TO: GROUNDWATER RECHARGE WORKGROUP
FROM: EXECUTIVE DIRECTOR'S OFFICE
SUBJECT: PILOT-SCALE RECHARGE REPORT AND 2012 RECHARGE PLANS
DATE: JUNE 5, 2012

Pilot-Scale Demonstration Project Report

EA Engineering, Science, and Technology, Inc. and Daniel B. Stephens and Associates, Inc. (Consultants) submitted a Draft Pilot-Scale Recharge Report (Report) that was prepared as part of the Nebraska Groundwater Feasibility Study to the Executive Director's Office (ED Office) on May 11, 2012. The ED Office and Special Advisor Hahn reviewed the Draft Report and discussed preliminary comments with the Consultants; the revised Draft Report dated May 30, 2012 can be accessed using the following link: http://www.platteriverprogram.org/intranet/WAC/GWRecharge/Forms/AllItems.aspx.

Key findings of the Report include:

1) Diversions for recharge were made from September 28, 2011 to January 5, 2012 (99 days).
2) A total of 5,558 acre-feet (ac-ft) was delivered to the Phelps Canal through the flume at mile 1.6; 19 ac-ft of this volume was delivered to the constructed recharge basin.
3) Diversion rates through the flume at mile 1.6 measured up to 200 cubic feet per second (cfs) during the initial filling and generally stabilized around 30 cfs, with lower diversion rates after mid-December.
4) A total of 5,439 ac-ft was recharged through the Phelps Canal between the flume at mile 1.6 and the return at mile 9.7.
5) The canal infiltration rate ranged from 0.28 to 0.75 feet/day, averaging 0.60 feet/day.
6) The basin infiltration rate ranged from 0.22 to 0.77 feet/day, and the long-term average was 0.28 feet/day. The basin infiltration rate decreased over time.
7) The pilot project was conducted during a period when groundwater levels were unusually high compared to historic levels.
8) Recharge operations increased groundwater levels, with more pronounced effects at monitoring wells located closer to the Phelps Canal. Recharge was terminated in early January to allow for full recovery (drop) of water levels to a "pre-project" condition.
9) Wintertime recharge operations did not encounter any major operational constraints. An ice cap was successfully formed on the canal and recharge basin for the duration of the pilot project allowing recharge to continue during periods of freezing temperatures.
10) The flow in drains appears to have responded to the pilot project, but the connection between the groundwater levels and the drain water levels was not as apparent as expected.

Key Report recommendations include:

1) Calibrate the numerical groundwater model using the results from the pilot project and refine return flow calculations.
2) Continue collecting monitoring data for an additional year through February 2013. Include 10 additional drain flow measurements.
3) Consider using the Phelps Canal for recharge activities during the upcoming 2012-2013 non-irrigation season.

ED Office and Special Advisor Hahn Supplemental Findings:

1) There is an observed decline in the calculated infiltration rate for the canal during the latter weeks of testing. The infiltration rate appears to have decreased from about 0.7 feet/day observed in earlier weeks to a rate of about 0.4 feet/day during the concluding weeks of the testing, as depicted on Figure 4 of the Report. The computed infiltration rate is highly dependent on canal diversions, which are difficult to measure accurately when water levels are near the lower end of the range for which the 30-foot Parshall flume is suited. Based on discussions with the Consultants and Central Nebraska Public Power and Irrigation District (CNPPID), the observed decline does not appear to reflect a systematic decline in infiltration rate as might be related to temperature change, plugging of the canal bottom, etc. Rather, the abrupt change in measured discharge in mid-December appears to be a result of stream gaging equipment limitations, and field notes indicate that readings from December 15 to December 20 may be erroneous and the data after this date may need to be adjusted. This would result in a higher infiltration rate during the latter weeks of the project and thus, a higher overall average infiltration rate.

   The ED Office is proposing to use the more conservative Consultants' reported average canal infiltration rate of 0.6 feet/day for project scoring purposes, which equates to a diversion rate of approximately 25 cfs. It is recommended that a more appropriately sized measuring device be installed if more accurate estimates are desired and recharge operations are conducted during the 2012-2013 non-irrigation season.

