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RULE 303.A.(5) CUMULATIVE IMPACTS ANALYSIS: BLUE 3-65 33-32-31

Prepared for

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ACRONYMS AND ABBREVIATIONS

APEN	Air Pollutant Emissions Notice
ATSDR	Agency for Toxic Substances and Disease Registry
BMP	Best Management Practice
BTEX	Benzene, Toluene, Ethylbenzene, and Xylenes
CI	Cumulative Impacts
CDPHE	Colorado Department of Public Health and Environment
COGCC	Colorado Oil and Gas Conservation Commission
EPA	United States Environmental Protection Agency
FLDP	Fluid Leak Detection Plan
FLIR	Forward Looking Infrared
GESC	Grading, Erosion, and Sediment Control
HAP	Hazardous Air Pollutant
LACT	Lease Automated Custody Transfer
LED	Light-Emitting Diode
SPCC	Spill Prevention Countermeasure and Control
SWMP	Stormwater Management Plan
tpy	tons per year
VOC	Volatile Organic Compound
VRT	Vapor Recovery Tower
VRU	Vapor Recovery Unit
WMP	Waste Management Plan

EXECUTIVE SUMMARY

Crestone Peak Resources ("Crestone") developed this Cumulative Impacts ("CI") analysis for the proposed Blue 3-65 33-32-31 Well Site[1] ("Blue" or "Well Site") pursuant to Colorado Oil and Gas Conservation Commission ("COGCC" or "Commission") Rule 303.a.(5). The Well Site is a proposed oil and natural gas development location in Aurora, Colorado. As part of the development of the Well Site, this CI analysis was developed to address resource impacts to the following six topics:

- Air resources;
- Public health;
- Water resources;
- Terrestrial and aquatic wildlife resources and ecosystems;
- Soil resources; and
- Public welfare.

The aim of the CI is two-fold: i) to identify the potential impacts the Well Site will have on the specific region; and ii) to identify ways the operator can avoid, minimize, or mitigate impacts. The operator of the Well Site, Crestone, has addressed CI for the six resources within this report and detailed further in the submitted interim Form 2B.

Figure 1: Blue 3-65 33-32-31 Site

[1] COGCC 100 Series Rules: "**WELL SITE** shall mean the areas that are directly disturbed during the drilling and subsequent operation of, or affected by production facilities directly associated with, any oil well, gas well, or injection well and its associated well pad."

With all oil and gas developments, there will be adverse impacts to natural resources.

- Air emissions will occur during all phases of development from construction through production. Conservatively estimated, maximum annual emissions during production are not expected to exceed the current major stationary source thresholds under a serious nonattainment area standard (50 tons per year of nitrogen oxides ["NOx"] or volatile organic compounds ["VOCs"]). Maximum annual hazardous air pollutant ("HAP") emissions during production are not expected to exceed 4 tons.
- A total of approximately 2.5 to 3.5 million barrels ("bbls") of water will be used for drilling and completions. Once all producing wells stabilize, about 10,500 bbls of produced water will be generated per year.
- Approximately 14.7 acres of topsoil and vegetation will be disturbed which may impact local ecosystems. No high priority habitats are within one-half mile of the Well Site.
- Cumulative impacts related to public welfare (traffic, noise, odor, etc.) may increase, though are likely to be minimal given the surrounding infrastructure.

Knowing these are these impacts, Crestone has implemented many strategies to reduce CI in and around the Well Site. One of the most notable is the selection of a location near existing Crestone oil and gas facilities. The multiple benefits of utilizing land in an area already used for oil and gas operations are detailed throughout this report. These benefits include the utilization of an existing haul route, access to an existing pipeline, and proximity to existing power and water sources, which will minimize truck traffic and construction.

The potential CI are minimized in multiple ways, such as: i) using electric drill rigs when line power is available; ii) using drilling fluid that is benzene, toluene, ethylbenzene, and xylene ("BTEX")-free and virtually odor-free; and iii) reducing the time between when wells are completed, and product is delivered to flowlines. When CI cannot be eliminated or minimized, Crestone works to mitigate issues through strategies such as: i) isolating noisy equipment with individual sound walls; ii) sending fugitive emissions from drilling to a combustor; and iii) utilizing its own community relations hotline to address citizen complaints in a timely manner.

An assessment of the qualitative cumulative impacts is found in **Attachment A.** Crestone strives to continually improve its operations, listen to its stakeholders, and increase transparency on relevant topics.

1. INTRODUCTION

Geosyntec Consultants, Inc. ("Geosyntec") was retained by Crestone to develop a CI analysis of the Well Site pursuant to COGCC Rule 303.a.(5) ("the Rule"). This CI analysis addresses resource impacts including:

- Air resources;
- Public health;
- Water resources;
- Terrestrial and aquatic wildlife resources and ecosystems;
- Soil resources; and
- Public welfare.

Additionally, the Form 2B addresses "Surrounding Oil and Gas Impacts and Other Industrial Impacts" pursuant to Rule 305.a.(5)C and D.

1.1 Purpose

As stated in the Rule, this analysis:

> [I]s intended to provide data for the COGCC's cumulative impacts data evaluation repository. The [COGCC] intends to use the data, in cooperation with CDPHE and other partners, to undertake basin-wide, statewide, and other studies to evaluate and address cumulative impacts to relevant resources at appropriate scales pursuant to Rules 304.c.(19) or 904.[2]

This report will provide data to evaluate contributions to CI and, "any measures the Operator will take to avoid, minimize, or mitigate any adverse impacts."

1.2 Well Site Background

The Well Site is in Aurora, CO, and based on aerial imagery, its planned development is on agricultural land. Crestone is currently constructing the Mustang Compressor Station within 1,000 feet east of the Well Site. About 2,000 feet to the northwest is the Martin Marietta Asphalt Plant. Interstate 70 is about one-half mile south and the Blue 3-65 32-33 1H Pad is about one-half mile to the north-northwest of the Site. There is one producing well at the Blue 3-65 32-33 1H Pad.

Beyond the half-mile radius, but within one mile of the Well Site are two residential developments (Foxridge Farm and Sky Ranch Subdivision) and multiple other residential buildings which are to the south and southwest. Additionally, Crestone operates wells at two other existing well pads

[2] Colorado Oil and Gas Conservation Commission, 2021. Rules – Permitting Process 300 Series. January 15, 2021.

within one mile, King 3-65 28-29 South and Florida 3-65 27-26 South, both with four producing wells. These pads are north of the Well Site.

Crestone selected a location for the Well Site that is next to a soon-to-be constructed compressor station, which provides access to existing resources, such as power, water, and a local access road. The benefits of utilizing land close to oil and gas operations are detailed throughout this report.

The planned development to drill for minerals at Blue includes:

- Installation of a road to access the Well Site;
- Construction of a pad that will hold seven wells;
- Installation of facilities at the Well Site; and
- Drilling seven wells at the Well Site.

1.3 Cumulative Impacts

The cumulative impacts of the Well Site are detailed in the following sections of this report and in the submitted Form 2B. Construction of the Well Site may result in air emissions which could potentially impact public health and the environment. These emissions include pollutants and greenhouse gases, such as VOCs, HAPs, and methane and are quantified and detailed in Sections 2.1 and 2.2. Generally, the highest emissions at the Well Site are short-lived and occur during drilling and completions operations.

Impacts to water are discussed in Section 2.3, and include possible effects from usage, production, and runoff on local water sources, surface water, groundwater, and public water intakes. Crestone estimates the Well Site will consume approximately 2.45 to 3.5 million bbls of water with daily consumption of about 96,600 bbls during completions. An additional 24,500 bbls will be used during drilling and pad construction. Once all producing wells stabilize, about 10,500 bbls of produced water will be generated per year.

Sections 2.4 and 2.5 detail potential impacts to terrestrial and aquatic wildlife resources and ecosystems and soil resources. A total of 14.7 acres and 7,040 cubic yards of topsoil and associated vegetation are expected to be disturbed for the development in farmland likely most recently used for hay-grass production. There is one high priority habitat within one mile of the pad – a western burrowing owl active nest site. The Well Site is greater than one-half mile from the habitat and no acreage within 500 feet of this high priority habitat will be disturbed.

Impacts to Public Welfare are summarized in Sections 2.6. There are multiple single-family residences between 3,000 feet and one mile to the south and southwest of the edge of the proposed working pad surface. All of these residences are on the opposite (south) side of Interstate 70.

Specific strategies to reduce CI through avoiding, minimizing, or mitigating impacts on resources are detailed in each section. However, the development plan as developed by Crestone, contains some overarching reductions to CI as detailed below.

Through the site selection detailed in Section 1.2, Crestone will:

- Minimize new pipeline construction as the pad will be built nearby existing Crestone infrastructure;
- Reduce the air emissions, truck traffic, and dust and noise impacts due to its location within a Crestone oil and gas corridor and away from developments; and
- Utilize an existing and nearby water source, minimizing impacts related to water transport.

A High Priority Habitat is located within one mile of the Well Site, but the pad, access road, and haul route do not disturb this habitat.

Crestone has a community relations hotline to promptly address citizen complaints and an incident on-call system to put in mitigation measures as needed. This system alerts Crestone to public welfare issues and provides a vehicle to deal with the issue.

A detailed qualitative assessment of CIs of the Well Site is provided in **Attachment A**.

2. RESOURCE IMPACTS

2.1 Air Resources

Crestone is committed to meeting or exceeding Colorado air quality requirements and deploys a series of industry-leading technologies and management practices intended to protect public health and the environment for all Coloradans. The efforts to reduce air emissions is focused on continual improvement.

2.1.1 Emission Increases

Pre-production activities and the first year of production at the Well Site will result in emissions from both stationary and mobile sources. Below is a summary of the emissions. Pre-production is total tons estimated to be emitted. Production values are in tons per year ("tpy").

Table 2.1 – Air Resources Emissions

Period	NO_x	CO	VOC	CH_4	C_2H_6	CO_2	N_2O
Pre-Production	203.3	138.3	34.4	22.7	7.57	28,732	0.30
Production (Year 1)	18.2	25.0	46.1	95.7	37.1	8,730	0.05

Note 1: oxides of nitrogen (NO_x), carbon monoxide (CO), volatile organic compounds (VOCs), methane (CH_4), ethane (C_2H_6), carbon dioxide (CO_2), and nitrous oxide (N_2O).
Note 2: Emissions "include both stationary and mobile sources of emissions during all pre-production activities, and both stationary and mobile sources of emissions for the first year of production based on all proposed wells and equipment."[3]

Pre-Production

Pre-production emissions calculations include pad activities from pad construction through flowback or completions. Pad construction includes use of heavy machinery and trucking for surface preparation and building infrastructure. Drilling includes boilers and drill rig engines as well as emissions from drilling mud and fluid storage. Fracturing and completions includes frac engines, cement and mortar mixers, generator sets, and pumps. Emission factors were retrieved from AP-42 or EPA Emissions Facts, EPA-420-F-08-027. The length of operational time was based on the project development scheduled provided in Form 2A.

Production – First Year

The first year of production was calculated using proposed equipment, representative analyses, ProMax simulation models, agency approved emission factors and manufacturers emission factors. Specifically, emissions were calculated for the following equipment:

[3] Colorado Oil and Gas Conservation Commission, 2021. Rules – Permitting Process 300 Series. January 15, 2021.

Topic	Description
Process Heaters or Boilers	Emissions are based on maximum heat input in MMBtu/hr and AP-42 Section 1.4 emission factors.
Truck Loadout	Pipeline takeaway for condensate is proposed. However, for the first several months truck loadout activities may be required until the pipeline can be appropriately sized for ongoing use. To be conservative, truck loadout emissions are assumed during the first year of production. A state approved emission factor for crude oil was utilized. Emissions from the truck loadout will be routed to the enclosed combustors for a 95% destruction efficiency.
Separator Heater	Emissions are based on maximum heat input in MMBtu/hr and AP-42 Section 1.4 emission factors.
Produced Water Tanks	A representative flash liberation analysis was utilized along with 95% destruction efficiency from the enclosed combustors.
Fugitive Emissions	Emissions from leaks are based on a representative component count of another Crestone facility ratioed by the equipment proposed for this pad. Emission factors from EPA Protocol for Equipment Leak Emission Estimates EPA-453R-95-017 Table 2.8 were used to estimate emissions.
Natural Gas Venting	Venting associated with equipment blowdown (e.g., compressor blowdowns for maintenance) were estimated to be 3.76 tpy VOC. All pneumatic devices and pumps will operate on instrument air.
Well Bradenhead and Maintenance	Emissions associated with routine and planned maintenance.
Generator and Compressor Engines	Emissions are based on maximum fuel usage and horsepower (“hp”) and both manufacturers’ guaranteed emissions and AP-42 Section 3.2 emission factors. The use of non-selective catalytic reduction to meet federal New Source Performance Standard emission limitations was included.
Tailpipe Emissions	Emissions are based on estimated mileage traveled by support trucks to the site.

2.1.2 Measures Taken to Avoid, Minimize, or Mitigate Impacts

The location selection efforts detailed in Section 1.2 included eliminating construction of a haul road in an otherwise undeveloped area and only requiring extension of an existing access road. The location of this pad proximate to existing Crestone infrastructure greatly reduced the CI, particularly by greatly reducing impacts from on-road mobile sources at the Well Site. There are no current air permits, and Crestone will follow the Colorado Department of Public Health and Environment (“CDPHE”) regulations on submitting Air Pollutant Emission Notices (“APENs”) and permit applications prior to drilling and facility construction. Additionally, the operations at the Well Site are designed to minimize and mitigate CI of air emissions including the following practices:

Category	Details and Description
Monitoring	Per CDPHE Regulation 7, continuous emissions monitoring will be performed for baseline air quality and monitoring during all pre-production operations through six-months of initial production. (Project Canary) Conducting weekly forward looking infrared ("FLIR") camera evaluation of completions operations to minimize leaks
Prevention	Using NeoFlo™ Drilling Fluid – a non-toxic and benzene, toluene, ethylbenzene, and xylenes ("BTEX")-free fluid Piping fugitive emissions during drilling to a combustor Using Tier 4 dual fuel engines for completions Utilizing electric line power (when available) to power drilling and pumping equipment Fuel augmentation with compressed natural gas for the completion fleet Construction of facility and pipeline takeaway prior to flowback operations Enclosed flowback equipped with vapor recovery units piped into sales line Production gas connected to pipeline during flowback (green completion) and production (no flaring of production gas during pipeline downtime) Production oil connected to pipeline during production utilizing lease automated custody transfer ("LACT") units Use of instrument air driven pneumatic controllers and pumps.

