



**Applewood
Gilkey Creek Rehabilitation Project**

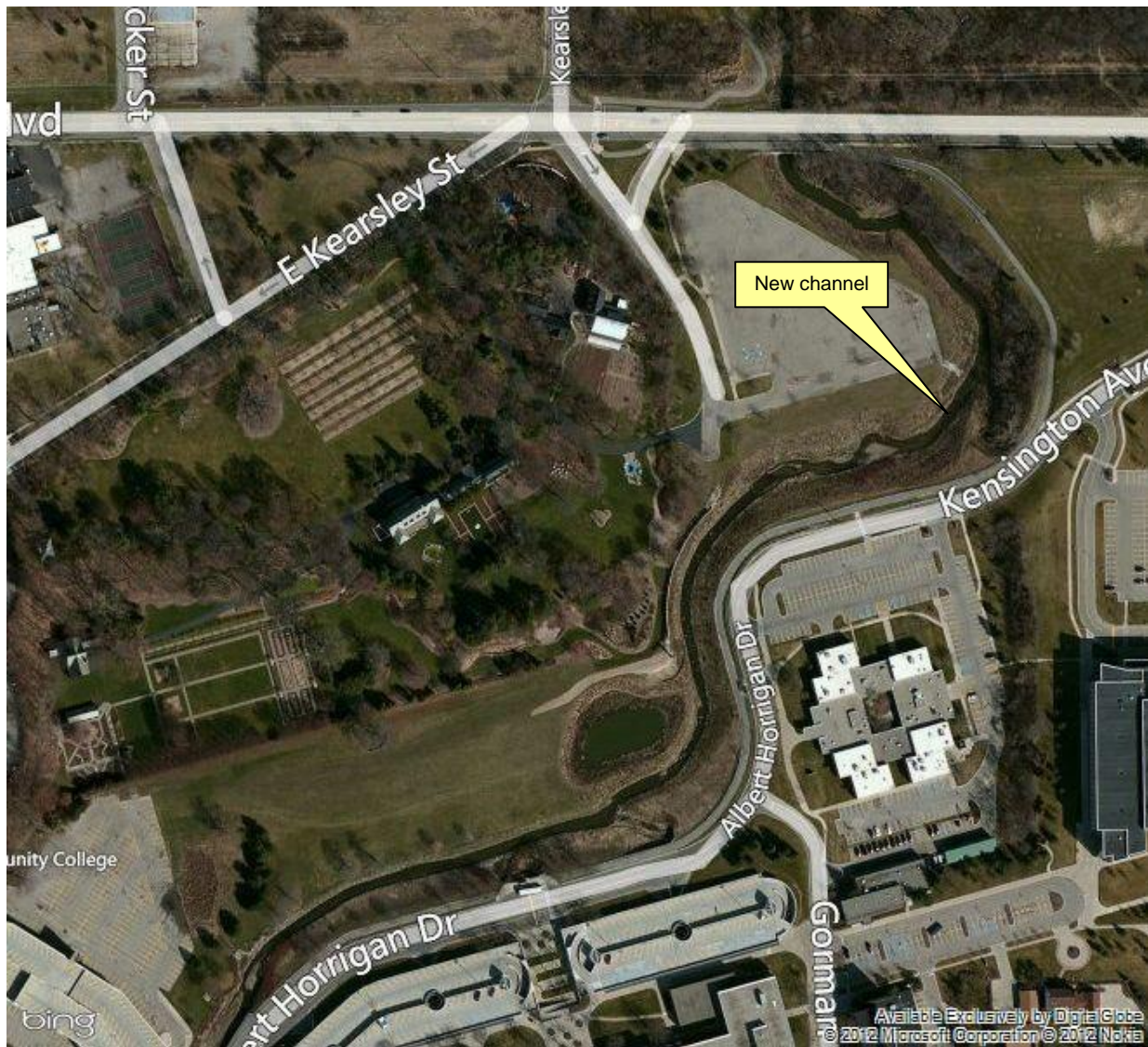
**Water Quality Assessment
2007 through 2011**

Produced by
The Flint River Watershed Coalition

January 2013

Executive Summary

During the summer and fall of 2007, a project to protect the Mott Applewood Estate from flooding and enhance wildlife habitat in Gilkey Creek was carried out in the reach encompassed by the estate. The project involved excavating a new stream channel and contouring stream banks to correct hydrological problems caused by channelization. In addition, a stormwater retention pond and wetland were constructed next to the creek; bank armoring was installed; and riffles, check dams, pools and other types of aquatic habitat were created in the new channel, which is shown below:



Soil erosion and sedimentation control measures were carefully employed throughout construction to prevent water pollution in the creek.

Flooding was exacerbated at Applewood by upstream commercial and residential development, mostly in the City of Burton, which increased the area of upstream impervious surfaces and volume of stormwater captured by them. Upstream stormwater is rapidly directed to Gilkey Creek through enclosed storm sewers and open drains. More recent upstream development includes the use of retention basins to slow stormwater flow to prevent flooding.

In the summer and fall of 2007, an initial study of the impact of the stream rehabilitation project on water quality was done while it was under construction. Samples were collected from the creek upstream and downstream of the project, and water quality index scores were calculated from sample test results. This was done during periods of dry and wet weather to evaluate the impact of stormwater runoff and stream bank erosion during high flows on water quality. A biological survey was also done upstream and downstream of the project for assessing the ecological health of the stream.

No substantial degradation in water quality was observed, and no correlation between rainfall amount and water quality was found.

Follow up studies were done in 2008, 2009, 2010 and 2011; and monitoring was also done within Applewood during these years.

From 2007 through 2011, water quality at all locations was typically good and ecological health was typically fair.

