# Water-Quality Data, Hydraulic Fracturing in the Upper Humboldt River Basin, Aquifer Quality Assessment Program, Report 2

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## INTRODUCTION

Noble Energy, Inc. (Noble) is currently exploring an oil play in low-permeability shale in three different areas of the upper Humboldt River basin, Elko County, Nevada (Figure 1) where hydraulic-fracturing technology will be used. Given Nevada's constitutional mandate to protect all "waters of the State," the Nevada Division of Minerals (NDOM) and Nevada Division of Environmental Protection (NDEP) have requested that non-proprietary data and information related to groundwater gathered by Noble during exploration be made available to NDOM and NDEP. The Aquifer Quality Assessment Program (AQUA Program) was established "to gather and share data and information on groundwater and geological conditions associated with the fate and transport of chemicals used for hydraulic fracturing" in a Memorandum of Understanding (MOU) between NDOM, NDEP, the Desert Research Institute (DRI) and Noble (MOU, 2013).

The Desert Research Institute is supporting Noble in their monitoring program in the upper Humboldt River basin by providing quality assurance of sampling and laboratory activities and analyses, by evaluating additional geochemical and isotopic parameters for usefulness for monitoring and hydrologic characterization of flow paths, and by collecting geochemical and isotopic parameters for springs in the project area. This report presents the analytical results from September 2013 through November 2014 for samples collected by DRI and Tetra Tech, Inc. (Tetra Tech) for Noble in Exploration Area 1 (Huntington), Area 2 (Humboldt), and Area 3 (Mary's River) as required for the AQUA Program in Section II.F.2 of the MOU (MOU, 2013). This data report is intended only to present currently available analytical results; however, it does not provide evaluation of these data other than a table to easily compare pre- and post-fracturing data from water in Exploration Area 2. Evaluation of water-quality, geochemical, and isotopic parameters will be included in the final report as required for the AQUA Program in Section II.F.3 of the MOU (MOU, 2013). Additional analytical results will be presented periodically as addendums to this data report as they become available.

## BACKGROUND

The upper Humboldt River basin consists of several deep structural basins where basin-fill deposits of Tertiary and Quaternary age and volcanic rocks of Tertiary age have accumulated. The bedrock of each basin and adjacent mountains are composed of carbonate and clastic sedimentary rocks of Paleozoic age and crystalline rocks of Cambrian, Jurassic, and Tertiary age. Target depths for the exploration wells are 6,000 – 12,000 ft below ground surface. Preliminary investigations suggest that the resource target is aligned with a Paleozoic trap play overlain by a Tertiary resource play. These targets include the Humboldt and Elko formations. Previous deep oil exploration efforts in the Humboldt River basin suggest that the resource zone may be underlain by carbonate rocks with relatively high permeability (Plume, 2009).

## SAMPLING PROCEDURES

Pre-hydraulic fracturing samples were collected from 35 locations in Exploration Area 1, Huntington, near Jiggs, Nevada (Figure 2), from nine locations in Exploration Area 2, Humboldt, near Lamoille, Nevada (Figure 3), and from 15 location in Exploration Area 3, Mary's River, northwest of Wells, Nevada (Figure 4). Samples were collected from 17 locations in Exploration Area 2 (Figure 5) after initial hydraulic-fracturing activities including a sample from one of the exploration wells. Additionally, two springs that flow from carbonate-rock outcrops in the greater Elko County area (1-12, and 2-14, Figure 1) were sampled to chemically and isotopically characterize groundwater in carbonate aquifers that underlie the targeted hydrocarbon containing shale formations in the centers of the valleys.

Prior to collecting water samples, domestic, stock, and irrigation wells were pumped roughly for 10-to-20 minutes; or until roughly one-to-three well volumes were removed (when well construction information was available); and, until temperature, electrical conductivity (EC), and pH had stabilized. Samples from wells were collected as close to the well head as possible. Samples from springs were collected as close to the spring orifice as possible; samples from diffuse seeps without a clear spring orifice were collected at the most convenient location. Samples were collected in various plastic or glass bottles, and preserved accordingly, as required by the different laboratory protocols and standard analytical methods. Samples for noble gas analyses were collected by the copper tube method (http://www.noblegaslab.utah.edu/pdfs/cu_tube_sampling.pdf). Because noble gas samples must be collected without exposure to the atmosphere to obtain good analytical results, samples could not be collected at all locations. Water samples were kept cool at approximately 4 °C, except the noble gas samples, until delivery to the different laboratories.

Samples collected for major and trace-ions were filtered in the field (0.45 µm) by DRI; samples collected by Tetra Tech were not filtered. Filtering is conducted to remove suspended or larger-sized colloidal particles from the water sample prior to analysis that could impact the analysis. Chemical constituents that pass through a 0.45 µm filter are operationally considered to be 'dissolved' while unfiltered samples are considered to represent the 'total' chemical load. Water samples collected for metals analysis (including the major cations [Ca, Mg, Na, K] and trace metal ions [e.g. Cr, Mn, Fe, Co, Ni, Cu, etc.]) are acidified in the field, to preserve the sample (keep the metals in solution), usually with concentrated nitric acid. When the acid preservative is added to the water sample, residual particles can dissolve, increasing the metals concentrations of the sample. Groundwater samples collected from a properly constructed well that was purged adequately, and at sufficiently low pumping rates, should have minimal suspended or large-sized colloidal particles. In this case, unfiltered 'total' and filtered 'dissolved' metals concentrations should be comparable. However, in surface water samples (e.g. springs and streams), there can be more suspended and colloidal particles; in this case, 'total' and 'dissolved' metals concentrations may not be comparable. The need to filter metals samples to remove larger particles is dependent on the turbidity of the sample. When turbidity is below

5-10 NTU (Matanoski and Murarka, 1997; Yeskis and Zavala, 2002) filtering may not be necessary. Turbidity is currently not being measured prior to sampling on this project.

Samples were analyzed for a suite of chemical, isotopic, and radiochemical parameters to establish background concentrations (pre-hydraulic fracturing) and to identify any potential contamination (post-hydraulic fracturing). Table 1 lists the field parameters and analyses conducted by Tetra Tech; Table 2 lists the field parameters and analyses conducted DRI. All laboratories listed in Table 1 and Table 2 are certified by the state of Nevada for the standard methods listed. There are no standard methods or state of Nevada certification programs for the isotopic ratio analyses conducted by University of California, Davis, University of Waterloo, and Dolan Integration Group; for noble gas analyses by the University of Utah; and, for the alcohols, glycols, glycerol, acrylonitrile, and ammonium persulfate analyses conducted by the DRI Organic Analysis Laboratory.

## CHEMICAL AND ISOTOPIC PARAMETER SELECTION

A summary of the chemical and isotopic parameters selected, and their purpose, as described below, is presented in Table 3.

The natural gas components, methane, ethane, and propane were selected for analysis in the monitoring program because they are associated with petroleum and because they will degas when pressure is lowered and may migrate more quickly than the target crude oil. Total petroleum hydrocarbons (TPH) separated into diesel range organics and gasoline range organics, and the hydrocarbons benzene, ethylbenzene, toluene, xylenes, are refined from crude oil at higher temperatures, and if present in groundwater, are indicative of ground surface activities as is the occurrence of methyl tert-butyl ether (MTBE, a gasoline additive).

The chemical parameters and constituents of water including temperature, EC, pH, total dissolved solids (TDS), dissolved cations (Ca, Mg, Na, K, B, Ba, Li, Sr), anions (alkalinity [$HCO_3$, $CO_3$], Cl, $SO_4$, $NO_3$, F, Br,), and $SiO_2$ are used to chemically characterize groundwater prior to hydraulic-fracturing activities and to identify potential water contamination after hydraulic-fracturing activities. Water from the target shale units is likely to be very high in TDS and chemically different from local groundwater (e.g. Rowan et al. 2011, Engle et al. 2012). If shale water were to mix with local groundwater, changes in the chemical character of the local groundwater would be evident.

Shale often has elevated, naturally occurring radioactivity from the presence of uranium and its daughter products; it is expected that the target shale units in the exploration areas also have uranium and its daughter products. The radioactivity analyses of gross alpha, gross beta, radium-226, and radium-228 are used to identify mixing of target shale water with local groundwater. These analyses have been shown to be an effective tracer of shale water in the Marcellus Shale in Pennsylvania (e.g. Rowan et al. 2011, Engle et al. 2012). Because uranium and its daughter products are also present in the granitic rock of the Ruby Mountains, it is

important to establish the natural background radioactivity in the exploration areas prior to hydraulic-fracturing of the target shale.

The stable isotopes of water, $\delta^2H$ and $\delta^{18}O$, and $\delta^{13}C$ of dissolved inorganic carbon (DIC) in water, are used to isotopically characterize local groundwater prior to hydraulic-fracturing activities and to identify potential water contamination after hydraulic-fracturing activities. It is assumed that water from the target shale units will have substantially different isotopic signatures (e.g. Sharma et al., 2011; Engle et al. 2012) as compared with local groundwater because the target shale water originated from precipitation that fell under different climatic conditions than more recently recharged local groundwater. Stable isotopes will be collected to characterize the local groundwater and to identify changes in the isotopic signatures of local groundwater in the event that water from the target shale units mixes with the local groundwater.

Isotopic tracers of methane ($\delta^{13}C$, $\delta^2H$) are used to identify the origin of the methane, whether it is of biogenic or thermogenic origin. Two distinct processes produce hydrocarbon gas: biogenic and thermogenic degradation of organic matter. Biogenic gas is formed at shallow depths and low temperatures by anaerobic bacterial decomposition of sedimentary organic matter. Thermogenic gas is formed at deeper depths by either thermal cracking of sedimentary organic matter into hydrocarbon liquids and gas or thermal cracking of oil at high temperatures into gas. The occurrence of biogenic gas is unrelated to the processes that form oil. Each process produces a different isotopic signature of methane so the isotopic signatures can be used to identify whether the methane came from deep target shale units or from the near surface (e.g. Jackson et al. 2013).

The abundance of noble gases and the isotopic composition of helium are used to distinguish between potential sources of natural gas and different fluids, including shallow groundwater and water from target shale units (e.g., Jackson et al., 2013). Dissolved noble-gas concentrations in water are dependent upon the temperature and pressure when gas exchange with the atmosphere occurs. When precipitation recharges and becomes groundwater, it is isolated from the atmosphere and retains its noble-gas concentration from the time of recharge and does not change as groundwater flows, with the exception of helium. Helium can increase in concentration as groundwater flows because it is also produced by radioactive decay of uranium and thorium in aquifer rocks and can also come from upward diffusion from the earth's mantle. The source of helium in groundwater can be evaluated by examining the ratio of helium-3 and helium-4 isotopes. Helium-4 is also a major component of thermogenic natural gas.

A variety of chemicals may be used to hydraulically fracture shale to increase the production of hydrocarbons (e.g. http://fracfocus.org/chemical-use/what-chemicals-are-used). Many of these chemicals are used in very low concentrations or breakdown quickly and may not be useful in identifying the presence of hydraulic fracturing fluids in groundwater. Based upon the list of hydraulic-fracturing chemicals provided by Noble in the MOU, an analytical suite of chemicals was developed to identify the occurrence of hydraulic-fracturing chemicals in groundwater. The chemicals analyzed include short-chained alcohols, glycerins, glycols,

ammonium persulfate, and acrylonitrile. This suite of chemicals was selected considering that they might be used in sufficient quantities during hydraulic fracturing to be detected in groundwater, or they might be breakdown products of chemicals used for hydraulic fracturing that are sufficiently long-lived and in sufficient quantities to be detected in groundwater.

## PRE- AND POST-HYDRAULIC FRACTURING CHEMICAL AND ISOTOPIC DATA-EXPLORATION AREA 2

Table 4 presents pre- and recent post-hydraulic fracturing chemical and isotopic data from samples collected in Area 2 in an easily comparable format. No evaluation or interpretation of these data is provided at this time. Evaluation of water-quality, geochemical, and isotopic parameters will be included in the final AQUA Program report. Additional analytical results will be presented periodically as addendums to this data report as they become available.

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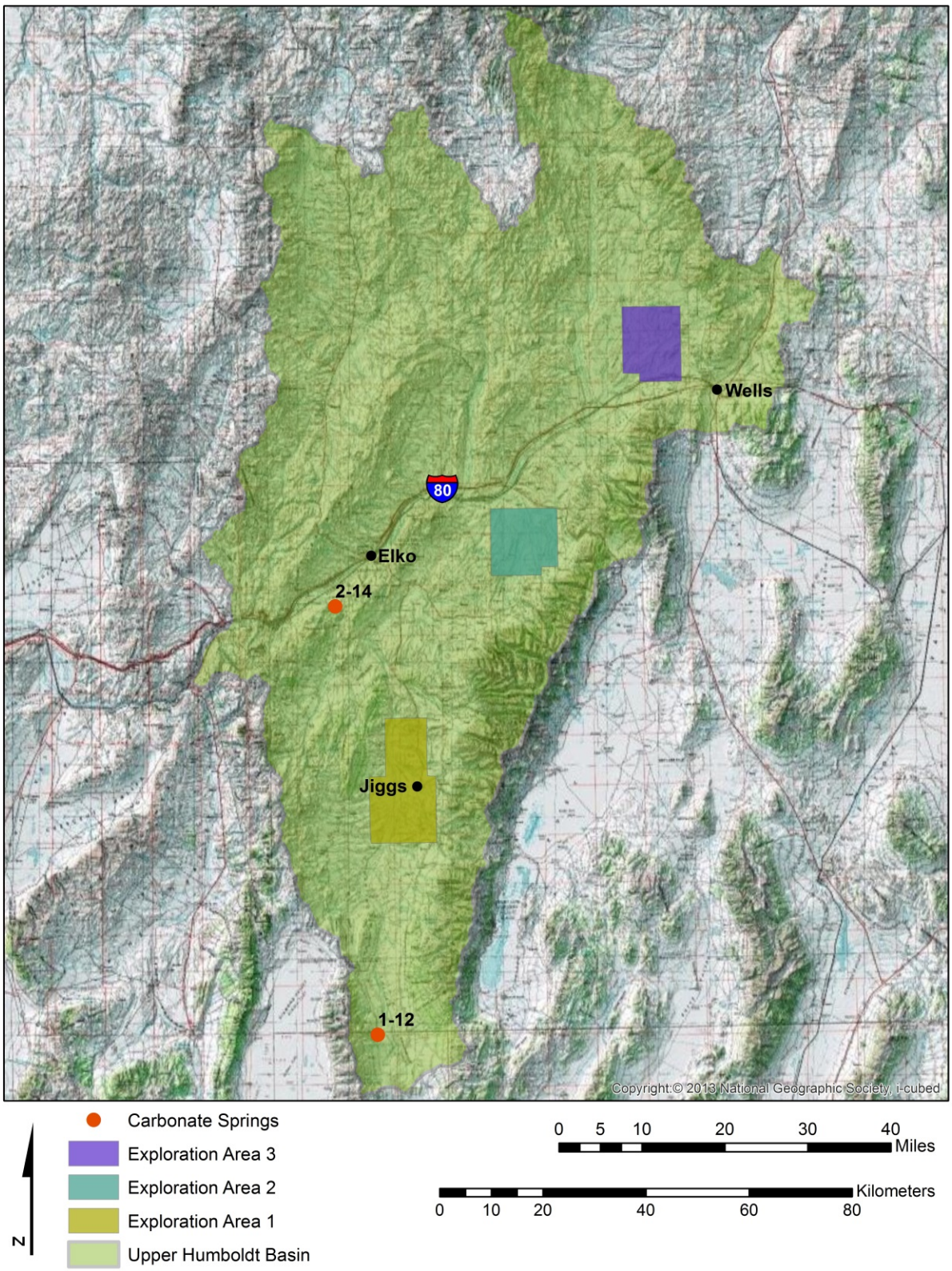


Figure 1. Noble Energy exploration areas in the upper Humboldt River basin and sample locations outside the vicinity of the exploration areas.

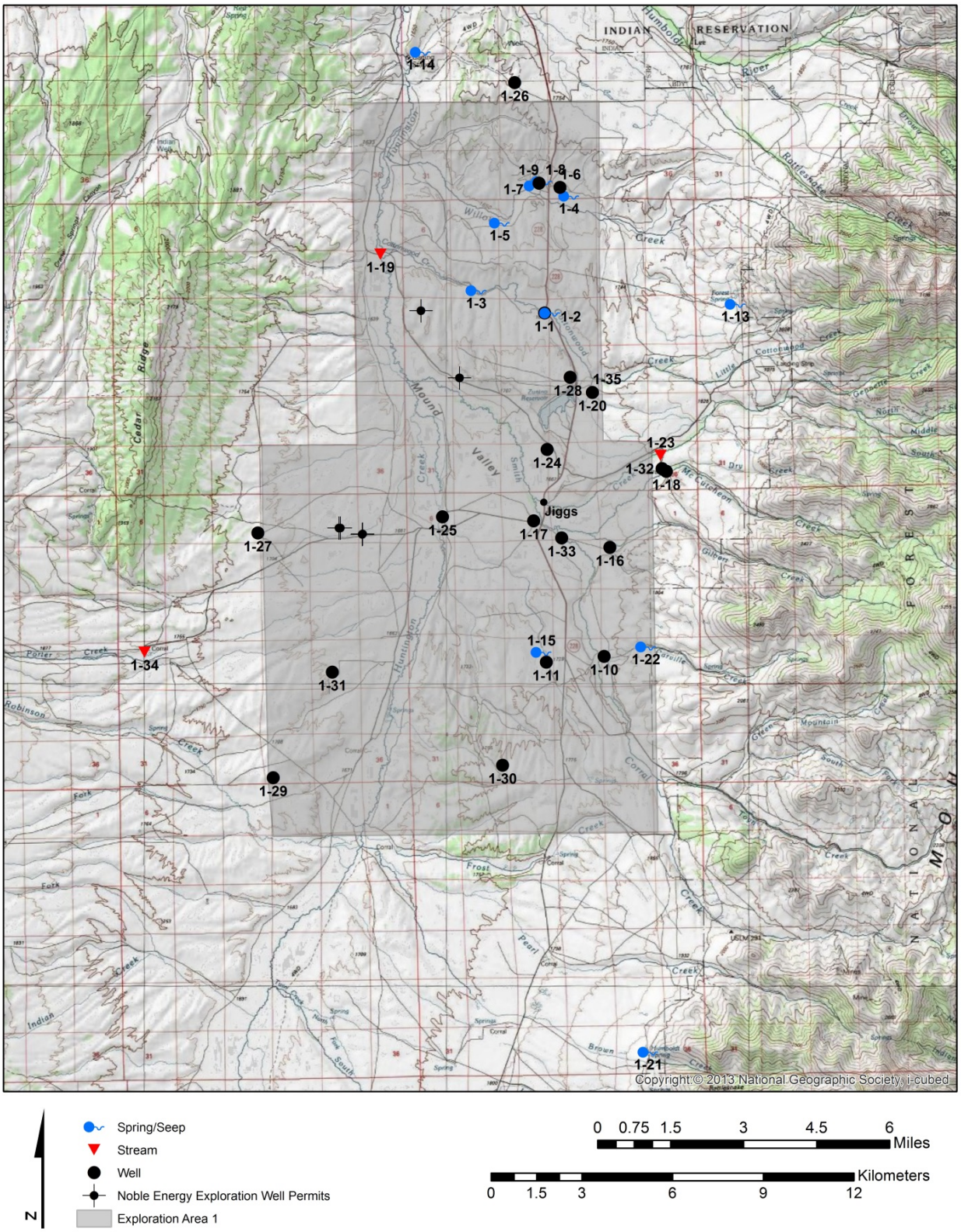


Figure 2. Noble Energy Exploration Area 1 (Huntington) – Pre-hydraulic fracturing water-quality sample locations.

