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July 9, 2010

Mr. Michael Kutney, P.G.
Bureau of Mining & Reclamation
PA Department of Environmental Protection
5 West Laurel Boulevard
Pottsville, PA 17901-2454

SUBJECT: Hydrogeologic Investigation Report (HIR) Addendum
Furlong Fault Groundwater Study
New Hope Crushed Stone
SMP No. 7974SM3
Solebury Township, Bucks County, PA
ERG Project No. 011012.009

Dear Mr. Kutney:

On behalf of New Hope Crushed Stone (NHCS), EarthRes Group, Inc. (ERG) is submitting the enclosed Hydrogeologic Investigation Report (HIR) Addendum in support NHCS's quarry deepening application of October 2008.

Through coordination with DEP, ERG met and corresponded with the DEP and Solebury Township's Hydrogeologist (EPC) and developed an investigation Work Plan to address the remaining issue of concern: the potential for significant out of basin flow along the Furlong Fault to be intercepted by the quarry. This report details the implementation of the Work Plan and the finding and conclusions of the study. We trust that this information satisfies the Department's final concerns regarding advancement of the quarry from -120' MSL to -170'MSL.

Please call me with any questions or if you wish to further discuss this matter.

Sincerely,
EarthRes Group, Inc.

Louis F Vittorio Jr.

Louis F. Vittorio Jr., P.G.
Vice President, Principal Hydrogeologist

cc: George Riordan, NHCS

Hydrogeologic Investigation Report Addendum

Furlong Fault Groundwater Study

New Hope Crushed Stone
SMP No. 7974SM3
Phillips Mill Road
Solebury Township, Bucks County, Pennsylvania

July 2010

Prepared for:

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1.0 INTRODUCTION

On October 20, 2008 ERG submitted an application to advance the New Hope Crushed Stone (NHCS) Quarry from -120' MSL to -170'MSL. The request was in accordance with the existing SMP #7974SM3, wherein the Quarry is currently permitted to mine to -200' MSL. Along with the October 2008 Application, ERG provided an updated Module 8 and an addendum to the June 2007 Groundwater Pumping Evaluation (GPE) that evaluated the potential for hydrologic impacts associated with the proposed deepening. The investigation found that the hydrogeological impacts were insignificant for many reasons, but mainly that the Quarry had already advanced into a lower formation having limited hydraulic conductivity. The data in the GPE continued to show that the hydrogeological balance of the basin is maintained and that Quarry pumping is in response to precipitation recharge.

On January 22, 2009, after the close of the public comment period, Solebury Township submitted a technical report entitled: "Technical Comments on October 24, 2008 Proposed Quarry Expansion Application for the New Hope Crushed Stone and Lime Company Quarry" prepared by Environmental Planning Consultants (EPC). Within the report EPC requested additional investigation prior to deepening to the permitted depth. Subsequently, the Department requested NHCS investigate the possibility of flow along Furlong Fault (see DEP's May 15, 2009 letter) and whether Quarry dewatering is impacting the Aquetong Spring (see DEP's August 18, 2009 letter). As directed by the DEP, ERG met and corresponded with the DEP and EPC (Solebury Township's Hydrogeologist) and determined that the one remaining issue of concern was the potential for significant out of basin flow along the Furlong Fault to be intercepted by the Quarry.

In coordination with DEP and EPC, ERG developed an investigation Work Plan to address this concern as discussed and agreed upon at the joint meeting between parties held on September 22, 2009. The investigation work plan was submitted by ERG on September 25, 2009 and was approved by the DEP and EPC via electronic mail on September 25, 2009.

This report details the implementation of the work plan and the finding and conclusions of the study. Introduction and relevant background information are included in Section 1.0. Discussion of the Fault geology and the drilling and installation of the Fault monitoring well, Well Nest-4, is included in Section 2.0. Section 3.0 describes the Quarry Sump Drawdown and Recovery Test and observation data. Section 4.0 is a discussion of results and Section 5.0 includes the investigation conclusions.

1.1 Hydrogeologic Setting

The area under consideration for this investigation has been described in detail in the 2005 HIR, the 2006 and 2008 Groundwater Pumping Evaluations and published reports referenced therein. The Quarry, Aquetong Spring, and the surrounding geology and topography are shown in Figure 1. Extensive normal faulting has brought the underlying Cambrian and Ordovician aged carbonates to the surface forming a large northeast trending valley, which is the Buckingham Valley, within the

Newark Basin. The Buckingham Valley is bounded by Furlong Fault to the east and is unconformably overlain by the Triassic age Stockton Formation to the west. Aquetong Spring is located in the Valley along the Furlong Fault approximately 8,600 feet South and upgradient of the Quarry. A hypothetical traverse from the Quarry to Aquetong Spring crosses numerous topographic divides which provide a degree of hydraulic isolation between the Quarry and the Spring. In addition, a large northeast-southwest trending diabase dike truncates the Buckingham Valley south of the Quarry. This Dike is a low-permeability boundary that hydraulically isolates the Quarry from the rest of the Valley.

Aquetong Spring is located approximately 8,600 feet south of the Quarry. The geologic setting and high discharge volume suggests Aquetong Spring is a fault contact spring supplied by groundwater from the adjacent carbonate aquifer. Considering recharge estimates for carbonate geology derived by the United States Geologic Survey (USGS), the estimated 3 million gallons per day (MGD) issuing from the spring would require a recharge area of approximately 4 square miles. EPC has delineated an estimated recharge area of approximately 6 square miles. The northern extent of this recharge area is approximately 4,800 feet south of the Dike at its nearest point. The northern extent of the recharge area in the vicinity of Furlong Fault is more than a mile south of the Dike. The outcrop area of the carbonate aquifer south of the Dike would provide over 6 MGD of baseflow during an average year. Therefore, discharge to Aquetong Spring is easily accounted for by the recharge area that has been estimated by the Township and by the areal extent of the carbonate aquifer south of the Dike.

Geologic investigation indicates the Fault zone has been heavily intruded by diabase in the vicinity of Aquetong Spring (Ratcliffe, 1988). USGS concluded that the diabase intruded into the Fault zone following major down-faulting. The presence of diabase would serve to limit the transmissivity of the Fault in that location. Similar conditions are indicated in the Fault zone near the Quarry as several diabase dikes have been identified trending along the orientation of the Fault and in close proximity to the Fault zone (see ERG Drawing E-067). Given the relationship between diabase intrusion and faulting, it is likely that the Fault is not a regionally extensive conduit for groundwater flow.

North of the dike at a location just south of the Quarry, the surface expression of the Fault corresponds with a pond (the Pond) and tributary drainage-way which is depicted on USGS topographic maps as an intermittent stream. The Pond and tributary are typically wet during the winter and spring and dry during the summer months, consistent with the stream designation, as was observed during this investigation. The Pond has a bottom elevation of approximately 104 feet msl based on 2-foot contour aerial fly-over topography. Topography rises steeply to the south, east and west of the Pond reaching elevations over 200 feet msl. The drainage area of the Pond and tributary, delineated using Pennsylvania StreamStats (available online at http://water.usgs.gov/osw/streamstats/), is 0.20 square miles based on ground surface topography. Given this drainage area and assuming an average year of precipitation (48.7 inches), and typical evapotranspiration (27.5 inches), the drainage area would contribute 0.20 MGD (132 gpm) on average to baseflow. Regression-based flows available from StreamStats, indicate an approximate baseflow of 0.16 MGD (112 gpm) for this area assuming the groundwater contributing area corresponds with the surface drainage.

ERG has been monitoring and reporting (on a monthly and more recently quarterly basis) on the water balance of the Quarry since 2005. In addition to Quarry pumping and stream flow, over 30 wells are regularly monitored to assess transient groundwater conditions within the Basin. As documented within the numerous monitoring reports, Quarry pumping shows a positive correlation with precipitation and groundwater levels indicating a condition of dynamic equilibrium within the Basin. Quarry pumping increases and decreases in response to precipitation within the Basin.

Due to the fact the Quarry intercepts the Primrose Creek Valley, the Quarry pumps both the groundwater and the surface water components of the Basin. The main inflow of water to the Quarry has been observed and documented within prior reports to occur at the west wall of the Quarry in the vicinity of the Primrose Creek Valley. The current study evaluates the potential for additional water inflows areas specifically related to the Furlong Fault.

2.0 FURLONG FAULT INVESTIGATION

2.1 Quarry Fault Geology

Modifications of the Quarry pit initiated in 2008 and completed by December 2008 exposed a section of the Fault within the pit. A photograph of this exposure is included in Figure 2. The blocky characteristic geology of the Allentown/Limeport Formation is shown on the right (western) portion of the outcrop. The red shale of the Brunswick Formation dominates the left (eastern) portion of the outcrop. The Fault zone is highly deformed and occurs near the center of the outcrop. Two (2) water bearing zones are observed in this area of the Pit. The first water bearing zone daylights along the high wall, at an elevation of approximately 90' msl and flows from a fracture within the Fault zone. Flow from this zone fluctuates greatly depending on precipitation. In periods of wet weather, flow cascades down the side of the wall; however, during dry weather no flow is apparent. The second water bearing zone occurs at the base of the highwall (approximately 30' msl) approximately 100 feet east of water bearing zone 1. Additionally, the area between these two water bearing zones is characterized by several small seeps. Flow from these zones was collected in a channel constructed alongside the haul road and was monitored from March 5, 2010 to April 13, 2010 (See Section 3.2.1). Flow was gauged with a global flow probe by measuring stage and water velocity at multiple points across the swale and then using the data to calculate flow.

2.2 Fault Monitoring Well Installation

Through due process, NHCS gained access to the PECO property south of the Quarry for installation of the Fault monitoring well nest. Final drill Site location was selected in consultation with PECO engineers due to Site access considerations. The surveyed location of the borehole and constructed monitoring well (Well Nest-4) is shown on Drawing E-067. Well Nest-4 is located approximately 210 feet east of the Pond and 550 southeast of the surface expression of the Fault in the Quarry.

Drilling and construction of the monitoring well was performed under the oversight of a Licensed Professional Geologist. The borehole was drilled utilizing air-rotary drilling and was telescoped with depth to facilitate construction of a nested wells. No water was added during drilling. A 10-inch hole was drilled to a depth of 49 feet below ground surface (bgs) and cased with 51.5 feet of 8.5-inch steel casing. The casing was grouted in place with a neat cement grout resulting in a 2-foot stick-up. The borehole was then drilled and telescoped to the remaining depth: 8.5 inches to a depth of 145 feet bgs; and 6 inches to a final depth of 295 feet bgs. The hydrogeologic characteristics encountered during drilling consisted of the following:

- Unconsolidated overburden consisting of soils and red brown silt loams to a depth of 31' bgs.
- Red shales and siltstones were encountered from 31' to 119' bgs.
- A dark gray Fault breccia was encountered from 119' to 125' bgs.

- A light red and buff dolomite was encountered from 125' to 295' bgs.
- Water bearing zones and fracture zones were encountered at 43' bgs (1gpm); 66' bgs (2gpm); 70' bgs (2gpm); 120' bgs (>100 gpm); 185' to 186' bgs; and 243' to 245' bgs.

Based on these characteristics, the nested monitoring well was constructed within the Fault with screened intervals above, within, and below the brecciated Fault zone. The nested wells were constructed using schedule 40 PVC with 10-inch screens through the interval of interest. The shallow monitoring well was set with 1-inch diameter PVC to a depth of 73' bgs and screened from 63' to 73' bgs. The intermediate monitoring well was set with 2-inch diameter PVC to a depth of 155' bgs and screened from 165' to 155' bgs. The deep monitoring well was set with 2-inch diameter PVC to a depth of 247' and screened from 237' to 247' bgs. The annular space surrounding the screened intervals was packed with clean sand to a height of approximately 2 feet above the screen and sealed with a bentonite plug as shown on the attached well log. The annular space between well settings was filled with a repeating sequence of approximately 20 feet of 3/8-inch clean fill followed by 5 feet of bentonite plug to effectively seal off the screened intervals from each other. The wells were pumped to verify the screens were hydraulically isolated within the annulus. The well log is included in Attachment D.

2.3 Hydraulic Testing

ERG personnel performed falling and rising head slug tests on Well Nest 4-I, and Well Nest 4-D. Slug-testing involves rapidly raising (rising head) or lowering (falling head) the water level and monitoring the water level as the well regains hydrostatic equilibrium. The tests were completed by introducing/withdrawing a sealed sand filled pipe to displace the water column in the well. Prior to testing, a pressure transducer/data logger was installed and programmed to record water levels during the test.

The water level data was downloaded into a spreadsheet program for graphing and analysis. The test results for Well Nest-4D were analyzed using the methodology developed by Bouwer and Rice (1976 and 1989). The test results for Well Nest-4I were analyzed using methodology developed by Van der Kamp (Halford, 2002) which is suitable for an oscillatory slug test response which occurred during the test. The analysis spreadsheets and test plots are included in Attachment E, Slug Test Results. The hydraulic conductivity of Nest-4D was calculated to be 20 feet per day. The hydraulic conductivity of Nest-4I was calculated to be 170 feet per day. The high hydraulic conductivity and oscillatory response of Nest-4I indicates a conduit/storage feature associated with the Fault.

