



Department of Public Works & Utilities

September 28, 2018

Tim Boese
District Manager
Equus Beds Groundwater Management District No. 2
313 Spruce St
Halstead, KS 67056-1925

RE: ASR Groundwater Modeling Data Submittal

Tim:

In response to direction from the Chief Engineer on 9/26/2018, the City is providing supplemental information for the parties' use. The electronic files transmitted include such data as necessary to convey the computerized groundwater modeling performed in the City's analyses, as summarized in the ASR Permit Modification Proposal, prepared by Burns & McDonnell.

Preface

As ordered, this transmission includes the version of the model used to develop its proposal, including model input files, as requested by Equus Beds Groundwater District No. 2 along with a brief explanation of differences from the previous version of the model provided to Equus Beds Groundwater District No. 2 in 2016. A copy is also being provided to the Division of Water Resources as ordered. It is important for all parties to consider the following facts pertinent to analyses:

1. The model – the model included in this transmittal has already been provided to GMD2 and remains unchanged. The GMD2 could have utilized the model to further analyze the City's proposal at any time and for whatever reason, has chosen not to.
2. Drought simulation inputs – inputs into the model incorporated documented modifications based on GMD2 input after extensive collaboration between City and GMD2 staff. Further, the GMD2 staff had time to, and could have, performed work to verify the City's outcomes as they have demonstrated the ability to run the model, including changing input files and varying scenarios. For whatever reason the GMD2 have chosen not to perform, or otherwise provide, any verification work to date. It should

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be noted, City staff estimates this work could still be accomplished in less than a half-day with the model and input files the GMD2 already has on hand.

3. ASR accounting simulation inputs – it should be noted that work performed on accounting was carried out with the same model already in the possession of GMD2 and inputs were developed using the same file structure as for the drought simulation inputs. The inputs were developed in a collaborative effort with GMD2 and the outcomes were documented in the ASR Permit Modification Proposal. Again, the GMD2 has demonstrated the ability to perform modeling and the work necessary to verify the City's results and for whatever purpose, have chosen not to.

Equus Beds Groundwater Flow Model

Electronic files transmitted herewith include those used in the USGS Equus Beds Groundwater Flow Model (EBGWM), which provides a computational engine and describes model parameters such as boundary conditions, surface elevation, bedrock elevation, aquifer hydraulic conductivity, storativity, and hydrologic unit groups. These components have been transmitted to Groundwater Management District No. 2 (GMD2) on 3/23/16 and 11/18/16, and are integral to all analyses contemplated by the Proposal, as well as the annual ASR Accounting Reports. No changes have been made to the Model during the development of the ASR Permit Modification Proposal.

- The EBGWM has been provided to GMD2, who elected not to review its content until 10/5/16.
- On 10/18/16, GMD2 suggested that a new model be constructed with City-provided content.
- After 11/18/16, GMD2 have operated the EBGWM as provided, with City-constructed input.
- The EBGWM is provided with this transmittal.

Drought Model Simulation Input Files

Additional electronic files are provided which reflect modeled aquifer conditions during drought. These Drought Model Simulation input files describe assumed initial aquifer status, environmental conditions throughout the modeled drought, and anticipated pumping from the aquifer.

Drought Modeling Simulation input files were also provided to GMD2 on 3/23/16; after this date, GMD2 had the files necessary to develop any simulation they might desire. Wichita presented important drought modeling assumptions at discussions with GMD2 on 6/28/16, 9/16/16, and 10/4/16. The electronic files transmitted to GMD2 on 11/18/16 included the EBGWM, input files necessary to represent drought conditions, supporting worksheets, and output files. These Drought Model Simulations were provided to demonstrate the potential results for the aquifer in various scenarios; use of ASR credits under existing or revised regulations were contemplated, as well as a scenario where no credits were used. The Simulations further provided the prototype of all modeling efforts done afterwards.

