Semiannual Progress Report on Selection of Remedy

for Compliance with the Coal Combustion Residuals (CCR) Rule

Valmont Station

Public Service Company of Colorado

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1 Introduction

Valmont Station, located in Boulder County, Colorado is owned and operated by Public Service Company of Colorado (PSCo), an Xcel Energy Company (Figure 1-1). Valmont Station has four CCR units subject to the U.S. Environmental Protection Agency's (EPA's) Coal Combustion Residuals (CCR) Rule specified in 40 CFR 257: the ash landfill, two former incised bottom ash impoundments, and a former ash settling pond. Three of these CCR units have triggered assessment of corrective measures and therefore are the subject of this update on remedy selection: the ash landfill and two incised bottom ash impoundments. The bottom ash impoundments were physically closed by removal of CCR in 2018, with ongoing groundwater monitoring. The landfill is substantially closed and is scheduled to receive final waste in late 2020 with closure completed in 2021.

In accordance with the CCR Rule, PSCo initiated groundwater monitoring in the certified network around the CCR units in 2015. In October 2018, PSCo first reported that concentrations of Appendix IV constituents in monitoring wells at the landfill and at the bottom ash impoundments were observed at statistically significant levels (SSLs) above Groundwater Protection Standards (GPS) (HDR, 2019a). Subsequently, PSCo drilled additional wells, completed additional hydrogeologic investigation, and completed the *Conceptual Site Model and Assessment of Corrective Measures (ACM) Report* in June 2019 and posted to PSCo's public website (HDR, 2019b).

The purpose of this report is to provide an update describing progress toward selecting a remedy for corrective action at the Valmont landfill and bottom ash impoundments, as required by 40 CFR 257.97(a) of the CCR Rule.

