendations for Elements 106 and 108.
References for Consideration: MRF Section 6.2		
110	3. Process defined to prevent annular over-pressurization.	**Recommendation:** COGCC should consider whether requiring pressure relief valves would be a valuable tool in areas where COGCC has established specific pressure thresholds.
Reference for Consideration: MRF Section 6.2(d)		
VII. Well Plugging		
	2. Timeframes	
117	a) Establishes timeframes for plugging dry holes.	**Recommendation:** COGCC should consider codifying practices that involve plugging dry holes while the drill rig is on location.
Reference for Consideration: MRF Section 7.3(a)		
118	b) Establishes timeframes for plugging inactive wells.	**Recommendation:** COGCC should review SOGRE Idle Well Report and assess implementation of suggested recommendations.
119	c) Establishes process for extensions and suspension of extensions.	
Reference for Consideration: MRF Section 7.3 and 7.3(b)		
	3. Temporary inactive (suspended) status	
120	a) Establishes a process for acquiring Temporary Inactive status.	**Recommendation:** COGCC should review its current requirements for maintaining inactive status and ensuring ongoing integrity during inactive status to determine whether additional requirements might be necessary.
	4. Plugging operations	
123	a) Defines zones that require isolation.	See discussion of zonal isolation in well completion, Elements 31, 33-36 (above).
References for Consideration: MRF Section 7.5 – 7.12		
126	d) Establishes standards for mix water quality.	**Recommendation:** COGCC should consider including mix water quality standards for cement in rules. (see Elements #46 and #48 above)
References for Consideration: MRF 7.5(3), API Standards (RP 10A), and 16 Tex. Admin Code (TAC) §3.13		
129	g) Specifies when and how plugs must be tagged or tested.	**Recommendation:** COGCC should consider codifying the current requirements for tagging isolation plugs and perform a review to determine if there are other circumstances when the plug should be tagged.
	5. Inspections	
132	b) Establishes criteria for plugging approval or corrective action order.	**Recommendation:** COGCC should consider if state requirements are adequate to compel operators to address failed plugs. For example, can COGCC require monitoring and corrective action and, if so, over what time frame?

References for Consideration: MRF Section 7.5(n)

Disclaimer

The SOGRE Team has not performed a legal analysis or interpretation of the COGCC's Rules or the Colorado Oil and Gas Conservation Act, and nothing contained in this Report should be construed to be a legal analysis or interpretation.

Appendix 1:
Supporting Materials for Assessment/Additional Information Used

The Act expressly vests the Commission with the following regulatory authority, among others:

34-60-106. Additional powers of commission - rules

1. The commission also has authority to require:
    a. Identification of ownership of oil and gas wells, producing leases, tanks, plants, and structures;
    b. The making and filing with the commission of copies of well logs, directional surveys, and reports on well location, drilling, and production; except that logs of exploratory or wildcat wells marked "confidential" shall be kept confidential for six months after the filing thereof, unless the operator gives written permission to release such logs at an earlier date;
    c. The drilling, casing, operation, and plugging of seismic holes or exploratory wells in such manner as to prevent the escape of oil or gas from one stratum into another, the intrusion of water into oil or gas stratum, the pollution of fresh water supplies by oil, gas, salt water, or brackish water; and measures to prevent blowouts, explosions, cave-ins, seepage, and fires;
    d. (Deleted by amendment, L. 94, p. 1980, § 6, effective June 2, 1994.)
    e. That every person who produces, sells, purchases, acquires, stores, transports, refines, or processes oil or gas in this state shall keep and maintain within this state, for a period of five years, complete and accurate records of the quantities thereof, which records, or certified copies thereof, shall be available for examination by the commission, or its agents, at all reasonable times within said period and that every such person shall file with the commission such reasonable reports as it may prescribe with respect to such oil or gas or the products thereof;
    f. That no operations for the drilling of a well for oil and gas shall be commenced without first giving to the commission notice of intention to drill and without first obtaining a permit from the commission, under such rules and regulations as may be prescribed by the commission, and paying to the commission a filing and service fee to be established by the commission for the purpose of paying the expense of administering this article as provided in section 34-60-122, which fee may be transferable or refundable, at the option of the commission, if such permit is not used; but no such fee shall exceed two hundred dollars;
    g. That the production from wells be separated into gaseous and liquid hydrocarbons and that each be accurately measured by such means and standards as prescribed by the commission;
    h. The operation of wells with efficient gas-oil and water-oil ratios, the establishment of these ratios, and the limitation of the production from wells with inefficient ratios;
    i. Certificates of clearance in connection with the transportation and delivery of oil and gas or any product; and
    j. Metering or other measuring of oil, gas, or product in pipelines, gathering systems, loading racks, refineries, or other places.
2. The commission has the authority to regulate:
    a. The drilling, producing, and plugging of wells and all other operations for the production of oil or gas;
    b. The shooting and chemical treatment of wells;
    c. The spacing of wells; and
    d. Oil and gas operations so as to prevent and mitigate significant adverse environmental impacts on any air, water, soil, or biological resource resulting from oil and gas operations to the extent necessary to protect public health, safety, and welfare, including protection of the environment and wildlife resources, taking into consideration cost-effectiveness and technical feasibility.
3. The commission also has the authority to:
    a. Limit the production of oil or gas, or both, from any pool or field for the prevention of waste, and to limit and to allocate the production from such pool or field among or between tracts of land having separate ownerships therein, on a fair and equitable basis so that each such tract will be

permitted to produce no more than its just and equitable share from the pool and so as to prevent, insofar as is practicable, reasonably avoidable drainage from each such tract which is not equalized by counter-drainage; and

b. Classify wells as oil or gas wells for purposes material to the interpretation or enforcement of this article.

