GeoTrans, Inc.
A TETRA TECH COMPANY

363 Centennial Parkway
Suite 210
Louisville, Colorado 80027

www.geotransinc.com

(303) 665-4390; FAX (303) 665-4391

Via Email and Express Mail

May 28, 2009

Mr. Scott Miller
Remedial Project Manager
U.S. Environmental Protection Agency, Region IV
4WD-SRTMB
61 Forsyth Street
Atlanta, Georgia 30303-3104

Subject: Comments on GRU January 30, 2009 Technical Memorandum entitled "*Evidence of DNAPL Movement at Koppers Site*,"

Dear Mr. Miller:

On behalf of Beazer East, Inc., attached to this letter is our response to the Gainesville Regional Utilities (GRU) January 30, 2009 Technical Memorandum (Memo) entitled "*Evidence of DNAPL Mobility at Koppers Site*". This document is also in response to the U. S. Environmental Protection Agency (EPA) email dated February 6, 2009, in which a request is made for Beazer to provide a separate evaluation of the DNAPL information included in the GRU Memo. As indicated in emails to the U. S. Environmental Protection Agency (EPA) dated February 10 and 11, 2009 the reported increase in DNAPL thickness in Hawthorn Group monitoring wells coincides with DNAPL measurements performed by a new O&M contractor for the Koppers portion of the Cabot Carbon/Koppers Superfund Site (Site). It is Beazer's position that most of the reported increases in DNAPL thickness in select monitoring wells are due to inaccurate DNAPL measurements coinciding with a transition of a new O&M contractor. In addition, increased DNAPL thicknesses for two monitoring wells in the former Process Area appear to correlate with the previously identified DNAPL source zones in the Hawthorn Group (HG) deposits. The following is a summary of key technical issues, comments on the GRU Memo and recommendations for improving DNAPL thickness measurements. A detailed discussion of these technical issues and Beazer's evaluation of the DNAPL data are presented in **Attachment 1**.

Summary of Issues and Comments:

The GRU Memo presents DNAPL thickness and recovery data for the five HG wells at the Site that contain measurable DNAPL. The primary purpose of the Memo is to further advance the GRU Team conceptual model of mobile DNAPL in the Surficial Aquifer, HG deposits and Upper Floridan Aquifer. The following is a summary of our evaluation of the DNAPL data and response to select technical issues raised in the GRU Memo.

1) Statistical analysis of the reported DNAPL data demonstrates that the 2007 data used by the GRU Team to support their flawed conceptual model of mobile DNAPL are questionable. A linear regression of the DNAPL thicknesses versus recovered volumes demonstrates that the data collected during the time period July to December 2007 are questionable and inaccurate. Data collected during the time periods June 2004 to June 2007 and January 2008 to present appear to be the most accurate and indicate that significant increases in DNAPL thickness did not occur in the former North Lagoon and Drip Track areas. The DNAPL thicknesses observed in the former Process Area wells correlate with the DNAPL source zone elevations identified during the well installations in 2004. The post-2007 increase in DNAPL thickness for these wells is likely due to additional well development resulting from bailing activities that increased hydraulic communication between the well and formation.

2) The GRU Team developed a flawed conceptual model for the release of excess DNAPL from the Surficial Aquifer due to a water-table decline at the Site that never occurred. A 15-foot water-table decline is hypothesized to have occurred at the Site as a result of below normal precipitation for calendar year 2006. This decline is based on observations for a monitoring well located 2.5 miles from the Site. It is not clear why the GRU Team chose to use an off-Site monitoring well when Surficial Aquifer water levels are monitored quarterly at the Site. It is also surprising that the GRU Team would claim a 15-foot decline in the water table when actual Site data show that the water-table decline was a small fraction of this amount. Actual Site water-table declines during 2006 in the former Process Area were less than 4 feet and by January 2007 the declines were less than 2 feet. These Site data do not support the GRU Team conceptual model of mobile DNAPL release caused by a 15-foot water-table decline at the Site. Actual Site data demonstrate that a 15-foot water-table decline never occurred.

3) The GRU Team failed to consider past water-table declines that would have previously drained the DNAPL on which the GRU Team flawed conceptual model relies. The GRU Team conceptual model of DNAPL release due to a declining water-table is theoretically possible. We agree that residual DNAPL trapped in pores immediately below the water-table has the potential of readjusting to a lower residual saturation in a three-phase system (i.e., water, DNAPL and air). Any reduction in residual saturation will result in a release of the excess DNAPL, with the potential for the excess DNAPL to migrate vertically downward. The flaw in the use of this technical argument for 2007 Site DNAPL data is that the release of DNAPL is likely to be a one-time event coinciding with the first sustained decline in the water table. The water-table decline observed in 2006 was the most recent of a series of 15 potential water-table declines going back to 1980. Any release of residual DNAPL due to a declining water table in the Surficial Aquifer would have occurred well in advance of 2006, with the most severe water-table decline occurring during a 5-year period from 1997 to 2001. Hence, DNAPL release in 2006 likely did not occur since previous water-table declines that preceded this date would have previously drained excess DNAPL from this water-table transition zone.

4) The GRU Memo hypothesizes that the increase in DNAPL thickness in the former Process Area is due to a continuous DNAPL pool that extends from the base of the Surficial Aquifer to the top of the HG middle clay unit. An alternative conceptual

GeoTrans, Inc.

model for the apparent increase in DNAPL thickness in well HG-15S is the presence of DNAPL in the HG. This alternative conceptual model is based on the observed location of potential DNAPL source zones in core samples collected during the installation of this well in 2004. A review of the lithologic logs for well HG-15S indicate that DNAPL impacted core was observed at a depth of 68 to 70 feet below land surface, which corresponds to a DNAPL thickness in the well of approximately 6.3 to 8.3 feet above the base of the well. The "Pre-Bailing" 2008 DNAPL thickness measured in well HG-15S is approximately 7 to 8 feet. The location of the DNAPL source zone is closely correlated with the DNAPL thickness reported for this well indicating that the source of the DNAPL is most likely this DNAPL source zone within the HG. The few isolated measurements of DNAPL thicknesses that extended above the top of the screen interval appear to be inaccurate data (see response to items #1 and #2). The GRU Team hypothesis of vertically connected DNAPL pools in the Surficial Aquifer is based on a few inaccurate DNAPL measurements and is not supported by the entire body of data for these wells. Similar to well HG-15S, DNAPL source zones identified in HG cores opposite well HG-11S screen interval correlate with measured DNAPL thicknesses in this well.

5) The figures in the GRU Memo **Attachment B** were modified by the GRU Team to highlight wells with mobile DNAPL. Five of the ten HG wells highlighted in Figures 5 and 8 by the GRU Team and identified in the explanation as "*Mobile DNAPL recovered in well*" do not have mobile DNAPL. Wells with no "*Mobile DNAPL*" include the following: (1) HG-9S; (2) HG-12D; (3) HG-18S; (4) HG-10D and (5) HG-16D. Contrary to the GRU Team's statements and figures, free-phase recoverable DNAPL is restricted to only five wells in the Upper Hawthorn; mobile DNAPL has not been encountered in the Lower Hawthorn.

Recommendations To Improve DNAPL Measurements:

The accuracy of the DNAPL measurements in wells HG-15S and HG-11S appear to be impacted by both DNAPL blebs entering the well from source zones adjacent to the screen interval and from mixing within the water column during NAPL removal with a bailer. In an attempt to improve DNAPL thickness measurements, Beazer proposes to investigate an alternative DNAPL removal method that would minimize mixing within the water column. Rather than lowering a bailer into the well for DNAPL recovery, Beazer proposes to attempt DNAPL recovery with a peristaltic pump in wells HG-15S and HG-11S. A ¼" diameter tube will be lowered to the base of the well, such that DNAPL will be removed via the tube by pumping from the base of the well. This will eliminate vertical mixing within the water column and will allow for more rapid DNAPL thickness measurements as the DNAPL interface drops during DNAPL removal. Once DNAPL discharge is observed to cease from the ¼" tube, pumping will stop and the recovery of the DNAPL interface will be monitored with the phase probe. Although the phase probe will still be impacted by DNAPL blebs entering the well from the impacted zone, the proposed approach will minimize mixing within the well, helping achieve the goal of obtaining more accurate measurements of post-DNAPL recovery.

A detailed evaluation of the DNAPL data and conceptual model is provided in **Attachment 1**.