3.0 QUARRY SUMP DRAWDOWN AND RECOVERY TEST

Water levels within the Fault were monitored during a period of filling and dewatering of the Quarry Sump to observe the propagation of Quarry pumping stress to the Fault. The Sump dewatering test was designed with a period of rapid filling and subsequent dewatering in an effort to induce the maximum sustained pumping rate operationally possible. During the fill period (February 16 to March 8), the Sump was allowed to fill from -106 feet msl to an elevation of -87 feet msl. The dewatering phase was started on March 9 and ran through May 23, 2010 lowering the Sump level to -112 feet msl. A total of 397.5 million gallons were pumped as recorded at the Quarry weir flow gage, resulting in an average pumping rate of 5.2 MGD over the dewatering phase. Following dewatering, the water level was held constant for 5 days, from May 24 through May 28 and then allowed to recover beginning on May 29. Table 1 includes a summary of test dates including all pump run times and cycling for comparison with deflections in the hydrographs.

3.1 Monitoring Network and Data Collection

ERG collected stage measurements of the Pond (Table 2) and flow measurements of the water flowing into the Quarry from the exposed section of the Fault (Table 3). Data from these monitoring points along with precipitation is summarized graphically in Figure 3. In addition, ERG established a continuous monitoring network for data collection during the test. ERG installed pressure transducers within the Quarry Sump; within Well Nest-4S, 4I and 4D; and within MW-7A to provide continuous coverage for the period of testing. Other continuously monitored points include: MW-3 (northwest within the Carbonate); MW-6 (north within the Carbonate; Bucciarelli (to the northeast along the Fault); and RG-1 (precipitation gage installed at the front office). Groundwater levels within the various wells are plotted in elevation space along with precipitation and important test dates on Figure 4, Monitoring Wells and Sump Hydrograph. In addition, ERG photographed the Quarry walls surrounding the Sump to document the presence of seeps and springs inflowing to the Quarry, see Attachment F.

3.2 Data Analysis and Discussion

3.2.1 Pond and Fault Discharge

A hydrograph presenting the Pond and Fault flow data (Tables 2 and 3) measured during the testing period is shown in Figure 3. The hydrograph shows that there is a positive correlation between the pond stage, Fault flow discharge to the Quarry, and precipitation. After a precipitation event, pond stage rises as does the Fault flow rate as measured at the Quarry monitoring location (see Drawing E-067). The data indicates that the shallow expression of the Fault in the area of the Quarry is recharged by the pond and additional surface water runoff collected during precipitation events. Following storm events, the flow of the Fault resumes a typical baseflow recession.

3.2.2 Hydrograph Analysis

Figure 4 is a hydrograph of the test monitoring wells shown in elevation space with callouts marking test dates. Groundwater levels within the monitoring wells were evaluated for spatial and temporal trends, specifically for deflections from Sump dewatering. The monitoring wells do not show deflections based on Sump dewatering (see Table 1 for Sump pumping schedule). Rather water levels respond to precipitation events and are unaffected by Sump dewatering. As shown, water levels began their seasonal decline during the growing season as in response to decreased precipitation recharge. Separate hydrographs were prepared for MW-7 (Figure 5) and Well Nest-4 (Figure 6) to show these levels in more detail.

<u>MW-7</u>

The water level in MW-7 is affected by routine pumping of a water source other than the Quarry Sump, as demonstrated by comparison of the Figure 5 hydrograph with the Sump pumping schedule presented on Table 1. Figure 5 shows the water level in MW-7 from Monday, May 3 through Wednesday May 12. Several pumping cycles are evident (a very pronounced cycle corresponding to longer pumping time and higher drawdown and a less pronounced cycle corresponding to short duration and low drawdown.) Pumping start times (as indicated by the start of drawdown) and durations are indicated to be: 17:30 for 1 hour (Tuesday, 5/4), 11:00 for 1.5 hours (Wednesday, 5/5), 18:00 for 1 hour (Thursday, 5/6), and 16:00 for 5 hours (Friday 5/7), 12:00 for 3 hours (Tuesday, 5/11). Also evident is a short pumping cycle starting at 3 AM. By contrast, Quarry dewatering pumping through May 6 was continuous with 2 electric submersible pumps. On May 6 one of the subs was turned off at 11:30 AM and then restarted at 7:00 AM on May 7. These pumps ran continuously until the start of the recovery period (May 26) when one of the subs was shut-off during the hold period. Based on comparison of the Quarry Sump pumping schedule and the drawdown presented on Figure 5, MW-7 was not affected by Quarry Sump dewatering.

<u>Furlong Fault Well Nest-4S, 4I, 4D</u>

It is demonstrated from the hydrographs (Figures 4 and 6) that groundwater levels in Well Nest-4 are approximately 200 hundred feet above the level of the Sump. Furthermore, the average water level is similar to the level indicated on the 1992 water table map of the area, prepared by USGS (Open-File report 93-28) and on groundwater contour maps for the Basin prepared and submitted quarterly by ERG.

It is apparent from the hydrographs that Well Nest-4I and Well Nest-4D demonstrate very similar water levels in terms of both elevation and temporal variation indicating that they are part of the same hydrogeologic unit. Both wells tested with a moderately high to high hydraulic conductivity indicating a connected fracture network. Well Nest-4S, completed within the Brunswick, has a higher water level but trends much like the deeper Nest wells. Based on the higher water level in Well Nest-4S, a downward vertical gradient exists between the shallow and deeper wells which indicates leakage from the Brunswick Formation into the Fault system.

In addition, Well Nest-4I and 4D exhibit a boundary condition in effect at approximately 104 feet msl where the trend of the groundwater recession takes a steeper slope. This boundary condition is demonstrated in the data as occurring on May 13, 2010. This was subsequently evaluated for pumping effects from Sump dewatering and was found to have no connection to pumping from the Sump. Subsequent recharge resulted in recovery of the water level to 104 feet msl for a period of several days; however, the water level soon resumed the steep downward trend after declining below 104 feet msl.

The elevation of 104 feet msl corresponds to the approximate bottom of the Pond and tributary system located near the Fault. Therefore, the shallow expression of the Fault is connected to the Pond system, and the Pond system provides recharge to the Fault until becoming depleted. Flow measured along the Fault clearly demonstrates a connection to surface water recharge given the measured surges corresponding with precipitation. Following depletion of the Pond storage, the water level in the Fault undergoes recession as the Fault comes into equilibrium with groundwater baseflow from the south and discharge to the Quarry.

The declining water level is significant and indicates that baseflow along the Fault is not sufficient to recharge the Fault system in the absence of recharge from the shallow pond system. Therefore it is demonstrated that the Fault system is not pulling large amounts of water from the south, otherwise neither the water level within the Fault nor the measured discharge from the Fault into the Quarry would decrease so dramatically. The hydrograph data shows that the Fault in the area of the Quarry responds to a local and shallow water system connected to the recharge/discharge of the Pond and tributary system. Deeper high volume flow along the Fault is not indicated in the data and further is not observed in the Quarry.

3.2.3 Photographic Assessment

Attachment F includes photographs of the Quarry at different monitoring locations showing seeps, and other water bearing features throughout the period of this study. Beginning with photographs from March 2010, the Quarry is shown to be receiving water through the shallow expression of the Fault zone through: 1) water cascading from a water bearing zone at approximately 90 feet msl entering the channel; and 2) water bearing zones observed along the base of the highwall. During March the Sump was infilling and being pumped to prevent overflow to the Quarry floor and maintain flow to the Primrose Creek. The April 2, 2010 photograph of the Pond shows the large amount of surface water that collects in the area along the Fault. A corresponding photograph from April 2, 2010 shows the Pond water draining and cascading down the south wall of the Quarry through the previously identified water bearing zone.

Photographs from May indicated drier conditions. Photographs taken on May 27th and 28th show the Quarry during the low hold period, when the water has drained from the Pond (due to low precipitation / low recharge conditions). Corresponding, there is no flow cascading down the south wall at the Fault zone. Photographs from May 25th and May 28th show two areas of groundwater seepage into the Quarry—at an area on the east wall and on the south wall behind the Sump transducer. These seeps are likely related to the Fault. During this time the Primrose Creek outflow on the west wall was flowing and was measured at the culvert in the northwest corner of the Sump.

Based on the field observation and direct measurements taken at these locations, flows were calculated. At the culvert located in the northwest corner of the Sump, flow from the Primrose Creek Valley was measured on May 25, 26, 27, and 28 (averaged 1.14 MGD). The measured 1.14 MGD underestimates the total flow from this feature as a portion of flow leaks directly to the Sump through fractures in the swale (see last photo from 5/28/2010). The total flow is conservatively estimated at 1.3 MGD. Seeps located on the west, northwest, east, and southeast walls are estimated to flow 0.05 MGD. The flow associated with the Fault Zone water bearing zone is calculated below.

3.2.4 Test Period Water Budget Analysis

A water budget was prepared for the Quarry from May 25, 2010 through May 28, 2010 during the low hold test period when storage effects could be minimized. From the perspective of the Quarry Sump, the equation for the water budget of the Quarry is as follows:

$$\Delta S = P_d + Q_{PC} + Q_Z + Q_S + Q_F - Q$$

Where:

ΔS	is the change in Sump Storage
P_d	is the direct precipitation over the Quarry
Q_{PC}	is the flow from the Primrose Creek (from the west wall)
Q_Z	is the vertical component of baseflow through the Quarry Floor
Q_S	is the flow from the various seeps from the west wall –unrelated to the Fault
Q_F	is the flow along the Fault, which also includes leakage from the East Wall
Q	is the Quarry pumping rate measured at the weir

During the low hold period, the water level in the Sump was held constant $\Delta Sg = 0$ so that Quarry flows could be evaluated without having to account for changes in surface water storage. The equation is solved for the flow rate along the Fault resulting in the following expression:

$$Q_F = Q - Q_{PC} - P_d - Q_Z - Q_S$$

A combination of direct measurements and estimates was used to complete the analysis. Quarry pumping (Q) is measured at the weir and averaged 1.949 MGD over the budget period. The flow from the Primrose Creek Valley through the West wall (Q_{PC}) was measured on the west side of the Sump where a swale runs through a culvert beneath the haul road and discharges into the Sump. The flow of Q_{PC} is conservatively estimated at 1.30 MGD. P_d is the precipitation over the pit which is the feet of precipitation (0.0308 feet) multiplied by the disturbed area (117 acres) and reduced by a factor of 0.8 to account for evaporation (0.222 MGD). The parameter, Q_z, is the vertical baseflow calculated from previous reports as 0.279 MGD (ERG HIR, 2005). The parameter, Q_s, is the estimated combined flow of various seeps on the west, southwest, and northwest walls and is estimated to be 0.05 MGD.

Substituting into the water budget equation, the baseflow of the Fault is conservatively calculated to be 0.10 MGD as shown below:

$$Q_F = 1.949MGD - 1.30MGD - 0.222MGD - 0.279MGD - 0.05MGD = 0.10MGD$$

The calculated value of 0.10 MGD (69 gpm) is the estimated baseflow of the Fault conservatively accounting for other Quarry inputs. Due to the conservative assumptions, it is likely that the baseflow measured during the test period is less than 0.10 MGD. Further, this estimated value also includes any leakage transmitted through the Fault from the adjacent Brunswick Formation in addition to any baseflow transmitted by the Fault from areas south of the Quarry.

The regression statistics for the sub-basin feeding the Fault zone south of the Quarry (available from StreamStats) indicate an approximate baseflow of 0.16 MGD. This baseflow is comparable but greater than the result from the water budget analysis. However, when the sub-basin is truncated (0.13 mi^2) to include only the area west of the Fault (assuming properly that the Fault acts as no-flow boundary), the baseflow is approximated as 0.10 MGD which is in very good agreement with the water budget analysis. For additional comparison, the truncated sub-basin area was multiplied by the published USGS baseflow for carbonate geology (0.706 MGD/mi^2 as reported in Schreffler, 1996) indicating a baseflow of 0.09 MGD for the sub-basin west of the fault. Based on this comparison, the observed Fault zone flow has a contributing area no larger than the sub-basin delineated for the Pond and tributary system.

4.0 RESULTS

The data collected in the current study indicate the following results:

- Both the Fault and the underlying carbonate aquifer tested with a moderate to high hydraulic conductivity and have equivalent water levels which indicate the presence of a connected conduit/fracture network within the Fault/carbonate.

- Given the reported relationship between Diabase intrusion and faulting, it is likely that the high K zone of the Fault is not laterally extensive.

- Stressing the Quarry Sump did not affect the water levels in the Fault or underlying carbonate aquifer which indicates that this Fault fracture system is not hydraulically connected to the Sump. Deeper high volume flow along the Fault is not indicated in the data and further is not observed in the Quarry.

- Discharge to the Quarry through the Fault originates as recharge from: 1) the Pond; 2) leakage from the overlying Brunswick Formation; 3) baseflow from the hills to the west and from areas south, truncating at the dike.

- The average annual discharge through the south wall as predicted by the StreamStat regression analysis is approximately 0.10 MGD for the area west of the Fault. This is consistent with the presented water budget analysis for the observed Fault flows, which is based upon the collection of site specific data.

Based on the water budgets, measured Fault flows, published data and direct observation, there is no justification for extending the recharge area of the Fault to out of basin areas. The current investigation is consistent with significant prior site investigations showing that the Fault is not transmitting out of basin flow to the Quarry.

