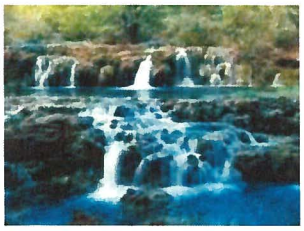


James R. Kunkel, Ph.D., P.E.
11341 West Exposition Drive
Lakewood, CO 80226

In the Matter of:	)	
	)	
SIERRA CLUB, ENVIRONMENTAL	)	
LAW AND POLICY CENTER,	)	
PRAIRIE RIVERS NETWORK, and	)	
CITIZENS AGAINST RUINING THE	)	
ENVIRONMENT	)	
Complainants,	)	PCB 2013-015
v.	)	(Enforcement – Water)
MIDWEST GENERATION, LLC,	)	
Respondent.	)	
	)	
	)	
	)	
	)	

Rebuttal Report to Temporal Trend Testing Results Notes: J. Seymour

by

James R. Kunkel, Ph.D., P.E.

March 16, 2016

Tel: 303-986-0562 Cel: 720-443-9136

INTRODUCTION

In this supplemental report, I discuss the "statistical analysis" performed by J. Seymour in his "Temporal Trend Testing Results Notes" dated 29 February 2016 which are given in Exhibit 8 of his deposition (Seymour, 2016) related to Case No. PCB 2013-015 (Enforcement – Water). In his notes, Seymour utilized linear regression to estimate time trends in the concentrations of B, Mn, and SO_4 for each of the MWG monitoring wells at the Joliet #29 (11 wells), Powerton (16 wells), Waukegan (9 wells) and Will County (10 wells) coal ash sites. Seymour (2016) used ground-water quality data through 2014 in his analyses. Because the data are censored (they have "less than" values), Seymour took one-half of the analytical detection limit for these data. For example, if the analytical detection limit was reported as <0.1, Seymour used a value of 0.05 for his analysis. He then used the Excel array function LINEST to calculate the slope and standard error of the slope for each well's time series data of B, Mn and SO_4. In Seymour's analyses, increasing slopes of regression analyses indicated increasing temporal concentration trends in the time series data whereas, decreasing regression slopes indicated decreasing temporal concentration trends in the data. If the calculated standard error of the slope was greater than the magnitude of the slope itself, then Seymour concluded that there was neither a decreasing nor increasing trend with time.

DISCUSSION

Trend analyses for long-term data are complex and are complicated by problems associated with pollutant data. Some of these problems are listed by Gilbert (1987) as:

- Changes in laboratories or laboratory analytical methods/procedures;
- Variations due to seasonal or other cycles; and
- Correlated data.

For a linear regression technique to provide the true trend slope as proposed by Seymour (2016), the data must have (1) no seasonal cycles present, (2) be normally distributed, and (3) not be serially correlated. The MWG data almost certainly have a seasonal cycle due to seasonally changing ground-water levels and meteoric leaching. Typically, environmental data also are not normally distributed, and may be highly serially correlated; i.e., the similarity between observations as a function of the time lag between them. Therefore, I conclude that the use of linear regression by Seymour to assess increasing or decreasing trends in ground-water quality data at the four MWG coal ash sites is not an accurate methodology. Even if the data were suitable for a linear regression analysis, a *t* test must be utilized to test that the true slope that the regression line is not different from zero. Seymour did not do this. In my opinion comparing the calculated standard error to the calculated slope is not a valid basis for concluding that there is or is not a temporal trend.

To overcome the issues related to seasonal cycles, non-normally distributed data, and serial data correlation, the statistical methods recommended by Gilbert (1987) should be utilized. One of the most commonly used trend tests recommended by Gilbert is the Mann-Kendall nonparametric test. A nonparametric test does not require that the data being analyzed are normally distributed. URS cites Gilbert (1987) for the Mann-Kendall test utilized for the ELUC well ground-water quality data at the MWG Waukegan site.

An additional criticism which I have related to the Seymour (2016) trend analysis is the use of only ground- water quality data through the fourth quarter of 2014. Supplemental ground-water data for the four quarters of 2015 provided by MWG for B (Bates Nos. 56411, 56314, 56501, 56603), Mn (Bates Nos. 56421, 56324, 56511, 56613) and SO_4 (Bates Nos. 56429, 56332, 56519, 56621) at the four coal ash sites showed, in some cases, concentrations of these pollutants higher than any of the previous data. Seymour failed to use all the available ground-water quality data for his trend analysis.

Yours truly,

JAMES R. KUNKEL, Ph.D., P.E.

REFERENCES

Seymour, J. 2016. Temporal Trend Testing Results Notes. Exhibit 8 of Seymour's Deposition. PCB 2013-015. 7 p.

Gilbert, R.O. 1987. Statistical Methods for Environmental Pollution Monitoring. New York: van Nostrand Reinhold. ISBN 0-442-23050-8. 320 p.

