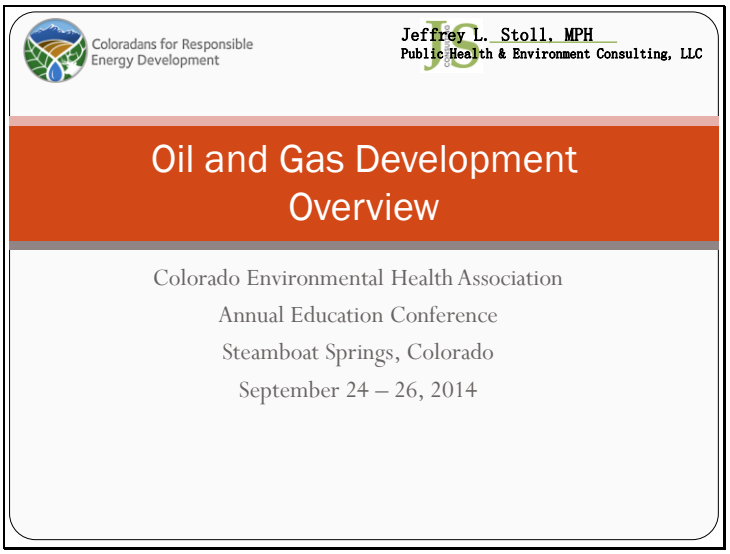
Oil and Gas Development Slides and Notes

Colorado Environmental Health Association
Annual Education Conference
September 24, 2014

Slide 1



Thank you for giving me the opportunity to present this orientation on oil and gas development to you.

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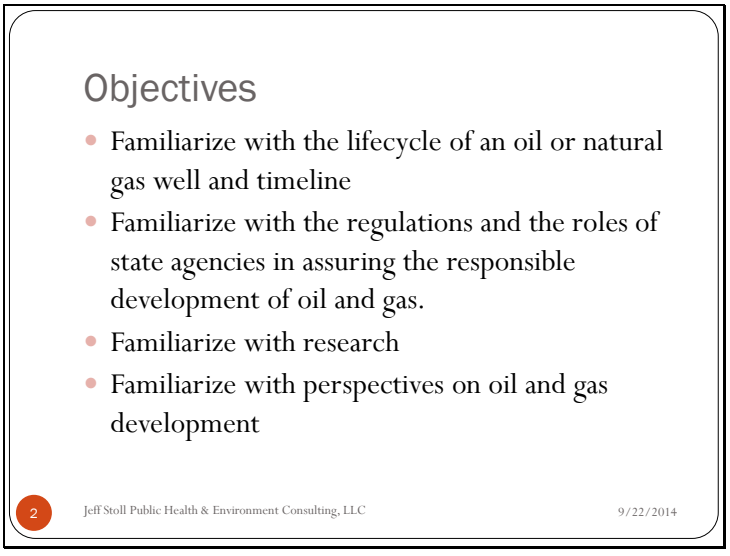

At the end of this Oil and Gas orientation I hope that you will leave with the following:

- Familiarity with the lifecycle of an oil or natural gas well and timeline;

- Familiarity with the regulations and the roles of state and local agencies in assuring the responsible development of oil and gas.
- Research
- Local perspectives on oil and gas development

Slide 3

Let's begin with our first objective of familiarizing you with the lifecycle of an oil well.

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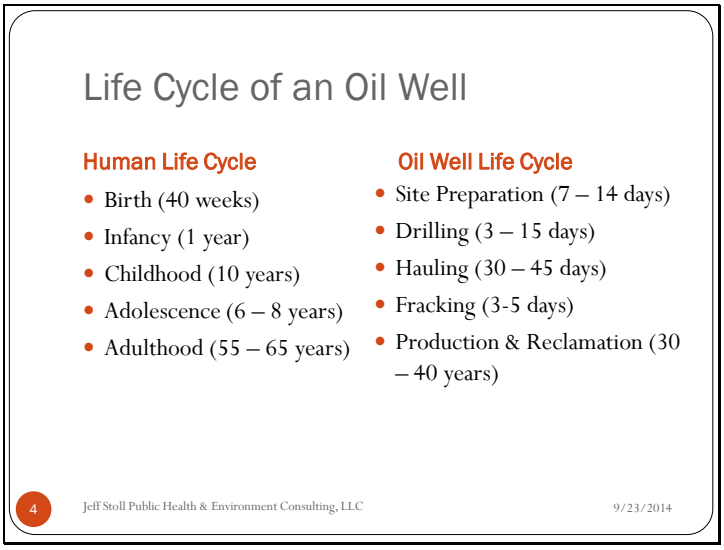

Let's start things off with a little Family Feud fun to get you all pumped about lifecycles. Name the stages of the human lifecycle. (Birth, Infancy, Childhood, Adolescence, Adulthood) Very

good! I'm going to build on your knowledge of the human lifecycle to introduce you to the 5 stages of an oil well's life.
Birth - During birth, beginning as a single cell, the human cells duplicate and specialize into specific body parts. They prepare for the birth of an infant. This stage takes about 40 weeks.
Site Preparation - As the name suggests, this stage similarly prepares the way for the birth of the Oil Well. During this time roads to the well site are constructed and the surface for the well pad is cleared. This stage lasts 7 - 14 days depending on the size of the well pad.
Infancy - During the first year of life, the human is totally dependent on parents for everything. During this time the infant learns a lot about how to survive in the world.
Drilling - The oil well is dependent on oil workers during this stage. Drilling takes from 3 - 15 days depending on the type of well. 4 - 6 wells are drilled per pad. Fresh water and clay are used to drill the well. Casings and cement are installed to protect groundwater. Pressure tests are conducted and logged to assure that the well is "developing" in a healthy manner.
Childhood - third stage, which lasts for about 10 years. We learn how to walk , talk and become a little more independent but still requiring a ton of attention and care.
Hauling - 30-45 days - Depending on when the completion contractor can be scheduled, there may be some time when no hauling occurs directly after drilling. After drilling is completed, it's time for water and tanks to be hauled in for the next stage.
Adolescence - Spans 6 - 8 years. One of the most dynamic and enigmatic stages of the human lifecycle. During this stage boys are changing into men and girls into women. There is confusion and chaos for a young person as they prepare for adulthood.
Fracking - This also is a dynamic and enigmatic time in the life of an oil well. The well is being prepared for adulthood. It requires extreme pressure as hydraulic fracturing crews pump a mixture of water, sand and fracturing compound into each well creating very small cracks in the dense rock a mile below the Earth's surface where oil is trapped. At the end of this stage, crews remove pumps and trucks. The fracking stage lasts only 3 - 5 days.
Adulthood - is the fifth stage, lasting 55 to 65 years. It is the period during which the human being becomes independent and self-supportive and gives back to the community.
Production and reclamation - This stage lasts 30 - 40 years. At the beginning, surfaces that are not used for operations are returned to original conditions and the oil well exists in a space the size of a two-car garage. This is where the well gives back to the community.
•It reduces energy costs to all consumers – (Coloradans pay as much as 25% less on energy than any other state);
Provides an important revenue source for community services and programs (CU Leeds School of Business reports that oil and gas industry generated $29.6 billion output in Colorado's economy and directly contributed almost $1.6
billion to public revenue in 2012); and
•Provides quality jobs for 51, 200 Coloradans.