5.0 CONCLUSIONS

The approved investigation Work Plan was implemented to address the remaining issue of concern regarding the pending quarry deepening application: the potential for significant out of basin flow along the Furlong Fault to be intercepted by the Quarry. In addition to the results of the study the following conclusions are indicated by the data:

- The Quarry intercepts the Furlong Fault along the east edge of the pit at the surface. The Fault dips to the east-southeast away from its surface expression along the east edge of the Quarry, while the carbonate rocks dip west-northwest – opposite from the Fault dip. The Sump is currently 500 feet from the Fault and with each new lift, the Quarry advances further away from the Fault zone into more massive carbonate rock having lower secondary porosity. The observed geology is consistent with results of the current study that shows a lack of significant hydraulic inflow from the Fault from out of basin groundwater sources.

- The existence of significant flow along the Fault is not supported by basin water budgets or the hydrographs contained in the current report and in the ongoing quarterly reports submitted to the PA DEP. The flow observed into the Quarry from along the Fault is mainly from surface from within the basin that collects in the pond / tributary directly to the south of the Quarry.

- Neither the east wall nor the northeast/southeast corners of the Quarry yield observable flow to the Quarry. If there was a significant connection between the pit and the Fault zone, we would expect to see significant inflow along these areas. If the flow occurred in the carbonate, we would see it all along the east side of the Quarry.

- If the Fault zone were a conduit providing significant flow to the Quarry, that flow would occur even in drought, as both the Delaware River and the Ingham spring flow during drought. During drought periods, the only visible inflow to the pit occurs from the west, not from the Fault area.

- Typically, a highly transmissive Fault would cause disappearance of overlying streams and lakes as water drains into the preferential flow path. Several streams and water bodies cross over or flow along the Furlong Fault without disappearing.

- The Ingham Spring occurrence is controlled by the location of the Furlong Fault, which forms a barrier to flow enabling spring emergence. If the Fault was a regional conduit flow pathway, the spring would not occur at the Fault contact. This conclusion is supported by research conducted by the USGS.

- Review of the Kochanov (PA DCNR) karst study for this area shows sinkholes to the west of the Fault and along carbonate-carbonate contacts, but almost none along the Fault. If the Fault were a flow conduit, we would expect to see sinkholes in the carbonate along the Fault.

The conclusions of the study indicate that out of basin flow along the Furlong Fault is not occurring, and this conclusion is consistent with prior findings, published reports and significant data on file with the Department.

6.0 REFERENCES

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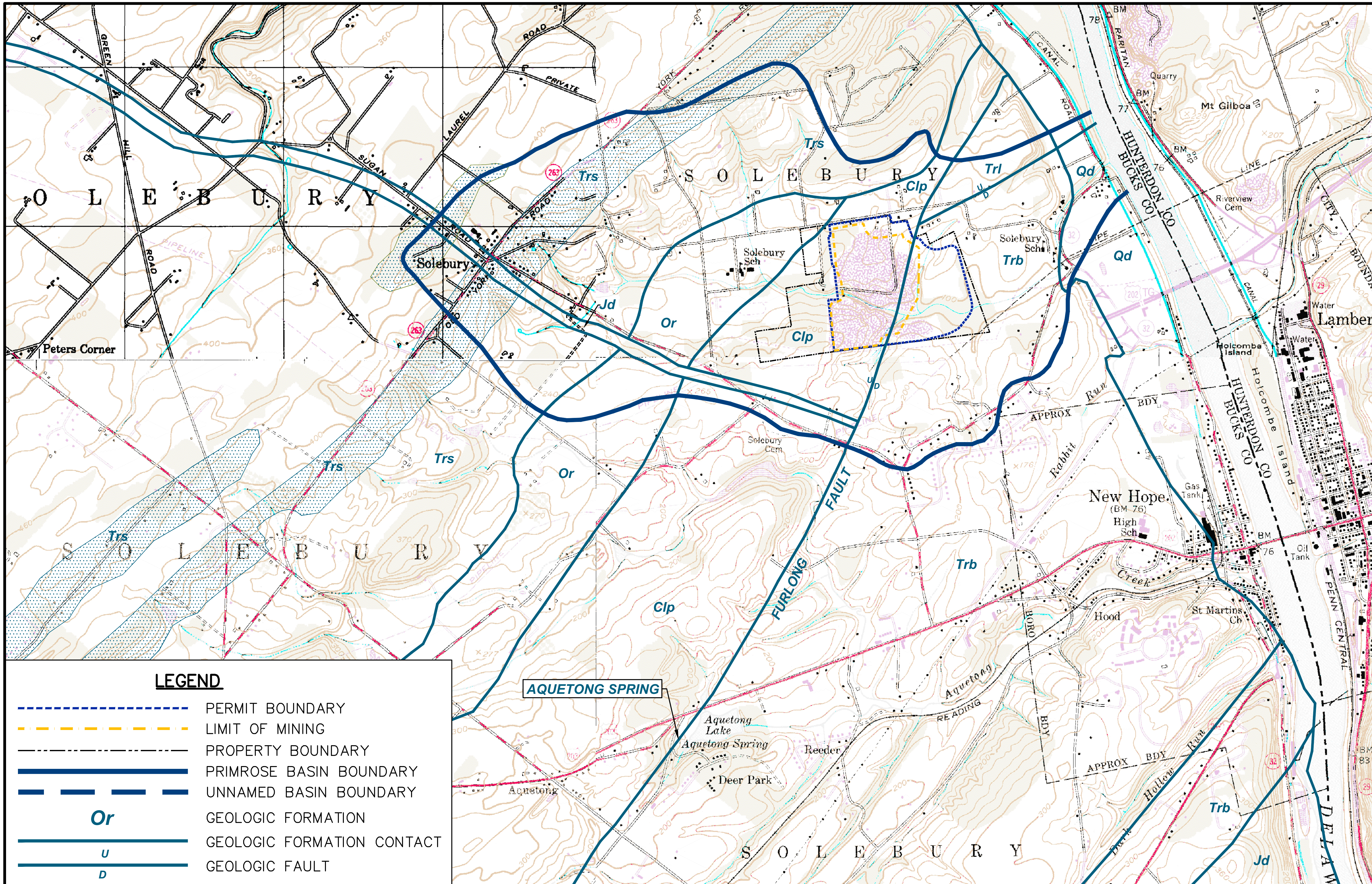
ATTACHMENT A
FIGURES



LEGEND

PERMIT BOUNDARY

LIMIT OF MINING

PROPERTY BOUNDARY

PRIMROSE BASIN BOUNDARY

UNNAMED BASIN BOUNDARY

Or GEOLOGIC FORMATION

GEOLOGIC FORMATION CONTACT

U / D GEOLOGIC FAULT

Clp LIMEPORT FORMATION **Jd** DIABASE **Or** RICKENBACH FORMATION **Qd** QUATERNARY DEPOSITS **Trb** BRUNSWICK FORMATION **Trl** LOCKATONG FORMATION **Trs** STOCKTON FORMATION

SOURCE: USGS 7.5 MINUTE QUADRANGLES – BUCKINGHAM, PA; LUMBERVILLE, PA; STOCKTON, NJ – PA; LAMBERTVILLE, NJ – PA

FIGURE 1

STUDY AREA WITH GEOLOGY

2010 FAULT STUDY

SOLEBURY TOWNSHIP, BUCKS COUNTY, PA

DRAWN BY: CMH	CHECKED BY: LFV
DATE: 07/02/10	PROJECT NO: 011012.009
DRAWING SCALE: 1" = 2000'	

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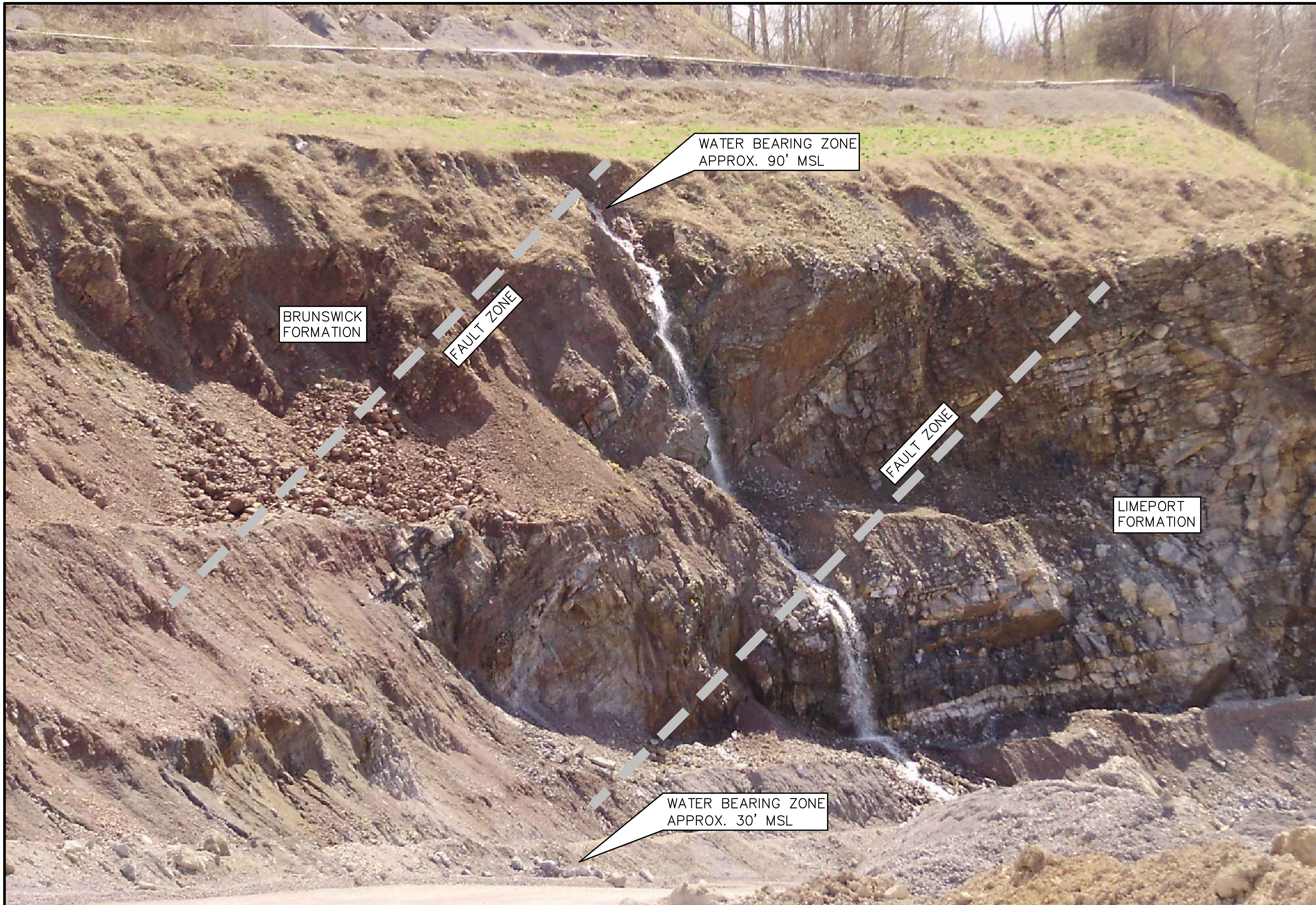
ERG EARTHRES GROUP



SOURCE: PHOTO TAKEN BY ERG ON 4/2/2010

FIGURE 2

FURLONG FAULT EXPOSURE ALONG SOUTH WALL OF QUARRY

2010 SITE WORK
SOLEBURY TOWNSHIP, BUCKS COUNTY, PA

DRAWN BY: CMH	CHECKED BY: LFV
DATE: 07/02/10	PROJECT NO: 011012.009
DRAWING SCALE: NOT TO SCALE	

ENVIRONMENTAL ENGINEERING and SCIENCE

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Figure 3. Pond and Fault Hydrograph

