

# **ConocoPhillips Groundwater Quality Monitoring Plan**

**Eastern Hills 4-65 17-18 1AH, 1BH, 1CH, 1DH, 2AH,  
2BH, 2CH, 2DH, 3H\_D - Eastern Hills North**

**Arapahoe County, Colorado**

**APTIM • Project 148083**

**August 23, 2019**

Prepared for:



ConocoPhillips Company

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## Acronyms and Abbreviations

ACRONYM	Definition
APTIM	APTIM Environmental and Infrastructure, LLC
BMP	Best Management Practices
BOCC	Board of County Commissioners
bgs	below ground surface
COGCC	Colorado Oil & Gas Conservation Commission
COGCC Program	COGCC Statewide Groundwater Sampling and Monitoring Program
ConocoPhillips	ConocoPhillips Company
DWR	Colorado Division of Water Resources
GPS	Global Positioning System
MOU	Memorandum of Understanding
NA	not applicable
OA	City of Aurora Operators Agreement
O&G	oil and gas
Rule 609	COGCC Statewide Groundwater Monitoring Program Rule 609
SEO	State Engineer's Office

## 1.0 INTRODUCTION

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APTIM Environmental & Infrastructure, LLC (APTIM) has been contracted by ConocoPhillips Company (ConocoPhillips) to perform groundwater sampling and monitoring to meet the requirements set forth in the City of Aurora Operators Agreement (OA), the Colorado Oil and Gas Conservation Commission (COGCC) Statewide Groundwater Sampling and Monitoring Program Rule 609 (Rule 609), the Arapahoe County Board of County Commissioners (BOCC) Memorandum of Understanding (MOU), and the Adams County BOCC MOU to monitor groundwater quality conditions around proposed oil and gas well locations in Arapahoe and Adams Counties. This Groundwater Quality Monitoring Plan presents the actions which APTIM proposes to take on behalf of ConocoPhillips to ensure all groundwater monitoring requirements are met for proposed oil and gas (O&G) well locations within the City of Aurora, Colorado.

### 1.1 Background

ConocoPhillips is committed to the Water Quality Monitoring requirements set forth by the Oil and Gas Operator Agreement and associated Best Management Practices (BMP) between ConocoPhillips Company, a Delaware corporation, and its subsidiaries, and Burlington Resources Oil & Gas Company LP, a Delaware limited partnership, and the City of Aurora (City), Colorado, a municipal corporation. This protocol currently requires collecting baseline water quality samples from water wells located within a ½ mile radius of a proposed O&G well location. To complete these requirements, the following water sampling protocol has been developed and a Colorado Certified PE will review and certify the plan once all comments issued by the City have been addressed and incorporated into this plan. The certification will be included as Appendix A. The City of Aurora BMPs are comprehensive enough to satisfy the requirements of the COGCC Rule 609 and the Arapahoe and Adams Counties MOUs.

## 2.0 PHASE I – ENVIRONMENTAL DUE DILIGENCE

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Once APTIM has received notice from ConocoPhillips to conduct Phase I Environmental Due Diligence the following tasks are completed:

1. Well Location Survey Plat (location survey is previously completed by 3<sup>rd</sup> Party Civil Surveyor and approved by ConocoPhillips prior to submittal) is provided to APTIM by ConocoPhillips.
2. APTIM conducts Phase I Environmental Due Diligence to identify any available sampleable water sources within ½ mile of the proposed O&G location. Due Diligence is composed of the water well identification steps noted in Section 2.1 and utilizes the best available data, including the Colorado Division of Water Resources (DWR), Well

Permit Search Database (<http://www.dwr.state.co.us/WellPermitSearch/default.aspx>) and a review of all publicly available digitized permit records.

## 2.1 Water Well Identification

APTIM will Review all water wells within ½ mile of the proposed O & G well.

Water wells that were correctly permitted through the State Engineer's Office (SEO) also known as the DWR and have completion records available for review and confirmation that the well was correctly installed according to the permit requirements will be given higher priority over wells with incomplete records or permits. The ranking criteria and well identification steps APTIM will utilize are listed below and are based on COGCC and BMP requirements and are listed in decreasing priority as it pertains to well prioritization:

1. **Proximity to proposed location** - Available domestic water wells closest to the proposed oil and gas well location are given a higher priority than those located further away from a proposed oil and gas well location.
2. **Type of water source** - Well maintained domestic water wells are preferred over other available water sources. Domestic water wells are given a higher priority than wells used for the following purposes, livestock, irrigation, monitoring, etc.
3. **Orientation of sampling location** - Sample locations from both down gradient and up-gradient locations are preferred if available over cross-gradient locations. If the groundwater flow direction is not known or cannot be inferred from topographic data, sample locations are prioritized to ensure wells are sampled in a radial pattern around the proposed oil and gas well location.
4. **Aquifer availability** - Multiple aquifers are preferred if available. Higher priority is assigned to various domestic water wells to ensure adequate aquifer representation is maintained when possible, sampling the deepest and shallowest aquifers is preferred.
5. **Condition of water source** - Water sources which are improperly maintained, non-operational, or otherwise have an impediment to sampling are not required to be sampled and are given a lower or "Not Applicable" (NA) priority. The condition and status of a domestic water well is determined based on the presence or absence of well completion records or other documentation available for review on the DWR well permit database including but not limited to approved permits, well completion documents (well construction, pump installation and test reports etc.), expired permits, emergency verbal agreements and associated permits, plugging and abandonment reports, visual field inspection reports, monitoring hole notices, and age of well. Domestic water wells with documents that indicate a correctly permitted well has been completed are placed at a higher priority than wells with (for example) expired permits,

monitoring hole notices without completion records, plugging reports, etc. which may be improperly maintained and could call into question the integrity of the well.

APTIM will then prepare a list of well owner names and contact data for the wells identified based on the criteria listed above utilizing the DWR Database and County Tax Assessor data. No contact with well owners will be made at this time unless specifically requested by ConocoPhillips.

Any wells which do not match the criteria listed above will be documented and labeled “Not Applicable” for sampling and include justification why sampling is not possible or not recommended. The specific criteria used to determine each individual well’s sample rank will also be included for review in **Table 1**.

APTIM will then finalize the list of available water monitoring sources and provide the list of water wells to ConocoPhillips and the permitting consultant along with a location map showing all identified water wells within ½ mile of the proposed O&G location, as shown in **Figure 1** as part of this Groundwater Monitoring Plan. The well information as noted above in Section 2.1 will include well permit number, distance to the proposed O&G location, sampling priority, sample priority determination explanation, etc. as listed in **Table 1**.

### **2.1.1 Aquifer Sample Priority**

If four or fewer wells have been identified in Section 2.1, APTIM will attempt to contact the landowners and obtain samples from all those wells following the steps outlined in Section 3 below. If greater than four wells have been identified in Section 2.1, APTIM will attempt to contact and obtain samples from additional wells until all available aquifers are included in the sample list or until no more differing well aquifer options remain. APTIM will contact landowners based on the previously assigned sample priorities and will substitute lower priority wells (in sequence) if APTIM is unable to gain sample consent from landowners higher in the priority list. The landowner contact and water well sample priority will follow the Sampling Priority column as listed in **Table 1**.

## **3.0 PHASE II – LANDOWNER NOTIFICATION AND BASELINE SAMPLING**

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Once authorization from ConocoPhillips to conduct Phase II activities is received along with confirmation of the approved sample list, APTIM will proceed with Landowner Notification and Baseline Sampling. Baseline Sampling is conducted prior to the start of drilling, but no earlier than 6 months prior to the anticipated spud date. Phase II – Landowner Notification and Baseline Sampling includes the activities as noted below.

### 3.1 Well Owner Communication

APTIM will prepare a mailing list and an access request letter for each water well owner on the approved sample list as identified in Section 2.1 and shown in **Table 1**. Landowner communications attempts will begin no earlier than 6 months prior to the scheduled spud date.

Letters will be sent to the address of record and follow-up phone calls (if contact information is available) will be made within approximately 5-10 business days. If a negative response is received (i.e. returned letter stating access is denied, or a verbal denial is issued), or there is no response to either the letter, or phone calls after 30 days, then that will constitute a denial of permission to sample. Samples will only be collected where permission has been granted by the landowner. Efforts to contact landowners and any refusals will be documented.

All requests for additional information not pertaining specifically to the sampling process will be directed to a ConocoPhillips representative.