In closing here are the five stages in an oil well's lifecycle. Some stages are rougher than others while some are pretty awesome. Awkward stages pass, as do all 5 stages in their time but in the end...isn't life beautiful?

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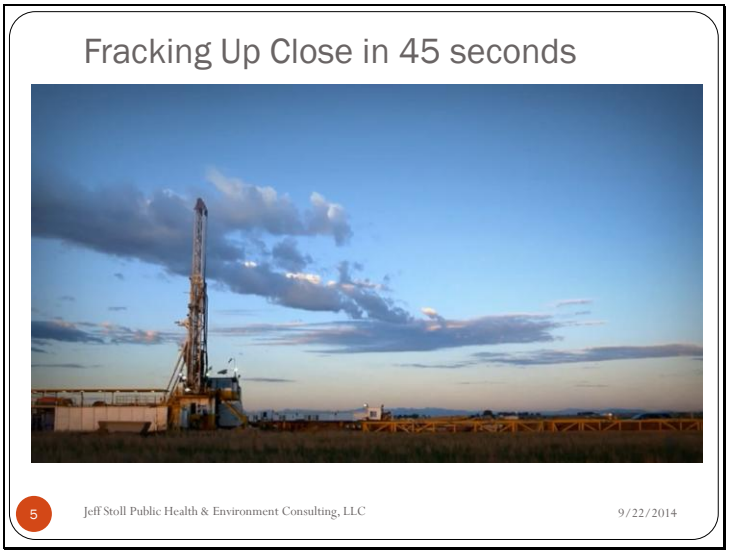

This next slide gives you a 45-second demonstration of this lifecycle. It doesn't go into the site preparation, hauling or production and reclamation stages that I discussed in the 5 stages of the lifecycle.

Slide 6

The purpose of this section of the orientation is to familiarize you with those regulations and the roles of the various Colorado state agencies that administer and enforce them.

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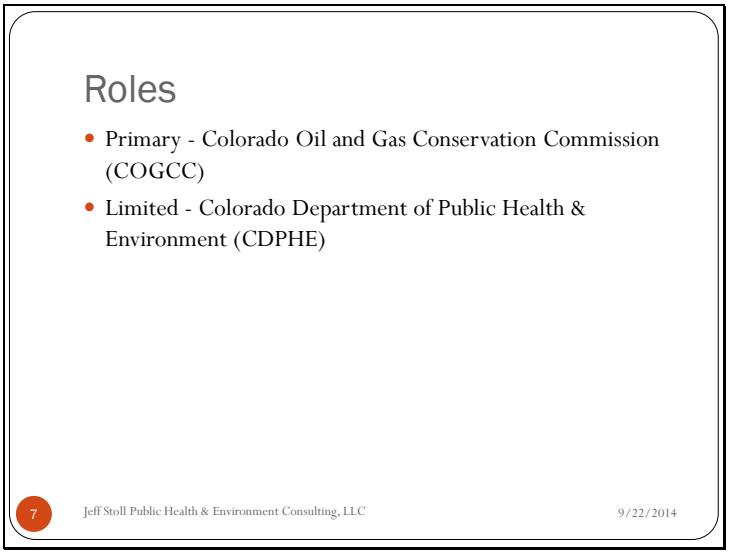
Slide 7



There are two state organizations that handle the regulation of the oil and gas industry in Colorado.

- The Colorado Oil and Gas Conservation Commission (COGCC) is authorized by the legislature to foster the responsible development of Colorado's oil and gas natural resources in a manner consistent with the protection of public health, safety and welfare, including the environment and wildlife.
- Colorado Department of Public Health and Environment (CDPHE) has a limited role in regulating oil and gas development in the areas of air, water and waste.

In the remainder of this section on regulation, I am going to summarize and compare the roles of these two agencies in the areas of water quality, waste management, and air quality.

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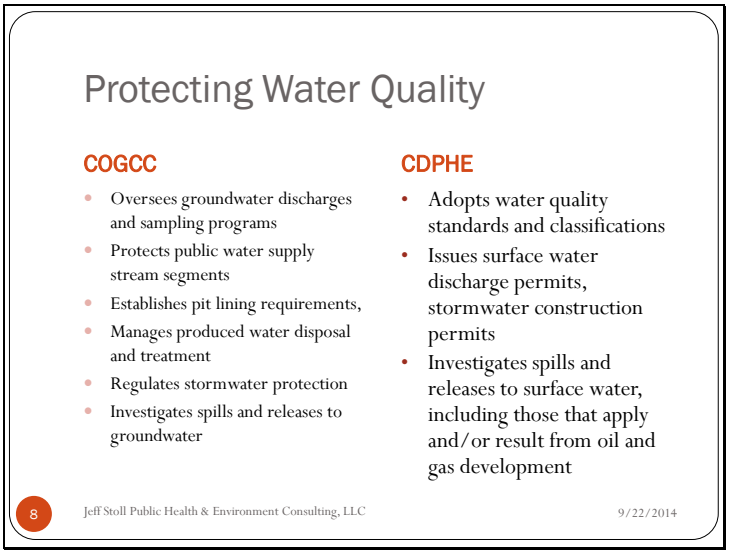

Let's look at how COGCC and CDPHE work together to protect water quality.

•The COGCC is responsible for ensuring that oil and gas operators adhere to the standards and classifications established for groundwater discharges from oil and gas development. The Colorado Oil and Gas Conservation Commission performs the following:

- Oversees groundwater discharges and sampling programs
- Protects public water supply stream segments
- Establishes pit lining requirements,
- Manages produced water disposal and treatment
- Regulates stormwater protection
- Investigates spills and releases to groundwater

CDPHE, through the WQCC and WQCD, protects from surface water impacts and handles permitting associated with those.

- Adopts water quality standards and classifications
- Issues surface water discharge permits, stormwater construction permits
- Investigates spills and releases to surface water, including those that apply and/or result from oil and gas development

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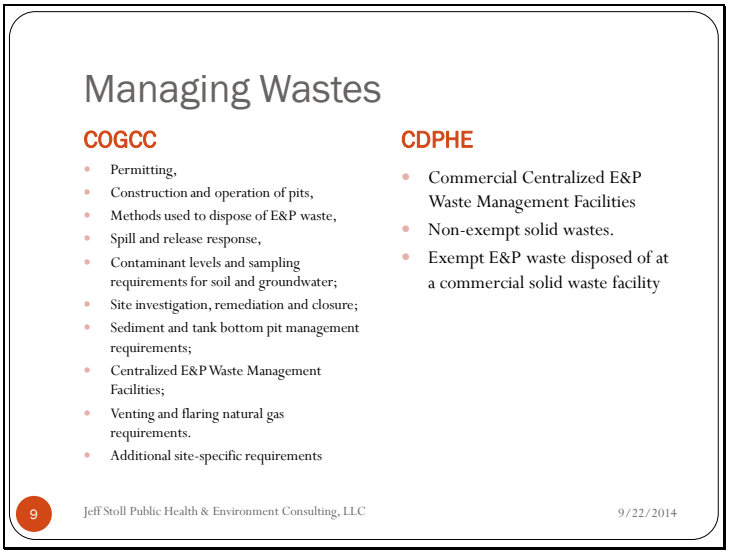

In waste management, the COGCC rules and regulations manage exploration and production (E&P) waste including

•Permitting,
•Construction and operation of pits,
•Methods used to dispose of E&P waste,
•Spill and release response,
•Contaminant levels and sampling requirements for soil and groundwater;
•Site investigation, remediation and closure;
•Sediment and tank bottom pit management requirements; and
•Venting and flaring natural gas requirements.
•Centralized E&P Waste Management Facilities;
•Additional requirements may apply depending on the situation e.g., sensitive area determinations. If the COGCC or the operator has data that indicates an impact or threat to groundwater or surface water may occur, the operator may be required to implement appropriate measures and controls to ensure compliance with standards that provide acceptable contaminant concentration levels for soil and groundwater.