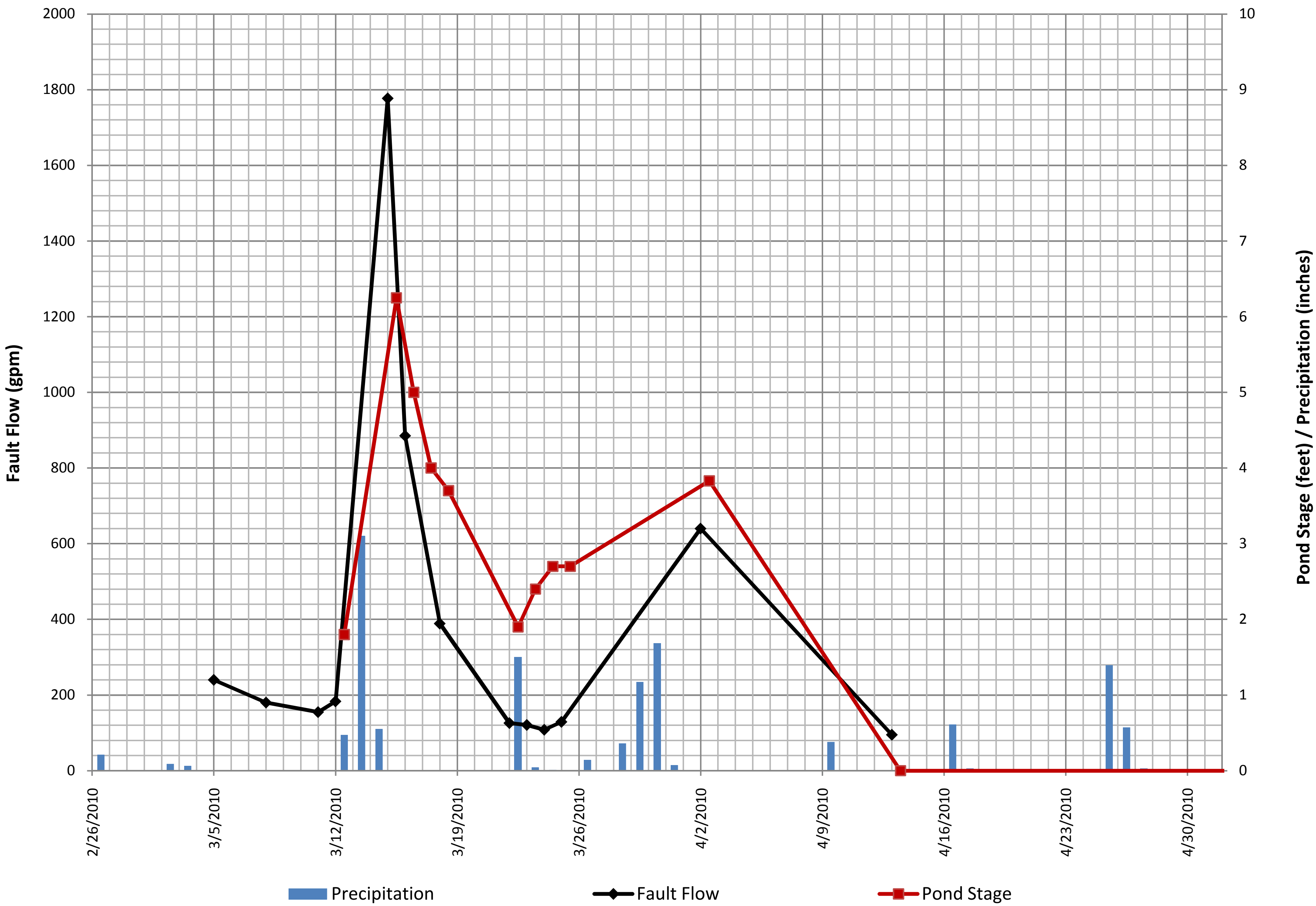


Figure 4. Monitoring Wells and Sump Hydrograph

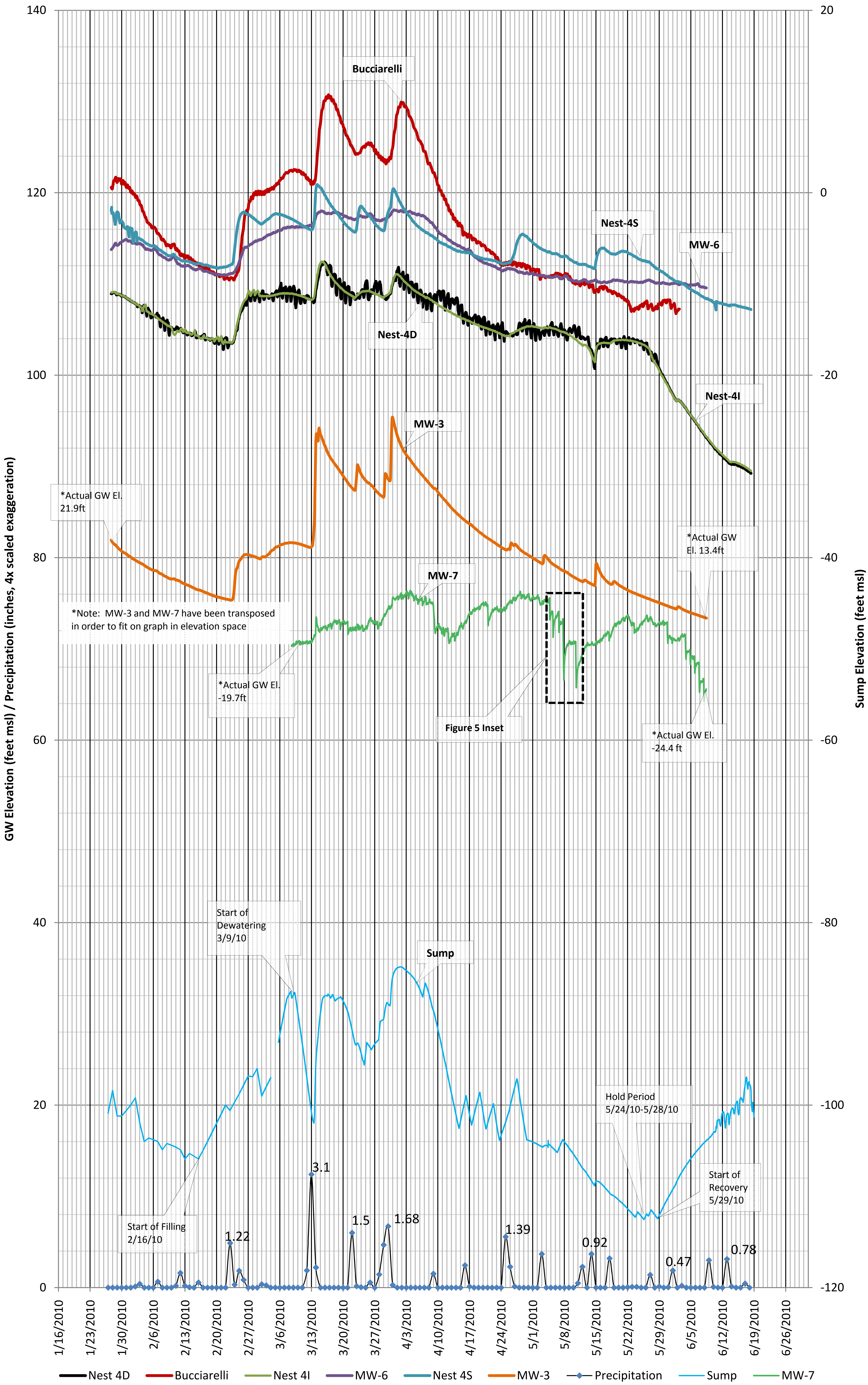


Figure 5. MW-7 (5/3/10 - 5/12/10)

