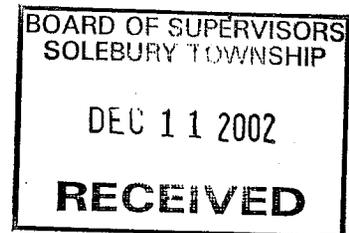


**AUGUST 2002 GROUNDWATER ELEVATION AND
STREAM FLOW MONITORING
PRIMROSE AND AQUETONG CREEK DRAINAGE BASINS
SOLEBURY TOWNSHIP, PENNSYLVANIA**

Prepared for:

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November 2002

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SOLEBURY TOWNSHIP, PENNSYLVANIA**

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1.0 INTRODUCTION

In the summer of 2002, Vincent Uhl Associates, Inc. (VUA) was retained by Solebury Township to continue annual groundwater elevation and stream flow monitoring for two drainage basins in the Township: Primrose Creek and Aquetong Creek (**Figure 1.1**). These measurements were added to the database developed in previous reports, the most recent being "March 2002 Groundwater Elevation and Stream Flow Monitoring, Solebury Township, Pennsylvania" (VUA, April 2002).

The principal tasks included:

- Task 1:** Water level measurements in August 2002 utilizing the monitoring well network in each drainage basin.
- Task 2:** The addition of new monitoring wells to the Primrose Creek Drainage Basin monitoring network.
- Task 3:** Stream flow measurements during a low stream flow period in September 2002.

2.0 WATER LEVEL MEASUREMENTS

Water level measurements utilizing the monitoring well networks were conducted from August 24 - 28, 2002 in both drainage basins. New wells in the Primrose Creek Drainage Basin network were also added during this measurement event.

2.1 Primrose Creek Drainage Basin

Water levels were measured in 37 wells in August 2002 following a sustained period of dry weather. Of these 37 wells, 12 wells were measured for the first time. **Table 2.1** provides the groundwater elevation calculations for the depth to water measurements for this event. **Table 2.2** provides a summary of water level measurements from 1997 through 2002. The updated groundwater elevation database is provided in **Table 2.3**, and **Figure 2.1** shows the locations of the monitored wells. A groundwater elevation contour map for the Primrose Creek Drainage Basin is shown on **Figure 2.2**. The water levels for the quarry monitoring network were obtained from the Pennsylvania Department of Environmental Protection (PADEP), Pottsville District Office. Note, the quarry

monitoring well elevations need to be updated and verified with PADEP as the elevations of certain monitoring wells have reportedly changed.

During this measurement event, 12 additional wells were added to the monitoring program. These included:

- Five (5) wells off of River Road (R-1 through R-5) in the northeast part of the carbonate rock area just north of the drainage divide,
- Three (3) wells along Ely Road (E-12, E-13, and E-14), and
- Four (4) wells on Sugan Road; two of these wells are northeast of Sugan Road (S-11 and S-17) and two are southwest (S-12 and S-13).

Wells S-11 and S-12, completed in the carbonate rock aquifer on opposite sides of the diabase dyke (**Figure 2.1**), had very similar water elevations of 14.52 and 16.25 feet above mean sea level. The dyke has been considered by PADEP, ERG, and VUA to be a barrier boundary wherein wells completed to the southwest of the dyke were considered out of the quarry pumping influence. These new water level data indicate that this is not the case and that the diabase dyke does not act as a barrier or no flow boundary.

Figures A.1 through A.4 in Appendix A show water-level trends in wells in different portions of the Primrose Creek Drainage basin from 1997 to 2002.

Figure A-1 provides water-level hydrographs for 5 wells completed in the carbonate rock aquifer and under the influence of the quarry pumpage. Water levels in these five wells have shown modest declines since the initiation of monitoring in 1997. In this same timeframe Quarry pumpage has decreased from a high of 2.55 MGD in 1997.

Figure A-2 characterizes water level conditions for wells completed in the Stockton Sandstone within 1,000 feet of the carbonate rock aquifer contact. Certain of these wells may be completed in both the Stockton and underlying carbonate rock aquifers. Water levels in the five wells located on Ely Road and Phillips Mill Road have all shown declines from the earliest records in 1992 to August 2002 except for E-11. Overall the declines have been from as much as 70 feet (P-9A) to 10 feet (P-5 and E-6C)

Figure A-3 is characteristic of water levels for wells completed in the Stockton Sandstone that appear un-influenced by the Quarry pumpage at current rates of withdrawal. These wells are located further to the west and north of the Quarry (and Carbonate Rock Aquifer contact) as compared to the wells shown on **Figure A-2**. Of interest is that water level fluctuations in these three plotted wells (CO-1, P-6, and P-13) are on the order of a few feet as compared to water level changes in wells under the influence of Quarry pumping which show a much wider range of fluctuation.

Figure A-4 is characteristic of water levels in the Brunswick shale along Phillips Mill Road, Chapel Road, and Sunset Drive. Well P-2 lies very close to the Furlong Fault and the Quarry. This well has shown very little water-level fluctuation over the past 5 years as has well C-3. Wells C-10, C-11, and SN-2 are located near the drainage divide between the Primrose Creek and Aquetong Creek drainage basins. Water level fluctuations in these three wells may reflect the influence of the nearby public water supply pumpage for the existing and new developments in the Aquetong Creek drainage basin.

Overall, a comparison of water level conditions from the March 2002 event shows modest declines probably related to the drought conditions that persisted last spring and summer.

2.2 Aquetong Creek Drainage Basin

Water levels were measured in 23 wells in August 2002 following a sustained period of dry weather. **Table 2.4** provides the groundwater elevation calculations for the depth to water measurements for this event. **Table 2.5** provides a summary of the water level measurements in April 2000, September 2000, September 2001, March 2002, and August 2002, and **Figure 2.3** shows the locations of the wells that have been monitored. The updated water level database is provided in **Table 2.6**.

Figures A.5 through A.7 in Appendix A show water-level trends in wells in three different portions of the Aquetong Creek Drainage basin from 2000 to 2002.

Figure A.5 is for the east-northeast part of the basin along Sugan Road and near the Sugan Road and Route 202 intersection. This is the area in the drainage basin with the most concentrated water supply pumpage for the Wilshire Hunt, Marshall Tract, Yorkshire Meadows, Logan Square, and Fieldstone communities.

Figure A.6 is for the western part of the drainage basin along Route 202 and north of Route 202 along Meetinghouse Road. Along Route 202, the principal pumping withdrawals are for the Fox Run Preserve, Hermitage, Ingham Mews, and Best Western Hotel.

Figure A.7 is for the southern portion of the drainage basin with residential well pumpage only.

Overall, water levels in these three basin areas have shown very little change over the past 2 years.

3.0 STREAM FLOW MEASUREMENTS

The September 2002 stream flow data represents the fourth low flow measurement event for Aquetong and Primrose Creeks.

3.1 Primrose Creek

Stream flow was measured at two locations along Primrose Creek downstream of the quarry (**Figure 3.1**). The measurements were made on September 24, 2002, during a dry base-flow period. The upstream location (Primrose Creek No. 1) had a flow of 1,222 gallons per minute (gpm) (**Table 3.1**). Approximately 1,200 feet downstream (Primrose Creek No. 2), stream flow was measured at 1,141 gpm. The stream flow rate measurements for Primrose Creek are greater than the previous measurements in March 2002 and slightly lower than the September 2001 measurements.

3.2 Aquetong Creek and Tributary

Stream flow measurements were made at two locations along Aquetong Creek and at one major tributary proximate to its confluence with Aquetong Creek (**Figure 3.1**) on September 24, 2002 during a dry base-flow period. Stream flow downstream of Aquetong Lake (Aquetong No. 2) was measured at 1,708 gpm (**Table 3.1**). Within the tributary to Aquetong Creek (Tributary to Aquetong Creek No. 1), stream flow was measured at 142 gpm. Approximately 5,000 feet downstream of the confluence with the tributary, stream flow in Aquetong Creek (Aquetong Creek No. 3) was measured at 2,147 gpm. These flow rate measurements are lower than the March 2002 measurements with the exception of the measurement at the confluence (No. 3). These measurements are greater than the September/November 2001 measurements with the exception of the tributary (No. 1) which was lower.

4.0 CONCLUSIONS AND RECOMMENDATIONS

4.1 Conclusions

- The water level measurements collected in wells completed in the carbonate rock aquifer on the northeast and southwest side of the diabase dyke are similar (wells S-11, S-12, and S-9) indicating that this geologic feature is not a barrier or no-flow boundary impeding groundwater flow in the Primrose Creek Drainage basin.
- The 100 feet amsl water-level contour on **Figure 2.2** defines the current zone-of-impact from the Quarry pumping. Residential, commercial, and institutional wells that experience yield reduction within the 100 feet amsl

water-level contour are candidates for replacement, deepening, and/or deeper pump settings.

- This zone-of-impact should be refined annually.

4.2 Recommendations

The following recommendations are provided for consideration:

- Continue annual water level measurements in the established monitoring well network within Primrose and Aquetong Creek Drainage Basins to track water level changes over time and to allow for a updating of the zone-of-impact from Quarry pumping.
- Continue stream flow measurements at the established network during a low flow period.
- Equip three wells without pumps in the Primrose Creek monitoring network with transducers for continuous long term water-level monitoring. Possible candidate wells include:
 - Well P-9A (completed in the Stockton Formation and within 1,000 feet of the Carbonate Rock Aquifer contact)
 - Well P-3 (completed in the carbonate Rock Aquifer).
 - The Quarry's Ely Road monitoring well.

Access to these locations would need to be obtained. Additional potential locations will be researched during the upcoming well replacement evaluation.

- During this year, the Quarry has replaced one well (E-11) and deepened a second (E-12). It would make sense that the records of this work be filed with the Township Engineer and Health Department. Further, we recommend that data collection during well replacements or deepening be standardized to acceptable professional hydrogeological standards.

**Table 2.1. Groundwater Elevation Calculations: August 2002
Primrose Creek Drainage Basin**

Well No.	Stickup Height (ft ags)	Estimated Ground Elevation ^a (ft amsl)	Estimated Measuring Point Elevation (ft amsl)	Depth to Water August 2002 (ft bmp)	Estimated Groundwater Elevation August 2002 (ft amsl)
School Lane					
SC-1	1.4	150	151.4	143.40	8.00
Phillips Mill Road					
P-2	0	135	135	14.00	121.00
P-3	2.1	190	192.1	164.40	27.70
P-4	-4	185	181	NM	NM
P-5	2	174	176	164.25	11.75
P-6	0	290	290	74.51	215.49
P-7A		145	145	NM	NM
P-7B		137	137	NM	NM
P-7C	1.3	137	138.3	123.20	15.10
P-7D		140	140	NM	NM
P-7E		140	140	NM	NM
P-7F	1.35	150	151.35	NM	NM
P-8	1.92	165	166.92	144.08	22.84
P-9A	-3	175	172	115.10	56.90
P-12	0.8	225	225.8	45.73	180.07
P-13	3.8	290	293.8	67.8	226.00
P-14	0	320	320	19.51	300.49
P-15	2	180	182	NM	NM

ags - Above ground surface.
amsl - Above mean sea level.
bmp - Below measuring point.
NM - Not measured.

^a Estimated based on USGS topographic map.

