Total Suspended Solids, Stable Flow, and Wet Weather Event Monitoring in the Bass River Watershed

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Grand Valley State University
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Table of Contents

List of Figures

List of Tables

1. Introduction

An investigation of streams in west Michigan was conducted to monitor the loading of Total Suspended Solids (TSS) and fluctuations in hydrology. The study sites were located in the lower Grand River watershed and included: Bass River, Sand Creek, Strawberry/Mill Creek, York Creek and an unnamed tributary north of Leonard Street and east of East Beltline (M-44). Each of these watersheds is a tributary to the Grand River and is included on Michigan's 2002 303(d) list as requiring a Total Maximum Daily Load (TMDL) because they were identified as not supporting the designated use for biota. The data for each watershed are summarized in individual reports. This report examines the discharge and loading of TSS at 6 locations in Bass River under base flow (dry conditions) and during storm events. The data from this project will be used to develop a Biota TMDL for the Bass River watershed.

2. Monitoring Locations and Watershed Description for the Bass River

Bass River has a 32,020 acre watershed located in Ottawa County (Figure 2.1). Land use in the watershed is primarily agricultural (52%), forests, fields, and wetlands (24%), and residential (20%). A summary of land use/and cover statistics is presented in Table 2.1. Stormwater discharge outfalls were inventoried and six stream locations were selected for flow and TSS monitoring (Figure 2.1). Descriptions and coordinates for the stormwater outfalls and monitoring stations are provided in Table 2.2. Data for the standard Michigan Department of Natural Resources (MDEQ) Steam Survey Form were collected at each monitoring station. The Steam Survey Forms are included in Appendix 1. Photographs of each monitoring station and stormwater location were taken and included in Appendix 2.

3. Sampling Methods

Dry weather sampling was conducted on 6/28/04, 7/14/04, and 7/28/04. One grab sample was collected from each station. Dry weather sampling was preceded by at least 72 hours without precipitation as measured at the Grand Rapids Airport.

Wet weather sampling was conducted on 8/25/04, 8/28/04, and 11/01/04. The wet weather runoff events were in response to precipitation events of 0.1, 1.1, and 1.3 inches that occurred in a 2 hour time period. Sampling was initiated near the start of each rain event. During the rise and fall of the hydrograph, individual grab samples were collected manually at hourly intervals. Wet weather sampling events lasted from 4-6 hrs. TSS samples were collected at the centroid of each stream transect where approximately 50% of cumulative flow occurred. If the stream was wadeable, samples were collected by immersing a 500 milliliter (ml) polyethylene bottle at mid depth. If the stream was not wadeable, a thief sampler was used. Sample containers were placed in coolers with ice

Figure 2.1 The Bass River Watershed.

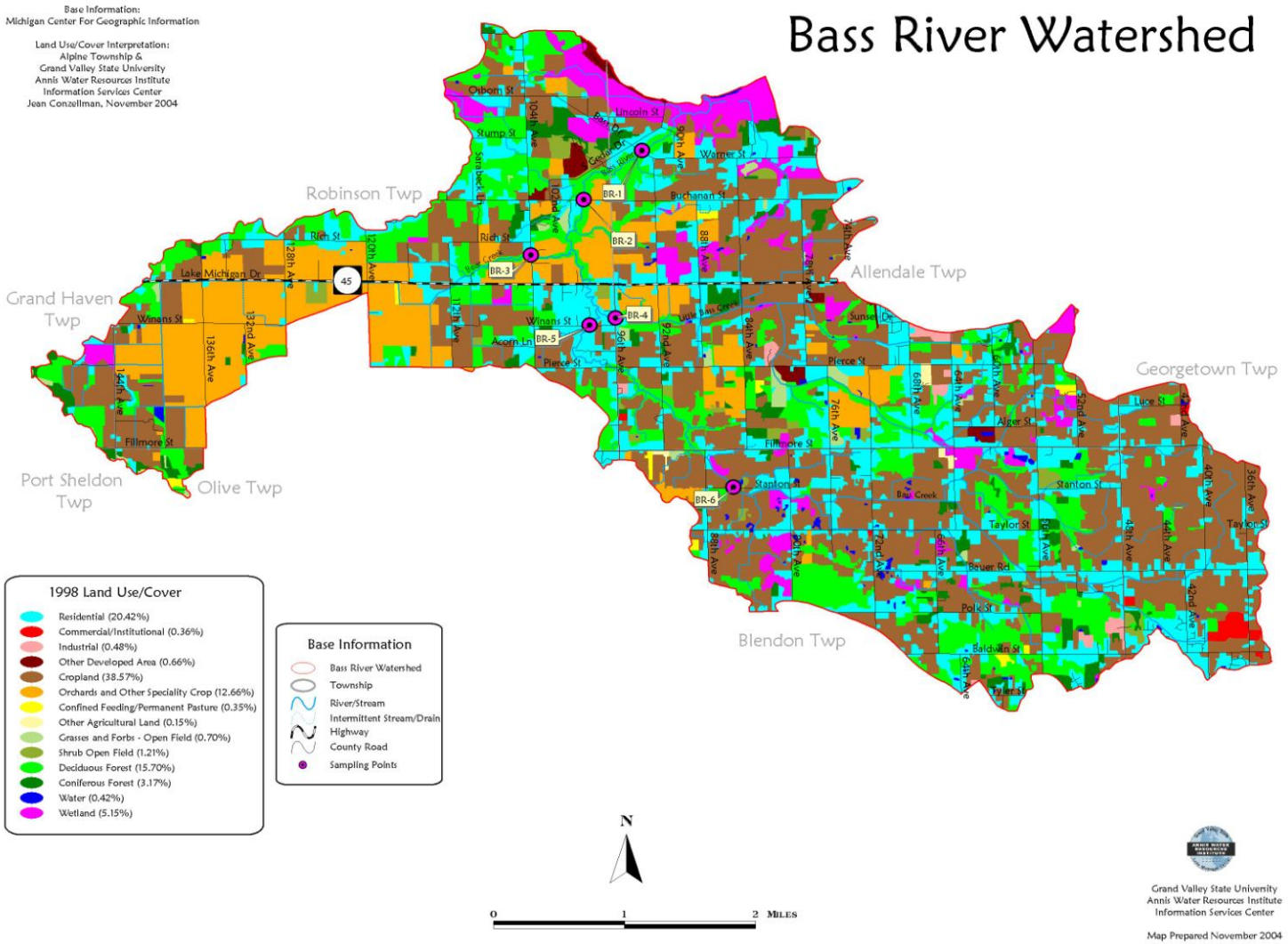


Table 2.1 Bass River Land Use and Cover Statistics.

Map Description	Acres	%
Commercial/Institutional	114	0
Confined Feeding/Permanent Pasture	111	0
Coniferous Forest	1016	3
Cropland	12349	39
Deciduous Forest	5027	16
Grasses and Forbs - Open Field	226	1
Industrial	155	0
Orchards and Other Specialty Crop	4053	13
Other Agricultural Land	48	0
Other Developed Area	211	1
Residential	6537	20
Shrub Open Field	388	1
Water	135	0
Wetland	1650	5
Total	32020	100

Table 2.2 Bass River Monitoring Stations, Stormwater Outfalls, and Coordinates.

Location and GPS Coordinates				
Type	Location	Site ID	Lat. (N)	Long. (W)
Monitoring	Warner Street (Downstream)	BR-1	42.99525	-86.0175
Monitoring	Buchanan Street (Downstream)	BR-2	42.98668	-86.0315
Monitoring	Bear Creek at 104th Avenue (Downstream)	BR-3	42.97690	-86.0437
Monitoring	96th Avenue (Upstream)	BR-4	42.96597	-86.0240
Monitoring	Winans Street (Downstream)	BR-5	42.96460	-86.0303
Monitoring	Stanton Street (Upstream)	BR-6	42.93602	-85.9956
Stormwater	Pond			
Stormwater	Worley			

and kept at 4^{o}C. One field blank sample was collected for every 20 investigative samples. One field duplicate sample was collected for every 10 investigative samples.

Flow was measured at each location using a Marsh-McBirney Flow Mate 2000 velocity meter according to United States Geological Survey protocols. Transects were established at each location and water depth measurements were collected using a bridge board and sounding reel or a self-leveling rod. The location of each transect was marked

by stakes. Depending on stream width, 4 – 12 equally spaced points along each transect were used for depth and flow measurements. Transect locations were selected to minimize interferences from structural anomalies such as debris jams, bridges, and highly eroded areas. Water elevations were measured at the MDEQ reference point located on each culvert or bridge. Flow measurements were collected during each wet and dry weather sampling event. If the stream depth was < 2.5 feet, flow measurements were taken at 0.6 depth at each transect point. If depths were > 2.5 feet, flow measurements were taken at 0.2 and 0.8 depths.

4. Analytical Methods

Total Suspended Solids (TSS) was measured gravimetrically by Environmental Protection Agency (EPA) Method 160.2. A complete method description was provided in the Quality Assurance Project Plan (QAPP). One laboratory blank and one laboratory duplicate were analyzed for every ten investigative samples.

5. Bass River Base Flow Data

Base flow and TSS loading data for the Bass River watershed are summarized in Table 5.1. High precipitation amounts in May (10 inches) and June (4.5 inches) resulted in elevated stream levels during the June 28 monitoring event. There was no measurable precipitation for 7 days prior to the June sampling. Rating Curves developed by the MDEQ for each monitoring station and the location of surface elevation reference points are provided in Appendix 3. Elevations reported at BR-4 (96th Ave) and BR-6 (Stanton Ave) were taken from the upstream location due to the relocation of the sampling station. The MDEQ reference locations for the rating curves were on the downstream side. The discharge data for these events should not be used to verify the rating curves.