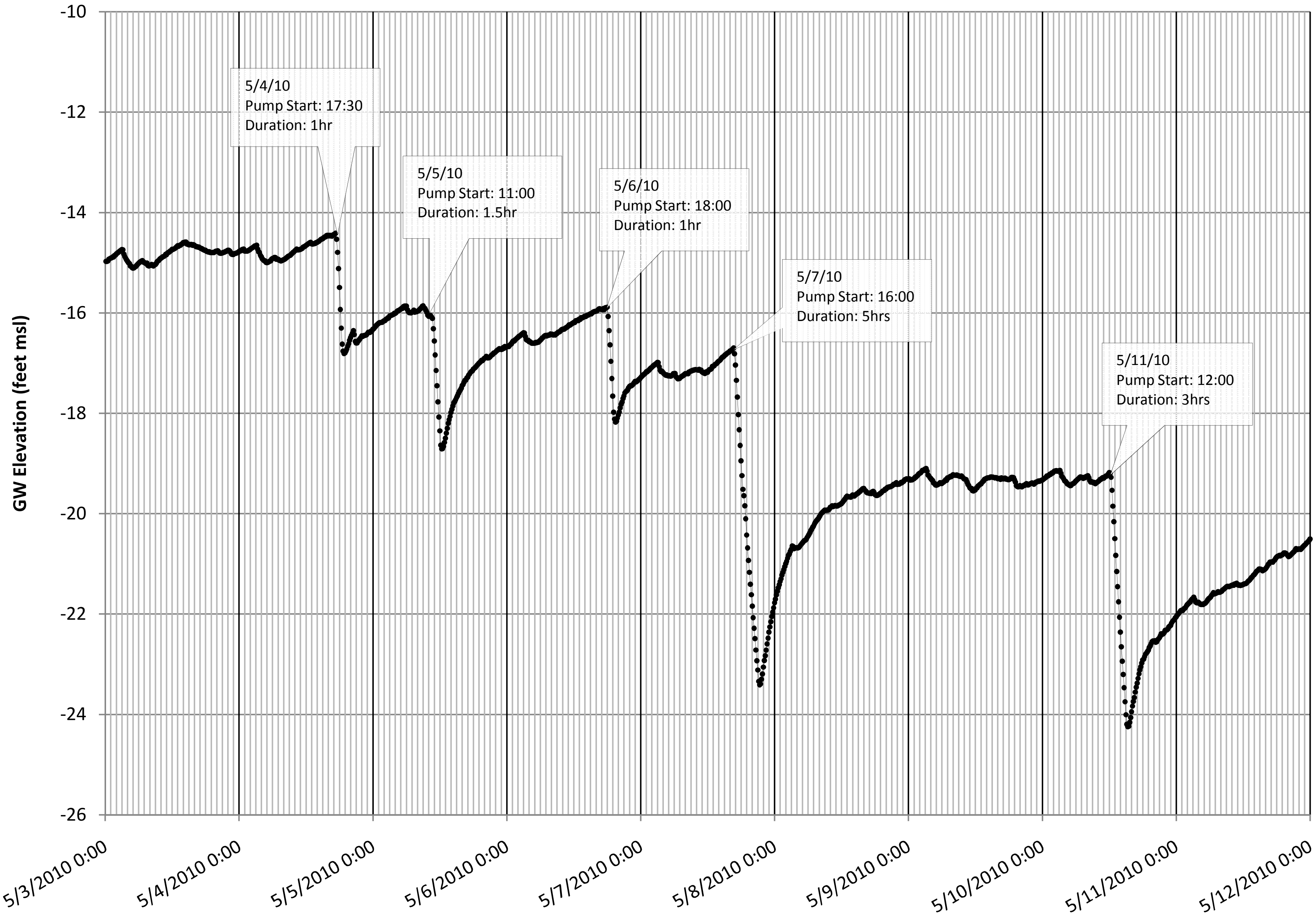


Figure 6. Well Nest-4 Hydrograph

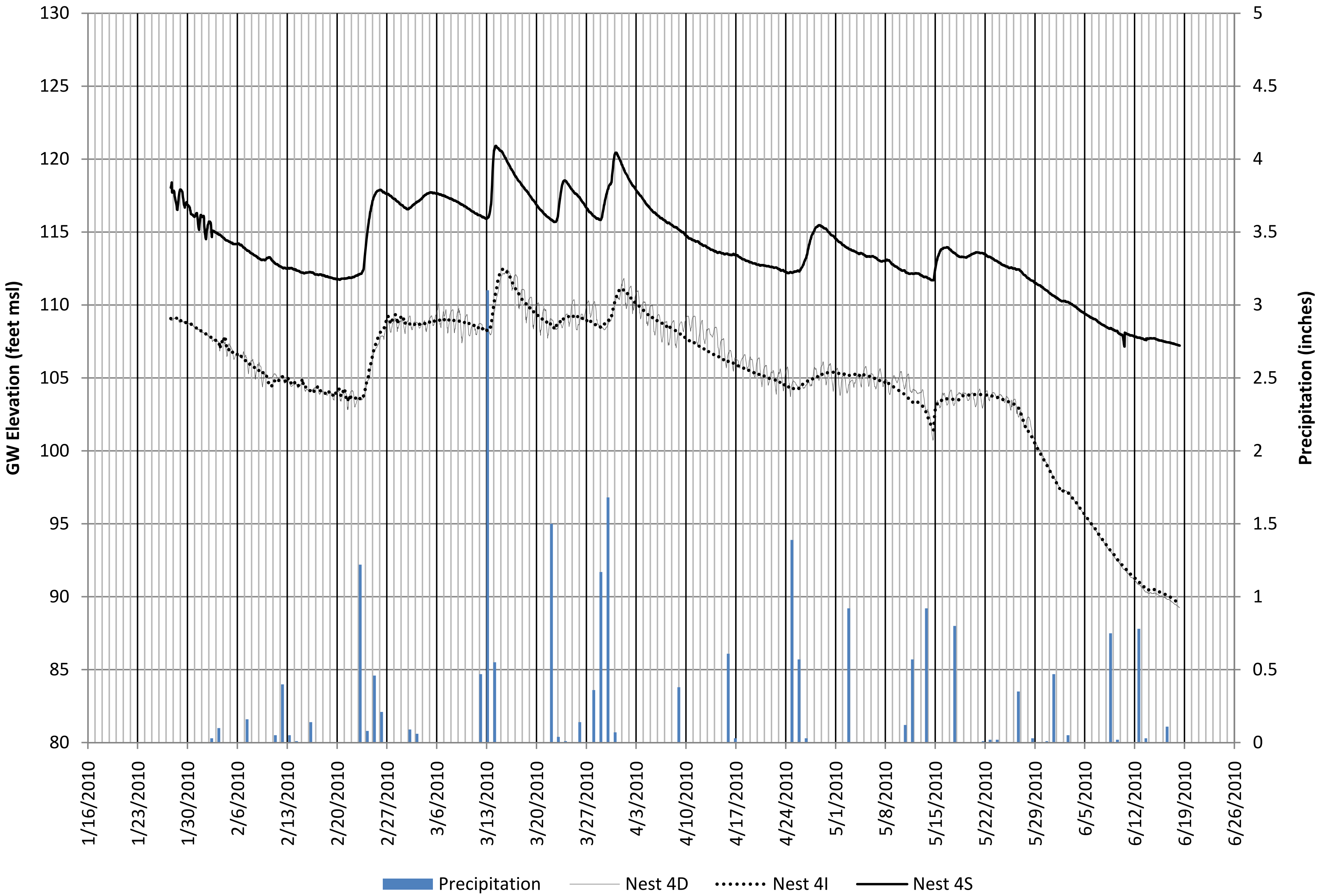
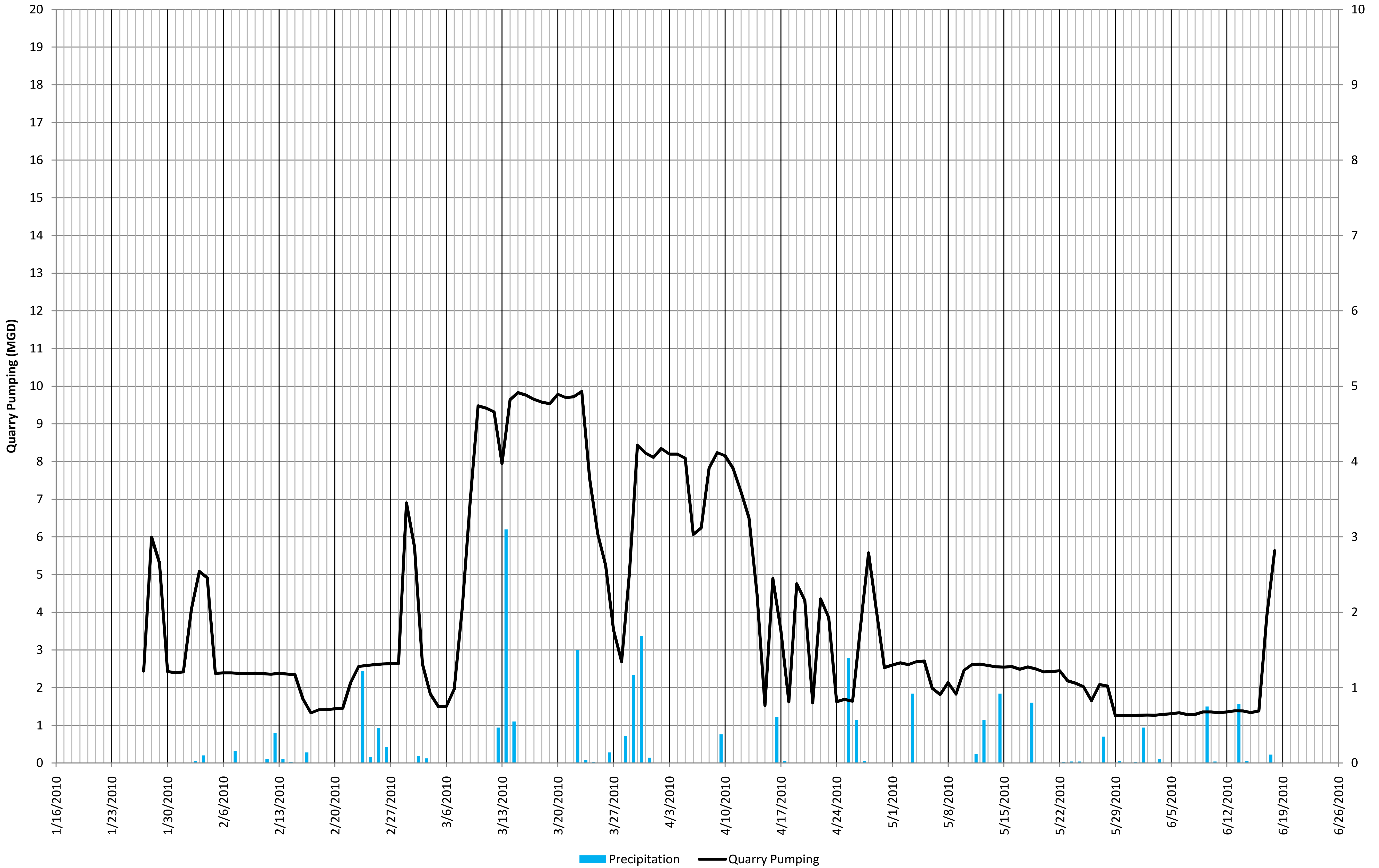


Figure 7. Quarry Pumping and Precipitation



ATTACHMENT B
TABLES

Table 1
Test Dates and Sump Pumping Schedule

New Hope Crushed Stone, Inc.
Solebury Township, Bucks Co., PA

Date	Description
2/16/2010	Start of Fill Period
3/9/2010	Start of Dewatering Period HL250, 150SUB1, 150SUB2
3/13/2010	150SUB1 & 150SUB1 off for 4 hours during storm
3/24/2020	150SUB1 off at 8:00; HL250 off 19:30
3/25/2020	HL250 on 7:00
3/26/2020	150SUB2 off 20:00
3/27/2010	HL250 Shut-down at 22:26
3/28/2010	HL250 Diesel Start-up at 7:00
3/29/2010	150SUB1 on 5:30
4/14/2010	HL250 off 17:00
4/16/2010	HL250 on 7:00
4/17/2010	HL250 off 12:15
4/19/2010	HL250 on 7:00
4/20/2010	HL250 off 17:00
4/22/2010	HL250 on 8:15
4/23/2010	HL250 off 7:00
4/27/2010	HL250 on 12:45
4/29/2010	150SUB2 on 16:00; HL250 off 16:30
5/6/2010	150SUB2 on 8:00
5/7/2010	150SUB2 off 11:31
5/24/2010	Start of Hold Period
5/26/2010	150Sub2 off
5/29/2010	Start of Recovery

Table 2.
Pond Stage Measurements

New Hope Crushed Stone, Inc.
Solebury Township, Bucks Co., PA

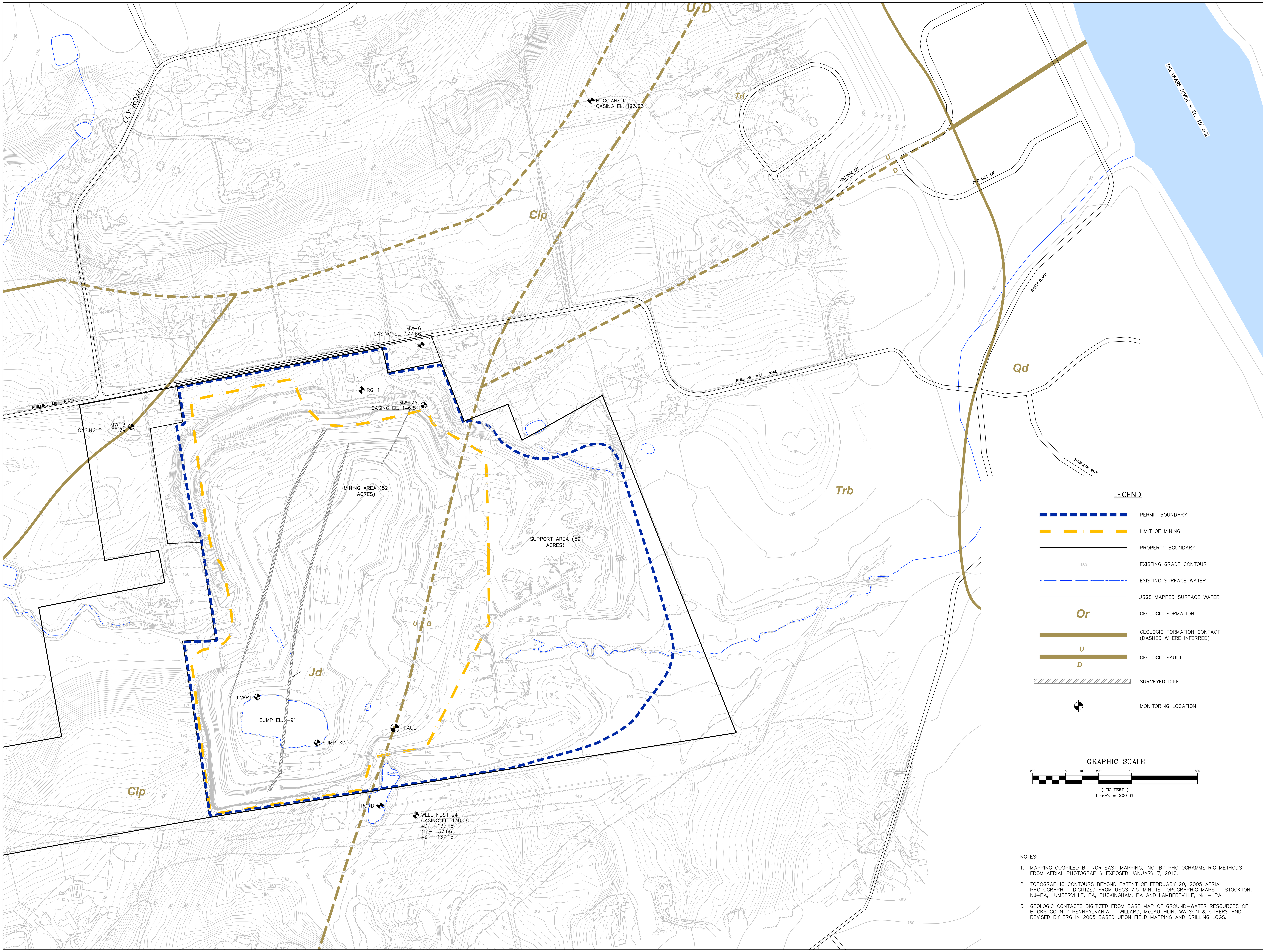
Date	Stage (feet)
3/12/2010	1.8
3/15/2010	6.25
3/16/2010	5
3/17/2010	4
3/18/2010	3.7
3/22/2010	1.9
3/23/2010	2.4
3/24/2010	2.7
3/25/2010	2.7
4/2/2010	3.8
4/13/2010	0.0
5/25/2010	0.0
5/26/2010	0.0
5/27/2010	0.0
5/28/2010	0.0
6/2/2010	0.0

Table 3.
Fault Flow Measurements

New Hope Crushed Stone, Inc.
Solebury Township, Bucks Co., PA

Date	Fault Flow (gpm)
3/5/2010	240
3/8/2010	180
3/11/2010	155.2
3/12/2010	183
3/15/2010	1777
3/16/2010	885
3/18/2010	389
3/22/2010	126
3/23/2010	121
3/24/2010	108
3/25/2010	129
4/2/2010	640
4/13/2010	95

ATTACHMENT C
DRAWING E-067



NOTES:

1. MAPPING COMPILED BY NOR EAST MAPPING, INC. BY PHOTOGRAMMETRIC METHODS FROM AERIAL PHOTOGRAPHY EXPOSED JANUARY 7, 2010.
2. TOPOGRAPHIC CONTOURS BEYOND EXTENT OF FEBRUARY 20, 2005 AERIAL PHOTOGRAPH DIGITIZED FROM USGS 7.5-MINUTE TOPOGRAPHIC MAPS – STOCKTON, NJ-PA, LUMBERVILLE, PA, BUCKINGHAM, PA AND LAMBERTVILLE, NJ – PA.
3. GEOLOGIC CONTACTS DIGITIZED FROM BASE MAP OF GROUND-WATER RESOURCES OF BUCKS COUNTY PENNSYLVANIA – WILLARD, McLAUGHLIN, WATSON & OTHERS AND REVISED BY ERG IN 2005 BASED UPON FIELD MAPPING AND DRILLING LOGS.

REVISIONS		
NO.	DATE	BY

PROJECT SITE: NEW HOPE CRUSHED STONE SMP # 7974SM3 NPDES # PA0595853 SOLEBURY TOWNSHIP, BUCKS COUNTY PENNSYLVANIA

PREPARED FOR:

PREPARED BY: EARTHRES GROUP — ENVIRONMENTAL ENGINEERING and SCIENCE
EarthRes Group, Inc.
P.O. Box 468
7137 Old Easton Road
Pipersville, PA 18947 USA
www.earthres.com
215-766-1211

FAULT INVESTIGATION AND MONITORING LOCATIONS

FUALT INVESTIGATION
NEW HOPE CRUSHED STONE & LIME CO.