**Table 2.1. Groundwater Elevation Calculations: August 2002
Primrose Creek Drainage Basin**

Well No.	Stickup Height (ft ags)	Estimated Ground Elevation ^a (ft amsl)	Estimated Measuring Point Elevation (ft amsl)	Depth to Water August 2002 (ft bmp)	Estimated Groundwater Elevation August 2002 (ft amsl)
Ely Road					
E-2	1.5	200	201.5	110.17	91.33
E-6A		250	250	NM	NM
E-6B		250	250	NM	NM
E-6C	1.5	250	251.5	247.12	4.38
E-8	1	240	241	204.54	36.46
E-11	1.25	245	246.25	215.00	31.25
E-12 New	2	230	232	199.05	32.95
E-13 New	0	240	240	194.70	45.30
E-14 New	0	220	220	187.82	32.18
Sugan Road					
S-6	0	170	170	166.14	3.86
S-7		225	225	NM	NM
S-9	0.95	237	237.95	225.65	12.30
S-10A	1.2	200	201.2	NM	NM
S-10B	1.86	195	196.86	61.50	135.36
S-10C		180	180	NM	NM
S-11 New	1.5	160	161.5	146.98	14.52
S-12 New	1.5	175	176.5	160.25	16.25
S-13 New	2	220	222	43.10	178.90
S-17 New	0	180	180	167.56	12.44

ags - Above ground surface.
amsl - Above mean sea level.
bmp - Below measuring point.
NM - Not measured.

^a Estimated based on USGS topographic map.

**Table 2.1. Groundwater Elevation Calculations: August 2002
Primrose Creek Drainage Basin**

Well No.	Stickup Height (ft ags)	Estimated Ground Elevation ^a (ft amsl)	Estimated Measuring Point Elevation (ft amsl)	Depth to Water August 2002 (ft bmp)	Estimated Groundwater Elevation August 2002 (ft amsl)
Chapel Road					
C-3	1.3	135	136.3	37.38	98.92
C-10	0.3	223	223.3	50.60	172.70
C-11	0.5	225	225.5	96.90	128.60
Sunset Drive					
SN-1	0.75	210	210.75	NM	NM
SN-2	1.1	200	201.1	65.42	135.68
SN-3	0.7	205	205.7	NM	NM
SN-4	0.7	180	180.7	NM	NM
Meetinghouse Road					
M-1	0.8	225	225.8	50.72	175.08
Comfort Road					
CO-1	0.3	370	370.3	29.88	340.42
Hillside Lane					
H-1	1	210	211	51.72	159.28
River Road					
R-1 New	2.6	180	182.6	69.57	113.03
R-2 New	1.3	90	91.3	21.35	69.95
R-3 New	1.05	90	91.05	16.23	74.82
R-4 New	2	90	92	43.02	48.98
R-5 New	0.75	160	160.75	30.02	130.73

ags - Above ground surface.
amsl - Above mean sea level.
bmp - Below measuring point.
NM - Not measured.

^a Estimated based on USGS topographic map.

**Table 2.1. Groundwater Elevation Calculations: August 2002
Primrose Creek Drainage Basin**

Well No.	Stickup Height (ft ags)	Estimated Ground Elevation ^a (ft amsl)	Estimated Measuring Point Elevation (ft amsl)	Depth to Water August 2002 (ft bmp)	Estimated Groundwater Elevation August 2002 (ft amsl)
Upper York Road					
Y-2	0.6	370	370.6	NM	NM
Y-5	0.6	370	370.6	NM	NM
New Hope Crushed Stone and Lime Quarry ^b					
Ely Road Monitoring Well		250	250	234.30	15.70
MW-3		158	158	137.95	20.05
MW-4		140	140	138.55	1.45
MW-5		155	155	130.18	24.82
MW-6		190	190	71.66	118.34
MW-7A		170	170	172.00	-2.00
MW-8		138	138	46.62	91.38
MW-9		125	125	36.45	88.55

ags - Above ground surface.
amsl - Above mean sea level.
bmp - Below measuring point.
NM - Not measured.

^a Estimated based on USGS topographic map.

^b Data obtained from PADEP, Pottsville District Office.

**Table 2.2. Summary of Water Level Measurements: 1997 - 2002
Primrose Creek Drainage Basin**

Well No.	Depth to Water November 1997 / January 1998 (ft bmp)	Depth to Water October / November 1998 (ft bmp)	Depth to Water October / November 1999 (ft bmp)	Depth to Water April 2000 (ft bmp)	Depth to Water September 2000 (ft bmp)	Depth to Water September 2001 (ft bmp)	Depth to Water March 2002 (ft bmp)	Depth to Water August 2002 (ft bmp)
School Lane								
SC-1	133.03	NM	110	122.62	135.36	136.77	140.31	143.40
Phillips Mill Road								
P-2	11.59	14.66	10.65	11.31	12.4	13.14	12.62	14.00
P-3	NM	157.32	148.12	142.31	157.45	156.95	164.16	164.40
P-4	144.04	151.7	152.67	NM	NM	NM	NM	NM
P-5	152	156.8	148.66	139.9	156.5	156.40	163.63	164.25
P-6	65.99	NM	61.80 ^a	60.28 ^a	67.8	68.40	68.63	74.51
P-7A	NM	NM	NM	NM	NM	NM	NM	NM
P-7B	>130 (dry)	Dry	NM	NM	NM	NM	NM	NM
P-7C	113.86	115.8	108.35	104.4	116.2	116.52	121.85	123.20
P-7D	NM	NM	NM	NM	NM	NM	NM	NM
P-7E	NM	NM	NM	NM	NM	NM	NM	NM
P-7F	127.84	129.6	122.92	NM	NM	NM	NM	NM
P-8	133.92	137.16	128.68	123.63	139.1	135.68	143.00	144.08
P-9A	79.6	115.6	66.3	>110 ^b	95.25	99.85	103.44	115.10
P-12	38.3	NM	NM	33.91	39.67	42.80	41.21	45.73
P-13	62.46	66.43	59.76	59.39	63.44	66.71	65.42	67.8
P-14	NM	NM	18.65	18.16	19.21	19.27	19.27	19.51
P-15	NM	NM	NM	203.95	203.97	NM	NM	NM

bmp - Below measuring point.

NM - Not measured.

^a Cascading.

^b Obstruction at 110 feet bgs.

**Table 2.2. Summary of Water Level Measurements: 1997 - 2002
Primrose Creek Drainage Basin**

Well No.	Depth to Water November 1997 / January 1998 (ft bmp)	Depth to Water October / November 1998 (ft bmp)	Depth to Water October / November 1999 (ft bmp)	Depth to Water April 2000 (ft bmp)	Depth to Water September 2000 (ft bmp)	Depth to Water September 2001 (ft bmp)	Depth to Water March 2002 (ft bmp)	Depth to Water August 2002 (ft bmp)
Ely Road								
E-2	132	136.5	NM	103.98 ^a	112.9	113.35	114.06	110.17
E-6A	Dry	Dry	NM	NM	NM	NM	NM	NM
E-6B	116.5	Dry	NM	NM	NM	NM	NM	NM
E-6C	237.8	NM	230.84	222.79	239.9	238.73	247.62	247.12
E-8	NM	197.5	183.4	141.03	196.6	196.70	205.06	204.54
E-11	212.82	NM	>220	219.87	229.8	242.18	247.85	215.00
E-12	NM	NM	NM	NM	NM	NM	NM	199.05
E-13	NM	NM	NM	NM	NM	NM	NM	194.70
E-14	NM	NM	NM	NM	NM	NM	NM	187.82
Sugan Road								
S-6	156.44	NM	NM	145.95	158.55	158.85	166.12	166.14
S-7	196.5	NM	NM	NM	NM	NM	NM	NM
S-9	NM	NM	199.4	195.53	210.87	212.45	223.32	225.65
S-10A	222.85	227.1	NM	222.58 ^a	203.3 ^a	220.58 ^a	132.25	NM
S-10B	NM	126.11	47.39	49.79	54.62	71.90	69.30	61.50
S-10C	NM	152.15	99.11	98.88	118.36	124.91	131.80	NM
S-11	NM	NM	NM	NM	NM	NM	NM	146.98
S-12	NM	NM	NM	NM	NM	NM	NM	160.25
S-13	NM	NM	NM	NM	NM	NM	NM	43.10
S-17	NM	NM	NM	NM	NM	NM	NM	167.56

bmp - Below measuring point.

NM - Not measured.

^a Cascading.

^b Obstruction at 110 feet bgs.

**Table 2.2. Summary of Water Level Measurements: 1997 - 2002
Primrose Creek Drainage Basin**

Well No.	Depth to Water November 1997 / January 1998 (ft bmp)	Depth to Water October / November 1998 (ft bmp)	Depth to Water October / November 1999 (ft bmp)	Depth to Water April 2000 (ft bmp)	Depth to Water September 2000 (ft bmp)	Depth to Water September 2001 (ft bmp)	Depth to Water March 2002 (ft bmp)	Depth to Water August 2002 (ft bmp)
Chapel Road								
C-3	36.25	NM	32.85	42.54	35.31	36.65	35.66	37.38
C-10	49.86	NM	42.75	34.21	44.36	51.67	48.48	50.60
C-11	79.4	NM	78.72	76.89	82.92	95.58	78.76	96.90
Sunset Drive								
SN-1	56	NM	NM	NM	NM	NM	NM	NM
SN-2	49.82	63.1	42.8	40.96	46.1	69.58	50.47	65.42
SN-3	47.25	NM	NM	NM	NM	NM	NM	NM
SN-4	37.27	NM	34.15	NM	NM	NM	NM	NM
Meetinghouse Road								
M-1	47.25	56.98	53.44	50.90	49.23	48.82	53.38	50.72
Comfort Road								
CO-1	29.54	34.05	23.08	20.47	29.55	29.13	33.42	29.88
Hillside Lane								
H-1	50.05	NM	NM	45.08	48.88	51.32	50.31	51.72
River Road								
R-1	NM	NM	NM	NM	NM	NM	NM	69.57
R-2	NM	NM	NM	NM	NM	NM	NM	21.35
R-3	NM	NM	NM	NM	NM	NM	NM	16.23
R-4	NM	NM	NM	NM	NM	NM	NM	43.02
R-5	NM	NM	NM	NM	NM	NM	NM	30.02

bmp - Below measuring point.

NM - Not measured.

^a Cascading.

^b Obstruction at 110 feet bgs.

**Table 2.2. Summary of Water Level Measurements: 1997 - 2002
Primrose Creek Drainage Basin**

Well No.	Depth to Water November 1997 / January 1998 (ft bmp)	Depth to Water October / November 1998 (ft bmp)	Depth to Water October / November 1999 (ft bmp)	Depth to Water April 2000 (ft bmp)	Depth to Water September 2000 (ft bmp)	Depth to Water September 2001 (ft bmp)	Depth to Water March 2002 (ft bmp)	Depth to Water August 2002 (ft bmp)
Upper York Road								
Y-2	54.73	NM	NM	NM	NM	NM	NM	NM
Y-5	62.72	NM	NM	NM	NM	NM	NM	NM
New Hope Crushed Stone and Lime Quarry ^c								
Ely Road	224.7	227.9	218.5	210.9	226.2	224.6	232.4	234.30
MW-3	128.7	130.5	124.1	121.6	129.8	129.7	135.1	137.95
MW-4	128.1	129.9	124.5	122.8	131.5	132.0	135.7	138.55
MW-5	121.0	122.0	116.6	114.6	120.8	122.2	127.4	130.18
MW-6	70.3	72.9	67.3	67.4	70.7	70.9	65.0	71.66
MW-7A	142.0	149.7	147.4	147.8	157.6	181.2	152.2	172.00
MW-8	40.0	44.6	41.7	42.1	42.6	45.0	38.9	46.62
MW-9	28.3	32.9	30.0	28.8	31.7	34.4	32.3	36.45

bmp - Below measuring point.

