STUDY PERFORMANCE REPORT

State: Michigan **Project No.:** F-80-R-7

Study No.: 230702 **Title:** Effects of sediment traps on Michigan river channels

Period Covered: October 1, 2005 to September 30, 2006

Study Objectives: To quantify the effect of sediment removal efforts on the channel morphology of select Michigan streams. More specifically, to 1) identify the rate and spatial extent of change in riverbed elevation and substrate conditions, and 2) relate these data to hydrologic, gradient, and valley characteristics of each stream.

Summary: I re-surveyed previously-established transects in Silver Lead and Twomile creeks and established new transects in the Baldwin River. Since two years of post-excavation data were available at all study sites (with the exception of the Baldwin River), I compared changes in channel depth, cross-sectional area, and substrate data from visual observations. The excavation of sediment traps generally had only small effects on mean channel depth, with changes occurring both upstream and downstream of the trap. Trap excavation initiated a headcut above the sediment trap at five of the six study sites surveyed. Visual observation data indicate some increases in coarse substrate, although in several cases these increases could not be explained by an increase in channel depth, suggesting observer bias from year-to-year. Changes in channel area were variable among study sites and appeared as likely to occur at transects proximal to sediment traps as at transects located further upstream or downstream. The lateral position of the channels at all sites remained constant, indicating little side cutting had occurred. Although two years of post-excavation pebble count data at two of the study sites demonstrated an increase in coarse particles after sediment trap excavation, particle size was larger upstream of the sediment trap at one site (Silver Lead Creek) and was still dominated by fines at the other (Twomile Creek).

Findings: Jobs 2, 3, and 4 were scheduled for 2005-06, and progress is reported below.

Job 2. Title: Survey bed elevations and substrate conditions.–I re-surveyed bed elevations and recorded substrate composition from visual observations and pebble counts at previously-established transects in Silver Lead Creek and Twomile Creek. I also established permanent transects, surveyed bed elevations, and recorded substrate composition from visual observations and pebble counts at a site in the Baldwin River where a new sediment trap will be excavated.

Job 3. Title: Analyze data.−Two years of post-excavation data were available at all six previously-surveyed sediment trap locations at the end of the 2006 field season. This allowed me to compare changes in channel depth, cross-sectional area, and substrate composition (from visual observation data) across these sites. Mean channel depth increased both upstream and downstream of the sediment traps after two years in three of the six streams surveyed (Table 1). The largest increase in mean channel depth (0.32 ft) occurred upstream of the sediment trap on Twomile Creek. Increases in mean channel depth upstream of the sediment traps also occurred in the Au Sable River, Boardman River, East Branch Au Sable River, and Silver Lead Creek (range 0.02–0.26 ft). The increases in the depth above the sediment traps were due to trap excavation, which initiated a headcut as the stream established a new grade. The largest increase in mean channel depth downstream of the sediment trap occurred in Twomile Creek, followed by the

Au Sable River and Silver Lead Creek (range 0.15–0.21 ft). Decreases in mean channel depth downstream of sediment traps ranging from 0.06–0.09 ft were observed in three of the six streams surveyed.

The increase in mean channel depth upstream and downstream of the sediment trap on the Au Sable River was accompanied by increases in substrate visually classified as gravel of 14% upstream and 4% downstream (Table 2). Gravel substrates also increased upstream and downstream of sediment traps in the East Branch Au Sable and Little Manistee rivers as well as Silver Lead Creek. The increase in gravel substrate upstream of the sediment trap in the East Branch Au Sable River and upstream and downstream of the sediment traps in the Au Sable River and Silver Lead Creek are explained by the increase in depth (headcutting or scour) exposing coarser substrate. However, increases in gravel substrate upstream or downstream of the sediment trap at other locations cannot be explained by an increase in mean channel depth, suggesting observer bias among different field crews. Continued pebble counts upstream and downstream of the sediment traps at all study sites will help to alleviate this problem. Mean channel depth and substrate composition were similar upstream and downstream of the proposed sediment trap location in the Baldwin River (Table 3).

The spatial extent of change in channel form (particularly cross-sectional area) was variable among study sites and displayed no discernable pattern. Changes in channel form were as likely to occur close to sediment traps as at transects located further upstream or downstream. Similar to changes in mean channel depth, overall increases or decreases in cross-sectional area upstream and downstream of sediment traps were small. The lateral position of the channel remained stable at all sites.