The following sections more detail on key practices and technologies mentioned above.

Continuous Monitoring and Air Quality Testing

Crestone monitors wells during each operational phase through its FLIR camera program to verify that sites are operating correctly and in compliance with regulations. Additionally, Crestone adopted a real-time, continuous air quality monitoring program using technology from Project Canary at its horizontal well sites, representing about 80% of total production. Crestone will implement continuous monitoring at the Blue facility per CDPHE Regulation 7. The monitoring will follow all CDPHE requirements. There will be three continuous air quality monitors at the Blue facility as shown in **Attachment B.** These monitors will be located based on the prevailing winds determined during the baseline monitoring period as well as to avoid sound walls and equipment. They will continuously monitor for methane, total VOCs, particulate matter, and meteorological conditions.

Pipelines and Gathering Facilities

Crestone utilizes pipelines and central gathering facilities to minimize the footprint of well pads, helping reduce truck traffic and eliminating storage tanks and emissions sources. These facilities allow for use of more efficient emissions reduction techniques like floating roof tanks and chillers.

'Tanklite' Production Facilities

Facilities are smaller in footprint and utilize pipelines for removing oil from a well site. This eliminates long-term storage and decreases truck traffic. Design requirements include:

- Vapor Recovery Towers ("VRTs") and Vapor Recovery Units ("VRUs") to capture flash gas; and
- Grid-powered instrument air skids, which remove natural gas-actuated pneumatic controllers, a potential emissions area.

Enclosed Flowback Operations

Crestone's company practice is to use VRUs and a vent-free closed loop system during the completions process to capture fugitive gas from the well that otherwise would be sent to a combustor and contribute to emissions. The natural gas is put into a gathering pipeline so that it can be used rather than wasted.

2.2 Public Health

In 2019, Crestone hired a third-party expert, CTEH, LLC ("CTEH"), to design and perform studies to characterize the short-term impacts on local air quality and public health from discrete operational phases at four oil and natural gas well pads being developed in Weld County, Colorado.[4] It is important to note that Crestone is using the same practices and technologies for the Well Site as was used in the four locations in the studies. See **Attachment C** for the report.

The specific goals of this project were to: (1) collect a high-resolution data set of chemical concentrations in air near the well pad and the surrounding communities; and (2) evaluate the impact on risks to public health, if any, from the release of oil and gas-related compounds into the air during specific operational phases of well development. CTEH conducted real-time air monitoring for total VOCs, hydrogen sulfide ("H_2S"), particulate matter ("PM"), and specific VOCs (such as benzene), simultaneously with other measurements. As the report states in its Executive Summary:

> More than 5,000 total measurements were collected in real-time by CTEH personnel in the communities surrounding the wellpads over a period of 26 days. Additionally, 20 analytical samples were collected from four locations around the Bighorn wellpad to evaluate potential community exposures over 5 days of flowback activities. Approximately 99% of the real-time VOC measurements recorded in the communities were non-detections, which means that VOCs were not present or that VOC concentrations were less than the instrument detection limit of 1 ppb [part per billion]

[4] Screening Level Health Risk Evaluation of Community Air Monitoring and Sampling Study, Crestone Peak Resources, Weld County, CO, written by CTEH, LLC, dated December 11, 2019.

> for VOCs. This detection limit is well below the federal (ATSDR) health guideline level for short-term adverse health effects for benzene (9 ppb). Of the over 1,500 measurements collected for benzene specifically or VOCs in general, just one reading was at a detectable level but did not exceed public health guideline values for the BTEX compounds. No H_2S was ever detected [at a detection limit of 0.1 part per million], and just one of over 1,500 readings taken for PM, taken on along a dirt road, was higher than typical background values. In the 20 analytical air samples collected in the surrounding community during flowback, the maximum measured concentrations for BTEX compounds were also all 10 to 13,000-times lower than their respective federal acute health guideline values.
>
> … the real-time and analytical data indicate no adverse health risks to nearby communities, including sensitive individuals, from cumulative exposures to VOCs that may be emitted from pre-production and production activities at Crestone well pads.

Since Crestone is planning to use the same practices and technologies for the Well Site as was used in the four locations in the studies, we are assuming the same conclusion can be relied upon.

2.2.1 Emission Increases

Pre-production activities and the first year of production at the Well Site will result in emissions from both stationary and mobile sources. Below is a summary of the emissions. Pre-production is total pounds estimated to be emitted. Production values are in in pounds per year ("lbs/year").

Table 2.2 Public Health Emissions

Period	B	T	E	X	n-Hexane	2,2,4-TMP	H_2S	HCOH	Methanol	Total HAP
Pre-Production	286.4	126.0	3.56	79.15	239.4	0.14	0.50	157.0	<0.01	892.1
Production	787.7	494.7	35.9	194.8	3,658	31.5	0.24	1,531	221.0	6,955

Note 1: benzene ("B"), toluene ("T"), ethylbenzene ("E"), xylene ("X"), 2,2,4-trimethylpentane ("2,2,4-TMP"), hydrogen sulfide ("H_2S"), formaldehyde ("HCOH"), total hazardous air pollutants ("Total HAPs").
Note 2: Emissions "include both stationary and mobile sources of emissions during all preproduction activities, and both stationary and mobile sources of emissions for the first year of production based on all proposed wells and equipment." [5]

Calculations for the above compounds were like those specified in Section 2.1.1. Production during the first year was calculated using representative gas analyses and agency approved emission factors. Apart from engines and tailpipe emissions, the other HAP emissions are based on the

[5] Colorado Oil and Gas Conservation Commission, 2021. Rules – Permitting Process 300 Series. January 15, 2021.

percent weight ("%wt"). HAP emissions from the engines were calculated based on maximum fuel usage and AP-42 emission factors. Tailpipe emissions were calculated based on operating hours, AP-42 Section emission factors, and emission factors from US EPA Emissions Facts, EPA-420-F-08-027, as applicable.

2.2.2 Potential Acute or Chronic, Short- or Long-Term Public Health Impacts

For a detailed discussion of potential acute or chronic public health impacts, please see **Attachment A** (Cumulative Impacts for Well Pad Development – Blue).

2.2.3 Disproportionately Impacted Community

The Well Site is not in a disproportionately impacted community as determined by Census Bureau data on the COGCC GIS map.

2.2.4 Measures Taken to Avoid, Minimize, or Mitigate Impacts

Similar measures used to reduce CI to Public Health are used for Air Resources. See Section 2.1.2 for details of these measures.

2.3 Water Resources

Water is a critical resource and Crestone takes responsible water use seriously. Water safety and conservation are priorities during operations – from drilling a new well and producing natural gas or oil, to the treatment and disposal of water. Each phase of operations has unique water requirements and challenges. Crestone adapts its water management approach to each well based on geological factors, local water resources, stakeholder feedback, and operational needs. Protection of water sources starts with proper design and construction of drilling sites and steadfast field inspection and logging to maintain the integrity of all components throughout its lifespan. Crestone strives to act as good stewards through a continued commitment to improving processes.

Crestone estimates the Well Site will consume approximately 2.45 to 3.5 million bbls of water with daily consumption of about 96,600 bbls during completions. This will create a short-term demand on water resources. Crestone and the City of Aurora have an executed agreement for the delivery of non-potable water for completions from the Aurora Water Prairie Waters line. If not enough of this source water is available, Flying B2O is the alternative source of water. An additional 24,500 bbls will be used during drilling and pad construction sourced from a fill station in the Rangeview Metropolitan District. In addition to the short-term impact on local water sources, wells will also generate waste streams, including produced water and tank bottoms, that require management and oversight. At this time, due to minimal generation, no produced water is expected to be recycled.

Crestone is planning on developing additional wells and well pads in the City of Aurora over the next five years. A total of 151 new wells are expected in this time frame with a per well water usage of approximately 490,000 bbls. Usage of the same water sources are planned and are likely to be used in the future for many of these new wells, though additional reclaimed water from a municipal source (e.g., from Murphy Creek) or freshwater from a lake or stream source (e.g., Farmers Reservoir and Irrigation Company) may be used.

There are two tributaries to the Prairie Dog Draw that are with one-half mile of the Well Site and access road and are potential contaminant migration pathways. In addition to the Well Site, there is the Blue 3-65 32-33 1H Pad, Mustang Compressor Station, and Martin Marietta Asphalt Plant that are cross-gradient or upgradient of these tributaries. Impacts of contaminants from these locations could cumulatively affect these wetlands.

2.3.1 On-Location Storage Volume Evaluation

Planned on-location storage volume of the following are below: i) oil; ii) condensate; iii) produced water; and iv) other volumes of stored hydrocarbons, chemicals, or exploration and production ("E&P") waste fluids. Storage of any of these materials is done in state-approved containment with a focus on preventing spills or releases. If a spill or release occurs, Crestone works to minimize the extent of the spill and mitigate any impacts.

Table 2.3. On-location Storage at Proposed Blue Pad

Est. Oil and Condensate (bbls)	Est. Produced Water (bbls)	Other Storage (bbls)
2,000	1,000	50

On-location water is stored for use in drilling and completions. For drilling, the fluids used will be stored in an onsite tank. During completions, a combination of water, sand and a small amount of additives is injected at high pressure through the well to the target rock formation deep underground. This injected fluid creates small cracks in the rock, allowing natural gas and oil to flow to the surface.

2.3.2 Potential Contaminant Migration Pathways

Within one-half mile of the Well Site there is one tributary to Prairie Dog Draw with an additional tributary within one-half mile of the eastern end of the planned access road. There are no ponds or lakes within one mile. Seven permitted groundwater wells are within one-half mile.

According to the Fish & Wildlife Service Wetlands Mapper[6] the two tributaries make up one wetland (classification code: R4SBA). These tributaries are riverine intermittent streambeds that

[6] https://www.fws.gov/wetlands/data/mapper.html

have brief periods of surface water, but the water table usually lies well below ground surface. The topography of the Well Site generally slopes downward from the southwest to the northeast. One tributary lies cross-gradient within one-half mile to the north of the Well Site, until it decreases in elevation and meets another tributary to the northeast. Therefore, water from the Well Site is projected to flow to the northeast toward these drainages. However, Crestone works to implement best management practices ("BMPs") for stormwater at the Well Site to mitigate potential contamination migration pathways. The Well Site does not lie within a floodplain, and there are no springs or irrigation ditches within one mile of the Well Site.

Groundwater may also be impacted by changes to stormwater patterns that occur during the development of a pad. Shallow groundwater is projected to follow the surface water drainage pattern to the northeast. No shallow groundwater wells are reported within one-half mile of the Well Site, and nearby domestic wells are drilled to a depth of over 300 feet below the ground surface. Also, BMPs at the Well Site are implemented to reduce impact to stormwater drainage and infiltration to groundwater resources. The City of Aurora is the relevant local government for the Well Site and requires an approved Stormwater Management Plan ("SWMP"). These BMPs can be found in the site-specific SWMP[7] submitted with Form 2A.

Spills and releases are potential sources of contaminants that could reach a migration pathway. Crestone works to prevent spills and releases from occurring and mitigates impacts if a spill or release occurs. This minimizes any short and long-term cumulative water resource impacts related to spills and releases.

In addition, another potential migration pathway is through the wellbore into upper aquifers, such as the Denver and Arapahoe Aquifers, that are used for drinking water. As an important component of Crestone's operations, water protection starts with an effective wellbore design and the proper execution of wellbore construction procedures. Every natural gas or oil well has an engineered steel casing system that is cemented externally to prevent any fluids from moving from the wellbore to groundwater aquifers. A casing and cementing program is designed for all types of Crestone drilling. The proper wellbore design, with layers of protective casing, protects groundwater throughout the development process and the life of the well. Crestone constructs and operates its wells in accordance with state requirements to protect potential contamination of soil and groundwater from its wellbores.

2.3.3 Potential Impact to Public Water System Intakes

There are no Public Water System intakes within one mile of the Well Site.

[7] Apex Companies, LLC, 2021. Stormwater Management Plan Submitted with Form 2A Application for: Blue 3-65 33-32-31 1BH, 2AH, 2BH, 3AH, 3BH, 4AH, & 4BH Adams County, Colorado. August 12.

2.3.4 Surface Water and Groundwater Usage

Crestone sources its water from leased water rights and municipal sources. The company works to establish closed-loop systems when appropriate and feasible. For the Well Site, produced water will be disposed of in state-approved disposal wells, outside of the city of Aurora.

Total estimated water to be used during drilling operations and pad construction activities for the Well Site is 24,500 bbls. The primary source for this water will be groundwater from a water hydrant located near the intersection of 6th Avenue and North Haysmount Road within the Rangeview Metropolitan District, which will be transported via water truck.

Crestone has an executed agreement with the City of Aurora for delivery of non-potable water from the district's Prairie Waters Line (near 6th Avenue and North Powhaton Road) to a holding pond (near 6th Avenue and North Haysmount Road) for the completions phase. Pending permit approvals, this groundwater under the direct influence of surface water will be transported from the Prairie Water Line to the holding pond and ultimately to the Well Site by Layflat line and a Crestone owned water line. If the City of Aurora cannot provide sufficient supply of water, surface water from Flying B2O will be used as a secondary or supplemental source. It is anticipated that Crestone will utilize approximately 96,600 bbls of water per day during the completions phase for a total of 2.45 to 3.5 million bbls.