It was found that dissolved solids and excessive algal growth, may be significantly degrading water quality and impairing beneficial uses of the creek.

Introduction

From 2007 to 2011, the Flint River Watershed Coalition monitored water quality in Gilkey Creek, upstream and downstream of the Mott Applewood Estate. Monitoring was also done within the estate.

Chemical, physical and biological methods were used to assess the impact of a stream rehabilitation project done at Applewood in 2007 for preventing flooding at the estate and improving wildlife habitat in the creek.

The project involved excavating a new stream channel and contouring stream banks to correct hydrological problems caused by channelization. In addition, a stormwater retention pond and wetland were constructed next to the creek; bank armoring was installed; and riffles, check dams, pools and other types of aquatic habitat were created in the new channel.

Sampling Locations

Samples were collected at sites upstream and downstream of the stream rehabilitation project, as well as within it.

For the chemical/physical survey, the upstream site was located at the downstream side of the bridge at the Mott Community College parking ramp next to Applewood (off Horrigan Drive) and the downstream site was located immediately downstream of the Kearsley Park Boulevard bridge (in Kearsley Park). The site in Applewood was located next to the visitor parking lot (near Longway Boulevard).

For the biological survey, the upstream site was located immediately upstream of the E. Court Street bridge in Burroughs Park and the downstream site was located immediately downstream of the Kearsley Park Boulevard bridge (in Kearsley Park). The site in Applewood was located next to the visitor parking lot (near Longway Boulevard).

Sampling and Measurement Methods

Grab samples were dipped from Gilkey Creek and routinely tested for: ammonia, alkalinity, color, conductivity, dissolved solids, hardness, pH, ortho-phosphate, nitrate, suspended solids, and turbidity. Dissolved oxygen and temperature were also routinely measured insitu with a probe.

A water quality score was calculated from the test results with a method developed by the National Sanitation Foundation (NSF) and an online calculator at <http://www.water-research.net/watqualindex/index.htm>.

Testing was done with the following Hach equipment and methods:

Device	Parameter	Method		Range
		Description	#	
HQ30d Dissolved Oxygen Meter and LDO101 IntelliCAL Probe.	Dissolved Oxygen	Electrometric	NA	
	Temperature	Electrometric	NA	
sensION1 pH Meter	pH	Electrometric	NA	0-14 S.U.
sensION5 Conductivity Meter	Conductivity	Electrometric	NA	
	Dissolved Solids	Electrometric	NA	
DR/890 Colorimeter	Ammonia	Salicylate, Colorimetric	8155	0-0.50 mg/L
	Color, True & Apparent	Photometric	8025	0-500 Pt/Co Units
	Nitrate	Cadmium Reduction, Colorimetric	8039	0-30.0 mg/L
	Phosphate	Ascorbic Acid, Colorimetric	8048	0-2.50 mg/L
	Suspended Solids	Photometric	8006	0-750 mg/L
	Turbidity	Absorptometric	8237	0-1000 FAU
Digital Titrator	Alkalinity, Total	Sulfuric Acid, Volumetric	8203	10-4000 mg/L
	Hardness, Total	EDTA, Volumetric	8213	10-4000 mg/L

Sampling was done during periods of dry and wet weather, and on-line precipitation data for Flint was recorded. Benthic macroinvertebrate organisms were also collected from various types of habitat in Gilley Creek, which were classified according to their pollution tolerance. The relative abundance of tolerant and intolerant organisms was determined for assessing the ecological health of the stream. In addition, water depth was measured with a yard stick and water velocity was measured with a Global Water FP201 Flow Probe in the concrete flume in Kearsley Park between Longway Boulevard and Kearsley Park Boulevard.

Findings

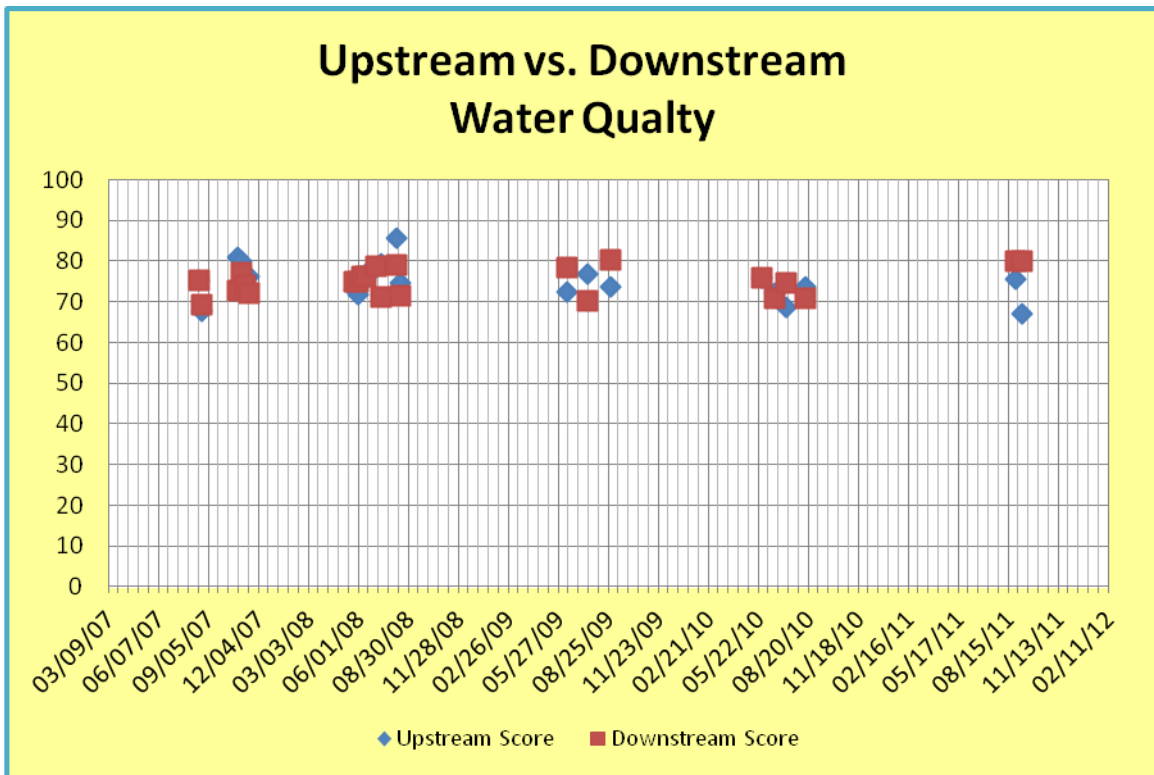
Water quality for supporting ecological health was assessed by chemical and physical analysis, and a water quality score and rating were determined using the following scale:

Score	Rating
91 - 100	Excellent water quality
71 - 90	Good water quality
51 - 70	Medium water quality
26 - 50	Fair water quality
0 - 25	Poor water quality

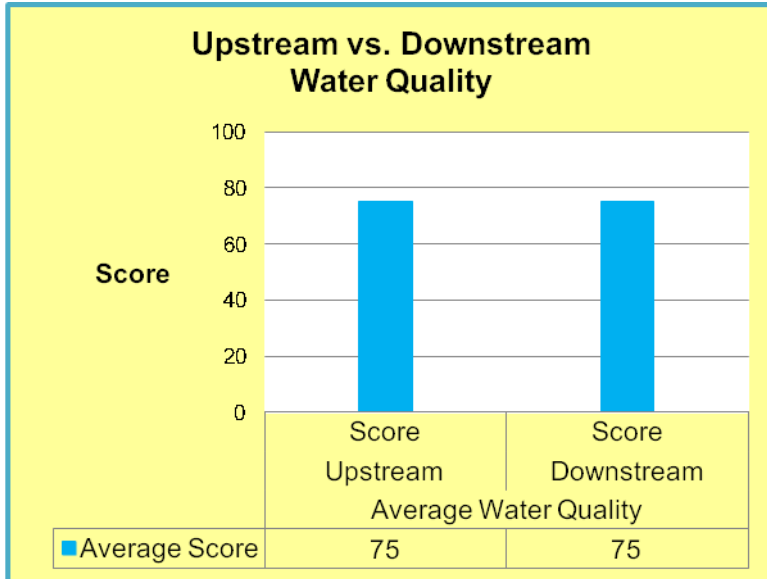
The upstream and downstream water quality scores and ratings were as follows:

Date	Upstream		Downstream	
	Score	Rating	Score	Rating
08/19/07	75	Good	75	Good
08/25/07	68	Medium	69	Medium
10/27/07	81	Good	73	Good
11/03/07	80	Good	77	Good
11/10/07	76	Good	74	Good

Date	Upstream		Downstream	
	Score	Rating	Score	Rating
11/18/07	76	Good	72	Good
05/24/08	73	Good	75	Good
05/31/08	72	Good	75	Good
06/08/08	76	Good	76	Good
06/15/08	77	Good	76	Good
07/04/08	78	Good	79	Good
07/13/08	79	Good	71	Good
08/10/08	86	Good	79	Good
08/17/08	75	Good	72	Good
06/12/09	73	Good	78	Good
07/18/09	77	Good	70	Good
08/30/09	74	Good	80	Good
05/28/10	76	Good	76	Good
06/20/10	72	Good	71	Good
07/11/10	69	Medium	75	Good
08/16/10	74	Good	71	Good
08/29/11	76	Good	80	Good
09/10/11	67	Medium	80	Good
Average	75	Good	75	Good