Figure 1-1. Valmont Station Vicinity Map

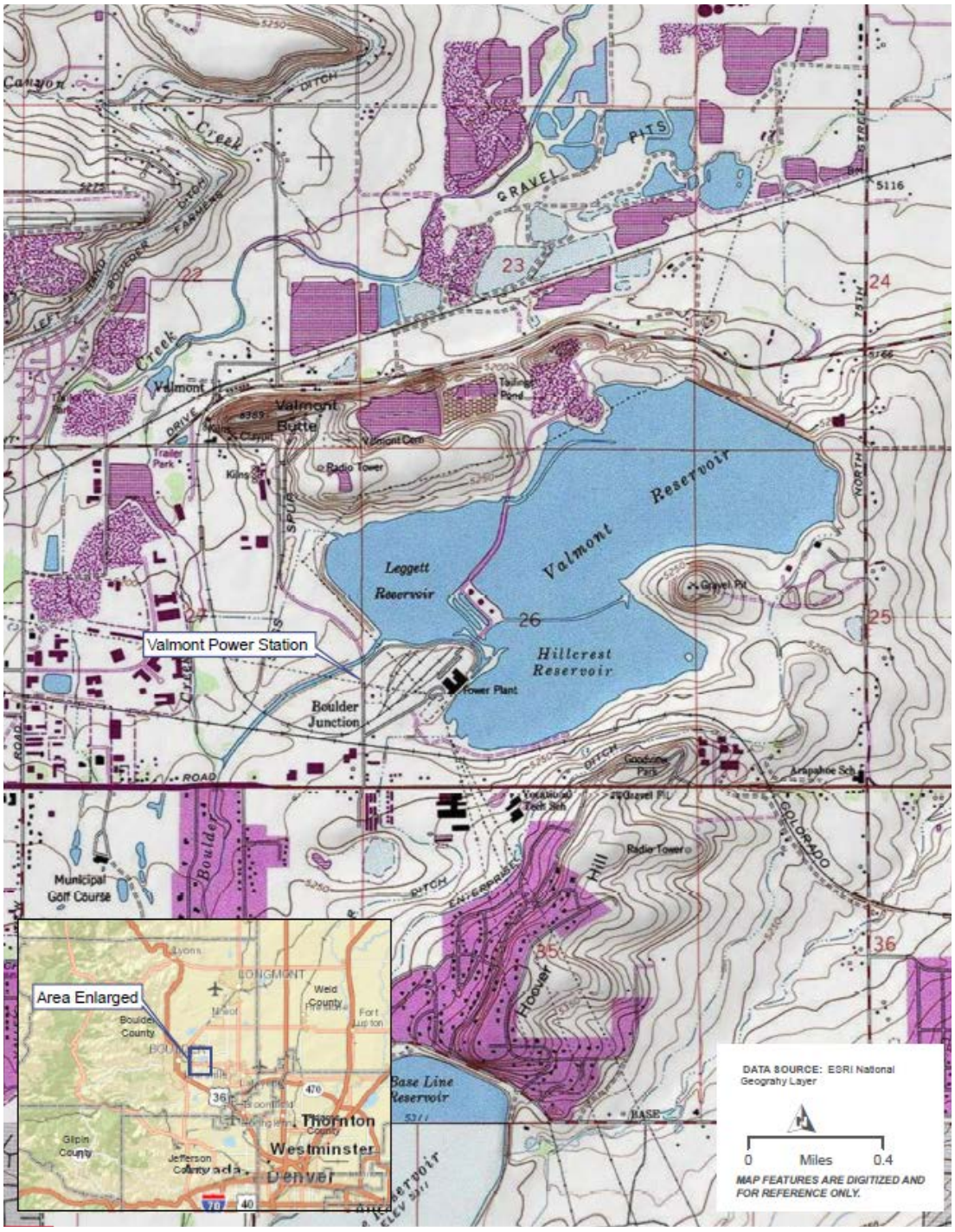
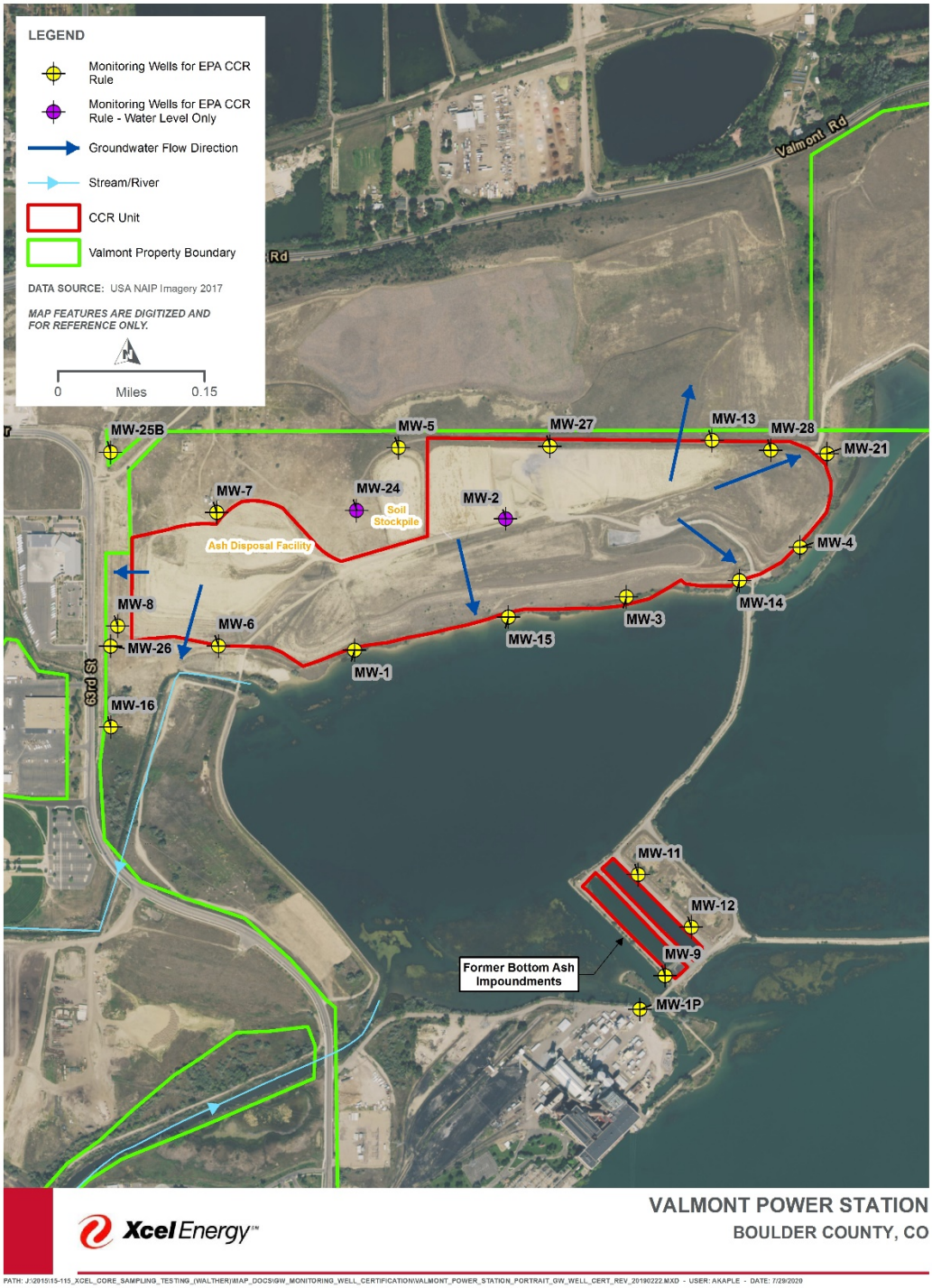


