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March 3, 2011

Mr. Ed Jones
Washington State Department of Ecology
3190 160th Avenue Southeast
Bellevue Washington 98008-5452

**RE: TIDAL STUDY AND AQUIFER CHARACTERIZATION RESULTS
CAPITAL INDUSTRIES, INC.
5801 THIRD AVENUE SOUTH, SEATTLE, WASHINGTON
FARALLON PN: 457-004**

Dear Mr. Jones:

This letter report has been prepared on behalf of Capital Industries, Inc. (Capital) to present the results of the tidal study and aquifer characterization conducted at the Capital Area of Investigation. Work was completed in accordance with the methods described in the Groundwater Monitoring Plan dated May 19, 2010, prepared by Farallon Consulting, L.L.C. (Farallon) (2010). Field activities were completed in July and August 2010 and consisted of a multi-well tidal study and aquifer characterization using slug tests in selected monitoring wells. The monitoring wells used in the studies are shown on Figure 1. A description of the study methods and results is presented below.

TIDAL STUDY

A tidal study was performed to assess tidal influences on groundwater elevations and gradients near the Duwamish Waterway. The tidal study evaluated the effects of the inland propagation of the pressure wave caused by the rise in the surface water in the Duwamish Waterway that can cause groundwater levels and gradients (both horizontal and vertical) to fluctuate. Filtering methods developed by Serfes (1991) were used to determine tidally averaged groundwater elevations. These data were then used to calculate the mean hydraulic gradients (horizontal and vertical) and the direction of groundwater flow at various times during the tidal cycle. Hydraulic conductivity also was estimated from the tidal data using the methods of Ferris (1963).

DATA COLLECTION

Water levels were measured in 15 monitoring wells located down-gradient of the Capital property for the tidal study:

- Water Table Interval: monitoring wells C-10-WT, CI-11-WT, CI-12-WT, CI-13-WT, and CI-14-WT;
- Shallow Interval: monitoring wells C-10-35, CI-11-30, CI-12-30, CI-13-30, and CI-14-35; and

- Intermediate Interval: monitoring wells C-10-65, CI-11-60, CI-12-60, CI-13-60, and CI-14-70.

Data were collected over a 14-day period between July 22 and August 5, 2010 using down-hole pressure transducers/data loggers placed in each monitoring well. A pressure transducer/data logger was deployed also in the Duwamish Waterway near South Front Street to record fluctuations in river stage. Water level data were collected at 5-minute intervals at each location over the 14-day test period. Vented pressure transducers were used to compensate for atmospheric pressure changes so barometric corrections to water level data were not required. A barometric pressure transducer was deployed to record barometric pressure fluctuations over the test period in the event that barometric corrections were required (e.g., if a transducer vent line became obstructed). Water levels were measured manually in each well before the data loggers were installed and before the loggers were removed to establish baseline groundwater elevations from the pressure transducer readings.

Data loggers were anchored securely in the wells to avoid slippage during the test and well boxes were secured after the test was started to prevent damage to the data loggers and cables. The wells were equipped with In-Situ, Inc. Level TROLL 700 pressure transducers/data loggers. A Level TROLL 700 pressure transducer/data logger was deployed also in the Duwamish Waterway by securely attaching the instrument to an offshore piling. Barometric pressure was recorded using a BaroTROLL 500 instrument. Manufacturer specifications for these instruments are provided in Appendix A.

DATA ANALYSIS

Water-level data obtained during the 14-day test period were downloaded from the data loggers and converted to groundwater elevations using the depth-to-water measurements obtained in each well at the beginning of the tidal study. Surface water level fluctuations recorded in the Duwamish Waterway are shown on Figure 2. The vertical elevation of the transducer in the Duwamish Waterway was not surveyed because only timing and magnitude of changes of river stage, not absolute elevations, are required for the tidal analyses discussed below.

The tidal filtering process developed by Serfes (1991) requires either a 25- or 72-hour data collection period. The 25-hour analysis is considered to be less accurate than the 72-hour process. Two 72-hour periods were selected over the 14-day tidal study, one reflective of a relatively high-peak tidal amplitude (high to low tide) in the Duwamish (approximately 13 feet), and the other of a relatively smaller tidal amplitude (approximately 9 feet). The two filtering periods were selected to determine whether the magnitude of the tidal amplitude in the river had an impact on average elevations/gradients calculated inland of the waterway. The two tidal analysis periods are illustrated on Figure 2. The first 72-hour period extended from July 24 to 27, 2010 (Tidal Study 1); the second period extended from August 1 to 4, 2010 (Tidal Study 2). The following calculations were completed using each of the datasets:

- Tidally averaged groundwater elevations in each monitoring well included in the tidal study, using the Serfes (1991) method;

- Horizontal hydraulic gradient and flow direction in each aquifer zone using monitoring well clusters CI-11, CI-13, and CI-14;
- Vertical hydraulic gradients in each aquifer zone, calculated using monitoring well pairs; and
- Aquifer hydraulic conductivity estimates using the stage-ratio and time-lag methods of Ferris (1963).

Average Groundwater Elevations

Tidally averaged groundwater elevations calculated for each aquifer zone during the two tidal study periods are presented in Table 1. Graphs showing groundwater elevation fluctuations and the tidal filtering process for each well are included in Appendix B. Using the average groundwater elevations in each aquifer zone, groundwater contour maps were developed for each of the two tidal study periods. These contour maps are presented in Figures 3 through 8.

The groundwater flow patterns interpreted from average groundwater elevations in each aquifer zone are similar to those interpreted from previous groundwater measurement events. Flow is generally to the southwest toward the Duwamish Waterway in each zone. The tidal study data indicate virtually no tidal response in monitoring well cluster CI-10, indicating that tidal influence does not extend beyond monitoring well CI-10. Tidal response was relatively minor in monitoring well cluster CI-14, suggesting that tidal influence extends to a point between these two monitoring well clusters (approximately 600 to 700 feet from the Duwamish Waterway).

Horizontal Gradient and Flow Direction

The horizontal gradient and flow direction in each aquifer zone near the Duwamish Waterway was calculated for both 72-hour tidal study periods using monitoring well clusters CI-11, CI-13, and CI-14. The gradient and flow direction were calculated using a solution to the standard "3-point problem" for groundwater flow. Calculations were made for every 5-minute measurement interval during the 72-hour test periods. The average gradient and flow direction in each zone for the July 24 through 27, and August 1 through 4, 2010 time periods are presented in Table 2. Rose diagrams showing the flow direction and relative frequency of flow in each aquifer zone are presented in Appendix C.

The average hydraulic gradient was fairly consistent between zones and time periods. The average gradients were 0.0035 (July 24 through 27) and 0.0036 (August 1 through 4) in the Water Table Zone; 0.0043 (July 24 through 27) and 0.0037 (August 1 through 4) in the Shallow Zone; and 0.0044 (July 24 through 27) and 0.0043 (August 1 through 4) in the Intermediate Zone. Average groundwater flow directions also were fairly consistent, with averages ranging from approximately 217 degrees (clockwise from north) to 219 degrees in the Water Table Zone, 216 degrees to 220 degrees in the Shallow Zone, and 222 degrees to 223 degrees in the Intermediate Zone. As illustrated by the Rose diagrams in Appendix C, the flow direction varied in each zone across a range of approximately 20 to 30 degrees during the tidal cycle, with very minor flow in some zones at higher ranges, although flow was predominantly in the average directions noted above.

Vertical Gradient Calculations

Vertical hydraulic gradients were calculated for both 72-hour tidal study periods using the tidally averaged groundwater elevations for monitoring well pairs screened in each aquifer zone. Vertical gradients were calculated by dividing the head difference between monitoring wells by the difference in well screen elevation mid-points. A negative value indicates a downward vertical gradient and a positive value indicates and upward gradient. If a well screen was not fully saturated, the well screen mid-point elevation was taken as the midpoint of the saturated interval of the well screen.

Table 3 lists the average vertical gradients calculated for each monitoring well pair. The vertical gradient was calculated also for each 5-minute measurement interval during each tidal study to determine the variations in vertical gradient over time. The maximum and minimum vertical gradients calculated for each tidal study period are listed in Table 3. As shown in this table, the average vertical gradients are relatively small, and fluctuate between upward flow and downward flow in most monitoring well pairs. These data suggest that the vertical gradient and flow direction is somewhat variable during a tidal cycle.

Hydraulic Conductivity Estimates

The tidal study data were used to estimate the hydraulic conductivity of each aquifer zone using the stage-ratio and time-lag methods developed by Ferris (1963). The stage-ratio method uses the ratio of the range in water-level fluctuation measured in observation wells to the corresponding range in stage of a nearby river. The ratio of groundwater fluctuation to change in river stage is computed for the rising and falling limb of each tidal cycle. These calculations were performed for monitoring well clusters CI-11, CI-13, and CI-14 located near the Duwamish Waterway and incorporated into the equations for hydraulic conductivity presented by Ferris. Table 4 presents the hydraulic conductivity values estimated using this method.

The time-lag method uses the time lag between the maximum and minimum stages of the Duwamish Waterway and corresponding maximum and minimum water levels in observation monitoring well clusters CI-11, CI-13, and CI-14. These time-lag values are then incorporated into the appropriate equations for hydraulic conductivity. The average time-lag values calculated for monitoring wells are listed in Table 5. The hydraulic conductivity values obtained using the time-lag method are presented in Table 6.

The hydraulic conductivity estimates are very sensitive to the assumed storativity values for both methods. The hydraulic conductivity calculated using a range of storativity values is presented in Table 6 to illustrate the impact of storativity ranging from 0.1 (unconfined) to 0.001 (semi-confined). Using a mid-range storativity value of 0.01, hydraulic conductivity ranges from approximately 50 feet per day to 230 feet per day. For the stage-ratio method, the hydraulic conductivity ranges from approximately 100 to 200 feet per day in each aquifer zone, assuming a storativity value of 0.1 (unconfined). In general, the results indicate a relatively high hydraulic conductivity across all aquifer zones.

AQUIFER CHARACTERIZATION

To further evaluate hydraulic conductivity in aquifer zones within the Capital Area of Investigation, slug tests were performed in a total of 12 monitoring wells situated near the Site and extending toward the Duwamish Waterway. Slug tests were completed in the following monitoring wells:

- Water Table Interval: monitoring wells MW-8, CI-9-WT, CI-10-WT, and CI-14-WT;
- Shallow Interval: monitoring wells C-8-40, CI-9-40, CI-10-35, and CI-14-35; and
- Intermediate Interval: monitoring wells C-8-60, CI-9-70, CI-10-65, and CI-14-70.

Hydraulic conductivity estimates obtained from the slug testing are presented in Table 7. The mean hydraulic conductivity for each aquifer zone was calculated and also is provided in Table 7. Slug test analysis plots are provided in Appendix D. The Bouwer and Rice method was used to analyze the slug test data for most wells (Bouwer and Rice 1976; Bouwer 1989). The Springer and Gelhar (1991) method was used for wells that showed an oscillating response.

The mean hydraulic conductivity was 99.1 feet per day in the Water Table Zone, 71.8 feet per day in the Shallow Zone, and 6.8 feet per day in the Intermediate Zone. The hydraulic conductivity estimates indicate a decreasing trend in hydraulic conductivity from the Water Table Zone to the Intermediate Zone.

CONCLUSIONS

The tidal study results indicate that the hydraulic gradient and groundwater flow directions in the three aquifer zones are relatively consistent during a tidal cycle and that tidal influence extends approximately 600 to 700 feet inland from the Duwamish Waterway. Minor variations in flow direction occur as a result of tidal influence; however, the flow direction remains predominantly toward the Duwamish Waterway (to the southwest from the Capital Site) during a tidal cycle. This suggests that routine long-term monitoring of water levels is not required to obtain accurate groundwater elevation and flow measurements in the area near the Duwamish Waterway.

Hydraulic conductivity estimates obtained using both tidal data and slug test results indicate relatively high hydraulic conductivity in the Water Table and Shallow Zones (in the range of 100 to 200 feet per day). The hydraulic conductivity in the Intermediate Zone appears to be somewhat lower based on slug test results (roughly 5 to 10 feet per day).

Sincerely,

Farallon Consulting, L.L.C.

for

Norm Colby, L.G., L.H.G.
Senior Hydrogeologist

Peter Jewett, L.G., L.E.G.
Principal

Attachments: Figure 1, *Site Plan Showing Monitoring Well Locations*
Figure 2, *Water Level Fluctuations Recorded in the Duwamish Waterway and Intervals Selected for Tidal Analysis*
Figure 3, *Water Table Zone Groundwater Elevation Contours Interpreted from Tidally Averaged Groundwater Elevations – July 24-27, 2010*
Figure 4, *Water Table Zone Groundwater Elevation Contours Interpreted from Tidally Averaged Groundwater Elevations – August 1-4, 2010*
Figure 5, *Shallow Zone Groundwater Elevation Contours Interpreted from Tidally Averaged Groundwater Elevations – July 24-27, 2010*
Figure 6, *Shallow Zone Groundwater Elevation Contours Interpreted from Tidally Averaged Groundwater Elevations – August 1-4, 2010*
Figure 7, *Intermediate Zone Groundwater Elevation Contours Interpreted from Tidally Averaged Groundwater Elevations – July 24-27, 2010*
Figure 8, *Intermediate Zone Groundwater Elevation Contours Interpreted from Tidally Averaged Groundwater Elevations – August 1-4, 2010*

Table 1, *Tidally Averaged Groundwater Elevations*
Table 2, *Average Hydraulic Gradient and Flow Direction*
Table 3, *Vertical Gradients Calculated from Paired Monitoring Wells*
Table 4, *Summary of Hydraulic Conductivity Estimates Using Stage-Ratio Method*
Table 5, *Average Time Lag Values in Monitoring Wells*
Table 6, *Summary of Hydraulic Conductivity Estimates Using Time Lag Method*
Table 7, *Hydraulic Conductivity Estimates from Slug Testing*

Attachment A, Manufacturer Specifications for Data Logging Instruments
Attachment B, Graphs Showing Groundwater Elevation Fluctuations and Tidal Filtering Process
Attachment C, Rose Diagrams Showing Groundwater Flow Direction and Relative Frequency of Flow
Attachment D, Slug Test Analysis Plots
Attachment E, References

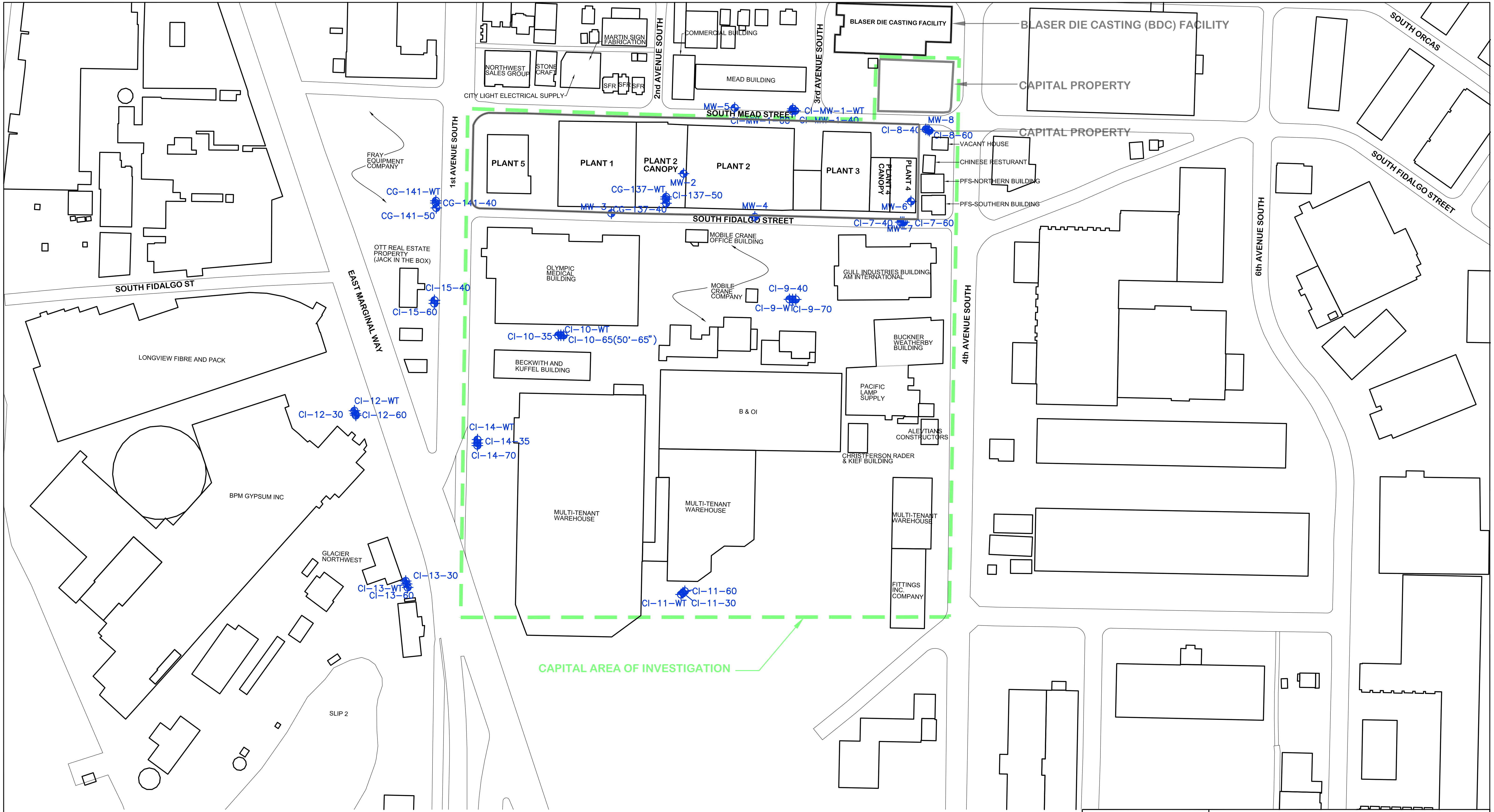
cc: Ron Taylor, Capital Industries, Inc.
Don Verfurth, Gordon and Rees LLP
Tong Li, GWS

NC/PJ:bjj

FIGURES

TIDAL STUDY AND
AQUIFER CHARACTERIZATION RESULTS
Capital Industries
5801 Third Avenue South
Seattle, Washington

Farallon PN: 457-004



LEGEND

⌖ CAPITAL INDUSTRIES MONITORING WELL

ALL LOCATIONS ARE APPROXIMATE

0 200
APPROXIMATE SCALE IN FEET

N

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FIGURE 1

SITE PLAN SHOWING
MONITORING WELL LOCATIONS
CAPITAL INDUSTRIES, INC.
SEATTLE, WASHINGTON

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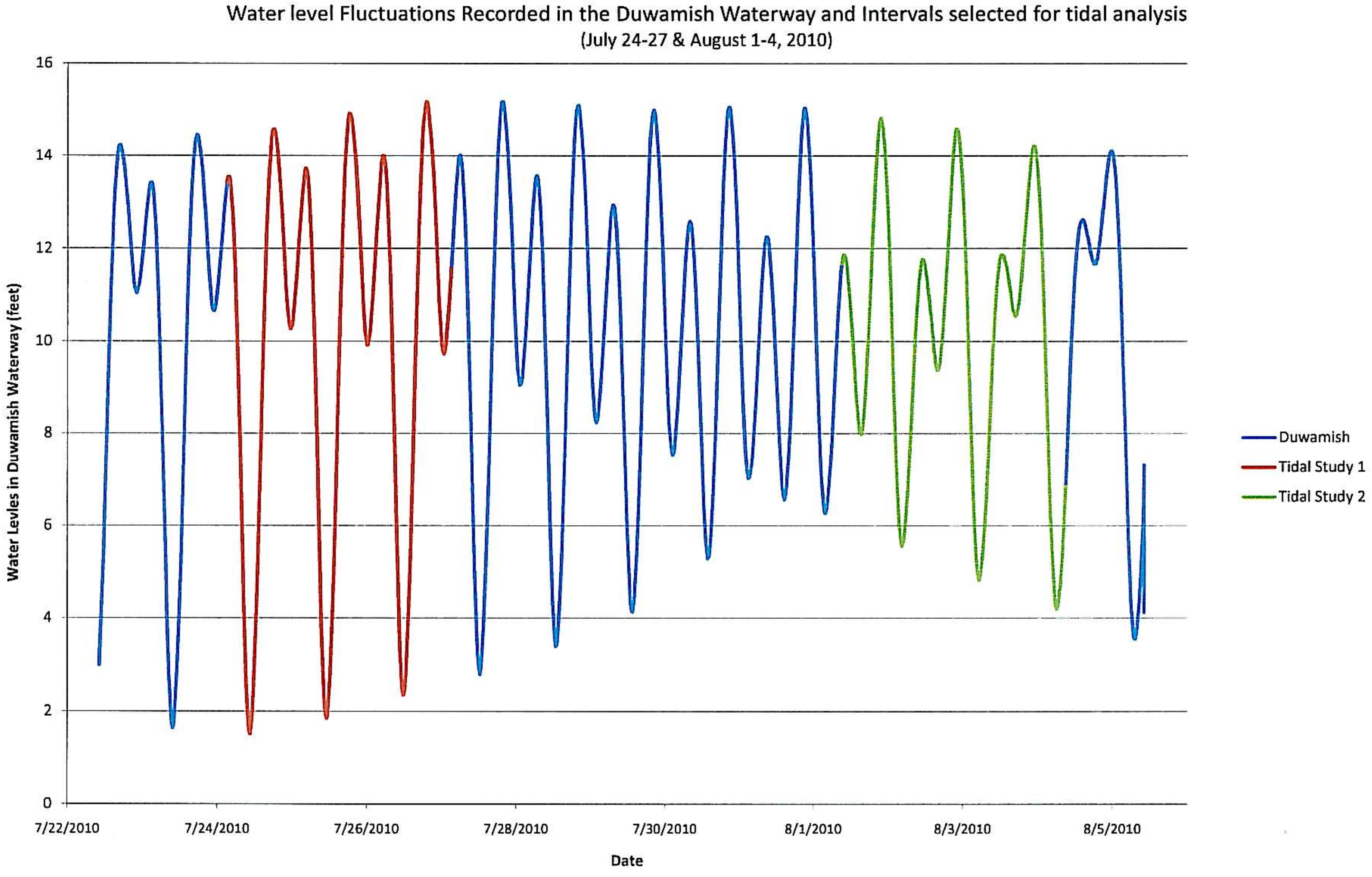
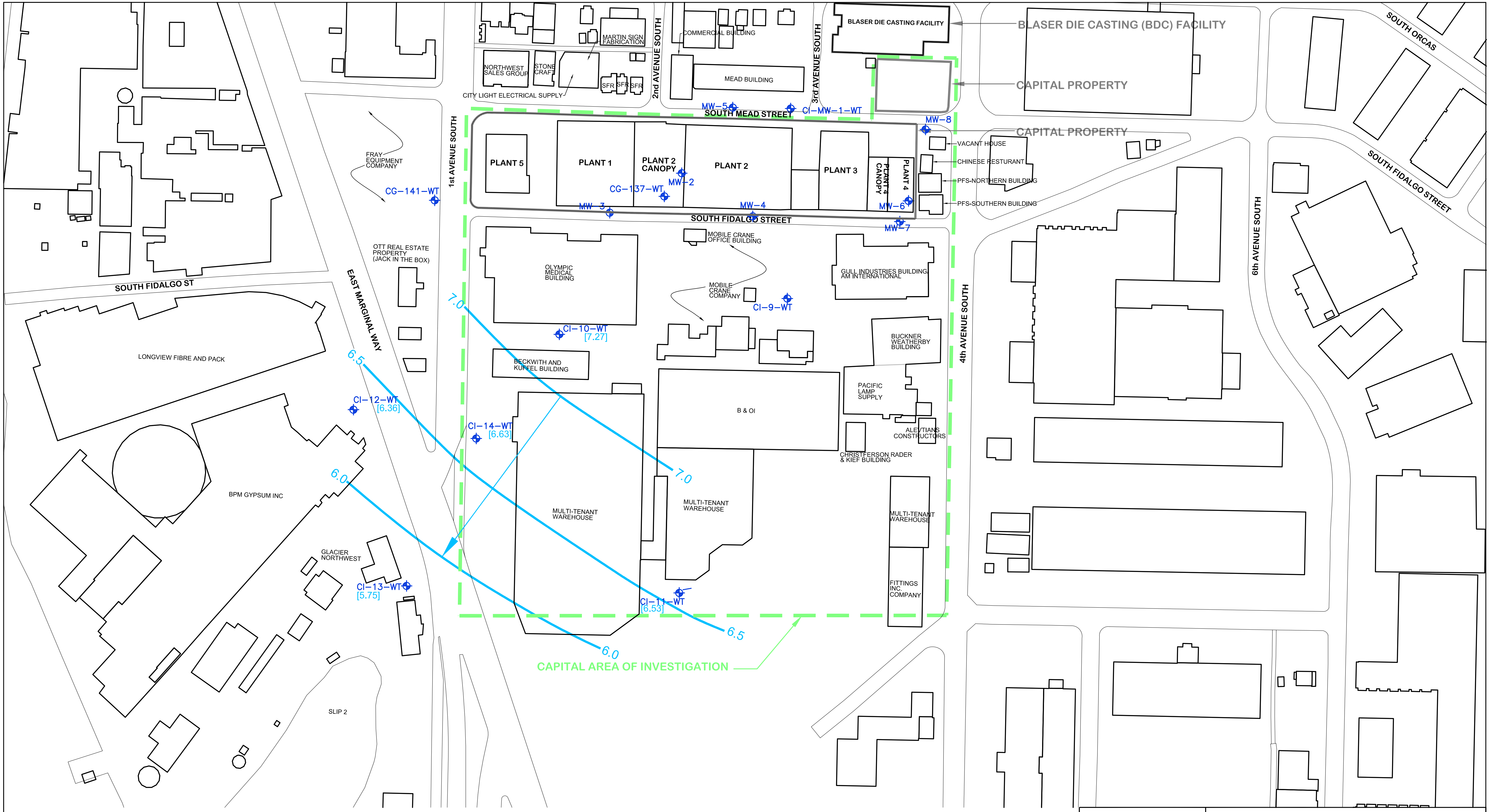
Figure 2



Water level Fluctuations Recorded in the Duwamish Waterway and Intervals selected for tidal analysis
(July 24-27 & August 1-4, 2010)
16
14
12
10
8
6
4
2
0
Water Levles in Duwamish Waterway (feet)
7/22/2010
7/24/2010
7/26/2010
7/28/2010
7/30/2010
8/1/2010
8/3/2010
8/5/2010
Date
Duwamish
Tidal Study 1
Tidal Study 2



LEGEND

⊕ CAPITAL INDUSTRIES MONITORING WELL

[6.53] TIDALLY AVERAGE GROUNDWATER ELEVATION

6.5 ── TIDALLY AVERAGE GROUNDWATER ELEVATION CONTOUR

← DIRECTION OF GROUNDWATER FLOW DIRECTION

0 200
APPROXIMATE SCALE IN FEET

N

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FIGURE 3

WATER TABLE ZONE GROUNDWATER ELEVATION
CONTOURS INTERPRETED FROM TIDALLY AVERAGED
GROUNDWATER ELEVATIONS JULY 24–27, 2010
CAPITAL INDUSTRIES, INC.
SEATTLE, WASHINGTON

FARALLON PN: 457–004

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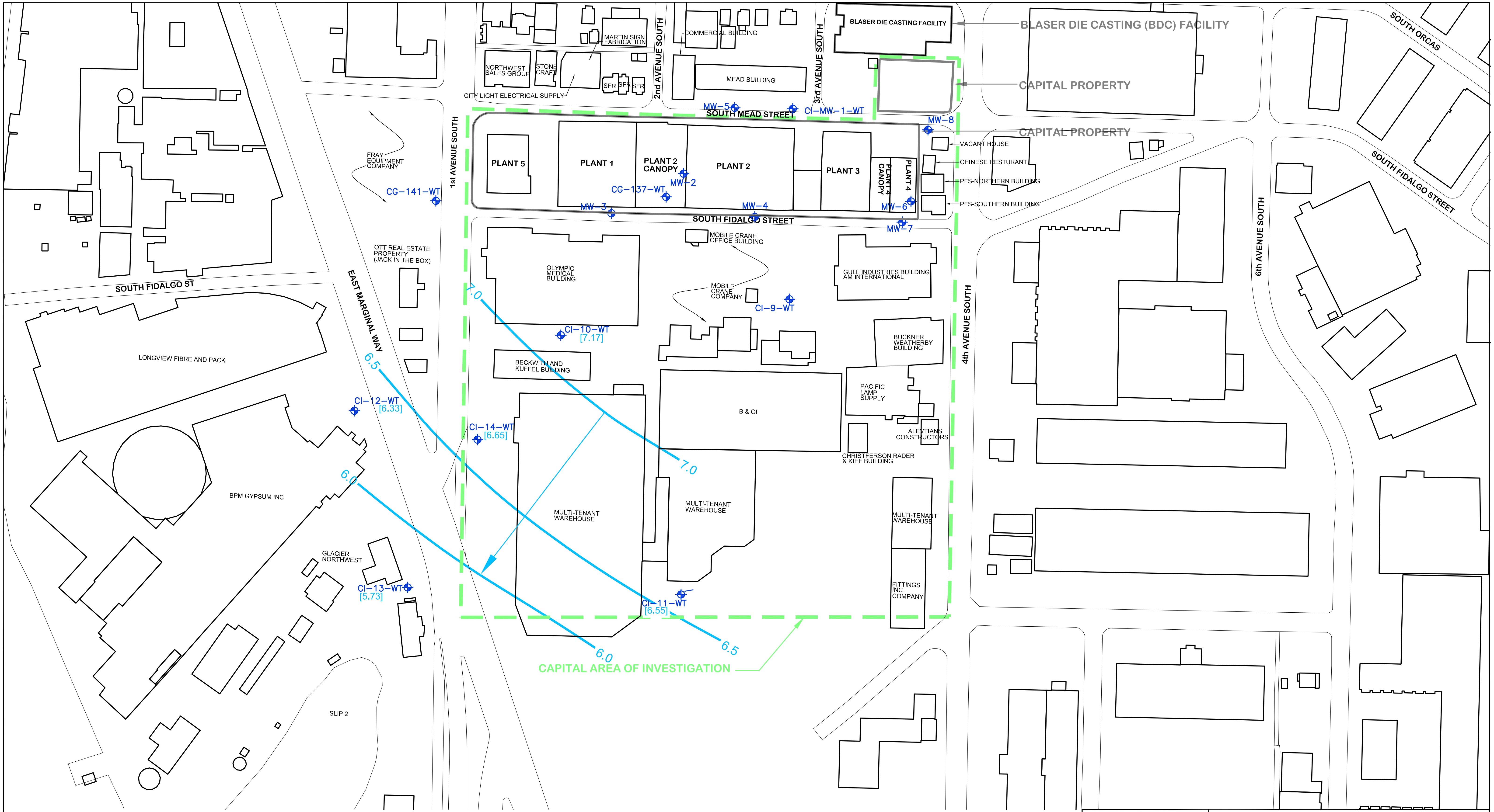

LEGEND

⌖	CAPITAL INDUSTRIES MONITORING WELL
[6.53]	TIDALLY AVERAGE GROUNDWATER ELEVATION
6.5 ——	TIDALLY AVERAGE GROUNDWATER ELEVATION CONTOUR
←	DIRECTION OF GROUNDWATER FLOW DIRECTION

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975 5th Avenue Northwest
Issaquah, WA 98027

FIGURE 4

WATER TABLE ZONE GROUNDWATER ELEVATION
CONTOURS INTERPRETED FROM TIDALLY AVERAGED
GROUNDWATER ELEVATIONS AUGUST 1–4, 2010
CAPITAL INDUSTRIES, INC.
SEATTLE, WASHINGTON

FARALLON PN: 457–004

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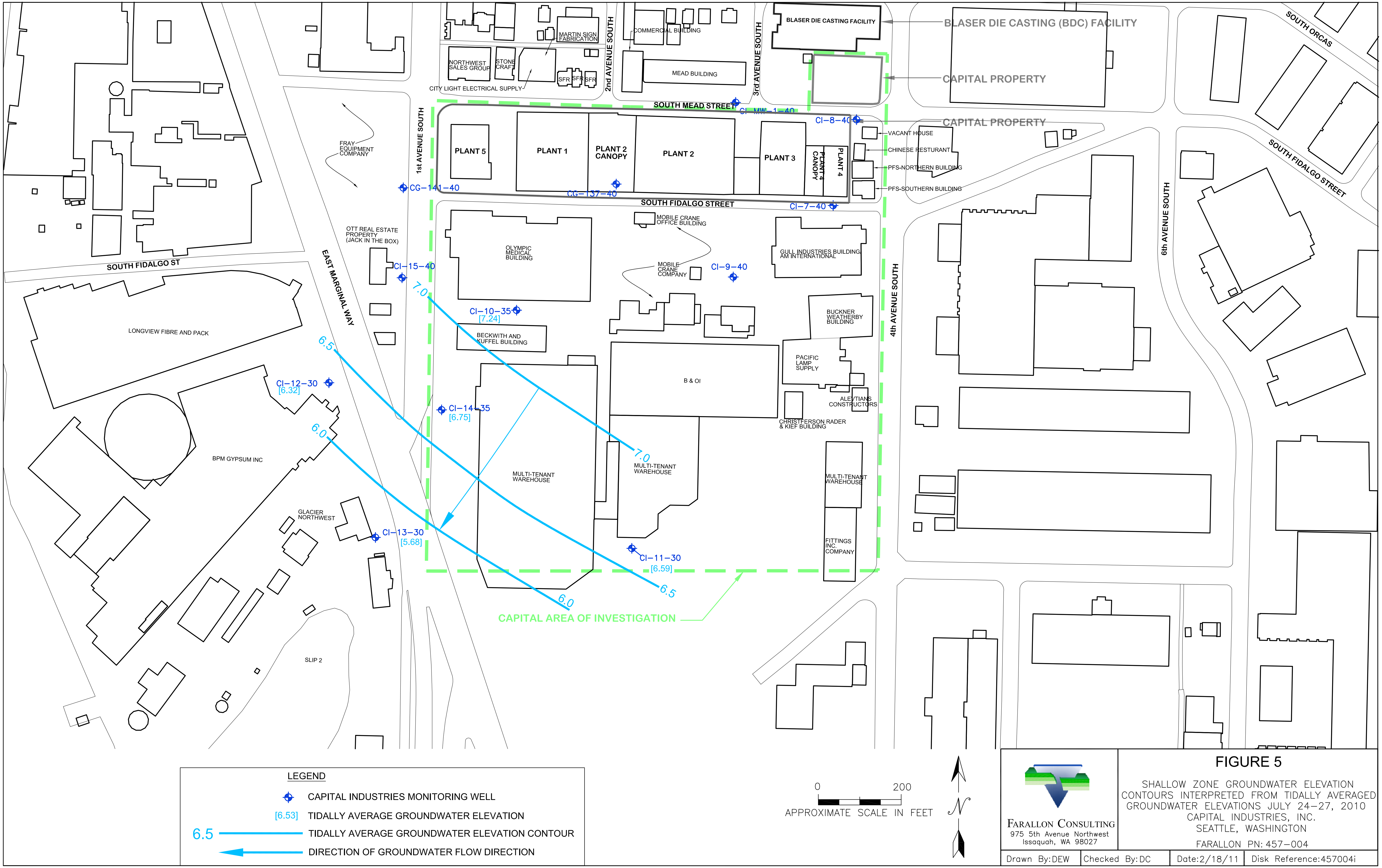

FIGURE 5

SHALLOW ZONE GROUNDWATER ELEVATION CONTOURS INTERPRETED FROM TIDALLY AVERAGED GROUNDWATER ELEVATIONS JULY 24–27, 2010
CAPITAL INDUSTRIES, INC.
SEATTLE, WASHINGTON

