January 26, 2012

Ms. Rebekah Cadigan
Environmental Manager
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6450 Airport Way, Suite 1
Fairbanks, Alaska 99709

Subject: Groundwater Elevations from Fall 2010 to Fall 2011: an Addendum to the 2010 Additional Characterization and Groundwater Monitoring Report, Former Drainage Pond Site, Fairbanks International Airport

Dear Ms. Cadigan:

OASIS Environmental, Inc. (OASIS) has prepared this addendum to the 2010 Additional Characterization and Groundwater Monitoring Report for the Former Drainage Pond Site at Fairbanks International Airport (FAI). Work was performed under Notice To Proceed Number 3 under the Innovative Term Agreement Number 025-0-1-046. The purpose of the additional characterization and monitoring was to characterize the vertical and horizontal extent of soil and groundwater contamination sufficiently to finalize a Feasibility Study (FS) for remedial action at the site.

OASIS installed Solinst Levelogger™ temperature and water level dataloggers into Former Drainage Pond Site monitoring wells MW-38S, MW-38D, MW-39 and MW-40 on October 29, 2010. A Solinst Barologger™ was installed on the same day in monitoring well MW-38S for barometric pressure compensation of water level measurements. The Leveloggers™ were programmed to record temperature and water level every 6 hours. OASIS retrieved the Leveloggers™ and Barologger™ on September 16, 2011. A series of charts have been prepared to present the groundwater elevation and temperature measurements. The charts are included after the text in this addendum and are discussed below. Refer to figures in the 2010 Additional Characterization and Groundwater Monitoring Report for monitoring well locations. Elevations in this addendum are based on the NGVD ’29 coordinate system to be consistent with past site reports.

Chart 1: MW-38S/D, MW-39, and MW-40 Groundwater Elevation (10/29/10 to 9/16/11)

Chart 1 shows approximately 4 feet of annual fluctuation in the groundwater elevation of monitoring wells MW-38S/D and MW-40. However, MW-39 exhibited greater fluctuation. Between April 21 and 23, 2011, the groundwater elevation in MW-39 appeared to jump by approximately 10 feet, remained high for nearly one month, and then dropped again on May 18, 2011. This could be attributed to ice in the well casing. It is possible that MW-39 temporarily froze and the datalogger was encased in ice, giving erroneous pressure readings. Ice plugs were observed in nearby well MW-30R on two occasions in 2009.

MW-39 also shows greater short-term fluctuations than the other three monitoring wells. Based on the behavior of the groundwater table and review of the MW-39 boring log, the saturated zone in this well is

interpreted to contain lower permeability soils than the saturated zone in the other three monitoring wells. This well displayed poor recharge during development and subsequent purging while sampling. In general at MW-39, it seems that infiltration water temporarily perches on the lower permeability soils before eventually infiltrating and equilibrating with the groundwater table at the other monitoring wells. Except for the period between April and June 2011 when the datalogger appeared to be encased in ice, the groundwater elevation in MW-39 was generally similar to the groundwater elevation in MW-40, although as discussed earlier, it showed much greater short-term fluctuations.

Chart 1 also shows that the groundwater flow direction varies seasonally. In fall, the groundwater elevation is greater in MW-40 and MW-39 than in MW-38S, indicating flow to the north or northwest. In early winter, the groundwater elevation rose in MW-38S relative to MW-40, resulting in a negligible horizontal groundwater gradient throughout December and January. In late winter, the groundwater elevation increased in MW-38S relative to MW-40, indicating flow to the south or southeast. The groundwater flow remained towards the southeast to southwest through the summer months until late August, when it reversed back to fall flow towards the north or northwest. Table 9a presents representative horizontal gradient calculations for each of these periods.

Chena River and Tanana River gage heights are also presented on Chart 1. Chena River gage heights are considered provisional and were taken from the United State Geological Survey (USGS) station 15514000 at the Steese Highway Bridge. Tanana River gage heights are considered provisional and were taken from USGS station 15485500 south of FAI. The period that groundwater appears to perch at MW-39 corresponds to the Chena River break-up.

Chart 2: MW-38S/D, MW-39, and MW-40 Groundwater Temperature (10/29/10 to 9/16/11)

Chart 2 shows that the groundwater temperature in MW-38S/D and MW-40 generally rises and falls in accordance with the seasons, with the maximum temperature of approximately 6°C reached in October and a minimum temperature of approximately 1.5°C reached in June. In MW-39, the groundwater temperature showed greater short-term fluctuations, similar to the groundwater elevation pattern. Chart 6 explores the temperatures and water levels during spring breakup in more detail.