Figure 1-2. Valmont Station—CCR Units in Assessment of Corrective Measures and Certified Monitoring Well Network at Each Unit



2 Landfill

In accordance with the CCR Rule, PSCo initiated background groundwater monitoring around the landfill in 2015, conducted detection monitoring at the landfill in 2017, and has been performing assessment monitoring continually since 2018. As described in the *Groundwater Protection Standards and Determination of SSLs per 257.95(g)*, downgradient wells at the landfill were first found to have concentrations of constituents at statistically significant levels (SSLs) above the GPS in October 2018 (HDR, 2019c). Concentrations of arsenic, lithium and selenium have been observed at statistically significant levels (SSLs) above the GPS in several downgradient landfill monitoring wells. Therefore, PSCo completed the *Conceptual Site Model and Assessment of Corrective Measures* on June 6, 2019 in accordance with CCR Rule 257.96. A groundwater flow and transport model were developed for the Valmont Landfill in 2019 to support the corrective measures assessment. The groundwater model is described in the *Conceptual Site Model and Assessment of Corrective Measures Report*.

2.1 Progress on Model and Evaluation of Potential Remedies

Since the last semiannual selection of remedy update in January 2020, substantial work has been completed to continue to refine the groundwater model and evaluate potential remedies. The model is a critical tool in evaluating the extent of constituent concentrations and the effectiveness of the identified potential remedies. Modeling is by its nature an iterative process that requires refinement (recalibration) as new data is incorporated. Recalibrating the model ensures the model is as representative of observed conditions as possible.

The model was developed in 2019 to create a digital representation of the groundwater flow system to predict groundwater movement and constituent fate and transport. Model calibration is the process of adjusting hydraulic parameters, hydrologic stresses, and model boundary conditions within reasonable ranges to achieve an acceptable match between modeled and observed calibration targets. The degree to which the observed and modeled water levels and constituent concentrations match at calibration targets reflects how closely the model represents observed conditions and therefore provides an indication that the model is capable of providing accurate predictions of future conditions, including the relative effectiveness of potential remedies.

Water quality data from four new monitoring wells installed in 2019 was evaluated and incorporated into the conceptual site model. These additional wells were located to provide important additional data points at the downgradient perimeter monitoring locations. The concentrations of constituents of concern (COC) in these wells near the property boundary better define the extent of GPS exceedances and the potential offsite transport of COCs.

The flow model developed in 2019 was recalibrated to monitoring well water levels from October 2019. The transport model was also recalibrated to constituent concentrations measured in monitoring wells from October 2019.

The recalibrated flow model with groundwater contours, calibration targets, and modeled head residuals (the difference between observed and modeled values) is provided as Figure 2.1-1. The recalibration continues to meet the model calibration goals with an acceptable degree of accuracy. Observed groundwater concentrations and modeled residual concentrations for each constituent are provided in Figures 2.1-2, 2.1-3, and 2.1-4 for selenium, lithium, and arsenic, respectively. Overall, the calibration to measured concentrations shows a good match and is acceptable as a starting point for predictive simulations.

The water quality sampling and preliminary model simulations predict that there is groundwater flow with concentrations of selenium, lithium, and arsenic moving offsite to the north at the northeastern property boundary. However, the predicted mass fluxes (constituent mass moving across the property boundary) are very small. Figure 2.1-5 displays the GPS concentration contours for the site for these three constituents of concern. PSCo has notified the adjacent landowner to the north of the predicted exceedances of lithium and selenium groundwater protection standards beneath their property. Subsequently, PSCo has identified the predicted exceedance of the arsenic groundwater protection standard beneath that property and will be providing an updated notification. The adjacent Valmont Butte property is owned by the City of Boulder and based upon a review of the state permitted well database, there are no water supply wells on that property, for either domestic/drinking water or agricultural/stock water. There are monitoring wells on the Valmont Butte property related to a recent cleanup project related to historic industrial activity at that site.

