

# City of River Falls North Kinnickinnic River Monitoring Project

## 2006 Summary

### Project Introduction:

The Kinnickinnic River is one of the premier, naturally sustaining trout fisheries in the Upper Midwest, primarily producing brown trout. There has been a lot of concern about how new development in River Falls may affect the river, especially due to storm water runoff from impervious surfaces in these urbanizing areas. Not only can storm water runoff contribute chemicals from lawns, cars, etc., but the thermal impacts of untreated storm water are also a concern, as described on the North Kinnickinnic River Monitoring Project website. In 2002, the City adopted a new [Storm Water Management Ordinance](#), which is designed to protect the Kinnickinnic River from the negative impacts of storm water runoff associated with new development. For new development and re-development projects, the City of River Falls Storm Water Management Ordinance requires that, for a 1.5-inch, 24-hour rainfall event, the post-development runoff volume and peak flow rate must not exceed the pre-development runoff volume and peak flow rate. To achieve this requirement, developers must provide on-site infiltration of storm water.

To take an active role in the river's health and well-being, the City has implemented a monitoring program aimed at evaluating the effectiveness of our Storm Water Management Ordinance for preventing degradation of the Kinnickinnic River due to new City development.

### *Project Scope:*

- Temperature Monitoring
- Water Quality Monitoring
- Base Flow Surveys
- Macroinvertebrate Monitoring

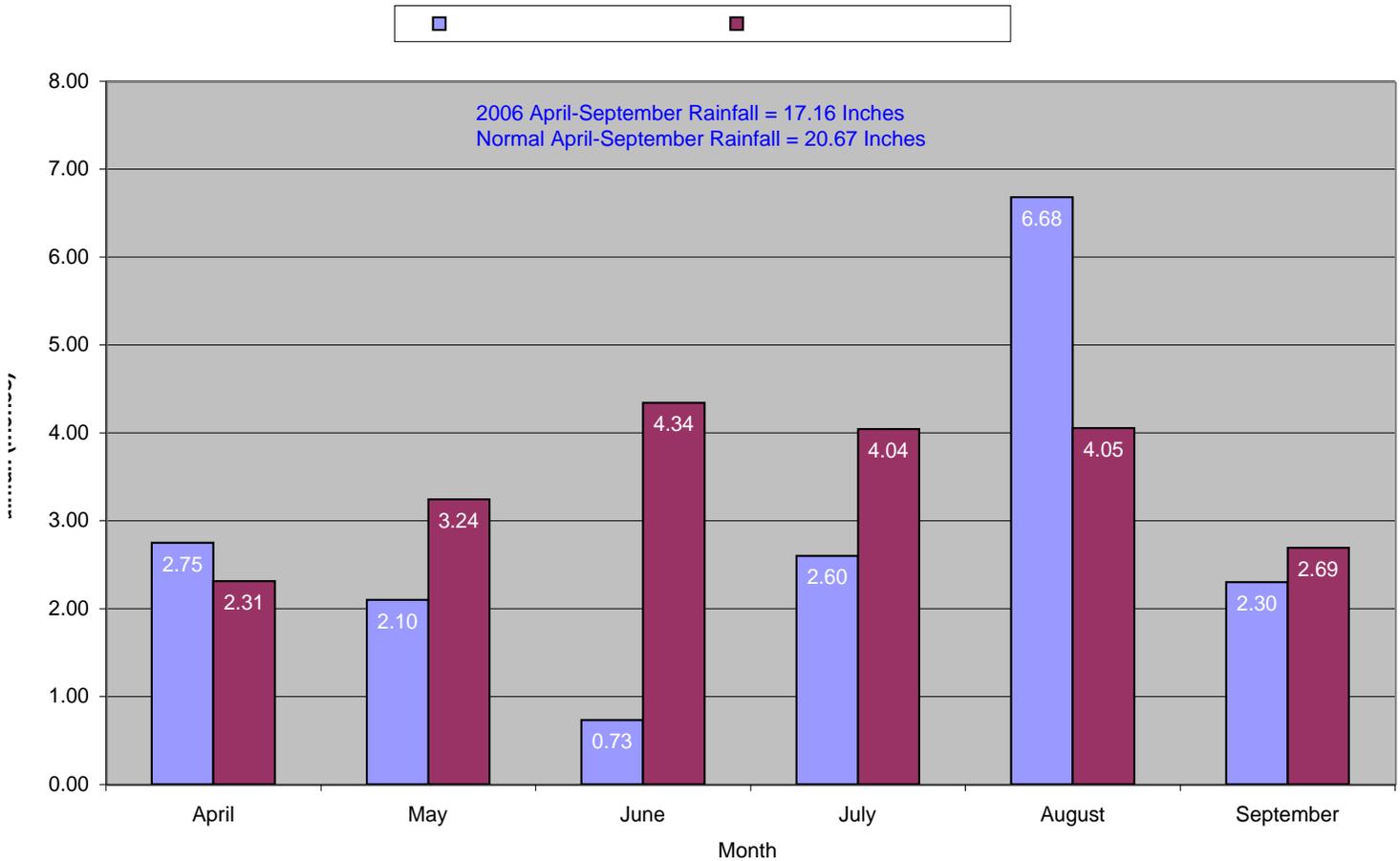
The City will examine the long-term results of each of these four monitoring elements to determine whether the new storm water ordinance is protecting the river as new development occurs. The project will use an “upstream/downstream” approach to determine if storm water management practices in the Sterling Ponds subdivision protect downstream river conditions. We will also take a focused look at the performance of the on-site storm water management practices that are incorporated into new developments. Our hope is that due to the ordinance requirements, the water quality and thermal impacts of new development will be undetectable or greatly reduced.

