TEDX
The Endocrine Disruption Exchange
211 Grand Avenue, Suite 114
P.O. Box 1407
Paonia, CO 81428
Phone & Fax: 970-527-4082
tedx@tds.net

To: Colorado Oil and Gas Conservation Commission

Re: Comments concerning rule making

From: Theo Colborn, PhD

Date: September 9, 2009

The mission of The Endocrine Disruption Exchange (TEDX) is to reduce the use of and exposure to chemicals that undermine public health -- especially those chemicals that have untoward effects at low exposure and often slip through government's safety nets. It is with this in mind that we submit the following information for your deliberations as you work to develop new rules for oil and gas operations in Colorado.

TEDX congratulates the Colorado Oil and Gas Conservation Commission (COGCC) on the progress it has been making to develop new rules for oil and gas development in our state. The progress you have made thus far is being heralded across the nation by others who are also seeking to better protect their life-support systems and public health where natural gas and oil activity is increasing.

TEDX has the following concerns which we hope the COGCC will seriously consider adopting:

1. **The COGCC must demand full disclosure with <u>no weight or volume exemptions</u> for chemicals used during natural gas and oil operations in Colorado.**

TEDX is pleased that you chose to address the issue of full disclosure. However, as the attachments below will demonstrate, anything less than *full* disclosure is unacceptable from a public health standpoint. TEDX also feels that the COGCC made a serious mistake in proposed Rule 205 when it exempted chemicals that are shipped at 500 lbs or less from its reporting requirements. The fire codes in most cities require that every product requiring a Material Safety Data Sheet (MSDS) be reported. Some of the chemicals that are used in products to produce natural gas are extremely toxic and even an ounce would be enough to cause serious to fatal health effects. To confirm the latter, there is now evidence from a recent incident in Colorado where the fumes from a product almost cost the life of an emergency room nurse.

2. **Setbacks for homes and water resources must be set at nothing less than 2000 feet.** TEDX is concerned about the COGCC decision in proposed Rule 603 to require only 150 feet setback from oil and gas operations. The COGCC must take into consideration the physical danger and noise created by the heavy equipment used in drilling and frac'ing operations that run continuously around the clock and sometimes for several months or more. The COGCC must also consider the

practice of drilling multiple wells from one pad and the fact that chemicals will be evaporating from reserve pits and contaminating the air, soil, and water for months until they are closed. And, most important, exposure to volatile compounds, including those naturally surfacing with the methane and those found in products used to maintain well pads, can continue through the life-span of the well. Wherever stationary equipment will be operating, there will be fugitive emissions either from the well or the motors/engines powering the equipment.

To support the above concerns, TEDX is providing the following narrative and accompanying documents that we have compiled over the past six years for you take into consideration as you move forward with rule making.

Attachment A. AN ANALYSIS OF POSSIBLE INCREASES IN EXPOSURE TO TOXIC CHEMICALS IN DELTA COUNTY, COLORADO WATER RESOURCES AS A RESULT OF GUNNISON ENERGY'S PROPOSED COAL BED METHANE ACTIVITY 10/22/02

This is a letter I submitted to the regional US Forest Service and BLM managers who were issuing permits to Gunnison Energy Corporation (a member of the Oxbow Group) to drill gas wells on the Grand Mesa, the source of water for hundreds of families and farms below. Two years after this letter was submitted, a woman called to tell me that she had developed a rare adrenal tumor while breast feeding her baby and had found my letter in the government docket. Along with the tumor, her adrenal gland had to be removed and she was worried about her daughter, whom she had breast fed over the 18 months while the tumor was growing. She wanted to know if I thought the damage to her family's domestic water well during a fracturing event could have released 2-butoxyethanol (2-BE) into their water. She read in my memo that 2-BE causes rare adrenal tumors in female laboratory animals as well as a number of other bizarre health effects. At first the company (ENCANA) and the Colorado Oil and Gas Conservation Commission (COGCC) denied that 2-BE was ever used during frac'ing. After several months of deliberation in 2005, ENCANA and the COGCC admitted that 2-BE had been used while frac'ing a nearby gas well on the day her well blew up. Her drinking water well was less than 1000 feet from well G33 where the frac'ing took place. Four years after the incident the company agreed to test the water from her well for 2-BE, which, not surprisingly, was negative. (See the physical characteristics and health effects of 2-BE described in my letter.) If the operator prior to frac'ing had reported fully to the COGCC what it intended to use, household water wells that erupted on the same day in the vicinity of the well pad could have been tested for 2-BE immediately and the residents could have been informed. In addition, there is nothing today to force industry to provide the names of the chemicals that are involved in spills and accidents, even to healthcare providers, who also need this information in order to treat their patients.

Attachment B CHEMICALS USED TO PRODUCE AND DELIVER NATURAL GAS: COLORADO

For several years, the Oil and Gas Accountability Project (OGAP) and others have been sending TEDX the Material Safety Data Sheets (MSDS) from products used in natural gas operations around the West. We were also sent MSDSs that were released following accidents and spills. Attachment B is TEDX's most current list of products and chemicals used in Colorado. It is important to note that at least 67 of the chemicals on this list are designated as hazardous by at least one of six Federal Laws. TEDX appears to be the only entity attempting to develop an inventory of chemicals used in gas operations.

Attachment C. ANALYSIS OF CHEMICALS USED IN NATURAL GAS PRODUCTION: COLORADO 02/06/08

This attachment provides an analysis and comments concerning the chemicals listed in TEDX's Colorado inventory in which we found 215 products containing 278 chemicals. We broke out the health effects associated with each chemical into 14 categories based on standards used in government reports to describe toxicological/health endpoints. In our comments we provide three graphs that depict the frequency at which those health effects are associated with the chemicals used in natural gas operations. Taking pathway of exposure into consideration we broke out the water soluble chemicals and the volatile chemicals to provide a better picture of the hazards involved. For example, 33% of the 278 chemicals on the list can cause brain and neurological damage. and/or damage. Looking only at the 73 volatile chemicals on the list, the percentage jumps to more than 60%. (See www.endocrinedisruption.org for lists and summaries for other western states.)

For emphasis we insert here Numbers 6 through 10 from Attachment C that cover the difficulty of determining what is in the products that are being used in natural gas operations. It is important to understand that the Occupation Safety and Health Administration (OSHA) provides a boiler plate form as guidance for what should be included on an MSDS. Information presented on a Material Safety Data Sheet is the sole responsibility of the product manufacturer. Unfortunately, OSHA is not structured to review the MSDSs before they are attached to a product. What appears on the MSDSs is solely what the manufacturer of the product chooses to reveal. As a result TEDX can in no way state that our list of chemicals in use in any state is complete or accurate.

6. Several reasons led to the lack of data about the health effects of some of the products and chemicals on the spread sheet:

(a) Some products list no ingredients.

(b) Some products provide only a general description of the content, such as "plasticizer", "polymer" etc.

(c) Some products list some or all of the ingredients as "proprietary".

(d) No health effect data were found for a particular chemical or product.

7. Much of the information about the composition of the products on the list comes from a Material Safety Data Sheet (MSDS). Ingredients on MSDSs are sometimes labeled as "proprietary", or "no hazardous ingredients" even when there are significant health effects listed on the MSDS.

8. Some of the citations used to establish the health effects of the chemicals on this list are old, dating back to the 1970's and 80's. In several cases data were derived from abstracts, not the full report or manuscript. In other cases, citations were taken from toxic chemical databases, such as TOXNET, Chem ID, etc. Many reports submitted to the US Environmental Protection Agency by the manufacturer to register a chemical are not accessible. In some cases it is impossible to track down any health effect for a chemical, especially when the manufacturer provides no Chemical Abstracts Service (CAS) number.

9. No health effects were found for 59 of the chemicals on the list. Of these, only 14 had been assigned a CAS number which facilitates searching the literature. We found no health related literature for these chemicals. It was impossible to determine the safety of the other 45 chemicals either because they were listed as mixtures, proprietary, or unspecified (10), or had chemical names that were so general that the specific chemical could not be identified (35).

10. From early on, as new products were added to the list, the sequence of the categories in the pattern of the percentages has shifted only slightly. Looking at data from other states, the pattern also holds. It is expected that slight changes in sequence from one position to another will continue to occur as more products and chemicals are entered into the database.

Attachment D FRAC'ING SPILL

Attachment D is also provided to emphasize the need to have the chemical information available immediately in the case of accidents or spills. A week or more following reports in newspapers about a "frac'ing mixing truck" accident with civilian vehicles in Garfield County, Colorado TEDX was sent the MSDSs for five products that leaked. It was estimated that a total of 318 gallons had spilled by the side of the road. This attachment provides a breakout of the health effects of the 15 chemicals reported on the product MSDSs. Seven of the chemicals were volatile and could have been inhaled at the time of the accident posing possible health effects in at least five of the nine health categories on the graph. The four chemicals that were soluble posed a possible health threat in all nine health categories. In this case, the State Patrol was the first responder at the scene.

Attachment E PERCENT OF ADVERSE HEALTH EFFECTS ASSOCIATED WITH DRILLING BLOWOUT

Attachment E is provide as an example of the dilemma other states in the West have faced and to emphasize the importance for full disclosure where human health and life support systems are at risk. In August, 2006, TEDX received an urgent request for information about 20 products that were used in a routine drilling operation in Crosby, Wyoming, during which the well blew out at a depth of 8,000 ft. The company involved gave the local authorities the MSDSs for the products they used to drill, which were then sent to us. It took 57 hours to get the blowout under control while muds and fumes blew back up the well. They were seeping out of cuts along a county road and from two large cracks in the earth that extended from the well pad toward a nearby housing development. People were trapped in their homes and could not go outside because of the fumes.

TEDX presents these data in response to industry's statements that their drilling chemicals are only soap, guar gum, and water and/or are organic and safe. These data reveal that the chemicals used to increase the efficiency of drilling muds can pose serious health problems and should be among those chemicals that are fully disclosed.

We add here, that this well was shut down permanently. Upon closure, Wyoming came up with a comprehensive, long-term recovery and remediation plan that could provide a model for Colorado. TEDX was impressed with the thoroughness and long-term considerations that went into the plans. (See URL: http://deq.state.wy.us/volremedi/downloads/Web%20Notices/Windsor%20Well_Clark/Work%20Plan%20FINAL%20020108.pdf)

Attachment F POTENTIAL HEALTH EFFECTS OF RESIDUES IN SIX NEW MEXICO OIL AND GAS DRILLING RESERVE PITS BASED ON COMPOUNDS DETECTED IN AT LEAST ONE SAMPLE.

In November 2007 I was asked to testify during hearings by the New Mexico Oil and Gas Commission that was in the process of writing new regulations on pit closures. The results provided in this attachment were based on industry's own test results from 6 New Mexico reserve pits that were in the process of shutting down. The 42 chemicals that were detected produced a pattern of higher frequencies of health categories than anything TEDX had discovered thus far. TEDX found that 34 of the 42 chemicals detected in the pits were not on the list of 224 chemicals used to produce gas and oil in New Mexico. (See TEDX's website www.endocrinedisruption.org for the complete list and Analysis and Summary for the chemicals used in New Mexico.) Many of the chemicals in the pits were at concentrations well above state and federal safety levels. We further discovered that the chemical analytical protocols used to test the pit residues looked for only 8 chemicals on the New Mexico list.