Numerous simulations of the groundwater flow and transport model have been run to predict groundwater movement and constituent transport under alternative corrective measures described in the ACM, including:

- Monitored natural attenuation
- Partial ash removal
- Complete ash removal
- Complete ash removal followed by a cover
- Installation of a Permeable Reactive Barrier (PRB)

Each model simulation assumed conditions reflective of the corrective measure being evaluated. For example, in the ash removal scenario, the model input values that previously represented ash material were removed from the model to predict future constituent concentrations if ash were to be removed. Similarly, the PRB model run used model input values that represent the expected constituent concentrations after groundwater has moved through the PRB and been treated to remove constituents of concern. The results of model simulation of the potential remedies are preliminary and do not yet provide a basis upon which

to select a remedy. Additional work is also needed to evaluate the feasibility and effectiveness of the potential remedies. For example, bench scale testing for the PRB is needed to evaluate the effectiveness of available reactive media in addressing all constituents of concern. The results of additional work may then need to be re-simulated in the model to evaluate the effectiveness of the remedy in the conceptual site model.

2.2 Next Steps

The following activities are anticipated to be completed or initiated in the next 6-month period for the landfill, but are subject to change based upon the iterative nature of the process, uncertainty about the results of each step, and interim findings: PSCo continues to proceed diligently through the process of further evaluating potential remedies, consistent with best practices and professional judgment.

- Completion of additional field and bench testing work to further evaluate the feasibility and effectiveness of some remedies.
- Completion of model simulations for corrective measure alternatives. Specifically, the model will simulate the extent of the COCs in groundwater and evaluate the effectiveness of potential corrective measures to reduce groundwater concentrations over time with the goal of selecting the best remedy or combination of measures for implementation.
- Preparation of a draft Groundwater Flow Model and Corrective Measures Evaluation Report.
- Continued communication with adjacent landowner regarding off-site migration.
- Continue semiannual groundwater assessment monitoring.

Figure 2.1-1. Valmont Station—Flow Model Calibration Results Displaying Residual Head Values at Calibration Targets

Figure 2.1-2. Valmont Station—Selenium Model Calibration Results Displaying Residual Concentration Values at Calibration Targets