2) The relationship between water levels in the drains and water levels in the adjacent groundwater varied over time; at times the water levels in the drains exceeded water levels in the adjacent groundwater, whereas at other times water levels in the groundwater exceeded water levels in the drains. Drain discharge appeared to increase in response to canal recharge; however, the magnitude of the combined response of the drains monitored during the pilot program was relatively small, and difficult to measure in the settings typical of the drains in this area (broad cross-section, low gradient, low water velocity). The combined discharge of drains that were measured as part of the investigation is estimated to have increased by about 9 cfs in response to canal recharge. Whereas this increase is about the same magnitude as is predicted by the groundwater model, there remains some uncertainty in attributing changes in drain discharge to the pilot program from changes that may have other causes. The Consultants recommended conducting additional drain discharge measurements during the 2012 irrigation season and fall non-irrigation season. These measurements will provide important background information in advance of recharge activities that could commence in the fall. They may also provide further insights on the relationship between drain discharge, canal recharge, river stage, runoff events, etc. **Input from the Workgroup on the need for additional drain discharge measurements is requested.**

3) Groundwater levels were unusually high prior to the pilot recharge project. Water levels recovered to near pre-project conditions over the winter months, and in some cases have started to increase in response to springtime irrigation operations (Attachment A). Given the current below-average runoff conditions, groundwater levels are expected to be lower in fall 2012 than they were at the beginning of the pilot recharge project. This condition could allow an extended recharge period during the 2012-2013 non-irrigation season.

2012-2013 Recharge Planning

The results of the demonstration project indicate that a recharge project along the Phelps Canal is feasible. The ED Office has been working with Special Advisor Hahn, with input from the Water Advisory Committee (WAC), to develop a proposed recharge plan for the 2012-2013 non-irrigation season. As discussed at the May 8, 2012 WAC meeting, the proposed plan for 2012-2013 is to conduct recharge operations in the Phelps Canal from October through April, as coordinated with CNPPID. No recharge basins are being proposed. Water would be diverted into the Phelps Canal down-gradient from the J-2 hydro facility when excesses to target flows exist at Grand Island and flows are physically available in CNPPID's system. Environmental Account releases would also be recharged if directed to do so by the U.S. Fish & Wildlife Service (USFWS).

The numerical groundwater model was partially recalibrated to field data about two-thirds of the way through the recharge demonstration project. Following the recalibration, the model was providing reasonable predictions of the timing and location of accretions and water level response to recharge; no further calibration is recommended at this time.

The updated groundwater model indicates that approximately 40% of the annual recharge volume will accrue to the Platte River during times with shortages to target flows, on average. Monthly efficiency values (volume of accretions during shortages ÷ volume recharged) range from 30% in October to 45% in January. Therefore, the WAC agreed that targeted recharge operations during isolated months are not justified, and noted the benefits of continuous recharge operations for developing and maintaining an ice cap. While the 2012 demonstration project terminated at the 9.7 mile return on the Phelps Canal, CNPPID has indicated that future operations could be extended to the return at mile 13.2. Hahn estimates that the expanded recharge length would increase the sustained recharge rate to approximately 40.4 cfs. It is anticipated that Tri-Basin Natural Resource District (TBNRD) may be interested in partnering with CNPPID and the Program on this recharge project.

Preliminary Scoring Considerations

Given the favorable results of the pilot-scale demonstration project, the ED Office has started to update the preliminary project scoring analysis that was completed as part of the August 2010 Pre-Feasibility Study. For consistency, the updated recharge scoring will be based on the assumptions that were used to evaluate the score of the J-2 Regulating Reservoir project when appropriate. Assumptions include using OpStudy Present Condition with Three State Projects without pulse flows hydrology, calculating excesses and shortages to USFWS target flows at Grand Island, using target flows from Appendix A-5, and not reregulating Environmental Account flows, among others. Excesses available for recharge will also need to be limited by the flow that is physically available downgradient of the J-2 hydro facility and the capacity of the Phelps Canal. While the J-2 Regulating Reservoir scoring was prepared with a daily model to reflect daily operational flexibility, the recharge project and most other Water Action Plan project scoring is anticipated to be conducted with a monthly time-step. Given that the Phelps Canal groundwater recharge and the J-2 Regulating Reservoir projects rely on the same source of excess flows and the physical capacity constraints of the Phelps Canal, the combined scores may also need to be considered.