Sincerely,

James R. Erickson, P.G.
Vice President
Principal Hydrogeologist

James W. Mercer, Ph.D., P.G.
Executive Vice President
Professional Geologist FL #275
Principal Hydrogeologist

Attachments

cc: W. O'Steen, U.S. EPA
K. Helton, FDEP
J. Mousa, ACEPD
R. Hutton, GRU
J. Spicuzza, KI
M. Brourman, BEI
M. Slenska, BEI
G. Council, GT

ATTACHMENT 1
DETAILED RESPONSE TO GRU TECHNICAL MEMORANDUM
"EVIDENCE OF DNAPL MOVEMENT AT KOPPERS SITE, JANUARY 30, 2009"

The GRU Technical Memorandum (Memo) presents an analysis of historical DNAPL thickness and recovery data to further the hypothesis that DNAPL is mobile and continuing to migrate at the Koppers, Inc. site (Site). The GRU Memo makes the following statement on page 1of the Memo concerning these data (Page 1, 2nd Paragraph):

> "*However, a distinct increase in DNAPL thickness is reported starting in the summer of 2007 in all of those wells except HG-10S. These data document unequivocally that DNAPL at the Koppers Site is mobile in the Hawthorn Group sediments beneath at least three of the four DNAPL source areas defined by GeoTrans in the Surficial aquifer.*"

Contrary to this conclusion, it is Beazer's position that the subset of data used by GRU to develop the mobility argument is questionable. The previous O&M contractor at the Site performed DNAPL measurements starting shortly after the wells were installed in June 2004 until June 2007. A new O&M contractor performed DNAPL measurements starting on July 10, 2007 and continuing to the present. The first measurement event performed by the new contractor on July 10, 2007 showed significant increases in DNAPL thickness in four of the five wells with recoverable DNAPL. The DNAPL thickness was reported to have increased by 6 to 8 feet in two of the wells and 2 to 3 feet in the remaining two wells. The reported increase was not a gradual rise in DNAPL thickness, but rather occurred as an immediate and abrupt increase from the previous recorded measurements. The following statistical evaluation of the DNAPL data supports the conclusion that the subset of DNAPL data utilized by the GRU Team for this evaluation is questionable and inaccurate.

Comment #1 Page 4, 1st Paragraph--"*In a recent conference call, GeoTrans suggested that the measurements of the greater DNAPL thicknesses do not correlate with the DNAPL volumes recovered and were unreliable. However, as Figure 7 shows, the correlation between the measured DNAPL thickness in the wells and the volume of DNAPL recovered from each well at the corresponding time is reasonable. With the exception of four measurements from HG-15S and a single measurement from HG-11S, the recovered DNAPL volumes correlate relatively well with the volume recovered (sic). The majority of the points fall around the 0.16 US gallon/foot line which represents the volume of DNAPL that would be contained in the well screen and well casing for a given DNAPL thickness in the well.*"

Response: The third sentence in the comment above appears to contains a typographical error, which has a direct impact on the meaning of the sentence and our response: "*With the exception of four measurements from HG-15S and a single measurement from HG-11S, the recovered DNAPL volumes correlate relatively well with the <u>volume recovered</u>.*" It appears that the authors intended to state the following: "*With the exception of four measurements from HG-15S and a single measurement from HG-11S, the recovered DNAPL volumes correlate relatively*

GeoTrans, Inc.

well with the <u>measured DNAPL thicknesses</u>." Assuming this was the intent of the authors, the corrected sentence will be used in our response to this quote.

Contrary to the statements above concerning Figure 7 in the GRU Memo, the correlation between reported DNAPL thicknesses versus recovered DNAPL volumes is poor for the majority of the June to December 2007 data. The GRU plot of thickness versus volume shown in Figure 7 is for all data collected from 2004 through 2008 for the five DNAPL wells. The problem with plotting all the data in a combined plot (GRU Figure 7) is that issues with a subset of these data are not readily apparent. The GRU Figure 7 does not directly address the data in question (i.e., data collected post-June 2007). The GRU conclusion "*..the volume of DNAPL recovered from each well at the corresponding time is reasonable.* " is correct for the majority of the data collected during the period June 2004 to June 2007; however, it is not "reasonable" for the majority of the data collected post-June 2007. Coincidentally, it is the post-June 2007 data that are being used in the GRU Memo (January 30, 2009) to make a case for mobile DNAPL. The following liner regression analysis of the data clearly demonstrates the issues with the DNAPL data collected post-June 2007.

Linear Regression Analysis of DNAPL Data

The volume of DNAPL removed from a well should have an approximately linear correlation with the measured DNAPL thickness in the well. The objective for performing linear regressions of subsets of the data for each well is to look for inconsistencies in the datasets. In general, if the data are accurate and reliable, there should be a high correlation between measured DNAPL thickness and recovered volumes. This correlation should be fairly consistent between measurement events, with minimal variation in the regression coefficients. In addition, the coefficient of determination (R^2) for the linear regression should be high, indicating a good correlation between DNAPL thicknesses versus recovered DNAPL volumes.

The DNAPL recovery dataset was subdivided into three time periods that corresponds to significant changes to the reported DNAPL thicknesses and volumes. A linear regression correlation was performed for each of the subsets of data collected in each well during the time periods: (1) June 2004 to June 2007; (2) July 2007 to December 2007; and (3) January 2008 to February 2009. The first subset of data corresponds to the time period when the data were fairly consistent and the original O&M contractor was performing the data collection. The second subset of data were collected by the new O&M contractor and corresponds to the time period when the DNAPL thicknesses and volumes increased significantly, thicknesses were highly variable from measurement to measurement, and the data appear to be inconsistent with the previous 3 years of data. The third subset of data corresponds to a time period when the majority of the DNAPL recovery data appears to be somewhat consistent between measurements and in agreement with pre-July 2007 data. Although data for select wells appears reasonable prior to December 2007, a consistent time period when data for the majority of the wells appeared reasonable was chosen for the analysis. **Figures 1** through **5** show a plot of DNAPL thickness versus recovered DNAPL volume for wells HG-10S through HG-16S, respectively.

Dataset 2004 to June 2007

The DNAPL thicknesses and recovered volumes for this time period vary over a range of thicknesses (< 1 to > 5 ft) and recovered volumes (< 0.1 to >1.0 gallon). The initial shorter time period between measurements and recovery provided data over a larger range of thicknesses and volumes, which helps with the linear regression analysis. Both reported DNAPL thicknesses and recovered volumes appear consistent and reasonable with historic trends for individual wells. These data also indicate that the DNAPL saturations in the vicinity of these wells are fairly stable and at an approximate steady-state condition.

The linear regression performed for first subset of data (June 2004 to June 2007) was universally the best fit for the three datasets in all five HG wells. The R^2 value ranged from 0.70 to 0.93, with a mean of approximately 0.88. The monitoring well with the highest R^2 value (0.93) was HG-15S, indicating that thickness and volume data collected prior to July 2007 is highly correlated. Similarly, wells HG-11S and HG-12S had R^2 values that were 0.88 indicating a good correlation between measured thickness and recovered DNAPL volume. The majority of the data collected pre-July 2007 appear to be highly correlated and consistent with previous measurements.

The linear-regression coefficient for feet of DNAPL in the well versus recovered volume for this time period indicated that 1 foot of DNAPL corresponds to a recovered DNAPL volume of approximately 0.15 to 0.16 gallons. A volume calculation based on the cross-sectional area of a 2-inch diameter well casing results in 0.162 gallons/foot of DNAPL, the same volume relation resulting from the linear regression of the Site data. The fact that the linear regression coefficient is approximately equal to the volume calculation indicates that essentially all DNAPL bailed from the wells is contained within the well casing/screen and virtually no DNAPL is derived from the filter pack outside of the screen. This is consistent with the conceptual model of low DNAPL saturations in the formation and filter pack material, resulting in slow DNAPL migration into the well. The low DNAPL saturations in sand lenses of HG deposits limit the rate at which DNAPL can flow to a well, such that little to no DNAPL flows into the well during the time that the well is being bailed. This conceptual model is consistent with the GRU Team observation for Figure 7 (Page 4, 1st Paragraph): "*The majority of the points fall around the 0.16 US gallon/foot line which represents the volume of DNAPL that would be contained in the well screen and well casing for a given DNAPL thickness in the well.*"

Beazer and GRU are in agreement with the conclusion that data collected prior to July 2007 appear to be reasonable. Beazer disagrees with the GRU statement

(Page 4, 1st Paragraph): "*With the exception of four measurements from HG-15S and a single measurement from HG-11S, the recovered DNAPL volumes correlate relatively well with the measured DNAPL thicknesses.*" It is Beazer's position that the majority of the data collected during the O&M contractor transition period (July-December 2007) are unreliable.

Dataset July to December 2007

The DNAPL thicknesses and recovered volumes for this time period vary over a wide range of thicknesses (< 1 to > 15 ft) and recovered volumes (< 0.1 to >2.7 gallon). In general, a large range of thicknesses and recovered volumes for each of the wells should provide a good dataset to perform the linear regression analysis. The reported DNAPL thicknesses and recovered volumes vary widely from measurement to measurement and do not follow a consistent trend for individual wells. If data collected during this time period are accurate, the high variability of these data would tend to indicate that the DNAPL saturations in the HG deposits are not stable and are fluctuating on a weekly basis.

The linear regression of DNAPL thickness versus recovered volume for each of the five HG DNAPL wells for the time period July to December 2007 is poorly correlated and not consistent with pre-July 2007 data. The R^2 value for these data ranged from 0.05 to 0.74, with an R^2 value of less than 0.35 for three of the five wells. An R^2 value of 0.05 (HG-15S) basically indicates that there is little correlation between the measured thicknesses and recovered volumes. Note that the reported increase in DNAPL thicknesses and recovered volumes for well HG-15S is the primary basis for the current GRU conceptual model of on-going DNAPL mobility.