CDPHE regulates:

•Commercial Centralized E&P Waste Management Facilities and non-exempt solid wastes.
•Non-exempt solid wastes. In Colorado, wastes that are not hazardous wastes are considered solid wastes unless specifically exempt. Oil and gas exploration and production (E&P) wastes are considered solid wastes and are exempt from regulation by the CDPHE. These wastes include but are not limited to drilling fluids and produced water and other wastes associated with the exploration, development, or production. However, an E&P waste is treated as a solid waste and

regulated by CDPHE if it is not unique to oil and gas industry. For example, synthetic pit liners must be disposed of in accordance to CDPHE's solid waste regulations because many industries, other than the oil and gas industry use synthetic liners.
•In addition, if an exempt E&P waste is disposed of at a commercial solid waste facility, it must be managed as a solid waste. Most wastes generated during oil and gas development are exempt; however, the COGCC rules and regulations are intended to manage E&P wastes.

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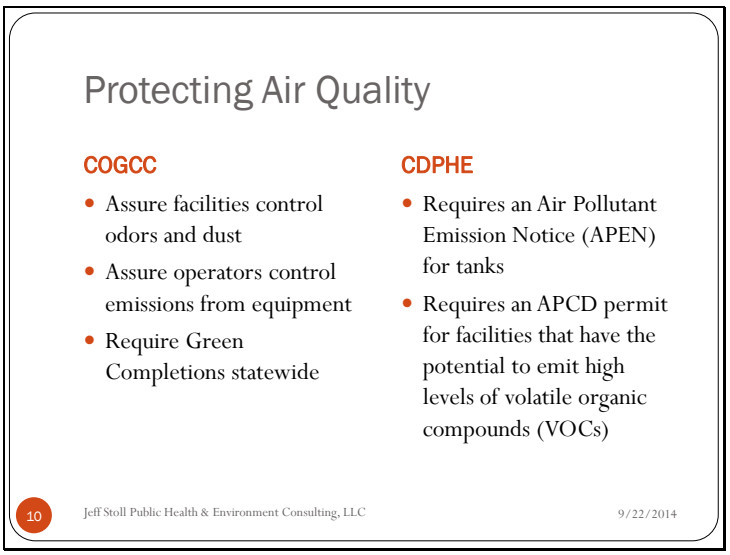


Protection of Air Quality

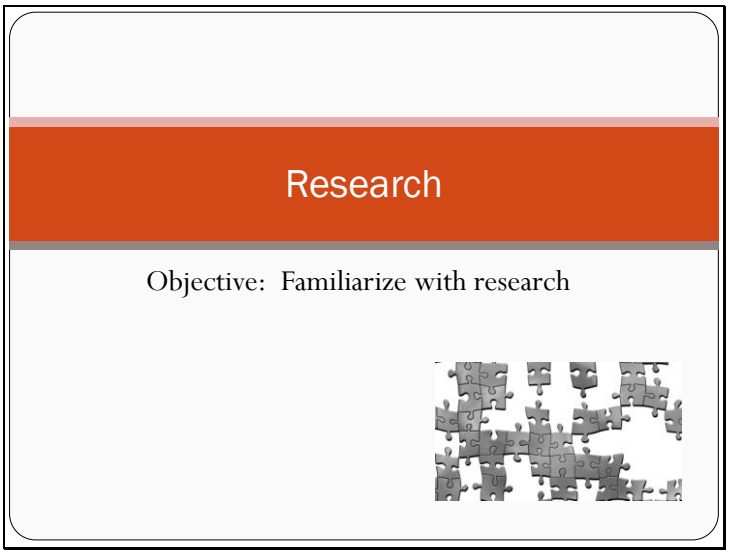
•COGCC rules require oil and gas facilities to be operated so that odors and dust do not constitute a nuisance or hazard to public welfare.
•COGCC rules require operators to control emissions from tanks, glycol dehydrators, pits and pneumatic devises that have potential to emit greater than five tons per year and are located within ¼ mile of any building unit, educational facility, or hospital.
•Green Completions are required statewide where technically feasible. Fugitive dust must be controlled by Operators.

CDPHE - The Air Pollution Control Division (APCD) regulates oil and gas facilities if they have the potential to emit volatile organic compounds (VOCs) above certain levels. APCD is responsible for oversight and permitting of federal and state air quality rules.

•An Air Pollutant Emission Notice (APEN) - is required for all E&P condensate tanks or multiple tanks with VOC emissions greater than one ton per year in a nonattainment area or greater than two tons per year in an attainment area. APENs are used for inventory and permitting purposes.
•An APCD permit - is required for facilities that have the potential to emit greater than two tons per year of VOCs in a nonattainment area or greater than five tons per year in an attainment

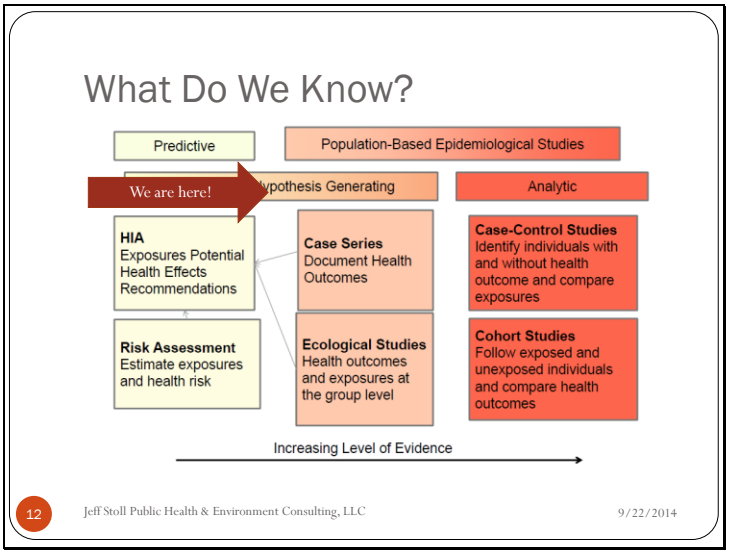
area. This document authorizes the legal emissions of air pollutants under certain terms and conditions. The permit defines what pollutants can be emitted, identifies steps a facility must take to reduce emissions, and specifies how emissions are measured and reported.

