WM-61

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Date: 02/07/2008 6:13:14 PM
Subject: Gunnison - Subdivision Flow and Transport Modeling

Paul,

Attached is the Tomichi Preserve Subdivision flow and transport modeling write-up for your information. Let us know if you have any questions or need additional information.

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Flow and Transport Modeling for Proposed Tomichi Creek Preserve Subdivision

Flow (MODFLOW) and transport (MT3DMS) modeling was conducted to determine if the proposed subdivision extraction wells would have any affect on the transport of uranium contamination at the former Gunnison processing site and particularly in the area of the subdivision. This evaluation assumes that each of the seven lots in the proposed subdivision would have a separate well.

The steady state calibrated flow model and the steady state transport model that were used for the Final Site Observation Work Plan (SOWP) for the Gunnison, Colorado, UMTRA Project Site was used as the basis for this modeling.

Seven extraction wells were added to the model, with one well being located on each of the proposed lots (Figure 1). Initially the wells were located in layer 2 of the model, which is from 10 to 25 ft below the surface. Five scenarios were modeled to determine the affect different extraction rates would have on the flow and transport. The results were also used to determine the sensitivity of the flow and transport models. To determine if the depth of the wells would have any affect on the models, the wells were located in layer 4 (45 to 65 ft below the surface) and then in layer 6 (85 to 105 ft below the surface). The results of these two well depth location scenarios were insignificant from the layer 2 results.

The results show that the extraction of up to 70,000 gallons/day (10,000 gallons/day from each of seven the wells) would have an insignificant affect on either the flow or transport results. In addition, the results show that the models are not sensitive to extraction rates as high as 10,000 gallons/day. Details of the results are described below.

Flow Results

Five flow model scenario simulations were run to determine if ground water extraction from wells would have any affect on the mass balance and the calibration statistics. These five scenarios are:

1. Extract 0 gallons/day (0 ft^3/day) from each of the seven wells. This is the steady state base case as reported in Appendix H of the Final SOWP.
2. Extract ~400 gallons/day (53.5 ft^3/day) from each of the seven wells.
3. Extract ~2,000 gallons/day (267.4 ft^3/day) from each of the seven wells.
4. Extract ~5,000 gallons/day (668.5 ft^3/day) from each of the seven wells.
5. Extract ~10,000 gallons/day (1,336.9 ft^3/day) from each of the seven wells.

The 400 gallons/day of scenario 2 is based on the design criteria of 100 gallons/day/person.

The calibration statistics and target residual do not vary at all between these runs. The statistics and results are the same as those reported in Table 3 and Table 4, respectively, in Appendix H of the Final SOWP.

The percent of water removed by the extraction wells compared to the total system outflow indicates why the pumping has no discernable affect on the flow system. At the maximum extraction rate of 70,000 gallons/day the percentage of total system outflow removed by the wells is less than 1%. The table below shows the extraction rate (ft^3/day) and total system outflow (ft^3/day) for each scenario.

	Extraction Rate at Each of the Seven Wells				
	0gpd	400gpd	2,000gpd	5,000gpd	10,000gpd
Extraction Rate	0.0	374.5	1,871.8	4,679.15	9,358.30
Total System Outflow	1,586,068.34	1,586,328.51	1,587,368.66	1,589,318.92	1,592,668.70
Percent	0.0	0.0236	0.1179	0.2944	0.5876

Transport Results

To evaluate the affect of extraction on the transport of uranium in ground water the predicted maximum remaining concentration at the Gunnison site in milligrams per liter (mg/L) at 5, 10, 20, 50, and 100 years was recorded for each of the scenarios as reported below.

	Maximum Remaining Concentration (mg/L) in Aquifer				
Years	0gpd	400gpd	2,000gpd	5,000gpd	10,000gpd
5	0.13628	0.13628	0.13628	0.13628	0.13638
10	0.10526	0.10526	0.10526	0.10526	0.10526
20	0.089926	0.089926	0.089926	0.089926	0.089926
50	0.068932	0.068932	0.068932	0.068932	0.068932
100	0.041561	0.041560	0.041556	0.041548	0.041535

This table shows that there is no difference in the maximum remaining concentration except at 100 years, and then it is not significant. The maximum remaining concentration at 100 years decreases slightly as the extraction rate increases, which is what would be expected as more water is being removed from the system.

To further evaluate the affect of pumping, the uranium concentration was recorded at each of the extraction wells at 5, 10, 20, 50, and 100 years. The table below shows the uranium concentration at each of the wells in mg/L at 100 years for each of the scenarios.

	Maximum Remaining Concentration (mg/L) at Each Well at 100 Years				
Lot	0gpd	400gpd	2,000gpd	5,000gpd	10,000gpd
1	0.00714	0.00714	0.00715	0.00717	0.00721
2	0.00681	0.00682	0.00683	0.00684	0.00687
3	0.00665	0.00665	0.00666	0.00668	0.00670
4	0.00832	0.00833	0.00836	0.00841	0.00850

5	0.00773	0.00774	0.00775	0.00777	0.00782
6	0.00891	0.00891	0.00894	0.00899	0.00908
7	0.0114	0.0114	0.0115	0.0116	0.0117

Again, the results are what would be expected. A slight increase is seen at each of the wells as the extraction rate is increased. However, the concentration is well below the UMTRA Project maximum concentration limit (MCL) of 0.044 mg/L. A similar pattern of a slight increase in uranium concentration with an increased extraction rate is shown for the other times of 5, 10, 20, and 50 years.