The linear-regression coefficient for feet of DNAPL in the well versus recovered volume ranged from 0.036 to 0.21, indicating that recovered volumes of DNAPL versus measured thicknesses were highly variable between wells and inconsistent with pre-July 2007 data. Well HG-15S had the lowest regression coefficient of 0.036, indicating that for every foot of DNAPL measured in the well, only 0.036 gallons of DNAPL were recovered. This is a physical impossibility given that at a minimum there should be 0.162 gallons of DNAPL for every foot of DNAPL in a 2-inch well. If additional DNAPL is contained in the filter pack outside of the screen, the volume could be greater than 0.162 gallons. Hence, the linear regression coefficient for data collected during this time period (July-December 2007) indicates that either the reported thicknesses and/or recovered DNAPL volumes are inaccurate for HG-15S. The regression analyses for the remaining four wells indicate similar issues with data collected during this time period (see **Figures 1** through **5**).

Dataset January 2008 to February 2009

The majority of the reported DNAPL thicknesses and recovered volumes are fairly stable for individual wells during this time period. Unlike the time period June to December 2007, the reported DNAPL thicknesses and recovered volumes do not vary widely between measurement events for individual wells. These data indicate that the DNAPL saturations in the HG deposits are fairly stable and at an approximate steady-state condition. These data also suggest that the measurement techniques have improved by this time period to provide more accurate thickness and volume readings at individual wells.

The R^2 values for January 2008 to February 2009 data range from 0.04 to 0.205. Again, the lowest R^2 value of 0.04 for this time period was for well HG-15S. This is consistent with the plotted data points (**Figure 4**) where the recovered DNAPL volumes vary considerably for the same approximate DNAPL thicknesses measured during this time period. The low R^2 values for the data collected during this time period indicate a poor correlation between measured thicknesses and recovered volumes. However, with the exception of HG-15S, the majority of the DNAPL thicknesses and recovered volumes are within the range of thicknesses measured pre-July 2007. The low R^2 values for this subset of data are partially due to the fact that the thicknesses and recovered volumes for each of the wells are not changing much over this time period. Because of the narrow range of data values, small inaccuracies in these measurements results in a lower R^2 value, even though the data appear to be reasonable on the plots.

The linear-regression coefficient for feet of DNAPL in the well versus recovered volume ranged from ranged from 0.027 to 0.089 indicating that recovered volume of DNAPL versus measured thickness was highly variable between wells for data collected 2008 to 2009. Similar to the July to December 2007 data, these regression coefficients are approximately half of the minimum volume of DNAPL that should be recoverable (0.162 gallons/foot of DNAPL) from a 2-inch diameter well. This further supports the conclusion that although the data appear to be reasonable on the plots, there is still an issue with accurate correlations between DNAPL thicknesses and recovered volumes for this time period. If the estimated recovered volumes are correct, the reported DNAPL thicknesses should be approximately half of the reported thicknesses. Conversely, if the reported DNAPL thicknesses are correct, the actual recovered volumes should be approximately double those reported.

The most likely source of error is in the reported DNAPL thickness because of false positives for the water/DNAPL interface. This is a common problem with interface probes and creosote DNAPLs. Small blebs of DNAPL suspended in the water column coat the probe as it is lowered in the well, resulting in false positive detections.

<u>Conclusions</u>

The linear regression of recovered DNAPL volume versus DNAPL thickness indicates that data collected prior to July 2007 appear to be reasonable. The data collected in the time period July to December 2007 appear to have issues with both the thickness measurements and recovered volumes. The data collected January 2008 to February 2009 are in relative agreement with the pre-July 2007 data; however, the linear regression indicates that there are some issues with the reported thicknesses and/or recovered volumes.

DNAPL data collected June 2004 to June 2007 in well HG-15S appear to be the most accurate data for the five wells based on the linear regression analysis. Conversely, the data collected post-July 2007 to present appear to be some of the least accurate data for the five wells.

Comment #2 Page 1, 2nd Paragraph--“ *These data document unequivocally that DNAPL at the Koppers Site is mobile in the Hawthorn Group sediments beneath at least three of the four DNAPL source areas defined by GeoTrans in the Surficial Aquifer.*”

Response: This statement is not based on a sound technical analysis and evaluation on the reliability of the data. The linear regression analysis, in conjunction with a visual inspection of the data plots, demonstrates the inaccuracy of the post-June 2007 data. In fact, DNAPL data collected during the initial 3-year period (June 2004 to June 2007) and the majority of the data collected post December 2008 support limited to no DNAPL mobility.

Comment #3 Page 2, 2nd Paragraph--“ *The increase in DNAPL thickness appears to coincide with decreasing groundwater levels. Graphing rainfall and water levels in the surficial aquifer (figure 3) reveals that 2006 was a very dry year—approximately 35 inches of rain as opposed to an average of 48 inches annually—and that water levels in the Surficial aquifer responded by dropping approximately 15 feet.*”

Response: The low precipitation in 2006 resulted in declining water levels in the Surficial Aquifer and Upper Hawthorn. The implication that water levels in the Surficial Aquifer declined 15 feet at the Site is incorrect. The majority of the Surficial Aquifer wells at the Site would be dry if water levels declined by this amount. It is not clear why the GRU Team chose to use a well 2.5 miles from the Site to make this claim when Surficial Aquifer water levels are monitored quarterly at the Site. It is also surprising that the GRU Team would claim a 15-foot decline in the water table at the Site, when the Site data clearly show that the decline was a relatively small fraction of this number. Using this off-Site data biased the GRU Team’s incorrect conclusions. A comparison of the maximum water-level elevation recorded in 2004 and 2005 in the former Process Area versus the minimum water level recorded in 2006 indicates that Surficial Aquifer water levels in the vicinity of the former Process Area declined less than 4 feet (**Figure 6**). By the end of January 2007, Surficial Aquifer water levels on Site were less than 2 feet lower than the highest elevation recorded in 2004 and 2005. These data appear to indicate that the GRU Team failed to properly evaluate the data prior to developing a flawed conceptual model of mobile DNAPL due to a water-table decline in 2006. Hence, quarterly water-level measurements in the Surficial Aquifer wells indicate that water-level declines at the Site ranged from 2 to 4 feet.

Comment #4 Page 2, 3rd Paragraph--" *It is reasonable to believe that the increased mobility of DNAPL observed in 2007 – as evidenced by the dramatic increase in DNAPL thickness – was initiated by the falling water levels in the Surficial aquifer*."

Response: The GRU Team presented a flawed conceptual model of DNAPL releases due to water-level declines in the Surficial Aquifer. It is recognized that precipitation is a cyclic event where historically there have been numerous periods where precipitation has been below the average of approximately 48 in/year in this area. There have been numerous water-table declines prior to 2006 that would have released residual DNAPL via the GRU conceptual model. Once DNAPL drains from individual pores, it will continue to migrate vertically until it establishes a new residual saturation or encounter a permeability barrier, such as a clay unit.

The technical argument based on declining water levels resulting in a release of DNAPL may have some validity, if we were discussing a relatively recent of DNAPL spill followed by a decline in the water table. However, DNAPL releases via the GRU conceptual model likely occurred over the operating history of the former source areas. The former North Lagoon was in operation from 1937 to the 1970s. Hence, the original DNAPL source to the former North Lagoon was eliminated over 30 years. Similarly, creosote use at the Site was significantly decreased in the 1960s and completely eliminated by 1992. Therefore, any potential on-going creosote source in the former Process Area would have ceased over 15 years ago. As indicated by the GRU Memo, the average precipitation in this area is approximately 48 inches/year. Precipitation amounts of less than 48 inches would result in a water-table decline and precipitation greater than this amount would like result in a rise in the water table. Once DNAPL is released from a pore space where the water table has dropped, it will migrate vertically downward. During subsequent rises in the water table the DNAPL will remain trapped above hydrologic restrictive layers and will not reverse direction and flow vertically upward. In addition, the GRU Team estimated that it will take months for the DNAPL to migrate vertically from the Surficial Aquifer to the base of the Upper Hawthorn "..*will occur not instantaneously but progressively over a matter of months*" (GRU Memo, Attachment A, Page A-2).

Given this conceptual model there are 15 annual periods since 1980 when the annual precipitation was less than 48 inches in Gainesville (**Figure 7**). Years of below average precipitation should correspond to years when the Surficial Aquifer water levels declined. Based on the GRU conceptual model, DNAPL would have been released from the pores during the first water table declined after the pores became saturated with DNAPL. The most recent sustained period of water-table decline would have occurred during the 5 year period 1997 to 2001 where precipitation continually declined from a high of 58 inches to a low of 34 inches in 2000 (**Figure 7**). During this 5- year drought, water levels in the Surficial Aquifer would have declined substantially and virtually all DNAPL above the air-DNAPL-Water saturation value would have been released. Given that there are multiple cycles of precipitation of less than 48 inches/year since

1980, there should have been multiple opportunities for DNAPL release via the GRU Team conceptual model. Hence, any DNAPL that had the potential of draining from the Surficial Aquifer pores should have drained long before 2006.