Attachment G NUMBER OF CHEMICALS DETECTED IN RESERVE PITS FOR SIX WELLS IN NEW MEXICO THAT APPEAR ON NATIONAL TOXIC CHEMICALS LIST

This attachment is based on the percent of the 42 chemicals found in the 6 pits that are on the superfund or CERCLA (Comprehensive Environmental Response, Compensation, and Liability Act Summary Data for 2005 Priority List of Hazardous Substances) and EPCRA (Emergency Planning and Community Right to Know Act Section 313 Chemical List for Reporting year 2006 including Toxic Chemical Categories) and EPCRA List of Lists: Consolidated List of Chemicals Subject to the emergency Planning and Community Right to Know Act (EPCRA) and Section 112(r)of the Clean Air Act. It is apparent that full disclosure must be required for all chemicals that are used during any part of operations to produce natural gas. The chemicals reported on MSDSs and Tier II reports do not fully account for what is being detected in the New Mexico pits.

States across the West are just beginning to discover chemicals that were used during natural gas operations for which there is no explanation. What little information is available concerning pit contents is more than sufficient to be a cause for concern. In my New Mexico testimony when asked by the Hearing Officer and Chairman of the Oil and Gas Commission about the chemicals found in the pits about to be closed, **I had to admit that if the pattern of chemical contaminants continues to be the same as more and more pits are tested across the country prior to closure, it would appear that every well pad will eventually become a superfund site.**

Attachment H CHEMICALS IN URS FIELD ACTIVITIES REPORT FOR CHARACTERIZATION OF PIT SOLIDS AND FLUIDS IN COLORADO ENERGY FIELDS

To emphasize how little is known about what is being introduced into the land, water, and air during natural gas operations and the need for full disclosure, TEDX is presenting Attachment H. This document shows the results of the recent, industry-funded report by the Colorado Oil and Gas Association (COGA). In this effort chemicals were measured in pit fluids and solids, drilling, frac'ing, and flowback fluids, produced water, and background soil across four natural gas basins in Colorado. URS, the company that did the chemical analysis, listed 159 chemicals along with the concentrations at which they were found in the samples. Only 20 of these chemicals are listed in the COGCC's **Table 910-1** **Contaminants of Concern Allowable Concentrations Draft Rules** . We should like to point out that 2-BE was found in every basin in 25 samples at levels that exceed the Minimal Risk Levels (MRLs) outlined in the Agency for Toxic Substances and Disease registry (ATSDR) Toxicological Profile for that substance. 2-BE is found in six of the products on TEDX's most recent inventory for Colorado. Yet, 2-BE is not on the COGCC list of contaminants of concern.

The mismatch between what can be eked out about the chemicals that are being introduced into the gas fields and what is turning up in the environment around well pads emphasizes the need for full disclosure of all chemicals to be used, and most important, prior to operations commencing. Full protection is needed for our watersheds, the laborers working in the gas fields, and the citizens who live near the activity. This can only be accomplished through full disclosure of all the chemicals in all the products being used, as well as full disclosure of where and how much of each chemical is used in each operation, how they are mixed, and how the residuals will be disposed of.

Please do not hesitate to call me if you have questions or would like to discuss our comments more. I can be contacted at 970-527-6548.

Theo Colborn, PhD
President

ATTACHMENT A

Theo Colborn, PhD
PO Box 1253
Paonia, CO 81428
970 527 6548

October 22, 2002

Allen Belt
Bureau of Land Management
2505 So Townsend
Montrose, CO 81405

Robert Storch
United States Forest Service
2250 Highway 50
Delta, CO 81416

RE: **An Analysis of Possible Increases in Exposure to Toxic Chemicals in Delta County, Colorado Water Resources as the Result of Gunnison Energy's Proposed Coal Bed Methane Extraction Activity**

BACKGROUND
Gunnison Energy is proposing to extract coal bed methane in Delta County, Colorado. In its notices to the public it makes claims that "…the threats posed by hydraulic fracturing of CBM wells to USDWs [US drinking water supplies] are low and do not justify additional study." They also claim that the "…fluids used to extract coal bed methane from the ground do not substantially threaten public health." [1] The following addresses these claims and looks at possible direct and indirect health effects of CBM extraction on the citizens, domestic animals, and wildlife in Delta County.

THE FRACTURING FLUIDS
Gunnison Energy proposes to use a solvent, ethylene glycol monobutyl ether (2-butoxyethanol), hereafter designated as 2-BE, in a liquid fracturing mixture to facilitate the extraction of coal bed methane in Delta County. 2-BE will be present in the liquid component of the fluid at approximately 7 ppm (parts per million) based on data provided to Delta County Commissioners following three local Area Planning Committee meetings by Gunnison Energy Corporation (GEC), May 29, 2002.

The structural formula for 2-BE is:
CH3-CH2-CH2-CH2-O-CH2-CH2-OH

2-BE is a highly soluble, colorless liquid with a very faint, ether-like odor.[2] At the concentration it is to be used in Delta County, it might not be detectable through odor or taste. 2-BE has low volatility, vaporizes slowly when mixed with water, and remains well dissolved throughout the water column.[2] Photolysis (degradation by sunlight) is not a factor in the breakdown of 2-BE. It mobilizes in soil and can easily leach into groundwater.[2] Because of these characteristics, it could remain entrapped underground for years and eventually migrate to a domestic well or to a surfacing spring. This contaminated water in some cases might not reach wells, springs, and rivers in Delta County until long after GEC will have gone out of business.

The half-life of 2-BE in natural surface waters ranges from 7 to 28 days.[2] With an aerobic bio-degradation rate this slow, humans, wildlife and domestic animals could come into direct contact with 2-BE through ingestion, inhalation, dermal sorption, and the eye in its liquid or vapor form as the entrapped water reaches the surface. Aerobic biodegradation requires oxygen and therefore the deeper 2-BE is injected underground the longer it will persist. To date the aerobic biodegradation breakdown products of 2-BE have not been identified. The chemistry to detect the glycol ethers, including 2-BE, in environmental samples is very difficult and therefore there are few laboratories with the ability to accurately quantify its presence.[2]

DIRECT HEALTH EFFECTS OF 2-BE

Immediate/Direct

Following inhalation or swallowing, 2-BE is distributed rapidly to all tissues in the body via the blood stream in laboratory animals. When applied directly to the skin, 2-BE is rapidly absorbed.[2] In solution, it is absorbed more rapidly. It is broken down to its toxic component, 2-butoxyacetic acid (BAA) in both humans and laboratory animals following all three exposure pathways[3]. Breakdown and excretion of BAA through the urine is identical regardless of the pathway of exposure according to laboratory studies[3] No laboratory studies could be found that assessed cumulative effects from simultaneous ingestion, inhalation, and dermal exposure to 2-BE, which could be the scenario in Delta County.

Hemolytic Effects - Primary

The most critical direct effect of 2-BE as the result of laboratory studies is its impact on red blood cells. It causes hemolysis (breakdown of red blood cells) by dissolving the fat in the cell membrane and causing the membrane to break down. 2-BE causes hematuria (blood in the urine) and blood in the feces. Blood appears in the urine as a result of kidney damage which can eventually lead to kidney failure. It is especially toxic to the spleen, the bones in the spinal column, and bone marrow (where new blood cells are formed) and the liver, where chemicals are detoxified (broken down for easy excretion from the body).[2] Chronic exposure can cause anemia, and in laboratory animals it leads to insufficient blood supply, cold extremities, and tail necrosis (a condition where the tail rots away.)[4]

Other Effects - Secondary

In a sub-chronic study over a period of 14 weeks, mice exposed to 2-BE exhibited the hemolytic effects mentioned above as well as a number of secondary problems involving the spleen and liver, and degeneration of kidney tubules.[5] In addition, females were more sensitive to fore-stomach necrosis, ulceration, and inflammation occurring at half the dose required to cause the same problems in males. Female fertility was also significantly reduced in mice because of embryo mortality.[6] In this study, the dead embryos were discarded, and as a result, the prenatal effects of 2-BE on the embryos were not determined.

EPA recommends that 2-BE be classified as a mild eye irritant.[3] However, a recent study published after EPA reached this classification could lead to a higher risk classification. Using oral exposure in rats, severe damage to the eye was discovered that led to retinal detachment, photoreceptor degeneration and occlusion resulting from multiple thrombosis of the blood vessels in the eye.[7] In this study, females were more susceptible.

With few exceptions most of the evidence mentioned above was derived from inhalation studies. All of the studies used standard, high-dose testing protocols to detect obvious birth defects and organ damage, cancer, mutations, convulsions, and skin and eye irritation. No long-term, multigenerational, chronic oral studies at environmentally relevant concentrations are available that could rule out prenatal damage.

Immunotoxicity

Early studies suggested that perhaps 2-BE does not affect the immune system[8],[9] more recent studies using more sophisticated measures and lower doses have determined otherwise. In an early immunotoxicity study, the lowest doses significantly increased the natural killer (NK) cell response in males and females, and the highest doses induced no response.[9] The investigators never did find the lowest dose at which there would be no effect. However, they did not consider this an indication of adversity.

In another study, rats exposed to 2-BE in water for 21 days showed no structural effects in the liver or the testes, however their livers were significantly heavier and the animals experienced reduced body weight even at the lowest dose. However, they were surprised to find that at the lowest 2-BE dose NK cell responses were increased. A more recent study exposing female mice topically for 4 days once again confirmed the elevated NK cell response.[10]

A 2002 study reports that 2-BE at unusually low doses inhibits a normal contact hypersensitivity response in female mice.[11]

Carcinogenicity

At the end of a two year chronic bioassay, elevated numbers of combined malignant and non-malignant tumors of the adrenal gland were reported in female rats and male and female mice.[5] Low survival rates in the male mice in this study may have been the result of the high rate of liver cancers in the exposed animals.[5] This study revealed that long-term exposure to 2-BE often led to liver toxicity before the hemolytic effects were discernible. [5]

No human epidemiological studies are available to assess the potential carcinogenicity of 2-BE. However, from the results of laboratory studies, using Guidelines for Carcinogenic Risk Assessment (1986), 2-BE has been classified by the USEPA as a *possible human carcinogen.* [3]

SENSITIVE POPULATIONS

A number of laboratory studies confirmed that aging increases susceptibility to the effects of 2-BE. Older animals have reduced ability to metabolize the toxic metabolite BAA and this, combined with reduced kidney function that accompanies aging reduces their ability to excrete it in the urine.[3]

Females are more susceptible to the hematological effects in laboratory animal and human studies. There is an obvious gender and age sensitivity to 2-BE in humans as determined from accidental poisonings with females being more sensitive. In addition, among humans there may be sub-populations that might be more sensitive than others.[3]

A list of risk factors for people exposed to 2-BE includes those:
(1) using the pharmaceuticals hydralazine, dilantin, chloramphenicol, and sulfonamides;
(2) with infections, such as herpes, malaria, parasites, and rubella;
(3) with a family history of gallstones, cholestectomy, jaundice, Rh and APO positive;
(4) with iron deficiency; and
(5) with systemic illnesses, such as cardiac, gastrointestinal, liver, and kidney disease, and hypothyroidism.[3,12]

From a wildlife and domestic animal perspective, it is important to note that a variety of studies with laboratory animals revealed that some species are more sensitive to 2-BE than others.[3] For example, rats are more sensitive than mice to the toxic effects of 2-BE on the liver. No studies were found using wildlife or domestic animals.

INDIRECT HEALTH EFFECTS OF 2-BE
2-BE is widely used as an emulsifying agent and as a solvent for mineral oils[2]. This makes it an excellent candidate for releasing the natural, oily, coal-tar hydrocarbons found in coal that have been recognized for over a century to cause cancer.