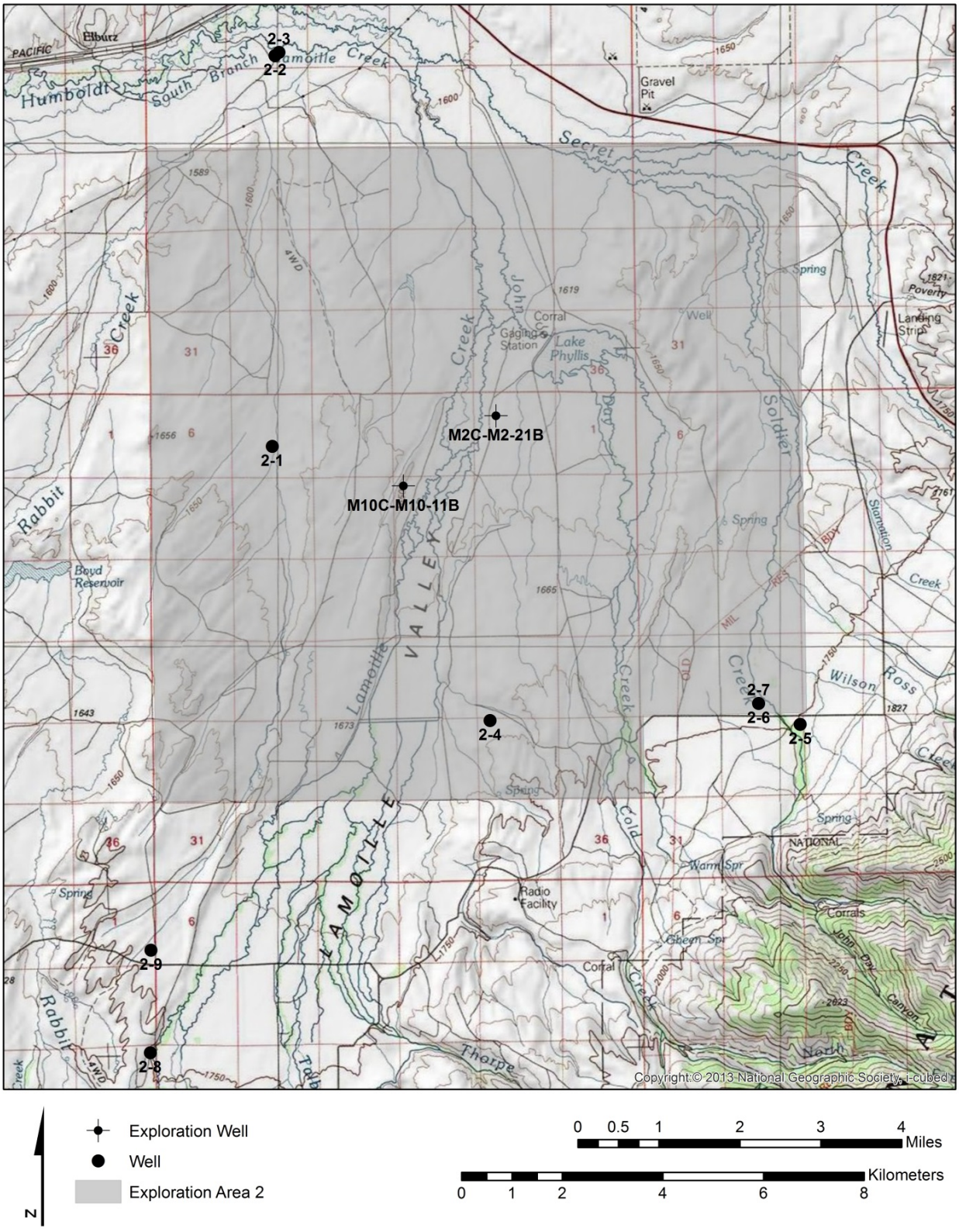


Figure 3. Noble Energy Exploration Area 2 (Humboldt) – Pre-hydraulic-fracturing water-quality sample locations.

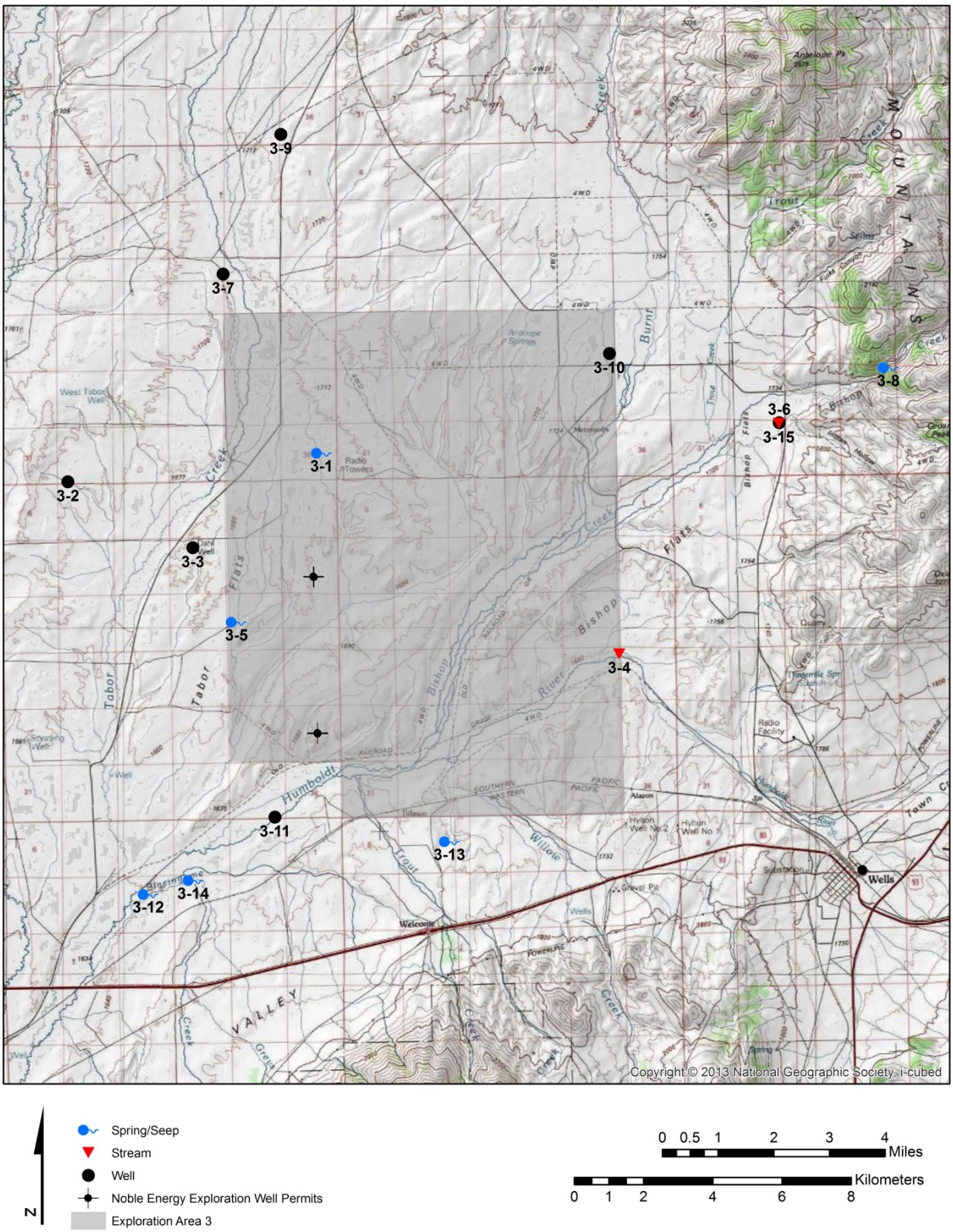


Figure 4. Noble Energy Exploration Area 3 (Mary's River) – Pre-hydraulic fracturing water-quality sample locations.

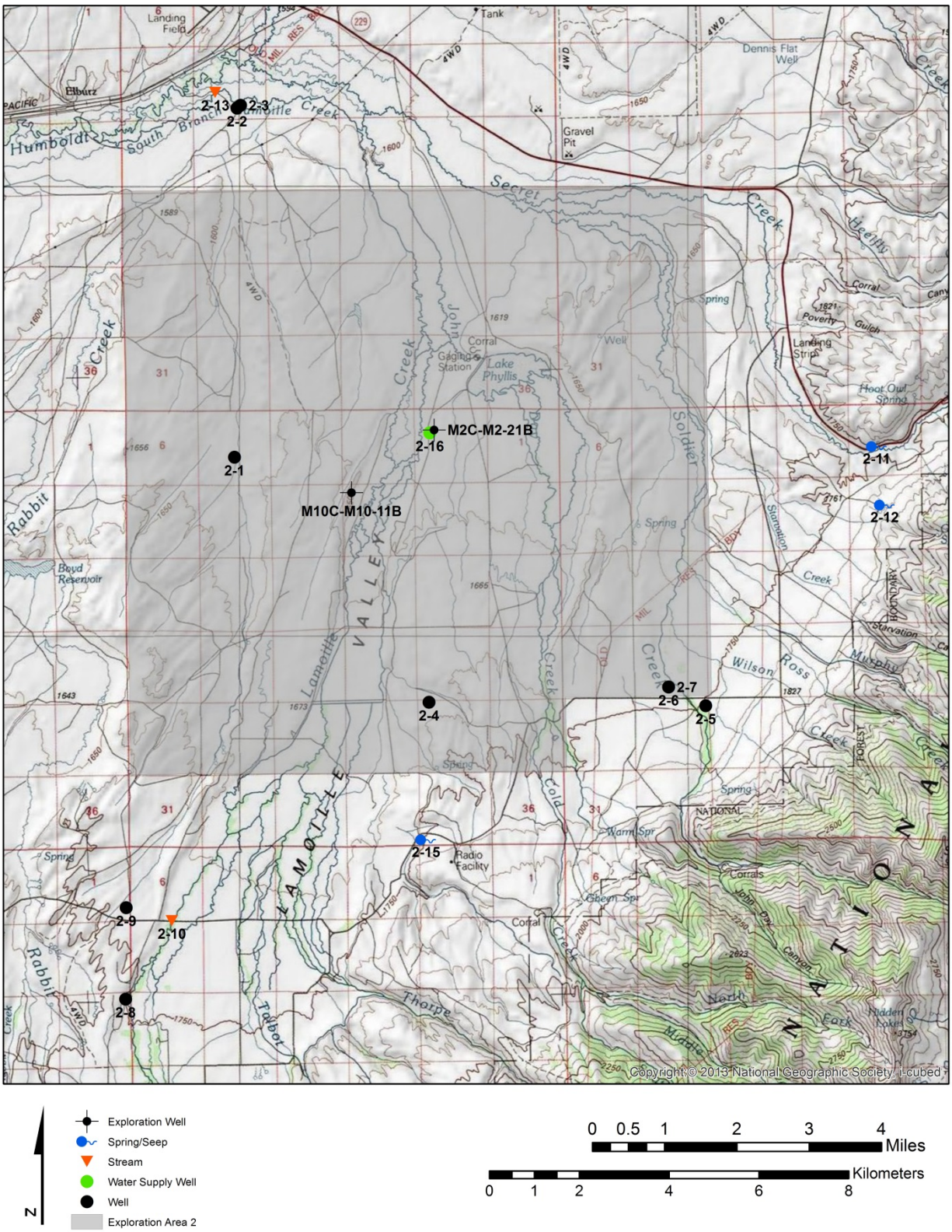


Figure 5. Noble Energy Exploration Area 2 (Humboldt) – Post-hydraulic-fracturing water-quality sample locations.

Table 1. Chemical and Isotopic Parameters, Units, Analytical Methods, and Laboratories for Water Samples Collected by Tetra Tech Inc.

| **Parameter or Constituent** | **Units** | **Method** | **Laboratory** |
|---|---|---|---|
| Temperature | ˚C | | |
| Field Electrical Conductivity | µS/cm | | |
| Field pH | pH units | | |
| Field Filtration | | No | |
| Ca, Mg, Na, K, Li | µg/L | 6010C | TestAmerica |
| Cl, $SO_4$, F, Br | mg/L | 300.0 | TestAmerica |
| Alkalinity | mg/L as $CaCO_3$ | SM 2320B | TestAmerica |
| Methane, Ethane, Propane | µg/L | RSK-175 | TestAmerica |
| Diesel Range Organics | µg/L | 8015C | TestAmerica |
| Gasoline Range Organics | µg/L | 8015C | TestAmerica |
| Benzene, Toluene, Ethylbenzene, Xylenes | µg/L | 8260B | TestAmerica |
| $\delta^{13}C$ Methane | ‰ | | Dolan Integration Group |
| $\delta^{2}H$ Methane | ‰ | | Dolan Integration Group |

| **Area 1 Huntington BLM EA** | **Units** | **Method** | **Laboratory** |
|---|---|---|---|
| Temperature | ˚C | | |
| Field Electrical Conductivity | µS/cm | | |
| Field pH | pH units | | |
| Field Filtration | | No | |
| Ca, Mg, Na, K, Li, B, Sr | mg/L | 6010C | TestAmerica |
| Ba | mg/L | 200.8 | TestAmerica |
| Cl, $SO_4$, F, Br | mg/L | 300.0 | TestAmerica |
| Alkalinity | mg/L as $CaCO_3$ | SM 2320B | TestAmerica |
| Total Dissolved Solids | mg/L | SM 2540C | TestAmerica |
| Methane, Ethane, Propane | µg/L | RSK-175 | TestAmerica |
| Diesel Range Organics | µg/L | 8015C | TestAmerica |
| Gasoline Range Organics | µg/L | 8015C | TestAmerica |
| Benzene, Toluene, Ethylbenzene, Xylenes, Acrylonitrile | µg/L | 8260B | TestAmerica |
| Radium-226 | pCi/L | 904 | TestAmerica |
| Gross Alpha, Gross Beta | pCi/L | 9310 | TestAmerica |

Table 2. Chemical and Isotopic Parameters, Units, Analytical Methods, and Laboratories for Water Samples Collected by Desert Research Institute.

| Parameter or Constituent | Units | Method | Laboratory |
|---|---|---|---|
| Temperature | ˚C | - | - |
| Field Electrical Conductivity | µS/cm | - | - |
| Field pH | pH units | - | - |
| Field Filtration | - | 0.45 µm | - |
| Lab Electrical Conductivity | µS/cm | SM 2510 B | DRI Water Laboratory, Silver State Analytical |
| Lab pH | pH units | SM 4500 H+ B | DRI Water Laboratory, Silver State Analytical |
| Ca, Mg, Na, K, Li | mg/L | SM 3111B | DRI Water Laboratory, Silver State Analytical |
| Cl, $SO_4$, Br | mg/L | EPA 300.0 | DRI Water Laboratory, Silver State Analytical |
| $NO_3$ | mg N/L | SM 4500-NO3 F | DRI Water Laboratory, Silver State Analytical |
| $SiO_2$ | mg/L | EPA 370.1 | DRI Water Laboratory, Silver State Analytical |
| Alkalinity | mg/L as $CaCO_3$ | USGS I 1030-85 SM 2320 B | DRI Water Laboratory, Silver State Analytical |
| F | mg/L | SM 4500F C | DRI Water Laboratory, Silver State Analytical |
| B, Ba, Sr | mg/L | EPA 200.8 | DRI Water Laboratory, Silver State Analytical |
| Total Dissolved Solids | mg/L | SM 2540 C | DRI Water Laboratory, Silver State Analytical |
| Methane, Ethane, Propane | µg/L | RSK-175 | Alpha Analytical |
| Diesel Range Organics | µg/L | SW8015B/C Ext | Alpha Analytical |
| Gasoline Range Organics | µg/L | SW8015B/C / SW8260B | Alpha Analytical |
| MTBE, Benzene, Toluene, Ethylbenzene, Xylenes | µg/L | SW8260B | Alpha Analytical |
| Gross Alpha, Gross Beta | pCi/L | EPA 900.0 | Eurofins Eaton Analytical |
| Radium-226 | pCi/L | RA-226 GA | Eurofins Eaton Analytical |
| Radium-228 | pCi/L | RA-228 GA | Eurofins Eaton Analytical |
| $\delta^2H$, $\delta^{18}O$, $\delta^{13}C$ DIC water | ‰ | Isotope Ratio Mass Spectrometry | UC Davis, University of Waterloo |
| $\delta^2H$, $\delta^{13}C$ methane | ‰ | Isotope Ratio Mass Spectrometry | UC Davis, University of Waterloo |
| Ne, Ar, Kr, Xe | ccSTP/g | Quadrupole Mass Spectrometry | University of Utah |
| $^4He$ | ccSTP/g | Sector-field Mass Spectrometry | University of Utah |
| $R/R_a$ ($[^3He/^4He]_{groundwater}$ / $[^3He/^4He]_{atmosphere}$) | - | Sector-field Mass Spectrometry | University of Utah |
| Methanol, Ethanol, Isopropanol, 2-Butoxyethanol, Acrylonitrile | mg/L | Gas Chromatography Flame Ionization Detection | DRI Organic Analysis Laboratory |
| Glycerol, Ethylene Glycol, Propylene Glycol, Ammonium Persulfate | mg/L | Liquid Chromatography Mass Spectrometry | DRI Organic Analysis Laboratory |

Table 3. Chemical and Isotopic Parameters and the Purpose These Parameters Were Selected for the Aquifer Quality Assessment Program.

| Parameter or Constituent | Purpose |
|---|---|
| Methane, Ethane, Propane | Early indicators of crude oil release |
| Diesel Range Organics | Refined hydrocarbon release from earth-surface activities |
| Gasoline Range Organics | Refined hydrocarbon release from earth-surface activities |
| MTBE, Benzene, Toluene, Ethylbenzene, Xylenes | Refined hydrocarbon release from earth-surface activities |
| Temperature, Electrical Conductivity, pH | Characterize local groundwater, identify mixing of shale water |
| Ca, Mg, Na, K, Li, B, Ba, Sr | Characterize local groundwater, identify mixing of shale water |
| Alkalinity, Cl, $SO_4$, Br, $NO_3$, F, $SiO_2$, Total Dissolved Solids | Characterize local groundwater, identify mixing of shale water |
| Gross Alpha, Gross Beta, Radium-226, Radium-228 | Establish natural background in local groundwater, identify mixing of shale water |
| $\delta^2H$, $\delta^{18}O$, $\delta^{13}C$ DIC water | Characterize local groundwater, identify mixing of shale water |
| $\delta^2H$, $\delta^{13}C$ methane | Identify source of methane: biogenic or thermogenic |
| Ne, Ar, Kr, Xe, $^4He$ | Identify source of natural gas, characterize local groundwater, identify mixing of shale water |
| $R/R_a$ ($[^3He/^4He]_{groundwater}$ / $[^3He/^4He]_{atmosphere}$) | Identify source of natural gas, characterize local groundwater, identify mixing of shale water |
| Methanol, Ethanol, Isopropanol, 2-Butoxyethanol, Acrylonitrile, Glycerol, Ethylene Glycol, Propylene Glycol, Ammonium Persulfate | Indicators of hydraulic-fracturing fluid release |

Table 4. Pre- and Post-Hydraulic Fracturing Chemical and Isotopic Parameter Analytical Results for Exploration Area 2, Humboldt.

| Agency (Units) | Location ID | Sample Date | Lab pH | Lab EC (µS/cm) | Ca (dissolved) (mg/L) | Mg (dissolved) (mg/L) | Na (dissolved) (mg/L) | K (dissolved) (mg/L) | $HCO_3$ (mg/L) | $CO_3$ (mg/L) | Cl (mg/L) | $SO_4$ (mg/L) | TDS (mg/L) | B (mg/L) | Ba (dissolved) (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DRI | 2-1 | 9/4/2013 | 9.61 | 632 | 0.57 | 0.06 | 157 | 1.8 | 238 | 82.8 | 3.7 | 2.8 | 435 | 0.86 | ND |
| DRI | 2-1 | 6/23/2014 | 9.50 | 700 | 0.61 | ND | 160 | 1.5 | 171 | 120 | 4.0 | 0.57 | 390 | 0.87 | ND |

| Agency (Units) | Location ID | Sample Date | Li (dissolved) (mg/L) | $SiO_2$ (mg/L) | $NO_3$ - N (mg/L) | F (mg/L) | Br (mg/L) | Gross Alpha (pCi/L) | Gross Beta (pCi/L) | Methane (µg/L) | Ethane (µg/L) | $\delta^{13}C$ $CH_4$ (‰) | $\delta^{2}H$ $CH_4$ (‰) | $\delta^{13}C$ DIC Water (‰) | $\delta^{2}H$ Water (‰) | $\delta^{18}O$ Water (‰) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DRI | 2-1 | 9/4/2013 | <0.01 | 54.3 | <0.01 | 3.73 | 0.02 | 16 | 11 | 2800* | 7.2 | -67.18* | -310.6* | -4.35 | -136.0 | -17.90 |
| DRI | 2-1 | 6/23/2014 | 0.01 | 49 | ND | 3.9 | ND | 16 | ND | 7200* | 18 | -69.14* | -314.0* | -3.29 | -136.1 | -18.09 |

| Agency (Units) | Location ID | Sample Date | Lab pH | Lab EC (µS/cm) | Ca (dissolved) (mg/L) | Mg (dissolved) (mg/L) | Na (dissolved) (mg/L) | K (dissolved) (mg/L) | $HCO_3$ (mg/L) | $CO_3$ (mg/L) | Cl (mg/L) | $SO_4$ (mg/L) | TDS (mg/L) | B (mg/L) | Ba (dissolved) (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DRI | 2-4 | 9/4/2013 | 7.98 | 323 | 37.4 | 6.7 | 21.6 | 2.4 | 152 | ND | 13.8 | 26.2 | 207 | 0.05 | ND |
| DRI | 2-4 | 6/23/2014 | 7.90 | 350 | 26 | 6.5 | 22 | 3.4 | 146 | ND | 13 | 25 | 190 | 0.11 | 0.055 |

| Agency (Units) | Location ID | Sample Date | Li (dissolved) (mg/L) | $SiO_2$ (mg/L) | $NO_3$ - N (mg/L) | F (mg/L) | Br (mg/L) | Gross Alpha (pCi/L) | Gross Beta (pCi/L) | Methane (µg/L) | Ethane (µg/L) | $\delta^{13}C$ $CH_4$ (‰) | $\delta^{2}H$ $CH_4$ (‰) | $\delta^{13}C$ DIC Water (‰) | $\delta^{2}H$Water (‰) | $\delta^{18}O$ Water (‰) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DRI | 2-4 | 9/4/2013 | 0.01 | 29.1 | 0.07 | 0.21 | 0.06 | 8.4 | 4.8 | <10.0 | <10.0 | -56.6 Q | -212.4 Q | -10.33 | -126.6 | -16.46 |
| DRI | 2-4 | 6/23/2014 | 0.01 | 25 | ND | ND | ND | 6.2 | 3 | 5.0 J | <5.0 | NC | NC | -9.90 | -127.9 | -16.72 |