**River Falls Precipitation:**

Due to the major influence of precipitation on river flow, temperature, and water quality, an analysis of seasonal precipitation is conducted as a part of this project. A total of 17.16 inches of precipitation was recorded in River Falls during the April-September 2006 period, 3.5 inches less than the normal total of 20.67 inches for this time period. Rain fell on 61 days, or 33% of the April-September 2006 period.

Except for April and August, all months during the April-September 2006 period (below) were drier than normal, with monthly rainfall deficits ranging from 0.4 inch to 3.6 inches. The greatest rainfall deficits occurred in June and July, with the lowest monthly rainfall amount (0.73 inch) recorded in June. August was the wettest month (6.68 inches), exceeding the normal monthly rainfall amount by 2.6 inches.

**River Falls Monthly Rainfall: April-September 2006**



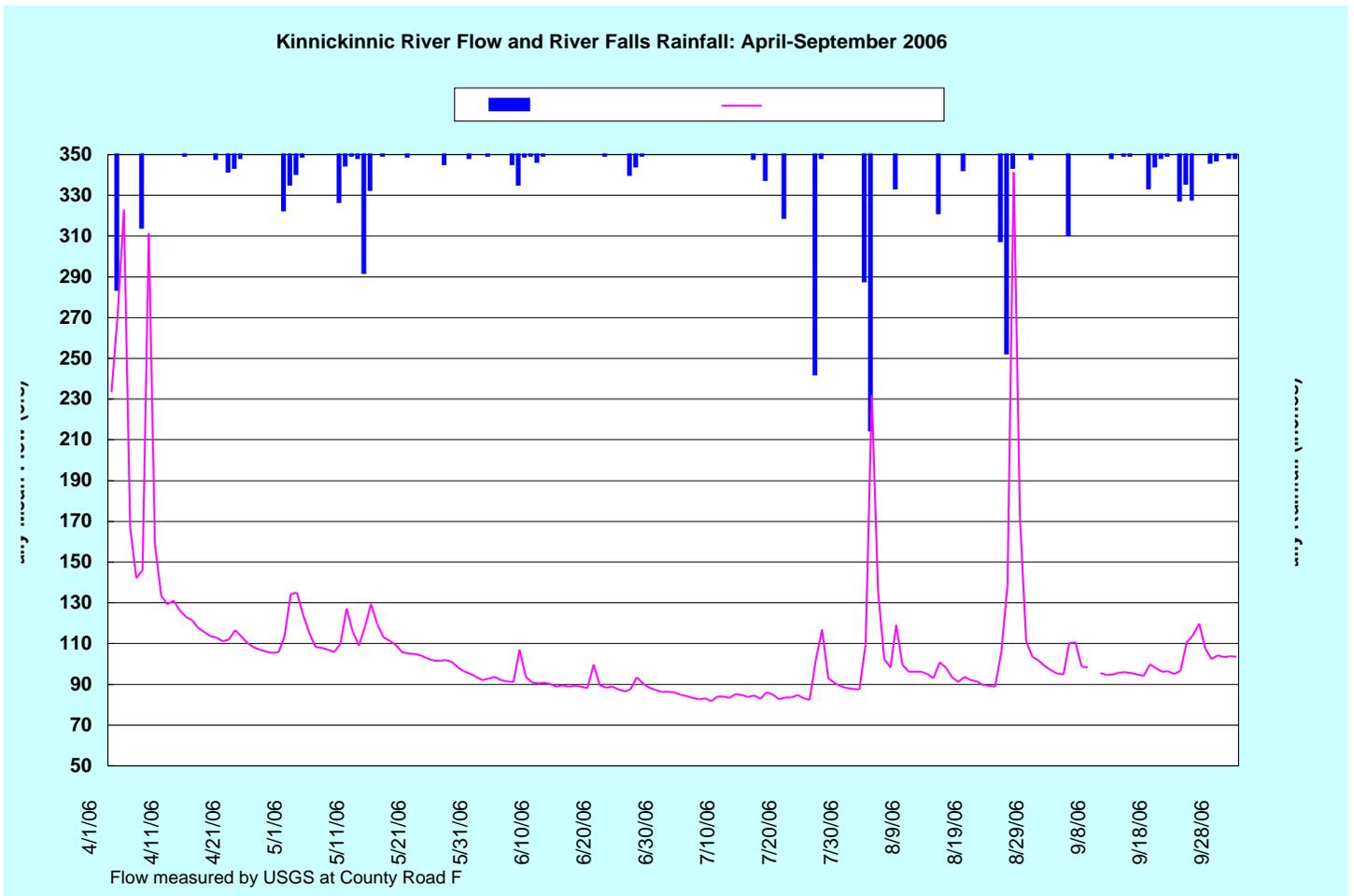
Besides being drier than normal, the April-September 2006 monitoring period was warmer than normal. The mean air temperature in River Falls during the April-September 2005 period was 64.8° Fahrenheit (F), 1.6° F higher than the normal mean of

63.2° F for this time period. With the exception of September, all months during the April-September 2006 period were warmer than normal. The month of April was nearly 7° F warmer than normal, while the month of July was 4° F warmer than normal. The month of September was 3° F colder than normal.

