February 14, 2008

Mr. Alan L. Larson, PE
City of Madison Water Utility
119 E. Olin Avenue
Madison, Wisconsin 53713

Re: UW 29 Pumping Test Report

Dear Al,

Montgomery Associates: Resource Solutions, LLC (MARS) in collaboration with RMT, Inc. is pleased to present this letter report summarizing the assessment of the UW 29 Pumping Test conducted in November, 2007. We present tables, graphics, analytical data, and text describing the methods and results of the assessment with recommendations for proceeding with pumping strategies for UW 29.

INTRODUCTION

The results of our investigation into the probable cause of elevated concentrations of manganese in the groundwater at UW 29 as presented in our March 2007 Summary Report indicated that the deep aquifer is relatively isolated from the surface based on our sampling and testing program. Based on the results of water quality sampling at UW 29, there was no indication of shallow groundwater being present in water being produced from UW 29. However, the fact remains that Sycamore Landfill, located to the west of the water supply well, is a potential source of surficial contaminants in the vicinity of the well.

We took advantage of the pumping at UW 29 between mid January and early February 2007 to complete an additional scope of work in which water levels at two monitoring wells at the Sycamore Landfill were monitored to evaluate the drawdown that occurred as a result of pumping UW 29. The results of the water level monitoring were presented in our March 2007 Summary Report and indicated that water levels in the two monitoring wells declined approximately 0.6 to 1.1 feet after a few weeks of pumping. The groundwater model simulated drawdowns of approximately 3 feet at the eastern edge of the landfill for steady state conditions. The observed drawdowns compared reasonably well with the model results considering that the model was run for steady state conditions. Based on the modeling conducted and reported in the March 2007 report, the drawdowns were not sufficient to divert groundwater beneath the landfill to UW 29 at pumping rates of 2,100 gpm or less. In groundwater jargon that means there was influence from the well, but not capture. However, given that there were declines in the water levels in both wells at the landfill, there are still uncertainties regarding the connectivity of the upper and lower aquifers and whether or not the Eau Claire shale is absent or is more leaky than is assumed in the model.

Other results of the modeling indicated that if groundwater beneath the landfill has moved deeper in the aquifer, or if the aquitard (Eau Claire shale) is missing, then it is likely that the groundwater could be captured by UW 29 pumping at 2,100 gpm in about twenty years. If manganese treatment is installed at UW 29, the future production of the well could increase to approximately 2,300 gpm. Based on the results of the computer modeling, the unknown condition of the Eau Claire shale underlying the landfill area and the potential need for pumping UW 29 at higher production rates, we recommended further evaluation of pumping impacts on the water levels at the landfill by conducting a more extensive pumping test at UW 29 and monitoring several wells at Sycamore Landfill.

OBJECTIVES (SEE FIGURE 1)

The project objectives include:

- Assessing the potential of UW 29 to capture groundwater beneath the landfill; and
- Providing the Water Utility with recommendations on management strategies for UW 29.

APPROACH

A pumping test was conducted at UW 29, in which UW 29 was pumped for 21 days at an average rate of 2,050 gpm. Water levels were monitored at selected wells at Sycamore Landfill for one week prior to, during pumping and one week after pumping. The water level data collected at the wells were analyzed and compared to groundwater modeling results. The model was adjusted to match observed drawdowns more closely and rerun to assess the potential range in hydraulic properties of the Eau Claire Shale. Finally a capture zone analysis was completed to evaluate the impacts of long term continuous pumping on groundwater flow beneath the landfill.

ACTIVITIES PERFORMED

The completed activities that were described in our scope of work for this project include the following:

- Review of Sycamore Landfill monitoring well data, water quality data, well construction reports, geology and cross-sections of the contaminant plume
- Selection of wells to be included in the monitoring network and installation of transducers and data loggers
- Collection of water level data for 1 week prior to pumping, 21 days during the pumping test, and 1 week after the pumping
- Preparation of graphs of pre-pumping water levels, drawdown and post-pumping water levels and correct data for changes in barometric pressure
- Groundwater flow modeling and particle tracking analysis

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RESULTS

Water Level Monitoring

A summary of the methods used for monitoring water levels during the pumping test is presented in a Technical Memorandum attached to this report. Six wells were selected for monitoring at Sycamore Landfill. Table 1 presents construction details for the wells and Figure 2 shows their location.

Table 1. Selected Monitoring Wells

Well ID	Screened Elevation [1]	Unit Screened	Distance from UW29 (ft)	Comments
MW13B	830-805	Sandstone	1350	Monitored previously.
MW19B	813-805	Sandstone	1450	Conductivity 2.1 E-3 cm/sec, monitored previously.
MW21B	817-809	Sandstone	2300	
MW14B	832-807	Sandstone	2750	
MW11B	830-820	Sandstone	2100	Conductivity 2.2 E-3 cm/sec
MW23A	865-855	Dolomite/ Sandstone Contact	1075	Shallow well but closest to UW 29 and screened elevation difference not significant.

Notes:
1. Information collected from Appendix H of report entitled Environmental Contamination Assessment Addendum, November 1996

The primary result of the monitoring is as follows:

> Measured declines in groundwater elevations in the Sycamore Landfill monitoring wells 11B, 13B, 14B, 19B, 21B and 23A during the UW 29 pumping test ranged from 0.71 ft to 1.07 ft (Figures 3 and 4). There was not a good correlation between distance from UW 29 and measured drawdown, however the wells with the highest drawdowns are located to the east-northeast of the landfill and the lowest drawdowns are located to the south and west which likely reflect variable hydraulic properties of the bedrock (Figure 5).

The City of Madison Water Utility operated UW 29 and monitored the pumping rates and water levels before, during, and after the pumping test. Based on these data, the average pumping rate was calculated to be 2,050 gpm during the test. Water level drawdown in the well was calculated as the difference between the static and dynamic water levels to be about 121 ft at the end of the test.

Groundwater Modeling

The existing Telescopic Mesh Refinement (TMR) groundwater model developed from the Dane County Regional Groundwater Model (Krohelski et al., 2000) for the manganese study (see our 2007 Summary Report, Unit Well 29 Manganese Study) was used to simulate groundwater flow conditions in the vicinity of UW 29 (Figure 6). The regional model was constructed using the U.S. Geological Survey groundwater flow model code, MODFLOW (McDonald and Harbaugh, 1988). The four layer regional model was constructed to represent the upper glacial and bedrock aquifers (layers 1 and 2), the Eau Claire shale (layer 3) and the lower sandstone aquifer (layer 4). The regional model grid has 200 rows and 240 columns with square grid cells having dimensions of 1312.4 feet on a side. The TMR model has 100 rows and 100 columns and has a reduced grid spacing of 301 feet on a side. Except for the reduction in the grid spacing, model parameters remained the same. In our previous study, the model was run for steady state conditions, that is, the hydraulic heads do not change with time. However, to simulate the drawdowns for the 21 day pumping test, the model was run for transient conditions. The model was run for two stress periods. The first was to simulate the groundwater system prior to pumping for 10,000 days (stress period 1) and the second was to simulate the 21 day pumping test (stress period 2). The model also included four other municipal wells, UW 11, UW 15, UW 23 and UW 25. Pumping rates at these wells were consistent during and after the pumping test.

Initial results of the modeling underestimated the measured drawdowns in the wells and in the lower aquifer at the pumping well and overestimated the water levels at the monitoring wells in the upper aquifer prior to pumping. To more closely match the simulated with measured drawdowns and water levels in the upper aquifer, hydraulic parameters were adjusted. This process was not a formal calibration as additional data would be necessary to calibrate the model. However, adjustments were made to the input parameters using a trial and error approach based on reasonable estimates. Although there are uncertainties within the model primarily because of the lack of data, it is still considered useful as a screening tool to evaluate the impacts of pumping.

Because the simulated drawdowns were less than measured drawdowns, the vertical hydraulic conductivity of the Eau Claire shale, the underlying confining layer, was increased to allow for more response in the upper aquifer from pumping in the lower aquifer. Based on a number of trial runs, the key hydraulic parameters were modified as follows:

- the value of the vertical hydraulic conductivity of the Eau Claire shale, 0.00072 ft/day, was increased to 0.005 ft/day.
- the value of the horizontal hydraulic conductivity of the lower aquifer, 11.96 ft/day, was decreased minimally to 9 ft/day.

To run the model for transient conditions, a value of storage coefficient for each cell is required. Water that is pumped comes from storage volume released from the compression of the mineral skeleton and expansion of water in confined aquifers and drainage of pores in unconfined aquifers from storage. The storage coefficient (storativity) used in the model ranged from 0.01 in the upper layer to 0.0004 for the lower aquifer. In the transient runs for the Regional Aquifer Model for Southeast Wisconsin, a value of 0.00039 was input for the deep sandstone aquifer (Feinstein et al., 2003).

The primary result of the groundwater modeling is as follows:

> With these adjusted values, the model predicts an average drawdown of 1.01 ft compared to the average measured drawdown of 0.89 ft for the six wells. The predicted and measured drawdowns for each well are shown in Figure 7. Simulated drawdowns were slightly higher (ranging from 0.63 ft to 1.4 ft) than measured drawdowns at the six monitoring wells and were

lower (105 feet vs. 121 ft) than those measured at UW 29. Simulated heads in the monitoring wells at the landfill ranged from 852.44 ft to 859. 84 ft ngvd as compared to the 1996 measured heads of 865.6 ft to 850.7 ft ngvd. Although modeled heads in the upper bedrock layer and modeled drawdowns in the upper and lower layers matched reasonably well, static head in the lower layer, not including turbulent losses in the well, was higher than measured at UW 29 (850 ft vs. 830 ft ngvd).

The model was run for various values of vertical hydraulic conductivity for the Eau Claire shale to evaluate the increased leakiness of the confining layer on the simulated drawdowns. The results are shown in Table 2 below and indicate that a value of approximately 0.005 ft/day is appropriate for the value of vertical hydraulic conductivity of the Eau Claire shale.

Table 2. Modeling Values of Eau Claire Shale Vertical Hydraulic Conductivity

Vertical Hydraulic Conductivity	0.00072 ft/day *(base case)	0.00145 ft/day	0.005 ft/day	0.07 ft/day
Average Modeled Drawdown at Monitoring Wells (measured = 0.89 ft)	0.096 ft	0.27 ft	1.01 ft	3.11 ft
Average Modeled Water Level at Monitoring Wells (1996 measured = 855. 65 ft)	865.42 ft	861.15 ft	856.47 ft	853.92 ft
Capture by UW 29 pumping 2,050 gpm	Not in 30 years	~ 25 years	~ 14 years	~ 6 years

Capture Analysis

The primary objective of the modeling was to assess the likelihood that groundwater impacted from Sycamore Landfill would be captured by UW 29 given the adjustments made in the model based on the drawdowns measured at the monitoring wells. The model code MODPATH (Pollock, 1994) was used to track particle movement from the landfill. The particles move in response to the average linear groundwater velocity as computed by the model. Particles were inserted at an elevation of approximately 780 ft ngvd, approximately 30 below bottom of the plume. The value of porosity used in the model was 0.05. This is a low value to reflect that the nature of flow may be via fractures in the bedrock and results in a faster velocity than using a higher value. Three scenarios in which UW 29 was pumped continuously at rates of 1,100 gpm, 1,700 gpm, and 2,300 gpm were simulated. For each scenario, the water supply source (zone of contribution) and the particle movement beneath the landfill were modeled (Figures 8 – 16). The model was run for transient conditions but instead of simulating 21 days, a period of 30 years was simulated.