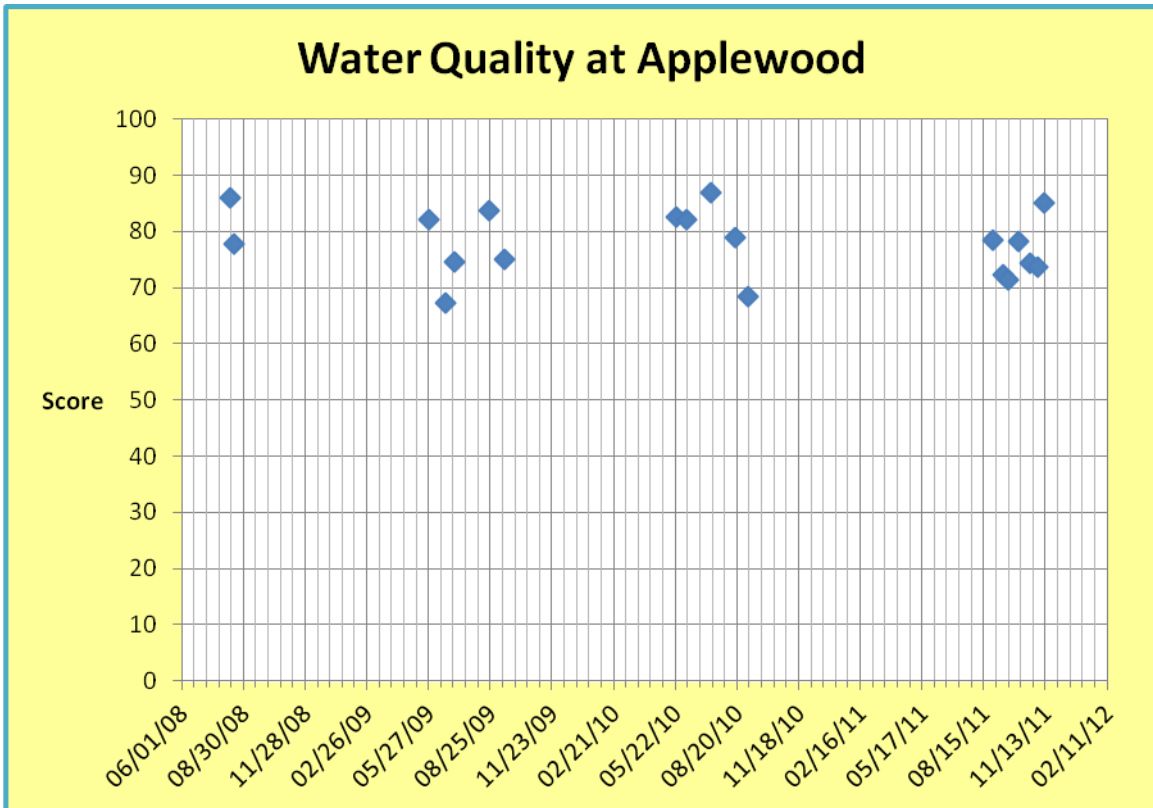


The average scores for each site were as follows:



The water quality scores and ratings within Applewood were as follows:

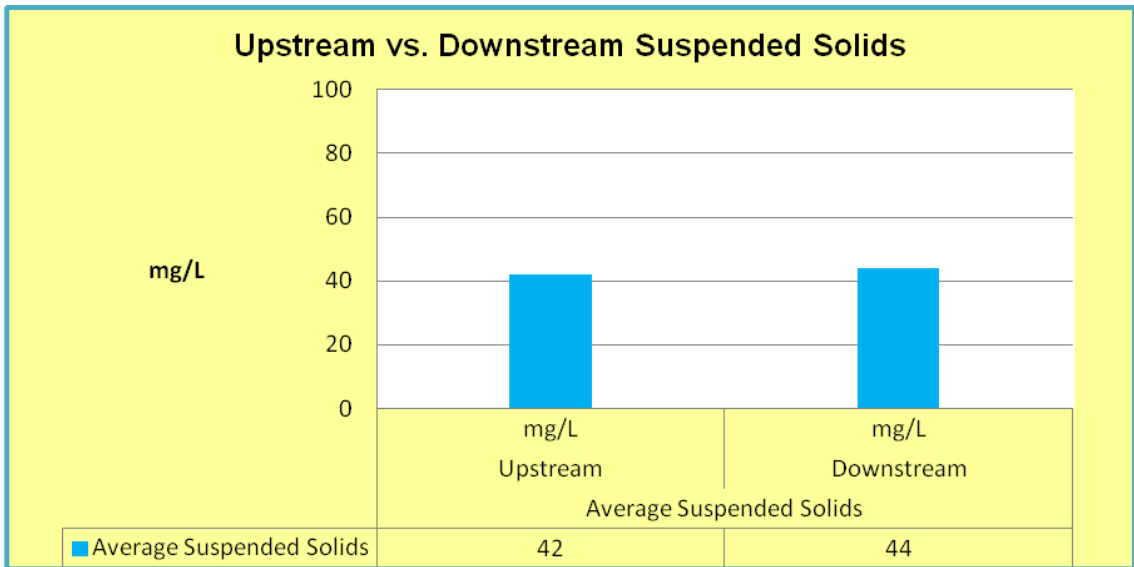
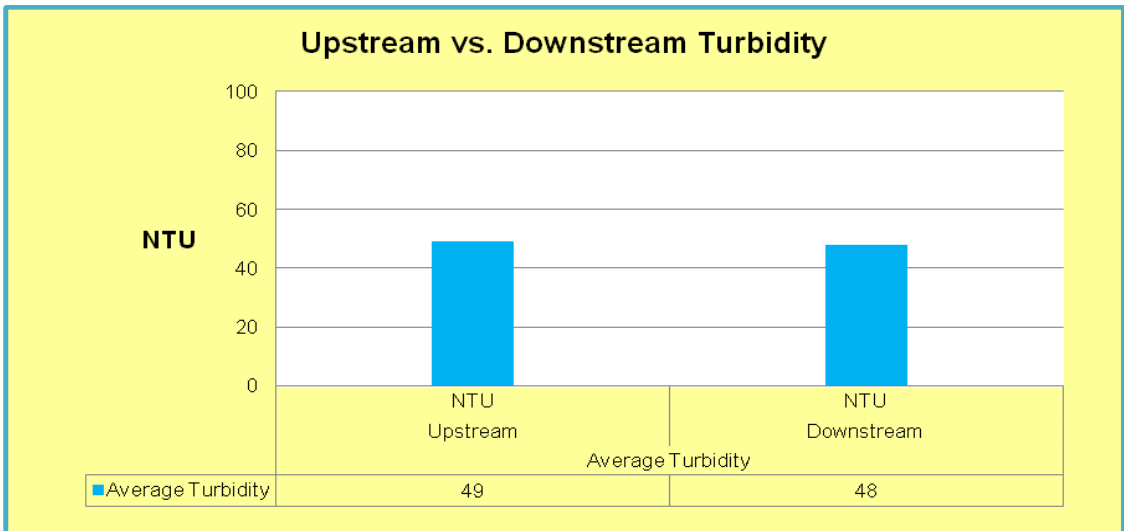
Date	Score	Rating
08/10/08	86	Good
08/17/08	78	Good
05/27/09	82	Good
06/21/09	67	Medium
07/03/09	75	Good
08/23/09	84	Good
09/15/09	75	Good
05/23/10	83	Good
06/07/10	82	Good
07/13/10	87	Good
08/18/10	79	Good
09/05/10	68	Medium
08/28/11	79	Good
09/12/11	72	Good
09/20/11	71	Good
10/05/11	78	Good
10/21/11	74	Good
11/02/11	74	Good
11/12/11	85	Good
Average	78	Good