Two years of post-excavation pebble count data were available from Silver Lead and Twomile creeks (Figure 1). Although a slight increase in fine particles upstream and downstream of the sediment trap in Silver Lead Creek occurred since the last survey in 2005, the substrate is still substantially coarser than it was before sediment trap excavation in late 2004. A slight shift in fine particle sizes (decrease in silt and detritus, increase in sand) occurred again in Twomile Creek. Similar to 2005, coarser particles occur more frequently upstream of the sediment trap in Silver Lead Creek, while fine substrate frequencies were similar above and below the sediment trap in Twomile Creek. All particles measured upstream and downstream of the proposed trap location in the Baldwin River were fines (Figure 2).

Job 4. Title: Write annual performance reports.−This progress report was prepared as scheduled.

Prepared by: Todd C. Wills
Date: September 30, 2006

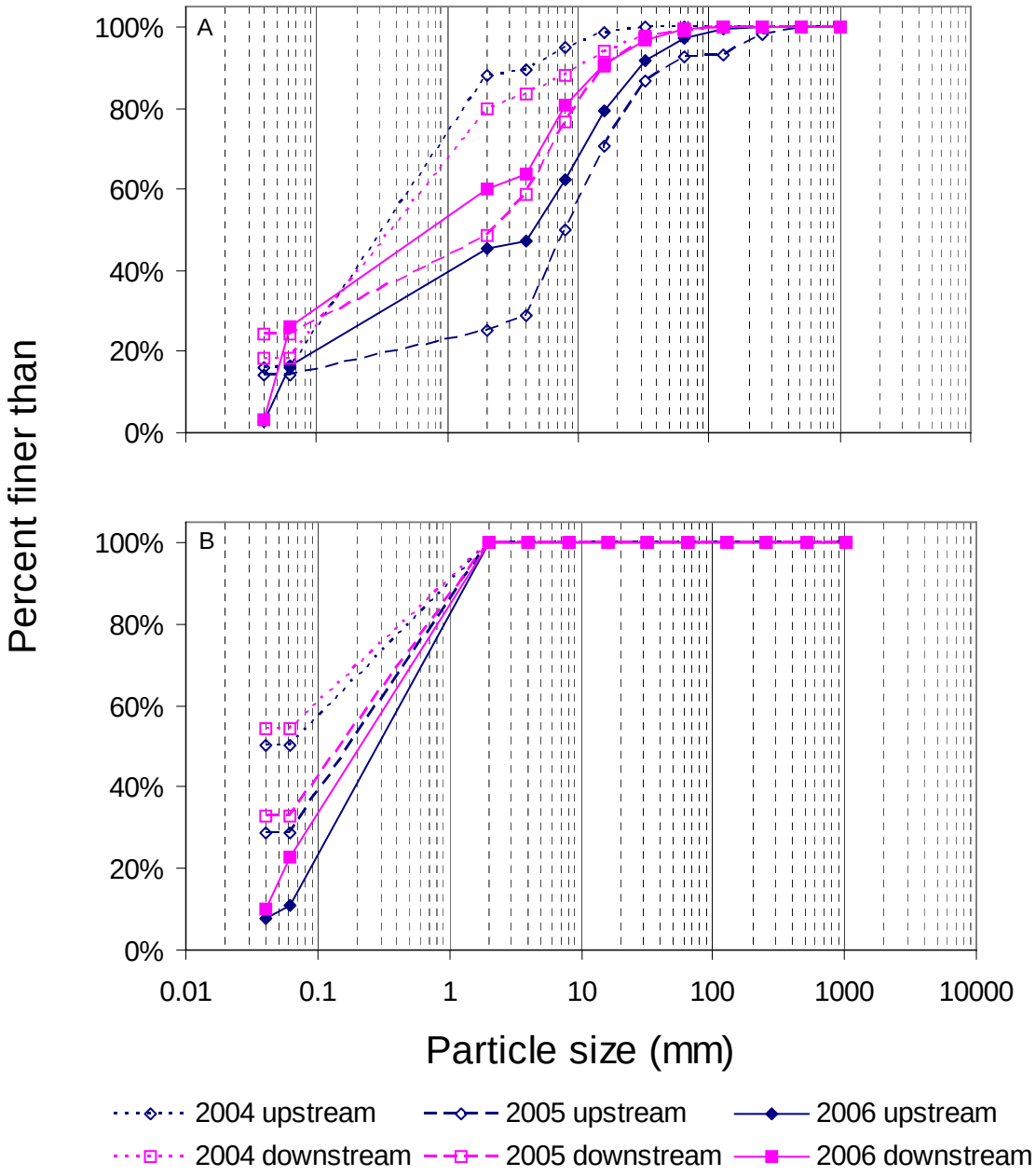

Figure 1.