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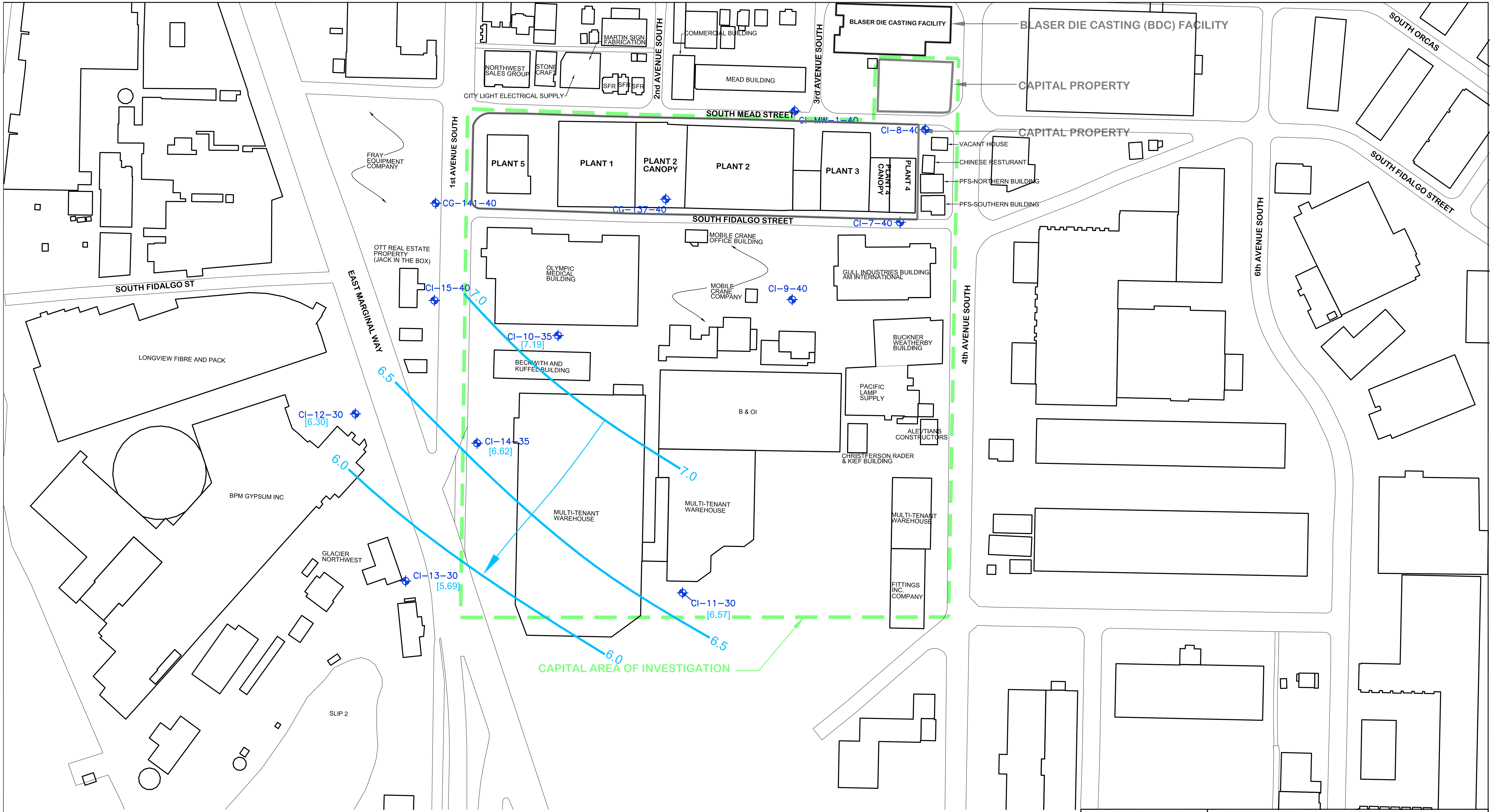

LEGEND

- CAPITAL INDUSTRIES MONITORING WELL
- [6.53] TIDALLY AVERAGE GROUNDWATER ELEVATION
- 6.5 TIDALLY AVERAGE GROUNDWATER ELEVATION CONTOUR
- DIRECTION OF GROUNDWATER FLOW DIRECTION

0 200
APPROXIMATE SCALE IN FEET

N

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975 5th Avenue Northwest
Issaquah, WA 98027

FIGURE 6

SHALLOW ZONE GROUNDWATER ELEVATION
CONTOURS INTERPRETED FROM TIDALLY AVERAGED
GROUNDWATER ELEVATIONS AUGUST 1–4, 2010
CAPITAL INDUSTRIES, INC.
SEATTLE, WASHINGTON

FARALLON PN: 457–004

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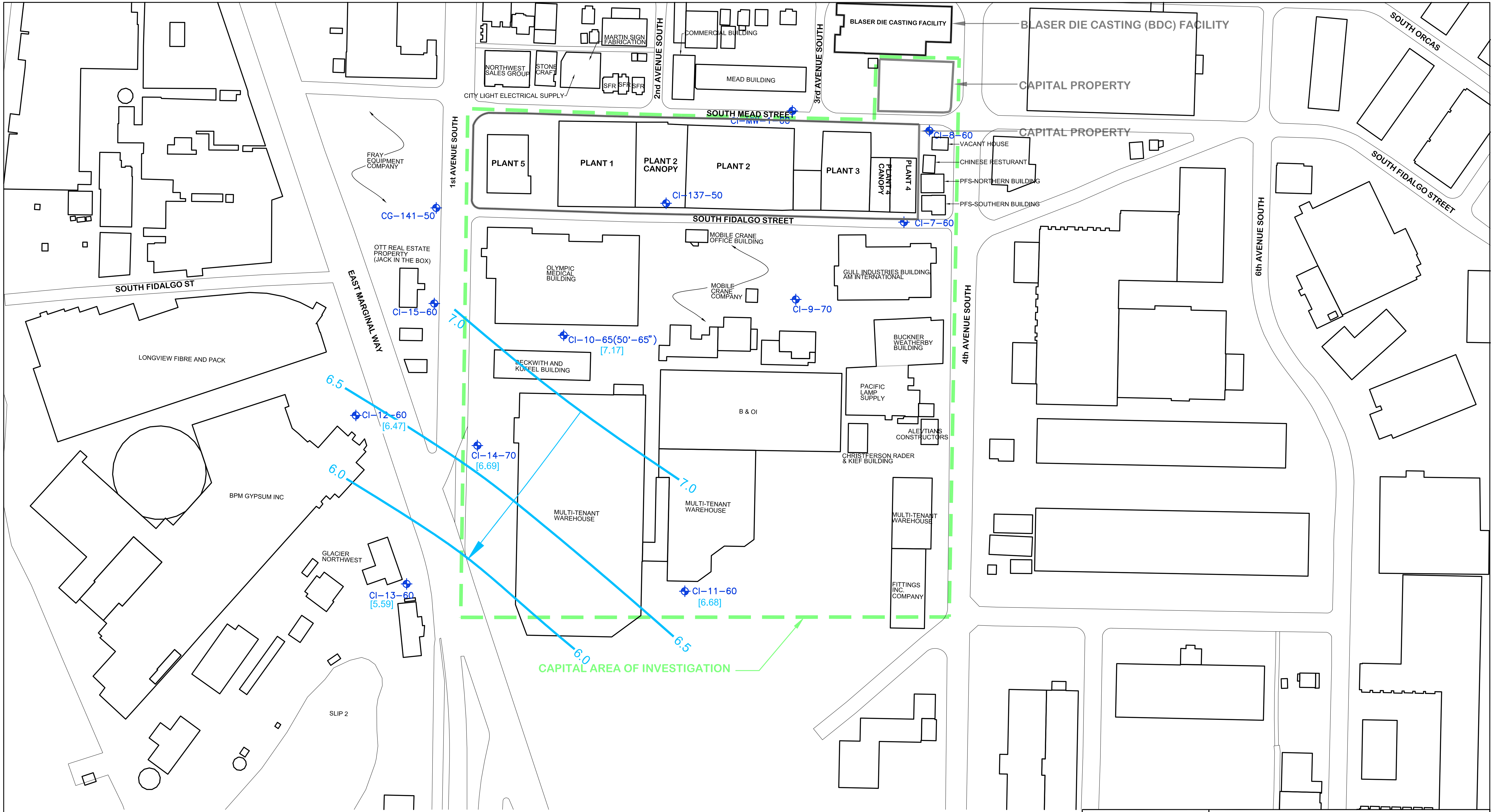

LEGEND

⊕	CAPITAL INDUSTRIES MONITORING WELL
[6.53]	TIDALLY AVERAGE GROUNDWATER ELEVATION
6.5 ———	TIDALLY AVERAGE GROUNDWATER ELEVATION CONTOUR
◀———	DIRECTION OF GROUNDWATER FLOW DIRECTION

0 200
APPROXIMATE SCALE IN FEET

N

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975 5th Avenue Northwest
Issaquah, WA 98027

FIGURE 7

INTERMEDIATE ZONE GROUNDWATER ELEVATION
CONTOURS INTERPRETED FROM TIDALLY AVERAGED
GROUNDWATER ELEVATIONS JULY 24–27, 2010
CAPITAL INDUSTRIES, INC.
SEATTLE, WASHINGTON

FARALLON PN: 457–004

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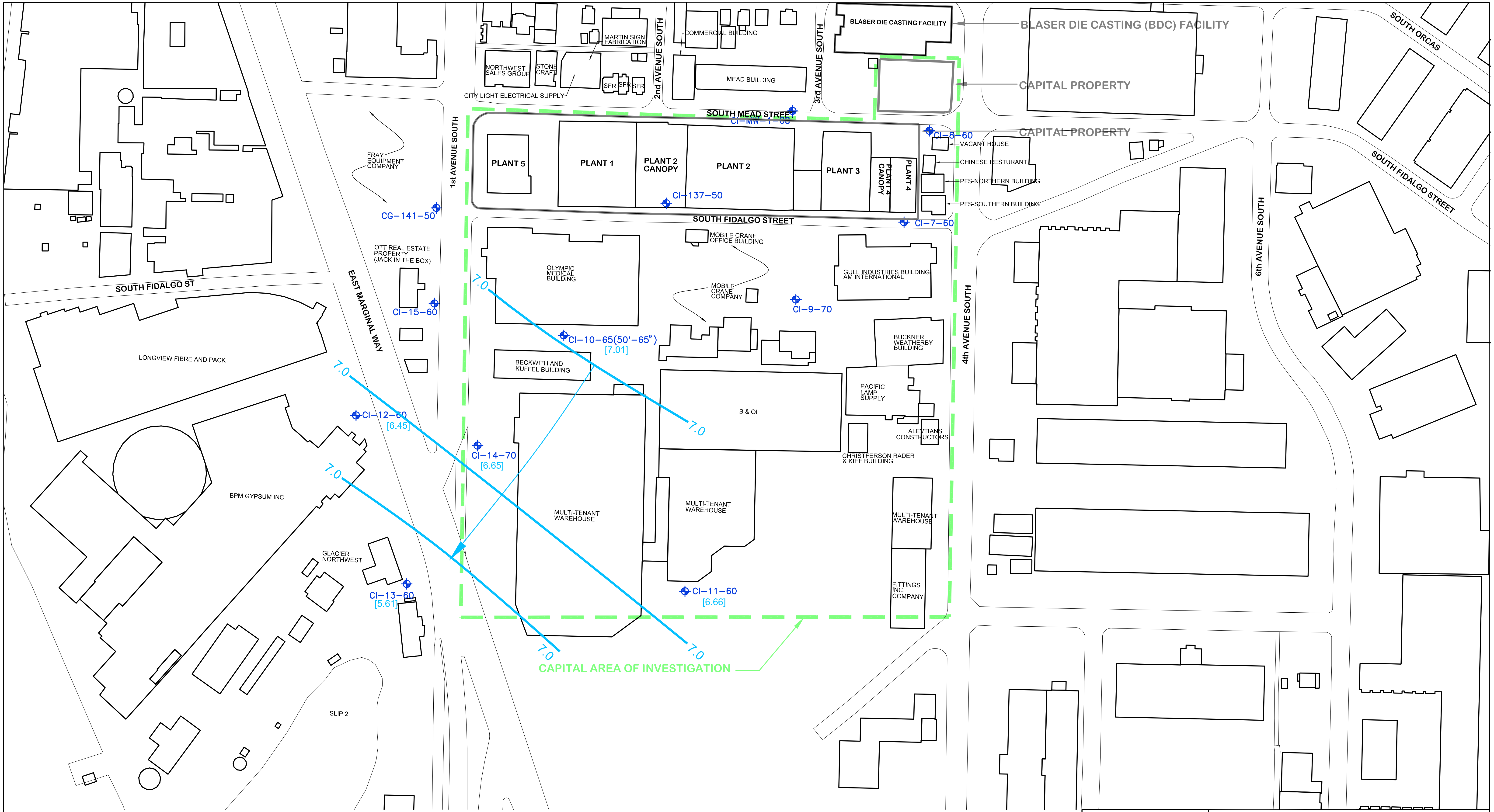

LEGEND

⌖	CAPITAL INDUSTRIES MONITORING WELL
[6.53]	TIDALLY AVERAGE GROUNDWATER ELEVATION
6.5 ───	TIDALLY AVERAGE GROUNDWATER ELEVATION CONTOUR
◄───	DIRECTION OF GROUNDWATER FLOW DIRECTION

0 200
APPROXIMATE SCALE IN FEET

N

FARALLON CONSULTING
975 5th Avenue Northwest
Issaquah, WA 98027

FIGURE 8

INTERMEDIATE ZONE GROUNDWATER ELEVATION
CONTOURS INTERPRETED FROM TIDALLY AVERAGED
GROUNDWATER ELEVATIONS AUGUST 1-4, 2010
CAPITAL INDUSTRIES, INC.
SEATTLE, WASHINGTON

FARALLON PN: 457-004

Drawn By: DEW	Checked By: DC	Date: 2/18/11	Disk Reference: 457004i

TABLES

TIDAL STUDY AND
AQUIFER CHARACTERIZATION RESULTS
Capital Industries
5801 Third Avenue South
Seattle, Washington

Farallon PN: 457-004

Table 1
Tidally Averaged Groundwater Elevations
Capital Industries, Inc.
Seattle, Washington
Farallon PN: 457-004

Well Identification	Tidal Study Investigation Period and Average Elevations	
	July 24 to 27, 2010	August 1 to 4, 2010
CI-10-WT	7.27	7.17
CI-10-35	7.24	7.19
CI-10-65	7.17	7.01
CI-11-WT	6.53	6.55
CI-11-30	6.59	6.57
CI-11-60	6.68	6.66
CI-12-WT	6.36	6.33
CI-12-30	6.32	6.30
CI-12-60	6.47	6.45
CI-13-WT	5.75	5.73
CI-13-30	5.68	5.69
CI-13-60	5.59	5.61
CI-14-WT	6.63	6.65
CI-14-35	6.75	6.62
CI-14-70	6.69	6.65

NOTES:

Groundwater elevations reported in feet above mean sea level.

Groundwater elevations calculated using Serfes (1991) method for 72-hour tidal cycle

Table 2
Average Hydraulic Gradient and Flow Direction
Capital Industries, Inc.
Seattle, Washington
Farallon PN: 457-004

Aquifer Zone	Average Gradient/Flow Direction	
	July 24 to 27, 2010	August 1 to 4, 2010
Water Table Zone	0.0035/219.2°	0.0036/217.1°
Shallow Zone	0.0043/215.9°	0.0037/220.2°
Intermediate Zone	0.0044/222.0°	0.0042/223.4°

NOTES:

Average flow direction reported as azimuth measured clockwise from north (0°)

Flow direction and gradient calculated using tidally averaged groundwater elevations in well clusters CI-11, CI-13 and CI-14

Table 3
Vertical Gradients Calculated from Paired Monitoring Wells
Capital Industries, Inc.
Seattle, Washington
Farallon PN 457-004

Monitoring Well Pair	July 24 to 27, 2010			August 1 to 4, 2010		
	Average Vertical Gradient	Maximum Vertical Gradient	Minimum Vertical Gradient	Average Vertical Gradient	Maximum Vertical Gradient	Minimum Vertical Gradient
CI-10-WT CI-10-35	-0.0020	-0.0008	-0.0029	0.0013	0.0025	-0.0024
CI-10-35 CI-10-65	-0.0025	0.0003	-0.0047	-0.0065	-0.0014	-0.0085
CI-11-WT CI-11-30	0.0059	0.0202	-0.0205	0.0020	0.0193	-0.0179
CI-11-30 CI-11-60	0.0030	0.0052	0.0015	0.0030	0.0072	0.0017
CI-12-WT CI-12-30	-0.0040	0.0015	-0.0108	-0.0030	0.0334	-0.0255
CI-12-30 CI-12-60	0.0050	0.0074	0.0024	0.0050	0.0072	-0.0077
CI-13-WT CI-13-30	-0.0072	0.0013	-0.0149	-0.0041	0.0039	-0.0171
CI-13-30 CI-13-60	-0.0029	0.0105	-0.0254	-0.0026	0.0103	-0.0206
CI-14-WT CI-14-35	0.0080	0.0225	-0.0079	-0.0020	0.0124	-0.0116
CI-14-35 CI-14-70	-0.0017	0.0024	-0.0084	0.0009	0.0059	-0.0060

NOTES:

A positive value indicates an upward vertical gradient; a negative value indicates a downward vertical gradient

Only the saturated portions of water table zone monitoring well screens that were fully submerged were used to calculate the midpoint elevations.

Vertical hydraulic gradients were calculated by dividing the difference in groundwater elevations by the difference in well screen midpoint elevations for each well pair.

Table 4
Summary of Hydraulic Conductivity Estimates Using Stage-Ratio Method
Capital Industries, Inc.
Seattle, Washington
Farallon PN: 457-004

	Water Table Zone		Shallow Zone		Intermediate Zone	
	July 24 to 27 2010	**August 1 to 4 2010**	**July 24 to 27 2010**	**August 1 to 4 2010**	**July 24 to 27 2010**	**August 1 to 4 2010**
Tidal Period (hours)	12.4	12.4	12.4	12.4	12.4	12.4
Tidal Period (days)	0.5	0.5	0.5	0.5	0.5	0.5
Delta X (feet)	390	490	370	440	430	370
Aquifer Thickness (feet)	150	150	150	150	150	150
Storage Coefficient	0.1	0.1	0.1	0.1	0.1	0.1
Transmissivity (gpd/foot)	133,848	211,288	120,472	170,368	162,712	120,472
Transmissivity (feet^2/day)	17,894	28,247	16,106	22,776	21,753	16,106
Hydraulic Conductivity (cm/sec)	4.21E-02	6.64E-02	3.79E-02	5.36E-02	5.12E-02	3.79E-02
Hydraulic Conductivity (feet/day)	**119**	**188**	**107**	**152**	**145**	**107**

NOTES:

Delta X is defined as the ratio of groundwater stage to surface water stage plotted against distance of observation wells from Duwamish over one log cycle for monitoring well clusters CI-11, CI-13 and CI-14

Aquifer thickness based on information in Duwamish Basin Groundwater Pathways Conceptual Model Report (Booth and Herman, 1989)

Storage coefficient is estimated based on literature values for unconfined aquifer (typical range is 0.1 to 0.3)

cm/sec = centimeters per second
gpd = gallons per day

Table 5
Average Time Lag Values in Monitoring Wells
Capital Industries, Inc.
Seattle, Washington
Farallon PN: 457-004

Well Identification	Distance to Duwamish (feet)	Average Lag Time vs. Duwamish (hours:minutes:seconds)	
		July 24 to 27, 2010	August 1 to 4, 2010
CI-11-WT	680	1:51:19	1:44:58
CI-11-30	680	1:52:08	1:52:03
CI-11-60	680	2:10:30	2:08:25
CI-12-WT	530	2:26:58	2:05:36
CI-12-30	530	2:11:41	2:23:03
CI-12-60	530	2:21:25	2:24:08
CI-13-WT	190	1:16:19	1:10:25
CI-13-30	190	1:16:47	1:12:14
CI-13-60	190	1:15:25	1:11:30
CI-14-WT	550	3:06:56	2:11:14
CI-14-35	550	2:18:14	1:58:41
CI-14-70	550	2:12:19	2:16:52

NOTE:
Average time lag calculated using maximum and minimum tidal levels over 72-hour periods

Table 6
Summary of Hydraulic Conductivity Estimates Using Time Lag Method
Capital Industries, Inc.
Seattle, Washington
Farallon PN: 457-004

	Water Table Zone		Shallow Zone		Intermediate Zone	
	July 24 to 27 2010	August 1 to 4 2010	July 24 to 27 2010	August 1 to 4 2010	July 24 to 27 2010	August 1 to 4 2010
Tidal Period (hours)	12.4	12.4	12.4	12.4	12.4	12.4
Tidal Period (days)	0.5	0.5	0.5	0.5	0.5	0.5
Delta X (feet)	570	720	770	570	620	850
Delta t_1 (hours)	3	2	2	2	2	3
Delta t_1 (days)	0.13	0.08	0.08	0.08	0.08	0.13
Aquifer Thickness (feet)	150	150	150	150	150	150
Storage Coefficient = 0.1						
Hydraulic Conductivity (cm/sec)	1.96E-01	7.04E-01	8.05E-01	4.41E-01	5.22E-01	4.36E-01
Hydraulic Conductivity (feet/day)	**556**	**1,996**	**2,283**	**1,251**	**1,480**	**1,236**
Storage Coefficient = 0.01						
Hydraulic Conductivity (cm/sec)	1.96E-02	7.04E-02	8.05E-02	4.41E-02	5.22E-02	4.36E-02
Hydraulic Conductivity (feet/day)	**56**	**200**	**228**	**125**	**148**	**124**
Storage Coefficient = 0.001						
Hydraulic Conductivity (cm/sec)	1.96E-03	7.04E-03	8.05E-03	4.41E-03	5.22E-03	4.36E-03
Hydraulic Conductivity (feet/day)	**5.6**	**20**	**23**	**13**	**15**	**12**

NOTES:

Delta X and t_1 obtained by plotting average time lag vs. distance of observation wells from Duwamish for monitoring well clusters CI-12, CI-13 & CI-14

cm/sec = centimeters per second

Aquifer thickness based on information in Duwamish Basin Groundwater Pathways Conceptual Model Report (Booth and Herman, 1989)

Storage coefficient is based on literature values for unconfined aquifer to semi-confined aquifer

Table 7
Hydraulic Conductivity Estimates From Slug Testing
Capital Industries, Inc.
Seattle, Washington
Farallon PN: 457-004

Well Name	Aquifer Zone	Total Depth (feet bgs)	Screen Interval (feet bgs)	Screen Length (feet)	Depth to Filter Pack (feet)	Radius of Casing (feet)	Effective Porosity of Filter Pack	Static Depth to Water (feet)	Static Water Column Height (feet)	Saturated Aquifer Thickness (feet)	Initial Slug Test Displacement (H_0) (feet)	Rising/Falling Head Test	Partially Submerged Sandpack	Test Solution Method	Estimated K (cm/sec)	Estimated K (feet/day)
MW-8	Water Table	20	10 to 20	10	8	0.083	0.3	7.93	12.07	62.07	3.15	rising	yes	Bouwer-Rice	3.52E-02	99.8
CI-8-40	Shallow	40	30 to 40	10	28	0.083	0.3	7.68	32.32	62.32	1.77	falling	no	Springer-Gelhar	7.51E-02	213
CI-8-60	Intermediate	60	50 to 60	10	48	0.083	0.3	7.77	52.23	62.23	2.05	rising	no	Bouwer-Rice	3.56E-03	10.1
CI-9-WT	Water Table	20	10 to 20	10	8	0.083	0.3	7.89	12.11	62.11	1.53	rising	no	Springer-Gelhar	4.76E-02	135
	Water Table	20	10 to 20	10	8	0.083	0.3	7.89	12.11	62.11	3.12	falling	no	Springer-Gelhar	1.26E-01	357
CI-9-40	Shallow	40	30 to 40	10	28	0.083	0.3	7.86	32.14	62.14	1.76	rising	no	Bouwer-Rice	9.00E-03	25.5
CI-9-70	Intermediate	70	60 to 70	10	58	0.083	0.3	7.90	62.1	62.1	4.36	rising	no	Bouwer-Rice	3.60E-03	10.2
CI-10-WT	Water Table	20	10 to 20	10	8	0.083	0.3	8.50	11.5	61.5	4.34	rising	yes	Bouwer-Rice	3.40E-02	96.5
	Water Table	20	10 to 20	10	8	0.083	0.3	8.50	11.5	61.5	4.32	falling	no	Springer-Gelhar	3.27E-02	92.8
CI-10-35	Shallow	35	25 to 35	10	23	0.083	0.3	8.54	26.46	61.46	2.78	rising	no	Bouwer-Rice	1.38E-02	39.1
	Shallow	35	25 to 35	10	23	0.083	0.3	8.54	26.46	61.46	3.92	falling	no	Bouwer-Rice	2.54E-02	71.9
CI-10-65	Intermediate	65	50 to 65	15	48	0.083	0.3	8.60	56.4	61.4	9.82	rising	no	Bouwer-Rice	3.74E-03	10.6
	Intermediate	65	50 to 65	15	48	0.083	0.3	8.60	56.4	61.4	2.30	falling	no	Bouwer-Rice	3.32E-03	9.4
CI-14-WT	Water Table	20	10 to 20	10	8	0.083	0.3	8.46	11.54	61.54	3.54	rising	yes	Bouwer-Rice	1.44E-02	40.9
	Water Table	20	10 to 20	10	8	0.083	0.3	8.46	11.54	61.54	3.97	falling	no	Bouwer-Rice	1.88E-02	53.4
CI-14-35	Shallow	35	25 to 35	10	23	0.083	0.3	8.56	26.44	61.44	3.70	rising	no	Bouwer-Rice	4.04E-02	114.4
	Shallow	35	25 to 35	10	23	0.083	0.3	8.56	26.44	61.44	2.29	falling	no	Bouwer-Rice	2.77E-02	78.4
CI-14-70	Intermediate	70	60 to 70	10	58	0.083	0.3	8.70	61.3	61.3	6.55	rising	no	Bouwer-Rice	1.16E-03	3.3
	Intermediate	70	60 to 70	10	58	0.083	0.3	8.70	61.3	61.3	3.01	falling	no	Bouwer-Rice	1.02E-03	2.9

Mean Hydraulic Conductivity in Water Table Zone:	3.5E-02	99.1
Mean Hydraulic Conductivity in Shallow Zone:	2.5E-02	71.8
Mean Hydraulic Conductivity in Intermediate Zone:	2.4E-03	6.8

NOTES:

Saturated aquifer thickness based on assumed aquifer thickness of 70 feet

Mean hydraulic conductivity calculated using geometric mean

bgs = below ground surface (bgs)

cm/sec = centimeters per second

Intermediate Aquifer Zone = 40 to 70 feet bgs

K = hydraulic connectivity

Shallow Aquifer Zone = 20 to 40 feet bgs

Water Table Aquifer Zone = approximately 10 to 20 feet bgs

ATTACHMENT A
MANUFACTURER SPECIFICATIONS FOR DATA LOGGING INSTRUMENTS

TIDAL STUDY AND
AQUIFER CHARACTERIZATION RESULTS
Capital Industries
5801 Third Avenue South
Seattle, Washington

Farallon PN: 457-004

In-Situ Inc.

Innovations in
Water Monitoring

Level **TROLL**® Instruments

Water Level Instruments for Every Application & Budget

*Level **TROLL**® 700 Instrument*

- Designed for aquifer characterization
- Vented (gauged) and non-vented (absolute) instruments
- Linear, fast linear, linear average, event, step linear, and true logarithmic logging modes
- Titanium construction for all applications (0.72” OD)

*Level **TROLL**® 500 Instrument*

- Designed for groundwater and surface-water monitoring
- Vented or non-vented instrument
- Linear, fast linear, and event logging modes
- Titanium body ideal for harsh environments (0.72” OD)

*Level **TROLL**® 300 Instrument*

- Designed for fresh water and industrial monitoring
- Non-vented instrument
- Linear, fast linear, and event logging modes
- Stainless steel construction (0.82” OD)

Powerful, Accurate, Reliable Performance

- **Low-power consumption** – Extend deployments and get the only industry guarantee for battery life — minimum of 5 years or 2 million readings. External power or battery packs can be used.
- **Telemetry and SCADA integration** – Access data when you need it. No adapters or confusing proprietary protocols required — fully compliant Modbus/RS485, SDI-12, and 4-20 mA.
- **Superior accuracy** – Get guaranteed accuracy under all operating conditions — instruments undergo extensive calibration procedures for pressure and temperature. Each instrument includes a serialized calibration report.
- **Intuitive interface** – Simplify data collection and management with Win-Situ® 5 and Win-Situ® Mobile software. Software features setup wizards, fast data download rates, multiple water level reference options, and more.

Applications

- Aquifer characterization
- Coastal deployments — tide/harbor levels, storm surge systems, and wetlands research
- Construction and mine dewatering
- River, lake, and reservoir monitoring
- Stormwater management

Level **TROLL**® 300, 500 & 700 Instruments

General	***Level TROLL 300***	***Level TROLL 500***	***Level TROLL 700***	***BaroTROLL***
Temperature ranges	Operational: -4-176° F (-20-80° C) Storage: -40-176° F (-40-80° C) Calibrated: 23-122° F (-5-50° C)	Operational: -4-176° F (-20-80° C) Storage: -40-176° F (-40-80° C) Calibrated: 23-122° F (-5-50° C)	Operational: -4-176° F (-20-80° C) Storage: -40-176° F (-40-80° C) Calibrated: 23-122° F (-5-50° C)	Operational: -4-176° F (-20-80° C) Storage: -40-176° F (-40-80° C) Calibrated: 23-122° F (-5-50° C)
Diameter	0.82 in (2.08 cm)	0.72 in (1.83 cm)	0.72 in (1.83 cm)	0.72 in (1.83 cm)
Length	9.0 in (22.9 cm)	8.5 in (21.6 cm)	8.5 in (21.6 cm)	8.5 in (21.6 cm)
Weight	0.54 lb (245 g)	0.43 lb (197 g)	0.43 lb (197 g)	0.43 lb (197 g)
Materials	Stainless steel body; Delrin® nose cone	Titanium body; Delrin nose cone	Titanium body; Delrin nose cone	Titanium body; Delrin nose cone
Output options	Modbus/RS485, SDI-12, 4-20 mA	Modbus/RS485, SDI-12, 4-20 mA	Modbus/RS485, SDI-12, 4-20 mA	Modbus/RS485, SDI-12, 4-20 mA
Battery type & life	3.6V lithium; 5 years or 2M readings[1]	3.6V lithium; 5 years or 2M readings[1]	3.6V lithium; 5 years or 2M readings[1]	3.6V lithium; 5 years or 2M readings[1]
External power	8-36 VDC	8-36 VDC	8-36 VDC	8-36 VDC
Measurement current	4 mA	4 mA	4 mA	4 mA
Sleep current	180 µA	180 µA	180 µA	180 µA
Memory	1.0 MB	2.0 MB	4.0 MB	1.0 MB
Data records[2]	65,000	130,000	260,000	65,000
Data logs	2	50	50	2
Fastest logging rate & Modbus rate	2 per second	2 per second	4 per second	1 per minute
Fastest SDI-12 & 4-20 mA output rate	1 per second	1 per second	1 per second	1 per second
Log types	Linear, Fast Linear, and Event	Linear, Fast Linear, and Event	Linear, Fast Linear, Linear Average, Event, Step Linear, True Logarithmic	Linear
Real-time clock	Accurate to 1 second/24-hr period	Accurate to 1 second/24-hr period	Accurate to 1 second/24-hr period	Accurate to 1 second/24-hr period
Sensor Type/Material	Piezoresistive; stainless steel	Piezoresistive; titanium	Piezoresistive; titanium	Piezoresistive; titanium
Range	*Non-vented* 30 psia: 35.8 ft (10.9 m) 100 psia: 197.3 ft (60.1 m) 300 psia: 658.7 ft (200.7 m)	*Non-vented* 30 psia: 35.8 ft (10.9 m) 100 psia: 197.3 ft (60.1 m) 300 psia: 658.7 ft (200.7 m) 500 psia: 1120 ft (341.3 m) *Vented* 5 psig: 11.5 ft (3.5 m) 15 psig: 35 ft (11 m) 30 psig: 69 ft (21 m) 100 psig: 231 ft (70 m) 300 psig: 692 ft (211 m) 500 psig: 1153 ft (351 m)	*Non-vented* 30 psia: 35.8 ft (10.9 m) 100 psia: 197.3 ft (60.1 m) 300 psia: 658.7 ft (200.7 m) 500 psia: 1120 ft (341.3 m) 1000 psia: 2306.4 ft (703 m) *Vented* 5 psig: 11.5 ft (3.5 m) 15 psig: 35 ft (11 m) 30 psig: 69 ft (21 m) 100 psig: 231 ft (70 m) 300 psig: 692 ft (211 m) 500 psig: 1153 ft (351 m)	0 to 16.5 psi; 0 to 1.14 bar
Burst pressure	Maximum 2x range; burst 3x range	Maximum 2x range; burst 3x range	Maximum 2x range; burst 3x range	Vaccum/over-pressure above 16.5 psi damages sensor
Accuracy @ 15° C	±0.1% full scale (FS)	±0.05% FS	±0.05% FS	±0.1% FS
Accuracy (FS)	±0.2% FS[3]	±0.1% FS[3]	±0.1% FS[3]	±0.2% FS[3]
Resolution	±0.01% FS or better	±0.005% FS or better	±0.005% FS or better	±0.005% FS or better
Units of measure	Pressure: psi, kPa, bar, mbar, mmHg, inHg, cmH$_2$O, inH$_2$O Level: in, ft, mm, cm, m	Pressure: psi, kPa, bar, mbar, mmHg, inHg, cmH$_2$O, inH$_2$O Level: in, ft, mm, cm, m	Pressure: psi, kPa, bar, mbar, mmHg, inHg, cmH$_2$O, inH$_2$O Level: in, ft, mm, cm, m	Pressure: psi, kPa, bar, mbar, mmHg, inHg, cmH$_2$O, inH$_2$O
Temperature Sensor	Silicon	Silicon	Silicon	Silicon
Range	Calibrated: 23-122° F (-5-50° C)	Calibrated: 23-122° F (-5-50° C)	Calibrated: 23-122° F (-5-50° C)	Calibrated: 23-122° F (-5-50° C)
Accuracy & resolution	±0.1° C; 0.01° C or better	±0.1° C; 0.01° C or better	±0.1° C; 0.01° C or better	±0.1° C; 0.01° C or better
Units of measure	Fahrenheit, Celsius	Fahrenheit, Celsius	Fahrenheit, Celsius	Fahrenheit, Celsius
Warranty	Level TROLL and BaroTROLL instruments come with a 1-year warranty. Up to 5-year extended warranties are available.			

*Baro**TROLL**® Instrument*

The titanium BaroTROLL instrument measures and logs barometric pressure and temperature. Use the BaroTROLL in conjunction with Level TROLL instruments.

Win-Situ Baro Merge™ software simplifies post-correction of water level data. Barometric readings are automatically subtracted from data collected by a Level TROLL to compensate for changes in water level due to barometric fluctuations.

24/7 Support

In-Situ technical experts assist with instrument setup, application support, and troubleshooting. Fast, friendly, and always free, technical answers are a phone call away.

---

[1] Battery life guaranteed when used within the factory-calibrated temperature range.

[2] 1 record = date/time plus 2 parameters logged (no wrapping) from device within the factory-calibrated temperature range.

[3] Across factory-calibrated temperature range.

Specifications are subject to change without notice. Delrin is a registered trademark of E.I. du Pont de Nemours and Company.