For additional authority granted to the commission it is recommended that the reader review the C.R.S. Title 34 and the COGCC Rules and Regulations.

Appendix 2:
Index to Implementing Statutes

TITLE 34. MINERAL RESOURCES: OIL AND NATURAL GAS

ARTICLE 60.OIL AND GAS CONSERVATION

34-60-101. Short title

34-60-102. Legislative declaration

34-60-103. Definitions

34-60-104. Oil and gas conservation commission - report - publication

34-60-104.5. Director of commission - duties

34-60-105. Powers of commission

34-60-106. Additional powers of commission - rules

34-60-107. Waste of oil or gas prohibited

34-60-108. Rules - hearings - process

34-60-109. Commission may bring suit

34-60-110. Witnesses - suits for violations

34-60-111. Judicial review

34-60-112. Plaintiff post bond

34-60-113. Trial to be advanced

34-60-114. Action for damages

34-60-115. Limitation on actions

34-60-116. Drilling units - pooling interests

34-60-117. Prevention of waste - protection of correlative rights

34-60-118. Agreements for development and unit operations

34-60-118.5. Payment of proceeds - definitions

34-60-119. Production - limitation

34-60-120. Application of article

34-60-121. Violations - penalties - rules - legislative declaration

34-60-122. Expenses - fund created

34-60-123. Interstate compact to conserve oil and gas

34-60-124. Oil and gas conservation and environmental response fund

34-60-125. Mitigation of adverse environmental impacts. (Repealed)

34-60-126. Credit allowed for prior payment for mitigation of environmental impacts. (Repealed)

34-60-127. Reasonable accommodation

ARTICLE 61. OIL WELLS AND BOREHOLES

ARTICLE 62. INSPECTION OF OIL WELLS

ARTICLE 63. ROYALTIES UNDER FEDERAL LEASING

ARTICLE 64. UNDERGROUND STORAGE

ARTICLE 70. GEOTHERMAL RESOURCES

Appendix 3:
Index to implementing Rules

Rules:

100 Series - Definitions

200 Series - General Rules

300 Series - Drilling, Development, Producing and Abandonment

400 Series Unit Operations, Enhanced Recovery Projects

500 Series Rules of Practice and Procedure

600 Series Safety Regulations

700 Series Financial Assurance and Environmental Response Fund

800 Series Aesthetic and Noise Control Regulations

900 Series Exploration and Production Waste Management

1000 Series Reclamation Regulations

1100 Series Flowline Regulations

1200 Series Protection of Wildlife Resources

Appendix I - Information on Completing COGCC Forms

Appendix III - Fee Structure

Appendix IV - Due Date/Response Time

Appendix V - Oil & Gas Conservation Act Title 34-Article 60 (Amended)

Appendix VI - Public Water Systems

Appendix VII - Restricted Surface Occupancy Maps (Amended)

Appendix VIII - Sensitive Wildlife Habitat Maps

Appendix 4:
COGCC Responses

This Appendix contains the response from COGCC on the recommendations made. Below is a response letter provided by COGCC and their responses keyed to the recommendations in the body of this assessment.

COLORADO
Oil & Gas Conservation Commission
Department of Natural Resources

1120 Lincoln Street, Suite 801
Denver, CO 80203

January 3, 2019

Mr. Gerry Baker
Interstate Oil and Gas Compact Commission
900 NE 23rd Street
Oklahoma City, OK 73105

RE: COGCC Response to SOGRE Colorado: Well Integrity Peer Assessment Report 2018

Dear Mr. Baker,

At the request of the Colorado Oil and Gas Conservation Commission (Commission), the State Oil and Gas Regulatory Exchange (SOGRE) has provided 132 comments and recommendations related to the Commission's rules, policies and guidances (Rules) on oil and gas well integrity and construction. The Commission appreciates SOGRE's review. It is through this review that the Commission can consider where Rules on oil and gas well construction, integrity and monitoring may need to be updated or revised. The benefit of the SOGRE review is that the assessment is a collaborative review from other states' regulatory oil and gas agencies (Texas, Pennsylvania, and Ohio), Groundwater Protection Council (GWPC) and Interstate Oil and Gas Compact Commission (IOGCC). These other states with the guidance from the GWPC/IOGCC have provided a balanced review. Many of these states have recently reviewed their well integrity and construction Rules. It is important for the Commission to review our Rules related to well integrity and construction due to the oil and gas industry transition into many new drilling, completion and production practices, as well as, better defining expectations currently set forth in Commission Rules. SOGRE's review utilized not only the other states Rules, but it used published information from Groundwater Protection Council, the Environmental Defense Fund and published academic and industry articles and standards as a basis for comments and recommendations.

SOGRE provided the recommendations in a tabular format, which has allowed Commission staff (Staff) to respond to each recommendation. Staff have reviewed

the 132 comments and recommendations along with the various references. Staff has provided clarifying comments, which are intended to provide understanding as to how the Commission does or does not currently regulate the topic or issue. There are Rule recommendations the Commission accepts fully, partially, or feels the current Rules address. There are a few rare cases were Staff does not support the recommendation.

In general, the Commission accepts incorporation of industry standards. These standards will be a benefit to the current rules as a way to incorporate industry best practices. Further, there are several current Commission standard practices, which need to be incorporated into regulations. As an example, Horizontal Offset Policies (Horizontal Offset - DJ Basin Policy and Horizontal Offset - Statewide Interim Policy were implemented in 2013 as a policies. The policy is a standard practice for permit review of adjacent wells.