NM - Not measured.

^a Cascading.

^b Obstruction at 110 feet bgs.

^c Data obtained from PADEP, Pottsville District Office.

**Table 2.3. Summary of Groundwater Elevations: 1997 - 2002
Primrose Creek Drainage Basin**

Well No.	Estimated Groundwater Elevation November 1997 / January 1998 (ft amsl)	Estimated Groundwater Elevation October / November 1998 (ft amsl)	Estimated Groundwater Elevation October / November 1999 (ft amsl)	Estimated Groundwater Elevation April 2000 (ft amsl)	Estimated Groundwater Elevation September 2000 (ft amsl)	Estimated Groundwater Elevation September 2001 (ft amsl)	Estimated Groundwater Elevation March 2002 (ft amsl)	Estimated Groundwater Elevation August 2002 (ft amsl)
School Lane								
SC-1	18.37	NM	41.4	28.78	16.04	14.63	11.09	8.00
Phillips Mill Road								
P-2	123.41	120.34	124.35	123.69	122.6	121.86	122.38	121.00
P-3	NM	34.78	43.98	49.79	34.65	35.15	27.94	27.70
P-4	36.96	29.3	28.33	NM	NM	NM	NM	NM
P-5	24	19.2	27.34	36.1	19.5	19.6	12.37	11.75
P-6	224.01	NM	228.2	229.72	222.2	221.6	221.37	215.49
P-7A	NM	NM	NM	NM	NM	NM	NM	NM
P-7B	<7	Dry	NM	NM	NM	NM	NM	NM
P-7C	24.44	22.5	29.95	33.9	22.1	21.78	16.45	15.10
P-7D	NM	NM	NM	NM	NM	NM	NM	NM
P-7E	NM	NM	NM	NM	NM	NM	NM	NM
P-7F	23.51	21.75	28.43	NM	NM	NM	NM	NM
P-8	33	29.76	38.24	43.29	27.82	31.24	23.92	22.84
P-9A	98.18	62.18	111.48	<67.78	76.75	72.15	68.56	56.90
P-12	187.5	NM	NM	191.89	186.13	183.00	184.59	180.07
P-13	231.34	227.37	234.04	234.41	230.36	227.09	228.38	226.00
P-14	NM	NM	301.35	301.84	300.79	300.73	300.73	300.49
P-15	NM	NM	NM	-21.95	-21.97	NM	NM	NM

amsl - Above mean sea level.
NM - Not measured.

**Table 2.3. Summary of Groundwater Elevations: 1997 - 2002
Primrose Creek Drainage Basin**

Well No.	Estimated Groundwater Elevation November 1997 / January 1998 (ft amsl)	Estimated Groundwater Elevation October / November 1998 (ft amsl)	Estimated Groundwater Elevation October / November 1999 (ft amsl)	Estimated Groundwater Elevation April 2000 (ft amsl)	Estimated Groundwater Elevation September 2000 (ft amsl)	Estimated Groundwater Elevation September 2001 (ft amsl)	Estimated Groundwater Elevation March 2002 (ft amsl)	Estimated Groundwater Elevation August 2002 (ft amsl)
Ely Road								
E-2	69.5	65	NM	97.52	88.6	88.15	87.44	91.33
E-6A	Dry	Dry	NM	NM	NM	NM	NM	NM
E-6B	123.5	Dry	NM	NM	NM	NM	NM	NM
E-6C	13.7	NM	20.66	28.71	11.6	12.77	3.88	4.38
E-8	NM	43.5	57.6	99.97	44.4	44.30	35.94	36.46
E-11	33.43	NM	<26.25	26.38	16.45	4.07	-1.60	31.25
E-12	NM	NM	NM	NM	NM	NM	NM	32.95
E-13	NM	NM	NM	NM	NM	NM	NM	45.30
E-14	NM	NM	NM	NM	NM	NM	NM	32.18
Sugan Road								
S-6	13.56	NM	NM	24.05	11.45	11.15	3.88	3.86
S-7	28.5	NM	NM	NM	NM	NM	NM	NM
S-9	NM	NM	38.55	42.42	27.08	25.5	14.63	12.30
S-10A	-21.65	-25.9	NM	-21.38	-2.1	-19.38	-19.38	NM
S-10B	NM	70.75	149.47	147.07	142.24	124.96	127.56	135.36
S-10C	NM	27.85	80.89	81.12	61.64	55.09	48.2	NM
S-11	NM	NM	NM	NM	NM	NM	NM	14.52
S-12	NM	NM	NM	NM	NM	NM	NM	16.25
S-13	NM	NM	NM	NM	NM	NM	NM	178.90
S-17	NM	NM	NM	NM	NM	NM	NM	12.44

amsl - Above mean sea level.

NM - Not measured.

**Table 2.3. Summary of Groundwater Elevations: 1997 - 2002
Primrose Creek Drainage Basin**

Well No.	Estimated Groundwater Elevation November 1997 / January 1998 (ft amsl)	Estimated Groundwater Elevation October / November 1998 (ft amsl)	Estimated Groundwater Elevation October / November 1999 (ft amsl)	Estimated Groundwater Elevation April 2000 (ft amsl)	Estimated Groundwater Elevation September 2000 (ft amsl)	Estimated Groundwater Elevation September 2001 (ft amsl)	Estimated Groundwater Elevation March 2002 (ft amsl)	Estimated Groundwater Elevation August 2002 (ft amsl)
Chapel Road								
C-3	100.05	NM	103.45	93.76	100.99	99.65	100.64	98.92
C-10	173.44	NM	180.55	189.09	178.94	171.63	174.82	172.70
C-11	146.1	NM	146.78	148.61	142.58	129.92	146.74	128.60
Sunset Drive								
SN-1	154.75	NM	NM	NM	NM	NM	NM	NM
SN-2	151.28	138	158.3	160.14	155.0	131.52	150.63	135.68
SN-3	158.45	NM	NM	NM	NM	NM	NM	NM
SN-4	143.43	NM	146.55	NM	NM	NM	NM	NM
Meetinghouse Road								
M-1	178.55	168.82	172.36	174.9	176.57	176.98	172.42	175.08
Comfort Road								
CO-1	340.76	336.25	347.22	349.83	340.75	341.17	336.88	340.42
Hillside Lane								
H-1	160.95	NM	NM	165.92	162.12	159.68	160.69	159.28
River Road								
R-1	NM	NM	NM	NM	NM	NM	NM	113.03
R-2	NM	NM	NM	NM	NM	NM	NM	69.95
R-3	NM	NM	NM	NM	NM	NM	NM	74.82
R-4	NM	NM	NM	NM	NM	NM	NM	48.98
R-5	NM	NM	NM	NM	NM	NM	NM	130.73

amsl - Above mean sea level.

NM - Not measured.

**Table 2.3. Summary of Groundwater Elevations: 1997 - 2002
Primrose Creek Drainage Basin**

Well No.	Estimated Groundwater Elevation November 1997 / January 1998 (ft amsl)	Estimated Groundwater Elevation October / November 1998 (ft amsl)	Estimated Groundwater Elevation October / November 1999 (ft amsl)	Estimated Groundwater Elevation April 2000 (ft amsl)	Estimated Groundwater Elevation September 2000 (ft amsl)	Estimated Groundwater Elevation September 2001 (ft amsl)	Estimated Groundwater Elevation March 2002 (ft amsl)	Estimated Groundwater Elevation August 2002 (ft amsl)
Upper York Road								
Y-2	315.87	NM	NM	NM	NM	NM	NM	NM
Y-5	307.88	NM	NM	NM	NM	NM	NM	NM
New Hope Crushed Stone and Lime Quarry								
Ely Road	25.3	22.1	31.5	39.1	23.8	25.4	17.6	15.70
MW-3	29.3	27.5	33.9	36.4	28.2	28.3	22.9	20.05
MW-4	11.9	10.1	15.5	17.2	8.5	8.0	4.3	1.45
MW-5	34.0	33.0	38.4	40.4	34.2	32.8	27.6	24.82
MW-6	119.7	117.1	122.7	122.6	119.3	119.1	125.0	118.34
MW-7A	28.0	20.3	22.6	22.2	12.4	-11.2	17.8	-2.00
MW-8	98.0	93.4	96.3	95.9	95.4	93.0	99.1	91.38
MW-9	96.7	92.1	95.0	96.2	93.3	90.6	92.7	88.55

amsl - Above mean sea level.

NM - Not measured.

**Table 2.4. Groundwater Elevation Calculations: August 2002
Aquetong Creek Drainage Basin**

Well No.	Stickup Height (ft ags)	Estimated Ground Elevation (ft amsl) ^a	Estimated Measuring Point Elevation (ft amsl)	Depth to Water August 2002 (ft bmp)	Estimated Groundwater Elevation August 2002 (ft amsl)
Heather Drive					
HE-1	2.2	190	192.2	80.21	111.99
HE-2	1.1	195	196.1	61.81	134.29
Lower Mountain Road					
L-1		210	210	89.83	120.17
Meetinghouse Road					
M-2	0.75	185	185.75	7.84	177.91
M-3	1.55	200	201.55	21.79	179.76
Sugan					
S-14	0.35	170	170.35	35.63	129.83
S-15		205	205	64.85	140.15
S-16 New	-10	230	220	46.49	173.51
Sprucefield Court					
SP-1	1.5	200	201.5	66.62	134.88
Windy Bush					
W-1	0.7	305	305.7	25.63	280.07
York Road					
Y-8	0	183	183	82.84	100.16
Y-9		165	165	NM	NM
Y-10	1	155	156	43.18	112.82
Y-11	1.85	120	121.85	NM	NM
Y-12	3	135	138	93.50	44.50

NA - Not accessible.

NM - Not measured.

ags - Above ground surface.

amsl - Above mean sea level.

bmp - Below measuring point.

^a Estimated based on USGS topographic map.

**Table 2.4. Groundwater Elevation Calculations: August 2002
Aquetong Creek Drainage Basin**

Well No.	Stickup Height (ft ags)	Estimated Ground Elevation (ft amsl) ^a	Estimated Measuring Point Elevation (ft amsl)	Depth to Water August 2002 (ft bmp)	Estimated Groundwater Elevation August 2002 (ft amsl)
Y-13	2	140	142	47.60	94.40
Y-14	0.75	160	160.75	79.67	81.08
Y-15	4.5	183	187.5	NM	NM
Y-16		200	200	NM	NM
Y-17	0.88	160	160.88	4.92	155.96
Y-18	1.9	160	161.9	7.04	154.86
Y-19	1.8	200	201.8	31.28	170.52
Y-20	1.84	190	191.84	NM	NM
Y-21	1.75	180	181.75	8.95	172.80
Y-22	1.2	175	176.2	7.56	168.64
Y-23	1.95	223	224.95	42.59	182.36
Y-24	2	245	247	42.03	204.97
Y-25	3	180	183	NM	NM
Y-26	1.4	200	201.4	NM	NM
Bucks County Water and Sewer Authority (BCWSA)					
S-1		205	205	NM	NM
S-1M		205	205	NM	NM
S-2		160	160	NM	NM
S-3	1.5	160	161.5	NM	NM
S-3M	3.1	145	148.1	46.90	101.20

NA - Not accessible.