Once the seven wells are operational at the Well Site, approximately 21,000 bbls/year of produced water will be generated at the Well Site. This amount will decrease during the first year or two of production and likely stabilize around 10,500 bbls/year. In the future, Crestone will evaluate whether the produced water can be recycled in its operations.

2.3.5 Water Use Reduction and Measures Taken to Avoid, Minimize, or Mitigate Impacts to Water Resources

The Well Site location selection detailed in Section 1.2 minimizes CI to Water Resources. Specifically, the location selection will:

- Utilize part of the existing haul road, eliminating the potential for new construction near or within the Prairie Dog Draw tributary riparian corridor or wetland; and
- Allow sourcing of non-potable water for completions from a City of Aurora water line.

In addition to these reductions, Crestone plans to take product away from the Well Site by pipeline. The Well Site will have spill containment around oil and produced water storage tanks. The engineered SWMP utilizes BMPs to control stormwater runoff in a manner that minimizes erosion, transport of sediment offsite, site degradation, and protects surface waters. This mitigates potential contamination of soil, groundwater, and surface water from spills. Non-potable water, sourced from the City of Aurora, will be delivered to the Well Site by a combination of temporary flow lines (layflat lines) and permanent water lines for use in fracturing.

Beyond the water use reduction measures, Crestone takes measures to prevent spills. Specifically, Crestone's Fluid Leak Detection Plan ("FLDP") provides details on Crestone's actions to prevent and manage leaks and releases. Crestone is committed to safe and environmentally responsible management to all COGCC rules governing environmental impact prevention and fluid leak detection. Crestone uses numerous BMPs and strategies to enhance fluid leak detection and minimize spills. Below are a few examples of the BMPs and strategies used during drilling and completions:

Phase of Operation	Best Practices and Strategies
Drilling	Inspections occur twice a day on all fluid equipment and are logged into a data system General secondary containment is placed under equipment Portable containers are stored inside portable containment Double-walled tanks are installed where available Closed loop drilling systems are used Continuous monitoring on equipment occurs
Completions	Inspections occur twice a day on key equipment and the results are input into a data management system There are frequent routine inspections during operation General secondary containment is placed under equipment Portable containers are stored inside portable containment Double-walled tanks are installed where available Continuous monitoring on equipment occurs
All	For leak prevention, Crestone conducts: • Weekly facility inspections • Annual Spill Prevention Countermeasure and Control ("SPCC") inspections • Equipment integrity inspections • Flowline and pipeline pressure testing Training is provided to Crestone employees and expected for all contractors and subcontractors working for Crestone

In addition, Crestone operates under a Waste Management Plan ("WMP") tailored to each location. Crestone's WMP provides guidelines and minimum requirements for waste management according to the Waste Management Corporate Standard, Crestone's Management, and state and federal laws. The guide is designed to reduce the impact of company operations on the environment and maintain compliance with company policy and regulatory requirements for waste management. By detailing handling practices and waste minimization and recycling information, Crestone works to minimize impacts associated with waste management.

2.4 Terrestrial and Aquatic Wildlife Resources and Ecosystems

The Blue site is proposed on land zoned as Airport District, was recently used for agricultural purposes, notably dryland grass-hay production, and currently is a disturbed field with non-native

plant species.[8] New construction at the Well Site will result in the stripping of approximately 14.7 acres and 7,040 cubic yards of topsoil and associated vegetation, which could be used for foraging by local wildlife. Within one-half mile of the Well Site include the Mustang Compressor Plan (13 acres), Blue 3-65 32-33 1H well pad (2 acres), and the Martin Marietta Asphalt Plant and associated access roads, driveways, and parking areas that contribute to the impacts to the ecosystems in the immediate surrounding areas. Additionally, a railway, East Colfax Avenue, and Interstate 70 are all within one-half mile to the south of the Well Site.

Some impacts to terrestrial ecosystems are also expected and would be additional to impacts from other current construction and built infrastructure in the area. One terrestrial high priority habitat, a western burrowing owl (Athene cunicularia) nest, is between one-half mile and one mile from the Well Site, but there will be no disturbance of land within 500 feet of it. Habitats suitable for raptors and migratory birds have been identified near the Well Site. Trees within one-half mile may be utilized for nesting by bald eagles (Haliaeetus leucocephalus) or golden eagles (Aquila chrysaetos) but are currently without nests. Potentially nesting non-eagle raptors that may utilize trees or ground vegetation within one-half mile of the Well Site include the great-horned owl (Bubo virginianus), Swainson's hawk (Buteo swainsoni), the red-tailed hawk (Buteo jamaicensis), and the ferruginous hawk (Buteo regalis). Three nests were found within one-half mile of the Well Site, which include two inactive nests and one active great-horned owl nest. The active nest lies on the opposite (south) side of Interstate 70, nearly one-half mile away, and is not expected to be impacted by development. Migratory bird species with the potential for nesting near the Well Site include the western burrowing owl, the lark bunting (Calamospiza melanocorys), the mountain plover (Charadrius montanus), and the killdeer (Charadrius vociferus). Three prairie dog colonies lie within one mile of the Well Site, which indicate potential habitats for western burrowing owls. A western burrowing owl nest is active near the colony to the northeast, with other potential habitats near the prairie dog colonies to the northwest and southeast. The Natural Resources Biological Assessment and Wildlife Protection Plan for the Well Site recommends that surveys should be completed prior to development activities[9].

There are six threatened or endangered species identified as possibly occurring within the area of development. The threatened species include the Preble's meadow jumping mouse (Zapus hudsonius preblei), piping plover (Charadrius melodus), Ute ladies'-tresses (Spiranthes diluvialis), and the western prairie fringed orchid, and the endangered species identified are the whooping crane (Grus americana) and the pallid sturgeon (Scaphirhynchus albus). No existing or suitable habitats exist near the Well Site for any of these species, so there are no expected impacts.

[8] Apex Companies, LLC, 2021. Natural Resources Biological Assessment and Wildlife Protection Plan, Blue 3-65 31-32-33, Adams County, Colorado. May 26

[9] Apex Companies, LLC, 2021. Natural Resources Biological Assessment and Wildlife Protection Plan, Blue 3-65 31-32-33, Adams County, Colorado. May 26

Reclaimed land will be seeded with native vegetation suitable for grazing and should improve the vegetative ecosystem for foraging wildlife. Wildlife fencing will be installed surrounding the construction area to further protect wildlife and is not expected to fragment the wildlife habitat.

Construction of the pad or access road would not occur on land that supports aquatic wildlife with the nearest aquatic ecosystem over one mile southwest of the Site. Additional information can be found in the Wildlife Protection Plan.

2.4.1 High Priority Habitats

There is one high priority habitat within one mile of the pad – a western burrowing owl active nest site. The Well Site is greater than one-half mile from the habitat and no acreage within 500 feet of this high priority habitat will be disturbed.

2.4.2 Acreage of New or Expanded Surface Disturbance

The total acreage of surface disturbance during construction will be 14.7 acres – 13.0 acres for the well pad and 1.7 acres for the access road. This acreage is currently agricultural land primarily used for dryland grass-hay production. The placement of this development, adjacent to existing Crestone infrastructure, near industrial facilities and roadways, and surrounded by farmland, is not expected to result in further fragmentation of wildlife, but there may be additional edge effects to the habitat surrounding the development. Within one-half mile of the proposed working pad surface is one asphalt plant and one oil and gas facility that have previously disturbed the surface. Additionally, the Mustang Compressor Station is currently being constructed within 1,000 feet of the Well Site. Each facility was constructed or is being constructed in a location with a similar prior use; however, most of the surrounding land is still suited for agriculture, and long-term adverse cumulative impacts of the proposed oil and gas development on the terrestrial ecosystem are expected to be localized and minimal. No aquatic ecosystems will be disturbed.

After reclamation, permanent disturbance will be 9.3 acres. The reclaimed 5.4 acres will be reseeded with vegetation that is considered a native plant community and selected to be suitable for large herbivores.[10]

2.4.3 Measures Taken to Avoid, Minimize, or Mitigate Impacts

The Well Site location selection detailed in Section 1.2 minimizes CI to terrestrial and aquatic wildlife resources and ecosystems. Specifically, this selection:

- Will utilize and extend an existing access road rather than having to construct a new road; and

[10] Uintah Engineering & Land Surveying, LLC. *BLUE 3-65 33-32-31 1BH, 2AH, 2BH, 3AH, 3BH, 4AH, & 4BH STORM WATER MANAGEMENT PLANS.* 17 February 2021.

- Will utilize land adjacent to existing Crestone oil and gas facilities rather than disturbing other undeveloped or agricultural lands.

Additionally, Crestone will conduct surveys for nesting on habitats suitable for raptors and migratory birds prior to construction. Infrastructure will be installed on tanks and other equipment to discourage raptor perching and nesting at the proposed working pad.

2.5 Soil Resources

2.5.1 Topsoil and Vegetative Communities Impacts

New construction at the Well Site will result in the stripping of approximately 7,040 cubic yards of topsoil. The Well Site is or recently was agricultural, likely for grass-hay production with smooth brome grass the predominant species.[11] This will be the primary ecological and vegetative community disturbed by the development. Topsoil will be stockpiled at the Site and used for reclamation. The topsoil that will be disturbed is Platner loam, with 3 to 5 percent slopes, which is a non-hydric, upland soil.[12] This topsoil will be temporarily seeded while stockpiled. It is expected that 9.3 acres of agricultural land, with associated topsoil and vegetation, will be impacted for the duration of the well pad's existence. Approximately 5.4 acres will be reclaimed using the local topsoil after construction is completed and impacts will be short-term.

The reclaimed 5.4 acres will be planted with a seed mixture of grasses, forbs, and shrubs.[13] This mixture will include native vegetation such as western wheatgrass (Pascopyrum smithii), Green Needlegrass (Nassella viridula), Blue Grama (Bouteloua gracilis), American Vetch (Vicia americana), Upright Prairie Coneflower (Ratibida columnifera), Scarlet Globemallow (Sphaeralcea coccinea), and Dotted Gayfeather (Liatris punctata), among other species. This reseeded ecosystem will replace a dryland agricultural ecosystem. After reclamation, the cumulative impacts to the area for vegetative communities are expected to be minimal.

2.5.2 Measures Taken to Avoid, Minimize, or Mitigate Impacts

The Well Site location selection detailed in Section 1.2 minimizes CI to soil resources. Specifically, this selection:

- Eliminates the need to strip topsoil for the construction of significant portions of an access road due to the proximity of a Crestone haul road; and

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[11] Apex Companies, LLC, 2021. Stormwater Management Plan Submitted with Form 2A Application for: Blue 3-65 33-32-31 1BH, 2AH, 2BH, 3AH, 3BH, 4AH, & 4BH Adams County, Colorado. August 12.

[12] United States Department of Agriculture Natural Resources Conservation Service Web Soil Survey. https://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx. 11 August 2021.

[13] Uintah Engineering & Land Surveying, LLC. *BLUE 3-65 33-32-31 1BH, 2AH, 2BH, 3AH, 3BH, 4AH, & 4BH STORM WATER MANAGEMENT PLANS.* 17 February 2021.

- Minimizes the construction of new pipeline given there is an adjacent pipeline to the Well Site.

Of the 14.7 acres planned to be disturbed by the construction of the Well Site, 5.4 acres will be reclaimed shortly after development activities for a working surface disturbance of 9.3 acres.

2.6 Public Welfare

Crestone strives to minimize the temporary and ongoing potential impacts oil and gas operations have on neighboring communities. Crestone monitors for and deploys a number of mitigation strategies to minimize any potential public welfare impacts associated with our operations.

There are multiple single-family residences between 3,000 feet and one mile to the south and southwest of the edge of the proposed Working Pad Surface. All of these residences are on the opposite (south) side of Interstate 70. The closest high occupancy building unit, designated outdoor activity area, school, or childcare facility is more than one mile from the Working Pad Surface of the Well Site. There are potential sources of short-term and long-term impacts related to noise, light, odor, dust, and recreational and scenic values. These potential sources include the following:

Topic	Description
Noise	During periods of drilling and hydraulic fracturing, noise may exceed COGCC Noise Limits at the residential building units without proper abatement. Additionally, intermittent noise from vehicular traffic on roads and from heavy equipment during construction will occur. During production, compressors and generators will operate onsite and vehicular traffic will travel on roadways.
Light	Lighting will be supplied by four Light-Emitting Diode ("LED") towers with lights angled at the pad that will be operated during low-light conditions as needed.
Odor	Odors from typical oil and natural gas development and production emission sources are expected.
Dust	Dust will be generated based on vehicle trips to and from the site on unpaved haul roads, by equipment operating at the site, and site activities such as use of proppant used during completions.
Recreation and Scenic Values	There are no State Parks, State Trust Lands, State Wildlife Areas, Designated Outdoor Activity Areas, or mapped trails that support outdoor recreational activities within one mile of the Well Site.

2.6.1 Measures Taken to Avoid, Minimize, or Mitigate Impacts

The Well Site is more than one-half mile from most receptors. Pad construction, drilling, hydraulic fracturing, and well completion activities will likely occur in a time frame prior to substantial development in the area. However, Crestone is committed to decreasing public welfare impacts in the area. These measures include the following measures to mitigate potential impacts to noise, light, odor, dust, and recreation and scenic values.

Noise Mitigation

Crestone is developing a noise mitigation plan for the Well Site that will detail specific strategies to mitigate noise effects. Based on this plan, Crestone will install and maintain sound walls around portions of the Well Site during drilling and completions and permanent noise mitigation, as needed. Additionally, sound panels will be used at the Well Site to isolate noise from individual pieces of equipment as needed. For equipment, Quiet-Fleet™ hydraulic fracturing technology will be utilized to decrease noise and electric drill rigs will be used when line power is available. Shipments of tubular deliveries and unloading will be limited to daylight hours, and truck traffic will be limited to daytime hours as well, as best as possible.

