Department of Energy
Carlsbad Field Office
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SEP 2 0 2011

Mr. John Kieling, Acting Chief
Hazardous Waste Bureau
New Mexico Environment Department
2905 E. Rodeo Park Dr. Bldg. 1
Santa Fe, New Mexico 87505-6303

Subject: Transmittal of the Waste Isolation Pilot Plant Calendar Year 2009 Culebra Potentiometric Surface Map Package

Dear Mr. Kieling:

On August 5, 2011 the New Mexico Environmental Department (NMED) approved the Groundwater Work Plan (Work Plan) submitted as a condition to the Final Stipulated Order (Order) dated December 1, 2009. A condition of the Order, upon approval of the Work Plan, is submittal of a series of revised Culebra Potentiometric surface maps (Culebra Potentiometric Surface Map Package) within timeframes specified by the Order. Enclosed is the first submittal due to the NMED within 90 days from the approval of the Work Plan. The submittal is the Calendar Year 2009 Culebra Potentiometric Surface Map Package.

We certify under penalty of law that this document and all attachments were prepared under our direction or supervision according to a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on our inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of our knowledge and belief, true, accurate and complete. We are aware that there are significant penalties for submitting false information, including the possibility of fines and imprisonment for knowing violations.

Please feel free to contact Mr. Daniel J. Ferguson at (575) 234-7018, if you have any questions regarding this transmittal.

Sincerely,

Original Signatures on File

Edward Ziemianski, Interim Manager
Carlsbad Field Office

M. F. Sharif, General Manager
Washington TRU Solutions LLC

Enclosure

cc: w/enclosure
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CBFO:OESH:DJF:ANC:11-1321:UFC 5486.00

Calendar Year 2009 Culebra Map Package

The Stipulated Final Order dated December 1, 2009, requires the Permittees to submit a Culebra Potentiometric Surface Map Package consistent with Groundwater Permit Modification Work Plan (work plan) for groundwater level data for the Calendar Year 2009. The work plan was approved on August 5, 2011, and the map package is due to the NMED within 90 days of this date.

For the Culebra wells in the vicinity of the WIPP site, equivalent freshwater heads for June 2009 were used to calibrate a groundwater flow model, which was used by SNL to compute a potentiometric surface using SNL procedure SP 9-9. June 2009 was determined to have a large number of Culebra water levels available, few wells affected by pumping events, and all wells in quasi-steady state with few individual wells contrary to the general water level trend. Table 1 shows the water level data set.

Table 1
Water Level Elevations for the June 2009 Potentiometric Surface Map Calibration, Culebra Hydraulic Unit

Well I.D.	Date of Measurement	Adjusted Freshwater Head (feet, amsl)	Density Used (grams/cc)
AEC-7	06/09/09	3064.59	1.078
C-2737 (PIP)	06/11/09	3023.32	1.029
ERDA-9	06/11/09	3033.59	1.067
H-02b2	06/10/09	3043.09	1.000
H-03b2	06/11/09	3013.69	1.038
H-04b	06/09/09	3005.97	1.013
H-05b	06/09/09	3081.40	1.093
H-06bR	06/08/09	3070.79	1.033
H-07b1	06/08/09	2998.35	1.000
H-09c (PIP)	06/09/09	2996.27	1.003
H-10c	06/09/09	3024.23	1.001
H-11b4	06/09/09	3006.94	1.062
H-12	06/09/09	3007.34	1.096
H-15R	06/10/09	3022.22	1.130
H-16	06/11/09	3050.00	1.039
H-17	06/09/09	3003.56	1.120
H-19b0	06/11/09	3017.73	1.075
I-461	06/08/09	3047.07	1.019
SNL-01	06/08/09	3084.61	1.032
SNL-02	06/08/09	3074.36	1.015