There are cases where Conditions of Approvals (COA) are routinely added to permits. Where COAs are indicating a required best practice across all permitted wells, the requirements should be codified to the greatest extent possible in COGCC rules. As an example, because there is not a statewide requirement for bradenhead testing, bradenhead testing and reporting prior and post hydraulic fracturing is a COA placed on all eastern Colorado drilling permits. A bradenhead monitoring rule would be beneficial to monitor well integrity through a well's productive life. There are a few other rule updates related to current industry practice: top of cement requirements, centralization, surface casing depth, and other technical aspects of well construction practice that could be updated.

It is important to understand the Commission Rules are focused on performance based standards with some prescriptive elements. The Commission believes an operator needs the flexibility to construct a well to meet an objective within industry standards. The means and method should reside on the operator to meet the objective. A good example is rule 317.k.

317.k. Production and intermediate casing pressure testing. The installed production casing or, in the case of a production liner, the intermediate casing, shall be adequately pressure tested for the conditions anticipated to be encountered during completion and production operations.

The simplicity of this rule is very dynamic. The use of "*... conditions anticipated to be encountered during completion and production operations*" directly includes perforation, hydraulic fracturing, pumping, or other completion and production operations. The Staff sees no benefit in creating a redundant rule specifically for the completion practice of hydraulic fracturing.

Another example is Rule 317 regarding formation fluid isolation, states all formation fluids (water or hydrocarbons) are to be isolated to the formation of origin. Neither hydrocarbon nor fresh water can move between formations. As a regulatory agency, any rule revision needs to provide for monitoring operator compliance, but also offer regulatory certainty for the regulated community. Thoughtful and thorough analysis of the rule (current or proposed) and its implementation through stakeholder engagement is an important aspect in the success of the final rules. Rules that are open to interpretation are difficult for both the Commission and the regulated community to navigate. It is for this reason the Commission supports performance based criteria. With solid criteria, regulatory monitoring through bradenhead testing, mechanical integrity testing and limiting the duration of inactive wells, COGCC can better ensure lasting wellbore integrity.

Attached is Commission Staff review and response of the SOGRE 132 point well Integrity analysis.

Sincerely,

Stuart Ellsworth
Engineering Manager

Individual Responses

1. General Recommendation/Observation

COGCC Response: The Commission is supportive where appropriate of the use and inclusion of API and ASTM standards. The Commission does review periodically its regulations for necessary updates to reference standards.

2. Recommendations Based on "Well Integrity Regulatory Elements for Consideration"

B. Plan Elements		
	1. Well Spacing	**COGCC Comments**
4	a) Owner identifies zones that may be tested and stimulated by hydraulic fracturing.	The Act and Rules 318, 318A and 318B regulate well spacing statewide, including the location of the wells relative to unit boundaries. Rule 318 applies generally statewide. Rule 318A and 318B are field wide rules for Greater Wattenberg Area and Yuma County, respectively. If an operator believes well spacing should be different from what the rules provide, the operator must file a spacing application to request to the Commission for a Commission hearing to allow for a variance from the rules. Further, prior to the Commission approving a drilling permit (APD) for a well in a unit, an operator must request the Commission create a unit. That process requires identification of the horizon to be produced and evidence of drainage with geologic and engineering testimony. The testimony must include discussion of stratigraphy and structural geology, hydrologic fracture models, microseismic results, transient models or other evidence to define the relationship between wells. Staff reviews the technical information in determining whether the spacing or setbacks effectively define an area of impact and prevent impacts to correlative rights. It is important to understand that in Colorado over 90% of the wells have had large volume hydraulic fracture treatments since the late 1980s due to the Federal Tight Gas Sand incentives. Therefore, Staff assumes all wells are to be hydraulically fractured until told otherwise and identifying zones to be hydraulically fractured may not be necessary nor perceived as unique.
5	b) Owner identifies the proposed location of the well relative to unit boundaries.	
6	c) Owner identifies and/or regulator evaluates the distance to offset wells that penetrate the target-producing zone or impacted strata within the "area of potential impact", to determine if proximal wellbores are potential conduits for out-of-zone migration of stimulation fluids, and to implement corrective action when necessary.	Currently, the state utilizes two policies related to an AOR for any proposed well. Both use a 1,500-foot radius around the proposed well. All wells within 1,500 feet are reviewed (including horizontal, directional and vertical wells, dry and abandoned, plugged and abandoned wells, and producing wells) for proper well construction which protects the usable water zones and isolates the hydrocarbon and flow zones from the pressure influences of an adjacent hydraulic fracture treatment. Current policies are: Horizontal Offset - Statewide Interim Policy, February 14, 2014. Horizontal Offset - DJ Basin Policy, December 17, 2013. These policies could be elevated to a rule with the inclusion of reviewing directional and vertical APDs. Such a rule would include a requirement to remediate inadequately constructed adjacent wells prior to hydraulic stimulation of the proposed well.

