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## Memorandum

**To:** Bassett Creek Watershed Management Commission  
**From:** Barr Engineering Company  
**Subject:** Item 6A – 2009 Water Quality Monitoring Activities  
BCWMC February 18, 2010 Meeting Agenda  
**Date:** February 11, 2010  
**Project:** 23/27 051 2009 003

### 6A. 2009 Water Quality Monitoring Activities

#### i. 2009 Lake Water Quality Study: Sweeney Lake, Twin Lake, Northwood Lake, North Rice Pond, and South Rice Pond

##### Recommended/requested Commission actions:

1. The BCWMC should accept the report and authorize Amy Herbert to post the report on the BCWMC Web site.
2. Consider collecting additional water quality samples in Twin Lake in February and March 2010, before ice out.
3. Consider collecting sediment samples in Twin Lake during the summer of 2010.

The executive summary of the referenced report is attached. The report will be posted on the Bassett Creek web site following BCWMC authorization. Contact Amy Herbert at [bcra@barr.com](mailto:bcra@barr.com) or at 952-934-6316 if you would like a paper copy of the report.

##### Twin Lake Water Quality Status and Recommended Actions

Water quality data collected for Twin Lake in 2008 indicated that the average summer phosphorus concentration in 2008 was about 44 ppb, which is significantly higher than the previous four years that were sampled—1992, 1996, 2000 and 2005. Although the 2008 data for Twin Lake would not require that the lake be listed as impaired, the change in the water quality of the lake was of concern and it was recommended that Twin Lake be monitored again in 2009 to try to identify the reasons for the significant change in water quality. The increase in the Twin Lake phosphorus concentration in the spring of 2008 was thought to be either related to an inflow from Sweeney Lake or from large internal loading from bottom sediments.

Starting in February 2009, water quality samples were collected from Twin Lake. The average phosphorus concentration in the water column in February was over 200 ppb and the average

dissolved oxygen concentration was less than 0.5ppm. Throughout the summer, phosphorus concentrations continued to decline to a low of 38 ppb in September. The average summer average phosphorus concentration for Twin Lake in 2009 was 69 ppb, which does not meet the state water quality standards. All of the three water quality indicators—phosphorus, chlorophyll a and Secchi disc show that the water quality in Twin Lake has degraded when compared to past water quality data. The 2009 lake data indicates that the water quality of the lake is currently the poorest observed since monitoring began. The cause of the lake's water quality degradation in 2008 and 2009 appears to be the result of high internal loading in the winter caused by very low dissolved oxygen levels. The late ice out in the spring of 2008 and 2009 appears to have created the unusually low oxygen levels.

Since the ice and snow cover this winter is worse than previous winters, it is expected that dissolved oxygen levels will again be low, which will again result in a large internal phosphorus loading from bottom sediments. It is recommended that the Commissioners consider collecting additional water quality samples in February and March 2010, before ice out. The cost of the sample collection, testing and a brief report is \$3,200.

It is also recommended that the Commissioners consider collecting sediment samples during the summer of 2010 to determine the potential internal load that can be released from bottom sediments. The sediment samples could also be used to determine the cost of treatment to minimize phosphorus release from bottom sediments. The cost of collecting the sediment samples, analyzing the samples and calculating potential phosphorus release is \$3,500.

## **ii. A Biotic Index Evaluation of Bassett Creek and Plymouth Creek: 2008-2009**

### **Recommended/requested Commission actions:**

1. The BCWMC should accept the report and authorize Amy Herbert to post the report on the BCWMC Web site.

The executive summary of the referenced report is attached. The report will be posted on the Bassett Creek web site following BCWMC authorization. Contact Amy Herbert at [bcra@barr.com](mailto:bcra@barr.com) or at 952-934-6316 if you would like a paper copy of the report.