*methane identified as biogenic origin by $\delta^{13}C$ $CH_4$ and $\delta^{2}H$ $CH_4$
J = result is less than the reporting limit but greater than or equal to the method detection limit and the concentration is an approximate value
NC = not collected
ND = none detected (below minimum detection limit)
Q = concentration below limit of quantification

Table 4. Pre- and Post-Hydraulic Fracturing Chemical and Isotopic Parameter Analytical Results for Exploration Area 2, Humboldt. (continued).

| Agency (Units) | Location ID | Sample Date | Field pH | Field EC (µS/cm) | Temperature (˚C) | Ca (total) (mg/L) | Mg (total) (mg/L) | Na (total) (mg/L) | K (total) (mg/L) | $HCO_3$ (mg/L) | $CO_3$ (mg/L) | Li (total) (mg/L) | Methane (µg/L) | Ethane (µg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TT | 2-1 | 9/4/2013 | 9.96 | 658 | 11.7 | 3.17 | 0.695 | 162 | ND | 190 | 106 | 0.0113 | 4690 | 11.1 |
| TT | 2-1 | 6/23/2014 | 9.70 | 640 | 14.0 | 0.84 | 0.039 J | 168 | 1.93 J | 176 | 105 | 0.0062 J | 4190 | 11.8 |
| TT | 2-2 | 9/4/2013 | 7.79 | 566 | 17.4 | 70.6 | 10.4 | 30.6 | 3.77 | 307 | ND | ND | 62 | <0.573 |
| TT | 2-2 | 6/23/2014 | 7.30 | 495 | 12.2 | 73.0 | 11.9 | 20.1 | 5.25 | 295 | ND | 0.0107 | 1070 | <0.573 |
| TT | 2-3 | 9/4/2013 | 7.54 | 573 | 16.8 | 81.5 | 12.5 | 21.5 | 5.26 | 346 | ND | ND | 12.2 | <0.573 |
| TT | 2-3 | 6/23/2014 | 7.45 | 595 | 13.3 | 90.9 | 14.2 | 22.3 | 5.78 | 332 | ND | 0.0096 J | 7.54 | <0.573 |
| TT | 2-4 | 9/4/2013 | 8.16 | 331 | 12.8 | 36.9 | 6.58 | 22.5 | ND | 153 | ND | ND | <0.218 | <0.573 |
| TT | 2-4 | 6/23/2014 | 7.60 | 327 | 12.8 | 37.5 | 6.99 | 23.0 | 2.59 J | 144 | ND | 0.0061 J | 0.715 J | <0.573 |
| TT | 2-5 | 9/4/2013 | 7.25 | 282 | 12.5 | 34.9 | 5.20 | 18.6 | ND | 172 | ND | ND | <0.218 | <0.573 |
| TT | 2-5 | 6/25/2014 | 6.60 | 262 | 14.9 | 34.8 | 5.24 | 17.4 | 0.954 J | 154 | ND | 0.0035 J | <0.218 | <0.573 |
| TT | 2-6 | 9/4/2013 | 7.09 | 278 | 12.6 | 44.8 | 4.18 | 5.31 | ND | 173 | ND | ND | <0.218 | <0.573 |
| TT | 2-6 | 6/25/2014 | 6.50 | 235 | 12.3 | 42.7 | 4.04 | 5.28 | 0.865 J | 138 | ND | ND | <0.218 | <0.573 |
| TT | 2-7 | 9/4/2013 | 8.93 | 274 | 17.4 | 50.4 | 7.57 | 10.9 | ND | 211 | ND | ND | <0.218 | <0.573 |
| TT | 2-7 | 7/1/2014 | 7.60 | 331 | 11.7 | 50.7 | 8.06 | 14.2 | 1.39 J | 200 | ND | ND | <0.218 | <0.573 |
| TT | 2-8 | 10/8/2013 | NC | NC | NC | 42.0 | 7.75 | 6.34 | ND | 145 | ND | ND | <0.218 | <0.573 |
| TT | 2-8 | 6/25/2014 | 7.58 | 288 | 13.9 | 43.9 | 8.54 | 6.35 | 1.28 J | 142 | ND | ND | <0.218 | <0.573 |
| TT | 2-9 | 10/8/2013 | NC | NC | NC | 43.7 | 8.02 | 40.7 | ND | 240 | ND | ND | <0.218 | <0.573 |
| TT | 2-9 | 6/25/2014 | 7.70 | 430 | 15.6 | 46.5 | 9.00 | 42.5 | 1.35 J | 226 | ND | 0.0068 J | <0.218 | <0.573 |

# APPENDIX A: CHEMICAL AND ISOTOPIC PARAMETERS FOR UPPER HUMBOLDT RIVER BASIN WELLS, SPRINGS, AND STREAMS

Table A1. Field and Laboratory Parameters and Radionuclides for Upper Humboldt River Basin Wells, Springs, and Streams.

| Agency (Units) | Location ID | Sample Date | Field pH | Lab pH | Field EC (µS/cm) | Lab EC (µS/cm) | Temperature (˚C) | Gross Alpha (pCi/L) | Gross Beta (pCi/L) | $^{226}$Ra (pCi/L) | $^{228}$Ra (pCi/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Area 1 Pre-Hydraulic Fracturing** | | | | | | | | | | | |
| TT | 1-1 | 3/31/2014 | 6.35 | NC | 394 | NC | 10.6 | NC | NC | NC | NC |
| DRI | 1-1 | 3/31/2014 | NC | 7.10 | NC | 382 | NC | ND | ND | ND | ND |
| TT | 1-2 | 3/31/2014 | 7.10 | NC | 416 | NC | 2.9 | 4.55 | 2.09 | NC | 0.289 U |
| TT | 1-3 | 3/31/2014 | 7.40 | NC | 727 | NC | 6.7 | 6.47 | 6.37 | NC | 0.323 U |
| TT | 1-4 | 3/31/2014 | 7.45 | NC | 354 | NC | 9.4 | 9.56 | 4.13 | NC | 0.372 U |
| TT | 1-5 | 3/31/2014 | 7.96 | NC | 208 | NC | 18.3 | 3.05 | 2.59 | NC | 0.407 U |
| TT | 1-6 | 3/31/2014 | 7.62 | NC | 254 | NC | 13.3 | NC | NC | NC | NC |
| TT | 1-7 | 4/1/2014 | 7.42 | NC | 570 | NC | 10.0 | 23.6 | 4.23 | NC | 0.563 |
| TT | 1-8 | 4/1/2014 | 7.89 | NC | 828 | NC | 10.0 | 13.5 G | 8.38 | NC | 0.365 U |
| TT | 1-9 | 4/1/2014 | 7.55 | NC | 365 | NC | 13.3 | NC | NC | NC | NC |
| TT | 1-10 | 4/1/2014 | 7.48 | NC | 332 | NC | 6.6 | NC | NC | NC | NC |
| TT | 1-11 | 4/1/2014 | 7.05 | NC | 363 | NC | 11.7 | NC | NC | NC | NC |
| DRI | 1-12 | 4/2/2014 | 7.54 | 7.86 | 333 | 339 | 17.1 | 9.0 | 6.8 | ND | ND |
| TT | 1-13 | 4/7/2014 | 7.64 | NC | 152 | NC | 13.9 | NC | NC | NC | NC |
| TT | 1-13 | 4/18/2014 | 6.72 | NC | 157 | NC | 13.1 | 3.39 | 3.88 | NC | 0.034 U |
| DRI | 1-13 | 4/18/2014 | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| TT | 1-14 | 4/18/2014 | 7.35 | NC | 1380 | NC | 10.6 | 83.0 G | 30.2 G | NC | 0.725 |
| DRI | 1-15 | 4/18/2014 | 8.76 | 8.65 | 968 | 1020 | 22.2 | 3.2 | 76 | ND | ND |
| DRI | 1-16 | 9/22/2014 | NC | 7.04 | NC | 149 | NC | ND | ND | ND | ND |
| TT | 1-16 | 9/22/2014 | 7.6 | NC | 144 | NC | 12.5 | NC | NC | NC | NC |
| DRI | 1-17 | 9/22/2014 | NC | 7.05 | NC | 530 | NC | 37 | 15 | ND | ND |
| TT | 1-17 | 9/22/2014 | 7.70 | NC | 583 | NC | 15.1 | NC | NC | NC | NC |
| DRI | 1-18 | 9/22/2014 | 6.66 | 7.11 | 271 | 249 | 14.4 | 8.8 | 4.5 | ND | ND |
| TT | 1-18 | 9/22/2014 | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| DRI | 1-19 | 9/23/2014 | NC | 7.70 | NC | 553 | NC | 16 | 9.7 | ND | ND |

Table A1. Field and Laboratory Parameters and Radionuclides for Upper Humboldt River Basin Wells, Springs, and Streams (continued).

| Agency (Units) | Location ID | Sample Date | Field pH | Lab pH | Field EC (µS/cm) | Lab EC (µS/cm) | Temperature (˚C) | Gross Alpha (pCi/L) | Gross Beta (pCi/L) | $^{226}$Ra (pCi/L) | $^{228}$Ra (pCi/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TT | 1-19 | 9/23/2014 | 7.55 | NC | 564 | NC | 15.7 | NC | NC | NC | NC |
| DRI | 1-20 | 9/23/2014 | NC | 7.10 | NC | 255 | NC | 14 | 6.2 | ND | ND |
| TT | 1-20 | 9/23/2014 | 7.55 | NC | 220 | NC | 19.8 | NC | NC | NC | NC |
| DRI | 1-21 | 9/23/2014 | 7.28 | 7.51 | NC | 365 | 12.4 | ND | ND | ND | ND |
| DRI | 1-22 | 9/24/2014 | NC | 7.74 | NC | 198 | 13.9 | 7.8 | ND | ND | ND |
| DRI | 1-23 | 9/24/2014 | NC | 7.56 | NC | 67 | 17.4 | ND | ND | ND | ND |
| DRI | 1-24 | 9/29/2014 | NC | 7.14 | NC | 264 | NC | 8.9 | ND | ND | ND |
| TT | 1-24 | 9/29/2014 | 7.20 | NC | 279 | NC | 13.8 | NC | NC | NC | NC |
| DRI | 1-25 | 9/29/2014 | NC | 7.37 | NC | 339 | NC | 8.0 | 6.3 | ND | ND |
| TT | 1-25 | 9/29/2014 | 7.49 | NC | 344 | NC | 17.6 | NC | NC | NC | NC |
| DRI | 1-26 | 10/7/2014 | NC | 7.76 | NC | 335 | NC | 10 | ND | ND | ND |
| TT | 1-26 | 10/7/2014 | 8.08 | NC | 327 | NC | 16.4 | NC | NC | NC | NC |
| DRI | 1-27 | 10/7/2014 | NC | 7.63 | NC | 407 | NC | 12 | 4 | ND | ND |
| TT | 1-27 | 10/7/2014 | 7.98 | NC | 409 | NC | 14.5 | NC | NC | NC | NC |
| DRI | 1-28 | 10/20/2014 | NC | 7.08 | NC | 287 | NC | 20 | 4.1 | ND | ND |
| TT | 1-28 | 10/20/2014 | 7.22 | NC | 288 | NC | 12.1 | NC | NC | NC | NC |
| DRI | 1-29 | 10/20/2014 | NC | 7.95 | NC | 279 | NC | 5.6 | 7.1 | ND | ND |
| TT | 1-29 | 10/20/2014 | 8.31 | NC | 289 | NC | 12.7 | NC | NC | NC | NC |
| DRI | 1-30 | 10/21/2014 | NC | 7.91 | NC | 254 | NC | 10 | ND | ND | ND |
| TT | 1-30 | 10/21/2014 | 8.31 | NC | 269 | NC | 16.9 | NC | NC | NC | NC |
| TT | 1-31 | 10/20/2014 | 8.30 | NC | 363 | NC | 13.7 | NC | NC | NC | NC |
| TT | 1-32 | 9/23/2014 | 7.48 | NC | 221 | NC | 15.7 | NC | NC | NC | NC |
| TT | 1-33 | 9/22/2014 | 7.33 | NC | 252 | NC | 13.2 | NC | NC | NC | NC |
| TT | 1-34 | 9/22/2014 | 7.46 | NC | 357 | NC | 12.3 | NC | NC | NC | NC |
| TT | 1-35 | 9/23/2014 | 7.55 | NC | 220 | NC | 19.8 | NC | NC | NC | NC |

Table A1. Field and Laboratory Parameters and Radionuclides for Upper Humboldt River Basin Wells, Springs, and Streams (continued).

| Agency (Units) | Location ID | Sample Date | Field pH | Lab pH | Field EC (µS/cm) | Lab EC (µS/cm) | Temperature (˚C) | Gross Alpha (pCi/L) | Gross Beta (pCi/L) | $^{226}$Ra (pCi/L) | $^{228}$Ra (pCi/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Area 2 Pre-Hydraulic Fracturing** | | | | | | | | | | | |
| DRI | 2-1 | 9/4/2013 | NC | 9.61 | NC | 632 | NC | 16 | 11 | ND | ND |
| TT | 2-1 | 9/4/2013 | 9.96 | NC | 658 | NC | 11.7 | NC | NC | NC | NC |
| TT | 2-1 | 10/8/2013 | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| TT | 2-2 | 9/4/2013 | 7.79 | NC | 566 | NC | 17.4 | NC | NC | NC | NC |
| TT | 2-3 | 9/4/2013 | 7.54 | NC | 573 | NC | 16.8 | NC | NC | NC | NC |
| DRI | 2-4 | 9/4/2013 | NC | 7.98 | NC | 323 | NC | 8.4 | 4.8 | ND | ND |
| TT | 2-4 | 9/4/2013 | 8.16 | NC | 331 | NC | 12.8 | NC | NC | NC | NC |
| TT | 2-5 | 9/4/2013 | 7.25 | NC | 282 | NC | 12.5 | NC | NC | NC | NC |
| TT | 2-6 | 9/4/2013 | 7.09 | NC | 278 | NC | 12.6 | NC | NC | NC | NC |
| TT | 2-7 | 9/4/2013 | 8.93 | NC | 274 | NC | 17.4 | NC | NC | NC | NC |
| TT | 2-8 | 10/8/2013 | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| TT | 2-9 | 10/8/2013 | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| **Area 2 Post-Hydraulic Fracturing** | | | | | | | | | | | |
| DRI | 2-1 | 6/23/2014 | NC | 9.50 | NC | 700 | NC | 16 | ND | ND | ND |
| TT | 2-1 | 6/23/2014 | 9.70 | NC | 640 | NC | 14.0 | NC | NC | NC | NC |
| DRI | 2-2 | 6/23/2014 | NC | 7.40 | NC | 520 | NC | ND | 5.7 | ND | ND |
| TT | 2-2 | 6/23/2014 | 7.30 | NC | 495 | NC | 12.2 | NC | NC | NC | NC |
| TT | 2-3 | 6/23/2014 | 7.45 | NC | 595 | NC | 13.3 | NC | NC | NC | NC |
| DRI | 2-4 | 6/23/2014 | NC | 7.90 | NC | 350 | NC | 6.2 | 3 | ND | ND |
| TT | 2-4 | 6/23/2014 | 7.60 | NC | 327 | NC | 12.8 | NC | NC | NC | NC |
| TT | 2-5 | 6/25/2014 | 6.60 | NC | 262 | NC | 14.9 | NC | NC | NC | NC |
| TT | 2-6 | 6/25/2014 | 6.50 | NC | 235 | NC | 12.3 | NC | NC | NC | NC |
| TT | 2-7 | 7/1/2014 | 7.60 | NC | 331 | NC | 11.7 | NC | NC | NC | NC |
| TT | 2-8 | 6/25/2014 | 7.58 | NC | 288 | NC | 13.9 | NC | NC | NC | NC |
| TT | 2-9 | 6/25/2014 | 7.70 | NC | 430 | NC | 15.6 | NC | NC | NC | NC |
| DRI | 2-10 | 4/1/2014 | 8.08 | 8.08 | 220 | 220 | 9.3 | ND | ND | ND | ND |

Table A1. Field and Laboratory Parameters and Radionuclides for Upper Humboldt River Basin Wells, Springs, and Streams (continued).

| Agency (Units) | Location ID | Sample Date | Field pH | Lab pH | Field EC (µS/cm) | Lab EC (µS/cm) | Temperature (˚C) | Gross Alpha (pCi/L) | Gross Beta (pCi/L) | $^{226}$Ra (pCi/L) | $^{228}$Ra (pCi/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| DRI | 2-10 | 6/23/2014 | 7.96 | 7.90 | 123 | 140 | 16.8 | ND | ND | ND | ND |
| DRI | 2-11 | 6/25/2014 | 8.04 | 7.90 | 354 | 370 | 21.8 | ND | ND | ND | ND |
| DRI | 2-12 | 6/24/2014 | 8.01 | 7.90 | 352 | 410 | 19.4 | 6.9 | ND | ND | ND |
| DRI | 2-13 | 6/24/2014 | 8.32 | 8.20 | 338 | 360 | 22.8 | 5.7 | ND | ND | ND |
| DRI | 2-14 | 6/24/2014 | 7.20 | 7.50 | 530 | 600 | 16.0 | 6.9 | 6.1 | ND | ND |
| DRI | 2-15 | 9/5/2014 | 7.88 | 7.91 | 316 | 305 | 13.0 | ND | ND | ND | ND |
| DRI | 2-16 | 9/25/2014 | 9.64 | 9.63 | 370 | 506 | 19.5 | 7.9 | 9.9 | ND | ND |
| DRI | M2C-M2-21B M10C-M10-11B | 9/25/2014 | 6.39 | 6.58 | 4447 | 12440 | 54.0 | 36 | 1200 | 11 | 14 |
| | | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- |
| **Area 3 Pre-Hydraulic Fracturing** | | | | | | | | | | | |
| DRI | 3-1 | 9/3/2014 | NC | 8.09 | NC | 354 | NC | ND | 15 | ND | ND |
| TT | 3-1 | 9/3/2014 | 7.97 | NC | 542 | NC | 14.3 | NC | NC | NC | NC |
| DRI | 3-2 | 9/3/2014 | NC | 8.38 | NC | 258 | NC | ND | 15 | ND | ND |
| TT | 3-2 | 9/3/2014 | 8.13 | NC | 273 | NC | 16.2 | NC | NC | NC | NC |
| DRI | 3-3 | 9/3/2014 | NC | 9.53 | NC | 791 | NC | ND | 7 | ND | ND |
| TT | 3-3 | 9/3/2014 | 9.47 | NC | 845 | NC | 14.8 | NC | NC | NC | NC |
| DRI | 3-4 | 9/4/2014 | 8.59 | 8.61 | 928 | 889 | 17.6 | ND | 15 | ND | ND |
| DRI | 3-5 | 9/5/2014 | 9.69 | 9.58 | 1252 | 1215 | 15.1 | ND | 36 | ND | ND |
| DRI | 3-6 | 9/30/2014 | NC | 7.32 | NC | 594 | NC | ND | 6.2 | ND | ND |
| TT | 3-6 | 9/30/2014 | 7.55 | NC | 606 | NC | 15.9 | NC | NC | NC | NC |
| DRI | 3-7 | 9/30/2014 | NC | 7.70 | NC | 387 | NC | 5.5 | 3.3 | ND | ND |
| TT | 3-7 | 9/30/2014 | 7.99 | NC | 394 | NC | 11.9 | NC | NC | NC | NC |
| DRI | 3-8 | 9/30/2014 | 7.16 | 7.52 | 489 | 493 | 38.2 | 11 | 4.4 | 4.5 | ND |
| DRI | 3-9 | 10/8/2014 | NC | 7.78 | NC | 331 | NC | 22 | ND | ND | ND |
| TT | 3-9 | 10/8/2014 | 7.9 | NC | 333 | NC | 15.0 | NC | NC | NC | NC |
| DRI | 3-10 | 10/21/2014 | NC | 7.66 | NC | 397 | 9.9 | 11 | ND | ND | ND |