Comment #5 Page 1, 3rd Paragraph--*“ Figures 1A, 1B, and 1C show the DNAPL thickness with time (Wells HG-10S, HG-11S, HG-12S, HG-15S and HG-16S) and the water levels in each well. The dramatic increase in DNAPL thickness during the mid- to late 2007 is easily observed. Note that in the Process Area wells (HG-11S and HG-15S) the DNAPL thickness remains higher than pre-2007 levels; in the case of HG-15S it is approximately 5 feet higher. More than 10 feet of DNAPL is reported in two wells – up to 12.45 ft in HG-11S and up to 15.75 feet in HG-15S during July and October 2007, respectively. Both of the wells that accumulated more than 10 feet of DNAPL are in the Process Area. It is significant that more than 10 feet o DNAPL accumulated in wells constructed with only 10 feet of screen (the 10-foot screen length for the wells is documented in Table 2 of the September 2004 Draft Report for Additional Investigations of Hawthorn Group Formation DNAPL Source Evaluation) in that it indicates a significant DNAPL Head..”*

Response: The GRU Team correctly points out that the questionable DNAPL data collected during the 2nd half of 2007 gives the appearance that there was a substantial DNAPL thickness increase in four of the five DNAPL wells. As discussed above, the linear regression of these data support the conceptual model that these data were inaccurate measurements. As will be discussed later in this response, individual DNAPL measurements during the 2nd half of 2007 further support the conclusion of “bad data”. There were only a few months of questionable DNAPL measurements in the former North Lagoon area wells (HG-10S and HG-16S) and by 2008 these measurements were fairly consistent with pre-July 2007 measurements. Similarly, DNAPL measurements in the former Drip Track area (well HG-12S) appear to be questionable for a period of a few months in 2007 before these data were in approximate agreement with pre-2007 levels. Conversely, the DNAPL thickness and volume data for the former Process Area wells (HG-11S and HG-15S) continue to be elevated from data collected pre-July 2007.

A plot of DNAPL thickness in well HG-15S shows a fairly constant thickness of about 1.7 to 2 feet from 2004 through 2005 (**Figure 8**). Beginning in 2006 the DNAPL thickness in this well increased to over 2 feet, with an average thickness of approximately 2.3 feet. The thickness remained fairly constant in this well until July 2007. With the change in the O&M contractor in July 2007, the data became very erratic with extreme thicknesses being reported for the remainder of 2007. Beginning in 2008 and continuing into 2009 the reported DNAPL thickness in this well fluctuated with an average thickness of approximately 8 feet. As indicated by the GRU Team, the average DNAPL thickness in this well increased approximately 5 feet from the pre-July 2007 thicknesses. The GRU Team flawed conceptual model for this apparent increase in DNAPL thickness is a continuous and connected DNAPL plume that extends from the base of the Surficial Aquifer to the top of the HG middle clay unit. The GRU conceptual model is based on inaccurate data collected during July 2007 until early 2008, which was previously addressed in the response to Comment #1. An alternative conceptual model to explain these elevated DNAPL thickness data is provided in the following paragraphs.

A conceptual model for the apparent increase in DNAPL thickness in well HG-15S is based on the observed location of DNAPL zones in HG cores collected during the installation of this well in 2004. A review of the lithologic logs for this well indicates that DNAPL-impacted core was observed at a depth of 68 to 70 feet below land surface. The depth where DNAPL was observed in the core corresponds to a depth in the well of approximately 6.3 to 8.3 feet above the base of the well (**Figure 8**). DNAPL entering the screen interval in well HG-15S will fill the well casing to an approximate maximum depth of 8.3 feet. This is the same approximate depth that DNAPL is currently accumulating in this well indicating that the source of DNAPL for this well is likely the DNAPL source zone at a depth below land surface of 66-68 feet (depth below TOC of 68.3 to 70.3 feet) identified during well installation.

The field procedure for DNAPL removal in these wells is to perform a depth to DNAPL measurement prior to DNAPL removal (i.e. Pre-Bailing); perform another measurement immediately after DNAPL removal (i.e. Post-Bailing), and perform a third measurement at the end of the day, approximately 2 to 5 hours after DNAPL removal (i.e. End Day). The results of these measurements are shown in **Figure 8**. The DNAPL measurements performed immediately after the completion of DNAPL removal (Post-Bailing) indicate that approximately 4 feet of DNAPL remains in the well, after all DNAPL had been removed. This is clearly a false positive reading in that all DNAPL was visually confirmed to be removed from the well via a bailer minutes prior to this measurement. The false positive reading is potentially due to DNAPL droplets entrained in the water column: (1) Resulting from mixing during DNAPL removal and (2) Influx from the DNAPL source zone. Similar to the "Post-Bailing" measurement, the DNAPL measurement at the "End Day" indicate approximately 5 to 6 feet of DNAPL in the well (**Figure 8**). Tests to confirm the presence of a continuous DNAPL layer were performed by lowering a bailer approximately 2 feet into the DNAPL zone. Results of this test confirmed that the upper 2 feet of the DNAPL in the well consisted of a mixture of DNAPL and water (verbal communication FTS, March 31, 2009). Therefore, depth to DNAPL measurements performed within hours after DNAPL removal represent false-positive readings that are not indicative of a continuous DNAPL layer at the base of the well.

The "Pre-Bailing", "Post-Bailing" and "End Day" DNAPL measurements provide some insight into DNAPL accumulation and flow into these wells. The time period July 2007 to January 2008 further support the conclusion of "bad data" during this time period. There are five "End Day" measurements that were substantially higher than the "Pre-Bailing" measurement for that event (**Figure 8**). The elevated DNAPL thicknesses recorded for the "End Day" are not reproducible in the subsequent "Pre-Bailing" DNAPL recovery measurements. Further, it has been observed by the present O&M contractor that DNAPL recovery to "Pre-Bailing" levels requires days to weeks to complete; however, the "End Day" measurements were performed within hours of completing DNAPL removal in these wells.

The "Post-Bailing" and "End Day" DNAPL thickness measurements for the time period January 2008 to present are relatively consistent. The "Post-Bailing" thickness appears to cluster around a 4.2 foot thickness and the "End Day" thickness clusters around 6 feet. The "Post-Bailing" thickness likely represents the zone within the well where DNAPL and water is mixed due to bailing; the "End Day" thickness coincides with the bottom of the zone where DNAPL was observed in cores for well HG-15S. Conceptually, DNAPL droplets are entering the well from the formation at this depth resulting in the false positive readings at this depth. This conceptual model was confirmed by the O&M contractor when a bailer consisting of a mixture of DNAPL and water was collected immediately after the "End Day" measurement at HG-15S.

A similar conceptual model has been developed for well HG-11S. A comparison of DNAPL core intervals with the well completion depths confirms that two primary DNAPL source areas are present in the formation opposite the screen interval (**Figure 9**): (1) DNAPL impacted core at a depth below land surface of 51 to 53 feet (depth below TOC 53.6 to 55.6 feet or 4 to 6 feet from the bottom of the well) and (2) DNAPL impacted core at a depth below land surface of 55 to 57 feet (depth below TOC 57.6 to 59.6 or 0 to 2 feet from the bottom of the well). The "Pre-Bailing" DNAPL thickness measurements correspond to the base of the 4 to 6 foot DNAPL core interval. The 0 to 2 foot depth interval corresponds to the January 2008 to present "Post-Bailing" and "End Day" DNAPL thickness measurements.

An obvious question this raises is "Why do DNAPL thicknesses currently correspond to the elevation of source zones in the formation, whereas prior to 2007 they did not?" The most likely explanation for this is that the wells were not fully developed. The HG wells in the former Process Area were installed with a mud-rotary technique resulting in a mud cake forming in both the formation and screen filter pack. The low water-producing capability of the HG deposits[1] prevented complete removal of this mud cake following the well installation. With the replacement of the previous O&M contractor, more aggressive bailing techniques may have been employed that helped to further develop the wells. This redevelopment of the wells increased the hydraulic communication with the formation allowing more DNAPL to flow into the well and to achieve a thickness

---

[1] The low hydraulic conductivity of the Hawthorn Group was confirmed by the Hawthorn pilot test conducted near HG-10S. An 18-inch recovery well could only pump between 0.5 and about 0.75 gpm. After 27 days of re-injection, 48 days of total pumping with significant drawdown, only a trace of DNAPL was recovered.

in the well coincidental with the DNAPL zones opposite the screen interval.

Comment #6 Attachment A Page A-1, 3rd and 4th Paragraphs--*" Therefore, a - foot drop in the water table elevation can cause about ½ gallon of creosote to drain to the water table. Thus, when PW-1 was pumped a few years ago, the water table dropped accordingly and DNAPL drained readily into the well. This was a much more rapid DNAPL response than lateral migration to a pumping well.*

Similarly, with a long-term decline in the water table during a year-long drought, as in 2006, creosote will be mobilized and sink to the bottom of the Surficial Aquifer. This will increase the pressure at the top of the DNAPL column and cause it to migrate deeper into the Hawthorn Group sediments, or at least laterally in that case where a capillary barrier prevents its further downward migration. Because of the viscosity of this DNAPL – i.e. 10-50 cp at 25^o C (computed from Table 12, 2004 DNAPL GeoTrans report) – this migration will occur not instantaneously but progressively over a matter of months."