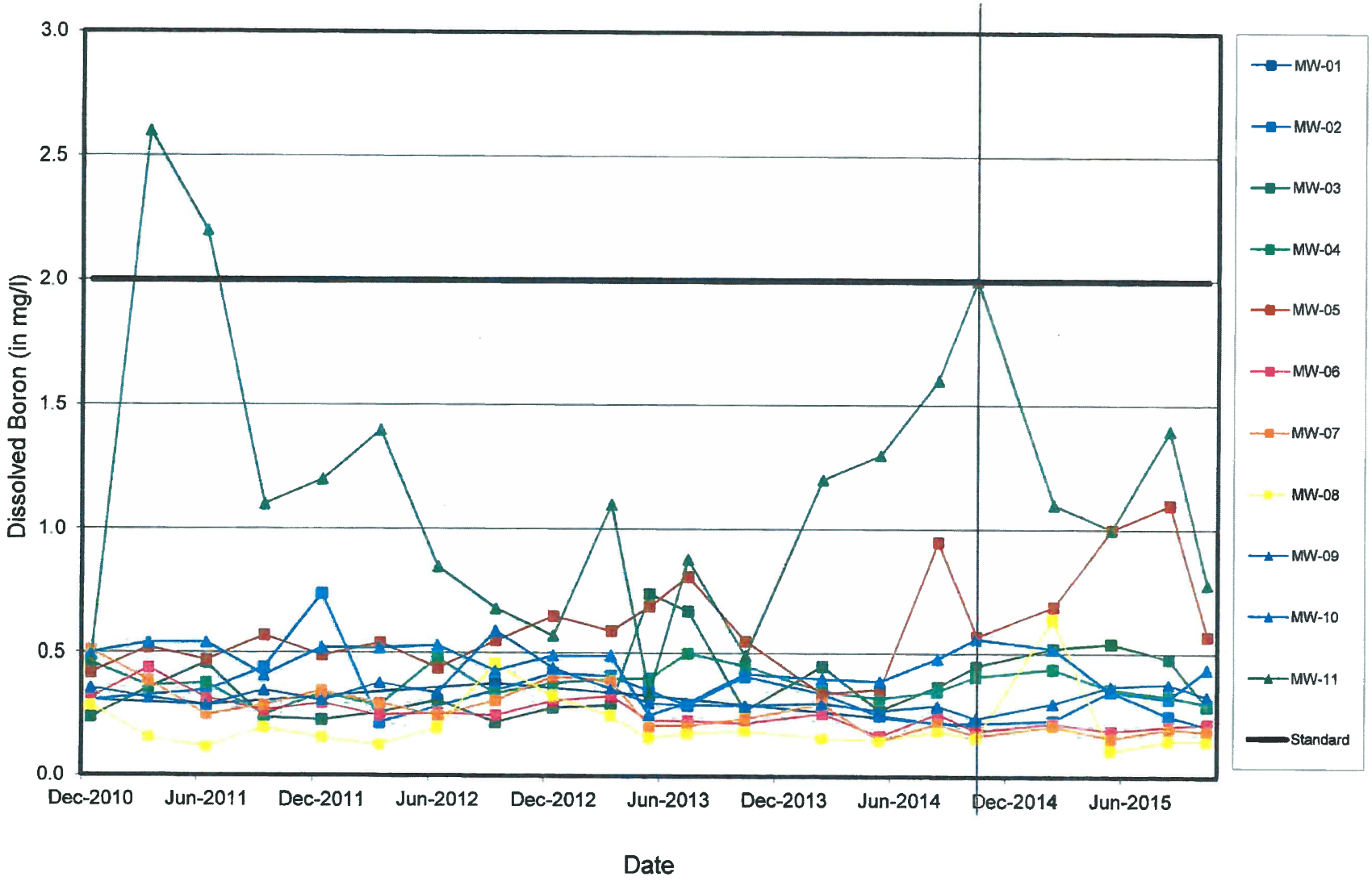
ATTACHMENTS

Figures Bates Nos. 56411, 56314, 56501, 56603, 56421, 56324, 56511, 56613, 56429, 56332, 56519, 56621.