Chart 3: Groundwater Elevations MW-12, MW-30R, MW-35 (9/21/10 to 10/16/10); MW-38S/D, MW-39, and MW-40 (10/29/10 to 4/16/11)

Chart 3 displays the groundwater elevations recorded in monitoring wells MW-12, MW-30R, and MW-35 in September/October 2010 along with the groundwater elevations recorded in MW-38S/D, MW-39, and MW-40, after they were installed in October 2010. Chart 3 shows that the water level in MW-30R behaved somewhat similarly to the water level in MW-39, although the short-term fluctuations are greater in MW-39. MW-30R has also consistently shown poor recharge while purging during sampling. The chart suggests lower permeability soils in both of these locations. This conclusion is consistent with the conclusions reached in the body of this report.

Chart 3 also shows a vertical line on November 2, 2011, which corresponds to the groundwater elevations on November 2, 2011. Figure 6 in the 2010 Additional Characterization and Groundwater Monitoring report is a groundwater table elevation contour map from November 2, 2011.

Chart 4: MW-38S/D Groundwater Elevations and Temperatures (10/29/10 to 4/30/11); and

Chart 5: MW-38S/D Groundwater Elevations and Temperatures (5/1/11 to 9/15/11)

Charts 4 and 5 present detailed views of the groundwater elevations and temperatures in MW-38S and MW-38D. Charts 4 and 5 indicate little difference between the groundwater elevations recorded in MW-38S and MW-38D. Table 9b presents representative vertical gradient calculations, showing that there is a negligible vertical gradient between MW-38S and MW-38D. Chart 4 shows transient temperature effects in both MW-38S and MW-38D during spring breakup in April 2011. These effects are shown in more detail on Chart 6.

Chart 6: MW-38S/D Groundwater Elevations and MW-38S/D, MW-39, and MW-40 Temperatures (4/7/11 to 5/7/11)

Chart 6 shows that groundwater temperature effects were measured in the dataloggers in MW-38S, MW-38D, and MW-39 during late April/early May. However, MW-40 showed little temperature effects.

In MW-38D, the groundwater temperature showed a short-term decrease of approximately 1 ^{o}C on April 16-17, 2011 and then a modest decrease (less than 0.25 ^{o}C)on April 28, which slowly equilibrated by May 7, 2011.

The groundwater temperature in MW-38S decreased by approximately 0.75^{o}C on April 26, 2011 and then gradually increased until it equilibrated around May 2, 2011. As shown on Chart 6, there was no corresponding difference in groundwater elevation in MW-38S and MW-38D during the periods of decreasing groundwater temperature.

The groundwater temperature in MW-39 showed the greatest degree of fluctuation, with an initial decrease of approximately 0.25 ^{o}C on April 22, 2011, followed by periods of short-term fluctuations of approximately 1^{o}C up to 2^{o}C through the end of the period shown on Chart 6 (May 7, 2011). Over this time period, the temperature fluctuations occurred on a daily basis, with the 6 am and noon temperatures consistently lower than the 6 pm and midnight temperatures. A comparison of Chart 6 and Chart 1 shows that the period of high groundwater temperature fluctuations in MW-39 coincides with the period of high groundwater elevation. It appears that, during the period with high groundwater elevation, the groundwater was shallow enough to reflect daily temperature fluctuations.

Conclusions

Important conclusions from the datalogger record are summarized below.

There is no indication of a measurable vertical gradient between MW-38S and MW-38D.

The horizontal groundwater gradient between MW-40 and MW-38S varied from approximately zero (in the winter months) to 0.04 ft/ft in the fall months to -0.01 to -0.03 during the spring and summer months.

The horizontal groundwater flow direction varies seasonally. In fall, groundwater flows to the north or northwest. A negligible horizontal gradient exists during December and January. From late winter through late August the groundwater flows to the southwest to southeast. In early September flow switches back towards the north or northwest.

The groundwater in MW-39 appears to be perched on a relatively low permeability layer in April and May at an elevation approximately 10 feet higher than in MW-38S. Except for this period, the groundwater

elevation in MW-39 is generally similar to the MW-40 elevation, although it shows greater short-term fluctuations.

Recommendations

The 2010-2011 datalogger study showed a variable horizontal groundwater flow direction but no measurable vertical gradient (between MW-38S and MW-38D) at the Former Drainage Pond site. The groundwater flow reversals affect migration of the groundwater plume and may explain why the plume does not appear to have migrated across Airport Industrial Road from the site.

In order to better define groundwater flow patterns at the site and their effect on plume migration, we recommend another datalogger study. Dataloggers may be placed into the two monitoring wells recommended to be installed in the body of this report to define the plume boundary (i.e., MW-41 northwest of MW-40 and MW-42 north of TW-3), along with MW-34 or MW-35, MW-36 or MW-37, MW-40, and MW-30R. This proposed datalogger study will include monitoring wells that are further apart to expand our understanding of groundwater flow patterns at the site. The 2010-2011 datalogger study focused on monitoring wells that are located close together on the Former Drainage Pond site to evaluate vertical gradients at MW-38S/D and horizontal gradients across the site itself. Since the 2010-2011 datalogger study did not suggest a measurable vertical gradient between MW-38S and MW-38D, no further datalogger monitoring is recommended in MW-38D.