The primary result of the capture zone analysis was as follows:

Tracking of particles emanating from beneath Sycamore Landfill at an elevation of approximately 780 ft ngvd for three long-term pumping scenarios for UW 29 indicated that:

- Pumping UW 29 at a continuous rate of 1,100 gpm did not result in particle capture within 30 years (Figures 8 - 11)
- Pumping UW 29 at a continuous rate of 1,700 gpm resulted in capture within 20 years (Figures 12 and 13)
- Pumping UW 29 at a continuous rate of 2,300 gpm resulted in capture within 15 years (Figures 14 - 16)

TREND ANALYSIS

Additional water level data from the Nine Springs monitoring wells located approximately 1,000 feet from UW 30 were provided by Ken Bradbury (WGNHS) on February 8, 2008 to evaluate the regional trend in water levels at the time of the pumping test. If water levels were increasing, the measured drawdowns may underestimate the impacts from pumping and if water levels were declining, the measured drawdowns may overestimate the impacts from pumping. From an analysis of the data, it was estimated that water levels near UW 30 declined a total of approximately 0.27 ft during the pumping test period at UW 29. Adjusting the average measured drawdown at the monitoring wells at Sycamore Landfill by this amount suggests that the average drawdown due to pumping may be closer to 0.6 ft.

The model was rerun with a value of 0.003 ft/day for the vertical hydraulic conductivity of the Eau Claire shale to match more closely the predicted drawdowns to the adjusted measured drawdowns. The modeling for the capture zone analysis was also redone. The results of additional modeling resulted in only minor changes. Also, because of the relatively long distance between the Nine Springs monitoring network and UW 29, the differences in geology that may exist, and the proximity of the monitoring network to UW 30, it is probable that the regional trend seen at the Nine Springs network may not be indicative of the regional water trend in the vicinity of UW 29. Based on the results of the additional analysis, the following conclusions and recommendations remain the same.

CONCLUSIONS

Based on the results of this study, the primary conclusions are the following:

1. Results of the November 2007 groundwater level monitoring at Sycamore Landfill generally are consistent with the less intensive groundwater level monitoring conducted during the manganese treatment pilot study in January and February 2007.

2. The Eau Claire shale confining layer identified at UW29 is likely present throughout the vicinity of UW 29 and Sycamore Landfill. The Eau Claire shale limits flow between the upper and lower bedrock aquifers. Declines in groundwater levels at the Sycamore Landfill monitoring wells would likely be much greater than those observed if the Eau Claire shale were absent.

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3. Continuous pumping at UW29 may have the following effects on groundwater from the vicinity of the Sycamore Landfill
    a. At 1,100 gpm – would probably not capture groundwater from the vicinity of the Sycamore Landfill under long term operation
    b. At 1,700 gpm – may capture groundwater within a period of 20 years
    c. At 2,300 gpm – may capture groundwater within a period of 15 years

RECOMMENDATIONS

Based on the conclusions of this study, we recommend the following:

1. **If impacts from the Sycamore landfill are to be avoided, the long term, 30 year, operational strategy for UW 29 should consider pumping at an average yearly rate of 1,100 gpm.** Since this is an average rate, the well could be pumped at a higher rate periodically or for specific intervals during the year.

2. **The operational strategy should consider all of the area municipal wells and any other high capacity wells that may influence the groundwater flow system beneath Sycamore Landfill. Pumping scenarios for the municipal wellfield should be evaluated to reduce the potential of impacting the water supply in the future. .**

3. **The Water Utility should work with City Engineering to develop a monitoring and analysis program for Sycamore Landfill.** This plan would include preparing periodic (quarterly or semi-annually) water table maps of the shallow groundwater and potentiometric surface maps of the shallow bedrock aquifer from the monitoring data that has recently been and will continue to be collected. The analysis along with water quality monitoring should include preparing hydrographs for the monitoring wells to evaluate whether or not a change in the gradients or water levels is occurring which would be evidence that the operation of UW 29 is affecting a change on the long term hydrology of the groundwater system beneath the landfill.

4. **To provide an additional monitoring point between the landfill and UW 29, a sentry well should be installed in the lower aquifer to monitor groundwater between UW29 and Sycamore Landfill along the line of a possible migration pathway from the landfill to the unit well.** A sentry well in the lower aquifer is a reasonable addition to the Sycamore Landfill monitoring program to determine whether landfill constituents are migrating toward the unit well. However, installation and monitoring of the sentry well should be seen as a supplement to, and not a replacement for, continued monitoring and analysis of the wells at the landfill.

REFERENCES

Feinstein, D.T., T.T. Eaton, D.J. Hart, J.T. Krohelski and K.R. Bradbury. 2003. Regional Aquifer Model for Southeastern Wisconsin, Report 1: data collection, conceptual model development, numerical model construction, and model calibration. United States Geological Survey, Wisconsin Geological and Natural

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History Survey, and University of Wisconsin-Extension. Administrative report to the Southeastern Wisconsin Regional Planning Commission. 73 p.

Krohelski, J.T., K.R. Bradbury, R.J. Hunt and S.K. Swanson. 2000. Numerical simulation of groundwater flow in Dane County, Wisconsin. Wisconsin Geological and Natural History Survey Bulletin 98. 31 p.

McDonald, M.G. and H.O. Harbaugh. 1988. A modular three-dimensional finite-difference ground-water flow model, Techniques of Water-Resources Investigations of the United States Geological Survey. Book 6, Modeling techniques; chapter A1, 576 p.

Pollock, D.E. 1994. User's guide for MODPATH/MODPATH-PLOT, version 3: A particle tracking post-processing package for MODFLOW, the U.S. Geological Survey finite-difference ground-water flow model: U.S. Geological Survey Open File Report 94-0464. 249 p.

CLOSING

Thank you for the opportunity to provide services for this project. Please contact me at 608-223-9585 with any questions or comments.

Montgomery Associates: *Resource Solutions, LLC*

Nancy R. Zolidis

Nancy R. Zolidis, PhD, PG, PH

Senior Hydrogeologist

Attachments: Figures 1 through 16

RMT Technical Memorandum on data collection

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1. **Assess the potential of UW 29 to capture groundwater beneath Sycamore Landfill**

2. **Recommend management strategies for UW 29**

Note: Groundwater flow lines are in the Lower Aquifer (below the Eau Claire Shale).

