Piney Branch Special Protection Area

4.3.1 Description of the Piney Branch SPA Watershed

The Piney Branch watershed was designated as an SPA because of the intensive development planned for the area and the existing high water quality found in the watershed. SPA designation was done by County Council resolution on October 24, 1995. The Piney Branch watershed, a subwatershed of Watts Branch, is located in south-central Montgomery County just west of the city of Rockville. Piney Branch originates just to the north of Shady Grove Rd. and east of Travilah Road (Figure 28). From its headwaters, Piney Branch flows to the south entering Watts Branch just south of Glen Road. The SPA includes all 2400 acres of the Piney Branch watershed.

Prior to 1990, the Piney Branch watershed consisted of a mix of agricultural land uses and large lot (1-2 acre) single family homes with some commercial and office development. In early 1993, residential construction began in the headwaters area of Piney Branch on the Willows of Potomac and Piney Glen Village, two large residential subdivisions. No SPA requirements were placed on these projects as they predated the SPA designation. In mid 1994, construction began in the Piney Branch stream valley on a sanitary sewer line from the Watts Branch up to the headwaters of Piney Branch.

4.3.2 Status of Development in Piney Branch SPA as of June 2002

Sixteen final water quality plans have been approved for this SPA (Table 15). There are several other projects in various stages of the planning and development process. Also, a significant amount of development had been approved prior to SPA designation. There is potential for adverse change to Piney Branch due to the cumulative impacts of these projects. This is being mitigated on projects currently under construction by strict adherence to approved standards and by innovative stormwater management techniques. All new development will have to adhere to more stringent SPA requirements.

Although the Piney Branch watershed has experienced an increase in development activity over the last couple of years, the majority of the proposed development is for large residential single family lots (0.5 acres to 2+ acres). One notable exception is the proposed Traville site. This site is 192 acres of proposed mixed-use development within the headwaters of the Piney Branch. The site is made up of five separate site plans (and five interconnected Final Water Quality Plans), with three of the site plans currently under construction and the two others nearing permit approval. It is expected that with this amount of construction activity that there may be some initial water quality impacts however, by using the oversized and redundant sediment trapping devices that were required these impacts should be kept to a minimum.

The planned Traville development includes a retail center, apartment buildings for elderly living, various multi-family dwelling units, a research and development campus for Human Genome Sciences and additional research and development areas for future development. This project will present a considerable challenge in maintaining water quality after construction is complete

Figure X. Piney Branch Special Protection Area

due to the inherently high percentage of impervious area that accompanies this type of development. The developers of Traville had originally agreed to limit the overall site imperviousness area to 35%, however that number was subsequently reduced to about 33%. This percentage may still appear to be somewhat high, but it is a significant reduction in imperviousness than what would normally be seen in this type of development. This reduction in imperviousness along with the redundant water quality BMPs (treating the first 1 inch of runoff from the impervious areas), expanded stream buffers and quantity control for the 1-year storm, will afford the best opportunity to mitigate the potential impacts of this development. It will be quite interesting to monitor the extensive and complex web of the interconnected BMPs on this site however, it could be some time (two to three years) before the BMPs are converted from temporary sediment control to permanent stormwater management at which time post development monitoring will begin.

As a separate initiative, DEP is also investigating other opportunities for improving existing stormwater management controls in the watershed through the Montgomery County Stormwater Management Capital Improvement Program (CIP). DEP has completed a study of the drainage area on the University of Maryland Shady Grove campus. This study investigated possible improvements to the existing SWM pond and stream valley upstream of the pond. These improvements consist of combinations of wetland enhancements, reforestation, and bank stabilization. Results of the study are now being reviewed by DEP. DEP has also met with the property owner, who has agreed, in principle, to participate in improvements on the property.

DEP has also worked cooperatively with the M-NCPPC to evaluate stream conditions and erosion problem areas throughout the Watts Branch watershed including Piney Branch. Over the next three years DEP will be identifying other potential stormwater retrofit and stream restoration projects within Watts Branch that may include additional projects to help protect Piney Branch.

Table 15. Piney Branch SPA Development Projects (1995 to June 2002)

PROJECT NAME	SPA LOCATION	DEVELOPMENT SIZE, TYPE	STATUS
Avon Glen	Piney Branch - middle reach	39.6 acres, RE-1 28 lots and sewer pumping station	Subdivision approval predated SPA designation. Construction substantially complete.
Boverman Property	Piney Branch - Lower reach	13.8 acres, RE-1	Final stages of construction.
Bruck Property	Piney Branch - Lower Reach	16 acres, RE-1	Final stages of construction. As-built pending.

Table 15. (continued)

Burton Glen	Piney Branch-Lower reach	3.3 acres, 3lots	Water quality inventory approved.
Cavanaugh Property	Piney Branch – middle reach	18.1 acres, RE-1 Cluster, 18 lots proposed	Construction complete.
Charles Duvall Farm	Piney Branch	0.5 acres, R-200 1 lot	Exempt from SPA Water Quality Plan Requirements.
Glen Mill Knolls	Piney Branch-Lower reach	4.13 acres, RE-1, 1 lot	Water quality inventory approved.
Grupenfoff Residence	Piney Branch	2 acres, 1 lot	Exempt from SPA Water Quality Plan Requirements.
Horizon Hills	Piney Branch-Lower reach	4.0 acres, RE-2	Water quality inventory approved. Sediment control permit pending.
Hunting Hill Woods	Headwaters	1.6 acres, R-200, 3 lots	Water quality inventory approved. Sediment control permit pending.
Lakewood Glen	Piney Branch	5.2 acres, RE-1 5 lots proposed	Exempt from water quality plan requirements.
Lankler Property (Highgate)	Piney Branch-Lower reach	60.3 acres, RE-2	Water quality inventory approved. Under construction.
New Life Christian Fellowship Church	Piney Branch – Headwater area	1.2 acres, Proposed church	Pre-application meeting complete. On hold.
Otsuka America Pharmaceutical, Inc.	Piney Branch – Headwaters	4.7 acres, R&D	Preliminary / final water quality plans approved. Construction complete, as-built pending.
Peters Property	Piney Branch-Lower reach	RE-1, Cluster Option	Construction substantially complete. As-built pending.
Piney Glen Village	Piney Branch – Middle reach	188 acres, Mixed residential	Some of the project predates SPA requirements. Sediment control permits issued. Under construction.

Table 15. (continued)

Piney Meetinghouse Road and Travillah Road Improvements	Piney Branch-Middle reach	Road Improvements	Preliminary/final water quality plans approved. Sediment control permit issued.
Piney Meetinghouse Road Site - Fling Property	Piney Branch – Middle reach	6.4 acres, RE-2, proposed mulching/ landscape operation	Preliminary/final water quality plans approved. Pending special exception.
Potomac Glen South	Piney Branch	15.3 acres, RE-1 8 lots proposed	Exempt from water quality plan requirements due to low imperviousness. Construction complete.
Shady Grove Adventist Hospital Addition	Piney Branch – Headwaters	4.8 acres	Preliminary/final water quality plans under review.
Shady Grove Life Sciences Center – Life Technologies Inc.	Piney Branch – Headwaters	18.1 acres – R & D	Preliminary plan approved prior to SPA designation; however, voluntary compliance. Water quality plans approved. Initial construction complete.
Shady Grove Road	Piney Branch – Headwaters	8 acres, Road extension	Construction is complete. Awaiting as-built approvals.
Simmons Property	Piney Branch	2.1 acres, 4 lots R-200/TDR	Water quality inventory approved.
Snider Property	Piney Branch – Lower Reach	21.9 acres, RE-1C	Under construction.
Temple Beth Ami	Piney Branch – Headwaters	7.9 acres, R-200 TDR Church	Preliminary and final water quality plans approved. Construction is complete. Permit closed.
Tenny Property	Piney Branch	2.5 acres, R-200 5 lots	Exempt from water quality plan requirements.
Travilah Road Project	Piney Branch	9.0 acres, Road improvements	Preliminary/final water quality plans under review.

Table 15. (continued)

Traville (5 Site Plans) 1) Senior Housing (sediment control plan pending) 2) Retail Center (under construction) 3) Village Center Streets (under construction) 4) Avalon Bay (sediment control plan pending) 5) Human Genome Sciences (under construction)	Piney Branch – Headwaters	192 acres, MXN and R&D (there are two additional R&D sites that will be developed in the future)	Preliminary water quality plan approved for the entire site. Separate final water quality plans have been approved.
Willow Oaks	Piney Branch-Middle reach	5.5acres, R-200	Preliminary/final water quality plan approved. Under construction.
Willows of Potomac	Piney Branch – Middle reach	245 acres, mixed residential	Subdivision approvals predate SPA requirements. Sediment control permits issued. Substantially complete.
Wilson Property	Piney Branch-Lower reach	10.3 acres, RE-2	Pre-application meeting complete.

4.3.3 Summary of Environmental Protection and Innovative Site Design: The Revised Traville Concept for Consolidation of Human Genome Sciences

The Traville project at the headwaters of the Piney Branch continues to provide many challenges in the effort to achieve a successful combination of development and water quality/environmental protection. However, recent changes to the concept for the largest Research and Development (R&D) portion (with Human Genome Sciences as the principal tenant) reflect achievement of many environmental objectives of the Special Protection Area program.

In addition to standard SPA elements such as SWM features in series, protection and enhancement of environmental buffers and the natural resources within them, including full reforestation of all unforested portions of the stream valley buffer which will be permanently protected through Category I Forest Conservation Easements, the concept proposes use of many site design elements to reduce environmental impacts of the development on Piney Branch,

within the framework of master planned land uses and zoning.

These elements include: use of taller buildings, internal garages, and structured parking leading to lower impervious cover; greater open space leading to enhanced opportunities for more gentle, natural appearing, aesthetic multi-use recharge/infiltration/ water quality treatment facilities (including two volleyball courts within a sand filter); flexibility in the location of the edge of grading resulting in better achievement of environmental and development objectives; and more opportunity for appropriate transitions between natural and developed areas. Further design enhancements serving multiple objectives are still being considered.

4.3.4 Summary of BMP Monitoring in Piney Branch

Ten development projects in the Piney Branch SPA are required to do BMP monitoring (Table 16). Five of these have completed construction and are now submitting post-development monitoring data. These five include Shady Grove Road, Cavanaugh Property, Bruck Property, Boverman Property and Peters Property. Analysis of the BMP monitoring results from these five projects is included in the following sections.

Three of the other five projects, Traville, Snider and Willow Oaks are currently under construction. Conclusions on BMP performance from these sites cannot yet be made. Life Sciences Center project submitted three months of pre-construction groundwater level data. DEP was to collect post-construction data. The very brief pre-construction data set is not adequate to compare with post-construction data and draw conclusions on BMP performance in maintaining groundwater levels. The Temple Beth Ami project was completed but no BMP data has been submitted. To help prevent this problem in the future, DPS implemented new procedures for development projects in SPA's that require BMP monitoring responsibilities to be included on the sediment control plan as part of a check off list of requirements that must be met before the sediment plan can be finalized.

Table 16 . Piney Branch BMP Monitoring

PROJECT NAME & CONSULTANT CONDUCTING THE MONITORING	REQUIRED BMP MONITORING	REQUIRED TIME FRAME FOR BMP MONITORING	DATA SUBMITTED THUS FAR
Shady Grove Road / Loiderman Assoc. ***(construction completed during summer of 2000)***	**4 turbidity stations** **4 embeddedness stations**	**pre-development monitoring:** 1 year **during-development monitoring:** until site is stabilized and sediment control structures converted to water quality **post-development monitoring:** min. 3 years	**turbidity data:** 4/97 - 11/01 **embeddedness data:** 4/97 - 11/01

Table 16 (continued)

Traville / Loiderman Assoc. Includes the Human Genome Sciences, Gateway Streets, Senior Housing, Traville Village Center (Beatty), and Avalon Bay projects ***(construction began 1/02)***	**2 continuous temperature loggers** **groundwater monitoring wells** *water level* **1 continuous flow logger** **3 Cross sections** **Surface water storm samples** **embeddedness** **Stormwater samples from sediment ponds** **Infiltration structure percolation rates**	**pre-development monitoring:** 1 year **during-development monitoring:** until site is stabilized and sediment control structures converted to water quality **post-development monitoring:** to be determined at final site plan approval.	**temperature data:** 6/97 - 9/97 6/98 - 9/98 6/99 - 9/99 6/01 – 9/01 **groundwater data:** 8/97 - 10/97 **flow data:** 8/97 - 10/97
Life Sciences Center / Schnabel Engineering *Project Completed*	**3 groundwater monitoring wells** *Water Level, Conductivity, pH*	total of 5 years beginning October 1997	**groundwater data:** 10/97 – 1/98
Bruck Property **(*construction began ~ 8/99)***	**2 continuous temperature loggers** **1 embeddedness station**	**pre-development monitoring:** 1 year **during-construction monitoring:** until site is stabilized and sediment control structures converted	**temperature data:** 7/98 – 9/01 **embeddedness data:** 6/99, 12/99, 5/00, 9/00, 5/01, 10/01
Boverman Property *(construction completed 5/02)*	**1 continuous temperature logger** **1 embeddedness station** **1 groundwater well:** *nitrate, nitrite, TKN,, total Phosphorus*	**pre-development monitoring:** 1 year **during construction monitoring:** until site is stabilized and sediment control structures converted to water quality **post construction monitoring:** 3 years	**temperature data:** 7/98 – 9/01 **embeddedness data:** 6/99, 12/00, 5/00, 9/00, 5/01, 10/01 **groundwater well data:** 6/99, 11/99, 1/00, 9/00, 5/01, 10/01
Cavanaugh Property *(construction completed)*	**3 continuous temperature loggers** **2 groundwater wells** **1 embeddedness station**	**pre-development monitoring:** 1 year **during construction monitoring:** until site is stabilized and sediment control structures converted to water quality **post construction monitoring:** 2 years	**temperature data:** 7/98 – 9/98 7/99 – 9/99 6/01 – 9/01 **groundwater data:** 3/98 – 5/01 **embeddedness data:** 8/98 – 11/01

Table 16. continued

Peters Property *(Construction completed during fall of 2001)*	**2 continuous temperature loggers** **2 embeddedness stations** **1 continuous flow logger** **photo documentation of pond outfall condition**	**pre-development monitoring:** 1 year **during construction monitoring:** until site is stabilized and sediment control structures converted to water quality **post construction monitoring:** 2 years for photo documentation and 3 years for all other monitoring	**temperature data:** 4/99 – 10/99, 6/00 – 10/00, 6/01-9/01 **embeddedness data:** 10/98 – 12/01 **flow data:** 2/00 – 5/02 **photo documentation:** 10/98 – 9/01
Snider Property *(Construction began 12/00*)	**3 Surface water samples annually** (nitrate, nitrite, TKN, Total P, Ortho P, TSS) **Quarterly photo documentation of pond outfall condition**	**pre-development monitoring**: 3 water samples **during construction monitoring**: until site is stabilized and sediment control structures converted to water quality **post construction monitoring**: 3 years	**Surface water samples:** 8/00 – 10/01 **photo documentation:** 9/00 – 10/01
Temple Beth Ami *(construction complete)*	**1 Water Temperature logger at outfall of BMP**	**pre-development monitoring**: none **during construction monitoring**: none **post construction monitoring**: 3 years	**No data submitted to date**
Willow Oaks *(construction began 1/02)*	**TSS sampling of sediment pond during construction** **One-time pesticide sampling of runoff after mass application of termite repellent.** **Chemical and nutrient sampling of BMP**	**pre-development monitoring**: none **during construction monitoring**: until site is stabilized and sediment control structures converted to water quality **post construction monitoring**: 3 years	**No data submitted to date**

Shady Grove Road

Best Management Practices monitoring at the Shady Grove Road project include turbidity measurements and embeddedness evaluations at four monitoring stations located in the upper Piney Branch. The project extends Shady Grove Road from Rt. 28 to Piney Meeting House Road. Construction began in May of 1998 and concluded in February of 2000. Two sediment control ponds were converted to storm water management facilities during the period of April – September of 2000 signifying completion of the project.

Turbidity and embeddedness monitoring is done upstream and downstream from each of the two sediment control / stormwater management facilities. Monitoring stations 1 and 2 are located on the western tributary, upstream and downstream of pond 2. Monitoring stations 3 and 4 are located on the eastern tributary, upstream and downstream of water quality facility 6A (figure 29).

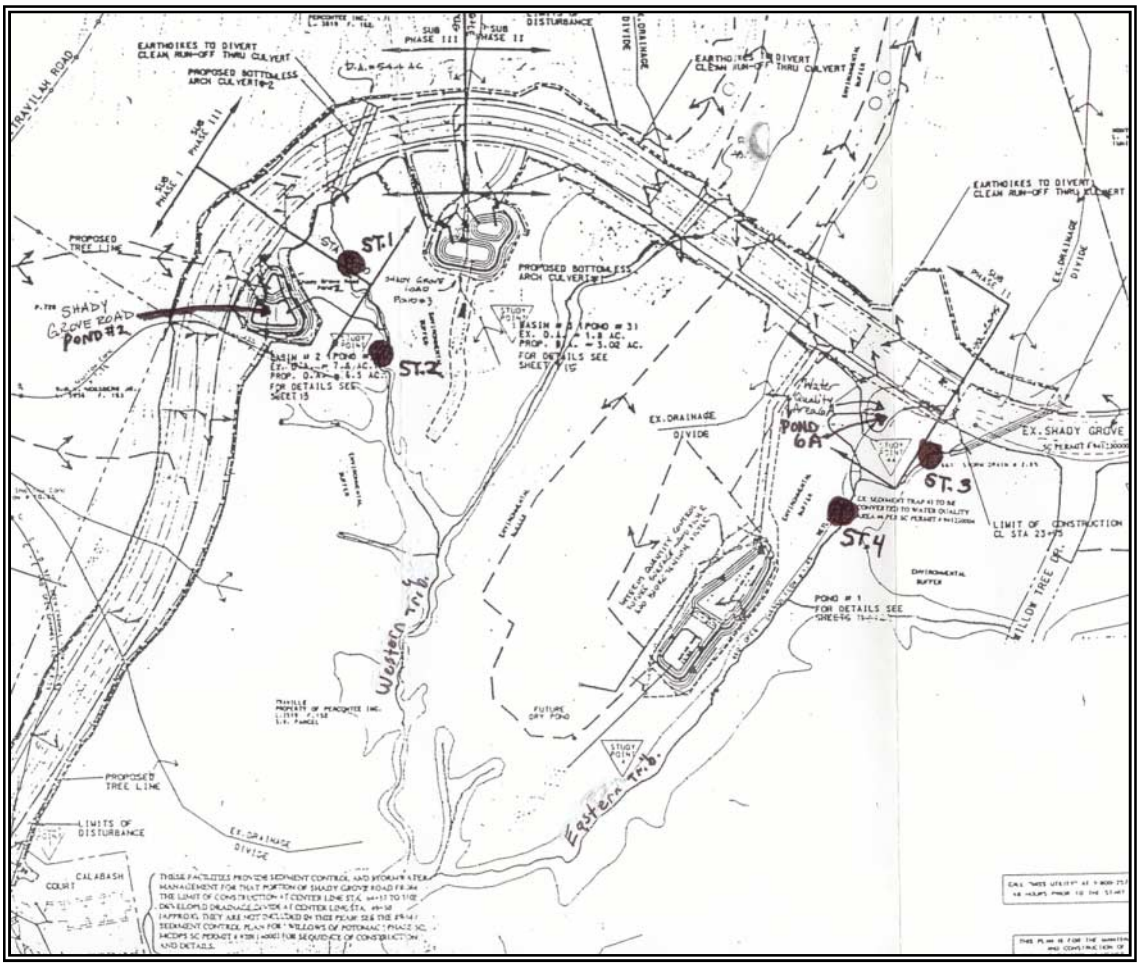

Figure 29. Site Map of Shady Grove Road Extended Construction Project.

Turbidity readings are taken within 24 hours of a precipitation event. As expected, results show

turbidity was highest downstream of both sediment control facilities during the construction period. At pond 2 turbidity levels were higher at the downstream station (ST. 2) throughout the pre and during construction phases (figure 30). Average increase in turbidity between station 1 and 2 was 2% for the pre-construction period and 200% for the construction period. Comparing post construction results from stations 1 and 2, to date, show turbidity levels decreasing at station 2 by an average of 12%.