7	d) Owner attests, and/or regulator affirms, that there are no known pathways (natural or wellbore) to convey stimulation fluids or gas from "impacted strata" into protected groundwater based upon an assessment of the area of potential impact.	The literature and studies have indicated that an inadequately constructed or abandoned adjacent well is the most likely case to convey the effects (pressure of fluids) from an adjacent hydraulic fracture treatment. Currently, operators perform an adjacent well review and comply with Rules 317.r. and 317.s., which are intended to mitigate any adjacent well impacts.
8	e) Establish standards for conducting wellbore deviation and inclination surveys.	Current COGCC rules (described below) require directional surveys be submitted for planned deviated, directional or horizontal wells. There is value in extending the requirement to include 'vertical' wells. Directional data for all wells has proven beneficial for future development as in the current DJ Basin horizontal play, where horizontal wells are placed near the existing deeper vertical and directional wells. ***COGCC Rule 303a.(5)E. Deviated Drilling Plan.*** *A Form 2 to drill a deviated wellbore (directional, highly deviated, or horizontal) utilizing controlled directional drilling methods shall have the deviated drilling plan attached. The deviated drilling plan shall meet the requirements set forth in Rule 321.* ***308A. COGCC Form 5. DRILLING COMPLETION REPORT*** *b. (2) E. Any directional survey shall be attached to the Form 5 and shall meet the requirements set forth in Rule 321.* **321. DIRECTIONAL DRILLING** (see rule for details) a. Deviated Drilling Plan. b. Well Location Plat. c. Directional Survey. d. Wellbore Setback Compliance.
	2. Wellbore Construction	**COGCC Comments**
10	b) Owner provides and/or regulator approves a casing and cementing plan that addresses how anticipated hazards will be addressed.	Current rules described below, require Permits-to-Drill identify hazards including mines, as stated in Rule 318.e. and 608.c. There is value to clarifying or codifying a requirement for surface casing coverage through the zones of known hazards like slope stability, near surface fracture zones (edge of Roan Plateau), mining activities or other geotechnical hazards. Due to the presence of shallow coal mining activities, engaging with the Colorado Department of Natural Resources Division of Reclamation, Mining and Safety Division is important, and engagement can include updating the existing COGCC Geographic Information System (GIS) mapping system to show mines. This is a COGCC GIS mapping layer available to industry and the public. *318.e. Wells located near a mine. No well drilled for oil or gas shall be located within two hundred (200) feet of a shaft or entrance to a coal mine not definitely abandoned or sealed, nor shall such well be located within one hundred (100) feet of any mine shaft house, mine boiler house, mine engine house, or mine fan; and the location of any proposed well shall insure that when drilled it will be at least fifteen (15) feet from any mine haulage or airway.* 608.c. addresses coal outcrop and coal mine monitoring.

	3. Well Stimulation	
13	c) Owner attests, or regulator affirms, that the intervening zone contains adequate confining layer(s) to prevent migration of pumped stimulation fluids or gas into a source of protected water.	See items 4-7 response above. Due to known and documented geology and stratigraphy in Colorado, the intervening zones between producing zones that confine the treatments are known. Nonetheless, Commission engineers review each permit to evaluate confinement in order to assure the isolation of wellbore fluids. The Commission's website has a white paper summarizing staff's review process and procedures. The review process is documented in a white paper on the COGCC Library/Technical Report website: Colorado's Wellbore Integrity Program – White Paper (09/15/2012) HYPERLINK "http://cogcc.state.co.us/documents/library/Technical/Engineering_White_Papers_and_Presentations/Wellbore%20Integrity%209-26-12.pdf"
C. Regulator Authority/Responsibilities		
		COGCC Comments
14	1. Regulator identifies aquifers that must be protected or establishes criteria for identifying protected groundwater.	The Commission works with the Department of Natural Resources Division of Water Resources (DWR), the Colorado Geological Survey, as well as the Colorado Department of Public Health and Environment and WQCC. Each of these agencies provide the Commission with feedback and a basis for defining current and future usable water resources. Each have published reference materials available to the COGCC on Colorado's water resources and hydrogeology. As a result staff have the following reference tools: 1. The Commission's GIS mapping system incorporates all the DWR permitted water wells. (All water wells in Colorado are required to be permitted.) 2. The Commission has required openhole geophysical logs for decades to define stratigraphy. Using these logs, DWR has mapped aquifers. 3. The Commission uses these logs to confirm surface casing coverage individually for each well drilling permit. 4. Further, the aquifer coverage is reviewed prior to any permit request for well intervention, i.e. recomplete or workover requiring cement. The Commission engineering staff review process is documented in a white paper on the COGCC Library/Technical Report website: Colorado's Wellbore Integrity Program – White Paper (09/15/2012) The Commission makes all of this data available to the public and to industry. The Regulation/Forms section of the website has instructions on how to access the GIS water well data. Commission staff brief stakeholders on using the GIS system and other website elements through the monthly Operator Meeting outreach meetings. Additionally, Commission Rule 910 sets forth the concentrations and sampling requirements for soil and groundwater. Rule 910.a. provides that the groundwater concentration set forth in the Rule "are derived from the ground water standards and classifications established by WQCC."
15	2. Regulator maintains data and provides information to the industry regarding the depth or basal elevation of protected groundwater, and wellbore depths and locations.	
16	3. Regulator determines or approves the depth of the deepest protected groundwater.	

17	4. Regulator may require sampling and testing, or logging to determine the deepest protected aquifer in areas where it is unknown.	The Commission can and has used the process of permit Conditions of Approval (COA) to require water sampling. In addition, Rule 317.f references unknown aquifers by addressing surface casing where subsurface conditions are unknown.
18	5. Regulator defines and establishes more stringent standards for wells that may be stimulated by hydraulic fracturing when there are questions about the adequacy of confining layer(s).	Due to most (over 90%) wells in Colorado being hydraulically fractured since the 1980s, the Commission reviews permits for all wells with the criteria that the treatment stay in formation. The applied treatment is to be managed through the well's casing and cementing design.
III. Well Control		
	B. Elements	**COGCC Comments**
20	1. Establishes requirements for blowout preventers, control heads and accumulators capable of controlling the maximum anticipated pressure that may be encountered during drilling operations.	Currently, the Commission rules reference API 53. There is an opportunity to broaden blowout prevention requirements to include workovers and well plugging operations.
22	3. If drilling with a mud system establishes standards for fluid properties necessary to maintain well control.	Many of the wells in Colorado, due to the low porosity and permeability, are drilled with managed pressure drilling methods. Well control is managed by circulating pressure and mechanical procedures and is not solely based on the traditional fluid density method. Therefore, a rule revision focused primarily on rheology might miss the objective of controlling the wells with managed pressure drilling methods. Here a rule based on performance objectives-requiring operators to maintain well control and utilizing reference to industry best practices and guidance are the preferred approach. There would be a benefit to adding a relevant API standard(s) for well control as a performance-based standard.
23	4. Establishes requirements for continual or regular monitoring of the fluid system.	See above
27	8. Establishes requirements for Formation Integrity Tests where necessary to assess breakdown pressure of strata beneath the surface and intermediate casing seats.	Currently, the Commission requires formation integrity tests on a case-by-case basis through COAs or a Commission Order. For example, the Commission Order for the Piceance Basin East Mamm Creek Area requires Formation Integrity Test (FIT) after surface casing drill out. Clarifying what circumstances warrant requiring a FIT test might benefit Colorado's regulatory regime. There are some circumstances where a FIT might be warranted, i.e. field extension, new formation development, or areas of known high bradenhead pressure.