Light Mitigation

Lighting will be supplied by four LED towers with lights angled at the pad to focus luminous intensity on the pad and minimize lighting areas beyond the pad surface. Site lighting will be directed downward and inward and shielded to avoid glare on public roads. Additionally, the sound walls described above will also serve as light barriers. The drill rig will be equipped with tinting around the rig derrick, lights will be tinted and downward and inward pointing, and other lights will be also shrouded to further reduce light pollution. Crestone is committed to working with homeowners to minimize the impact of light from activities and traffic to people in their homes. Example mitigation measures include installing berms and hay bales.

Odor Mitigation

Crestone utilizes a new high-performance drilling fluid, NeoFlo™, that is virtually odor-free, non-toxic, and readily biodegradable. Other benefits of using this product include:

- Reduced drilling time, meaning less time on location;
- Minimal aromatic content and intrinsically cleaner when compared to conventional fluids such as diesel and straight run gas oil; and
- Low vapor, reducing the impact on health and safety of the nearby community and the on-site team.

Also, mud chillers are used to reduce odors from mud as it is removed from the wellbore and drill pipe is wiped down during tripping events to prevent odors from formation cuttings. Crestone consistently monitors operations and is committed to improving and adjusting operations as needed to minimize the impact on nearby residents.

Dust Mitigation

Crestone will follow its fieldwide fugitive dust suppression plan. This plan includes: i) application of freshwater or magnesium chloride for suppression; ii) use of high-quality construction materials for roads; iii) reestablishment of vegetation; iv) establishment of speed limits; and v) limiting or stopping work during high wind conditions. Additional BMPs such as wind breaks and barriers or

automation of wells to reduce truck traffic may also be utilized if feasible. Crestone will also sweep roads near the access point to minimize fugitive dust emissions and maintain a clean entrance. If necessary, Crestone can deploy water trucks to further minimize fugitive dust.

Mitigation for Recreation and Scenic Values

There are no recreational areas (parks, trails, etc.) within a one-mile radius of the Well Site, so recreation impacts are negligible. The pad will also have permanent fencing placed around the production equipment and wells after it has gone into permanent production. The eight-foot fencing will be visually impervious and largely block the view of production equipment. Crestone is prepared to construct berms and impervious fencing around the facility if necessary. The facility may also be painted in a color that blends in the natural background, if feasible.

ATTACHMENT A: CUMULATIVE IMPACTS FOR WELL PAD CONSTRUCTION – BLUE 3-65 33-32-31

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Memorandum

Date:	August 25, 2021
To:	David Stewart, VP Environmental, Health, Safety & Regulatory
Copies to:	Jill Cooper
From:	Patrick Medland
Subject:	Cumulative Impacts for Well Pad Construction – Blue 3-65 33-32-31

In accordance with Senate Bill 19-181, Section 303 and the revised Colorado Oil & Gas Conservation Commission (COGCC) procedural requirements for an Oil and Gas Development Plan (Plan), Part (5) Cumulative Impacts Data Evaluation Repository, provides for a qualitative evaluation to address Cumulative Impacts (CI) within the Plan. The following responds to this requirement for the Blue 3-65 33-32-31 (Blue or Well Pad) proposed development and discusses activities that will occur within approximate one year of the initiation of work at Blue.

Relevant Site Features

An aerial photograph of Blue is provided in Figure 1. Important site features for Blue are:

- Crestone's Mustang Compressor Station is currently under construction and located within 1,000 feet east of the Blue pad;
- An asphalt plant is approximately 2,000 feet to the northwest of the Well Pad;
- There is one producing oil and gas well about one-half mile to the north-northwest of Blue at the Blue 3-65 32-33 1H pad;
- Interstate 70 is approximately one-half mile south of the Well Pad;
- There are two other Crestone operated well pads within one mile to the north, both with four producing wells: King 3-65 28-29 South and Florida 3-65 27-26 South;
- There are multiple residential buildings to the south and southwest of the Blue pad within one mile (but greater than one-half mile) including two developments – Foxridge Farm and Sky Ranch Subdivision;
- There are no high occupancy building units, schools, designated outside activity areas, or childcare facilities within one mile;
- Other land within 2,000 feet of the working pad surface is mostly farmland; and
- Concerning future potential residential development, there are no platted residential lots within 2,000 feet of Blue.

Figure 1: Blue Well Pad

Overview of One Year Plan

The general plan for Blue is to:

- Obtain an approved development plan and permit to start production;
- Install a road to access the Well Site;
- Construct a pad that will hold seven wells and associated facilities; and
- Install seven new wells sequentially, one at a time, and bring each into production.

The details of the size, production parameters, and other relevant information are found in other sections of the Plan.

Evaluation of Potential Incremental Pre-production Pollutant Increases

Using the general overview of the Plan, this section describes the potential pre-production incremental increase of pollutant from both mobile and stationary sources that might occur at Blue. With each potential pre-production incremental increase, mitigation or management measures will be employed to reduce potential impact from hazardous air pollutants.

New Pad Construction

Mobile Sources

During construction of the new well pad at Blue, there is expected to be an increase in truck traffic bringing equipment and pad materials to the facility. This will increase particulate and tailpipe emissions.

Stationary Sources

Construction of the new pad will require the use of on-site lifting, moving, and earthwork machinery. This will increase particulate and tailpipe emissions.

Initial Well Development – Drilling and Completions

Construction of the wells will necessitate bringing on-location all the equipment and resources for drilling, piping, fracturing, and completing the wells. All wells will be drilled prior to completion at the first well. Once drilling is completed, drilling equipment will be removed, and completion equipment mobilized to the site. The completion equipment at the site will remain until the end of the completion process and the wells enter the production phase.

Mobile Sources

During construction of the new wells at Blue, there is expected to be an increase in truck traffic bringing equipment and resources to the facility. This activity will increase tailpipe and particulate emissions.

Stationary Sources

The drilling process requires drilling activity, drilling fluids, and the use of drill muds, all of which will increase emissions from the facility. Well development uses water and fracking fluids, and generates water containing well byproducts, including petroleum-related volatiles: benzene, toluene, ethyl benzene and xylene (BTEX), hexane, 2,2,4-trimethylpentane (2,2,4-TMP), formaldehyde, and methanol (collectively called specific hazardous pollutants, or SHP). Byproducts from the drilling, fracturing, flow-back, and completion process (produced water) will increase SHP emissions. Byproducts will be stored on-site, and fluids returned from the drillings will be stored in closed containers to reduce SHP emissions until they are transported offsite in produced water hauling trucks and managed through a Class II Underground Injection Control (UIC) well. There will be no extended flowback phase during development which will likely decrease the release of SHPs to the environment. This phase of the process is likely to result in the highest relative releases of SHPs.

Mitigation measures for this stage of the process will include: Tier 4 (low emission) engines will be used, stationary engine emissions will be piped to a combustor to reduce emissions, and fuel for the completion fleet will be supplemented with natural gas to reduce emissions.

Produced water will be trucked offsite. This water will be temporarily stored onsite in containment systems that will reduce SHP releases. Water will be provided from local municipal sources and via layflat line from the nearby Rangeview Metropolitan District and City of Aurora infrastructure.

No flares will be used, and SHPs from well development will be piped to a combustor. Because the process will not include extended flowback, emission of SHPs during this phase will be held to a minimum.

Initial Production Phase and CI from Multiple Wells

Once the first well is completed, it will start producing while the second well is completed. This will be followed by the third well, followed by the fourth, and so on. The incremental additional increase of SHPs from one well is expected to be low, but by the end of the process, it is anticipated that there will be six wells in production and one well in the completion phase.

Mobile Sources

During the production phase, it is anticipated there will be a low level of truck traffic to the well pad.

Stationary Sources

When a well is brought into production it is anticipated there will be low levels of SHP releases. However, the cumulative impacts for all wells together are expected to be incrementally lower than during the development phase for one well.

Cumulative Impacts from Seven Wells

It is important to note the drilling, construction, and development of the wells at Blue will be conducted in series, that is, one well at a time. One drill rig will drill all seven wells in series and then one completion rig will complete all seven wells in series. Therefore, CI are due to the number of wells being developed and not from multiple wells being developed at the same time.

Mobile Sources

Activities during the drilling, construction, development, and completion will occur sequentially. Increased truck traffic bringing equipment and resources and removing produced water is expected throughout this process.

Stationary Sources

The sequence and associated releases for single well installation discussed above applies to stationary sources for the seven wells over the development phase and first year of production. During the process of pad development there will be one well drilled at a time. During completions, one well will be brought into production at a time. After one well is brought into production, completions at the second will be started. After the second is brought into production the third will be started and continue in that manner. The worst-case scenario will be when there are six producing wells while completions at the final well is underway. The incremental additional increase of SHPs from one well in production is expected to be low. While there will be an incremental increase of SHPs from six wells in production, it is anticipated that the CI of emissions from six wells in production will be low compared with the one well in the completion phase.

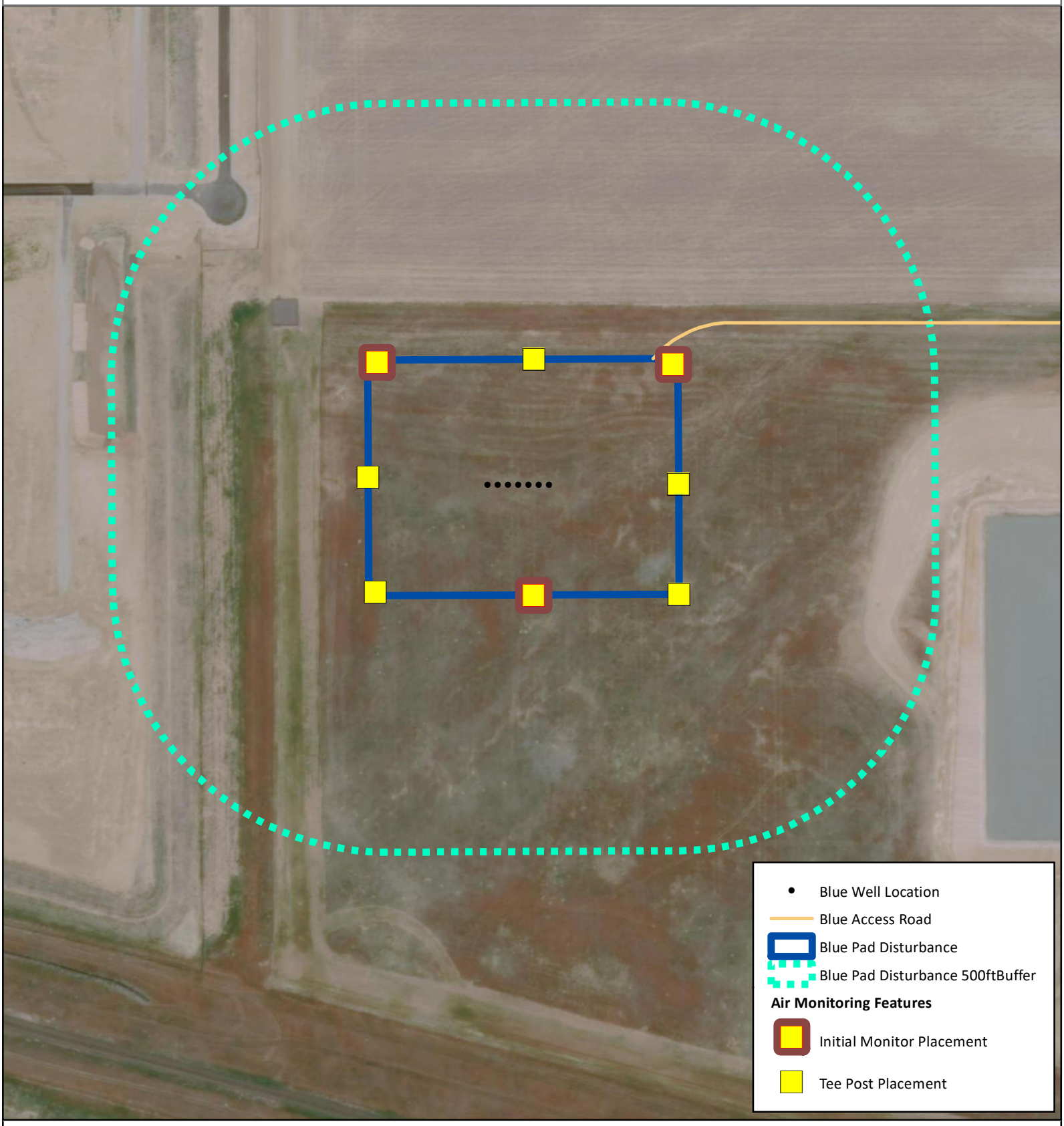
Cumulative Impacts from Surrounding Sources

There is one compressor station under construction within 1,000 feet, an asphalt plant within 2,000 feet, Interstate 70 approximately one-half mile away, and three well pads with producing wells from one-half to one mile from Blue. Emissions from Interstate 70 and the asphalt plant are variable and are not controlled by Crestone. Emissions from the three well pads are not expected to change substantially over the life of these wells. The Mustang Compressor Station, which is currently under construction, will also increase emissions near Blue.

ATTACHMENT B:

BLUE 3-65 33-32-31 AIR MONITORING LOCATIONS

BLUE 3-65 33-3231
1BH, 2AH, 2BH, 3AH, 3BH, 4AH, 4BH
PAD LOCATION DRAWING



Blue
Air Monitoring

0 250 500 Feet

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W E
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Coordinate System: NAD 1983 BLM Zone 13N

CRESTONE PEAK RESOURCES

4/23/2021

Document Path: S:\GIS\Maps\EHS\Air\Pad\Blue\BlueAirQuality.mxd

ATTACHMENT C:

SCREENING LEVEL HEALTH RISK EVALUATION OF COMMUNITY AIR MONITORING AND SAMPLING STUDY

THE SCIENCE OF READY℠

SCREENING LEVEL HEALTH RISK EVALUATION OF COMMUNITY AIR MONITORING AND SAMPLING STUDY

Prepared on Behalf of:

Crestone Peak Resources
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Prepared By:

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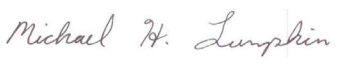
	Name	Signature	Date Signed
Prepared by:	Tami McMullin, PhD		12/11/2019
Reviewed by:	Michael Lumpkin, PhD, DABT		12/11/2019

Executive Summary

CTEH, LLC (CTEH) was requested by Crestone Peak Resources (Crestone) to design and perform studies to characterize the short-term impacts on local air quality and public health from discrete operational phases at four oil and gas wellpads being developed in Weld County, Colorado: Big Horn, Cosslett, Echevarria, and Kugel wellpads. The specific goals of this project were to: (1) collect a high-resolution data set of chemical concentrations in air near the wellpad and the surrounding communities, and (2) evaluate the impact on risks to public health, if any, from the release of oil and gas-related compounds into the air during specific operational phases of well development.