Results from pond 2 indicate significant increase in turbidity during construction which is largely driven by three precipitation events on 5/6/98 (0.84 inches *), 8/11/98 (0.79 inches *) and 8/28/00 (0.96 inches *). All other events monitored during the construction phase indicate considerably less increase in turbidity at station 2 (28% on average). This suggests that, apart from big precipitation events, pond 2 was fairly effective in minimizing turbiditity.

* *Precipitation data from Colesville Maintenance Depot on Maydale Rd. (Colesville, MD)*

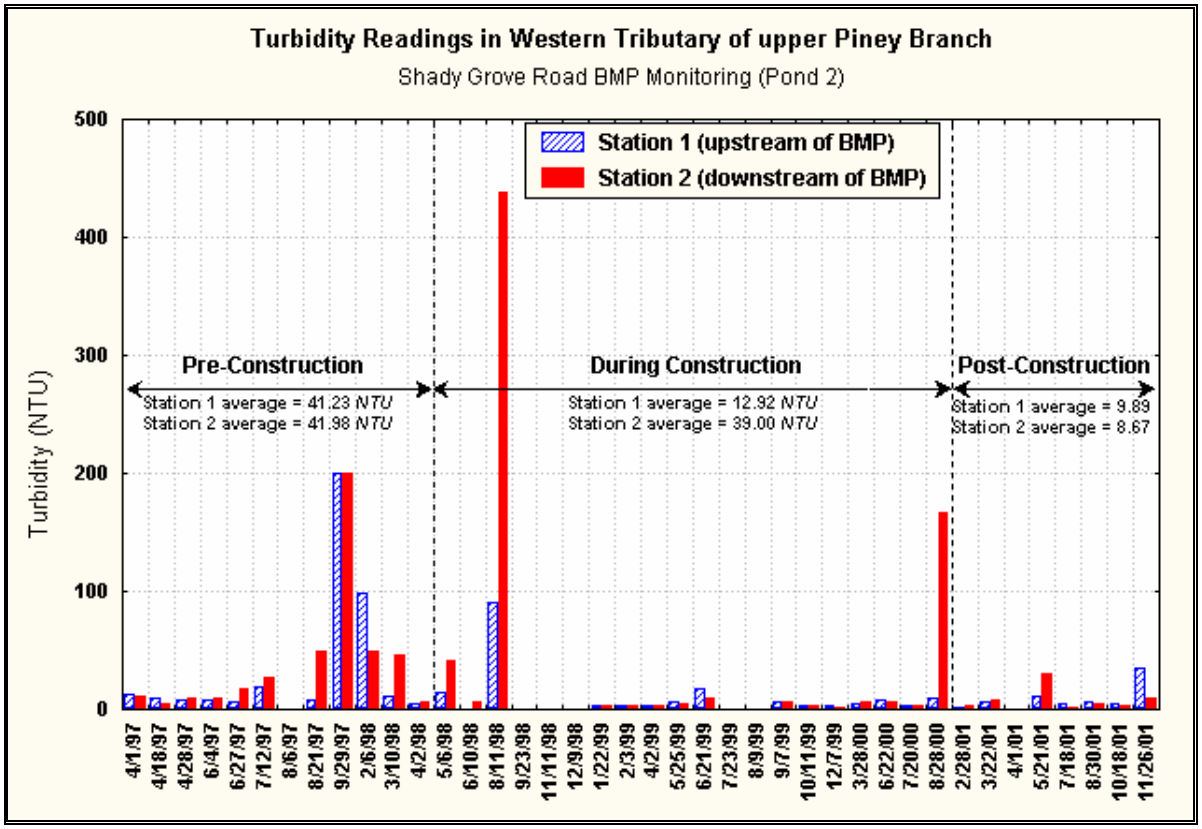

Figure 30. Turbidity Monitoring Results at Pond 2

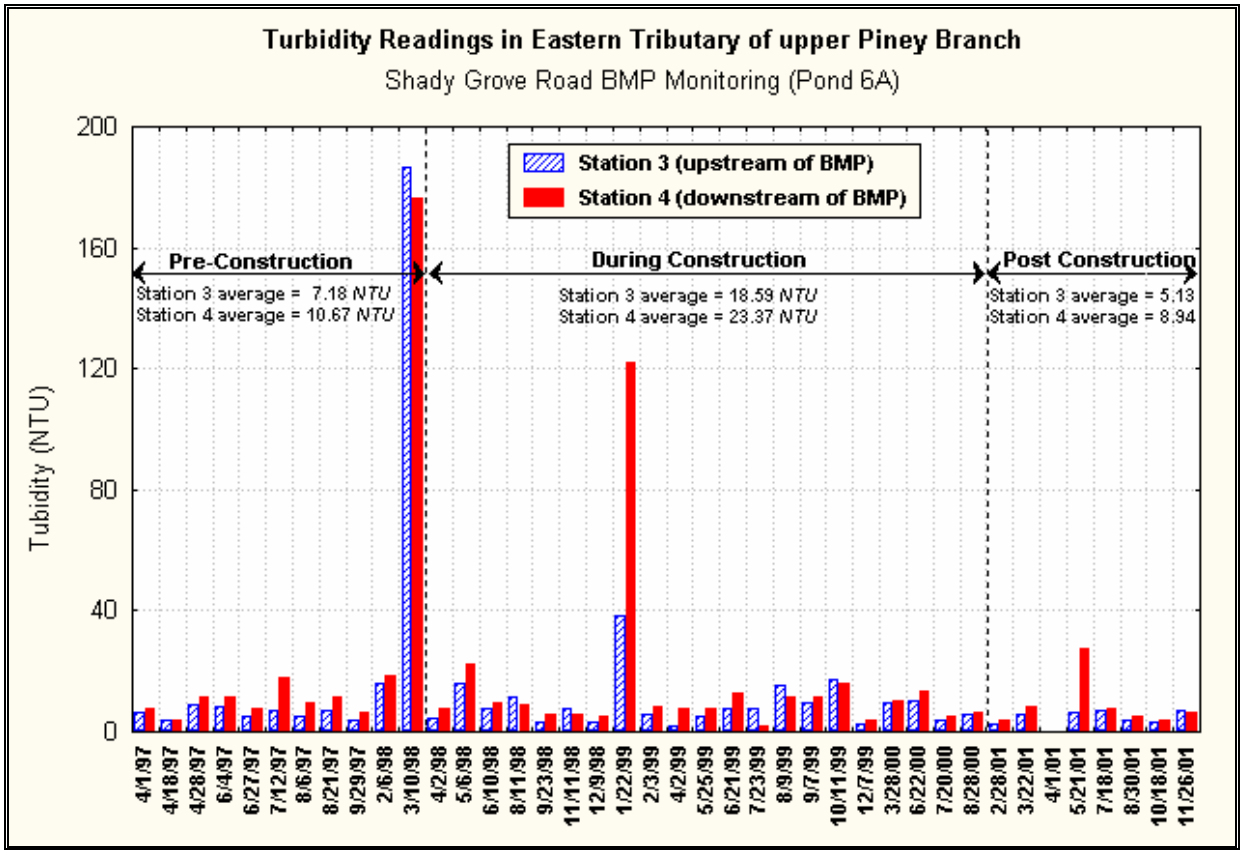

Figure 31. Turbidity Monitoring Results at Pond 6A

At pond 6A turbidity increased between the upstream station 3 and the downstream station 4 during all three phases of the monitoring (figure 31). Turbidity increased at station 4 an average of 48% during the pre-construction period, 26% during construction and 75% during the post construction period to date. For the during-construction phase one precipitation event on 1/22/99 is responsible for driving up the average increase of turbidity. Removing this event from the data shows an average increase of 4% for the during-construction phase. These results indicate turbidity impacts were almost non-existent during the construction phase. This suggests pond 6A functioned exceptionally well in preventing turbidity impacts during the construction of Shady Grove Road.

Results of embeddedness monitoring show some increase of stream sediment during the construction phase (figures 32 and 33). Average embeddedness values increased at stations 1,3 and 4 by 25%, 20% and 16%, respectively. However, post-construction monitoring indicates a return to pre-construction condition at all three stations. This data suggests that an increase in sediment within the stream channel occurred during the construction phase and subsequently has flushed downstream.

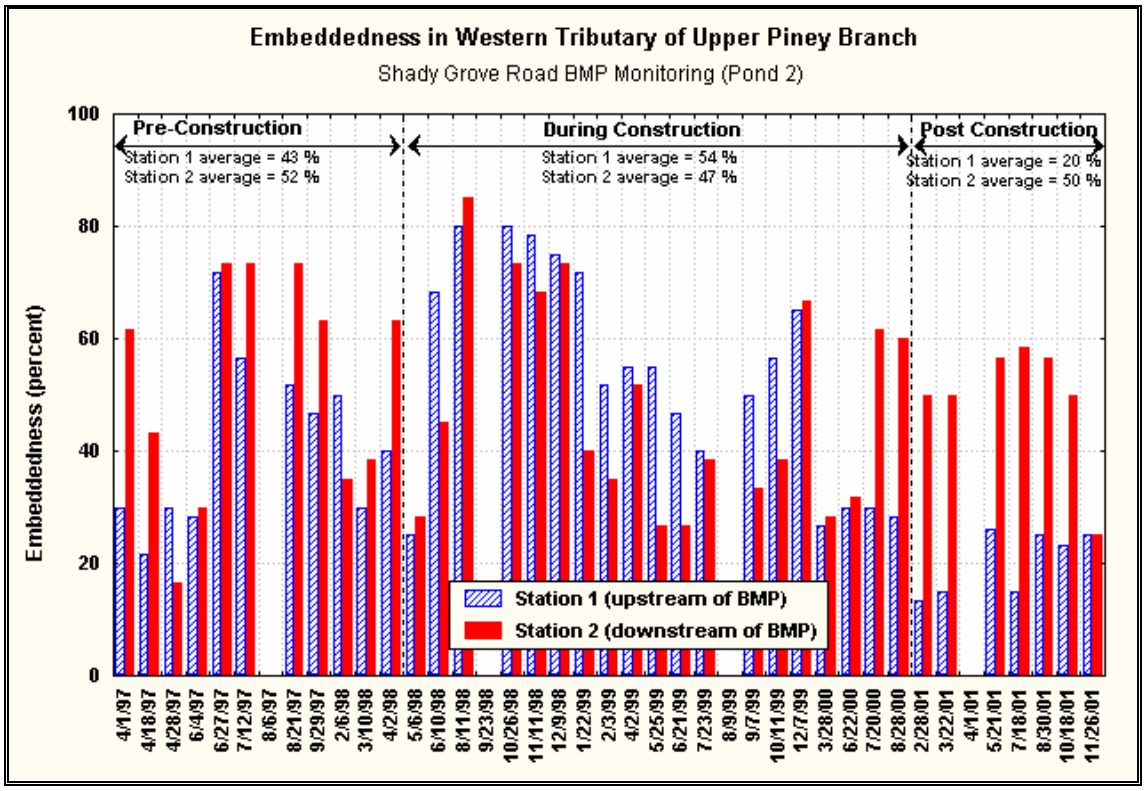

Figure 32. Embeddedness Monitoring Results From Pond 2

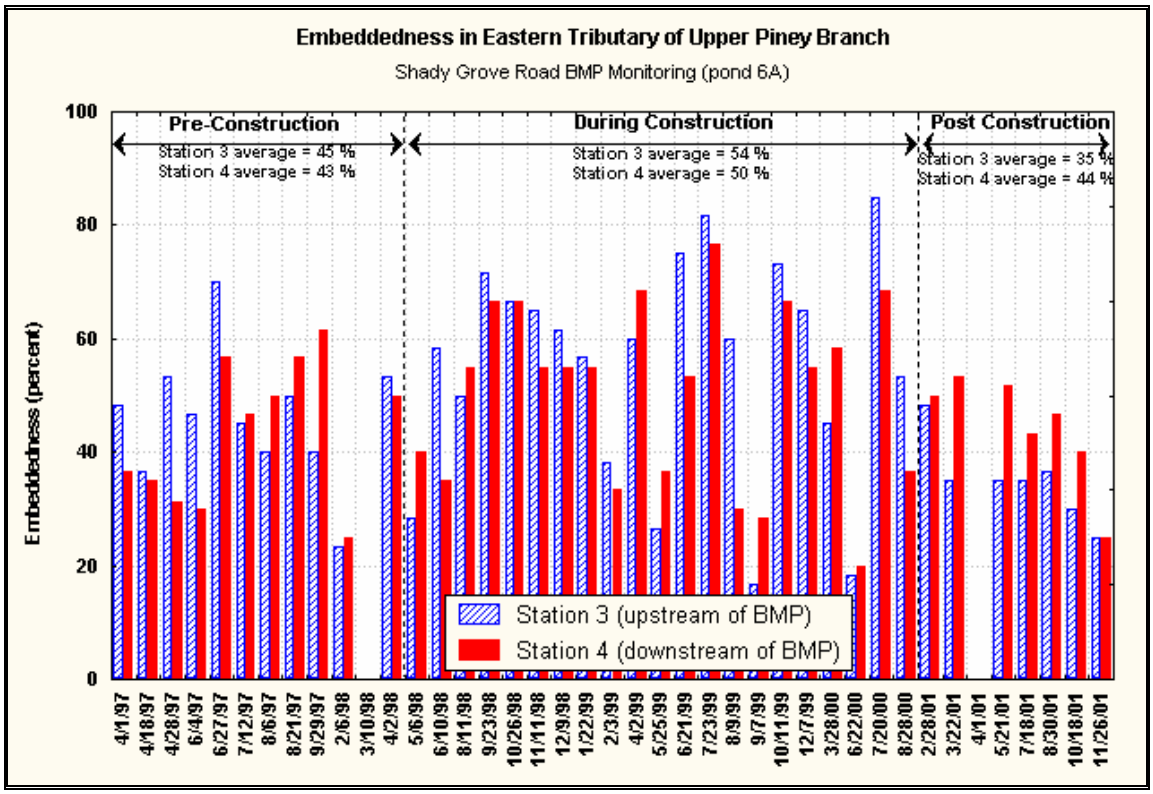

Figure 33. Embeddedness Monitoring Results From Pond 6A

Bruck Property

The Bruck property is a 16 acre parcel of land (zoning is RE-1) located at the corner of Glen Mill Road and Burton Glen Drive. Piney Branch flows through the southwest corner of the property. Development of the property consists of 11 single-family homes and associated infrastructure. Water quality control consists of an infiltration trench sized to treat the first one inch of runoff. Vegetated road-side swales provide pre-treatment. Due to the relatively small percentage of imperviousness and the large water quality control structure, stream channel restoration was required in lieu of on-site water quantity control. The stream restoration includes biologs, rock stabilization and willow plantings on the stream banks.

BMP monitoring includes two continuous water temperature loggers and one stream habitat / embeddedness monitoring station. One temperature logger is placed near the western property line, the other at the southern property line where the stream exits the property. Habitat and embeddedness monitoring is done near the point that Piney Branch exits the property (figure 34).

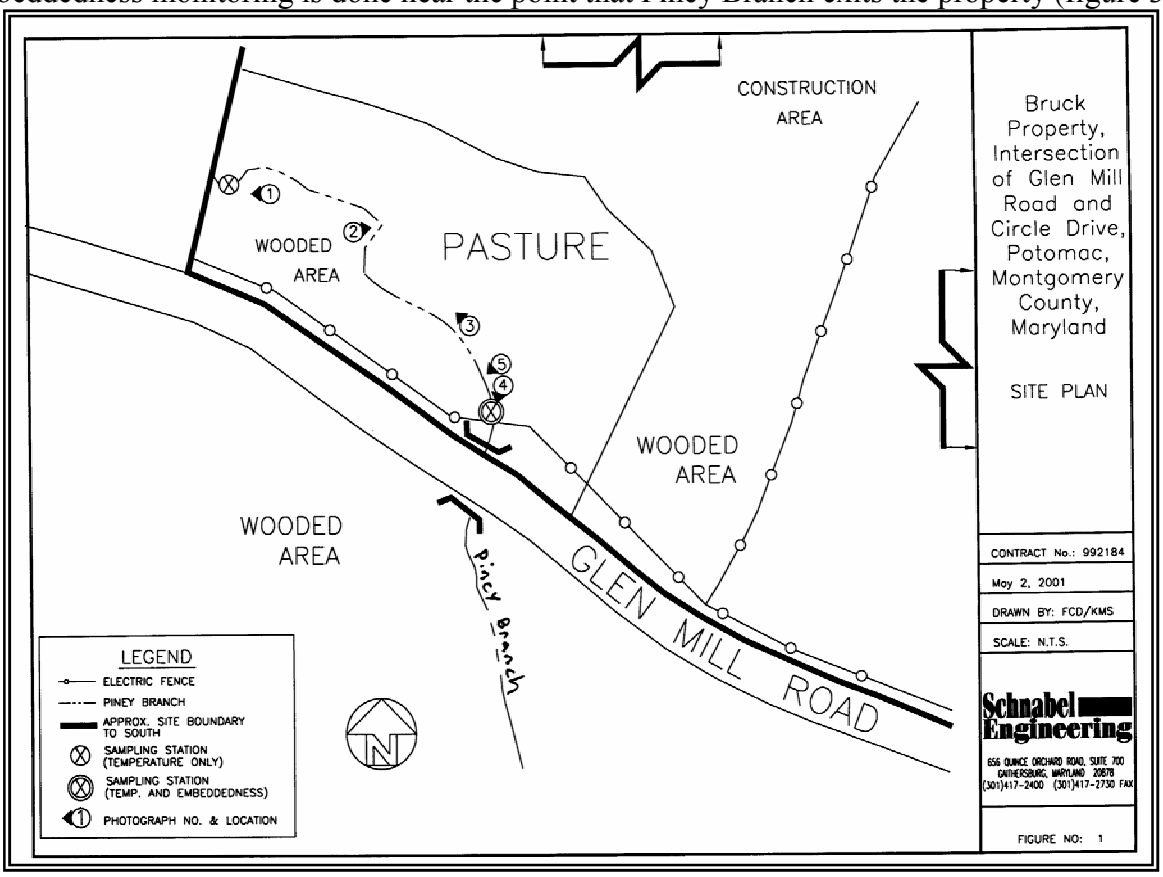

Figure 34. Site Map of BMP Monitoring at the Bruck Property

Construction on the Bruck property began in August of 1999 and was completed in early 2001. Temperature monitoring during 1998 and 1999 is considered as pre-construction, 2000 is during construction and 2001 is the first of three post-construction years. Results are presented in figures 35-38.

Results from 1998 show large daily fluctuations of water temperature at the downstream station (figure 35). DEP loggers in Piney Branch did not show this pattern in 1998. This was not explained by the consultant. However such fluctuations are usually caused by loggers not being set deep enough in the water and consequently being exposed to air temperatures during low flow periods. Because of this, results from 1998 will not be used in analysis of BMP effects on water temperature.

Results from 1999 show large daily fluctuations beginning on 8/26 (figure 36). Again, no explanation from the consultant, but presumably the stream level dropped to a point where the logger was exposed to air temperatures. For comparison purposes, the period of time between 6/1 and 8/26 will be used to study temperature impacts during subsequent years of 2000, 2001 and beyond. Results from 1999 will serve as baseline pre-construction temperature condition.

Table 17 summarizes the water temperature data from both the upstream and downstream stations. Discharge from the BMP enters Piney Branch at a point immediately above the downstream station.

Table 17. Summary of Water Temperatures From the Bruck Property BMP Monitoring

YEAR (6/1 – 8/26)	**STATION**	**N** # Observations	**MAX.** (^{0}F)	**MEAN** (^{0}F)	**STANDARD DEVIATION** (^{0}F)	**AVERAGE DIFFERENCE** (^{0}F) downstream - upstream
1999 Pre-Construction	Upstream	1043	76.7	68.9	3.75	
	Downstream	1043	79.6	70.6	3.95	1.7
2000 During – Construction	Upstream	870	76.7	58.3	3.3	
	Downstream	870	77.4	58.9	3.6	0.6
2001 Post-Construction	Upstream	870	74.0	68.0	2.8	
	Downstream	870	78.1	69.3	3.6	1.3

Mean water temperature for the period of June 1 – August 26 is higher at the downstream station during each of the three years. Placement of the temperature loggers is the likely cause. The upstream logger is placed in a location that is well shaded while the downstream logger receives more solar radiation. The sun can also have a stronger effect on the downstream logger because it is in water that is about four inches deep at base flow while the upstream logger is about twelve inches below the surface at baseflow. Average difference between the two stations is greatest during the pre-construction year of 1999. This suggests that for the during- and post-construction periods, to date, no thermal impact on Piney Branch occurred. If the difference between the two stations continues to be less then that of the pre-construction, over the course of the next two years, then it can be concluded that the project has not caused thermal impact.