The City of River Falls Storm Water Management Ordinance would have provided infiltration of approximately 93% (15.97 inches) of the total rainfall (17.16 inches) that occurred during the April-September 2006 period. This percentage was determined using some conservative estimates further described in the 2006 technical report.

**Kinnickinnic River Flow:**

The flow of the Kinnickinnic River is a reflection of strong ground water contributions, as well as precipitation-induced storm water runoff from predominantly agricultural and urban land uses throughout the 165-square mile Kinnickinnic River Watershed. The daily mean (average) flow of the Kinnickinnic River at County Highway F during the April-September 2006 period is presented in the figure below. Daily rainfall, as measured in River Falls, is also presented in the figure below.



The Kinnickinnic River hydrograph suggests that five significant runoff events occurred during the April-September 2006 period. Two of these five significant runoff events occurred in April, due to early spring rains. Three of the five significant runoff events occurred during the July-August period, when rainfall amounts in excess of 1 inch had the greatest influence on the Kinnickinnic River hydrograph. A large rainfall event on July 24 resulted in only a moderate increase in the Kinnickinnic River hydrograph, with a peak daily mean flow of 117 cfs. Large, back-to-back rainfall events on August 1-2 and August 23-24 produced the two largest runoff events of the summer, with peak daily mean flows of 232 and 342 cfs, respectively. During dry periods between runoff events, the Kinnickinnic River maintained a base flow condition of approximately 85-95 cfs at County Highway F.

### **Temperature Monitoring:**

Information about the thermal impacts of untreated storm water runoff can be found in the “*Thermal Impacts*” section of the North Kinni Monitoring website.

The intent of the City of River Falls Storm Water Management Ordinance is to prevent storm water impacts on the Kinnickinnic River, including thermal pollution, in areas of the city with new development, such as the Sterling Ponds Subdivision.



**A direct storm sewer discharge to the Kinnickinnic River at Division Street**

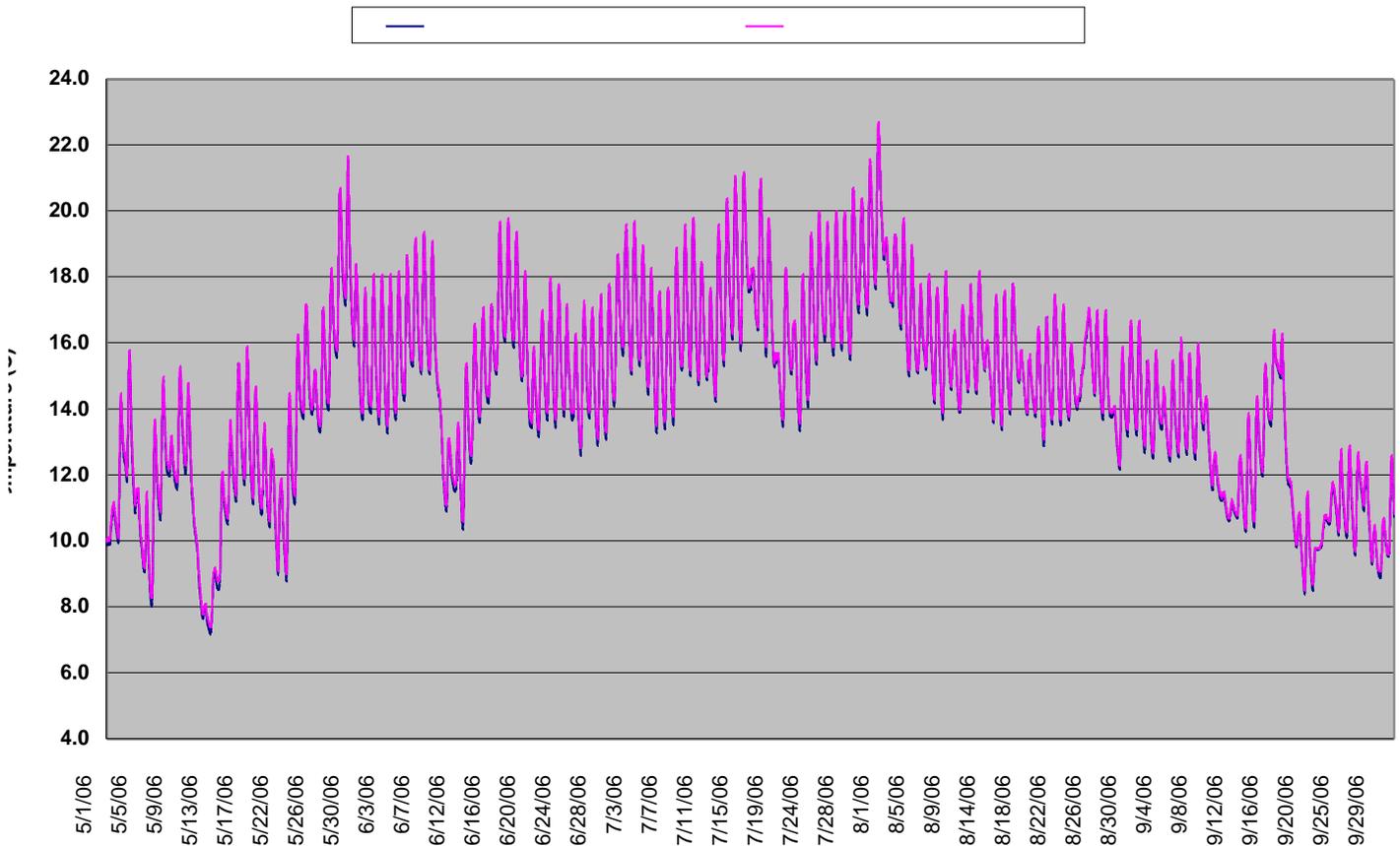
### ***Kinnickinnic River Temperature Monitoring Results:***