***2009 Lake Water Quality Study***

***Sweeney Lake, Twin Lake, Northwood Lake,  
North Rice Pond, and South Rice Pond***

***Prepared by  
Bassett Creek Watershed Management Commission***

***January 2010***



# Executive Summary

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Since 1970, the Bassett Creek Watershed Management Commission (BCWMC) has monitored water quality in ten major lakes within the Bassett Creek watershed. This long-term monitoring program was developed to detect changes or trends in lake water quality over time that will help determine the effects of changing land use patterns within the watershed as well as the effectiveness of BCWMC's efforts to maintain and improve water quality. The BCWMC adopted its current watershed management plan in 2004. This second-generation plan complies with the provisions of the Minnesota Rules Chapter 8410, the Metropolitan Surface Water Management Act, the Water Resources Management Policy Plan, and other regional plans, and it sets the vision and guidelines for managing surface water within the boundaries of the BCWMC.

Three indicators that are commonly used to measure water quality include chlorophyll *a* (a measurement of algae or small plants), the amount of total phosphorus (the main nutrient required for algal growth), and Secchi depth (transparency of the water). This report summarizes the results of water quality monitoring during 2009 in Sweeney, Lake, Twin Lake, Northwood Lake, and North and South Rice Ponds. The lakes were monitored for both chemical and biological water quality parameters, the latter including phytoplankton and zooplankton. Monitoring results are summarized by lake and include a description of the results along with graphical representations of the data.

The conclusions and recommendations from 2009 water quality monitoring are as follows:

## **Sweeney Lake**

During 2009, the water quality of Sweeney Lake did not meet the state water quality standard and Bassett Creek Water Management Commission's (BCWMCs) goals for the lake. The water quality status of Sweeney Lake was eutrophic (nutrient rich and poor quality), and the summer average phosphorus concentration was *hypereutrophic* (very nutrient rich, very poor water quality).

The observed 2009 water quality degraded significantly from the observed 2008 water quality. All three indicators show that the water quality in Sweeney Lake has degraded when compared to 2005, 2007, and 2008 because chlorophyll *a* and total phosphorus have increased, while Secchi depth has decreased.

The cause of the lake's water quality degradation in 2009 appears to be internal loading. Phosphorus released from sediment in 2009 was continuously mixed into the lake's surface waters during the growing season, thus increasing algal growth and reducing water clarity; while phosphorus released from sediment in 2008 was trapped in the lake's bottom waters until the fall mixing event, thus minimizing algal growth and increasing water clarity.

## **Twin Lake**

During 2009, Twin Lake's water quality did not meet the state water quality standard and Bassett Creek Water Management Commission's (BCWMCs) goals for the lake were not met. The water quality status of Twin Lake was eutrophic and the summer average phosphorus concentration was hypereutrophic.

The observed 2009 water quality degraded from the observed 2008 water quality. All three indicators show that the water quality in Twin Lake has degraded when compared to 2000, 2005, and 2008 because chlorophyll *a* and total phosphorus have increased, while Secchi depth has decreased. The lake is currently at the poorest water quality observed since monitoring began. In 2009, late summer phytoplankton included the blue-green toxin-producing species *Cylindrospermopsis raciborski*, which comprised 25 percent of the algal community on August 12 and more than half of the algal community on August 26. Large numbers of this species are indicative of degraded water quality.

The cause of the lake's water quality degradation in 2009 appears to be internal loading.

It is recommended that the Commissioners consider collecting sediment samples during 2010 to determine if internal loading is causing the recent decline in the water quality of Twin Lake. It is also recommended that the Commissioners consider collecting additional water quality samples in February and March 2010, prior to ice out.

## **Northwood Lake**

During 2009, Northwood Lake's water quality met state water quality standards and the BCWMC's goals for chlorophyll *a* and Secchi depth, but the lake's summer average total phosphorus concentration was more than five times greater than the state water quality standard and more than four times greater than the BCWMC's goal. Because Northwood Lake is a shallow lake, the water quality standards for the lake are less stringent than those for deep lakes (e.g., Sweeney Lake and Twin Lake).

2009 water quality status for Northwood Lake was eutrophic and the summer average phosphorus concentration was hypereutrophic.