CUMULATIVE AND AGGREGATE HEALTH HAZARDS
As mentioned above, no cumulative exposure studies have been done that evaluate the simultaneous impact of ingestion, inhalation, and topical exposure to 2-BE, which could be the mode of exposure to residents in Delta County. If 2-BE comes directly into the home via a well it will be used for drinking, bathing, showering, and doing laundry and dishes. Laboratory studies have revealed that in the case of bathing or applying 2-BE to the skin, it is readily absorbed through the skin rather than volatilizing. If water containing 2-BE is heated, as it comes out of the tap some of the 2-BE will off-gas into the home environment. Most of the studies mentioned above used inhalation as the pathway of exposure to 2-BE. Inhalation of 2-BE in the home could become a problem. For example, concern about exposure to the volatile by-products (trihalomethanes or THMs) in chlorine treated tap water [13] led to the discovery that taking a bath or a shower can lead to excessively high dose exposure to THMs. This exposure can exceed the level of exposure from drinking the water and add to the dose from drinking the water. Because of the volatility of 2-BE, the same pathway of exposure could become of concern for Delta County residents if 2-BE reaches their wells and especially if the water is heated.

Of increasing concern by federal health agencies are the *unpredictable,* interactive effects of mixtures of chemicals.[14] Under the scenario described in Gunnison Energy's prospectus, the concentrations of three classes of chemicals that are toxic individually at very low concentrations could become introduced or increased in the environment of Delta County. These include (1) the trace elements arsenic, molybdenum, and selenium, already a problem in Delta county, (2) a synthetic solvent, 2-BE, and (3) the polyaromatic hydrocarbons and coal tars found in coal beds. Arsenic, 2-BE, and aromatic coal bed tar derivatives are known carcinogens. In aggregate, whether their effects would be additive or synergistic has not been determined. However, in one study, the authors were surprised to find that 2-BE potentiated the lethality of low level exposure to another toxicant, a bacterially produced lipopolysaccharide (LPS) that is found in the human gut under certain conditions.[8]

Additional contamination of potable water could come from the impurities in the 2-BE product used in the extraction process. Commercial grade 2-BE can range in impurities depending upon the production process, manufacturer, and grade of the solvent. One impurity, sodium hydroxide (lye), a strong caustic, might possibly contribute to the alkalinity of the water. It was discovered in one product at 0.25%. Even high grade 2-BE with greater than 99% purity can contain 0.2% w/w ethylene glycol (anti-freeze), diethylene glycol, and diethyl monobutyl ether, sister compounds to 2-BE with much higher toxicity.[2]

ENVIRONMENTAL EFFECTS

Increased salinity

2-BE leaves an alkaline residue upon evaporation which might slightly add to the alkalinity problem that increases as surface water approaches the lower reaches of Delta County. Because of the solubility of sodium salts they can travel long distances in rivers and could increase the salinity problem in the Colorado River downstream.

Locally, any additional water that increases the salinity could also increase the mobilization of some of the alkaline soluble, problem elements such as arsenic and selenium, already posing health risks in Delta County. Health advisories are already in effect for Sweitzer Lake warning people not to eat the fish because of the high levels of selenium in the fish tissue.

A peer reviewed report by the US Forest Service on the threat of increased selenium contamination in the Mancos and La Plata River drainages describes a scenario similar to the Gunnison River drainage in Delta County where selenium is already at levels of concern.[15] The hazards include threats to wetlands, aquatic habitat, invertebrates, fish, birds and other wildlife reproduction. Delta County is in a unique and fragile situation – (1) it already has the natural geological existence of selenium, (2) its local hydrology that has been embellished and complicated through extensive irrigation activity, and (3) a climate prone to drought .

There is a growing collection of scientific papers on the adverse health effects of selenium in wildlife exposed to elevated concentrations of selenium in seep-like situations (natural and human-induced) in the West. Waterfowl, fish, and invertebrates have experienced decreased hatching success and increased birth defects as a result of exposure in the egg. Chicks of avocets, stilts, ducks, coots, etc. have been found with crossed bills, missing eyes, and other deformities in aquatic systems where irrigation run off water collects.

HEALTH RISKS TO BE TAKEN INTO CONSIDERATION

Although no standard has been established yet for 2-BE in drinking water, in 1993 the EPA set a minimum risk level (MRL) for 2-BE at 0.07 mg/kg/day based on an adult 70 kg male drinking two liters of water a day. This value is based on liver toxicity studies in rats and not on more sensitive immune, developmental, and functional health effects that have become of concern over the past decade. In 1998 EPA derived a reference dose RfD for 2-BE at 0.5 mg/kg/day for non-cancer effects. This is based on lifetime exposure. EPA admits " Since drinking water exposures are highly complex and variable, a simplifying assumption was used in all simulations ….". EPA had no human data to derive its value.[3]

GEC is planning to inject fluid into the ground in Delta County at 7 ppm. If this fluid reaches the taps in Delta County at that concentration, it will be providing 0.2 mg/kg/day per two liters of water, approximately three times higher than the MRL and a little more than half the RfD.

RECOMMENDATIONS

1. First and most important, it is imperative to understand the hydrology of Delta County better. In addition, the complex diversions of potable water for irrigation and domestic use throughout the county must be factored into this knowledge.

2. Second, it is imperative to determine the current concentrations of the toxic chemicals in the coal bed water to be released during extraction prior to introducing the fracturing liquids. This must include the entire scope of trace elements from alkaline to acid based derivatives in both their dissolved and suspended form. In addition, the entire scope of polyaromatic hydrocarbons (both parent and alkylated forms) in the underground coal bed water should be quantified prior to any activity. Because of the toxicity of the elements and compounds of concern, detection limits throughout this monitoring should be no higher than a part per trillion. Information such as this will allow for determining if the fracturing liquid releases additional toxic components, and in the case of the PAHs, through dissolution by the 2-BE.

3. Throughout the mining life of the well, the underground fluid with which it will interface should be monitored on a regular basis for its toxic components. See those components mentioned in Number 2. If the concentrations of the contaminants decrease, this could indicate that precious potable subsurface or surface water is being drained from above. This provides an approach for detecting dewatering before too much potable water is lost.

4. If exploration begins, GEC must keep daily inventories of the total amount of fracturing liquid injected, including the exact amount of each component in the fluid.

5. GEC should be required to retrieve all surfacing liquid for containment. The volume of the retrieved liquid should be reported and the concentrations of the chemicals in that liquid quantified on a regular basis for auditing purposes to account for the toxic chemicals that were introduced under Number 4.

5. GEC's plans for disposal of this toxic liquid should be presented to the residents of Delta County for approval before any leases are approved.

6. Any changes in the composition of the fracturing liquid must be reported to the citizens of Delta County for consideration before the liquid is used.

7. If GEC should find that it needs or wants to use anything other than sand for propping, it must provide to the citizens of Delta County for consideration all the components in the alternative material before the material is used. The purity of the alternative products used must be provided as well. Trade names will not be acceptable.

---

[1] The Daily Sentinel, Sunday, September 8, 2002. p. 8C

[2] Agency for Toxic Substances and Disease Registry . US Department of Health and Human Services. (1998) Toxicological Profile of 2-Butoxethanol and 2-Butoxyethanol Acetate.

---

[3] US Environmental Protection Agency. Toxicological Review of Ethylene Glycol Monobutyl Ether (EGBE) In Support of Summary Information on the Integrated Risk Information System (IRIS), October 1999

[4] Nyska A, Maronpot RR, PH Long, JH Roycroft, JR Hailey, GS Traylor, BI Ghanayem (1999) Disseminated thrombosis and bone infarction in female rats following inhalation exposure to 2-butoxyethanol. Toxicol Pathol 27(3):287-294.

[5] National Toxicology Program (NTP). 1998 NTP Technical report on the toxicology and carcinogenesis studies of 2-butoxyethanol (Cas No. 111-76-2) in F344/N rats and B6C3F1 mice (inhalation studies). US Department of Health and Human Services, Public Health Service, National Institutes of Health, Research Triangle Park, NC NTP TR 484. NIH Draft Publ. No. 98 -3974.

[6] Heindel,JJ, Gulati, DK, Russell, VS, et al. (1990) assessment of ethylene glycol monobutyl and monoethyl ether reproductive toxicity using a continuous breeding protocol in Swiss CD-1 mice. Fundam Apply Toxicol 15:683-696.

[7] Nyska A, RR Maronpot, BI Ghanayam. (1999) Ocular thrombosis and retinal degeneration induced in female F344 rats by 2-butoxyethanol. Hum Exp. Toxiol 18(9):577-582.

[8] Smialowicz, RJ, Williams, WC, Riddle,MM. etal. (1992). Comparative immunosuppression of various glycol ethers orally administered to Fischer 344 rats. Fundam Apply Toxiocl 18:621-627.

[9] Exon JH, GG Mather, JLBussiere, DP Olson, PA Talcott. (1991) Effects of subchronic exposure of rats to 2-methoxyethanol or 2-butoxyethanol: thymic atrophy and immunotoxicity. Fudam Appl Toxicol 16(4):830-840.

[10] Singh P, Zhao S, Blaylock RL. ()2001). Topical exposure to 2-butoxyethanol alters immune responses in female BALB/c mice. Int Jrl Toxicol 20:383-390.

[11] Singh P, Morris B, Zhao S, Blaylock RL. (2002) Suppresssion of the contact hypersensitivity response following topical exposure to 2-butoxyethanol in female BALB/c mice. Int Jrl Toxicol, 21:107-115.

[12] (Berliner N, Duffy, TP, Abelson HT. (1999) Approach to adult and child anemia. In: Hoffman, R ed. Hematology:Basic Principles and Practice. 2nd ed. New York, NY: Churchill Livingtsone, pp.468-483.

[13] Nester AM, Singer PC, Ashley DL, Lynberg MC, Mendola P, Langlois PH, Nichols JR. (2002). Comparison of trihalomethanes in tap water and blood. Env Sc Techn. 36(8):1692-1698.

[14] Department of Health and Human Services, Agency for Toxic Substances and Disease Registry , (2001). Guidance Manual for the Assessment of Joint Toxic Action of Chemical Mixtures. Draft for Public Comment.

[15] Lemly AD (1997). Environmental hazard of selenium in the Animas La Plata water development project. Ecotoxicol Environ Safety 37:92-96.

ATTACHMENT B

TEDX
The Endocrine Disruption Exchange
P.O. Box 1407, Paonia, CO 81428
970-527-4082
www.endocrinedisruption.org
tedx@tds.net