ATTACHMENTS

Midwest Generation Joliet Station #29, Joliet, IL

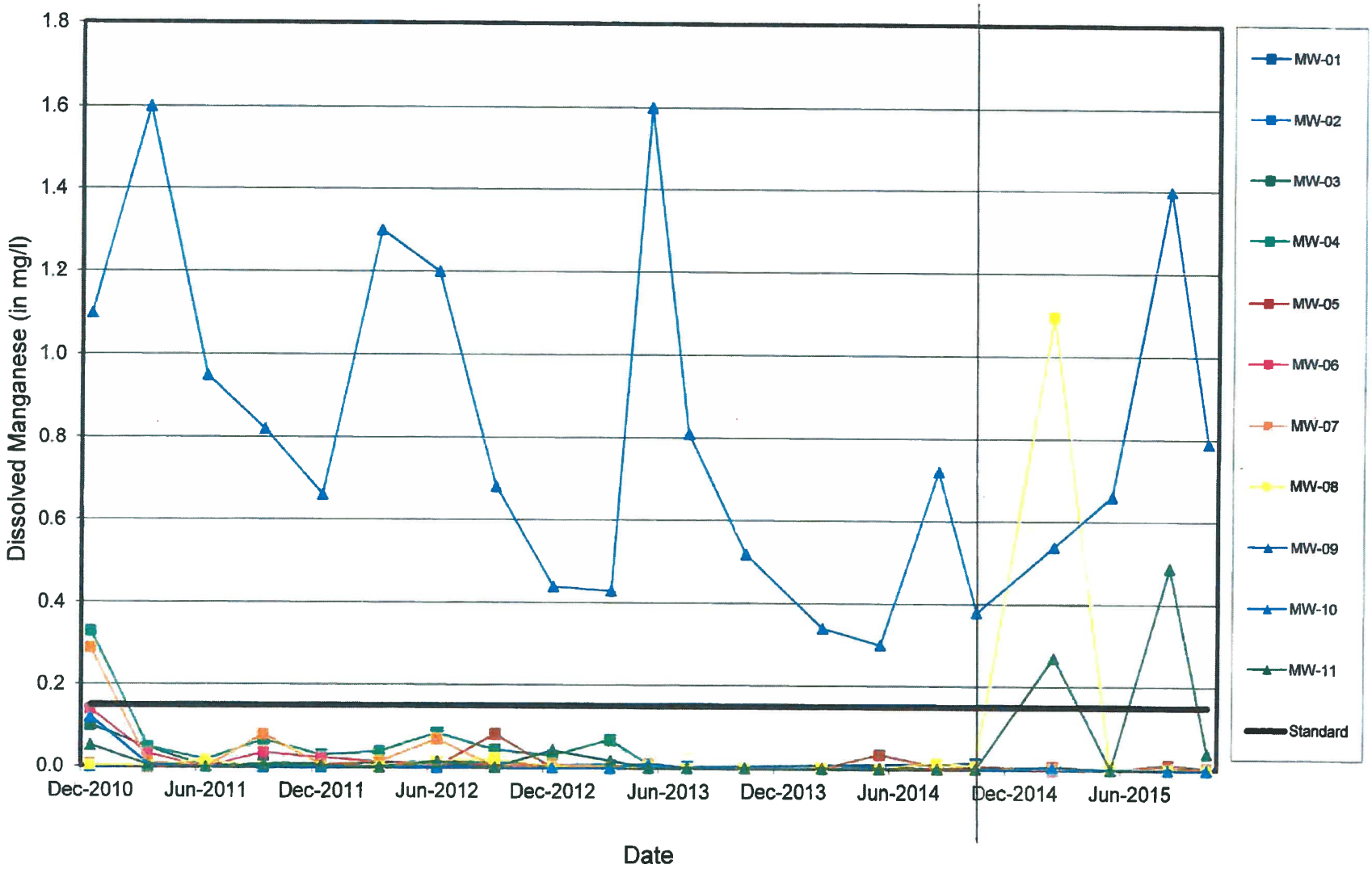
Dissolved Boron vs. Time



MWG13-15_56411

Midwest Generation Joliet Station #29, Joliet, IL

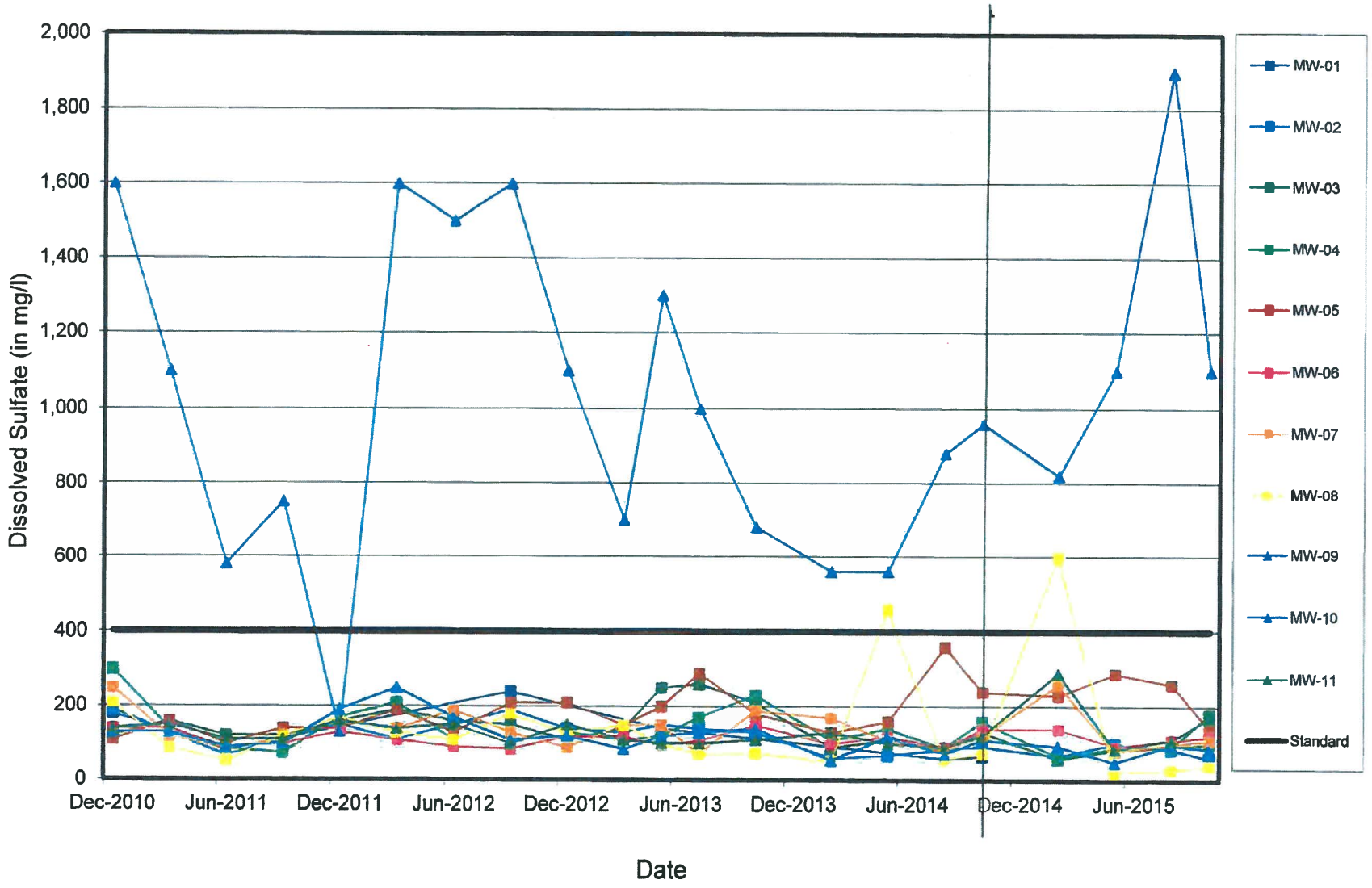
Dissolved Manganese vs. Time