When not restricted by the operations of the J-2 Regulating Reservoir project, the average volume of excess flows available for recharge in the Phelps Canal at a rate of 40.4 cfs is about 8,250 ac-ft/year[1]. Maximizing diversions to recharge could reduce the diversions to the J-2 Regulating Reservoir, which

[1] The values presented represent the total volume available for recharge and have not been scored to account for accretions at times of shortages to USFWS target flows and other factors.

could reduce the score of that project. Given that the J-2 Regulating Reservoir can be operated to maximize reductions to target flow shortages on a daily basis, and since all return flows from recharge do not accrue at times of shortages, it would likely be in the best interest of the Program to prioritize maximizing the score of the J-2 Regulating Reservoir. If diversions to recharge are limited to 40.4 cfs at times when the J-2 Regulating Reservoir is full, then the average volume of excess flows available for Phelps Canal recharge is reduced to about 5,300 ac-ft/year, or approximately 64% of the unrestricted supply. However, this should be viewed as a worst-case scenario because the recharge operations could be operated to prevent reductions to the J-2 Regulating Reservoir score while maximizing diversions to the Phelps Canal when capacity permits. Preliminary analyses show that depending on the optimization method used, the supply of excess flows available for Phelps Canal recharge ranges from about 6,500 to 7,000 ac-ft/year.

While scoring the J-2 Regulating Reservoir project[2], the USFWS indicated that an additional score reduction would be necessary in cases where the entire Overton to Duncan habitat reach does not benefit from the flow improvements. The return flows from recharge operations terminating at mile 9.7 of the Phelps Canal were spatially distributed, but primarily accrued to the Platte River approximately 2 miles downstream of Overton. If future operations are extended to mile 13.2, then the majority of return flows would accrue further downstream. The ED Office is in the process of evaluating the specific location of return flows with Hahn. Transit losses must be subsequently applied to the return flows to account for routing from the point of accretion to Grand Island.

Future scoring adjustments will be evaluated using the COHYST 2010 model; however additional input from the WAC or Governance Committee (GC) on the appropriate score adjustment for habitat benefits is requested in the interim to keep projects advancing. It may be possible to have TBNRD make use of accretions that occur at times of excess to target flows as well as accretions that do not benefit the entire habitat reach.