6. Bass River Storm Event Data

Storm flow and TSS loading data for the Bass River watershed are summarized in Tables 6.1, 6.2, and 6.3 for the 0.1, 1.1, and 1.3 inch rainfall events, respectively.

7. Deviations from the Quality Assurance Project Plan

Some of the field and laboratory duplicates with low suspended solids (<10 mg/l) exceeded the RPD limits. The difference between duplicates ranged from 1-3 mg/l. The small relative difference between duplicates reflects normal variations associated with sampling and analysis at low concentration levels. Based on professional judgment, the data was not qualified. The results of field and laboratory duplicates and blanks were submitted in a separate Quality Assurance report.

Table 5.1. Base Flow TSS Loading Data for the Bass River.

Site ID:	Name	Discharge m^3/ sec	Discharge cfs	TSS mg/l	Loading lb/d	Surface ft	Method
June 28, 2004							
BR-1	Warner (Bass Drive)	0.91	32.13	21	3632	13.27	Meter
BR-2	Buchanan St	0.69	24.36	19	2492	10.40	Meter
BR-3	Bear Creek at 104th Ave (Tributary)	0.24	8.47	5	228	6.30	Meter
BR-4	96th Ave	0.26	9.18	19	939	7.76	Meter
BR-5	Winans St	0.18	6.36	14	479	9.24	Meter
BR-6	Stanton St	0.11	3.88	17	355	9.47	Meter
July 15, 2004							
BR-1	Warner (Bass Drive)	0.48	16.95	11	1004	13.89	Meter
BR-2	Buchanan St	0.33	11.65	13	815	11.06	Meter
BR-3	Bear Creek at 104th Ave (Tributary)	0.08	2.82	1	15	6.63	Meter
BR-4	96th Ave	0.14	4.94	10	266	8.02	Meter
BR-5	Winans St	0.07	2.47	11	146	9.60	Meter
BR-6	Stanton St	0.08	2.82	15	228	9.64	Meter
July 29, 2004							
BR-1	Warner (Bass Drive)	0.38	13.42	6	433	14.09	Meter
BR-2	Buchanan St	0.31	10.95	6	354	11.22	Meter
BR-3	Bear Creek at 104th Ave (Tributary)	0.13	4.59	8	198	6.53	Meter
BR-4	96th Ave	0.08	2.82	3	46	8.28	Meter
BR-5	Winans St	0.14	4.94	8	213	9.77	Meter
BR-6	Stanton St	0.04	1.41	9	68	9.67	Meter

Table 6.1. Bass River TSS Loading Data for the 0.1 Inch Rain Event on 8/25/04.

Site ID:	Name	Discharge m^3/ sec	Discharge cfs	TSS mg/l	Loading lb/d	Loading lb/hr	Water Elevation (ft)	Method
			5:00					
BR-1	Warner (Bass Drive)	0.32	11.30	10	608	25.3	13.98	Meter
BR-2	Buchanan Street	0.26	9.18	9	445	18.5	11.13	Meter
BR-3	Bear Creek at 104th Avenue (Tributary)	0.10	3.53	6	114	4.8	6.54	Meter
BR-4	96th Avenue	0.11	3.88	11	230	9.6	8.32	Meter
BR-5	Winans Street	0.08	2.82	9	137	5.7	9.85	Meter
BR-6	Stanton Street	0.04	1.41	8	61	2.5	9.78	Meter
			6:00					
BR-1	Warner (Bass Drive)	0.34	12.01	12	776	32.3	13.91	Meter
BR-2	Buchanan Street	0.31	10.95	14	825	34.4	11.08	Meter
BR-3	Bear Creek at 104th Avenue (Tributary)	0.14	4.94	21	559	23.3	6.42	Meter
BR-4	96th Avenue	0.13	4.59	14	346	14.4	8.28	Meter
BR-5	Winans Street	0.09	3.18	11	188	7.8	9.75	Meter
BR-6	Stanton Street	0.09	3.18	22	376	15.7	9.68	Meter
			7:00					
BR-1	Warner (Bass Drive)	0.34	12.01	13	840	35.0	13.93	Meter
BR-2	Buchanan Street	0.31	10.95	15	884	36.8	11.10	Meter
BR-3	Bear Creek at 104th Avenue (Tributary)	0.09	3.18	17	291	12.1	6.48	Meter
BR-4	96th Avenue	0.12	4.24	14	319	13.3	8.26	Meter
BR-5	Winans Street	0.11	3.88	16	335	13.9	9.79	Meter
BR-6	Stanton Street	0.12	4.24	23	525	21.9	9.59	Meter
			8:00					
BR-1	Warner (Bass Drive)	0.32	11.30	16	973	40.6	13.96	Meter
BR-2	Buchanan Street	0.28	9.89	13	692	28.8	11.13	Meter
BR-3	Bear Creek at 104th Avenue (Tributary)	0.07	2.47	11	146	6.1	6.68	Meter
BR-4	96th Avenue	0.12	4.24	14	319	13.3	8.34	Meter
BR-5	Winans Street	0.08	2.82	13	198	8.2	9.88	Meter
BR-6	Stanton Street	0.08	2.82	18	274	11.4	9.62	Meter
			9:00					
BR-1	Warner (Bass Drive)	0.32	11.30	13	791	32.9	13.98	Meter
BR-2	Buchanan Street	0.26	9.18	9	445	18.5	11.15	Meter
BR-3	Bear Creek at 104th Avenue (Tributary)	0.10	3.53	9	171	7.1	6.64	Meter
BR-4	96th Avenue	0.10	3.53	10	190	7.9	8.32	Meter
BR-5	Winans Street	0.08	2.82	11	167	7.0	9.84	Meter
BR-6	Stanton Street	0.07	2.47	14	186	7.8	9.68	Meter

Table 6.2. Bass River TSS Loading Data for the 1.1 Inch Rain Event on 8/28/04.

Site ID:	Name	Discharge m^3/ sec	Discharge cfs	TSS mg/l	Loading lb/d	Loading lb/hr	Water Elevation (ft)	Method
			4:30					
BR-1	Warner (Bass Drive)	0.28	9.89	6	319	13.3	14.01	Meter
BR-2	Buchanan Street	0.21	7.42	6	240	10.0	11.25	Meter
BR-3	Bear Creek at 104th Avenue (Tributary)	0.07	2.47	8	106	4.4	6.66	Meter
BR-4	96th Avenue	0.08	2.82	3	46	1.9	8.30	Meter
BR-5	Winans Street	0.06	2.12	8	91	3.8	9.74	Meter
BR-6	Stanton Street	0.03	1.06	9	51	2.1	9.74	Meter
			5:30					
BR-1	Warner (Bass Drive)	0.56	19.77	83	8835	368	13.61	Meter
BR-2	Buchanan Street	0.54	19.07	216	22171	924	10.89	Meter
BR-3	Bear Creek at 104th Avenue (Tributary)	0.22	7.77	308	12880	537	6.33	Meter
BR-4	96th Avenue	0.21	7.42	310	12374	516	7.94	Meter
BR-5	Winans Street	0.19	6.71	108	3900	163	9.45	Meter
BR-6	Stanton Street	0.15	5.30	86	2452	102	9.48	Meter
			6:30					
BR-1	Warner (Bass Drive)	0.55	19.42	137	14323	597	13.61	Meter
BR-2	Buchanan Street	0.74	26.13	296	41635	1735	10.66	Meter
BR-3	Bear Creek at 104th Avenue (Tributary)	0.13	4.59	109	2693	112	6.49	Meter
BR-4	96th Avenue	0.34	12.01	268	17320	722	7.64	Meter
BR-5	Winans Street	0.26	9.18	83	4102	171	9.35	Meter
BR-6	Stanton Street	0.18	6.36	54	1848	77	9.41	Meter
			7:30					
BR-1	Warner (Bass Drive)	0.82	28.95	179	27900	1162	13.28	Meter
BR-2	Buchanan Street	0.68	24.01	177	22878	953	10.56	Meter
BR-3	Bear Creek at 104th Avenue (Tributary)	0.11	3.88	10	209	9	6.56	Meter
BR-4	96th Avenue	0.32	11.30	225	13686	570	7.68	Meter
BR-5	Winans Street	0.28	9.89	68	3619	151	9.25	Meter
BR-6	Stanton Street	0.22	7.77	168	7025	293	9.32	Meter
			8:30					
BR-1	Warner (Bass Drive)	0.83	29.31	198	31238	1302	13.25	Meter
BR-2	Buchanan Street	0.71	25.07	114	15385	641	10.56	Meter
BR-3	Bear Creek at 104th Avenue (Tributary)	0.10	3.53	9	171	7	6.56	Meter
BR-4	96th Avenue	0.28	9.89	155	8249	344	7.71	Meter
BR-5	Winans Street	0.27	9.53	58	2977	124	9.22	Meter
BR-6	Stanton Street	0.33	11.65	101	6335	264	9.22	Meter
			9:30					
BR-1	Warner (Bass Drive)	0.88	31.07	171	28603	1192	13.25	Meter
BR-2	Buchanan Street	0.71	25.07	112	15115	630	10.56	Meter
BR-3	Bear Creek at 104th Avenue (Tributary)	0.12	4.24	11	251	10	6.50	Meter
BR-4	96th Avenue	0.29	10.24	146	8048	335	7.74	Meter
BR-5	Winans Street	0.34	12.01	58	3748	156	9.22	Meter
BR-6	Stanton Street	0.48	16.95	51	4653	194	9.02	Meter
			10:30					
BR-1	Warner (Bass Drive)	0.88	31.07	166	27767	1157	13.26	Meter
BR-2	Buchanan Street	0.82	28.95	145	22601	942	10.56	Meter
BR-3	Bear Creek at 104th Avenue (Tributary)	0.09	3.18	9	154	6	6.59	Meter
BR-4	96th Avenue	0.25	8.83	132	6273	261	7.81	Meter
BR-5	Winans Street	0.44	15.54	62	5185	216	9.19	Meter
BR-6	Stanton Street	0.46	16.24	51	4459	186	9.11	Meter

Table 6.3. Bass River TSS Loading Data for the 1.3 Inch Rain Event on 11/01/04.