Well I.D.	Date of Measurement	Adjusted Freshwater Head (feet, amsl)	Density Used (grams/cc)
SNL-03	06/08/09	3082.29	1.029
SNL-05	06/08/09	3077.12	1.012
SNL-06**	06/10/09	2971.33	1.253
SNL-08	06/09/09	3055.63	1.104
SNL-09	06/08/09	3057.38	1.026
SNL-10	06/08/09	3056.29	1.013
SNL-12	06/09/09	3004.22	1.011
SNL-13	06/08/09	3012.75	1.028
SNL-14	06/09/09	3005.56	1.048
SNL-15**	06/09/09	2937.74	1.232
SNL-16	06/08/09	3010.83	1.023
SNL-17	06/09/09	3006.87	1.007
SNL-18	06/08/09	3077.16	1.011
SNL-19	06/08/09	3073.30	1.008
WIPP-11	06/10/09	3082.30	1.035
WIPP-13	06/10/09	3081.40	1.055
WIPP-19	06/09/09	3063.24	1.046
WIPP-25 (PIP)	06/11/09	3068.52	1.010
WQSP-1	06/10/09	3077.17	1.048
WQSP-2	06/10/09	3085.57	1.048
WQSP-3	06/09/09	3073.79	1.144
WQSP-4	06/10/09	3015.58	1.074
WQSP-5	06/10/09	3013.46	1.025
WQSP-6	06/10/09	3025.61	1.015

** SNL-6 and SNL-15 excluded from mapping; long term water level recovery.

Modeled freshwater head contours for June 2009 for the model domain are shown in Figure 1. These contours were generated using the results of the Culebra MODFLOW 2K (Harbaugh et al.,2000) model run utilizing ensemble average distributed aquifer parameters from the SNL Culebra flow model, calibrated as part of the performance assessment baseline calculation for the 2009 Compliance Recertification Application (DOE, 2009). Because that model was calibrated to both a snapshot of assumed steady-state water levels (May 2007), and to transient multi-well responses observed during large-scale pumping tests throughout the domain, the boundary conditions were adjusted to improve the match between the model and the observed June 2009 Culebra freshwater heads presented in this synopsis. The portion of the flow domain of interest to the site is extracted on Figure 2. The freshwater head values for June 2009 were estimated using densities computed from 2008. The base transmissivity fields and the 100 calibrated model realizations derived from them for the performance assessment baseline calculation (PABC) embody the hydrologic and geologic understanding of the

Culebra behavior in the vicinity surrounding the WIPP site (Kuhlman, 2010). Using the ensemble average of these 100 realizations, therefore, captures the mean flow behavior of the system, and allows straightforward contouring of results from a single-flow model.

The Culebra flow model is a single-layer groundwater flow model. The boundary conditions of the flow model are of two types. First are the geologic or hydrologic-type boundary conditions, which include the specified head along the eastern boundary, and the no-flow boundary along the northwestern boundary of the domain. The second type of boundary condition is specified head. The northern and southern boundaries are of this type, along with the southern portion of the west boundary. The no-flow constant head boundary defined in Figure 2 is due to the low transmissivity for this area. The second type of boundary condition was determined using a computational code called PEST (Doherty, 2002) as part of this modeling effort. PEST is used to systematically adjust the boundary conditions to maximize the fit between modeled and observed heads at wells. The illustrated particle in Figure 2 (heavy blue line) shows the DTRKMF-predicted path a water particle would take through the Culebra from the coordinates corresponding to the WIPP facility Waste Shaft to the land withdrawal boundary (LWB) (a computed path length of 4.089 km). Assuming a thickness of 4 m for the transmissive portion of the Culebra and a constant porosity of 16 percent, the travel time to the LWB is 5,900 years (output from DTRKMF is adjusted from a 7.75-m Culebra thickness), for an average velocity of 0.69 m/yr. Since the flow model has the ensemble hydraulic conductivity and anisotropy fields as inputs, the freshwater head contours and particle tracks take into account the variability of known aquifer conditions across the site.