DRAWN BY: CMH
CHECKED BY: LFV
DATE: 07/02/10
PROJECT NO: 01012.009
DRAWING NUMBER: E-067

ATTACHMENT D
MONITORING WELL LOG

EarthRes Group, Inc.
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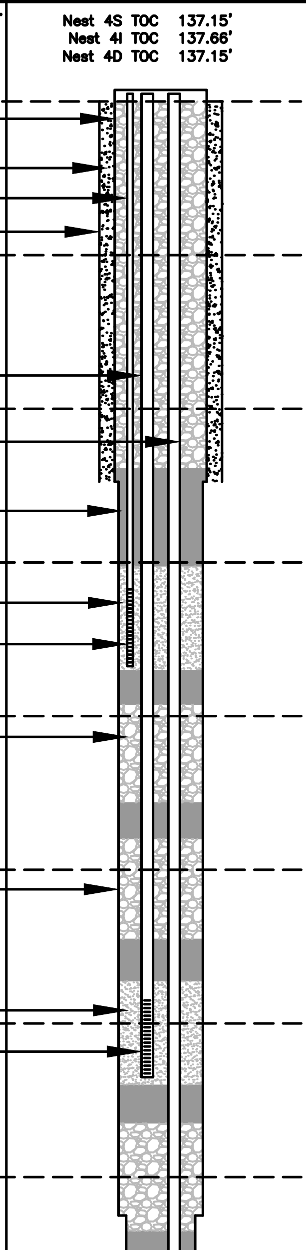
ENVIRONMENTAL ENGINEERING *and* SCIENCE

Borehole Number: WELL NEST #4
Surface Elevation (Ft/Arb.): 136.17' MSL
Borehole Diameter: 10 Inches, From 0 To 49.5'
8.5 Inches, From 49.5' To 145'
6 Inches, From 145' To 295'
Depth to Static Water Level (SWL): 19.8–28.66–28.3 (Ft)
Date SWL Measured: 01/27/2010 (mm/dd/yy)

Drilling Method: Air Rotary
Date Drilled: 01/18/2010 – 01/20/2010 (mm/dd/yyyy)
Drilled By: C.S. GARBER & SONS, INC.
Drillers License Number: 0188
Logged By: AJG
County: BUCKS
Township or Municipality: SOLEBURY TOWNSHIP

Depth (Ft)	Lithologic Description	Additional Description	Comments
			Note: Water was not added while drilling borehole.
0	0'–31' Red–Brown Silt Loam (dry)		8.5"ø steel casing to 49.5' bgs (2.0' stickup)
10			Neat cement grout
			1"ø Sch 40 PVC solid riser to 63' bgs
			10" ø borehole to 49.5'
30	31'–35' Red Shale		
	35'–38' Gray Shale		2"ø Sch 40 PVC solid riser to 117' bgs
40	38'–119' Red Shale	43' Fracture (< 1 GPM)	2"ø Sch 40 PVC solid riser to 237' bgs
50			Bentonite
60	66' Fracture	66' Small Water Bearing Zone (~ 2 GPM)	#2 ANSI/NSF 61 clean sand
70	70'–77' Soft Drilling	70' Additional Yield (Total ~ 5 GPM)	1"ø Sch 40 PVC screen from 63' to 73' bgs
80			3/8" clean limestone gravel fill
100			8.5"ø borehole to 145'
110	110'–111' Soft Drilling		
120	119'–125' Dark Gray Calcareous Fault Breccia	120' Large Water Bearing Zone (> 100 GPM)	#2 ANSI/NSF 61 clean sand
			2"ø Sch 40 PVC screen from 117' to 127' bgs
130	125'–295' Lt. Red and Buff Dolomite		
150			

Borehole Construction



▽ Encountered Groundwater ▼ Composite Static Water Level ** Recovered/Attempted

EarthRes Group
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FAX 215-766-1245
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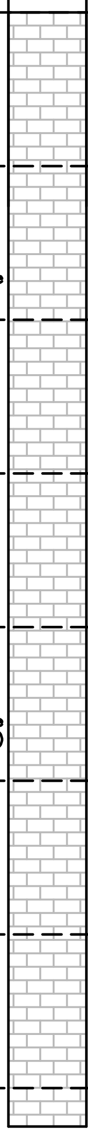
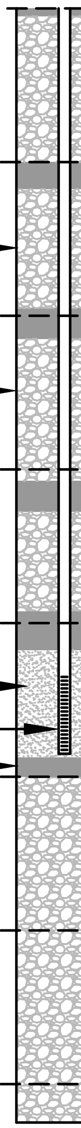
Environmental Engineering *and* Science

Borehole Number: WELL NEST #4
Surface Elevation (Ft/Arb.): 136.17' MSL
Borehole Diameter: 10 Inches, From 0 To 49.5'
8.5 Inches, From 49.5' To 145'
6 Inches, From 145' To 295'
Depth to Static Water Level (SWL): 19.8-28.66-28.3 (Ft)
Date SWL Measured: 01/27/2010 (mm/dd/yy)

Drilling Method: Air Rotary
Date Drilled: 01/18/2010 - 01/20/2010 (mm/dd/yyyy)
Drilled By: C.S. GARBER & SONS, INC.
Drillers License Number: 0188
Logged By: AJG
County: BUCKS
Township or Municipality: SOLEBURY TOWNSHIP

Depth (Ft)	Lithologic Description	Plot	Additional Description	Comments	Borehole Construction	Depth (Ft)
				Note: Water was not added while drilling borehole.		
150	125'-295' Lt. Red and Buff Dolomite					150
160						160
170						170
180				3/8" clean limestone gravel fill		180
190	185'-186' Fracture					190
200				6"ø borehole to 295'		200
210						210
220						220
230						230
240				#2 ANSI/NSF 61 clean sand		240
250	243'-245' Fracture (Hammer Dropped)			2"ø Sch 40 PVC screen from 237' to 247' bgs; Bentonite		250
260						260
270						270
280						280
290						290
300			Total Yield > 100 GPM			300

▽ Encountered Groundwater ▼ Composite Static Water Level ** Recovered/Attempted

ATTACHMENT E
SLUG TEST ANALYSIS

WELL ID: Well Nest 4I

Local ID:
Date:
Time:

INPUT

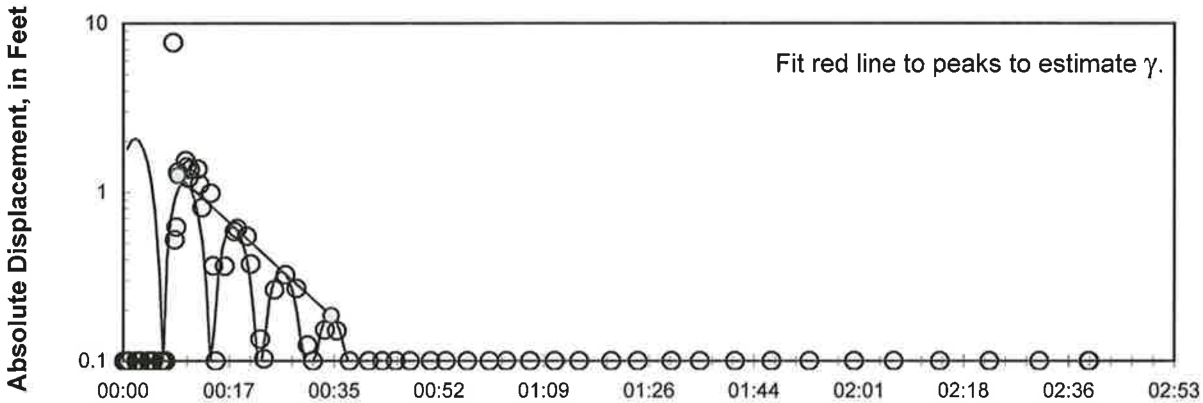
Construction:	
Casing dia. (d_c)	2 Inch
Annulus dia. (d_w)	6 Inch
Depths to:	
water level (DTW)	60 Feet
Top of Screen	237 Feet
Base of Screen	247 Feet
Annular Fill:	
across screen --	Medium Sand
above screen --	Bentonite
Aquifer Material --	Karst
ASSUMED S =	1.00E-05 d'less

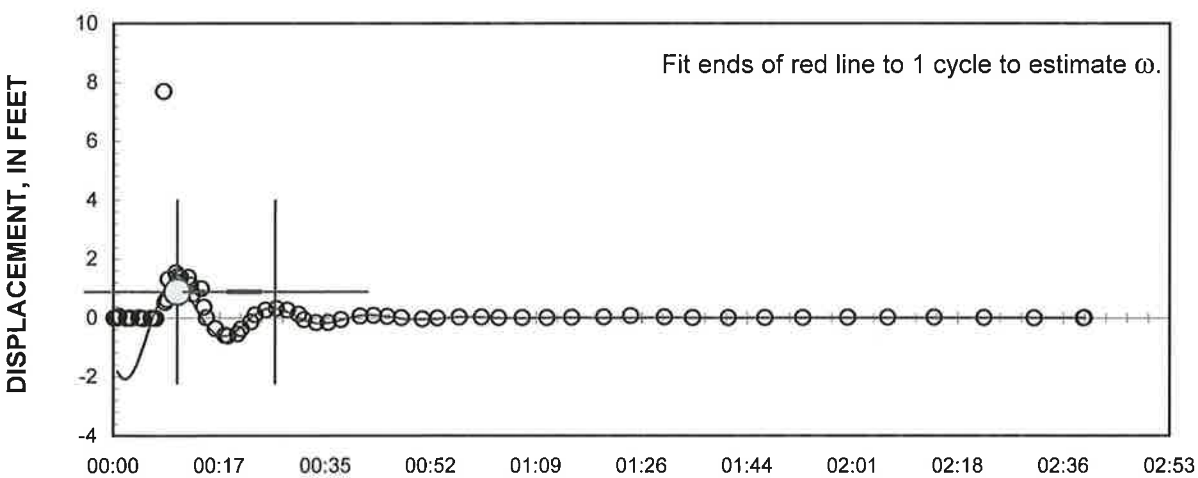
COMPUTED

Aquifer Thickness	20 Feet
$y_{0\text{-DISPLACEMENT}}$ =	2.5 Feet
$y_{0\text{-SLUG}}$ =	1.97 Feet
γ =	0.0756675 sec^{-1}
ω =	0.3930922 sec^{-1}
L =	201 Feet

Input is consistent.

T =	1700 Feet²/Day
K =	170 Feet/Day
S =	0.00001 d'less





REMARKS:

van der Kamp, 1976 Water Resources Research

Well Nest 4I, located south of the NHCS Quarry, Solebury PA

Reduced Data

Entry	Time, Hr:Min:Sec	Water Level
1	12:01:31.0	60.09
2	12:01:31.2	60.10
3	12:01:31.5	60.08
4	12:01:31.7	60.15
5	12:01:33.0	60.08
6	12:01:33.2	60.08
7	12:01:33.5	60.08
8	12:01:33.7	60.09
9	12:01:35.0	60.09
10	12:01:35.2	60.08
11	12:01:35.5	60.08
12	12:01:35.7	60.06
13	12:01:37.0	60.08
14	12:01:37.2	60.08
15	12:01:37.5	60.07
16	12:01:37.7	60.07
17	12:01:39.0	67.78
18	12:01:39.3	60.61
19	12:01:39.5	60.71
20	12:01:39.7	61.40
21	12:01:41.0	61.62
22	12:01:41.2	61.50
23	12:01:41.5	61.30
24	12:01:41.7	61.45
25	12:01:43.0	61.46
26	12:01:43.4	61.20
27	12:01:43.7	60.90
28	12:01:45.1	61.07
29	12:01:45.6	60.45
30	12:01:46.0	60.09
31	12:01:47.5	59.72
32	12:01:49.0	59.50
33	12:01:49.5	59.48
34	12:01:51.1	59.54
35	12:01:51.7	59.71
36	12:01:53.3	59.95
37	12:01:53.9	60.19
38	12:01:55.7	60.35
39	12:01:57.4	60.41
40	12:01:59.2	60.36
41	12:02:01.1	60.21
42	12:02:02.0	60.03
43	12:02:03.9	59.93
44	12:02:05.9	59.94
45	12:02:08.0	60.03
46	12:02:11.1	60.14
47	12:02:13.3	60.17
48	12:02:15.6	60.14
49	12:02:17.9	60.09
50	12:02:21.3	60.04

Entry	Time, Hr:Min:Sec	Water Level
51	12:02:23.8	60.08
52	12:02:27.4	60.11
53	12:02:31.1	60.12
54	12:02:33.9	60.09
55	12:02:37.7	60.09
56	12:02:41.8	60.09
57	12:02:45.9	60.10
58	12:02:51.1	60.11
59	12:02:55.5	60.16
60	12:03:01.0	60.11
61	12:03:05.6	60.09
62	12:03:11.5	60.09
63	12:03:17.5	60.10
64	12:03:23.6	60.10
65	12:03:31.0	60.10
66	12:03:37.6	60.10
67	12:03:45.2	60.10
68	12:03:53.4	60.10
69	12:04:01.6	60.09
70	12:04:09.8	60.10

Slug Test Well Nest 4D

Falling Head Slug Test:
(Bouwer & Rice, 1976 & 1989)

Well Dia. (rc) = 2 in
Borehole Dia. (rw) = 6 in

Definition	Variable	Value
Corr. Casing Radius	rcc =	0.154 ft
Depth to Water	Static =	28.3 ft
Saturated Thickness	D =	266.7 ft
W.L. to Screen Bot.	H =	266.7 ft
Borehole Radius	rw =	0.25 ft
Screen Length	L =	10 ft
Head Change @ t=0	yo =	0.2 ft
Head Change @ t	yt =	0.010 ft
t pick < t intercept	t =	50 sec.
	L/rw =	40.000
Functions of L/rw:	A =	2.8
	B =	0.5
	C =	2.5

$$\frac{1}{t} \ln \frac{yo}{yt} = 0.059914645$$

$$\ln \frac{Re}{rw} = 4.565570422$$

K = 27.90154239 ft/day
= 0.000322935 ft/sec
= 0.009843044 cm/sec

Rising Head Slug Test:
(Bouwer & Rice, 1976 & 1989)