Response: The GRU Memo **Attachment A** is a continuation of the conceptual model of DNAPL release due to a declining water-table elevation. The **Attachment A** discussion attempts to quantify the potential volume of DNAPL that could be released per unit foot of water-table decline. This attachment further states that DNAPL was likely released due to water-table declines during the pumping of PW-1 in 2004 and as a result of the water-table decline in 2006. The flaw in this technical argument is that it ignores the fact that once DNAPL is released from the aquifer pores the DNAPL migrates vertically downward, i.e., it is gone from the pore (see response to Comment #4). The GRU model appears to be based on the assumption that each time the water table declines more DNAPL is released from the pores; however, there is finite amount of DNAPL in each pore that is released the first time the water table declines. The pores do not continue to release DNAPL each time the water table drops. The water-table decline in 2006 is relatively minor compared to the potential water-table decline that would have occurred over a 5 year period from 1997 to 2001. In addition, there were 15 annual periods of below average precipitation since 1980 that potentially would have released DNAPL via the GRU conceptual model. Hence, any DNAPL released via this mechanism would have been occurred well before 2006.

Similarly, well PW-1 was pumped for 158 days from November 2004 to April 2005[2]. Given the GRU following statement "*..this migration will occur not instantaneously but progressively over a matter of months.*" The increase in

[2] Over a period of 158 days, an estimated 335,169 gallons of groundwater were extracted and 89.95 gallons of DNAPL were recovered. The groundwater to DNAPL extracted ratio for PW-1 is 0.000268 (0.03%). That is, for every 1 gallon of DNAPL recovered, approximately 3,726 gallons of groundwater needed to be extracted and treated. This DNAPL recovery rate is relatively low as compared to other DNAPL recovery programs conducted by Beazer, but is consistent with local hydrogeological and residual (non-mobile) DNAPL conditions in the Surficial Aquifer. Typically, more effective and efficient DNAPL recovery programs operate at approximately 1 to 3% DNAPL recovery (RETEC and GeoTrans, May 23, 2005).

DNAPL thickness observed in HG wells should have occurred in late 2005 and not in 2007 when GRU is attempting to correlate increased DNAPL thickness in the former Process Area.

Comment #7: Attachment B -- Pages 54 and 55, Figures 5 and 8

Response: The figures in **Attachment B** were modified by the GRU Team to highlight wells with mobile DNAPL. Five of the ten HG wells highlighted in Figures 5 and 8 by the GRU Team and identified in the explanation as "*Mobile DNAPL recovered in well*" do not have mobile DNAPL. Wells with no "*Mobile DNAPL*" include the following: (1) HG-9S; 2) HG-12D: (3) HG-18S; (4) HG-10D and (5) HG-16D. Well HG-9S had 0.1 gal of DNAPL removed from it shortly after it was installed in 2004 and has never had a detectable layer of DNAPL in over 4.5 years. It has been our experience with installing wells at wood-treating sites that trace amounts of DNAPL will accumulate in a well sump shortly after it is installed due to disturbances resulting from drilling. The observation of DNAPL in these wells tends to be a one-time event and DNAPL is typically never detected in the well following the initial measurement. Similarly, well HG-12D had a one-time reported DNAPL thickness of 1.13 feet in 2004 immediately after it was installed, but has never had measurable DNAPL in 4.5 years since this one detection. Again, the accuracy of this reported thickness is questionable since DNAPL was never recovered from this well and subsequent measurements in this well did not detect DNAPL. Wells HG-18S, HG-16D[3] and HG-10D have reported stains on the measurement probe as a result of blebs of DNAPL trapped in the sump of these wells; however, over the period of record for these wells a DNAPL layer has never been detected. In addition, DNAPL has never been recovered from wells HG-18S, HG-16D and HG-10D. Contrary to the GRU Team's statements and figures, free-phase recoverable DNAPL is restricted to five wells in the Upper Hawthorn and is not present in the Lower Hawthorn.

[3] HG-16D was completed on June 24, 2004 and did not contain DNAPL and never has contained DNAPL. Laboratory results for density and viscosity from Texas Oil Tech (run July 29, 2004) for a DNAPL sample allegedly from HG-16D are reported in Table 12 (GeoTrans, September 15, 2004). This sample was collected by Mike McKinney and is believed to have been mislabeled (Mike McKinney, personal communication, June 13, 2008). This error was propagated in the GeoTrans report. The sample is thought to have been from HG-16S. That the sample was collected from HG-16S instead of HG-16D is corroborated by another sample collected from HG-16S and analyzed by Augustine Scientific Laboratories, yielding a similar creosote viscosity.

Figure 1. HG-10S -- Linear regression of DNAPL thickness versus recovery volume.

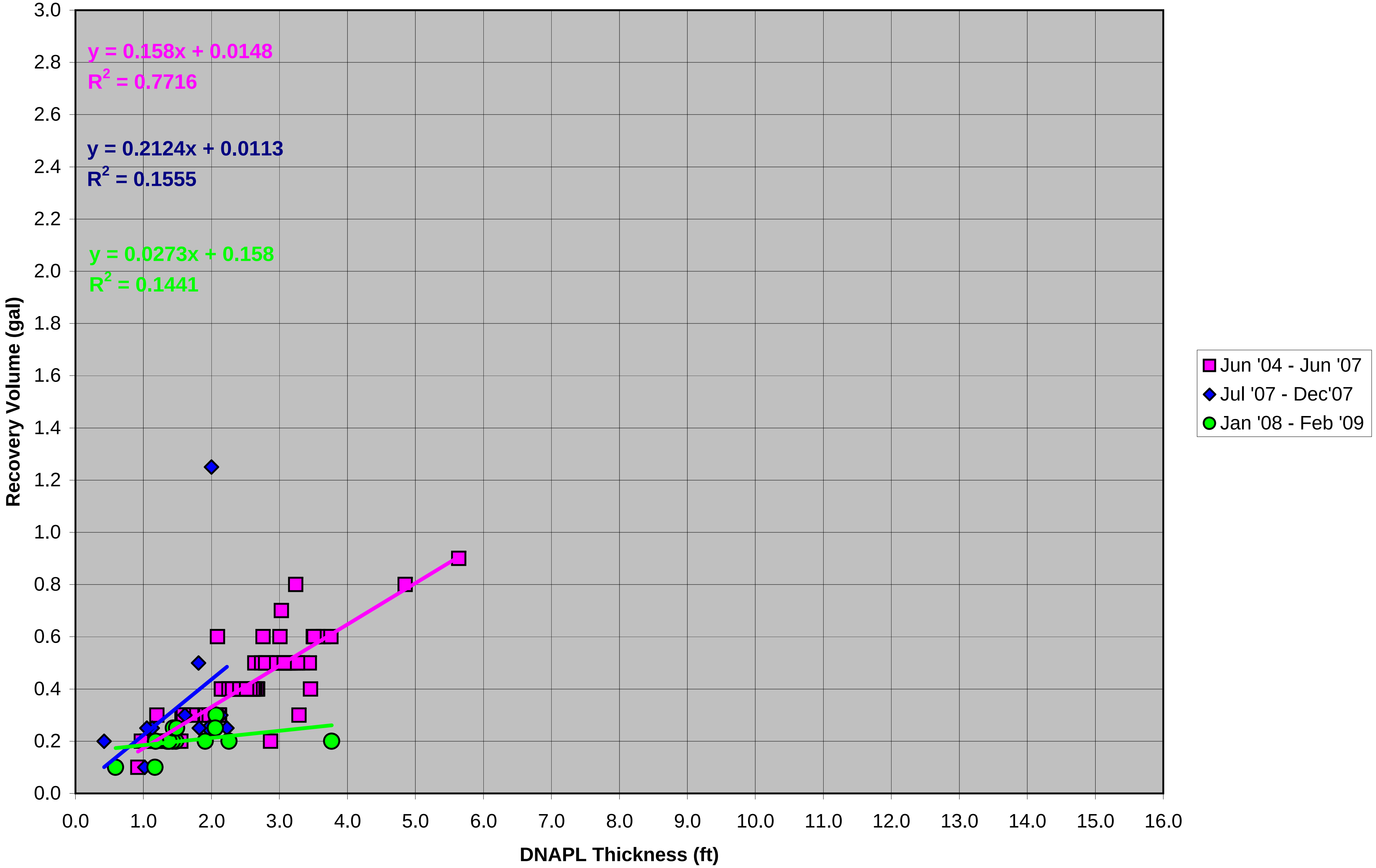

Figure 2. HG-11S -- Linear regression of DNAPL thickness versus recovery volume.