OASIS appreciates the opportunity to assist FAI with this project. Please call on us with any questions or comments you have regarding this report.

Sincerely,
OASIS Environmental, Inc.

Jane Paris
Sr. Hydrogeologist

Andrew Weller
Project Manager

Charts:

1. MW-38S/D, MW-39, and MW-40 Groundwater Elevation (10/29/10 to 9/16/11)
2. MW-38S/D, MW-39, and MW-40 Groundwater Temperature (10/29/10 to 9/16/11)
3. Groundwater Elevations MW-12, MW-30R, MW-35 (9/21/10 to 10/16/10); MW-38S/D, MW-39, and MW-40 (10/29/10 to 4/16/11)
4. MW-38S/D Groundwater Elevations and Temperatures (10/29/10 to 4/30/11)
5. MW-38S/D Groundwater Elevations and Temperatures (5/1/11 to 9/15/11)
6. MW-38S/D Groundwater Elevations and MW-38S/D, MW-39, and MW-40 Temperatures (4/7/11 to 5/7/11)

Table:

9. Groundwater Gradient Calculations

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CHARTS

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Chart 1: Groundwater Elevation 10/29/10 to 9/16/11
MW-38S/D, MW-39, and MW-40
FAI Drainage Pond

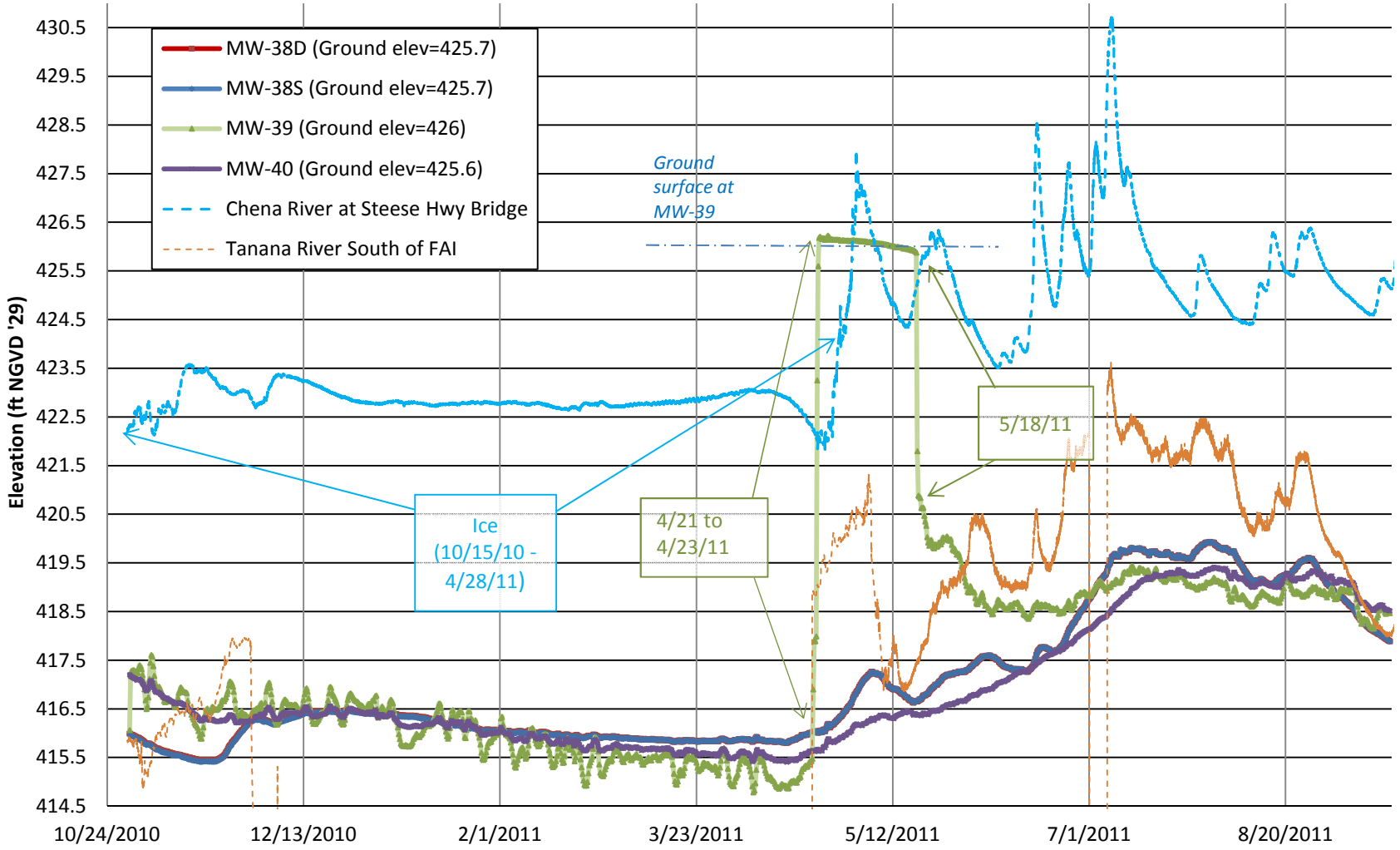

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Chart 2: Groundwater Temperature 10/29/10 to 9/16/11
MW-38S/D, MW-39, and MW-40
FAI Drainage Pond

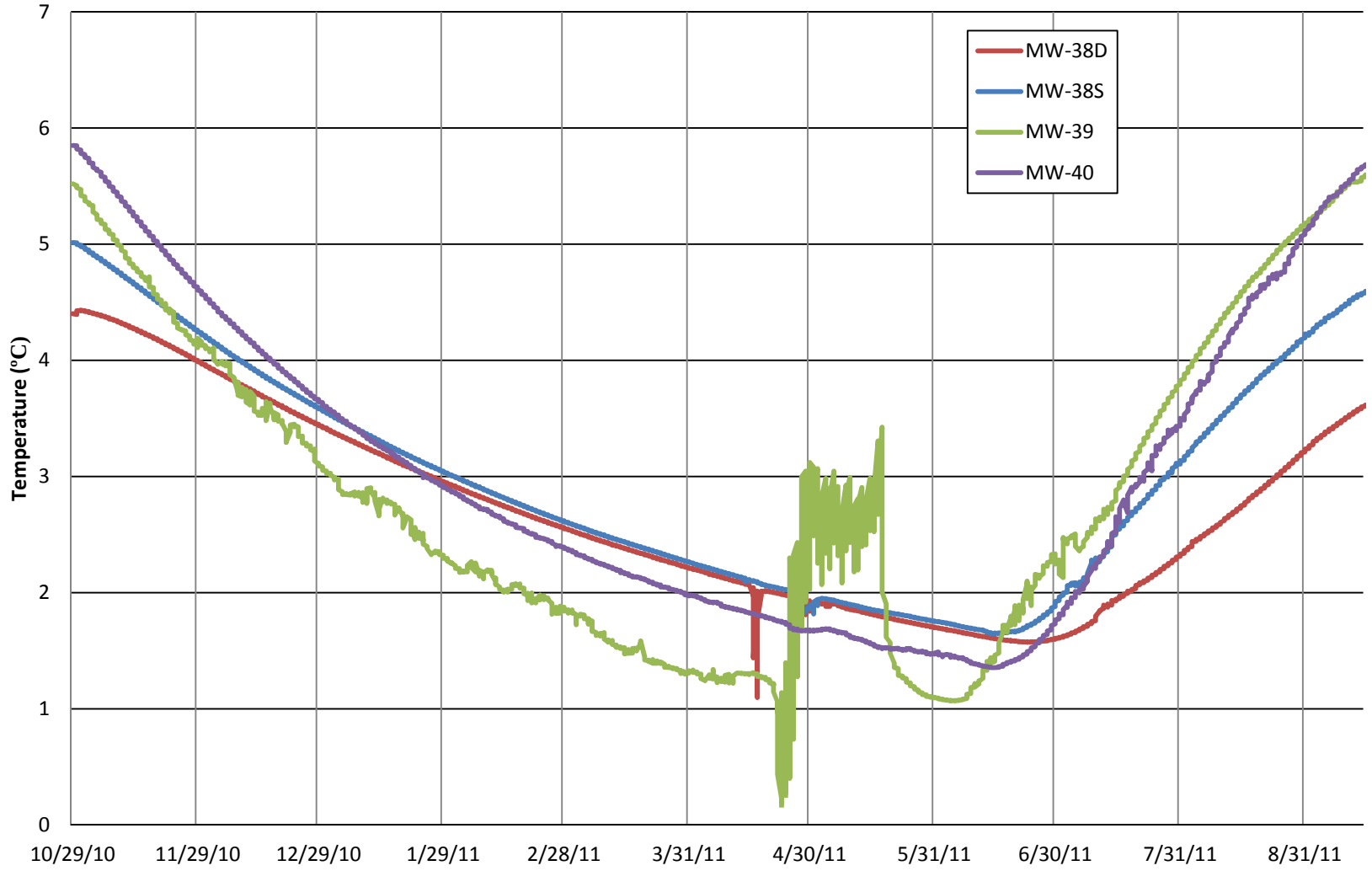

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Chart 3: Groundwater Elevations
MW-12, MW-30R, MW-35 (9/21/10 to 10/16/10)
MW-38S/D, MW-39, and MW-40 (10/29/10 to 4/16/11)
FAI Drainage Pond