–Cumulative frequencies of substrate particle size from pebble counts before (2004) and after (2005-06) sediment trap construction in Silver Lead (A) and Twomile (B) creeks. Substrate particle size categories (and dimensions in mm) were organic and clay (0–0.04mm), silt (0.05–0.062mm), sand (0.063–2mm), very fine gravel (2–4mm), fine gravel (5–8mm), medium gravel (9–16mm), coarse gravel (17–32mm), very coarse gravel (33–64mm), small cobble (65–128mm), large cobble (129–256mm), small boulder (257–512mm), and medium boulder (>512mm).

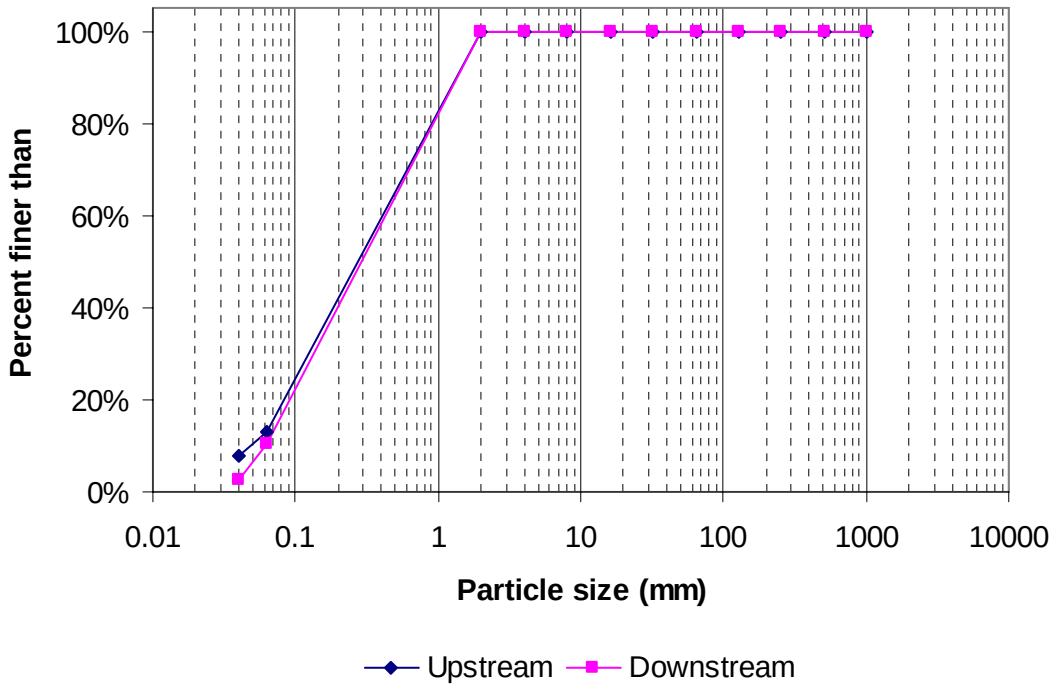

Figure 2.–Cumulative frequencies of substrate particle size from 2006 pebble counts in the Baldwin River. Substrate particle size categories (and dimensions in mm) were organic and clay (0–0.04mm), silt (0.05–0.062mm), sand (0.063–2mm), very fine gravel (2–4mm), fine gravel (5–8mm), medium gravel (9–16mm), coarse gravel (17–32mm), very coarse gravel (33–64mm), small cobble (65–128mm), large cobble (129–256mm), small boulder (257–512mm), and medium boulder (>512mm).

Table 1.–Summary of change in mean channel depth following sediment trap excavation for six study river reaches over a five-year period. Post-excavation data are in bold. Pre-excavation data were not collected in the Boardman or Little Manistee rivers. U = upstream, d = downstream of sediment trap.