		Rule 207 allows the Commission to require a test. The rule currently has a subpart for bradenhead testing. For clarity, this rule could be expanded to include the situation when the commission would request a FIT.
29	10. Establishes standards for wellhead assemblies.	Rule 341 requires "During stimulation operations, bradenhead annulus pressure shall be continuously monitored and recorded on all wells being stimulated." Additional requirements to provide the capability to monitor additional annuli is appropriate. There have been no recent documented wellhead failures in Colorado due to manufacture, operations or maintenance. There have been a few accidents, where agriculture equipment struck the wellhead. Including an industry standard for wellhead assembly could enhance the MI of wellheads.
30	11. Establishes standards for emergency response planning.	The Commission engages with the local governments and state emergency response agencies to coordinate responses to natural events, wildfires and hydrocarbon releases. However, these engagements are not set forth in a formalized agreement. Whether formalizing the process could be achieved via Memorandum of Understanding or rulemaking would need to be reviewed given that current Rule 602 directs operators to engage local emergency response. Further, the rule requires an operator report spills, releases, accidents, and well control issues to the Commission through Forms 19, 44, 22 and 23. We see this as a discussion outside of a narrowed well integrity rule or policy review.
IV. Drilling-Well Construction		**COGCC Comments**
	A. Performance objectives; examples:	
33	3. Isolate corrosive zones.	To date, Colorado does not have a major corrosive zone issue and, therefore, staff has addressed this concern by reviewing drilling permits for cement isolation in the two areas of the state that have corrosive concerns. The two areas are the Blaine Formation in eastern Colorado, which is mostly gypsum with some salt, and the Paradox Basin, which has some salt. It should be noted that the Commission Rule *317.e.* ***Casing and cement program to protect hydrocarbon formations and ground water.*** *The casing and cement program for each well must prevent oil, gas, and water from migrating from one formation to another behind the casing. Ground water bearing zones penetrated during drilling must be protected from the infiltration of hydrocarbons or water from other formations penetrated by the well.* Rule 317.e. would include the concept of flow zones. The Commission could consider clarifying the concept of "flow zones." Current Rule 317 implies that all fluids need to be isolated in their formation of origin, including hydrocarbons and formation waters. However, corrosion and steel casing wear can occur with both "fresh" and brine formation waters. Therefore, including isolation of flow zones could provide clarity and reduce confusion when staff require cement across flow zones.
34	4. Isolate flow zones capable of over-pressurizing the surface casing annulus or adversely affecting the cement job.	

35	5. Isolate potentially productive zones including the target-producing zone.	As with comment 34 above, the Commission has basin and area specific requirements for cement placement to provide zonal isolation. In the Piceance Basin, Field Scout Cards define the required well construction and cement isolation. These are found on the Commission website Data/ Field Scout Card Page. The Commission could provide operators with a bulletin regarding known geologic and formation pressure issues of concern. A bulletin would allow the Commission to provide updates. The inclusion of over-pressured and under-pressured zones would have benefits for drilling and cementing operations.
	C. Drilling Fluids	**COGCC Comments**
41	1. Establishes types of fluids and additives that may be used while drilling through protected groundwater in an uncased wellbore.	The Commission's Form 2, Permit to Drill requires an operator to acknowledge the type of drilling fluid: water, oil or brine based. During the engineering staff review of every Form 2, the fluid type is reviewed. Whenever an operator is intending to use oil or brine based drilling fluid, staff engineers place a COA to require fresh water drilling fluids be used during drilling, running, and cementing of the surface casing. Operators are currently using fresh water to drill the surface casing through the freshwater zones and use oil-based mud after setting the surface casing. The current practice of using fresh water to drill and place the surface casing could be codified. Including this as a revision to Rule 317 may be more efficient, reducing engineering staff need to place the COA on permits.
	D. Appropriate casing and casing equipment quality standards	
		COGCC Comments
42	1. Establishes criteria for casing quality (new and/or reconditioned) based on well depth and other anticipated completion factors, including an appropriate safety factor.	This seems an appropriate place to use industry standards. Rule 317.k. is very powerful in its simplicity. It requires operators to maintain the casing strength to <u>any anticipated applied pressure</u>. COGCC understands to calculate casing burst and collapse strength, the applied pressures and safety factors are elements of the computation, which are based on industry standards (API and ASTM). It would seem more appropriate for the Commission to utilize industry standards along with the current rule as written. ***317.k. Production and intermediate casing pressure testing.*** *The installed production casing or, in the case of a production liner, the intermediate casing, shall be adequately pressure tested for the conditions anticipated to be encountered during completion and production operations.*
44	3. Establishes or references quality standards for centralizers.	The addition of industry standards would be appropriate.