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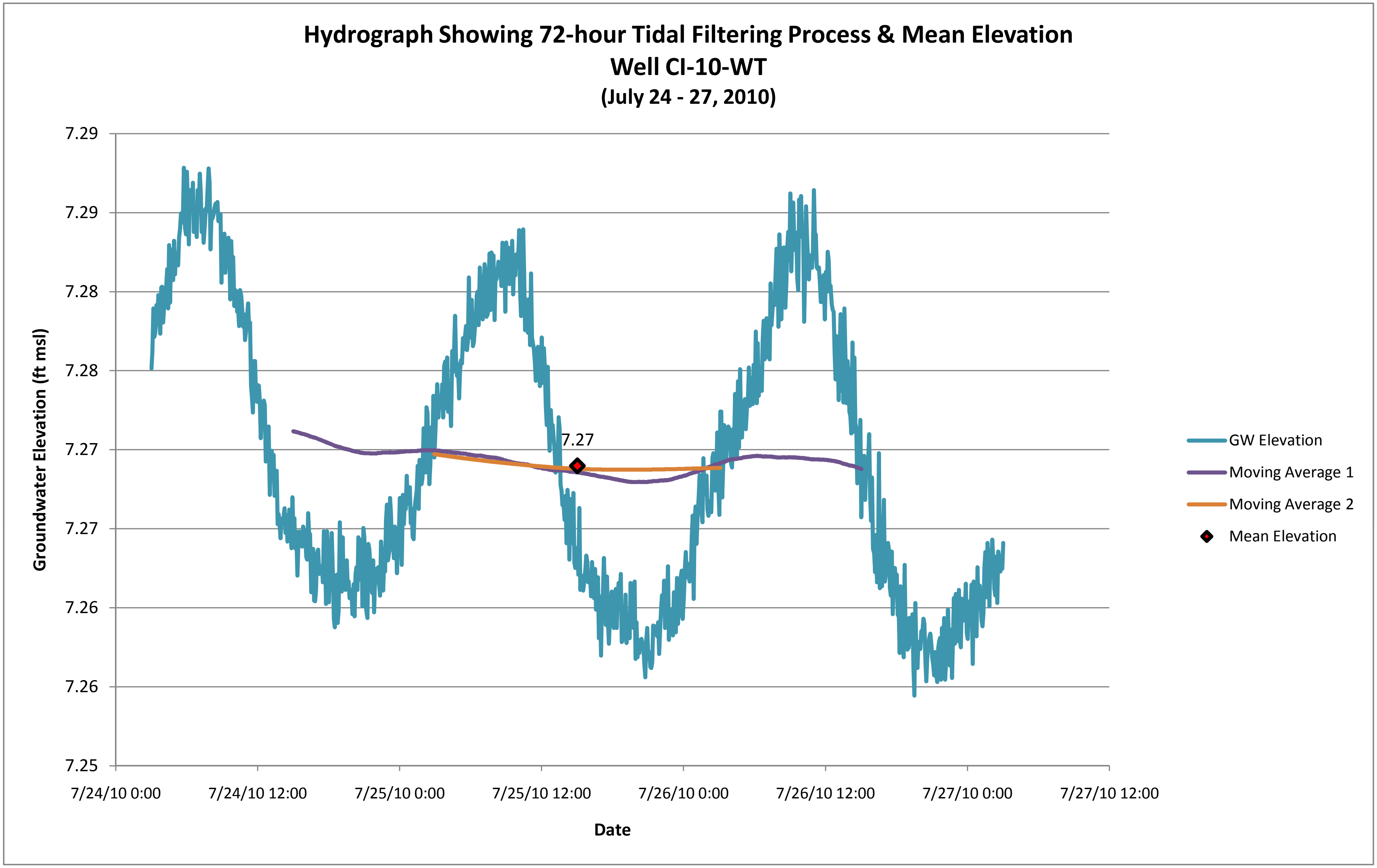
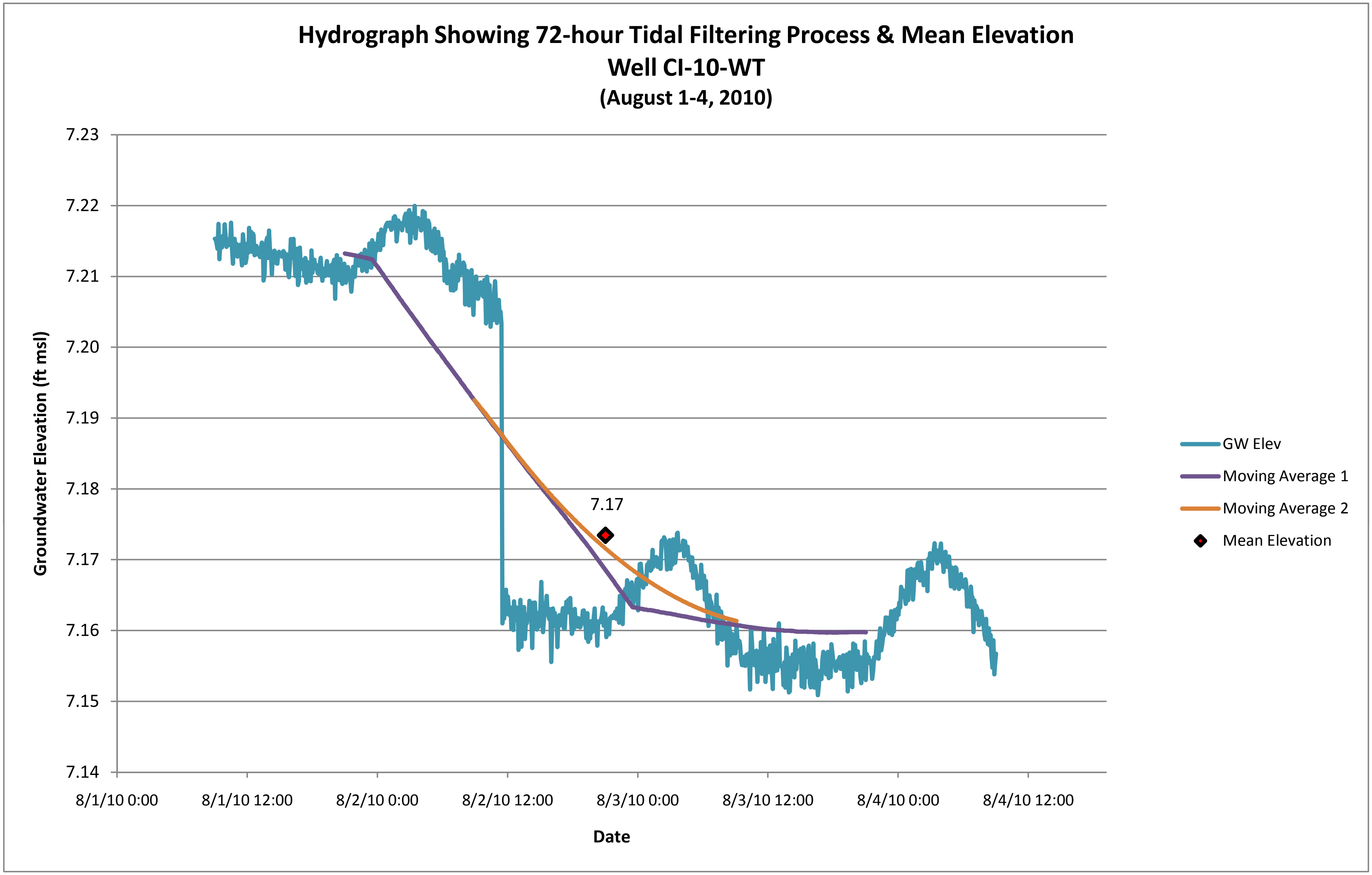
ATTACHMENT B
GRAPHS SHOWING GROUNDWATER ELEVATION FLUCTUATIONS AND TIDAL FILTERING PROCESS

TIDAL STUDY AND
AQUIFER CHARACTERIZATION RESULTS
Capital Industries
5801 Third Avenue South
Seattle, Washington

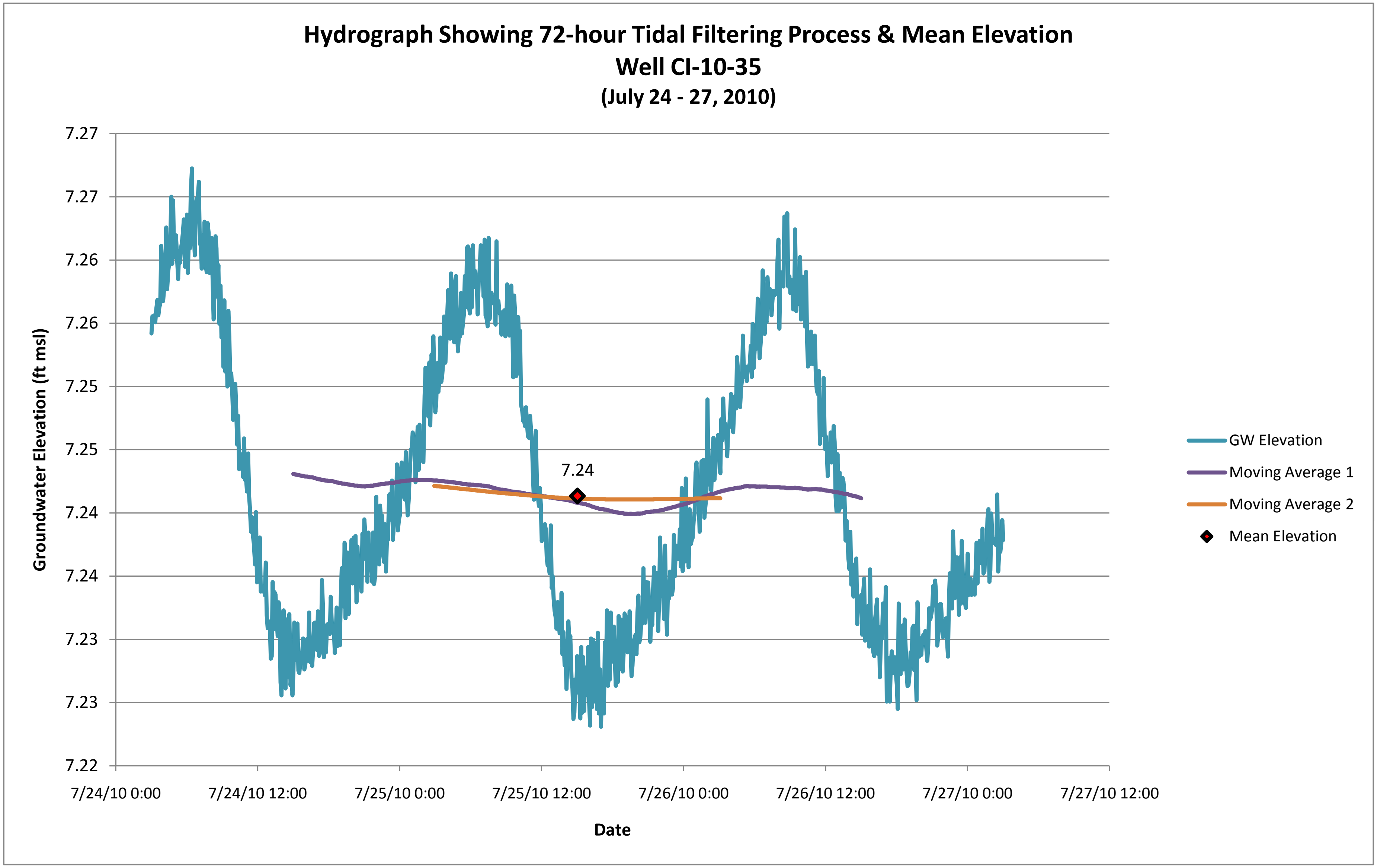
Farallon PN: 457-004



Hydrograph Showing 72-hour Tidal Filtering Process & Mean Elevation
Well CI-10-WT
(July 24 - 27, 2010)

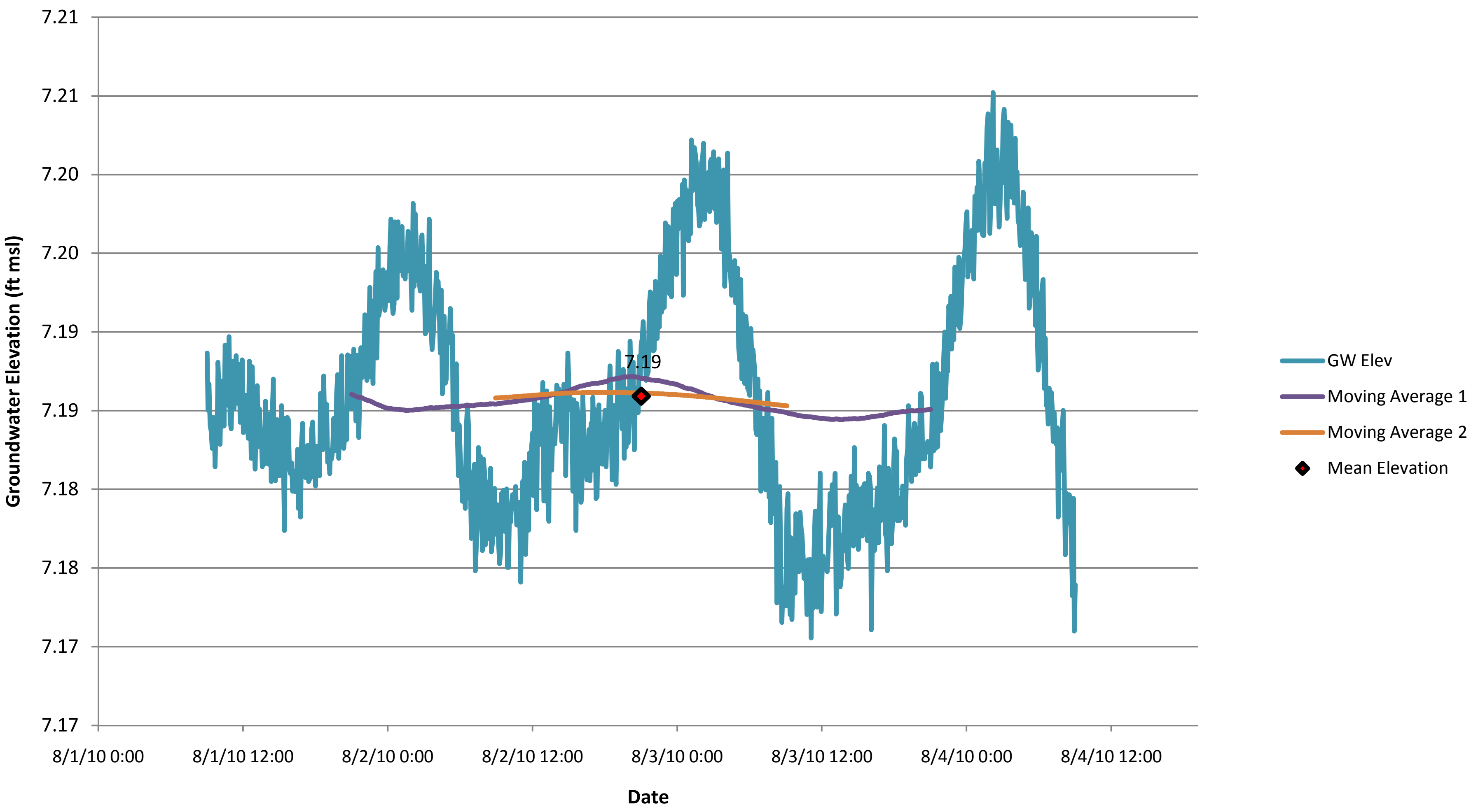


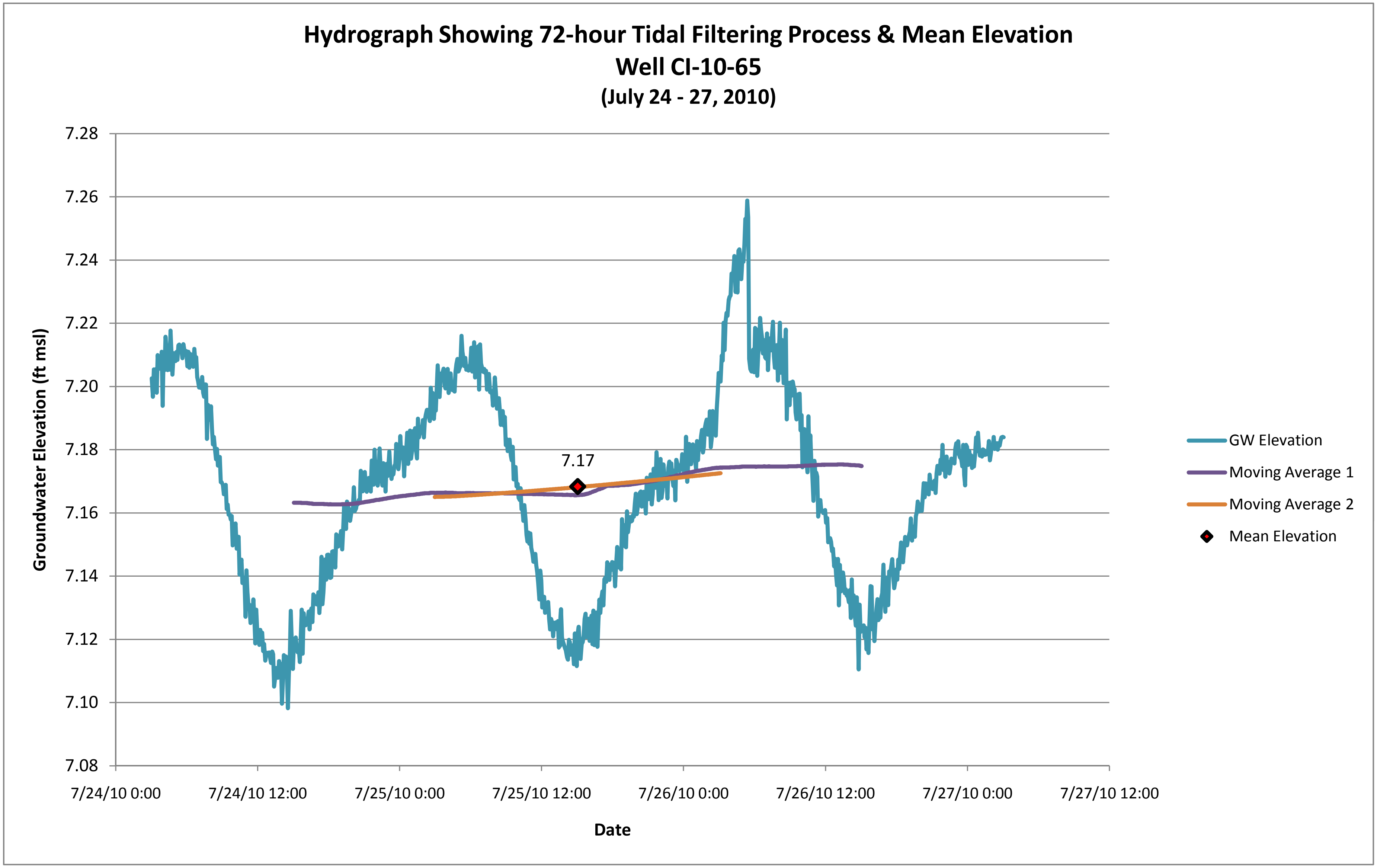
Hydrograph Showing 72-hour Tidal Filtering Process & Mean Elevation
Well CI-10-WT
(August 1-4, 2010)



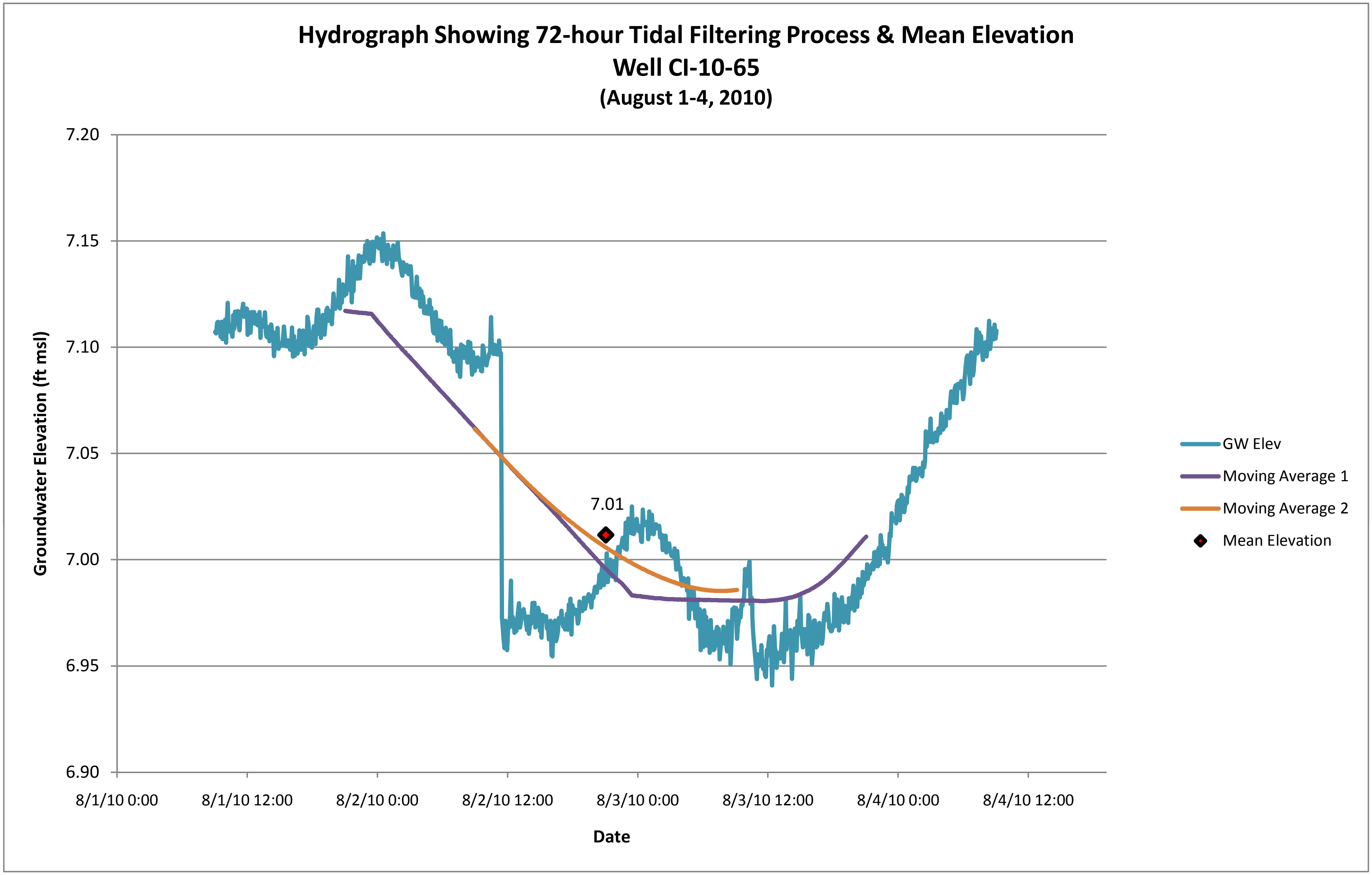
Hydrograph Showing 72-hour Tidal Filtering Process & Mean Elevation
Well CI-10-35
(July 24 - 27, 2010)

Hydrograph Showing 72-hour Tidal Filtering Process & Mean Elevation
Well CI-10-35
(August 1-4, 2010)



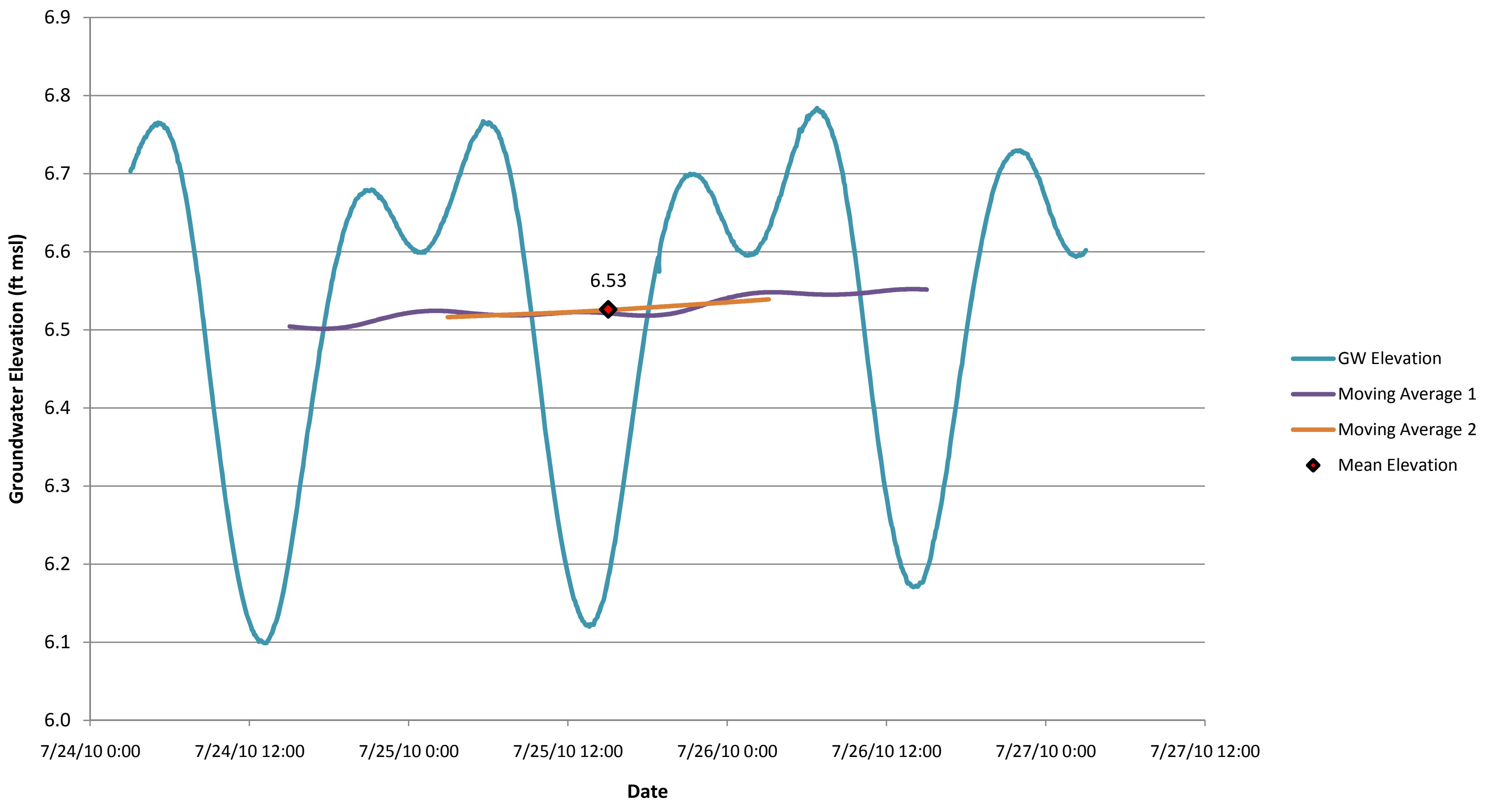


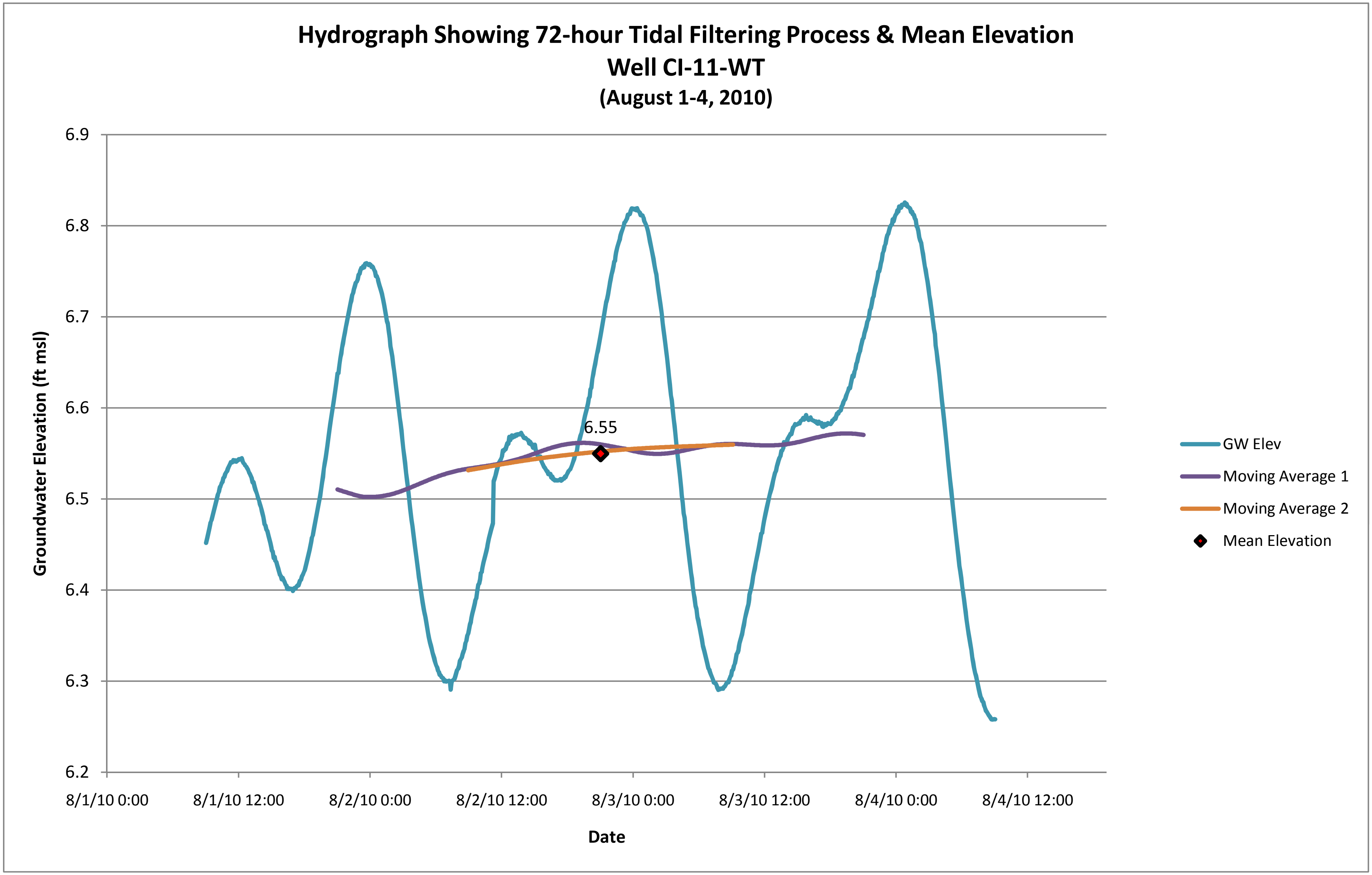
Hydrograph Showing 72-hour Tidal Filtering Process & Mean Elevation
Well CI-10-65
(July 24 - 27, 2010)



Hydrograph Showing 72-hour Tidal Filtering Process & Mean Elevation
Well CI-10-65
(August 1-4, 2010)
7.20
7.15
7.10
7.05
7.00
6.95
6.90
Groundwater Elevation (ft msl)
8/1/10 0:00
8/1/10 12:00
8/2/10 0:00
8/2/10 12:00
8/3/10 0:00
8/3/10 12:00
8/4/10 0:00
8/4/10 12:00
Date
7.01
GW Elev
Moving Average 1
Moving Average 2
Mean Elevation

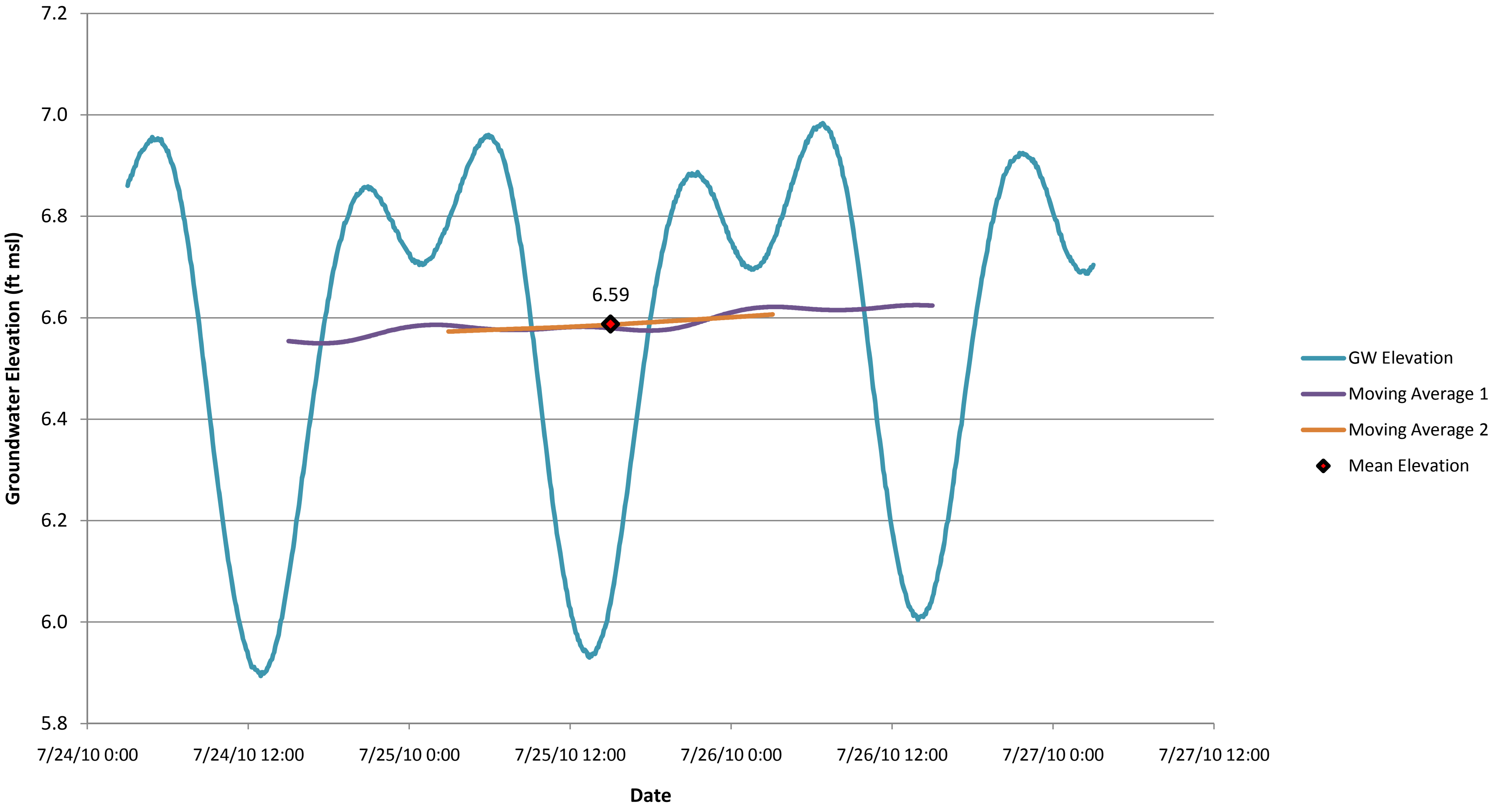
Hydrograph Showing 72-hour Tidal Filtering Process & Mean Elevation
Well CI-11-WT
(July 24 - 27, 2010)

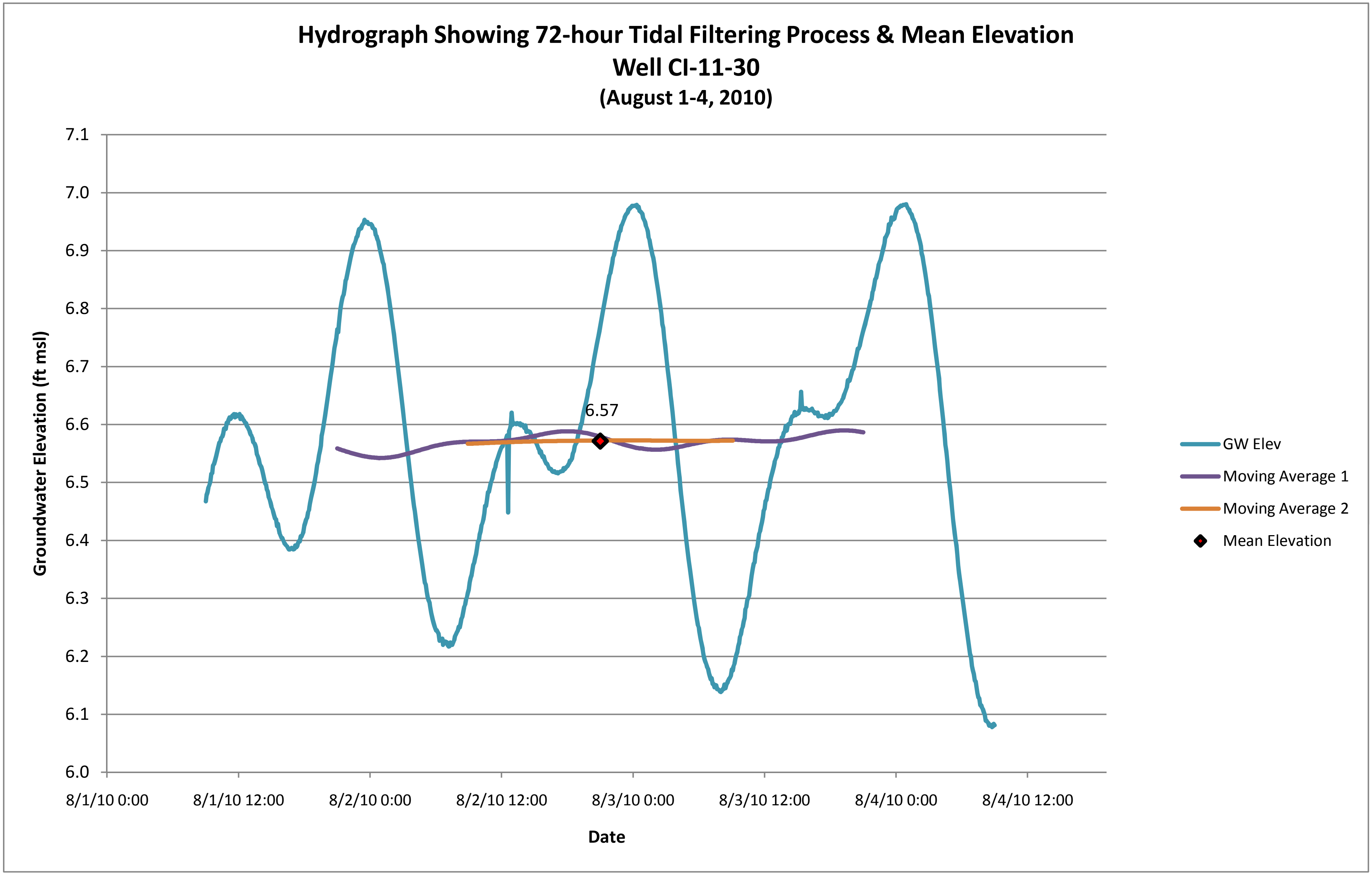




Hydrograph Showing 72-hour Tidal Filtering Process & Mean Elevation
Well CI-11-WT
(August 1-4, 2010)