Slide 11



In this section, I will summarize some of the information that I have gleaned from my reading about studies and literature. I'll share those with you to familiarize you with the current state of research on oil and gas at least from my own study of the topic over the past several months. The CSPH will soon be releasing a literature review that is a good accounting of the current state of research.

Slide 12



First, what do we know about impacts from oil and gas development? This slide shows the levels of evidence gained from research on any given subject. The least/lowest level evidence is on the left moving towards the right in a continuum that brings us to the highest level of evidence the comes from case-controlled and cohort studies.

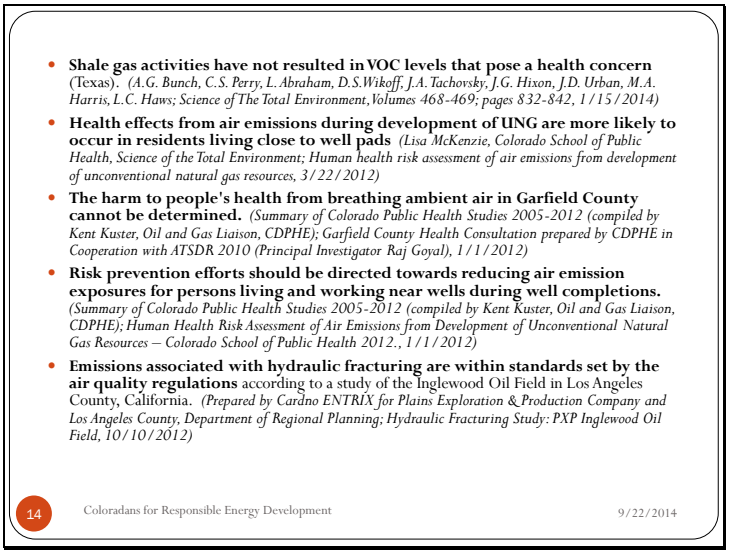
On the subject of oil and gas impacts, we are here (click). The evidence that is currently available lies somewhere between "predictive" and "population-based epidemiological"—between descriptive and hypothesis-generating. We know there are things that are inherent in oil and gas development that contain ingredients and practices that are potentially hazardous, but we are a long way from knowing at what levels or to what level of exposure for the public exists. The continuum represented here is a process that can span twenty to thirty years.

Next, I will summarize some take-aways from research done in Colorado as well other areas of the country. I have a resource handout for you that references each specific statement of mine with its respective references along with more summary information. I have given each of you my business card with my website. You can retrieve the handout electronically by visiting my website.

Slide 13

Here are the take away messages regarding air quality.

Slide 14



Shale gas activities have not resulted in VOC levels that pose a health concern (Texas). *(A.G. Bunch, C.S. Perry, L. Abraham, D.S. Wikoff, J.A. Tachovsky, J.G. Hixon, J.D. Urban, M.A. Harris, L.C. Haws; Science of The Total Environment, Volumes 468-469; pages 832-842, 1/15/2014)*
Health effects from air emissions during development of UNG are more likely to occur in residents living close to well pads *(Lisa McKenzie, Colorado School of Public Health, Science of the Total Environment; Human health risk assessment of air emissions from development of unconventional natural gas resources, 3/22/2012)*

The harm to people's health from breathing ambient air in Garfield County cannot be determined. *(Summary of Colorado Public Health Studies 2005-2012 (compiled by Kent Kuster, Oil and Gas Liaison, CDPHE); Garfield County Health Consultation prepared by CDPHE in Cooperation with ATSDR 2010 (Principal Investigator Raj Goyal), 1/1/2012)*
Risk prevention efforts should be directed towards reducing air emission exposures for persons living and working near wells during well completions. *(Summary of Colorado Public Health Studies 2005-2012 (compiled by Kent Kuster, Oil and Gas Liaison, CDPHE); Human Health Risk Assessment of Air Emissions from Development of Unconventional Natural Gas Resources – Colorado School of Public Health 2012., 1/1/2012)*
Emissions associated with hydraulic fracturing are within standards set by the air quality regulations according to a study of the Inglewood Oil Field in Los Angeles County, California. *(Prepared by Cardno ENTRIX for Plains Exploration & Production Company and Los Angeles County, Department of Regional Planning; Hydraulic Fracturing Study: PXP Inglewood Oil Field, 10/10/2012)*

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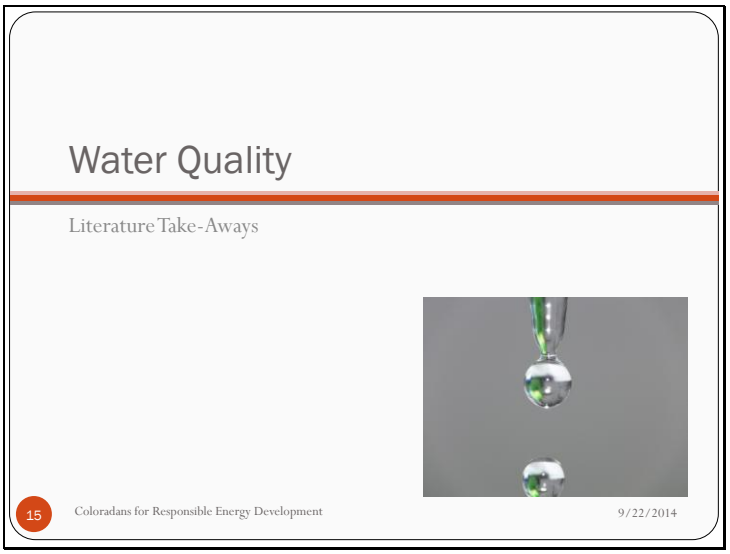
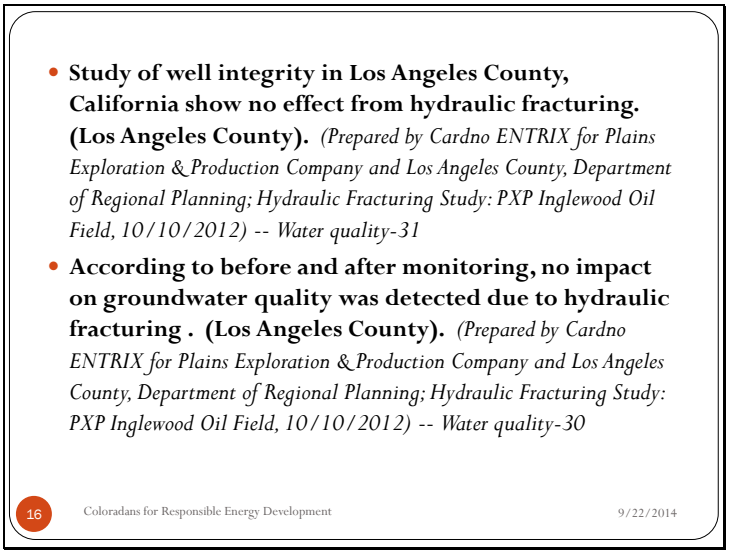


Here are some highlights that I gleaned regarding water quality.