Well Diameter = 2 in
Borehole Diameter = 6 in

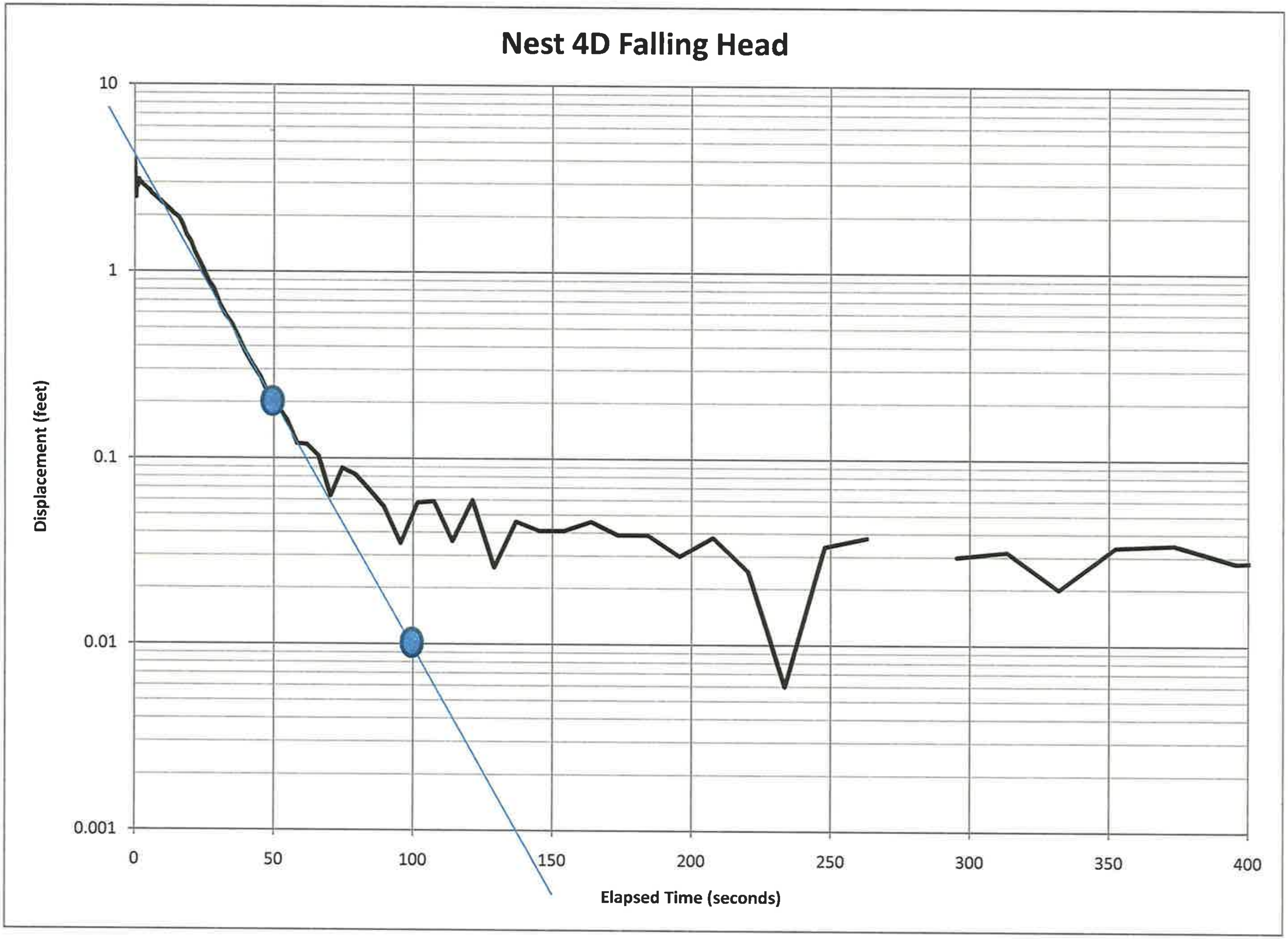
Definition	Variable	Value
Corr. Casing Radius	rcc =	0.154 ft
Depth to Water	Static =	28.3 ft
Saturated Thickness	D =	266.7 ft
W.L. to Screen Bot.	H =	266.7 ft
Borehole Radius	rw =	0.83 ft
Screen Length	L =	10 ft
Head Change @ t=0	yo =	0.400 ft
Head Change @ t	yt =	0.07 ft
t pick < t intercept	t =	50 sec.
	L/rw =	12.048
Functions of L/rw:	A =	2.0
	B =	0.3
	C =	1.3

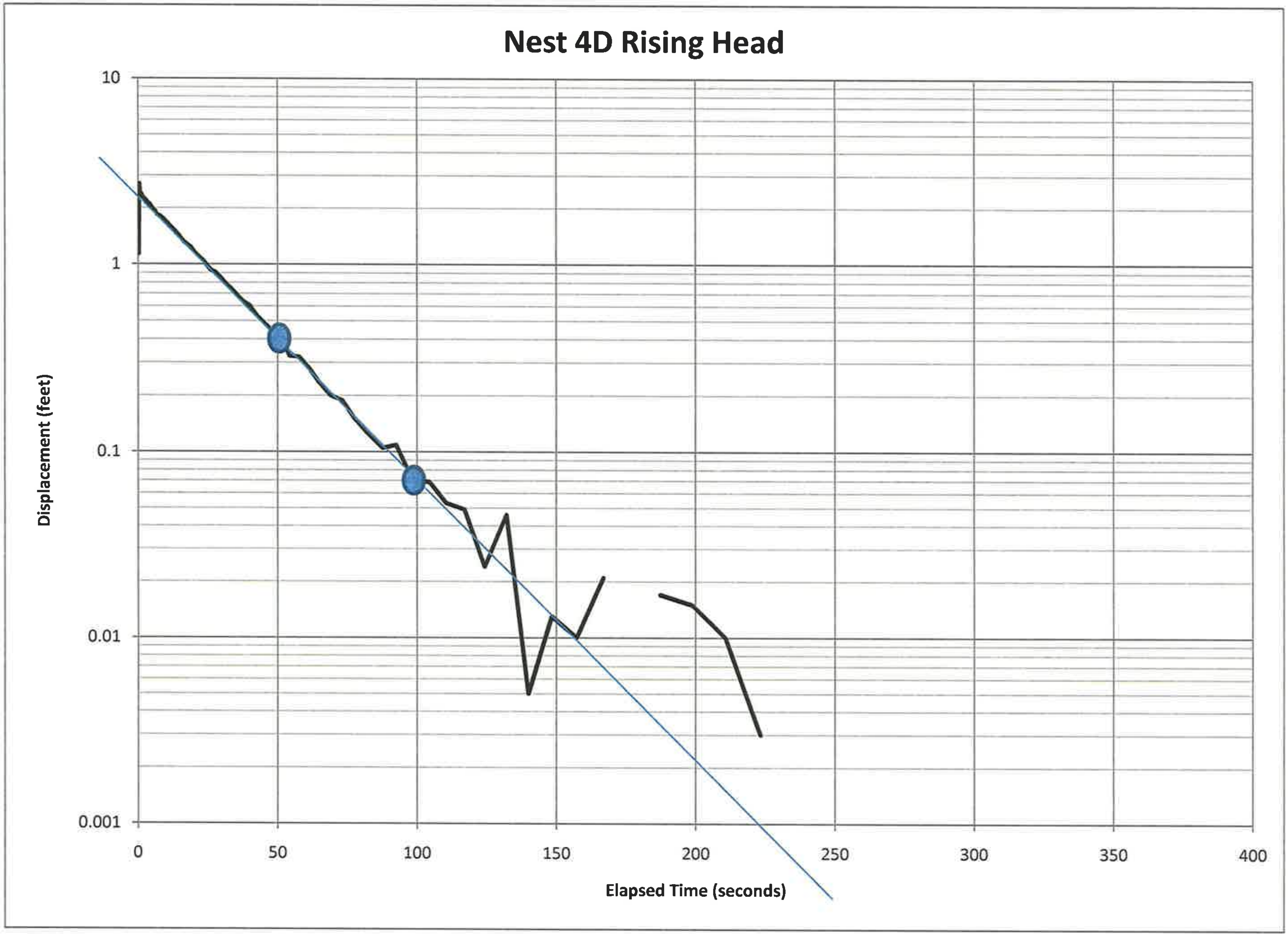
$$\frac{1}{t} \ln \frac{yo}{yt} = 0.034859386$$

$$\ln \frac{Re}{rw} = 3.306215037$$

K = 11.7557679 ft/day
= 0.000136062 ft/sec
= 0.004147174 cm/sec

AVERAGE K = 19.82865514 ft/day
= 0.000229498 ft/sec
= 0.006995109 cm/sec


Nest 4D Falling Head
10
1
0.1
0.01
0.001
Displacement (feet)
0
50
100
150
200
250
300
350
400
Elapsed Time (seconds)


Nest 4D Rising Head
Displacement (feet)
10
1
0.1
0.01
0.001
0
50
100
150
200
250
300
350
400
Elapsed Time (seconds)

ATTACHMENT F
PHOTOGRAPHS

3/15/2010

Fault zone (looking up from base of highwall)

Fault zone swale (looking Northeast or "upstream")

Sump (looking east)

3/16/2010

Southeast Wall (behind sump transducer, wall very wet)

3/18/2010

Looking North across sump to Primrose Creek outflow on west wall

4/2/2010

Pond (with staff gauge nearly completely submerged, looking west)


Fault Zone (south wall, with water cascading)

5/5/2010

Fault Zone swale – filled with rock (looking southwest)

5/25/2010

Seep (photo taken from pit floor, looking east)

5/27/2010

Sump

Fault zone (south wall, dry)

5/28/2010

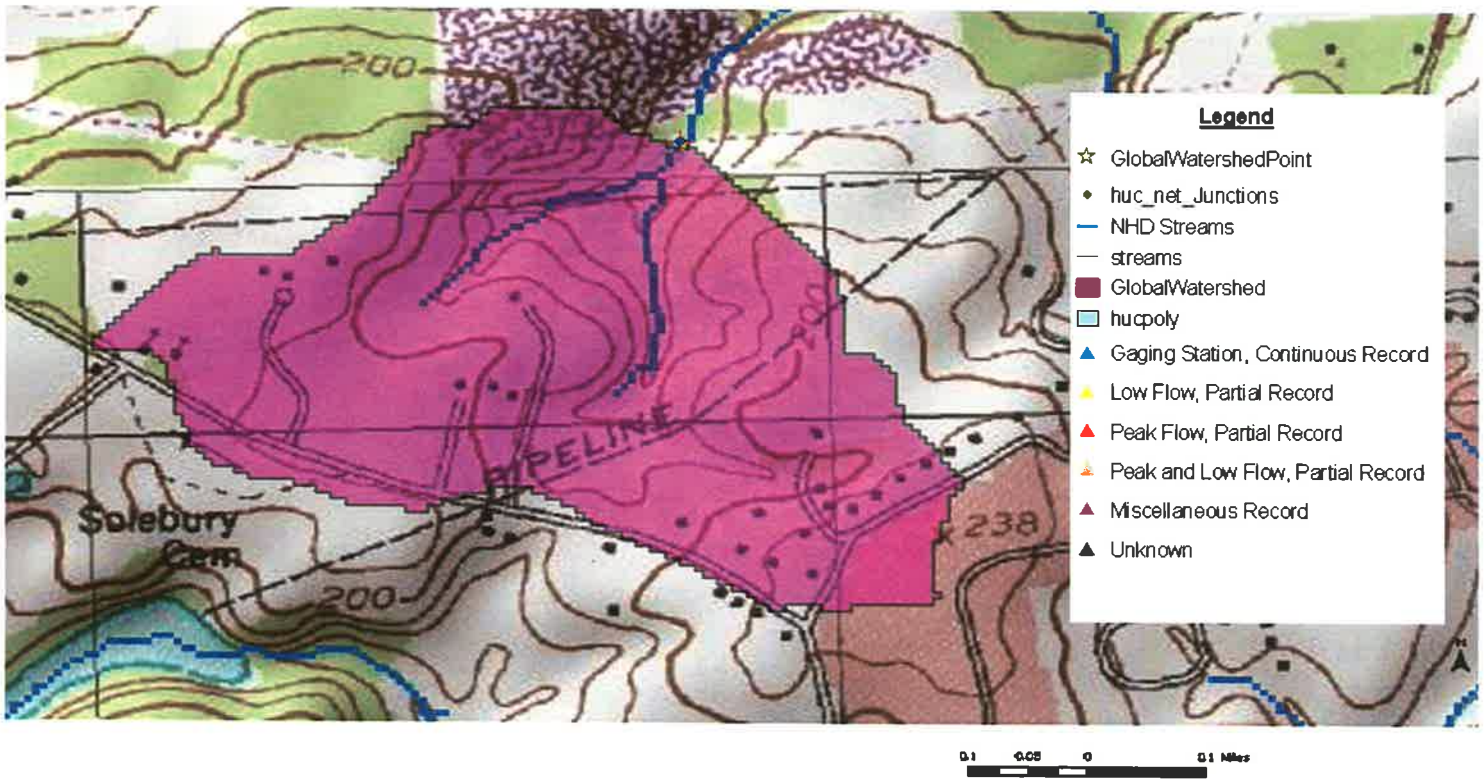
Pond area (with staff gauge, looking west)

South Wall

Culvert (northwest corner of sump); Primrose Creek outflow on west wall

ATTACHMENT G
STREAMSTATS INFORMATION

StreamStats Print Page



USGS Pennsylvania Streamstats

Streamstats Ungaged Site Report

Date: Wed Mar 24 2010 08:45:12 Mountain Daylight Time
Site Location: Pennsylvania
NAD83 Latitude: 40.3755 (40 22 31)
NAD83 Longitude: -74.9786 (-74 58 42)
NAD27 Latitude: 40.3754 (40 22 31)
NAD27 Longitude: -74.9790 (-74 58 44)
Drainage Area: 0.204 mi2

Low Flow Basin Characteristics			
98% Low Flow Region 1 (0.2 mi2)			
Parameter	Value	Regression Equation Valid Range	
		Min	Max
Drainage Area (square miles)	0.2 (below min value 4.78)	4.78	1150
Mean Basin Slope degrees (degrees)	3.5	1.7	6.4
Depth to Rock (feet)	4.718	4.13	5.21
Percent Urban (percent)	11.1006	0	89

Warning: Some parameters are outside the suggested range. Estimates will be extrapolations with unknown errors.