Overall, the lake's water quality has improved since 2000 because chlorophyll *a* concentrations have declined and Secchi depth has increased. Although total phosphorus concentrations have increased since 2000, the increase has not resulted in increased algal growth or declining water transparency. Because increasing total phosphorus concentrations coincided with declining chlorophyll concentrations and increasing Secchi transparency, it appears that phosphorus is not the variable that limits algal growth in Northwood Lake.

### **North Rice Pond**

During 2009, North Rice Pond's water quality met BCMC's goals for total phosphorus, chlorophyll *a*, and Secchi depth. Because North Rice Pond is a wetland, there are no state water quality standards applicable to the pond. Water quality was eutrophic, although the summer average phosphorus concentration was hypereutrophic.

Historical water quality data for North Rice Pond from 1994 and 1998 as well as 2009 show a trend toward water quality improvement.

### **South Rice Pond**

During 2009, South Rice Pond's water quality met BCWMC's goal for chlorophyll *a*, but did not meet BCWMC's goals for total phosphorus and Secchi depth. Water quality was hypereutrophic and the summer average chlorophyll *a* value was eutrophic.

Historical water quality data indicates that consistently poor water quality has been observed in South Rice Pond during the period of record. A comparison of water quality observed in 2008 and 2009 indicates that total phosphorus concentrations increased while chlorophyll concentrations declined and water transparency improved. Hence, the water quality of South Rice Pond improved in 2009 despite increased phosphorus concentrations.

***A Biotic Index Evaluation of  
Bassett Creek and Plymouth Creek: 2008-2009***

***Prepared by  
Bassett Creek Watershed Management Commission***

***January 2010***



# 1.0 Executive Summary

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Bassett Creek is currently listed on the List of Impaired Waters [303(d) list approved by U.S. EPA] for biota/fish. Because Bassett Creek is impaired, the MPCA assisted the Bassett Creek Watershed Management Commission (BCWMC) with the collection of biological samples from the Main Stem of Bassett Creek during 2008. Although the MPCA had intended to again sample the Main Stem during 2009, a change in plans occurred and the Main Stem was not monitored in 2009. During 2009, the BCWMC conducted biological monitoring for Plymouth Creek and Bassett Creek (North Branch and Sweeney Lake Branch) to evaluate the water quality of the streams. The Main Stem was not monitored by BCWMC in 2009 since the MPCA had planned to monitor this reach. Data collected from the 2008 MPCA monitoring program, however, are included in this study to evaluate current conditions in the Main Stem as well as changes since the reach was monitored in 2006. Data collected by the MPCA and BCWMC in 2009 were collected under similar climatic conditions. Precipitation was below normal during both years.

The BCWMC completed biological monitoring for Plymouth Creek and Bassett Creek during 1980, 1983, 1991, 1995, 2000, 2003, 2006, and 2009. In addition, samples were collected from the Sweeney Lake Branch and the Main Stem east of Zane Avenue in 1996. These historical data were compared with current data to determine changes in the stream's biological community over time as well as to estimate water quality changes indicated by changes in the biological community.

Bassett Creek has been evaluated with the Hilsenhoff Biotic Index (HBI) since 1980. The HBI results for 1980-2009 are summarized Figure EX-1. The current HBI results indicate a significant decrease in water quality (i.e., oxygen levels) from fair to poor occurred in the North Branch location during the 2008 through 2009 period. HBI results indicate Plymouth Creek maintained good water quality between the 2006 and 2009 studies. Similarly, the Main Stem locations maintained good water quality between the 2006 and 2008 studies. The bio-indicator data from the Sweeney Lake Branch location indicated water quality was fair and relatively similar to 2006, although an insignificant decline in water quality occurred. This location has observed a continuing decline in water quality (i.e. oxygen levels) beginning in 2000 and continuing through 2009.