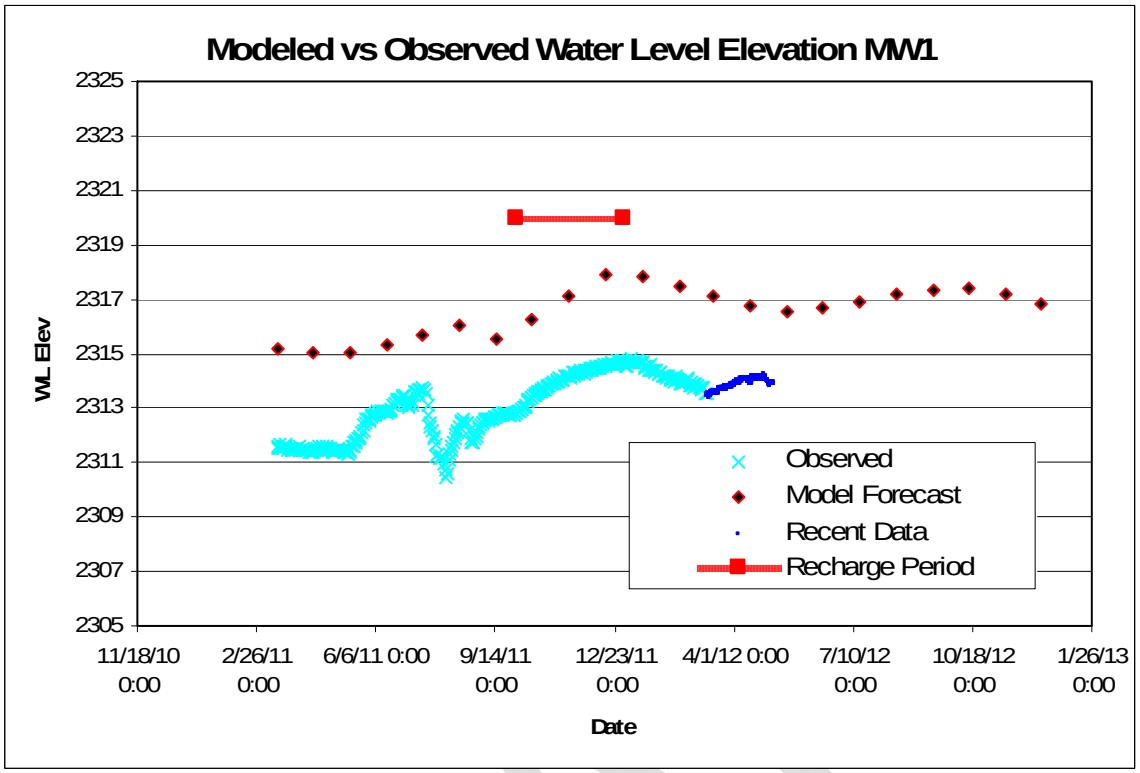
Recommendations and Action Items

At the May 8, 2012 WAC meeting, the WAC expressed support for conducting recharge operations in the Phelps Canal during the upcoming non-irrigation season from October 2012 through April 2013, and that the next steps would need to include:

a. CNPPID filing a temporary recharge application with Nebraska Department of Natural Resources;
b. The ED Office working with CNPPID to prepare an Agreement for review by the Workgroup and GC;
c. The ED Office continuing to work with Hahn to evaluate the effects of extending recharge operations to mile 13.2 and working with CNPPID to develop a monitoring and operating plan for 2012-2013;
d. The WAC requested that the GC form a scoring sub-committee to address the scoring questions summarized above; the request will be made at the June GC meeting.

[2] Section IV.D.4. in "Water Action Plan Project Scoring Case Study: CNPPID Reregulating Reservoir" dated April 22, 2010 by the ED Office. Section 2.10 of the Central Platte River Model documentation included in Volume 3 of the Final Environmental Impact Statement dated February 2006 states that scoring adjustments should be based on the Big Bend reach that extends from Lexington to Chapman. Further input/clarification from the USFWS and WAC will be requested during the groundwater recharge project scoring.