Hydrograph Showing 72-hour Tidal Filtering Process & Mean Elevation
Well CI-11-30
(July 24 - 27, 2010)




Hydrograph Showing 72-hour Tidal Filtering Process & Mean Elevation
Well CI-11-30
(August 1-4, 2010)
Groundwater Elevation (ft msl)
7.1
7.0
6.9
6.8
6.7
6.6
6.5
6.4
6.3
6.2
6.1
6.0
6.57
8/1/10 0:00
8/1/10 12:00
8/2/10 0:00
8/2/10 12:00
8/3/10 0:00
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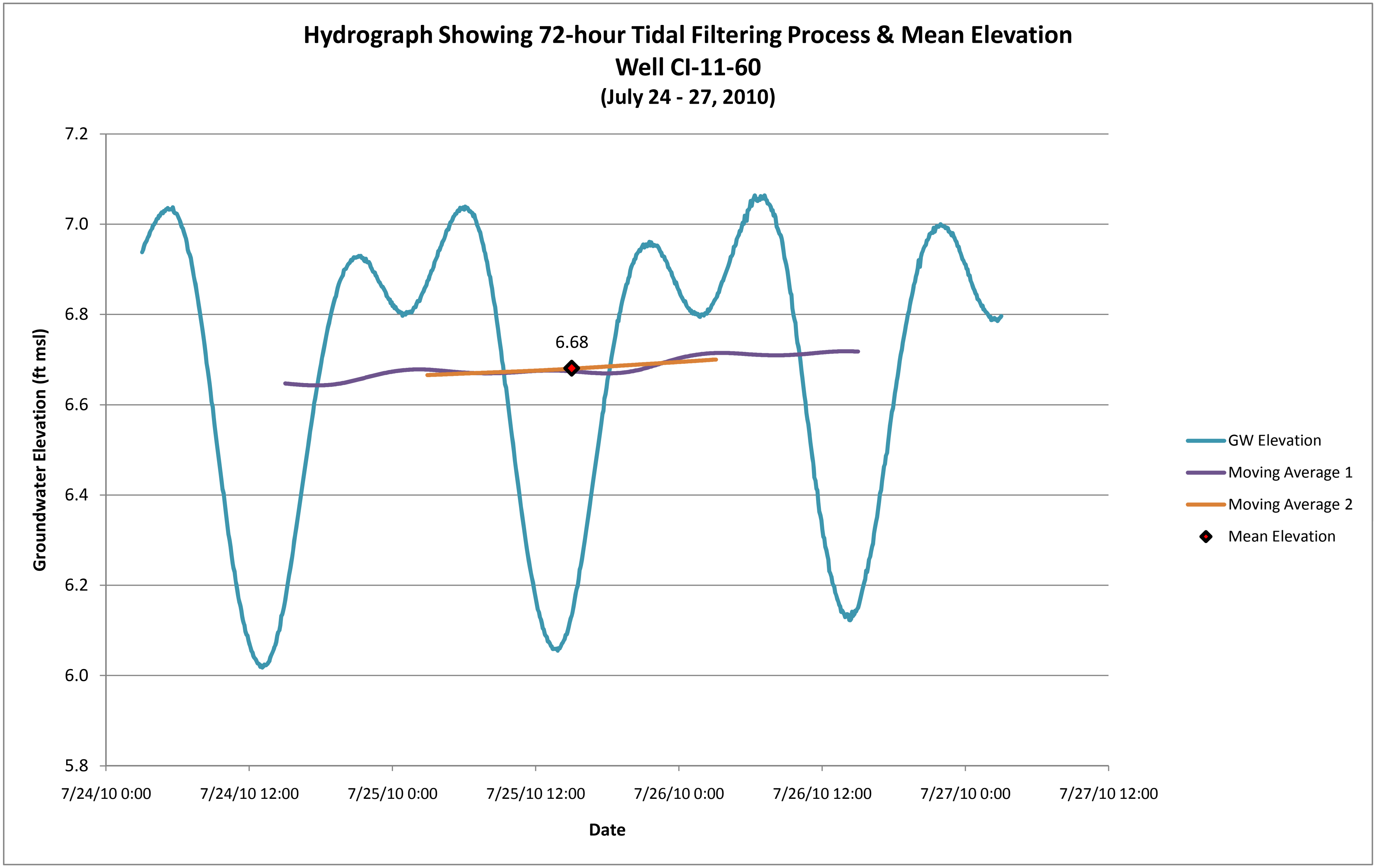
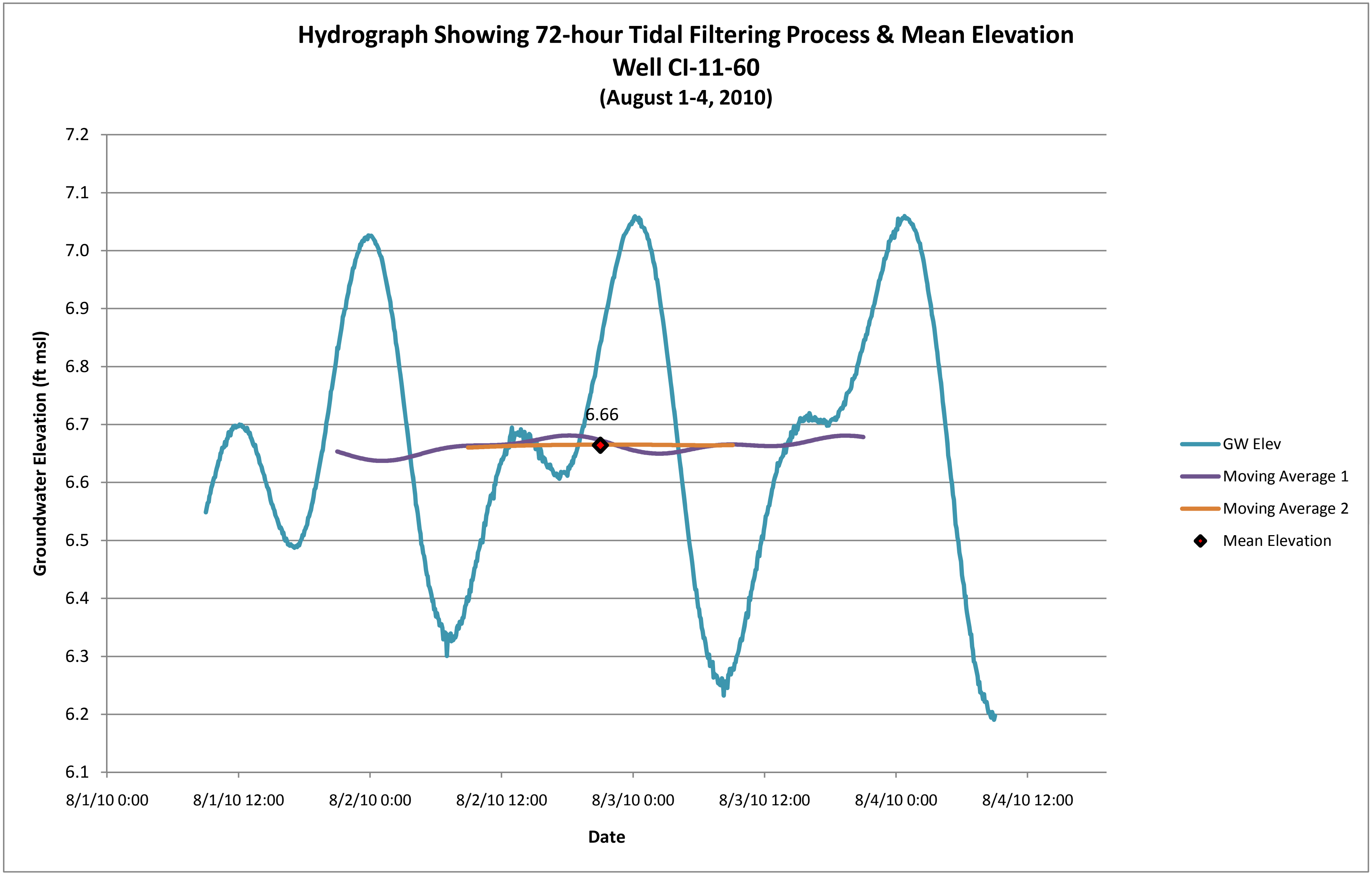
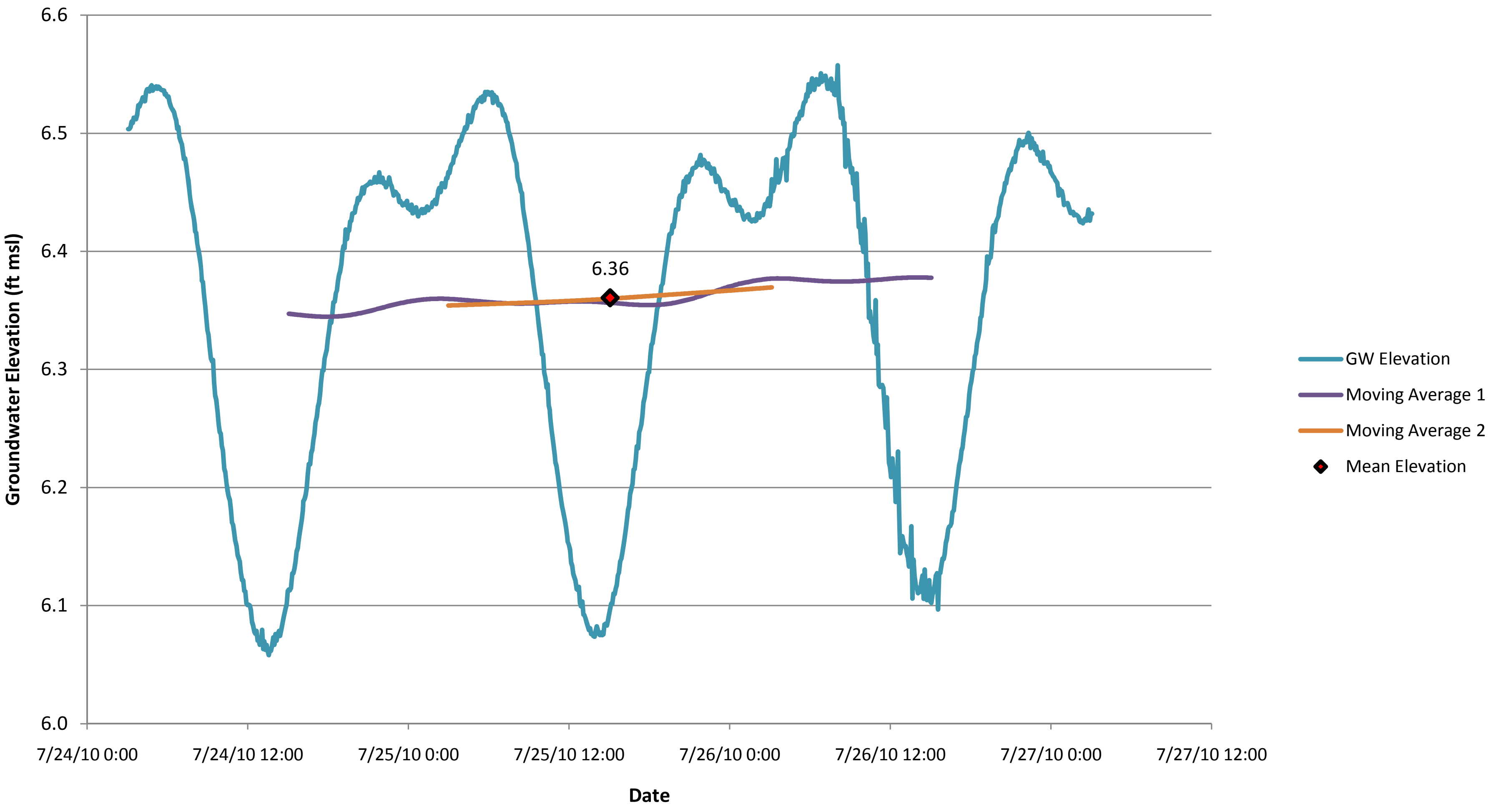
8/4/10 0:00
8/4/10 12:00
Date
GW Elev
Moving Average 1
Moving Average 2
Mean Elevation

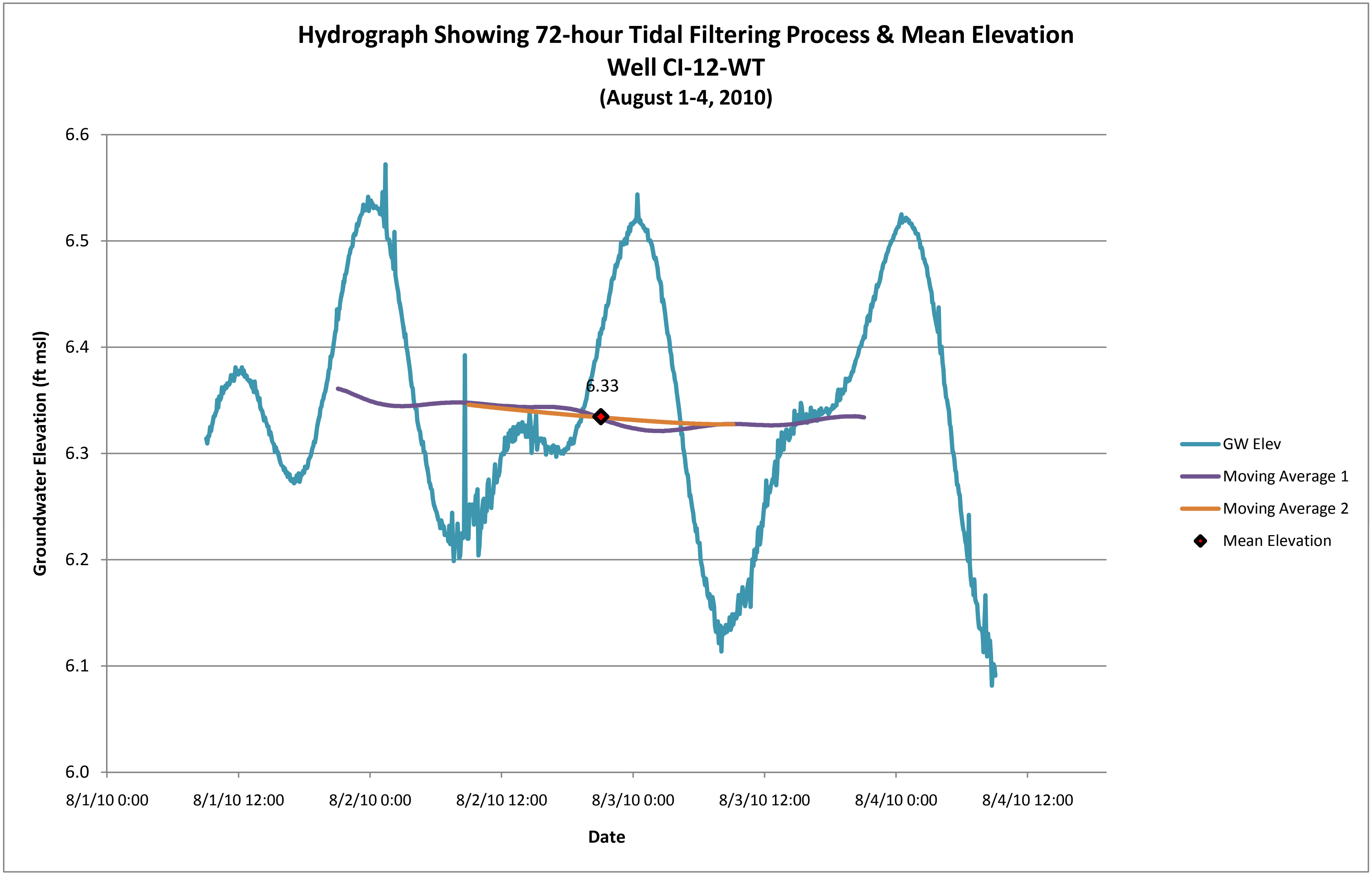


Hydrograph Showing 72-hour Tidal Filtering Process & Mean Elevation
Well CI-11-60
(July 24 - 27, 2010)


Hydrograph Showing 72-hour Tidal Filtering Process & Mean Elevation
Well CI-11-60
(August 1-4, 2010)
Groundwater Elevation (ft msl)
7.2
7.1
7.0
6.9
6.8
6.7
6.6
6.5
6.4
6.3
6.2
6.1
6.66
8/1/10 0:00
8/1/10 12:00
8/2/10 0:00
8/2/10 12:00
8/3/10 0:00
8/3/10 12:00
8/4/10 0:00
8/4/10 12:00
Date
GW Elev
Moving Average 1
Moving Average 2
Mean Elevation

Hydrograph Showing 72-hour Tidal Filtering Process & Mean Elevation
Well CI-12-WT
(July 24 - 27, 2010)




Hydrograph Showing 72-hour Tidal Filtering Process & Mean Elevation
Well CI-12-WT
(August 1-4, 2010)
6.6
6.5
6.4
6.3
6.2
6.1
6.0
Groundwater Elevation (ft msl)
6.33
8/1/10 0:00
8/1/10 12:00
8/2/10 0:00
8/2/10 12:00
8/3/10 0:00
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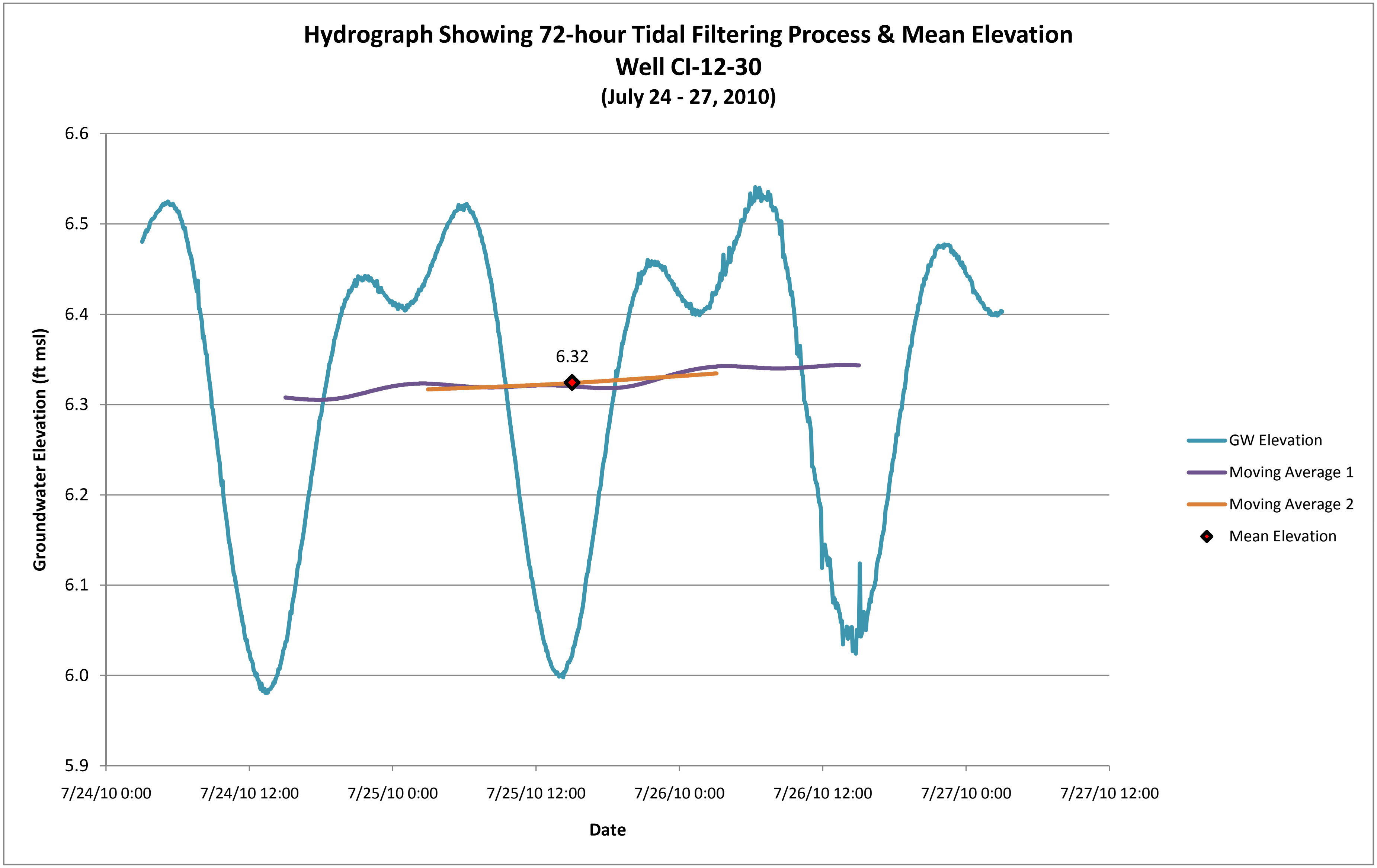
8/4/10 12:00
Date
GW Elev
Moving Average 1
Moving Average 2
Mean Elevation


Hydrograph Showing 72-hour Tidal Filtering Process & Mean Elevation
Well CI-12-30
(July 24 - 27, 2010)
Groundwater Elevation (ft msl)
6.6
6.5
6.4
6.3
6.2
6.1
6.0
5.9
6.32
7/24/10 0:00
7/24/10 12:00
7/25/10 0:00
7/25/10 12:00
7/26/10 0:00
7/26/10 12:00
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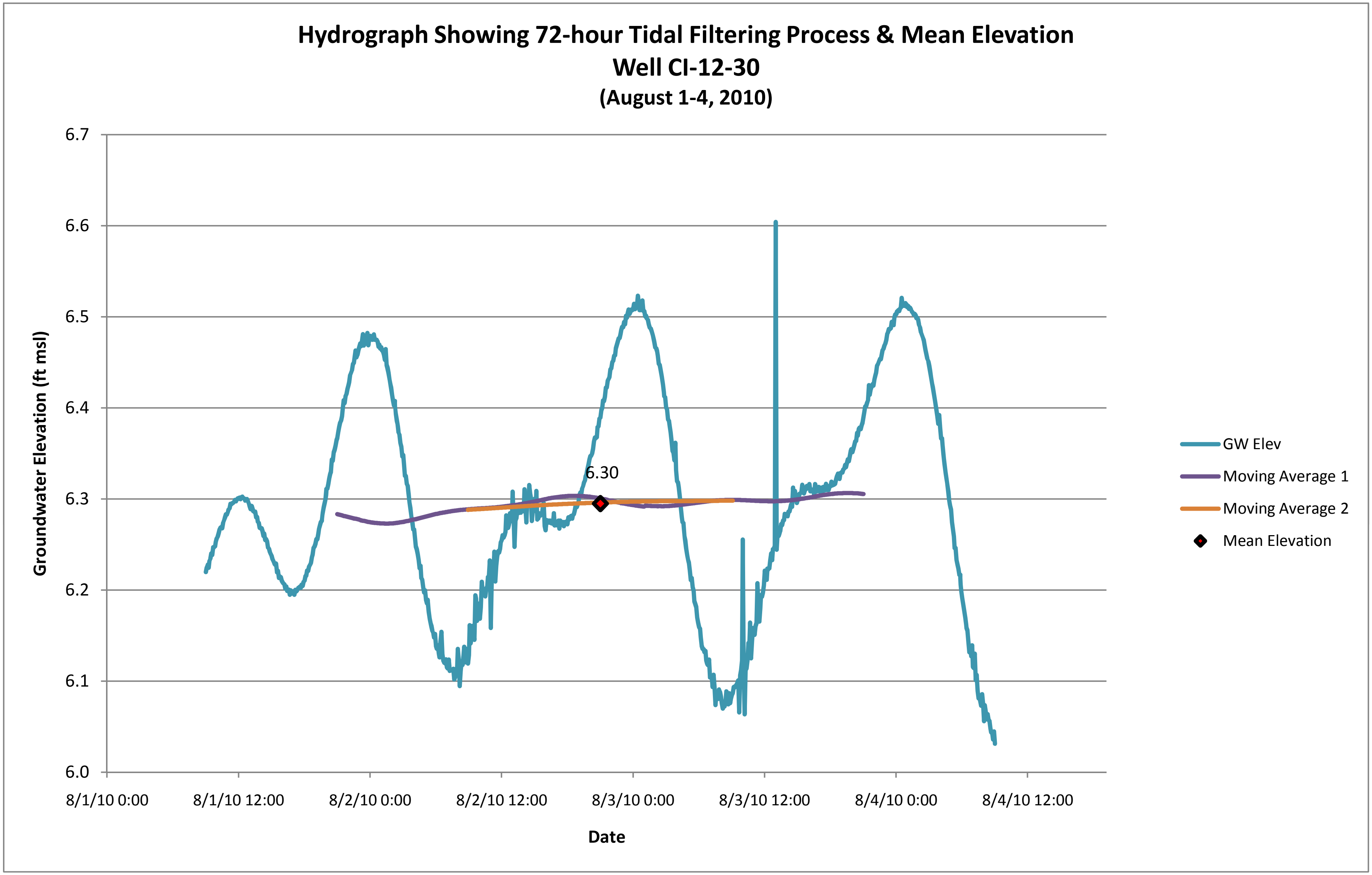
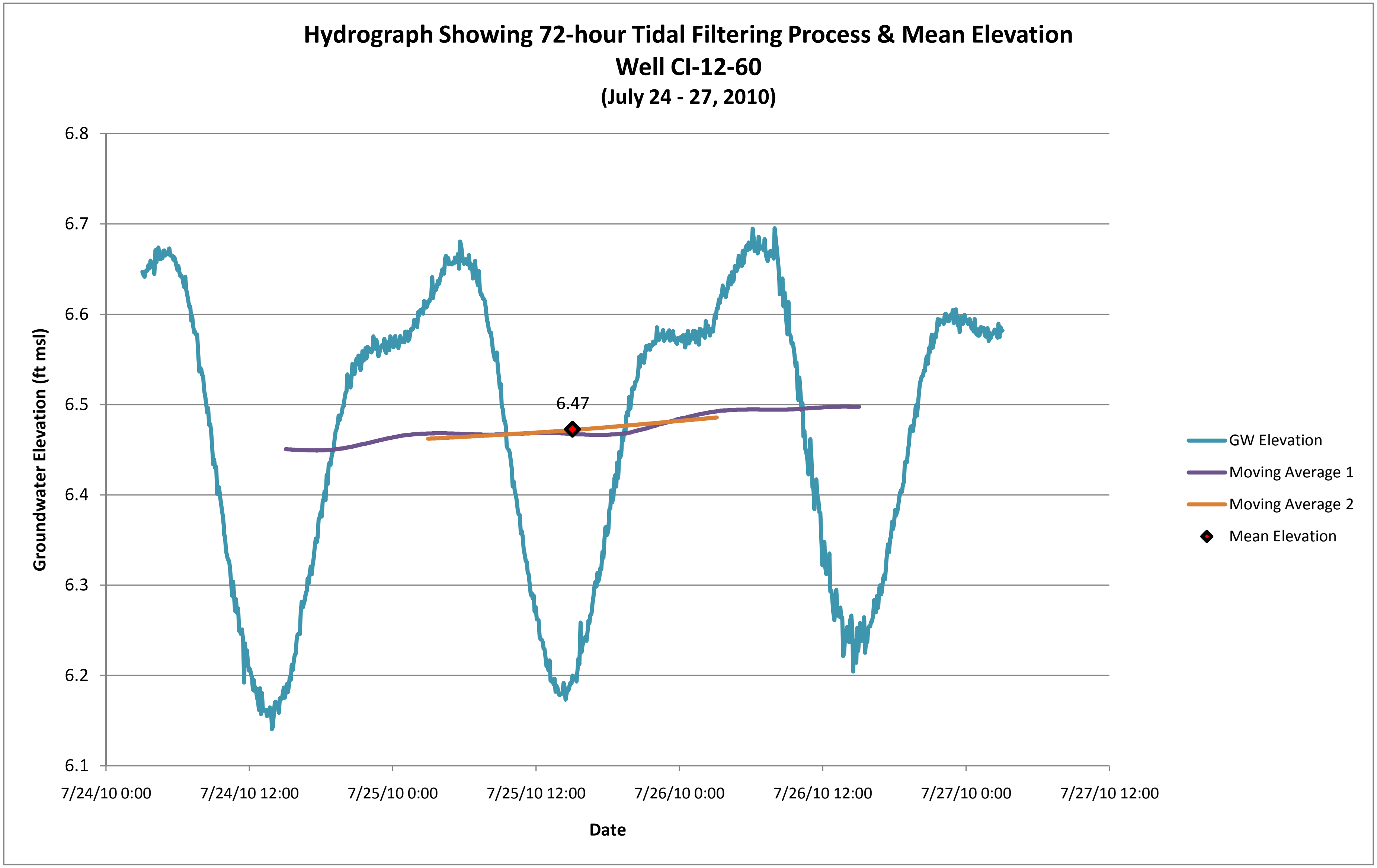
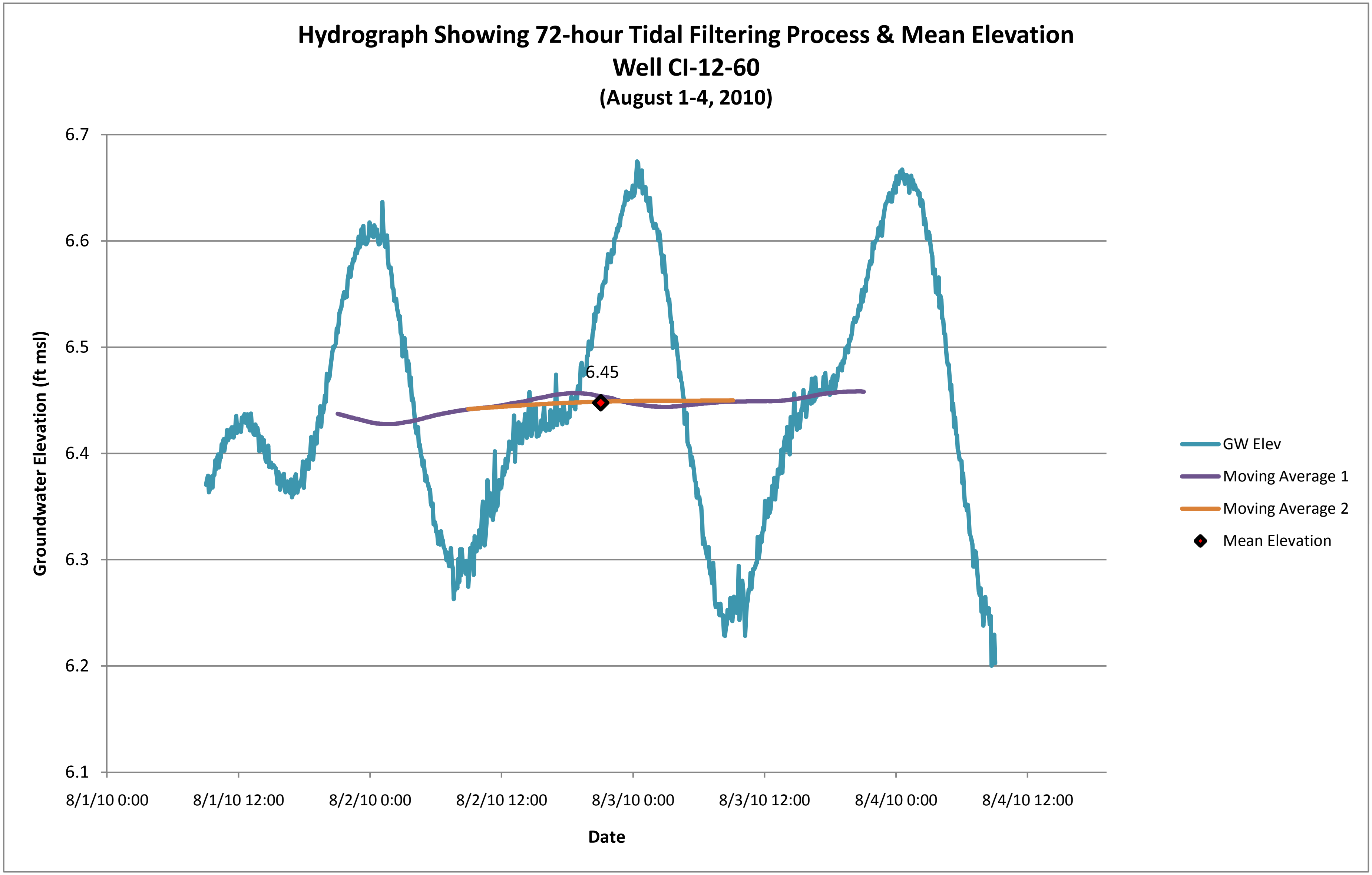
7/27/10 12:00
Date
GW Elevation
Moving Average 1
Moving Average 2
Mean Elevation