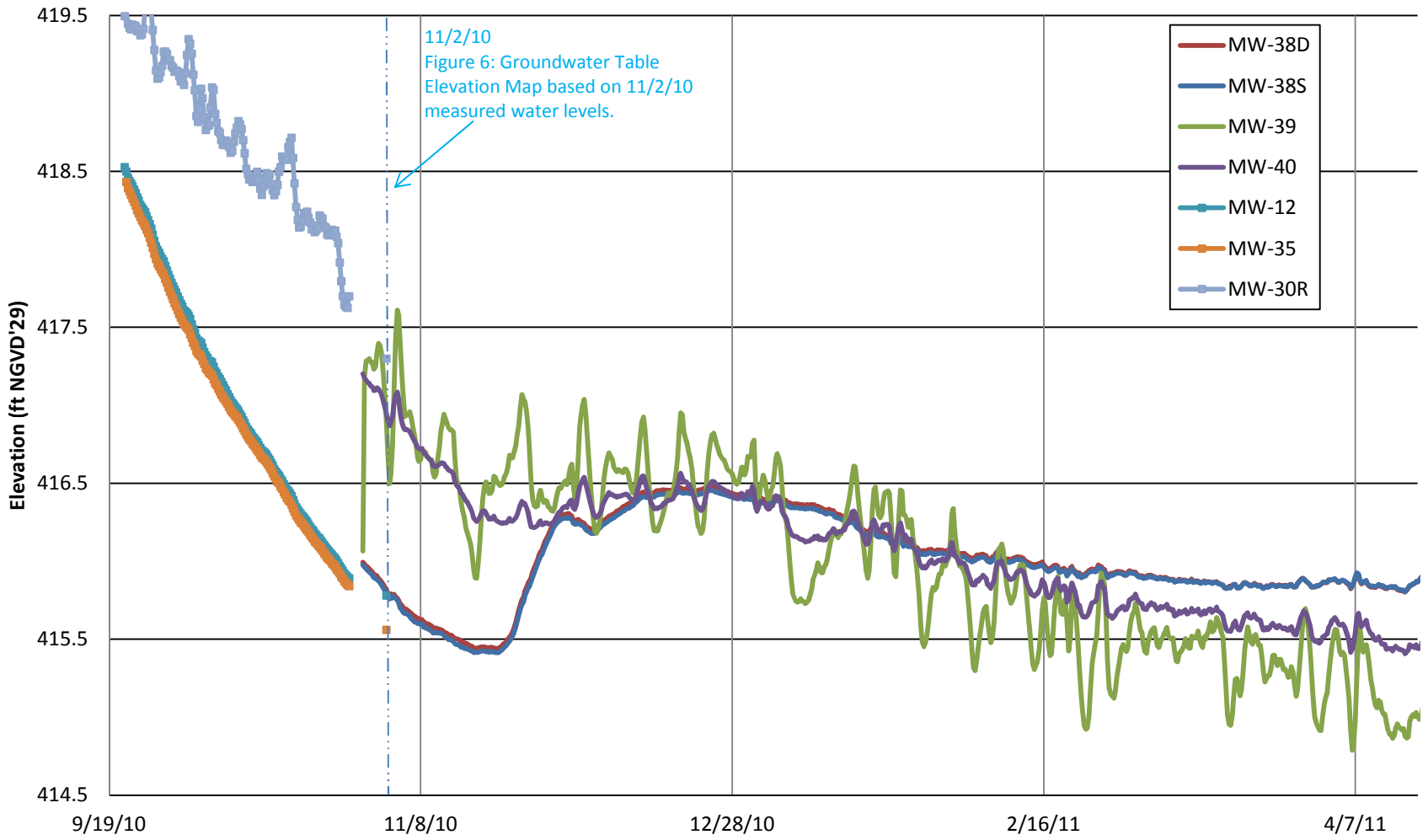

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Chart 4: MW-38S/D Groundwater Elevations and Temperatures
10/29/10 to 4/30/11
FAI Drainage Pond