	E. Appropriate cement quality standards	
		COGCC Comments
45	1. Establishes or references standard methods for manufacture of cements.	The addition of industry standards would be appropriate.
46	2. Establish quality standards for preparation of slurry.	The addition of industry standards would be appropriate.
47	3. Establishes or references testing standards for consideration of cement slurries for which published data is unavailable, prior to cementing.	The addition of industry standards would be appropriate.
48	4. Establishes standards for mix water quality.	Engineering staff are cautious about codifying a rule based on cement mix designs due to the need for mix designs to be based on the specific application, use and performance objectives. The designs need to meet strength and isolation seal criteria as defined by Rule 317. Codifying design specifications can restrict the ability for a cement mix to meet an objective. Here again, COGCC believes performance-based rules with reference to industry standards are best. The addition of industry standards would be appropriate.
49	5. Establishes authority to require specific blends to isolate problematic zones (such as corrosive H2S-bearing zones).	See comment 33 above
50	6. Establishes or references standards for cement slurries circulated to effectively isolate natural gas flow zones.	The addition of industry standards would be appropriate.
	F. Wellbore circulation and conditioning	
		COGCC Comments
51	1. Establishes standards for proper conditioning of the wellbore prior to cement emplacement.	We are cautious of being too prescriptive for fear operators will think this is the maximum effort necessary prior to placing cement. This is an example where using an industry standard would be appropriate. There is value in adding language stating circulation is to be established with turbulent flow prior to placing cement, which would have benefits to improve cement placement. The addition of industry standards would be appropriate.
52	2. Establishes standards for wellbore circulation prior to commencement of	Current Rule 317.i & j use the language regarding circulation: “After thorough circulation of a wellbore, cement shall be pumped behind the production casing…” This is an example of COGCC’s performance

	cementing, if technically feasible.	based criteria. This is enhanced with the existing Rule 317.p. requirement to confirm cement place m with a cement bond log, CBL. The addition of industry standards would be appropriate.
	G. Cement placement and job evaluation	
		COGCC Comments
53	1. Establishes allowable methods for effective cement placement.	Current Rules 317.f. for surface casing and 319.a.(2) discuss cement placement methods; this could be added to other portion of 317 for intermediate and production casing cement placement. The addition of industry standards would be appropriate.
54	2. Establishes standards for mixing and pumping cement slurry (e.g., free water separation and optimum density standards).	The addition of industry standards would be appropriate. See response 48.
55	3. Establishes requirements for minimum annular space, between wellbore and casing, or casing and casing, to ensure emplacement of an effective cement sheath that can be verified by test or log.	COGCC's current policy as stated in The "CLARIFICATION ON PROCEDURES FOR FILING CHANGES TO APPLICATIONS FOR PERMIT-TO-DRILL Revised 1/18/2011" states "The clearance between the outside of the widest part of the casing and the inside of the next casing or hole is no less than .42 inches when measured on any radius from the center of the casing" During an engineering staff review of each Form 2, Permit to Drill, engineers assure there is at least a 0.42-inches annular space between casings or casing and the wellbore. This could be codified. The addition of industry standards would be appropriate.
56	4. Establishes standards for centralization of casing.	The addition of industry standards would be appropriate.
63	11. Establishes operator oversight/responsibility standard.	In Colorado, the operator is the responsible party. Service Companies work at the request and direction of the operator. Therefore, regulatory compliance with the Commission is the responsibility of the operator.
H. Contractor/Service Company Licensing or Approvals		
		COGCC Comments
64	1. Establishes standards for approved cement contractors and service companies.	The Commission does not require the registration of contractors and services companies. The Commission holds the operator responsible for all activities occurring on location.

65	2. Establish criteria for approval of contractors and service companies.	
I. Construction standards address performance objectives (By string)		
	2. Surface Casing	**COGCC Comments**
71	e) Establishes standards for casing centralization.	The addition of industry standards would be appropriate.
	4. Production Casing	**COGCC Comments**
74	a) Establishes a minimum standard for the height of cement above the uppermost perforation of the production casing or top of the production zone, or upper most flow zone.	COGCC's current Rule 317.j. reads "… cement shall be pumped behind the production casing (200) feet above the top of the shallowest uncovered known producing horizon. All fresh water aquifers, which are exposed below the surface casing, shall be cemented behind the production casing. All such cementing around an aquifer shall consist of a continuous cement column extending from at least fifty (50) feet below the bottom of the freshwater aquifer which is being protected to at least fifty (50) feet above the top of said fresh water aquifer…." This rule defines a minimum standard, which has been modified by Order to manage specific situation. The Piceance Basin Order is a good example, i.e. *NOTICE TO OPERATORS DRILLING MESAVERDE GROUP OR DEEPER WELLS IN THE MAMM CREEK FIELD AREA IN GARFIELD COUNTY WELL CEMENTING PROCEDURE AND REPORTING REQUIREMENTS* In the Piceance Basin a field-by-field review has been conducted to define field based wellbore designs defining cement placement uniquely for each field. These Field Scout Cards are located on the website under DATA/Field Scout Card tab. Due the cement reviews and studies in the Piceance Basin and the recent changes in completion techniques, there might be value to consider raising the minimum cement top level from 200 to 500 feet above the perforations or completed interval.
75	b) Hydrocarbon-bearing zones above the target producing zone, must be isolated if necessary, to prevent annular over-pressurization (if not isolated using intermediate casing).	The current rule references producing zones and aquifers. Consideration of other zones needing isolation (flow zones, lost circulation, under-pressure, over-pressure and corrosive zones) might be a rule revision consideration.