The comparative upstream and downstream turbidity and suspended solids levels were as follows:

Date	Turbidity			Suspended Solids		
	Upstream	Downstream	Difference	Upstream	Downstream	Difference
	NTU	NTU	%	mg/L	mg/L	%
08/19/07	31	31	0	20	24	-20
08/25/07	90	102	-13	68	77	-13
10/27/07	64	71	-11	55	60	-9
11/03/07	9	11	-22	5	6	-20
11/10/07	20	53	-165	11	46	-318
11/18/07	9	9	0	4	5	-25
05/24/08	12	11	8	4	4	0
05/31/08	9	8	11	10	11	-10
06/08/08	87	86	1	65	63	3
06/15/08	16	15	6	14	15	-7
07/04/08	17	19	-12	15	16	-7
07/13/08	7	5	29	8	7	13
08/10/08	13	14	-8	8	10	-25
08/17/08	5	8	-60	6	9	-50
06/09/09	103	97	6	72	74	-3
06/12/09	17	9	47	6	9	-50
06/17/09	230	229	0	209	211	-1
06/20/09	100	99	1	86	88	-2

Date	Turbidity			Suspended Solids		
	Upstream	Downstream	Difference	Upstream	Downstream	Difference
	NTU	NTU	%	mg/L	mg/L	%
07/18/09	15	9	40	6	7	-17
08/08/09	148	145	2	131	139	-6
08/30/09	16	10	38	9	9	0
05/28/10	18	10	44	13	28	-115
06/20/10	18	11	39	10	11	-10
07/09/10	34	27	21	23	22	4
07/11/10	16	8	50	6	7	-17
07/16/10	54	48	11	36	37	-3
08/16/10	14	9	36	6	8	-33
05/20/11	35	36	-3	27	24	11
07/28/11	104	102	2	65	69	-6
	45	45		34	38	



Except for the exceedances indicated in red font, test results met applicable Michigan Department of Environment Quality (MDEQ) water quality standards (WQSs), as shown below:

Location	Date	Ammonia Nitrogen		Dissolved Oxygen		Dissolved Solids		pH		Temperature	
		Result	WQS	Result	WQS	Result	WQS	Result	WQS	Result	WQS
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	SU	SU	°F	°F
Horrigan Dr.	08/19/07			7.6	5.0	241	750	7.72	6.5-9.0	64.0	85
Horrigan Dr.	08/25/07			7.3	5.0	278	750	7.69	6.5-9.0	72.0	85
Horrigan Dr.	10/27/07			8.4	5.0	159	750	7.85	6.5-9.0	56.3	68
Horrigan Dr.	11/03/07			11.9	5.0	702	750	8.30	6.5-9.0	49.5	55
Horrigan Dr.	11/10/07			11.1	5.0	673	750	8.06	6.5-9.0	48.0	55
Horrigan Dr.	11/18/07			14.7	5.0	817	750	8.32	6.5-9.0	42.3	55
Horrigan Dr.	02/09/08					2820	750				
Horrigan Dr.	02/17/08					1590	750				
Horrigan Dr.	05/24/08			8.4	5.0	964	750	8.37	6.5-9.0	57.0	76
Horrigan Dr.	05/31/08			7.8	5.0	1155	750	8.15	6.5-9.0	67.3	76
Horrigan Dr.	06/08/08			6.3	5.0	293	750	7.89	6.5-9.0	73.0	84
Horrigan Dr.	06/15/08			7.7	5.0	536	750	8.10	6.5-9.0	69.6	84
Horrigan Dr.	07/04/08			8.7	5.0	413	750	8.22	6.5-9.0	64.6	85
Horrigan Dr.	07/13/08			9.4	5.0	812	750	8.17	6.5-9.0	72.0	85
Horrigan Dr.	08/10/08			8.4	5.0	466	750	8.07	6.5-9.0	63.1	85
Horrigan Dr.	08/17/08			12.8	5.0	783	750	8.37	6.5-9.0	69.3	85
Horrigan Dr.	06/12/09	0.06	0.210	8.8	5.0	618	750	8.25	6.5-9.0	62.1	84
Horrigan Dr.	07/18/09	0.08	0.210	8.9	5.0	796	750	8.24	6.5-9.0	66.4	85
Horrigan Dr.	08/30/09	0.06	0.210	9.2	5.0	520	750	7.64	6.5-9.0	60.6	85
Horrigan Dr.	05/28/10	0.06	0.210	10.0	5.0	928	750	6.76	6.5-9.0	70.5	76
Horrigan Dr.	06/20/10	0.03	0.210	10.6	5.0	802	750	8.13	6.5-9.0	72.1	84
Horrigan Dr.	07/11/10	0.07	0.210	8.0	5.0	545	750	7.34	6.5-9.0	75.7	85
Horrigan Dr.	08/16/10	0.03	0.210	9.1	5.0	526	750	8.15	6.5-9.0	73.4	85
Horrigan Dr.	08/29/11	0.00	0.210	9.1	5.0	990	750	7.02	6.5-9.0	64.6	85
Horrigan Dr.	09/10/11	0.00	0.210	15.3	5.0	903	750	6.99	6.5-9.0	68.5	79
Longway Blvd.	08/10/08	0.03	0.210	9.5	5.0	473	750	8.07	6.5-9.0	64.2	85
Longway Blvd.	08/17/08	0.03	0.210	20.5	5.0	773	750	8.81	6.5-9.0	78.8	85
Longway Blvd.	05/27/09	0.10	0.210	11.9	5.0	935	750	8.25	6.5-9.0	65.7	76
Longway Blvd.	06/21/09	0.07	0.210	7.83	5.0	378	750	7.83	6.5-9.0	68.0	84
Longway Blvd.	07/03/09	0.05	0.210	9.39	5.0	558	750	7.69	6.5-9.0	66.7	85
Longway Blvd.	08/23/09	0.03	0.210	9.31	5.0	497	750	7.32	6.5-9.0	67.3	85
Longway Blvd.	09/15/09	0.01	0.210	OR	5.0	861	750	8.43	6.5-9.0	70.5	79
Longway Blvd.	05/23/10	0.02	0.210	13.1	5.0	653	750	7.90	6.5-9.0	67.3	76
Longway Blvd.	06/07/10	0.08	0.210	8.8	5.0	530	750	6.64	6.5-9.0	64.4	84
Longway Blvd.	07/13/10	0.09	0.210	8.4	5.0	398	750	7.99	6.5-9.0	72.1	85
Longway Blvd.	08/18/10	0.07	0.210	15.8	5.0	632	750	7.12	6.5-9.0	77.0	85
Longway Blvd.	09/05/10	0.03	0.210	13.7	5.0	451	750	6.44	6.5-9.0	71.6	79
Longway Blvd.	08/28/11	0.01	0.210	14.9	5.0	1017	750	6.98	6.5-9.0	74.1	85
Longway Blvd.	09/12/11	0.01	0.210	5.4	5.0	1050	750	6.92	6.5-9.0	69.4	79
Longway Blvd.	09/20/11			8.3	5.0	324	750	7.58	6.5-9.0	64.6	79