The scatter plot in Figure 3 shows measured and modeled freshwater heads at the observation locations used in the PEST calibration. The observations are divided into three groups, based on proximity to the WIPP site. Wells within the LWB are represented by red crosses, wells outside but within 3 km of the LWB are represented with green "×"s, and other wells within the MODFLOW model domain but distant from the WIPP site are given by a blue asterisk. These groupings were utilized in the PEST calibration; higher weights (2.5) were given to wells inside the LWB, and lower weights (0.4) were given to wells distant to the WIPP site, while wells in the middle received an intermediate weight (1.0). Additional observations representing the average heads north of the LWB and south of the LWB were used to help prevent over-smoothing of the estimated results across the LWB. This allowed PEST to improve the fit of the model to observed heads inside the area contoured in Figure 2, at the expense of fitting wells closer to the boundary conditions (i.e., wells shown in Figure 1). The central diagonal line in Figure 3 represents a perfect model fit (1:1 or 45-degree slope); the two lines on either side of this represent a 1-m misfit above or below the perfect fit. Wells more than 1.5 m from the 1:1 line are labeled. AEC-7 has a large misfit (12.5 m) for two reasons. First, this well has historically had an anomalously low freshwater head elevation, lower than wells around it in all directions. Secondly, it did not have a May 2007 observation (due to ongoing well reconfiguration activities) and therefore was not included as a calibration target in the SNL Performance Assessment MODFLOW model calibration. The ensemble-average transmissivity, anisotropy, and recharge fields used here were not calibrated to accommodate this observation. This well is situated in a low-transmissivity region, and near the constant-head boundary associated with the halite margin, therefore PEST will not be able to improve this fit solely through adjustment of the second type boundary conditions along the edges of the domain (Figure 1). Figure 4 and Figure 5 show the distribution of errors resulting from the PEST-adjusted fit to observed data. The distribution in Figure 4 is roughly symmetric about 0, indicating there is not a strong bias. Aside from AEC-7, and to a lesser degree some other distant wells whose modeled values do not greatly impact the contours shown in Figure 2, the model fit to the June 2009 observations is very good. The ensemble-average model captures the average Culebra behavior, while the PEST calibration improved the model fit to the specific June 2009 observations.