Assessment of in-stream habitat has been completed for all years (1998-2001) and indicates no change in habitat structure or quality.

Evaluation of embeddedness has also been completed for all years. Except for a slight increase noted in May of 2001 values have remained at 0-25%. This suggests that no impact from sediment has been observed in the stream below the Bruck property.

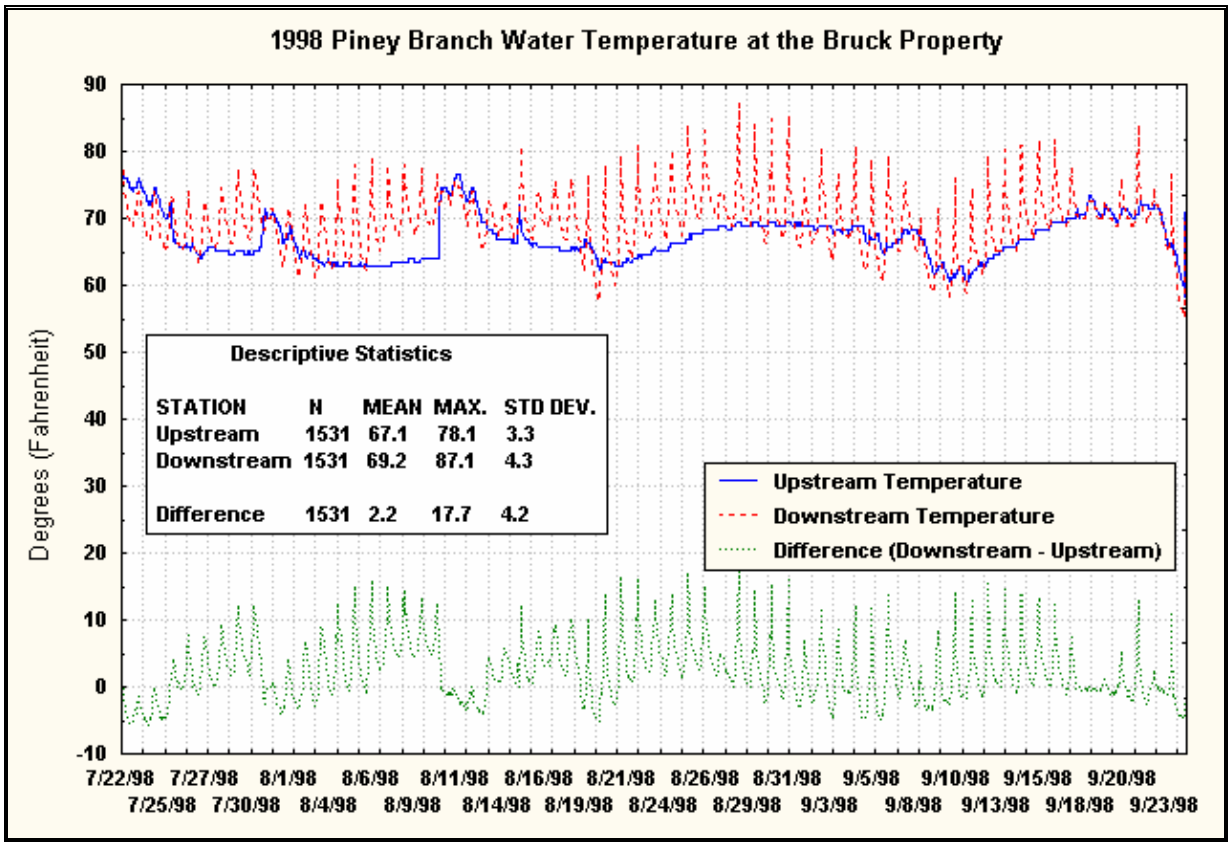

Figure 35. 1998 Stream Water Temperatures, Upstream and Downstream of Bruck Property

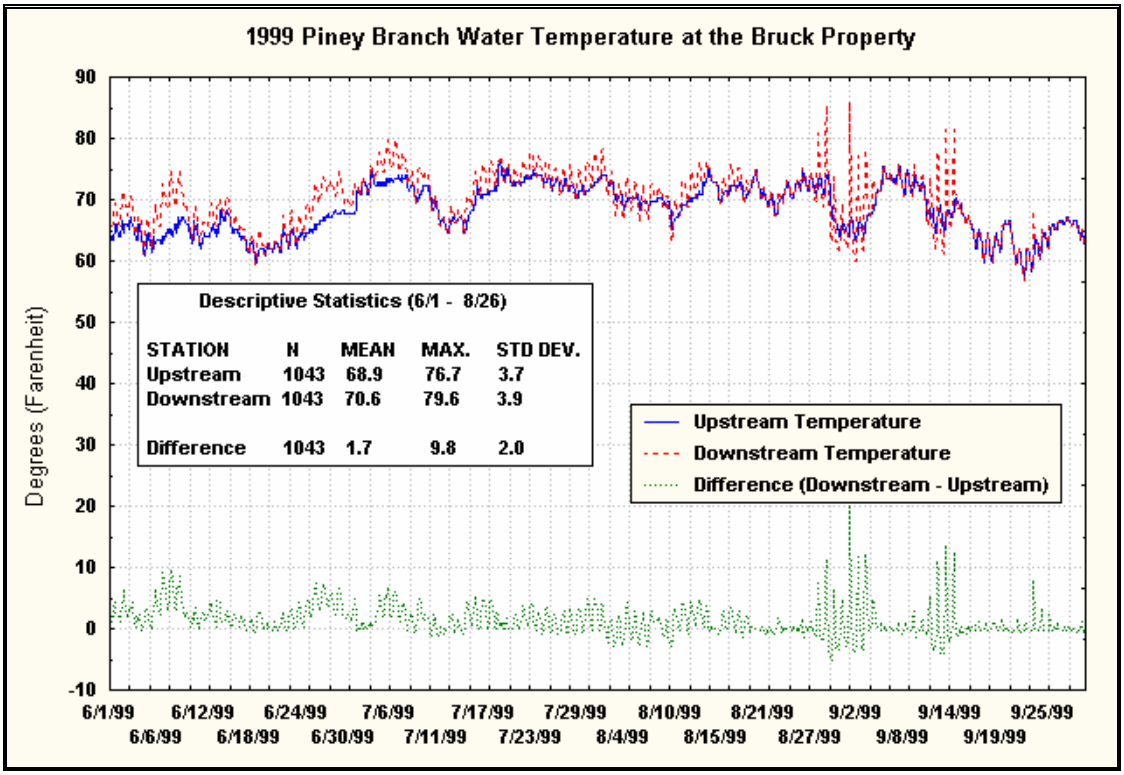

Figure 36. 1999 Stream Water Temperatures, Upstream and Downstream of Bruck Property

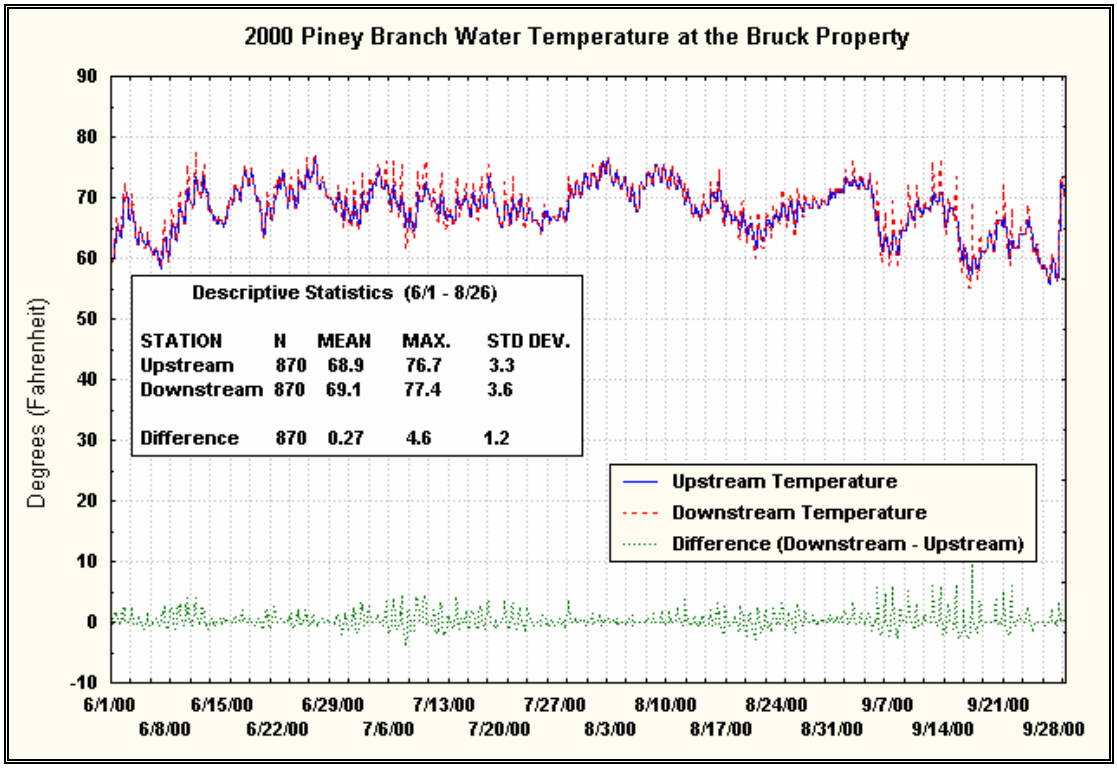

Figure 37. 2000 Stream Water Temperatures, Upstream and Downstream of Bruck Property

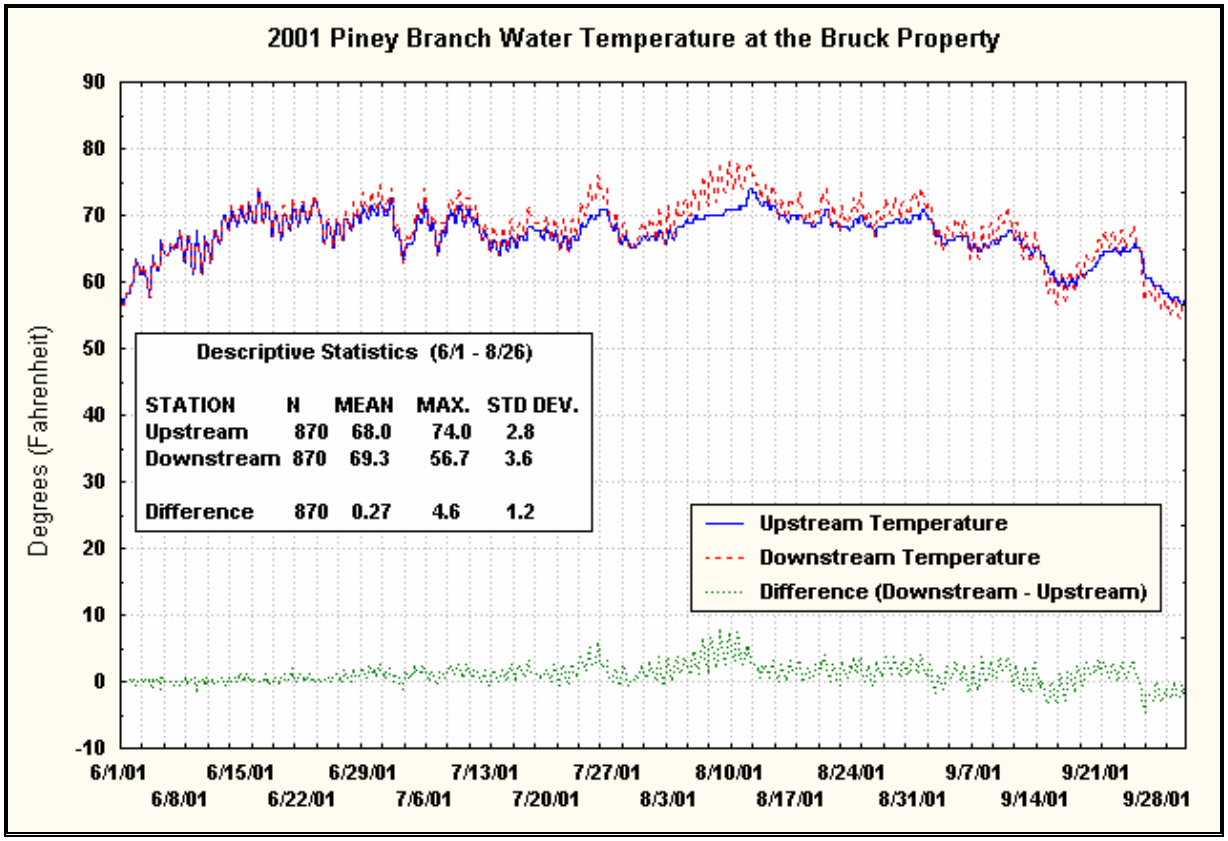

Figure 38. 2001 Stream Water Temperatures, Upstream and Downstream of Bruck Property

Boverman Property

The Boverman Property is a 13.8 acre parcel of land located near the intersection of Tulip Lane and Glen Mill Road. An unnamed tributary runs through the western side of the property. The tributary flows through a small pond located near the northwestern corner of the property. The site consists of nine single-family lots and associated infrastructure.
Storm water control consists of a dry pond providing two-year control and dual sand filters providing quality control of the first inch of runoff over the contributing impervious area. Pre-treatment is provided by vegetated road-side swales before entering the sandfilters. A level spreader is installed at the outfall to reduce water velocity from the dry detention pond.

BMP monitoring includes one temperature logger, embeddness evaluations in the unnamed tributary and one groundwater well from which nutrient concentrations are tested twice annually (figure 39).

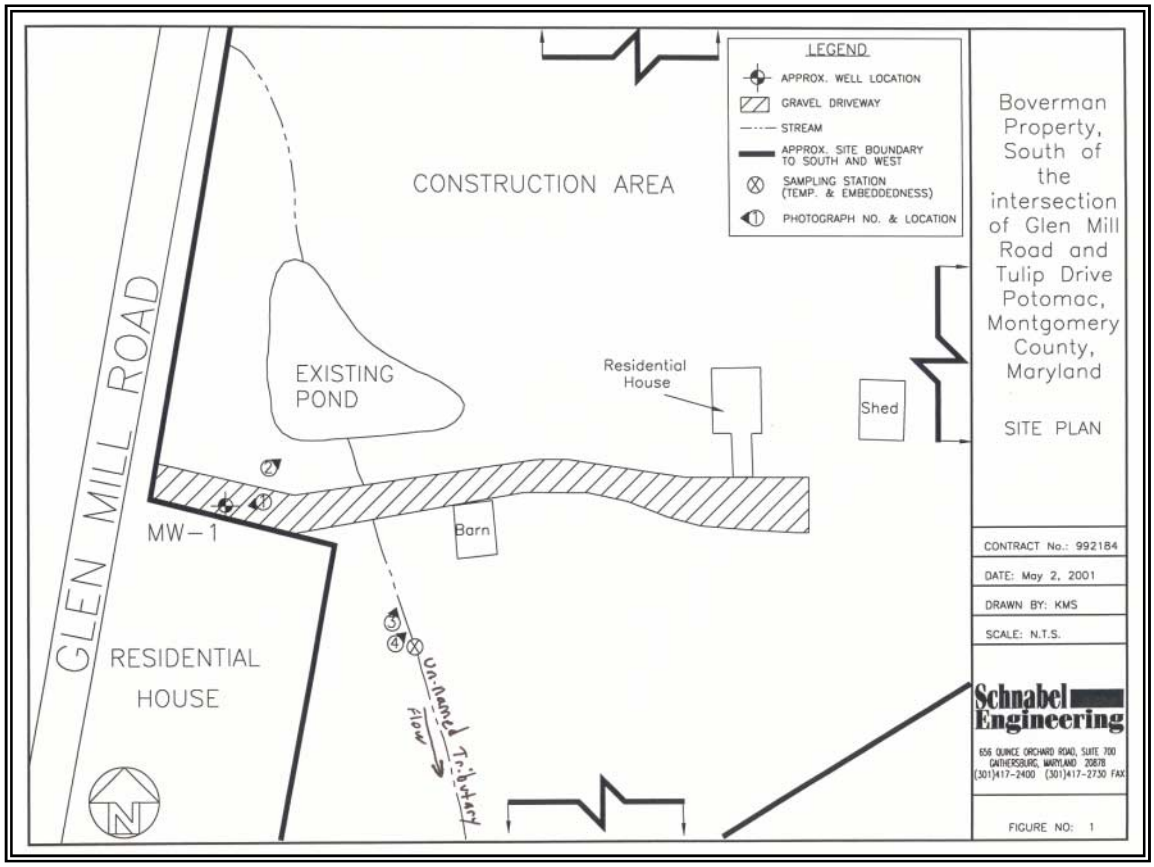

Figure 39. Site Map of BMP Monitoring at the Boverman Property.

Pre-construction BMP monitoring began in July of 1998. Construction began in July of 1999 and has just recently been completed. Sediment control was converted to stormwater management in May of 2002. Post-construction monitoring is to be done for three years.

Results of stream water temperature monitoring are presented in figures 40 – 43. Pre-construction monitoring during 1998 shows water temperatures remaining below the Use Class I criteria of 90^0 F. In addition, daily fluctuation in water temperature is relatively low during 1998.

Results from 1999, the first year of during-construction monitoring, show large fluctuations in daily water temperatures. The summer of 1999 was very warm and dry. Many smaller streams went dry during the period of late July through August when the greatest daily fluctuations of water temperature occurred in the un-named tributary. The monitoring report submitted by the consultant made no mention of the tributary drying up or that the logger was exposed to the air.

The summer of 2000 was relatively cool and wet. Average water temperature was equal to average pre-construction water temperature.

The summer of 2001 was close to average for temperature but still cooler then 1998. However, despite the cooler weather, average water temperature was one degree (F) warmer then that of 1998.

In summary, average stream water temperatures for the three years of during-construction monitoring all were higher or equal to the pre-construction year of 1998. In addition, daily fluctuation of water temperature is greater for all three during-construction years.
The sediment control pond could not explain this because it only discharged water for a day or two following a rain event. Analysis of precipitation and water temperature showed no correlation between the two. At this point the cause of greater daily fluctuation of water temperature for the during-construction period is unknown.

Results of embeddedness monitoring are presented in table 18. Only one pre-construction embeddeness evaluation was submitted. Embeddedness was found to be very high for all observations. Values of between 75 and 100 percent indicate that stones on the stream bottom were between 75 and 100 percent covered with sediment. A more typical value for Piney Branch is 20 – 40 percent. These results suggest a high degree of sedimentation in the un-named tributary existed prior to construction. Also, sedimentation appears to have decreased over the construction period which suggests that sediment control was successful in keeping soil from the disturbed ground out of the stream.

Table 18. Embeddedness evaluations from un-named tributary on Boverman Property

Date	Embeddedness (Percent)
06/30/1999 (pre-construction)	75 – 100
12/19/1999 (during-construction)	75 – 100
05/05/2000 (during-construction)	75 – 100

Table 18. (continued)

09/28/2000 (during-construction)	50 – 75
05/02/2001 (during-construction)	50 – 75
10/10/2001 (during-construction)	50 – 75

Water samples obtained from the groundwater well are analyzed for nutrients. Results, presented in table 19 indicate increased concentrations of nitrate and total phosphorus throughout the construction period. These concentrations are low but increasing. The highest nitrate value obtained is a fraction of the EPA 10 mg/L standard for drinking water. The cause for the increase could be related to disturbance and grading of the site. Grading changes drainage patterns from the site and exposes soil to rain water and weathering. This can result in the leaching of nutrients previously bound to soil particles. The site is also fertilized and seeded during construction to control sediment leaving the site. Fertilizers can have high levels of nitrogen and phosphorus. As houses are completed, new lawns are planted and fertilized which also contributes nutrients to the area. Other possible causes include off-site fertilizer application or leaking sewage. The sewer line in the area is relatively new and should still be in good repair but could conceivably be leaking. An active or abandoned leaking septic system on the site or in the vicinity could also be contributing nutrients to the local aquifer. DPS has been notified and will watch for other wells in the area that may be exhibiting similar results.

Table 19. Nutrient Concentrations from Groundwater Samples Collected From Boverman Property.