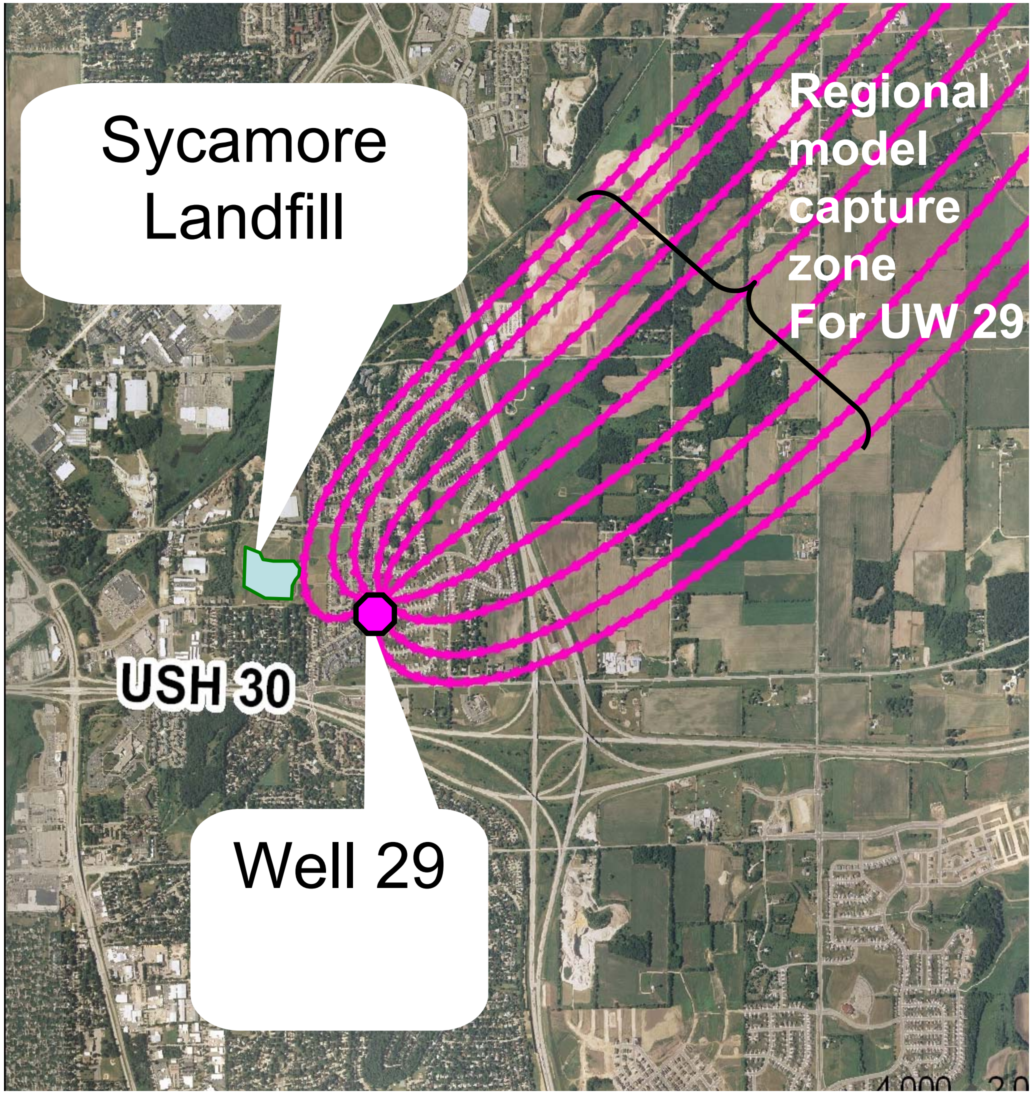

Figure 1. Objectives of UW 29 Pumping Test Study

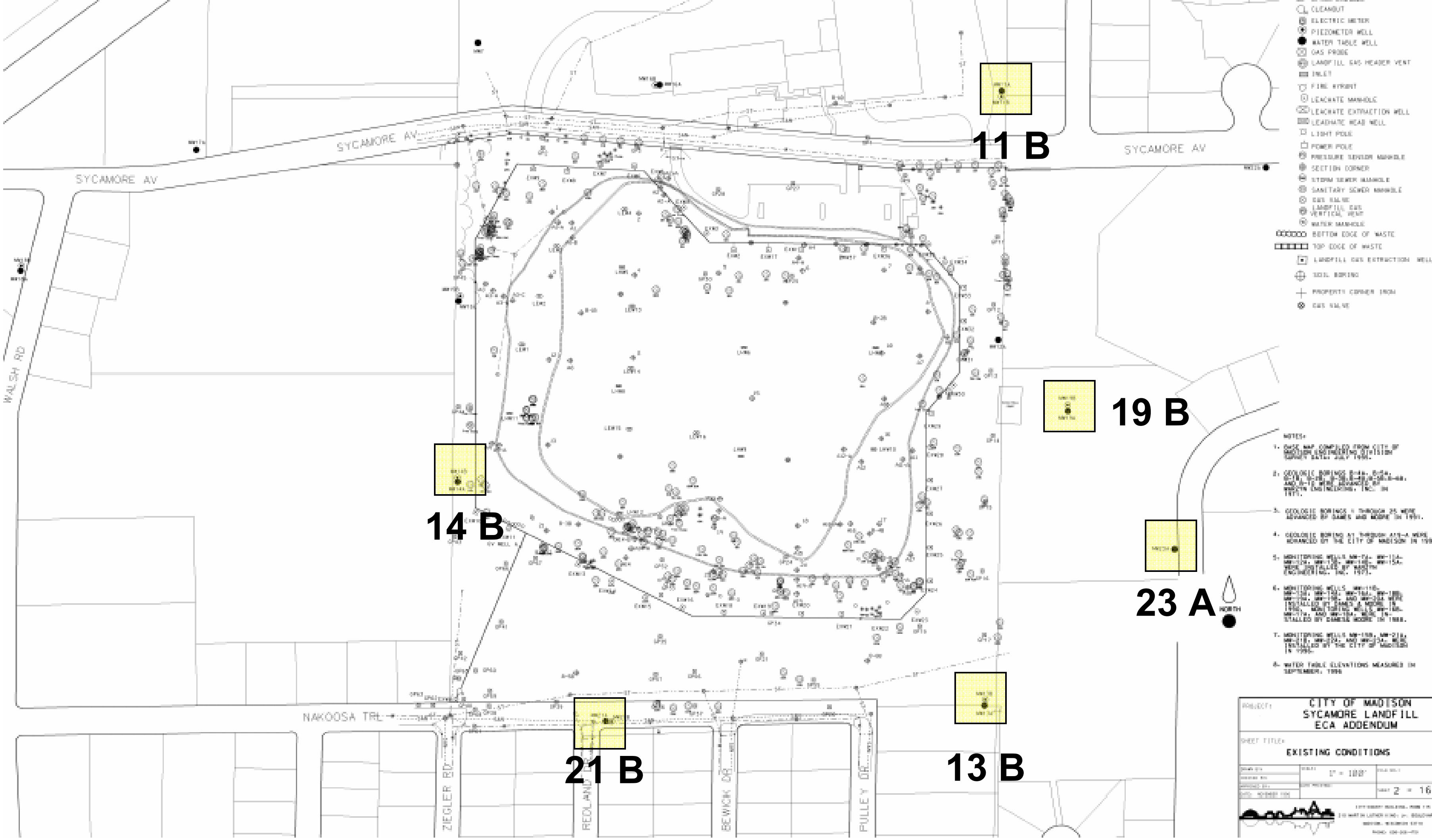

Figure 2. Monitoring Network at Sycamore Landfill

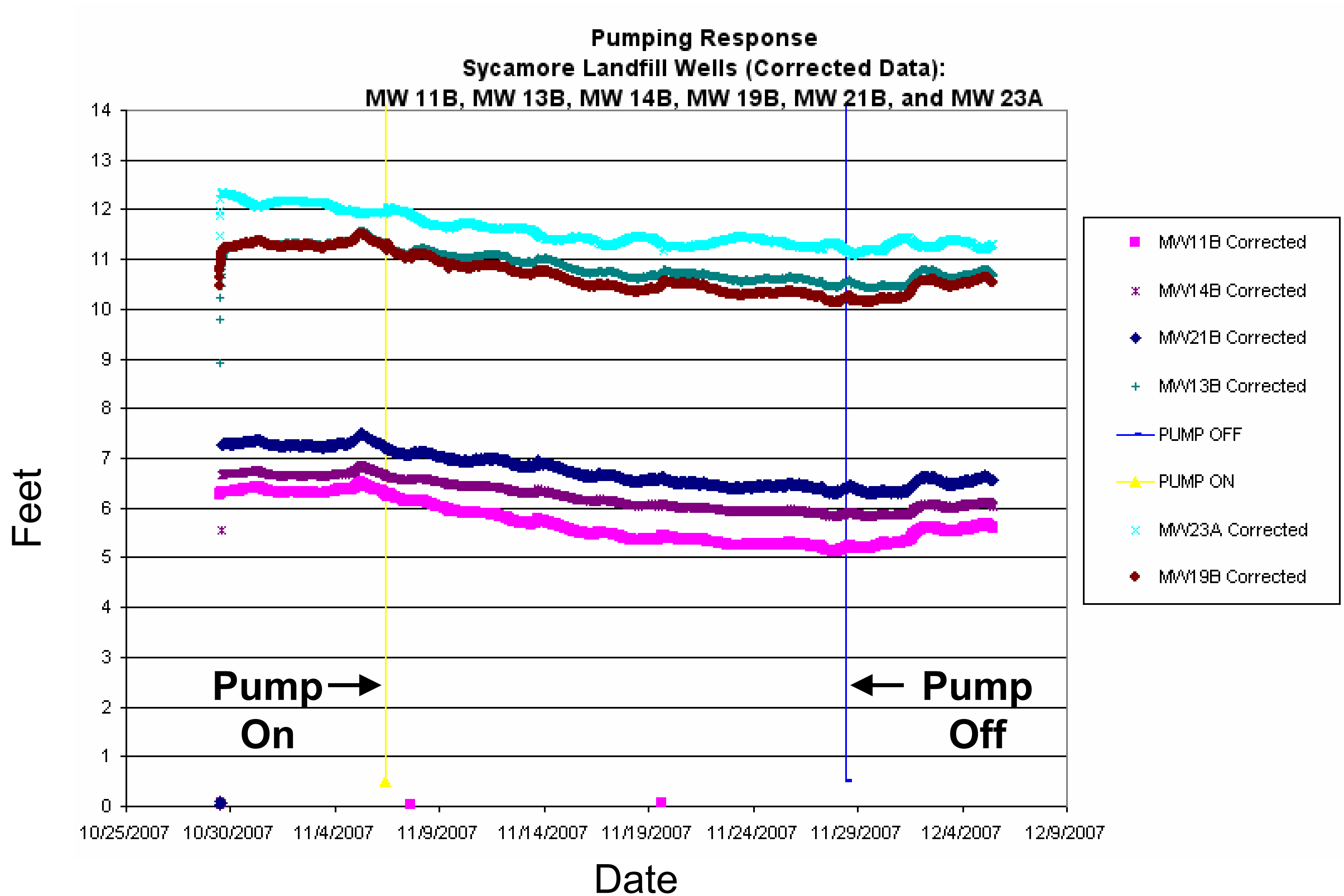

Figure 3. Pumping Response at Selected Sycamore Landfill Wells

Note: Raw data corrected to remove barometric pressure effects from unvented transducers.