FIGURES

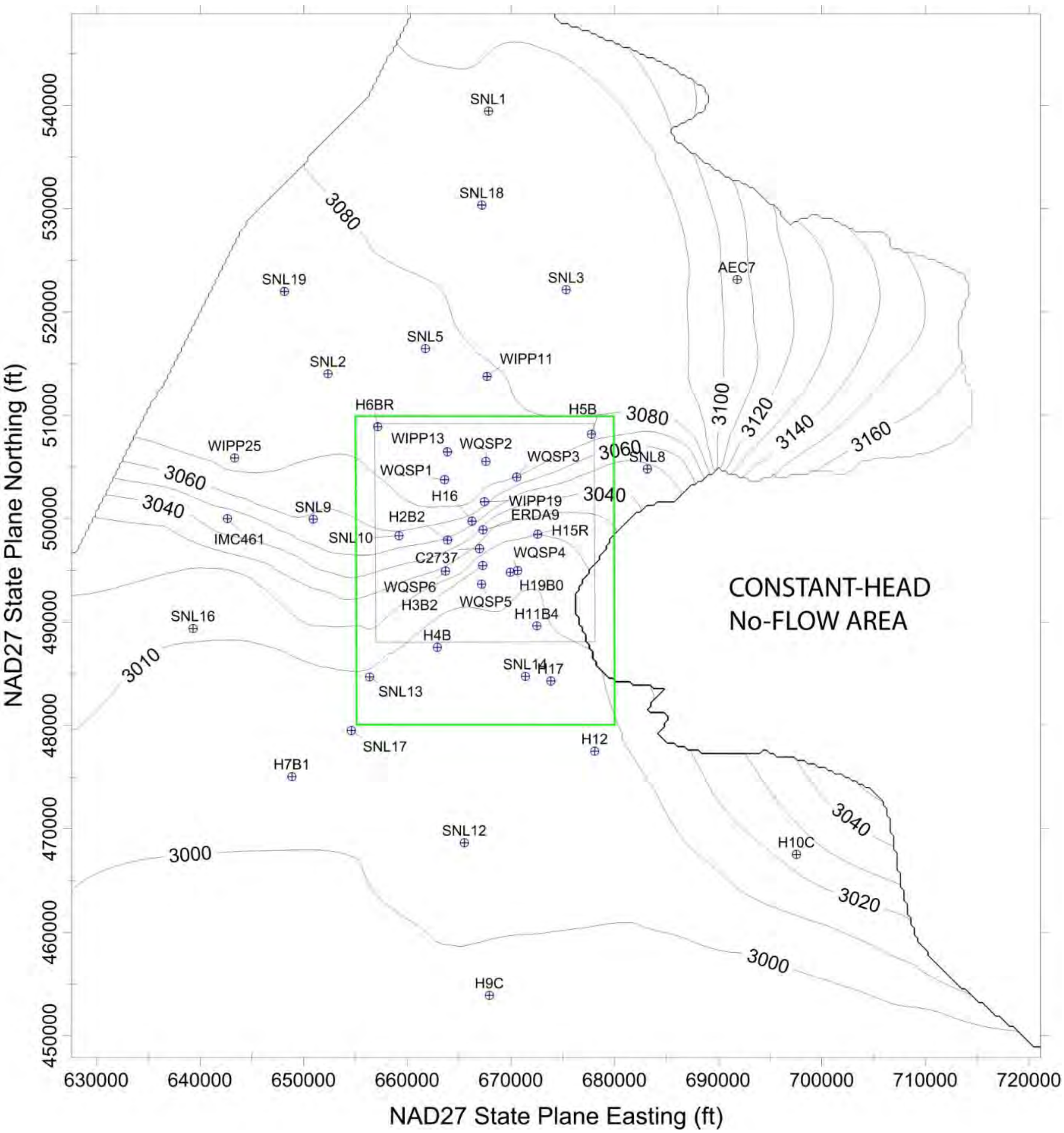

Figure 1 – Model-Generated June 2009 Freshwater Head Contours in the Model Domain (Contour Interval = 10 feet amsl)