Location	Date	Ammonia Nitrogen		Dissolved Oxygen		Dissolved Solids		pH		Temperature	
		Result	WQS	Result	WQS	Result	WQS	Result	WQS	Result	WQS
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	SU	SU	°F	°F
Longway Blvd.	10/05/11			13.5	5.0	808	750	7.38	6.5-9.0	61.0	68
Longway Blvd.	10/21/11			9.6	5.0	358	750	7.62	6.5-9.0	49.8	68
Longway Blvd.	11/02/11			14.1	5.0	1017	750	7.47	6.5-9.0	52.0	55
Longway Blvd.	11/12/11			13.6	5.0	681	750	7.73	6.5-9.0	49.5	55
Kearsley Park Blvd.	07/15/07	0.01	0.210	10.4	5.0	543	750	8.42	6.5-9.0	66.9	85
Kearsley Park Blvd.	07/21/07	0.06	0.210	7.8	5.0	361	750	8.22	6.5-9.0	73.9	85
Kearsley Park Blvd.	08/12/07	0.11	0.210	9.2	5.0	440	750	8.07	6.5-9.0	75.4	85
Kearsley Park Blvd.	08/18/07	0.04	0.210	12.2	5.0	608	750	8.55	6.5-9.0	70.0	85
Kearsley Park Blvd.	08/19/07	0.04	0.210	7.7	5.0	234	750	7.73	6.5-9.0	63.7	85
Kearsley Park Blvd.	08/25/07	0.12	0.210	7.4	5.0	280	750	7.65	6.5-9.0	73.2	85
Kearsley Park Blvd.	09/02/07	0.05	0.210	11.7	5.0	604	750	8.37	6.5-9.0	70.5	79
Kearsley Park Blvd.	09/15/07	0.03	0.210	9.3	5.0	480	750	8.12	6.5-9.0	55.4	79
Kearsley Park Blvd.	09/25/07	0.04	0.210	10.6	5.0	781	750	8.45	6.5-9.0	72.1	79
Kearsley Park Blvd.	10/07/07	0.04	0.210	8.79	5.0	544	750	8.15	6.5-9.0	69.3	68
Kearsley Park Blvd.	10/13/07	0.02	0.210	14.5	5.0	540	750	8.76	6.5-9.0	59.4	68
Kearsley Park Blvd.	10/27/07	0.00	0.210	8.6	5.0	149	750	7.86	6.5-9.0	55.8	68
Kearsley Park Blvd.	11/03/07	0.04	0.210	12.8	5.0	636	750	8.30	6.5-9.0	52.7	55
Kearsley Park Blvd.	11/10/07	0.05	0.210	12.3	5.0	586	750	8.15	6.5-9.0	48.6	55
Kearsley Park Blvd.	11/18/07	0.04	0.210	17.0	5.0	605	750	8.38	6.5-9.0	47.8	55
Kearsley Park Blvd.	05/24/08	0.27	0.210	10.3	5.0	720	750	8.21	6.5-9.0	64.6	76
Kearsley Park Blvd.	05/31/08	0.16	0.210	11.0	5.0	948	750	8.15	6.5-9.0	73.6	76
Kearsley Park Blvd.	06/08/08	0.15	0.210	6.5	5.0	294	750	7.89	6.5-9.0	73.6	84
Kearsley Park Blvd.	06/15/08	0.13	0.210	8.8	5.0	484	750	8.20	6.5-9.0	72.3	84
Kearsley Park Blvd.	07/04/08	0.06	0.210	10.2	5.0	409	750	8.39	6.5-9.0	70.0	85
Kearsley Park Blvd.	07/13/08	0.00	0.210	12.9	5.0	545	750	8.37	6.5-9.0	74.8	85
Kearsley Park Blvd.	08/10/08	0.02	0.210	9.9	5.0	440	750	8.29	6.5-9.0	66.0	85
Kearsley Park Blvd.	08/17/08	0.02	0.210	11.1	5.0	657	750	8.54	6.5-9.0	73.9	85
Kearsley Park Blvd.	06/12/09	0.03	0.210	10.3	5.0	635	750	8.39	6.5-9.0	70.3	84
Kearsley Park Blvd.	07/18/09	0.04	0.210	14.1	5.0	791	750	8.36	6.5-9.0	75.2	85
Kearsley Park Blvd.	08/30/09	0.02	0.210	13.0	5.0	536	750	8.06	6.5-9.0	64.2	85
Kearsley Park Blvd.	05/28/10	0.05	0.210	13.6	5.0	949	750	8.26	6.5-9.0	80.1	76
Kearsley Park Blvd.	06/20/10	0.00	0.210	16.9	5.0	781	750	8.79	6.5-9.0	80.1	84
Kearsley Park Blvd.	07/11/10	0.01	0.210	13.7	5.0	571	750	8.15	6.5-9.0	82.2	85
Kearsley Park Blvd.	08/16/10	0.05	0.210	12.4	5.0	644	750	7.24	6.5-9.0	76.3	85
Kearsley Park Blvd.	08/29/11	0.00	0.210	13.7	5.0	992	750	7.25	6.5-9.0	68.0	85
Kearsley Park Blvd.	09/10/11	0.00	0.210	14.0	5.0	858	750	7.19	6.5-9.0	75.4	79
Average		0.05		10.8		663		7.9		66.6	