NM - Not measured.

ags - Above ground surface.

amsl - Above mean sea level.

bmp - Below measuring point.

^a Estimated based on USGS topographic map.

**Table 2.5. Summary of Water Level Measurements: 2000 - 2002
Aquetong Creek Drainage Basin**

Well No.	Depth to Water April 2000 (ft bmp)	Depth to Water September 2000 (ft bmp)	Depth to Water September 2001 (ft bmp)	Depth to Water March 2002 (ft bmp)	Depth to Water August 2002 (ft bmp)
Heather Drive					
HE-1	73.09	75.20	77.24	76.86	80.21
HE-2	52.53	54.37	57.17	58.02	61.81
Lower Mountain Road					
L-1	76.78	85.63	84.91	80.84	89.83
Meetinghouse Road					
M-2	3.54	7.31	7.76	6.76	7.84
M-3	19.72	21.10	21.64	21.13	21.79
Sugan					
S-14	20.35	23.86	40.52	25.23	35.63
S-15	47.33	50.88	69.70	54.88	64.85
S-16	NM	NM	NM	NM	46.49
Sprucefield Court					
SP-1	53.33	58.26	64.25	55.15	66.62
Windy Bush					
W-1	3.53	17.57	26.18	28.42	25.63
York Road					
Y-8	59.91	67.78	72.71	65.03	82.84
Y-9	31.06	NM	NM	NM	NM
Y-10	36.98	38.13	39.75	40.53	43.18
Y-11	18.00	NM	NM	NM	NM
Y-12	80.00	31.26	34.93	57.78	93.50

NM - Not measured.
bmp - Below measuring point.

**Table 2.5. Summary of Water Level Measurements: 2000 - 2002
Aquetong Creek Drainage Basin**

Well No.	Depth to Water April 2000 (ft bmp)	Depth to Water September 2000 (ft bmp)	Depth to Water September 2001 (ft bmp)	Depth to Water March 2002 (ft bmp)	Depth to Water August 2002 (ft bmp)
York Road (continued)					
Y-13	44.57	40.95	39.00	41.73	47.60
Y-14	59.39	69.30	77.67	70.94	79.67
Y-15	60.53	71.20	81.67	NM	NM
Y-16	70.53	81.40	NM	NM	NM
Y-17	1.66	4.65	5.88	4.91	4.92
Y-18	5.82	7.17	7.52	6.75	7.04
Y-19	29.28	31.00	31.30	31.03	31.28
Y-20	13.77	17.10	18.15	NM	NM
Y-21	7.07	10.32	11.46	11.26	8.95
Y-22	5.62	7.45	7.87	6.15	7.56
Y-23	42.12	42.34	42.43	42.51	42.59
Y-24	41.78	42.37	42.48	42.46	42.03
Y-25	10.22	11.15	11.84	NM	NM
Y-26	22.22	22.43	22.50	25.33	NM
Bucks County Water and Sewer Authority (BCWSA)					
S-1	341	342	NM	NM	NM
S-1M	NM	NM	NM	NM	NM
S-2	185	202	NM	NM	NM
S-3	44.08	45.05	49.54	NM	NM
S-3M	32.31	33.52	38.41	34.30	46.90

NM - Not measured.
bmp - Below measuring point.

**Table 2.6. Summary of Groundwater Elevations: 2000 - 2002
Aquetong Creek Drainage Basin**

Well No.	Historical Water Level - Date Measured	Estimated Groundwater Elevation Historical (ft amsl)	Estimated Groundwater Elevation April 2000 (ft amsl)	Estimated Groundwater Elevation September 2000 (ft amsl)	Estimated Groundwater Elevation September 2001 (ft amsl)	Estimated Groundwater Elevation March 2002 (ft amsl)	Estimated Groundwater Elevation August 2002 (ft amsl)
Heather Drive							
HE-1		NM	119.11	117.00	114.96	115.34	111.99
HE-2	8/11/98	134.19	143.57	141.73	138.93	138.08	134.29
Lower Mountain Road							
L-1	6/30/60	141.68	133.22	124.37	125.09	129.16	120.17
Meetinghouse Road							
M-2	1/3/92, 8/11/98	180.3, 178.78	181.46	178.44	177.99	178.99	177.91
M-3	1/3/92, 8/11/98	182.25, 180.30	180.28	180.45	179.91	180.42	179.76
Sugan							
S-14	7/1/98, 8/7/98	148.02, 135.20	150.00	146.49	129.83	145.12	129.83
S-15		NM	157.67	154.12	135.30	150.12	140.15
S-16		NM	NM	NM	NM	NM	173.51
Sprucefield Court							
SP-1		NM	148.17	143.24	137.25	146.35	134.88
Windy Bush							
W-1		NM	302.17	288.13	279.52	277.28	280.07
York Road							
Y-8	8/11/98	99.2	123.09	115.22	110.29	117.97	100.16
Y-9	8/11/98	114.84	133.94	NM	NM	NM	NM
Y-10		NM	118.02	117.87	116.25	115.47	112.82
Y-11		NM	103.85	NM	NM	NM	NM
Y-12		NM	55.00	106.74	103.07	80.22	44.50

NM - Not measured.
amsl - Above mean sea level.

**Table 2.6. Summary of Groundwater Elevations: 2000 - 2002
Aquetong Creek Drainage Basin**

Well No.	Historical Water Level - Date Measured	Estimated Groundwater Elevation Historical (ft amsl)	Estimated Groundwater Elevation April 2000 (ft amsl)	Estimated Groundwater Elevation September 2000 (ft amsl)	Estimated Groundwater Elevation September 2001 (ft amsl)	Estimated Groundwater Elevation March 2002 (ft amsl)	Estimated Groundwater Elevation August 2002 (ft amsl)
Y-13		NM	97.43	101.05	103.00	100.27	94.40
Y-14		NM	100.61	91.45	83.08	89.81	81.08
Y-15	5/18/99	112.1	126.97	116.30	105.83	NM	NM
Y-16		NM	129.47	118.60	NM	NM	NM
Y-17	8/11/98	157.02	159.22	156.23	155.00	155.97	155.96
Y-18	8/11/98	154.86	156.08	154.73	154.38	155.15	154.86
Y-19	8/11/98	171.25	172.52	170.80	170.50	170.77	170.52
Y-20	8/11/98	173.14	178.07	174.74	173.69	NM	NM
Y-21	8/11/98	169.72	174.68	171.43	170.29	170.49	172.80
Y-22	8/11/98	166.99	170.58	168.75	168.33	170.05	168.64
Y-23	8/11/98	182.83	182.83	182.61	182.52	182.44	182.36
Y-24	8/11/98	204.98	205.22	204.63	204.52	204.54	204.97
Y-25	8/11/98	171.86	172.78	171.85	171.16	NM	NM
Y-26	8/11/98	177.69	177.78	178.97	178.90	176.07	NM
Bucks County Water and Sewer Authority (BCWSA)							
S-1	8/12/98	-147	-136	-137	NM	NM	NM
S-1M	8/11/98	133.08	NM	NM	NM	NM	NM
S-2	8/12/98	-48	-25	-42	NM	NM	NM
S-3	8/11/98	107.3	117.42	116.45	111.96	NM	NM
S-3M	8/11/98	105.33	115.79	114.58	109.69	113.80	101.20

NM - Not measured.
amsl - Above mean sea level.

Table 3.1. Description of Stream Flow Measurement Locations and Summary of Flow Rates

Name	Location	Stream Flow Rate October 4, 2000		Stream Flow Rate September 18, 2001 and November 29, 2001 ^a		Stream Flow Rate March 1, 2002		Stream Flow Rate September 24, 2002	
		(ft ³ /s)	(gpm)	(ft ³ /s)	(gpm)	(ft ³ /s)	(gpm)	(ft ³ /s)	(gpm)
Primrose Creek									
Primrose Creek #1	Utility access road, off Chapel Road: ~50 feet from where utility road crosses over stream to the east near ~15 foot tall dead tree	4.5	2029	4.0	1807	2.1	920	2.7	1222
Primrose Creek #2	River Road, near Old Solebury School: ~50 feet downstream of footbridge near 2nd big tree on east bank	4.2	1900	2.8	1247	2.0	889	2.5	1141
Aquetong Creek									
Tributary to Aquetong Creek #1	US 202, Guiseppe's Restaurant: ~135 feet southwest of bridge over 202	1.6	739	0.7	333	0.7	302	0.3	142
Aquetong Creek #2	Reeder Road: ~100 feet east of bridge ~0.5 miles south of US 202; upstream of tributary	5.4	2416	3.5	1577	3.9	1771	3.8	1708
Aquetong Creek #3	West Mechanic Street: ~50 feet south of bridge at tree on west bank	5.7	2540	4.7	2111	4.2	1887	4.8	2147

ft³/s - Cubic feet per second

gpm - Gallons per minute.

^a Primrose Creek was measured on September 18, 2001 and Aquetong Creek on November 29, 2001.

Table 5.1. New Hope Quarry Calculated Annual Average Daily Pumpage Rate and Monthly Pumpage Rate Data

Year	Average Daily Pumpage (million gallons per day)		1996 (mgd)	1997 (mgd)	1998 (mgd)	1999 (mgd)	2000 (mgd)	2001 (mgd)	2002 (mgd)
1987	1.44	January	1.01	3.60	1.88	2.40	a	0.70	0.24
1988	1.58	February	1.41	4.16	2.30	2.56	a	1.26	0.28
1989	2.34	March	1.27	3.52	2.57	3.36	a	1.84	0.38
1990	1.73	April	1.46	3.14	2.68	3.26	a	1.13	b
1991	1.57	May	1.50	3.59	4.59	2.85	0.93	1.10	b
1992	1.70	June	1.14	3.37	4.35	1.91	1.06	1.43	b
1993	2.18	July	1.64	2.17	3.03	0.66	0.70	1.13	b
1994	2.29	August	1.35	2.47	1.31	0.49	0.71	0.64	b
1995	0.92	September	1.79	1.36	1.01	0.94	0.48	0.56	b
1996	1.83	October	1.84	1.33	1.45	2.10	0.50	0.41	--
1997	2.55	November	3.73	0.95	1.41	1.06	0.37	0.36	--
1998	2.33	December	3.76	0.89	1.33	0.97	0.54	0.37	--
1999	1.88	Statistics							
2000	0.78	<i>Annual Total (million gallons)</i>	<i>668.0</i>	<i>933.1</i>	<i>847.0</i>	<i>578.6</i>	<i>152.8</i>	<i>310.3</i>	<i>--</i>
2001	0.91	<i>Minimum</i>	<i>1.01</i>	<i>0.89</i>	<i>1.01</i>	<i>0.49</i>	<i>0.37</i>	<i>0.36</i>	<i>0.24</i>
From 1987 - 2001	1.73	<i>Maximum</i>	<i>3.76</i>	<i>4.16</i>	<i>4.59</i>	<i>3.36</i>	<i>1.06</i>	<i>1.84</i>	<i>0.38</i>
		<i>Average</i>	<i>1.83</i>	<i>2.55</i>	<i>2.33</i>	<i>1.88</i>	<i>0.78</i>	<i>0.91</i>	<i>0.30</i>

Sources:
 Data from 1996 through 1999 from verbal communication with Bob Elliot, PADEP (Annual Withdrawal Reports for DRBC Pennsylvania Portion.)
 Data for 2000 and 2002 from communication with Michael Hill, PADEP.
^a Data unavailable from January 2000 to April 2000 due to construction at the quarry.
^b Data has been requested from PADEP.