### 3.2 Baseline Water Quality Testing

Once APTIM has received consent from landowners, APTIM will proceed to schedule and sample private water wells where landowners using standard industry procedures, consistent with the COGCC Rule 609 Model Sampling and Analysis plan and test for the following analytes:

#### Baseline water quality test

<b><i>Inorganic Chemicals</i></b>
Antimony, Arsenic, Asbestos, Barium, Beryllium, Cadmium, Chromium, Cyanide, Fluoride, Mercury, Nitrate, Nitrite, Total Nitrate and Nitrite, Selenium, and Thallium
<b><i>Volatile Organic Compounds</i></b>
Methane, Ethane, Propane, BTEX as Benzene, Toluene, Ethylbenzene and Xylenes, Total Petroleum, and Hydrocarbons (TPH) Vinyl Chloride, Carbon Tetrachloride, 1,2-Dichloroethane, Trichloroethylene, Para-Dichlorobenzene, 1,1-Dichloroethylene, 1,1,1-Trichloroethane, cis-1,2 Dichloroethylene, 1,2-Dichloropropane, Ethylbenzene, Monochlorobenzene, o-Dichlorobenzene, Styrene, Tetrachloroethylene, Toluene, Trans-1,2 Dichloroethylene, Xylenes (total), Dichloromethane (methylene chloride), 1,2,4-Trichlorobenzene, 1,1,2 Trichloroethane
<b><i>Synthetic Organic Contaminants</i></b>
Alachor, Aldicarb1, Aldicarb sulfoxide, Aldicarb sulfone, Atrazine, Carbofuran, Chlordane, Dibromochloropropane, 2,4-D, Ethylene dibromide, Heptachlor, Heptachlor epoxide, Lindane, Methoxychlor, Polychlorinated biphenyls, Pentachlorophenol, Toxaphene, 2,4,5-TP (Silvex), Benzopyrene, Dalopon, Di(2-ethylhexyl)adipate, Di(2-ethylhexyl)phthalate, Dinoseb, Diquat, Endothall, Endrin, Glyphosate, Hexachlorobenzene, Hexachlorocyclopentadiene, Oxamyl (Vydate), Picloram, Simazine, 2,3,7,8-TCDD (Dioxon)
<b><i>Radionuclides</i></b>

Combined radium-226 and radium-2281, Gross alpha particle activity (including radium-226 but excluding radon and uranium), Beta particle and photon radioactivity <sup>2</sup>
<b><i>Secondary Maximum Contaminant Levels</i></b>
Aluminum, Chloride, Color, Corrosivity, Foaming Agents, Odor, pH, Silver, Sulfate, Total Dissolved Solids, Zinc
PFOA (perfluorooctanoic acid) and PFOS (Perfluorooctane Sulfonate)
<b><i>General Water Quality</i></b>
Alkalinity, Conductivity & TDS, pH, Dissolved Organic Carbon (or Total Organic Carbon), Bacteria, and Hydrogen Sulfide
<b><i>Major Ions</i></b>
Bromide, Chloride, Magnesium, Potassium, Sodium, Sulfate
<b><i>Metals</i></b>
Boron, Copper, Iron, Lead, Manganese, Strontium, Uranium, and Radium
<b><i>Other</i></b>
Water Level, Stable isotopes of water (Oxygen, Hydrogen, Carbon), Phosphorus

1. If four or fewer available water sources exist within a ½ mile radius of the location of a proposed O&G well, a sample shall be collected from each available water source. Any additional sampling efforts will be completed as described above in Section 2.1.1 Aquifer Sample Priority
2. The City of Aurora BMPs allow for ConocoPhillips to rely on existing groundwater sampling data provided the sample was collected in accordance with accepted City standards and within 12 months preceding the beginning of drilling activities for the applicable O&G location. In addition, the analytical data must include all the constituents as noted above and there must not have been any significant O&G activity within 1 mile of the sample location since the sample was initially collected and prior to beginning the drilling phase for the applicable O&G location.

## 4.0 SUBSEQUENT ANNUAL SAMPLING

APTIM (or appropriate contractor) will conduct post-stimulation sampling of previously sampled water sources annually following the completion of the first O&G well at a well site until the Reclamation Phase is completed for the well site.

Efforts to obtain sample permissions for all subsequent annual sampling events will follow the notification processes outlined in Section 3.1 and will begin no later than 3 months before the anniversary of the first O&G well completion date for the well site. Subsequent sampling will only be carried out where the landowner provides consent and will follow all the standard industry procedures, consistent with the COGCC Rule 609 Model Sampling and Analysis plan and test for the following analytes:

### Subsequent annual water quality test

<b><i>General Water Quality</i></b>
Alkalinity, Conductivity & TDS, pH, Dissolved Organic Carbon (or Total Organic Carbon), Bacteria, and Hydrogen Sulfide
<b><i>Major Ions</i></b>
Bromide, Chloride, Fluoride, Magnesium, Potassium, Sodium, Sulfate, and Nitrate + Nitrite as N
<b><i>Metals</i></b>
Arsenic, Barium, Boron, Chromium, Copper, Iron, Lead, Manganese, Selenium, Strontium, Mercury, Uranium, and Radium
<b><i>Dissolved Gases and Volatile Organic Compounds</i></b>
Methane, Ethane, Propane, BTEX as Benzene, Toluene, Ethylbenzene and Xylenes, Total Petroleum, and Hydrocarbons (TPH)
<b><i>Other</i></b>
Water Level, Stable isotopes of water (Oxygen, Hydrogen, Carbon), Phosphorus