To address these goals, CTEH staff conducted real-time air monitoring for total volatile organic compounds (VOCs), hydrogen sulfide (H_2S), particulate matter ($PM_{2.5}$ and PM_{10}), and specific VOCs such as benzene with simultaneous observations of odors, wind direction, and wind speed relative to the wellpad. CTEH also collected discrete air samples around the perimeter of the wellpads to be analyzed by a certified analytical laboratory. These samples were analyzed for VOCs, including benzene, toluene, ethylbenzene and xylenes (BTEX compounds). The study focused on collecting data during activities that may produce the greatest emissions for each phase of operations. This approach uses a robust and widely accepted method for characterizing potential public health risks. This report provides the data and health risk evaluations from real-time air monitoring and analytical sampling (BTEX compounds) conducted in the communities surrounding the wellpads during the various phases of operations to date. Findings contained in this report include the drilling phase at Kugel wellpad, hydraulic fracturing and flowback phases at Big Horn wellpad and the production phases at the Cosslett and Echevarria wellpads.

More than 5,000 total measurements were collected in real-time by CTEH personnel in the communities surrounding the wellpads over a period of 26 days. Additionally, 20 analytical samples were collected from four locations around the Bighorn wellpad to evaluate potential community exposures over 5 days of flowback activities. Approximately 99% of the real-time VOC measurements recorded in the communities were non-detections, which means that VOCs were not present or that VOC concentrations were less than the instrument detection limit of 1 ppb for VOCs. This detection limit is well below the federal (ATSDR) health guideline level for short-term adverse health effects for benzene (9 ppb). Of the over 1,500 measurements collected for benzene specifically or VOCs in general, just one reading was at a detectable level but did not exceed public health guideline values for the BTEX compounds. No H_2S was ever detected, and just one of over 1,500 readings taken for PM, taken on along a dirt road, was higher than typical background values. In the 20 analytical air samples collected in the surrounding community during flowback, the maximum measured concentrations for BTEX compounds were also all 10 to 13,000-times lower than their respective federal acute health guideline values.

These data, combined with corresponding documented wind directions, suggest that oil and gas-related analytes that may come from the wellpads are not migrating to the surrounding communities to any significant extent. Thus, the real-time and analytical data indicate no adverse health risks to nearby communities, including sensitive individuals, from cumulative exposures to VOCs that may be emitted from pre-production and production activities at Crestone wellpads.

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1.0 Introduction

In the State of Colorado, concerns have been raised by government, non-government, and individual stakeholders regarding the impact of air quality on public health at regional and local (i.e., neighborhood, city/town, county) levels from oil and gas drilling and completion activities. Based on these stakeholder concerns, CTEH, LLC (CTEH) was requested by Crestone Peak Resources (Crestone) to design and perform studies to characterize the short-term impacts on local air quality and public health from discrete operational phases at four wellpads being developed in Weld County, Colorado: the drilling phase at Kugel wellpad, hydraulic fracturing and flowback phases at Big Horn wellpad and the production phases at the Cosslett and Echevarria wellpads.

CTEH is an environmental and human health consulting firm specializing in health risk assessment and regulatory compliance, as well as responding to hazardous materials emergencies and chemical releases.

Specific Goals: CTEH designed and executed a study of the Crestone wellpads with the specific goals of (1) collecting a high-resolution data set of chemical concentrations that have potential for public health impacts in air near the wellpad and the surrounding communities, and (2) evaluating the impact on short-term risks to public health, if any, from the release of oil and gas-related compounds into the air during specific operational phases of well development and production.

The specific analytes evaluated in this study were selected based on their association with oil and gas operations and their potential for public health impact. For example, multiple studies conducted during all phases of natural gas well development, both on-site and in residential communities near oil and gas sites, including studies conducted by the Colorado Department of Public Health and Environment (CDPHE), have shown that benzene has the greatest potential to cause short-term and long-term health effects and therefore, is considered a risk driver.[1][2][3][4]

This report provides an overview and a screening level analysis of data collected by CTEH during real-time air monitoring and air sampling (during flowback) in communities surrounding the Crestone wellpads.

[1] https://www.colorado.gov/pacific/cdphe/oil-and-gas-community-investigations
[2] McMullin, T.S., Bamber, A.M., Bon, D., and VanDyke, M. (2018). Exposures and Health Risks from Volatile Organic Compounds in Communities Located near Oil and Gas Exploration and Production Activities in Colorado (U.S.A.). International Journal of Environmental Research and Public Health. Jul 16; 157 (7). DOI: 10.3390/ijerph15071500
[3] Collett, J.; Ham, J.; Hecobian, A. North Front Range Oil and Gas Air Pollutant Emission and Dispersion Study; Colorado State University: Fort Collins, CO, USA, 2016.
[4] Collett, J.; Ham, J.; Hecobian, A. Characterizing Emissions from Natural Gas Drilling and Well Completion Operations in Garfield County, Co; Colorado State University: Fort Collins, CO, USA, 2016.

1.1 Site Descriptions

The four Crestone wellpads around which CTEH performed monitoring and sampling (Big Horn, Cosslett, Echevarria, and Kugel) are in Longmont, Weld County, Colorado. Monitoring and sampling occurred from September 2, 2019 to October 21, 2019

Table 1: Wellpad Descriptions

Wellpad	Phase	Monitoring Dates	Location	Site Description
Big Horn	Hydraulic Fracturing and Flowback	September 9, 2019 to September 13, 2019 October 16, 2019 to October 21, 2019	North of County Road 20	Bordered by agricultural land on three sides, residential neighborhood on the west side and nearby production wells on private land
Cosslett	Production (Hub)	September 16, 2019 to September 20, 2019	West of Interstate 25 and south of Erie Parkway (County Road 8)	Surrounded by primarily agricultural land
Echevarria	Production (Tank Light)	September 23, 2019 to September 27, 2019	South of Co road 26 and west of Co Rd 21 ½	Rural area
Kugel	Drilling	September 2, 2010 to September 6, 2019	South of Sable Ave (Co Rd 22) and west of Frontier St (Co Rd 15)	Residential properties surrounding the wellpad on three sides with a more densely-developed residential subdivision to the north and drilling/production activities to the west

1.2 Operations Description

Data were collected during four operational phases: drilling, hydraulic fracturing, flowback and production. Table 2 lists best management practices (BMPs) in place to address potential sources of emissions for each phase of operation.

Table 2: Description of Best Management Practices

Phase	BMPs
Drilling	• Class III Drilling Fluid - oil based mud (odorless, no BTEX) • Mud Chillers - used to control cuttings odor while drilling through hydrocarbon bearing zones • Rotary steerable unit that reduces drilling time on-site • Local electrical power for drill rig - reduces air emissions, NOx • All equipment is on impermeable ground liners during drilling and completions
Flowback	• Vapor Recovery Units are used during flowback operations and initial year of production • Closed-top oil tanks - used during flowback operations and drill out • Combustor used for tank vapors during flowback and drill out
Production	• Hub facility - a central gathering facility serving several well sites which allows for smaller wellpads and fewer emission sources • Tank-lite facilities - Use of Lease Automatic Custody Transfer (LACT) units for custody transfer of oil, reduces the need to open tanks • Electric permanent production equipment - no gas actuated pneumatics
Completions	• Completions fleet fuel substitution – use compressed natural gas to reduce use of diesel fuel; up to 50% replacement when possible • Low-noise completion fleets – utilizing insulated engine housing and hospital grade mufflers

2.0 Methods

CTEH combined analytical sampling with real-time monitoring to provide a comprehensive set of data from which to assess short-term health risks in addition to public welfare impacts, such as odors. Real-time monitoring can capture near-instantaneous and short-term, transient changes in air quality while analytical sampling provides information about specific airborne compounds in the air over a longer period. The strategy for real-time air monitoring and analytical sampling used for this study is like that used routinely by CTEH during chemical emergency responses at accidental releases as well as support of regulatory compliance at numerous sites in North America, including petroleum-related industrial facilities and their neighboring communities.

This report describes the real-time air monitoring results conducted by CTEH personnel using hand-held instruments throughout the communities surrounding the Big Horn, Cosslett, Echevarria and Kugel

wellpads. This report also describes the analytical data collected in the community during flowback operations at the Big Horn wellpad.

2.1 Real-Time Air Monitoring

The objective of the real-time monitoring was to measure analyte levels in the communities with respect to specific wellpad operations CTEH staff targeted the surrounding communities with an emphasis on locations downwind of the pad using handheld instruments to monitor the ambient air quality at breathing zone level.

Real-time air monitoring for each wellpad was performed for at least 48 continuous hours followed by 12-hour shift monitoring over the subsequent three days. The duration of phase-specific data capture representative of normal operating activities (Table 1). Real-time air monitoring was conducted during the drilling phase at Kugel wellpad, hydraulic fracturing and flowback phases at Big Horn wellpad and during the production phases at the Cosslett and Echevarria wellpads. Measurements were collected at various distances from the pads ranging from the fence line to approximately one mile from wellpad operations. Maps of the specific location of each real-time measurement are provided in Appendix A.

Real-time air monitoring was conducted according to the CTEH site-specific sampling and analysis plan. Measured analytes included hydrogen sulfide (H_2S), particulate matter with a mean diameter of 2.5 microns ($PM_{2.5}$) and 10 microns (PM_{10}), nitrogen dioxide (NO_2), total non-methane volatile organic compounds (VOCs) and benzene, toluene, xylene, and hexane using hand-held instruments (Table 1). CTEH personnel used handheld instruments including TSI SidePak aerosol monitors, Gastec GV-100 pumps with chemical-specific, colorimetric detector tubes, and Honeywell/RAE Systems ppbRAEs, UltraRAEs, and MultiRAEs. Instruments were calibrated daily at a minimum and according to manufacturer specifications.

Table 3: Airborne analytes measured using real-time monitoring and/or analytical sampling

Analyte	Justification
Total volatile organic compounds (VOCs)	Assesses for the presence of elevated total non-methane VOCs compared to background.
Benzene	Multiple studies conducted during all phases of natural gas well development, both on-site and in residential communities near oil and gas sites, have repeatedly shown that of all measured VOCs, benzene has the highest potential to cause short-term and long-term health effects and therefore, is considered a risk driver
Toluene	Frequently detected during historical monitoring of oil and gas activities and responses to untended releases, represents a petroleum constituent that has relatively low health screening guideline values, indicating higher potential for adverse effects.
Ethylbenzene	
***m,o,p*-Xylenes**	

Analyte	Justification
Hydrogen Sulfide	Although studies have shown that hydrogen sulfide levels are generally negligible during oil and gas operations in Colorado, its low odor threshold combined with community concern warrants monitoring.
Particulate Matter ($PM_{2.5}$/PM_{10})	Measurement of airborne particulate matter (PM2.5 and PM10) is also proposed because it is frequently cited as a concern from community members that live near oil and gas sites. The main source of PM, if any, is likely to come from dust entrained from vehicular activity or diesel fuel-powered combustion engines.
Nitrogen Dioxide	Nitrogen dioxide is a by-product of gasoline/diesel engine combustion. It has relatively low health screening guideline value, indicating higher potential for adverse effects.

During real-time air monitoring, CTEH personnel also recorded simultaneous observations of odors, wind direction and speed relative to the wellpad, and observed activities or potential odor sources in the community. Fixed locations in the community(s) were monitored at regular intervals (i.e., once per hour) to provide concentration averages that may be observed and analyzed for trends over time within the community. Locations that provide upwind (background) and downwind characterization of compounds were selected, with a primary focus on measuring at locations that were generally downwind of the wellpad in adjacent communities. Wind rose plots of wind direction and wind speed can be provided upon request. This approach was intended to capture the highest number of analyte measurements relevant to potential public health risks in a community. CTEH personnel entered readings from handheld instruments, observations of wind direction and speed, presence of odors, and GPS coordinates of their reading locations into a CTEH smartphone application, which saves the data to a CTEH server. All real-time data were reviewed and underwent an in-house QA/QC process to verify that the concentration values reflected the analytes being measured, data were entered correctly and accurately characterized the environment in which they are being measured.

2.2 Community Analytical Air Sampling

In addition to real-time air monitoring, analytical air samples were collected at four discrete locations away from the work area and in the community during the flowback phase at the Bighorn wellpad. A map of the sample locations is provided in Appendix A.

Samples were collected using 1.4-liter evacuated canisters with 24-hour flow controllers. These samples were deployed for 24-hour periods, which represents a conservative estimate of potential exposures from which to compare to federally established short term health guideline values. All samples were sent under chain-of custody to Pace Analytical, a NELAP-accredited laboratory, and analyzed for a suite of VOCs in accordance with the United States Environmental Protection Agency (US EPA) method TO-15, plus tentatively identified compounds (TICs). A formal QA/QC evaluation of the laboratory data was conducted by Environmental Standards, Inc.

For the initial screening evaluation of potential for community health risks for further decision making, this assessment evaluated acute (short-term) exposures during the flowback phase. BTEX compounds (benzene, toluene, ethylbenzene, and xylene) were selected as high priority compounds of potential concern (COPCs) related to oil and gas activities for this initial evaluation.