Table A1. Field and Laboratory Parameters and Radionuclides for Upper Humboldt River Basin Wells, Springs, and Streams (continued).

| Agency (Units) | Location ID | Sample Date | Field pH | Lab pH | Field EC (µS/cm) | Lab EC (µS/cm) | Temperature (˚C) | Gross Alpha (pCi/L) | Gross Beta (pCi/L) | $^{226}$Ra (pCi/L) | $^{228}$Ra (pCi/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TT | 3-10 | 10/29/2014 | 5.67 | NC | 395 | NC | 12.6 | NC | NC | NC | NC |
| DRI | 3-11 | 10/21/2014 | NC | 7.99 | NC | 1018 | NC | 4.9 | 4.5 | ND | ND |
| TT | 3-11 | 10/21/2014 | 8.22 | NC | 1070 | NC | 13.8 | NC | NC | NC | NC |
| TT | 3-12 | 10/21/2014 | 7.86 | NC | 696 | NC | 12.4 | NC | NC | NC | NC |
| DRI | 3-12 | 10/22/2014 | NC | 7.59 | NC | 652 | NC | 11 | ND | ND | ND |
| DRI | 3-13 | 10/22/2014 | NC | 9.04 | NC | 5510 | 15.4 | ND | 26 | ND | ND |
| TT | 3-14 | 10/21/2014 | 8.10 | NC | 708.9 | NC | 11.9 | NC | NC | NC | NC |
| TT | 3-15 | 9/30/2014 | 8.44 | NC | 620 | NC | 17.3 | NC | NC | NC | NC |

DRI = Desert Research Institute
EC = electrical conductivity
NC = not collected
ND = none detected (below minimum detection limit)
TBA = to be analyzed
TT = Tetra Tech

G = the minimum detection concentration of the sample is greater than the requested reporting limit
$R/R_a = (^3He/^4He)_{groundwater} / (^3He/^4He)_{atmosphere}$
U = result is less than the sample detection limit

Table A2. Major-Ion Chemistry and Total Dissolved Solids for Upper Humboldt River Basin Wells, Springs, and Streams.

| Agency (Units) | Location ID | Sample Date | Ca (dissolved) (mg/L) | Ca (total) (mg/L) | Mg (dissolved) (mg/L) | Mg (total) (mg/L) | Na (dissolved) (mg/L) | Na (total) (mg/L) | K (dissolved) (mg/L) | K (total) (mg/L) | $HCO_3$ (mg/L) | $CO_3$ (mg/L) | Cl (mg/L) | $SO_4$ (mg/L) | TDS (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Area 1 Pre-Hydraulic Fracturing** | | | | | | | | | | | | | | | |
| TT | 1-1 | 3/31/2014 | NC | 36.9 | NC | 8.84 | NC | 36.3 | NC | 3.74 | 161 | ND | 21.8 | 35.1 | 265 |
| DRI | 1-1 | 3/31/2014 | 34.8 | NC | 8.03 | NC | 33.5 | NC | 3.3 | NC | 159 | ND | 21.9 | 34.3 | 274 |
| TT | 1-2 | 3/31/2014 | NC | 30.0 | NC | 7.35 | NC | 55.5 | NC | 4.11 | 205 | ND | 9.42 | 37.9 | 266 |
| TT | 1-3 | 3/31/2014 | NC | 70.7 | NC | 16.1 | NC | 51.8 | NC | 10.0 | 185 | ND | 84.9 | 114 | 452 |
| TT | 1-4 | 3/31/2014 | NC | 33.0 | NC | 8.35 | NC | 35.4 | NC | ND | 176 | ND | 14.5 | 24.2 | 226 |
| TT | 1-5 | 3/31/2014 | NC | 25.1 | NC | 1.43 | NC | 16.6 | NC | 4.44 | 109 | ND | 6.4 | 9.12 | 166 |
| TT | 1-6 | 3/31/2014 | NC | 29.1 | NC | 6.07 | NC | 15.2 | NC | ND | 112 | ND | 12.5 | 18.3 | 183 |
| TT | 1-7 | 4/1/2014 | NC | 50.9 | NC | 13.3 | NC | 59.6 | NC | 3.66 | 268 | ND | 21.5 | 40.3 | 376 |
| TT | 1-8 | 4/1/2014 | NC | 58.4 | NC | 29.1 | NC | 103 | NC | 12.1 | 462 | ND | 40.4 | 34.0 | 571 |
| TT | 1-9 | 4/1/2014 | NC | 46.4 | NC | 8.03 | NC | 22.2 | NC | ND | 181 | ND | 10.4 | 19.9 | 235 H |
| TT | 1-10 | 4/1/2014 | NC | 30.0 | NC | 6.7 | NC | 33.1 | NC | ND | 133 | ND | 16.5 | 30.1 | 232 H |
| TT | 1-11 | 4/1/2014 | NC | 4.34 | NC | 7.66 | NC | 30.1 | NC | ND | 207 | ND | 6.65 | 9.82 | 225 H |
| DRI | 1-12 | 4/2/2014 | 49.1 | NC | 10.2 | NC | 8.07 | NC | 1.07 | NC | 190 | ND | 4.9 | 17.3 | 203 |
| TT | 1-13 | 4/7/2014 | NC | 11.8 | NC | 3.17 | NC | 15.0 | NC | ND | 74 | ND | 5.12 | 6.52 | 107 |
| DRI | 1-13 | 4/18/2014 | 10.2 | NC | 3.09 | NC | 15.1 | NC | 2.57 | NC | NC | NC | NC | NC | NC |
| TT | 1-14 | 4/18/2014 | NC | 109 | NC | 20 | NC | 201 | NC | 26.4 | 366 | ND | 66.0 B | 328 | 976 |
| DRI | 1-15 | 4/18/2014 | 34.1 | NC | 21.5 | NC | 184 | NC | 17.7 | NC | 519 | 25.4 | 41.9 | 68.1 | 799 |
| DRI | 1-16 | 9/22/2014 | 11.9 | NC | 2.86 | NC | 9.2 | NC | 7.1 | NC | 73 | ND | 3.6 | 5.89 | 110 |
| TT | 1-16 | 9/22/2014 | NC | 11.9 | NC | 3.05 | NC | 14.4 | NC | 1.64 J | 76 | ND | NC | NC | NC |
| DRI | 1-17 | 9/22/2014 | 59.1 | NC | 10.9 | NC | 37.8 | NC | 7.8 | NC | 210 | ND | 39.9 | 59.4 | 488 |
| TT | 1-17 | 9/22/2014 | NC | 62.3 | NC | 10.7 | NC | 37.3 | NC | 2.35 J | 212 B | ND | NC | NC | NC |
| DRI | 1-18 | 9/22/2014 | 23.5 | NC | 5.7 | NC | 17.3 | NC | 7.2 | NC | 127 | ND | 6.32 | 9.4 | 92 |
| TT | 1-18 | 9/22/2014 | NC | 23.4 | NC | 5.31 | NC | 23.2 | NC | 1.94 J | 127 B | ND | NC | NC | NC |
| DRI | 1-19 | 9/23/2014 | 46.0 | NC | 12.4 | NC | 52.0 | NC | 14.1 | NC | 293 | ND | 22.2 | 20.8 | 475 |
| TT | 1-19 | 9/23/2014 | NC | 47.5 | NC | 12.0 | NC | 56.6 | NC | 10.9 | 292 B | ND | NC | NC | NC |

Table A2. Major-Ion Chemistry and Total Dissolved Solids for Upper Humboldt River Basin Wells, Springs, and Streams (continued).

| Agency (Units) | Location ID | Sample Date | Ca (dissolved) (mg/L) | Ca (total) (mg/L) | Mg (dissolved) (mg/L) | Mg (total) (mg/L) | Na (dissolved) (mg/L) | Na (total) (mg/L) | K (dissolved) (mg/L) | K (total) (mg/L) | $HCO_3$ (mg/L) | $CO_3$ (mg/L) | Cl (mg/L) | $SO_4$ (mg/L) | TDS (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DRI | 1-20 | 9/23/2014 | 27.6 | NC | 7.2 | NC | 18.4 | NC | 6.9 | NC | 127 | ND | 4.32 | 7.67 | 251 |
| TT | 1-20 | 9/23/2014 | NC | 26.9 | NC | 6.69 | NC | 14.7 | NC | 2.20 J | 129 B | ND | NC | NC | NC |
| DRI | 1-21 | 9/23/2014 | 61.2 | NC | 6.7 | NC | 11.8 | NC | 0.5 | NC | 220 | ND | 2.96 | 7.65 | 280 |
| DRI | 1-22 | 9/24/2014 | 17.6 | NC | 3.27 | NC | 17.7 | NC | 5.3 | NC | 84 | ND | 7.89 | 14.1 | 110 |
| DRI | 1-23 | 9/24/2014 | 6.4 | NC | 1.33 | NC | 2.2 | NC | 5.8 | NC | 34 | ND | 1.22 | 0.40 | 81 |
| DRI | 1-24 | 9/29/2014 | 27.4 | NC | 6.82 | NC | 17.8 | NC | 6.9 | NC | 103 | ND | 15.8 | 22.8 | 220 |
| TT | 1-24 | 9/29/2014 | NC | 25.9 | NC | 6.39 | NC | 19.1 | NC | 2.91 J | 106 B | ND | NC | NC | NC |
| DRI | 1-25 | 9/29/2014 | 28.3 | NC | 3.24 | NC | 35.4 | NC | 10.2 | NC | 185 | ND | 5.03 | 11.3 | 280 |
| TT | 1-25 | 9/29/2014 | NC | 25.8 | NC | 2.88 | NC | 43.6 | NC | 7.36 | 183 | ND | NC | NC | NC |
| DRI | 1-26 | 10/7/2014 | 37.3 | NC | 2.09 | NC | 19.7 | NC | 3.13 | NC | 107 | ND | 23.2 | 28.6 | 200 |
| TT | 1-26 | 10/7/2014 | NC | 39.0 | NC | 2.09 | NC | 28.0 B | NC | 3.05 | 104 B | ND | NC | NC | NC |
| DRI | 1-27 | 10/7/2014 | 49.6 | NC | 8.08 | NC | 17.8 | NC | 6.59 | NC | 171 | ND | 23.3 | 24.1 | 262 |
| TT | 1-27 | 10/7/2014 | NC | 52.4 | NC | 7.9 | NC | 22.4 B | NC | 6.26 | 165 | ND | NC | NC | NC |
| DRI | 1-28 | 10/20/2014 | 24.0 | NC | 6.09 | NC | 20.7 | NC | 2.2 | NC | 122 | ND | 9.2 | 18.3 | 168 |
| TT | 1-28 | 10/20/2014 | NC | 20.7 | NC | 4.93 | NC | 26.1 | NC | 1.9 J | 127 | ND | NC | NC | NC |
| DRI | 1-29 | 10/20/2014 | 27.3 | NC | 4.82 | NC | 21.9 | NC | 6.9 | NC | 112 | ND | 12.9 | 25.6 | 200 |
| TT | 1-29 | 10/20/2014 | NC | 23.1 | NC | 3.84 | NC | 27.3 | NC | 6.33 | 120 | ND | NC | NC | NC |
| DRI | 1-30 | 10/21/2014 | 29.5 | NC | 4.61 | NC | 14.1 | NC | 2.8 | NC | 107 | ND | 12.8 | 17.3 | 150 |
| TT | 1-30 | 10/21/2014 | NC | 27.0 | NC | 4.04 | NC | 18.2 | NC | 2.77 J | 109 | ND | NC | NC | NC |
| TT | 1-31 | 10/20/2014 | NC | 35.4 | NC | 6.56 | NC | 18.5 | NC | 6.46 | 98 | ND | NC | NC | NC |
| TT | 1-32 | 9/23/2014 | NC | 19.4 | NC | 4.23 | NC | 21.0 | NC | 1.57 J | 115 | ND | NC | NC | NC |
| TT | 1-33 | 9/22/2014 | NC | 22.7 | NC | 5.01 | NC | 23.6 | NC | 2.31 J | 116 | ND | NC | NC | NC |
| TT | 1-34 | 9/22/2014 | NC | 36.0 | NC | 7.62 | NC | 29.9 | NC | 5.53 | 145 | ND | NC | NC | NC |
| TT | 1-35 | 9/23/2014 | NC | 19.3 | NC | 5.31 | NC | 19.1 | NC | 1.83 J | 114 | ND | NC | NC | NC |

Table A2. Major-Ion Chemistry and Total Dissolved Solids for Upper Humboldt River Basin Wells, Springs, and Streams (continued).

| Agency (Units) | Location ID | Sample Date | Ca (dissolved) (mg/L) | Ca (total) (mg/L) | Mg (dissolved) (mg/L) | Mg (total) (mg/L) | Na (dissolved) (mg/L) | Na (total) (mg/L) | K (dissolved) (mg/L) | K (total) (mg/L) | $HCO_3$ (mg/L) | $CO_3$ (mg/L) | Cl (mg/L) | $SO_4$ (mg/L) | TDS (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Area 2 Pre-Hydraulic Fracturing** | | | | | | | | | | | | | | | |
| DRI | 2-1 | 9/4/2013 | 0.57 | NC | 0.06 | NC | 157 | NC | 1.8 | NC | 238 | 82.8 | 3.7 | 2.8 | 435 |
| TT | 2-1 | 9/4/2013 | NC | 3.17 | NC | 0.695 | NC | 162 | NC | ND | 190 | 106.2 | 3.74 | ND | NC |
| TT | 2-2 | 9/4/2013 | NC | 70.6 | NC | 10.4 | NC | 30.6 | NC | 3.77 | 307 | ND | 13.6 | 17.8 | NC |
| TT | 2-3 | 9/4/2013 | NC | 81.5 | NC | 12.5 | NC | 21.5 | NC | 5.26 | 346 | ND | 10.7 | 15.4 | NC |
| DRI | 2-4 | 9/4/2013 | 37.4 | NC | 6.7 | NC | 21.6 | NC | 2.4 | NC | 152 | ND | 13.8 | 26.2 | 207 |
| TT | 2-4 | 9/4/2013 | NC | 36.9 | NC | 6.58 | NC | 22.5 | NC | ND | 153 | ND | 13.6 | 25.2 | NC |
| TT | 2-5 | 9/4/2013 | NC | 34.9 | NC | 5.2 | NC | 18.6 | NC | ND | 172 | ND | ND | 7.25 | NC |
| TT | 2-6 | 9/4/2013 | NC | 44.8 | NC | 4.18 | NC | 5.31 | NC | ND | 173 | ND | ND | ND | NC |
| TT | 2-7 | 9/4/2013 | NC | 50.4 | NC | 7.57 | NC | 10.9 | NC | ND | 211 | ND | ND | 7.89 | NC |
| TT | 2-8 | 10/8/2013 | NC | 42 | NC | 7.75 | NC | 6.34 | NC | ND | 145 | ND | 11.5 | 13.8 | NC |
| TT | 2-9 | 10/8/2013 | NC | 43.7 | NC | 8.02 | NC | 40.7 | NC | ND | 240 | ND | 5.25 | 29.4 | NC |
| **Area 2 Post-Hydraulic Fracturing** | | | | | | | | | | | | | | | |
| DRI | 2-1 | 6/23/2014 | 0.61 | NC | ND | NC | 160 | NC | 1.5 | NC | 171 | 120 | 4.0 | 0.57 | 390 |
| TT | 2-1 | 6/23/2014 | NC | 0.842 | NC | 0.0386 J | NC | 168 | NC | 1.93 J | 176 | 105 | NC | NC | NC |
| DRI | 2-2 | 6/23/2014 | 51 | NC | 12 | NC | 19 | NC | 4.9 | NC | 293 | ND | 6.6 | 10 | 290 |
| TT | 2-2 | 6/23/2014 | NC | 73.0 | NC | 11.9 | NC | 20.1 | NC | 5.25 | 295 | ND | NC | NC | NC |
| TT | 2-3 | 6/23/2014 | NC | 90.9 | NC | 14.2 | NC | 22.3 | NC | 5.78 | 332 | ND | NC | NC | NC |
| DRI | 2-4 | 6/23/2014 | 26 | NC | 6.5 | NC | 22 | NC | 3.4 | NC | 146 | ND | 13 | 25 | 190 |
| TT | 2-4 | 6/23/2014 | NC | 37.5 | NC | 6.99 | NC | 23.0 | NC | 2.59 J | 144 | ND | NC | NC | NC |
| TT | 2-5 | 6/25/2014 | NC | 34.8 | NC | 5.24 | NC | 17.4 | NC | 0.954 J | 154 | ND | NC | NC | NC |
| TT | 2-6 | 6/25/2014 | NC | 42.7 | NC | 4.04 | NC | 5.28 | NC | 0.865 J | 138 | ND | NC | NC | NC |
| TT | 2-7 | 7/1/2014 | NC | 50.7 | NC | 8.06 B | NC | 14.2 | NC | 1.390 J | 200 | ND | NC | NC | NC |
| TT | 2-8 | 6/25/2014 | NC | 43.9 | NC | 8.54 | NC | 6.35 | NC | 1.28 J | 142 | ND | NC | NC | NC |
| TT | 2-9 | 6/25/2014 | NC | 46.5 | NC | 9 | NC | 42.5 | NC | 1.35 J | 226 | ND | NC | NC | NC |
| DRI | 2-10 | 4/1/2014 | 37.2 | NC | 2.54 | NC | 5.16 | NC | 1.2 | NC | 130 | ND | 2.4 | 5.4 | 138 |

Table A2. Major-Ion Chemistry and Total Dissolved Solids for Upper Humboldt River Basin Wells, Springs, and Streams (continued).

| Agency (Units) | Location ID | Sample Date | Ca (dissolved) (mg/L) | Ca (total) (mg/L) | Mg (dissolved) (mg/L) | Mg (total) (mg/L) | Na (dissolved) (mg/L) | Na (total) (mg/L) | K (dissolved) (mg/L) | K (total) (mg/L) | $HCO_3$ (mg/L) | $CO_3$ (mg/L) | Cl (mg/L) | $SO_4$ (mg/L) | TDS (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DRI | 2-10 | 6/23/2014 | 16 | NC | 0.97 | NC | 1.9 | NC | 1.6 | NC | 89 | ND | 0.71 | 1.9 | 71 |
| DRI | 2-11 | 6/25/2014 | 32 | NC | 5.2 | NC | 23 | NC | 1.7 | NC | 171 | ND | 12 | 16 | 220 |
| DRI | 2-12 | 6/24/2014 | 36 | NC | 12 | NC | 16 | NC | 1.8 | NC | 232 | ND | 6.5 | 7.4 | 210 |
| DRI | 2-13 | 6/24/2014 | 38 | NC | 6.7 | NC | 11 | NC | 2.2 | NC | 220 | ND | 3.3 | 5 | 190 |
| DRI | 2-14 | 6/24/2014 | 51 | NC | 14 | NC | 33 | NC | 8.2 | NC | 317 | ND | 12 | 25 | 300 |
| DRI | 2-15 | 9/5/2014 | 37.2 | NC | 5.5 | NC | 14.4 | NC | 1.7 | NC | 127 | ND | 12.8 | 16 | 322 |
| DRI | 2-16 | 9/25/2014 | 1.43 | NC | 0.025 | NC | 112 | NC | 6.8 | NC | 103 | 101 | 2.87 | 1.12 | 508 |
| DRI | M2C-M2-21B | 9/25/2014 | 56.8 | NC | 3.62 | NC | 3390 | NC | 524 | NC | 791 | ND | 5854 | 11.1 | 8527 |
| | M10C-M10-11B | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- |
| **Area 3 Pre-Hydraulic Fracturing** | | | | | | | | | | | | | | | |
| DRI | 3-1 | 9/3/2014 | 17.2 | NC | 7.9 | NC | 36.9 | NC | 20.7 | NC | 195 | ND | 3.42 | 14.8 | 290 |
| TT | 3-1 | 9/3/2014 | NC | 16.7 | NC | 7.44 | NC | 48.6 | NC | 15.1 | 204 | ND | NC | NC | NC |
| DRI | 3-2 | 9/3/2014 | 8.4 | NC | 1.8 | NC | 29.0 | NC | 22.5 | NC | 140 | ND | 3.53 | 5.87 | 239 |
| TT | 3-2 | 9/3/2014 | NC | 8.11 | NC | 1.31 | NC | 39.8 | NC | 17.3 | 148 | 2 | NC | NC | NC |
| DRI | 3-3 | 9/3/2014 | 10.6 | NC | 0.2 | NC | 191 | NC | 6.4 | NC | 307 | 86 | 5.09 | 2.7 | 634 |
| TT | 3-3 | 9/3/2014 | NC | 0.721 | NC | 0.035 J | NC | 203 | NC | 3.04 | 211 | 137 | NC | NC | NC |
| DRI | 3-4 | 9/4/2014 | 28.1 | NC | 21.9 | NC | 135 | NC | 27.1 | NC | 378 | 5 | 66.9 | 77.6 | 827 |
| DRI | 3-5 | 9/5/2014 | 17.7 | NC | 24 | NC | 201 | NC | 50.6 | NC | 207 | 48 | 137 | 223 | 1182 |
| DRI | 3-6 | 9/30/2014 | 70.2 | NC | 18.5 | NC | 24.8 | NC | 10.9 | NC | 300 | ND | 10.0 | 46.5 | 348 |
| TT | 3-6 | 9/30/2014 | NC | 73.2 | NC | 18.1 | NC | 26.3 B | NC | 7.72 | 325 | ND | NC | NC | NC |
| DRI | 3-7 | 9/30/2014 | 48.9 | NC | 15.2 | NC | 12.0 | NC | 7.1 | NC | 220 | ND | 5.0 | 21.5 | 272 |
| TT | 3-7 | 9/30/2014 | NC | 49.1 | NC | 14.5 | NC | 11.4 ^ B | NC | 3.18 | 222 | ND | NC | NC | NC |
| DRI | 3-8 | 9/30/2014 | 65.0 | NC | 18.3 | NC | 15.7 | NC | 8.9 | NC | 264 | ND | 6.75 | 44.9 | 328 |
| DRI | 3-9 | 10/8/2014 | 36.5 | NC | 14.0 | NC | 9.1 | NC | 5.06 | NC | 176 | ND | 5.25 | 15.4 | 200 |
| TT | 3-9 | 10/8/2014 | NC | 35.7 | NC | 13.5 | NC | 10.9 B | NC | 4.99 | 174 B | ND | NC | NC | NC |