A second index, the Invertebrate Community Index (ICI), was applied to the 1995 through 2009 data, as a second opinion. Both biotic indices (HBI and ICI) generally show similar water quality classifications for 2008 and 2009 at all monitoring locations. Results of the HBI evaluation of

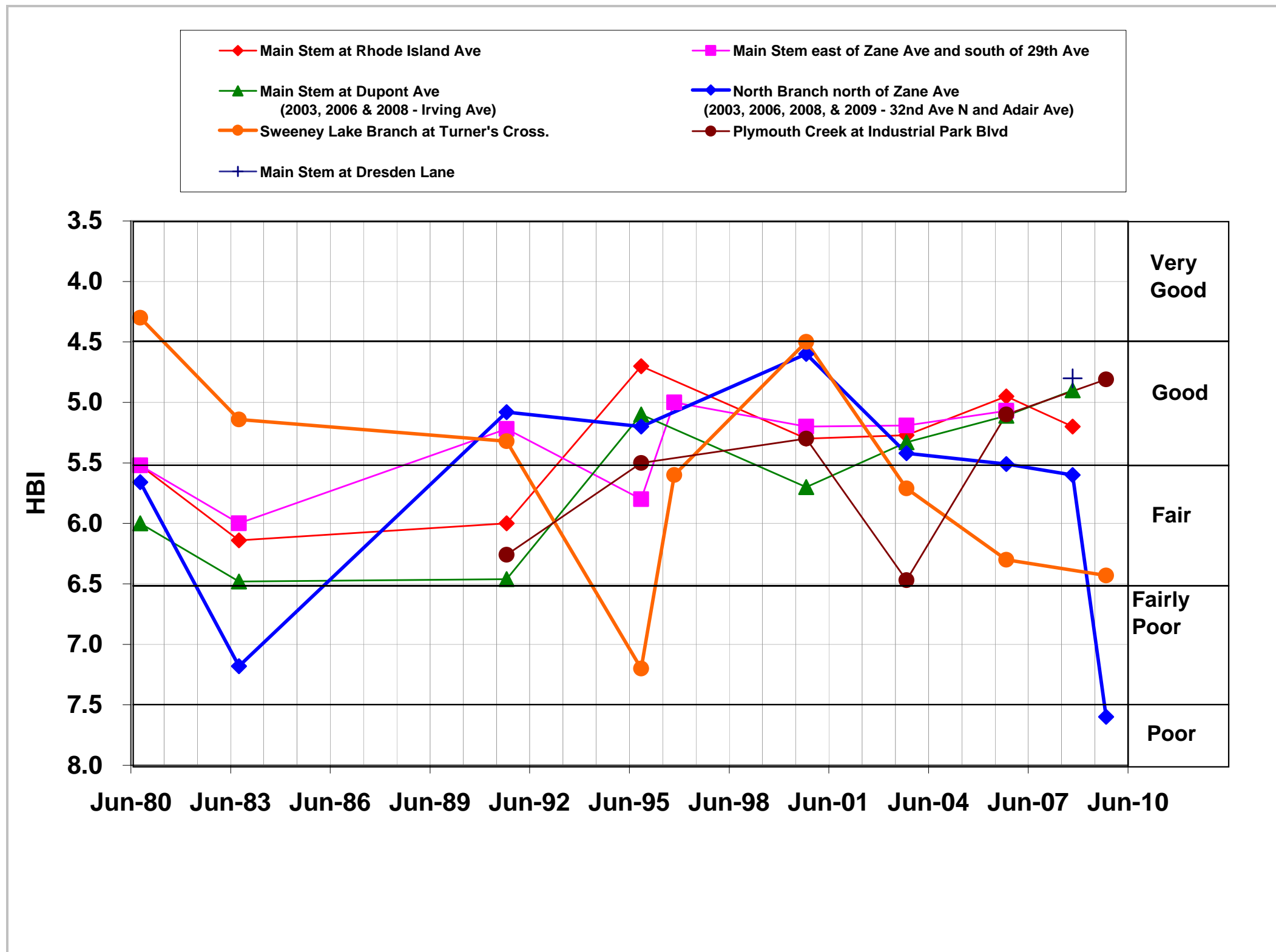


Figure EX-1. 1980-2009 Bassett's Creek and Plymouth Creek HBI Summary

Plymouth Creek and Bassett Creek (North Branch, Main Stem and Sweeney Lake Branch) are described as follows:

**Plymouth Creek**, an intermittent stream, contains organisms that are sensitive to both high and low flows. The current HBI score, as well as the score in 2006, indicate good water quality. Good water quality was also indicated by the biological community during 2000. Either low flow conditions or high flow conditions during other monitoring years changed the population structure of the stream so that there were fewer individuals and these individuals were more tolerant organisms. The 1980 low flow and 1983 high flow severely limited the number of organisms colonizing the stream. Since very low numbers of organisms were collected, the HBI evaluation during 1980 and 1983 was not possible. A sufficient number of organisms were present during 1991 and 2003 to complete an HBI evaluation of the stream, but the high flows during 1991 (37 inches of precipitation) and the low flows during 2003 (23 inches of precipitation) impacted the population structure of the biological community resulting in more tolerant organisms. The HBI score indicated fair water quality during both years.

The **North Branch of Bassett Creek** contained tolerant organisms during 2009 and observed an HBI score that indicated poor water quality. Low flows during 2003, 2006, and 2009, years in which below normal precipitation occurred, resulted in lower stream oxygen levels and the colonization of the stream by more tolerant organisms than had been observed in previous years. As tolerant organisms replaced more sensitive organisms, HBI scores indicated more degraded water quality. The stream's HBI score indicated good water quality in 2000 and 2003, borderline good/fair in 2006, fair in 2008, and poor in 2009. Prior to 2006, the stream's HBI score consistently indicated good water quality. It is not clear if below normal precipitation and low flows were the sole causes of the declining water quality in recent years.

The **Main Stem of Bassett Creek** water quality has remained relatively stable during 1980 through 2008. There was a significant improvement in water quality at the Rhode Island and Dupont Avenue sample locations in 1995, which was likely due to climatic changes since 1991 was a very wet year and 1995 was a relatively average precipitation year. The reduced quantities of stormwater runoff and lower pollutant loads in 1995 resulted in improved water quality. The Main Stem water quality has ranged from good to fair during the period of record. The 2008 water quality scores were consistent for each main stem site and remained in the good range.

The **Sweeney Lake Branch of Bassett Creek** observed significant water quality degradation in 1983, 1995 and 2003. Higher loads of pollutants washed into the stream during 1983, a very wet

year, and changed the water quality from very good to good. The water quality remained good in 1991, another very wet year. In 1995, sediment and silt from an upstream construction project washed into the stream and degraded the water quality to fairly poor. The stream recovered from construction impacts during the 1996 through 2000 period, and the stream observed a borderline good/very good water quality during 2000. Low flows in 2003, a very dry year, resulted in lower oxygen levels and the colonization of the stream by more tolerant organisms. Because of this change, HBI results indicate significantly decreased water quality (from good to fair). This decline continued in 2006 and 2009, years in which below normal precipitation occurred. However, the decline from 2003 through 2009 is not significant. HBI results indicate water quality remained fair during 2003 through 2009.

Based on the results of the 2008 and 2009 monitoring program, the Commissioners will consider:

- Continuation of its management efforts of Bassett Creek and Plymouth Creek, including installation of BMPs to protect and, if possible, to improve the water quality of the stream, as opportunities become available.
- Continuation of the use of the two biotic indices because the results of the biotic indices demonstrate they are useful in assessing the water quality of Bassett Creek and Plymouth Creek.
- Sampling all stations again in 3 to 5 years to maintain the long-term monitoring record and assess stream water quality changes.
- Continuation of flow and water quality monitoring from the Watershed Outlet Monitoring Point (WOMP) sample stations located on the Main Stem at Irving Avenue to evaluate physical and chemical parameters impacting the stream's biota.
- Continuation of management practices that preserve or improve the current water quality of Bassett Creek and Plymouth Creek.