Acute toxicity values (called health guideline values) for comparison with the air sampling data were selected following CDPHE memo[1]: FA2019 HGVs (updated acute and chronic health guideline values for use in preliminary risk assessments). For BTEX, all health guideline values were from the Agency for Toxic Substances and Disease Registry (ATSDR). According to ATSDR, an acute MRL is an estimate of the daily human exposure to a hazardous substance that is likely to be without appreciable risk of adverse non-cancer health effects over for up to 14 days of exposure. ATSDR states, "These substance-specific estimates, which are intended to serve as screening levels, are used by ATSDR health assessors and other responders to identify contaminants and potential health effects that may be of concern at hazardous waste sites. It is important to note that MRLs are not intended to define clean up or action levels for ATSDR or other Agencies."[2].

3.0 Results

3.1 Real-time Air Monitoring

More than 5,000 readings were collected in real-time by CTEH personnel in the communities surrounding the Crestone wellpads over 26 days. A cumulative summary of off-pad real-time monitoring measurements is provided in Table 4. Summaries of real-time air monitoring measurements by phase are provided in tables 5 through 9.

Table 4: Cumulative Community Real-Time Air Monitoring Summary (All Phases)

Analyte	Instrument	# of Readings	# of Detections	Range*
H_2S	MultiRAE Pro	212	0	< 0.1 ppm
NO_2	MultiRAE	1283	0	< 0.1 ppm
PM_{10}	AM510/AM520/DustTrak	1297	1297	0.00 - 0.790 mg/m^3
$PM_{2.5}$	AM510/AM520/DustTrak	1299	1299	0.001 - 0.080 mg/m^3
VOCs	MultiRAE	1	0	< 0.1 ppm
	ppbRAE	1308	1	18 ppb

*If no detections were observed, the instrument detection limit preceded by a "<" is listed.

[1] https://drive.google.com/file/d/1P2KEvu0MFiyzQAOQtjQUclqR-WGh1bEX/view
[2] https://www.atsdr.cdc.gov/mrls/index.asp

Table 5: Community Real-Time Air Monitoring Summary for Kugel Drilling Phase

Analyte	Instrument	# of Readings	# of Detections	Range*
NO_2	MultiRAE	228	0	< 0.1 ppm
PM_{10}	AM510	238	238	0.005 - 0.046 mg/m^3
$PM_{2.5}$	AM520	238	238	0.005 - 0.049 mg/m^3
VOCs	ppbRAE	237	0	< 1 ppb

*If no detections were observed, the instrument detection limit preceded by a "<" is listed.

Table 6: Community Real-Time Air Monitoring Summary for Big Horn Hydraulic Fracturing Phase

Analyte	Instrument	# of Readings	# of Detections	Range*
NO_2	MultiRAE	269	0	< 0.1 ppm
PM_{10}	AM510	272	272	0.005 - 0.049 mg/m^3
$PM_{2.5}$	AM520	273	273	0.004 - 0.062 mg/m^3
VOCs	ppbRAE	271	0	< 1 ppb

*If no detections were observed, the instrument detection limit preceded by a "<" is listed.

Table 7: Community Real-Time Air Monitoring Summary for Big Horn Flowback Phase

Analyte	Instrument	# of Readings	# of Detections	Range*
H_2S	MultiRAE Pro	212	0	< 0.1 ppm
NO_2	MultiRAE	245	0	< 0.1 ppm
PM_{10}	AM520/DustTrak	245	245	0.001 - 0.790 mg/m^3
$PM_{2.5}$	AM510/DustTrak	247	247	0.001 - 0.08 mg/m^3
VOCs	ppbRAE	257	1	18 ppb

*If no detections were observed, the instrument detection limit preceded by a "<" is listed.

Table 8: Community Real-Time Air Monitoring Summary for Cosslett Production Phase

Analyte	Instrument	# of Readings	# of Detections	Range*
NO_2	MultiRAE	272	0	< 0.1 ppm
PM_{10}	AM510	273	273	0.005 - 0.052 mg/m^3
$PM_{2.5}$	AM520	272	272	0.003 - 0.039 mg/m^3
VOCs	MultiRAE	1	0	< 0.1 ppm
	ppbRAE	274	0	< 1 ppb

*If no detections were observed, the instrument detection limit preceded by a "<" is listed.

Table 9: Community Real-Time Air Monitoring Summary for Echevarria Production Phase

Analyte	Instrument	# of Readings	# of Detections	Range*
NO_2	MultiRAE	269	0	< 0.1 ppm
PM_{10}	AM510	269	269	0.003 - 0.045 mg/m^3
$PM_{2.5}$	AM520	269	269	0.002 - 0.027 mg/m^3
VOCs	ppbRAE	269	0	< 1 ppb

*If no detections were observed, the instrument detection limit preceded by a "<" is listed.

Over 99.9% of all total VOC real-time measurements were non-detects (< 1 ppb) in surrounding communities over the duration of all pre-production and production activities. One (1) out of 1,308 total VOC measurements was above the detection limit of 1 ppb. This detection occurred on October 18, 2019 and measured a one-minute sustained detection of 18 ppb total VOC approximately 4,000 feet northeast of the Bighorn wellpad during the flowback phase of operations. At that time, CTEH personnel noted that they were downwind of site and observed a "manure-like" odor. They also noted that there was livestock nearby. No other odors were noted in the community during real-time monitoring, even during conditions when the VOCs were detected or when transient odors were reported on the wellpad. There were no exceedances of the 20ppb action-level set for VOCs in the community, therefore, no chemical specific measurements were taken for benzene, toluene, xylene or hexane.

No H_2S concentrations were detected. Of the approximately 1,500 readings for PM, only one was higher than typical background values. This reading was recorded on a dirt road at the entrance to the site.

3.2 Off-Pad Analytical Air Sampling

Because flowback phase has been identified by CDPHE as an operational phase that may product higher emissions that other phases, additional analytical air sampling was conducted at four fixed locations in the community over five consecutive days during the flowback phase at the Bighorn Wellpad. A total of 20 samples were deployed for 24-hour periods over five days. As an initial screening level assessment, the air sampling data for selected VOCs were compared to their respective health guideline values that are used by CDPHE to evaluate the potential for short-term health impacts (Table 10). A full summary of lab results is provided in Appendix B.

All detections for each analyte were below their acute health guideline value established by the federal Agency for Toxic Substances and Disease Registry (ATSDR). Acute guideline values were consulted because the analytical data represent potential 5-day (acute) airborne exposures in the surrounding community, and ATSDR acute guideline values are designed to protect even sensitive persons for continuous, 24-our exposures of up to 14 days. The highest concentration of benzene (0.896 ppb) was reported on October 16 (BHCO1016MC005). This sample was collected at AS05 which is located approximately 500 yards northwest of the wellpad. On October 18, when the real-time detection of 18 ppb total VOCs was recorded

northeast of the wellpad, the corresponding analytical sample (BHCO1018MC008) reported a concentration of 0.785 ppb benzene. This sample was collected at AS08, which is approximately 470 yards northeast of the wellpad. These detections, including the maximum measured benzene concentration, were from 10 to over 13,000-times lower than their respective acute health guideline values.

Table 10: Analytical Air Sampling Summary for Big Horn Flowback Phase

Analyte	# of Samples	# of Detections	Range of Detections (ppbv)	ATSDR Acute Health Guideline Value (ppb)[1]
Benzene	20	19	0.207 - 0.896	9
Ethylbenzene	20	2	0.295 - 0.38	5,000
m,p-xylenes	20	8	0.429 - 1.22	2,000
o-xylene	20	3	0.214 - 0.66	2,000
Toluene	20	20	0.358 - 13.1	2,000

[1] https://drive.google.com/file/d/1P2KEvu0MFiyzQAOQtjQUclqR-WGh1bEX/view

4.0 Impact on Public Health

The real-time air monitoring data and analytical BTEX samples did not indicate any potential increase in adverse health risks to in nearby communities from potential exposures to VOCs that may be emitted by oil and gas wellpad activities at Crestone wellpads. Approximately 99% of the total VOC real-time measurements in the community were non-detects, which means the VOC concentrations were not present or less than 1 ppb total VOCs. Additionally, real-time data indicate no adverse health risks to nearby communities, including sensitive individuals, from exposures to VOCs, H_2S or PM that may be emitted from the operations associated with well development at the various wellpad sites. Corresponding continuous analytical air samples of BTEX were well below their federally established acute health guideline levels.

5.0 Conclusions

CTEH designed and performed a study of air monitoring and sampling to characterize potential for short-term (acute) adverse health impacts to nearby communities resulting from oil and gas activities at Crestone wellpads in Weld County, Colorado. To accomplish this, CTEH collected over 5,000 real-time measurements, along with 20 analytical samples, in communities around multiple Crestone wellpads. Findings from this dataset indicate:

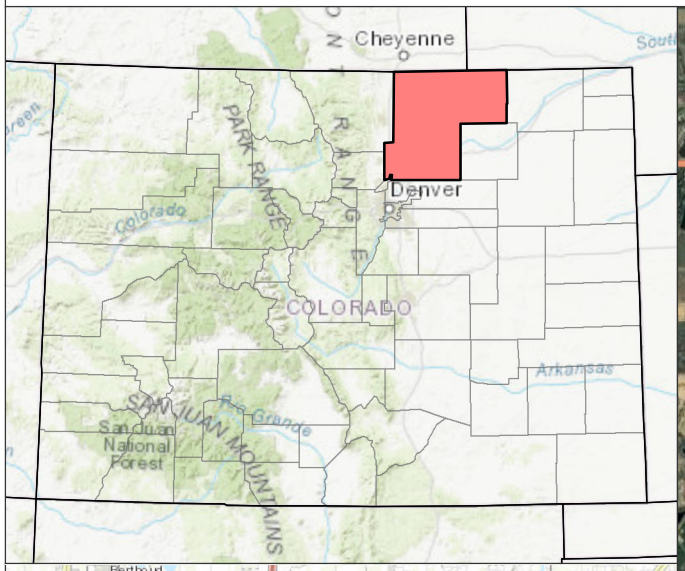
- Pre-production and production activities on Crestone wellpads occurring during the time of these monitoring studies did not result in off-pad migration of VOCs, including benzene, in the nearby community areas at levels expected to cause acute adverse health effects.
- During flowback phase, the maximum detected levels of BTEX in the air in surrounding communities were below their acute health guideline values established by the federal Agency for Toxic Substances and Disease Registry (ATSDR).
- Total VOCs and BTEX concentrations measured during this study were not likely to impact the health of a maximally exposed hypothetical individual living at each of the sampling locations in nearby communities.