MWG13-15_56421

Midwest Generation Joliet Station #29, Joliet, IL

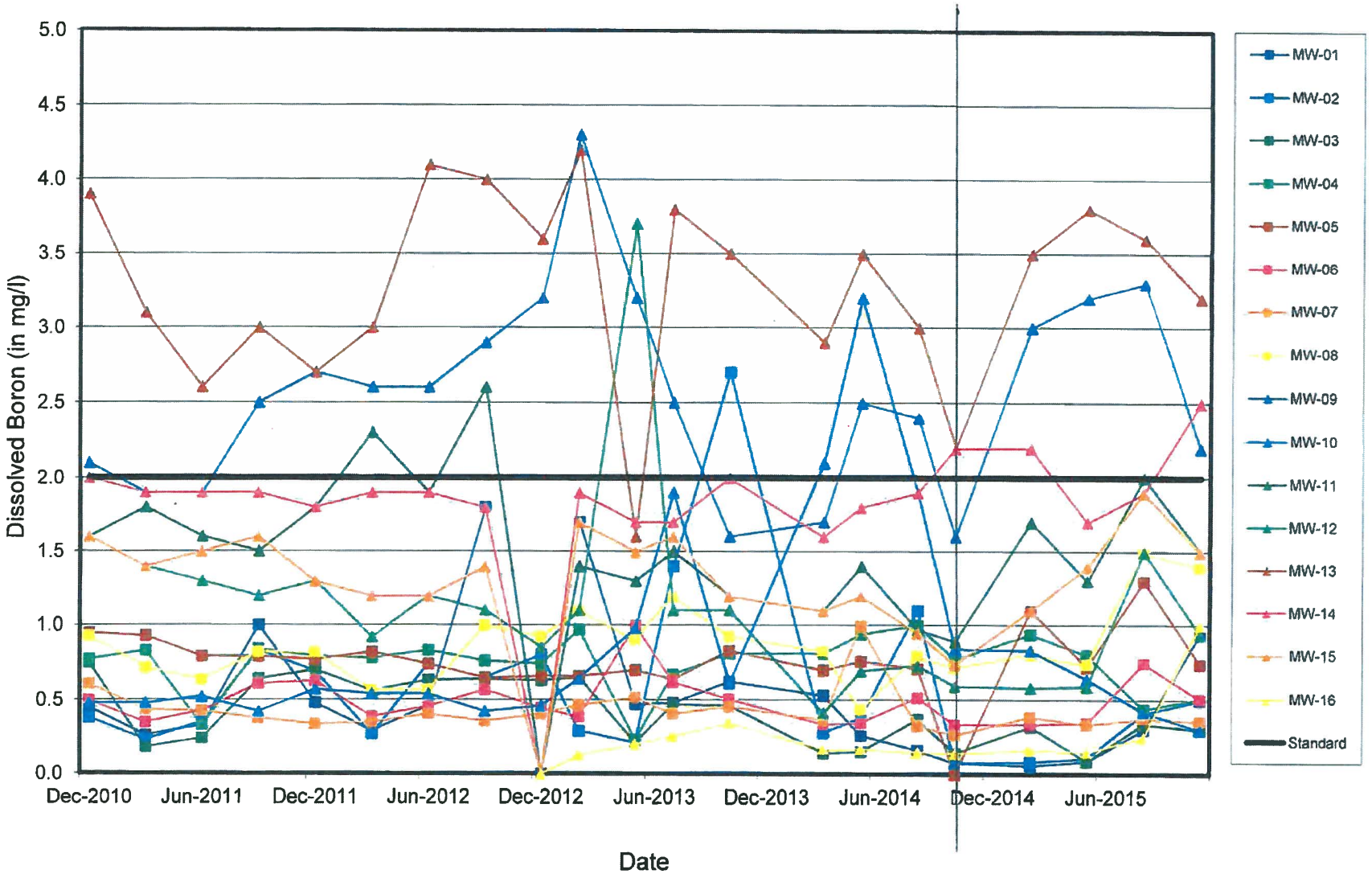
Dissolved Sulfate vs. Time



MWG13-15_56429

Midwest Generation Powerton Station, Pekin, IL

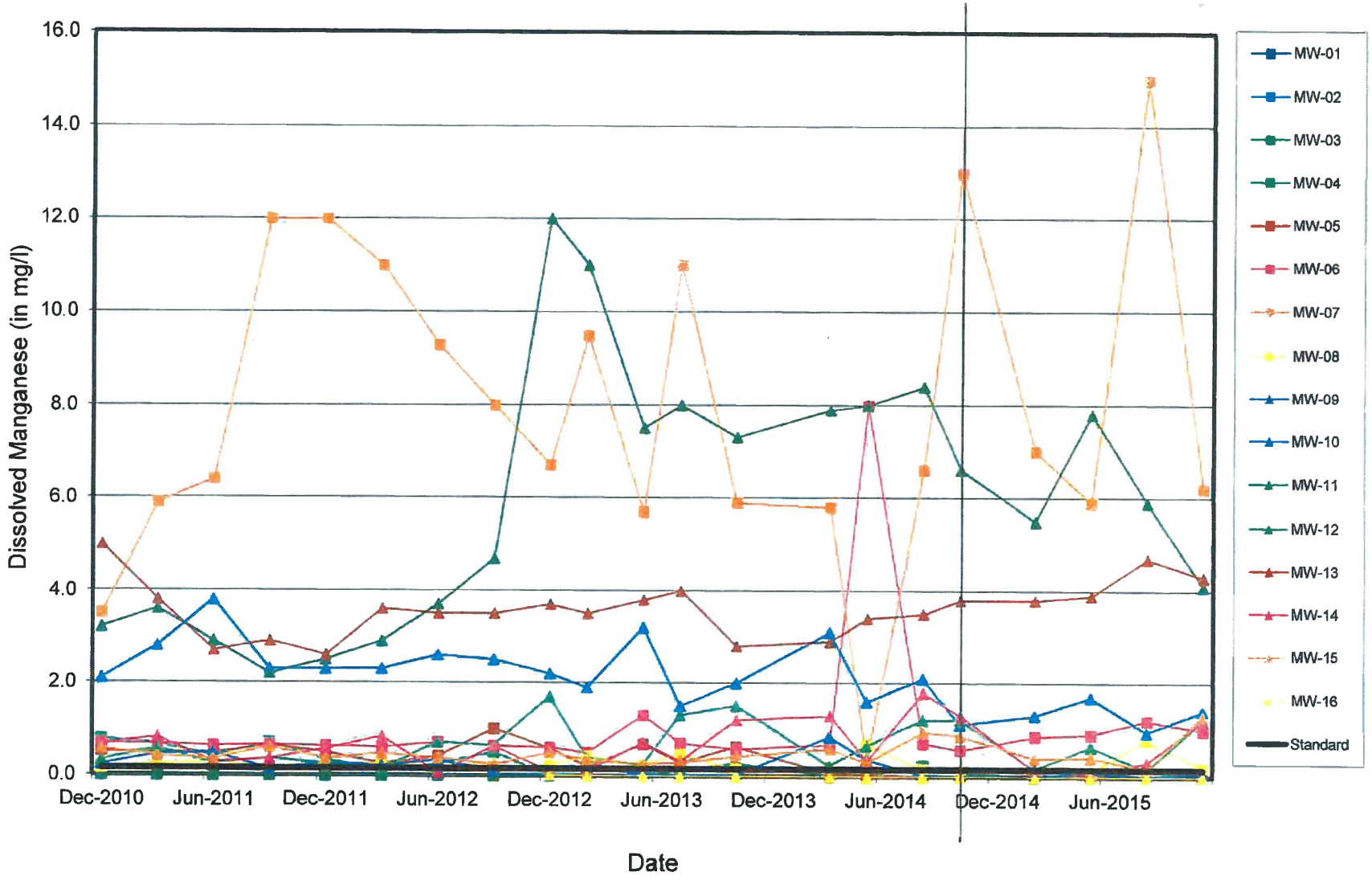
Dissolved Boron vs. Time