May-September (summer) 2006 temperature monitoring data were obtained for the Kinnickinnic River at Sites 1, 1A, and 3. River temperatures at these three monitoring sites averaged 14.6° C and ranged from 5.9-23.1° C over the course of the summer.

For the second consecutive year, slightly higher-than-normal river temperatures probably prevailed in the North Kinnickinnic River Monitoring Project Area during the summer of 2006. The 2006 summer average air temperature of 19.4° C (67.0° F) was slightly higher than the normal summer average air temperature of 19.2° C (66.5° F).

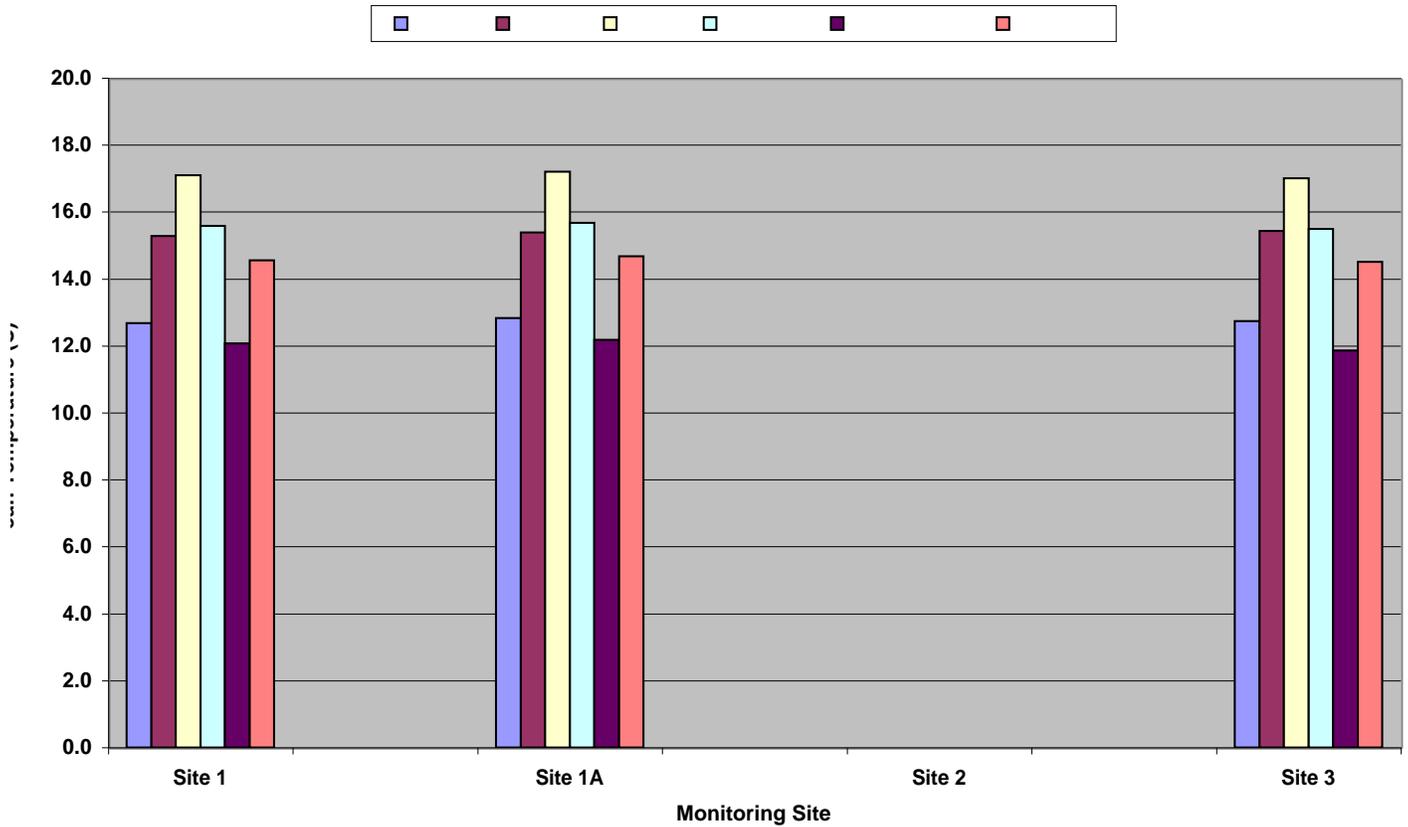
Upstream summer temperatures at Site 1A were nearly identical to downstream summer temperatures at Site 1. A comparison of temperatures at Site 1A (upstream) and Site 1 (downstream) is shown below.

Kinnickinnic River Temperatures at Sites 1 and 1A: May-September 2006



The 2006 monthly and summer average temperatures at Sites 1, 1A, and 3 were also nearly identical, as shown below.