Date	**Total Kjeldahl Nitrogen** mg/l	**Nitrate Nitrogen** mg/l	**Nitrite Nitrogen** mg/l	**Total Phosphorus** mg/l
06/30/99 (pre-construction)	<0.1	1.2	<0.1	<0.1
11/03/99 (during-construction)	0.5	NA	NA	0.07
05/05/00 (during-construction)	0.3	1.9	<0.2	0.10
09/28/00 (during-construction)	0.5	2.6	<0.2	0.06
05/02/01 (during-construction)	1.84	2.44	<0.05	0.33
10/10/01 (during-construction)	<0.50	3.65	0.05	0.72

In summary, BMP monitoring at the Boverman Property to date has provided the following results:

- Average water temperatures in the un-named tributary have remained at pre-construction levels. However, greater daily fluctuation in water temperature has occurred throughout the during-construction phase of monitoring. This may be because the temperature loggers were reading air temperatures in these years but the consultant has not identified this.
- Embeddedness values have decreased throughout the construction phase.
- Groundwater nutrient concentrations have steadily increased during the construction phase.

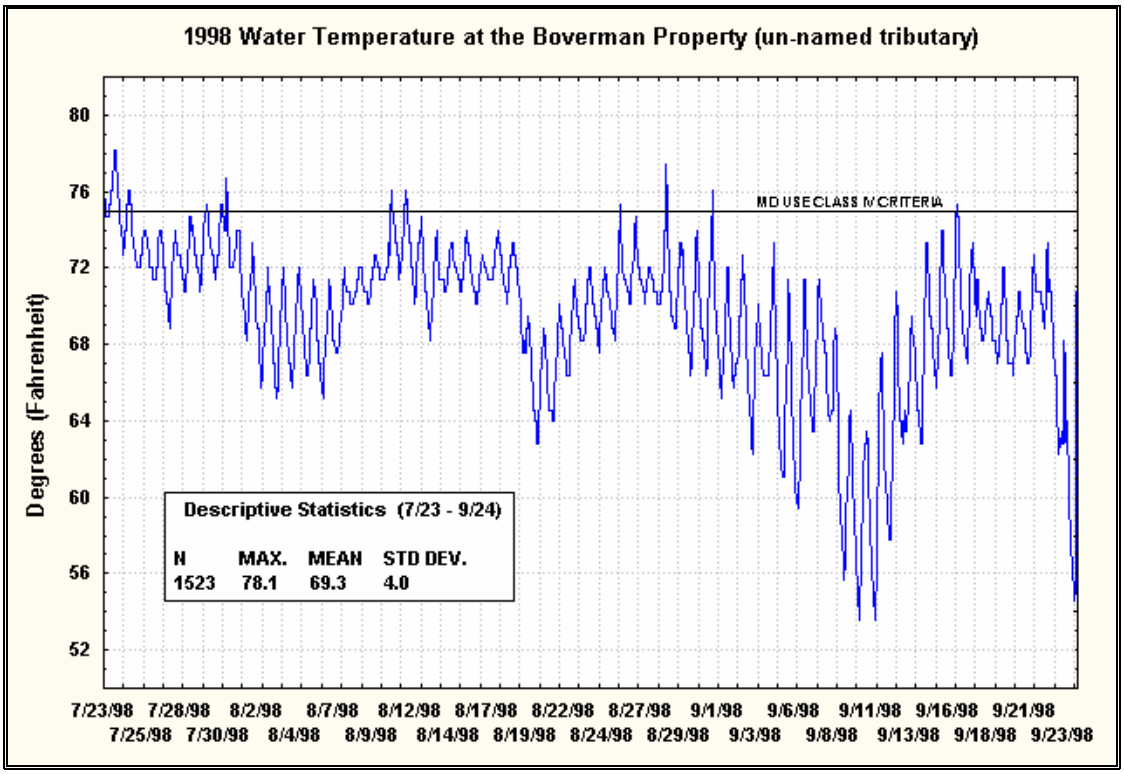

Figure 40. 1998 Stream Water Temperature From Boverman Property

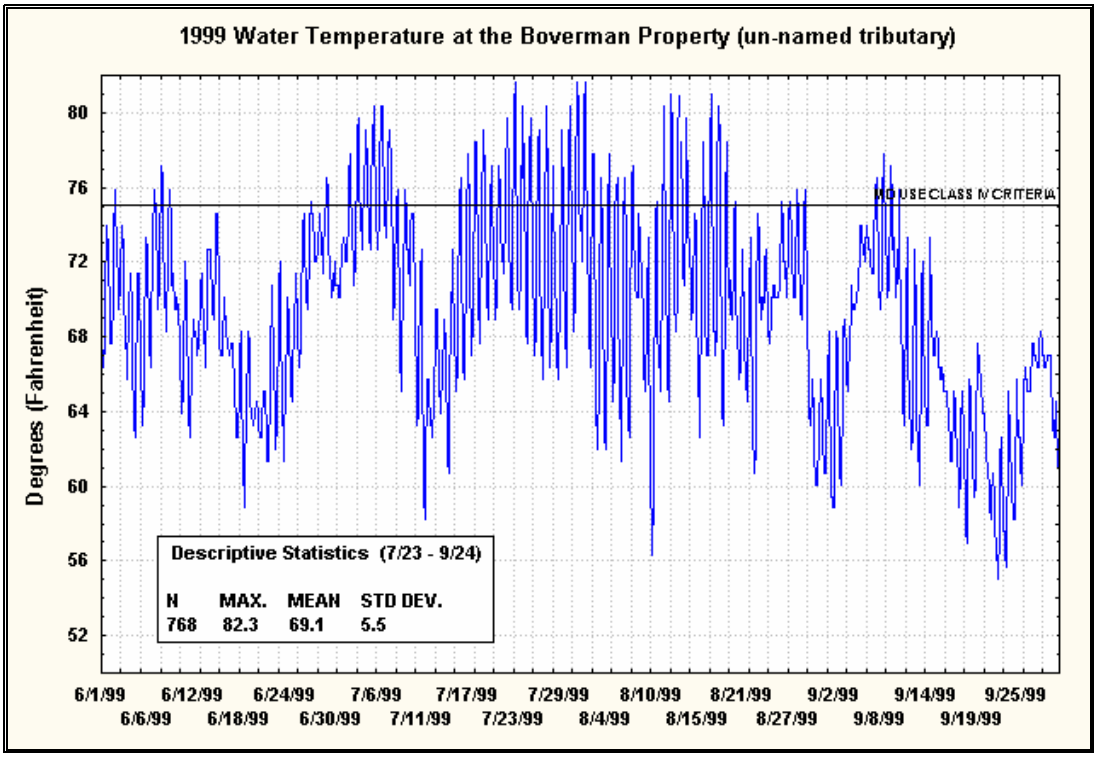

Figure 41. 1999 Stream Water Temperature From Boverman Property

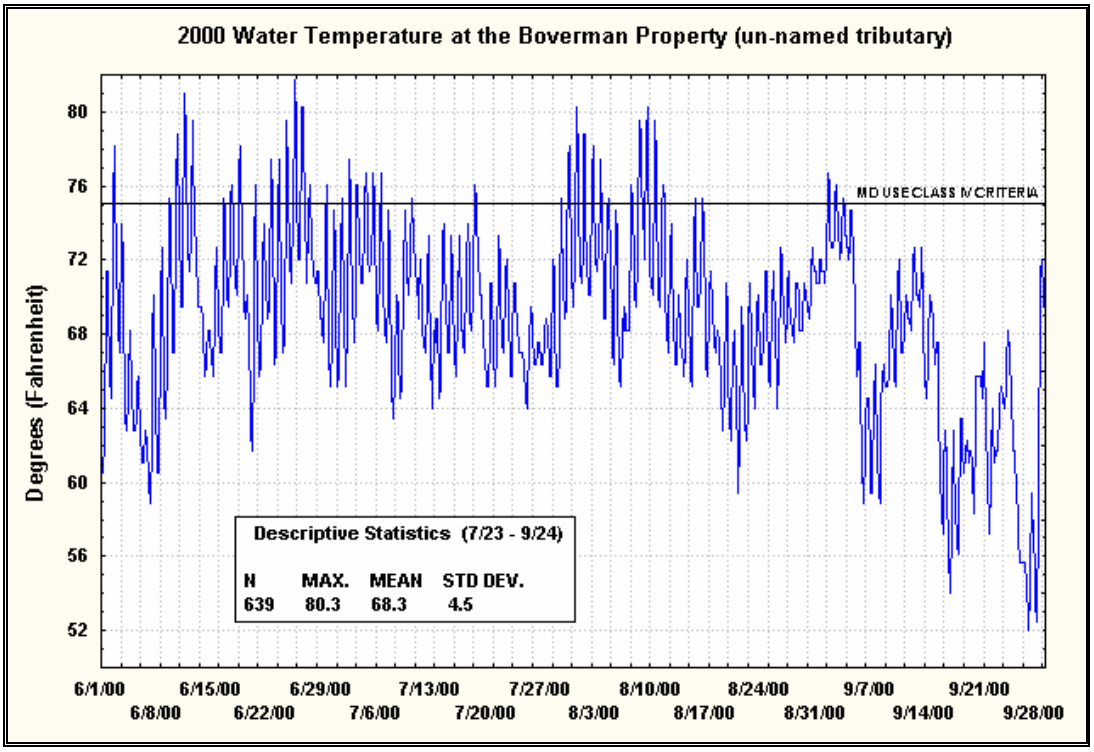

Figure 42. 2000 Stream Water Temperature From Boverman Property

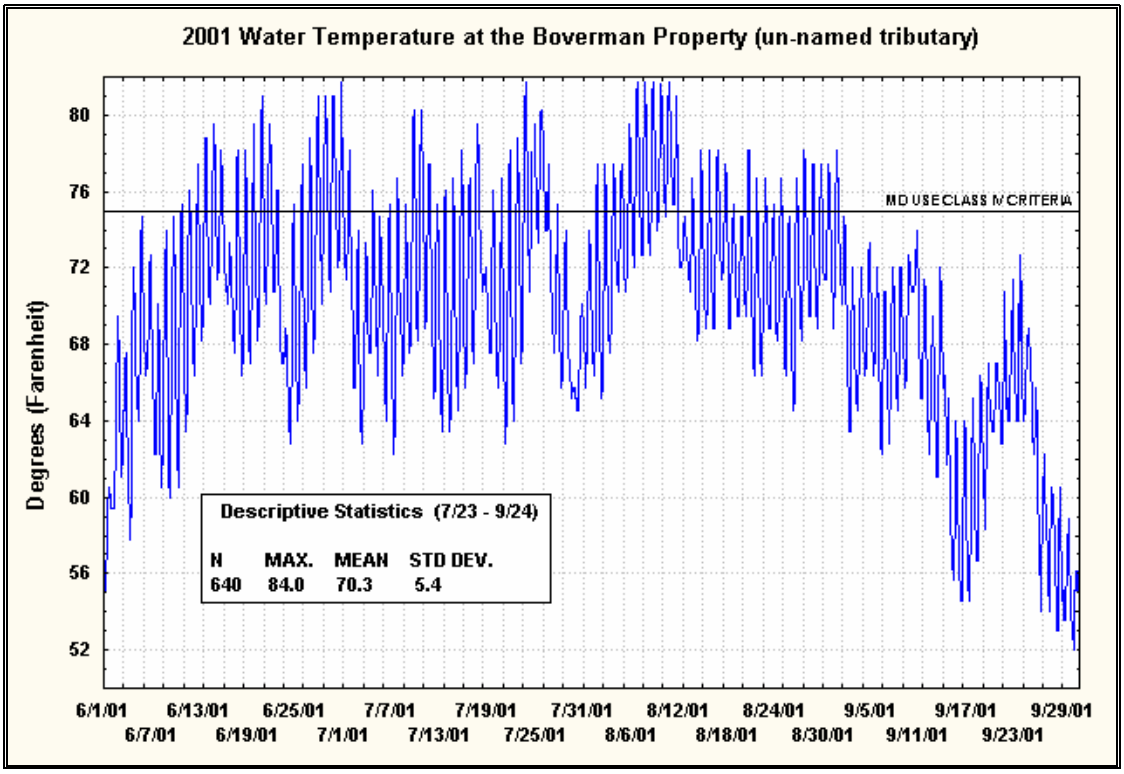

Figure 43. 2001 Stream Water Temperature From Boverman Property

Peters Property

The Peters Property is a 50 acre parcel of land located on the east side of Glen Mill Road between White Clover Terrace and Unity Lane. The site was developed under the RE-1 cluster option and consists of 26 single-family lots. Stormwater management for the site consists of two dry ponds providing storage for the 2-year storm with a pre-developed release rate. Level spreaders are installed at the dry pond outfalls to reduce water velocity. Water quality control is provided by the use of dual infiltration cells which outfall to the dry ponds. Infiltration cells are sized to treat the first inch of runoff over the contributing impervious area. Pre-treatment of runoff, prior to entering the infiltration cells, is provided through the use of road side grass swales.

BMP monitoring includes the following (see figure 44 for monitoring locations):

- Two temperature loggers, one placed at the north end of the property where Piney Branch enters the site (T1). The other placed at the southern end of the property (T2).
- Two embeddedness monitoring stations, one in Piney Branch near the southern end of property (E1) the other in Sheeps Run (E2).
- Flow logger placed in Piney Branch downstream of outfall from pond 1.

The Final Water Quality Plan calls for stream restoration along stretches of Piney Branch identified as having steep eroding banks.

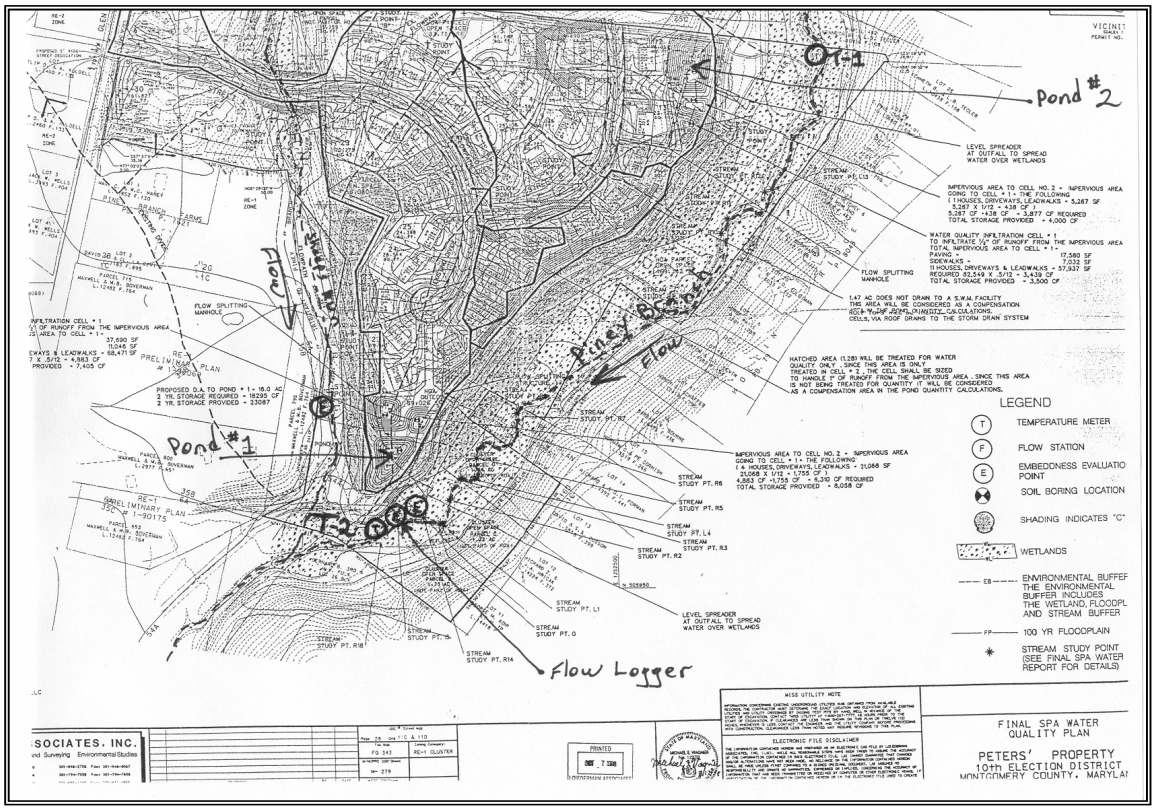

Figure 44. Site Map of Peters Property and Associated BMP Monitoring Locations

Construction began in June of 1999 and concluded during the fall of 2001. Pre-construction BMP monitoring began in October of 1998. One full year of pre-construction monitoring was not completed making it difficult to determine changes in stream water temperature as a result of this development. However, the upstream / downstream temperature monitoring locations should allow for analysis of thermal impact from the site.

The period of 5/1/99 – 6/5/99 represents the pre-construction condition for stream temperature. Data from this period show stream temperature to be slightly warmer at the upstream station by 0.7^0 F, on average (figure 45).

For the during-construction period of 6/6/99 – 9/30/99 stream water temperatures continued to be higher at the upstream station by 0.6^0 F, on average (figure 46). These results suggest that as Piney Branch flowed through the site, picking up runoff from two sediment ponds, no thermal impact was detected.

Water temperature data submitted for 2000 included un-realistic values and was deemed unreliable (2000 SPA Annual Report). During 2001 the consultant had problems with the downstream temperature logger and no data was obtained from station 2.

Embeddedness monitoring was completed throughout the construction-phase at both stations. Results indicate a large increase in embeddedness at station E2, located in Sheeps Run (figure 47). Embeddedness here was rated at 35 – 63 percent for the pre-construction period. Towards the later part of the during-construction period embeddeness went up to 85 – 100 percent. This means rocks on the stream bottom were completely buried under sediment which likely had a harmful effect on the aquatic life in Sheeps Run. This sediment could not have come from the two sediment ponds as neither one drains to Sheeps Run. The likely sources include: 1) ground disturbance in area of new road crossing over Sheeps Run, 2) perimeter sediment control (i.e. silt fence) failure adjacent to Sheeps Run, 3) construction activity on neighboring site (Snider Property) including installation of in-stream sediment control ponds within the headwater area of Sheeps Run. Embeddedness values at monitoring station E1, located in Piney Branch, increased for a brief period of time during the beginning of construction. Embeddedness was at pre-construction levels throughout the rest of the construction period.

Stream flow data has been collected beginning in February of 2000. The purpose of this monitoring is to determine if this site changes the stream hydrology by either increasing stormflow or decreasing baseflow. Because flow monitoring did not begin until well into the construction period it will be difficult to make these determinations. However, this flow monitoring will be helpful in evaluating changes to stream flow caused by new development and increased imperviousness in the headwater area of Piney Branch. Flow data along with precipitation data from Cabin John Park are used to analyze stream flow response to precipitation. For example, during a storm event on June 7, 2001 stream flow increased to approximately 90 CFS in response to 1.26 inches of rainfall over an eight hour period of time (figure 49). Baseflow at this location in Piney Branch runs between 1.0 and 3.0 CFS depending on the season.