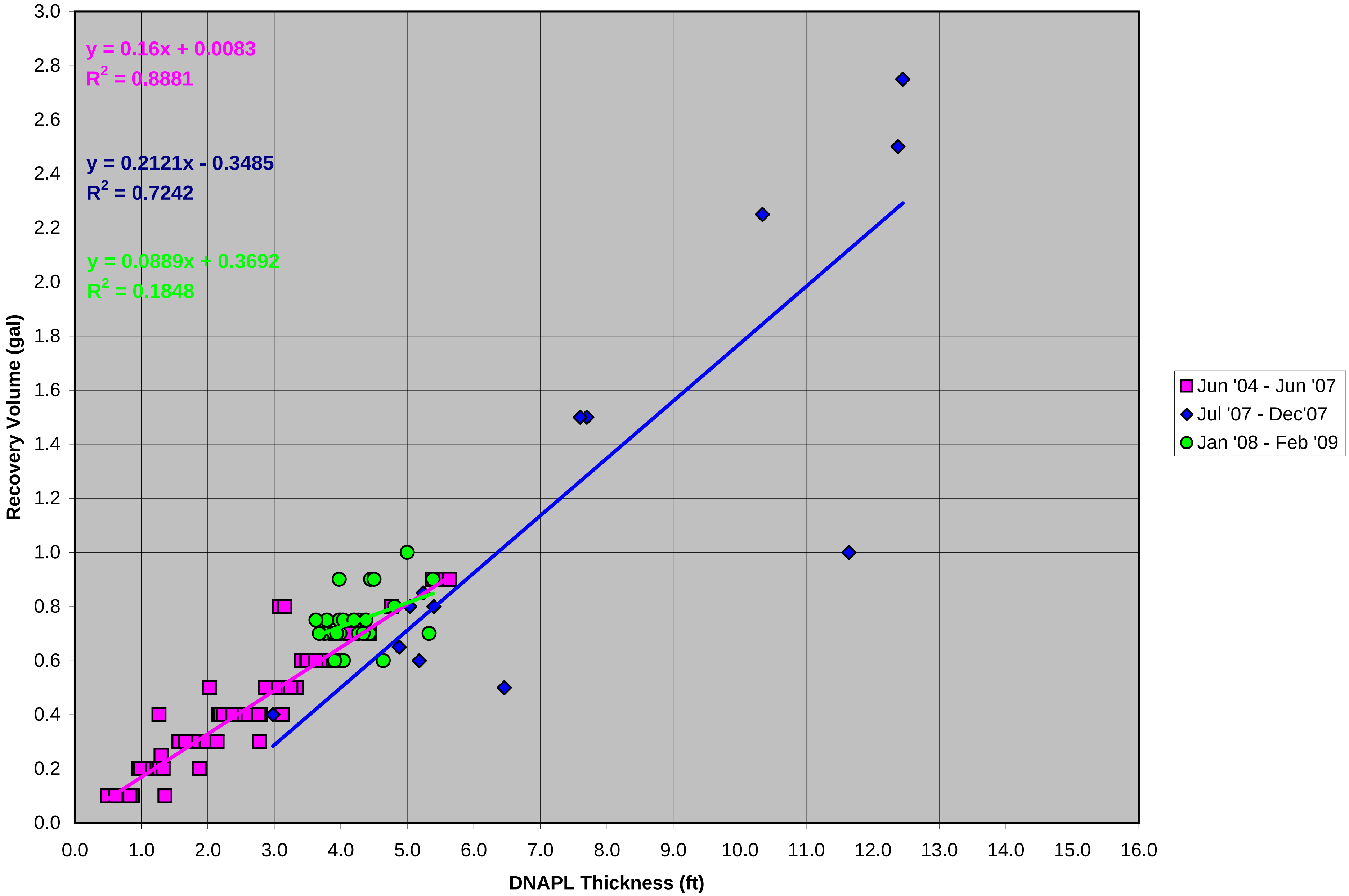

Figure 3. HG-12S -- Linear regression of DNAPL thickness versus recovery volume.

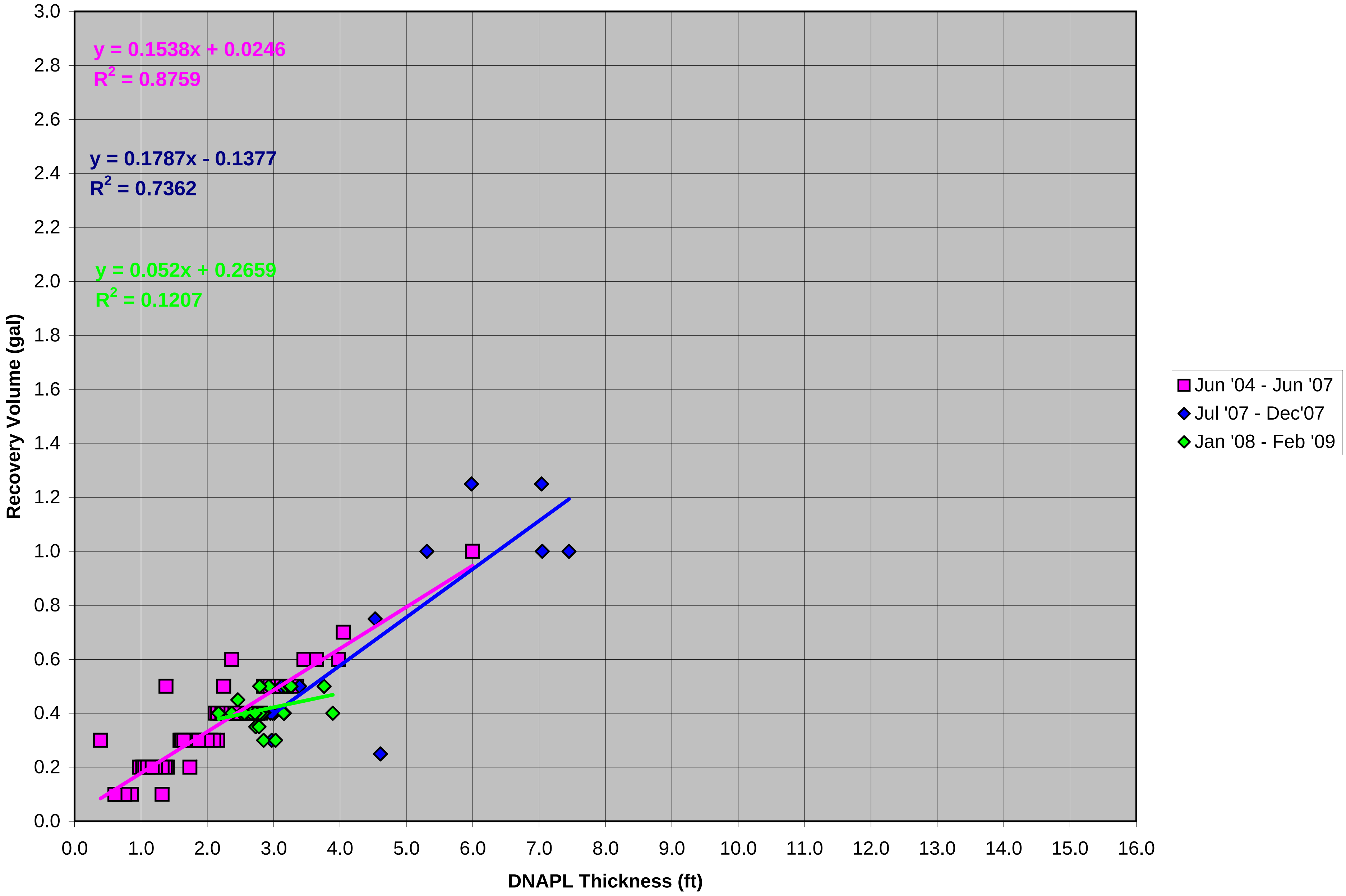

Figure 4. HG-15S -- Linear regression of DNAPL thickness versus recovery volume.