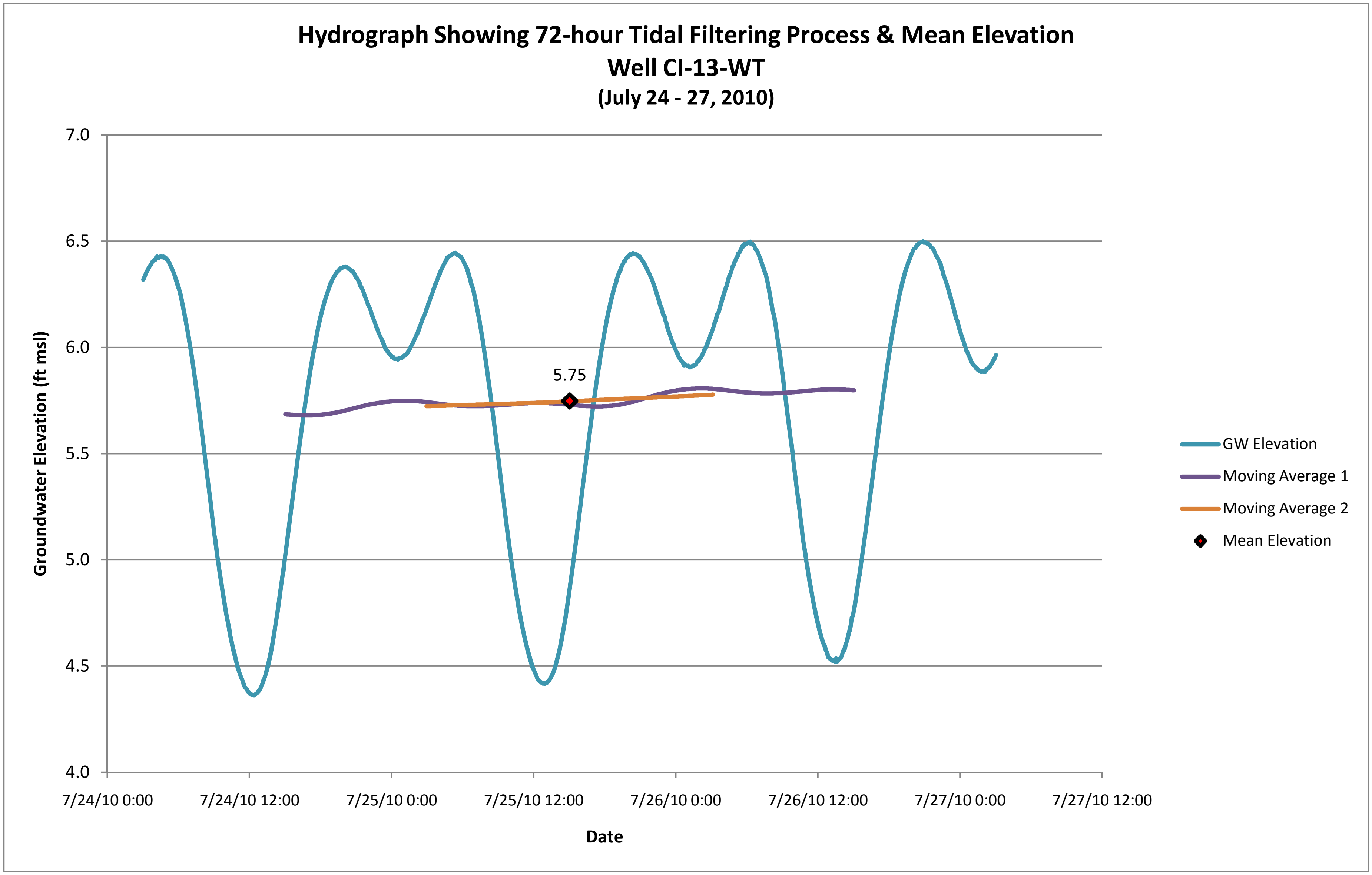


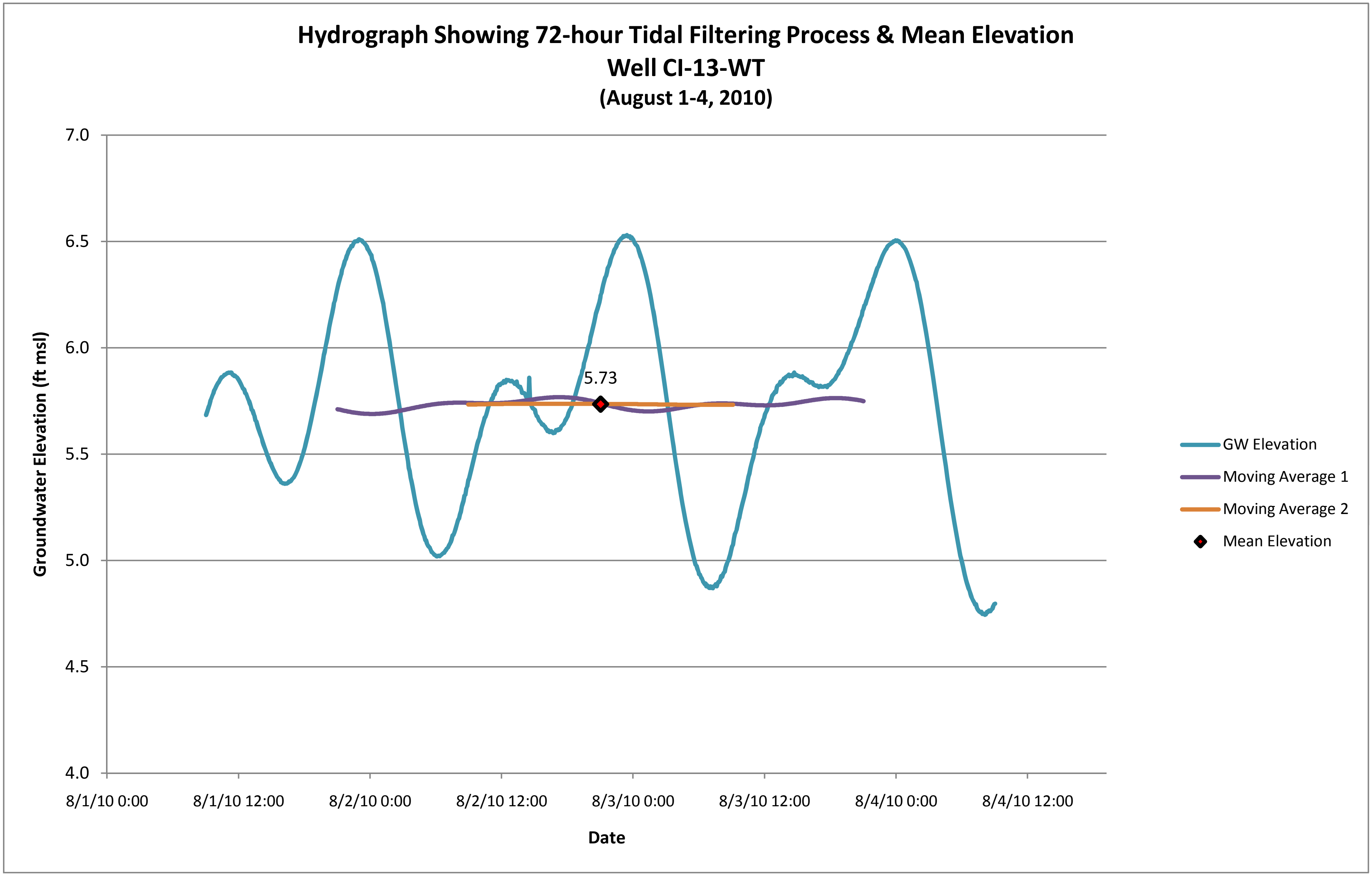


Hydrograph Showing 72-hour Tidal Filtering Process & Mean Elevation
Well CI-12-60
(July 24 - 27, 2010)

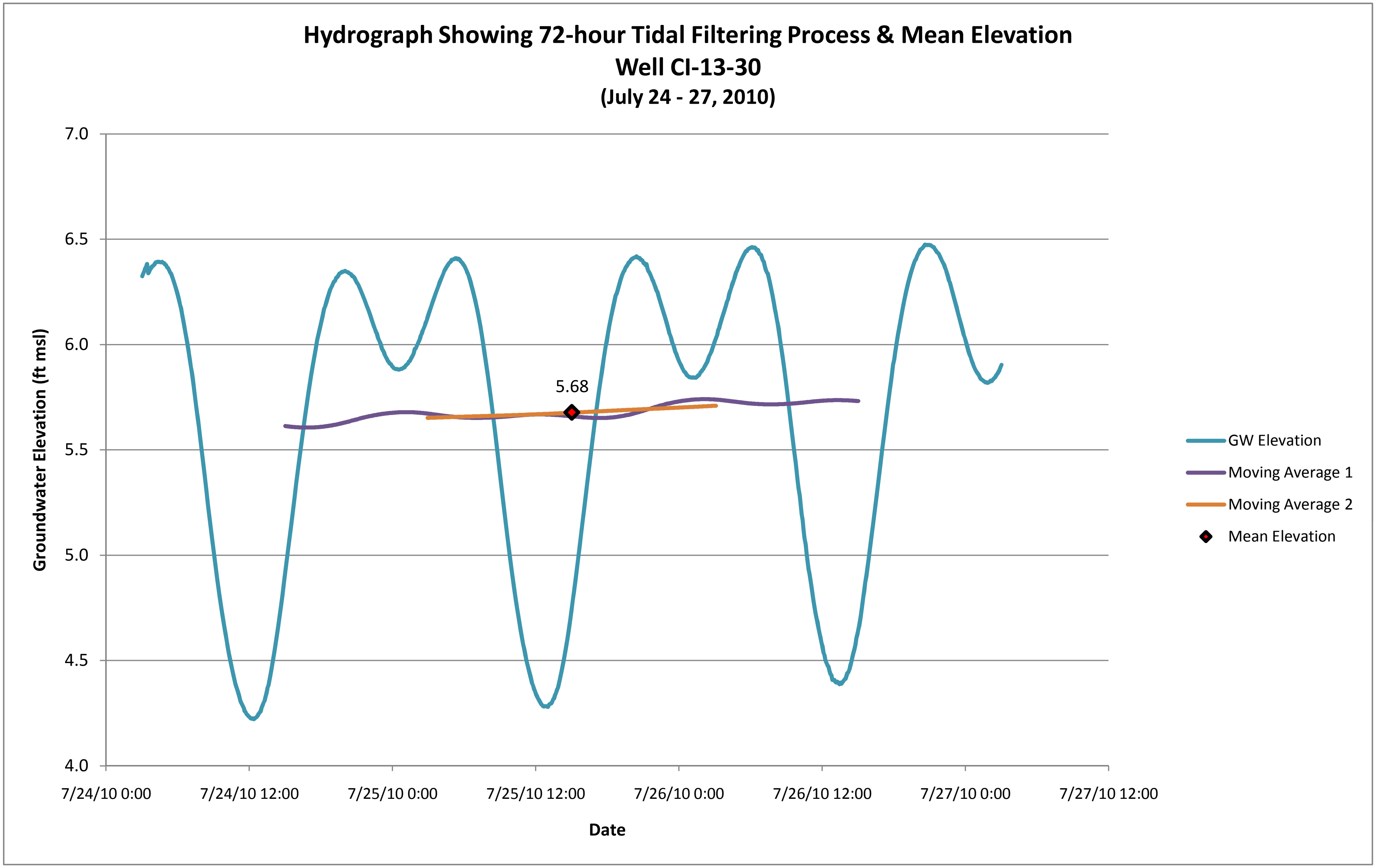


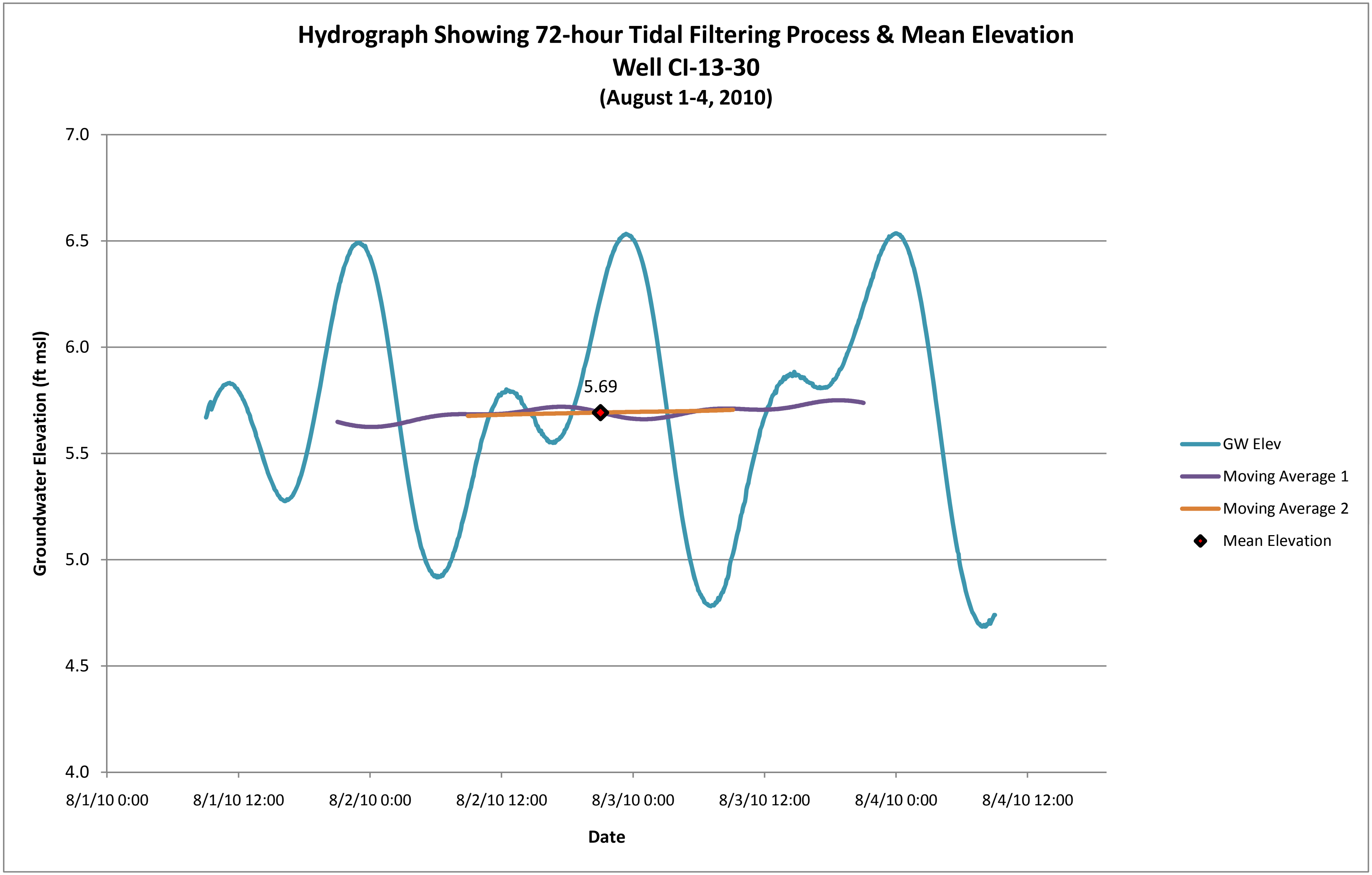
Hydrograph Showing 72-hour Tidal Filtering Process & Mean Elevation
Well CI-12-60
(August 1-4, 2010)

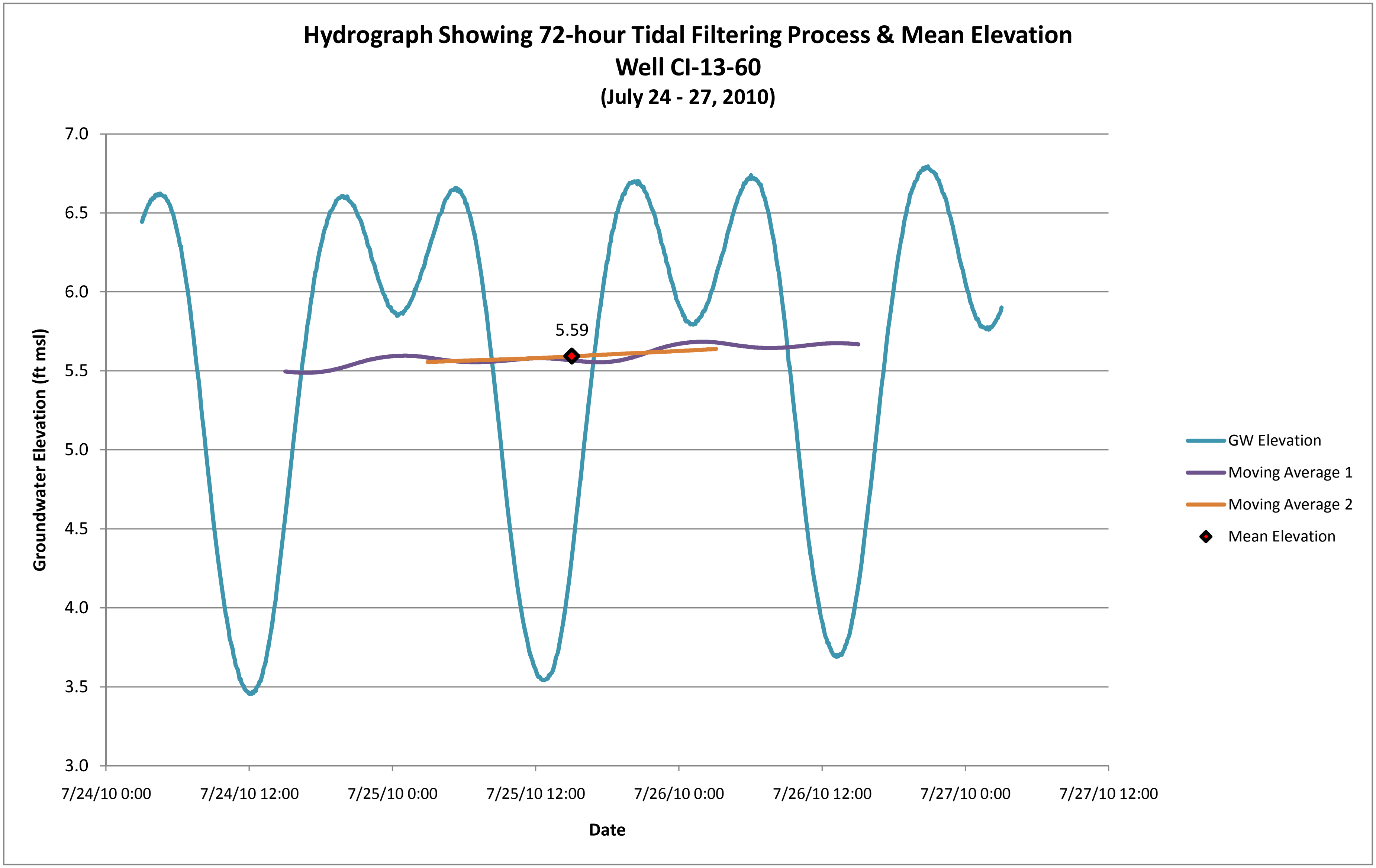

Hydrograph Showing 72-hour Tidal Filtering Process & Mean Elevation
Well CI-13-WT
(July 24 - 27, 2010)
7.0
6.5
6.0
5.5
5.0
4.5
4.0
Groundwater Elevation (ft msl)
5.75
7/24/10 0:00
7/24/10 12:00
7/25/10 0:00
7/25/10 12:00
7/26/10 0:00
7/26/10 12:00
7/27/10 0:00
7/27/10 12:00
Date
GW Elevation
Moving Average 1
Moving Average 2
Mean Elevation



Hydrograph Showing 72-hour Tidal Filtering Process & Mean Elevation
Well CI-13-WT
(August 1-4, 2010)

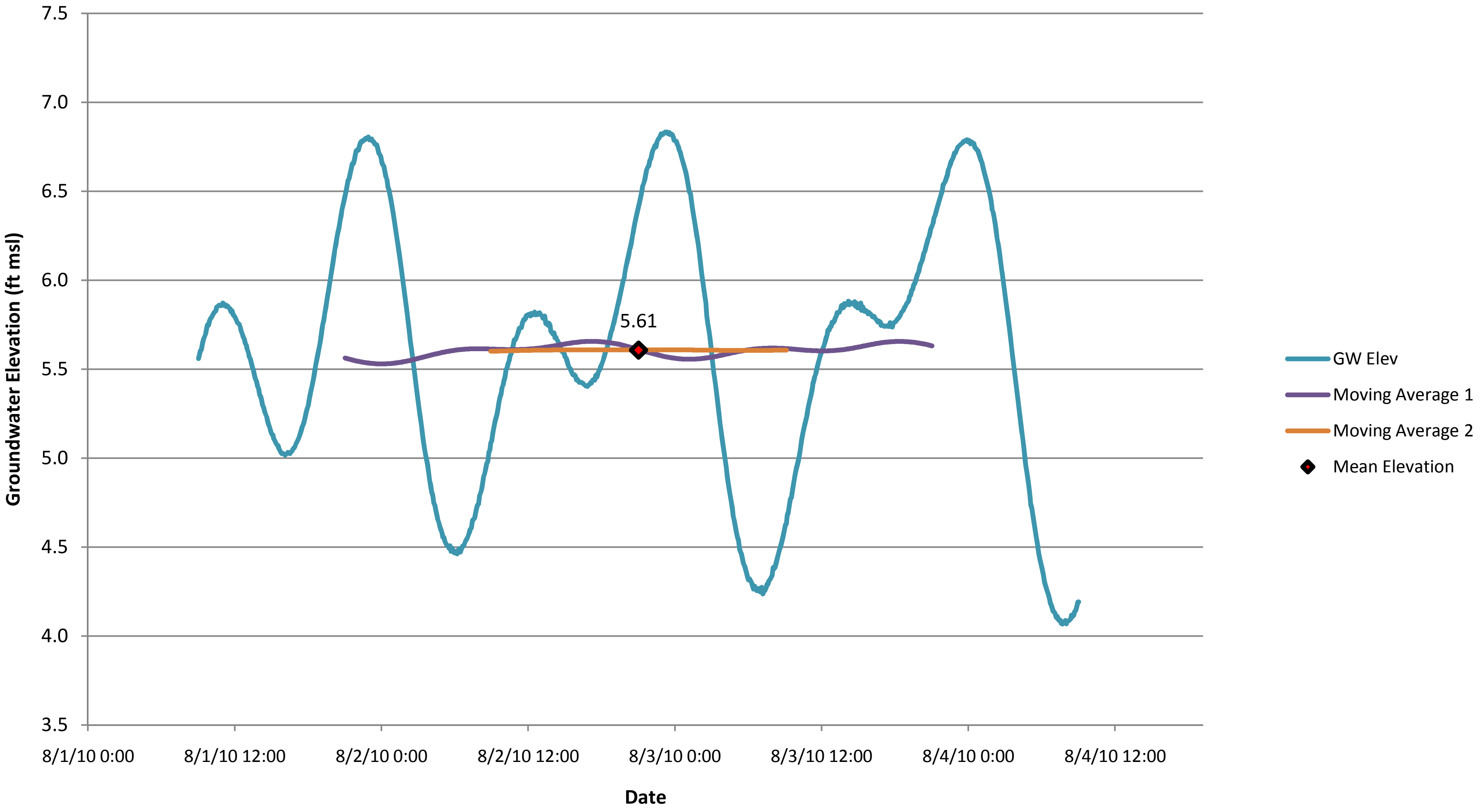

Hydrograph Showing 72-hour Tidal Filtering Process & Mean Elevation
Well CI-13-30
(July 24 - 27, 2010)
7.0
6.5
6.0
5.5
5.0
4.5
4.0
Groundwater Elevation (ft msl)
5.68
7/24/10 0:00
7/24/10 12:00
7/25/10 0:00
7/25/10 12:00
7/26/10 0:00
7/26/10 12:00
7/27/10 0:00
7/27/10 12:00
Date
GW Elevation
Moving Average 1
Moving Average 2
Mean Elevation

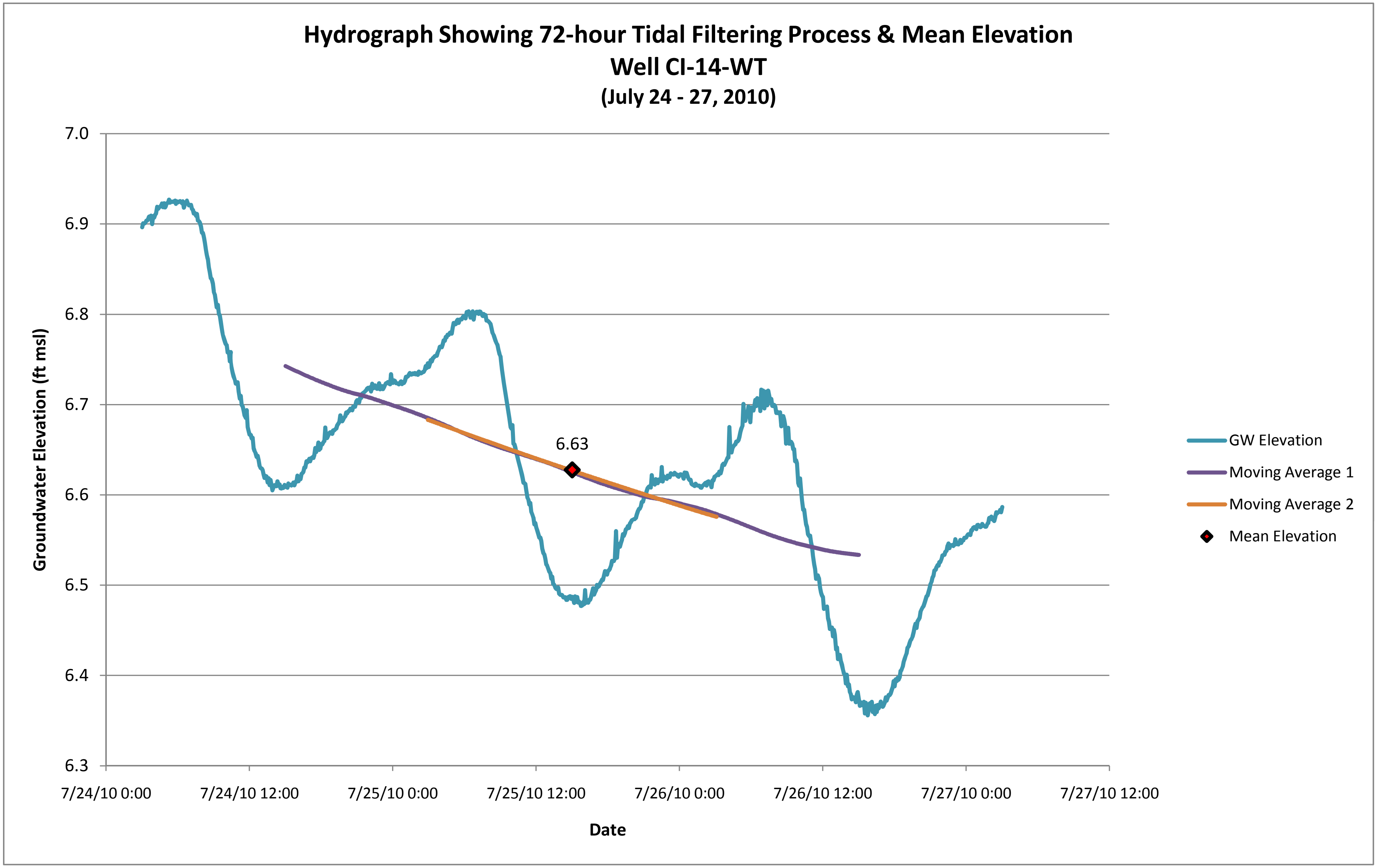

Hydrograph Showing 72-hour Tidal Filtering Process & Mean Elevation
Well CI-13-30
(August 1-4, 2010)
7.0
6.5
6.0
5.5
5.0
4.5
4.0
Groundwater Elevation (ft msl)
5.69
8/1/10 0:00
8/1/10 12:00
8/2/10 0:00
8/2/10 12:00
8/3/10 0:00
8/3/10 12:00
8/4/10 0:00
8/4/10 12:00
Date
GW Elev
Moving Average 1
Moving Average 2
Mean Elevation



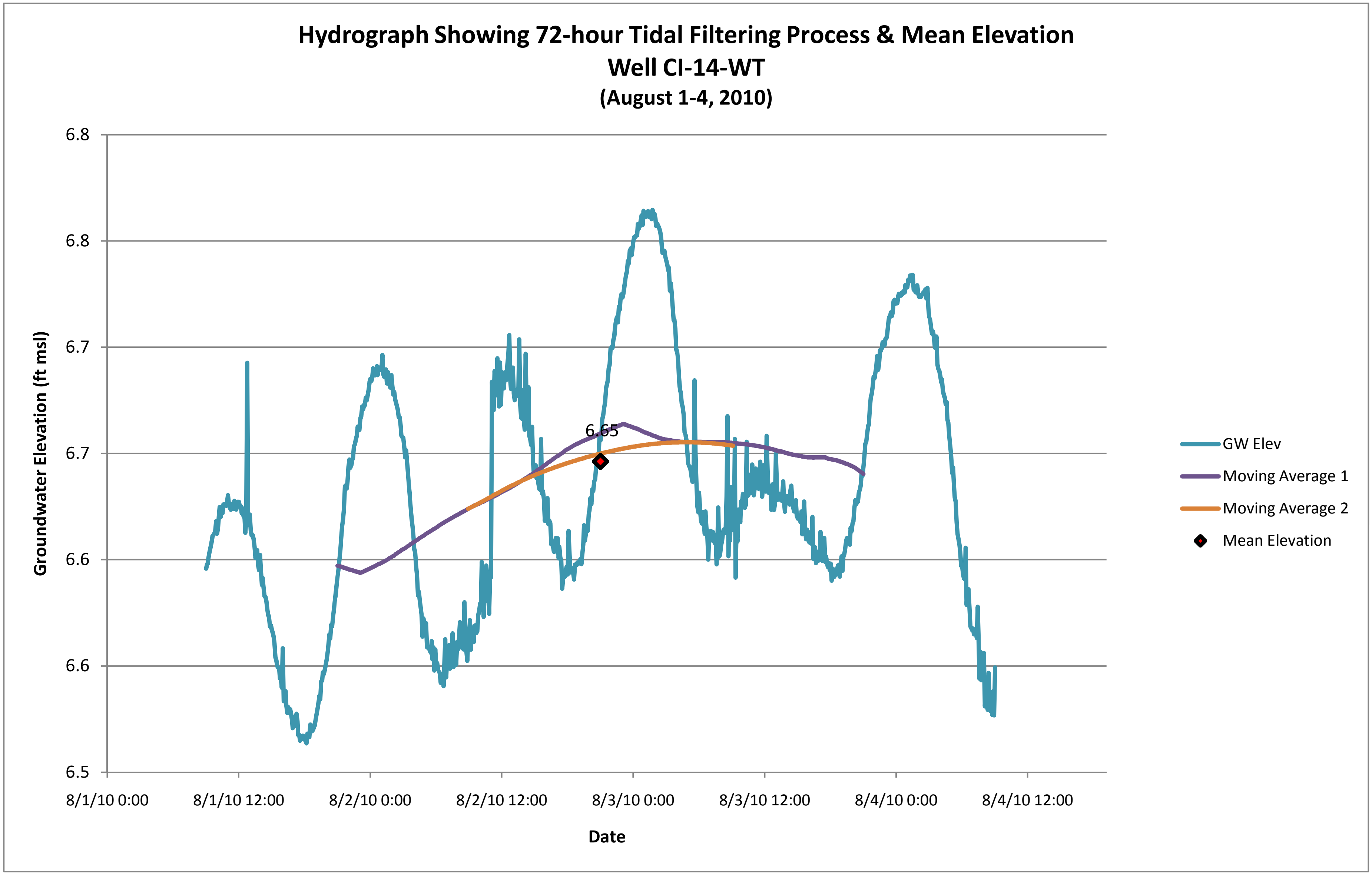
Hydrograph Showing 72-hour Tidal Filtering Process & Mean Elevation
Well CI-13-60
(July 24 - 27, 2010)

Hydrograph Showing 72-hour Tidal Filtering Process & Mean Elevation
Well CI-13-60
(August 1-4, 2010)

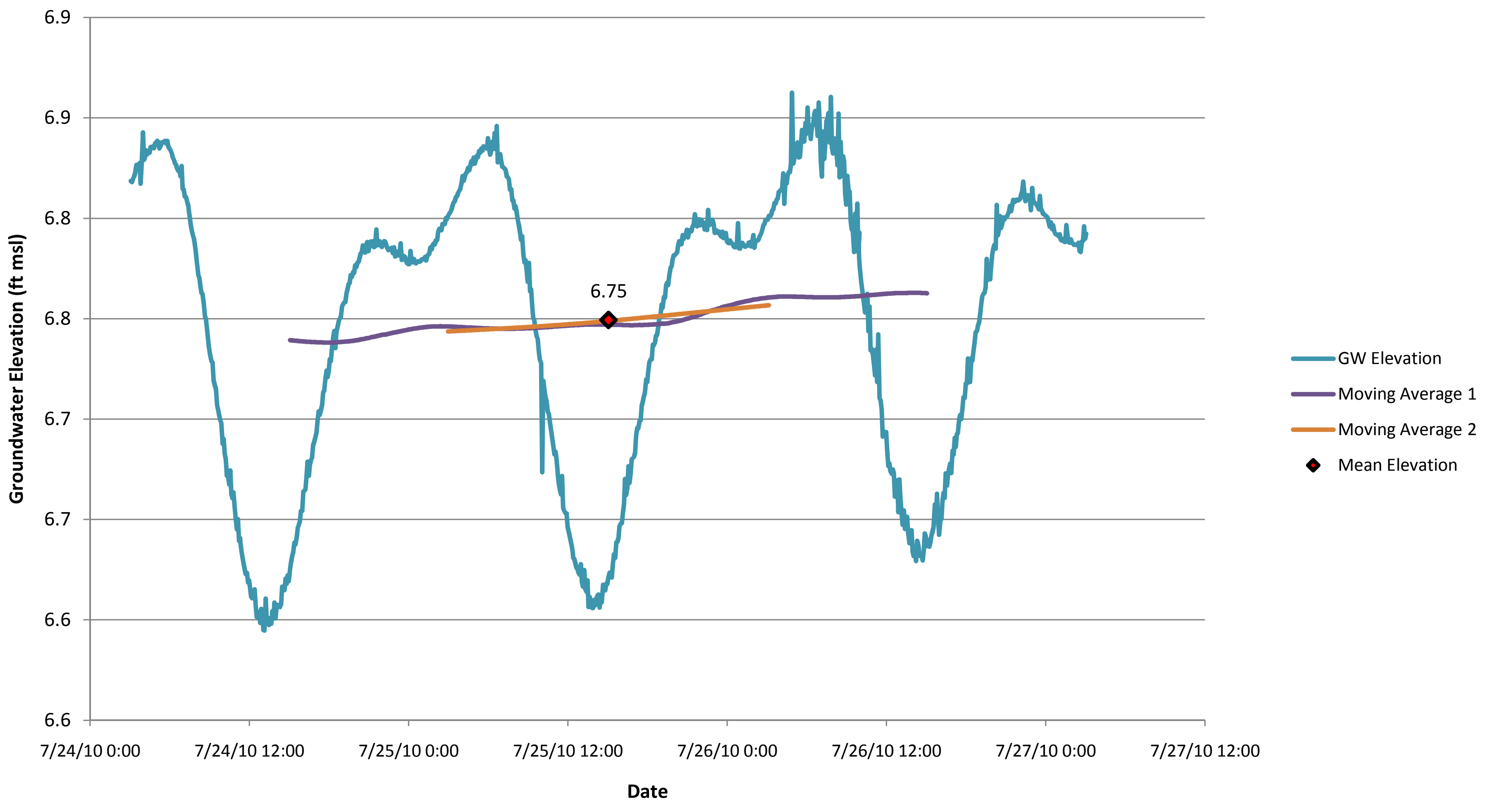


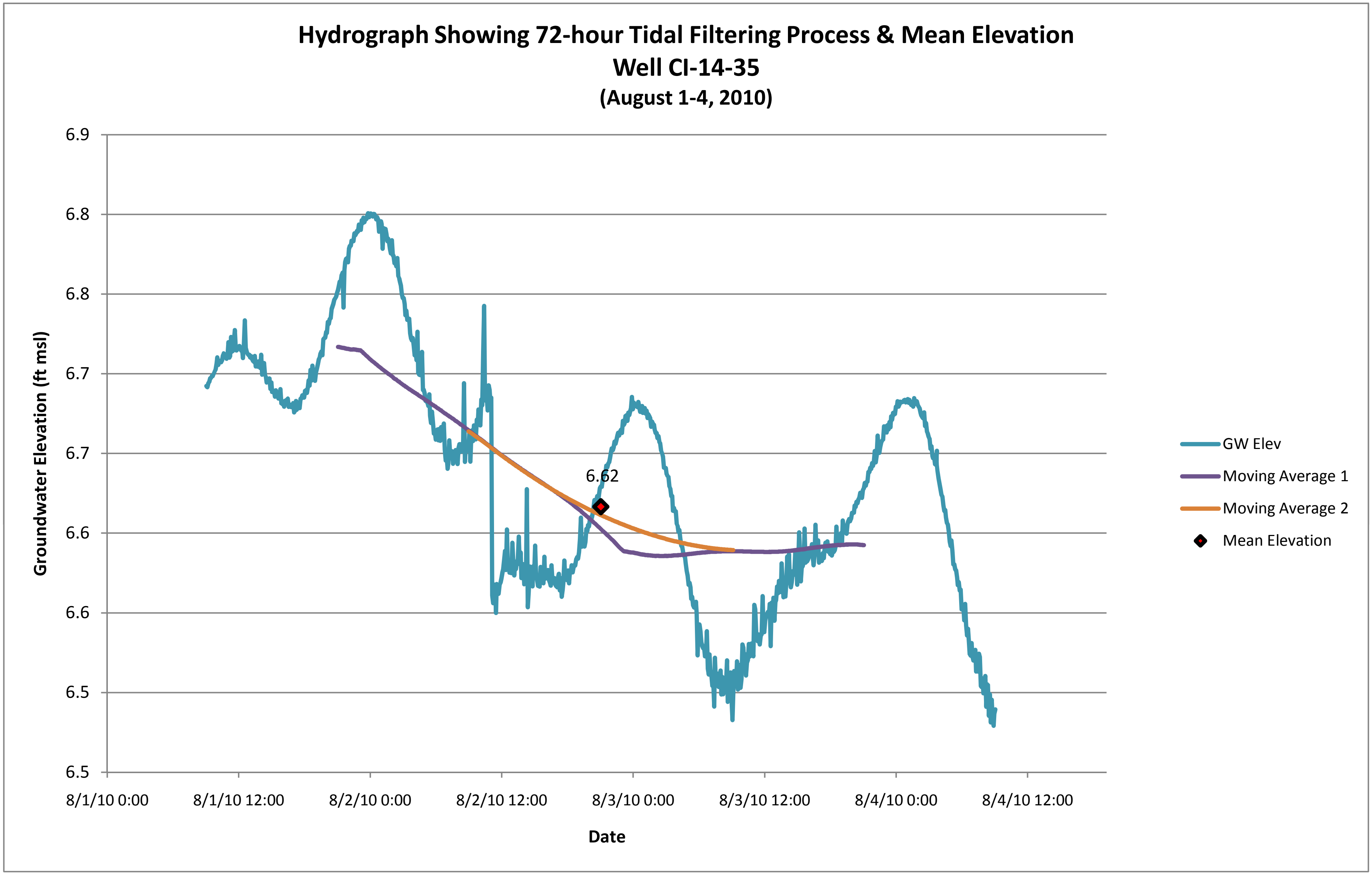


Hydrograph Showing 72-hour Tidal Filtering Process & Mean Elevation
Well CI-14-WT
(July 24 - 27, 2010)