Chemicals Used to Produce and Deliver Natural Gas: Colorado
2-6-08

Chemical	CAS #	Chemical	CAS #
(2-BE) Ethylene glycol monobutyl ether	111-76-2	Chromium	7440-47-3
1,2-Bromo-2-nitropropane-1,3-Diol (2-Bromo-2-nitro-1,3-propanediol or Bronopol)	52-51-7	Chromium (III) compounds (as Cr)	
1,6-Hexanediamine	124-09-4	Chromium acetate	1066-30-4
1-methoxy-2-propanol	107-98-2	Chromium III	16065-83-1
1-Propanaminium, 3-amino-N-(carboxymethyl)-N,N-dimethyl-, N-coco acyl derivs, inner salts	61789-40-0	Citric acid	77-92-9
2-(2-Methoxyethoxy)ethanol	111-77-3	Cobalt	7440-48-4
2-(Thiocyanomethylthio) benzothiazole (TCMTB)	21564-17-0	Combustable liquid	Unspecified
2,2',2"-Nitrilotriethanol	102-71-6	Contains no hazardous substances	
2,2-Dibromo-3-Nitrilopropionamide (DBNPA)	10222-01-2	Copper	7440-50-8
2-acrylamide-2-propane sulfonic acid and N,N-dimethyl acrylamide copolymer		Copper iodide	7681-65-4
2-Bromo-3-Nitrilopropionamide	1113-55-9	Cottonseed hulls	
2-ethylhexanol	104-76-7	Crystalline silica (Silicon dioxide)	7631-86-9
2-Propenamide, polymer with 2-propenoic ammonium salt	26100-47-0	Crystalline Silica, cristobalite	14464-46-1
5-chloro-2-methyl-4-isothiazolin-3-one	26172-55-4	Crystalline Silica, quartz	14808-60-7
Acetic acid	64-19-7	Crystalline Silica, tridymite	15468-32-3
Acrylamide	79-06-1	Deionized Water	7732-18-5
Adipic acid	124-04-9	Diammonium phosphate	7783-28-0
Alcohols, C10-16, ethoxylated with 6.5 EO *(Alcohols, C10-16, ethoxylate)*	68002-97-1	Dicalcium silicate	10034-77-2
Aluminium dicalcium iron pentaoxide	12068-35-8	Diesel	Unspecified
Aluminum oxide	1344-28-1	Diesel 2	68476-34-6
Aluminum tristearate	637-12-7	Diethylene glycol	111-46-6
Ammonium bisulfite	10192-30-0	Diethylene glycol monobutyl ether	112-34-5
Ammonium persulfate	7727-54-0	Dimethyl formamide	68-12-2
Amoco NT-45 process oil [Diesel 2]	64742-46-7	Dipropylene glycol monomethyl ether	34590-94-8
Anionic polyacrylamide		Distallates (petroleum) hydrotreated light; kerosine-unspecified	
Anionic surfactants		Distillates (petroleum), hydrotreated (mild) heavy naphthenic	64742-52-5
Antimony	7440-36-0	Distillates (petroleum), hydrotreated (mild) heavy paraffinic	64742-54-7
Aqueous emulsion of diethylpolysiloxane		Dodecylbenzene sulfonic acid	27176-87-0
Aqueous suspension of cellulose	proprietary	Drakeol	8042-47-5
Aromatic naphtha, Type I (light) (Light aromatic solvent)	64742-95-6	EDTA/Copper chelate	60-00-04
Aromatic solvent		EO-C7-9-iso-,C8 rich-alcohols	78330-19-5
Arsenic	7440-38-2	EO-C9-11-iso, C10-rich alcohols	78330-20-8
Asphaltite (Gilsonite)	12002-43-6	Ester Salt	Unspecified
Attapulgite clay	12174-11-7	Ethanol (Acetylenic alcohol)	64-17-5
Barite (BaSO4)	7727-43-7	Ethoxylated 4-nonylphenol	26027-38-3
Barium	7440-39-3	Ethoxylated alcohol	68439-50-9
Bentonite	1302-78-9	Ethoxylated alcohol linear (1)	Proprietary
Benzyl chloride	100-44-7	Ethoxylated alcohol linear (2)	Proprietary
Blend of vegetable & polymer fibers		Ethoxylated alcohol linear (3)	Proprietary
Boric acid	10043-35-3	Ethoxylated nonylphenol	9016-45-9
Boric oxide	1303-86-2	Ethoxylated nonylphenol (branched)	68412-54-4
Butanol (N-butyl alcohol, Butan-1-OL, 1-Butanol)	71-36-3	Ethyl benzene	100-41-4
Cadmium	7440-43-9	Ethyl octynol	5877-42-9
Calcium aluminate	12042-78-3	Ethylene glycol	107-21-1
Calcium carbonate (sized)	471-34-1	Ethylene oxide	75-21-8
Calcium chloride	10043-52-4	Fatty acid soap	70321-73-2
Calcium hydroxide	1305-62-0	Fatty acids, C18-unsat, dimers, compds. With diethylenetriamine-tall-oil fatty acid reaction products	68647-57-4
Calcium oxide	1305-78-8	Ferrous sulfate	7720-78-7
Carbon	7440-44-0	Ferrous sulfate (Monohydrate ferrous sulfate)	17375-41-6
Carboxylic acids	Proprietaty	Fluoride	16984-48-8
Carboxymethyl hydroxypropyl guar gum		Fly ash	
Carboymethyhydroxy-propyl guar blend	Mixture	Formamide	75-12-7
Cationic polymer		Formic acid	64-18-6
Cedar fiber - processed		Formic Acid Sodium Salt (Sodium Formate)	141-53-7
Cellophane (polymer)		Fumaric Acid	110-17-8

Cellulase enzyme	unspecified	Galactomannan	11078-30-1
Cellulose	9004-34-6	Gas oils (petroleum), vacuum, hydrocracked, hydroisomerized, hydrogenated, C 15-30, branched and cyclic, high viscosity	178603-64-0
Cellulose derivative		Gas oils (petroleum), vacuum, hydrocracked, hydroisomerized, hydrogenated, C 20-40, branched and cyclic, high viscosity	178603-65-1
Cellulose material			
Gas oils (petroleum), vacuum, hydrocracked, hydroisomerized, hydrogenated, C 25-55, branched and cyclic, high viscosity	178603-66-2	Nut hulls	
Gilsonite *(Asphaltite)*	12002-43-6		
Glutaraldehyde	111-30-8	Oxidized tall oil	Unspecified
Glyceride esters		Oxyalkalated alcohol (1)	proprietary
Glycerin Mist (glycerol)	56-81-5	Oxyalkalated alcohol (2)	proprietary
Glycerol		Oxyalkylated Alcohol	unspecified
Glyoxal	107-22-2	Oxyalkylated alkyl alcohol (1)	proprietary
Graphite	7782-42-5	Oxyalkylated fatty alcohol salt	
Ground cellulosic material (ground walnut shells)		Oxyalkylated phenolic resin	
Ground pecan shells		Paraffinic solvent	
Guar Gum	Proprietary	Petroleum distillate	
Guar gum	9000-30-0	Petroleum distillate	Proprietary
Guar Gum blend	mixture	Petroleum distillate hydrotreated light	64742-47-8
Gypsum	7778-18-9	Petroleum product	445411-73-4
Gypsum respirable fraction	13397-24-5	Petroleum solvent	ID: P04500000
Haloalkyl heteropolycycle salt	Proprietaty	Phosphogypsum	13397-24-5
Heavy aromatic petroleum naphtha (aromatic solvent)	64742-94-5	Phosphonium, tetrakis(hydroxymethly)-sulfate	55566-30-8
High molecular weight polymer		Pine oil	8002-09-3
High pH conventional enzymes		Plasticizers	
Hulls		Polyacrylamide	9003-05-8
Hydrocarbon black solid	12002-43-5	Polyacrylamide/polyacrylate copolymer (Copolyer of acrylamide & sodium acrylate)	25085-02-3
Hydrochloric Acid (HCl)	7647-01-0	Polyacrylate	9003-01-4
Hydrofluoric Acid	7664-39-3	Polyaminated fatty acid	Unspecified
Hydrotreated heavy petroleum naphtha	64742-48-9	Polyaminated fatty acid surfactants	
Hydroxyethylcellulose	9004-62-0	Polyether polyol	
Hydroxypropyl guar blend	Mixture	Polyethylene glycol	25322-68-3
Hydroxypropylcellulose	9004-64-2	Polyglycerols	
Inert material		Polyglycol ether	Unspecified
Inorganic borate	Proprietary	Polymers	
Inorganic salts		Polypropylene (C6H6)N	9003-07-0
Iron	7439-89-6	Polypropylene glycols	
Isoalkane fluid		Polysaccaride polymers in suspension	
Isobutyl alcohol (2-methyl-1-propanol)	78-83-1	Polysaccharide	
Isopropanol (Propan-2-OL)	67-63-0	Polysaccharide	
Kerosene	8008-20-6	Polysaccharide ("Carbohydrate")	
Latex base		Polyvinyl acetate copolymer	
Lead	7439-92-1	Polyvinyl alcohol [AlcoteX 17F-H]	9002-89-5
Light aromatic solvent		Potassium carbonate	584-08-7
Lignite	129521-66-0	Potassium chloride	7447-40-7
Lignosulfonate	8062-15-5	Potassium hydroxide	1310-58-3
Lignosulfonic acid, chromium salt	9066-50-6	Potassium persulfate	7727-21-1
Lubricating oils (petroleum), C15- 30, hydrotreated neutral oil-based	72623-86-0	Potassium sulfate	7778-80-5
Lubricating oils (petroleum), C20- 50, hydrotreated neutral oil-based	72623-87-1	Propargyl alcohol (Prop-2-YN-1-OL	107-19-7
Lubricating oils (petroleum), C20- 50, hydrotreated neutral oil-based, high-viscosity	72623-85-9	Propene polymer	
Lubricating oils, (petroleum), C15-30, hydrotreated neutral oil-based, contg. solvent deasphalted residual oil	72623-84-8	Proprietary	
Magnesium oxide	1309-48-4	Proprietary	
Mercury	7439-97-6	Proprietary complex organic solution	
Methanol	67-56-1	Proprietary ingredients	
Methyl salicylate	119-36-8	Pryidinium, 1-(Phenylmethyl)-, ethyl methyl derivatives, Chlorides	68909-18-2
Methyl-4-isothiazolin	2682-20-4	Quanternary ammonium compounds	
Methylene bis(thiocyanate)	6317-18-6	Quaternary ammonium compound	proprietary
Mica	12001-26-2	Quaternary ammonium salts	unspecified
Modified lignosulfonate		Recycled newsprint	
Modified polysaccharide or Pregelatinized cornstarch or starch	9005-25-8	Resin	
Monoethanolamine	141-43-5	Sodium acid pyrophosphate	7758-16-9
Monofilament fiber		Sodium aluminate	1302-42-7
Monopentaerythritol	115-77-5	Sodium aluminum phosphate	7785-88-8
N,N-dimethylformamide and 2-acrylamido-2-methylpropane sulfonic acid copolymer		Sodium asphalt sulfonate	68201-32-1
NaHCO3	144-55-8	Sodium carbonate *(Soda ash)*	497-19-8
Naphthalene	91-20-3	Sodium carboxymethylcellulose (*Polyanionic cellulose)*	9004-32-4

Natural fibers		Terpene	
Nickel	7440-02-0	Tetrahydro-3,5-dimethyl-2H-1,3,5-thiadiazine-2-thione (Dazomet)	533-74-4
Nitrogen	7727-37-9	Tetramethyl ammonium chloride	75-57-0
Non-hazardous and other components below reportable levels		Tetrasodium ethylenediaminetetraacetate	64-02-8
Non-regulated components		Thiourea	62-56-6
n-propyl alcohol	71-23-8	Tricalcium silicate	12168-85-3
Sodium hydroxide	1310-73-2	Trimethylbenzene	25551-13-7
Sodium ligninsulfonate	8061-51-6	Trisodium nitrilotriacetate	5064-31-3
Sodium persulfate	7775-27-1	Unknown	
Sodium polyacrylate	9003-04-7	Vanadium	7440-62-2
Sodium polyacrylate polymer		Walnut hulls	977069-77-4
Sodium sulfate	7757-82-6	Wood by-product	
Sodium tetraborate decahydrate (Borax)	1303-96-4	Xanthan Gum	11138-66-2
oftwood dust		Xylene	1330-20-7
Styrene	100-42-5	Zinc	7440-66-6
Substituted alcohol	Proprietaty	Zinc Carbonate	3486-35-9
Substituted alcohol	Proprietaty	Zirconium nitrate	13746-89-9
Sulfomethylated quebracho	68201-64-9	Zirconium sulfate	14644-61-2
Sulfomethylated tannin	Proprietaty		
Sulfonic acid salt (organosulfur)			
Surfactant			
Synthetic copolymer			

ATTACHMENT C

TEDX
The Endocrine Disruption Exchange
P.O. Box 1407, Paonia, CO 81428
970-527-4082
www.endocrinedisruption.org
tedx@tds.net