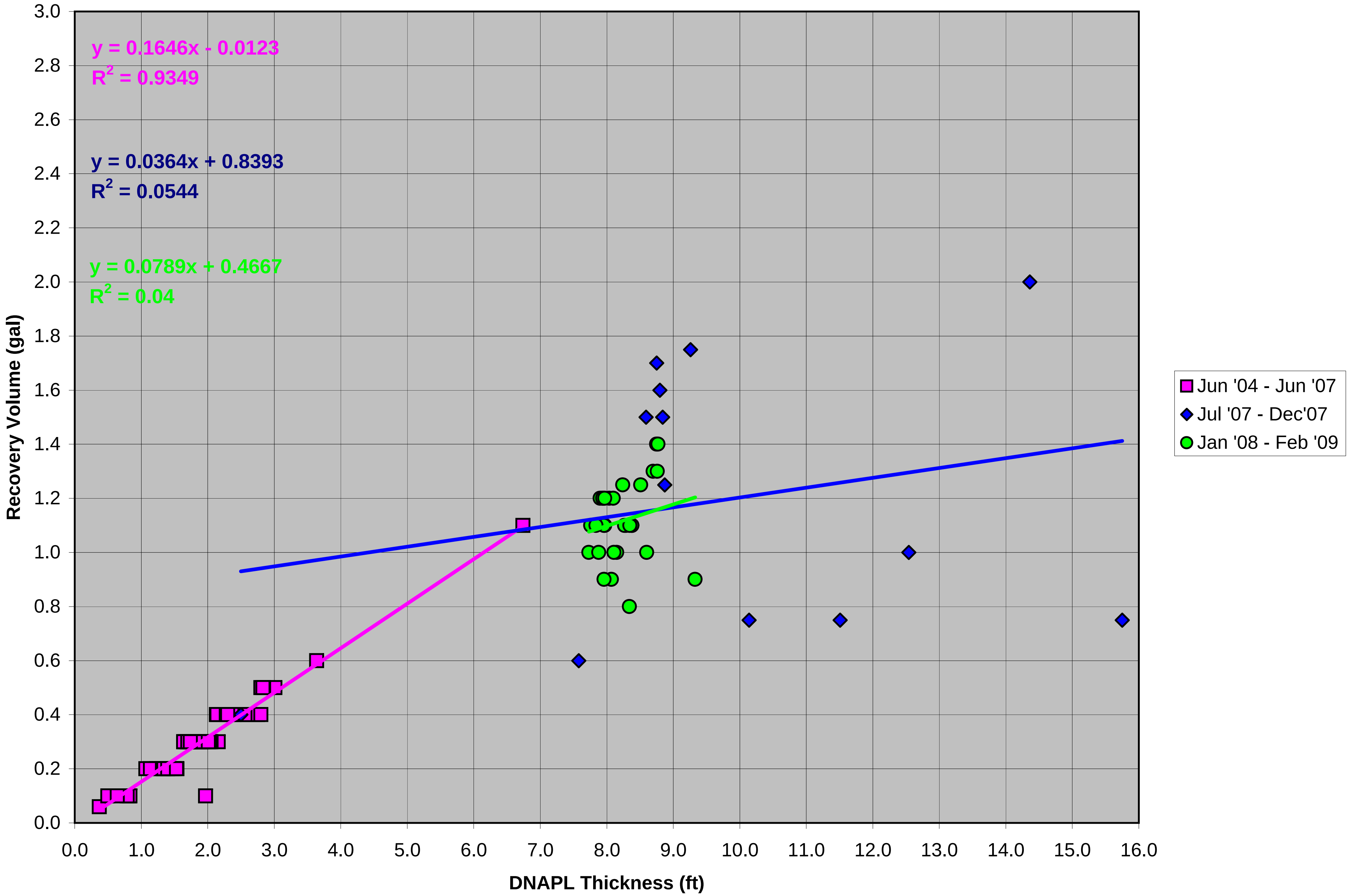

Figure 5. HG-16S -- Linear regression of DNAPL thickness versus recovery volume.

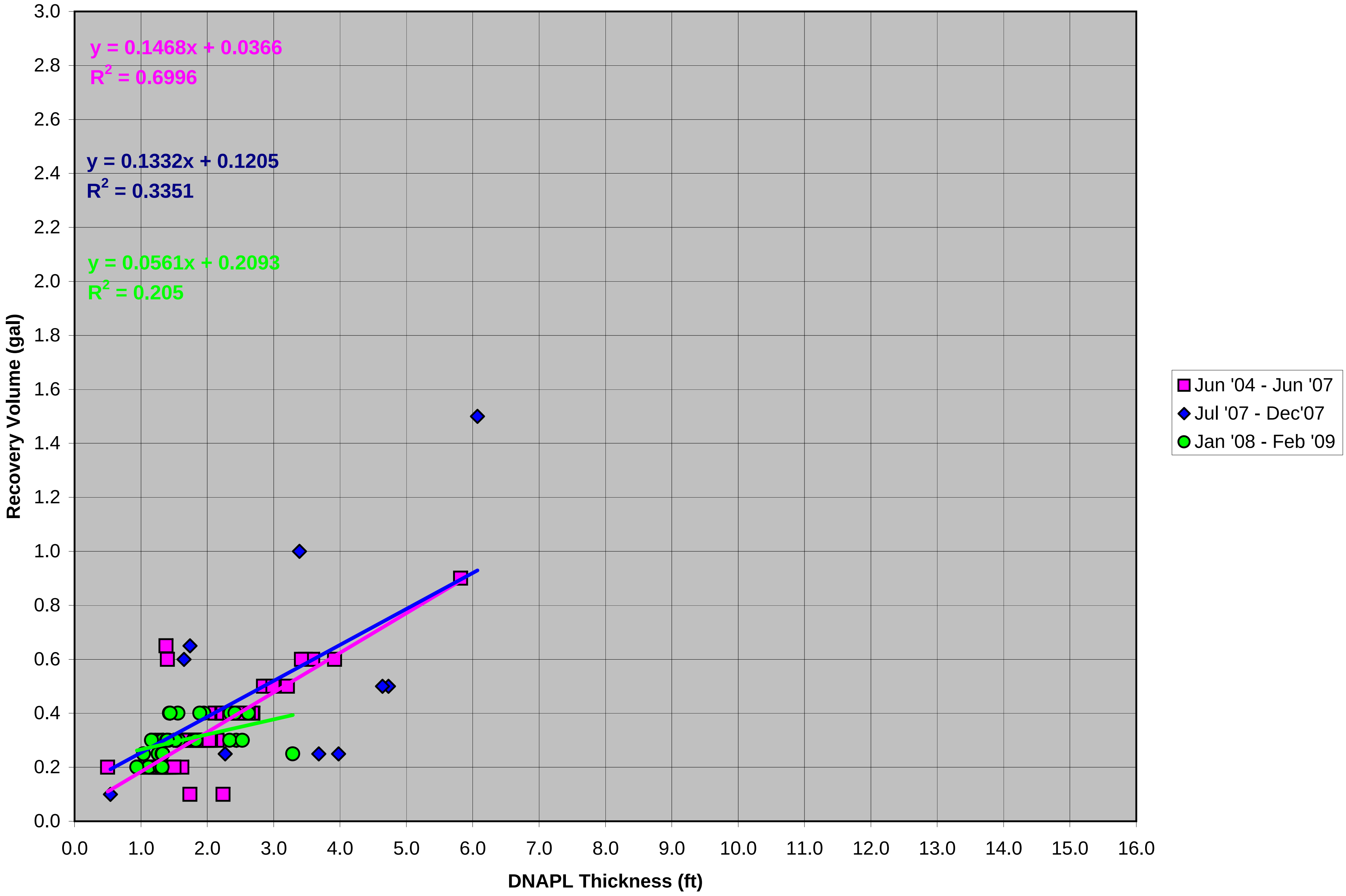

Figure 6. Surficial Aquifer Water Levels.

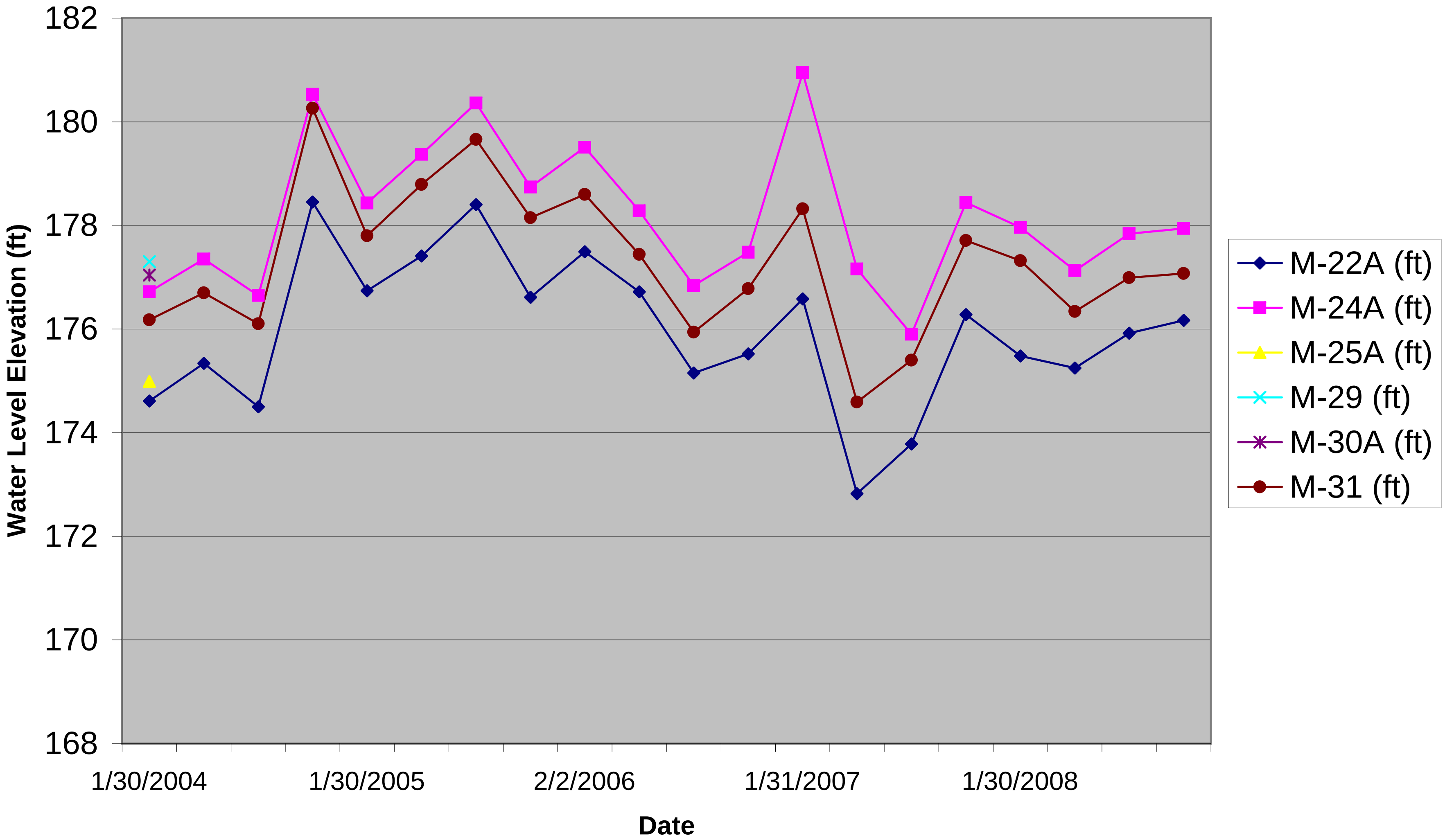

Figure 7. Annual precipitation 1980 to 2008 for Gainesville, Florida.