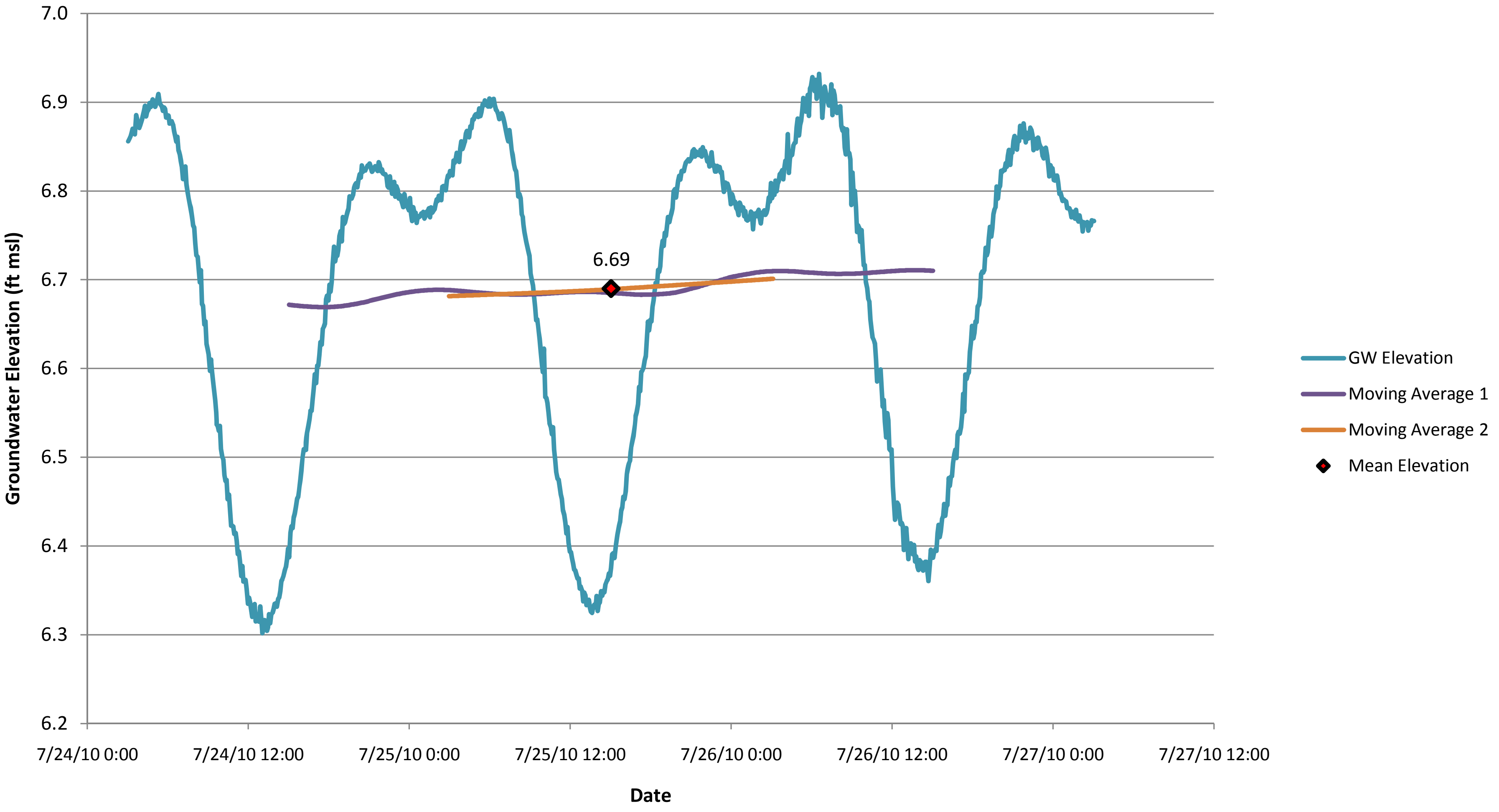

Hydrograph Showing 72-hour Tidal Filtering Process & Mean Elevation
Well CI-14-WT
(August 1-4, 2010)
Groundwater Elevation (ft msl)
6.8
6.8
6.7
6.7
6.6
6.6
6.5
6.65
8/1/10 0:00
8/1/10 12:00
8/2/10 0:00
8/2/10 12:00
8/3/10 0:00
8/3/10 12:00
8/4/10 0:00
8/4/10 12:00
Date
GW Elev
Moving Average 1
Moving Average 2
Mean Elevation

Hydrograph Showing 72-hour Tidal Filtering Process & Mean Elevation
Well CI-14-35
(July 24 - 27, 2010)

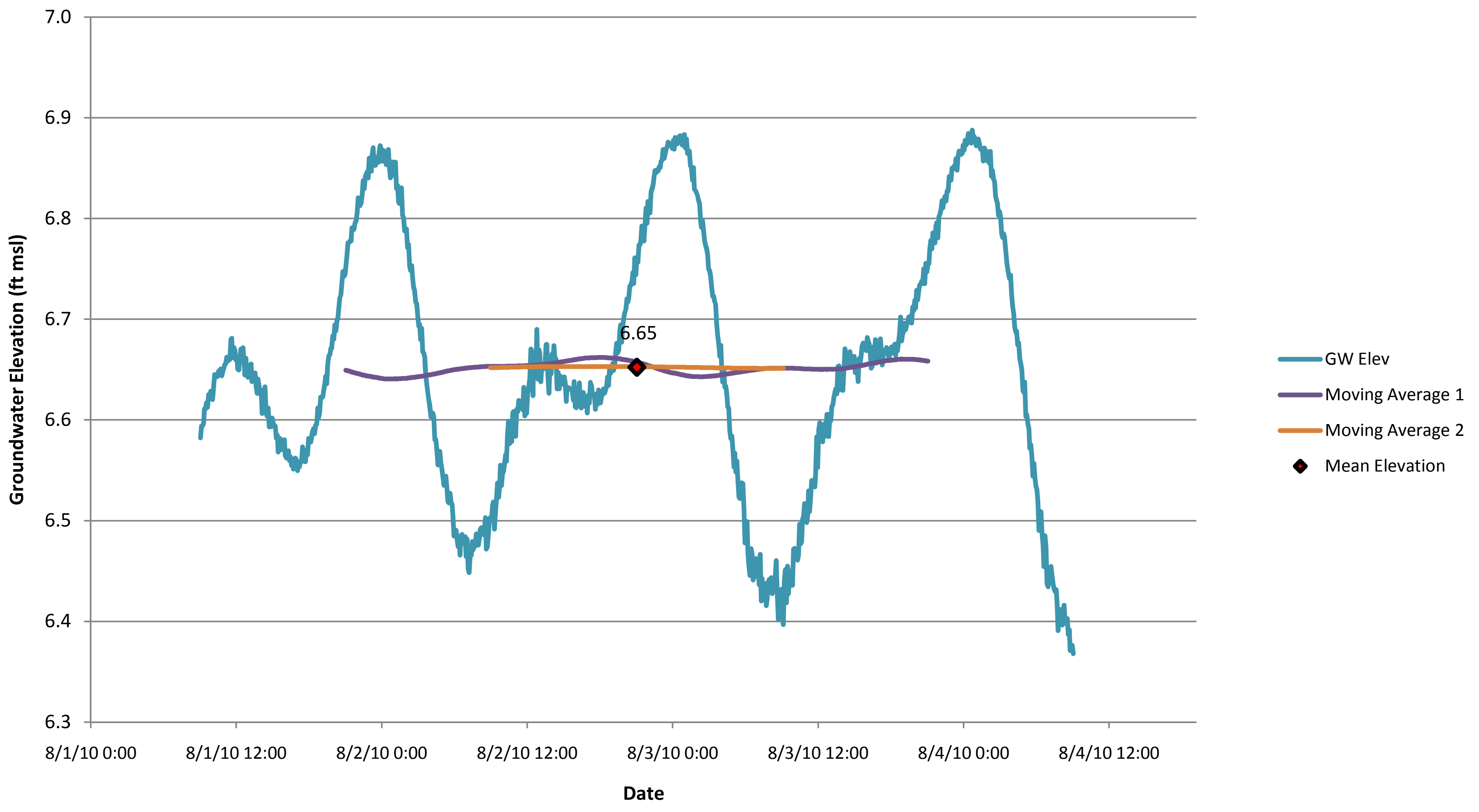



Hydrograph Showing 72-hour Tidal Filtering Process & Mean Elevation
Well CI-14-35
(August 1-4, 2010)
6.9
6.8
6.8
6.7
6.7
6.6
6.6
6.5
6.5
Groundwater Elevation (ft msl)
8/1/10 0:00
8/1/10 12:00
8/2/10 0:00
8/2/10 12:00
8/3/10 0:00
8/3/10 12:00
8/4/10 0:00
8/4/10 12:00
Date
6.62
GW Elev
Moving Average 1
Moving Average 2
Mean Elevation

Hydrograph Showing 72-hour Tidal Filtering Process & Mean Elevation
Well CI-14-70
(July 24 - 27, 2010)



Hydrograph Showing 72-hour Tidal Filtering Process & Mean Elevation
Well CI-14-70
(August 1-4, 2010)

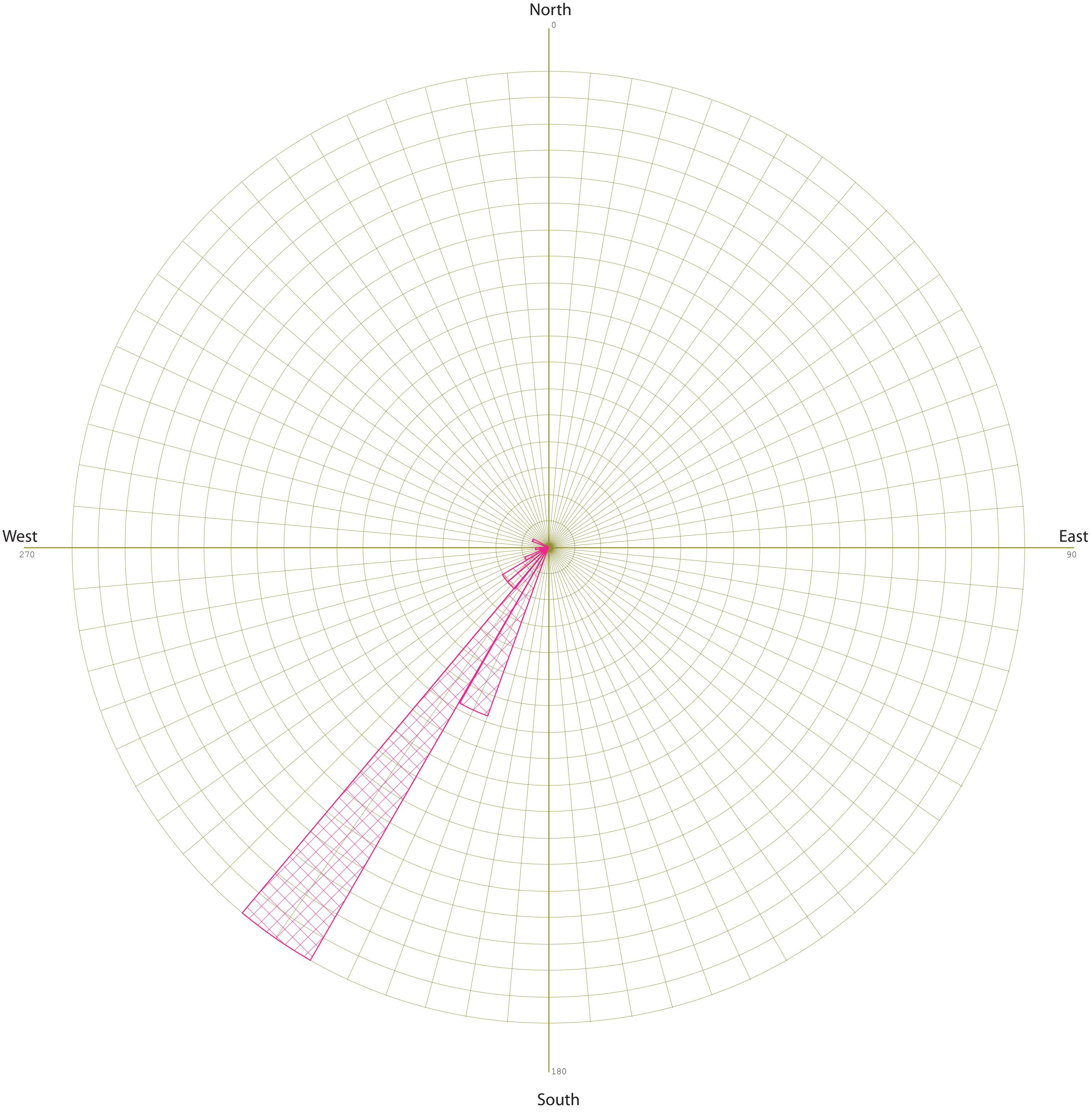


ATTACHMENT C
ROSE DIAGRAMS SHOWING GROUNDWATER FLOW DIRECTION AND RELATIVE FREQUENCY OF FLOW

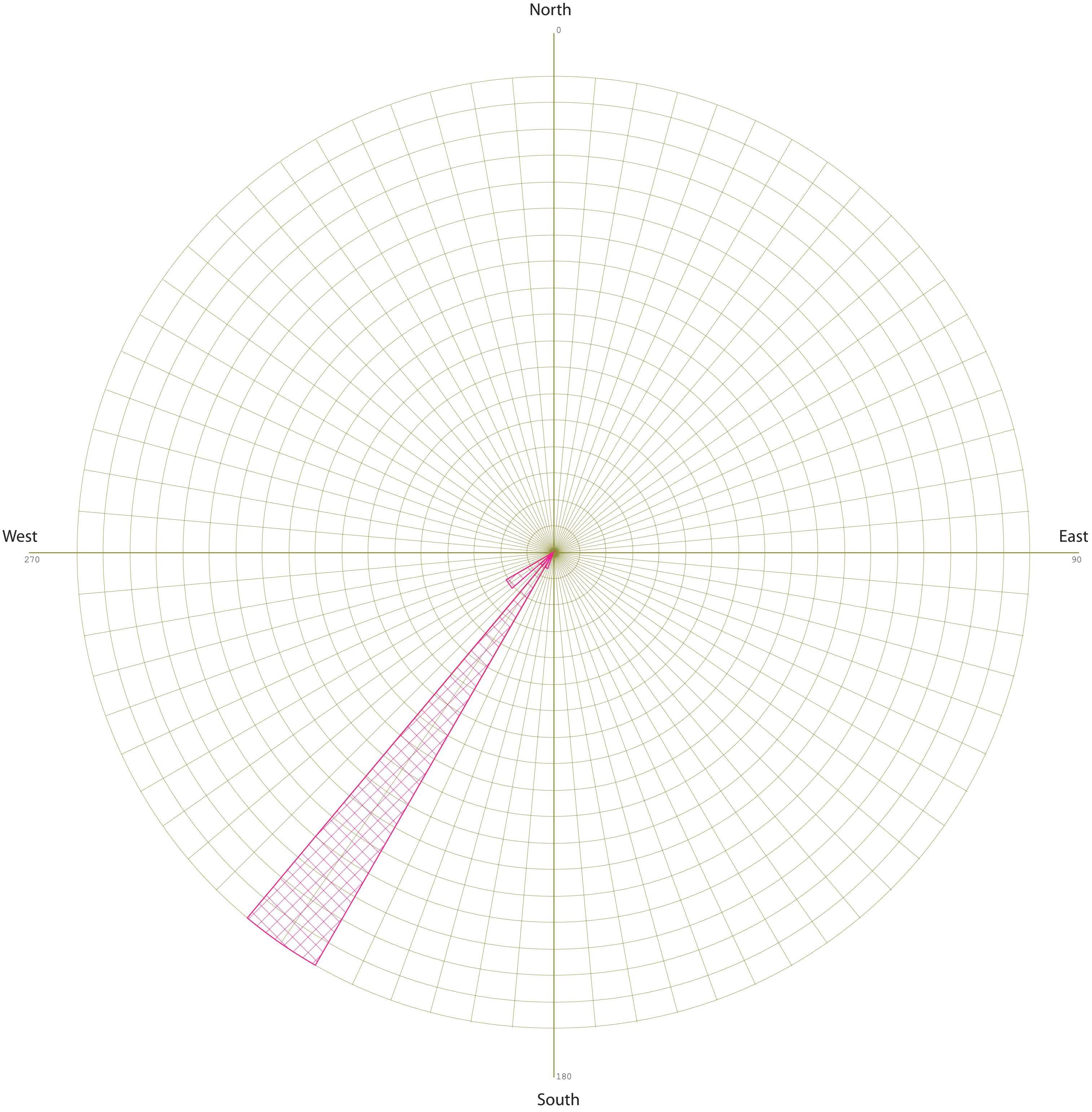
TIDAL STUDY AND
AQUIFER CHARACTERIZATION RESULTS
Capital Industries
5801 Third Avenue South
Seattle, Washington

Farallon PN: 457-004

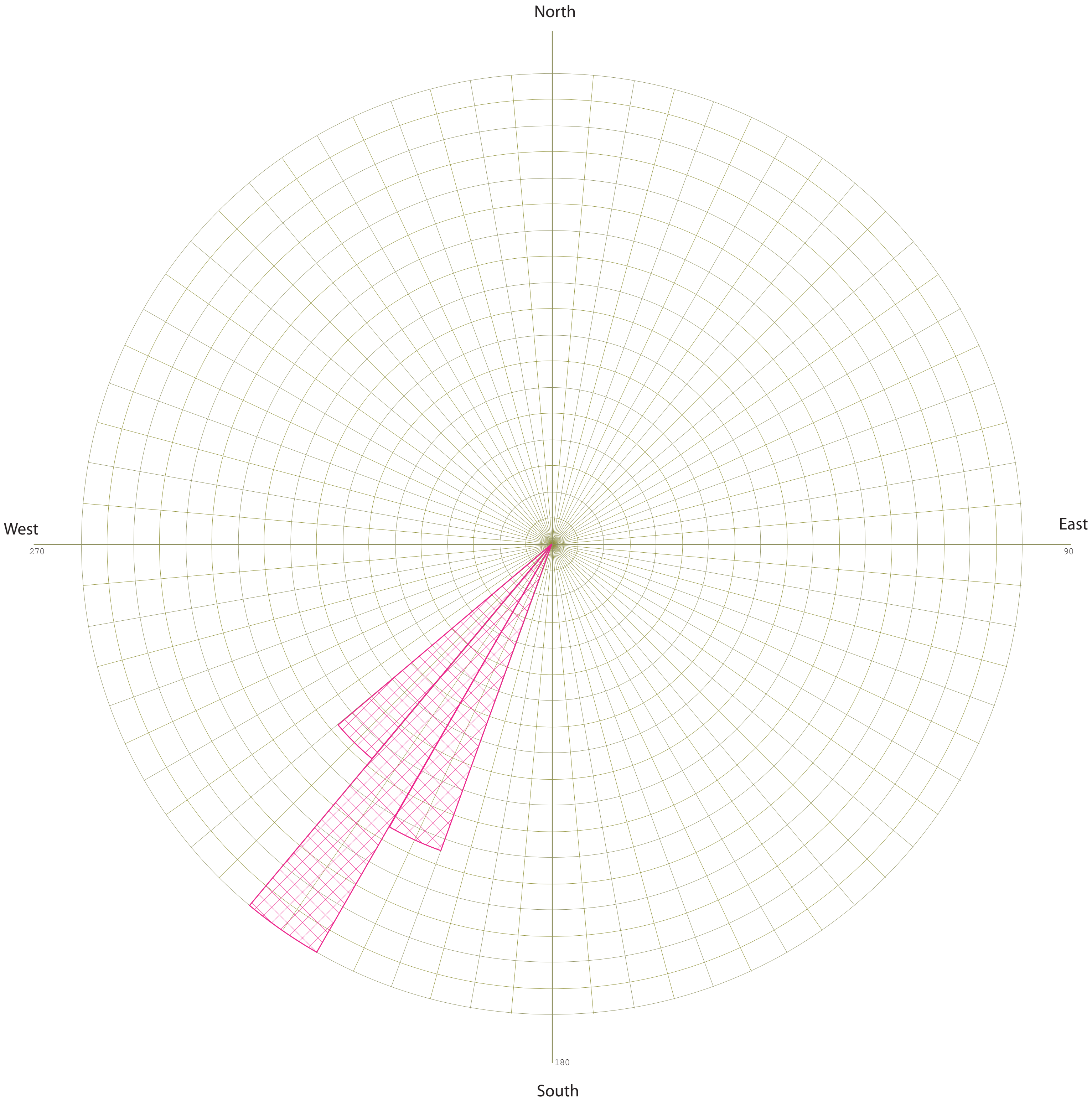
Rose Diagram Showing Frequency of Groundwater Flow Direction in Water Table Zone
July 24 -27, 2010
Wells CI-11-WT, CI-13-WT & CI-14-WT
Capital Tidal Investigation



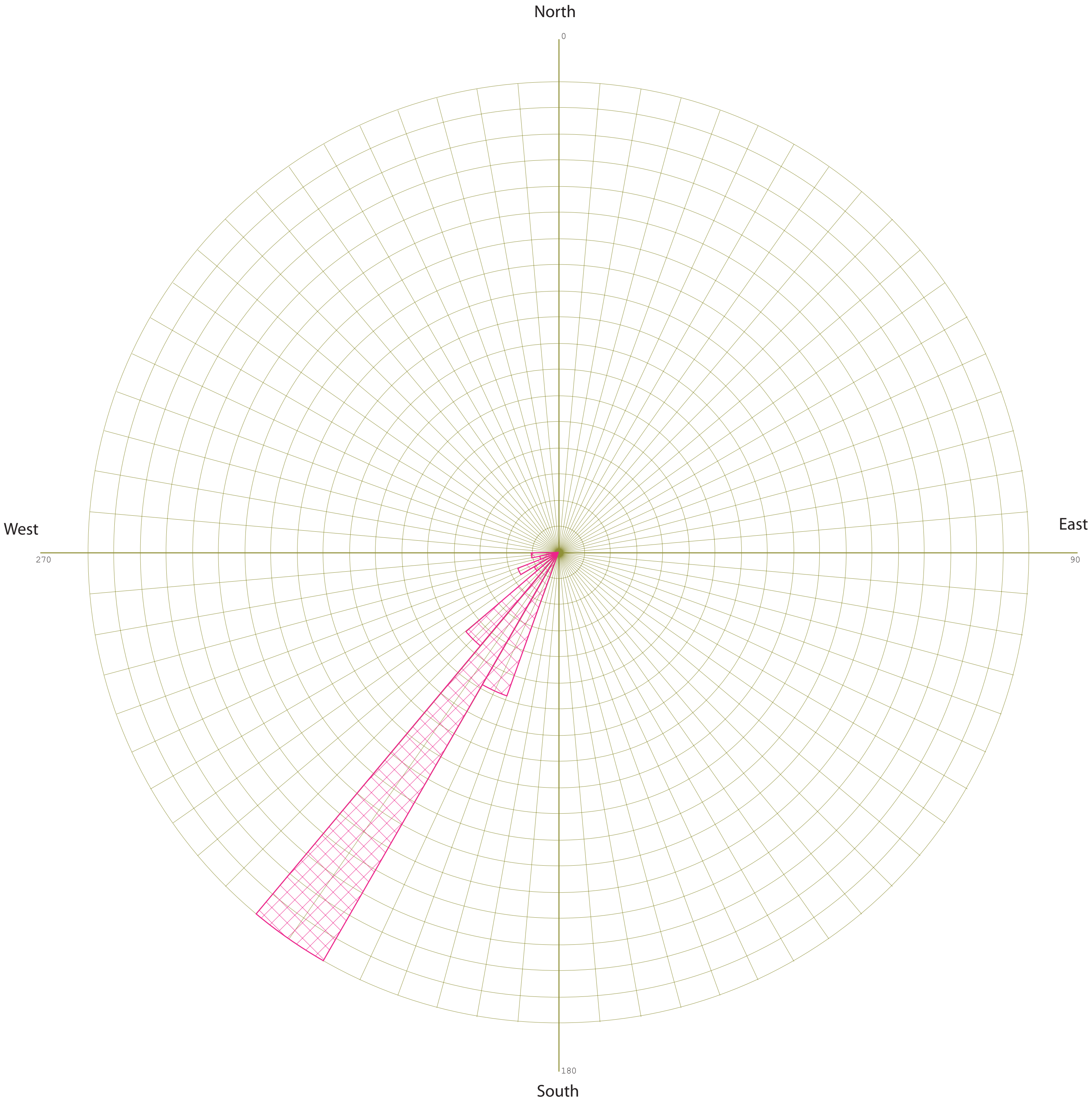
Rose Diagram Showing Frequency of Groundwater Flow Direction in Water Table Zone
August 1-4, 2010
Wells CI-11-WT, CI-13-WT & CI-14-WT
Capital Tidal Investigation



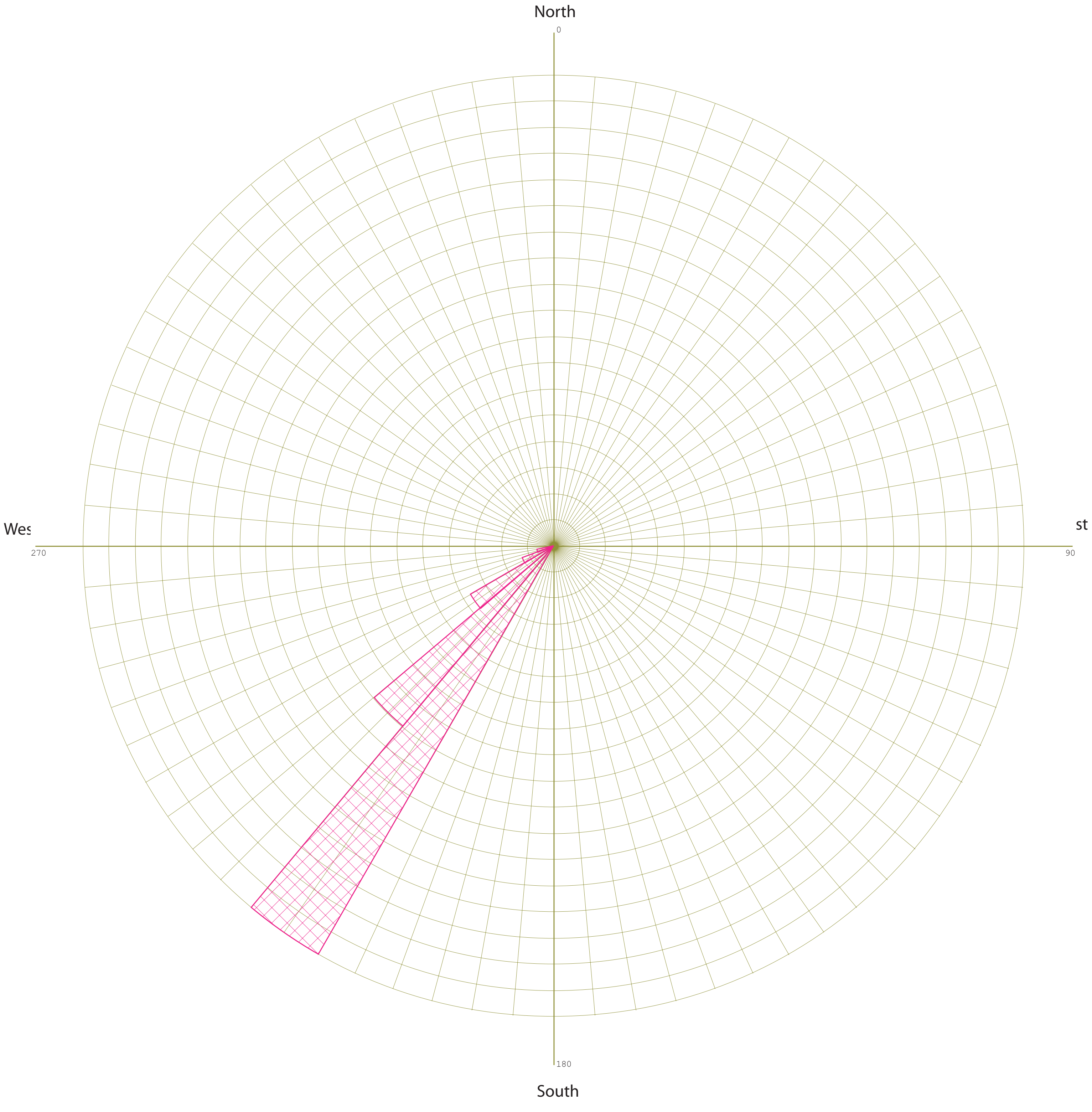
Rose Diagram Showing Frequency of Groundwater Flow Direction in Shallow Zone
July 24 -27, 2010
Wells CI-11-30, CI-13-30 & CI-14-35
Capital Tidal Investigation



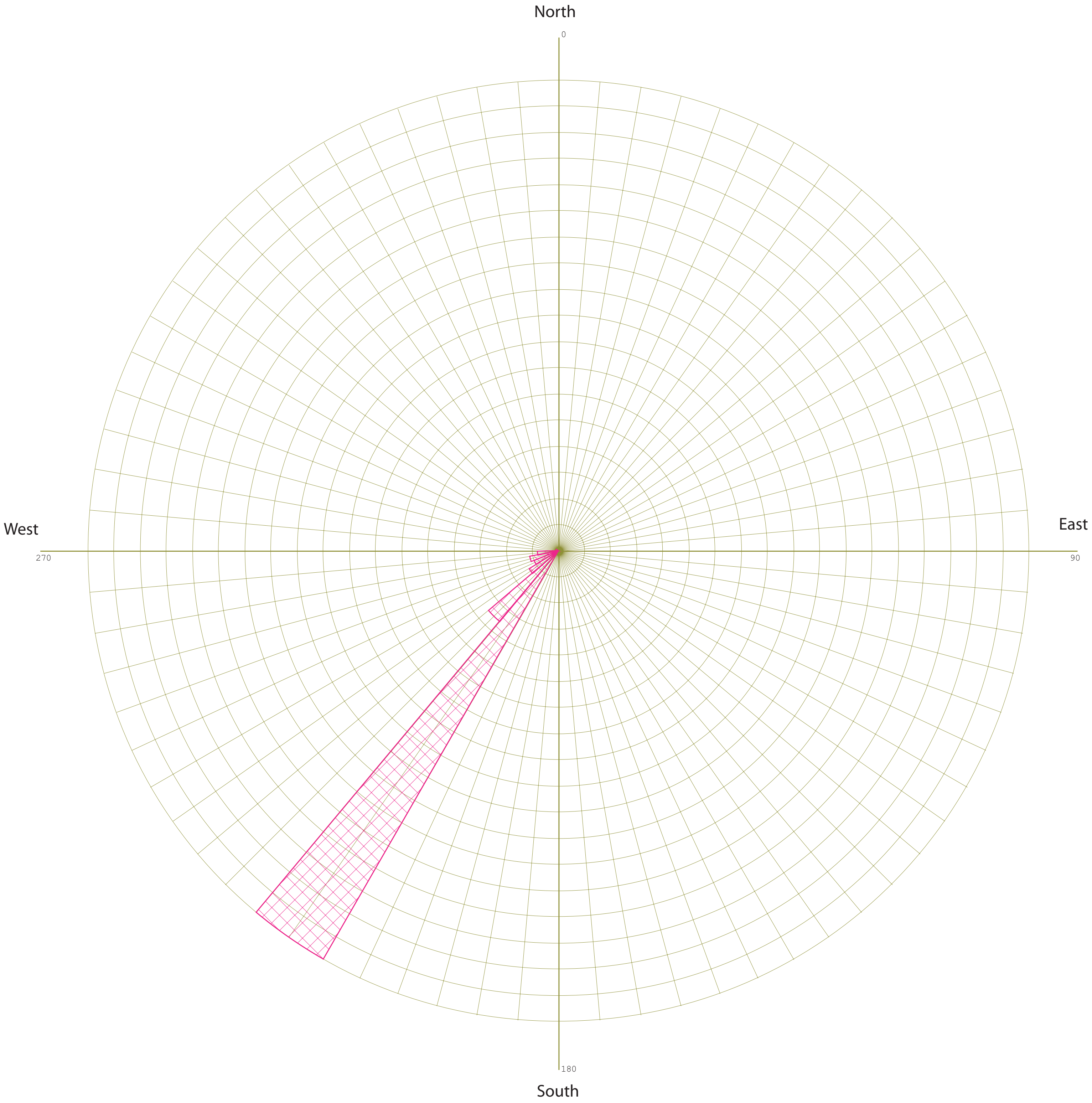
Rose Diagram Showing Frequency of Groundwater Flow Direction in Shallow Zone
August 1-4, 2010
Wells CI-11-30, CI-13-30 & CI-14-35
Capital Tidal Investigation



Rose Diagram Showing Frequency of Groundwater Flow Direction in Intermediate Zone
July 24 -27, 2010
Wells CI-11-60, CI-13-60 & CI-14-70
Capital Tidal Investigation



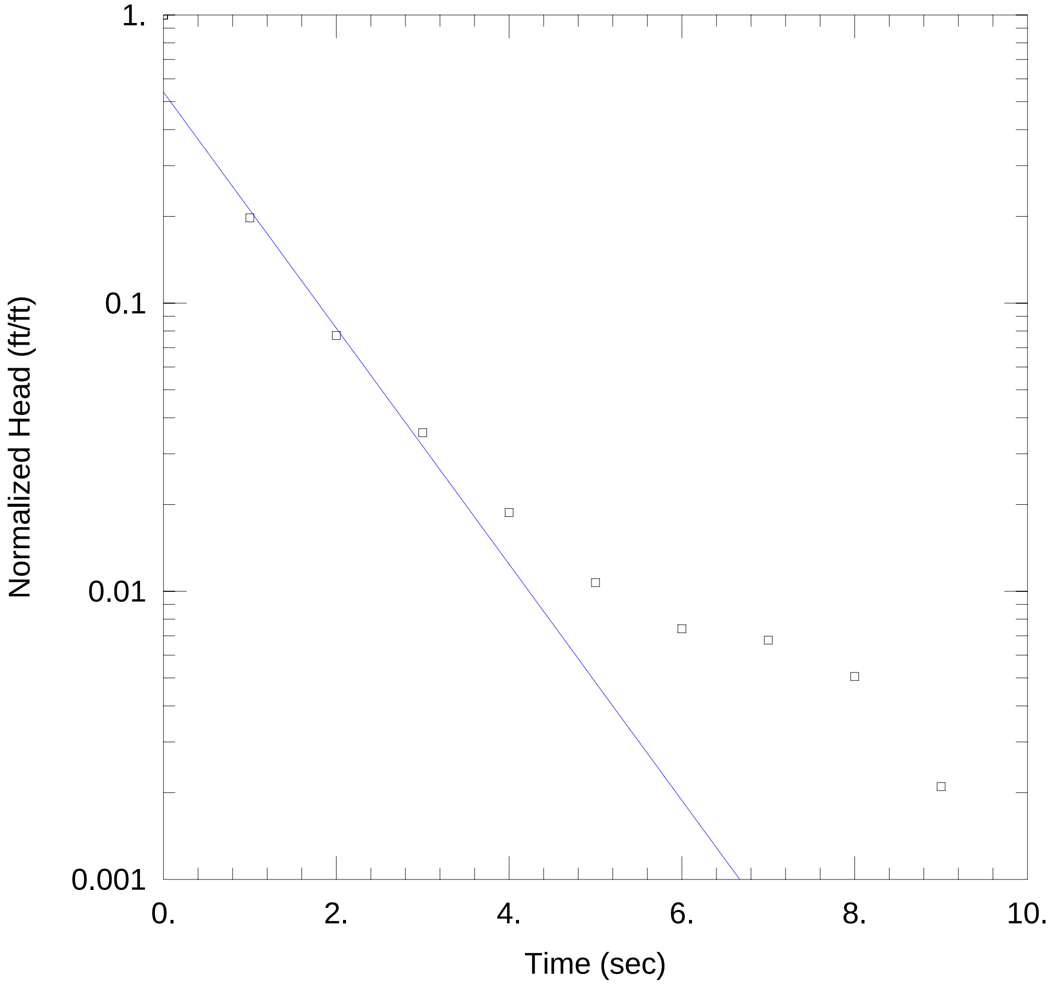
Rose Diagram Showing Frequency of Groundwater Flow Direction in Intermediate Zone
August 1-4, 2010
Wells CI-11-60, CI-13-60 & CI-14-70
Capital Tidal Investigation



ATTACHMENT D
SLUG TEST ANALYSIS PLOTS

TIDAL STUDY AND
AQUIFER CHARACTERIZATION RESULTS
Capital Industries
5801 Third Avenue South
Seattle, Washington

Farallon PN: 457-004



SLUG TEST RESULTS FOR MW-8 (RISING HEAD)

Data Set: N:\Farallon\Capital Industries\Slug Testing Aug 2010\Aqtesolv Files\MW-8.aqt
Date: 01/21/11
Time: 15:28:05

PROJECT INFORMATION

Company: Farallon Consulting
Client: Capital
Test Well: MW-8
Test Date: 8-6-10

AQUIFER DATA

Saturated Thickness: 62.07 ft
Anisotropy Ratio (Kz/Kr): 1.