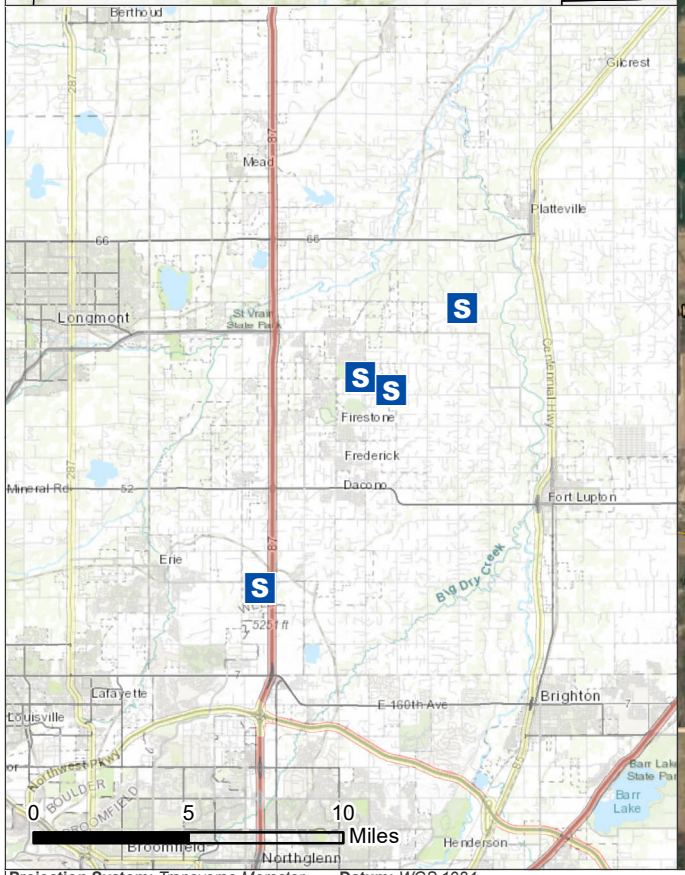
Appendix A

Maps

Crestone Peak Resources Well Pad Monitoring
Pad Locations

Project: 111976
Client: Crestone
City: Longmont, CO
County: Weld





Projection System: *Transverse Mercator* **Datum:** *WGS 1984*

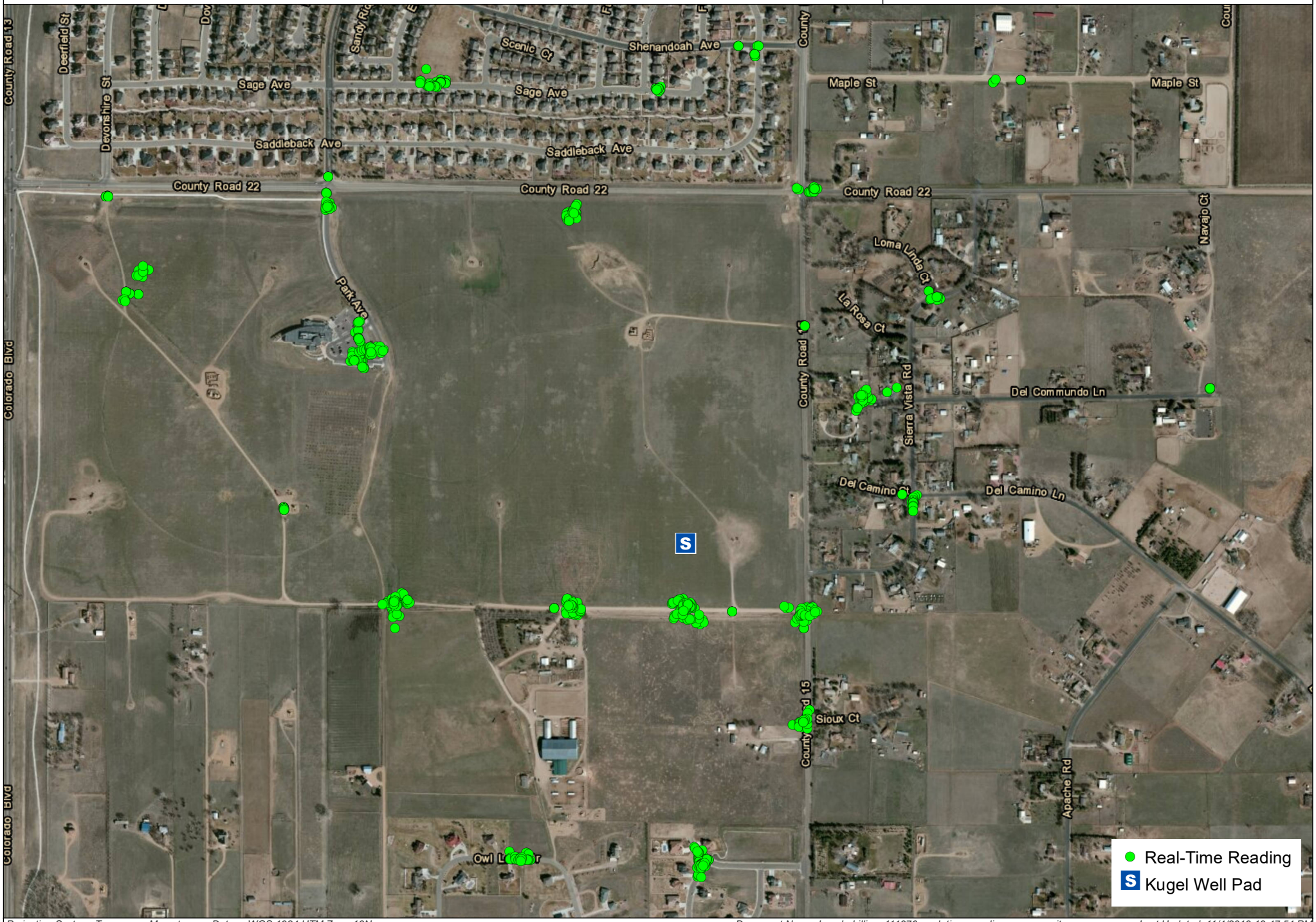
Document Name: site_location **Last Updated:** *11/20/2019 3:28:14 PM*

Crestone Peak Resources Kugel Well Pad Drilling Phase

Hand-Held Real-Time Monitoring Locations | Community Monitoring

0 500 1,000 Feet

Project: 111976
Client: Crestone
City: Longmont, CO
Counties: Boulder/Weld



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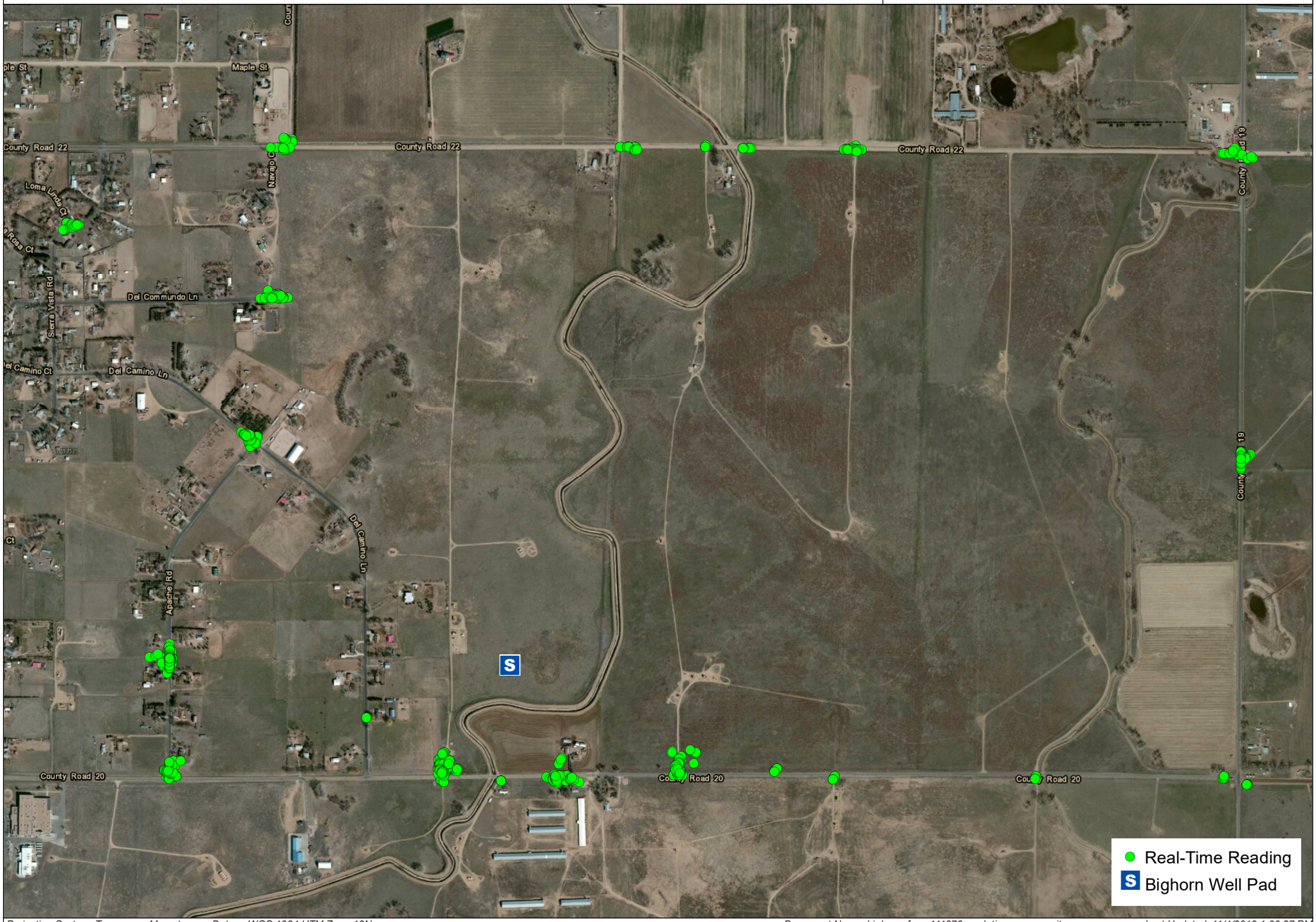
*GPS Coordinates are Approximate

Crestone Peak Resources Bighorn Well Pad Hydraulic Fracturing Phase

Hand-Held Real-Time Monitoring Locations | Community Monitoring

Project: 111976
Client: Crestone
City: Longmont, CO
Counties: Boulder/Weld

0 700 1,400 Feet



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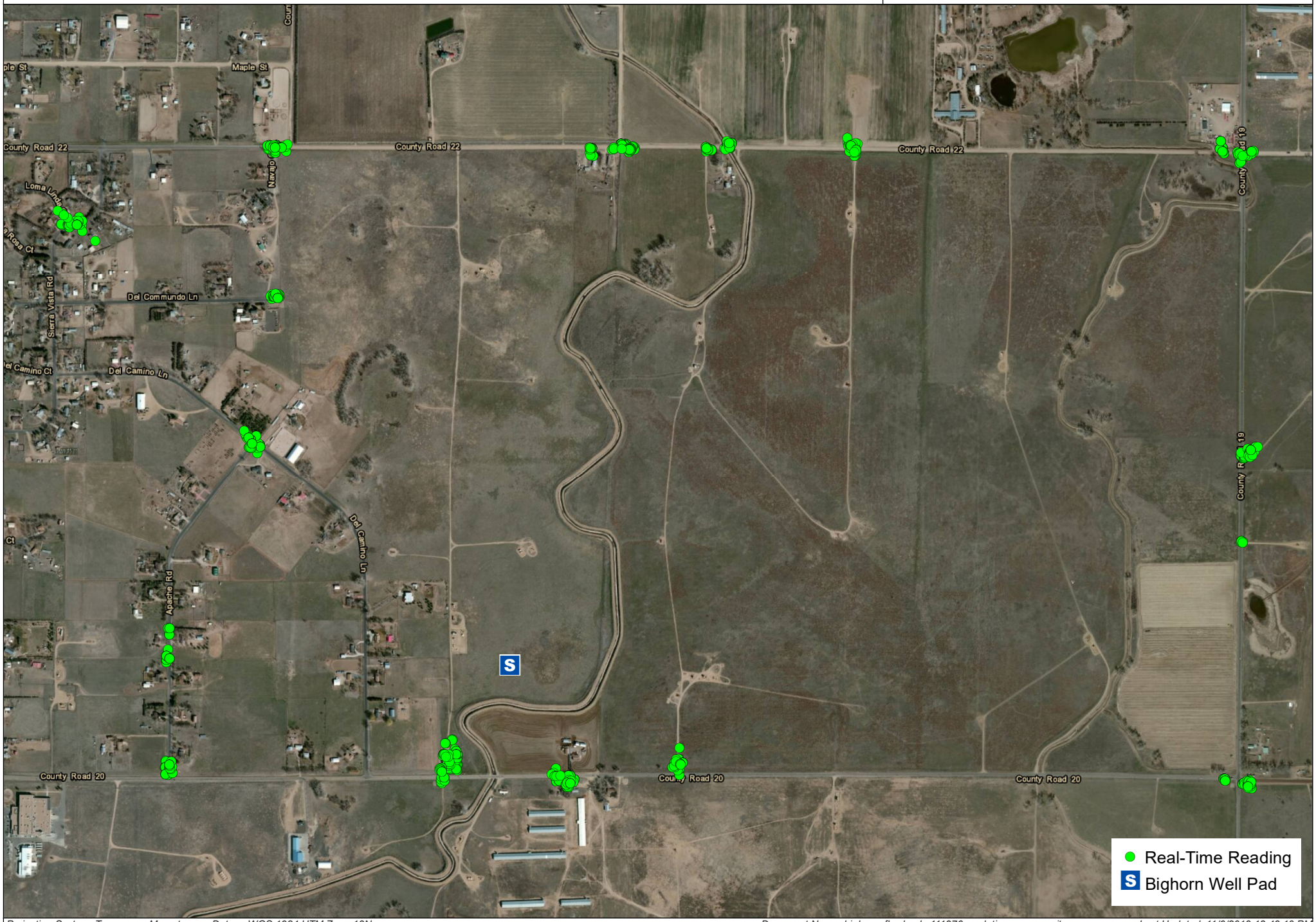
*GPS Coordinates are Approximate

Crestone Peak Resources Bighorn Well Pad Flowback Phase

Hand-Held Real-Time Monitoring Locations | Community Monitoring

Project: 111976
Client: Crestone
City: Longmont, CO
Counties: Boulder/Weld

0 700 1,400 Feet



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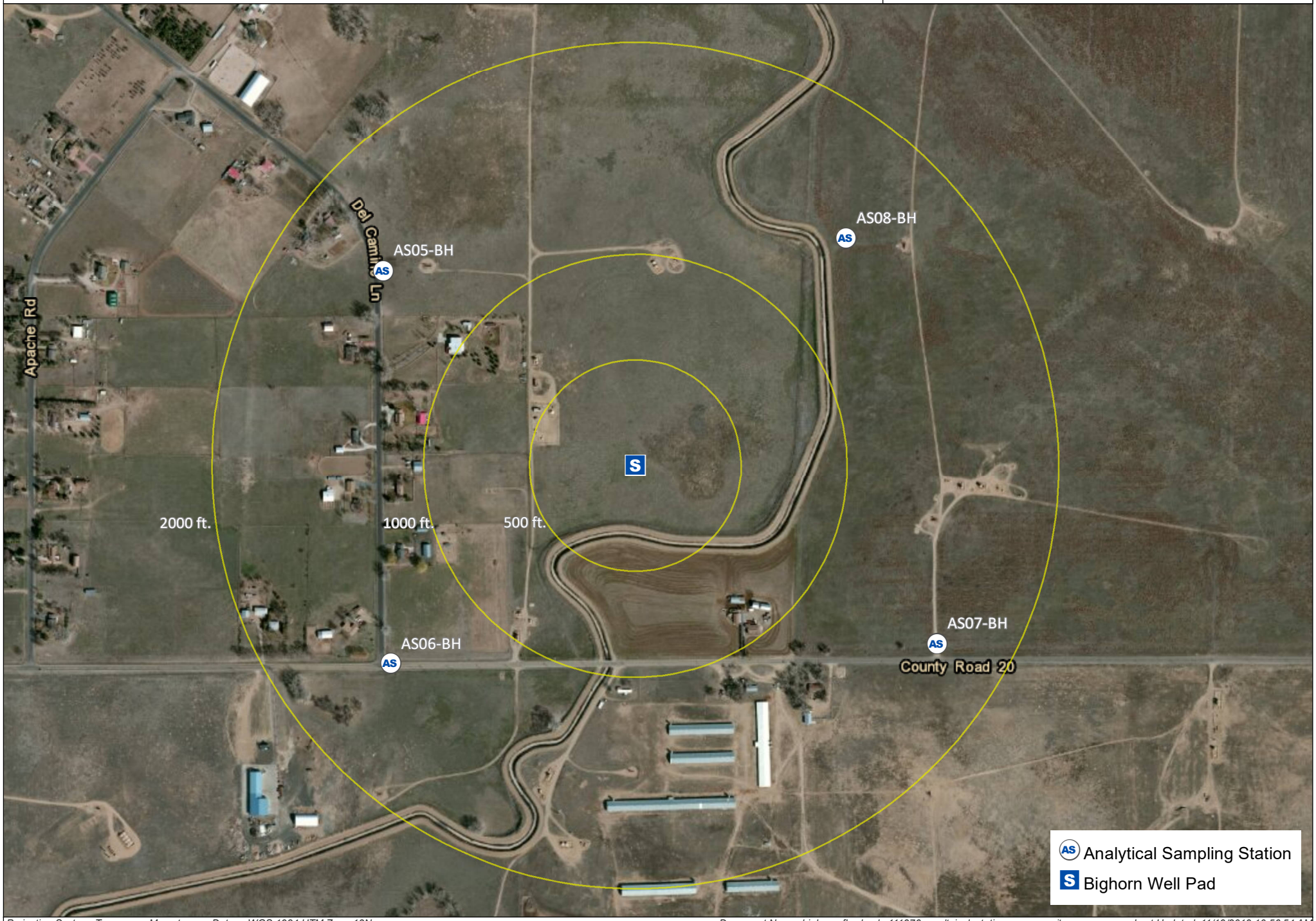
*GPS Coordinates are Approximate