Slide 16



Study of well integrity in Los Angeles County, California show no effect from hydraulic fracturing. (Los Angeles County). *(Prepared by Cardno ENTRIX for Plains Exploration & Production Company and Los Angeles County, Department of Regional Planning; Hydraulic Fracturing Study: PXP Inglewood Oil Field, 10/10/2012) -- Water quality-31*
According to before and after monitoring, no impact on groundwater quality was detected due to hydraulic fracturing . (Los Angeles County). *(Prepared by Cardno ENTRIX for Plains Exploration & Production Company and Los Angeles County, Department of Regional Planning; Hydraulic Fracturing Study: PXP Inglewood Oil Field, 10/10/2012) -- Water quality-30*

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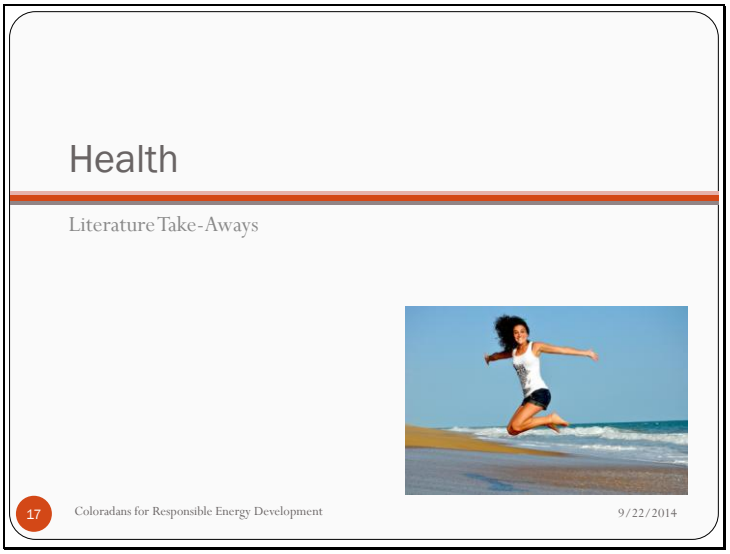

In the area of health impacts, there is a lot of literature that describes potential impacts from oil and gas production as well as beginning formation of hypotheses for future research. You'll hear a theme amongst these take-away messages that indicates a need for more research and understanding.

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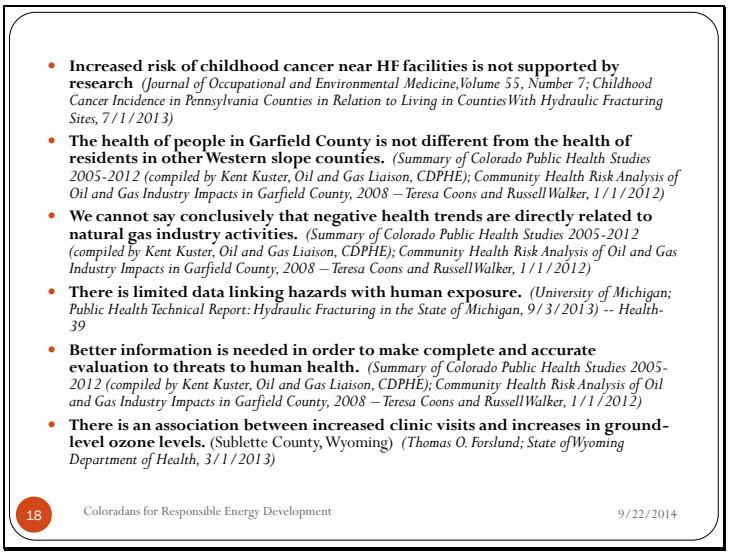

- **Increased risk of childhood cancer near HF facilities is not supported by research** *(Journal of Occupational and Environmental Medicine, Volume 55, Number 7; Childhood Cancer Incidence in*

Pennsylvania Counties in Relation to Living in Counties With Hydraulic Fracturing Sites, 7/1/2013)

- **The health of people in Garfield County is not different from the health of residents in other Western slope counties.** *(Summary of Colorado Public Health Studies 2005-2012 (compiled by Kent Kuster, Oil and Gas Liaison, CDPHE); Community Health Risk Analysis of Oil and Gas Industry Impacts in Garfield County, 2008 – Teresa Coons and Russell Walker, 1/1/2012)*

- **We cannot say conclusively that negative health trends are directly related to natural gas industry activities.** *(Summary of Colorado Public Health Studies 2005-2012 (compiled by Kent Kuster, Oil and Gas Liaison, CDPHE); Community Health Risk Analysis of Oil and Gas Industry Impacts in Garfield County, 2008 – Teresa Coons and Russell Walker, 1/1/2012)*

- **There is limited data linking hazards with human exposure.** *(University of Michigan; Public Health Technical Report: Hydraulic Fracturing in the State of Michigan, 9/3/2013) -- Health-39*

- **Better information is needed in order to make complete and accurate evaluation to threats to human health.** *(Summary of Colorado Public Health Studies 2005-2012 (compiled by Kent Kuster, Oil and Gas Liaison, CDPHE); Community Health Risk Analysis of Oil and Gas Industry Impacts in Garfield County, 2008 – Teresa Coons and Russell Walker, 1/1/2012)*

- **There is an association between increased clinic visits and increases in ground-level ozone levels.** (Sublette County, Wyoming) *(Thomas O. Forslund; State of Wyoming Department of Health, 3/1/2013)*

Slide 19

Among the research being conducted, occupational health and safety is an emerging area for this industry. Here are a few insights.

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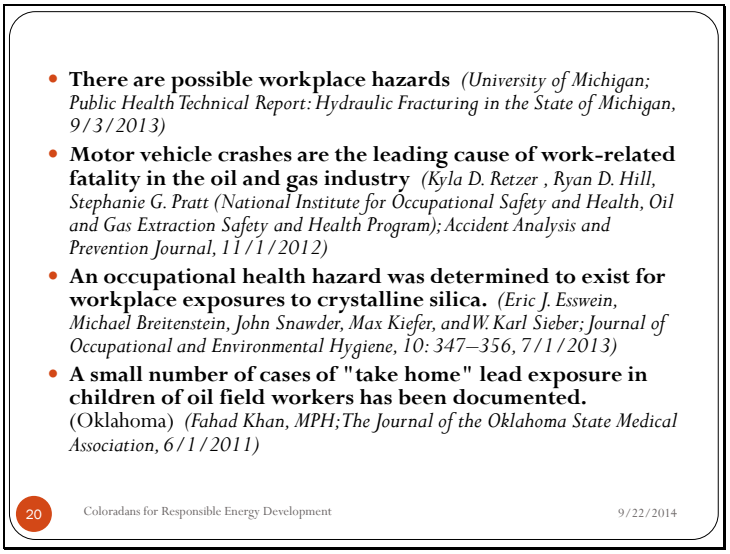

•**There are possible workplace hazards** *(University of Michigan; Public Health Technical Report: Hydraulic Fracturing in the State of Michigan, 9/3/2013)*

•**Motor vehicle crashes are the leading cause of work-related fatality in the oil and gas industry** *(Kyla D. Retzer , Ryan D. Hill, Stephanie G. Pratt (National Institute for Occupational Safety and Health, Oil and Gas Extraction Safety and Health Program); Accident Analysis and Prevention Journal, 11/1/2012)*