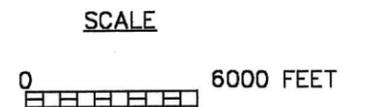
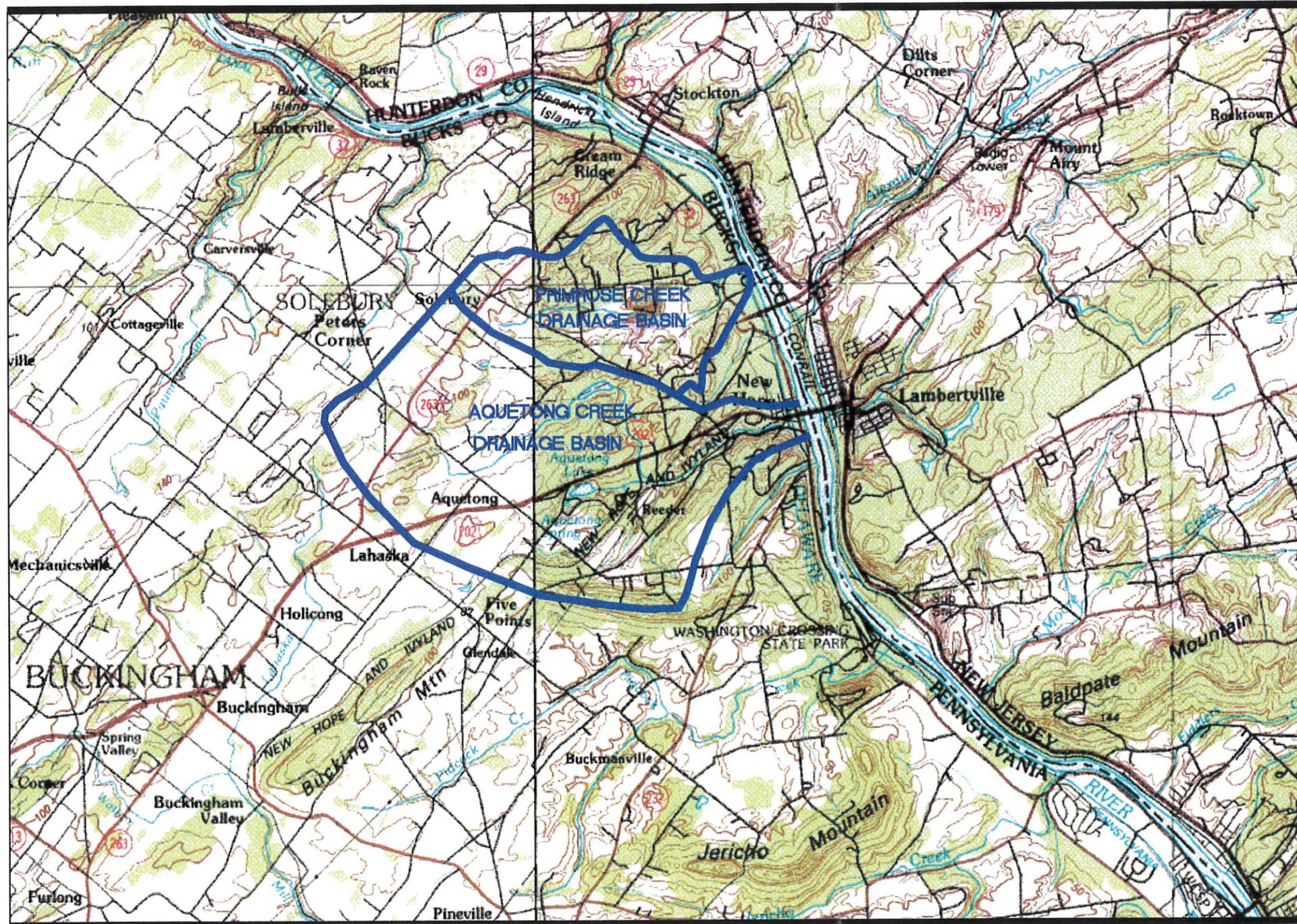
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LOCATION OF PRIMROSE CREEK
AND AQUETONG CREEK
DRAINAGE BASINS

SOLEBURY TOWNSHIP, PENNSYLVANIA

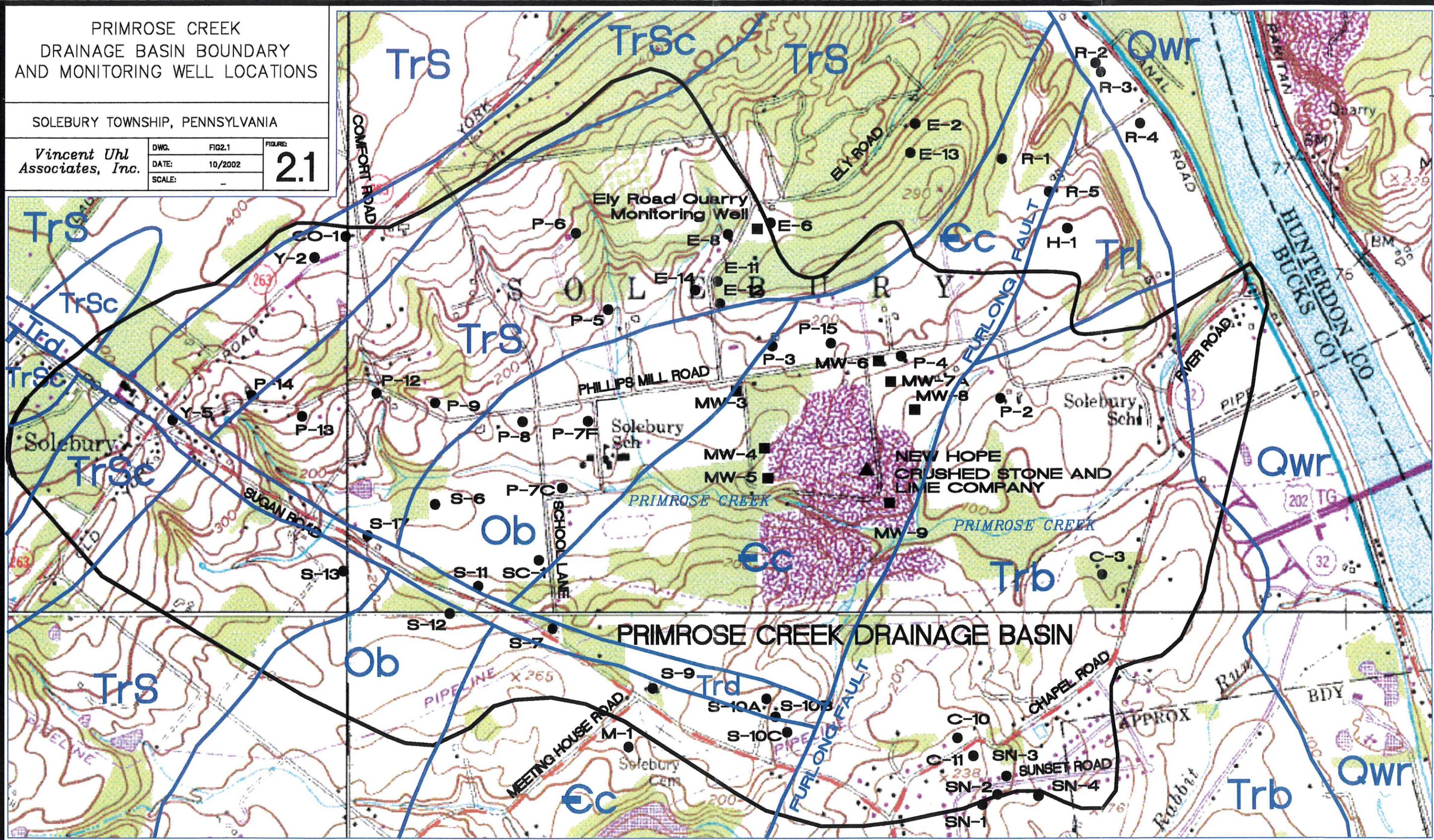
<i>Vincent Uhl</i> Associates, Inc.	DWG.	SB1-1	FIGURE: 1.1
	DATE:	11/2002	
	SCALE:	SHOWN	

PRIMROSE CREEK
DRAINAGE BASIN BOUNDARY
AND MONITORING WELL LOCATIONS

SOLEBURY TOWNSHIP, PENNSYLVANIA

Vincent Uhl
Associates, Inc.

DWG.	FIG. 2.1	FIGURE:
DATE:	10/2002	2.1
SCALE:	-	

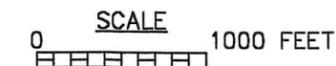


Legend

P-4 ● Monitoring Network Well
MW-7A ■ Quarry Monitoring Well

Qwr = Pleistocene Wisconsin and Recent deposits
Trd = Triassic Diabase
Trb = Triassic Brunswick Formation
Ob = Ordovician Beekmantown Formation
Trl = Triassic Lockatong Formation
TrS/TrSc = Triassic Stockton Formation

Ec = Cambrian Conococheague (Limeport) Formation

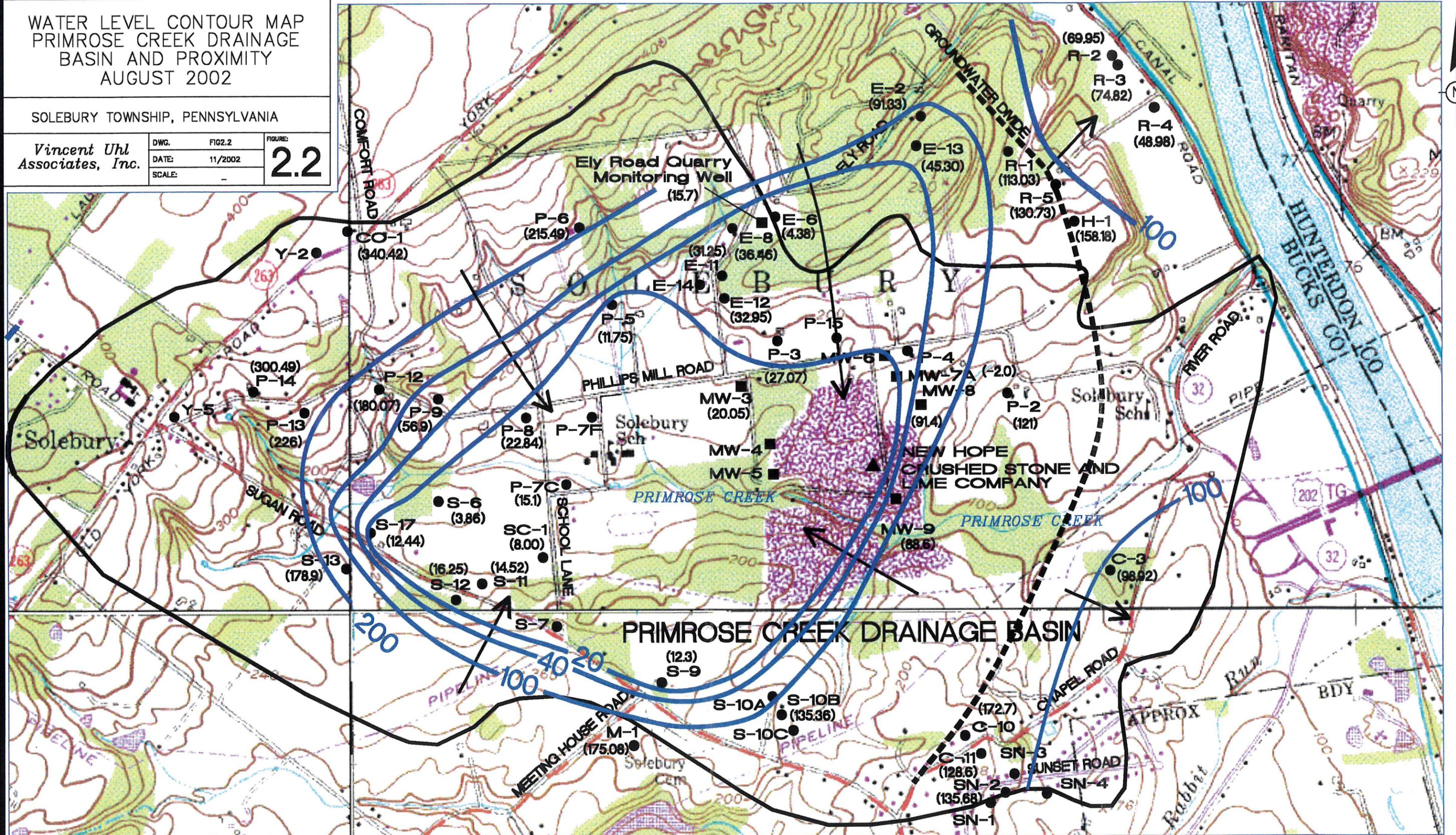


WATER LEVEL CONTOUR MAP
 PRIMROSE CREEK DRAINAGE
 BASIN AND PROXIMITY
 AUGUST 2002

SOLEBURY TOWNSHIP, PENNSYLVANIA

Vincent Uhl
 Associates, Inc.