## 4.1 Enhanced Water Quality Testing

If subsequent sampling shows degradation of water quality, additional measures may be required including:

- If free gas or a dissolved methane concentration levels greater than one milligram per liter (mg/l) are detected in a water source, determination of the gas type using gas compositional analysis and stable isotope analysis of the methane (carbon and hydrogen) will be conducted.
- If the test results indicate thermogenic or a mixture of thermogenic and biogenic gas, an action plan to determine the source of the gas.
- Immediate notification to the City, the COGCC, and the owner of the water well if the methane concentration increases by more than five mg/l between sampling periods, or increases to more than 10 mg/l.
- Immediate notification to the City, the COGCC and the owner of the water well if BTEX and/or TPH are detected as a result of testing. Such detections may result in required subsequent sampling for additional analytes.
- Further water well sampling in response to complaints from water source owners.
- Timely production and distribution of test results in electronic deliverable format to the City, the COGCC and the water source owners.



- Qualified Independent Professional Consultant. All water source testing must be conducted by the Operator or, if requested by a surface owner, by a qualified independent professional consultant.
- If Operator identifies degradation to water quality as a result of its oil and gas development, Operator shall be responsible to mitigate the degradation of water quality to the applicable regulatory standards.

APTIM will carry out the above tasks, after receiving authorization from ConocoPhillips, if analytical results indicate a degradation in water quality.

## 5.0 REPORTING RESULTS

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APTIM will provide Baseline Water Report and Subsequent Annual Water Reports to ConocoPhillips following the conclusion of each task respectively. The *Baseline Water Report* and *Subsequent Annual Water Reports* will include an accounting of the efforts APTIM has undertaken to sample available water sources as well as documentation, including analytical results, pertaining to each water well sampled as part of both baseline and subsequent sampling efforts. APTIM will also provide analytical results to the water well owners, as well as upload the analytical results to the COGCC database per Rule 609 within 30 days of receiving the results.

ConocoPhillips will provide copies of the analytical results to the City of Aurora along with sub meter GPS information for sampled wells and other field observations to include any of the following as identified by APTIM during each sampling event; damaged or unsanitary well conditions, adjacent potential pollution sources, odor, color, sediment, and effervescence. This information is to be provided within 30 days after receiving final analytical results.

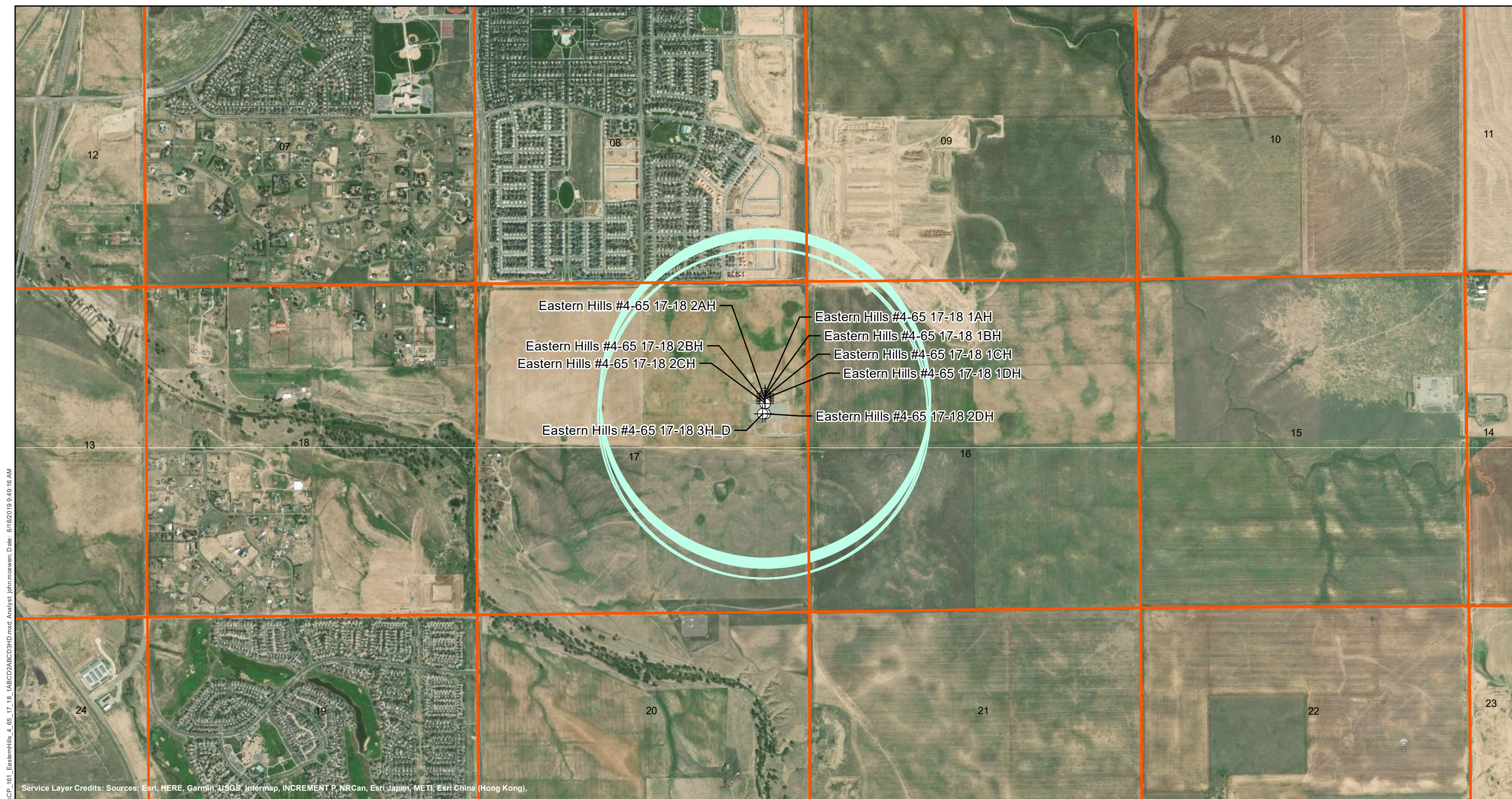
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## Figure 1