While we continue to work on the items above, the ED Office requests the Workgroup review the Consultants' draft Report and provide comments to the ED Office by **Tuesday June 19, 2012**. The ED Office will compile the comments and work with the Consultants to finalize the Report by the end of July, unless comments are of a nature that requires a conference call to discuss.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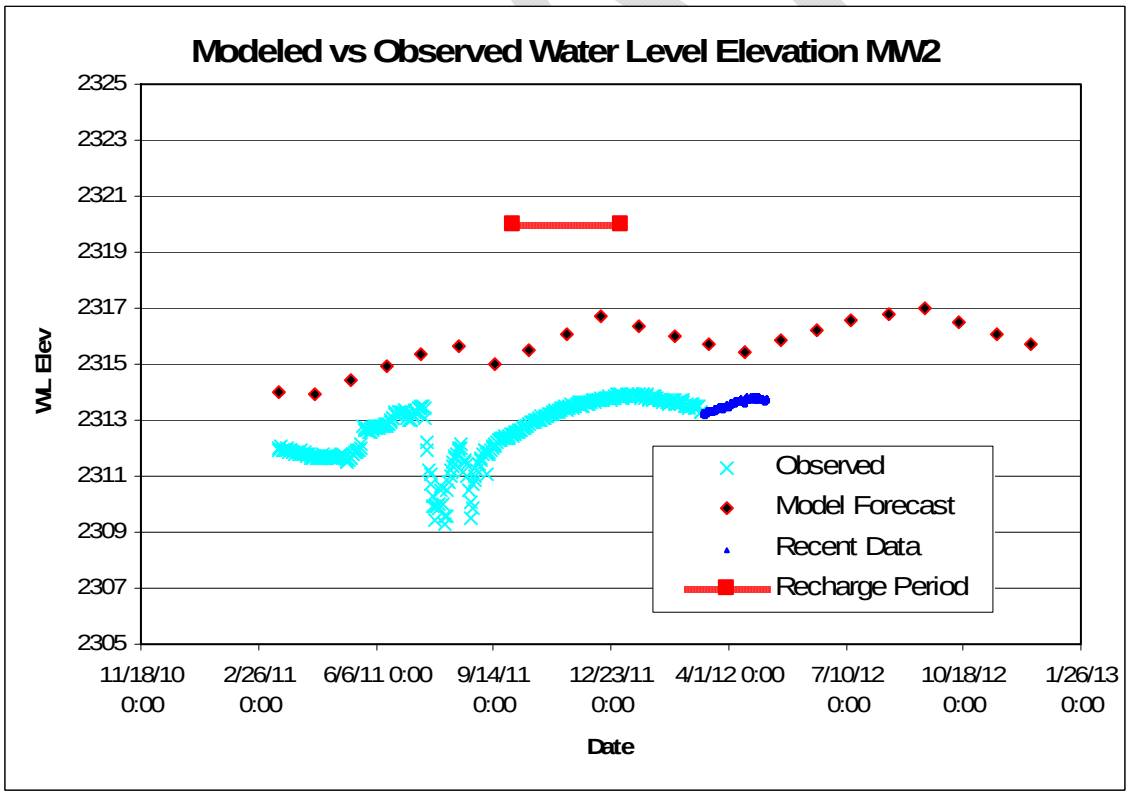
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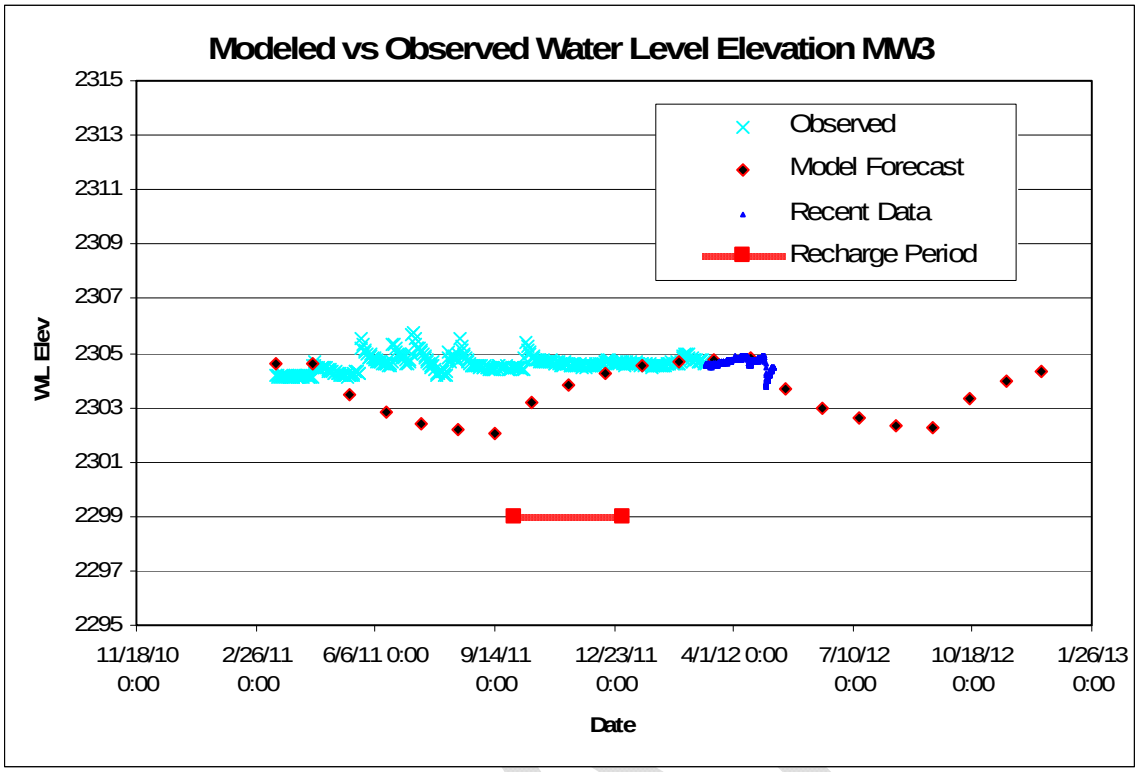