Dissolved oxygen levels and water temperatures at dawn were as follows:

Date	Time	Location	Dissolved Oxygen		Temperature	
			mg/L	% Saturation	°C	°F
08/30/11	6:00 AM	Kearsley Park	5.37	51.8	17.7	63.9
08/30/11	@ 6:00AM	Applewood	5.00	53.4	17.1	62.8
08/30/11	@ 6:00AM	MCC	6.40	68.4	17.1	62.8
08/30/11	@ 6:00AM	E. Court St.	6.23	66.5	17.1	62.8

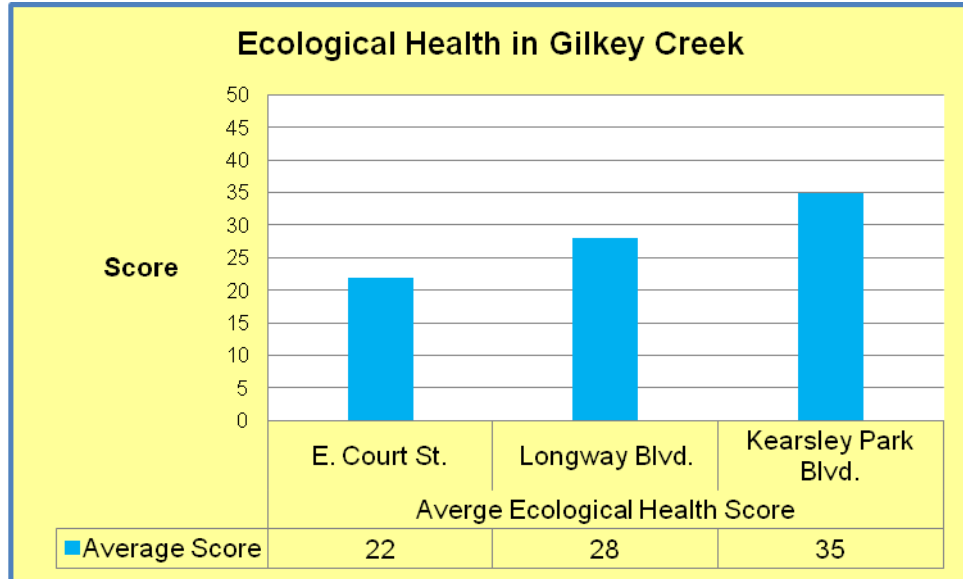
Scores and ratings for indicating stream ecological health were determined based on the benthic macro-invertebrate organism counts using the following scale:

Score	Rating
>48	Excellent
34 – 48	Good
19 - 33	Fair
<19	Poor

The ecological health scores and ratings were as follows:

Date	Location					
	E. Court St.		Longway Blvd.		Kearsley Park Blvd.	
	Score	Rating	Score	Rating	Score	Rating
Oct-07	21	Fair	Not sampled	Not sampled	Not sampled	Not sampled
Apr-08	14	Poor	Not sampled	Not sampled	Not sampled	Not sampled
Oct-08	25	Fair	Not sampled	Not sampled	Not sampled	Not sampled
Apr-09	24	Fair	18	Poor	41	Good
Oct-09	35	Good	36	Good	29	Fair
Apr-10	13	Poor	19	Fair	33	Fair
Oct-10	29	Fair	38	Good	36	Good
May-11	11	Poor	Not sampled	Not sampled	22	Fair
Oct-11	35	Good	35	Good	42	Good
May-12	11	Poor	25	Fair	40	Good
Average	23	Fair	28	Fair	35	Good