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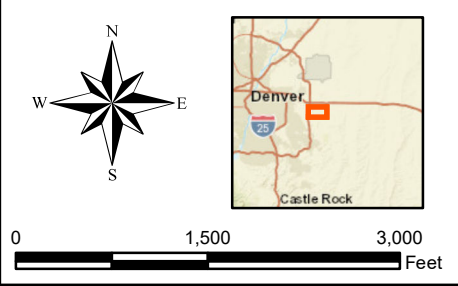
G:\ConocoPhillips\GIS\_Documents\Project\_Maps\CP\_161\_EasternHills\_4\_65\_17\_18\_1ABCD2ABCD3HD.mxd; Analyst: john.meeven; Date: 8/16/2019 9:49:15 AM




Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong),

- ⊕ Proposed Oil Well
- Current Well Status
- 1/2-Mile Buffer
- Sections

PHASE 1



CONOCO PHILLIPS	
EASTERN HILLS 4-65 17-18 1AH, 1BH, 1CH, 1DH, 2AH, 2BH, 2CH, 2DH, 3H_D	
FIGURE 1	PERMITTED WELLS WITHIN A 1/2-MILE RADIUS
 6380 S. Fiddlers Green Circle Greenwood Village, CO 80111 www.APTIM.com	



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**Table 1**

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Table 1 is not applicable for this site, no wells identified within a 1/2 mile radius of the location.

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**Appendix A – PE  
Certification  
Page**

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## **Appendix A**

### **Professional Engineer Certification**

- In accord with the City of Aurora's request, I hereby certify that:
- I am familiar with the provisions of the Operators Agreement between ConocoPhillips Company, a Delaware corporation, and its subsidiaries, and Burlington Resources Oil & Gas Company LP, a Delaware limited partnership, and the City of Aurora, Colorado, a municipal corporation.
- I, or my agent, have completed a Due Diligence Phase I review of all available water sources in the vicinity of the subject oil and gas well location to identify potential sample sites.
- The procedures contained herein for water monitoring and testing for baseline and subsequent monitoring events have been established in accord with industry standards or recommended practices; and
- This Groundwater Monitoring Plan is adequate for the subject location.

Well Name:	<u>Eastern Hills 4-65 17-18 1AH, 1BH, 1CH, 1DH,</u> <u>2AH, 2BH, 2CH, 2DH, 3H D - Eastern Hills North</u>
Company:	<u>APTIM</u>
Name of Professional Engineer (typed):	<u>Jeffrey Hillson</u>
PE Registration Number:	<u>30762</u>
PE Registration State:	<u>Colorado</u>

Signature and Seal:	_____
Certification Date:	<u>August 20, 2019</u>