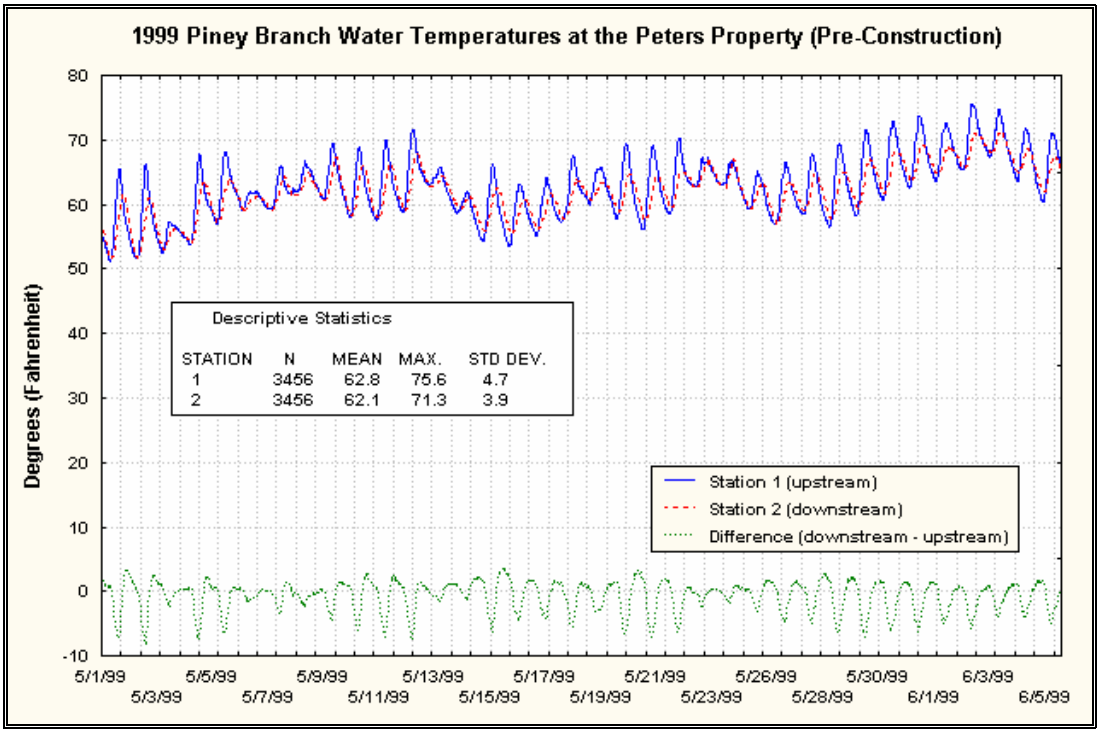

Figure 45. Piney Branch Water Temperatures For Pre-Construction Period

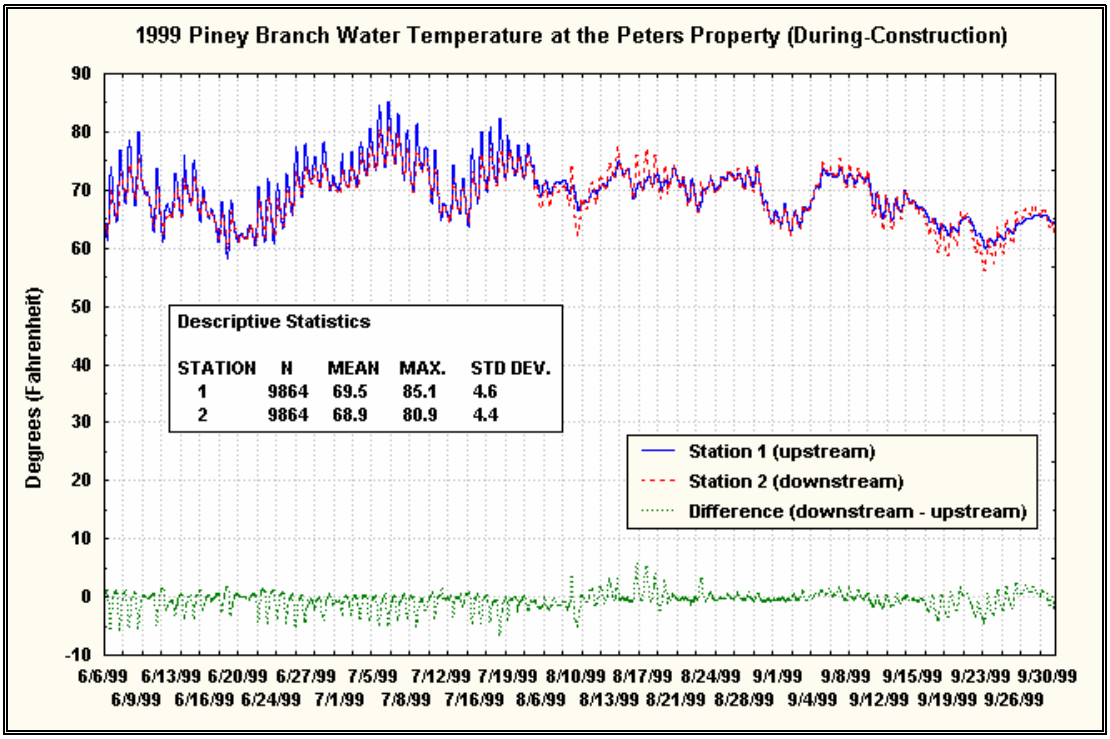

Figure 46. Piney Branch Water Temperatures For During-Construction Period

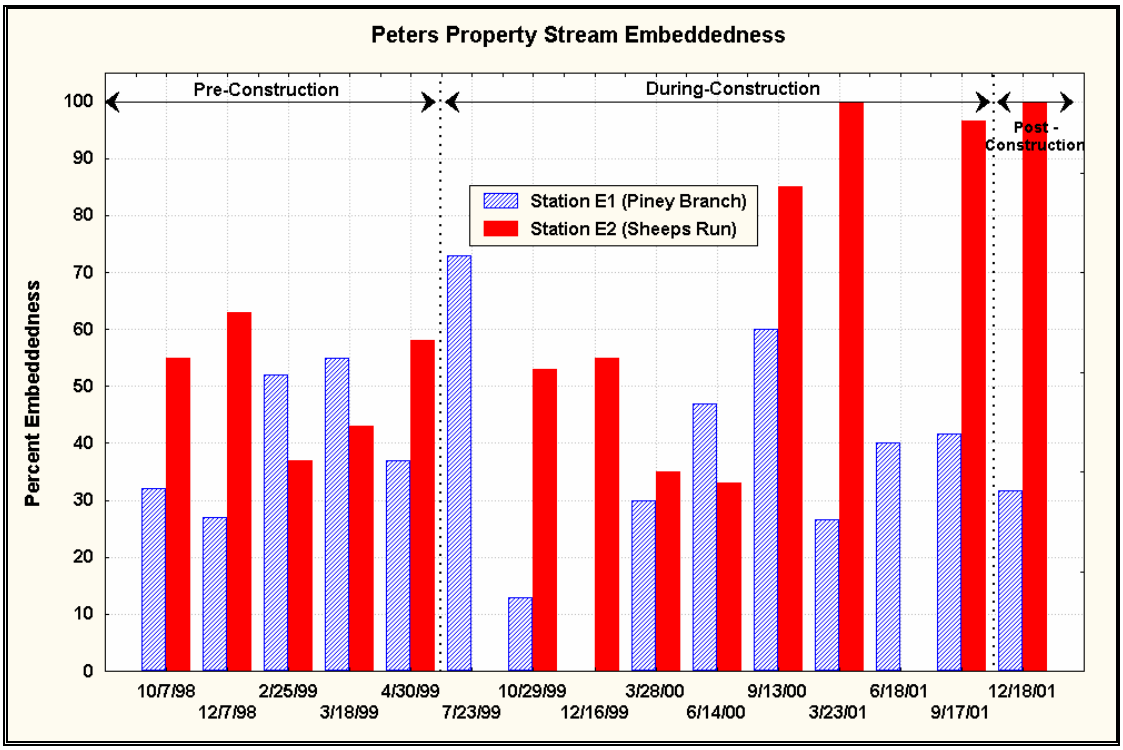

Figure 47. Embeddedness Monitoring From Peters Property

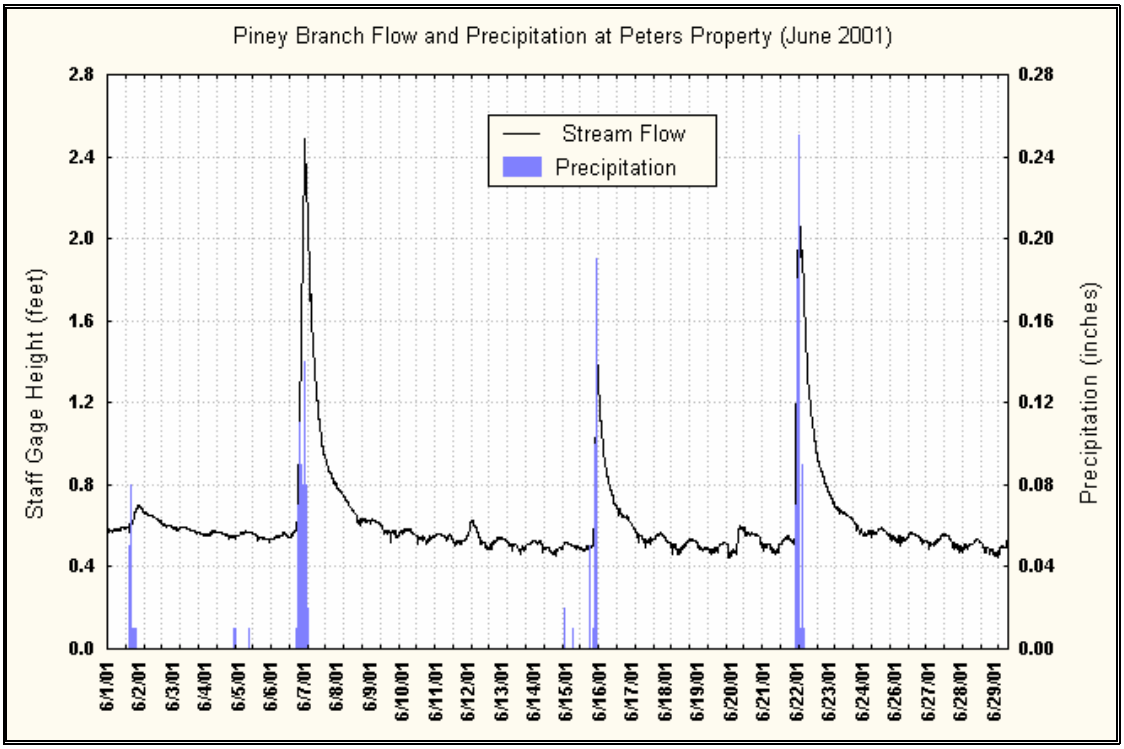

Figure 48. June 2001 Piney Branch Hydrograph From Peters Property

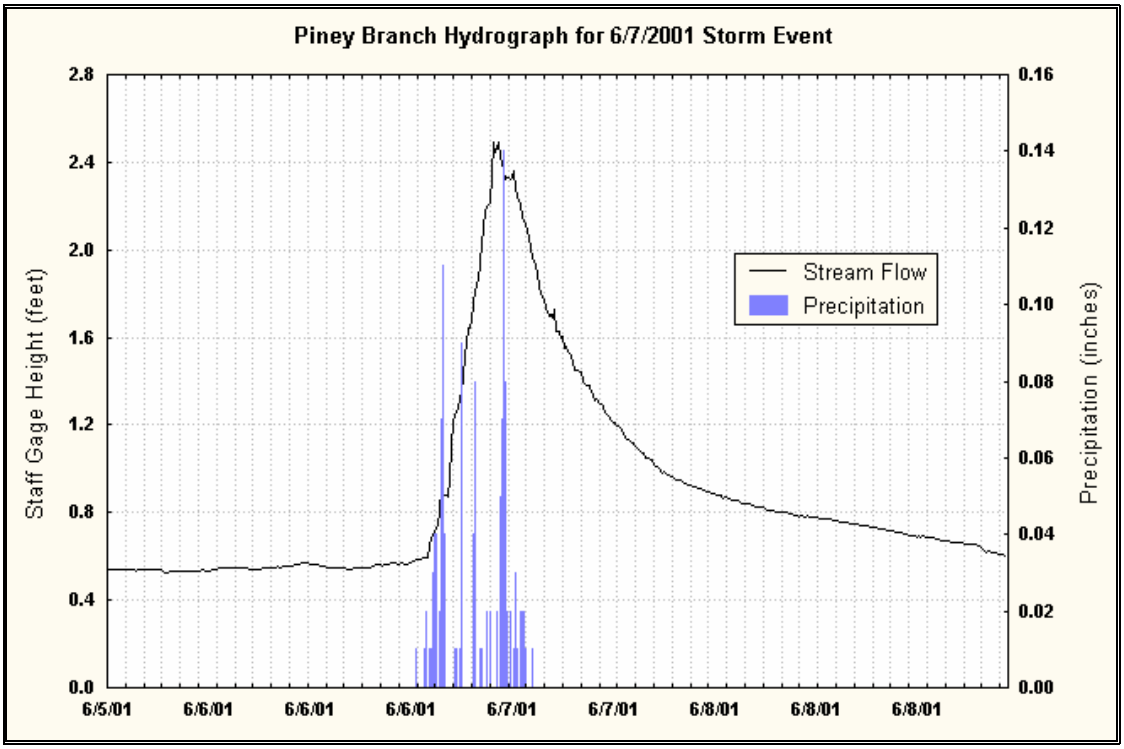

Figure 49. June 7, 2001 Piney Branch Storm Hydrograph From Peters Property

In summary BMP monitoring at the Peters Property to date has provided the following results:

- No thermal impact was detected from two sediment ponds on the site.
- Sedimentation of the stream bottom (embeddedness) increased in Piney Branch for a brief period of time at the beginning of construction.
- Sedimentation in Sheeps Run increased dramatically towards the end of construction.

The Final Water Quality Plan for Peters Property called for stream restoration along stretches of Piney Branch where stream banks were in need of stabilization to prevent future sediment input from stream bank erosion. Staff from DEP and DPS met with representatives from Mitchell & Best Home Builders, Loiderman Associates and Environmental Quality Resources on site to walk and identify areas of the stream in need of restoration. Stream restoration included clearing stream banks of invasive vegetation, grading back steep stream banks, stabilizing the toe of the bank (zone of frequent water contact) and planting native vegetation on stream banks. This work was completed in fall of 2001. Pictures of this restoration work are available in figures 50 –51.

Figure 50. Piney Branch Stream Restoration at the Peters Property

Figure 51. Stream Bank Stabilization with Fiber Rolls and Rock Revetment Along Piney Branch at the Peters Property

Cavanaugh Property

Cavanaugh project preconstruction monitoring was conducted from July 1998 through April 1999. Construction phase monitoring began in June 1999 and is in still in progress. At this site temperature data is collected at three stations. Embeddedness data is collected at one station and there are two groundwater wells being monitored. Unfortunately, a beaver dam was constructed at the site this year which interfered with data collection at the downstream end of the project (station 1). Embeddedness values may have been affected and the station 1 temperature logger could not be recovered. Embeddedness values are presented in figure 52 below. Embeddedness values averaged 63.1 % prior to construction. In the early stages of construction higher levels of embeddedness were observed. Embeddedness values averaged 83.0% from June 1999 until December 1999. At least once during this period, fresh sediment deposits were noted in the stream when embeddedness readings were being taken. Beginning in 2000, embeddedness values were more comparable to values observed prior to construction. From March 2000 through November of 2001 embeddedness values averaged 54.3%. These data indicate that the Cavanaugh BMPs were not able to stop sediment from leaving the site and affecting the stream in the early stages of construction when large areas are disturbed. Later on in the construction process, as portions of the site were stabilized and grading activity diminished, the site had a lesser impact on stream embeddedness values.

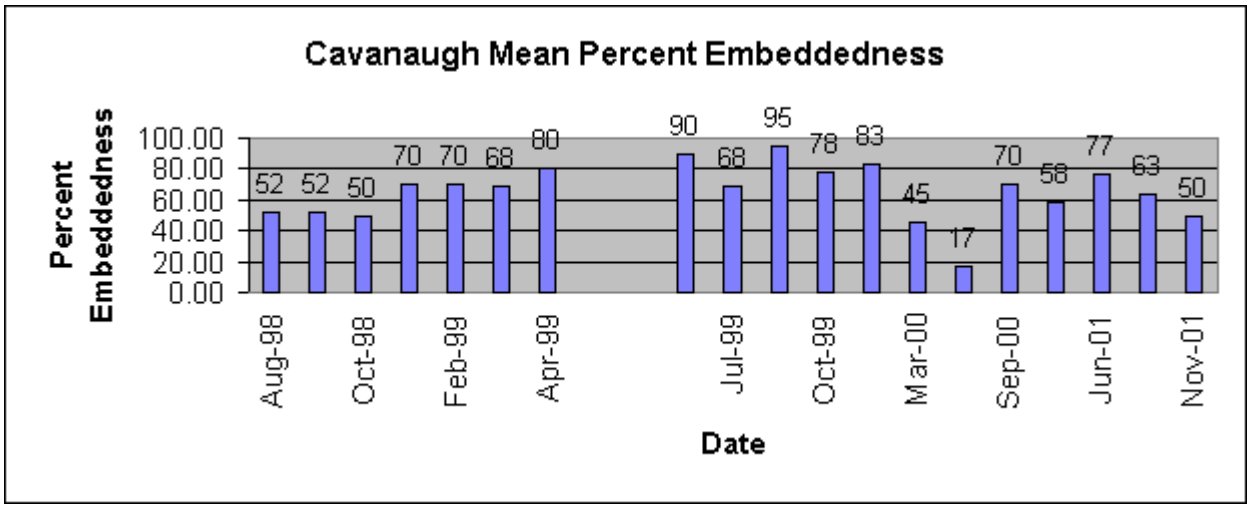

Figure 52. Embeddedness Readings Taken Downstream of Cavanaugh Property

Groundwater levels at the site are plotted in figure 53 below. Although there are two monitoring wells at the site one well has had water flowing out of the top of the well casing on most days it was checked. Useful readings cannot be obtained under such conditions and the data are not plotted here. The other well has shown generally stable groundwater levels when measured. The last data point DEP has for this well is from May of 2001. The monitoring consultant had difficulty locating the well on a subsequent visit and stopped collecting data. DEP has recently notified the developer that data collection efforts need to resume. As the region is in a hydrologic drought period, DEP is interested to see if groundwater levels are affected at the site.

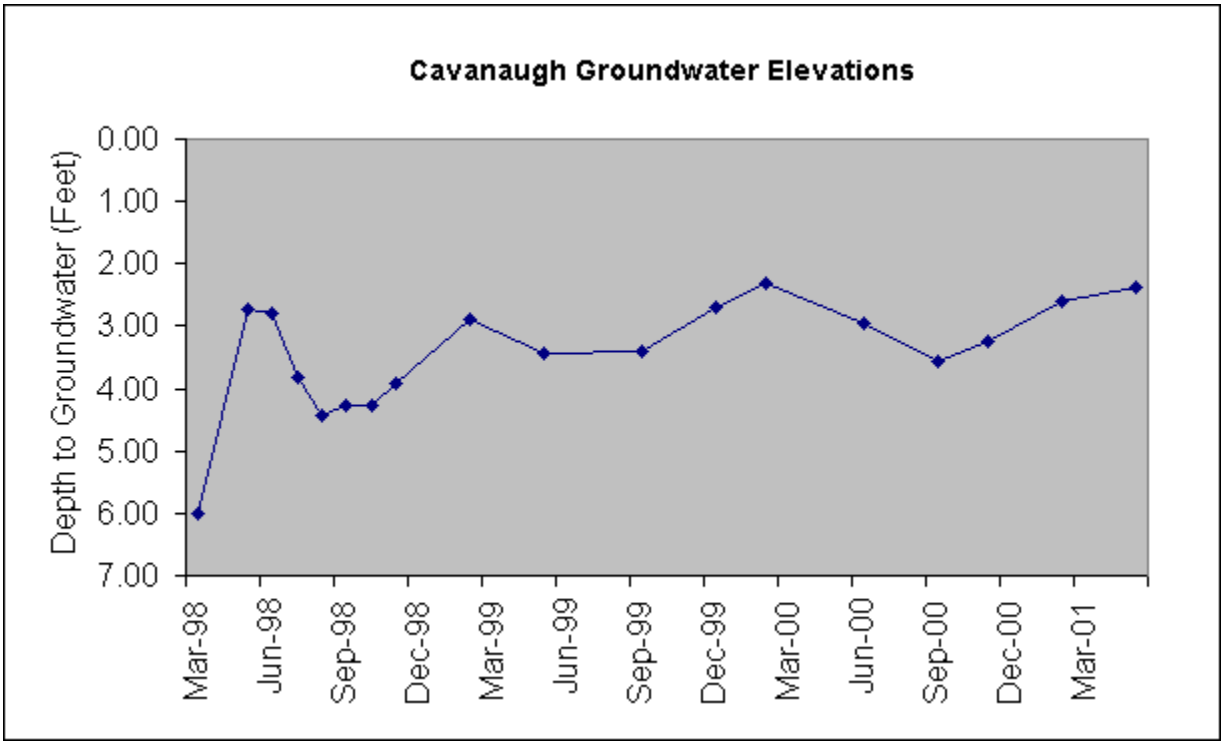

Figure 53. Groundwater Readings From Cavanaugh Property

Station 1 stream temperatures are not available from the site for 2001 due to the construction of a beaver dam on top of the temperature recording instrument. Temperatures were collected prior to construction at the site from July 20, 1998 to September 13, 1998. Table 20 below shows the median temperature values collected from the site during preconstruction and also for the summers of 1999, 2000 and 2001 during the construction period. Cavanaugh temperature data is also plotted in figures 54 - 57.

Although the preconstruction data collection period was limited, it showed that median stream temperatures increased progressively from the upstream station to the downstream station on the site. The median temperature increased 3.33 degrees Fahrenheit across the site in 1998. A similar pattern was observed in 1999 when the median temperature increased 4.5 degrees Fahrenheit across the site during the period from July 20, 1999 to September 13, 1999. A different pattern was observed in 2000. Temperatures did not increase as much across the site in that year. The median temperature increased 1.01 degrees in 2000 during the period from July 20 to September 13. The difference between years is apparent in the following graphs of temperature data from the site. Without data from station 1 DEP cannot determine whether this condition continued into 2001.