ANALYSIS OF
CHEMICALS USED IN NATURAL GAS PRODUCTION:
COLORADO

February 6, 2008

Introduction

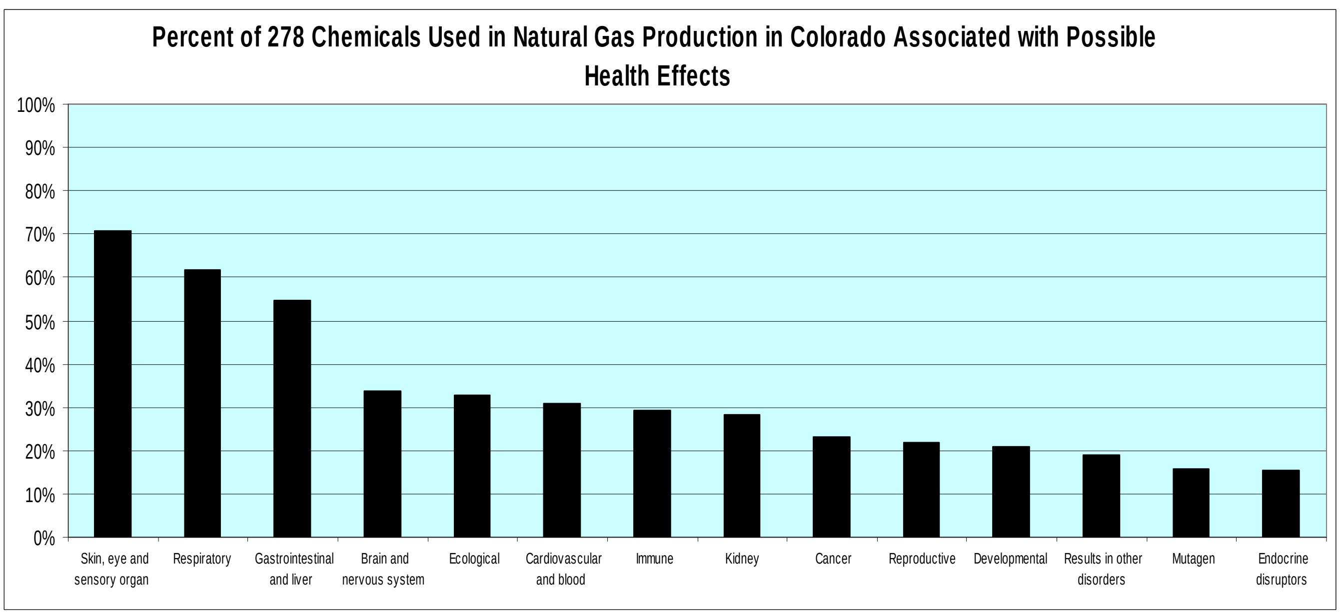
This project was designed to explore the health effects of the products and chemicals used in operations to produce natural gas in Colorado. It provides a glimpse at the pattern(s) of possible health hazards for those living in regions where gas development is taking place. The names of the products and chemicals were entered in an EXCEL spreadsheet for easy sorting and searching. Health impacts for chemicals were researched and fell into 14 categories based on standard use in government toxicological literature. We make no claim that this list is complete.

---

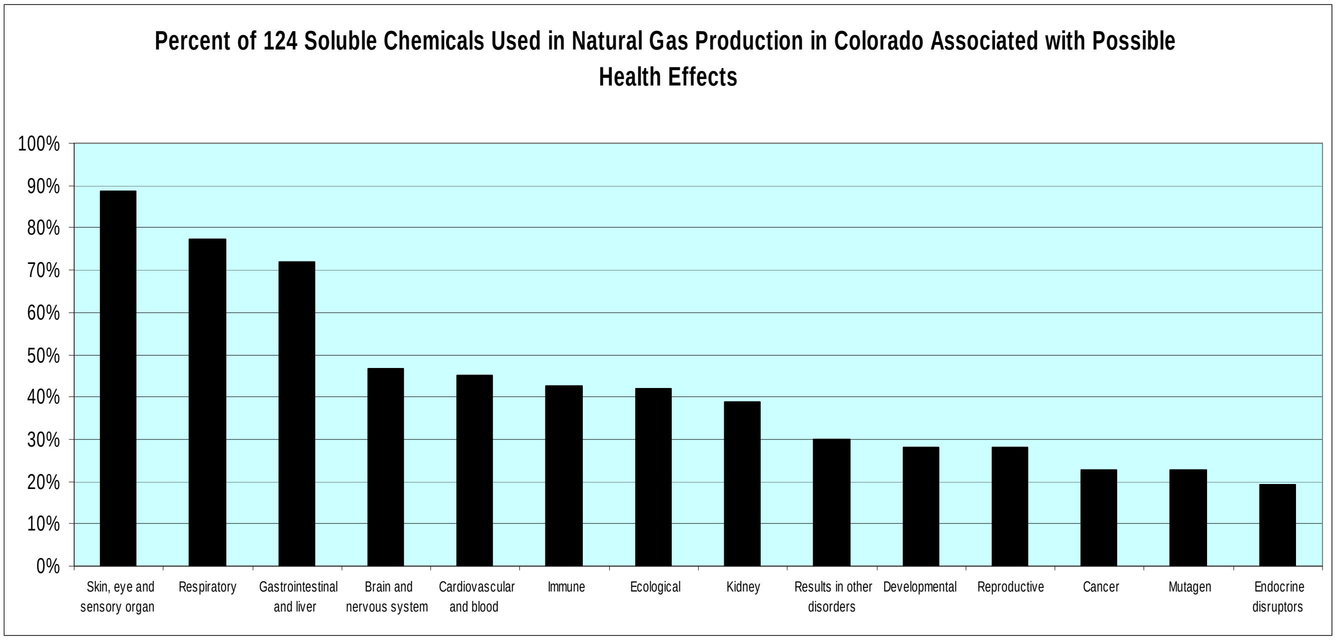
1. The 215 products contain at least 278 chemicals.

2. Ninety-three percent of the products have one or more adverse health effects. Of these, 19% have one to three possible health effects, and 81% have between four and fourteen possible health effects. Twenty-five products have 14 adverse health effects.

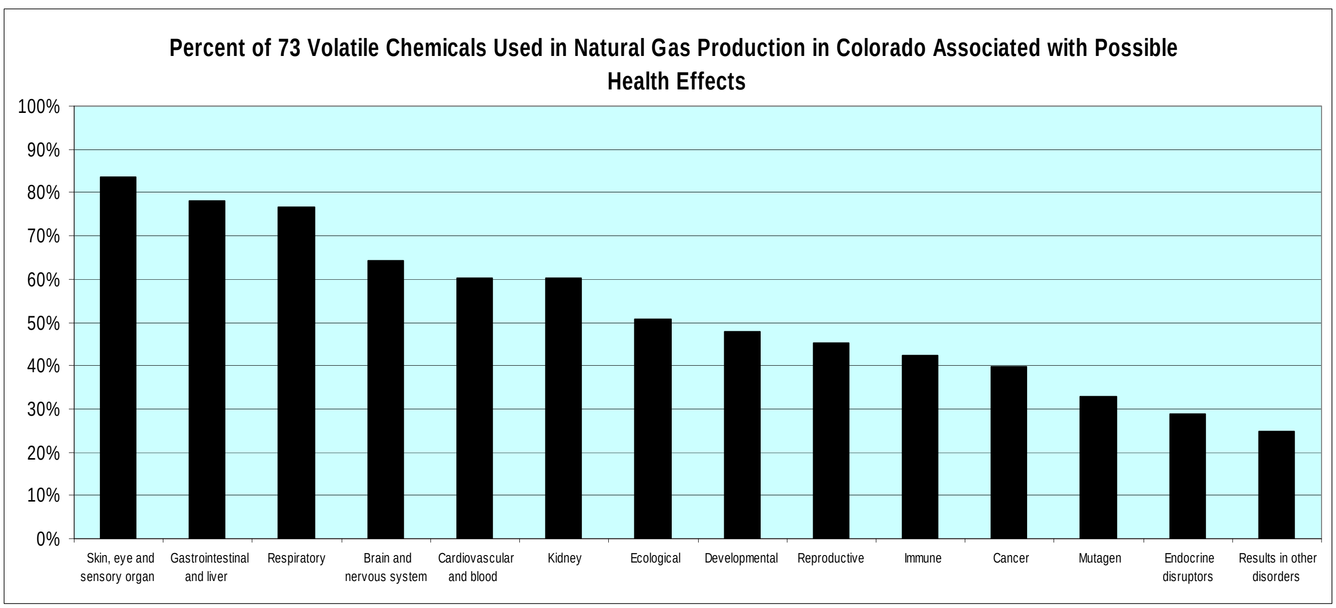
3. Upon plotting the percent of chemicals in each health category, a pattern emerged of the possible health effects for the 278 chemicals. The four categories with the highest exposure risk are (1) eyes, skin, and sensory organs; (2) respiratory system; (3) gastrointestinal tract and liver; and (4) brain and nervous system.



4. One hundred twenty-four chemicals were water soluble. The four categories with the highest exposure risk are (1) eyes, skin, and other sensory organs: (2) respiratory system; (3) gastrointestinal tract and liver; and (4) the brain and nervous system.



5. Seventy-three chemicals were volatile. The four categories with the highest exposure risk are (1) eyes, skin, and other sensory organs; (2) gastrointestinal tract and liver; (3) respiratory system; and (4) the brain and nervous system.



6. Several reasons led to the lack of data about the health effects of some of the products and chemicals on the spread sheet:

(a) Some products list no ingredients.

(b) Some products provide only a general description of the content, such as "plasticizer", "polymer" etc.
(c) Some products list some or all of the ingredients as "proprietary".
(d) No health effect data were found for a particular chemical or product.

7. Much of the information about the composition of the products on the list comes from a Material Safety Data Sheet (MSDS). Ingredients on MSDSs are sometimes labeled as "proprietary", or "no hazardous ingredients" even when there are significant health effects listed on the MSDS.

8. Some of the citations used to establish the health effects of the chemicals on this list are old, dating back to the 1970's and 80's. In several cases data were derived from abstracts, not the full report or manuscript. In other cases, citations were taken from toxic chemical databases, such as TOXNET, Chem ID, etc. Many reports submitted to the US Environmental Protection Agency by the manufacturer to register a chemical are not accessible. In some cases it is impossible to track down any health effect for a chemical, especially when the manufacturer provides no Chemical Abstracts Service (CAS) number.

9. No health effects were found for 59 of the chemicals on the list. Of these, only 14 had been assigned a CAS number which facilitates searching the literature. We found no health related literature for these chemicals. It was impossible to determine the safety of the other 45 chemicals either because they were listed as mixtures, proprietary, or unspecified (10), or had chemical names that were so general that the specific chemical could not be identified (35).

10. From early on, as new products were added to the list, the sequence of the categories in the pattern of the percentages has shifted only slightly. Looking at data from other states, the pattern also holds. It is expected that slight changes in sequence from one position to another will continue to occur as more products and chemicals are entered into the database.

For Further Consideration

MSDSs are designed to inform those who handle, ship, and use the product(s) about the products' physical and chemical characteristics, and its direct/immediate health effects to prevent injury. The sheets are also designed to inform emergency response crews in case of accidents or spills. The data in the MSDSs do not generally take into consideration the health impacts resulting from chronic or long-term, continuous, and/or intermittent exposure. Many products that have MSDSs have not gone through a rigorous and extensive scientific peer-review process that would permit conclusions to be drawn about "safe" and/or "hazardous" exposure levels.

The use of respirators, goggles and gloves is advised on many of the MSDSs for products on this list. This indicates serious, acute toxicity problems that are not being addressed in the recovery process when the chemicals come back to the surface. It also raises concern over possible hazards posed to those living in regions where gas production is taking place.

The product manufacturers are responsible for the MSDSs, which are based on a form provided by the Occupational Safety Health Administration (OSHA). OSHA provides no review or approval of the sheets, which are often sketchy and may provide health effects information for only one or two chemicals in a product. In many cases the chemicals listed equal less than 100% of the product. In the case of mixtures, the health effects warnings are often not chemical-specific.