Monthly and Summer Mean Temperatures at Kinnickinnic River Monitoring Sites:  
May-September 2006



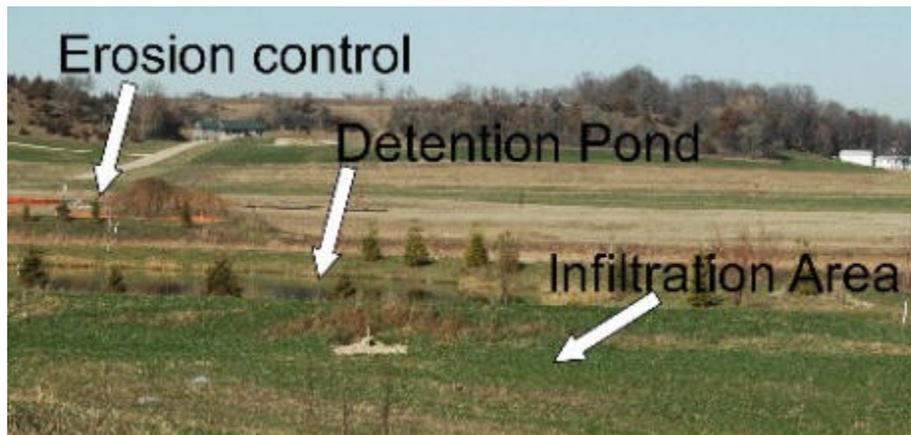
The summer 2006 temperature regime in the Kinnickinnic River at Sites 1 and 1A was excellent for coldwater macroinvertebrate and brown trout communities. Approximately 81% of all temperatures recorded at Sites 1 and 1A during the May-September 2006 period were less than or equal to ( $\leq$ ) 17° C, which is the top of the optimum temperature range for a healthy coldwater macroinvertebrate community. A temperature of 17° C is also considered to be the optimum for brown trout survival. Approximately 95% of all temperatures recorded at Sites 1 and 1A during the May-September 2006 period were  $\leq$  19° C, which is the top of the optimum temperature range for brown trout growth. Approximately 98% of all temperatures recorded at Sites 1 and 1A during the May-September 2006 period were  $\leq$  20° C, which is the top of the optimum temperature range for brown trout survival. River temperatures exceeding 20° C were only recorded on two dates in late May and eight dates in mid-to-late July, when air temperatures exceeded 32° C (90° F).

Downstream from Sumner Creek and Sterling Ponds, no storm water-related thermal impacts were apparent at Site 1 after summer rain events, including three significant rainfall and runoff events in July and August 2006.



### ***Sumner Creek and Sterling Ponds Temperature Monitoring Results:***

May-September (summer) 2006 temperature monitoring data were obtained for Sumner Creek at Site 6 (upstream from Sterling Ponds) and at Sites 4 and 4A (downstream from Sterling Ponds). Site 4A is located near the mouth of Sumner Creek. Temperature monitoring data for the Sterling Ponds storm water management practices were obtained in the wet detention pond (Site 5P), at the wet pond discharge to the infiltration basin (Site 5IB), and at the wet pond discharge to Sumner Creek (Site 5MHW). The Sumner Creek and Sterling Ponds temperature monitoring results helped document the effectiveness of the City of River Falls Storm Water Management Ordinance in 2006.