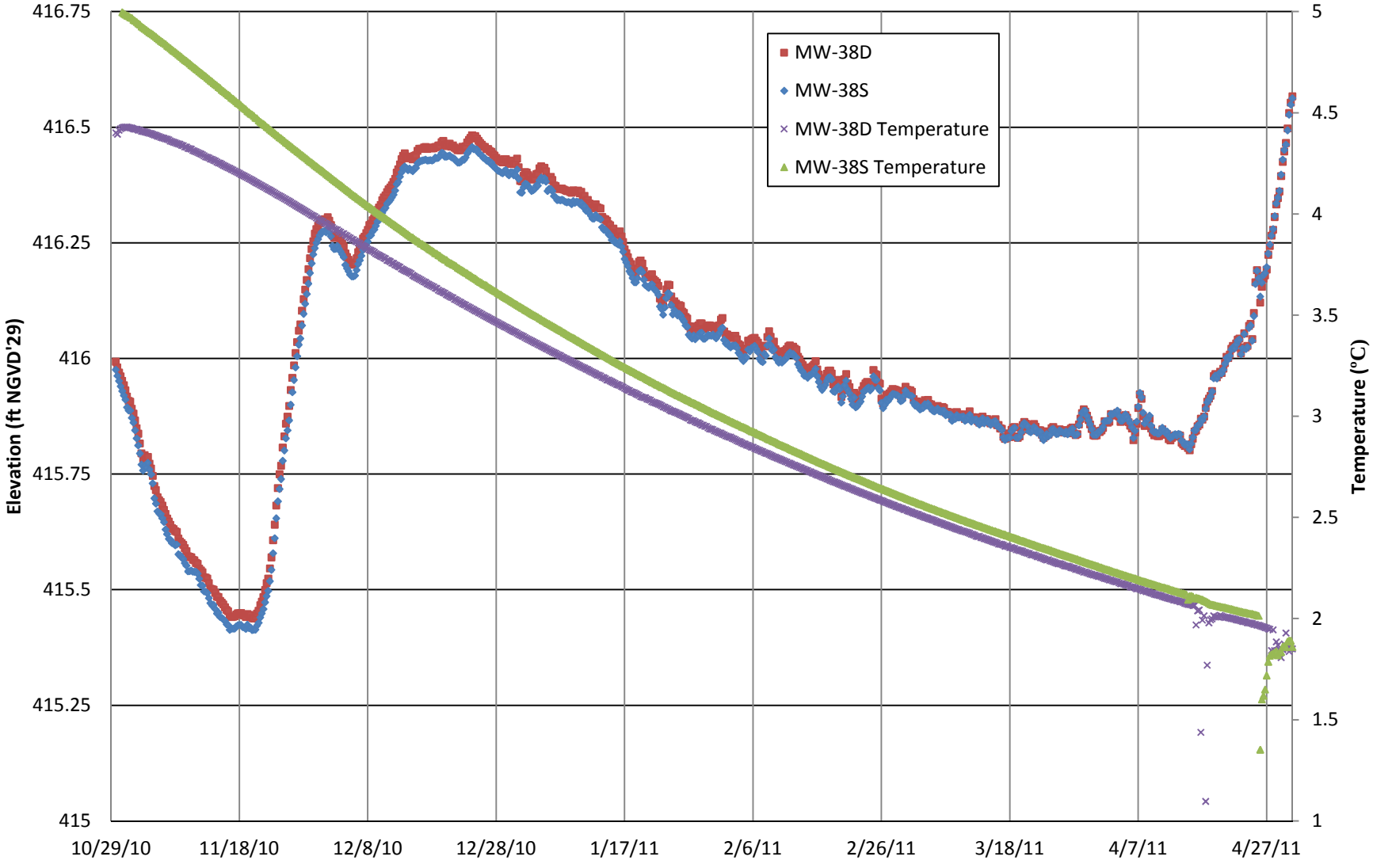

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Chart 5: MW-38S/D Groundwater Elevations and Temperatures
5/1/11 to 9/15/11
FAI Drainage Pond