River	Location	Mean channel depth (ft) 2002	2003	2004	2005	2006	N[1]	Net change (ft)
Au Sable	u	1.92	**2.04**	**1.94**	–	–	301	0.02
	d	1.94	**2.07**	**2.09**	–	–	599	0.15
Boardman	u	–	**2.62**	**2.64**	–	–	175	0.02
	d	–	**2.15**	**2.06**	–	–	403	-0.09
East Branch Au Sable	u	1.80	**1.89**	**1.89**	–	–	242	0.09
	d	2.08	**2.05**	**2.02**	–	–	454	-0.06
Little Manistee	u	**3.38**	**3.32**	**–**	**3.31**	–	286	-0.07
	d	**3.65**	**3.67**	**–**	**3.57**	–	605	-0.06
Silver Lead Creek	u	–	1.63	1.65	**1.96**	**1.91**	334	0.26
	d	–	1.43	1.48	**1.57**	**1.66**	700	0.18
Twomile Creek	u	–	–	2.37	**2.64**	**2.69**	216	0.32
	d	–	–	2.28	**2.50**	**2.49**	511	0.21

[1] Total number of depth measurements collected.

Table 2.–Summary of net change in visually classified substrate data (shaded area) following sediment trap excavation for six study river reaches over a five-year period. Years in which post-excavation data were collected are in bold. Pre-excavation data were not collected in the Boardman or Little Manistee rivers. Substrate categories (and dimensions in mm) were silt (0.004–0.063), sand (0.064–2), gravel (3–64), small cobble (65–128), large cobble (129–256) and other (clay, boulder, or wood). U = upstream, d = downstream of sediment trap.

			Percent						
River	Year	Location	Silt or detritus	Sand	Gravel	Small cobble	Large cobble	Other	N[1]
Au Sable	2002	u	35	59	0	0	0	6	97
		d	30	65	3	0	0	3	183
	2003	u	32	46	7	0	0	14	84
		d	27	55	8	0	0	10	181
	2004	u	31	49	14	0	0	6	95
		d	28	55	7	0	0	10	183
	Net change	u	-5	-9	14	0	0	0	
		d	-2	-10	4	0	0	8	
Boardman	**2003**	u	7	33	54	5	0	1	83
		d	19	26	42	5	0	8	184
	2004	u	6	36	46	0	0	12	78
		d	16	31	37	0	0	16	189
	Net change	u	-1	3	-8	-5	0	10	
		d	-3	6	-5	-5	0	8	
East Branch Au Sable	2002	u	20	47	28	0	0	5	76
		d	26	43	31	0	0	0	136
	2003	u	14	18	60	7	0	3	71
		d	36	15	41	6	0	2	135
	2004	u	20	23	56	0	0	1	71
		d	30	26	38	0	0	5	141
	Net change	u	0	-25	29	0	0	-4	
		d	4	-16	7	0	0	5	
Little Manistee	2002	u	12	55	33	0	0	0	93
		d	18	54	25	1	0	1	203
	2003	u	8	37	29	20	0	5	95
		d	11	47	39	1	0	2	199
	2005	u	9	47	43	0	0	0	74
		d	24	39	37	0	0	0	155
	Net change	u	-2	-8	10	0	0	0	
		d	6	-15	12	-1	0	-1	

Table 2.–Continued.

River	Year	Location	Percent						N[1]
			Silt or detritus	Sand	Gravel	Small cobble	Large cobble	Other	
Silver Lead Creek	2003	u	15	57	28	0	0	0	82
		d	10	62	15	9	1	3	156
	2004	u	7	71	12	0	0	9	80
		d	12	60	22	0	0	6	155
	2005	u	14	11	68	0	7	0	71
		d	23	24	53	0	0	0	161
	2006	u	10	23	54	0	3	11	71
		d	21	36	41	0	0	3	165
	Net change	u	2	-49	41	0	3	-3	
		d	8	-24	19	0	0	-3	
Twomile Creek	2004	u	33	50	0	0	0	17	54
		d	39	46	0	0	0	16	114
	2005	u	29	71	0	0	0	0	69
		d	33	67	0	0	0	0	174
	2006	u	3	97	0	0	0	0	68
		d	15	83	0	0	0	2	176
	Net change	u	-30	47	0	0	0	-17	
		d	-24	37	0	0	0	-14	

[1] Total number of substrate observations.

Table 3.–Summary of depth and visually classified substrate data for the study reach of the Baldwin River prior to sediment trap construction. Substrate categories (and dimensions in mm) were silt (0.004–0.063), sand (0.064–2), gravel (3–64), small cobble (65–128), large cobble (129–256), boulder (>256), and other (clay, boulder, or wood) wood. U = upstream, d = downstream of sediment trap.

River	Location	Mean channel depth (ft)	Percent						N[1]
			Silt or detritus	Sand	Gravel	Small cobble	Large cobble	Other	
Baldwin	u	4	5	95	0	0	0	0	76
	d	4	8	85	0	0	0	7	155

[1] Total number of substrate observations.