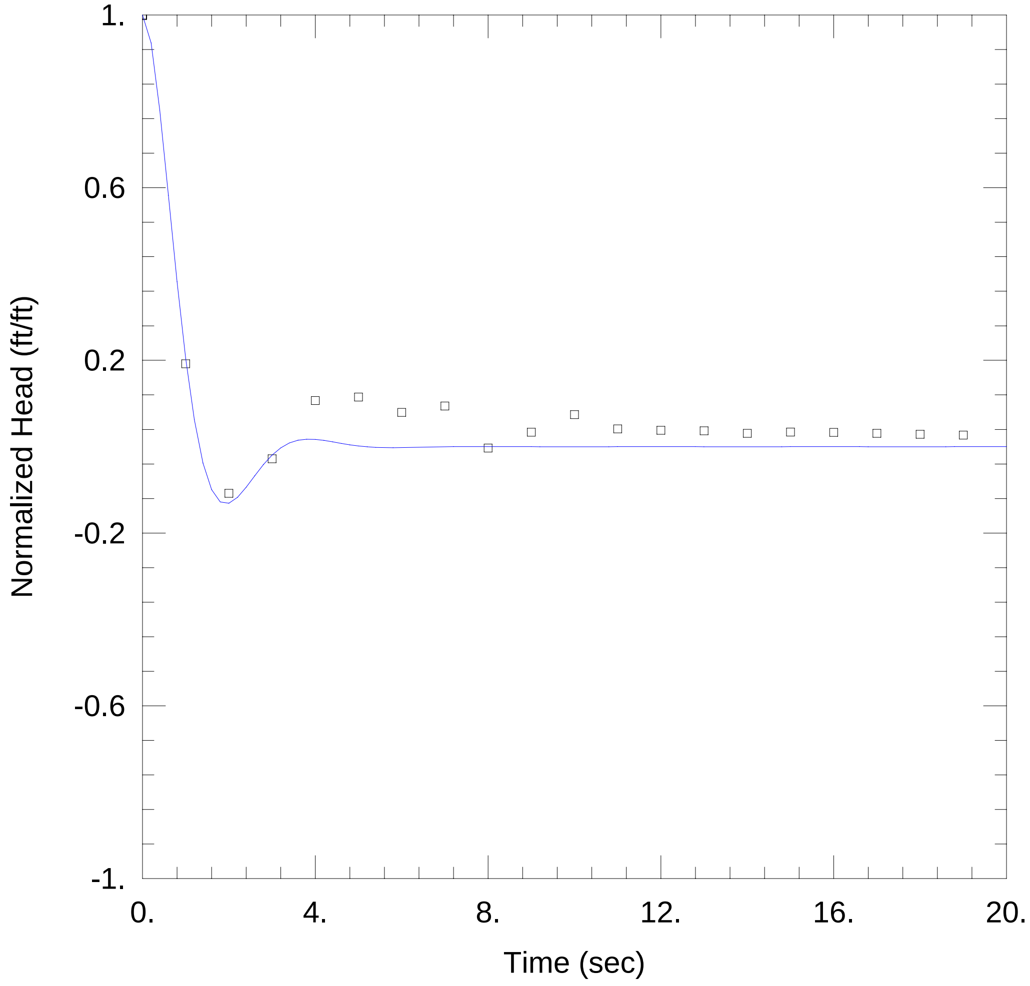
WELL DATA (MW-8)

Initial Displacement: 3.15 ft
Total Well Penetration Depth: 20. ft
Casing Radius: 0.083 ft
Static Water Column Height: 12.07 ft
Screen Length: 10. ft
Well Radius: 0.083 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 99.79 ft/day
y0 = 1.7 ft



SLUG TEST RESULTS FOR CI-8-40 (FALLING HEAD)

Data Set: N:\Farallon\Capital Industries\Slug Testing Aug 2010\Aqtesolv Files\CI-8-40.aqt
Date: 01/21/11 Time: 15:28:27

PROJECT INFORMATION

Company: Farallon Consulting
Client: Capital
Test Well: CI-8-40
Test Date: 8-6-10

AQUIFER DATA

Saturated Thickness: 62.32 ft
Anisotropy Ratio (Kz/Kr): 1.

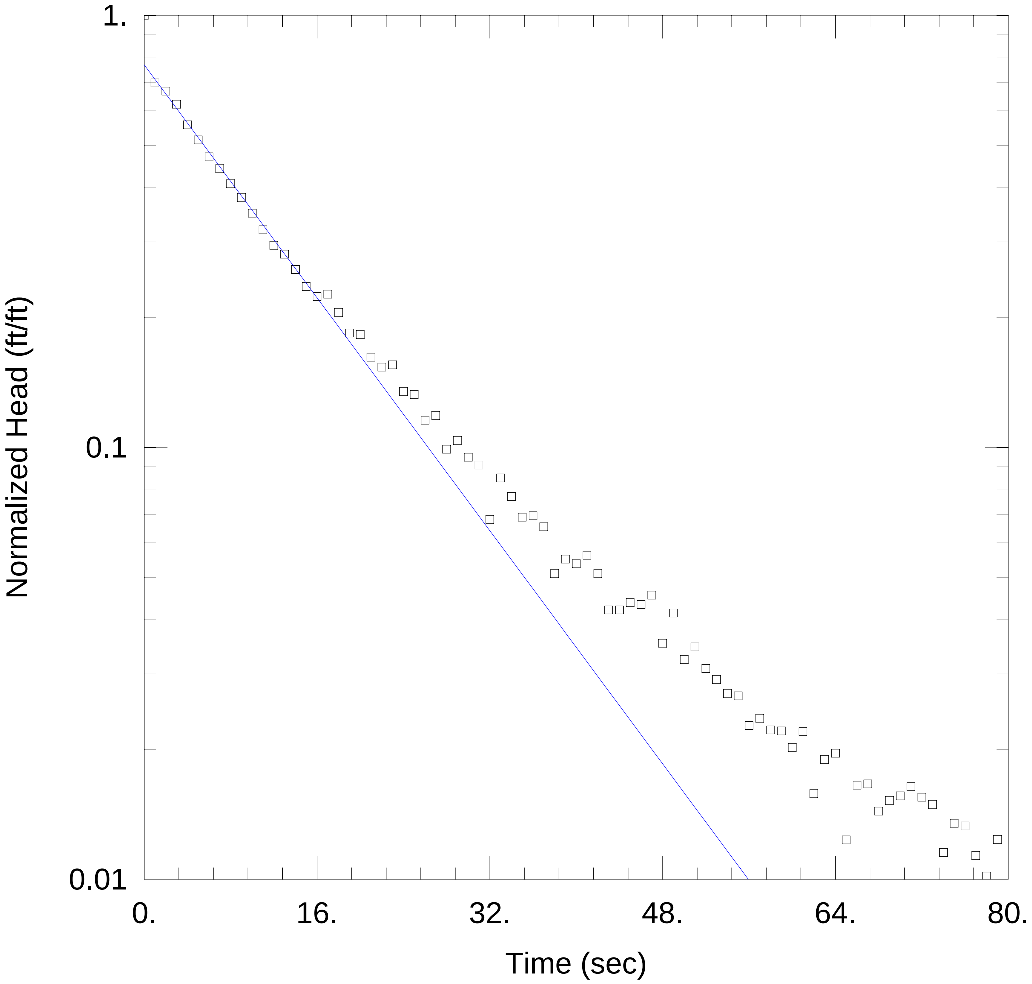
WELL DATA (CI-8-40)

Initial Displacement: 1.77 ft
Total Well Penetration Depth: 40. ft
Casing Radius: 0.083 ft
Static Water Column Height: 32.32 ft
Screen Length: 10. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Springer-Gelhar

K = 213. ft/day
Le = 8.556 ft



SLUG TEST RESULTS FOR CI-8-60 (RISING HEAD)

Data Set: N:\Farallon\Capital Industries\Slug Testing Aug 2010\Aqtesolv Files\CI-8-60.aqt
Date: 01/21/11 Time: 15:28:42

PROJECT INFORMATION

Company: Farallon Consulting
Client: Capital
Test Well: CI-8-40
Test Date: 8-6-10

AQUIFER DATA

Saturated Thickness: 62.23 ft Anisotropy Ratio (Kz/Kr): 1.

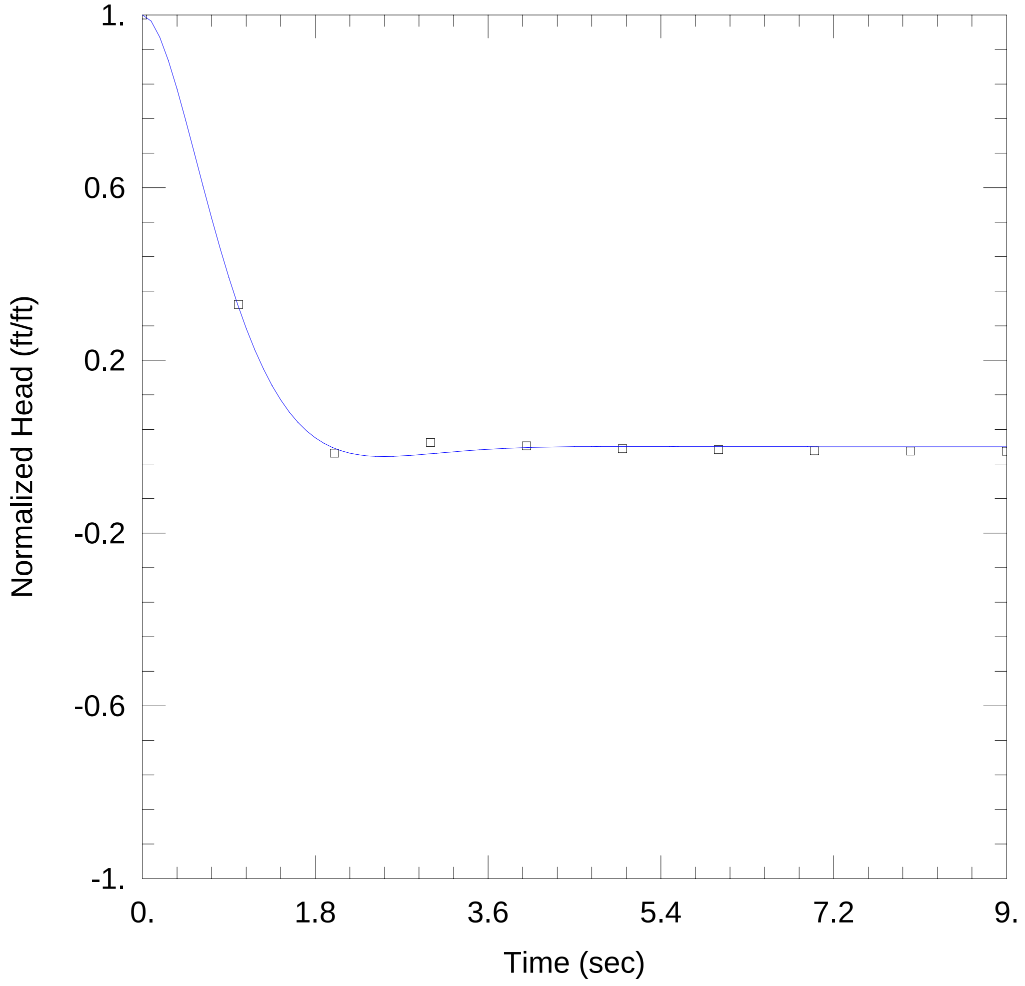
WELL DATA (CI-8-60)

Initial Displacement: 2.05 ft Static Water Column Height: 52.23 ft
Total Well Penetration Depth: 60. ft Screen Length: 10. ft
Casing Radius: 0.083 ft Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 10.06 ft/day y0 = 1.573 ft



SLUG TEST RESULTS FOR CI-9-WT (RISING HEAD)

Data Set: N:\...\CI-9-WT RisingHead-Short.aqt
Date: 01/21/11 Time: 15:29:20

PROJECT INFORMATION

Company: Farallon Consulting
Client: Capital
Test Date: 8-6-10

AQUIFER DATA

Saturated Thickness: 62.11 ft
Anisotropy Ratio (Kz/Kr): 1.

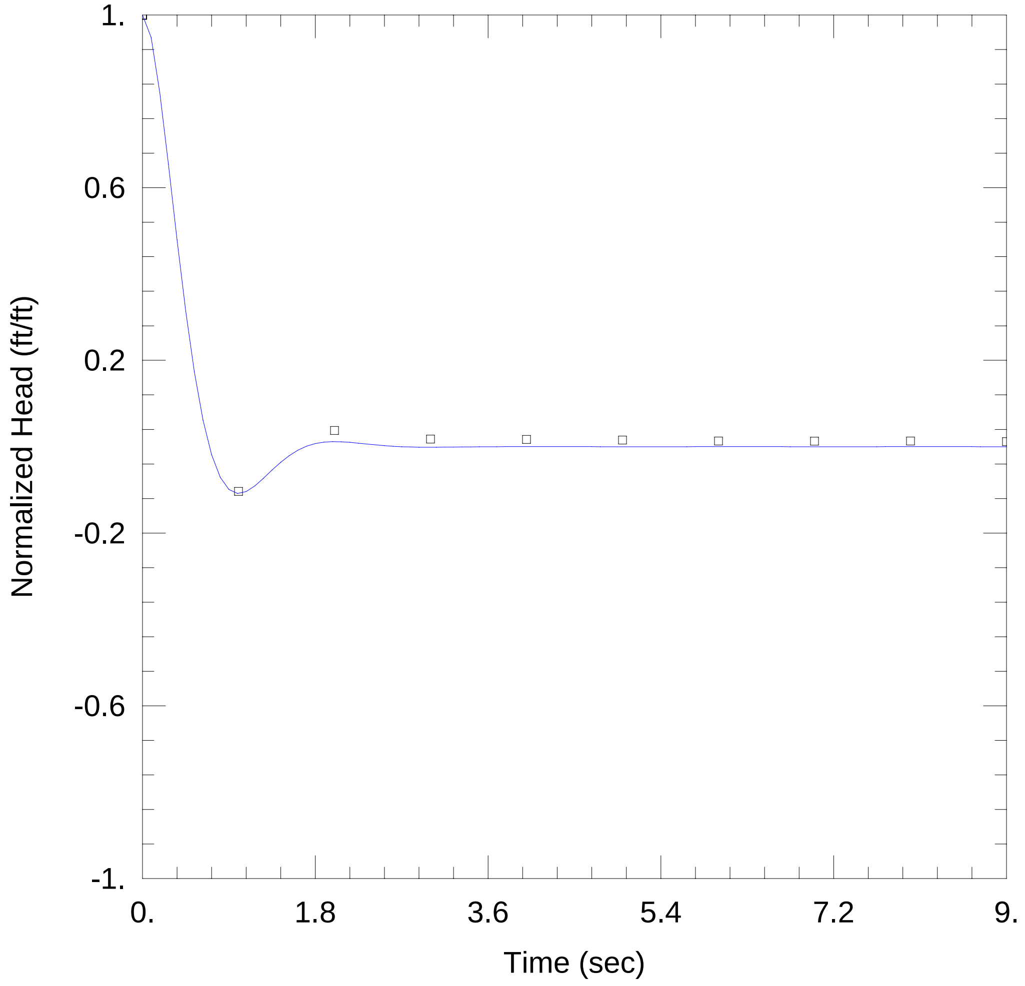
WELL DATA (CI-9-WT)

Initial Displacement: 1.53 ft
Total Well Penetration Depth: 20. ft
Casing Radius: 0.083 ft
Static Water Column Height: 12.11 ft
Screen Length: 10. ft
Well Radius: 0.083 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Springer-Gelhar

K = 135.1 ft/day
Le = 8.4 ft



SLUG TEST RESULTS FOR CI-9-WT (FALLING HEAD)

Data Set: N:\Farallon\Capital Industries\Slug Testing Aug 2010\Aqtesolv Files\CI-9-WT FallingHead.aqt
Date: 01/21/11 Time: 15:29:40

PROJECT INFORMATION

Company: Farallon Consulting
Client: Capital
Test Date: 8-6-10

AQUIFER DATA

Saturated Thickness: 62.11 ft
Anisotropy Ratio (Kz/Kr): 1.

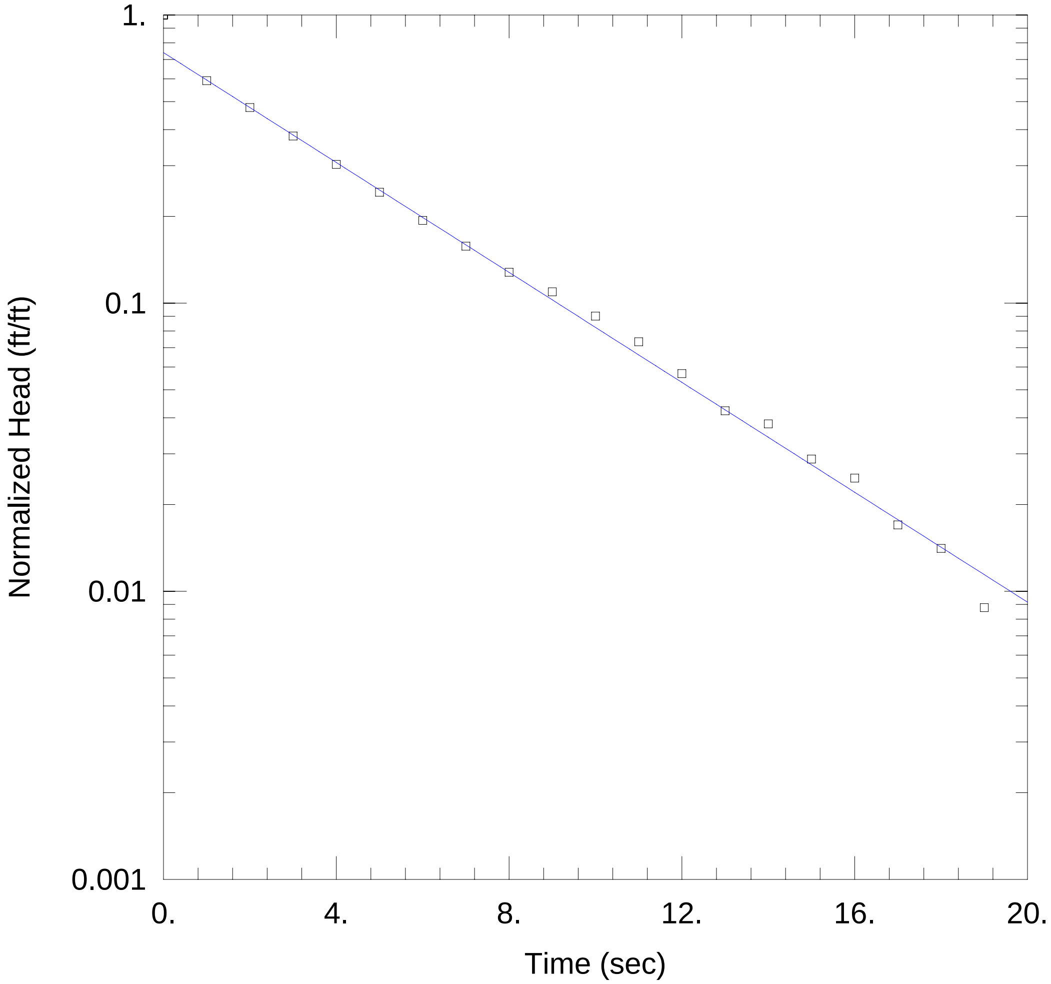
WELL DATA (CI-9-WT)

Initial Displacement: 3.12 ft
Total Well Penetration Depth: 20. ft
Casing Radius: 0.083 ft
Static Water Column Height: 12.11 ft
Screen Length: 10. ft
Well Radius: 0.083 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Springer-Gelhar

K = 356.5 ft/day
Le = 2.173 ft



SLUG TEST RESULTS FOR CI-9-40 (RISING HEAD)

Data Set: N:\Farallon\Capital Industries\Slug Testing Aug 2010\Aqtesolv Files\CI-9-40 RisingHead.aqt
Date: 01/21/11 Time: 15:30:09

PROJECT INFORMATION

Company: Farallon Consulting
Client: Capital
Test Date: 8-6-10

AQUIFER DATA

Saturated Thickness: 62.14 ft
Anisotropy Ratio (Kz/Kr): 1.

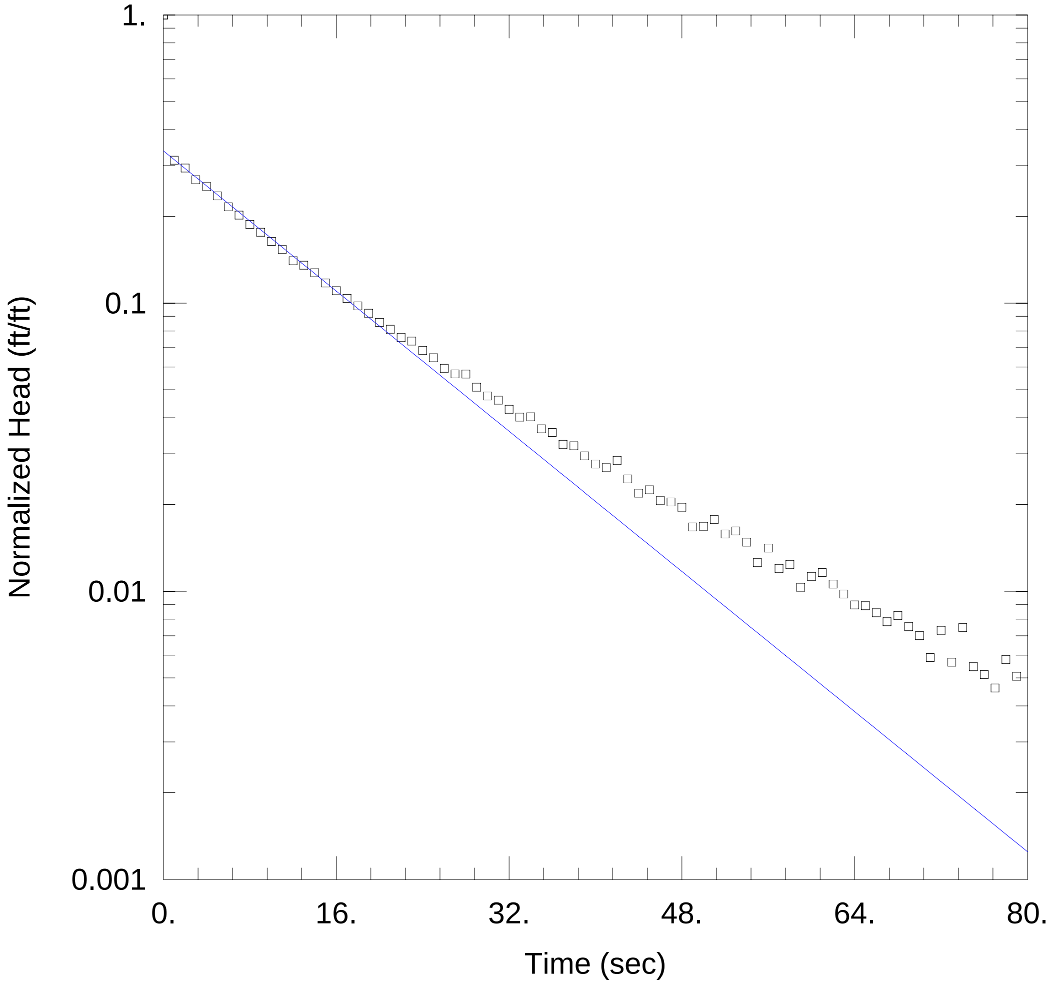
WELL DATA (CI-9-40)

Initial Displacement: 1.76 ft
Static Water Column Height: 32.14 ft
Total Well Penetration Depth: 40. ft
Screen Length: 10. ft
Casing Radius: 0.083 ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 25.52 ft/day
y0 = 1.302 ft



SLUG TEST RESULTS FOR CI-9-70 (RISING HEAD)

Data Set: N:\Farallon\Capital Industries\Slug Testing Aug 2010\Aqtesolv Files\CI-9-70 RisingHead.aqt
Date: 01/21/11 Time: 15:30:32

PROJECT INFORMATION

Company: Farallon Consulting
Client: Capital
Test Date: 8-6-10

AQUIFER DATA

Saturated Thickness: 62.1 ft
Anisotropy Ratio (Kz/Kr): 1.

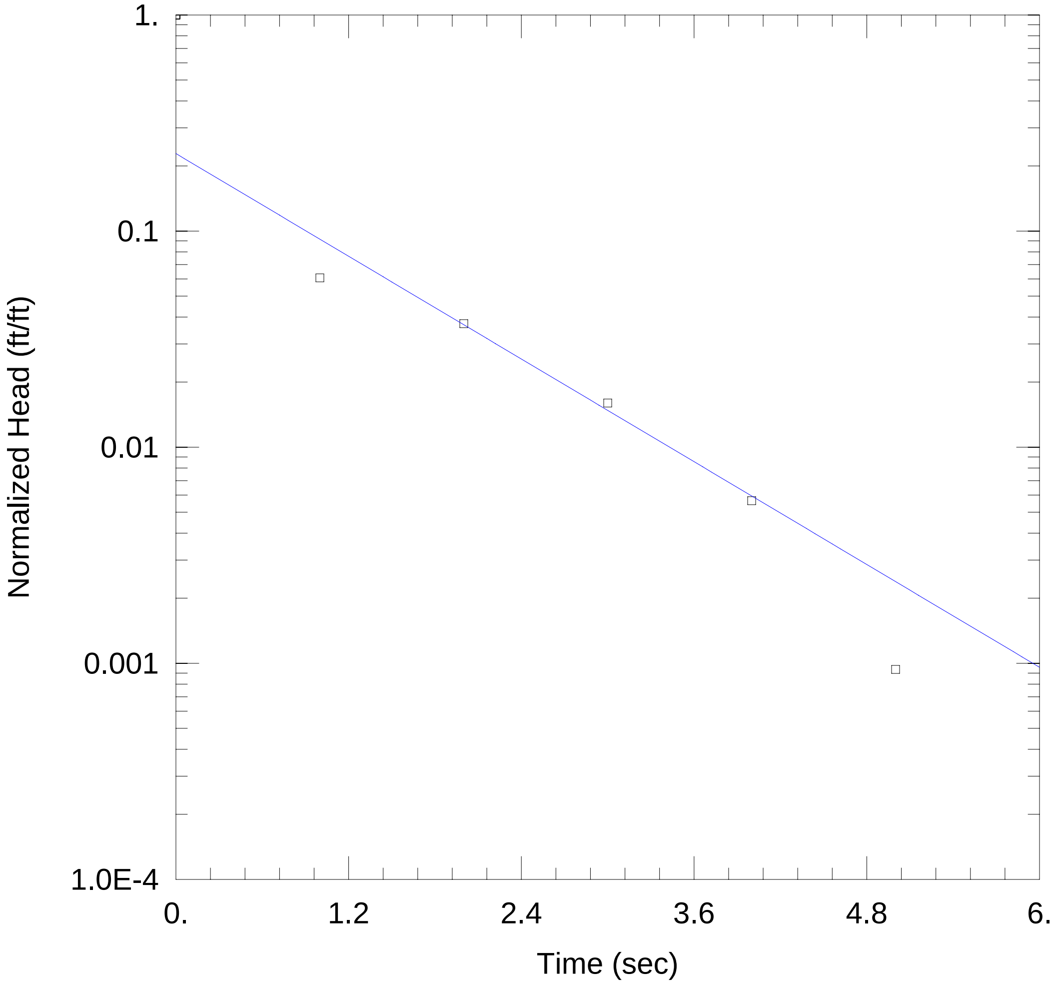
WELL DATA (CI-9-70)

Initial Displacement: 4.36 ft
Total Well Penetration Depth: 70. ft
Casing Radius: 0.083 ft
Static Water Column Height: 62.1 ft
Screen Length: 10. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 10.19 ft/day
y0 = 1.47 ft



SLUG TEST RESULTS FOR CI-10-WT (RISING HEAD)

Data Set: N:\...\CI-10-WT RisingHead.aqt
Date: 01/21/11 Time: 15:30:54

PROJECT INFORMATION

Company: Farallon Consulting
Client: Capital
Test Date: 8-6-10

AQUIFER DATA

Saturated Thickness: 61.5 ft
Anisotropy Ratio (Kz/Kr): 1.

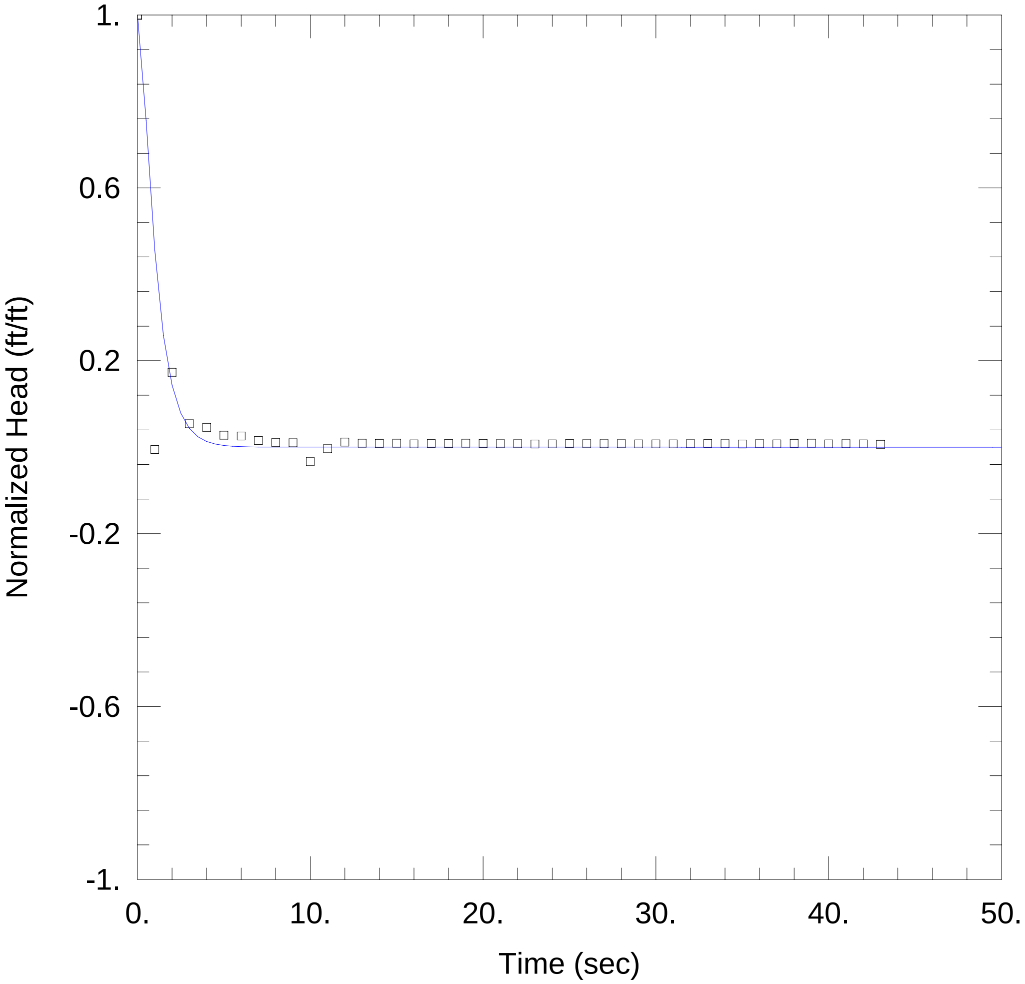
WELL DATA (CI-10-WT)

Initial Displacement: 4.34 ft
Total Well Penetration Depth: 20. ft
Casing Radius: 0.083 ft
Static Water Column Height: 11.5 ft
Screen Length: 10. ft
Well Radius: 0.083 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 96.5 ft/day
y0 = 0.9909 ft



SLUG TEST RESULTS FOR CI-10-WT (FALLING HEAD)

Data Set: N:\...\CI-10-WT FallingHead.aqt
Date: 01/21/11 Time: 15:34:56

PROJECT INFORMATION

Company: Farallon Consulting
Client: Capital
Test Date: 8-6-10

AQUIFER DATA

Saturated Thickness: 61.5 ft
Anisotropy Ratio (Kz/Kr): 1.

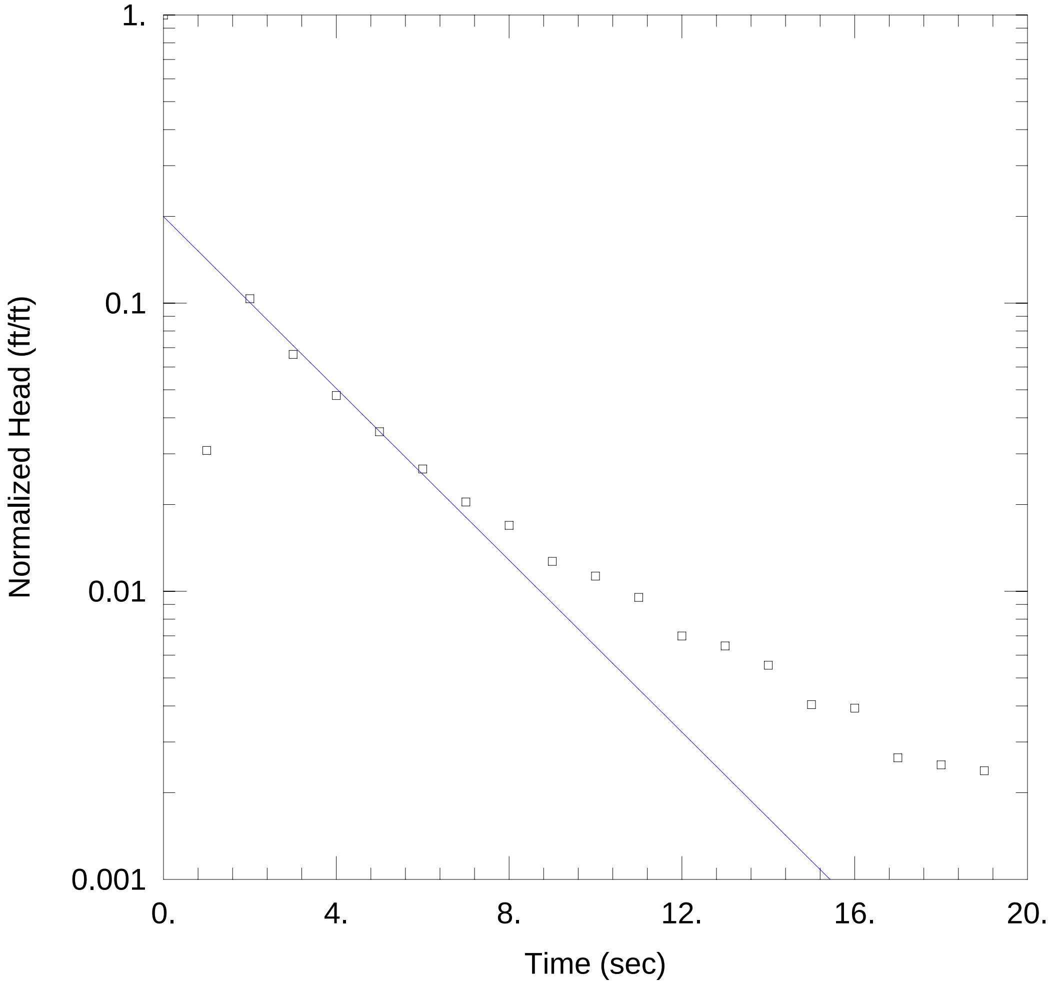
WELL DATA (CI-10-WT)

Initial Displacement: 4.32 ft
Total Well Penetration Depth: 20. ft
Casing Radius: 0.083 ft
Static Water Column Height: 11.5 ft
Screen Length: 10. ft
Well Radius: 0.083 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Springer-Gelhar

K = 92.8 ft/day
Le = 8.282 ft



SLUG TEST RESULTS FOR CI-10-35 (RISING HEAD)

Data Set: N:\Farallon\Capital Industries\Slug Testing Aug 2010\Aqtesolv Files\CI-10-35 RisingHead.aqt
Date: 01/21/11 Time: 15:35:21

PROJECT INFORMATION

Company: Farallon Consulting
Client: Capital
Test Date: 8-6-10

AQUIFER DATA

Saturated Thickness: 61.46 ft Anisotropy Ratio (Kz/Kr): 1.