•**An occupational health hazard was determined to exist for workplace exposures to crystalline silica.** *(Eric J. Esswein, Michael Breitenstein, John Snawder, Max Kiefer, and W. Karl Sieber; Journal of Occupational and Environmental Hygiene, 10: 347–356, 7/1/2013)*

•**A small number of cases of "take home" lead exposure in children of oil field workers has been documented.** (Oklahoma) *(Fahad Khan, MPH; The Journal of the Oklahoma State Medical Association, 6/1/2011)*

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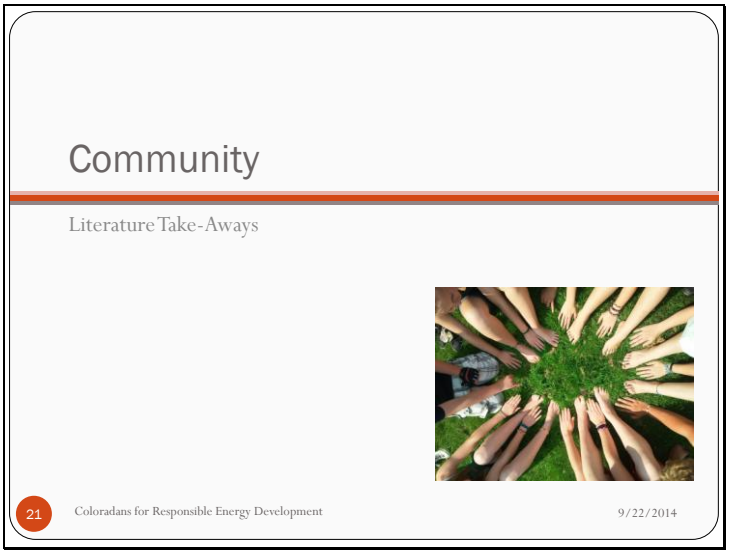

Here are a few take-away messages regarding general community impacts on quality of life and public health.

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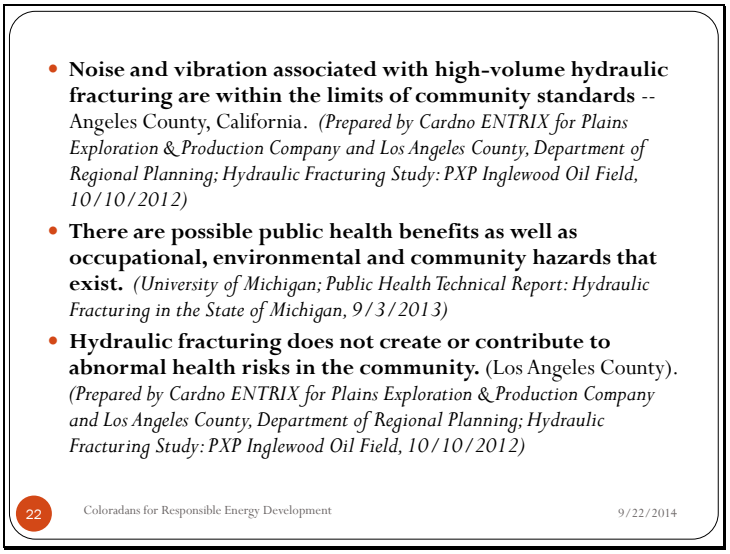

Noise and vibration associated with high-volume hydraulic fracturing are within the limits of community standards --Angeles County, California. *(Prepared by Cardno ENTRIX for Plains Exploration & Production Company and Los Angeles County, Department of Regional Planning; Hydraulic Fracturing Study: PXP Inglewood Oil Field, 10/10/2012)*

There are possible public health benefits as well as occupational, environmental and community hazards that exist. *(University of Michigan; Public Health Technical Report: Hydraulic Fracturing in the State of Michigan, 9/3/2013)*
Hydraulic fracturing does not create or contribute to abnormal health risks in the community. (Los Angeles County). *(Prepared by Cardno ENTRIX for Plains Exploration & Production Company and Los Angeles County, Department of Regional Planning; Hydraulic Fracturing Study: PXP Inglewood Oil Field, 10/10/2012)*

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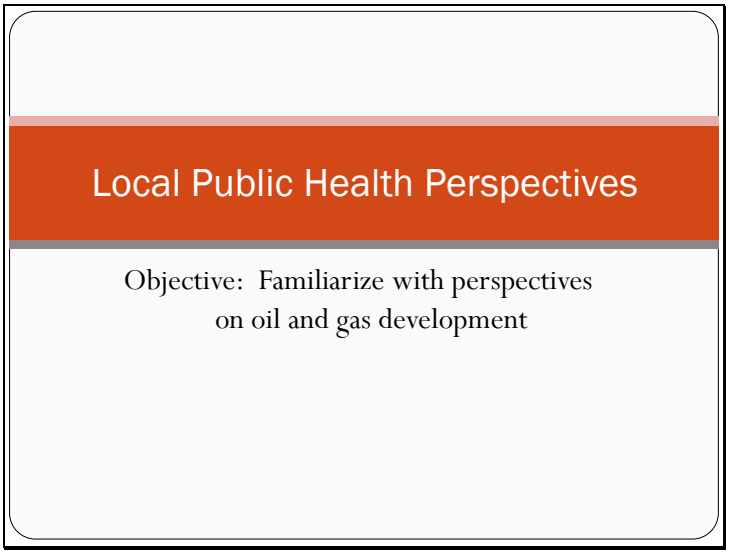
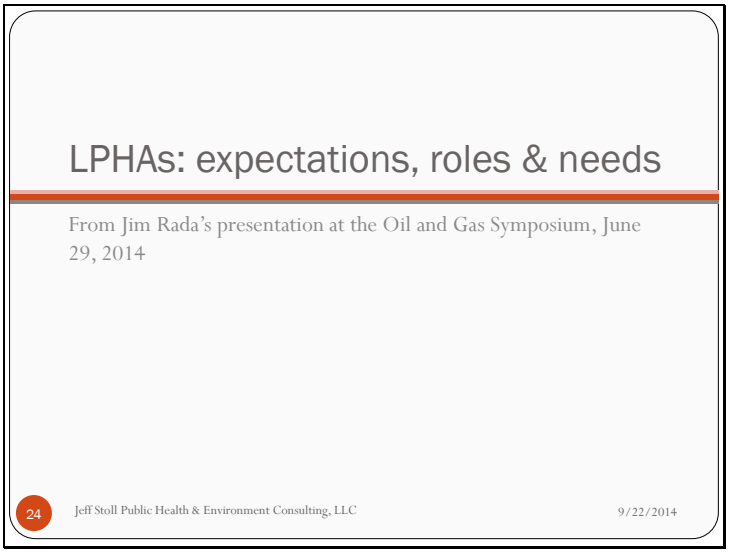


I will share local perspectives..

Slide 24



This discussion on expectations, roles and needs of local public health agencies is taken from discussions that Jim Rada, Environmental Health Director for Jefferson County Public Health, had with Colorado environmental health directors on the topic of oil and gas development.