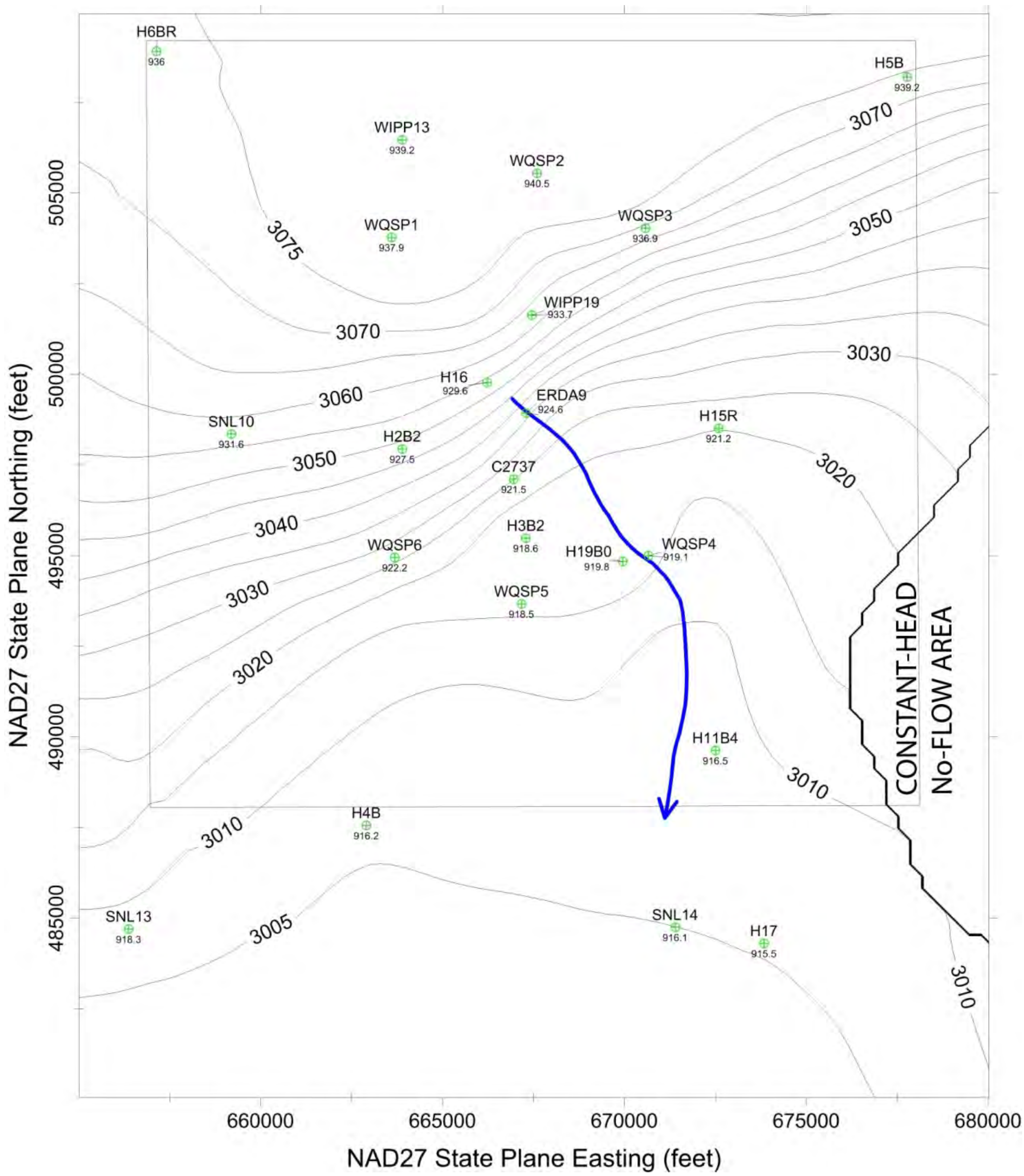

Figure 2 – Model-Generated June 2009 Freshwater Head Contours (5-foot Contour Interval) in the WIPP Vicinity with Blue Water Particle Track From Waste Shaft to WIPP LWB

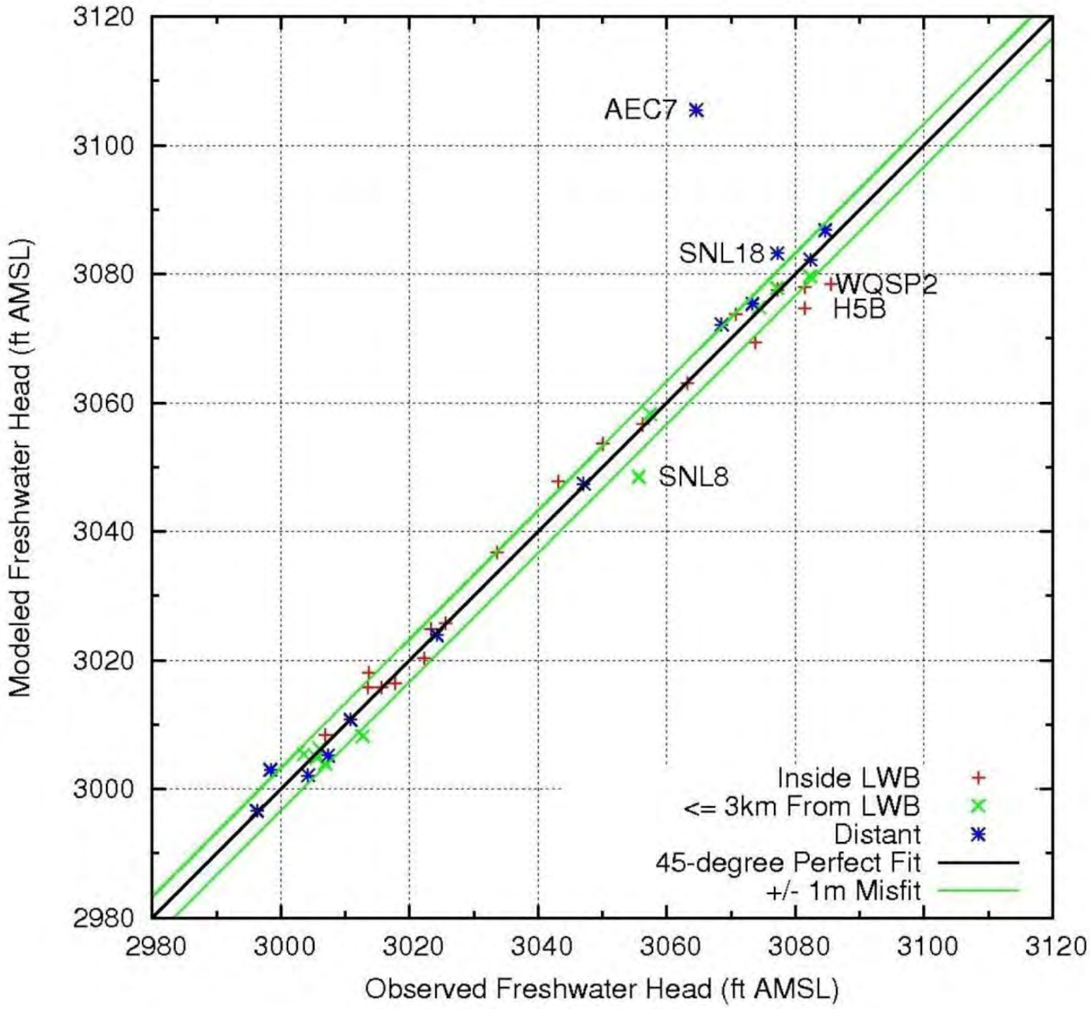

Figure 3 – Measured Versus Modeled Scatter Plot for PEST-Calibrated MODFLOW-2000 Generated Heads and June 2009 Observed Freshwater Heads