76	c) Establishes additional standards for wells with a limited intervening zone.	COGCC can look to adding elements from the current *Stimulation at Depths 2,000 Feet or Less – Practices and Procedures* guidance to a rule revision.
	J. Assessment of MI after each casing string is emplaced and cemented.	
77	1. Establishes authority to require reporting of defective casing or cement diagnostic work and appropriate corrective action.	See response to 58 through 61 above, and 74.
78	2. Establishes standard for pressure test prior to drill-out to verify casing integrity and cement displacement.	The addition of industry standards would be appropriate. See response to 58 through 61, 74 and 77 above
79	3. Defines when cement evaluation logs or other approved methods are required to assess integrity.	See response to 58 through 61, 74 and 77 above
	K. Reports	**COGCC Comments**
82	3. Establishes log and reporting requirements for geologic information (e.g., mud log records, wire line logs, well completion reports) including base of protected water zones, depth and thickness of hydrocarbon bearing flow zones, lost circulation zones, formation voids, the intervening zone, and all zones to be tested or produced.	See response to 58 through 61, 74 and 77 above. COGCC Rule 317.p requires wells to have at minimum a resistivity log with gamma ray or other petrophysical log(s) approved by the Director that adequately describes the stratigraphy of the wellbore. A cement bond log shall be run on all production casing or, in the case of a production liner, the intermediate casing, when these casing strings are run. These logs and all other logs run shall be submitted with the Drilling Completion Report, Form 5. Open-hole logs or equivalent cased-hole logs shall be run at depths that adequately verify the setting depth of surface casing and any aquifer coverage. These requirements shall not apply to unlogged open-hole completion intervals. As a confirmation and monitoring tool, the commission would suggest statewide annual bradenhead testing requirements.
V. Well Completion- Hydraulic Fracturing		
	A. Performance Objectives, e.g.	**COGCC Comments**

87	4. Integrity failures are addressed and corrective actions affirmed by test prior to commencement of hydraulic fracturing operations.	*Rule 317.k. Production and intermediate casing pressure testing. The installed production casing or, in the case of a production liner, the intermediate casing, shall be adequately pressure tested for the conditions anticipated to be encountered during completion and production operations.* We believe the phrase conditions anticipated to be encountered during completion and production operations would include the applied pressure during a hydraulic fracture treatment. There could be value in defining a rule similar to the EDF MRF Section 5.2(a)., which defines an acceptable test as using a pressure 10% greater than the anticipated applied pressure with the test pressure stabilized for 30-minutes.
	B. Pre-Stimulation Testing	**COGCC Comments**
88	1. Specifies when an owner is required to notify regulator prior to commencement of testing and stimulation.	Existing Rule 316C.a. Notice of Intent to Conduct Hydraulic Fracturing Treatment is required at least 48 hours prior to conducting a hydraulic fracturing treatment at any well. Such notice shall be provided on a Field Operations Notice, Form 42 - Notice of Hydraulic Fracturing Treatment. The Commission shall provide prompt electronic notice of such intention to the relevant local governmental designee (LGD). As to pressure testing prior to hydraulic fracture treatment see response 42. 43 and 87 above.
89	2. Establishes standard for wellbore MI verification before commencement of hydraulic fracturing operations.	As to pressure testing prior to hydraulic fracture treatment see response 42. 43, 87 and 88 above
90	**3. Establishes standard for surface equipment integrity verification before commencement of hydraulic fracturing operations.**	While this is already an industry practice, the Commission will consider adding surface equipment testing to its rules.
	C. Hydraulic Fracturing Operations	
		COGCC Comments
91	1. Specifics which casing strings may be perforated for stimulation purposes.	COGCC asks for clarity on what is meant by single string. We assume this would be a surface casing only, with an open hole completion. There are several locations in Colorado where this is a historic well construction configuration. In the Florence-Canon City Field, there are wells being permitted with an open hole completion. Due to the producing formation being naturally fractured, operators air drill the well and do not stimulate the wells. At a minimum, COGCC requires a dual string configuration of surface casing and production casing for any well that is hydraulically fractured.

92	2. Establishes criteria for continuous monitoring of wellbore integrity throughout the hydraulic fracturing operation.	Currently, COGCC Rule 341 requires bradenhead monitoring of the well being stimulated. An operator guidance has been created to expand the monitoring in the Greater Wattenberg Field of the Denver Basin to all wells within 300-feet the treated wellbore: COGCC Policy for *Bradenhead Monitoring During Hydraulic Fracturing Treatments in the Greater Wattenberg Area.* Rule 341 could be expanded to incorporate the current practice requirement of annular monitoring of adjacent wells within 300-feet. Also, the rule could be expanded to establish a reaction requirement if either well experiences an increased Bradenhead pressure during stimulation - currently only a reporting requirement, with no expectation that the treatment is discontinued until it can be assured that there is not a threat to water resources if the treatment continues.
93	3. Identifies injection parameters that should be continuously monitored and recorded during the hydraulic fracturing operation.	See 92 above. There may be value in requiring that operator's record and keep the treatment records for the life of the well. Records could include the items referenced in API-100-1.
94	4. Establishes criteria for terminating hydraulic fracturing operations if there is evidence of MI failure or breach.	See 92 above Currently, COGCC Rule 341 requires bradenhead monitoring of the well being stimulated. "... If at any time during stimulation operations the bradenhead annulus pressure increases more than 200 psig, the operator shall verbally notify the Director as soon as practicable, but no longer than 24 hours following the incident. ..." There is merit to add the inclusion of pressure monitoring scenarios as referenced in EDF MRF Section 5.3(d) and API 100. Since offset wells are also monitored during stimulation - evidence of failure in the offset wells should also have thresholds.
95	5. Establishes conditions for notifying regulator if failure symptoms are observed.	see 94 above This would be an opportunity to establish a guidance with requirements for proactive engagement with the Commission when compromised wellbore integrity or formation integrity are indicated.
	D. Reports	**COGCC Comments**
97	2. Establishes report types and minimum data elements for wellbore construction reports (e.g., perforation reports,	COGCC Rule 308A Drilling Completion Report, Form 5, requires the submission of many of the suggested items to confirm the wellbore construction.

