EXECUTIVE SUMMARY

ANALYSIS OF POTENTIAL IMPACTS OF FOUR EXPLORATORY NATURAL GAS WELLS TO WATER RESOURCES OF THE SOUTH FLANK OF THE GRAND MESA DELTA COUNTY, COLORADO

March 2003

Gunnison Energy Corporation (GEC) proposes to conduct an exploratory drilling project for natural gas at four locations named Dever Creek #1, Lone Pine #1, Spaulding Peak #1 and Steven's Gulch #1. All of these proposed wells are on private lands on the south flank of the Grand Mesa in Delta County, Colorado (Figure ES-1 and Table ES-1). The proposal is for exploration activities only, which will consist of drilling, completion, testing, and monitoring at the well sites, along with construction of new access roads and water use and disposal activities. This program will gather scientific information and data about the extent and distribution of natural gas resources and will perform tests on each of the wells to assess the economic viability of future production. The proposed drilling targets potential gas producing zones in the sandstones and coal seams of the Mesaverde Formation. The exploratory drilling program and associated monitoring program will also gather information and data on potential impacts to local water resources such as streams, springs, wells, wetlands, and other features.

The purpose of this report is to assess the potential impacts of the proposed exploratory natural gas wells on water resources, based on information that is currently available. This report relies on the hydrologic and geologic data compiled and interpreted in *Characterization and Assessment of Water Resources on the Southeastern Flank of the Grand Mesa, Delta, Gunnison, and Mesa Counties, Colorado* (Baseline Report) prepared by Wright Water Engineers, Inc. (WWE) in January 2003.

Table ES-1

Proposed Exploratory Natural Gas Well Descriptions

Well Name	Location	Approximate Well Pad Dimensions (ft x ft)	Approximate Length of New Road Construction (ft)	Well Pad Ground Surface Elevation (ft)	Approximate Total Well Depth (ft below ground surface)[1]
Dever Creek #1	SE ¼, NW ¼, Sec. 12, T13S, R93W	225 x 150 (0.8 acre)	1,000 (0.2 miles)	9,051	2,940
Lone Pine #1	SE ¼, NW ¼, Sec. 25, T12S, R91W	225 x 150 (0.8 acre)	2,000 (0.4 miles)	7,962	3,300
Spaulding Peak #1	SW ¼, NW ¼, Sec. 24, T12S, 94W	225 x 150 (0.8 acre)	2,500 (0.5 miles)	8,601	3,750
Stevens Gulch #1	SE ¼, NE ¼, Sec. 1, T13S, R92W	225 x 150 (0.8 acre)	1,100 (0.2 miles)	8,028	2,170

[1]Approximate depths that will be adjusted during drilling, based on actual geology.

All of the proposed exploration wells are located in remote areas with these characteristics: moderate to steep slopes; soil and surface conditions that produce low to moderate rates of infiltration; 21-30 inches per year of average precipitation; vegetation characterized by aspen, scrub oak, and/or grasses; and current surface uses focused on open space, grazing, and hunting. Various ephemeral and perennial streams, along with ponds, lakes, and wetlands, are located within one mile of each of the proposed wells. Baseline water chemistry data have been collected from multiple surface water sources in the vicinity of the proposed wells. Groundwater baseline data are also available. There are four Colorado State Engineer's Office (SEO)-permitted water wells within one-mile radius circles of the proposed wells. All of these wells draw water from the surficial unconsolidated (alluvial/colluvial) deposits.

The proposed exploratory wells could potentially impact local water resources due to: (1) construction activities (surface disturbances and features) and (2) gas production activities, including hydraulic stimulation and produced water management. Selected potential impacts and associated mitigation measures are discussed below.

The primary construction activities will include well pad and road construction to access the well sites. During construction, straw bales, silt fences, crimped mulch, check dams, erosion control "mats" and netting on steep slopes, terracing/benching, energy dissipation measures downstream from culverts, and other drainage and erosion control best management practices (BMPs) will be used. Multiple BMPs will be used to provide a conservative level of mitigation. These BMPs will be monitored after runoff events to assure they are properly functioning and protecting local water resources; necessary repairs and/or upgrades will be made promptly.