Decreased heating of the stream may be related to increased shading as riparian vegetation grew up, installation of a road crossing or some other factor. The effect could also be an artifact of temperature logger location, error, groundwater levels or some other cause. The consultant doing the monitoring, has been contacted for their analysis.

Table 20. Median Cavanaugh Stream Temperatures July 20 through September 13 for the years 1998 (Pre-construction), and 1999 through 2001 (During Construction) in Degrees Fahrenheit

	Station #1 (Downstream Station)	Difference between middle and downstream stations (#1 minus #2)	Station #2 (Middle Station)	Difference between upstream and middle stations (#2 minus #3)	Station #3 (Upstream Station)	Total Temperature change at site
Pre-construction 7/20/98 – 9/13/98	66.78	+1.79	64.99	+1.54	63.45	+3.33
7/20/99 – 9/13/99	68.52	+1.78	66.74	+2.72	64.02	+4.50
7/20/00 – 9/13/00	66.27	+0.70	65.57	1.12	64.45	+1.82
7/20/01 – 9/13/01	Lost	N/A	65.57	+0.76	64.81	N/A

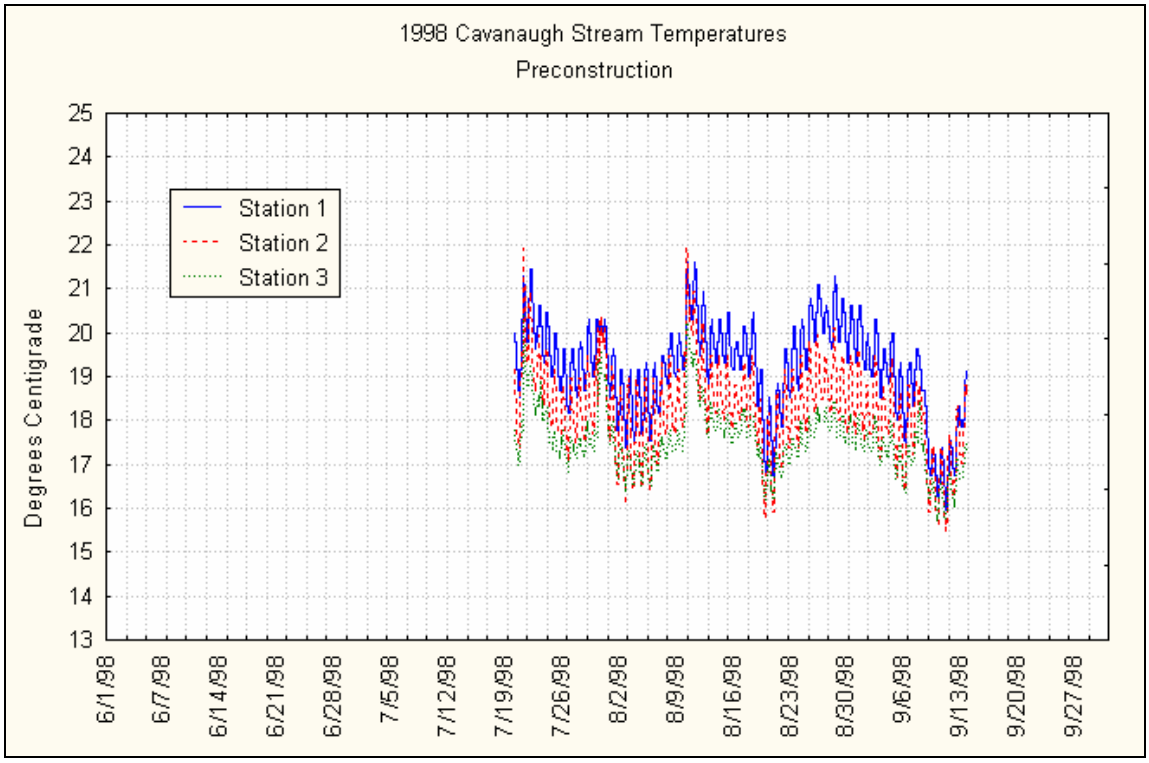

Figure 54. 1998 Cavanaugh Stream Temperatures

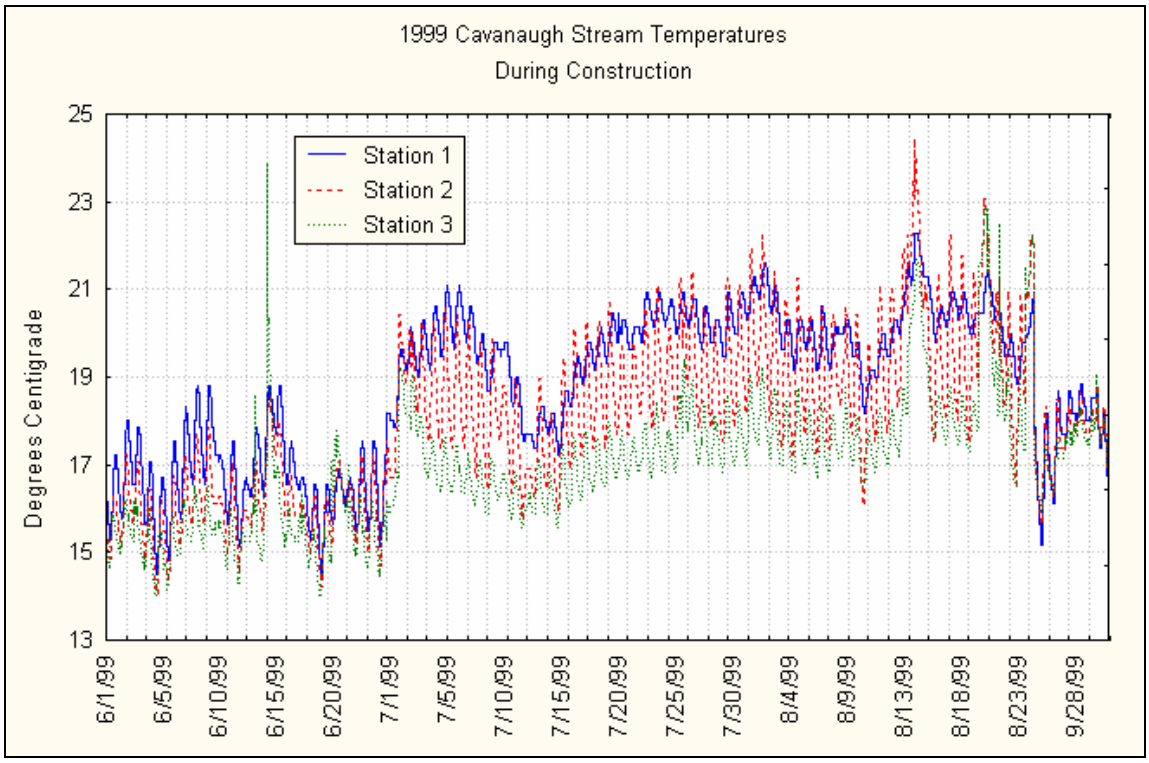

Figure 55. 1999 Cavanaugh Stream Temperatures

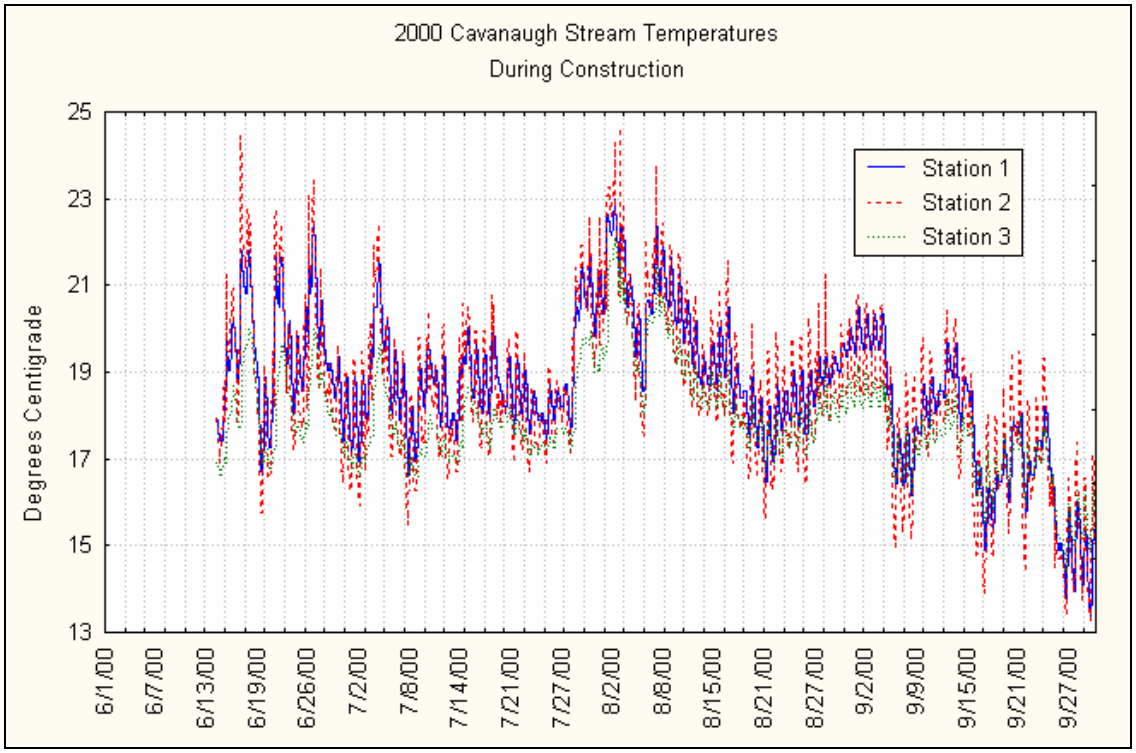

Figure 56. 2000 Cavanaugh Stream Temperatures

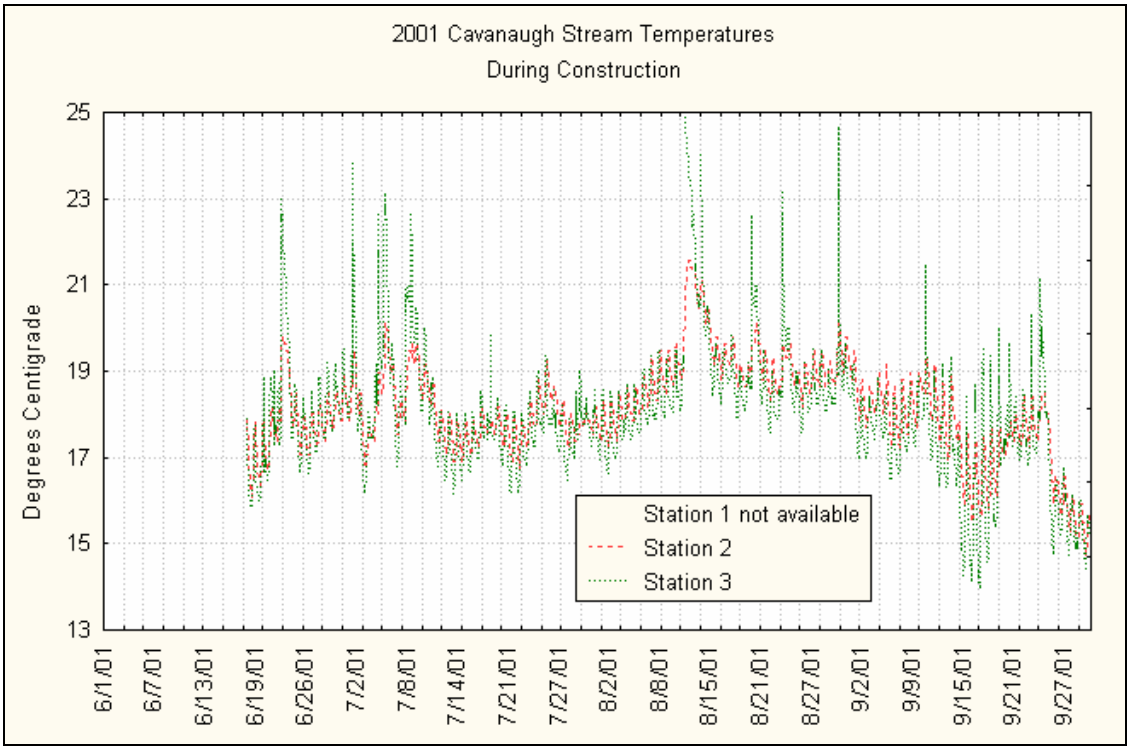

Figure 57. 2001 Cavanaugh Stream Temperatures

4.3.5 Summary of Stream Monitoring in Piney Branch

Baseline stream monitoring began in the spring of 1995 at six stations along Piney Branch. Four stations were added in 1997 to provide data immediately downstream of development sites (figure 28). Benthic macroinvertebrates were sampled at all ten stations in 2001 and fish were sampled from seven stations. There is evidence in both faunal groups that the ecosystem along the mainstem of Piney Branch continues to decline.

Ten temperature loggers were deployed in Piney Branch during the summer of 2001. The purpose was to study the thermal impact of large stormwater management ponds (wetponds) located within the Willows of Potomac and Piney Glen Village developments.

Continuously recording water quality instruments were deployed for several days at various locations along Piney Branch during the summer of 2001. The purpose was to further investigate potential causes of biological decline occurring throughout the mainstem of Piney Branch.

4.3.5.a Biological Monitoring

Biological monitoring results are used to calculate Index of Biological Integrity (IBI) scores. IBI scores from 2001 are presented in figures 60 and 61 along with previous years. Examining fish IBI scores indicate little or no change in the fish community at most stations during 2001. Trends identified in prior years continue to exist. For example, stations located in the upper reaches of Piney Branch (WBPB201, WBPB202, WBPB203A) support a fish community of lower quality then those stations located in the middle and lower portions of the watershed. This is due, primarily, to smaller stream size and reduced habitat availability. The fish community at station WBPB201 exhibited additional decline during 2001. Changes in the fish community to account for this decline include, loss of Rosyside dace and diminishing number of Potomac sculpins. Numbers of Rosyside dace were low in previous years, ranging from 10 in 1997 to 1 in 1998. The reduction in number of sculpins is a steady trend occurring throughout the mainstem of Piney Branch from 1995 to 2001 (figure 58). For example, at station WBPB201 the number of sculpins has gone from 69 in 1997 to 3 in 2001.

If this trend continues, the regression model predicts that most mainstem sites will have no sculpins by 2006. Sculpins are bottom dwelling fish species that feed on aquatic insects. For successful spawning they require clean gravel and cobble sized stones on the stream bottom, under which they deposit their eggs. For eggs to develop, cool, well-oxygenated water must pass under and through empty spaces between stones. In recent years (since 1999) DEP has noted increased levels of algal growth on the stream bottom. This could be inhibiting sculpin reproduction by clogging the spaces under the stones and reducing the ability of water to flush through. An increase in algal growth is the result of increased nutrients (nitrogen and phosphorus). At this point in time we do not know the source(s) of increased nutrients.

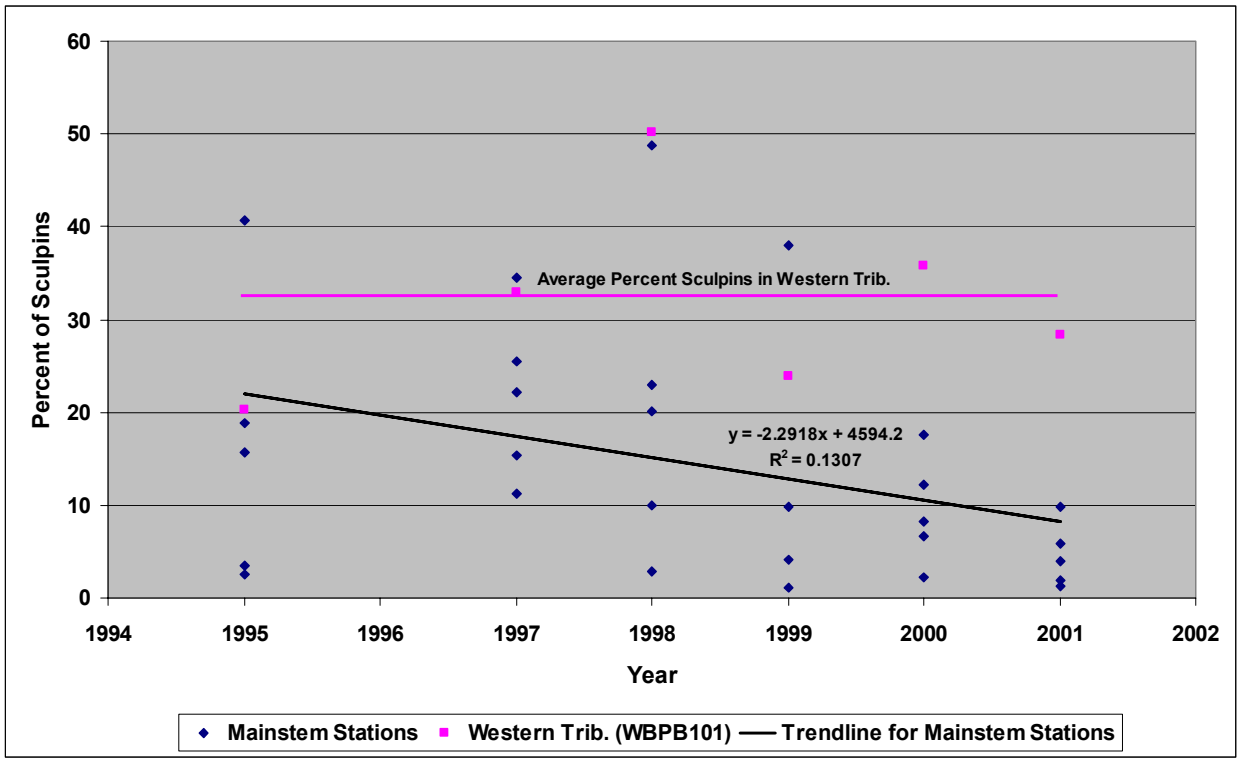

Figure 58. Relative abundance of sculpins. Blue diamonds are data from stations located along Piney Branch mainstem. Black line is the trendline for sculpin abundance at all mainstem stations over the period 1995 – 2001 (p=0.05). Purple squares are data from the Western Tributary (WBPB101). Purple line represents the average percent sculpins. Regression analysis on WBPB101 data shows no significant trend (p=0.83)

Regression analysis on data from the Western Tributary (WBPB101) indicate no statistically significant trend in sculpin abundance over the period of 1995 - 2001 (figure 58). The number of sculpins (expressed as percentage of the total fish community) has remained unchanged indicating stability with this sensitive fish species. It is noteworthy that increased algal growth has not been observed over the period of study in the Western tributary.

Results of benthic macroinvertebrate monitoring from 2001 are presented in Figure 61 along with results from previous years. Overall condition of the benthic macroinvertebrate community is in the lower fair or poor range at all mainstem stations for a third year indicating a shift to a more pollution tolerant community. Results from the Western Tributary (WBPB101) indicate no such shift has occurred there as IBI scores for the past three years have remained in the good range.

The summer of 2000 was cool and wet, conditions favorable to the benthic macroinvertebrate community. These conditions were expected to lead to improved condition of the community. There was slight improvement in 2001 IBI scores at four monitoring stations. Overall though, conditions remained in the fair/poor range.

Regression analysis on benthic macroinvertebrate IBI scores from 1995 to 2001 indicate a negative trend within the Piney Branch mainstem from fair condition in 1995 to poor in 2001 (figure 59). This trend is not present in the Western tributary where condition has remained in the good range. This leaves little doubt that the macroinvertebrate community has been impaired along the mainstem of Piney Branch. Whatever the cause, the impact does not exist in the Western tributary.