Site ID:	Name	Discharge m^3/ sec	Discharge cfs	TSS mg/l	Loading lb/d	Loading lb/hr	Water Elevation (ft)	Method
			4:30					
BR-1	Warner (Bass Drive)	0.49	17.30	12	1118	46.6	13.75	B Board
BR-2	Buchanan Street	0.42	14.83	12	958	39.9	10.88	Meter
BR-3	Bear Creek at 104th Avenue (Tributary)	0.14	4.94	16	426	17.7	6.55	Meter
BR-4	96th Avenue	0.16	5.65	6	182	7.6	7.26	Meter
BR-5	Winans Street	0.12	4.24	16	365	15.2	9.65	Meter
BR-6	Stanton Street	0.06	2.12	18	205	8.6	9.65	Meter
			5:30					
BR-1	Warner (Bass Drive)	0.85	30.01	92	14885	620	13.58	B Board
BR-2	Buchanan Street	0.72	25.42	261	35769	1490	10.64	Meter
BR-3	Bear Creek at 104th Avenue (Tributary)	0.40	14.22	370	28298	1179	6.00	Meter
BR-4	96th Avenue	0.18	6.36	353	12091	504	7.44	Meter
BR-5	Winans Street	0.23	8.18	108	4759	198	9.28	Meter
BR-6	Stanton Street	0.18	6.36	98	3354	140	9.45	Meter
			6:30					
BR-1	Warner (Bass Drive)	0.93	32.95	245	43457	1811	13.34	B Board
BR-2	Buchanan Street	0.78	27.62	337	50133	2089	10.42	Meter
BR-3	Bear Creek at 104th Avenue (Tributary)	0.47	16.50	395	35124	1463	5.85	Meter
BR-4	96th Avenue	0.21	7.27	382	14929	622	7.20	Meter
BR-5	Winans Street	0.22	7.72	121	5030	210	9.20	Meter
BR-6	Stanton Street	0.18	6.42	101	3490	145	9.40	Meter
			7:30					
BR-1	Warner (Bass Drive)	1.16	40.82	278	61089	2545	13.10	B Board
BR-2	Buchanan Street	0.96	33.92	267	48747	2031	10.34	Meter
BR-3	Bear Creek at 104th Avenue (Tributary)	0.52	18.22	479	46936	1956	5.77	Meter
BR-4	96th Avenue	0.30	10.68	310	17826	743	7.15	Meter
BR-5	Winans Street	0.29	10.10	145	7892	329	9.15	Meter
BR-6	Stanton Street	0.23	8.09	122	5320	222	9.32	Meter
			8:30					
BR-1	Warner (Bass Drive)	1.24	43.68	325	76416	3184	13.98	B Board
BR-2	Buchanan Street	0.98	34.63	234	43622	1818	10.25	Meter
BR-3	Bear Creek at 104th Avenue (Tributary)	0.38	13.40	210	15146	631	5.90	Meter
BR-4	96th Avenue	0.27	9.62	222	11495	479	7.00	Meter
BR-5	Winans Street	0.35	12.34	166	11023	459	9.05	Meter
BR-6	Stanton Street	0.38	13.40	180	12983	541	9.25	Meter
			9:30					
BR-1	Warner (Bass Drive)	0.95	33.54	266	48033	2001	13.20	B Board
BR-2	Buchanan Street	0.81	28.60	210	32333	1347	10.49	Meter
BR-3	Bear Creek at 104th Avenue (Tributary)	0.32	11.30	78	4744	198	6.15	Meter
BR-4	96th Avenue	0.29	10.24	135	7442	310	7.08	Meter
BR-5	Winans Street	0.32	11.30	58	3528	147	9.00	Meter
BR-6	Stanton Street	0.41	14.48	51	3975	166	8.90	Meter
			10:30					
BR-1	Warner (Bass Drive)	0.88	31.07	171	28603	1192	13.35	B Board
BR-2	Buchanan Street	0.82	28.95	145	22601	942	10.30	Meter
BR-3	Bear Creek at 104th Avenue (Tributary)	0.21	7.42	44	1756	73	6.30	Meter
BR-4	96th Avenue	0.22	7.77	88	3680	153	7.32	Meter
BR-5	Winans Street	0.42	14.83	62	4950	206	8.95	Meter
BR-6	Stanton Street	0.48	16.95	51	4653	194	9.05	Meter

Appendix 1

Bass River Watershed Survey Forms for Monitoring Stations 2004

Date: 6/28/04 **Single Site Watershed Survey Data Sheet** Time:

Waterbody Name: Bass River County: Ottawa Station #: 1 W

Location: BR-1 Township: Allendale Sec 18 T 7N R 14W ¼ SE ¼ NW

Investigator: BTS Lat: 42.99525 Long: 86.01745

Coordinate Determination Method (check the one that applies):

__X_ GPS ___ GPS w/ DBR ___ Digital mapping software ___ Topographic map ___ Other (describe _____)

Map Scale (if known _____)

/Downstream Side

PHYSICAL HABITAT

BACKGROUND INFORMATION - pg. 18

Event Conditions noted at site	None				
Days since Rain	≥3				
Water Temp./D.O./pH *					
Water Color			Brown		
Waterbody Type-u/s	Stream				
Waterbody Type-d/s	Stream				
Stream Width (ft.)		10-25			
Avg. Stream Depth (ft.)		1-3			
Water Velocity (ft./sec) *					
Stream Flow Type			L		

PHYSICAL APPEARANCE - pg. 20
(Check all that apply)

Aquatic Plants		
Floating Algae		
Filamentous Algae		
Bacterial Sheen/Slimes		
Turbidity		
Oil Sheen		
Foam		
Trash		

SUBSTRATE (%) – pg. 22
(add to 100%)

Boulder – 10 in. diam.	
Cobble/Gravel –10 to .08 in. diam.	X 20%
Sand – coarse grain	X 80%
Silt/Detritus/Muck - fine grain/organic matter	
Hardpan/Bedrock – solid clay/rock surface	
Artificial – manmade	
Unknown	

INSTREAM COVER – pg. 23
(check all that apply)

Undercut Banks	
Overhanging Vegetation	X
Deep Pools	X
Boulders	
Aquatic Plants	
Logs or Woody Debris	

RIVER MORPHOLOGY – pg. 23

Riffle			
Pool	Present		
Channel			Maintained
Designated Drain	?		

Highest Water Mark (ft.)	?					

STREAM CORRIDOR – pg. 26

Riparian Veg. Width ft.(L)		10-30		
Riparian Veg. Width ft.(R)			30-100	
Bank Erosion		L		
Streamside Land Cover		Grass	Shrub	Trees
Stream Canopy %				>50

Stream Cross Section

Adjacent Land Uses

Wetlands		
Shrub or Old Field		
Forest	L	R
Pasture		
Crop Residue		
Rowcrop		
Residential Lawns, Parks		
Impervious Surface		
Disturbed Ground		
No Vegetation		

Single Site Watershed Survey Data Sheet (page 2)

Date: 6/28/04 **Station #: 1**
/Downstream Side

POTENTIAL SOURCES (Severity: S – slight; M – moderate; H – high) – pg. 28							
Crop Related Sources				Land Disposal			
Grazing Related Sources				On-site Wastewater Systems			
Intensive Animal Feeding Operations				Silviculture (Forestry NPS)			
Highway/Road/Bridge Maintenance and Runoff (Transportation NPS)				Resource Extraction (Mining NPS)			
Channelization				Recreational/Tourism Activities (general)			
Dredging				• Golf Courses			
Removal of Riparian Vegetation				• Marinas/Recr. Boating (water releases)			
Bank and Shoreline Erosion/ Modification/Destruction				• Marinas/Recr. Boating (bank or shoreline erosion)			
Flow Regulation/ Modification (Hydrology)				Debris in Water	S		
Upstream Impoundment				Industrial Pt. Source			
Construction:Highway/Road /Bridge/Culvert				Municipal Pt. Source			
Construction: Land Development				Natural Sources			
Urban Runoff (Residential/ Urban NPS)				Source(s) Unknown			

SITE SUMMARY INFORMATION – pg. 33			
SURVEY DIRECTION	N/A	U/S	D/S
SITE SIMILARITY	?	Y	N
OVERALL SITE RANKING	L	M	H
SITE FOLLOW-UP RANK	L	M	H