The four exploratory natural gas wells will range from about 2,170 to 3,750 feet (ft) in total depth. Hydraulic stimulation (also known as hydraulic fracturing, hydrofracing and hydrofracturing) will be used within the exploratory holes. Approximately 0.5 acre-feet (AF) of water will be trucked from the Oxbow Mining facilities (Oxbow Mining, L.L.C., owns various water rights) to the sites in order to drill and hydraulically stimulate each well. The space between the outside of the steel casing and inside of the drill hole (annulus) will be filled with cement (grout) from top to bottom, thus isolating gas production zones and minimizing potential impacts to groundwater.

Hydraulic fractures are created by pumping a thick, water-based, non-hazardous fluid into the formation. This technique results in increased flow of natural gas from the pore spaces within the rock (where it may be trapped) to the wellbore. GEC anticipates that the majority of the fracturing fluid will be recovered, with the remainder posing no residual hazard.

A common misconception with hydraulic stimulation is that the process cannot be effectively controlled and can result in large vertical and horizontal fracture networks. In fact, if properly planned and executed, hydraulic stimulation results in a well-defined and limited fracture network. GEC and its hydraulic stimulation consultant estimate that the maximum horizontal extent of the fracturing will be 500 ft in two directions from the well (1,000 ft total) in each of the four exploratory wells. The maximum hydraulic fracture height may extend upwards approximately 200 ft into the lower portion of the Barren Member of the Mesaverde Formation. These hydraulic fracture dimensions limit the potential for adverse impacts to surface and groundwater resources. Specifically, the SEO-permitted water wells that are within one mile of

the proposed exploratory wells withdraw shallow groundwater from unconsolidated alluvial/colluvial deposits. These deposits will not be impacted by the exploratory natural gas wells because these wells will be cased and cemented to a level below all water supply wells within one mile and will be hydraulically stimulated only in the Mesaverde Formation. The top of the projected hydrofracture zone will be far below the unconsolidated deposits. Just as shallow groundwater will not be affected by the exploratory wells, neither will surface water resources be impacted.

Another consideration regarding the large separation distances between the hydraulic fracture zone and the water wells is that when a fracture reaches deformable, soft rock, it will stop propagating. The Wasatch Formation, which overlies the Mesaverde Formation in the vicinity of the exploratory wells, is not conducive to fracture growth for this reason. This formation will provide additional protection for the shallow groundwater wells and surface water resources.

Shallow groundwater and surface water are further protected by the changes in internal stresses within the bedrock according to depth below the ground surface. In general, at depths shallower than approximately 1,000 feet below the ground surface, the least principal internal stresses are vertical. Therefore, hydrofractures, which form at right angles to the direction of least principal stress, become horizontal as they approach depths of less than 1,000 feet (USEPA 2002). Because of this, vertical hydrofractures would not penetrate upward to intercept groundwater sources less than approximately 1,000 feet in depth.

In a recent study, the U.S. Environmental Protection Agency (USEPA 2002) found that hydraulic stimulation of wells completed in coalbed formations does not pose a risk to underground sources of drinking water because of the characteristics of coalbed formations. In this study, the USEPA reviewed 11 United States coal basins containing an estimated 13,973 producing wells, including the Piceance basin with 50 wells. Although thousands of wells are hydraulically stimulated annually, the USEPA found no confirmed cases of drinking water well contamination or water loss as the result of hydraulic stimulation in any of the basins.

A summary of chemicals to be used at the proposed exploratory natural gas wells is provided in this report, including hazard level, concentrations, amounts left in the wellbore, and residual hazard. The only hazardous chemicals to be used at the exploratory well sites are diesel fuels for equipment and dilute hydrochloric acid. Handling and storage of these substances and all other chemicals at the sites will be in accordance with all state and federal regulations and guidelines.

Unlike many coalbed methane production areas (e.g., Powder River Basin in Wyoming, San Juan and Raton Basins in Southern Colorado), substantial evidence (see Baseline Report) indicates that the coal seams of the south flank of the Grand Mesa will be different, producing only small amounts of water. For example, as described in the Baseline Report, seven oil and gas wells in the study area produced an average of less than 1 gallon per minute (gpm) of water, which is less than the flow of a typical garden hose of 6-10 gpm (AWWA 1975). All produced waters will be temporarily stored in either tanks or the lined reserve pit on site, and periodically trucked to a licensed off-site disposal facility. Thus, there will be no adverse impacts to water resources from the discharges of produced water.