Crestone Peak Resources Bighorn Well Pad Flowback Phase

Analytical Sampling Stations | Community

Project: 111976
Client: Crestone
City: Longmont, CO
Counties: Boulder/Weld

0 400 800 Feet



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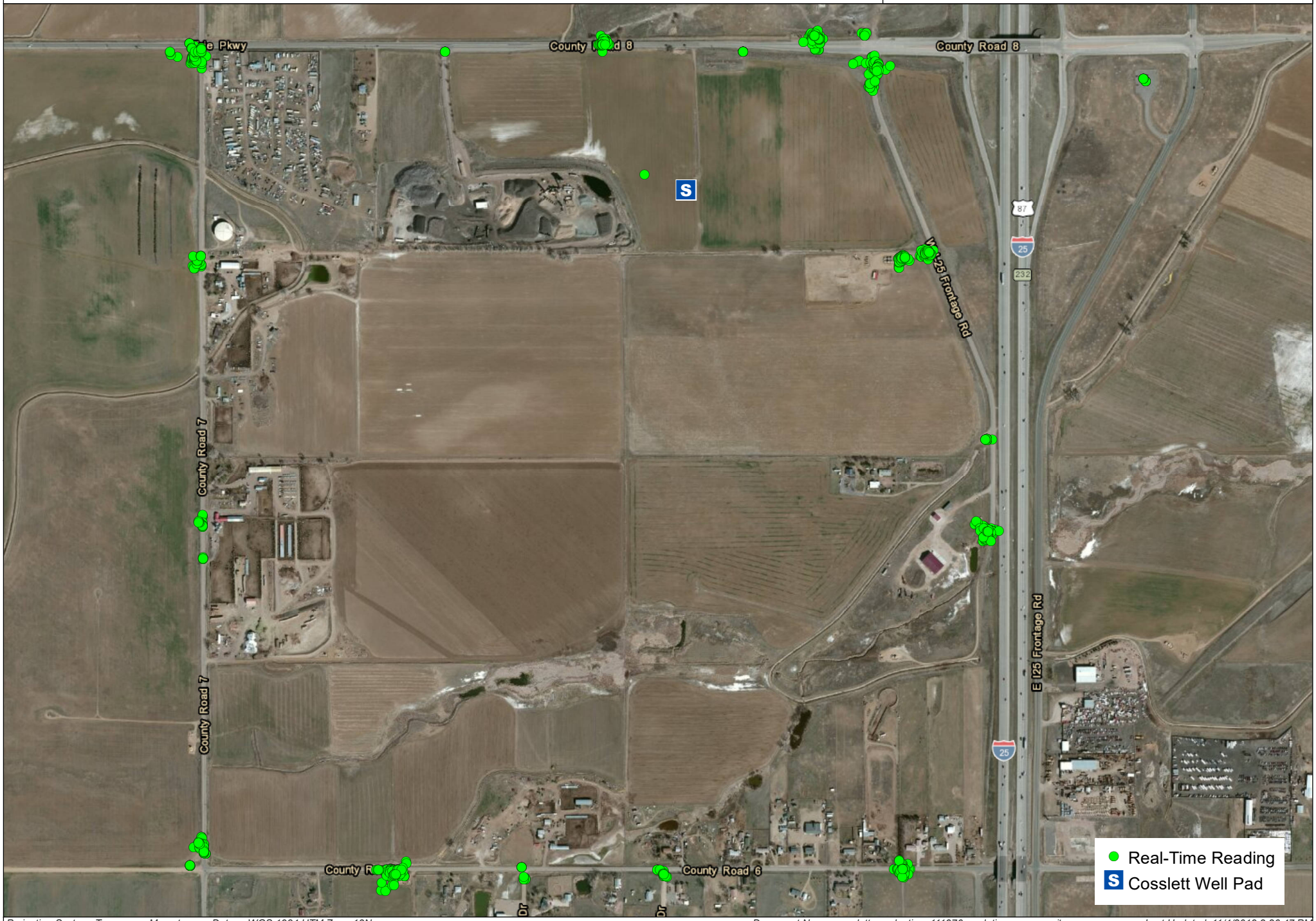
*GPS Coordinates are Approximate

Crestone Peak Resources Cosslett Well Pad Production Phase

Hand-Held Real-Time Monitoring Locations | Community Monitoring

0 500 1,000 Feet

Project: 111976
Client: Crestone
City: Longmont, CO
Counties: Boulder/Weld



Projection System: Transverse Mercator Datum: WGS 1984 UTM Zone 13N Document Name: cosslett_production_111976_real_time_community Last Updated: 11/4/2019 2:26:47 PM

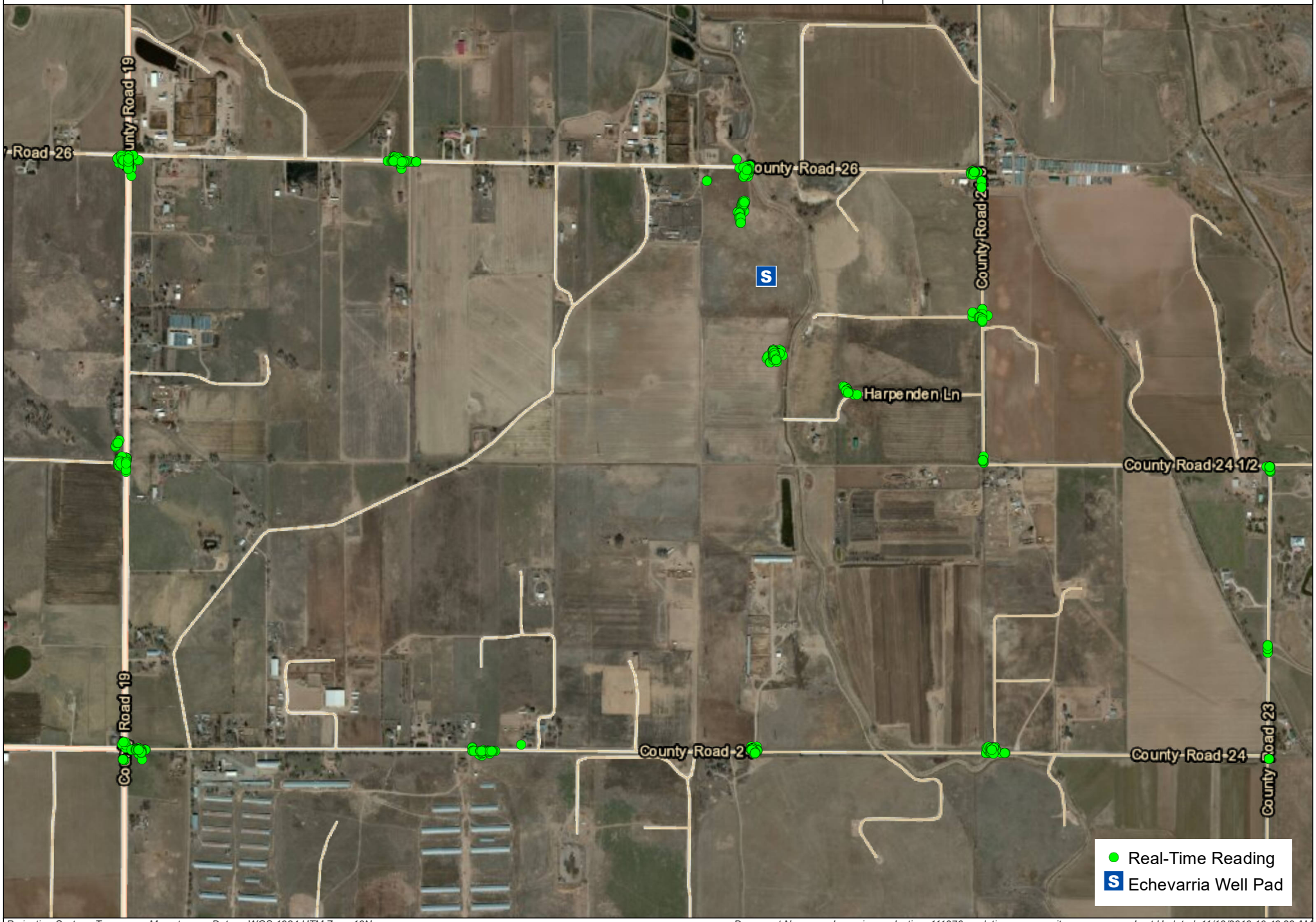
*GPS Coordinates are Approximate

Crestone Peak Resources Echevarria Well Pad Production Phase

Hand-Held Real-Time Monitoring Locations | Community Monitoring

Project: 111976
Client: Crestone
City: Longmont, CO
Counties: Boulder/Weld

0 750 1,500 Feet



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*GPS Coordinates are Approximate

Appendix B

Analytical Summary Table

Analtyical Results BTEX | Crestone Peak Resources

Bighorn Pad - Flowback Phase

Last updated: 12/4/2019 3:25:15 PM

			AS05-BH					AS06-BH				
			Approx. 520 yds NW of well pad					Approx. 510 yds SW of pad				
			October 16, 2019	October 17, 2019	October 18, 2019	October 19, 2019	October 20, 2019	October 16, 2019	October 17, 2019	October 18, 2019	October 19, 2019	October 20, 2019
			BHCO1016MC005	BHCO1017MC005	BHCO1018MC005	BHCO1019MC005	BHCO1020MC005	BHCO1016MC006	BHCO1017MC006	BHCO1018MC006	BHCO1019MC006	BHCO1020MC006
Analysis Method	**Result Type**	**Analyte**										
EPA TO-15 + TICs	Target Analyte	BENZENE	0.896 ppbv	0.543 ppbv	0.353 ppbv	0.438 ppbv	0.260 ppbv	0.615 ppbv	0.467 ppbv	0.544 ppbv	0.265 ppbv	0.253 ppbv
		ETHYLBENZENE	0.295 ppbv	< 0.051 ppbv	< 0.051 ppbv	< 0.051 ppbv	< 0.051 ppbv	< 0.051 ppbv	< 0.051 ppbv	< 0.051 ppbv	< 0.051 ppbv	< 0.051 ppbv
		M,P-XYLENES	1.080 ppbv	0.505 ppbv	< 0.095 ppbv	< 0.095 ppbv	< 0.095 ppbv	0.459 ppbv	0.502 ppbv	< 0.095 ppbv	< 0.095 ppbv	< 0.095 ppbv
		O-XYLENE	0.361 ppbv	< 0.063 ppbv	< 0.063 ppbv	< 0.063 ppbv	< 0.063 ppbv	< 0.063 ppbv	< 0.063 ppbv	< 0.063 ppbv	< 0.063 ppbv	< 0.063 ppbv
		TOLUENE	3.510 ppbv	1.490 ppbv	1.180 ppbv	1.080 ppbv	0.433 ppbv	1.430 ppbv	1.620 ppbv	0.947 ppbv	0.681 ppbv	0.457 ppbv

[1]Laboratory non-detections are reported as less than ("<") the laboratory method detection limit.

Detection Color Legend

Detection

Non-detect

Analtyical Results BTEX | Crestone Peak Resources

Bighorn Pad - Flowback Phase

Last updated: 12/4/2019 3:25:15 PM

			AS07-BH					AS08-BH				
			Approx. 530 yds SE of well pad					Approx. 470 yds NE of well pad				
			October 16, 2019	October 17, 2019	October 18, 2019	October 19, 2019	October 20, 2019	October 16, 2019	October 17, 2019	October 18, 2019	October 19, 2019	October 20, 2019
			BHCO1016MC007	BHCO1017MC007	BHCO1018MC007	BHCO1019MC007	BHCO1020MC007	BHCO1016MC008	BHCO1017MC008	BHCO1018MC008	BHCO1019MC008	BHCO1020MC008
Analysis Method	**Result Type**	**Analyte**										
EPA TO-15 + TICs	Target Analyte	BENZENE	0.419 ppbv	0.600 ppbv	0.343 ppbv	0.313 ppbv	0.207 ppbv	0.787 ppbv	0.705 ppbv	0.785 ppbv	0.348 ppbv	< 0.046 ppbv
		ETHYLBENZENE	< 0.051 ppbv	< 0.051 ppbv	< 0.051 ppbv	< 0.051 ppbv	< 0.051 ppbv	< 0.051 ppbv	< 0.051 ppbv	0.380 ppbv	< 0.051 ppbv	< 0.051 ppbv
		M,P-XYLENES	0.512 ppbv	< 0.095 ppbv	< 0.095 ppbv	< 0.095 ppbv	< 0.095 ppbv	0.583 ppbv	0.429 ppbv	1.220 ppbv	< 0.095 ppbv	< 0.095 ppbv
		O-XYLENE	< 0.063 ppbv	< 0.063 ppbv	< 0.063 ppbv	< 0.063 ppbv	< 0.063 ppbv	0.214 ppbv	< 0.063 ppbv	0.660 ppbv	< 0.063 ppbv	< 0.063 ppbv
		TOLUENE	1.480 ppbv	1.130 ppbv	0.606 ppbv	0.876 ppbv	0.741 ppbv	1.600 ppbv	1.330 ppbv	13.100 ppbv	0.699 ppbv	0.358 ppbv

[1]Laboratory non-detections are reported as less than ("<") the laboratory method detection limit.

Detection Color Legend

Detection

Non-detect