Some of the chemicals on this list have been tested for lethality and acute toxicity based on short-term contact looking for possible ecological damage. The tests are done to find out how long it would take to kill 50% of the organisms within a predetermined time limit, such as 24, 48, or 96 hours. The results of these tests are presented as the lethal concentration (LC50) or lethal dose (LD50). The tests are used for precautionary label notations in order to reduce immediate harmful effects on "non-target" organisms such as invertebrates, algae, beneficial insects, fish, etc. in the food web. These tests are not intended to provide information about long-term exposure effects and they do not exclude the fact that other health effects can occur.

Background

Prior to use, these products must be shipped to and stored somewhere before being transported to the well site. They pose a hazard on highways, roads, and rail systems, as well as to communities near the storage facilities.

During the well-drilling stage, underground water, drilling muds, and cuttings of rock and debris from the well bore surface are deposited in production pits on the well pad. After development ceases on a pad and the well(s) goes into production, the residues in the production pits are often bulldozed over. It is impossible to predict how long the buried chemicals will remain in place. Highly persistent and mobile chemicals could migrate from these pits into underground water resources, or gradually surface over time.

Fracturing, frac'ing, and stimulation are terms used to describe a process commonly used to facilitate the release of the gas and improve production. In this process approximately a million gallons of fluid, under extremely high pressure, are injected underground, and, with explosives, create mini-earthquakes that open up fractures in the strata being mined. The gas industry claims that 70% of the material it injects underground is retrieved. While the fate of the remaining 30% is unknown, the recovered materials are often placed in holding pits on the surface and allowed to evaporate. This activity results in highly toxic chemicals being released in the air. New technology is now available to re-inject the recovered frac'ing fluid either on site, or pipe it to a central re-injection well. Where the fluids sit in open pits, their condensed residuals are taken off-site and dealt with in two ways: (1) they can be re-injected in the ground, or (2) they can be "land farmed" in which they are incorporated into the soil through disking. Here, toxic metals and silica fines would continually build up in the disked soils and could be mobilized on dust particles. At some locations, because of regional differences in geology and technology, 100% of the injected frac'ing fluids may remain underground.

For the life of a gas well in most regions, water may be stripped from the gas before it enters the delivery pipeline. Each gas well has a condensate water tank where this contaminated water is stored. In some instances the condensate water is re-injected on site or piped to a central re-injection well. In other instances, water levels are monitored in the condensate tanks and the water trucked to large open-pit, waste facilities where the water and volatile chemicals escape into the air. This will continue until the well stops producing gas, which could be as long as 20 to 25 years.

Discussion

The physical characteristics of a chemical can contribute to its becoming a chemical of concern, as well as its application or use. For example, crystalline silica is reported in 33 products on this list ranging from <1% to 30% of the total composition. It poses its hazard as a respirable dust that lodges permanently in the lungs and can cause silicosis, emphysema, obstructive airway diseases, and lymph node fibrosis. It is not captured in either the water-soluble or volatile pathways in this analysis. It poses a long-term, delayed health hazard similar to asbestos, but can rapidly turn into malignant lung cancer. It is reported in both drilling and fracturing products. Oftentimes, the cuttings captured in drill pad reserve pits are used to produce berms or as fill on the pad. Over time, silica in the drilling muds could become airborne as dust along with other toxic compounds. The MSDSs recommend the use of respirators and goggles when handling the silica-containing products when dust is formed.

The foamer and solvent, 2 butoxyethanol (2-BE), is reported in 6 products on the list ranging from 5 to 40% of the total composition. 2-BE is captured in both the water-soluble and volatile pathways in this analysis. It is highly soluble (miscible) in water, colorless, and odorless at low concentrations, and evaporates at room temperature. It has a number of unusual health impacts that would baffle physicians and veterinarians and also causes several kinds of rare cancers. If it were to penetrate a drinking water source, exposure could be through ingestion, inhalation, and the skin.

The products labeled as biocides on the list are extremely toxic and with good reason. Bacterial activity in well casings, pipes and joints can be highly corrosive, costly, and dangerous. Bacteria can also alter the chemical structure of polymers and make them useless. Nonetheless, when these products return to the surface either through deliberate retrieval processes, or accidentally, they pose a significant danger to workers and those living near the well and evaporation ponds. They can also sterilize the soil and inhibit normal bacterial and plant growth for many years.

Among the 93% of products on the list with adverse health effects, 42% contain chemicals that have the potential to disturb the endocrine system, expressed as problems of the thyroid, pancreas, and gonads to mention a few. Like many categories at lower risk of exposure, the effects may not become apparent until years after exposure. Health problems in other lower risk categories such as kidney, reproductive problems, and cancer may not be diagnosed until years later.

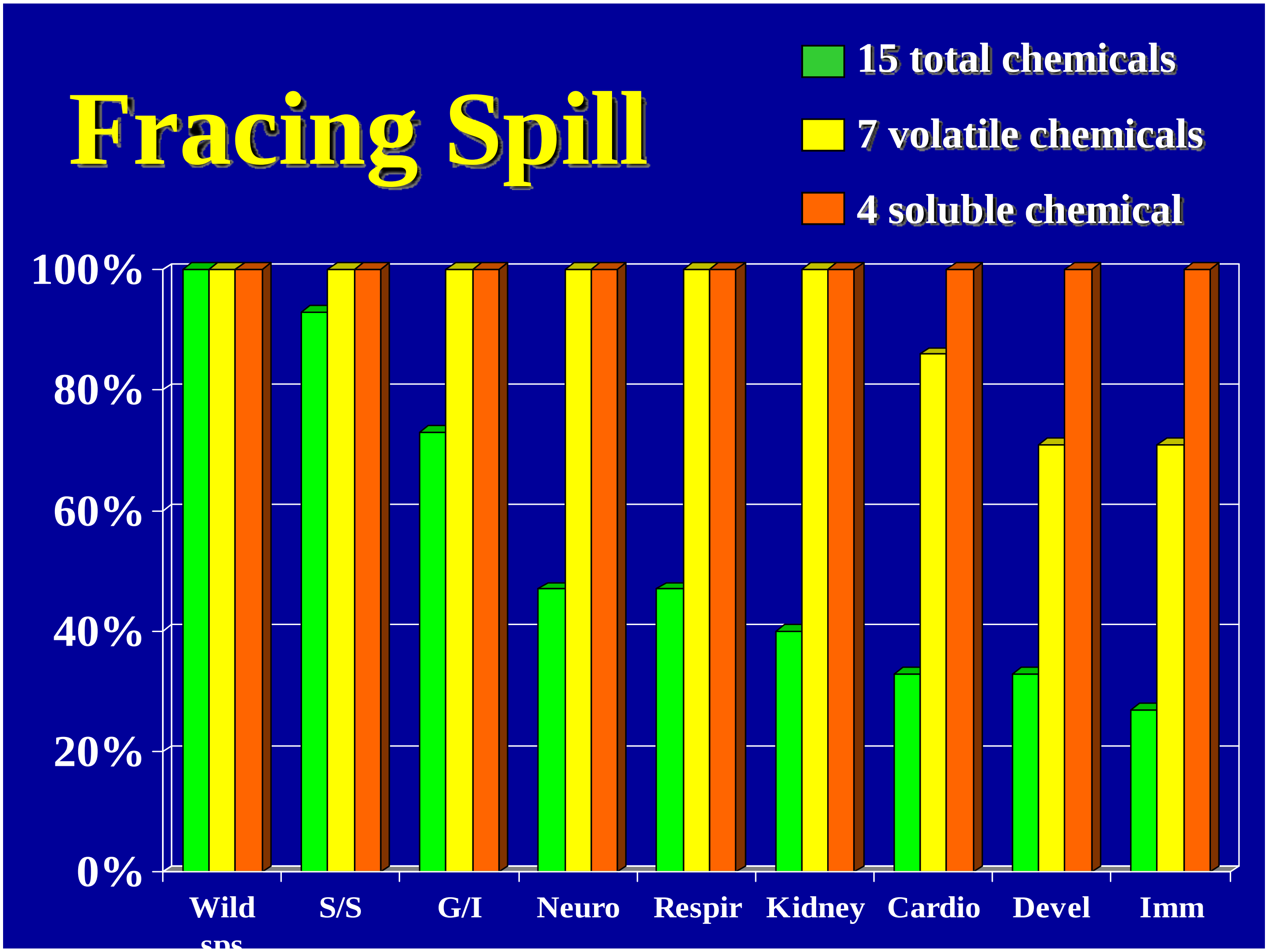
A number of chemicals on this list are toxic when encountered in high concentrations. Exposure route, such as ingestion, inhalation, or through the skin, can delay or shorten reaction time. The long term effects of the chemicals of this nature cannot be predicted. Because only a small percentage of the total composition of most of the products on this list is available, it is not possible to determine if the chemicals are harmless in their application. In addition, under the present system, there are not enough data to determine the safety of products that contain mixtures of relatively “benign” ingredients and unknown chemicals, when the actual percentage composition is not provided.

Cumulative exposure impacts cannot be addressed in this analysis. The EXCEL spreadsheet provides a hint of the combinations and permutations of mixtures possible and the possible aggregate exposure. Each drilling and fracturing incident is custom-designed depending on the geology, depth, and resource available. The chemicals and products used, and the amounts or volumes used can differ from well to well. In addition, the fluids or vehicles that make up the full composition of a product are frequently not provided and nowhere are there data accounting for the fluids that make up the million gallons of fracturing fluid. The only way to get a realistic picture of what is being introduced into watersheds, air, and soil is to keep complete records on each specific well site (state, county, township, section, etc.), the formulation of the products used at each stage of development and production and their weight and/or volume, the total volume injected underground and recovered, the depths at which material/mixtures were injected, the amount and composition of the recovered liquids, and their disposal method and location.

ATTACHMENT D

TEDX
The Endocrine Disruption Exchange
P.O. Box 1407, Paonia, CO 81428
970-527-4082
www.endocrinedisruption.org
tedx@tds.net