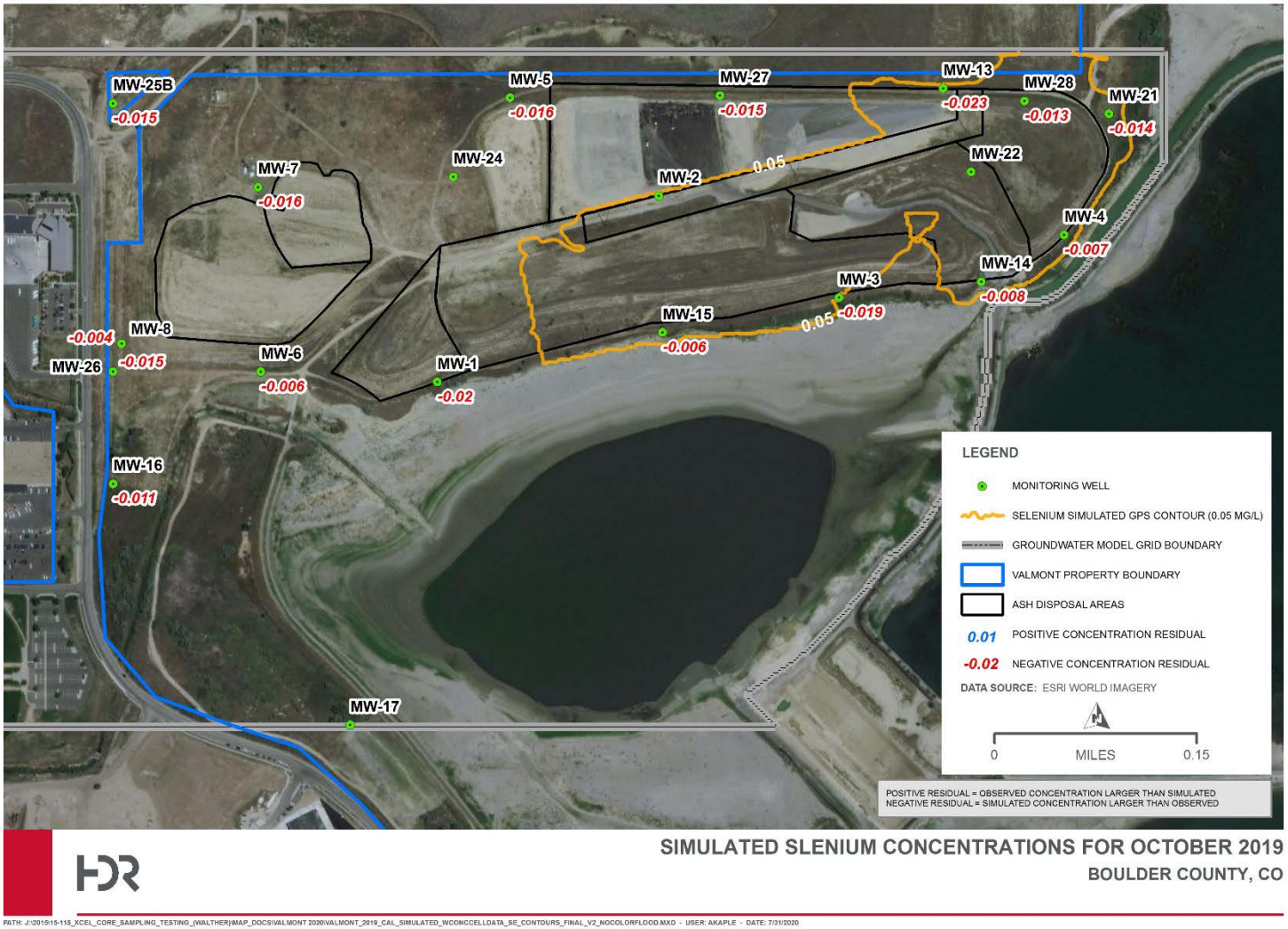


Figure 2.1-3. Valmont Station—Lithium Model Calibration Results Displaying Residual Concentration Values at Calibration Targets

Figure 2.1-4. Valmont Station—Arsenic Model Calibration Results Displaying Residual Concentration Values at Calibration Targets