### **Storm water best management practices in place at Sterling Ponds**

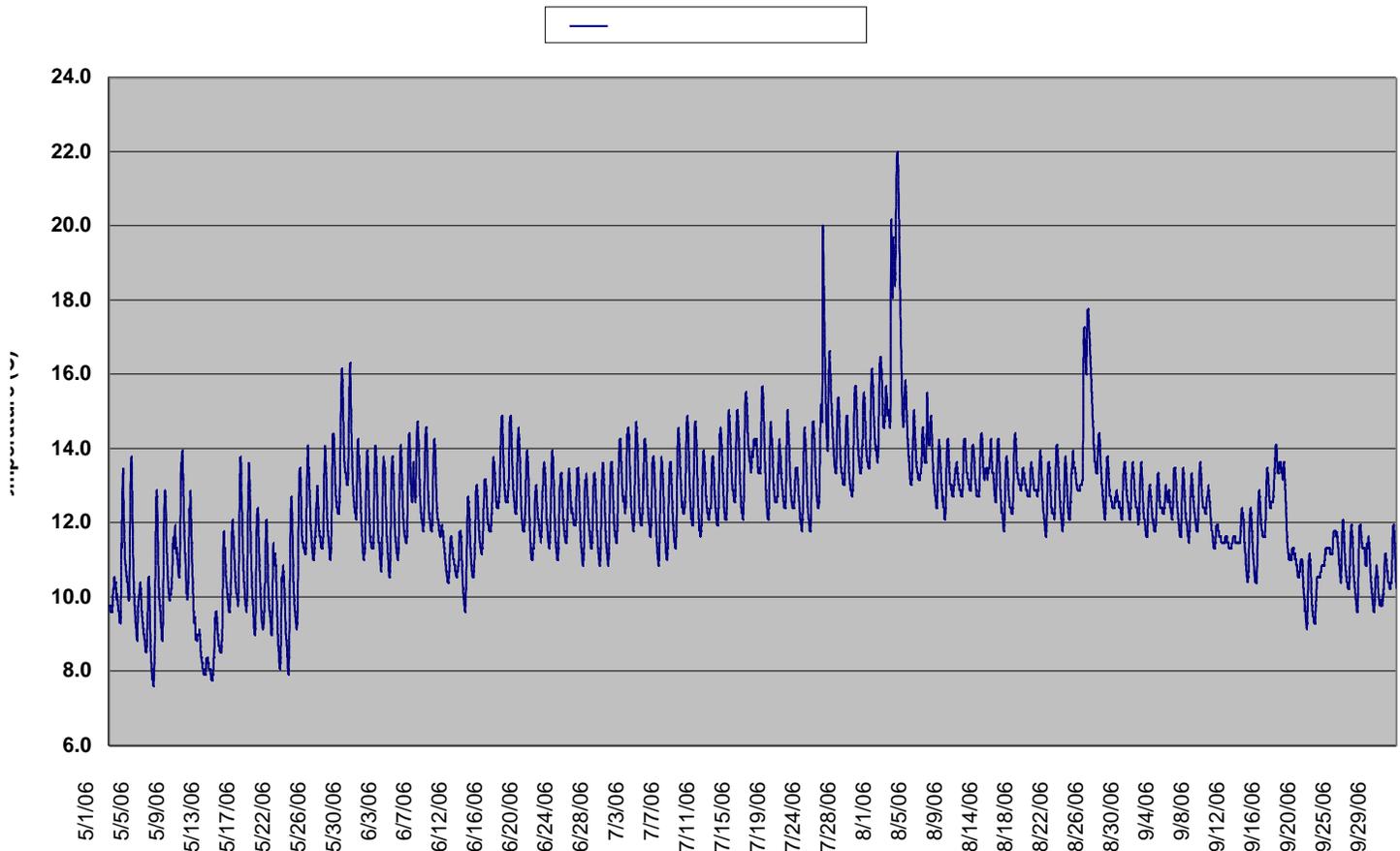
Temperature monitoring data indicate that the storm water management practices at Sterling Ponds caused no major thermal impacts on the Kinnickinnic River during the May-September 2006 period. The summer mean temperature of the Sterling Ponds wet detention pond at Site 5P was 21.4° C, but much of this warm storm water was effectively discharged to the adjacent infiltration basin. With the exception of the three largest rain events in July and August, all summer rainfall events were fully infiltrated, as required by the River Falls Storm Water Management Ordinance. The remaining 49 rain events, ranging in magnitude from 0.01-1.04 inches, represent a total of 8.72 inches of precipitation, or 60% of the total summer rainfall amount (14.41 inches).

The Sterling Ponds wet detention pond only discharged to Sumner Creek after the three largest rain events in July and August. During these events (all in excess of 1.5 inches), the wet detention pond discharged very warm water (23.4-26.5° C) to the Sumner Creek drainage way, often for an extended time period (4 hours). Although the magnitude of these rain events clearly exceeded the 1.5-inch infiltration requirement of the storm water management ordinance, the events nonetheless resulted in warm storm water discharges that produced pronounced thermal spikes in Sumner Creek at Site 4. After the largest rain event of the summer on August 2, a “plug” of warm water (including Sterling Ponds storm water) moved downstream from Site 4, also causing a thermal spike at Site 4A, near the mouth of Sumner Creek. However, no thermal spike was apparent downstream

in the Kinnickinnic River, at Site 1. The duration of the July and August storm water discharges to Sumner Creek was relatively short (4 hours), compared with lengthy discharges of storm water to the Sterling Ponds infiltration basin (4-8.5 days), suggesting that the majority of storm water from these three large rain events was infiltrated rather than discharged to the creek.

Permanent flow occurred in lower Sumner Creek at Site 4A throughout the summer. The summer mean temperature (12.4° C) reflects strong spring flow. The creek potentially provides a good thermal environment for a brook trout fishery, and is an important contributor of cold water to the Kinnickinnic River. However, thermal spikes of significant magnitude (4.1-7.1° C) occurred at this location after the large rain events in July and August. These spikes (shown below) appear unrelated to the storm water discharges at Sterling Ponds, and seem to have a more local cause that needs further investigation.