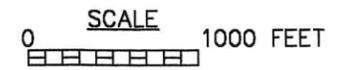
DWG.	FIG2.2	FIGURE:
DATE:	11/2002	2.2
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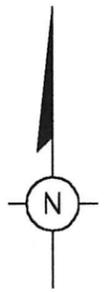
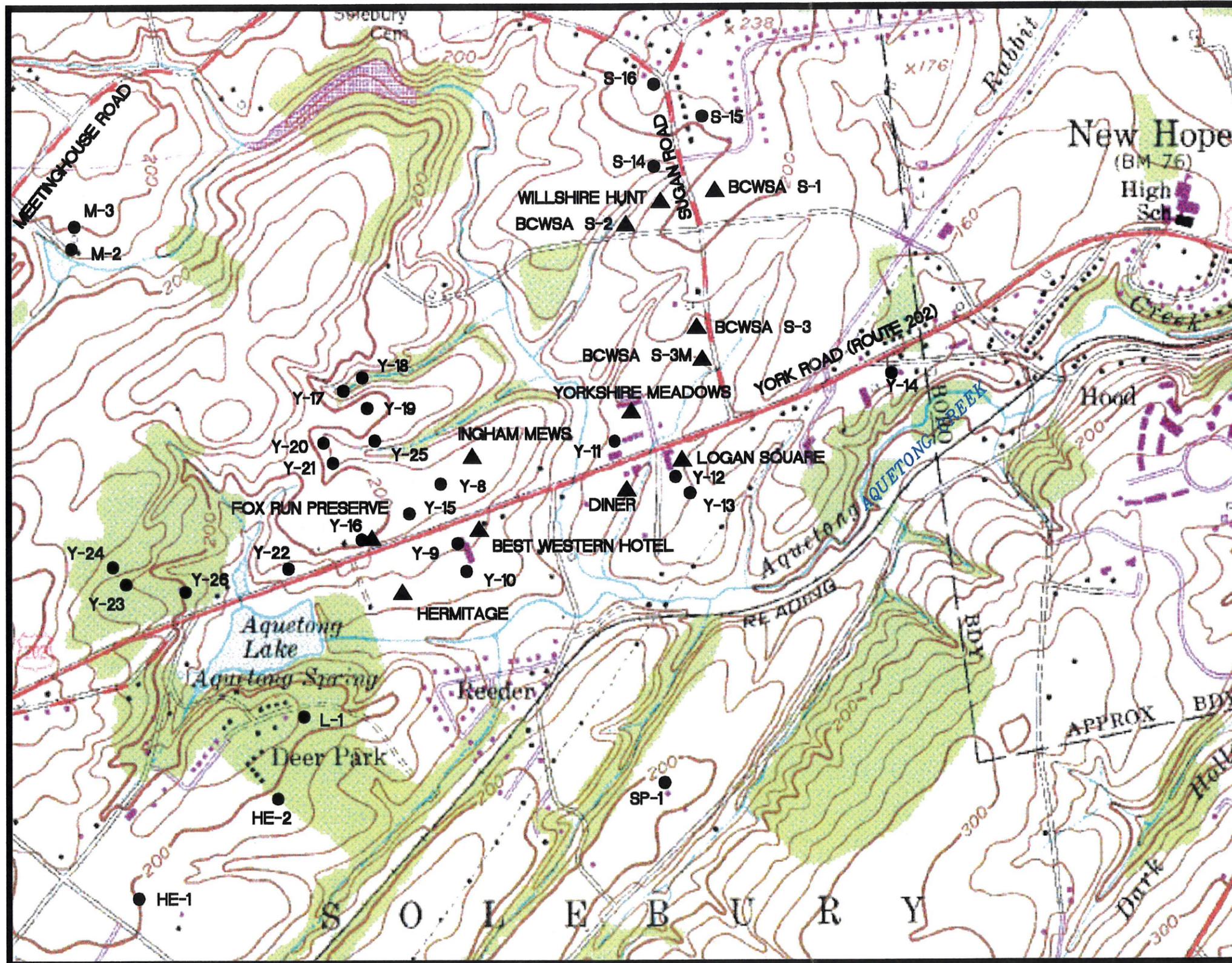


Legend

- P-6 ● Monitoring Network Well
- MW-7A ■ Quarry Monitoring Well

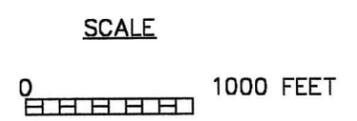
- 20 Groundwater Elevation Contour
- (215.49) Groundwater Elevation Above Mean Sea Level (AMSL)
- Direction of Groundwater Flow





LEGEND

- Y-8 ● WATER LEVEL MEASURING POINT
- ▲ MAJOR PUMPING CENTER



LOCATION OF WATER LEVEL MONITORING WELLS
AND MAJOR PUMPING CENTERS

AQUETONG CREEK DRAINAGE BASIN

SOLEBURY TOWNSHIP, PENNSYLVANIA

<i>Vincent Uhl Associates, Inc.</i>	DWG. SB2-2	FIGURE:
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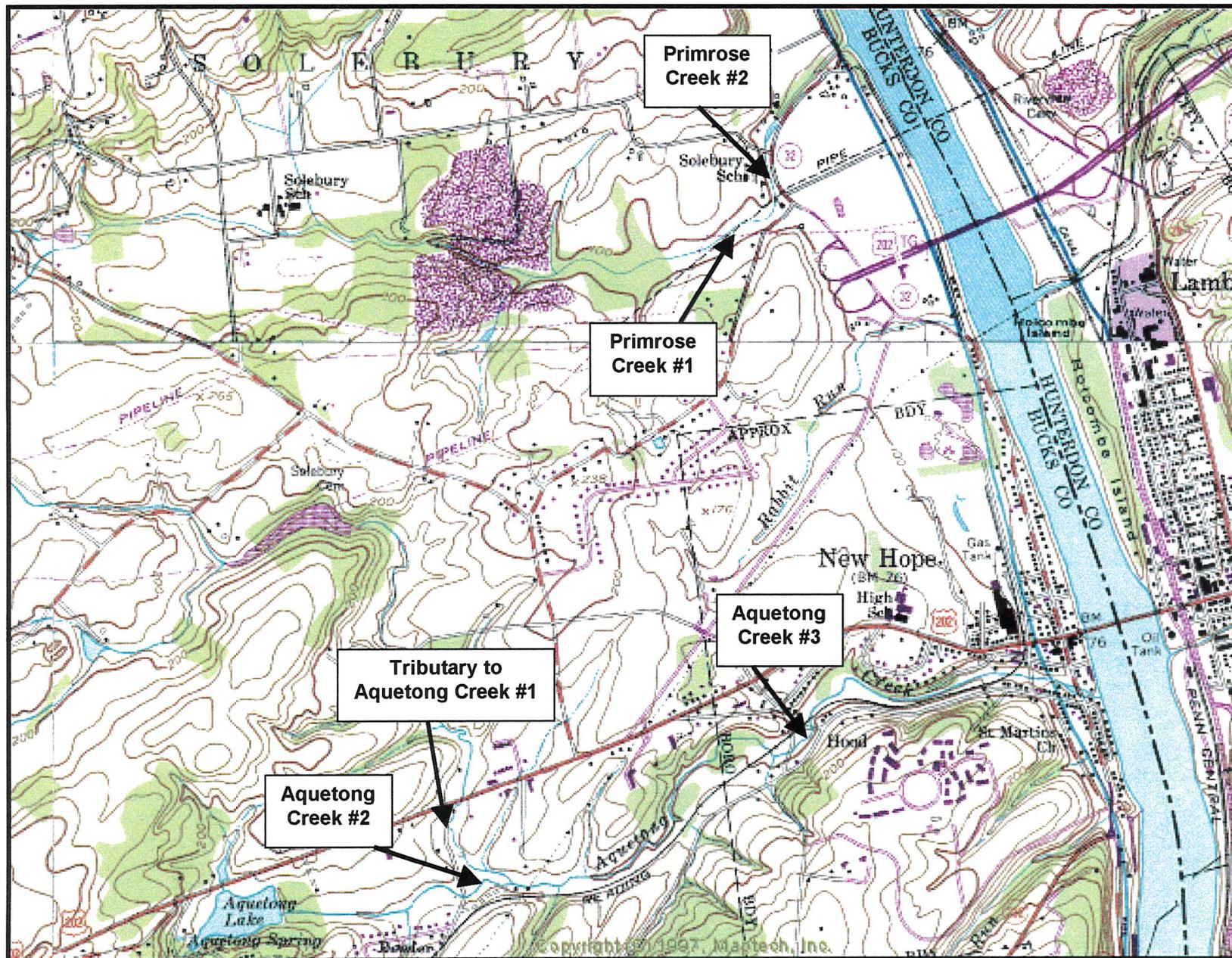
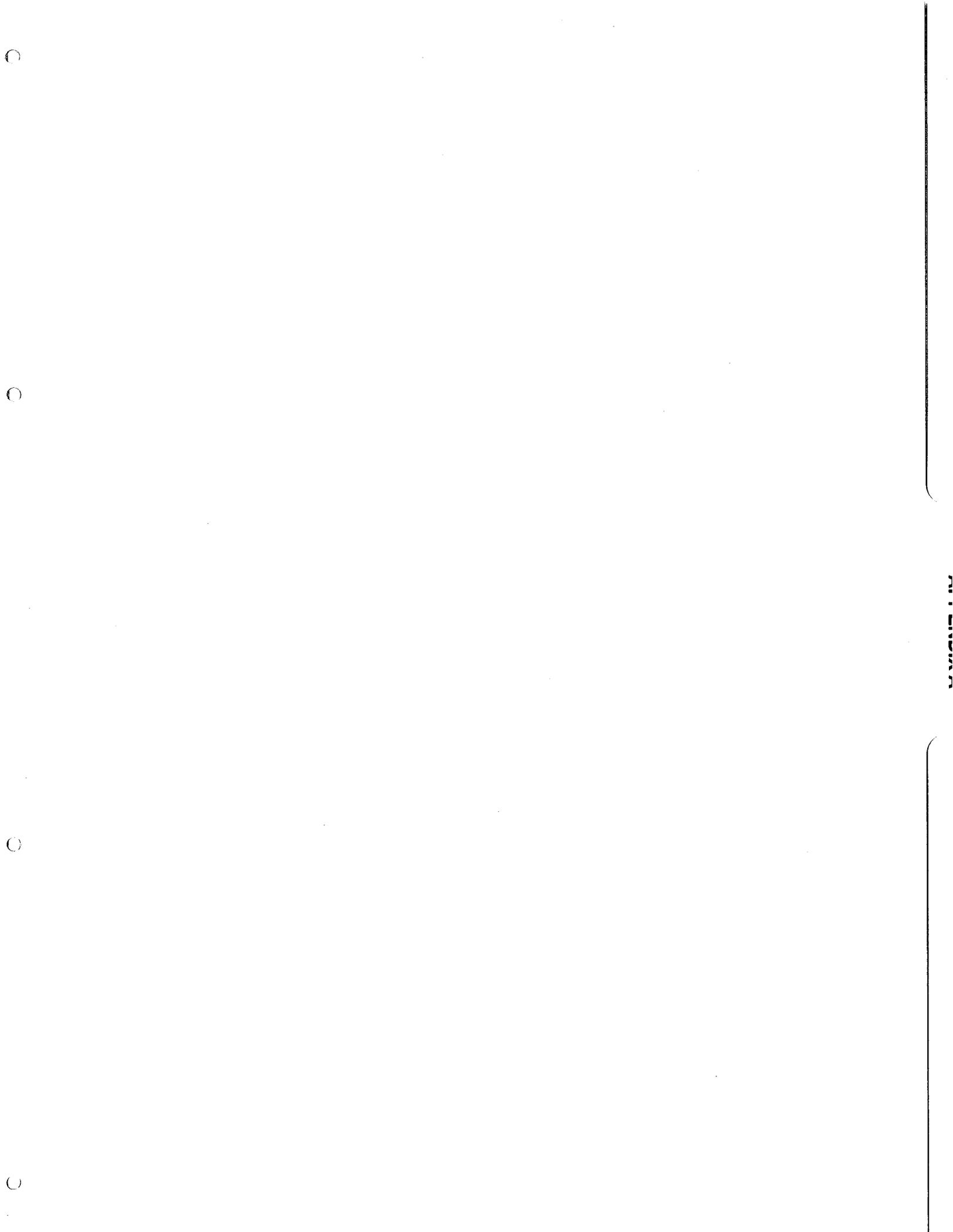