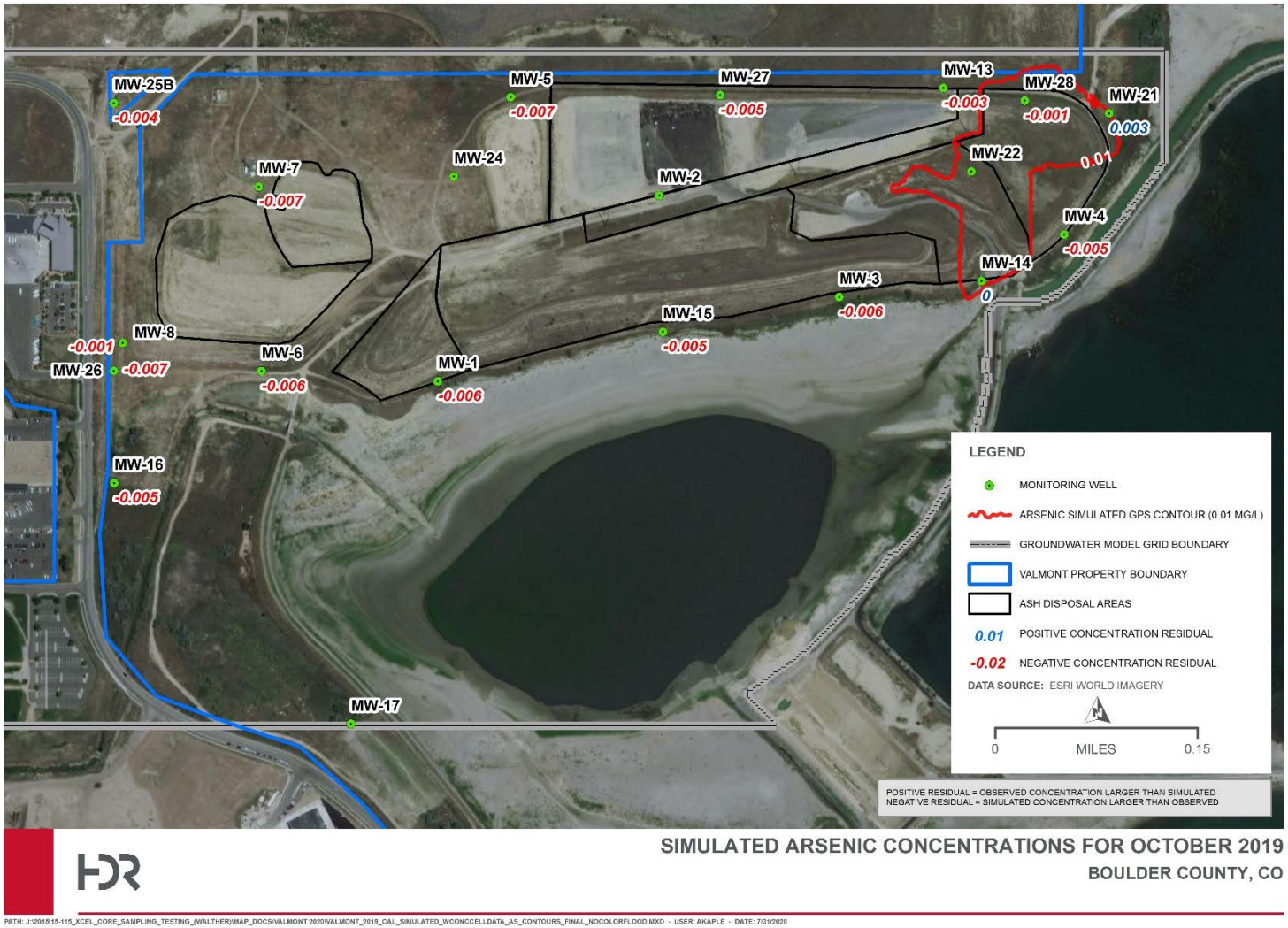
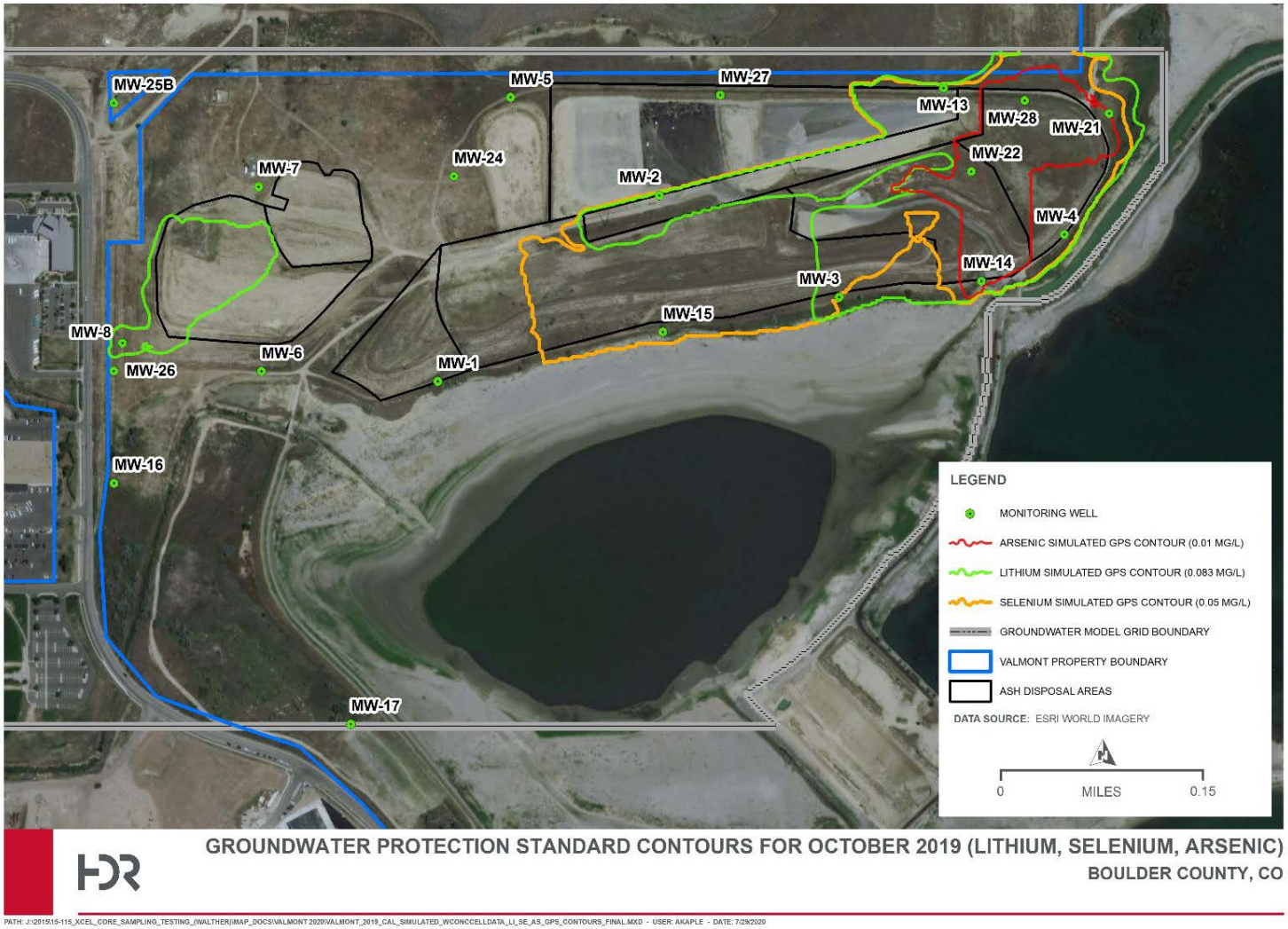