Sumner Creek Temperature at Site 4A: May-September 2006



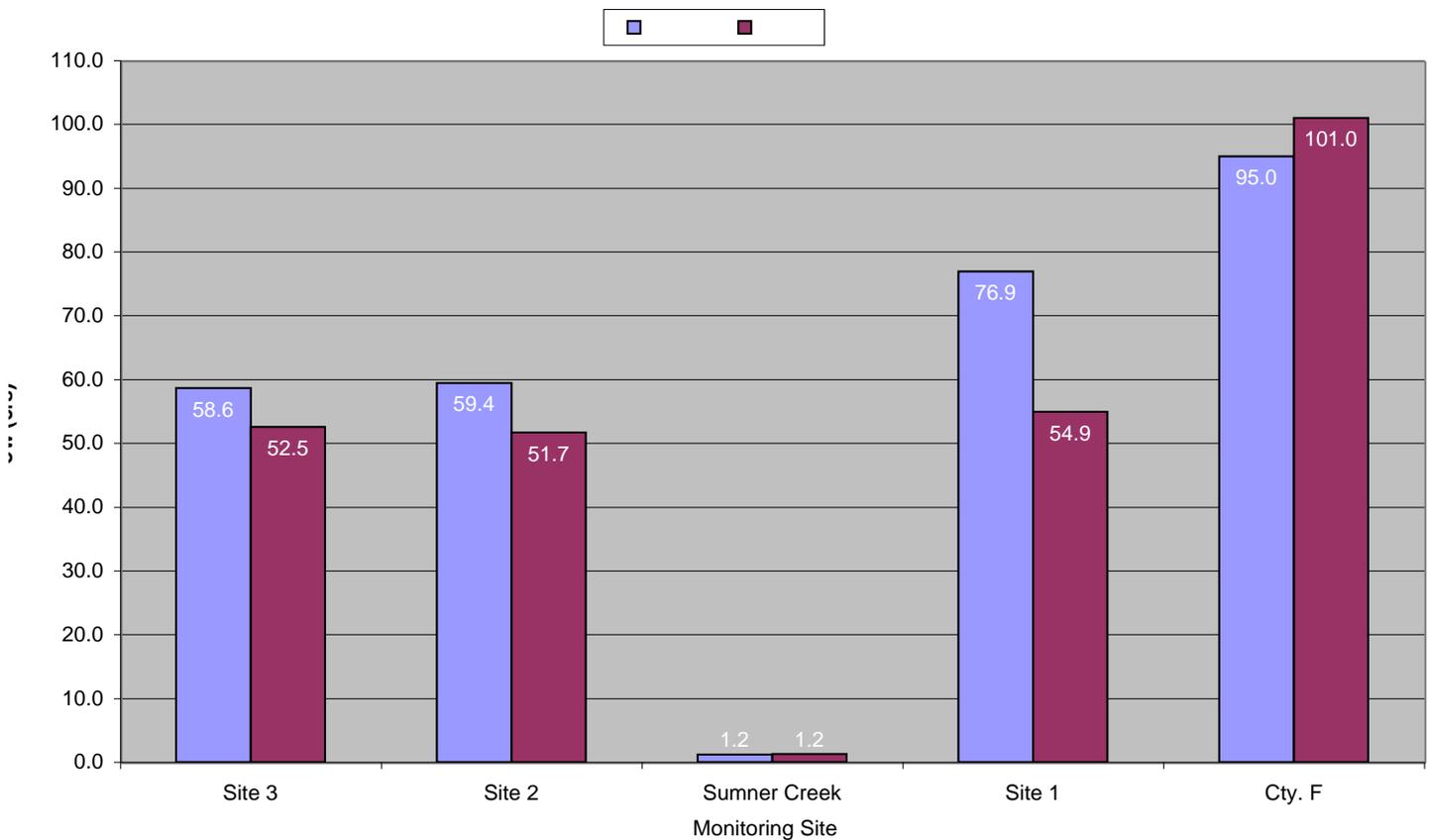
**Base Flow Surveys:**

In May and October 2006, base flow measurements were obtained at Sites 1-3 in the Kinnickinnic River and at the mouth of Sumner Creek (Site 4A) within the North

Kinnickinnic River Monitoring Project Area. The Kinnickinnic River was assumed to be in a base flow condition when 3-4 days of “flat-line” flow were observed at the USGS stream flow gauging station located at County Highway F (as described in the 2006 technical report). During the April-September 2006 period, the Kinnickinnic River generally maintained a base flow condition of approximately 85-95 cfs at County Highway F. Spring measurements were not conducted in 2005, therefore comparisons between the spring base flow measurements will occur next year.

The October 2006 base flow survey results are presented below, with a comparison to the 2005 survey results. In 2006, Kinnickinnic River base flows were nearly identical at Sites 2 and 3. The base flow at Site 1 was only slightly higher, with Sumner Creek providing a small contribution upstream of Site 1. The 2006 Kinnickinnic River base flows in the project area (Sites 1-3) were reduced compared to 2005, likely due to below-normal precipitation during the summer of 2006.

**Autumn Baseflow Conditions in the Kinnickinnic River and Sumner Creek: 2005-2006**



One goal of the River Falls Storm Water Management Ordinance is to maintain strong base flow conditions in the Kinnickinnic River by requiring storm water management practices that promote infiltration of rainfall, thereby maintaining shallow aquifer levels,

as well as the springs that provide cold water for the river. The initial base flow surveys in 2005 and 2006 will provide a baseline for determining if base flow conditions will be sustained in the future as development progresses in the North Kinnickinnic River Monitoring Project Area.

**Macroinvertebrate Monitoring:**

Biological indicators such as macroinvertebrates (aquatic insects) are often used to complement physical and chemical measurements in stream monitoring programs. Because macroinvertebrates live in the stream environment for a year or more, they are excellent indicators of past as well as present water quality conditions. Annual macroinvertebrate samples are collected at Sites 1-3 within the North Kinnickinnic River Monitoring Project Area. Organisms are identified and counted in the laboratory, and various biological indices can then be calculated for each monitoring site. The index values are indicative of water quality, depending upon the pollution tolerances of the macroinvertebrates collected at the monitoring sites.