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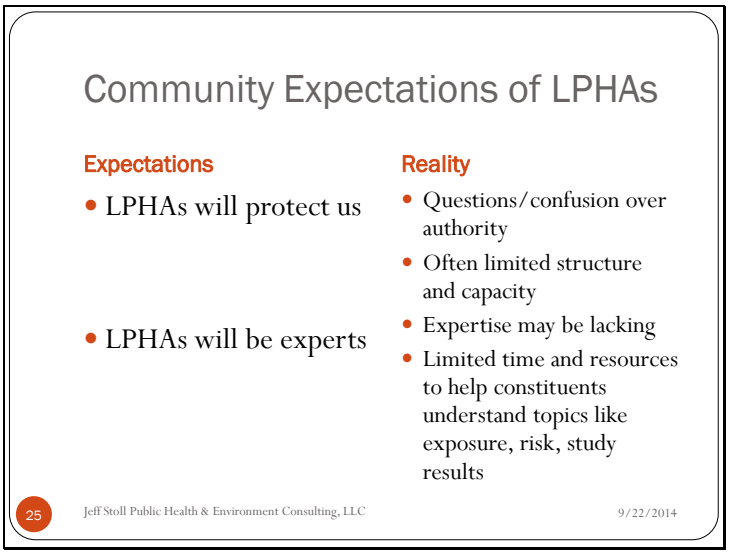

Local public health agencies have expectations placed on them by their communities.
• Communities expect that their local public health agency will protect them
• Communities expect that their local public health officials will have all the “right” answers.

The reality, however, for many local agencies doesn’t already support this.
•Questions/confusion over authority
•Often limited structure and capacity
•Not all LPHA have the needed expertise to provide the right answers
•Limited time and resources to help constituents understand topics like exposure, risk, study results

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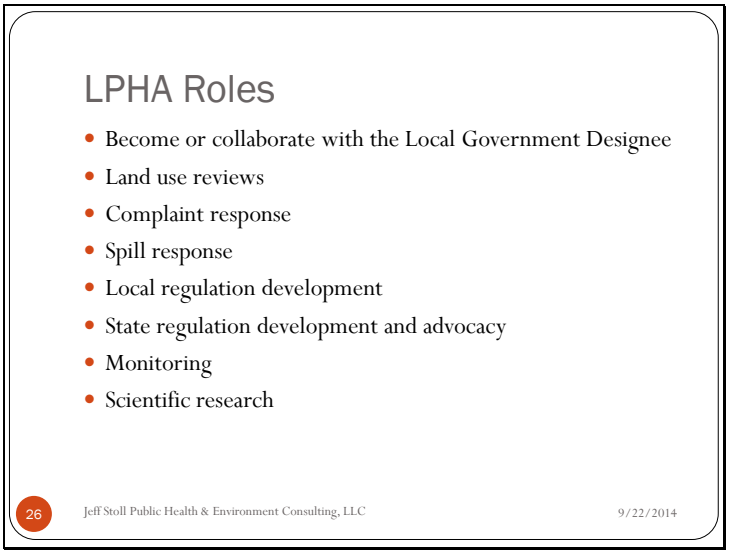
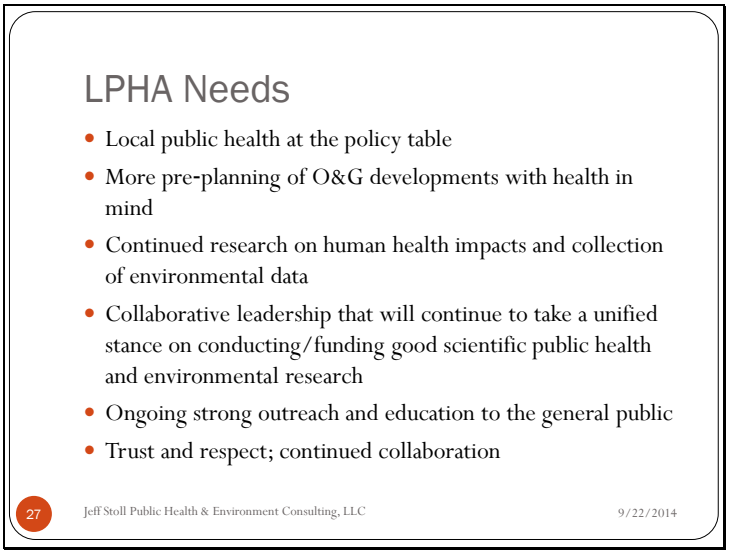


Recognizing the community expectations and limited capacity that may exist to meet those, there are agencies, especially in communities where oil and gas has been traditional part of the community, that have more or less figured it out. Local public health agencies around Colorado have assumed certain roles to address oil and gas development in their communities. Here are some of the common roles, especially in areas where oil and gas activity is most prevalent.

•Become or collaborate with the Local Government Designee – this is a role that is assigned and is trained and subsequently works closely with the COGCC on oil and gas permitting and site assessments and receiving important notices and communications relevant to activity in their county.
•Land use reviews
•Complaint response
•Spill response
•Local regulation development
•State regulation development and advocacy
•Monitoring
•Scientific research

Slide 27



Environmental public health leaders recognize that several things need to occur to support local public health efforts in this area:

•Local public health at the policy table
•More pre-planning of O&G developments with health in mind
•Continued research on human health impacts and collection of environmental data
•Collaborative leadership that will continue to take a unified stance on conducting/funding good scientific public health and environmental research
•Ongoing strong outreach and education to the general public
•Trust and respect; continued collaboration

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During my work for CRED this summer, I had the opportunity to discuss oil and gas development with public and environmental health officials through out Colorado. I spoke with more than 40 officials representing at least 24 agencies. These conversations helped shape the content for this presentation as well as provided me valuable insights into what is going on in Colorado communities from the perspective of my public health colleagues and friends. My purpose in sharing these perspectives is not to represent a unified opinion of local public health. These are specific statements that I collected from individual officials in my travels this summer.

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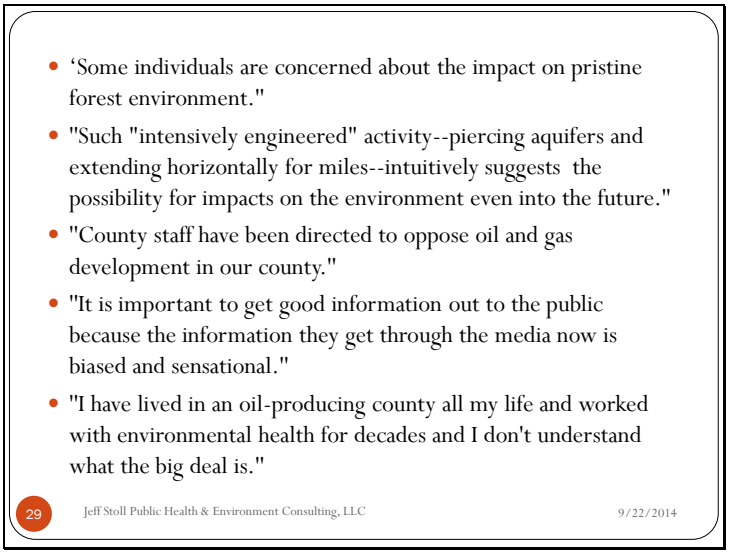