On 11/18/16, GMD2 staff were able to import the files necessary to construct the Drought Modeling Simulations in Aquaveo's Groundwater Modeling System (GMS) software. A brief review of the model was undertaken, and then an automated test of the model's contents was

performed. Minor input revisions were made on 11/21/16 to a portion flagged by GMS, with new water level results varying less than 0.1 feet from the submitted results. Independently, GMD2 had by 11/28/16 processed each of the Simulations presented, and provided commentary on other concerns on 12/15/16. Wichita acknowledged the GMD2 contributions in the modeling effort, and presented the revised modeling assumptions and results in a Draft report submitted to GMD2 on 6/29/17.

- Example Drought Modeling Simulation Input Files were provided to GMD2 on 3/23/16.
- Additional Drought Modeling Simulation Input Files were developed after consultation with GMD2, and provided on 11/18/16 to demonstrate the nature of the input revisions necessary to represent drought conditions in the EBGWM.
- GMD2 has presented no alternative input or output files that represent other simulations considered. However, GMD2 discussed their own modeling efforts in a 6/21/17 meeting with the City and DWR, and suggested that an easier approach might be taken without the model.
- The City provided response to GMD2 commentary, and submitted a Draft Modeling Report on 6/29/17.
- The Drought Modeling Simulation Input Files utilized for the development of the Draft Modeling Report and the subsequent ASR Permit Modification Proposal, as developed by Burns & McDonnell after 11/15/16, are provided with this transmittal.

Revisions to Drought Model Simulations Input Files

Changes in the Simulations after 11/15/16 reflect adjustments in individual Wichita well production during the drought; the total amount of water pumped from the aquifer in drought years remains the same. This refinement, incorporated to reflect pumping limitations that reduce the total amount that can be pumped by a well in a year, has been shown to result in water level changes less than 1 foot in other wells.

The Simulations presented 11/15/16 utilized drought conditions applied to starting aquifer water levels equivalent to January 2011 conditions. It is asserted that these near-full conditions may not adequately represent the long-term average conditions in the vicinity of the Wichita wellfield. Use of the 1998 water levels as a starting condition accommodates the potential for partial depletion of the aquifer prior to the intense pumping associated with drought. The Simulations summarized by the Proposal begin the drought at 91% full in the Wichita wellfield.

Accounting Simulations Input Files

Electronic files are provided which represent analytical efforts utilized to develop proposed rules for Aquifer Maintenance Credits (AMCs). These Accounting Simulations Input files describe assumed initial aquifer status, environmental conditions, pumping, and anticipated artificial aquifer recharge. While not a part of the Chief Engineer's Order, these Input Files can be used by the Parties for evaluation of the ASR Permit Modification Proposal.

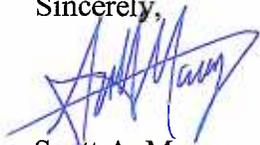
On 10/2/17, GMD2 expressed interest in establishing a unified accounting system for the development and tracking of both physical recharge credits and AMCs. The unified system would be centered on a simplified but defensible spread sheet method, based off groundwater modeling results, historical ASR operation, or another alternative. Burns & McDonnell prepared

Simulations to demonstrate migration and loss of recharged water in a variety of scenarios, as described in Appendix J of the ASR Permit Modification Proposal.

- Accounting Simulation Input Files have been developed in the same manner as Drought Simulation Files. The assumptions integral to the Simulations were presented by the ASR Permit Modification Proposal transmitted to GMD2 by DWR after 3/22/18.
- GMD2 has presented no alternative input assumptions that represent other simulations to be considered.
- The Accounting Simulation Input Files utilized for the development of the ASR Permit Modification Proposal, as developed by Burns & McDonnell, are provided with this transmittal.

Please find attached with this transmittal letter a DVD containing the above-described input files.

Sincerely,



Scott A. Macey
Water Resources Engineer

Enclosure: ASR Groundwater Modeling Data DVD

cc: Lane Letourneau, Water Appropriation Program Manager, KS Department of Agriculture
Aaron B. Oleen, Staff Attorney, Kansas Department of Agriculture
Alan King, Director, Wichita Public Works & Utilities
Brian McLeod, Deputy City Attorney, Wichita Law Department