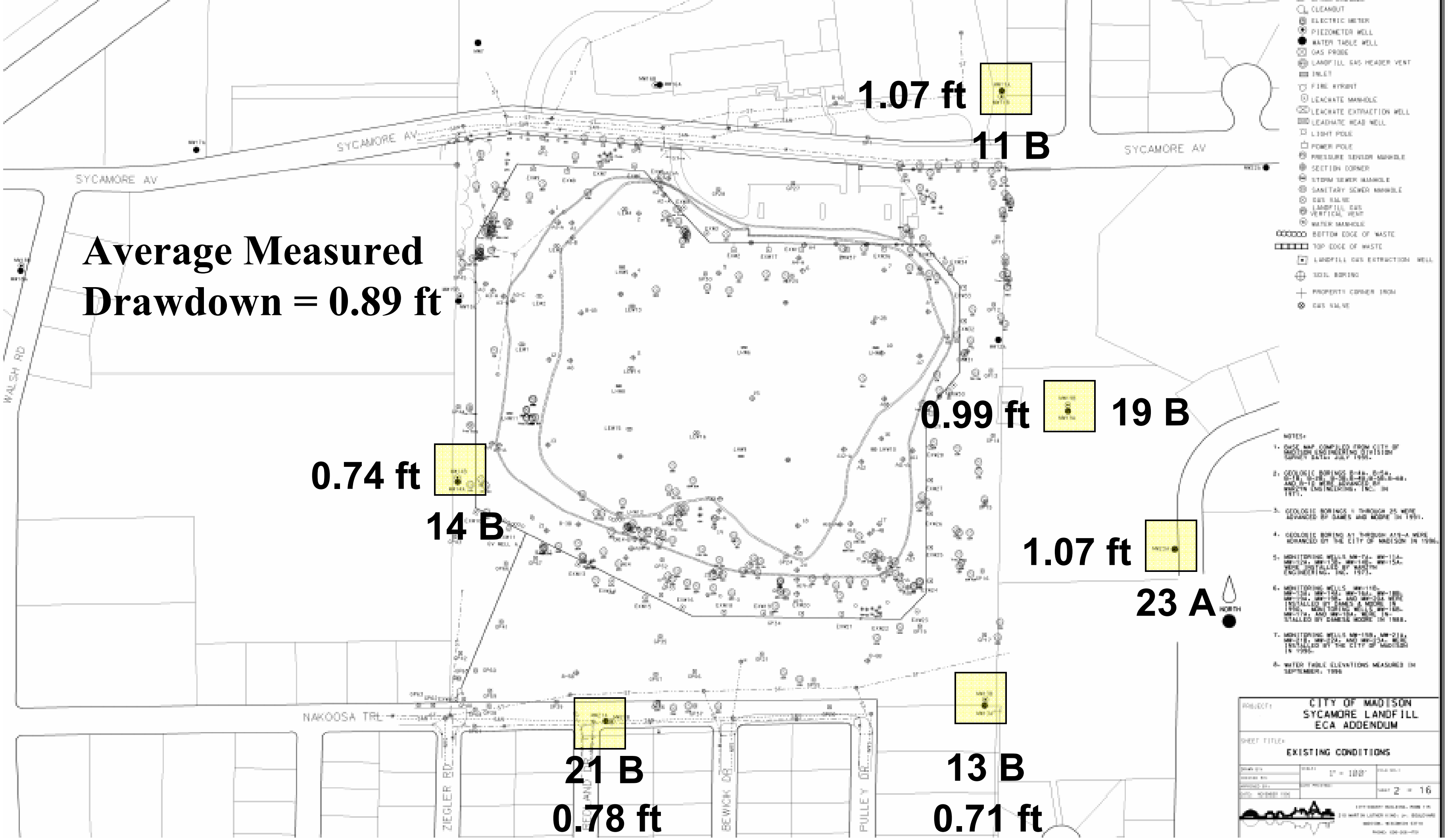

Figure 4. Measured Water Level Drawdowns at Sycamore Landfill Wells

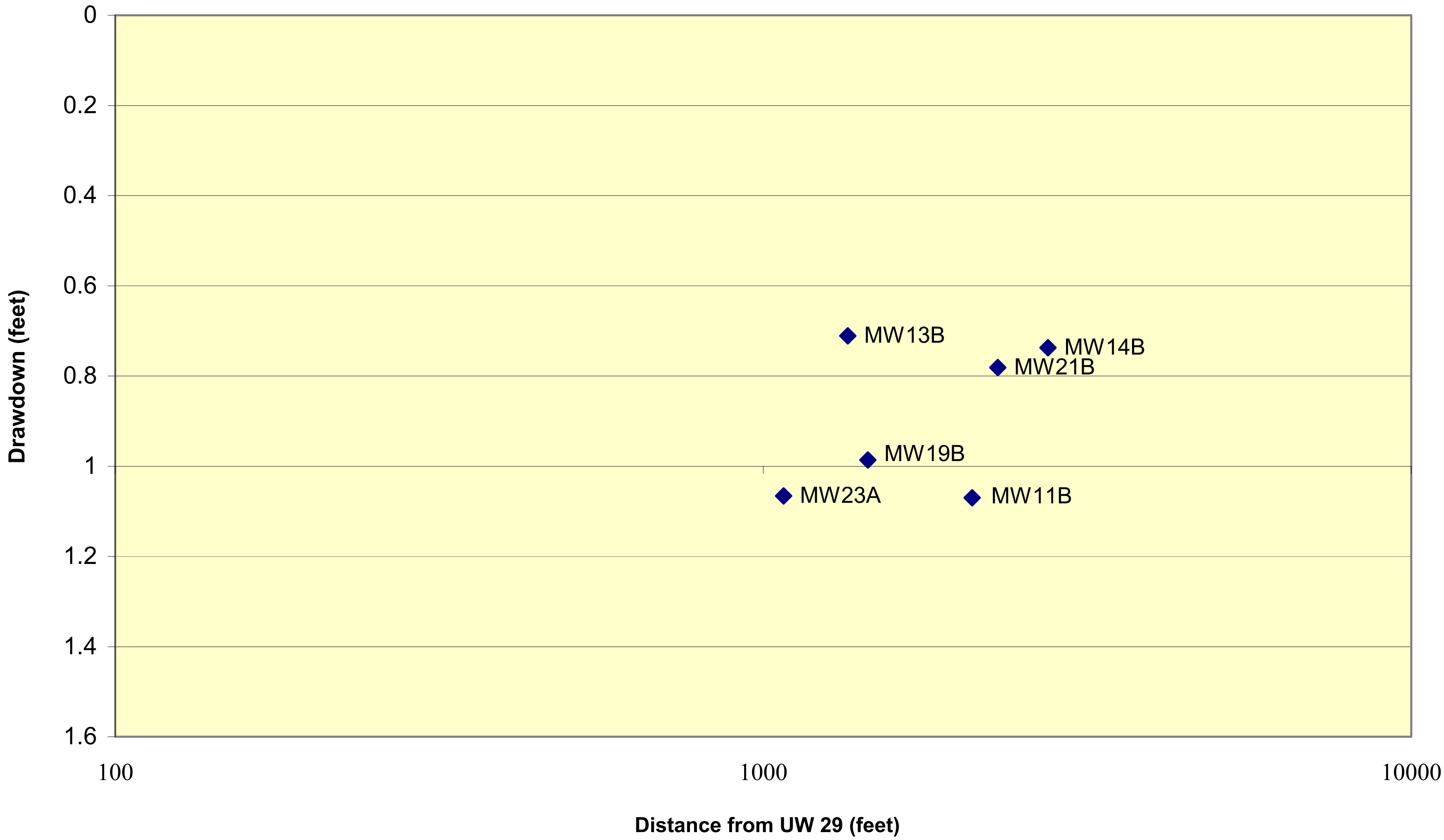

Figure 5. Distance versus Drawdown at Sycamore Landfill Wells

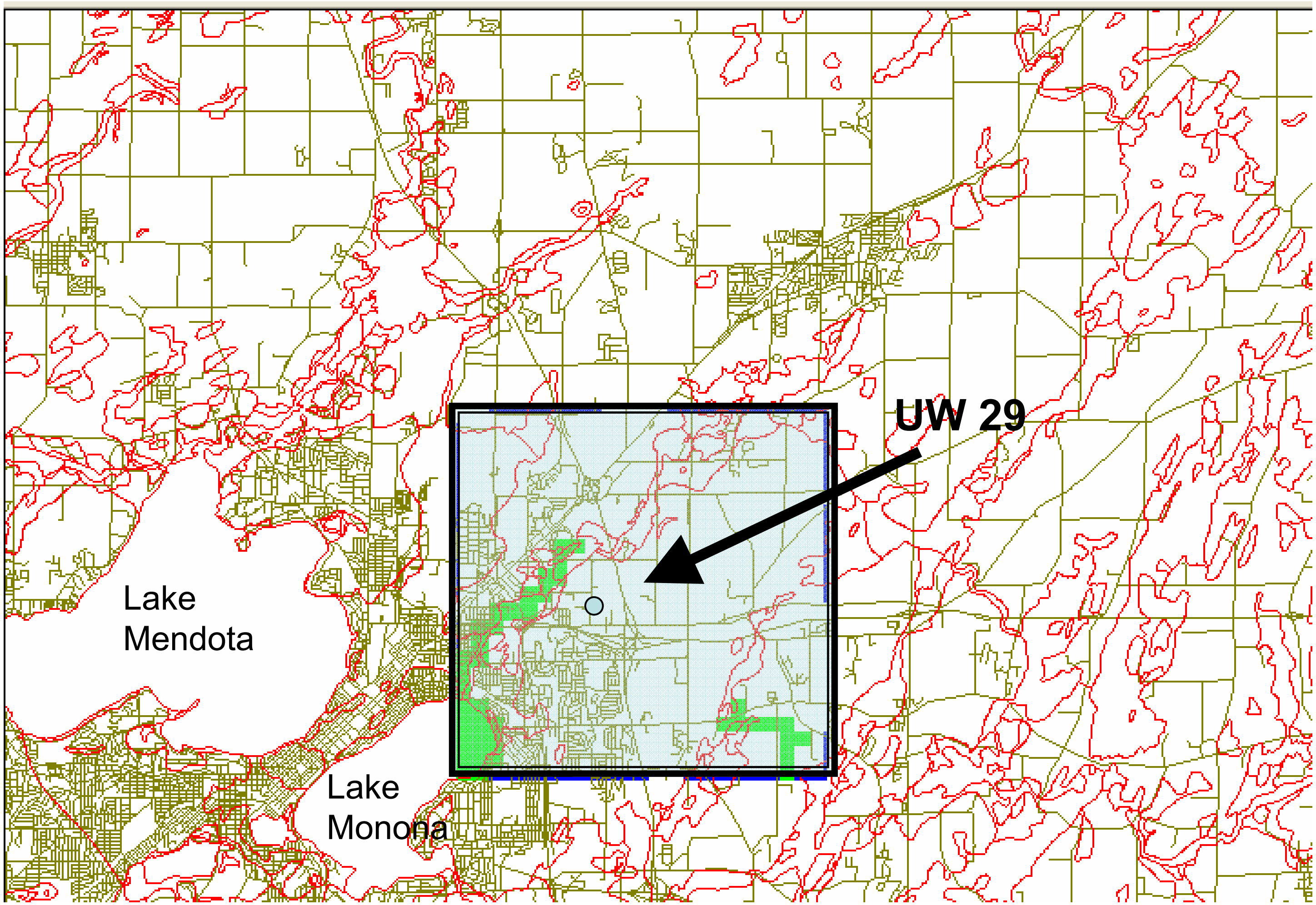

Figure 6. Location of Telescopic Mesh Refinement within the Dane County Regional Model.

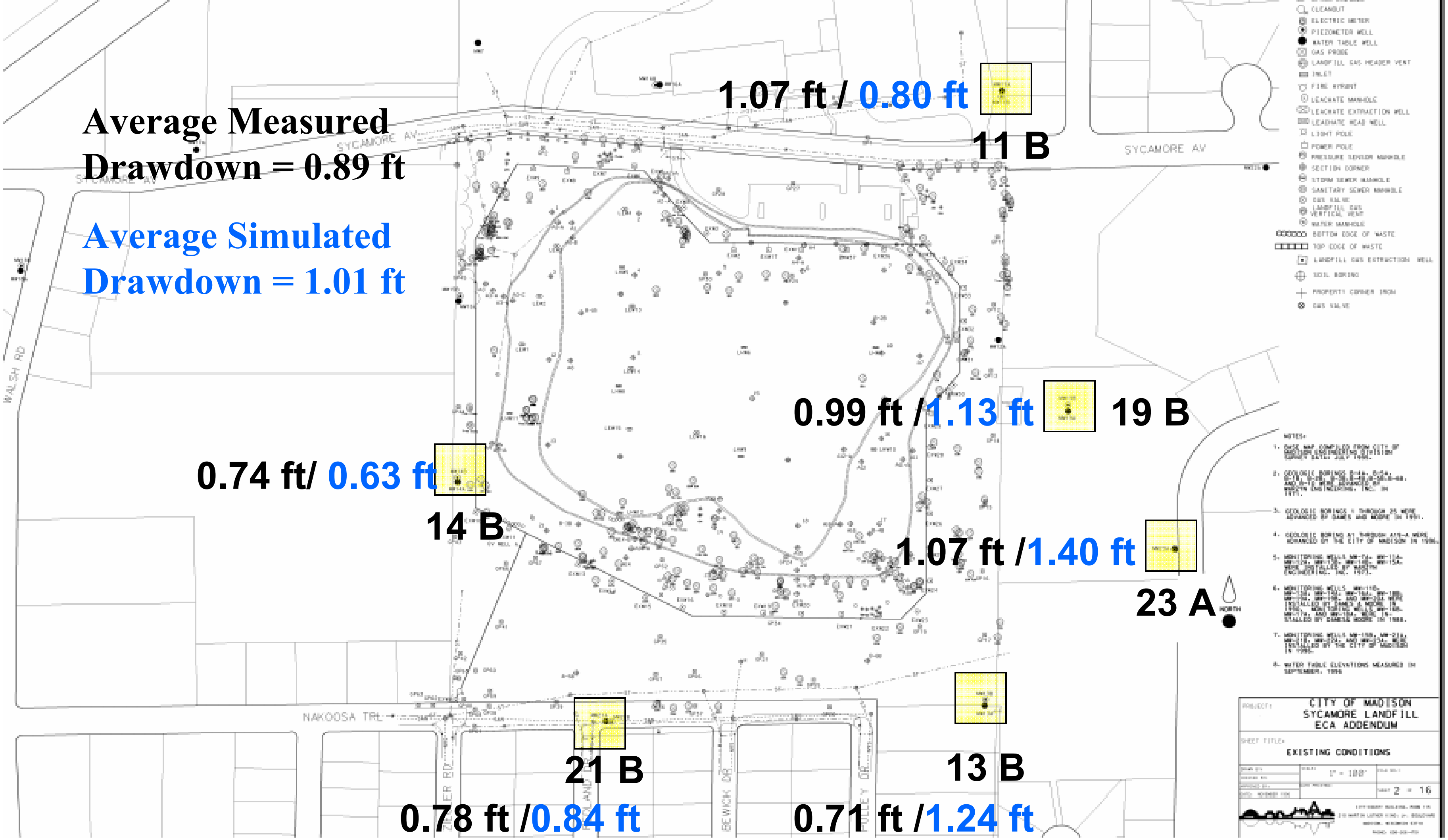

Figure 7. Predicted and Measured Water Level Drawdowns at Sycamore Landfill Wells