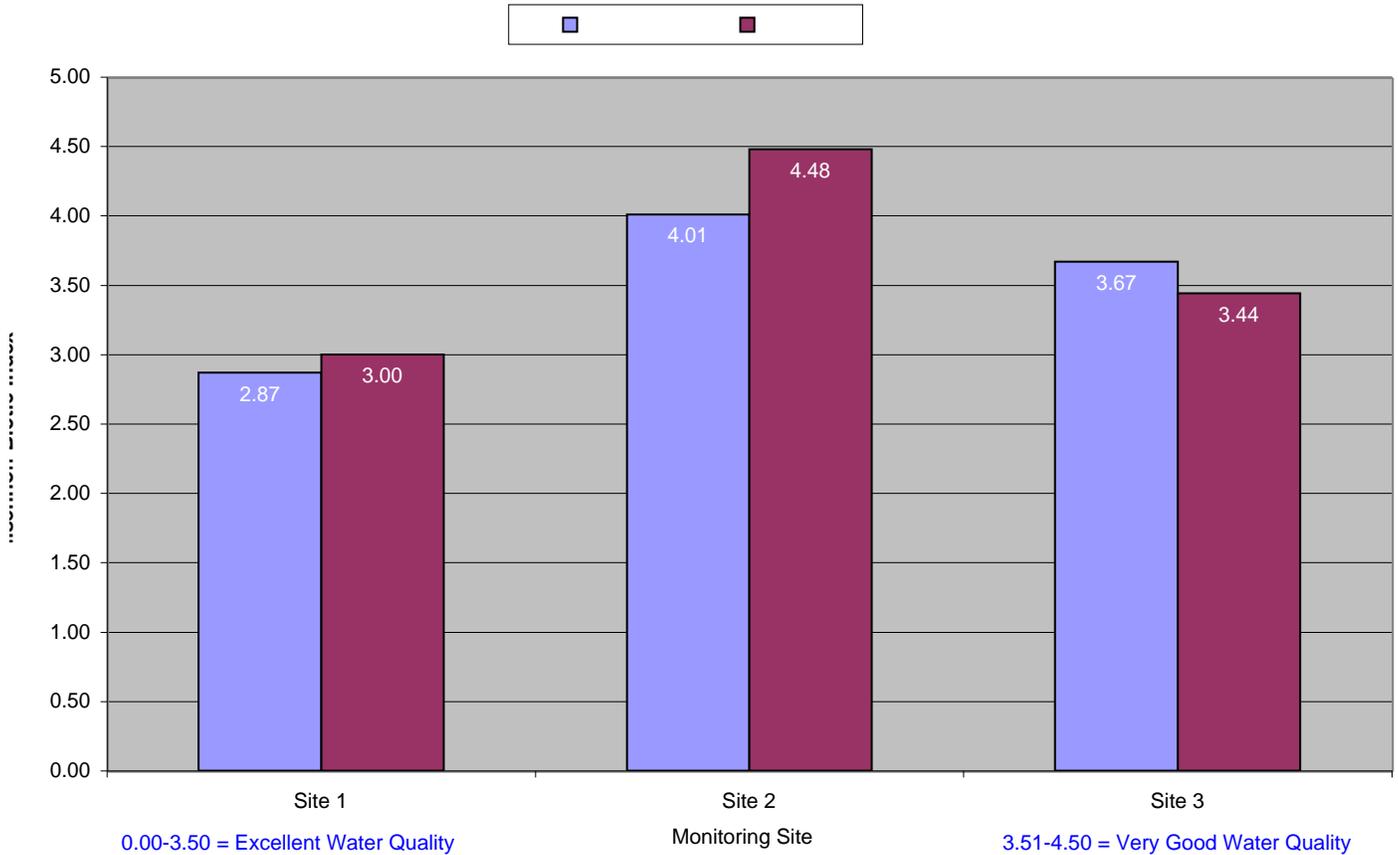
The Hilsenhoff Biotic Index (HBI) is particularly useful for determining the influence of organic pollution on macroinvertebrates. The Wisconsin Department of Natural Resources has used this index for many years in long-term stream monitoring efforts. Each macroinvertebrate taxon (genus and/or species) has been assigned a specific tolerance value, ranging from 0 (extremely intolerant of organic pollution) to 10 (extremely tolerant of organic pollution). The more intolerant taxa that are present, the lower the HBI value, indicating better water quality, as follows:

<b>HBI Value</b>	<b>Water Quality</b>	<b>Degree of Organic Pollution</b>
0.00-3.50	Excellent	No apparent organic pollution
3.51-4.50	Very Good	Slight organic pollution
4.51-5.50	Good	Some organic pollution
5.51-6.50	Fair	Fairly significant organic pollution
6.51-7.50	Fairly Poor	Significant organic pollution
7.51-8.50	Poor	Very significant organic pollution
8.51-10.00	Very Poor	Severe organic pollution

The 2004-2005 macroinvertebrate HBI values at Sites 1-3 are presented below. These 2004 and 2005 data were generated to establish a macroinvertebrate-based water quality baseline at the start of this monitoring project. In 2004 and 2005, HBI values at Site 1 were indicative of excellent water quality, HBI values at Site 2 were indicative of very good water quality, and HBI values at Site 3 were indicative of very good-excellent water quality. Macroinvertebrate monitoring was again conducted in May 2006, but the sample

analysis has not yet been completed by the University of Wisconsin-Stevens Point laboratory. Annual HBI values and site comparisons will continue to be posted as they become available.

Macroinvertebrate HBI Values in the Kinnickinnic River: 2004-2005



**Water Quality Monitoring:**

No runoff event-based water quality monitoring was conducted in 2006. With below-normal precipitation during the April-September period, very few significant runoff events occurred in the North Kinnickinnic River Monitoring Project Area. Given more normal precipitation and runoff conditions, the water quality monitoring component of this project will be initiated in 2007.