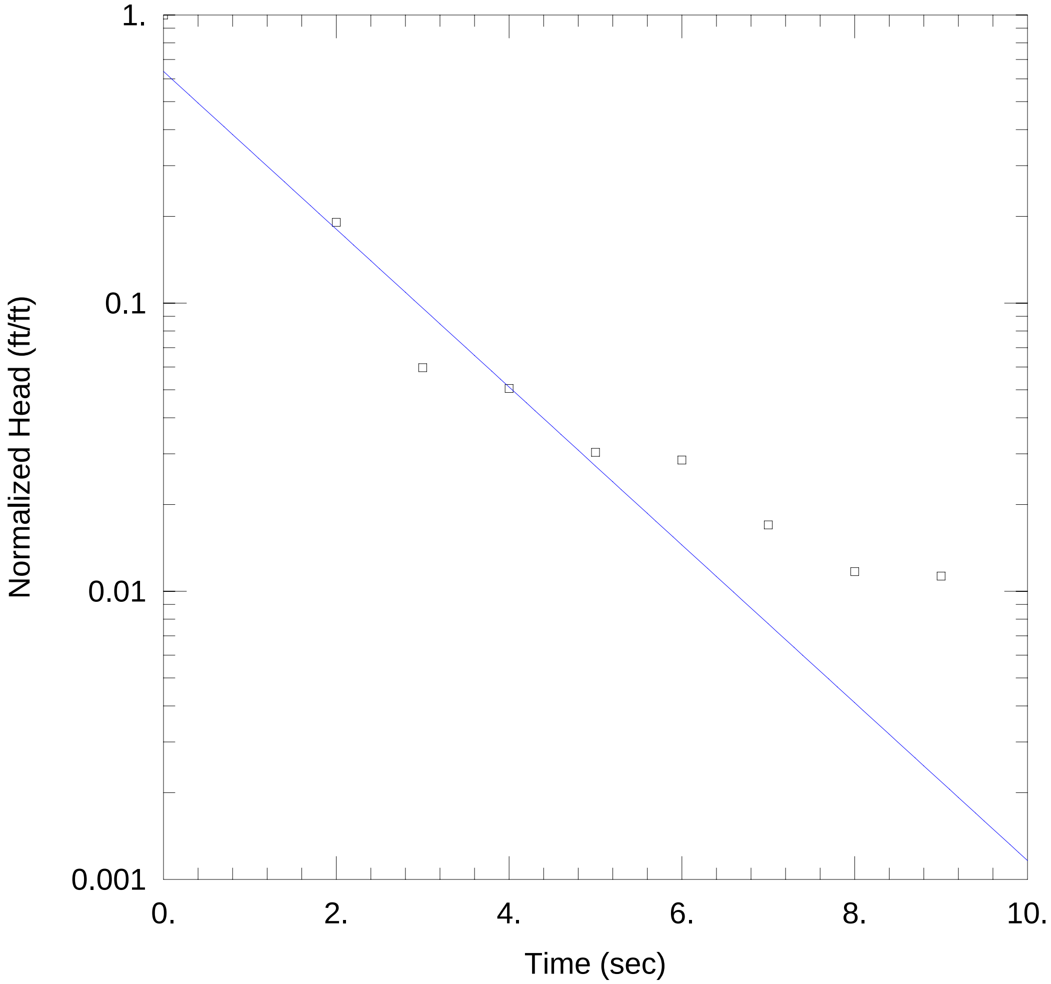
WELL DATA (CI-10-35)

Initial Displacement: 2.78 ft
Total Well Penetration Depth: 35. ft
Casing Radius: 0.083 ft
Static Water Column Height: 26.46 ft
Screen Length: 10. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 39.11 ft/day y0 = 0.5545 ft



SLUG TEST RESULTS FOR CI-10-35 (FALLING HEAD)

Data Set: N:\Farallon\Capital Industries\Slug Testing Aug 2010\Aqtesolv Files\CI-10-35 FallingHead.aqt
Date: 01/21/11 Time: 15:35:49

PROJECT INFORMATION

Company: Farallon Consulting
Client: Capital
Test Date: 8-6-10

AQUIFER DATA

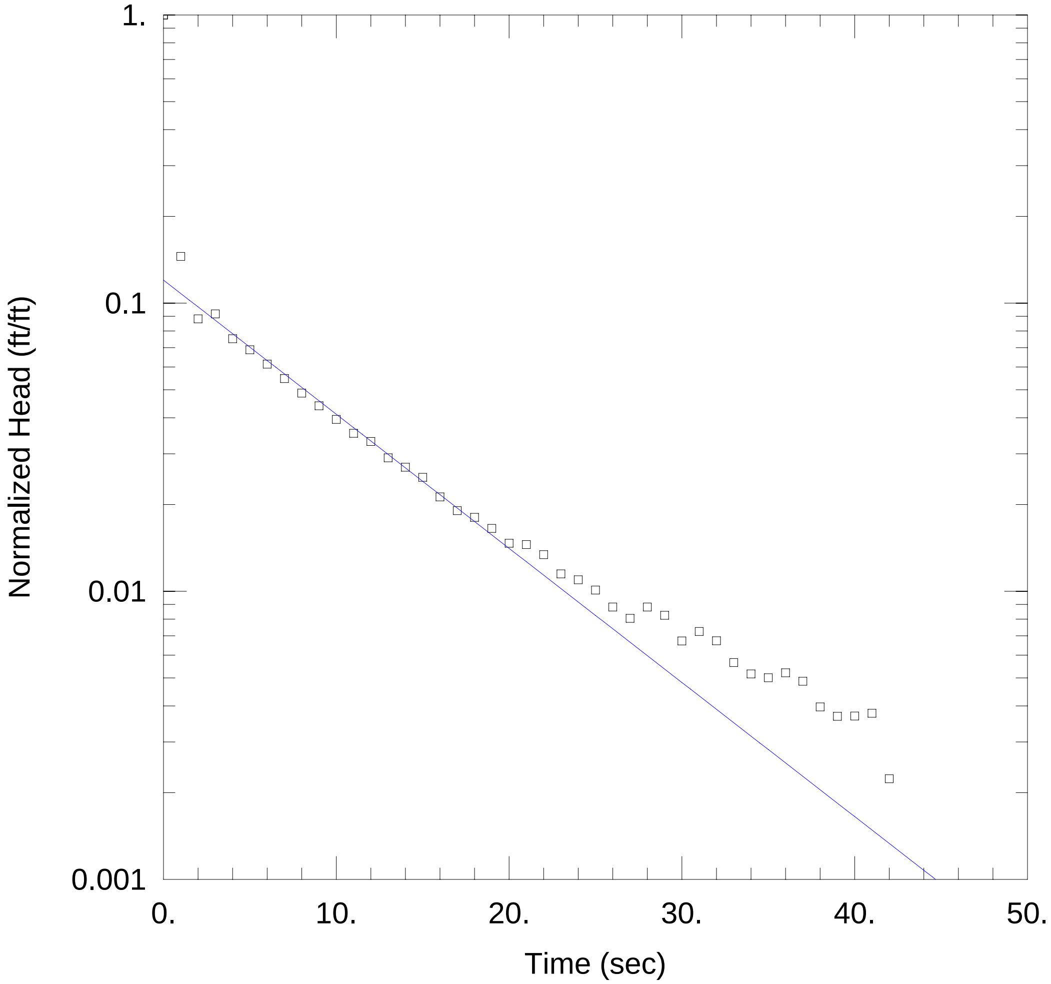
Saturated Thickness: 61.46 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (CI-10-35)

Initial Displacement: 3.92 ft
Static Water Column Height: 26.46 ft
Total Well Penetration Depth: 35. ft
Screen Length: 10. ft
Casing Radius: 0.083 ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 71.86 ft/day
y0 = 2.496 ft



SLUG TEST RESULTS FOR CI-10-65 (RISING HEAD)

Data Set: N:\Farallon\Capital Industries\Slug Testing Aug 2010\Aqtesolv Files\CI-10-65 RisingHead.aqt
Date: 01/21/11
Time: 15:36:10

PROJECT INFORMATION

Company: Farallon Consulting
Client: Capital
Test Date: 8-6-10

AQUIFER DATA

Saturated Thickness: 61.4 ft
Anisotropy Ratio (Kz/Kr): 1.

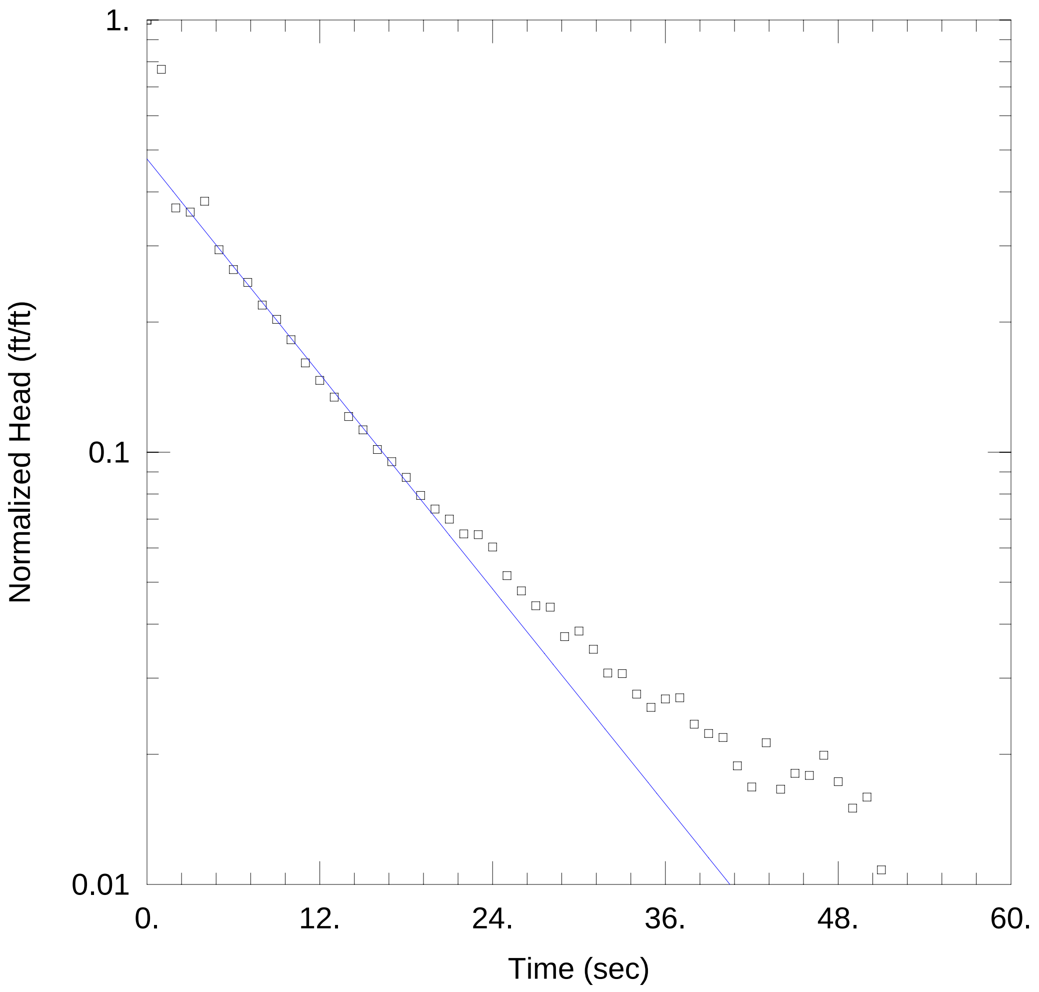
WELL DATA (CI-10-65)

Initial Displacement: 9.82 ft
Static Water Column Height: 56.4 ft
Total Well Penetration Depth: 65. ft
Screen Length: 15. ft
Casing Radius: 0.083 ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 10.58 ft/day
y0 = 1.18 ft



SLUG TEST RESULTS FOR CI-10-65 (FALLING HEAD)

Data Set: N:\Farallon\Capital Industries\Slug Testing Aug 2010\Aqtesolv Files\CI-10-65 FallingHead.aqt
Date: 01/21/11 Time: 15:36:30

PROJECT INFORMATION

Company: Farallon Consulting
Client: Capital
Test Date: 8-6-10

AQUIFER DATA

Saturated Thickness: 61.4 ft
Anisotropy Ratio (Kz/Kr): 1.

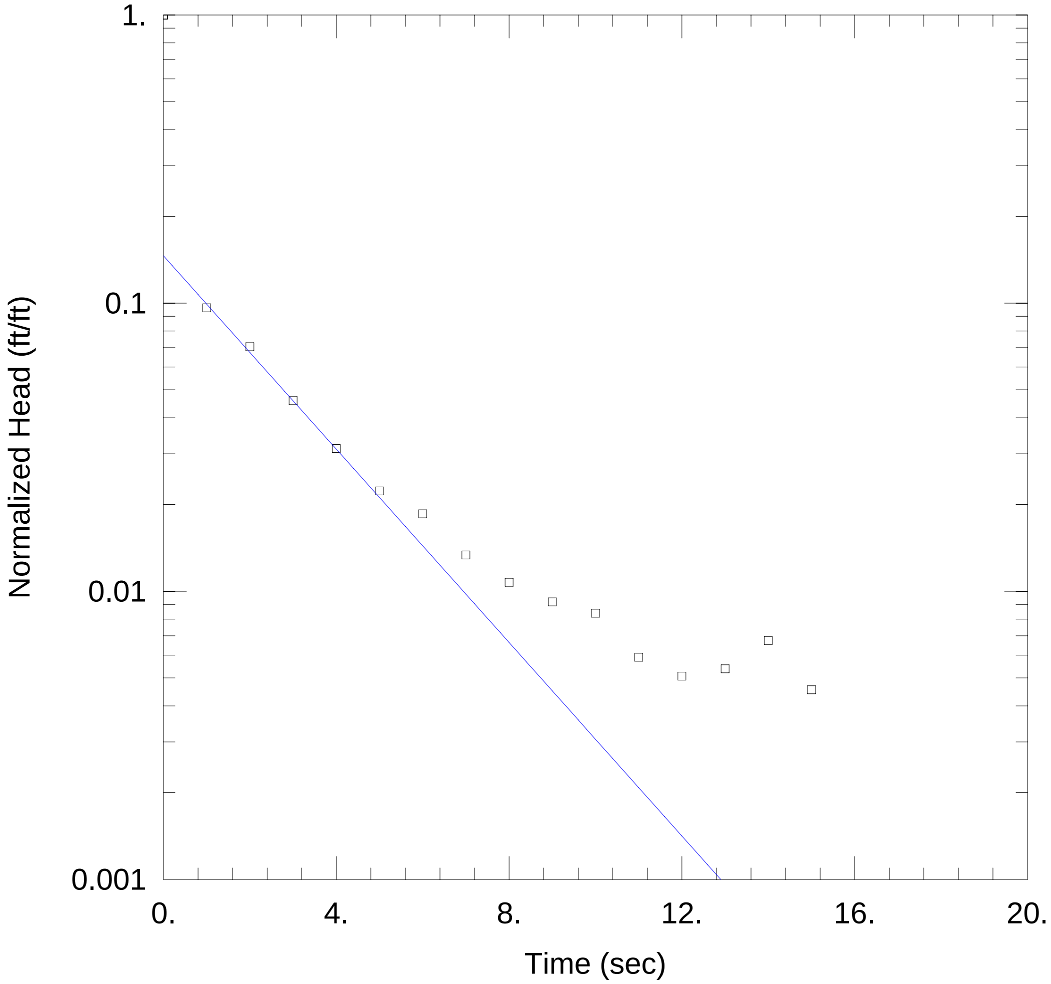
WELL DATA (CI-10-65)

Initial Displacement: 2.3 ft
Static Water Column Height: 56.4 ft
Total Well Penetration Depth: 65. ft
Screen Length: 15. ft
Casing Radius: 0.083 ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 9.423 ft/day
y0 = 1.097 ft



SLUG TEST RESULTS FOR CI-14-WT (RISING HEAD)

Data Set: N:\...\CI-14-WT RisingHead.aqt
Date: 01/21/11 Time: 15:36:52

PROJECT INFORMATION

Company: Farallon Consulting
Client: Capital
Test Date: 8-6-10

AQUIFER DATA

Saturated Thickness: 61.54 ft
Anisotropy Ratio (Kz/Kr): 1.

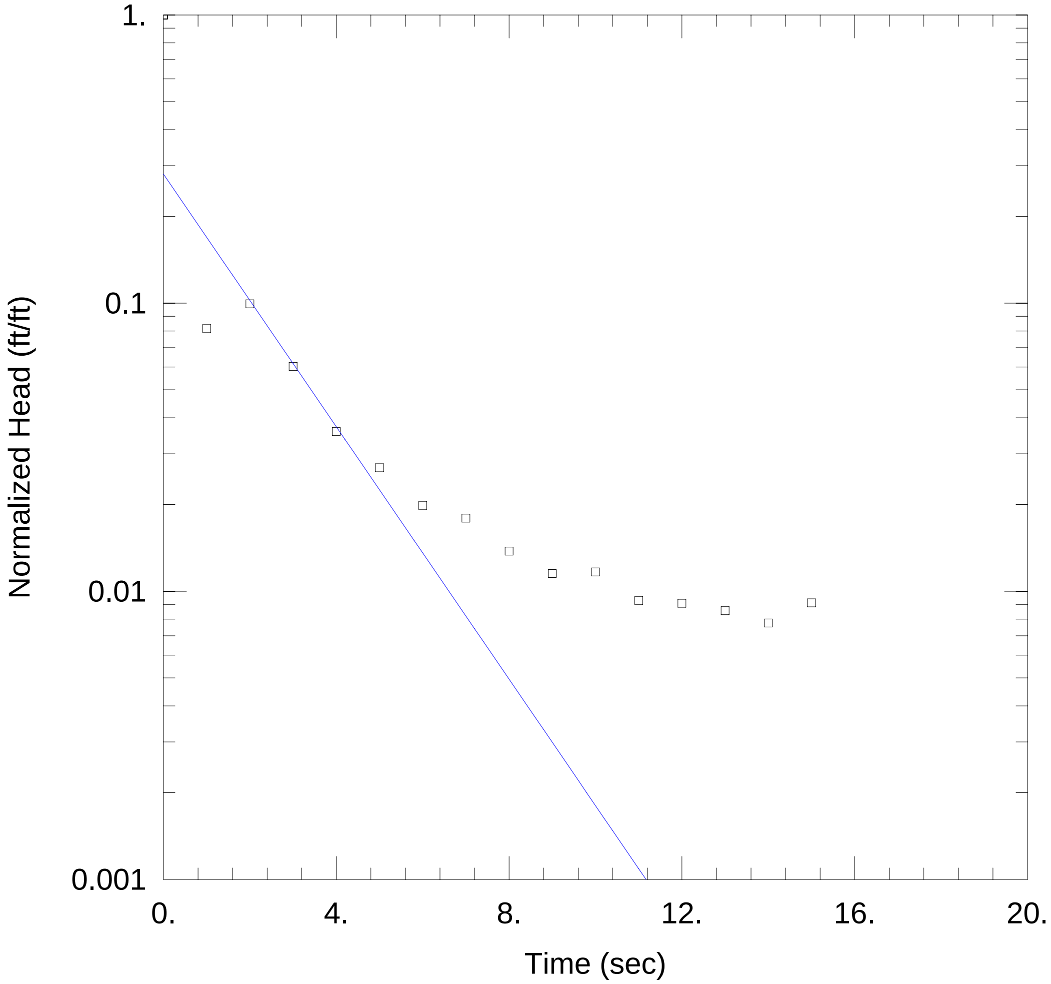
WELL DATA (CI-14-WT)

Initial Displacement: 3.54 ft
Static Water Column Height: 11.54 ft
Total Well Penetration Depth: 20. ft
Screen Length: 10. ft
Casing Radius: 0.083 ft
Well Radius: 0.083 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 40.87 ft/day
y0 = 0.5165 ft



SLUG TEST RESULTS FOR CI-14-WT (FALLING HEAD)

Data Set: N:\...\CI-14-WT FallingHead.aqt
Date: 01/21/11
Time: 15:37:11

PROJECT INFORMATION

Company: Farallon Consulting
Client: Capital
Test Date: 8-6-10

AQUIFER DATA

Saturated Thickness: 61.54 ft
Anisotropy Ratio (Kz/Kr): 1.

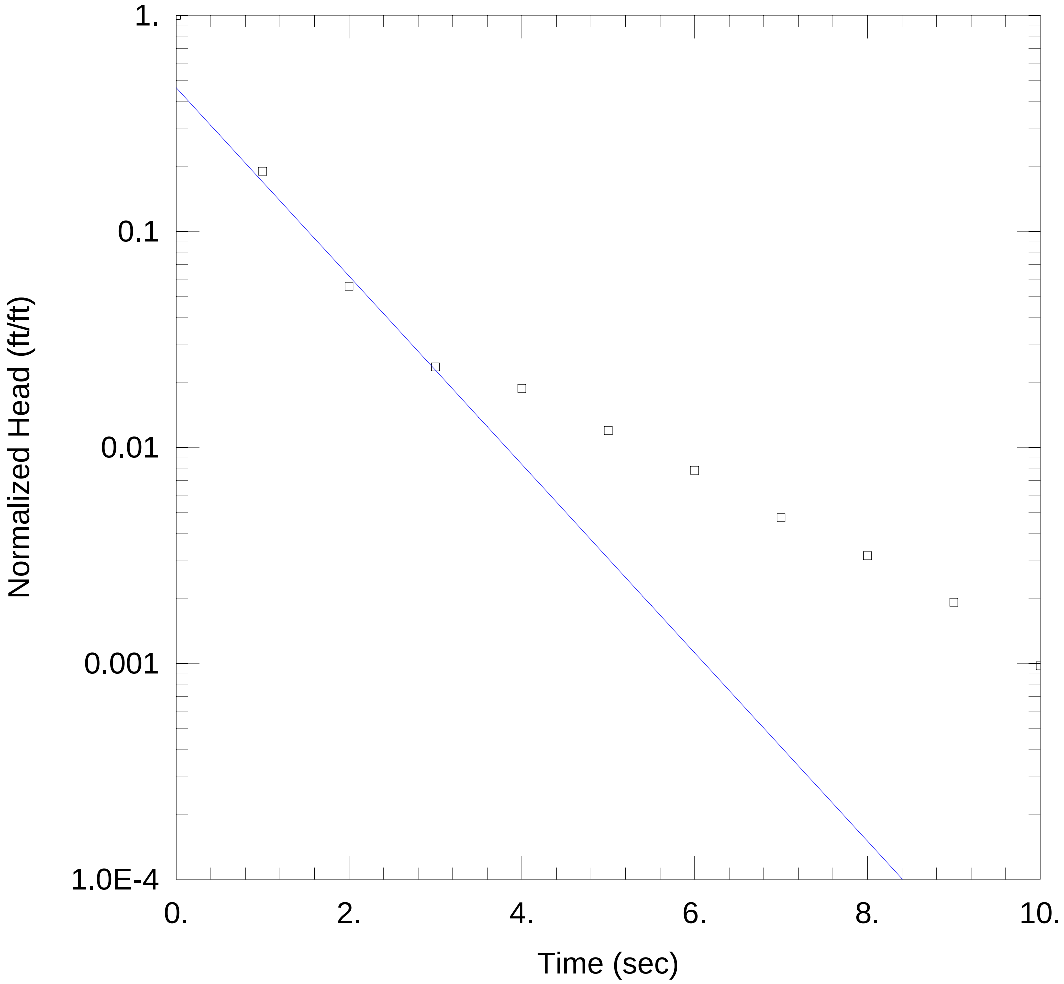
WELL DATA (CI-14-WT)

Initial Displacement: 3.97 ft
Total Well Penetration Depth: 20. ft
Casing Radius: 0.083 ft
Static Water Column Height: 11.54 ft
Screen Length: 10. ft
Well Radius: 0.083 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 53.37 ft/day
y0 = 1.112 ft



SLUG TEST RESULTS FOR CI-14-35 (RISING HEAD)

Data Set: N:\Farallon\Capital Industries\Slug Testing Aug 2010\Aqtesolv Files\CI-14-35 RisingHead.aqt
Date: 01/21/11 Time: 15:37:29

PROJECT INFORMATION

Company: Farallon Consulting
Client: Capital
Test Date: 8-6-10

AQUIFER DATA

Saturated Thickness: 61.44 ft
Anisotropy Ratio (Kz/Kr): 1.

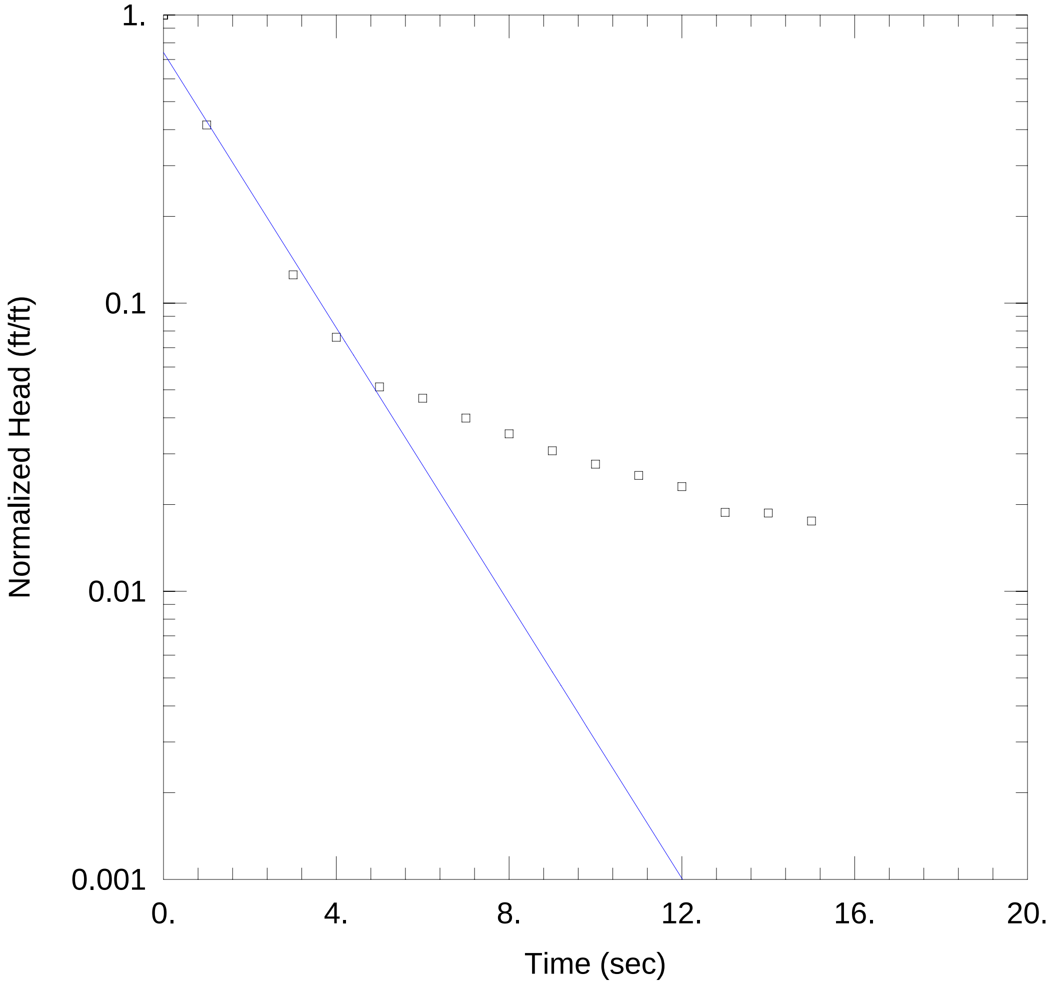
WELL DATA (CI-14-35)

Initial Displacement: 3.7 ft
Static Water Column Height: 26.44 ft
Total Well Penetration Depth: 35. ft
Screen Length: 10. ft
Casing Radius: 0.083 ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 114.4 ft/day
y0 = 1.707 ft



SLUG TEST RESULTS FOR CI-14-35 (FALLING HEAD)

Data Set: N:\Farallon\Capital Industries\Slug Testing Aug 2010\Aqtesolv Files\CI-14-35 FallingHead.aqt
Date: 01/21/11 Time: 15:37:52

PROJECT INFORMATION

Company: Farallon Consulting
Client: Capital
Test Date: 8-6-10

AQUIFER DATA

Saturated Thickness: 61.44 ft
Anisotropy Ratio (Kz/Kr): 1.

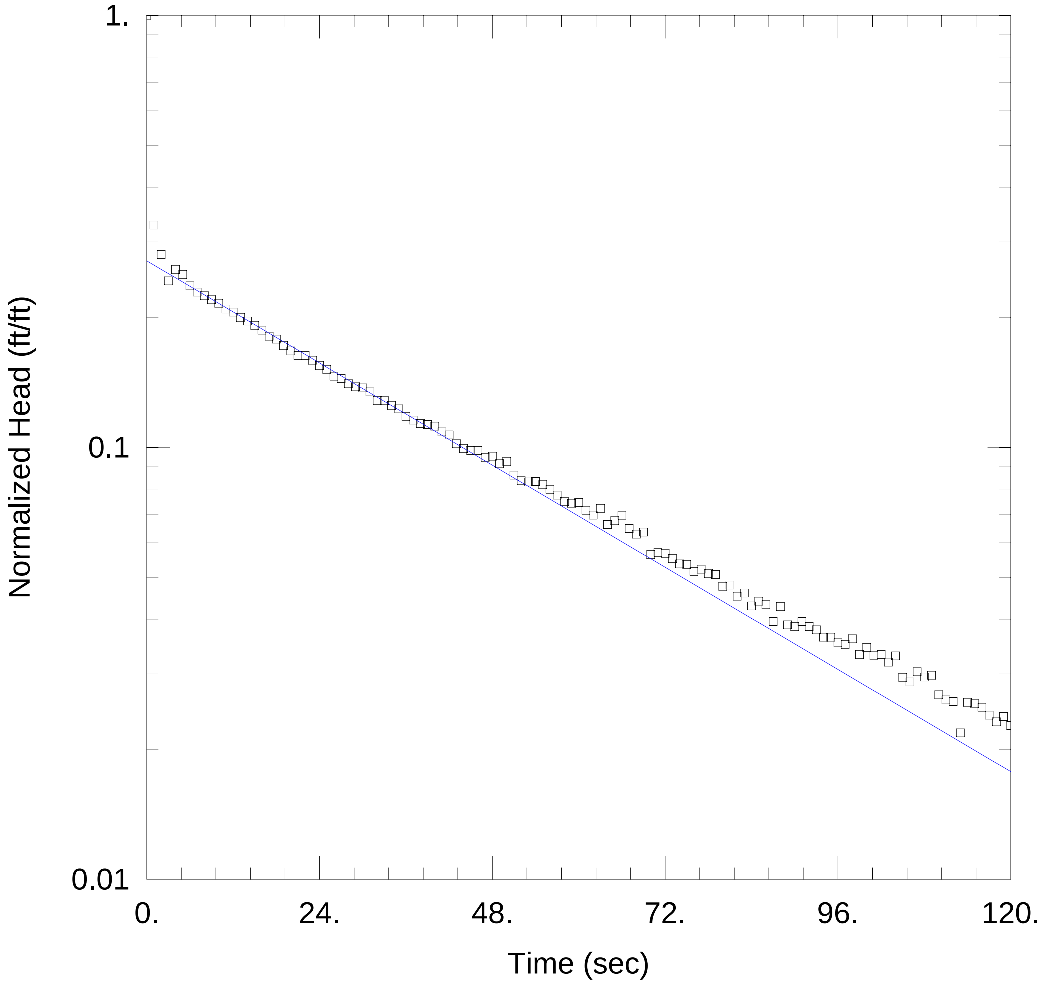
WELL DATA (CI-14-35)

Initial Displacement: 2.29 ft
Total Well Penetration Depth: 35. ft
Casing Radius: 0.083 ft
Static Water Column Height: 26.44 ft
Screen Length: 10. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev

K = 78.4 ft/day
y0 = 1.696 ft



SLUG TEST RESULTS FOR CI-14-70 (RISING HEAD)

Data Set: N:\Farallon\Capital Industries\Slug Testing Aug 2010\Aqtesolv Files\CI-14-70 RisingHead.aqt
Date: 01/21/11
Time: 15:38:26

PROJECT INFORMATION

Company: Farallon Consulting
Client: Capital
Test Date: 8-6-10

AQUIFER DATA

Saturated Thickness: 61.3 ft
Anisotropy Ratio (Kz/Kr): 1.

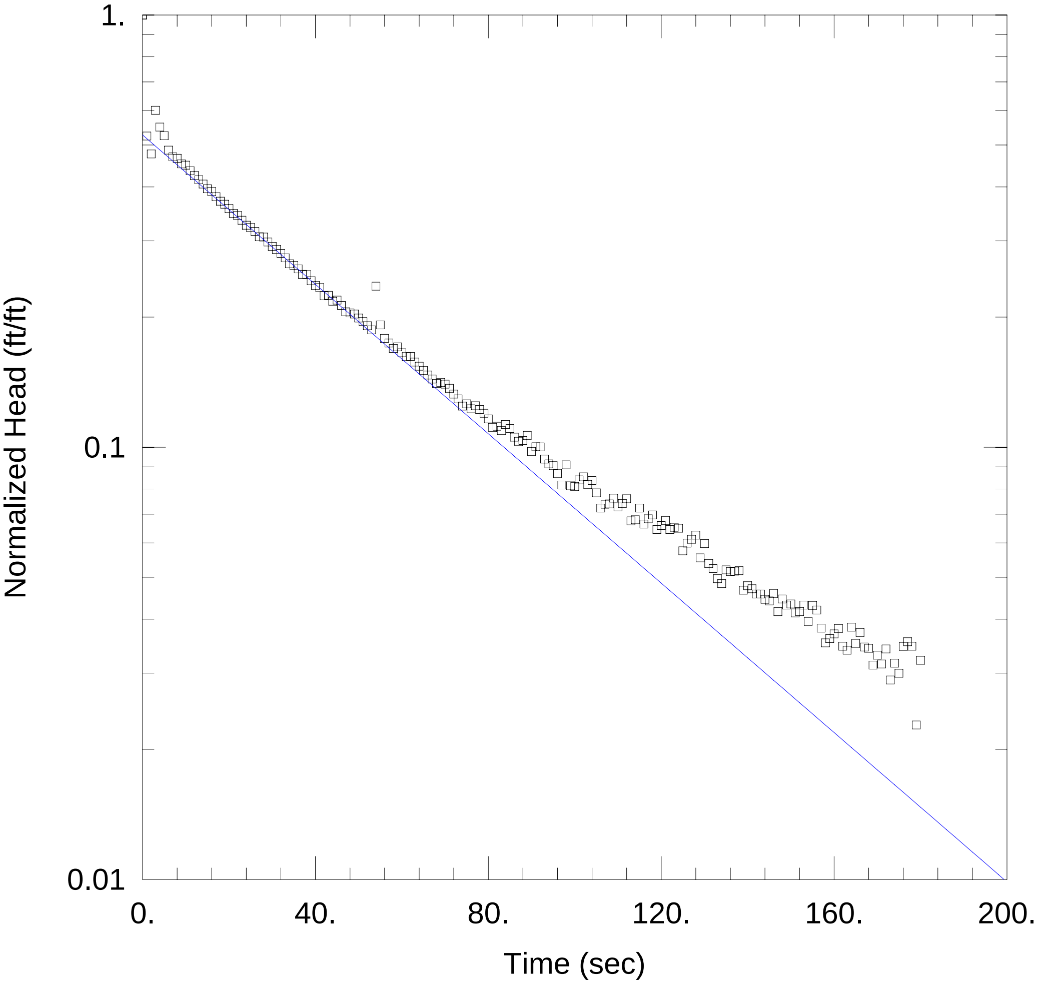
WELL DATA (CI-14-70)

Initial Displacement: 6.55 ft
Static Water Column Height: 61.3 ft
Total Well Penetration Depth: 70. ft
Screen Length: 10. ft
Casing Radius: 0.083 ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 3.305 ft/day
y0 = 1.769 ft



SLUG TEST RESULTS FOR CI-14-70 (FALLING HEAD)

Data Set: N:\Farallon\Capital Industries\Slug Testing Aug 2010\Aqtesolv Files\CI-14-70 FallingHead.aqt
Date: 01/21/11 Time: 15:38:52

PROJECT INFORMATION

Company: Farallon Consulting
Client: Capital
Test Date: 8-6-10

AQUIFER DATA

Saturated Thickness: 61.3 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (CI-14-70)

Initial Displacement: 3.01 ft
Static Water Column Height: 61.3 ft
Total Well Penetration Depth: 70. ft
Screen Length: 10. ft
Casing Radius: 0.083 ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 2.898 ft/day
y0 = 1.588 ft

ATTACHMENT E
REFERENCES

TIDAL STUDY AND
AQUIFER CHARACTERIZATION RESULTS
Capital Industries
5801 Third Avenue South
Seattle, Washington

Farallon PN: 457-004

ATTACHMENT E
REFERENCES

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