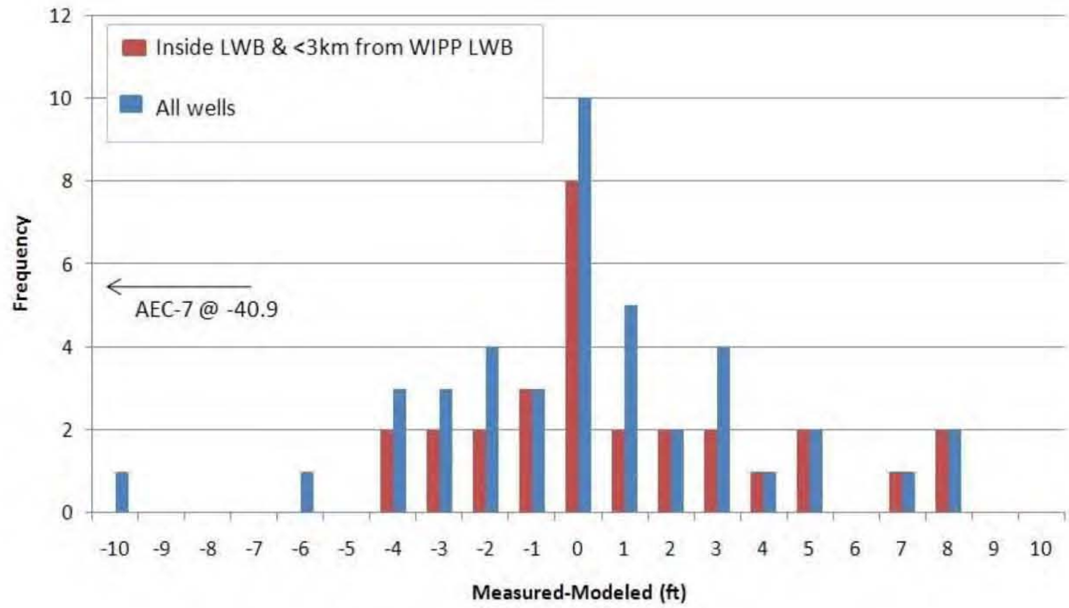

Figure 4 - Frequency of Modeled Freshwater Head Residuals

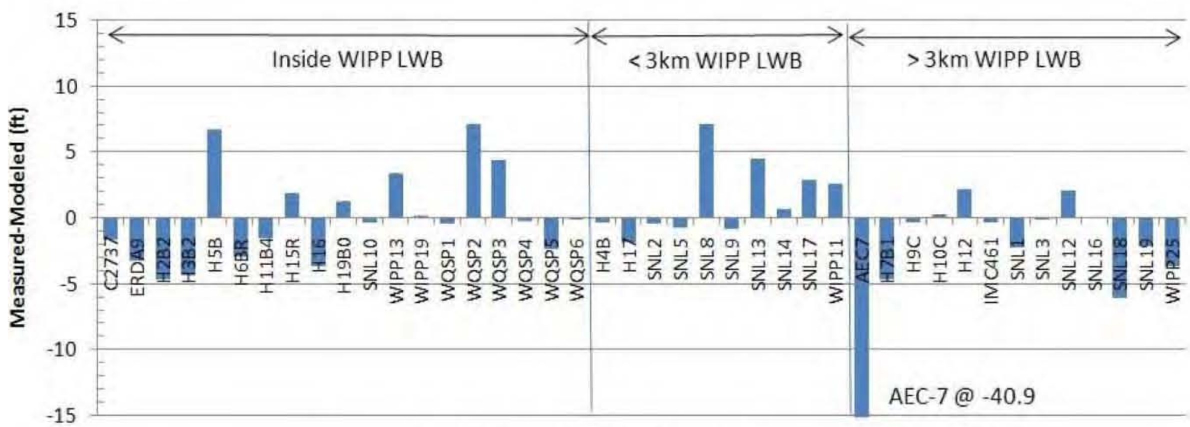

Figure 5 - Modeled Residual Freshwater Head at Each Well

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