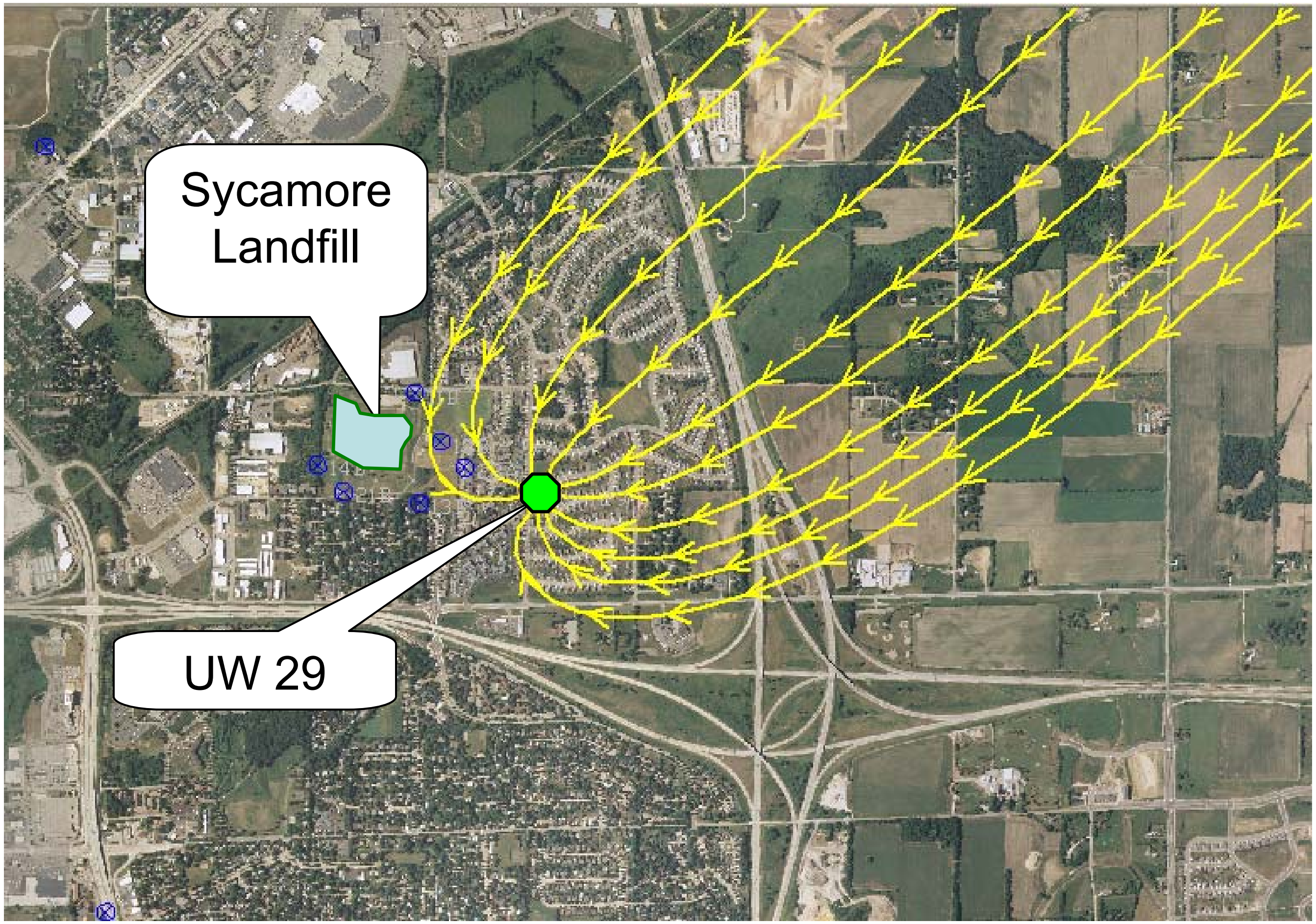

Figure 8. Long Term Supply to UW 29 Pumping at 1,100 gpm

Note: Groundwater flow lines are in the Lower Aquifer (below the Eau Claire Shale).

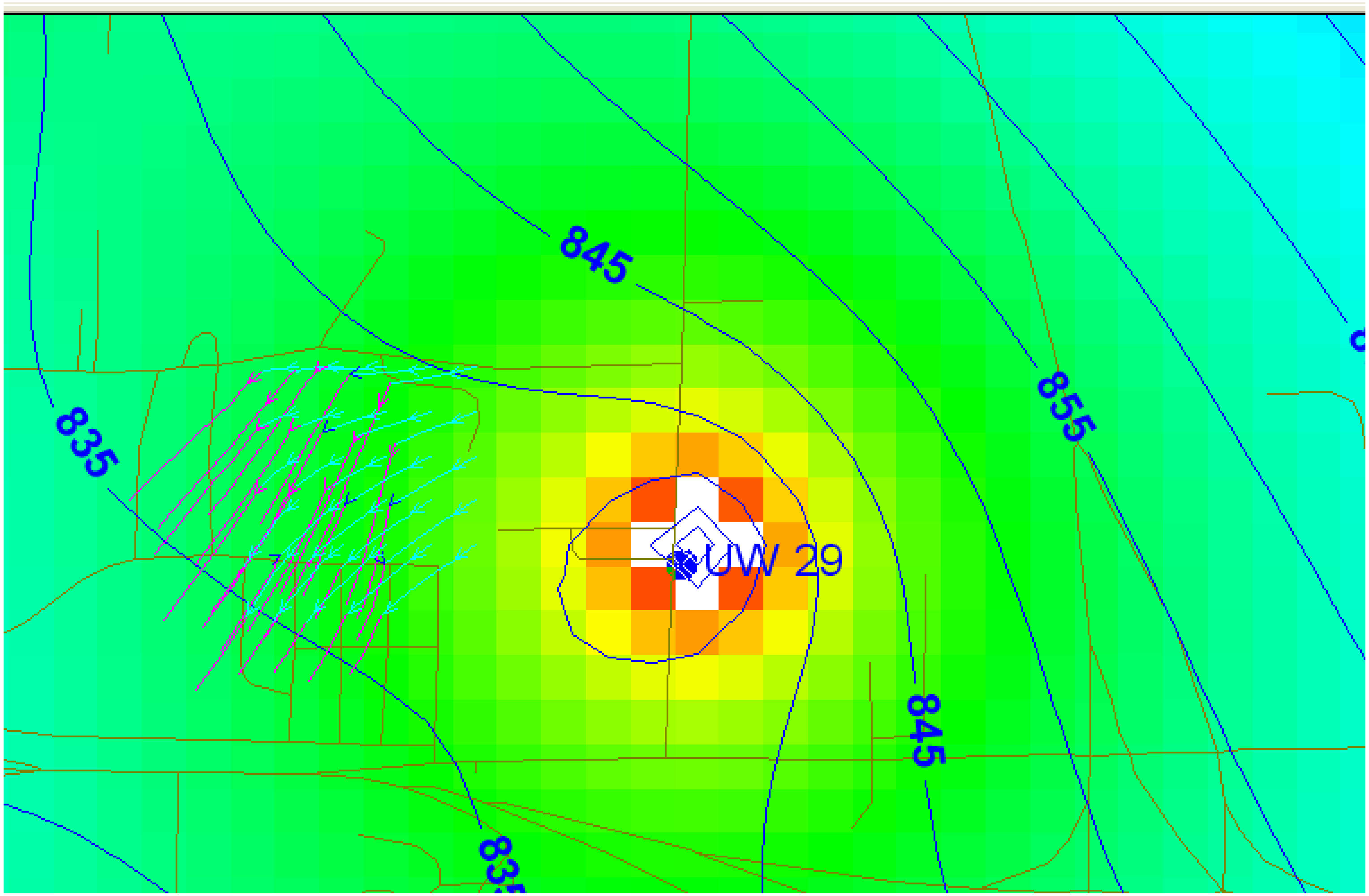

Figure 9. Modeled Groundwater flow and Particle Tracking for 20 Years with UW 29 Pumping at 1,100 gpm

Note: Groundwater flow lines are in the Lower Aquifer (below the Eau Claire Shale).

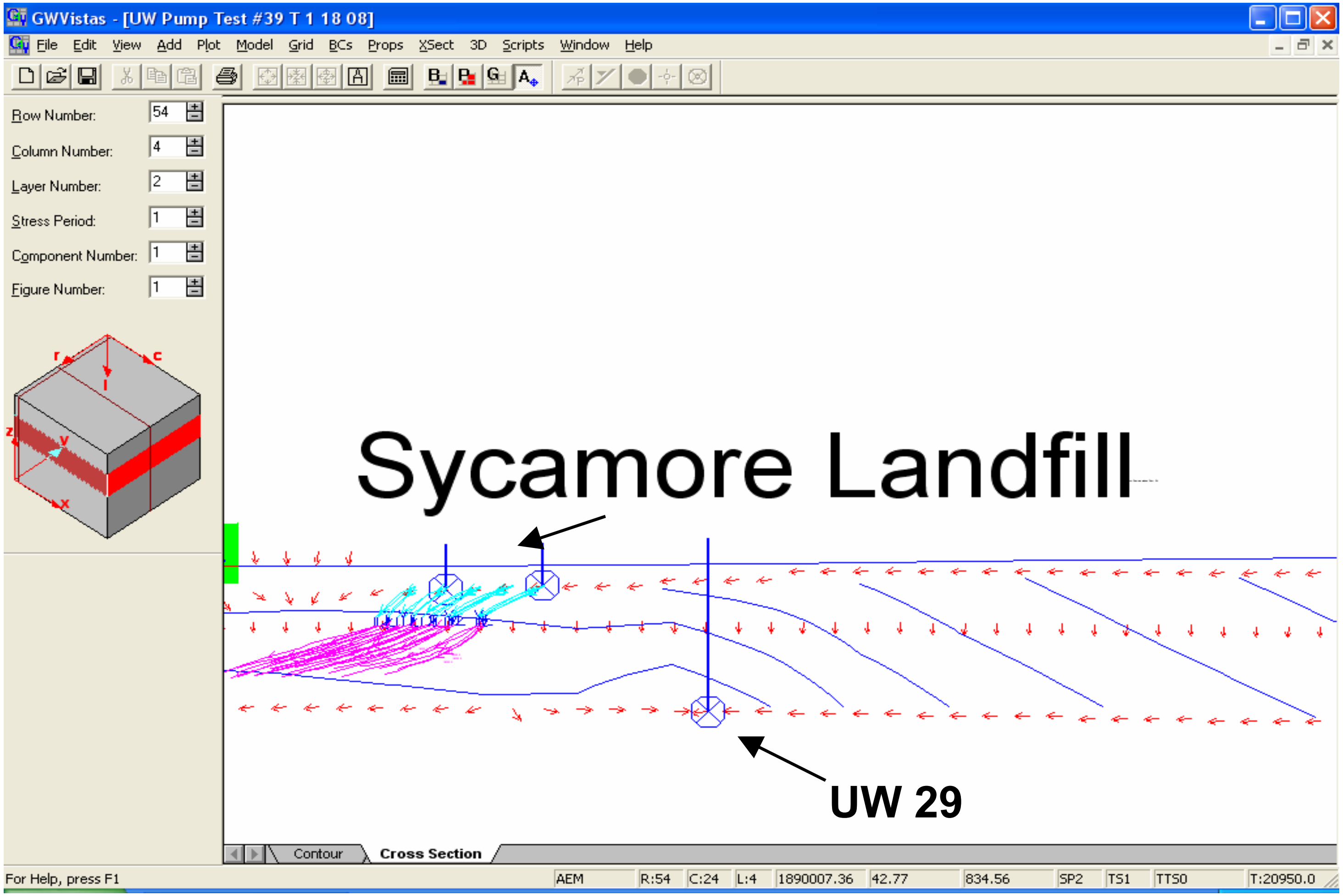

Figure 10. Modeled Cross-section Showing Velocity Vectors and Particle Movement underneath Sycamore Landfill, with UW 29 Pumping at 1,100 gpm.