Figure 3.1. Stream Flow Measurement Locations

Scale: 1 inch = 3000 feet





APPENDIX A

Groundwater Elevation and Quarry Pumpage Over Time

**Figure A.1. Primrose Creek Drainage Basin:
Wells in Carbonate Rock Aquifer Influenced by Quarry
(Phillips Mill Road, Sugan Road, and School Lane)**

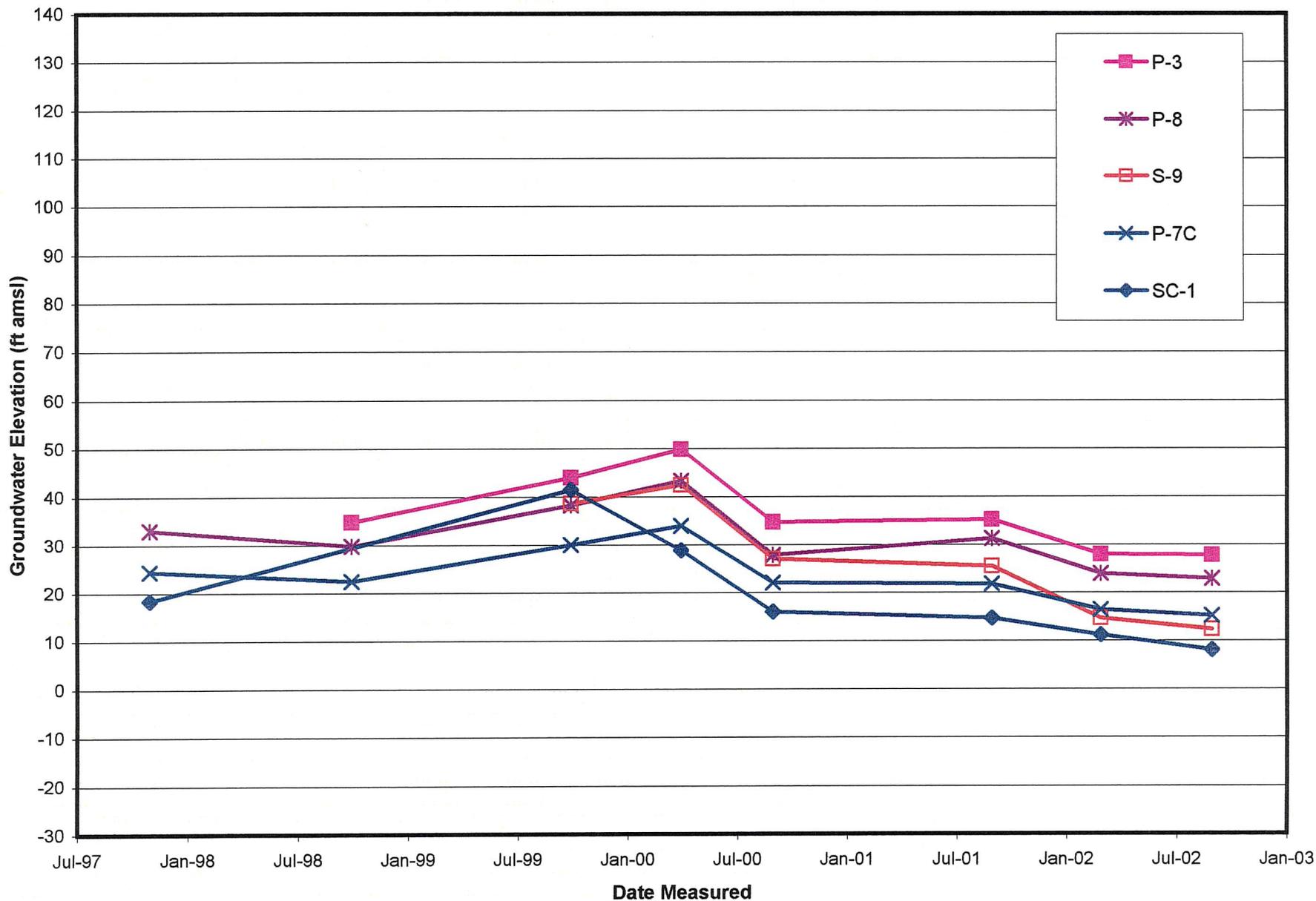


Figure A.2. Primrose Creek Drainage Basin: Wells in Stockton Sandstone Within 1,000 Feet of Carbonate Rock Contact (Phillips Mill Road and Ely Road)

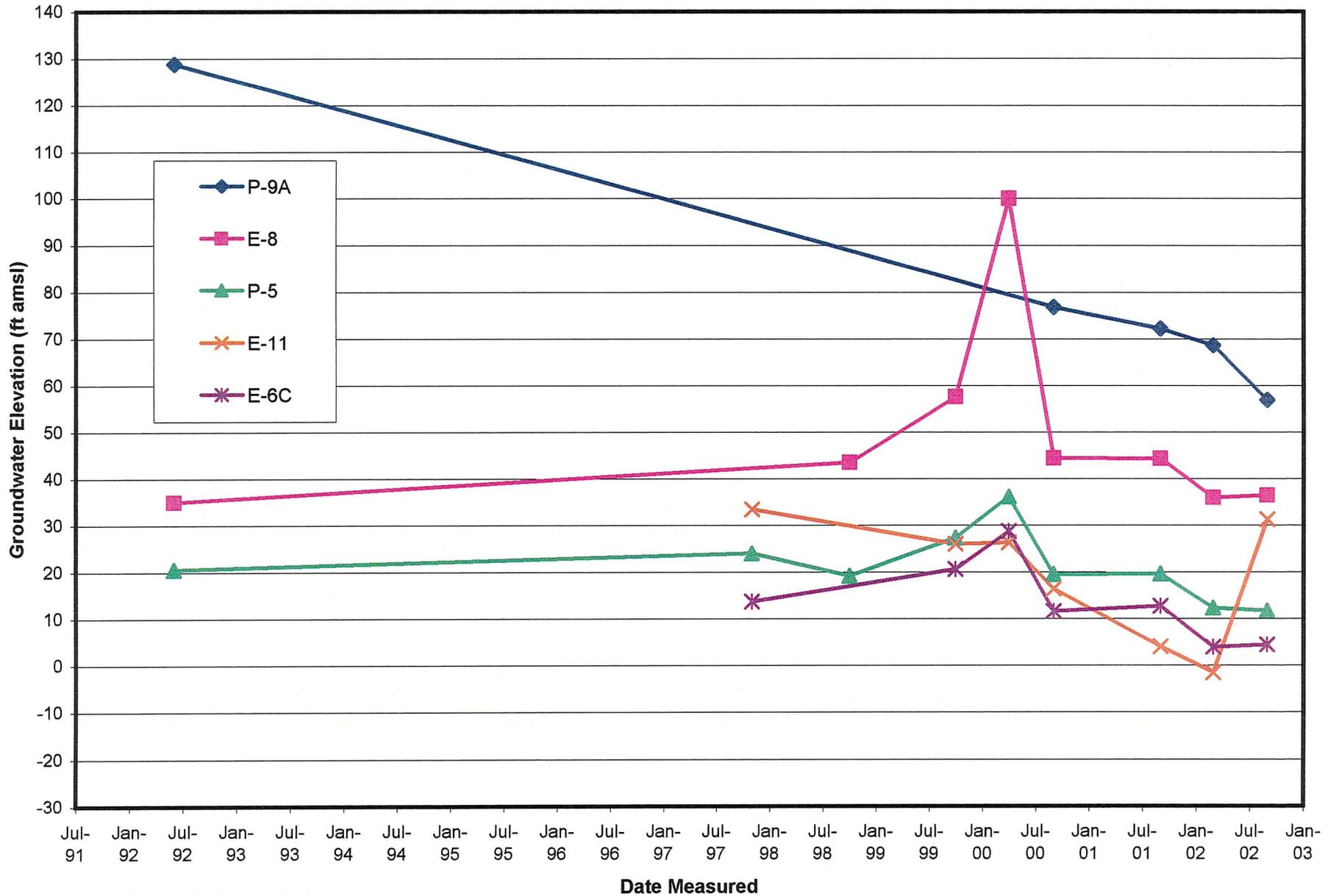
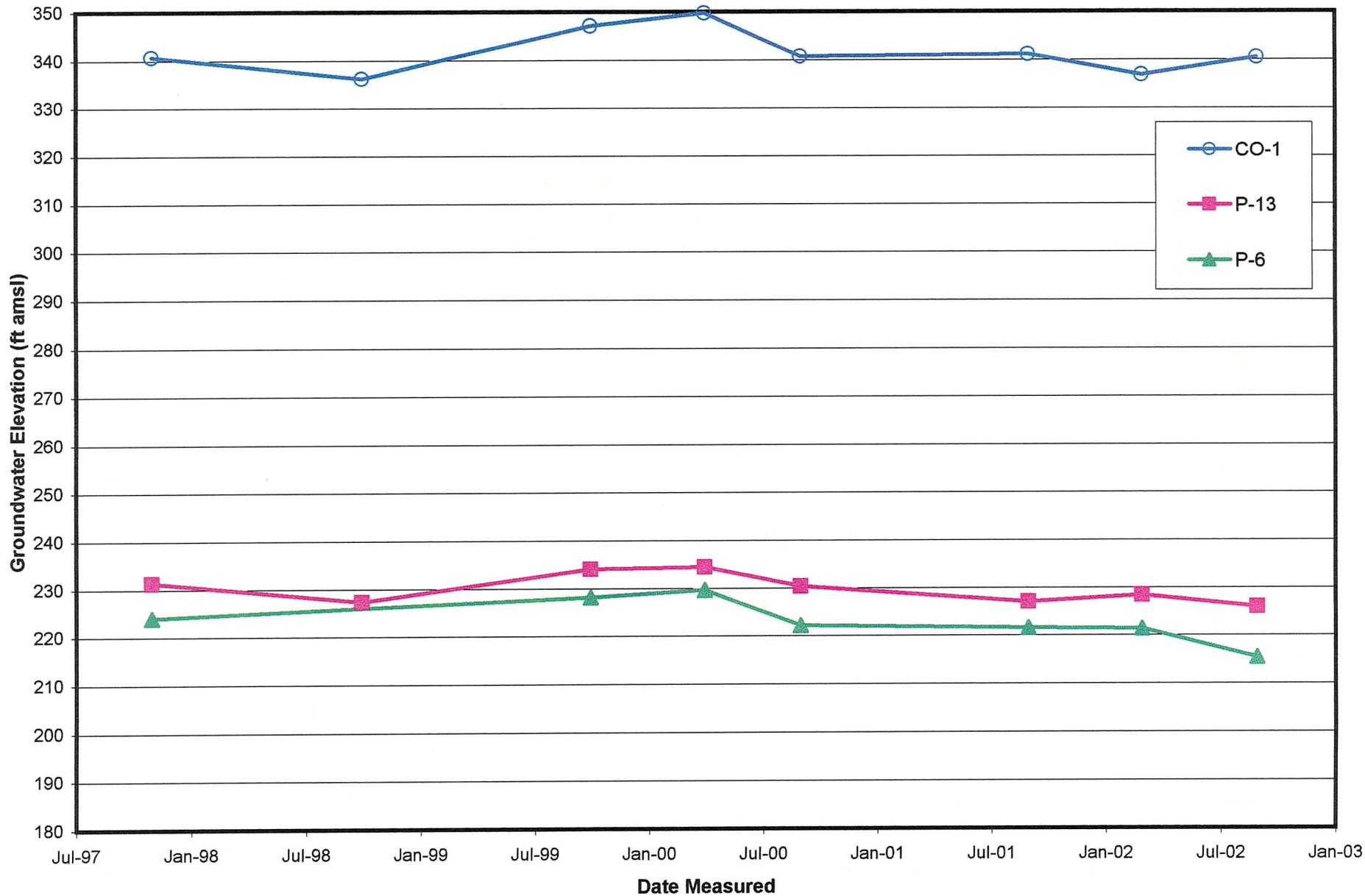