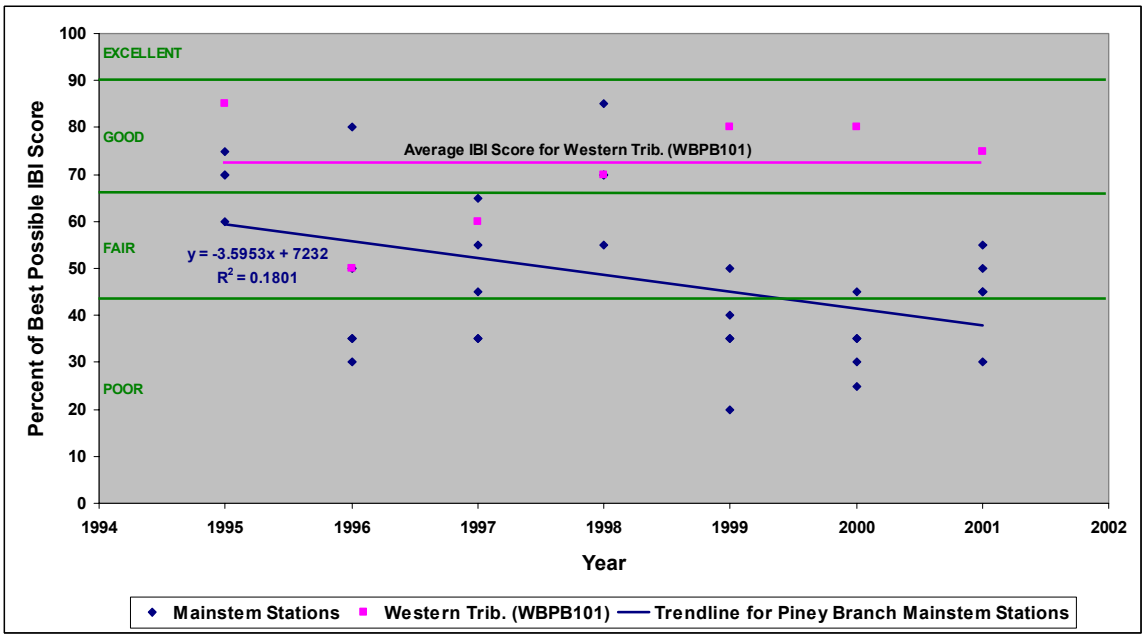

Figure 59. Piney Branch benthic macroinvertebrate IBI scores 1995-2001. Blue diamonds are mainstem stations. Blue line is the trendline (P=0.014) for mainstem stations. Purple squares are data from the Western tributary (WBPB101). Purple line is average IBI for WBPB101. There is no significant trend in Western Trib. IBI scores.

Possible causes of impairment include increased water temperature, toxic substances, hydrological changes caused by development, nutrient enrichment, sedimentation or some combination of these factors. DEP began investigating two of these potential impacts during 2001. Stream temperature and water quality studies were conducted at various locations in Piney Branch.

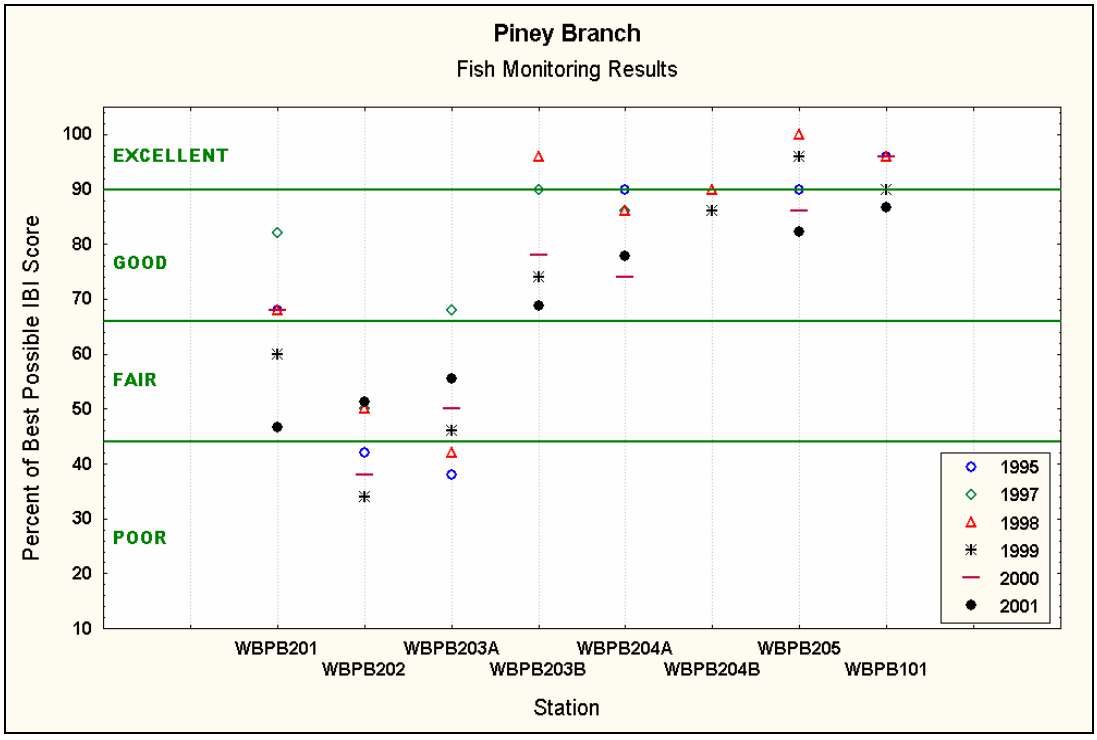

Figure 60. Results of Fish Monitoring in Piney Branch

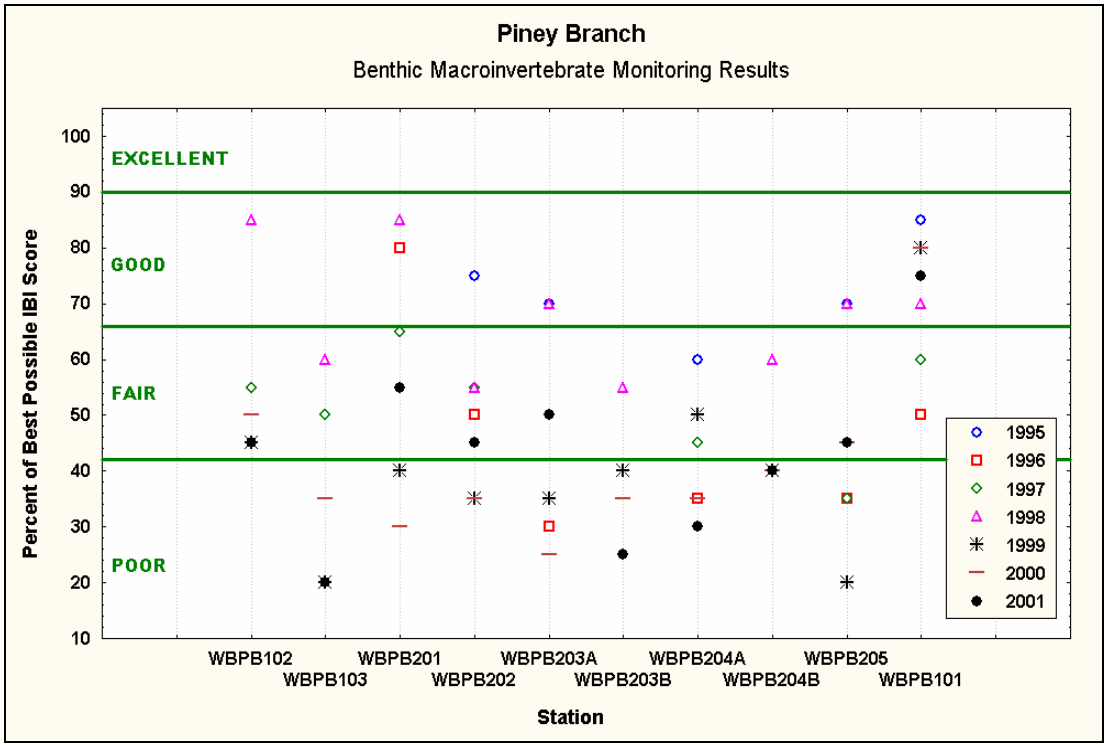

Figure 61. Results of Benthic Macroinvertebrate Monitoring in Piney Branch

Temperature Study

Continuously recording temperature loggers were placed in various locations throughout Piney Branch SPA to study thermal impact from new development (Willows of Potomac and Piney Glenn Village) constructed between 1994 and 2000. Both of these developments have large wet ponds for storm water management. The ponds were designed to minimize thermal impact to the stream by conveying base flow around the standing water thus preventing continuous warm water discharge from the pond.

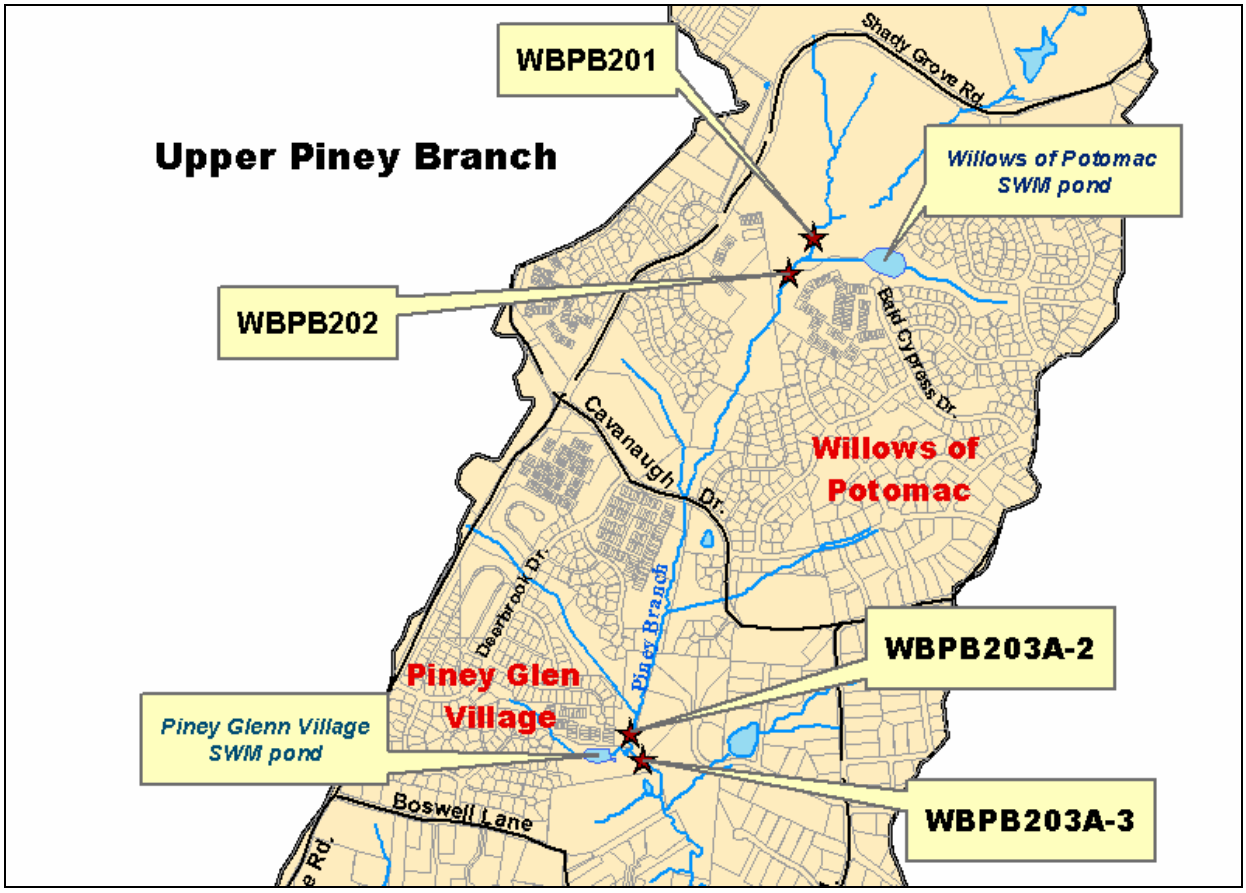

Figure 62. Location of Temperature Loggers in Upper Piney Branch

Temperature loggers were deployed in Piney Branch, upstream and downstream of the outfalls from the Willows pond and the Piney Glenn Village pond to study thermal impact (figure 62). Data is not available from WBPB201 as the logger was lost. Data provided by Loiederman Soltesz Associates from their monitoring site 11, which is about 35 meters upstream from WBPB201, is used instead. Data from the Willows site 11 and WBPB202 indicate that stream temperature is not greatly affected by the Willows pond outfall (Figure 63). Stream temperatures remained below the 90^0 (F) class I criteria throughout the summer.

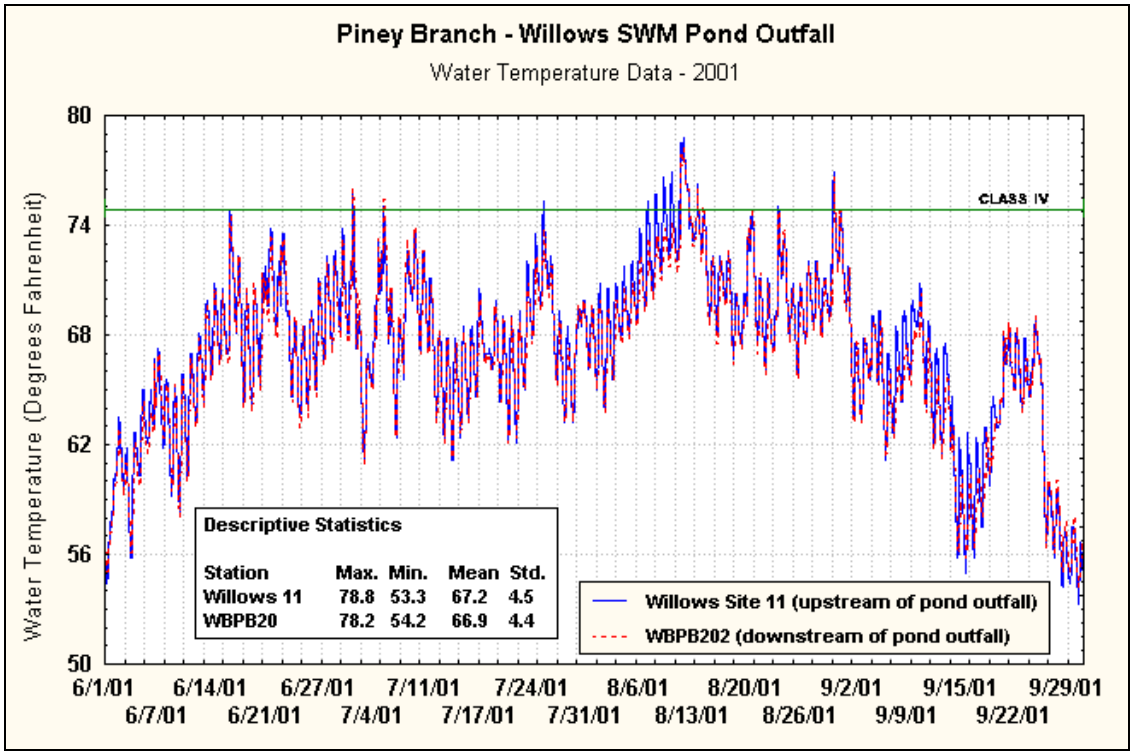

Figure 63. Stream Water Temperature Data From Willows Pond Outfall

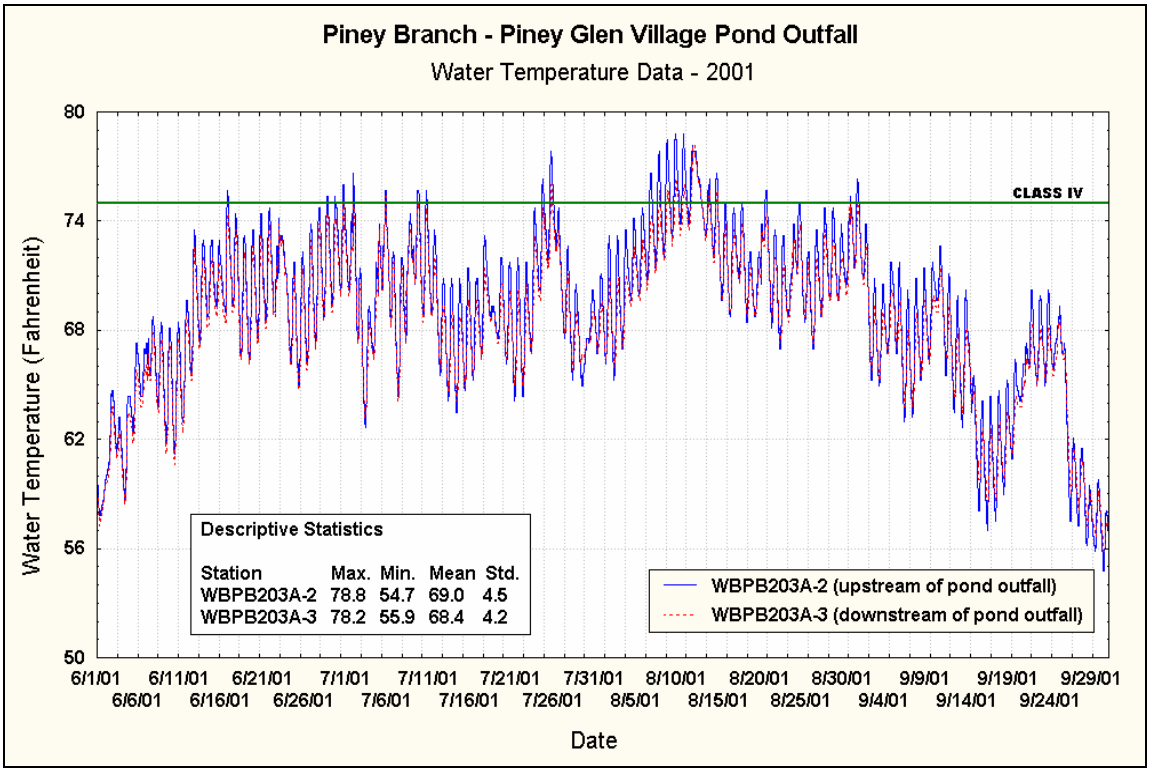

Figure 64. Water Temperature Data From Piney Glen Village Pond Outfall

Results from temperature loggers placed upstream and downstream of the Piney Glen Village pond outfall show no thermal impact. Water temperatures are slightly cooler downstream of the pond outfall (figure 64). This could be due to the downstream logger being deployed at a greater depth in the stream. These results are consistent with Loiederman, Soltesz, Associates, the consulting firm conducting stream monitoring during and after construction.

The data suggest that the goal of minimizing thermal impact has been achieved at both the Willows of Potomac and Piney Glen Village where virtually no increase in water temperature was detected. The base flow by-pass system is effective in mitigating thermal impact. Even during large rain events, when it might be expected that warm pond water is flushed out, there is no thermal impact on the stream. This is probably due to relatively low flows from the pond mixing with large flows in the stream.

Results from temperature loggers placed in lower portions of Piney Branch are presented in figure 65 (see figure 28 for station location). Water temperatures are highest at station WBPB204A, which is consistent with results from previous years. Further downstream at station WBPB204B water temperatures cool somewhat. Between these two monitoring stations the stream flows past three construction projects. Sediment control ponds on these projects are not elevating stream temperature.