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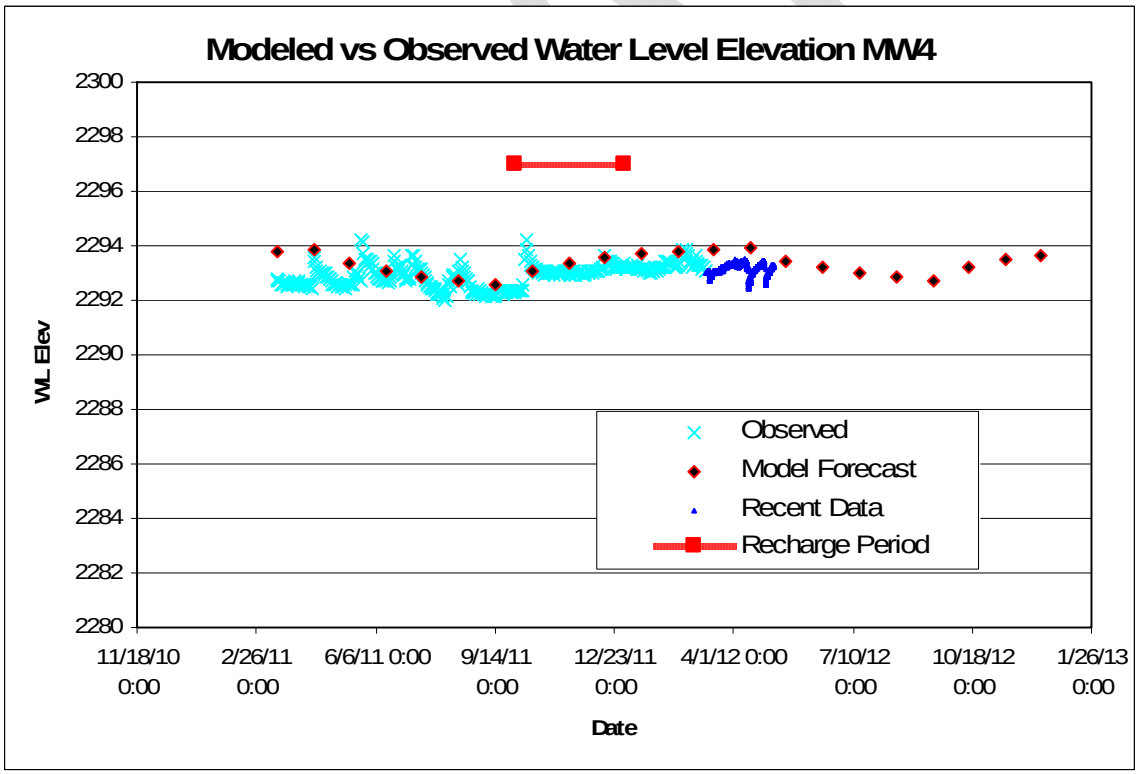
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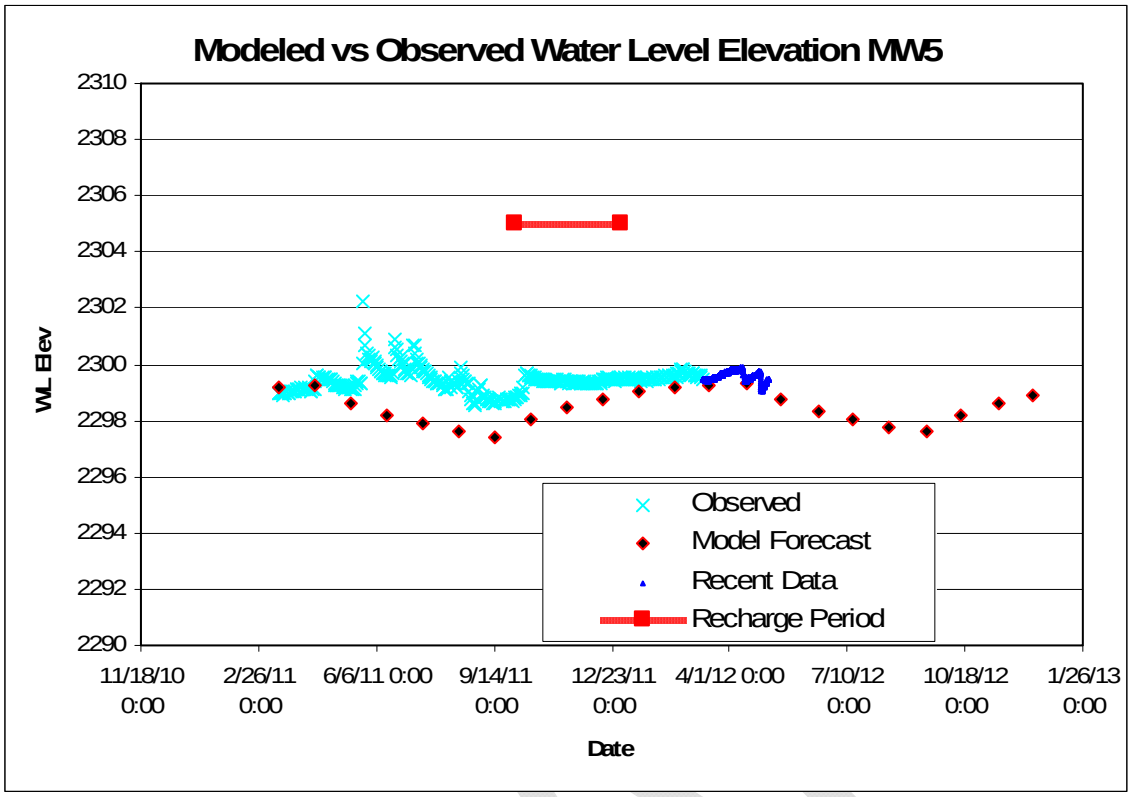
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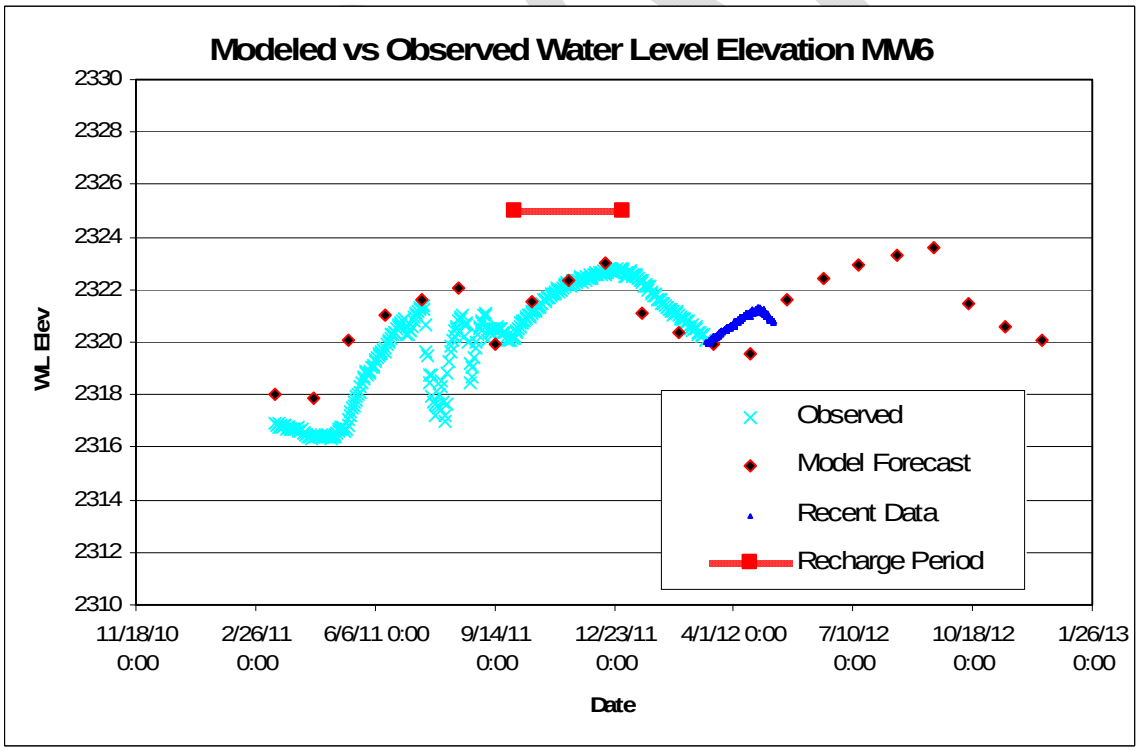
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