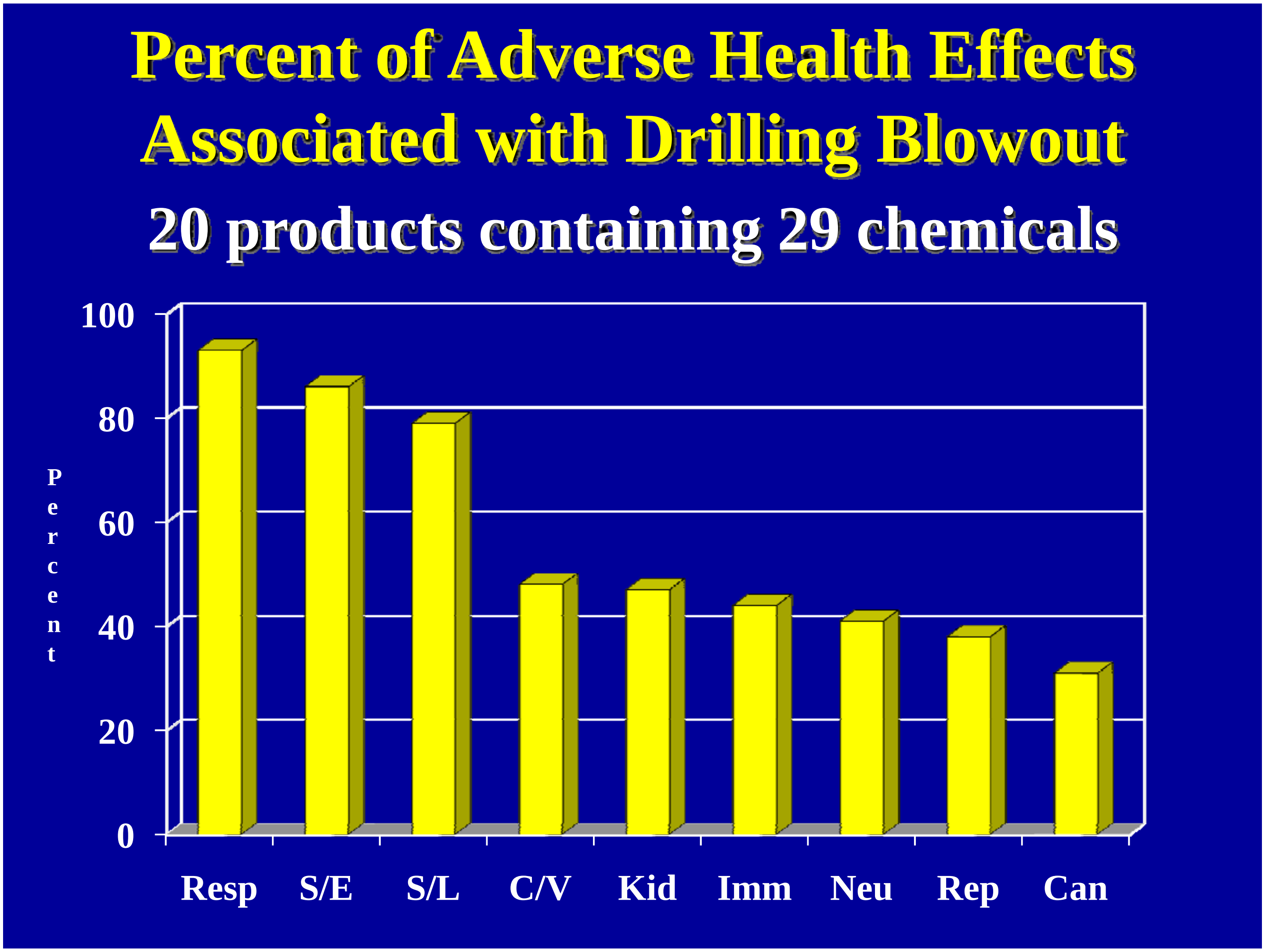
Garfield County, Colorado



ATTACHMENT E

TEDX
The Endocrine Disruption Exchange
P.O. Box 1407, Paonia, CO 81428
970-527-4082
www.endocrinedisruption.org
tedx@tds.net

Crosby 25-3 Well – Windsor Energy, Park County Wyoming



ATTACHMENT F

TEDX
The Endocrine Disruption Exchange
211 Grand Ave, Ste. 114, P.O. Box 1407, Paonia, CO 81428
970-527-4082
tedx@tds.net

Potential Health Effects of Residues in 6 New Mexico Oil and Gas Drilling Reserve Pits Based on Compounds Detected in at Least One Sample Revised November 15, 2007

List of Substances Detected

The following substances were detected in six drilling reserve pits in the San Juan Basin of northwestern New Mexico and the Permian Basin of southeast New Mexico. An industry committee comprised of 19 oil and gas companies that operate in New Mexico sponsored a sampling and analysis program (SAP) of pit solids. The SAP was completed by a third party consultant and analytical laboratory. The SAP focused on drilling/reserve pits prior to closure.

This list was amended on November 15, 2007 after discovering that the laboratory doing the analysis admitted it purposefully added nine chemicals (listed below) to the samples prior to testing. This amended document is a reanalysis of the chemicals in the reserve pits excluding those added by industry.

1,2,4-Trimethylbenzene	Iron	Uranium
1,3,5-Trimethylbenzene	Isopropylbenzene	Zinc
1-Methylnaphthalene	Lead	Oil and Grease
2-Butanone	m+p-Xylene	Radium 226
2-Methylnaphthalene	Manganese	Radium 228
3+4 Methylphenol	Mercury	Chloride
Acetone	Methylene chloride	Sulfate
Arsenic	Naphthalene	
Barium	N-Butylbenzene	
Benzene	N-Propylbenzene	
Benzo(a)pyrene	O-xylene	**Substances eliminated**
Cadmium	Pentachlorophenol	*Dibromofluoromethane*
Carbon disulfide	Phenol	*2-Fluorophenol*
Chromium	P-Isopropyltoluene	*2,3,4-Trifluorotoluene*
Copper	Sec-butylbenzene	*2,4,6-Tribromophenol*
Cyanide, total	Selenium	*2-Fluorobiphenyl*
Diesel range organics	Silver	*4-Bromofluorobenzene*
Ethylbenzene	Tert-butylbenzene	*Decachlorobiphenyl*
Fluoride	Tetrachloroethene	*O-Terphenyl*
Gasoline range organics	Toluene	*Tetrachloro-m-xylene*

Possible health effects associated with the 42 substances detected in 6 New Mexico drilling reserve pits

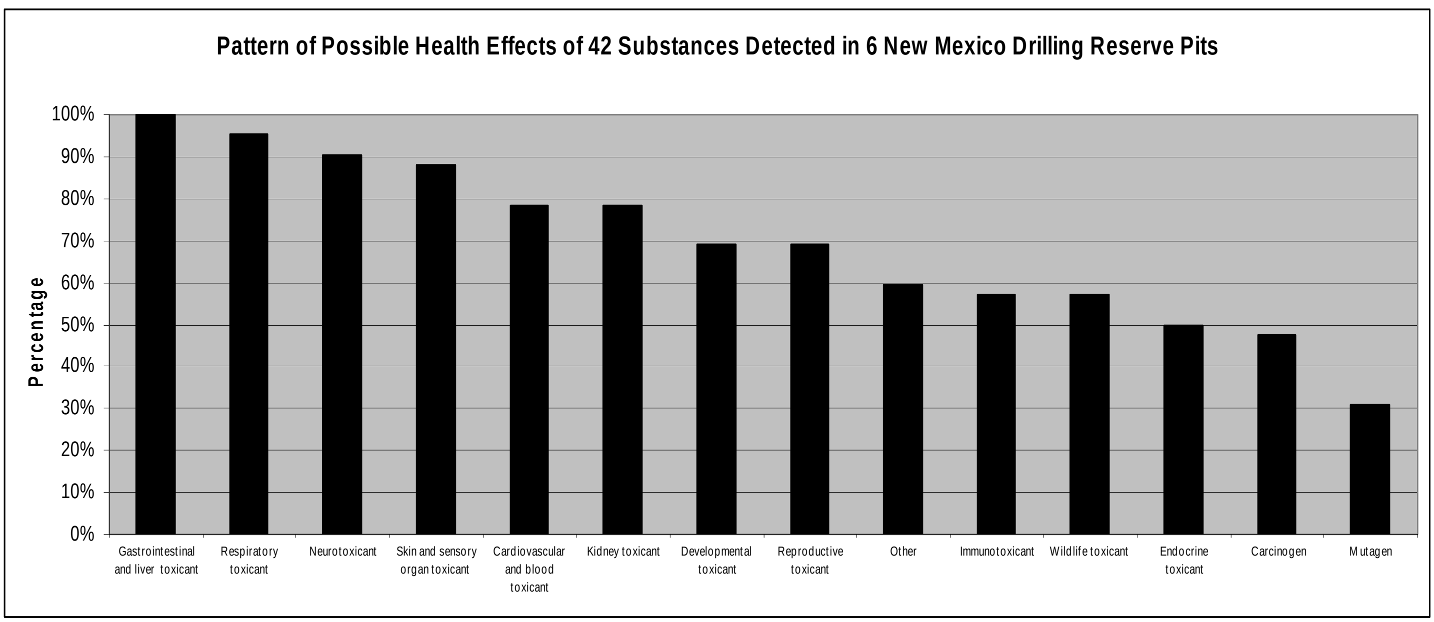
Percentage	Number	Effect
100%	42	gastrointestinal and liver toxicants
95%	40	respiratory toxicants
90%	38	neurotoxicants
88%	37	skin and sensory organ toxicants
79%	33	cardiovascular and blood toxicants
79%	33	kidney toxicants
69%	29	developmental toxicants
69%	29	reproductive toxicants
60%	25	result in other disorders
57%	24	immunotoxicants
57%	24	wildlife toxicants
50%	21	endocrine disruptors
48%	20	carcinogens
31%	13	mutagens

Possible health effects associated with 24 (57%) volatile substances in 6 drilling reserve pits in New Mexico:

Percentage	Number	Effect
100%	24	gastrointestinal and liver toxicants
96%	23	respiratory toxicants
96%	23	skin and sensory organ toxicants
92%	22	neurotoxicants
83%	20	kidney toxicants
79%	19	cardiovascular and blood toxicants
79%	19	developmental toxicants
75%	18	wildlife toxicants
75%	18	result in other disorders
67%	16	reproductive toxicants
63%	15	immunotoxicants
54%	13	carcinogens
54%	13	endocrine disruptors
42%	10	mutagens

Possible health effects associated with 4 (10%) soluble substances in 6 New Mexico drilling reserve pits

Percentage	Number	Effect
100%	4	cardiovascular and blood toxicants
100%	4	gastrointestinal and liver toxicants
100%	4	kidney toxicants
100%	4	neurotoxicants
100%	4	reproductive toxicants
100%	4	respiratory toxicants
100%	4	skin and sensory organ toxicants
75%	3	developmental toxicants
75%	3	endocrine disruptors
75%	3	wildlife toxicants
75%	3	result in other disorders
50%	2	carcinogens
50%	2	mutagens
50%	2	immunotoxicants



ATTACHMENT G

TEDX
The Endocrine Disruption Exchange
211 Grand Ave, Ste. 114, P.O. Box 1407, Paonia, CO 81428
970-527-4082
tedx@tds.net

Number of chemicals detected in reserve pits for 6 wells in New Mexico that appear on national toxic chemicals lists
Amended document
November 15, 2007

This list was amended on November 15, 2007 after discovering that the laboratory doing the analysis admitted it purposefully added nine chemicals to the samples prior to testing. This amended document is a reanalysis of the chemicals in the reserve pits excluding those added by industry.

Toxic chemicals lists and the 42 chemicals detected

LIST	# of chemicals on list	Percentage
CERCLA 2005	39	93%
EPCRA 2006	26	62%
EPCRA List of Lists	29	69%

Chemicals not on any toxics list:

2-Methylnaphthalene
Diesel range organics[1]
Gasoline range organics[1]
[1] Too general to be included on lists that categorize by CAS numbers