COMMENTS: Measurements taken on the downstream side of the bridge

Date: 6/28/04 **Single Site Watershed Survey Data Sheet** Time: 11:08

Waterbody Name: Bass River County: Ottawa Station #: 2

Location: BR-2 Township: Robinson (S), Crockery (S) Sec 13 T 9N R 15W ¼ SW ¼ SE

Investigator: B. Scull Lat: 42.98668 Long: 86.03147

Coordinate Determination Method (check the one that applies):

_X GPS ___ GPS w/ DBR ___ Digital mapping software ___ Topographic map ___ Other (describe _____)

Map Scale (if known _____)

/Downstream Side

PHYSICAL HABITAT

BACKGROUND INFORMATION - pg. 18

Event Conditions noted at site	None				
Days since Rain	≤ 1				
Water Temp./D.O./pH *					
Water Color			Brown		
Waterbody Type-u/s	Stream				
Waterbody Type-d/s	Stream				
Stream Width (ft.)		10-25			
Avg. Stream Depth (ft.)		1-3			
Water Velocity (ft./sec) *					
Stream Flow Type			L		

PHYSICAL APPEARANCE - pg. 20
(Check all that apply)

Aquatic Plants	Present	
Floating Algae		
Filamentous Algae		
Bacterial Sheen/Slimes		
Turbidity		
Oil Sheen		
Foam		
Trash		

SUBSTRATE (%) – pg. 22
(add to 100%)

Boulder – 10 in. diam.	
Cobble/Gravel –10 to .08 in. diam.	
Sand – coarse grain	X 50%
Silt/Detritus/Muck - fine grain/organic matter	X 50%
Hardpan/Bedrock – solid clay/rock surface	
Artificial – manmade	
Unknown	

INSTREAM COVER – pg. 23
(check all that apply)

Undercut Banks	
Overhanging Vegetation	X
Deep Pools	X
Boulders	
Aquatic Plants	
Logs or Woody Debris	X

RIVER MORPHOLOGY – pg. 23

Riffle	Present					
Pool	Present					
Channel	Natural					
Designated Drain	?					
Highest Water Mark (ft.)	?					

STREAM CORRIDOR – pg. 26

Riparian Veg. Width ft.(L)				>100
Riparian Veg. Width ft.(R)				>100
Bank Erosion		L		
Streamside Land Cover		Grass	Shrub	Trees
Stream Canopy %				>50

Stream Cross Section

Adjacent Land Uses

Wetlands		
Shrub or Old Field	L	R
Forest	L	R
Pasture		
Crop Residue		
Rowcrop		
Residential Lawns, Parks		
Impervious Surface		
Disturbed Ground		
No Vegetation		

* Optional Data Item

Data Sheet Version 4/27/00

Single Site Watershed Survey Data Sheet (page 2)

Date: 6/28/04 Station # 2
/Downstream Side

POTENTIAL SOURCES (Severity: S – slight; M – moderate; H – high) – pg. 28							
Crop Related Sources				**Land Disposal**			
Grazing Related Sources				**On-site Wastewater Systems**			
Intensive Animal Feeding Operations				**Silviculture (Forestry NPS)**			
Highway/Road/Bridge Maintenance and Runoff (Transportation NPS)				**Resource Extraction (Mining NPS)**			
Channelization				**Recreational/Tourism Activities (general)**			
Dredging				• **Golf Courses**			
Removal of Riparian Vegetation				• **Marinas/Recr. Boating (water releases)**			
Bank and Shoreline Erosion/ Modification/Destruction				• **Marinas/Recr. Boating (bank or shoreline erosion)**			
Flow Regulation/ Modification (Hydrology)				**Debris in Water**			
Upstream Impoundment				**Industrial Pt. Source**			
Construction:Highway/Road /Bridge/Culvert				**Municipal Pt. Source**			
Construction: Land Development				**Natural Sources**		M	
Urban Runoff (Residential/ Urban NPS)				**Source(s) Unknown**			

SITE SUMMARY INFORMATION – pg. 33			
SURVEY DIRECTION	**N/A**	**U/S**	**D/S**
SITE SIMILARITY	**?**	**Y**	**N**
OVERALL SITE RANKING	**L**	**M**	**H**
SITE FOLLOW-UP RANK	**L**	**M**	**H**

COMMENTS: Sample site downstream from bridge.

Date: 6/28/04 **Single Site Watershed Survey Data Sheet** Time: 11:45

Waterbody Name: Bass River County: Ottawa Station #: 3

Location: BR-3 Township: Robinson (S), Crockery (S) Sec 24 T 7N R 15W ¼ NW ¼ SW

Investigator: B. Scull Lat: 42.9769 Long: 86.04365

Coordinate Determination Method (check the one that applies):

_X GPS ___ GPS w/ DBR ___ Digital mapping software ___ Topographic map ___ Other (describe _____)

Map Scale (if known _____)

/Downstream Side

PHYSICAL HABITAT

BACKGROUND INFORMATION - pg. 18

Event Conditions noted at site	None				
Days since Rain	≤ 1				
Water Temp./D.O./pH *					
Water Color	Clear				
Waterbody Type-u/s	Stream				
Waterbody Type-d/s	Stream				
Stream Width (ft.)	<10				
Avg. Stream Depth (ft.)	<1				
Water Velocity (ft./sec) *					
Stream Flow Type				M	

PHYSICAL APPEARANCE - pg. 20
(Check all that apply)

Aquatic Plants		
Floating Algae		
Filamentous Algae		
Bacterial Sheen/Slimes		
Turbidity	Present	
Oil Sheen		
Foam		
Trash		

SUBSTRATE (%) – pg. 22
(add to 100%)

Boulder – 10 in. diam.	
Cobble/Gravel –10 to .08 in. diam.	
Sand – coarse grain	
Silt/Detritus/Muck - fine grain/organic matter	X 100%
Hardpan/Bedrock – solid clay/rock surface	
Artificial – manmade	
Unknown	

INSTREAM COVER – pg. 23
(check all that apply)

Undercut Banks	
Overhanging Vegetation	X
Deep Pools	
Boulders	
Aquatic Plants	
Logs or Woody Debris	

RIVER MORPHOLOGY – pg. 23

Riffle						
Pool						
Channel	Natural					
Designated Drain	?					
Highest Water Mark (ft.)	?					

STREAM CORRIDOR – pg. 26

Riparian Veg. Width ft.(L)			30-100	
Riparian Veg. Width ft.(R)				>100
Bank Erosion		0		
Streamside Land Cover		Grass	Shrub	Trees
Stream Canopy %				>50

Stream Cross Section

Adjacent Land Uses

Wetlands		
Shrub or Old Field		
Forest	L	R
Pasture		
Crop Residue		
Rowcrop		
Residential Lawns, Parks		
Impervious Surface		
Disturbed Ground		
No Vegetation		

* Optional Data Item

Data Sheet Version 4/27/00

Single Site Watershed Survey Data Sheet (page 2)

Date: 6/28/04 Station # 2
/Downstream Side

POTENTIAL SOURCES (Severity: S – slight; M – moderate; H – high) – pg. 28							
Crop Related Sources				Land Disposal			
Grazing Related Sources				On-site Wastewater Systems			
Intensive Animal Feeding Operations				Silviculture (Forestry NPS)			
Highway/Road/Bridge Maintenance and Runoff (Transportation NPS)		M		Resource Extraction (Mining NPS)			
Channelization				Recreational/Tourism Activities (general)			
Dredging				• Golf Courses			
Removal of Riparian Vegetation				• Marinas/Recr. Boating (water releases)			
Bank and Shoreline Erosion/ Modification/Destruction	S			• Marinas/Recr. Boating (bank or shoreline erosion)			
Flow Regulation/ Modification (Hydrology)				Debris in Water			
Upstream Impoundment				Industrial Pt. Source			
Construction:Highway/Road /Bridge/Culvert				Municipal Pt. Source			
Construction: Land Development				Natural Sources	S		
Urban Runoff (Residential/ Urban NPS)				Source(s) Unknown			

SITE SUMMARY INFORMATION – pg. 33			
SURVEY DIRECTION	N/A	U/S	D/S
SITE SIMILARITY	?	Y	N
OVERALL SITE RANKING	L	M	H
SITE FOLLOW-UP RANK	L	M	H

COMMENTS: Sample site downstream of bridge.

Date: 6/28/2004

Single Site Watershed Survey Data Sheet

Time: 12:15

Waterbody Name: Bass River County: Ottawa Station #: 4

Location: BR-4 Township: Allendale (W), Polkton (S), Tallmadge(W) Sec 30 T7N R14W SW ¼ NW ¼

Investigator: B. Scull Lat: 42.96597 Long: -86.02395

Coordinate Determination Method (check the one that applies):

_X_ GPS ___ GPS w/ DBR ___ Digital mapping software ___ Topographic map ___ Other (describe _____)

Map Scale (if known _____)

Upstream Side

PHYSICAL HABITAT

BACKGROUND INFORMATION - pg. 18

Event Conditions noted at site	None				
Days since Rain	<1				
Water Temp./D.O./pH *					
Water Color			Brown		
Waterbody Type-u/s	Stream				
Waterbody Type-d/s	Stream				
Stream Width (ft.)	<10				
Avg. Stream Depth (ft.)	<1				
Water Velocity (ft./sec) *					
Stream Flow Type			L		

PHYSICAL APPEARANCE - pg. 20

(Check all that apply)

Aquatic Plants	Present	
Floating Algae		
Filamentous Algae		
Bacterial Sheen/Slimes		
Turbidity	Present	
Oil Sheen		
Foam		
Trash		

SUBSTRATE (%) – pg. 22

(add to 100%)

Boulder – 10 in. diam.	
Cobble/Gravel –10 to .08 in. diam.	
Sand – coarse grain	80%
Silt/Detritus/Muck - fine grain/organic matter	20%
Hardpan/Bedrock – solid clay/rock surface	
Artificial – manmade	
Unknown	

INSTREAM COVER – pg. 23

(check all that apply)

Undercut Banks	
Overhanging Vegetation	yes
Deep Pools	
Boulders	
Aquatic Plants	yes
Logs or Woody Debris	yes

RIVER MORPHOLOGY – pg. 23

Riffle			
Pool	Present		
Channel	Natural		
Designated Drain	?		