Table A2. Major-Ion Chemistry and Total Dissolved Solids for Upper Humboldt River Basin Wells, Springs, and Streams (continued).

| Agency (Units) | Location ID | Sample Date | Ca (dissolved) (mg/L) | Ca (total) (mg/L) | Mg (dissolved) (mg/L) | Mg (total) (mg/L) | Na (dissolved) (mg/L) | Na (total) (mg/L) | K (dissolved) (mg/L) | K (total) (mg/L) | $HCO_3$ (mg/L) | $CO_3$ (mg/L) | Cl (mg/L) | $SO_4$ (mg/L) | TDS (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DRI | 3-10 | 10/21/2014 | 54.2 | NC | 17.1 | NC | 9.7 | NC | 4.1 | NC | 205 | ND | 10.1 | 29.7 | 242 |
| TT | 3-10 | 10/29/2014 | NC | 51.8 ^ | NC | 15.4 | NC | 14.2 ^ B | NC | 4.23 | 212 | ND | NC | NC | NC |
| DRI | 3-11 | 10/21/2014 | 91.0 | NC | 28.9 | NC | 83.2 | NC | 8.5 | NC | 383 | ND | 62.9 | 116 | 612 |
| TT | 3-11 | 10/21/2014 | NC | 66.5 | NC | 17.7 | NC | 36.9 | NC | 5.62 | 305 | ND | NC | NC | NC |
| TT | 3-12 | 10/21/2014 | NC | 82.0 | NC | 25.7 | NC | 112 | NC | 5.29 | 428 | 3 | NC | NC | NC |
| DRI | 3-12 | 10/22/2014 | 70.6 | NC | 19.6 | NC | 41.0 | NC | 4.5 | NC | 336 | ND | 27.8 | 45.0 | 396 |
| DRI | 3-13 | 10/22/2014 | ND | NC | ND | NC | 1240 | NC | 64.4 | NC | 2001 | 264 | 518 | ND | 3336 |
| TT | 3-14 | 10/21/2014 | NC | 58.4 | NC | 15.8 | NC | 49.0 | NC | 3.08 | 354 | ND | NC | NC | NC |
| TT | 3-15 | 9/30/2014 | NC | 71.0 | NC | 21.6 | NC | 28.4 B | NC | 7.47 | 332 | 7 | NC | NC | NC |

DRI = Desert Research Institute
NC = not collected
ND = none detected (below minimum detection limit)
TT = Tetra Tech

B = compound was found in the blank and sample
H = sample was prepped or analyzed beyond the specified holding time
J = result is less than the reporting limit but greater than or equal to the method detection limit and the concentration is an approximate value
^ = instrument related quality check exceeds the control limits

Table A3. Trace Elements, $SiO_2$, and $NO_3$-N for Upper Humboldt River Basin Wells, Springs, and Streams.

| Agency (Units) | Location ID | Sample Date | B (mg/L) | Ba (dissolved) (mg/L) | Ba (total) (mg/L) | Li (dissolved) (mg/L) | Li (total) (mg/L) | Sr (dissolved) (mg/L) | Sr (total) (mg/L) | $SiO_2$ (mg/L) | $NO_3$ - N (mg/L) | F (mg/L) | Br (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Area 1 Pre-Hydraulic Fracturing** | | | | | | | | | | | | | |
| TT | 1-1 | 3/31/2014 | ND | NC | 0.154 | NC | 0.0133 | NC | 0.321 | NC | NC | ND | ND |
| DRI | 1-1 | 3/31/2014 | 0.07 | 0.14 | NC | 0.01 | NC | 0.26 | NC | 57.0 | 1.17 | 0.16 | 0.08 |
| TT | 1-2 | 3/31/2014 | 0.112 | NC | 0.0606 | NC | ND | NC | 0.229 | NC | NC | ND | ND |
| TT | 1-3 | 3/31/2014 | ND | NC | 0.106 | NC | ND | NC | 0.609 | NC | NC | ND | 0.424 |
| TT | 1-4 | 3/31/2014 | ND | NC | 0.583 | NC | ND | NC | 0.227 | NC | NC | ND | ND |
| TT | 1-5 | 3/31/2014 | ND | NC | 0.00433 | NC | ND | NC | 0.150 | NC | NC | ND | ND |
| TT | 1-6 | 3/31/2014 | ND | NC | 0.0545 | NC | ND | NC | 0.174 | NC | NC | ND | ND |
| TT | 1-7 | 4/1/2014 | 0.111 | NC | 0.0686 | NC | ND | NC | 0.33 | NC | NC | ND | ND |
| TT | 1-8 | 4/1/2014 | 0.194 | NC | 0.128 | NC | 0.0172 | NC | 0.495 | NC | NC | 0.582 | 0.262 |
| TT | 1-9 | 4/1/2014 | ND | NC | 0.088 | NC | ND | NC | 0.234 | NC | NC | ND | ND |
| TT | 1-10 | 4/1/2014 | ND | NC | 0.0852 | NC | 0.0181 | NC | 0.271 | NC | NC | ND | ND |
| TT | 1-11 | 4/1/2014 | ND | NC | 0.102 | NC | 0.141 | NC | 0.291 | NC | NC | ND | ND |
| DRI | 1-12 | 4/2/2014 | 0.04 | 0.12 | NC | <0.01 | NC | 0.13 | NC | 12.1 | 0.93 | 0.08 | 0.02 |
| TT | 1-13 | 4/7/2014 | ND | NC | 0.0164 | NC | ND | NC | 0.0924 | NC | NC | ND | ND |
| TT | 1-13 | 4/18/2014 | NC | NC | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| DRI | 1-13 | 4/18/2014 | 0.05 | 0.02 | NC | 0.01 | NC | 0.09 | NC | NC | NC | NC | NC |
| TT | 1-14 | 4/18/2014 | 0.393 B | NC | 0.163 | NC | 0.196 | NC | 0.509 | NC | NC | 1.42 J | 0.761 |
| DRI | 1-15 | 4/18/2014 | 0.51 | 0.03 | NC | 0.06 | NC | 0.55 | NC | NC | 0.59 | 0.98 | 0.24 |
| DRI | 1-16 | 9/22/2014 | ND | 0.02 | NC | 0.03 | NC | 0.093 | NC | 42.5 | 0.17 | 0.17 | ND |
| TT | 1-16 | 9/22/2014 | 0.0417 J B | NC | NC | NC | 0.0151 B | NC | 0.093 | NC | NC | NC | NC |
| DRI | 1-17 | 9/22/2014 | ND | 0.097 | NC | ND | NC | 0.33 | NC | 53.1 | 0.70 | 0.35 | 0.152 |
| TT | 1-17 | 9/22/2014 | 0.0722 J B | NC | NC | NC | 0.0133 B | NC | 0.342 | NC | NC | NC | NC |
| DRI | 1-18 | 9/22/2014 | ND | 0.037 | NC | ND | NC | 0.2 | NC | 35.3 | 0.78 | 0.20 | ND |
| TT | 1-18 | 9/22/2014 | 0.0674 J B | NC | NC | NC | 0.00637 J B | NC | 0.190 | NC | NC | NC | NC |
| DRI | 1-19 | 9/23/2014 | 0.26 | 0.06 | NC | ND | NC | 0.42 | NC | 30.2 | 0.08 | 0.71 | ND |

Table A3. Trace Elements, $SiO_2$, and $NO_3$-N for Upper Humboldt River Basin Wells, Springs, and Streams (continued).

| Agency (Units) | Location ID | Sample Date | B (mg/L) | Ba (dissolved) (mg/L) | Ba (total) (mg/L) | Li (dissolved) (mg/L) | Li (total) (mg/L) | Sr (dissolved) (mg/L) | Sr (total) (mg/L) | $SiO_2$ (mg/L) | $NO_3$ - N (mg/L) | F (mg/L) | Br (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TT | 1-19 | 9/23/2014 | 0.273 B | NC | NC | NC | 0.059 B | NC | 0.418 | NC | NC | NC | NC |
| DRI | 1-20 | 9/23/2014 | 0.07 | 0.04 | NC | ND | NC | 0.22 | NC | 38.7 | 2.58 | 0.20 | ND |
| TT | 1-20 | 9/23/2014 | 0.0768 J B | NC | NC | NC | 0.0105 B | NC | 0.197 | NC | NC | NC | NC |
| DRI | 1-21 | 9/23/2014 | 0.01 | 0.005 | NC | ND | NC | 0.24 | NC | 20.4 | 0.06 | 0.08 | ND |
| DRI | 1-22 | 9/24/2014 | 0.02 | 0.05 | NC | 0.014 | NC | 0.18 | NC | 42.9 | 0.50 | 0.30 | ND |
| DRI | 1-23 | 9/24/2014 | ND | ND | NC | 0.04 | NC | 0.05 | NC | 19.1 | 0.01 | 0.08 | ND |
| DRI | 1-24 | 9/29/2014 | 0.08 | 0.14 | NC | ND | NC | 0.24 | NC | 62.9 | 1.37 | 0.18 | 0.0604 |
| TT | 1-24 | 9/29/2014 | 0.0421 J | NC | NC | NC | 0.015 | NC | 0.223 | NC | NC | NC | NC |
| DRI | 1-25 | 9/29/2014 | 0.2 | ND | NC | 0.016 | NC | 0.125 | NC | 99.4 | 0.14 | 2.20 | 0.0264 |
| TT | 1-25 | 9/29/2014 | 0.164 | NC | NC | NC | 0.047 | NC | 0.118 | NC | NC | NC | NC |
| DRI | 1-26 | 10/7/2014 | 0.067 | 0.03 | NC | 0.011 | NC | 0.18 | NC | 35.0 | 3.05 | 0.386 | 0.105 |
| TT | 1-26 | 10/7/2014 | 0.0601 J | NC | NC | NC | 0.0118 | NC | 0.196 | NC | NC | NC | NC |
| DRI | 1-27 | 10/7/2014 | 0.109 | 0.086 | NC | 0.011 | NC | 0.22 | NC | 57.8 | 0.355 | 0.339 | 0.078 |
| TT | 1-27 | 10/7/2014 | 0.0807 J | NC | NC | NC | 0.0126 | NC | 0.246 | NC | NC | NC | NC |
| DRI | 1-28 | 10/20/2014 | ND | 0.094 | NC | 0.007 | NC | 0.18 | NC | 33.1 | 1.76 | 0.236 | 0.0484 |
| TT | 1-28 | 10/20/2014 | 0.0619 J | NC | NC | NC | 0.00834 J | NC | 0.164 | NC | NC | NC | NC |
| DRI | 1-29 | 10/20/2014 | ND | 0.043 | NC | 0.011 | NC | 0.15 | NC | 70.9 | 0.122 | 0.467 | 0.0413 |
| TT | 1-29 | 10/20/2014 | 0.0968 J | NC | NC | NC | 0.0118 | NC | 0.144 | NC | NC | NC | NC |
| DRI | 1-30 | 10/21/2014 | ND | 0.124 | NC | 0.009 | NC | 0.47 | NC | 26.3 | 1.45 | 0.486 | 0.0587 |
| TT | 1-30 | 10/21/2014 | 0.0424 J | NC | NC | NC | 0.011 | NC | 0.446 | NC | NC | NC | NC |
| TT | 1-31 | 10/20/2014 | 0.0807 J | NC | NC | NC | 0.0151 | NC | 0.226 | NC | NC | NC | NC |
| TT | 1-32 | 9/23/2014 | 0.0629 J B | NC | NC | NC | 0.00926 J B | NC | 0.167 | NC | NC | NC | NC |
| TT | 1-33 | 9/22/2014 | 0.0512 J B | NC | NC | NC | 0.0254 B | NC | 0.176 | NC | NC | NC | NC |
| TT | 1-34 | 9/22/2014 | 0.146 B | NC | NC | NC | 0.010 B | NC | 0.245 | NC | NC | NC | NC |
| TT | 1-35 | 9/23/2014 | 0.0798 J B | NC | NC | NC | 0.00772 J B | NC | 152 | NC | NC | NC | NC |

Table A3. Trace Elements, $SiO_2$, and $NO_3$-N for Upper Humboldt River Basin Wells, Springs, and Streams (continued).

| Agency (Units) | Location ID | Sample Date | B (mg/L) | Ba (dissolved) (mg/L) | Ba (total) (mg/L) | Li (dissolved) (mg/L) | Li (total) (mg/L) | Sr (dissolved) (mg/L) | Sr (total) (mg/L) | $SiO_2$ (mg/L) | $NO_3$ - N (mg/L) | F (mg/L) | Br (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Area 2 Pre-Hydraulic Fracturing** | | | | | | | | | | | | | |
| DRI | 2-1 | 9/4/2013 | 0.86 | ND | NC | <0.01 | NC | NC | NC | 54.3 | <0.01 | 3.73 | 0.02 |
| TT | 2-1 | 9/4/2013 | NC | NC | NC | NC | 0.0113 | NC | NC | NC | NC | 3.3 | ND |
| TT | 2-2 | 9/4/2013 | NC | NC | NC | NC | ND | NC | NC | NC | NC | ND | ND |
| TT | 2-3 | 9/4/2013 | NC | NC | NC | NC | ND | NC | NC | NC | NC | ND | ND |
| DRI | 2-4 | 9/4/2013 | 0.05 | ND | NC | 0.01 | NC | NC | NC | 29.1 | 0.07 | 0.21 | 0.06 |
| TT | 2-4 | 9/4/2013 | NC | NC | NC | NC | ND | NC | NC | NC | NC | ND | ND |
| TT | 2-5 | 9/4/2013 | NC | NC | NC | NC | ND | NC | NC | NC | NC | ND | ND |
| TT | 2-6 | 9/4/2013 | NC | NC | NC | NC | ND | NC | NC | NC | NC | ND | ND |
| TT | 2-7 | 9/4/2013 | NC | NC | NC | NC | ND | NC | NC | NC | NC | ND | ND |
| TT | 2-8 | 10/8/2013 | NC | NC | NC | NC | ND | NC | NC | NC | NC | ND | ND |
| TT | 2-9 | 10/8/2013 | NC | NC | NC | NC | ND | NC | NC | NC | NC | ND | ND |
| **Area 2 Post-Hydraulic Fracturing** | | | | | | | | | | | | | |
| DRI | 2-1 | 6/23/2014 | 0.87 | ND | NC | 0.0074 | NC | ND | NC | 49 | ND | 3.9 | ND |
| TT | 2-1 | 6/23/2014 | 0.911 | NC | NC | NC | 0.00622 J | NC | 0.00689 J | NC | NC | NC | NC |
| DRI | 2-2 | 6/23/2014 | 0.13 | 0.055 | NC | 0.013 | NC | 0.26 | NC | 31 | ND | 0.26 | ND |
| TT | 2-2 | 6/23/2014 | 0.0782 J | NC | NC | NC | 0.0107 | NC | 0.313 | NC | NC | NC | NC |
| TT | 2-3 | 6/23/2014 | 0.0942 J | NC | NC | NC | 0.00964 J | NC | 0.368 | NC | NC | NC | NC |
| DRI | 2-4 | 6/23/2014 | 0.11 | 0.055 | NC | 0.01 | NC | 0.25 | NC | 25 | ND | ND | ND |
| TT | 2-4 | 6/23/2014 | 0.0513 J | NC | NC | NC | 0.00614 J | NC | 0.295 | NC | NC | NC | NC |
| TT | 2-5 | 6/25/2014 | 0.0394 J | NC | NC | NC | 0.0035 J | NC | 0.161 | NC | NC | NC | NC |
| TT | 2-6 | 6/25/2014 | 0.0198 J | NC | NC | NC | ND | NC | 0.146 | NC | NC | NC | NC |
| TT | 2-7 | 7/1/2014 | 0.0397 J B | NC | NC | NC | ND | NC | 0.211 | NC | NC | NC | NC |
| TT | 2-8 | 6/25/2014 | 0.0209 J | NC | NC | NC | ND | NC | 0.241 | NC | NC | NC | NC |
| TT | 2-9 | 6/25/2014 | 0.237 | NC | NC | NC | 0.00683 J | NC | 0.278 | NC | NC | NC | NC |
| DRI | 2-10 | 4/1/2014 | 0.02 | 0.02 | NC | <0.01 | NC | 0.11 | NC | 13.4 | <0.01 | 0.05 | <0.02 |

Table A3. Trace Elements, $SiO_2$, and $NO_3$-N for Upper Humboldt River Basin Wells, Springs, and Streams (continued).

| Agency (Units) | Location ID | Sample Date | B (mg/L) | Ba (dissolved) (mg/L) | Ba (total) (mg/L) | Li (dissolved) (mg/L) | Li (total) (mg/L) | Sr (dissolved) (mg/L) | Sr (total) (mg/L) | $SiO_2$ (mg/L) | $NO_3$ - N (mg/L) | F (mg/L) | Br (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DRI | 2-10 | 6/23/2014 | ND | 0.0075 | NC | ND | NC | 0.059 | NC | 6.7 | ND | ND | ND |
| DRI | 2-11 | 6/25/2014 | 0.12 | 0.070 | NC | 0.015 | NC | 0.21 | NC | 32 | 1.3 | 0.4 | ND |
| DRI | 2-12 | 6/24/2014 | ND | 0.10 | NC | 0.0075 | NC | 0.25 | NC | 22 | ND | ND | ND |
| DRI | 2-13 | 6/24/2014 | ND | 0.028 | NC | 0.0061 | NC | 0.19 | NC | 17 | ND | ND | ND |
| DRI | 2-14 | 6/24/2014 | 0.17 | 0.13 | NC | 0.060 | NC | 0.58 | NC | 22 | 0.36 | 0.65 | ND |
| DRI | 2-15 | 9/5/2014 | 0.08 | 0.0423 | NC | 0.0035 | NC | 0.17 | NC | 25.7 | 1.1 | 0.14 | ND |
| DRI | 2-16 | 9/25/2014 | 0.33 | ND | NC | 0.05 | NC | 0.007 | NC | 113 | 0.01 | 3.43 | ND |
| DRI | M2C-M2-21B | 9/25/2014 | 15.0 | 10.8 | NC | 19.2 | NC | 46.7 | NC | 192 | ND | 24.1 | ND |
| | M10C-M10-11B | | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- |
| **Area 3 Pre-Hydraulic Fracturing** | | | | | | | | | | | | | |
| DRI | 3-1 | 9/3/2014 | 0.20 | 0.0129 | NC | 0.0413 | NC | 0.21 | NC | 51.2 | ND | 0.43 | ND |
| TT | 3-1 | 9/3/2014 | 0.0992 J | NC | NC | NC | 0.0433 | NC | 0.202 | NC | NC | NC | NC |
| DRI | 3-2 | 9/3/2014 | 0.25 | 0.033 | NC | 0.033 | NC | 0.15 | NC | 58.8 | 0.002 | 0.51 | ND |
| TT | 3-2 | 9/3/2014 | 0.168 | NC | NC | NC | 0.0356 | NC | 0.141 | NC | NC | NC | NC |
| DRI | 3-3 | 9/3/2014 | 1.23 | 0.0056 | NC | 0.0024 | NC | 0.01 | NC | 72.5 | ND | 9.26 | ND |
| TT | 3-3 | 9/3/2014 | 1.05 | NC | NC | NC | ND | NC | 0.0126 | NC | NC | NC | NC |
| DRI | 3-4 | 9/4/2014 | 0.48 | 0.214 | NC | 0.131 | NC | 0.71 | NC | 66.7 | ND | 1.05 | ND |
| DRI | 3-5 | 9/5/2014 | 0.62 | 0.0222 | NC | 0.066 | NC | 0.31 | NC | 11.7 | ND | 1.16 | ND |
| DRI | 3-6 | 9/30/2014 | 0.13 | 0.15 | NC | ND | NC | 0.35 | NC | 46.3 | 0.43 | 0.41 | 0.0353 |
| TT | 3-6 | 9/30/2014 | 0.0913 J | NC | NC | NC | 0.0422 | NC | 0.349 | NC | NC | NC | NC |
| DRI | 3-7 | 9/30/2014 | 0.06 | 0.18 | NC | ND | NC | 0.19 | NC | 42.1 | 0.16 | 0.17 | 0.0198 |
| TT | 3-7 | 9/30/2014 | 0.0327 J | NC | NC | NC | 0.00638 J | NC | 0.179 | NC | NC | NC | NC |
| DRI | 3-8 | 9/30/2014 | 0.08 | 0.19 | NC | ND | NC | 0.48 | NC | 37.8 | 30 | 0.73 | 23.4 |
| DRI | 3-9 | 10/8/2014 | 0.047 | 0.14 | NC | 0.011 | NC | 0.21 | NC | 49.9 | 0.277 | 0.373 | 0.0218 |
| TT | 3-9 | 10/8/2014 | 0.0324 J | NC | NC | NC | 0.0128 | NC | 0.231 | NC | NC | NC | NC |