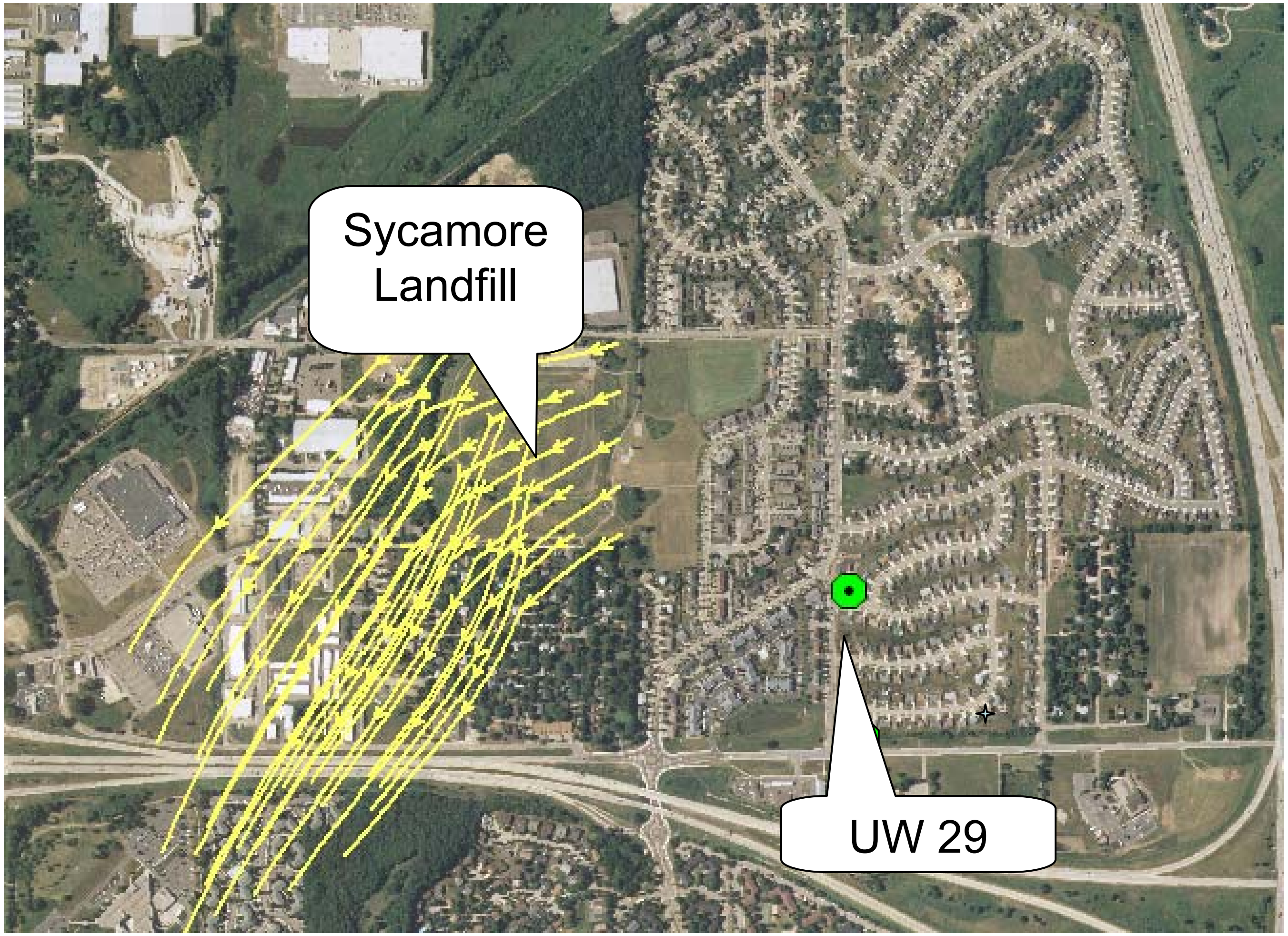

Figure 11. Modeled Groundwater Flow from Landfill with UW 29 Pumping at 1,100 gpm for 30 Years

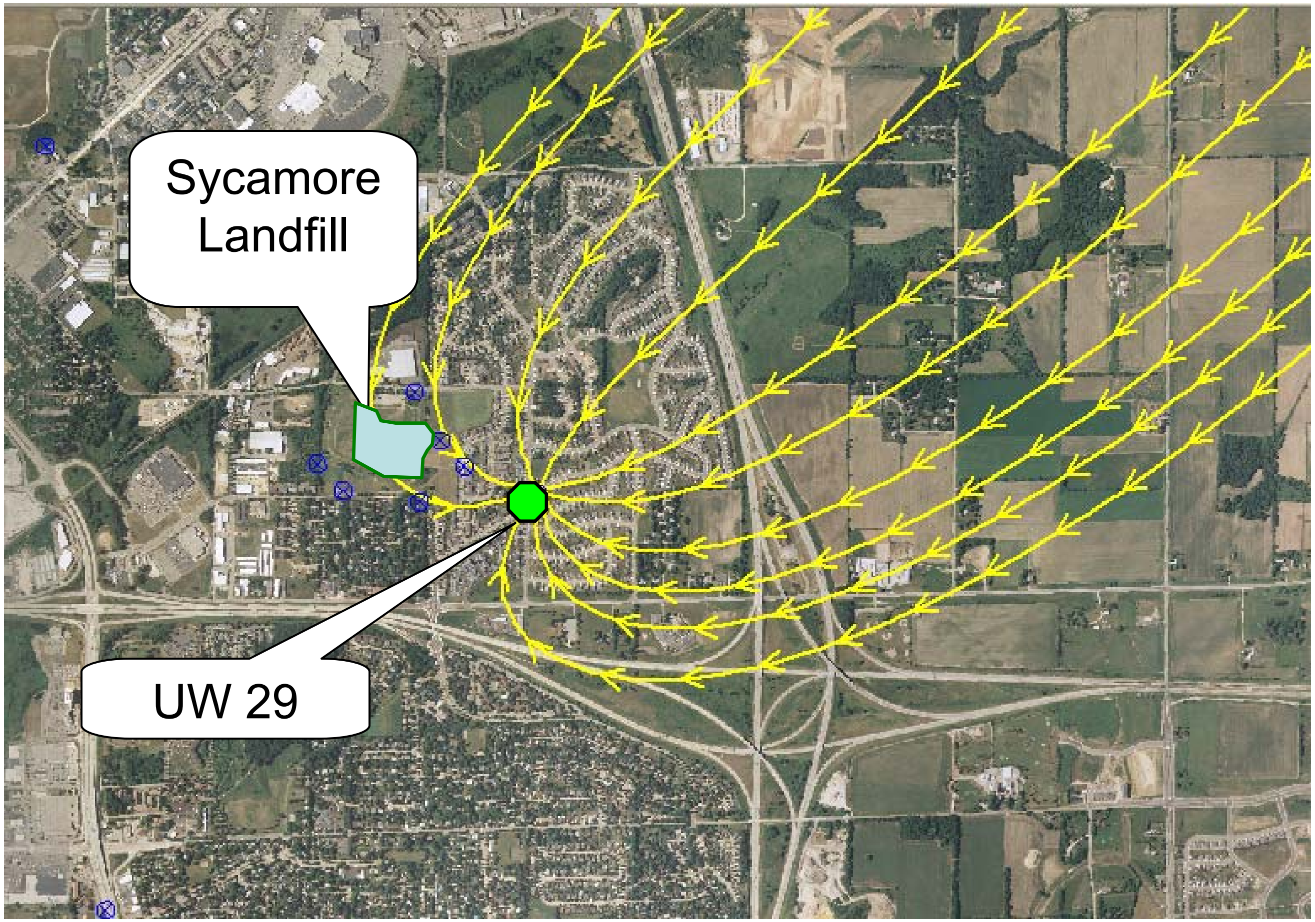

Figure 12. Long Term Supply to UW 29 Pumping at 1,700 gpm

Note: Groundwater flow lines are in the Lower Aquifer (below the Eau Claire Shale).

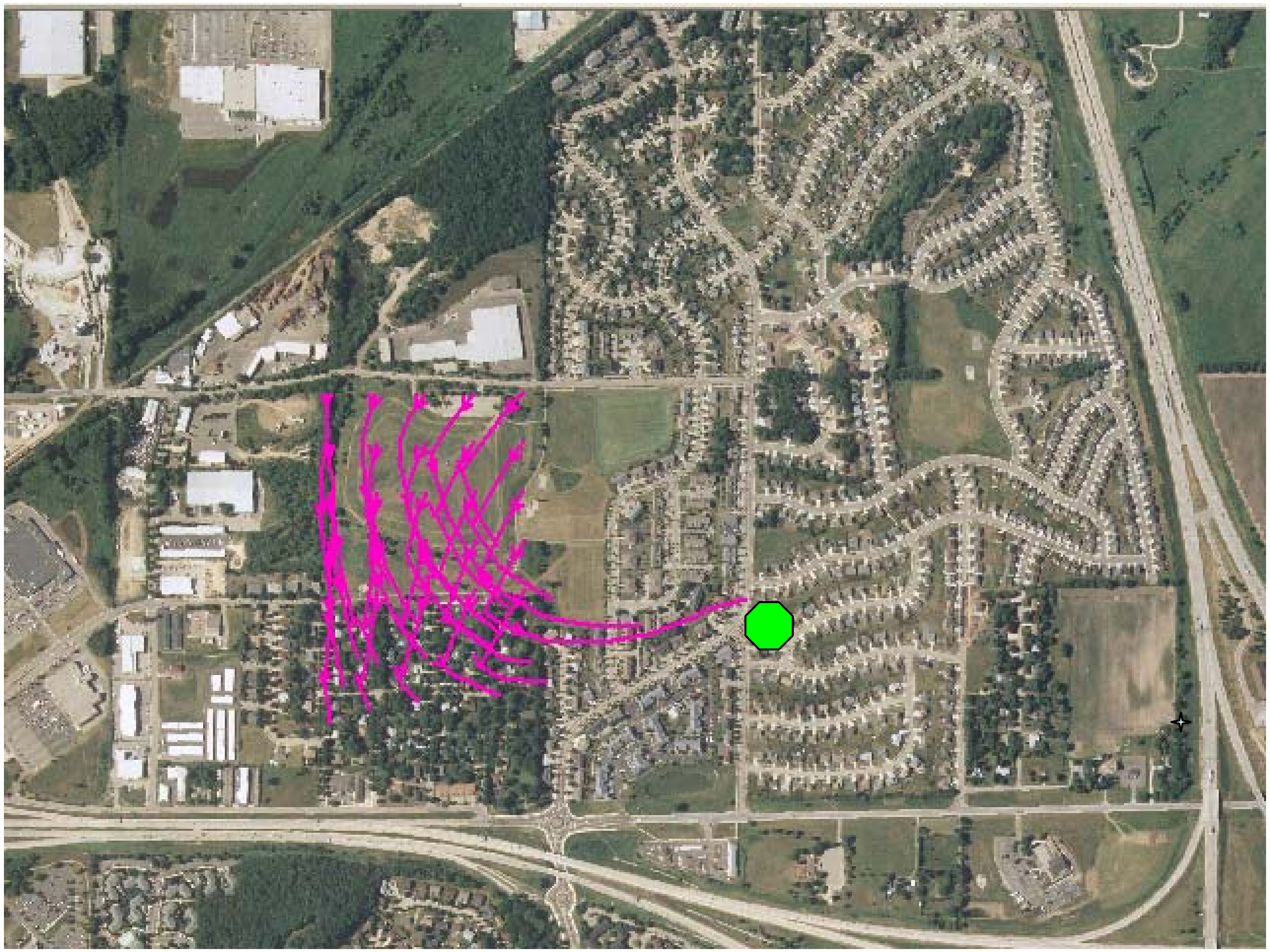

Figure 13. Modeled Groundwater Flow from Landfill with UW 29 Pumping at 1,700 gpm for 16 Years