MWG13-15_56314

Midwest Generation Powerton Station, Pekin, IL

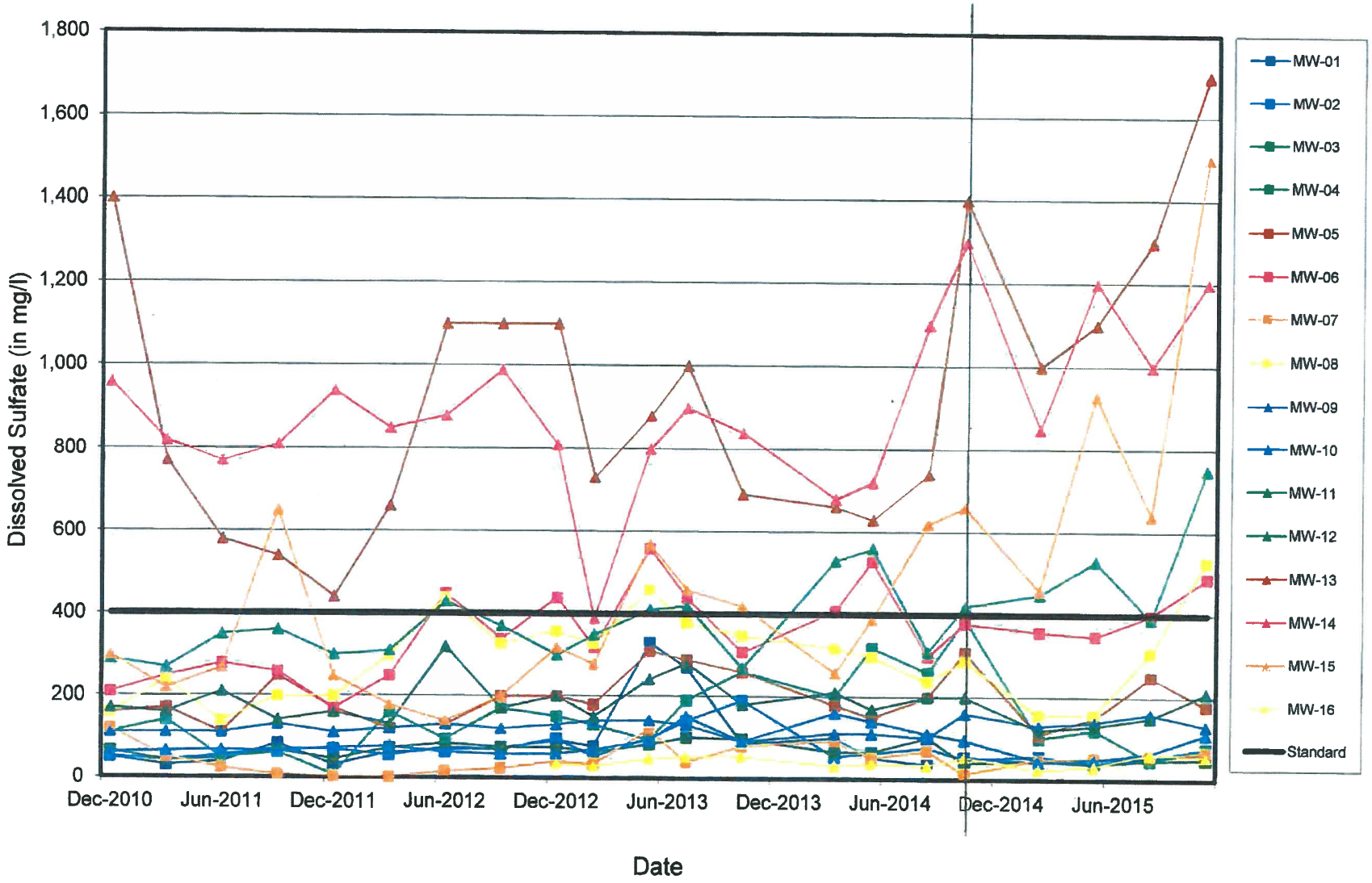
Dissolved Manganese vs. Time



MWG13-15_56324

Midwest Generation Powerton Station, Pekin, IL

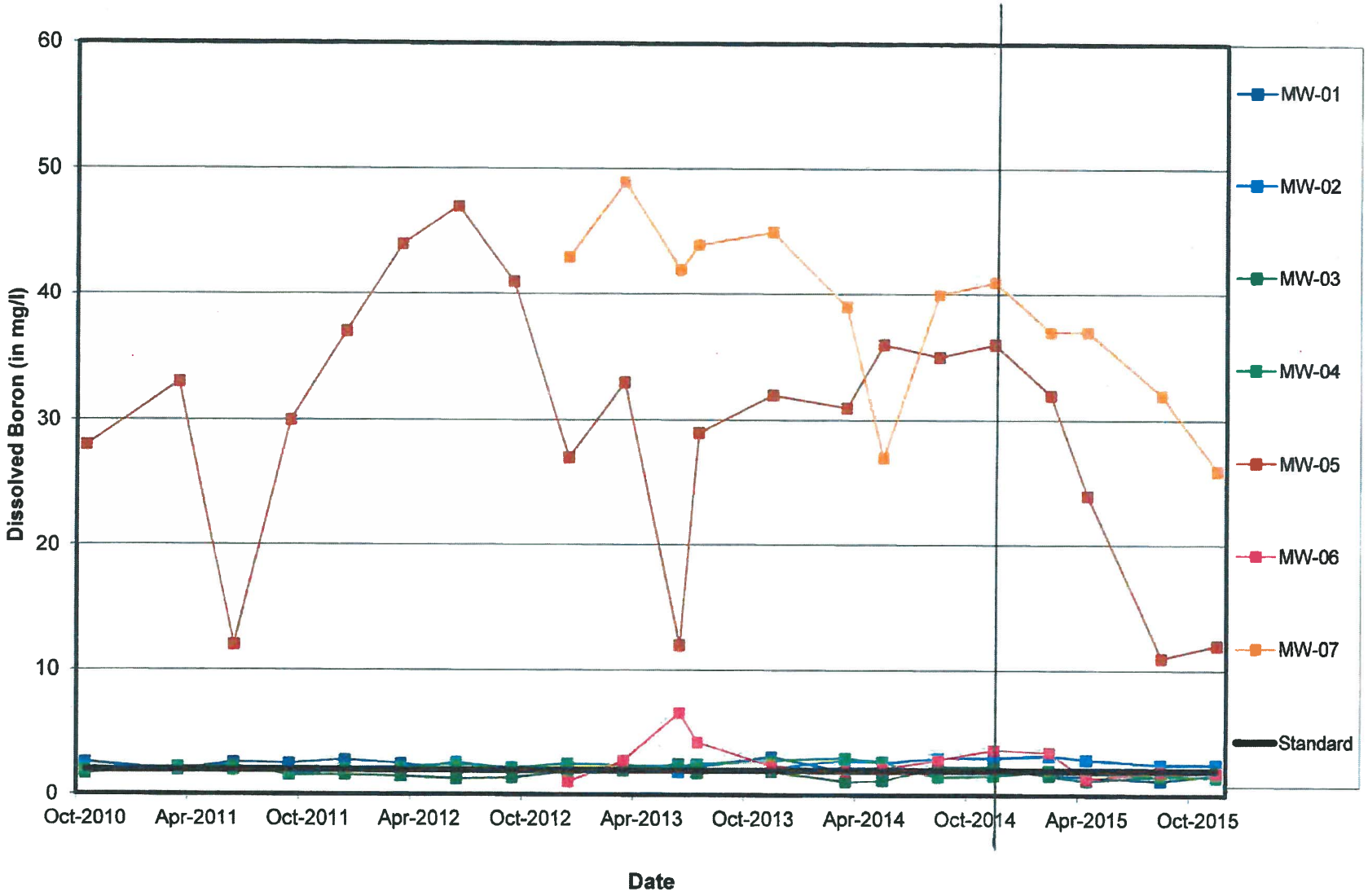
Dissolved Sulfate vs. Time