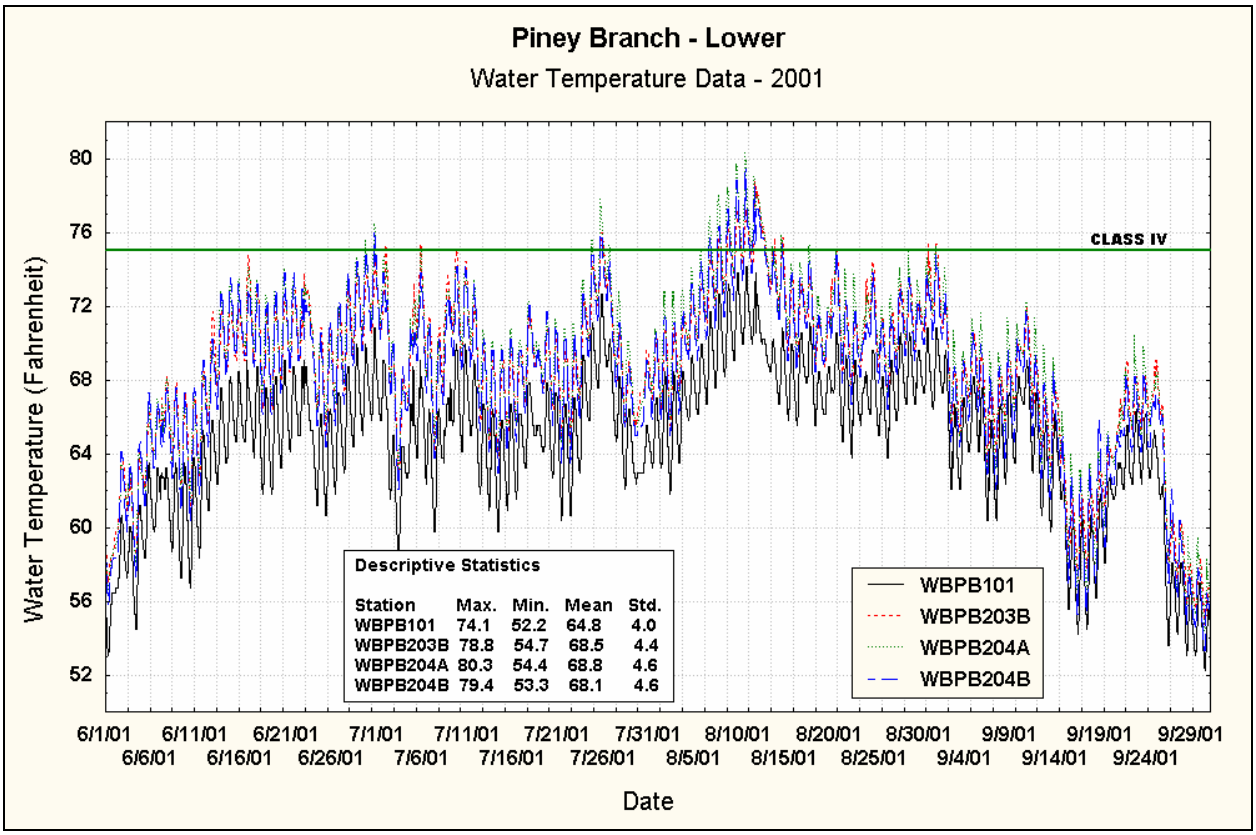

Figure 65. Stream Water Temperature Data From Lower Piney Branch.

In summary, no thermal impact exists downstream of wet ponds at Piney Glen Village or the Willows of Potomac. Stream water temperatures are highest in the middle portions of Piney Branch, in the vicinity of WBPB204A. This is a trend that has persisted in Piney Branch since monitoring began in 1995. Water temperature has remained somewhat consistent over the past six years and therefore does not explain the continued decline of the stream ecosystem.

Piney Branch Water Quality

Water quality readings (pH, dissolved Oxygen (DO), conductivity and water temperature) are taken during each of three daytime visits to monitoring stations, once during spring, summer and fall. Trend analysis on this data indicates a significantly positive trend for DO and conductivity over the period of 1995 – 2001.

Regression analysis of all daytime DO readings shows a significantly positive trend (p=0.00013) for stations located along the mainstem of Piney Branch (figure 66). Regression analysis on data from the Western tributary (WBPB101) does not show a significant trend (p=0.2469). The data set shows daytime DO levels increasing over time within the mainstem while no change has occurred within the Western tributary. This suggests an increase in plant growth (algae) has occurred in the mainstem but not in the Western tributary.

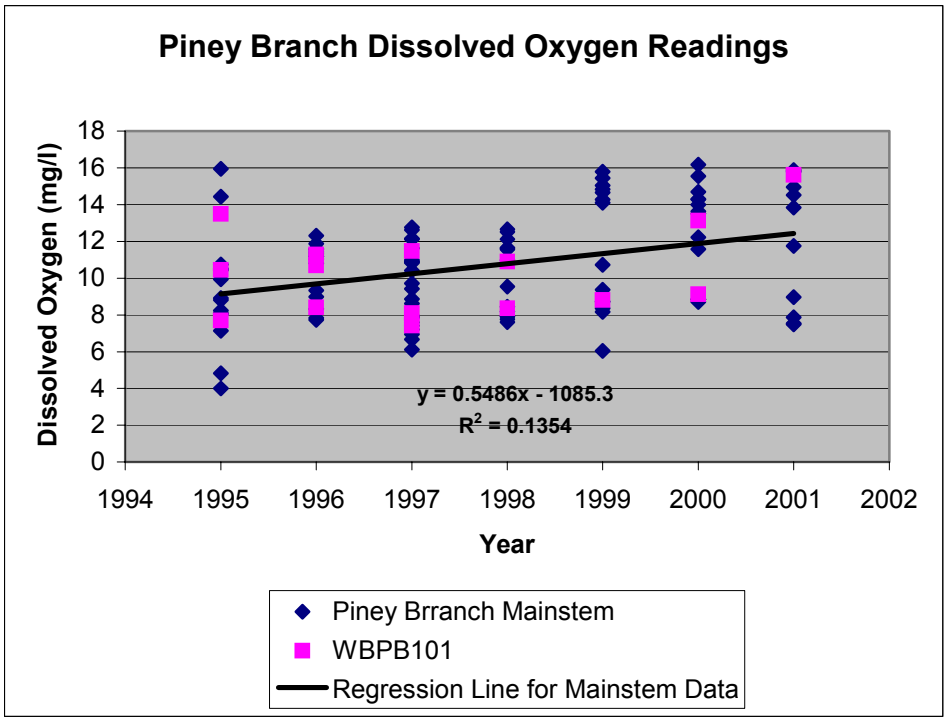

Figure 66. Regression analysis of dissolved oxygen data from Piney Branch. Blue diamonds are data from monitoring stations located along the mainstem. Purple squares are data from the Western tributary (WBPB101).

Plants, such as algae, produce energy from sunlight through a process called photosynthesis. During daylight hours, photosynthesis results in the production of oxygen. During night-time hours plants switch to respiration for energy production, which uses oxygen and produces carbon dioxide (CO_2). As plants produce oxygen during the day, DO levels in the water go up. During the night when plants are using oxygen (respiration) DO levels go down. Increased algal growth

in a stream causes greater swings in DO between day and night. All readings of dissolved oxygen shown in figure 66 were taken between the hours of 09:00 and 16:00 when plants are producing oxygen. Increased dissolved oxygen over time suggests that increased algal growth has occurred within the mainstem. Conversely, no change in dissolved oxygen within the Western tributary suggests algal growth has not increased.

DEP deployed continuously recording water quality meters in Piney Branch during the summer of 2001 to further study the effects of photosynthesis (algae) on dissolved oxygen levels. Meters were placed at WBPB204B (located at Glen Mill Road) and at WBPB101 (located in the Western tributary).

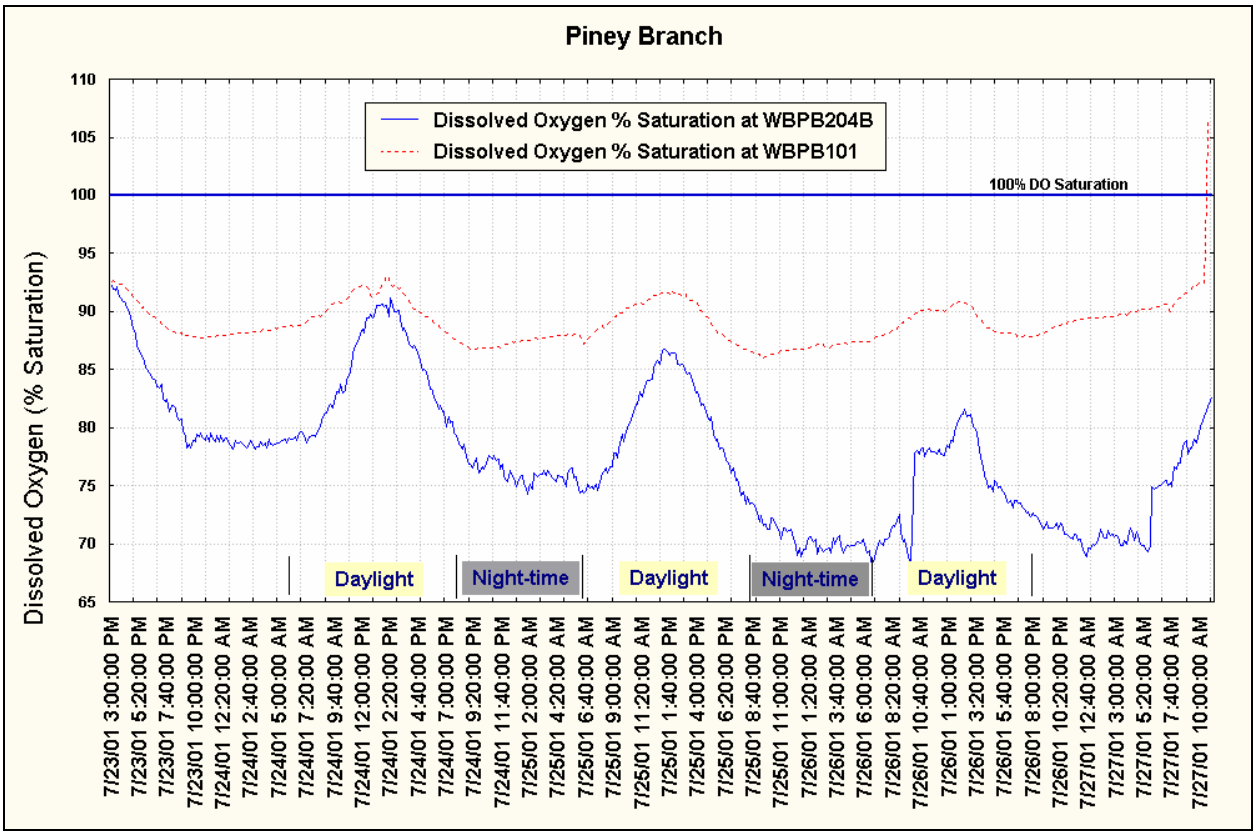

Figure 67. Plot of dissolved oxygen levels from two locations in Piney Branch. WBPB204B is located in the mainstem of Piney Branch at Glen Mill Rd. WBPB101 is located in the Western tributary.

Results from the two stations are very different. Large swings occurred at station WBPB204B such that DO reached a peak during mid-day and a low during early morning hours (figure 67). This same diurnal pattern can be seen in the data from WBPB101 but not as pronounced. Dissolved oxygen ranged between 93 and 69 percent saturated at WBPB204B, a 24 percent range. At station WBPB101 DO range was between 93 and 86 percent saturation, a 7 percent range.

At station WBPB204B DO concentration reached a low of 5.7 mg/l while at WBPB101 the low

was 7.5 mg/l. It is generally recognized that DO levels of 5.0 mg/l and below are stressful to aquatic life. Dissolved oxygen conditions in the mainstem of Piney Branch are clearly exerting more stress on the aquatic community then that in the Western tributary. This very well could explain why the decline in the biological community is occurring along the mainstem and not in the Western tributary.

Figures 68 and 69 help explain why there is a problem with DO in the mainstem and not in Western tributary. The photos clearly show more algal growth in the mainstem then in the Western tributary. In the mainstem all stones on the stream bottom are covered with algae and fine sediments. In the western tributary stones are free of algae and only slight amounts of fine sediment are present.

Figure 68. Stream bottom in Piney Br. mainstem

Figure 69. Stream bottom in Western tributary

Increased nutrient input is the cause of accelerated algal growth. Where additional nutrients are coming from is the question DEP is currently trying to answer. There are several pathways through which nutrients may enter the stream, including: 1) overland runoff carrying fertilizers 2) excessive fertilizers soaking into groundwater and delivered to the stream through springs and seeps, 3) animal waste 4) bound to fine grained sediments that are discharged from sediment control ponds.

As a first step in identifying sources of nutrients, DEP has developed a study design to look for 'hot spots' in the watershed where nutrient levels are elevated. The study calls for nutrient analysis at 39 locations throughout the Piney Branch watershed during baseflow conditions. Sampling is to be done twice, once during winter, and once during summer. Winter sampling was completed on March 7, 2001. Results from this sampling identified one area in the watershed as contributing high levels of nutrients. This area is in the lower portion of Piney Branch in the vicinity of monitoring station WBPB205. All results from this study will be presented in the 2002 SPA annual report.

The other water quality reading that has significantly changed over time (1995 – 2001) is conductivity. Conductivity is simply a measure of water's capacity to conduct an electrical current. Pure water does not conduct electricity and therefore has a conductivity of zero. As impurities are added, such as salts, minerals, chemical compounds, etc., conductivity of the water increases. Conductivity of streams varies widely depending largely on local geology and soil characteristics. However, conductivity of a particular stream should not change over time unless additional impurities are added.

Regression analysis on conductivity readings taken in Piney Branch over the time period of 1995 - 2001 shows a significantly positive trend for stations located along the mainstem (p=0.000034) (figure 70). Regression analysis on readings from the Western tributary show a significantly negative trend (p=0.0156). These results indicate that conductivity is increasing within the mainstem of Piney Branch. The cause of this increase is unknown at this time. However, it is noteworthy that increased nutrient concentrations can cause higher conductivity values.

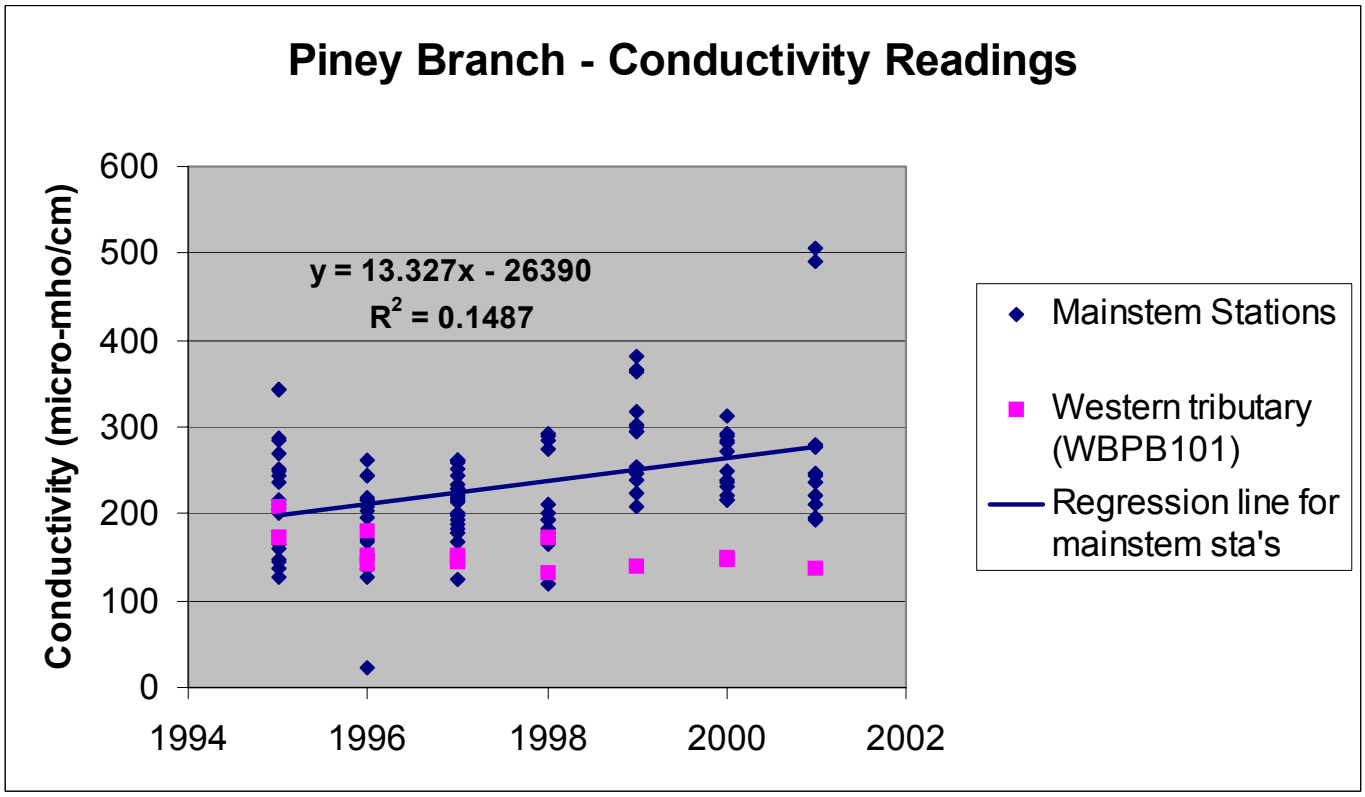

Figure 70. Regression analysis of conductivity data from Piney Branch.

4.3.5.b Habitat Monitoring

Results of all habitat assessments done in Piney Branch are presented in Figure 71. Habitat scores from all stations have remained in the sub-optimal range. This means that overall, condition of stream habitat is adequate to support a diverse biological community.

Results of habitat assessment completed during 2001 at stations WBPB102 and WBPB103 are slightly lower then in previous years. Analysis of individual parameters that make up the habitat assessment show sediment deposition is slightly lower at both stations for a second year. This indicates that sedimentation continues to be a problem at these two stations located in the headwater portion of Piney Branch. Land disturbances which could be contributing sediment to the stream include construction of Human Genome Sciences campus, on the north side Shady Grove Road.

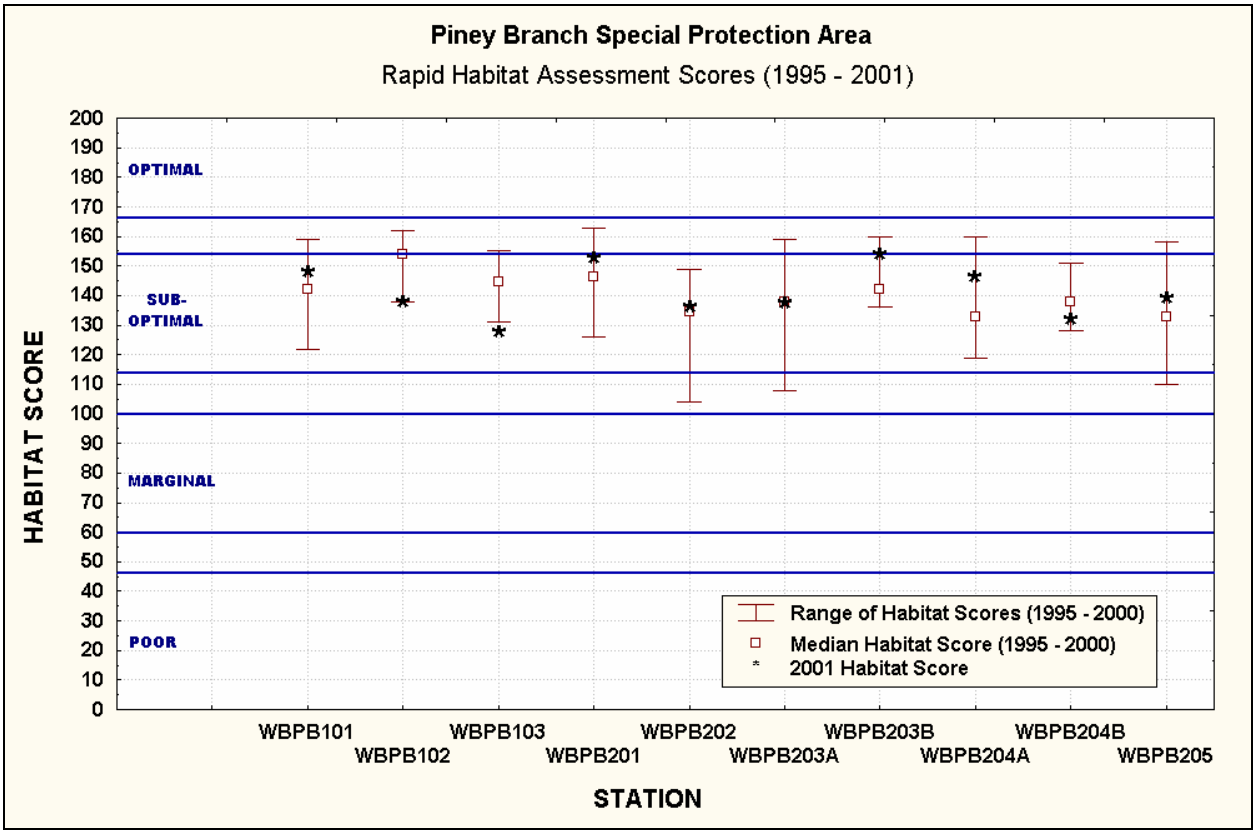

Figure 71. Summary of All Piney Branch Habitat Assessments (asterisk represents the average of two assessments done in 2001)

Stream Channel Morphology Assessment

Quantitative habitat assessments were not completed in Piney Branch during 2001. Several years of quantitative habitat measurements exist for all monitoring stations to provide baseline condition. Because changes in channel morphology are generally slow, this monitoring will be scaled back in frequency.