Highest Water Mark (ft.)	?				

STREAM CORRIDOR – pg. 26

Riparian Veg. Width ft.(L)				>100
Riparian Veg. Width ft.(R)			30-100	
Bank Erosion		L		
Streamside Land Cover		Grass	Shrub	Trees
Stream Canopy %				>50

Stream Cross Section

Adjacent Land Uses

	L	R
Wetlands		
Shrub or Old Field		
Forest	L	R
Pasture		
Crop Residue		
Rowcrop		
Residential Lawns, Parks	L	R
Impervious Surface		
Disturbed Ground		
No Vegetation		

* Optional Data Item

Data Sheet Version 4/27/00

Single Site Watershed Survey Data Sheet (page 2)

Date: 6/28/2004 Station #: 4

Upstream Side

POTENTIAL SOURCES (Severity: S – slight; M – moderate; H – high) – pg. 28							
Crop Related Sources				Land Disposal			
Grazing Related Sources				On-site Wastewater Systems			
Intensive Animal Feeding Operations				Silviculture (Forestry NPS)			
Highway/Road/Bridge Maintenance and Runoff (Transportation NPS)	S			Resource Extraction (Mining NPS)			
Channelization				Recreational/Tourism Activities (general)			
Dredging				• Golf Courses			
Removal of Riparian Vegetation				• Marinas/Recr. Boating (water releases)			
Bank and Shoreline Erosion/ Modification/Destruction				• Marinas/Recr. Boating (bank or shoreline erosion)			
Flow Regulation/ Modification (Hydrology)				Debris in Water		M	
Upstream Impoundment				Industrial Pt. Source			
Construction:Highway/Road /Bridge/Culvert				Municipal Pt. Source			
Construction: Land Development				Natural Sources			H
Urban Runoff (Residential/ Urban NPS)	S			Source(s) Unknown	S		

SITE SUMMARY INFORMATION – pg. 33			
SURVEY DIRECTION	N/A	U/S	D/S
SITE SIMILARITY	?	Y	N
OVERALL SITE RANKING	L	M	H
SITE FOLLOW-UP RANK	L	M	H

COMMENTS: Sample site upstream of bridge.

Date: 6/28/2004

Single Site Watershed Survey Data Sheet

Time: 12:30

Waterbody Name: Bass River | County: Ottawa | Station #: 5

Location: BR-5 | Township: Robinson/Crockery | Sec 25 T7N R15W SW ¼ NE ¼

Investigator: B. Scull | Lat: 42.9646 | Long: -86.03032

Coordinate Determination Method (check the one that applies):

_X_ GPS ___ GPS w/ DBR ___ Digital mapping software ___ Topographic map ___ Other (describe _____)

Map Scale (if known _____)

Downstream Side

PHYSICAL HABITAT

BACKGROUND INFORMATION - pg. 18

Event Conditions noted at site	None
Days since Rain	<1
Water Temp./D.O./pH *	
Water Color	Brown
Waterbody Type-u/s	Stream
Waterbody Type-d/s	Stream
Stream Width (ft.)	10-25
Avg. Stream Depth (ft.)	1-3
Water Velocity (ft./sec) *	
Stream Flow Type	L

PHYSICAL APPEARANCE - pg. 20

(Check all that apply)

Aquatic Plants	
Floating Algae	
Filamentous Algae	
Bacterial Sheen/Slimes	
Turbidity	Present
Oil Sheen	
Foam	
Trash	

SUBSTRATE (%) – pg. 22

(add to 100%)

Boulder – 10 in. diam.	
Cobble/Gravel –10 to .08 in. diam.	
Sand – coarse grain	70%
Silt/Detritus/Muck - fine grain/organic matter	30%
Hardpan/Bedrock – solid clay/rock surface	
Artificial – manmade	
Unknown	

INSTREAM COVER – pg. 23

(check all that apply)

Undercut Banks	
Overhanging Vegetation	yes
Deep Pools	yes
Boulders	
Aquatic Plants	
Logs or Woody Debris	yes

RIVER MORPHOLOGY – pg. 23

Riffle		
Pool	Present	
Channel	Natural	
Designated Drain	?	

Highest Water Mark (ft.)	?

STREAM CORRIDOR – pg. 26

Riparian Veg. Width ft.(L)		10-30		
Riparian Veg. Width ft.(R)			30-100	
Bank Erosion		L		
Streamside Land Cover		Grass	Shrub	Trees
Stream Canopy %				>50

Stream Cross Section

Adjacent Land Uses

	L	R
Wetlands		
Shrub or Old Field		
Forest	L	R
Pasture		
Crop Residue		
Rowcrop		
Residential Lawns, Parks		R
Impervious Surface		
Disturbed Ground		
No Vegetation		

* Optional Data Item

Data Sheet Version 4/27/00

Single Site Watershed Survey Data Sheet (page 2)

Date: 6/28/2004 **Station #: 5**

Upstream Side

POTENTIAL SOURCES (Severity: S – slight; M – moderate; H – high) – pg. 28							
Crop Related Sources				Land Disposal			
Grazing Related Sources				On-site Wastewater Systems			
Intensive Animal Feeding Operations				Silviculture (Forestry NPS)			
Highway/Road/Bridge Maintenance and Runoff (Transportation NPS)	S			Resource Extraction (Mining NPS)			
Channelization				Recreational/Tourism Activities (general)			
Dredging				• Golf Courses			
Removal of Riparian Vegetation				• Marinas/Recr. Boating (water releases)			
Bank and Shoreline Erosion/ Modification/Destruction				• Marinas/Recr. Boating (bank or shoreline erosion)			
Flow Regulation/ Modification (Hydrology)				Debris in Water	S		
Upstream Impoundment				Industrial Pt. Source			
Construction: Highway/Road /Bridge/Culvert				Municipal Pt. Source			
Construction: Land Development				Natural Sources		M	
Urban Runoff (Residential/ Urban NPS)			H	Source(s) Unknown	S		

SITE SUMMARY INFORMATION – pg. 33			
SURVEY DIRECTION	N/A	U/S	D/S
SITE SIMILARITY	?	Y	N
OVERALL SITE RANKING	L	M	H
SITE FOLLOW-UP RANK	L	M	H

COMMENTS: Sample site downstream of bridge.

Date: 6/28/2004

Single Site Watershed Survey Data Sheet

Time: 13:15

Waterbody Name: Bass River | County: Ottawa | Station #: 6

Location: BR-6 | Township: Blendon | Sec 5 T6N R14W SE ¼ NW ¼

Investigator: B. Scull | Lat: 42.93602 | Long: -85.99557

Coordinate Determination Method (check the one that applies):

_X_ GPS ___ GPS w/ DBR ___ Digital mapping software ___ Topographic map ___ Other (describe _____)

Map Scale (if known _____)

Upstream Side

PHYSICAL HABITAT

BACKGROUND INFORMATION - pg. 18

Event Conditions noted at site	None				
Days since Rain			≥3		
Water Temp./D.O./pH *					
Water Color	Clear				
Waterbody Type-u/s	Stream				
Waterbody Type-d/s	Stream				
Stream Width (ft.)	<10				
Avg. Stream Depth (ft.)	<1				
Water Velocity (ft./sec) *					
Stream Flow Type			L		

PHYSICAL APPEARANCE - pg. 20

(Check all that apply)

Aquatic Plants		
Floating Algae		
Filamentous Algae		
Bacterial Sheen/Slimes		
Turbidity		
Oil Sheen		
Foam		
Trash		

SUBSTRATE (%) – pg. 22

(add to 100%)

Boulder – 10 in. diam.	
Cobble/Gravel –10 to .08 in. diam.	
Sand – coarse grain	100%
Silt/Detritus/Muck - fine grain/organic matter	
Hardpan/Bedrock – solid clay/rock surface	
Artificial – manmade	
Unknown	

INSTREAM COVER – pg. 23

(check all that apply)

Undercut Banks	
Overhanging Vegetation	grasses
Deep Pools	
Boulders	
Aquatic Plants	
Logs or Woody Debris	

RIVER MORPHOLOGY – pg. 23

Riffle				
Pool				
Channel	Natural			
Designated Drain	?			

Highest Water Mark (ft.)	?					