MWG13-15_56332

Midwest Generation Waukegan Station, Waukegan, IL

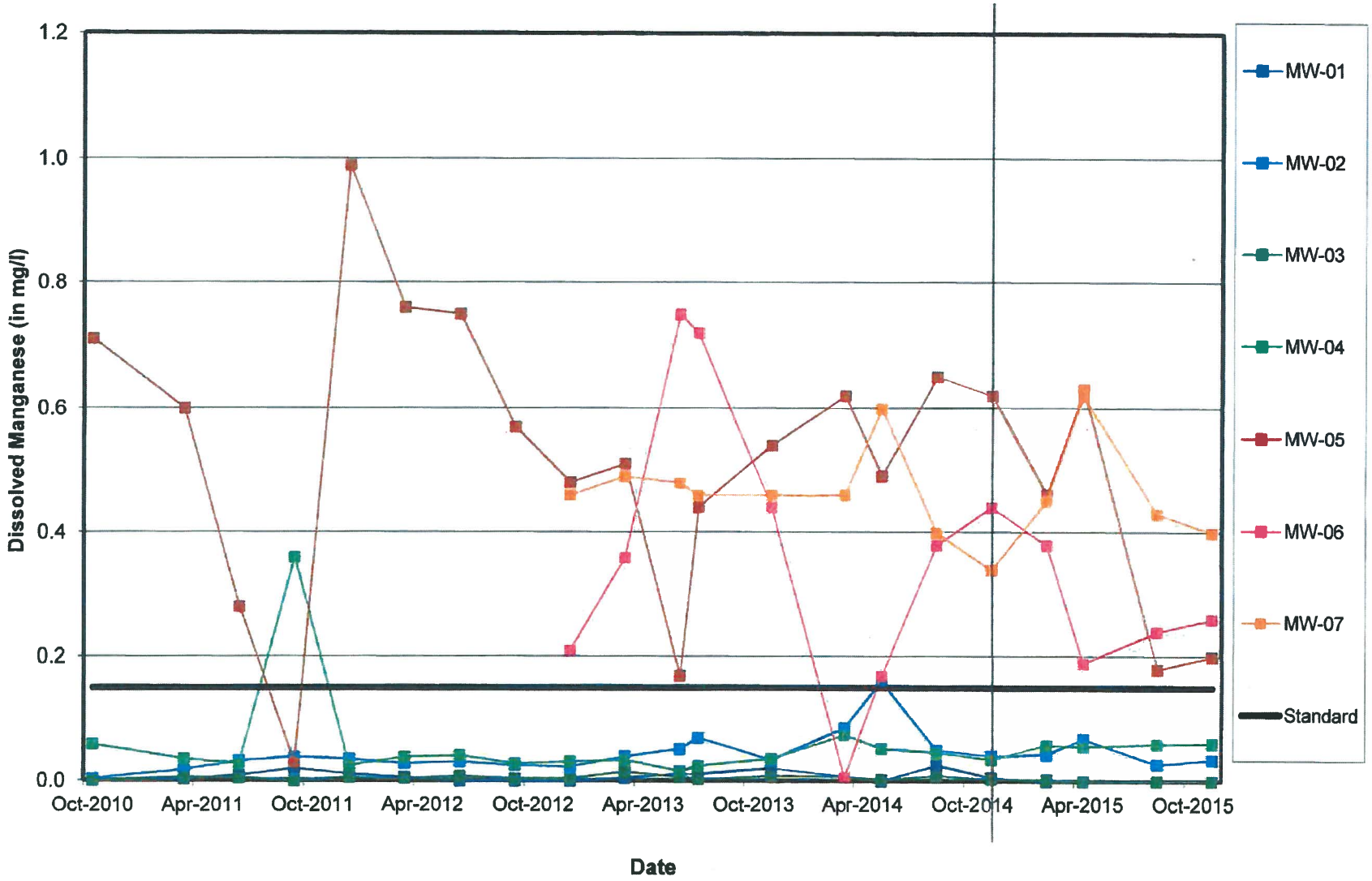
Dissolved Boron vs. Time



MWG13-15_56501

Midwest Generation Waukegan Station, Waukegan, IL

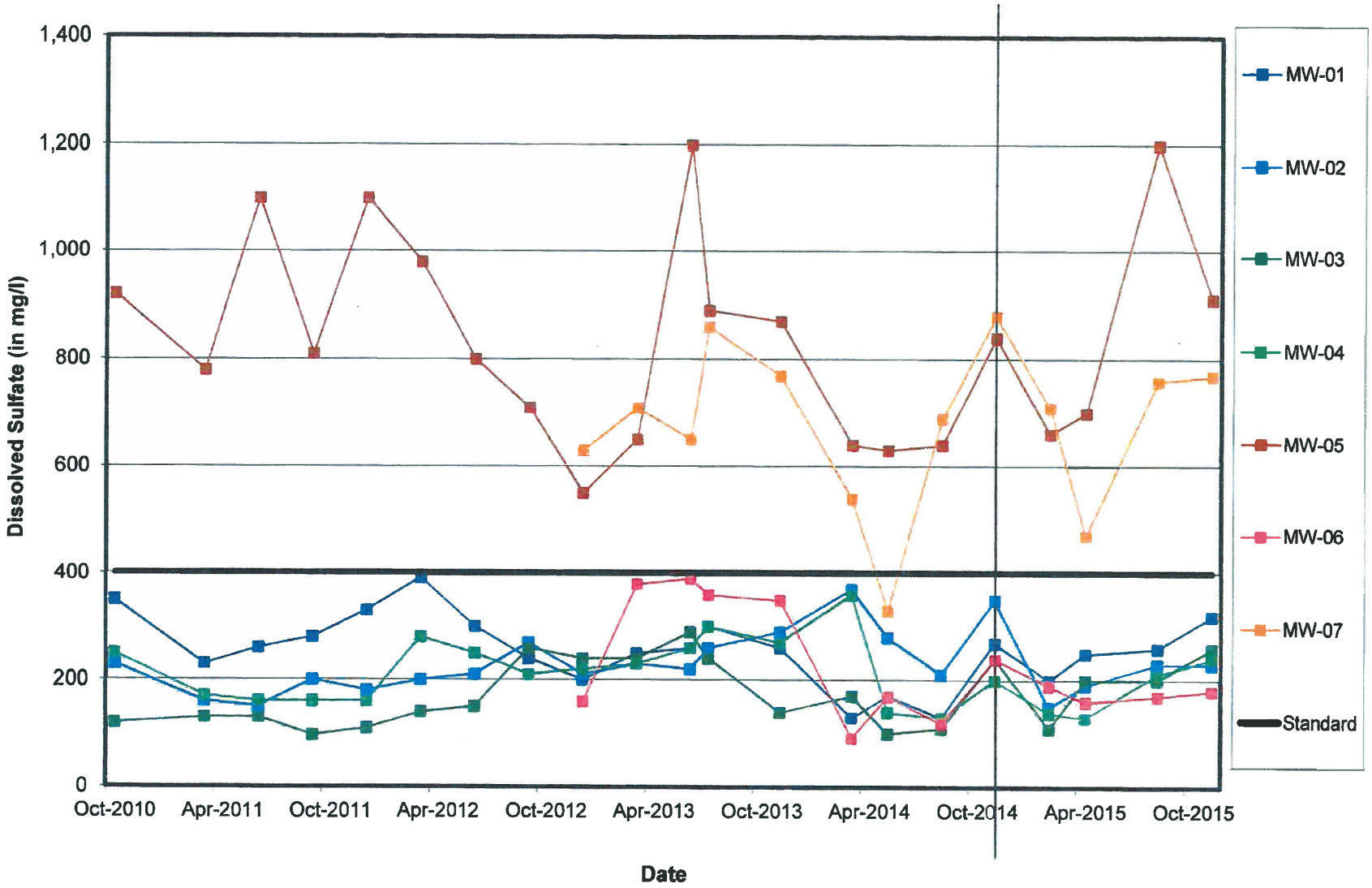
Dissolved Manganese vs. Time