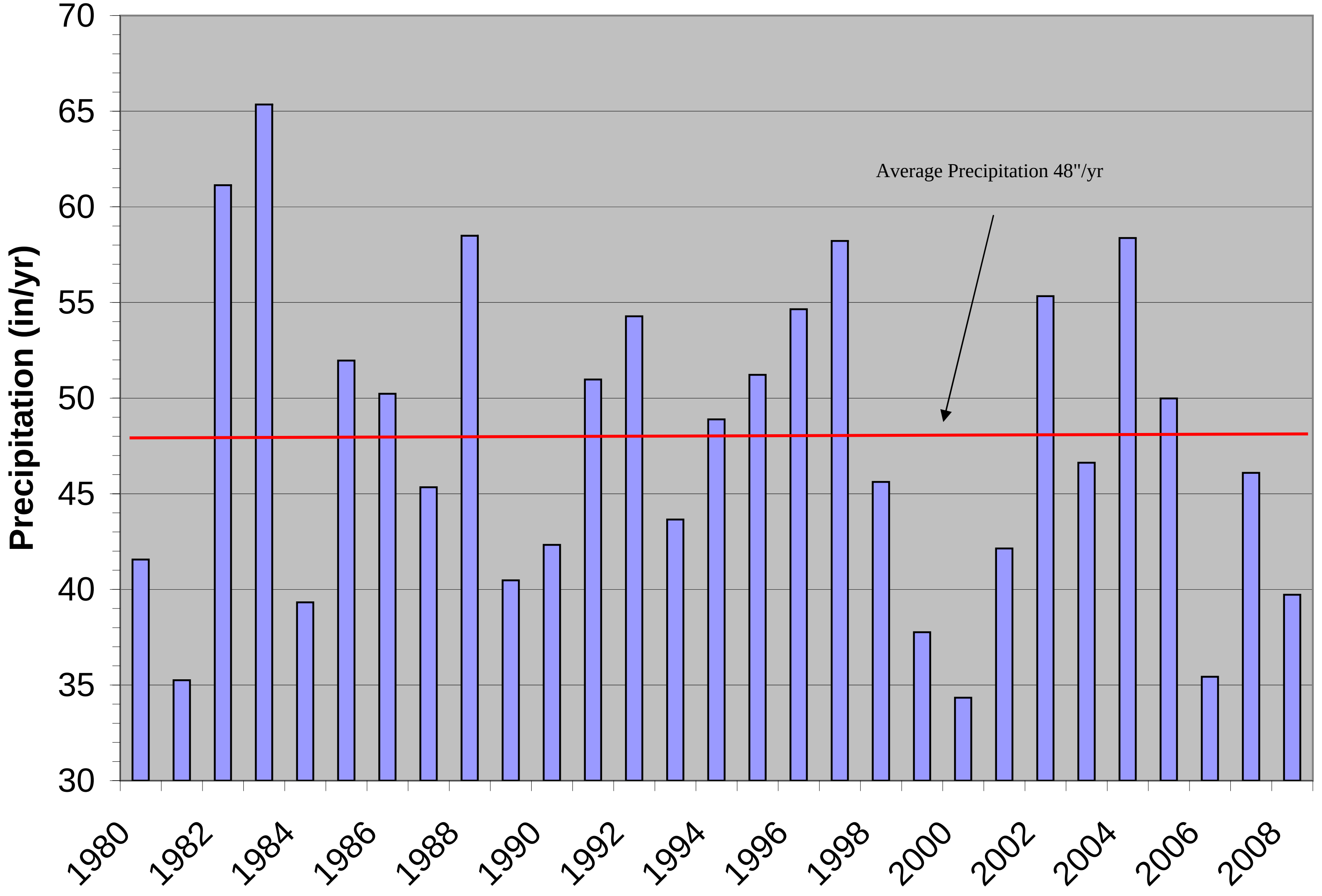

Figure 8. Well HG-15S DNAPL thickness measurements pre-bailing, post-bailing and end day.

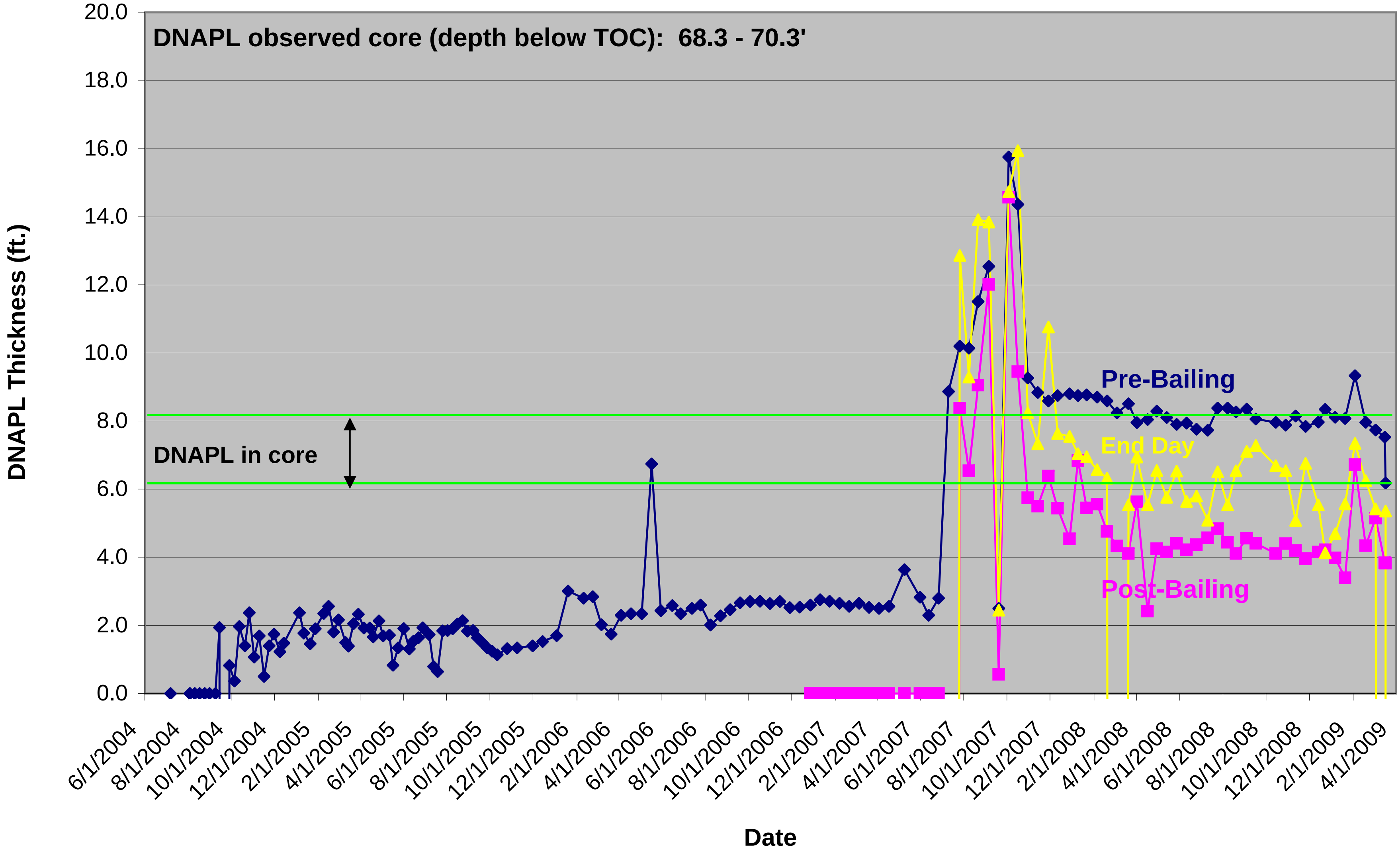

Figure 9. Well HG-11S DNAPL thickness measurements pre-bailing, post-bailing and end day.