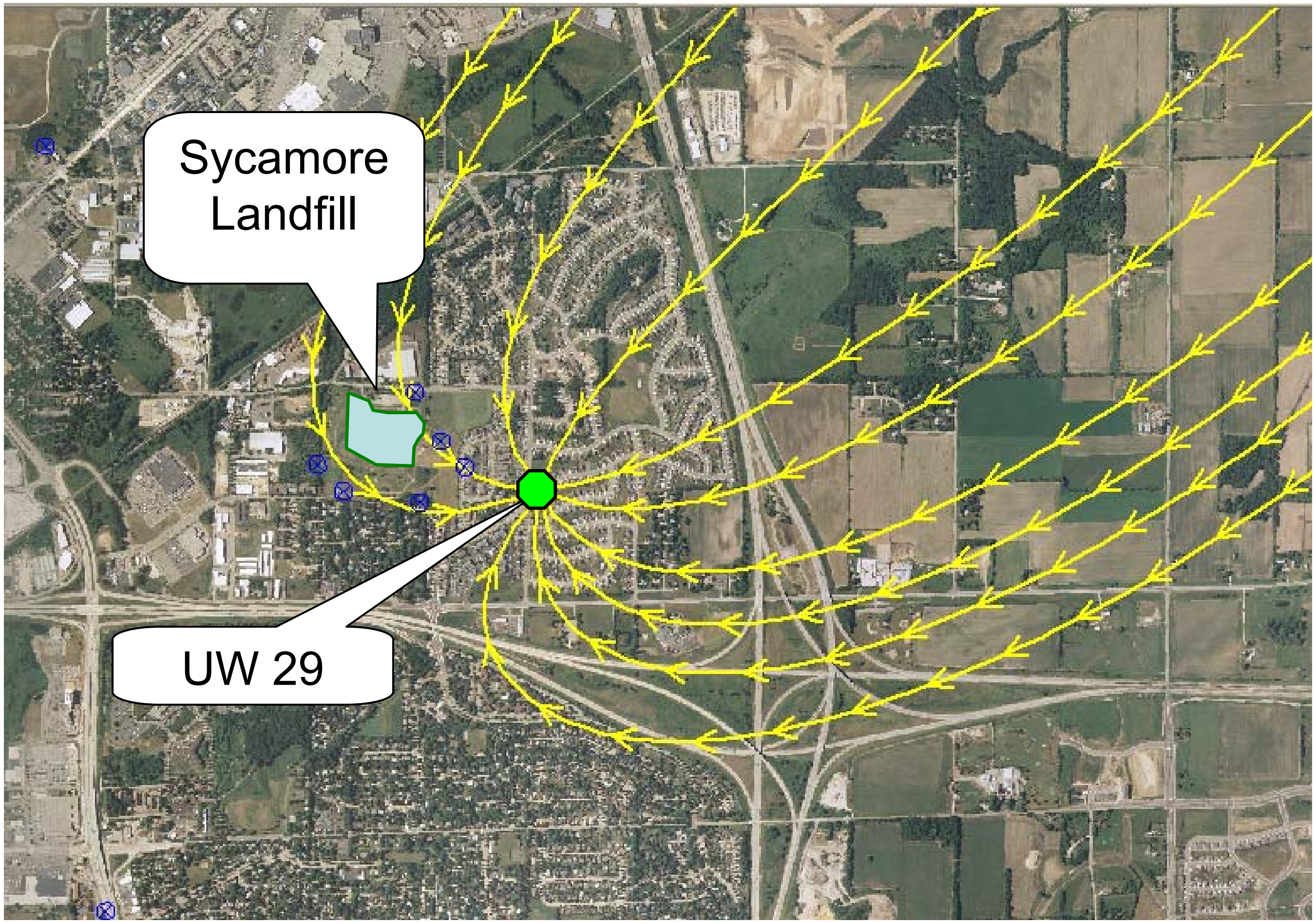

Figure 14. Long Term Supply to UW 29 Pumping at 2,300 gpm

Note: Groundwater flow lines are in the Lower Aquifer (below the Eau Claire Shale).

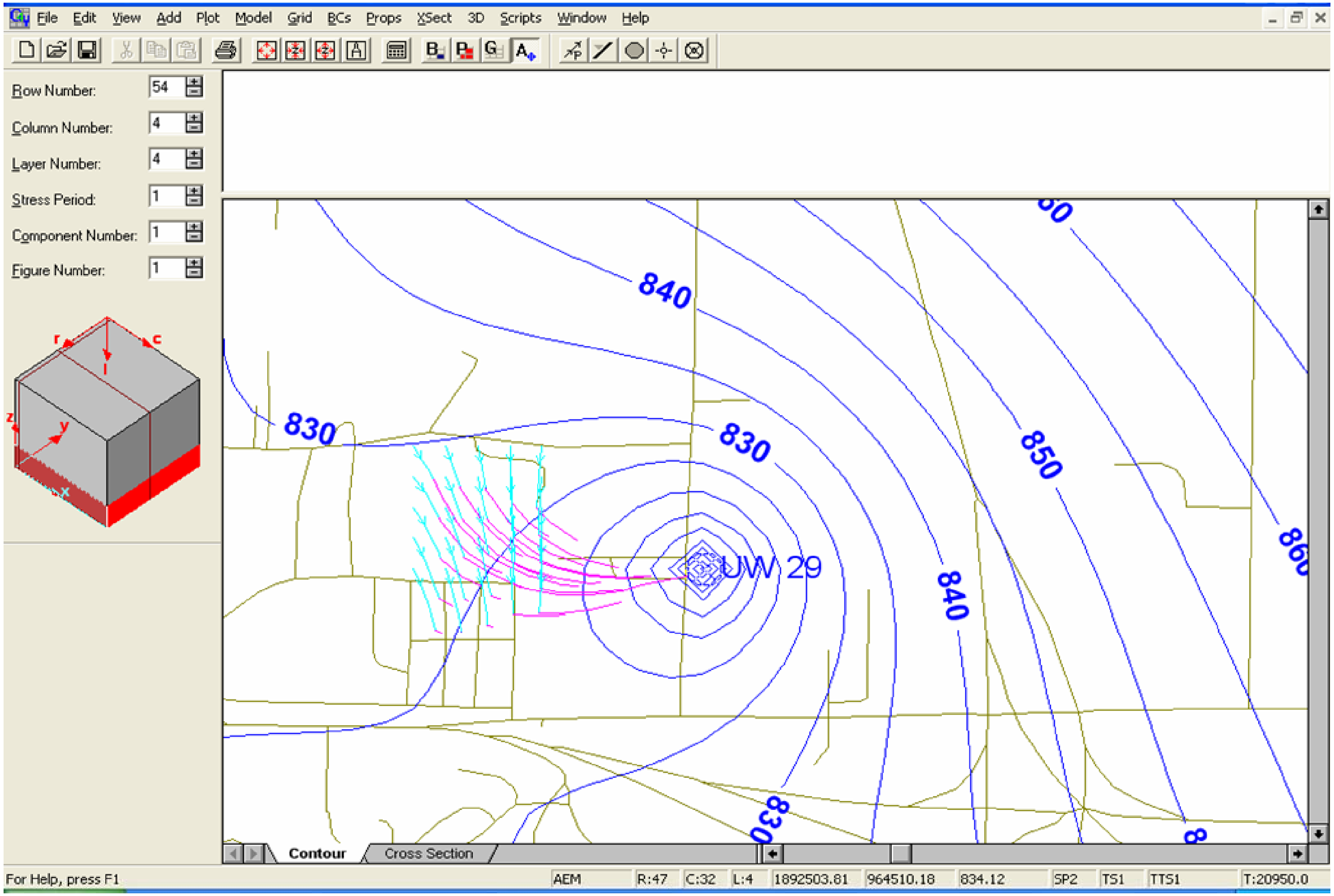

Figure 15a. Modeled Groundwater Flow from Landfill with UW 29 Pumping at 2,300 gpm for 12 Years