	pumping charts, job summary reports, well completion reports, etc.).	The "Final" Drilling Completion Report, Form 5 shall include the following information: A. A cement job summary for every casing string set, except for those with verification by a cement bond log as required by Rule 317.p. or by permit conditions, shall be attached to the form. B. All logs run, open-hole and cased-hole, electric, mechanical, mud, or other, shall be reported and copies submitted as specified here: i. A digital image file (PDF, TIFF, PDS, or other format approved by the Director) of every log run shall be attached to the form. A paper copy may be submitted in lieu of the digital image file and shall be so noted on the form. ii. A digital data file (LAS, DLIS, or other format approved by the Director) of every log run, with the exception of mud logs and cement bond logs, shall be attached to the form. C. All drill stem tests shall be reported and test results shall be attached to the form. D. All cores shall be reported and the core analyses attached to the form. If core analyses are not yet available, the Operator shall note this on the Form 5 and provide a copy of the analyses as soon as it is available, via a Sundry Notice, Form 4. E. Any directional survey shall be attached to the form and shall meet the requirements set forth in Rule 321. F. The latitude and longitude coordinates of the "as drilled" well location shall be reported on the form. The latitude and longitude coordinates shall be in decimal degrees to an accuracy and precision of five decimals of a degree using the North American Datum of 1983 (e.g.; latitude 37.12345, longitude -104.45632). If GPS technology is utilized to determine the latitude and longitude, all GPS data shall meet the requirements set forth in Rule 215 and the Position Dilution of Precision reading, the GPS instrument operator's name and the date of the GPS measurement shall also be reported on the form. 308B. COGCC Form 5A. COMPLETED INTERVAL REPORT requires the reporting of the perforated interval and how the well was stimulated, hydraulically fractured.
	E. Hydraulic Fracturing Service Company Licensing or Approvals	
		COGCC Comments
99	1. Establishes authority to require use of approved service companies.	See response to 64 & 65
100	2. Establishes criteria for approval of hydraulic fracturing service companies.	
VI. Production Operations		

	A. Objectives, e.g.	COGCC Comments
106	2. Maintain wellbore integrity.	An annual bradenhead testing and reporting requirements across the state would be an effective method to monitor well integrity. Further, an engineering process to review and establish action thresholds would need to be defined by basin.
	B. Elements	**COGCC Comments**
108	1. Establishes standard for monitoring of wellbore integrity during the production phase of E&P operations (e.g., Post-completion tubing, casing, and bradenhead pressures are monitored to detect M.I. failures and potential annular over-pressurization).	See 106 above Thresholds may be needed for reporting and action requirements.
109	2. Identifies when owner must notify Regulator if M.I. failures and/or annular over-pressurization are detected.	See 106 above Thresholds may be needed for reporting and action requirements.
110	3. Process defined to prevent annular over-pressurization.	See 106 above Thresholds may be needed for reporting and action requirements.
VII. Well Plugging		
	2. Timeframes	**COGCC Comments**
117	a) Establishes timeframes for plugging dry holes.	The general practice by Colorado operators is to plug a dry hole while the drill rig is on location. Therefore, inclusion of the 30-day timeframe suggested in the EDF MRF rules seems unnecessary.
118	b) Establishes timeframes for plugging inactive wells.	As part of the SOGRE inactive well review, the Commission's response is incorporated there.
119	c) Establishes process for extensions and suspension of extensions.	
	3. Temporary inactive (suspended) status	**COGCC Comments**
120	a) Establishes a process for acquiring Temporary Inactive status.	See 118 Current Rule 319 requires a Mechanical Integrity Tests (MIT) at the initiation of temporary abandoned status with subsequent MITs every 5 years, along with an annual Sundry Notice requesting continued temporarily abandoned status with an explanation of operator's intent to produce the well. The inclusion of a bradenhead monitoring requirement would be beneficial.
	4. Plugging operations	**COGCC Comments**

123	a) Defines zones that require isolation.	Current Rule 319.a describes plugging requirements.
126	d) Establishes standards for mix water quality.	The addition of industry standards would be appropriate.
129	g) Specifies when and how plugs must be tagged or tested.	The engineering staff require tagging of any isolation plugs which are placed without a mechanical device. The Form 6, Notice of Intent to Abandon includes the ability to add a COA to require plug tagging. Rule 319.a(6) states "...the Director may require that a cement plug be tagged if a cement retainer or bridge plug is not used."
	5. Inspections	
132	b) Establishes criteria for plugging approval or corrective action order.	Staff inspectors do witness a portion of the pluggings as part of their duties. There is merit in adding a plugging procedure step to include a monitoring period between plugs to assure there is no flow after the plug has been set. Operators are required to submit a Subsequent Report of Abandonment, Form, 6 with third party documentation to verify how the well was plugged. 311.b Subsequent Report of Abandonment, Form, 6. Within 30 days after abandonment, the Form 6 - Subsequent Report of Abandonment, is required with a verifying documentation (casing pressure test results, downhole logs run, plugging verification reports to confirm details for depths of mechanical plugs, casing cuts, the depths and volumes of all cement plugs, the amount, size and depth of casing and junk left in the well, the volume and weight of fluid left in the wellbore and the nature and quantities of any other materials used in the plugging).