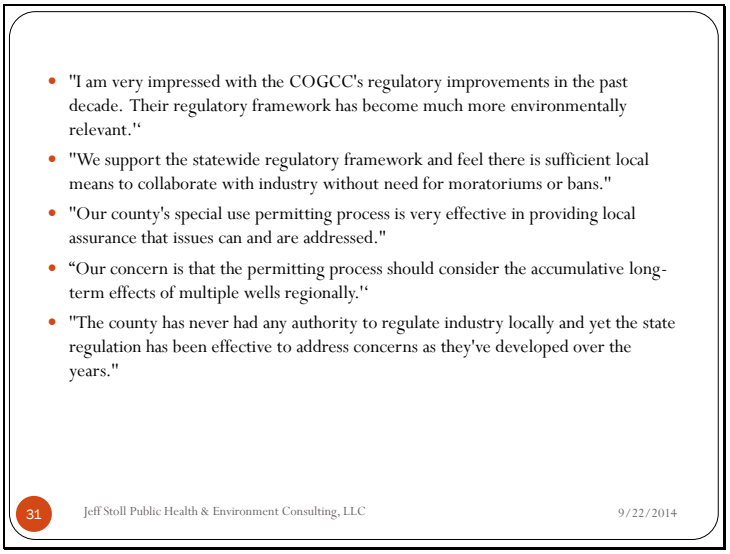
- Some individuals are concerned about the impact on pristine forest environment."

- ''Such "intensively engineered" activity--piercing aquifers and extending horizontally for miles--intuitively suggests the possibility for impacts on the environment even into the future.''
- ''County staff have been directed to oppose oil and gas development in our county.''
- ''It is important to get good information out to the public because the information they get through the media now is biased and sensational.''
- ''I have lived in an oil-producing county all my life and worked with environmental health for decades and I don't understand what the big deal is.''

Slide 30

With respect to regulation of the industry, here is what I heard from indiviual local public health officials.

Slide 31

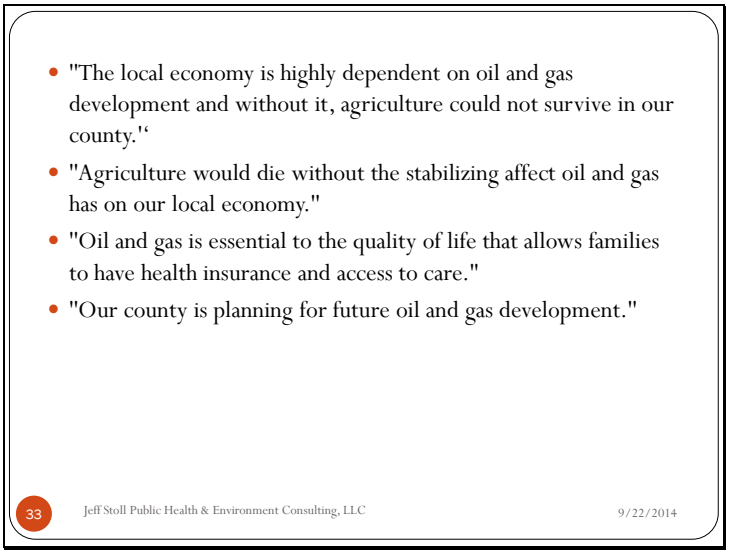


- "I am very impressed with the COGCC's regulatory improvements in the past decade. Their regulatory framework has become much more environmentally relevant."
- "We support the statewide regulatory framework and feel there is sufficient local means to collaborate with industry without need for moratoriums or bans."
- "Our county's special use permitting process is very effective in providing local assurance that issues can and are addressed."
- "Our concern is that the permitting process should consider the accumulative long-term effects of multiple wells regionally."
- "The county has never had any authority to regulate industry locally and yet the state regulation has been effective to address concerns as they've developed over the years."

Slide 32

Finally, local public health officials recognize that economy is important to good community quality of life. Here is what I heard from public health officials regarding economy and oil and gas.

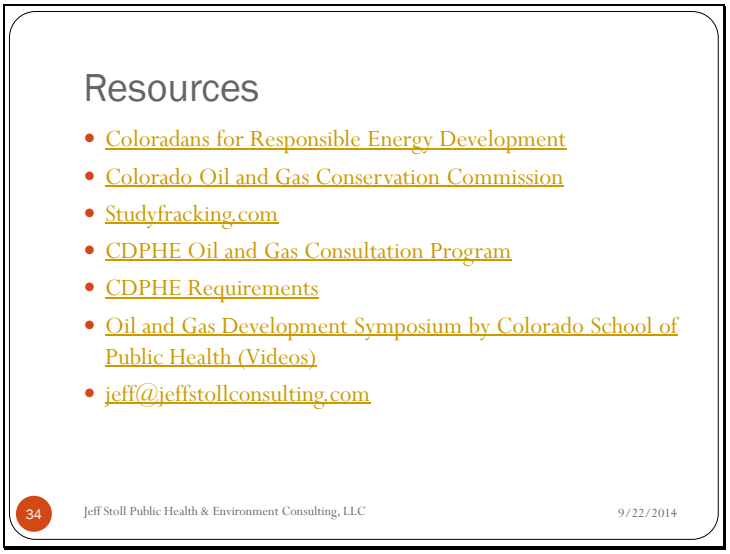
Slide 33



- "The local economy is highly dependent on oil and gas development and without it, agriculture could not survive in our county."
- "Agriculture would die without the stabilizing affect oil and gas has on our local economy."
- "Oil and gas is essential to the quality of life that allows families to have health insurance and access to care."

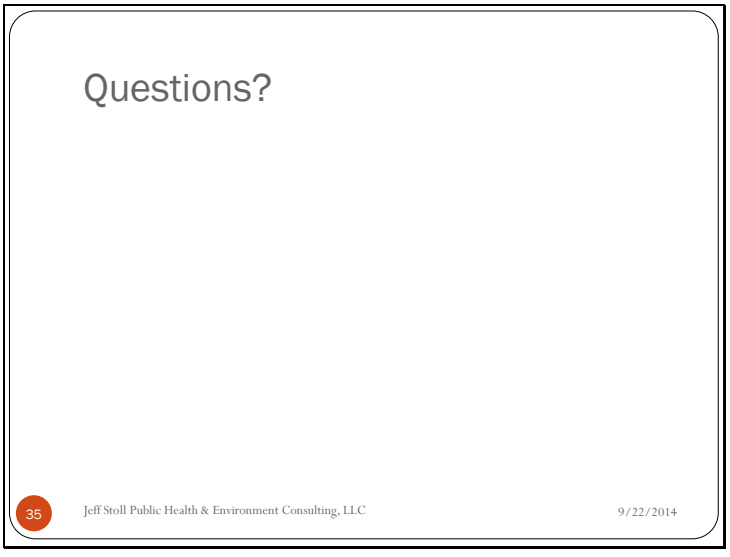
- "Our county is planning for future oil and gas development."

Slide 34



In closing, I hope that you've increased your understanding and knowledge about oil and gas development – Its life cycle, regulation, research and local perspectives. For your continued learning, I have provided several links below to some good sources of information. Also, please do not hesitate to contact me anytime and I would be glad to help answer your questions or direct you to people who can.

Slide 35



Do you have any questions?