Table A3. Trace Elements, $SiO_2$, and $NO_3$-N for Upper Humboldt River Basin Wells, Springs, and Streams (continued).

| Agency (Units) | Location ID | Sample Date | B (mg/L) | Ba (dissolved) (mg/L) | Ba (total) (mg/L) | Li (dissolved) (mg/L) | Li (total) (mg/L) | Sr (dissolved) (mg/L) | Sr (total) (mg/L) | $SiO_2$ (mg/L) | $NO_3$ - N (mg/L) | F (mg/L) | Br (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DRI | 3-10 | 10/21/2014 | ND | 0.166 | NC | 0.006 | NC | 0.23 | NC | 42.5 | 0.885 | 0.262 | 0.0543 |
| TT | 3-10 | 10/29/2014 | 0.041 J | NC | NC | NC | 0.00749 J | NC | 0.260 | NC | NC | NC | NC |
| DRI | 3-11 | 10/21/2014 | 0.5 | 0.2 | NC | 0.048 | NC | 0.42 | NC | 24.6 | ND | 0.62 | 0.214 |
| TT | 3-11 | 10/21/2014 | 0.126 | NC | NC | NC | 0.00932 J | NC | 0.345 | NC | NC | NC | NC |
| TT | 3-12 | 10/21/2014 | 0.502 | NC | NC | NC | 0.053 | NC | 0.417 | NC | NC | NC | NC |
| DRI | 3-12 | 10/22/2014 | ND | 0.075 | NC | 0.014 | NC | 0.33 | NC | 39.9 | 0.267 | 0.551 | 0.1 |
| DRI | 3-13 | 10/22/2014 | 22.8 | 0.083 | NC | 0.001 | NC | 0.08 | NC | 76 | ND | 78.0 | ND |
| TT | 3-14 | 10/21/2014 | 0.220 | NC | NC | NC | 0.0132 | NC | 0.290 | NC | NC | NC | NC |
| TT | 3-15 | 9/30/2014 | 0.0903 J | NC | NC | NC | 0.0746 | NC | 0.451 | NC | NC | NC | NC |

DRI = Desert Research Institute
NC = not collected
ND = none detected (below minimum detection limit)
TT = Tetra Tech

B = compound was found in the blank and sample
J = result is less than the reporting limit but greater than or equal to the method detection limit and the concentration is an approximate value

Table A4. Methane, Ethane, Propane, Methane Isotopes, and Noble Gases for Upper Humboldt River Basin Wells, Springs, and Streams.

| Agency (Units) | Location ID | Sample Date | Methane (µg/L) | Ethane (µg/L) | Propane (µg/L) | $\delta^{13}C\ CH_4$ (‰) | $\delta^{2}H\ CH_4$ (‰) | Ar (ccSTP/g) | Ne (ccSTP/g) | Kr (ccSTP/g) | Xe (ccSTP/g) | $^{4}He$ (ccSTP/g) | $R/R_a$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Area 1 Pre-Hydraulic Fracturing** | | | | | | | | | | | | | |
| TT | 1-1 | 3/31/2014 | <0.218 | <0.573 | <0.560 | NC | NC | NC | NC | NC | NC | NC | NC |
| DRI | 1-1 | 3/31/2014 | NC | NC | NC | -49.95 | Q | 4.11E-04 | 3.09E-07 | 8.67E-08 | 1.19E-08 | 7.44E-08 | 2.48 |
| TT | 1-2 | 3/31/2014 | 16.7 | <0.573 | <0.560 | NC | NC | NC | NC | NC | NC | NC | NC |
| DRI | 1-2 | 3/31/2014 | NC | NC | NC | -45.61 | -344.8 | 3.80E-04 | 1.86E-07 | 8.36E-08 | 1.36E-08 | 4.11E-08 | 0.98 |
| TT | 1-3 | 3/31/2014 | 79.6 | <0.573 | <0.560 | NC | NC | NC | NC | NC | NC | NC | NC |
| DRI | 1-3 | 3/31/2014 | NC | NC | NC | -37.03 | -355.7 | TBA | TBA | TBA | TBA | TBA | TBA |
| TT | 1-4 | 3/31/2014 | <0.218 | <0.573 | <0.560 | NC | NC | NC | NC | NC | NC | NC | NC |
| DRI | 1-4 | 3/31/2014 | NC | NC | NC | -45.98 | Q | 3.36E-04 | 1.97E-07 | 7.54E-08 | 1.14E-08 | 4.62E-08 | 1.15 |
| TT | 1-5 | 3/31/2014 | <0.218 | <0.573 | <0.560 | NC | NC | NC | NC | NC | NC | NC | NC |
| DRI | 1-5 | 3/31/2014 | NC | NC | NC | -48.93 | Q | NC | NC | NC | NC | NC | NC |
| TT | 1-6 | 3/31/2014 | <0.218 | <0.573 | <0.560 | NC | NC | NC | NC | NC | NC | NC | NC |
| TT | 1-7 | 4/1/2014 | <0.218 | <0.573 | <0.560 | NC | NC | NC | NC | NC | NC | NC | NC |
| DRI | 1-7 | 4/1/2014 | NC | NC | NC | -44.96 | Q | NC | NC | NC | NC | NC | NC |
| TT | 1-8 | 4/1/2014 | 47.4 | <0.573 | <0.560 | NC | NC | NC | NC | NC | NC | NC | NC |
| DRI | 1-8 | 4/1/2014 | NC | NC | NC | -40.75 | -384.1 | NC | NC | NC | NC | NC | NC |
| TT | 1-9 | 4/1/2014 | <0.218 | <0.573 | <0.560 | NC | NC | NC | NC | NC | NC | NC | NC |
| TT | 1-10 | 4/1/2014 | <0.218 | <0.573 | <0.560 | NC | NC | NC | NC | NC | NC | NC | NC |
| TT | 1-11 | 4/1/2014 | <0.218 | <0.573 | <0.560 | NC | NC | NC | NC | NC | NC | NC | NC |
| DRI | 1-12 | 4/2/2014 | <5.0 | <5.0 | <5.0 | -50.32 | Q | 3.20E-04 | 1.79E-07 | 7.63E-08 | 1.13E-08 | 5.84E-08 | 0.79 |
| TT | 1-13 | 4/7/2014 | 63.5 | <0.573 | <0.560 | NC | NC | NC | NC | NC | NC | NC | NC |
| DRI | 1-13 | 4/18/2014 | NC | NC | NC | -31.05 | BAL | NC | NC | NC | NC | NC | NC |
| TT | 1-14 | 4/18/2014 | 0.64 J | <0.573 | <0.560 | NC | NC | NC | NC | NC | NC | NC | NC |
| DRI | 1-14 | 4/18/2014 | NC | NC | NC | -18.24 | BAL | NC | NC | NC | NC | NC | NC |
| DRI | 1-15 | 4/18/2014 | 21 | <5.0 | <5.0 | -17.14 | BAL | NC | NC | NC | NC | NC | NC |
| DRI | 1-16 | 9/22/2014 | <5.0 | <5.0 | <5.0 | NC | NC | TBA | TBA | TBA | TBA | TBA | TBA |

Table A4. Methane, Ethane, Propane, Methane Isotopes, and Noble Gases for Upper Humboldt River Basin Wells, Springs, and Streams (continued).

| Agency (Units) | Location ID | Sample Date | Methane (µg/L) | Ethane (µg/L) | Propane (µg/L) | $\delta^{13}C\ CH_4$ (‰) | $\delta^{2}H\ CH_4$ (‰) | Ar (ccSTP/g) | Ne (ccSTP/g) | Kr (ccSTP/g) | Xe (ccSTP/g) | $^{4}He$ (ccSTP/g) | $R/R_a$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TT | 1-16 | 9/22/2014 | ND | ND | ND | NC | NC | NC | NC | NC | NC | NC | NC |
| DRI | 1-17 | 9/22/2014 | <5.0 | <5.0 | <5.0 | NC | NC | NC | NC | NC | NC | NC | NC |
| TT | 1-17 | 9/22/2014 | ND | ND | ND | NC | NC | NC | NC | NC | NC | NC | NC |
| DRI | 1-18 | 9/22/2014 | <5.0 | <5.0 | <5.0 | NC | NC | NC | NC | NC | NC | NC | NC |
| TT | 1-18 | 9/22/2014 | ND | ND | ND | NC | NC | NC | NC | NC | NC | NC | NC |
| DRI | 1-19 | 9/23/2014 | 45 | <5.0 | <5.0 | TBA | -335.8 | NC | NC | NC | NC | NC | NC |
| TT | 1-19 | 9/23/2014 | 22.7 | ND | ND | NC | NC | NC | NC | NC | NC | NC | NC |
| DRI | 1-20 | 9/23/2014 | <5.0 | <5.0 | <5.0 | NC | NC | TBA | TBA | TBA | TBA | TBA | TBA |
| TT | 1-20 | 9/23/2014 | ND | ND | ND | NC | NC | NC | NC | NC | NC | NC | NC |
| DRI | 1-21 | 9/23/2014 | 28 | <5.0 | <5.0 | TBA | -362.7 | NC | NC | NC | NC | NC | NC |
| DRI | 1-22 | 9/24/2014 | 7.0 J | <5.0 | <5.0 | TBA | -224.4 Q | NC | NC | NC | NC | NC | NC |
| DRI | 1-23 | 9/24/2014 | <5.0 | <5.0 | <5.0 | NC | NC | NC | NC | NC | NC | NC | NC |
| DRI | 1-24 | 9/29/2014 | 32 | 8.0 J | <5.0 | TBA | -264.8 Q | TBA | TBA | TBA | TBA | TBA | TBA |
| TT | 1-24 | 9/29/2014 | ND | ND | ND | NC | NC | NC | NC | NC | NC | NC | NC |
| DRI | 1-25 | 9/29/2014 | <5.0 | <5.0 | <5.0 | NC | NC | NC | NC | NC | NC | NC | NC |
| TT | 1-25 | 9/29/2014 | ND | ND | ND | NC | NC | NC | NC | NC | NC | NC | NC |
| DRI | 1-26 | 10/7/2014 | <5.0 | <5.0 | <5.0 | NC | NC | TBA | TBA | TBA | TBA | TBA | TBA |
| TT | 1-26 | 10/7/2014 | ND | ND | ND | NC | NC | NC | NC | NC | NC | NC | NC |
| DRI | 1-27 | 10/7/2014 | <5.0 | <5.0 | <5.0 | NC | NC | NC | NC | NC | NC | NC | NC |
| TT | 1-27 | 10/7/2014 | ND | ND | ND | NC | NC | NC | NC | NC | NC | NC | NC |
| DRI | 1-28 | 10/20/2014 | <5.0 | <5.0 | <5.0 | NC | NC | NC | NC | NC | NC | NC | NC |
| TT | 1-28 | 10/20/2014 | ND | ND | ND | NC | NC | NC | NC | NC | NC | NC | NC |
| DRI | 1-29 | 10/20/2014 | <5.0 | <5.0 | <5.0 | NC | NC | TBA | TBA | TBA | TBA | TBA | TBA |
| TT | 1-29 | 10/20/2014 | ND | ND | ND | NC | NC | NC | NC | NC | NC | NC | NC |
| DRI | 1-30 | 10/21/2014 | <5.0 | <5.0 | <5.0 | NC | NC | TBA | TBA | TBA | TBA | TBA | TBA |

Table A4. Methane, Ethane, Propane, Methane Isotopes, and Noble Gases for Upper Humboldt River Basin Wells, Springs, and Streams (continued).

| Agency (Units) | Location ID | Sample Date | Methane (µg/L) | Ethane (µg/L) | Propane (µg/L) | $\delta^{13}C\ CH_4$ (‰) | $\delta^{2}H\ CH_4$ (‰) | Ar (ccSTP/g) | Ne (ccSTP/g) | Kr (ccSTP/g) | Xe (ccSTP/g) | $^{4}He$ (ccSTP/g) | $R/R_a$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TT | 1-30 | 10/21/2014 | ND | ND | ND | NC | NC | NC | NC | NC | NC | NC | NC |
| TT | 1-31 | 10/20/2014 | 0.247 J | <0.573 | <0.560 | NC | NC | NC | NC | NC | NC | NC | NC |
| TT | 1-32 | 9/23/2014 | ND | ND | ND | NC | NC | NC | NC | NC | NC | NC | NC |
| TT | 1-33 | 9/22/2014 | ND | ND | ND | NC | NC | NC | NC | NC | NC | NC | NC |
| TT | 1-34 | 9/22/2014 | ND | ND | ND | NC | NC | NC | NC | NC | NC | NC | NC |
| TT | 1-35 | 9/23/2014 | ND | ND | ND | NC | NC | NC | NC | NC | NC | NC | NC |
| **Area 2 Pre-Hydraulic Fracturing** | | | | | | | | | | | | | |
| DRI | 2-1 | 9/4/2013 | 2800 | 7.2 | <10.0 | -67.18 | -310.6 | 4.85E-04 | 3.73E-07 | 1.08E-07 | 1.52E-08 | 1.12E-06 | 0.136 |
| TT | 2-1 | 9/4/2013 | 4690 | 11.1 | <0.560 | NC | NC | NC | NC | NC | NC | NC | NC |
| TT | 2-1 | 10/8/2013 | NC | NC | NC | -78.8 | -315 | NC | NC | NC | NC | NC | NC |
| TT | 2-2 | 9/4/2013 | 62 | <0.573 | <0.560 | NC | NC | NC | NC | NC | NC | NC | NC |
| TT | 2-3 | 9/4/2013 | 12.2 | <0.573 | <0.560 | NC | NC | NC | NC | NC | NC | NC | NC |
| DRI | 2-4 | 9/4/2013 | <10.0 | <10.0 | <10.0 | -56.6 Q | -212.4 Q | 3.26E-04 | 1.80E-07 | 7.61E-08 | 1.12E-08 | 4.41E-08 | 0.945 |
| TT | 2-4 | 9/4/2013 | <0.218 | <0.573 | <0.560 | NC | NC | NC | NC | NC | NC | NC | NC |
| TT | 2-5 | 9/4/2013 | <0.218 | <0.573 | <0.560 | NC | NC | NC | NC | NC | NC | NC | NC |
| TT | 2-6 | 9/4/2013 | <0.218 | <0.573 | <0.560 | NC | NC | NC | NC | NC | NC | NC | NC |
| TT | 2-7 | 9/4/2013 | <0.218 | <0.573 | <0.560 | NC | NC | NC | NC | NC | NC | NC | NC |
| TT | 2-8 | 10/8/2013 | <0.218 | <0.573 | <0.560 | NC | NC | NC | NC | NC | NC | NC | NC |
| TT | 2-9 | 10/8/2013 | <0.218 | <0.573 | <0.560 | NC | NC | NC | NC | NC | NC | NC | NC |
| **Area 2 Post-Hydraulic Fracturing** | | | | | | | | | | | | | |
| DRI | 2-1 | 6/23/2014 | 7200 | 18 | <5.0 | -69.14 | -314.0 | TBA | TBA | TBA | TBA | TBA | TBA |
| TT | 2-1 | 6/23/2014 | 4190 | 11.8 | <0.560 | NC | NC | NC | NC | NC | NC | NC | NC |
| DRI | 2-2 | 6/23/2014 | 1600 | <5.0 | <5.0 | -48.72 | -382.2 | NC | NC | NC | NC | NC | NC |
| TT | 2-2 | 6/23/2014 | 1070 | <0.573 | <0.560 | NC | NC | NC | NC | NC | NC | NC | NC |
| TT | 2-3 | 6/23/2014 | 7.54 | <0.573 | <0.560 | NC | NC | NC | NC | NC | NC | NC | NC |

Table A4. Methane, Ethane, Propane, Methane Isotopes, and Noble Gases for Upper Humboldt River Basin Wells, Springs, and Streams (continued).

| Agency (Units) | Location ID | Sample Date | Methane (µg/L) | Ethane (µg/L) | Propane (µg/L) | $\delta^{13}C\ CH_4$ (‰) | $\delta^{2}H\ CH_4$ (‰) | Ar (ccSTP/g) | Ne (ccSTP/g) | Kr (ccSTP/g) | Xe (ccSTP/g) | $^{4}He$ (ccSTP/g) | $R/R_a$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DRI | 2-4 | 6/23/2014 | 5.0 J | <5.0 | <5.0 | NC | NC | TBA | TBA | TBA | TBA | TBA | TBA |
| TT | 2-4 | 6/23/2014 | 0.715 J | <0.573 | <0.560 | NC | NC | NC | NC | NC | NC | NC | NC |
| TT | 2-5 | 6/25/2014 | <0.218 | <0.573 | <0.560 | NC | NC | NC | NC | NC | NC | NC | NC |
| TT | 2-6 | 6/25/2014 | <0.218 | <0.573 | <0.560 | NC | NC | NC | NC | NC | NC | NC | NC |
| TT | 2-7 | 7/1/2014 | <0.218 | <0.573 | <0.560 | NC | NC | NC | NC | NC | NC | NC | NC |
| TT | 2-8 | 6/25/2014 | <0.218 | <0.573 | <0.560 | NC | NC | NC | NC | NC | NC | NC | NC |
| TT | 2-9 | 6/25/2014 | <0.218 | <0.573 | <0.560 | NC | NC | NC | NC | NC | NC | NC | NC |
| DRI | 2-10 | 4/1/2014 | <5.0 | <5.0 | <5.0 | -47.8 | Q | 3.24E-04 | 1.66E-07 | 7.81E-08 | 1.21E-08 | 3.78E-08 | 0.99 |
| DRI | 2-10 | 6/23/2014 | 5.0 J | <5.0 | <5.0 | NC | NC | NC | NC | NC | NC | NC | NC |
| DRI | 2-11 | 6/25/2014 | <5.0 | <5.0 | <5.0 | NC | NC | NC | NC | NC | NC | NC | NC |
| DRI | 2-12 | 6/24/2014 | 7.0 J | <5.0 | <5.0 | NC | NC | NC | NC | NC | NC | NC | NC |
| DRI | 2-13 | 6/24/2014 | 11 | <5.0 | <5.0 | -44.07 | -292.5 Q | NC | NC | NC | NC | NC | NC |
| DRI | 2-14 | 6/24/2014 | <5.0 | <5.0 | <5.0 | NC | NC | TBA | TBA | TBA | TBA | TBA | TBA |
| DRI | 2-15 | 9/5/2014 | <5.0 | <5.0 | <5.0 | NC | NC | NC | NC | NC | NC | NC | NC |
| DRI | 2-16 | 9/25/2014 | 960 | <5.0 | <5.0 | TBA | -368.9 | NC | NC | NC | NC | NC | NC |
| DRI | M2C-M2-21B M10C-M10-11B | 9/25/2014 ----- | 1100 ----- | 1300 ----- | 1100 ----- | TBA ----- | -377.8 ----- | TBA ----- | TBA ----- | TBA ----- | TBA ----- | TBA ----- | TBA ----- |
| **Area 3 Pre-Hydraulic Fracturing** | | | | | | | | | | | | | |
| DRI | 3-1 | 9/3/2014 | 95 | <5.0 | <5.0 | TBA | -258.4 | NC | NC | NC | NC | NC | NC |
| TT | 3-1 | 9/3/2014 | 74.7 | <0.573 | <0.560 | NC | NC | NC | NC | NC | NC | NC | NC |
| TT | 3-1 | 10/1/2014 | NC | NC | NC | BAL | BAL | NC | NC | NC | NC | NC | NC |
| DRI | 3-2 | 9/3/2014 | 46 | <5.0 | <5.0 | TBA | -239.1 | TBA | TBA | TBA | TBA | TBA | TBA |
| TT | 3-2 | 9/3/2014 | 33.8 | <0.573 | <0.560 | NC | NC | NC | NC | NC | NC | NC | NC |
| TT | 3-2 | 10/1/2014 | NC | NC | NC | -75.7 | BAL | NC | NC | NC | NC | NC | NC |
| DRI | 3-3 | 9/3/2014 | 4100 | <5.0 | <5.0 | TBA | -304.1 | NC | NC | NC | NC | NC | NC |