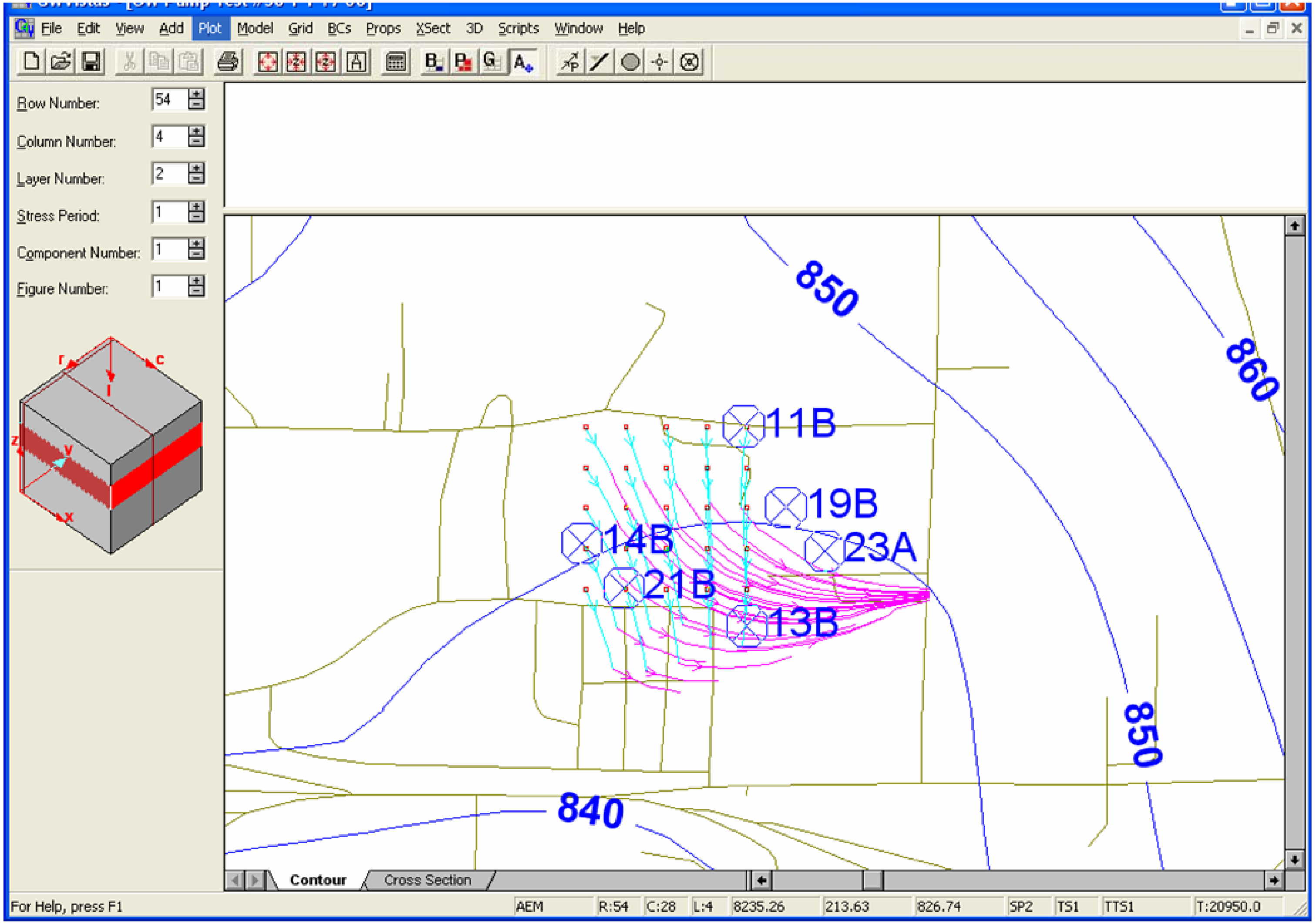

Figure 15b. Modeled Groundwater Flow from Landfill with UW 29 Pumping at 2,300 gpm for 15 Years

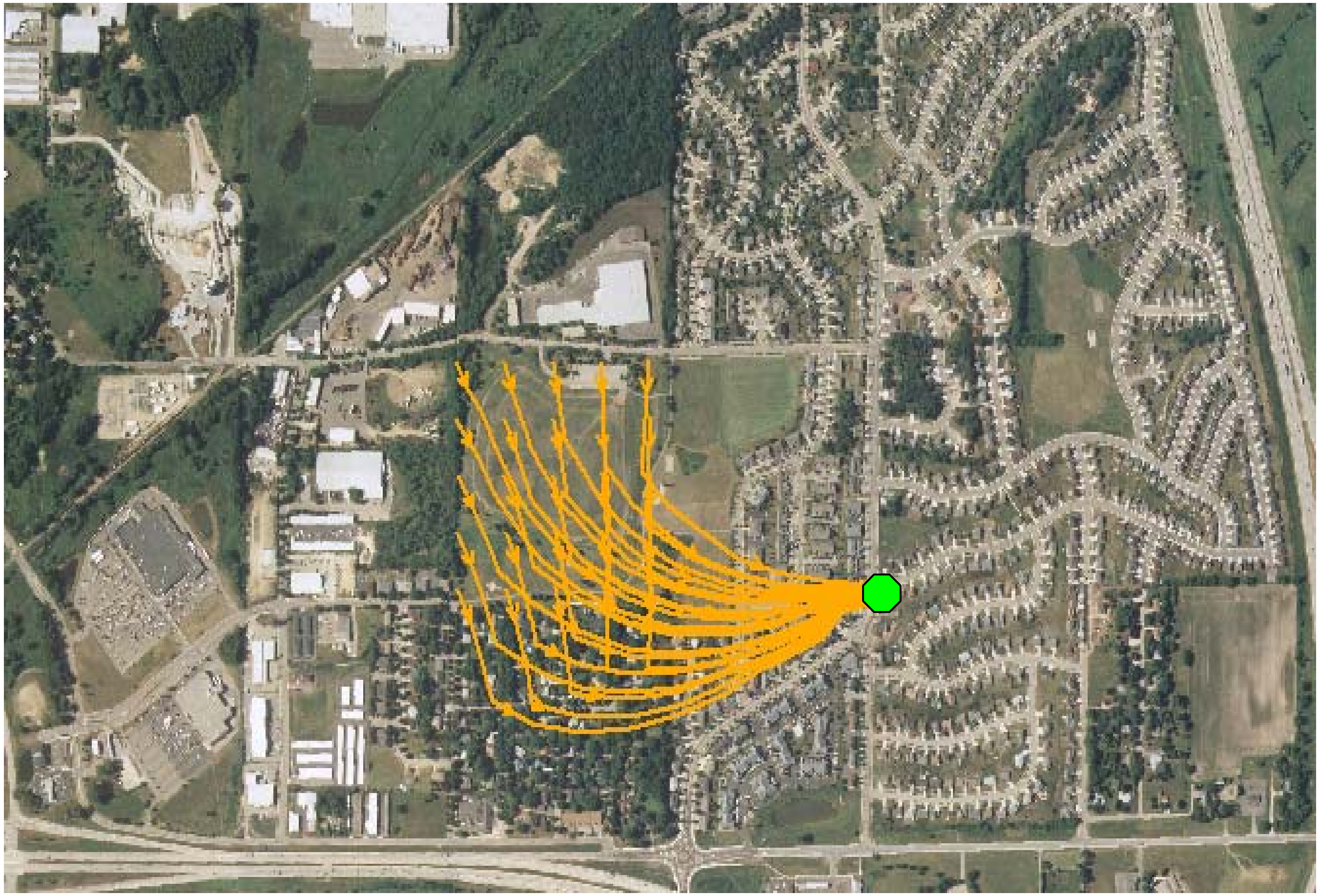

Figure 16. Modeled Groundwater Flow from Landfill with UW 29 Pumping at 2,300 gpm for 30 years

RMT

Technical Memorandum

Date: January 30, 2008

To: Nancy Zolidis – MARS

From: Ken Quinn and Nate Keller

Project No.: 7353.09

Subject: UW29 Pumping Test Methods

The purpose of this memorandum is to be used as an appendix to the UW 29 Pumping Test Report.

This appendix summarizes the methods used for monitoring the pumping test at the City of Madison Water Utility Unit W ell 29. After review of the Sycamore Landfill hydrogeologic data, and discussion with Janet Battista, the following wells were identified as being the most valuable to monitor potential head changes while pumping UW29.

Selected Monitoring Wells

Well ID	Screened Elevation (1)	Unit Screened	Distance from UW29 (ft)	Comments
MW13B	830-805	Sandstone	1350	Monitored previously.
MW19B	813-805	Sandstone	1450	Conductivity 2.1 E-3 cm/sec, monitored previously.
MW21B	817-809	Sandstone	2300	
MW14B	832-807	Sandstone	2750	
MW11B	830-820	Sandstone	2100	Conductivity 2.2 E-3 cm/sec
MW23A	865-855	Dolomite/ Sandstone Contact	1075	Shallow well but closest to UW 29 and screened elevation difference not significant.

Notes:
1. Information collected from Appendix H of report entitled Environmental Contamination Assessment Addendum, November 1996

Recording pressure transducers (Solinst Model 3001 Levelogger Gold, F15 with a range of +/- 15 feet of water) were installed into each of the wells and started recording data on October 29, 2007 at 12:00 PM. The transducers recorded the water level (feet above transducer) and temperature (degrees Celsius) on a 10-minute interval. A separate transducer that measures and records barometric pressure only was installed in MW-23A above the water level and recorded atmospheric pressure on the same interval. Before installation water levels were measured to the nearest hundredth of a foot. A table of measured water levels is included below. Transducers were then installed into the well using mason's twine and a

PVC cap. During the test the transducers were removed at two separate times and downloaded to prevent loss of data if the data loggers in the transducers failed. Again water levels were measured prior to removing the transducers to compare with previous measurements. Once the data had been downloaded the transducer was reinstalled using the same mason's twine and allowed to continue collecting data. Because the pumps for the monitoring wells were not removed from the wells during the pumping test, there were some small changes in elevation of the transducer after downloading data. It is likely the transducer became tangled with pump tubing, or the PVC cap was not attached in the exact same configuration. These changes were apparent in the uncorrected data and appeared as sharp declines or inclines in the water levels.

Well ID	Screened Elevation (1)	Unit Screened	Distance from UW29 (ft)	Depth to Water Measurements			
				10/29/2007	11/7/2007	11/19/2007	12/5/2007
MW13B	830-805	Sandstone	1350	76.01	76.29	76.70	76.85
MW19B	813-805	Sandstone	1450	60.23	60.61	61.10	60.99
MW21B	817-809	Sandstone	2300	63.21	63.41	63.79	64.03
MW14B	832-807	Sandstone	2750	53.32	53.60	54.00	54.05
MW11B	830-820	Sandstone	2100	80.77	81.15	81.91	81.75
MW23A	865-855	Dolomite/ Sandstone Contact	1075	58.19	58.79	58.91	59.30
MW-15B	817-809	Sandstone	NM	NM	NM	46.88	46.95
MW-16B	834-810	Sandstone	NM	NM	NM	71.44	71.40
MW-18B	812-803	Alluvium/Sandstone Contact	NM	NM	NM	11.53	NM
MW-20A	858-848	Till	NM	NM	NM	17.50	17.45
MW-21B	817-809	Sandstone	NM	NM	NM	63.79	64.03
MW-22A	858-843	Sandstone	NM	NM	NM	55.00	55.30

Notes:
1. Information collected from Appendix H of report entitled Environmental Contamination Assessment Addendum, November 1996
NM = Not measured.

The monitoring began approximately 1 week before UW29 was turned on, to record a baseline head at each location. Well UW29 was turned on November 6, 2007, and pumped until November 28, 2007. The transducers remained in the wells to monitor potential recovery of water levels until, December 5, 2007. The transducers were then removed and the final data was downloaded.

The collected data were plotted on graphs to determine if there was any response to UW29 pumping observed in the monitoring wells. The initial plot of height of water above transducer versus time displayed variability due to barometric pressure and transducer elevation changes which were caused by the periodic data downloads. Correction of barometric pressure was required because the pressure transducers were unvented, measuring total pressure (i.e., water pressure + barometric pressure). To correct for changes in barometric pressure, the change in barometric pressure from the initial readings was subtracted from the transducer readings.. The changes in the transducer position when removed and reinstalled were corrected by evaluating the depths to water when the transducers were removed, and also the change in the transducer reading after the transducer was downloaded and reinstalled. The difference between the two readings (before and after the download) was subtracted from the remaining data to create a consistent transducer elevation.

The second graph displaying drawdown versus distance was constructed using drawdowns calculated from the transducer data. The transducer values (feet of water above the transducer) from when the UW29 pump was turned off were subtracted from transducer values (feet of water above) when the pump turned on to determine the maximum drawdown created by pumping. These values for drawdown were then plotted versus the distance between the monitoring wells and UW29.