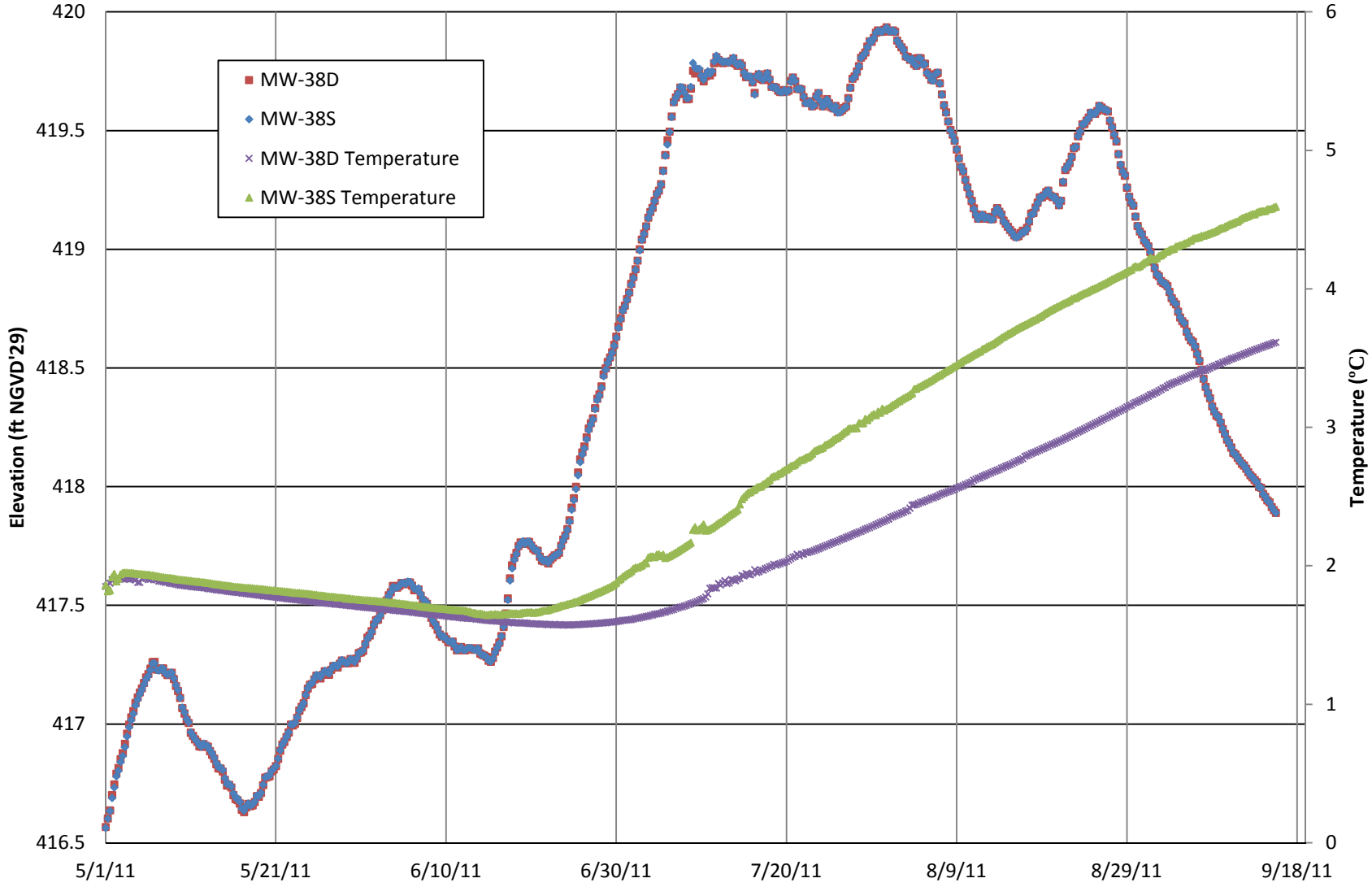

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Chart 6: MW-38S/D Groundwater Elevations and MW-38S/D, MW-39, and MW-40 Temperatures 4/7/11 to 5/7/11 FAI Drainage Pond