Toxic chemicals lists and the 11 chemicals detected over state limits

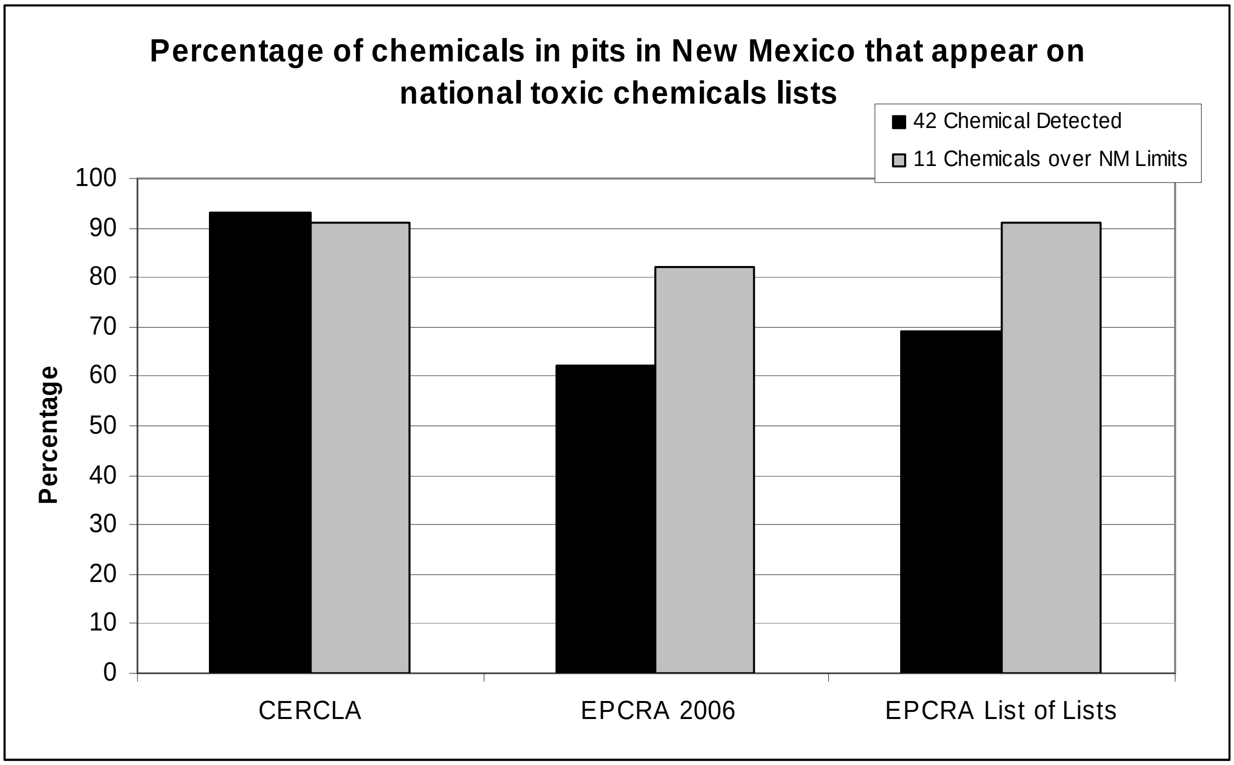
LIST	# of chemicals on list	Percentage
CERCLA 2005	10	91%
EPCRA 2006	9	81.8%
EPCRA List of Lists	10	91%

Chemicals not on any toxics list:

Diesel range organics[1]
[1] Too general to be included on lists that categorize by CAS numbers

CERCLA 2005: Comprehensive Environmental Response, Compensation, and Liability Act Summary Data for 2005 Priority List of Hazardous Substances
EPCRA 2006: Emergency Planning & Community Right to Know Act Section 313 Chemical List For Reporting Year 2006 (including Toxic Chemical Categories)
EPCRA List of Lists: Consolidated List of Chemicals Subject to the Emergency Planning and Community Right-To-Know Act (EPCRA) and Section 112(r) of the Clean Air Act

©TEDX 2007


Percentage of chemicals in pits in New Mexico that appear on national toxic chemicals lists
42 Chemical Detected
11 Chemicals over NM Limits
Percentage
100
90
80
70
60
50
40
30
20
10
0
CERCLA
EPCRA 2006
EPCRA List of Lists

©TEDX 2007

ATTACHMENT H

TEDX
The Endocrine Disruption Exchange
P.O. Box 1407, Paonia, CO 81428
970-527-4082
www.endocrinedisruption.org
tedx@tds.net

Chemicals in URS Field Activities Report for Characterization of Pit Solids and Fluids in Colorado Energy Fields, May 14, 2008[1]

	Chemical	CAS #		Chemical	CAS #
1	(2-BE) Ethylene glycol monobutyl ether	111-76-2	43	3-Methylheptane	589-81-1
2	.Alpha.,.alpha.,4-trimethyl 3-cyclohexene-1-methan	10482-56-1	44	3-Methylhexane	589-34-4
3	.Alpha.-caryophyllene1	6753-98-6	45	3-Methylpentane	96-14-0
4	.Beta.-pinene1	127-91-3	46	3-Methyl-tetradecane1	18435-22-8
5	1-(2-Butoxyethoxy)-ethanol	54446-78-5	47	4-(Methoxymethyl)phenol1	5355-17-9
6	1-(2-Methoxypropoxy)-2-propanol1	13429-07-7	48	4,4'-(1-Methylethylidene)biphenol	80-05-7
7	1-(2-Propenyloxy)-2-propanol1	21460-36-6	49	4,4'-Methylenbis-phenol1	620-92-8
8	1,1,3-Trimethylcyclohexane	3073-66-3	50	4b,5,6,7,8,8a,9,10-Octahydro-4b,8,2-phenanthrenol1	511-15-9
9	1,2,3,4-Tetrahydro-5-methyl-naphthalene1	2809-64-5	51	4-Hydroxy-3-methocy-5-nitro-benzaldehyde1	6635-20-7
10	1,2,3,4-Tetrahydro-naphthalene	119-64-2	52	4-Hydroxy-3-nitrobenzaldehyde1	3011-34-5
11	1,3-Butadiene	106-99-0	53	4-Methyl-octane	2216-34-4
12	1,4,5-Trimethyl-naphthalene	2131-41-1	54	4-Nitrophenol	100-02-7
13	1,4-Dioxane	123-91-1	55	5-Methyl-undecane	1632-70-8
14	1,4-Methanoazulene, decahydro-4,8,8-trimethyl-9-me	475-20-7	56	9-Octadecenamide, (z)-	301-02-0
15	1-Butoxy-2-propanol1	5131-66-8	57	Acetaldehyde	75-07-0
16	1-Methylethyl ester nitric acid	1712-64-7	58	Acetyl triethyl citrate1	77-89-4
17	1r-.Alpha.-pinene1	7785-70-8	59	Anthracene	120-12-7
18	1s-.Alpha.-pinene1	7785-26-4	60	Antimony, Dissolved	7440-36-0
19	2-(2-Methoxyethoxy)ethanol	111-77-3	61	Arsenic	7440-38-2
20	2,2'-Dithiobisethanol	1892-29-1	62	Barium	7440-39-3
21	2,2'-Methylenebis-phenol1	2467-02-9	63	Benzene	71-43-2
22	2,3,4,4a,10,10a-Hexahydro-6-hydroxy-1,9(1h)-phenan	511-05-7	64	Bis(2-ethylhexyl)phthalate	117-81-7
23	2,3-Dihydro-5,7-dihydroxy-2-4h-1-bensopyran-4-one1	480-39-7	65	Boron	7440-42-8
24	2,4-Dimethylphenol	105-67-9	66	Bromodichloromethane	75-27-4
25	2,4-Dinitro-6-methoxy-phenol1	4097-63-6	67	Bromoform	75-25-2
26	2,4-Dinitrophenol	51-28-5	68	Butanal	123-72-8
27	2,5,8,11,14-Pentaoxahexadecan -16-ol1	23778-52-1A	69	Butanoic Acid1	107-92-6
28	2,6,10-Trimethylpentadecane	3892-00-0	70	Butanol (N-butyl alcohol, Butan-1-OL, 1-Butanol)	71-36-3
29	2,6-Bis(1-methylethyl)-benzenamine	24544-04-5	71	Cadmium	7440-43-9
30	2,6-Dimethoxybenzoquinone1	530-55-2	72	Caprolactam	105-60-2
31	2,6-Dimethyloctane	2051-30-1	73	Chloroform	67-66-3
32	2-[(2-Ethylhexyl)oxy]-ethanol1	1559-35-9	74	Chromium (unknown if III or IV)	7440-47-3
33	2-[(4-Hydroxyphenyl)methyl]-phenol1	2467-03-0	75	Chrysene	218-01-9
34	2-Ethylhexanoic acid	149-57-5	76	Copper	7440-50-8
35	2-ethylhexanol	104-76-7	77	Cyclohexane	110-82-7
36	2-Methylbutane1	78-78-4A	78	Cyclohexanol	108-93-0
37	2-Methylheptane	592-27-8	79	Decahydro-2-methyl-naphthalene	2958-76-1
38	2-Methylhexane	591-76-4	80	Decahydronaphthalene	91-17-8
39	2-Methylpentane	107-83-5	81	Decane	124-18-5
40	2-Methylphenol	95-48-7	82	Decanoic acid	334-48-5
41	3,7-Dimethyl-1,6-octadien-3-ol1	78-70-6	83	Dibromo acetic acid	631-64-1
42	3-Carene	13466-78-9	84	Dibromochloromethane	124-48-1

[1] Colorado Oil and Gas Association, Rebuttal Statement Exhibits 10-2, Colorado Oil and Gas Conservation Commission Hearing Docket #0803-RM-02 (2008). Available at: http://cogcc.state.co.us/RuleMaking/2007RuleMaking.cfm

	Chemical	CAS #		Chemical	CAS #
85	Dicyclohexyl ester 1.2-bensenedicarboxylic acid1	84-61-7	123	n-Heptane	142-82-5
86	Diethylene glycol	111-46-6	124	Nickel	7440-02-0
87	Diethylene glycol monobutyl ether	112-34-5	125	Nitrate	14797-55-8
88	Dimethyl sulfide	75-18-3	126	Nitrite	14797-65-0
89	Dodecane	112-40-3	127	N-Nitrosodiphenylamine	86-30-6
90	Dodecanoid acid	143-07-7	128	Nonadecane	629-92-5
91	Dodecene1	7206-14-6	129	Nonane	111-84-2
92	Ethanol (Acetylenic alcohol)	64-17-5	130	Nonanoic acid	112-05-0
93	Ethoxycitronellal	1000132-02-6	131	n-Pentane	109-66-0
94	Ethylbenzene	100-41-4	132	n-propyl alcohol	71-23-8
95	Ethylcyclohexane	1678-91-7	133	Octadecanoic acid	57-11-4
96	Fluorene	86-73-7	134	Octane1	111-65-9
97	Heptylcyclohexane	5617-41-4	135	Pentadecane	629-62-9
98	Hexacanoic acid	57-10-3	136	P-Isopropyltoluene	99-87-6
99	Hexadecane	544-76-3	137	Propane	74-98-6
100	Hexanal	66-25-1	138	Propane-1,2-Diol	57-55-6
101	Hexane	110-54-3	139	Propene	115-07-1
102	Isobutane	75-28-5	140	Propylcyclohexane	1678-92-8
103	Isobutyl alcohol (2-methyl-1-propanol)	78-83-1	141	Pyrene	129-00-0
104	Isopentane (2-Methylbutane)	78-78-4	142	Selenium	7782-49-2
105	Isopropanol (Propan-2-OL)	67-63-0	143	Silver	7440-22-4
106	Lead	7439-92-1	144	Squalene	7683-64-9
107	Limonene1	138-86-3	145	Tetrachloroethene	127-18-4
108	Mercury	7439-97-6	146	Tetradecanoic acid	544-63-8
109	Methyl cyclohexane	108-87-2A	147	Tetrahydro-2h-pyran-2-one1	542-28-9
110	Methyl ester acetic acid	79-20-9	148	Thallium	7440-28-0
111	Methyl ester docosanoic acid	929-77-1	149	Toluene	108-88-3
112	Methyl ester eicosanoic acid	1120-28-1	150	Total Xylenes	1330-20-7
113	Methyl ester heptadecanoic acid1	1731-92-6	151	Tributlyphosphat1	126-73-8
114	Methyl ester tetracosanoic acid1	2442-49-1	152	Tridecane	629-50-5
115	Methyl ester-8-octadecenoic acid	2345-29-1	153	Triethyl phosphate	78-40-0
116	Methyl nitrite	624-91-9	154	Triethylene glycol	112-27-6
117	Methylcyclohexane	108-87-2	155	Undecane	1120-21-4
118	Methylcyclopentane	96-37-7	156	Undecanoic acid	112-37-8
119	Methylene chloride	75-09-2	157	Vanillin1	121-33-5
120	Naphthalene	91-20-3	158	Z-11-hexadecenoic acid	2416-20-8
121	Naphthalene, 1,2,3,4-tetrahydro-6-methyl-	1680-51-9	159	Zinc	7440-66-6
122	n-Butane	106-97-8			