MWG13-15_56511

Midwest Generation Waukegan Station, Waukegan, IL

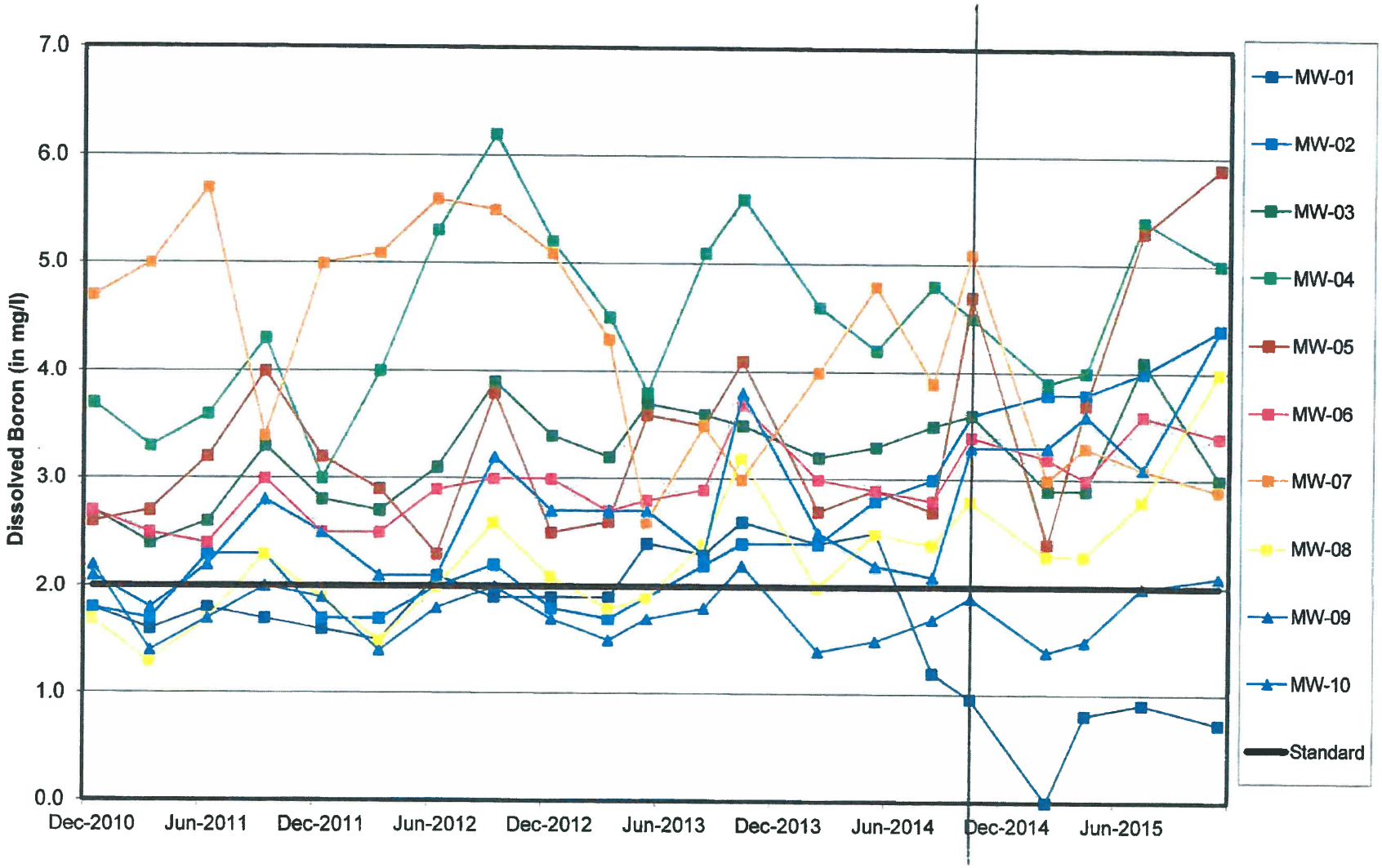
Dissolved Sulfate vs. Time



MWG13-15_56519

Midwest Generation Will County Station, Romeoville, IL

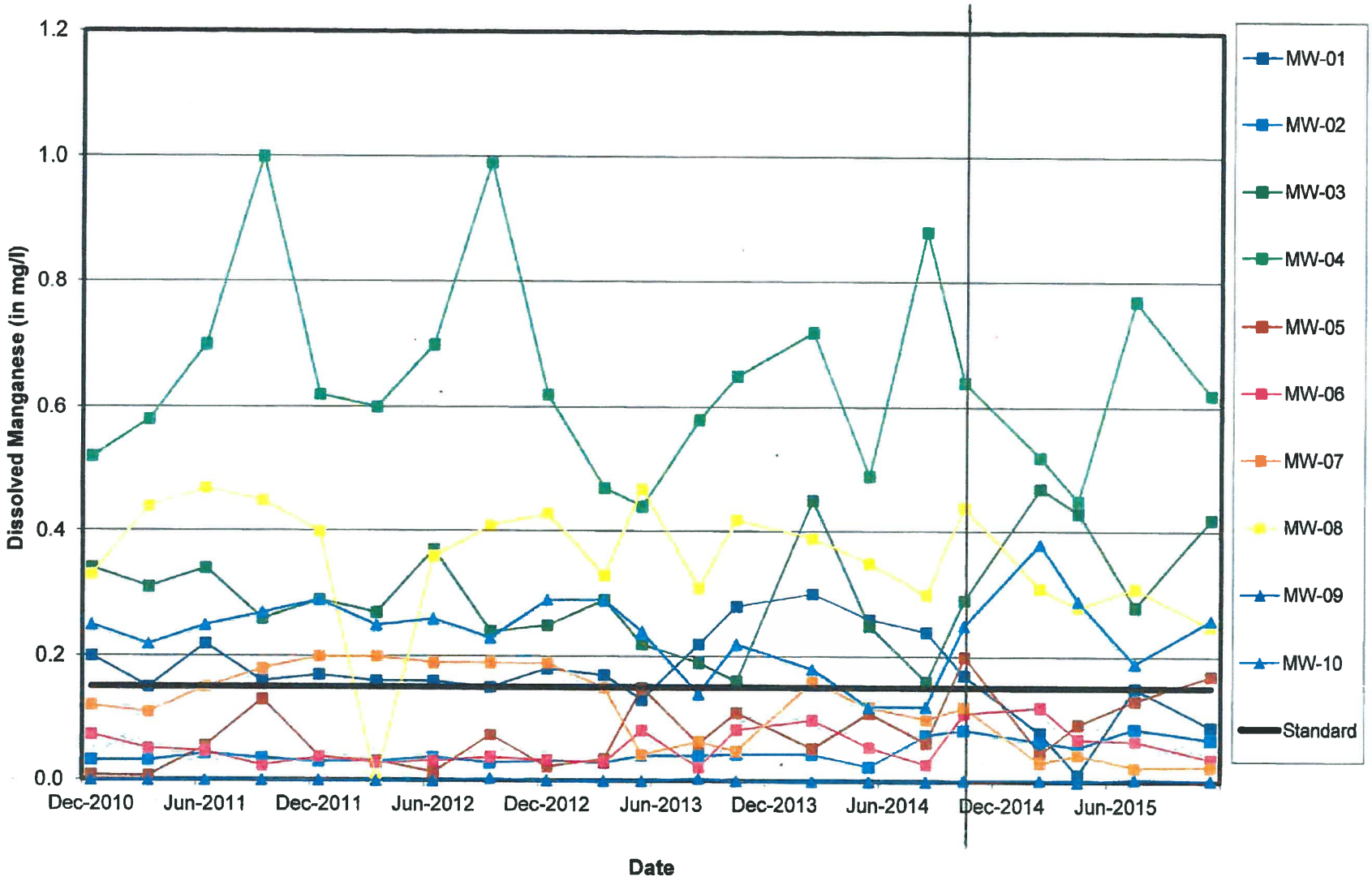
Dissolved Boron vs. Time