The potential for hydraulic stimulation to initiate fault movement has been researched and evaluated. None of the maximum projected hydraulic fracture lengths from the four wells will reach any mapped fault. Even if a fault were encountered, it is important to recognize the following information:

- When a hydraulic fracture intercepts a fault plane that is open or capable of transmitting water, the immediate marked drop in pressure signifies that the hydraulic stimulation fluid is being lost to a fault and the hydraulic stimulation operation would be halted.

- Some have postulated that hydraulic fracturing into a fault would affect wells and springs at great distances from the gas well or even cause earthquakes. Literature review and interviews with experts by the authors of this report failed to locate any evidence to support this concern.

- Although some groundwater injection projects have triggered fault movement (such as the U.S. Bureau of Reclamation salt brine injection program at Paradox Valley,

Colorado; waste injection during the 1960s at the Rocky Mountain Arsenal in Denver, Colorado; and the Rangely, Colorado oil field injection and testing program by the U.S. Geological Survey in the early 1970s), research indicates that these projects involved quantities of water that were orders of magnitude larger than the amount of water that will be used to hydraulically stimulate each of the four exploratory wells. Moreover, the durations of high pressure injections were long compared to the short (episodic) durations associated with hydraulically stimulating natural gas wells.

- Less than 0.5 AF of water will be used to hydraulically stimulate each well. This is an insignificant quantity of water relative to, for example, the Surface Creek fault, which is seven miles long and 10,000 ft high, with a surface area of about 8,500 acres (See Exhibit 4 of the Baseline Report for more information on fault dimensions).

- The question of whether or not hydraulic stimulation will induce earthquakes along existing faults was evaluated by considering the external stresses and rock material strengths on the fault surface. Stability against earthquakes along a fault in a continuous mass can be evaluated by comparing the material strengths that tend to maintain the mass in equilibrium to external forces, which tend to destabilize the mass and cause it to move. This analysis indicated that the probability of destabilization is insignificant.

Analysis of records from the Colorado Division of Minerals and Geology indicates that none of the four proposed exploratory wells will impact current coal mines. Future mining could easily avoid the wells, or the well casing could be cut and removed to facilitate mining.

The four proposed exploration wells will withdraw small quantities of water from the Mesaverde Formation. Recharge characteristics and hydrogeologic properties of the Mesaverde Formation were discussed extensively in the Baseline Report. There is no evidence to suggest a continuous hydraulic connection between the top of the water-rich Grand Mesa and the Mesaverde Formation, which lies thousands of feet below and is separated by the typically fine-grained (low to very low permeability) Uinta, Green River, and Wasatch Formations. There is no reliable evidence that substantiates that the potentiometric surface of the Mesaverde Formation beneath

the top of the Grand Mesa is elevated by thousands of feet above the formation itself, and there is much evidence to the contrary. Nevertheless, WWE has quantified the hydrologic significance of this hypothetical scenario. The associated calculations, which are included in this report, show that the hydrologic impacts are not significant, primarily due to the tightness (low permeability) of the Mesaverde Formation.

Review of data from the Colorado SEO indicates that there are decreed surface water rights downstream of the four proposed exploration wells. As described above, surface waters will not be affected by the exploratory wells; therefore, these water rights will not be impacted.

Reclamation practices will be designed, implemented, monitored, and maintained to assure that no long-term adverse impacts to water resources occur, in accordance with all applicable regulations and permit requirements.

GEC will collect monitoring data prior to, during, and after drilling operations for the four exploration wells. GEC has emphasized that exploration wells must be constructed to gather scientific data related to gas production, geology, hydrogeology, hydrology, and other subjects. Consequently, the scope of the water resources monitoring program proposed for the four exploration wells is broader than both that required by the Colorado Oil and Gas Conservation Commission and typical monitoring programs for other oil and gas producers in Colorado. Based on the experience and data gained from the exploration well monitoring program, a separate monitoring plan will eventually be prepared by GEC for the production wells, should they be shown to be feasible and approved for construction.

SUMMARY

In summary, this study showed no significant impacts to water resources from drilling of four exploratory natural gas wells. Specifically:

- No adverse effects to local water wells are expected due to protective measures during drilling operations, the limited extent of hydraulic fractures, and the vertical separation distance between the water wells and the top of the hydraulic fracture zones.

- No impact to surface waters from hydraulic stimulation will occur because there will be no hydraulic connection between the fracture zone and the surface water.