STREAM CORRIDOR – pg. 26

Riparian Veg. Width ft.(L)		10-30		
Riparian Veg. Width ft.(R)		10-30		
Bank Erosion		L		
Streamside Land Cover		Grass		
Stream Canopy %	<25			

Stream Cross Section

Adjacent Land Uses

Wetlands		
Shrub or Old Field		
Forest		
Pasture	L	R
Crop Residue		
Rowcrop	L	R
Residential Lawns, Parks		
Impervious Surface		
Disturbed Ground		
No Vegetation		

* Optional Data Item

Data Sheet Version 4/27/00

Single Site Watershed Survey Data Sheet (page 2)

Date: 6/28/2004 **Station #: 6**

Upstream Side

POTENTIAL SOURCES (Severity: S – slight; M – moderate; H – high) – pg. 28							
Crop Related Sources			**H**	**Land Disposal**			
Grazing Related Sources			**H**	**On-site Wastewater Systems**			
Intensive Animal Feeding Operations				**Silviculture (Forestry NPS)**			
Highway/Road/Bridge Maintenance and Runoff (Transportation NPS)				**Resource Extraction (Mining NPS)**			
Channelization	**S**			**Recreational/Tourism Activities (general)**			
Dredging				• **Golf Courses**			
Removal of Riparian Vegetation				• **Marinas/Recr. Boating (water releases)**			
Bank and Shoreline Erosion/ Modification/Destruction				• **Marinas/Recr. Boating (bank or shoreline erosion)**			
Flow Regulation/ Modification (Hydrology)				**Debris in Water**			
Upstream Impoundment				**Industrial Pt. Source**			
Construction:Highway/Road /Bridge/Culvert				**Municipal Pt. Source**			
Construction: Land Development				**Natural Sources**		**M**	
Urban Runoff (Residential/ Urban NPS)	**S**			**Source(s) Unknown**	**S**		

SITE SUMMARY INFORMATION – pg. 33			
SURVEY DIRECTION	**N/A**	**U/S**	**D/S**
SITE SIMILARITY	**?**	**Y**	**N**
OVERALL SITE RANKING	**L**	**M**	**H**
SITE FOLLOW-UP RANK	**L**	**M**	**H**

COMMENTS: Sample site upstream of bridge.

Appendix 2

Bass River Watershed

Monitoring Station Pictures

2004

BR-1 Downstream

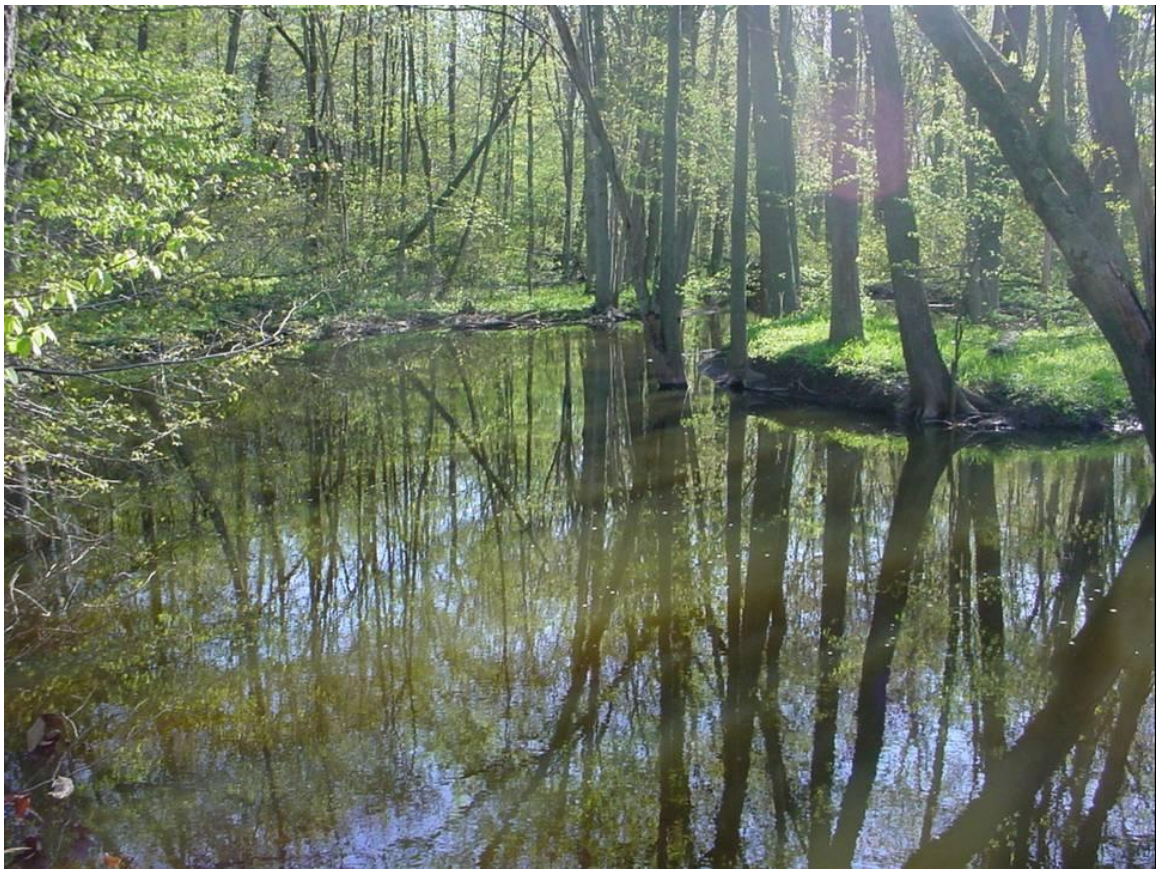
BR-2 Downstream

BR-3 Downstream

BR-3 Culvert

BR-4 Upstream

BR-4 Culvert



BR-5 Downstream

BR-5 Bridge

BR-6 Upstream

BR-6 Bridge

Stormwater Pond

Stormwater Pond

Appendix 3

Bass River Watershed

MDEQ Rating Curves 2004

2004

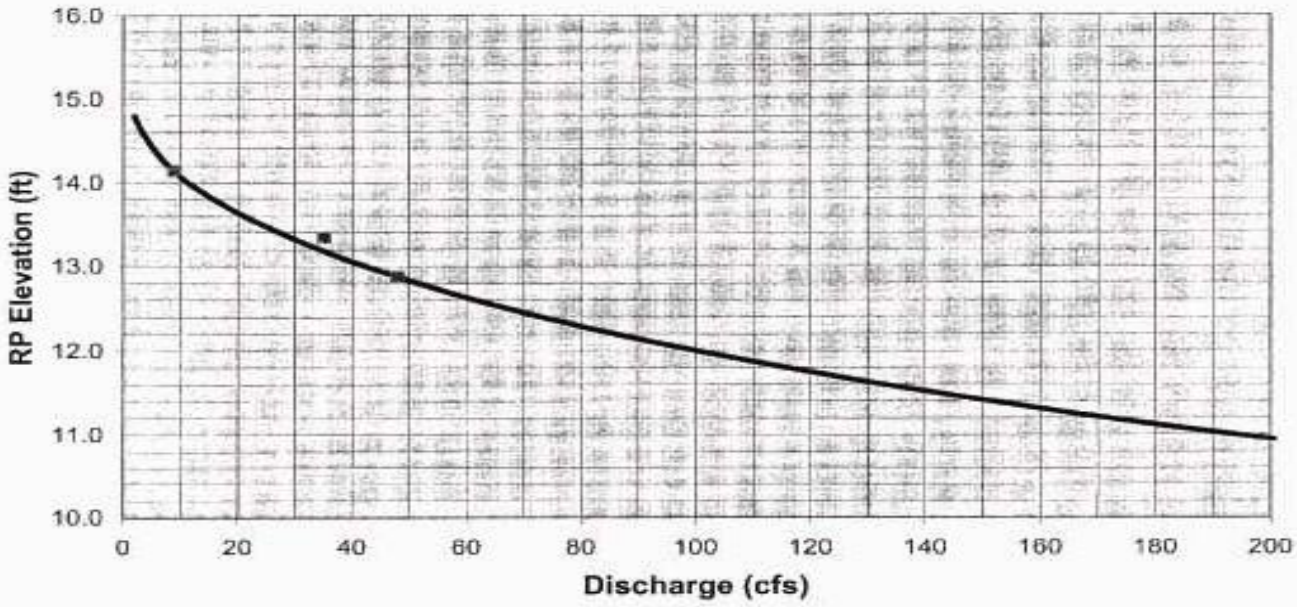
DEQ Michigan Department of Environmental Quality - Land and Water Management Division
Stage-Discharge Rating Curve

Station: BR-01, Bass River at Warner Street

RP: Downstream side of bridge a V notched on top of the 6th I-beam railing support from the left edge of water.