Mean/Base-flow Basin Characteristics			
98% Statewide Mean and Base Flow (0.2 mi2)			
Parameter	Value	Regression Equation Valid Range	
		Min	Max
Drainage Area (square miles)	0.2 (below min value 2.26)	2.26	1720
Mean Basin Elevation (feet)	193	130	2700
Mean Annual Precipitation (inches)	45.000	33.1	50.4
Percent Carbonate (percent)	77.3071	0	99
Percent Forest (percent)	70.5371	5.1	100
Percent Urban (percent)	11.1006	0	89

Warning: Some parameters are outside the suggested range. Estimates will be extrapolations with unknown errors.

Peak Flow Basin Characteristics			
98% Peak Flow Region 1 (0.2 mi2)			
Parameter	Value	Regression Equation Valid Range	
		Min	Max
Drainage Area (square miles)	0.2 (below min value 1.72)	1.72	1280
Mean Basin Elevation (feet)	193	0	1960
Percent Carbonate (percent)	77.3071	0	83
Percent Urban (percent)	11.1006	0	20
Percent Storage (percent)	0.0000	0	21.2

Warning: Some parameters are outside the suggested range. Estimates will be extrapolations with unknown errors.

Low Flow Streamflow Statistics					
Statistic	Flow (ft^3/s)	Standard Error (percent)	Equivalent years of record	90-Percent Prediction Interval	
				Minimum	Maximum
M7D2Y	0.0329				
M30D2Y	0.0468				
M7D10Y	0.0121				
M30D10Y	0.0184				
M90D10Y	0.0347				

Mean/Base-flow Streamflow Statistics					
Statistic	Flow (ft^3/s)	Standard Error (percent)	Equivalent years of record	90-Percent Prediction Interval	
				Minimum	Maximum
QA	0.28				
QAH	0.25				
BF10YR	0.25				
BF25YR	0.22				
BF50YR	0.21				

BF10YR = 0.25 CFS
CONVERT CFS TO MGD
1 CFS = 0.646 MGD

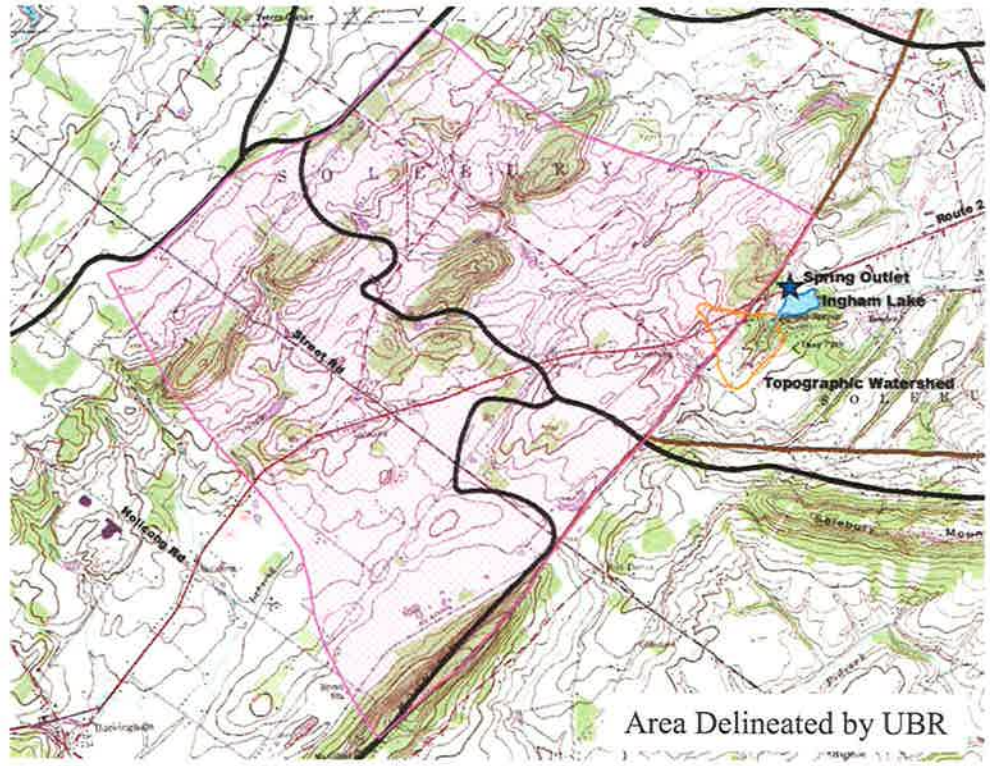
0.25 CFS * 0.646 MGD/CFS = 0.16 MGD

Peak Flow Streamflow Statistics					
Statistic	Flow (ft^3/s)	Prediction Error (percent)	Equivalent years of record	90-Percent Prediction Interval	
				Minimum	Maximum
PK2	17.6		3		
PK5	33.6		6		
PK10	46.6		9		
PK50	81.7		13		
PK100	99.6		13		
PK500	149		14		

ATTACHMENT H
SOLEBURY TOWNSHIP POWERPOINT SLIDES

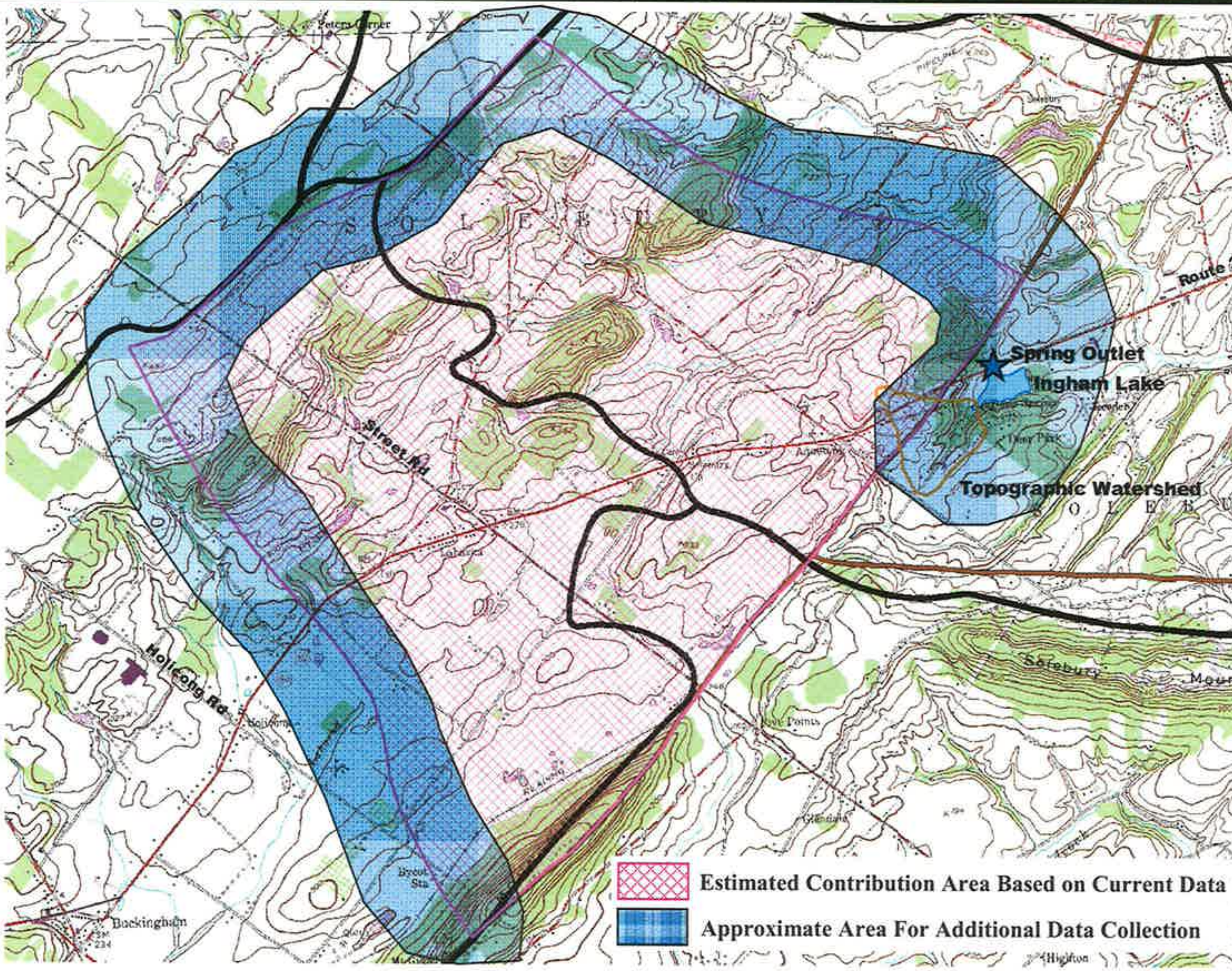
Ingham Spring Contribution Area

- Water quality and quantity in carbonate aquifers are highly susceptible to land use impacts
- To protect Ingham Spring and its aquifer that supplies its water
  - Identify the area that contributes ground water to the Spring
  - Develop policies to protect water quantity and quality
- Proposed activities:
  - Evaluate previously collected data
  - Collect additional data to refine understanding



Solebury a natural choice

EPC



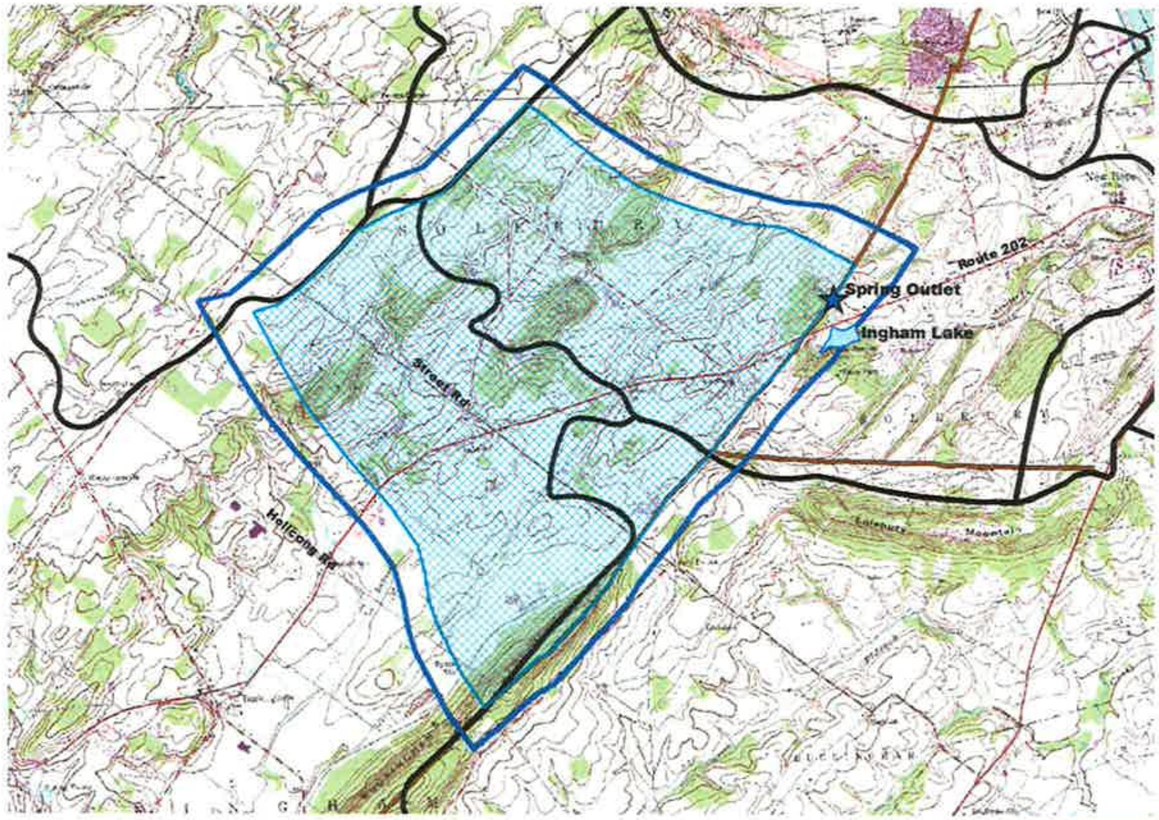
Solebury
a natural choice

2009 Proposed Activities

EPC

Ingham Spring Contribution Area

- Goal is to identify primary and secondary areas for protection, based on seasonal and yearly fluctuations in contribution area



- For example:
  - Primary Protection Area (light blue hatched)
  - Secondary Protection Area (dark blue outline)

Solebury a natural choice

EPC