Figure A.3. Primrose Creek Drainage Basin: Wells in Stockton Sandstone Greater than 1,000 Feet from the Carbonate Rock Contact (Comfort Road and Phillips Mill Road)



**Figure A.4. Primrose Creek Drainage Basin:
Wells in Brunswick Shale
(Phillips Mill Road, Chapel Road, and Sunset Drive)**

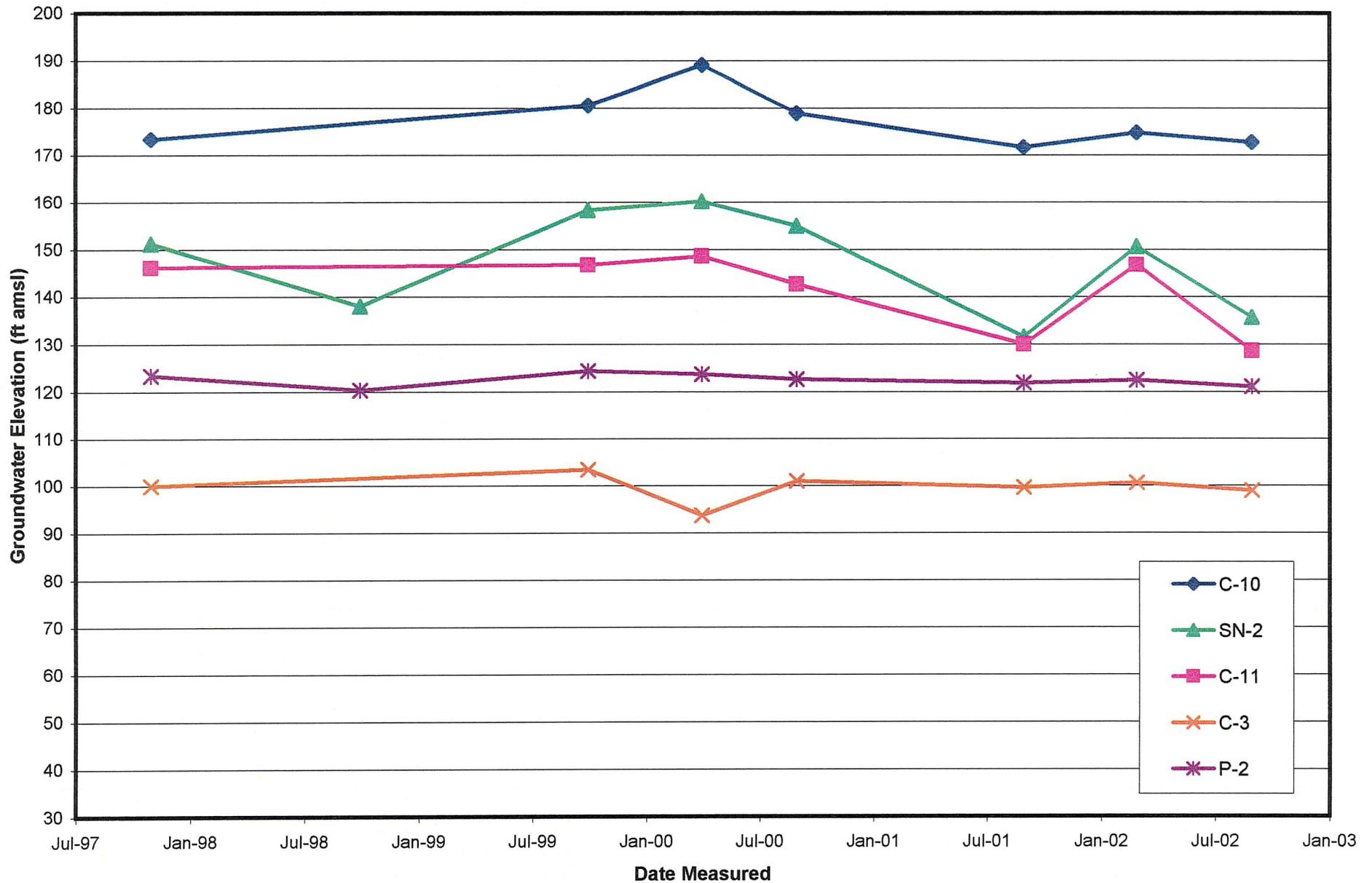


Figure A.5: Northeastern Aquetong Creek Drainage Basin

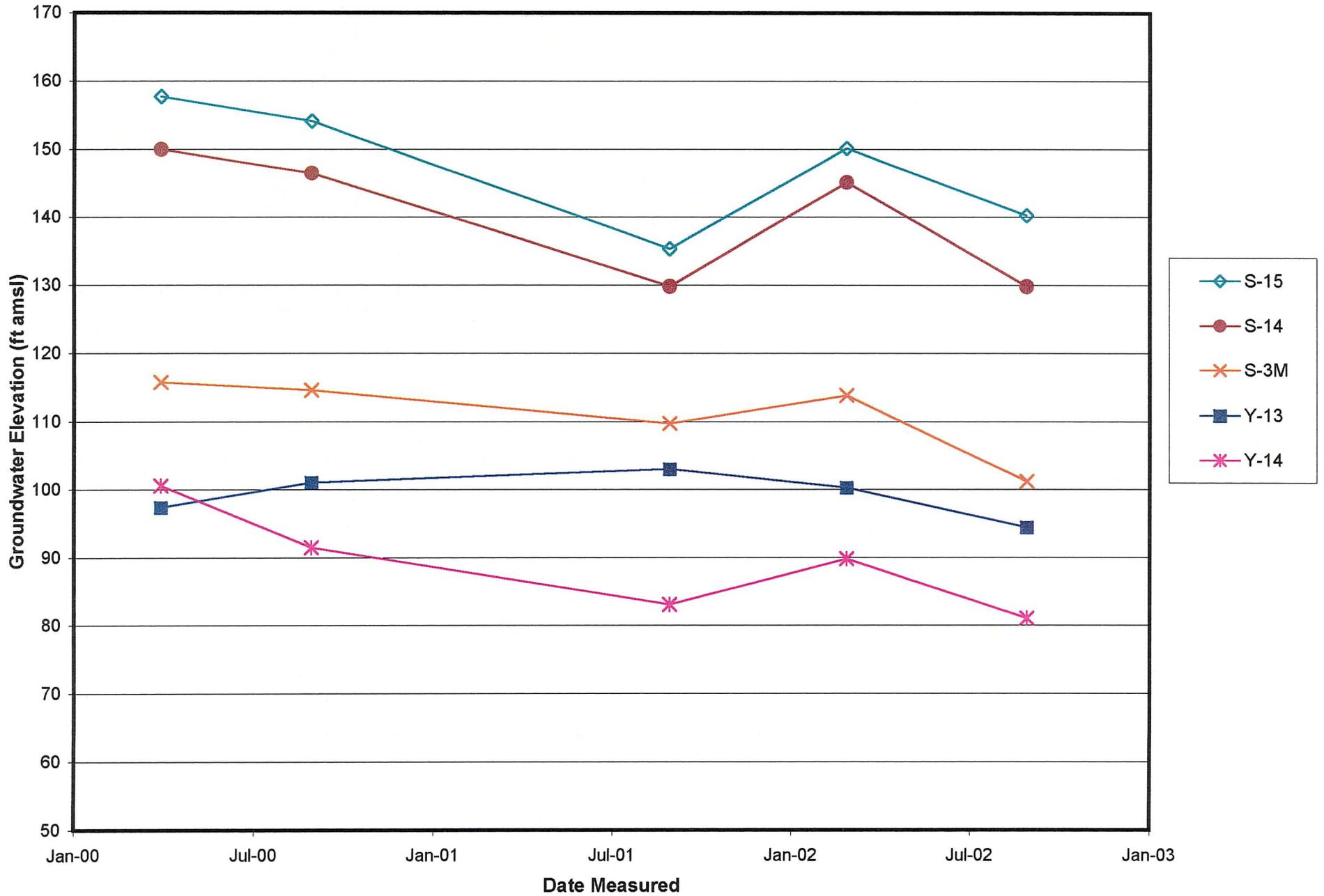


Figure A.6: Western Portion of Aquetong Creek Drainage Basin