MWG13-15_56603

Midwest Generation Will County Station, Romeoville, IL

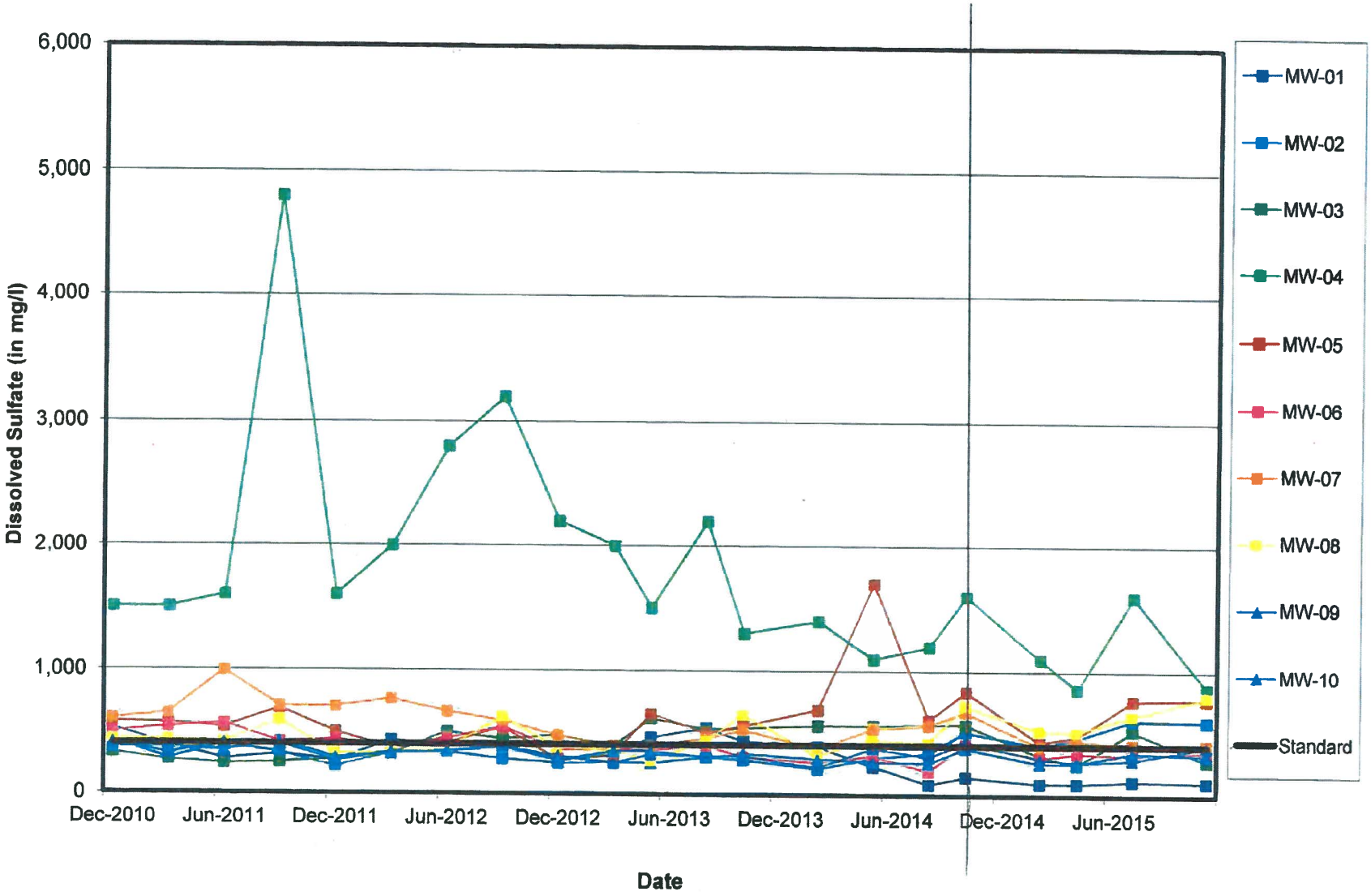
Dissolved Manganese vs. Time



MWG13-15_56613

Midwest Generation Will County Station, Romeoville, IL

Dissolved Sulfate vs. Time



MWG13-15_56621