- No impact to surface waters from produced water will occur. Produced water will be collected and transported to a licensed disposal facility. Potential impacts from stormwater runoff will be controlled by an array of best management practices (BMPs), which will be regularly and carefully monitored and maintained.

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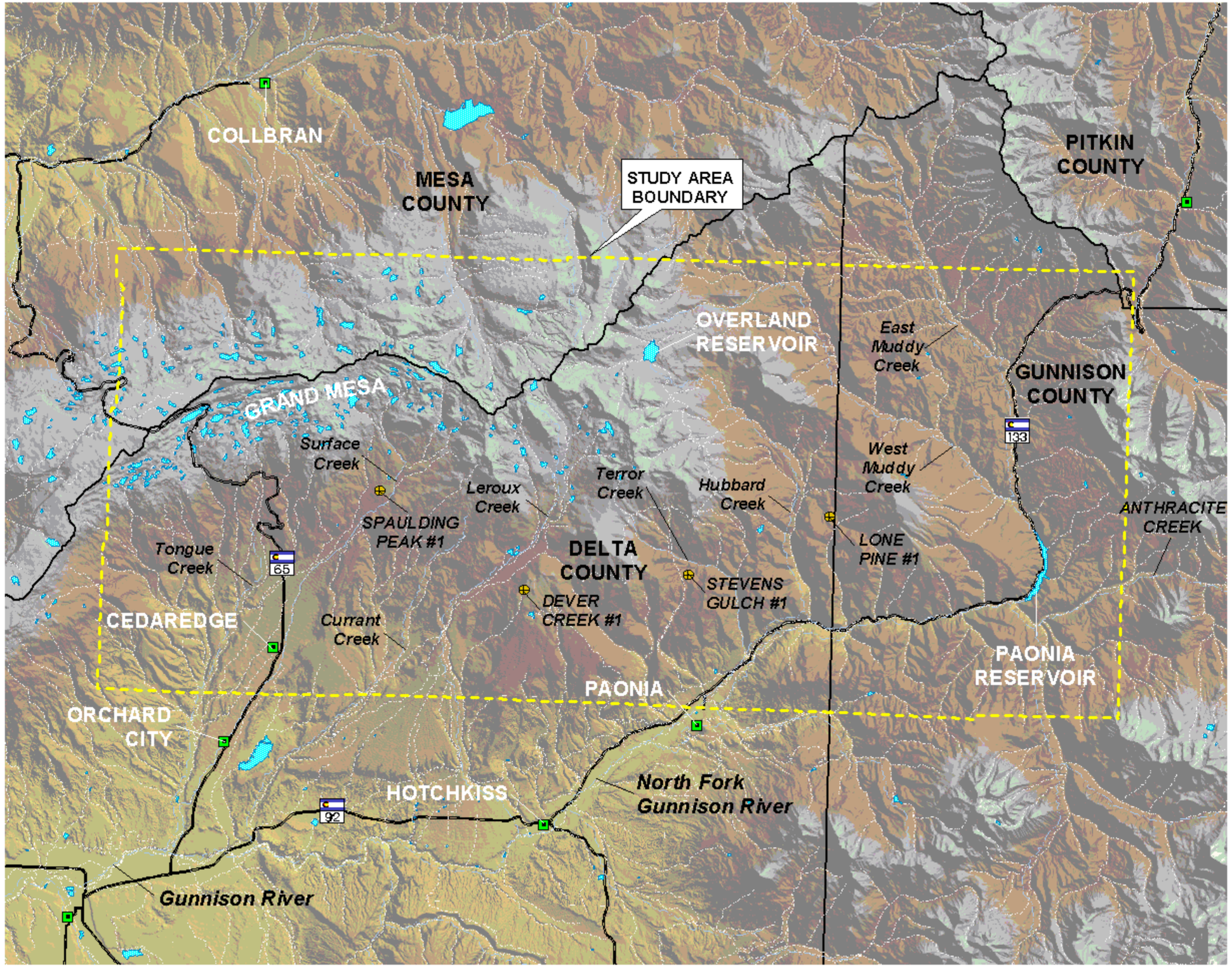

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FIGURE ES-1

GENERAL LOCATION MAP

DATA / MAPPING SOURCE:
COLORADO CDSS
BASE CONSISTS OF
COLOR SHADED RELIEF
OF COLORADO

N
W E
S

4 0 4 Miles

1" = 4 MILES

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