Table A4. Methane, Ethane, Propane, Methane Isotopes, and Noble Gases for Upper Humboldt River Basin Wells, Springs, and Streams (continued).

| Agency (Units) | Location ID | Sample Date | Methane (µg/L) | Ethane (µg/L) | Propane (µg/L) | $\delta^{13}C\ CH_4$ (‰) | $\delta\ ^2H\ CH_4$ (‰) | Ar (ccSTP/g) | Ne (ccSTP/g) | Kr (ccSTP/g) | Xe (ccSTP/g) | $^4He$ (ccSTP/g) | $R/R_a$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TT | 3-3 | 9/3/2014 | 2760 | 1.71 J | <0.560 | NC | NC | NC | NC | NC | NC | NC | NC |
| DRI | 3-4 | 9/4/2014 | 110 | <5.0 | <5.0 | TBA | -249.7 Q | NC | NC | NC | NC | NC | NC |
| DRI | 3-5 | 9/5/2014 | 29 | <5.0 | <5.0 | TBA | -324.5 | TBA | TBA | TBA | TBA | TBA | TBA |
| DRI | 3-6 | 9/30/2014 | <5.0 | <5.0 | <5.0 | NC | NC | TBA | TBA | TBA | TBA | TBA | TBA |
| TT | 3-6 | 9/30/2014 | ND | ND | ND | NC | NC | NC | NC | NC | NC | NC | NC |
| DRI | 3-7 | 9/30/2014 | <5.0 | <5.0 | <5.0 | NC | NC | TBA | TBA | TBA | TBA | TBA | TBA |
| TT | 3-7 | 9/30/2014 | <0.218 | <0.573 | <0.560 | NC | NC | NC | NC | NC | NC | NC | NC |
| DRI | 3-8 | 9/30/2014 | <5.0 | <5.0 | <5.0 | NC | NC | TBA | TBA | TBA | TBA | TBA | TBA |
| DRI | 3-9 | 10/8/2014 | <5.0 | <5.0 | <5.0 | NC | NC | TBA | TBA | TBA | TBA | TBA | TBA |
| TT | 3-9 | 10/8/2014 | <0.218 | <0.573 | <0.560 | NC | NC | NC | NC | NC | NC | NC | NC |
| DRI | 3-10 | 10/21/2014 | <5.0 | <5.0 | <5.0 | NC | NC | TBA | TBA | TBA | TBA | TBA | TBA |
| TT | 3-10 | 10/29/2014 | <0.218 | <0.573 | <0.560 | NC | NC | NC | NC | NC | NC | NC | NC |
| DRI | 3-11 | 10/21/2014 | <5.0 | <5.0 | <5.0 | NC | NC | NC | NC | NC | NC | NC | NC |
| TT | 3-11 | 10/21/2014 | 1.9 J | <0.573 | <0.560 | NC | NC | NC | NC | NC | NC | NC | NC |
| TT | 3-12 | 10/21/2014 | 2.08 J | <0.573 | <0.560 | NC | NC | NC | NC | NC | NC | NC | NC |
| DRI | 3-12 | 10/22/2014 | <5.0 | <5.0 | <5.0 | NC | NC | NC | NC | NC | NC | NC | NC |
| DRI | 3-13 | 10/22/2014 | 21000 | 11 | <5.0 | TBA | -302.3 | TBA | TBA | TBA | TBA | TBA | TBA |
| TT | 3-14 | 10/21/2014 | <0.218 | <0.573 | <0.560 | NC | NC | NC | NC | NC | NC | NC | NC |
| TT | 3-15 | 9/30/2014 | 4.4 J | ND | ND | NC | NC | NC | NC | NC | NC | NC | NC |

DRI = Desert Research Institute
NC = not collected
ND = none detected (below minimum detection limit)
TBA = to be analyzed
TT = Tetra Tech

J = result is less than the reporting limit but greater than or equal to the method detection limit and the concentration is an approximate value
Q = concentration below limit of quantification

Table A5. TPH, MTBE, Benzene, Toluene, Ethylbenzene, Xylene, and Stable Isotopes of Water for Upper Humboldt River Basin Wells, Springs, and Streams.

| Agency (Units) | Location ID | Sample Date | TPH-DRO (mg/L) | TPH-GRO (mg/L) | MTBE (µg/L) | Benzene (µg/L) | Toluene (µg/L) | Ethylbenzene (µg/L) | m,p-Xylene (µg/L) | o-Xylene (µg/L) | Xylenes Total (µg/L) | $\delta^{13}$C DIC Water (‰) | $\delta^{2}$H Water (‰) | $\delta^{18}$O Water (‰) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Area 1 Pre-Hydraulic Fracturing** | | | | | | | | | | | | | | |
| TT | 1-1 | 3/31/2014 | <0.245 | <0.01 | NC | <0.16 | <0.17 | <0.16 | NC | NC | <0.19 | NC | NC | NC |
| DRI | 1-1 | 3/31/2014 | NC | NC | NC | NC | NC | NC | NC | NC | NC | -12.80 | -120.1 | -15.28 |
| TT | 1-2 | 3/31/2014 | <0.245 | <0.01 | NC | <0.16 | <0.17 | <0.16 | NC | NC | <0.19 | NC | NC | NC |
| DRI | 1-2 | 3/31/2014 | NC | NC | NC | NC | NC | NC | NC | NC | NC | -14.91 | -117.3 | -15.28 |
| TT | 1-3 | 3/31/2014 | <0.245 | <0.01 | NC | <0.16 | <0.17 | <0.16 | NC | NC | <0.19 | NC | NC | NC |
| DRI | 1-3 | 3/31/2014 | NC | NC | NC | NC | NC | NC | NC | NC | NC | -9.82 | -117.0 | -14.51 |
| TT | 1-4 | 3/31/2014 | <0.245 | <0.01 | NC | <0.16 | <0.17 | <0.16 | NC | NC | <0.19 | NC | NC | NC |
| DRI | 1-4 | 3/31/2014 | NC | NC | NC | NC | NC | NC | NC | NC | NC | -13.37 | -123.9 | -16.19 |
| TT | 1-5 | 3/31/2014 | <0.245 | <0.01 | NC | <0.16 | <0.17 | <0.16 | NC | NC | <0.19 | NC | NC | NC |
| DRI | 1-5 | 3/31/2014 | NC | NC | NC | NC | NC | NC | NC | NC | NC | -13.27 | -126.0 | -16.45 |
| TT | 1-6 | 3/31/2014 | <0.245 | <0.01 | NC | <0.16 | <0.17 | <0.16 | NC | NC | <0.19 | NC | NC | NC |
| TT | 1-7 | 4/1/2014 | <0.245 | <0.01 | NC | <0.16 | <0.17 | <0.16 | NC | NC | <0.19 | NC | NC | NC |
| DRI | 1-7 | 4/1/2014 | NC | NC | NC | NC | NC | NC | NC | NC | NC | -13.44 | -121.6 | -15.61 |
| TT | 1-8 | 4/1/2014 | <0.245 | <0.01 | NC | <0.16 | <0.17 | <0.16 | NC | NC | <0.19 | NC | NC | NC |
| DRI | 1-8 | 4/1/2014 | NC | NC | NC | NC | NC | NC | NC | NC | NC | -13.01 | -119.4 | -15.51 |
| TT | 1-9 | 4/1/2014 | <0.245 | <0.01 | NC | <0.16 | <0.17 | <0.16 | NC | NC | <0.19 | NC | NC | NC |
| TT | 1-10 | 4/1/2014 | <0.245 | <0.01 | NC | <0.16 | <0.17 | <0.16 | NC | NC | <0.19 | NC | NC | NC |
| TT | 1-11 | 4/1/2014 | <0.245 | <0.01 | NC | <0.16 | <0.17 | <0.16 | NC | NC | <0.19 | NC | NC | NC |
| DRI | 1-12 | 4/2/2014 | <0.25 | <0.25 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | NC | -8.50 | -124.8 | -16.73 |
| TT | 1-13 | 4/7/2014 | <0.245 | <0.01 | NC | <0.16 | <0.17 | <0.16 | <0.34 | <0.19 | <0.19 | NC | NC | NC |
| DRI | 1-13 | 4/18/2014 | NC | NC | NC | NC | NC | NC | NC | NC | NC | -14.32 | -127.88 | -16.56 |
| TT | 1-14 | 4/18/2014 | <0.245 | <0.01 | NC | <0.16 | <0.17 | <0.16 | <0.34 | <0.19 | <0.19 | NC | NC | NC |
| DRI | 1-14 | 4/18/2014 | NC | NC | NC | NC | NC | NC | NC | NC | NC | -10.22 | -130.85 | -16.67 |
| DRI | 1-15 | 4/18/2014 | <0.25 | <0.25 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | NC | -10.04 | -117.8 | -14.25 |

Table A5. TPH, MTBE, Benzene, Toluene, Ethylbenzene, Xylene, and Stable Isotopes of Water for Upper Humboldt River Basin Wells, Springs, and Streams (continued).

| Agency (Units) | Location ID | Sample Date | TPH-DRO (mg/L) | TPH-GRO (mg/L) | MTBE (µg/L) | Benzene (µg/L) | Toluene (µg/L) | Ethylbenzene (µg/L) | m,p-Xylene (µg/L) | o-Xylene (µg/L) | Xylenes Total (µg/L) | $\delta^{13}$C DIC Water (‰) | $\delta^{2}$H Water (‰) | $\delta^{18}$O Water (‰) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DRI | 1-16 | 9/22/2014 | <0.25 | <0.25 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | NC | -14.57 | TBA | TBA |
| TT | 1-16 | 9/22/2014 | ND | ND | NC | ND | ND | ND | NC | NC | ND | NC | NC | NC |
| DRI | 1-17 | 9/22/2014 | <0.25 | <0.25 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | NC | -14.50 | TBA | TBA |
| TT | 1-17 | 9/22/2014 | ND | ND | NC | ND | ND | ND | NC | NC | ND | NC | NC | NC |
| DRI | 1-18 | 9/22/2014 | <0.25 | <0.25 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | NC | -17.56 | TBA | TBA |
| TT | 1-18 | 9/22/2014 | ND | ND | NC | ND | ND | ND | NC | NC | ND | NC | NC | NC |
| DRI | 1-19 | 9/23/2014 | <0.25 | <0.25 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | NC | -4.00 | TBA | TBA |
| TT | 1-19 | 9/23/2014 | ND | ND | NC | ND | ND | ND | NC | NC | ND | NC | NC | NC |
| DRI | 1-20 | 9/23/2014 | <0.25 | <0.25 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | NC | -17.69 | TBA | TBA |
| TT | 1-20 | 9/23/2014 | ND | ND | NC | ND | ND | ND | NC | NC | ND | NC | NC | NC |
| DRI | 1-21 | 9/23/2014 | <0.25 | <0.25 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | NC | -12.04 | TBA | TBA |
| DRI | 1-22 | 9/24/2014 | <0.25 | <0.25 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | NC | -13.23 | TBA | TBA |
| DRI | 1-23 | 9/24/2014 | <0.25 | <0.25 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | NC | -11.91 | TBA | TBA |
| DRI | 1-24 | 9/29/2014 | <0.25 | <0.25 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | NC | TBA | TBA | TBA |
| TT | 1-24 | 9/29/2014 | ND | ND | NC | ND | ND | ND | NC | NC | ND | NC | NC | NC |
| DRI | 1-25 | 9/29/2014 | <0.25 | <0.25 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | NC | TBA | TBA | TBA |
| TT | 1-25 | 9/29/2014 | ND | ND | NC | ND | ND | ND | NC | NC | ND | NC | NC | NC |
| DRI | 1-26 | 10/7/2014 | <0.25 | <0.25 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | NC | TBA | TBA | TBA |
| TT | 1-26 | 10/7/2014 | <0.031 | <0.01 | NC | <0.16 | <0.17 | <0.16 | NC | NC | <0.19 | NC | NC | NC |
| DRI | 1-27 | 10/7/2014 | <0.25 | <0.25 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | NC | TBA | TBA | TBA |
| TT | 1-27 | 10/7/2014 | <0.031 | <0.01 | NC | <0.16 | <0.17 | <0.16 | NC | NC | <0.19 | NC | NC | NC |
| DRI | 1-28 | 10/20/2014 | <0.25 | <0.25 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | NC | TBA | TBA | TBA |
| TT | 1-28 | 10/20/2014 | 0.0562 J* | <0.01 | NC | <0.16 | <0.17 | <0.16 | NC | NC | <0.19 | NC | NC | NC |
| DRI | 1-29 | 10/20/2014 | <0.25 | <0.25 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | NC | TBA | TBA | TBA |
| TT | 1-29 | 10/20/2014 | <0.0309 | <0.01 | NC | <0.16 | <0.17 | <0.16 | NC | NC | <0.19 | NC | NC | NC |

Table A5. TPH, MTBE, Benzene, Toluene, Ethylbenzene, Xylene, and Stable Isotopes of Water for Upper Humboldt River Basin Wells, Springs, and Streams (continued).

| Agency (Units) | Location ID | Sample Date | TPH-DRO (mg/L) | TPH-GRO (mg/L) | MTBE (µg/L) | Benzene (µg/L) | Toluene (µg/L) | Ethylbenzene (µg/L) | m,p-Xylene (µg/L) | o-Xylene (µg/L) | Xylenes Total (µg/L) | $\delta^{13}$C DIC Water (‰) | $\delta^{2}$H Water (‰) | $\delta^{18}$O Water (‰) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DRI | 1-30 | 10/21/2014 | <0.25 | <0.25 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | NC | TBA | TBA | TBA |
| TT | 1-30 | 10/21/2014 | <0.031 | <0.01 | NC | <0.16 | <0.17 | <0.16 | NC | NC | <0.19 | NC | NC | NC |
| TT | 1-31 | 10/20/2014 | <0.031 | <0.01 | NC | <0.16 | <0.17 | <0.16 | NC | NC | <0.19 | NC | NC | NC |
| TT | 1-32 | 9/23/2014 | ND | ND | NC | ND | ND | ND | NC | NC | ND | NC | NC | NC |
| TT | 1-33 | 9/22/2014 | ND | ND | NC | ND | ND | ND | NC | NC | ND | NC | NC | NC |
| TT | 1-34 | 9/22/2014 | ND | ND | NC | ND | ND | ND | NC | NC | ND | NC | NC | NC |
| TT | 1-35 | 9/23/2014 | ND | ND | NC | ND | ND | ND | NC | NC | ND | NC | NC | NC |
| **Area 2 Pre-Hydraulic Fracturing** | | | | | | | | | | | | | | |
| DRI | 2-1 | 9/4/2013 | <0.25 | <0.25 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | NC | -4.35 | -136.0 | -17.90 |
| TT | 2-1 | 9/4/2013 | <0.245 | <0.01 | NC | <0.16 | <0.17 | <0.16 | NC | NC | NC | NC | NC | NC |
| TT | 2-1 | 10/8/2013 | NC | NC | NC | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| TT | 2-2 | 9/4/2013 | <0.245 | <0.01 | NC | <0.16 | <0.17 | <0.16 | NC | NC | <0.19 | NC | NC | NC |
| TT | 2-3 | 9/4/2013 | <0.245 | <0.01 | NC | <0.16 | <0.17 | <0.16 | NC | NC | <0.19 | NC | NC | NC |
| DRI | 2-4 | 9/4/2013 | <0.25 | <0.25 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | NC | -10.33 | -126.6 | -16.46 |
| TT | 2-4 | 9/4/2013 | <0.245 | <0.01 | NC | <0.16 | <0.17 | <0.16 | NC | NC | NC | NC | NC | NC |
| TT | 2-5 | 9/4/2013 | <0.245 | <0.01 | NC | <0.16 | <0.17 | <0.16 | NC | NC | <0.19 | NC | NC | NC |
| TT | 2-6 | 9/4/2013 | <0.245 | <0.01 | NC | <0.16 | <0.17 | <0.16 | NC | NC | <0.19 | NC | NC | NC |
| TT | 2-7 | 9/4/2013 | <0.245 | <0.01 | NC | <0.16 | <0.17 | <0.16 | NC | NC | <0.19 | NC | NC | NC |
| TT | 2-8 | 10/8/2013 | <0.245 | <0.01 | NC | <0.16 | <0.17 | <0.16 | NC | NC | <0.19 | NC | NC | NC |
| TT | 2-9 | 10/8/2013 | <0.245 | <0.01 | NC | <0.16 | <0.17 | <0.16 | NC | NC | <0.19 | NC | NC | NC |
| **Area 2 Post-Hydraulic Fracturing** | | | | | | | | | | | | | | |
| DRI | 2-1 | 6/23/2014 | <0.25 | <0.25 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | NC | -3.29 | -136.1 | -18.09 |
| TT | 2-1 | 6/23/2014 | <0.245 | <0.01 | NC | <0.16 | <0.17 | <0.16 | NC | NC | <0.19 | NC | NC | NC |
| DRI | 2-2 | 6/23/2014 | <0.25 | <0.25 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | NC | -13.84 | -116.1 | -15.09 |
| TT | 2-2 | 6/23/2014 | <0.245 | <0.01 | NC | <0.16 | <0.17 | <0.16 | NC | NC | <0.19 | NC | NC | NC |

Table A5. TPH, MTBE, Benzene, Toluene, Ethylbenzene, Xylene, and Stable Isotopes of Water for Upper Humboldt River Basin Wells, Springs, and Streams (continued).

| Agency (Units) | Location ID | Sample Date | TPH-DRO (mg/L) | TPH-GRO (mg/L) | MTBE (µg/L) | Benzene (µg/L) | Toluene (µg/L) | Ethylbenzene (µg/L) | m,p-Xylene (µg/L) | o-Xylene (µg/L) | Xylenes Total (µg/L) | $\delta^{13}$C DIC Water (‰) | $\delta^{2}$H Water (‰) | $\delta^{18}$O Water (‰) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TT | 2-3 | 6/23/2014 | <0.245 | <0.01 | NC | <0.16 | <0.17 | <0.16 | NC | NC | <0.19 | NC | NC | NC |
| DRI | 2-4 | 6/23/2014 | <0.25 | <0.25 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | NC | -9.90 | -127.9 | -16.72 |
| TT | 2-4 | 6/23/2014 | <0.245 | <0.01 | NC | <0.16 | <0.17 | <0.16 | NC | NC | <0.19 | NC | NC | NC |
| TT | 2-5 | 6/25/2014 | <0.245 | <0.01 | NC | <0.16 | <0.17 | <0.16 | NC | NC | <0.19 | NC | NC | NC |
| TT | 2-6 | 6/25/2014 | <0.245 | <0.01 | NC | <0.16 | <0.17 | <0.16 | NC | NC | <0.19 | NC | NC | NC |
| TT | 2-7 | 7/1/2014 | <0.245 | <0.01 | NC | <0.16 | <0.17 | <0.16 | NC | NC | <0.19 | NC | NC | NC |
| TT | 2-8 | 6/25/2014 | <0.245 | <0.01 | NC | <0.16 | <0.17 | <0.16 | NC | NC | <0.19 | NC | NC | NC |
| TT | 2-9 | 6/25/2014 | <0.245 | <0.01 | NC | <0.16 | <0.17 | <0.16 | NC | NC | <0.19 | NC | NC | NC |
| DRI | 2-10 | 4/1/2014 | <0.25 | <0.25 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | NC | -8.48 | -121.3 | -16.05 |
| DRI | 2-10 | 6/23/2014 | <0.25 | <0.25 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | NC | -6.94 | -121.9 | -16.27 |
| DRI | 2-11 | 6/25/2014 | <0.25 | <0.25 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | NC | -11.83 | -127.7 | -15.83 |
| DRI | 2-12 | 6/24/2014 | <0.25 | <0.25 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | NC | -11.55 | -122.1 | -15.62 |
| DRI | 2-13 | 6/24/2014 | <0.25 | <0.25 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | NC | -11.12 | -121.2 | -15.51 |
| DRI | 2-14 | 6/24/2014 | <0.25 | <0.25 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | NC | -2.72 | -126.8 | -16.03 |
| DRI | 2-15 | 9/5/2014 | <0.25 | <0.25 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | NC | -12.21 | TBA | TBA |
| DRI | 2-16 | 9/25/2014 | <0.25 | <0.25 | <0.5 | <0.5 | 17 | <0.5 | <0.5 | <0.5 | NC | TBA | TBA | TBA |
| DRI | M2C-M2-21B | 9/25/2014 | 1.3 C L | 18 | <20 V | 3800 | 4000 | 170 | 700 | 350 | NC | TBA | TBA | TBA |
| | M10C-M10-11B | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- |
| **Area 3 Pre-Hydraulic Fracturing** | | | | | | | | | | | | | | |
| DRI | 3-1 | 9/3/2014 | <0.25 | <0.25 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | NC | -14.01 | TBA | TBA |
| TT | 3-1 | 9/3/2014 | 0.0377 J | <0.01 | NC | <0.16 | <0.17 | <0.16 | NC | NC | <0.19 | NC | NC | NC |
| DRI | 3-2 | 9/3/2014 | <0.25 | <0.25 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | NC | -10.67 | TBA | TBA |
| TT | 3-2 | 9/3/2014 | <0.0309 | <0.01 | NC | <0.16 | <0.17 | <0.16 | NC | NC | <0.19 | NC | NC | NC |
| DRI | 3-3 | 9/3/2014 | <0.25 | <0.25 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | NC | -3.37 | TBA | TBA |