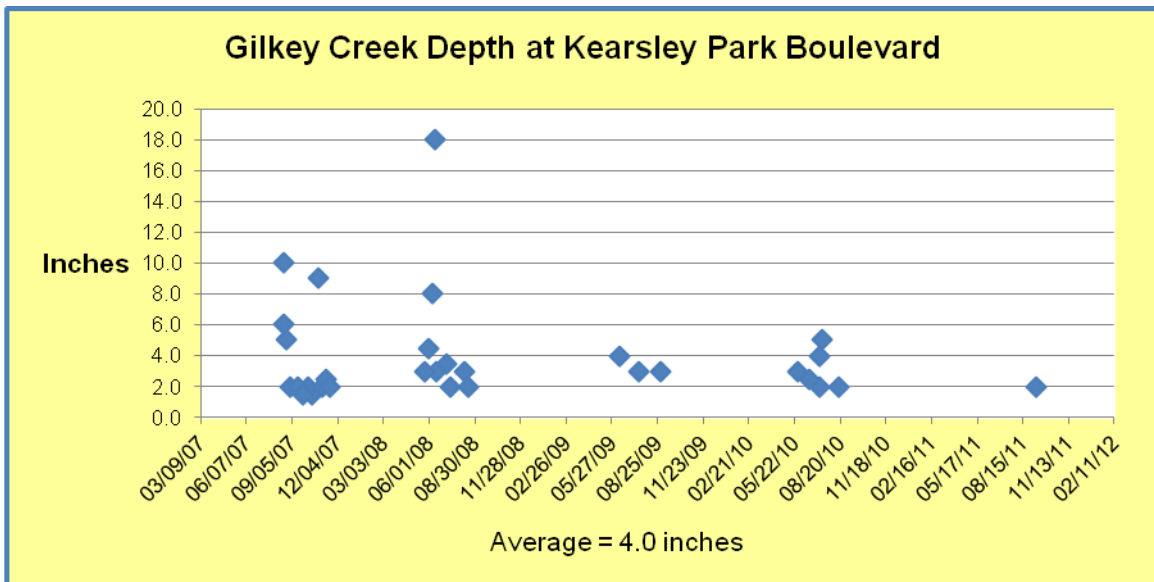
The average scores for each site were as follows:



Gilkey Creek water and flow depth measurements at Kearsley Park Boulevard were as follows:

Date	Depth	Velocity		Flow	Flow
	inches		ft/s	cfs	mgd
08/25/07	5.0		1.83	15.3	9.9
06/13/08	18.0		3.78	113.4	73.3
07/04/08	3.5	<	1.31	7.6	4.9
09/02/07	2.0	<	1.31	4.4	2.8
06/08/08	8.0		1.85	24.7	15.9
06/12/09	4.0	<	1.31	8.7	5.6
08/20/07	10.0		2.73	45.5	29.4
10/13/07	1.5	<	1.31	3.3	2.1
07/11/10	2.0	<	1.31	4.4	2.8
06/15/08	3.0	<	1.31	6.6	4.2
10/27/07	9.0		1.68	25.2	16.3
07/09/10	4.0	<	1.31	8.7	5.6
07/16/10	5.0		1.31	0.8	0.5
10/07/07	2.0	<	1.31	4.4	2.8
08/30/09	3.0	<	1.31	6.6	4.2
08/10/08	3.0	<	1.31	6.6	4.2
09/15/07	2.0	<	1.31	4.4	2.8
06/20/10	2.5	<	1.31	5.5	3.5
08/19/07	6.0		1.83	18.3	11.8
09/10/11	2.0	<	1.31	4.4	2.8
05/31/08	4.5	<	1.31	9.8	6.3
05/24/08	3.0	<	1.31	6.6	4.2
07/13/08	2.0	<	1.31	4.4	2.8

Date	Depth	Velocity	Flow	Flow	
	inches	<	ft/s	cfs	mgd
08/16/10	2.0	<	1.31	4.4	2.8
11/03/07	2.0	<	1.31	4.4	2.8
11/10/07	2.5	<	1.31	5.5	3.5
11/18/07	2.0	<	1.31	4.4	2.8
07/18/09	3.0	<	1.31	6.6	4.2
05/28/10	3.0	<	1.31	6.6	4.2
08/17/08	2.0	<	1.31	4.4	2.8
09/25/07	1.5	<	1.31	3.3	2.1
Average	4.0	<	2.14	12.2	7.9



Discussion

The water quality, as determined by chemical and physical testing, was typically good at all locations, but only medium occasionally. And it was found that, the average upstream and downstream water quality scores were the same. Therefore, the stream rehabilitation project caused no substantial degradation or improvement of downstream water quality in Gilkey Creek. In addition, as determined by biological analysis, the stream ecological health was typically fair and sometimes both good and poor.

Sampling was done during periods of both dry and wet weather to evaluate the effect of stormwater runoff and stream bank erosion during high flows. The alkalinity and hardness measurements indicated that the creek had higher amounts of groundwater in it during low flow conditions following prolonged periods of dry weather and higher amounts of rainwater in it during high flow conditions following storms. In addition, during high flows in the creek, turbidity and suspended solids levels increased, but dissolved solids levels decreased. Thus, the water quality scores did not significantly decrease as a result of high flow.

The high level of dissolved solids in the creek during low flow typically had a strong effect (negative) on the water quality scores. In fact, the dissolved solids concentration was found to exceed the MDEQ water quality standard for maximum concentration (750 mg/L) numerous times. In addition, it was found to be as high as 2,820 mg/L and 1,590 mg/L in February 2008 at the upstream location after heavy snowmelt (and road deicing), which greatly exceeded the average concentration (663) found during this study and the water quality standard for maximum concentration. This suggests that winter road deicing may be significantly degrading water quality and impacting benthic macro-invertebrates. It is notable that, very few pollution-sensitive benthic macro-invertebrates were found at any of the locations sampled for this study.

Very high dissolved oxygen concentrations were often observed at Applewood and in Kearsley Park where there was abundant filamentous algae growth and full sun exposure. Algae generates dissolved oxygen, through photosynthesis, during the day; but it consumes oxygen, both day and night, through respiration. Therefore, it may be severely depleting dissolved oxygen at night, when oxygen is not being produced. However, dissolved oxygen levels were found to be low, but above the MDEQ water quality standard (5 mg/L), at dawn.

Gilkey Creek is normally extremely shallow during dry weather, which results in degraded fish habitat.