Figure 2.1-5. Valmont Station—Modeled Groundwater Protection Standard Concentration Contours



3 Former Bottom Ash Impoundments

In accordance with the CCR Rule, PSCo initiated background groundwater monitoring around the bottom ash impoundments in 2015, conducted detection monitoring at the impoundments in 2017, and has been performing assessment monitoring continually since 2018. As described in *Groundwater Protection Standards and Determination of SSLs per 257.95(g)*, downgradient wells at the impoundments were found to have concentrations of cobalt and molybdenum at SSLs above the GPS. In response to these SSLs, the assessment of corrective measures completed on June 6, 2019 included evaluation of corrective measures for the impoundments in accordance with CCR Rule 257.96. The assessment evaluated three corrective measures for the impoundments: CCR source removal, monitored natural attenuation (MNA), and enhanced natural attenuation. Of these three, CCR source removal has already been implemented, having been completed in September 2018 as part of the clean closure of the units. Monitored attenuation is a recognized approach for attainment of groundwater protection standards, especially where the source has been removed, provided it can meet the remedy criteria, particularly timeliness.

As discussed in the *Conceptual Site Model and Assessment of Corrective Measures,* concentrations of CCR constituents that exceeded GPS (cobalt and molybdenum) are fairly low at the monitoring wells, and the extent of impacts to groundwater is confined to the area of the former impoundments, which are completely surrounded by the Leggett, Valmont, and Hillcrest reservoirs. In addition, because the gradient is so flat at the former impoundments, operation of the on-site reservoirs may result in fluctuations of the water table that may effectively flush the groundwater from the sediments, accelerating attainment of the GPS. Therefore, PSCo continues assessment monitoring at the former impoundments to evaluate concentration trends of these COCs and to assess if the implemented corrective measures (source removal, combined with MNA) appears to be an effective remedy. The groundwater chemistry from 2019 and April 2020 appears to have decreased concentrations of both cobalt and molybdenum in all three downgradient wells; therefore groundwater chemistry is expected to further improve as a result of the source removal. At the rate of concentration decline observed, it is estimated that all Appendix IV constituent concentrations will be below GPS within the next few years.

3.1 Next Steps

The following activities are proposed to be completed in the next 6-month period:

- Continued semiannual groundwater assessment monitoring.
- Continued evaluation of COC concentration trends.

4 References

HDR, 2019a. Conceptual Site Model and Assessment of Corrective Measures - Compliance with the Coal Combustion Residuals Rule Valmont Station. June 6, 2019.

HDR, 2019b. Groundwater Protection Standards and Determination of SSLs per 257.95(g). June 7, 2019.

HDR, 2020. Annual Groundwater Monitoring and Corrective Action Annual Report and Semi-Annual Remedy Selection and Design Progress Report - Compliance with the Coal Combustion Residuals Rule. January 31, 2020.