Table A5. TPH, MTBE, Benzene, Toluene, Ethylbenzene, Xylene, and Stable Isotopes of Water for Upper Humboldt River Basin Wells, Springs, and Streams (continued).

| Agency (Units) | Location ID | Sample Date | TPH-DRO (mg/L) | TPH-GRO (mg/L) | MTBE (µg/L) | Benzene (µg/L) | Toluene (µg/L) | Ethylbenzene (µg/L) | m,p-Xylene (µg/L) | o-Xylene (µg/L) | Xylenes Total (µg/L) | $\delta^{13}$C DIC Water (‰) | $\delta^{2}$H Water (‰) | $\delta^{18}$O Water (‰) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TT | 3-3 | 9/3/2014 | <0.0313 | <0.01 | NC | <0.16 | <0.17 | <0.16 | NC | NC | <0.19 | NC | NC | NC |
| DRI | 3-4 | 9/4/2014 | <0.25 | <0.25 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | NC | -1.66 | TBA | TBA |
| DRI | 3-5 | 9/5/2014 | <0.25 | <0.25 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | NC | -7.66 | TBA | TBA |
| DRI | 3-6 | 9/30/2014 | <0.25 | <0.25 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | NC | TBA | TBA | TBA |
| TT | 3-6 | 9/30/2014 | ND | ND | NC | ND | 0.325 J | ND | NC | NC | ND | NC | NC | NC |
| DRI | 3-7 | 9/30/2014 | <0.25 | <0.25 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | NC | TBA | TBA | TBA |
| TT | 3-7 | 9/30/2014 | <0.0309 | <0.01 | NC | <0.16 | <0.17 | <0.16 | NC | NC | <0.19 | NC | NC | NC |
| DRI | 3-8 | 9/30/2014 | <0.25 | <0.25 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | NC | TBA | TBA | TBA |
| DRI | 3-9 | 10/8/2014 | <0.25 | <0.25 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | NC | TBA | TBA | TBA |
| TT | 3-9 | 10/8/2014 | <0.0309 | <0.01 | NC | <0.16 | 0.181 J | <0.16 | NC | NC | <0.19 | NC | NC | NC |
| DRI | 3-10 | 10/21/2014 | <0.25 | <0.25 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | NC | TBA | TBA | TBA |
| TT | 3-10 | 10/29/2014 | <0.031 | <0.01 | NC | <0.16 | <0.17 | <0.16 | NC | NC | <0.19 | NC | NC | NC |
| DRI | 3-11 | 10/21/2014 | <0.25 | <0.25 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | NC | TBA | TBA | TBA |
| TT | 3-11 | 10/21/2014 | <0.0311 | 0.014 J | NC | <0.16 | <0.17 | <0.16 | NC | NC | <0.19 | NC | NC | NC |
| TT | 3-12 | 10/21/2014 | <0.0315 | <0.01 | NC | <0.16 | <0.17 | <0.16 | NC | NC | <0.19 | NC | NC | NC |
| DRI | 3-12 | 10/22/2014 | <0.25 | <0.25 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | NC | TBA | TBA | TBA |
| DRI | 3-13 | 10/22/2014 | <0.25 | <0.25 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | NC | TBA | TBA | TBA |
| TT | 3-14 | 10/21/2014 | <0.0309 | <0.01 | NC | <0.16 | <0.17 | <0.16 | NC | NC | <0.19 | NC | NC | NC |
| TT | 3-15 | 9/30/2014 | ND | ND | NC | ND | ND | ND | NC | NC | ND | NC | NC | NC |

DRI = Desert Research Institute
NC = not collected
ND = none detected (below minimum detection limit)
TBA = to be analyzed
TT = Tetra Tech

J = result is less than the reporting limit but greater than or equal to the method detection limit and the concentration is an approximate value
* = relative percent difference of the lab control sample and lab control sample duplicate exceeds the control limits

Table A6. Hydraulic-Fracturing Chemical Tracers for Upper Humboldt River Basin Wells, Springs, and Streams.

| Agency (Units) | Location ID | Sample Date | Methanol (mg/L) | Ethanol (mg/L) | Isopropanol (mg/L) | Glycerol (mg/L) | Ethylene Glycol (mg/L) | Propylene Glycol (mg/L) | 2-Butoxyethanol (mg/L) | Acrylonitrile (mg/L) | Ammonium Persulfate (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Area 1 Pre-Hydraulic Fracturing** | | | | | | | | | | | |
| TT | 1-1 | 3/31/2014 | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| DRI | 1-1 | 3/31/2014 | <2.0 | <2.0 | <2.0 | <0.5 | <0.5 | <0.5 | <0.5 | <2.0 | <1.0 |
| TT | 1-2 | 3/31/2014 | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| DRI | 1-2 | 3/31/2014 | <2.0 | <2.0 | <2.0 | <0.5 | <0.5 | <0.5 | <0.5 | <2.0 | <1.0 |
| TT | 1-3 | 3/31/2014 | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| DRI | 1-3 | 3/31/2014 | <2.0 | <2.0 | <2.0 | <0.5 | <0.5 | <0.5 | <0.5 | <2.0 | <1.0 |
| TT | 1-4 | 3/31/2014 | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| DRI | 1-4 | 3/31/2014 | <2.0 | <2.0 | <2.0 | <0.5 | <0.5 | <0.5 | <0.5 | <2.0 | <1.0 |
| TT | 1-5 | 3/31/2014 | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| DRI | 1-5 | 3/31/2014 | <2.0 | <2.0 | <2.0 | <0.5 | <0.5 | <0.5 | <0.5 | <2.0 | <1.0 |
| TT | 1-6 | 3/31/2014 | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| TT | 1-7 | 4/1/2014 | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| DRI | 1-7 | 4/1/2014 | <2.0 | <2.0 | <2.0 | <0.5 | <0.5 | <0.5 | <0.5 | <2.0 | <1.0 |
| TT | 1-8 | 4/1/2014 | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| DRI | 1-8 | 4/1/2014 | <2.0 | <2.0 | <2.0 | <0.5 | <0.5 | <0.5 | <0.5 | <2.0 | <1.0 |
| TT | 1-9 | 4/1/2014 | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| TT | 1-10 | 4/1/2014 | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| TT | 1-11 | 4/1/2014 | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| DRI | 1-12 | 4/2/2014 | <2.0 | <2.0 | <2.0 | <0.5 | <0.5 | <0.5 | <0.5 | <2.0 | <1.0 |
| TT | 1-13 | 4/7/2014 | NC | NC | NC | NC | NC | NC | NC | <0.0014 | NC |
| DRI | 1-13 | 4/18/2014 | <2.0 | <2.0 | <2.0 | <0.5 | <0.5 | <0.5 | <0.5 | <2.0 | <1.0 |
| TT | 1-14 | 4/18/2014 | NC | NC | NC | NC | NC | NC | NC | <0.0014 | NC |
| DRI | 1-14 | 4/18/2014 | <2.0 | <2.0 | <2.0 | <0.5 | <0.5 | <0.5 | <0.5 | <2.0 | <1.0 |
| DRI | 1-15 | 4/18/2014 | <2.0 | <2.0 | <2.0 | <0.5 | <0.5 | <0.5 | <0.5 | <2.0 | <1.0 |
| DRI | 1-16 | 9/22/2014 | TBA | TBA | TBA | TBA | TBA | TBA | TBA | TBA | TBA |

Table A6. Hydraulic-Fracturing Chemical Tracers for Upper Humboldt River Basin Wells, Springs, and Streams (continued).

| Agency (Units) | Location ID | Sample Date | Methanol (mg/L) | Ethanol (mg/L) | Isopropanol (mg/L) | Glycerol (mg/L) | Ethylene Glycol (mg/L) | Propylene Glycol (mg/L) | 2-Butoxyethanol (mg/L) | Acrylonitrile (mg/L) | Ammonium Persulfate (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TT | 1-16 | 9/22/2014 | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| DRI | 1-17 | 9/22/2014 | TBA | TBA | TBA | TBA | TBA | TBA | TBA | TBA | TBA |
| TT | 1-17 | 9/22/2014 | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| DRI | 1-18 | 9/22/2014 | TBA | TBA | TBA | TBA | TBA | TBA | TBA | TBA | TBA |
| TT | 1-18 | 9/22/2014 | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| DRI | 1-19 | 9/23/2014 | TBA | TBA | TBA | TBA | TBA | TBA | TBA | TBA | TBA |
| TT | 1-19 | 9/23/2014 | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| DRI | 1-20 | 9/23/2014 | TBA | TBA | TBA | TBA | TBA | TBA | TBA | TBA | TBA |
| TT | 1-20 | 9/23/2014 | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| DRI | 1-21 | 9/23/2014 | TBA | TBA | TBA | TBA | TBA | TBA | TBA | TBA | TBA |
| DRI | 1-22 | 9/24/2014 | TBA | TBA | TBA | TBA | TBA | TBA | TBA | TBA | TBA |
| DRI | 1-23 | 9/24/2014 | TBA | TBA | TBA | TBA | TBA | TBA | TBA | TBA | TBA |
| DRI | 1-24 | 9/29/2014 | TBA | TBA | TBA | TBA | TBA | TBA | TBA | TBA | TBA |
| TT | 1-24 | 9/29/2014 | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| DRI | 1-25 | 9/29/2014 | TBA | TBA | TBA | TBA | TBA | TBA | TBA | TBA | TBA |
| TT | 1-25 | 9/29/2014 | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| DRI | 1-26 | 10/7/2014 | TBA | TBA | TBA | TBA | TBA | TBA | TBA | TBA | TBA |
| TT | 1-26 | 10/7/2014 | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| DRI | 1-27 | 10/7/2014 | TBA | TBA | TBA | TBA | TBA | TBA | TBA | TBA | TBA |
| TT | 1-27 | 10/7/2014 | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| DRI | 1-28 | 10/20/2014 | TBA | TBA | TBA | TBA | TBA | TBA | TBA | TBA | TBA |
| TT | 1-28 | 10/20/2014 | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| DRI | 1-29 | 10/20/2014 | TBA | TBA | TBA | TBA | TBA | TBA | TBA | TBA | TBA |
| TT | 1-29 | 10/20/2014 | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| DRI | 1-30 | 10/21/2014 | TBA | TBA | TBA | TBA | TBA | TBA | TBA | TBA | TBA |
| TT | 1-30 | 10/21/2014 | NC | NC | NC | NC | NC | NC | NC | NC | NC |

Table A6. Hydraulic-Fracturing Chemical Tracers for Upper Humboldt River Basin Wells, Springs, and Streams (continued).

| Agency (Units) | Location ID | Sample Date | Methanol (mg/L) | Ethanol (mg/L) | Isopropanol (mg/L) | Glycerol (mg/L) | Ethylene Glycol (mg/L) | Propylene Glycol (mg/L) | 2-Butoxyethanol (mg/L) | Acrylonitrile (mg/L) | Ammonium Persulfate (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TT | 1-31 | 10/20/2014 | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| TT | 1-32 | 9/23/2014 | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| TT | 1-33 | 9/22/2014 | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| TT | 1-34 | 9/22/2014 | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| TT | 1-35 | 9/23/2014 | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| **Area 2 Pre-Hydraulic Fracturing** | | | | | | | | | | | |
| DRI | 2-1 | 9/4/2013 | <2.0 | <2.0 | <2.0 | <0.5 | <0.5 | <0.5 | <0.5 | <2.0 | <1.0 |
| TT | 2-1 | 9/4/2013 | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| TT | 2-2 | 9/4/2013 | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| TT | 2-3 | 9/4/2013 | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| DRI | 2-4 | 9/4/2013 | <2.0 | <2.0 | <2.0 | <0.5 | <0.5 | <0.5 | <0.5 | <2.0 | <1.0 |
| TT | 2-4 | 9/4/2013 | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| TT | 2-5 | 9/4/2013 | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| TT | 2-6 | 9/4/2013 | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| TT | 2-7 | 9/4/2013 | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| TT | 2-8 | 10/8/2013 | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| TT | 2-9 | 10/8/2013 | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| **Area 2 Post-Hydraulic Fracturing** | | | | | | | | | | | |
| DRI | 2-1 | 6/23/2014 | <2.0 | <2.0 | <2.0 | <0.5 | <0.5 | <0.5 | <0.5 | <2.0 | <1.0 |
| TT | 2-1 | 6/23/2014 | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| DRI | 2-2 | 6/23/2014 | <2.0 | <2.0 | <2.0 | <0.5 | <0.5 | <0.5 | <0.5 | <2.0 | <1.0 |
| TT | 2-2 | 6/23/2014 | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| TT | 2-3 | 6/23/2014 | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| DRI | 2-4 | 6/23/2014 | <2.0 | <2.0 | <2.0 | <0.5 | <0.5 | <0.5 | <0.5 | <2.0 | <1.0 |
| TT | 2-4 | 6/23/2014 | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| TT | 2-5 | 6/25/2014 | NC | NC | NC | NC | NC | NC | NC | NC | NC |

Table A6. Hydraulic-Fracturing Chemical Tracers for Upper Humboldt River Basin Wells, Springs, and Streams (continued).

| Agency (Units) | Location ID | Sample Date | Methanol (mg/L) | Ethanol (mg/L) | Isopropanol (mg/L) | Glycerol (mg/L) | Ethylene Glycol (mg/L) | Propylene Glycol (mg/L) | 2-Butoxyethanol (mg/L) | Acrylonitrile (mg/L) | Ammonium Persulfate (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TT | 2-6 | 6/25/2014 | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| TT | 2-7 | 7/1/2014 | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| TT | 2-8 | 6/25/2014 | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| TT | 2-9 | 6/25/2014 | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| DRI | 2-10 | 4/1/2014 | <2.0 | <2.0 | <2.0 | <0.5 | <0.5 | <0.5 | <0.5 | <2.0 | <1.0 |
| DRI | 2-10 | 6/23/2014 | <2.0 | <2.0 | <2.0 | <0.5 | <0.5 | <0.5 | <0.5 | <2.0 | <1.0 |
| DRI | 2-11 | 6/25/2014 | <2.0 | <2.0 | <2.0 | <0.5 | <0.5 | <0.5 | <0.5 | <2.0 | <1.0 |
| DRI | 2-12 | 6/24/2014 | <2.0 | <2.0 | <2.0 | <0.5 | <0.5 | <0.5 | <0.5 | <2.0 | <1.0 |
| DRI | 2-13 | 6/24/2014 | <2.0 | <2.0 | <2.0 | <0.5 | <0.5 | <0.5 | <0.5 | <2.0 | <1.0 |
| DRI | 2-14 | 6/24/2014 | <2.0 | <2.0 | <2.0 | <0.5 | <0.5 | <0.5 | <0.5 | <2.0 | <1.0 |
| DRI | 2-15 | 9/5/2014 | TBA | TBA | TBA | TBA | TBA | TBA | TBA | TBA | TBA |
| DRI | 2-16 | 9/25/2014 | TBA | TBA | TBA | TBA | TBA | TBA | TBA | TBA | TBA |
| DRI | M2C-M2-21B | 9/25/2014 | TBA | TBA | TBA | TBA | TBA | TBA | TBA | TBA | TBA |
| | M10C-M10-11B | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- |
| **Area 3 Pre-Hydraulic Fracturing** | | | | | | | | | | | |
| DRI | 3-1 | 9/3/2014 | TBA | TBA | TBA | TBA | TBA | TBA | TBA | TBA | TBA |
| TT | 3-1 | 9/3/2014 | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| DRI | 3-2 | 9/3/2014 | TBA | TBA | TBA | TBA | TBA | TBA | TBA | TBA | TBA |
| TT | 3-2 | 9/3/2014 | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| DRI | 3-3 | 9/3/2014 | TBA | TBA | TBA | TBA | TBA | TBA | TBA | TBA | TBA |
| TT | 3-3 | 9/3/2014 | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| DRI | 3-4 | 9/4/2014 | TBA | TBA | TBA | TBA | TBA | TBA | TBA | TBA | TBA |
| DRI | 3-5 | 9/5/2014 | TBA | TBA | TBA | TBA | TBA | TBA | TBA | TBA | TBA |
| DRI | 3-6 | 9/30/2014 | TBA | TBA | TBA | TBA | TBA | TBA | TBA | TBA | TBA |
| TT | 3-6 | 9/30/2014 | NC | NC | NC | NC | NC | NC | NC | NC | NC |

Table A6. Hydraulic-Fracturing Chemical Tracers for Upper Humboldt River Basin Wells, Springs, and Streams (continued).

| Agency (Units) | Location ID | Sample Date | Methanol (mg/L) | Ethanol (mg/L) | Isopropanol (mg/L) | Glycerol (mg/L) | Ethylene Glycol (mg/L) | Propylene Glycol (mg/L) | 2-Butoxyethanol (mg/L) | Acrylonitrile (mg/L) | Ammonium Persulfate (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| DRI | 3-7 | 9/30/2014 | TBA | TBA | TBA | TBA | TBA | TBA | TBA | TBA | TBA |
| TT | 3-7 | 9/30/2014 | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| DRI | 3-8 | 9/30/2014 | TBA | TBA | TBA | TBA | TBA | TBA | TBA | TBA | TBA |
| DRI | 3-9 | 10/8/2014 | TBA | TBA | TBA | TBA | TBA | TBA | TBA | TBA | TBA |
| TT | 3-9 | 10/8/2014 | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| DRI | 3-10 | 10/21/2014 | TBA | TBA | TBA | TBA | TBA | TBA | TBA | TBA | TBA |
| TT | 3-10 | 10/29/2014 | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| DRI | 3-11 | 10/21/2014 | TBA | TBA | TBA | TBA | TBA | TBA | TBA | TBA | TBA |
| TT | 3-11 | 10/21/2014 | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| TT | 3-12 | 10/21/2014 | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| DRI | 3-12 | 10/22/2014 | TBA | TBA | TBA | TBA | TBA | TBA | TBA | TBA | TBA |
| DRI | 3-13 | 10/22/2014 | TBA | TBA | TBA | TBA | TBA | TBA | TBA | TBA | TBA |
| TT | 3-14 | 10/21/2014 | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| TT | 3-15 | 9/30/2014 | NC | NC | NC | NC | NC | NC | NC | NC | NC |

DRI = Desert Research Institute

NC = not collected

TBA = to be analyzed

TT = Tetra Tech

# APPENDIX B. TESTAMERICA NEVADA ENVIRONMENTAL LABORATORY CERTIFICATION

STATE OF NEVADA
Department of Conservation & Natural Resources
DIVISION OF ENVIRONMENTAL PROTECTION
Brian Sandoval, Governor
Leo M. Drozdoff, P.E., Director
Colleen Cripps, Ph.D., Administrator

July 26, 2013

Test America - Denver
4955 Yarrow Street
Arvada, CO 80002-

RE: Nevada Environmental Laboratory Certification 1 Year Extension.

Dear Sir or Madam:

Your laboratory's 2012-2013 Nevada scope has been extended until July 31, 2014 or until you receive the updated 2013-2014 scope.

This will serve as official notice to you and your clients.

**Be advised this letter is only valid as long as your laboratory maintains compliance with State of Nevada regulation NAC 445A.0552 to .067, NAC 445A.542 to .54296 and/or NAC 459.96902 to .9699.**

Failure to do so will result in invalidation of any data submitted to the Nevada Department of Environmental Protection.

If you or your clients have any questions, please contact Donald LaFara at 775-687-9491.

Sincerely,

Don LaFara

Donald LaFara, Laboratory Certification Officer
Program Manager, Laboratory Certification Program
State of Nevada Division of Environmental Protection