R.P. (ft)	Discharge (cfs)
14.80	1.91
14.60	3.36
14.40	5.32
14.20	7.87
14.00	11.37
13.80	15.83
13.60	21.16
13.40	27.31
13.20	34.29
13.00	42.25
12.80	51.24
12.60	61.32
12.40	72.81
12.20	85.79
12.00	100.07
11.80	115.68
11.60	132.68
11.40	151.11
11.20	171.02
11.00	193.50
10.80	217.68

Measurements		
Date	R.P.	Discharge
4/19/2004	13.33	35.12
6/7/2004	12.87	47.97
8/16/2004	14.13	8.92



10/28/2004

DEQ Michigan Department of Environmental Quality - Land and Water Management Division
Stage-Discharge Rating Curve

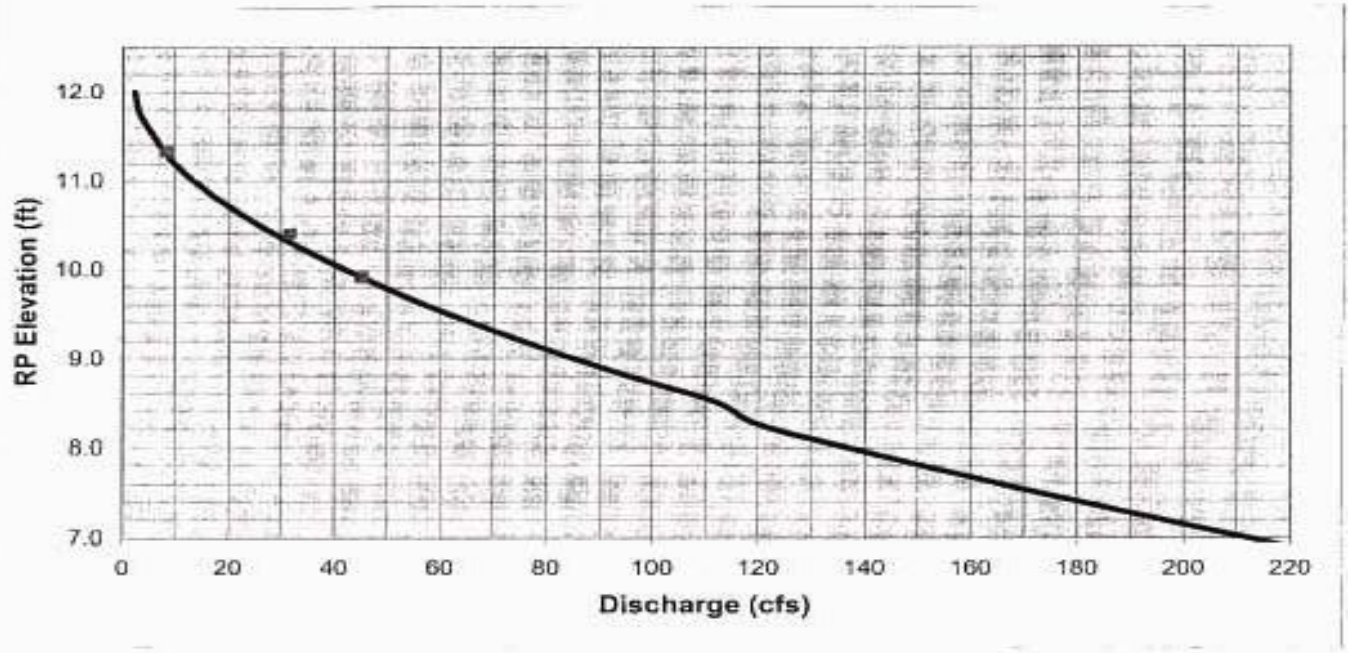
Station: BR-02, Bass River at Buchanan Street

RP: Downstream side of bridge a V notched on top of railing between the 5th and 6th railing support from the left edge of water.

R.P. (ft)	Discharge (cfs)
12.00	2.31
11.75	3.30
11.50	5.90
11.25	8.85
11.00	13.39
10.75	19.12
10.50	25.80
10.25	33.41
10.00	41.93
9.75	51.36
9.50	61.69
9.25	72.90
9.00	85.01
8.75	98.00
8.50	111.88
8.25	119.99
8.00	136.74
7.75	154.37
7.50	172.85
7.25	192.16
7.00	212.28
6.75	233.17

Measurements

Date	R.P.	Discharge
4/19/2004	10.40	31.66
6/7/2004	9.91	45.22
8/16/2004	11.32	8.24



10/28/2004

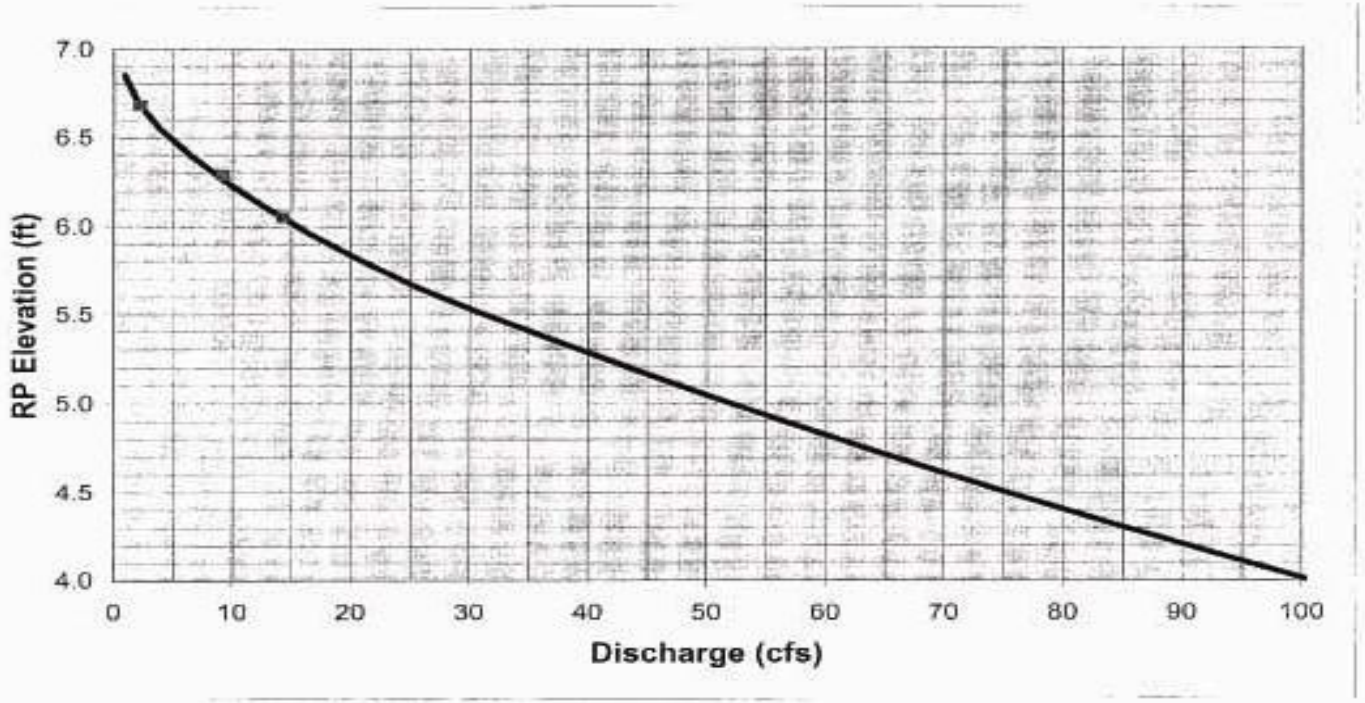
DEQ Michigan Department of Environmental Quality - Land and Water Management Division
Stage-Discharge Rating Curve

Station: BR-03, Bear Creek at 104th Avenue

RP: Downstream side of box culvert at the low cord (the inside top of the box culvert) below bolt on the right edge of water.

R.P. (ft)	Discharge (cfs)
6.85	0.91
6.70	2.05
6.55	3.88
6.40	6.41
6.25	9.47
6.10	13.00
5.95	16.77
5.80	20.90
5.65	25.69
5.50	31.29
5.35	37.19
5.20	43.38
5.05	49.83
4.90	56.51
4.75	63.41
4.60	70.52
4.45	77.81
4.30	85.28
4.15	92.92
4.00	100.71

Measurements		
Date	R.P.	Discharge
6/7/2004	6.05	14.27
8/16/2004	6.68	2.25
4/26/2004	6.29	9.24



10/28/2004

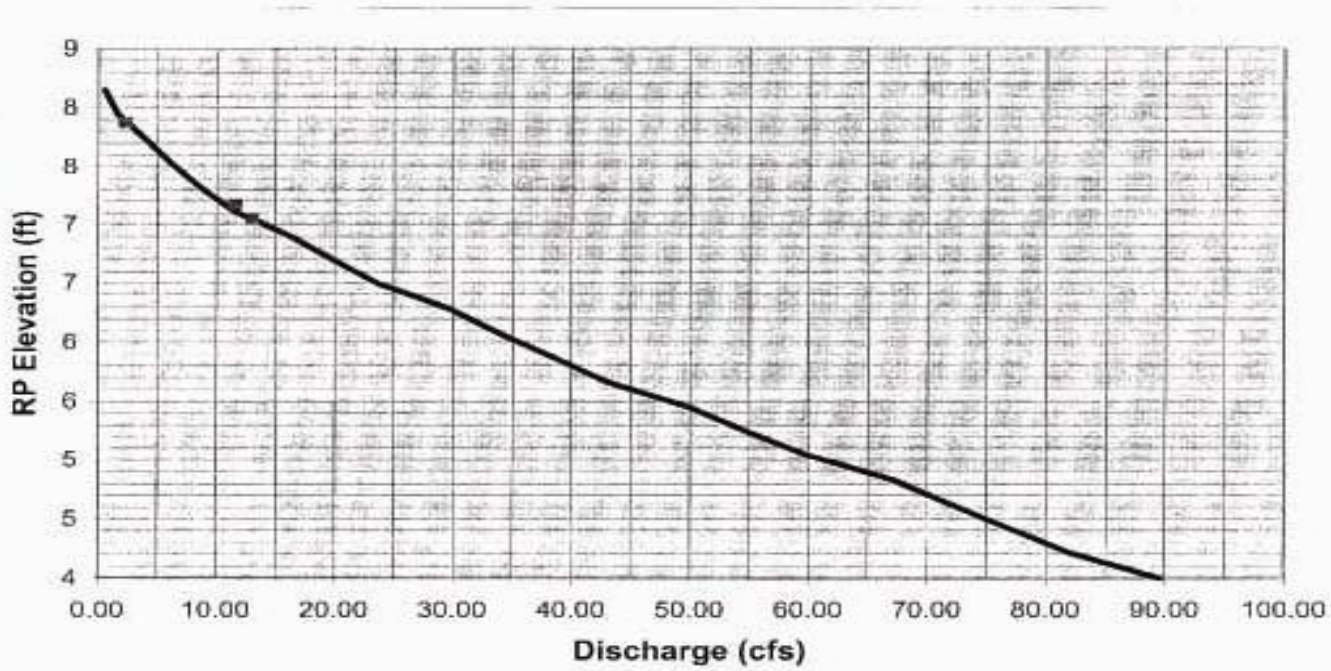
DEQ Michigan Department of Environmental Quality - Land and Water Management Division
Stage-Discharge Rating Curve

Station: BR-04, Little Bass River at 96th Avenue
RP: Downstream side of culvert, a V notch on top of Pipe Arch Culvert.