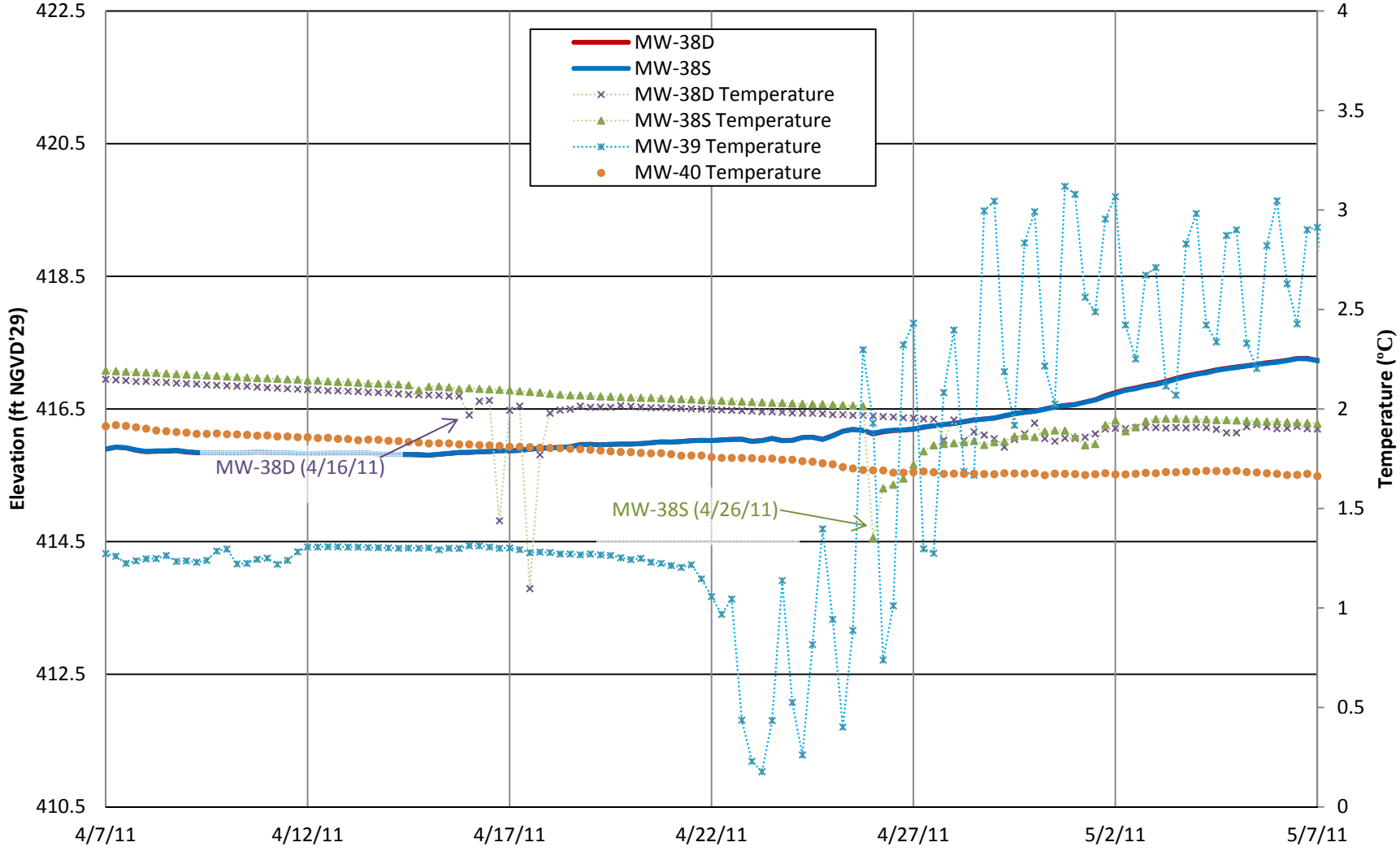

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TABLE

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Tables 9a and 9b
Groundwater Gradient Calculations
Fairbanks International Airport, Drainage Pond

Table 9a Horizontal Gradient

Monitoring Well	11/2/10 GW Elevation		12/28/10 GW Elevation		4/16/11 GW Elevation		5/6/11 GW Elevation*	
MW-38S	low	415.71	low	416.41	high	415.86	mid	417.26
MW-38D		415.73		416.43		415.86		417.26
MW-39	mid	416.82	high	416.50	low	415.00	high*	426.09
MW-40	high	416.87	mid	416.41	mid	415.45	low	416.30
high to low distance (ft)	30		66		66		68	
equipotential line (ft)	1.3		65.7		31.7		61.4	
Flow Direction	N-NW		W-NW		SE		W-SW	
Gradient (ft/ft)	0.040		0.001		0.013		0.144	

* Questionable MW-39 groundwater elevation

ft = feet

Equipotential line is distance in feet from well with highest groundwater elevation (GWE) and is calculated by ((high GWE - mid GWE)/(high GWE - low GWE))*high to low distance

Gradient is in feet/feet and is calculated by (mid GWE - low GWE)/distance of equipotential line to well with low GWE

Summary

From 9/19/10 to 11/21/10: Groundwater flow from MW-40 towards MW-38 (e.g., 11/2/10 gradient is representative)

From 11/21/10 to 11/30/10: Horizontal gradient decreasing to negligible

From 11/30/11 to 1/31/11: Negligible horizontal gradient (i.e., 12/28/10 gradient is representative)

From 2/1/11 to 4/16/11: Horizontal gradient increasing but in opposite direction, from MW-38 towards MW-40 (i.e., 4/16/11 gradient is maximum)

From 4/17/11 to 8/31/11: Groundwater flow from MW-38 towards MW-40 with magnitude fluctuating (i.e., 5/6/11 gradient is maximum)

From 8/31/11 to 9/15/11: Horizontal gradient reverses again with flow from MW-40 towards MW-38

Table 9b Vertical Gradient (MW-38S to MW-38D)

Date	Distance*	Elevation Change (ft)	Gradient (ft/ft)
11/2/2010	21.5	0.020	0.001
12/28/2010	21.5	0.024	0.001
4/16/2011	21.5	0.000	0.000
5/6/2011	21.5	0.005	0.000

* Middle of screen to middle of screen

Summary

Slight upward vertical gradient is negligible.

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