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Memorandum

TO: Joe Davis
FROM: Jim Riesterer, Jay Lazarus
DATE: June 24, 2013
RE: Evaluation of MX-5 Pumping Test on Springs and Wells in the Muddy Springs Area

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Dear Mr. Davis,

At the request of the Moapa Valley Water District (MVWD), Glorieta Geoscience, Inc. (GGI) has compared pre- and post-September 2010 monitoring well water levels and spring discharge data to determine possible effects of the MX-5 pumping test on the Muddy Springs area and the regional carbonate aquifer (RCA). The data analyzed were collected for the Muddy Springs Area Monitoring Report prepared annually for submittal to the Nevada Division of Water Resources (DWR) by MVWD. The annual report for 2012 is attached as Appendix A. The following summary of observed pumping test effects are based on the data and graphs contained in the monitoring report.

Springs Discharging from the RCA

Spring discharge measurements from RCA springs are provided in Figures 3 and 4 in Appendix A. Pederson Spring and Pederson East Spring exhibit declines in discharge during the MX-5 pumping test that are likely attributable to drawdown effects from the test. Test effects are especially apparent in Pederson Spring, where the sustained rate of declining discharge after the start of MX-5 pumping in September 2010 is significantly greater than at any other time observed in the historical data. Sustained declines in discharge at Warm Springs West (cumulative flow from numerous small springs including Pederson and Pederson East Springs) and Baldwin Spring during the test may also be caused by pumping effects, but the rate of decline from the start of pumping to December 2012 is not appreciably greater than during other periods of observed historical declines. Muddy Spring at LDS farm and Pipeline Jones Spring do not exhibit discernible effects from the MX-5 pumping test.

The differing magnitude of responses of the springs to the pumping test is probably related to the elevation of the springs, with the higher elevation springs (Pederson, Pederson East) affected more by declining water levels in the aquifer than the lower elevation springs. For higher elevation springs, every unit change in head in the water table represents a higher percentage loss in head driving discharge at the spring orifice as defined by Darcy's law (Mayer and Congdon, 2008).

Monitoring Wells Completed in the RCA
The four monitoring wells completed in the RCA (Figure 6 in Appendix A) all show effects of the MX-5 pumping test. The average rate of water level decline in these wells during the pumping test is greater than at any time in the historical period of record, indicating an accelerated rate of water level declines caused by MX-5 pumping.

Monitoring Wells Completed in Alluvium
Effects of MX-5 pumping were not observed in the alluvial wells (Figure 7 in Appendix A).

Conclusions
Pumping of MX-5 beginning in September 2010 resulted in accelerated rates of water level decline in monitoring wells completed in the RCA. Pumping of MX-5 also contributed to declining discharge from 4 of 6 springs monitored in the RCA, with effects being most pronounced on higher elevation springs.

If you have any questions regarding this evaluation, please feel free to contact me or Jay Lazarus.

Sincerely,

Jim Riesterer, P.G.

References
Mayer, T.D., and Congdon, R.D., 2008, Evaluating Climate Variability and Pumping Effects in Statistical Analyses, Ground Water, vol. 46 no. 2, pp. 212-227

APPENDIX A.
MUDDY SPRINGS AREA MONITORING REPORT
For January 2012 through December 2012