R.P. (ft)	Discharge (cfs)
8.15	0.51
7.94	1.62
7.73	4.02
7.53	6.12
7.32	8.64
7.11	11.48
6.90	16.23
6.70	19.84
6.49	23.65
6.28	29.72
6.07	34.02
5.87	38.43
5.66	43.04
5.45	49.90
5.24	54.84
5.04	59.82
4.83	67.11
4.62	72.11
4.41	77.09
4.21	82.04
4.00	89.62

Measurements

Date	R.P.	Discharge
4/26/2004	7.17	11.60
6/7/2004	7.04	13.02
8/16/2004	7.87	2.28



10/28/2004

DEQ Michigan Department of Environmental Quality - Land and Water Management Division
Stage-Discharge Rating Curve

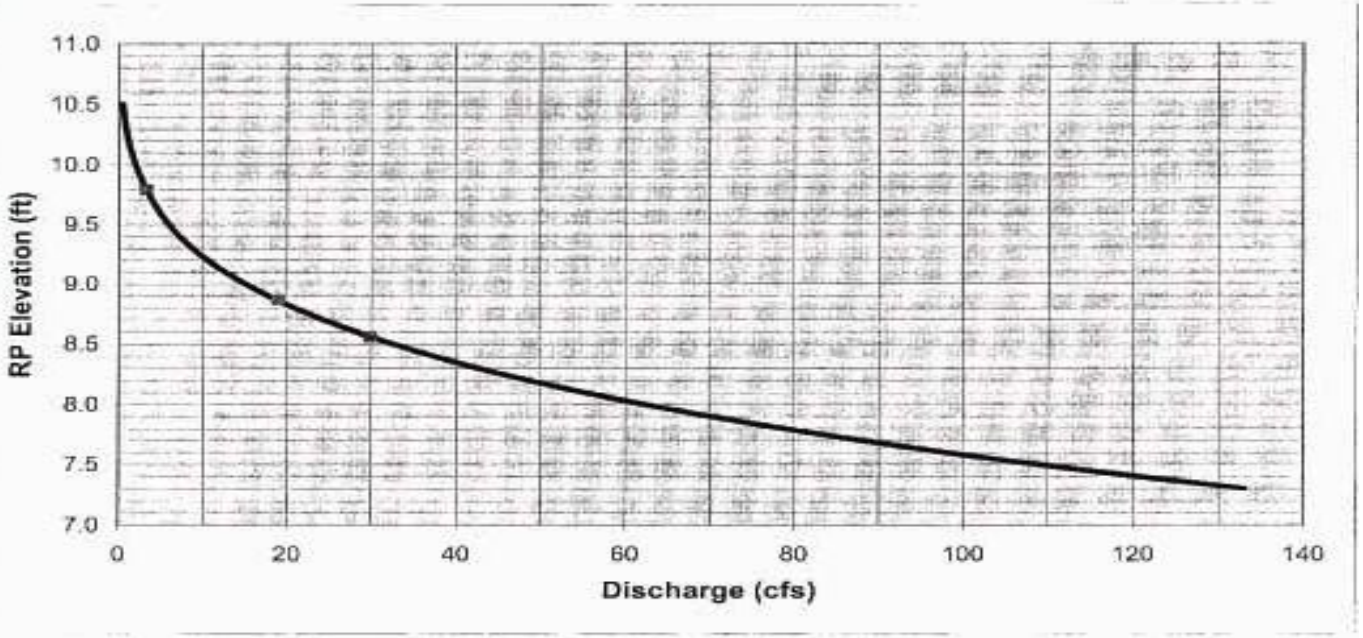
Station: BR-05, Bass River at Winans Street

RP: Downstream side of Bridge a V notched on top of the railing between the 3rd and 4th railing support from the left edge of water.

R.P. (ft)	Discharge (cfs)
10.50	0.48
10.30	0.91
10.10	1.56
9.90	2.59
9.70	4.01
9.50	5.96
9.30	8.73
9.10	12.67
8.90	17.81
8.70	24.37
8.50	32.61
8.30	42.78
8.10	55.16
7.90	70.06
7.70	87.79
7.50	108.70
7.30	133.15

Measurements

Date	R.P.	Discharge
4/26/2004	8.56	29.95
6/7/2004	8.87	16.98
8/16/2004	9.79	3.31



10/28/2004

DEQ Michigan Department of Environmental Quality - Land and Water Management Division

Stage-Discharge Rating Curve

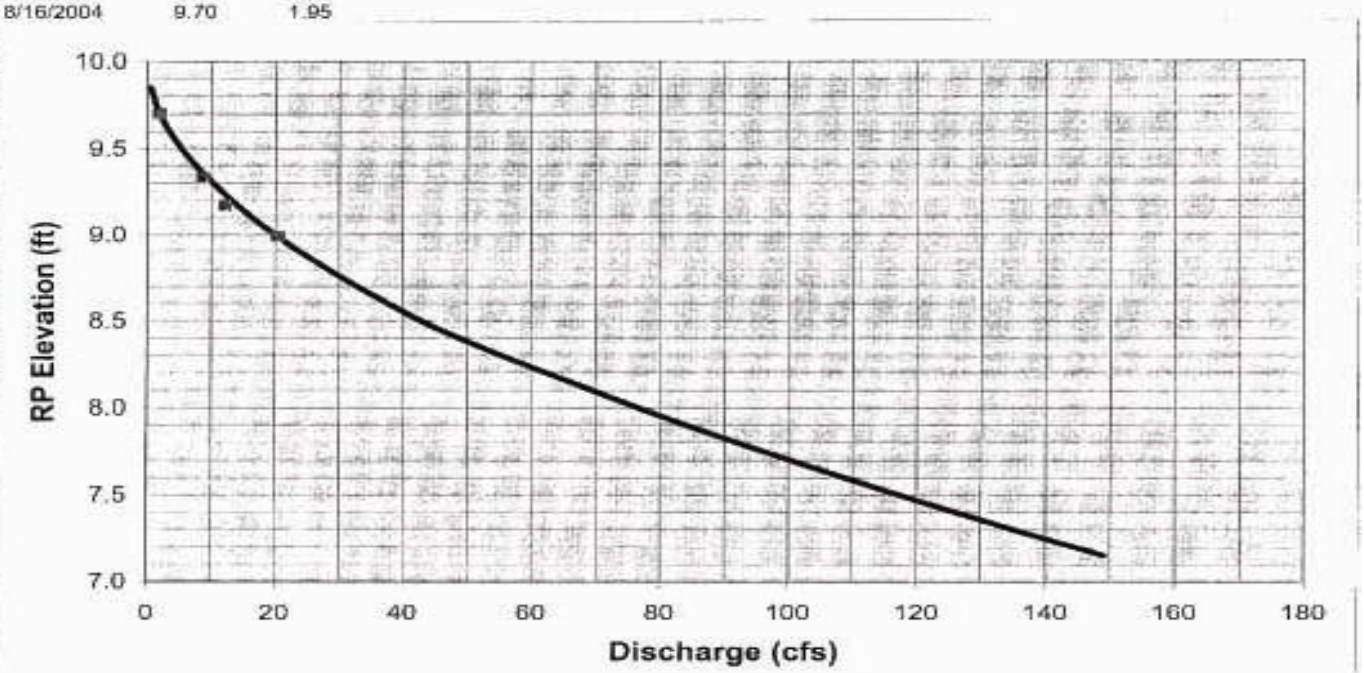
Station: BR-06, Bass River at Stanton Street

RP: Downstream side of Bridge a V notched on top of the railing between the 2nd and 3rd railing support from the left edge of water.

R.P. (ft)	Discharge (cfs)
9.85	0.53
9.70	1.95
9.55	4.40
9.40	7.67
9.25	11.70
9.10	16.45
8.95	21.93
8.80	28.13
8.65	35.06
8.50	42.72
8.35	52.12
8.20	62.20
8.05	72.92
7.90	84.25
7.75	96.16
7.60	108.62
7.45	121.60
7.30	135.10
7.15	149.07
7.00	163.52
6.85	178.41

Measurements

Date	R.P.	Discharge
4/19/2004	9.33	8.86
4/26/2004	8.99	20.40
6/7/2004	9.17	12.26
8/16/2004	9.70	1.95



10/28/2004