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Subject: [External_Sender] MEA-TR
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Tom:

Below is CBO's response to open issue item h, submitted May 20, 2016. At the end of this response is CBO's proposal for a potential license condition to monitor the water level impacts.

h. Description of Crow Butte's monitoring and contingency plans to ensure that the Basal Chadron Sandstone aquifer remains saturated throughout the proposed operations and ground water restoration at the MEA.

CBO Response

Section 7.2.5.4, *Water Level Impacts*, was revised to include the information provided in the AquiferTek report with a paragraph added which describes a monitoring and contingency plan.

7.2.5.4 Cumulative Impacts

Potential cumulative impacts to groundwater resources are expected to be minimal due to the site controls and distance from the MEA site to the CPF and proposed TCEA and NTEA. The operational control and instrumentation systems and excursion monitoring system to be used at the MEA site are designed to quickly detect potential excursions and any leaks, spills or releases. Therefore, any area of impact would be considered to be small. These same conditions will also apply to operations at the proposed NTEA and TCEA, and already apply at the CPF site. Therefore, it would be extremely unlikely for any groundwater impacts reaching beyond the license boundary at the MEA site, as well as the CPF, NTEA and TCEA could contribute to any cumulative impacts.

The NRC has indicated a concern with potential cumulative impacts on groundwater from operating multiple ISR facilities in the Crawford basin. In an effort to try to address these concerns, an evaluation of the potential cumulative impacts associated with development of expansion areas was conducted, and includes an assessment of water levels and water quality in the basal sandstone of the Chadron Formation, as well as overlying and underlying aquifers. Additionally, the effect of deep disposal well operation on the Lower Dakota, Morrison, and Sundance Formations was assessed. Existing water level data collected prior to, and during active mining at the CPF site and expansion areas, hydraulic testing results, water quality results, and deep disposal well design calculations were consulted in conjunction with the anticipated mine development and production timelines to assess potential cumulative impacts.

Water Level Impacts

As has been demonstrated at the CPF, water levels in the basal sandstone of the Chadron Formation have decreased approximately 60 feet due to production (bleed rate implementation) in order to maintain an inward hydraulic gradient. Water quality in the basal

sandstone of the Chadron Formation is considered poor as compared to the shallower Brule formation. Therefore, there are limited wells completed in the basal sandstone of the Chadron Formation to allow for monitoring of offsite water levels. According to a 1991 Industrial Groundwater Use Permit, water levels in Crawford are expected to decrease up to 20 feet from static levels as a result of mining operations at the CPF site (CBR 2007).

Additionally, pumping tests have been conducted in the basal sandstone of the Chadron Formation at similar rates as anticipated production bleed rates. These tests have generally been less than three days in duration, and have resulted in estimated water level decreases greater than one foot at a distance up to 5,700 feet from the pumping well (Petrotek 2002). The cone of depression would continue to expand during long-duration pumping, as is the case during production and groundwater restoration activities. Therefore, the results of pumping tests as well as observed and projected water levels resulting from the CPF mining operations indicate that water levels in the basal sandstone of the Chadron Formation will decrease in a mining unit, with drawdown propagating up to several miles from the pumping center.

Observed water levels in the overlying Brule Formation resulting from CPF mining operations and during pumping tests indicate the basal sandstone of the Chadron Formation and Brule Formations are hydraulically disconnected. Therefore, sustained water level decreases in the basal sandstone of the Chadron Formation are expected to have an insignificant effect on Brule Formation water levels.

The disposal option for process bleed water and groundwater restoration that is likely to impact groundwater levels or water quality is injection into the Lower Dakota, Morrison, and/or Sundance Formations using deep disposal wells. Each expansion area is expected to operate up to two deep disposal wells. Characterization of the injection zone of Deep Disposal Well #2 at the CPF site indicates the formation thickness is approximately 67 feet. In order to calculate a radius of influence resulting from deep disposal well injection over the course of 10 years, mobile porosity was assumed to be 10 percent. The radius of influence resulting from injecting 45 gpm into a single well over 10 years is approximately 1,200 feet. The calculated radius of influence assumes uniform flow across the full injection interval (thickness) and area, and that no impediments to injection such as injection pressure or aquifer boundaries exist. While deep disposal well configurations and locations at each expansion area are not yet determined, this calculation provides some estimate of the area where deep disposal wells will displace formation groundwater, which may result in increased pressures or redistribution of groundwater to adjacent areas.

An analysis of the drawdown impacts resulting from MEA operations, and the cumulative drawdown impacts resulting from the simultaneous operation of the MEA, Crow Butte, and Three Crow Expansion Area facilities, was conducted and is located in **Appendix GG** (AquiferTek 2016b). The drawdown of the potentiometric surface of the basal sandstone of the Chadron Formation was computed using the Theis solutions for confined aquifers (Theis, 1935). Drawdown impacts were computed over the period 2011 through 2052, corresponding to the approximate historical groundwater monitoring period at MEA, future ISR facility operations and aquifer recovery period. Cumulative drawdown impacts from multiple ISR facilities were computed by summing the drawdown impacts of individual facilities using the principal of superposition. Additional drawdown resulting from a lateral no-flow boundary was computed using image well theory (Ferris and others, 1962).

CBO will use performance confirmation to verify actual mining performance follows model drawdown projections (**Appendix GG, AquiferTek, 2016b**) to ensure that the basal sandstone

of the Chadron Formation remains saturated. To monitor performance, CBO will install within each mine unit a minimum of one monitor well for collection of quarterly water level data. If needed recalibration of the models drawdown projections will be performed and if necessary, a corrective action plan will be developed and submitted to the NRC for review and approval. (Response dated May 20, 2016).

CBO proposes two options to a license condition that would require annual reporting in the Semi-Annual Effluent and Environmental Monitoring Program:

1. Submit the quarterly water level data as described above with a written assessment of the drawdown of the Chadron Formation based upon the current operation of the mine and drawdown projections based upon recalibration of the model.
2. Instead of installing one monitor well per mine unit for collection of water level data, use the water level data from the perimeter monitor wells with the same written assessment of the drawdown of the Chadron Formation as described in option #1.

Regards.

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