

003710

Water Quality Division
Michigan Department of Natural Resources
January, 1981

Biological Assessment of Pine Creek, Vicinity of Hartford,
Van Buren County, August, 1979 to September, 1980

This survey was conducted to determine the impacts of the DuWel Metal Protection plant discharge on Pine Creek. Biological assessments were made through stream observations and qualitative macroinvertebrate sampling on four occasions: August 2, 1979, April 28, 1980, June 10, 1980, and September 4, 1980. Metals in water and sediment were also sampled on June 10 and September 4, 1980, respectively.

CONCLUSIONS

1. The DuWel plant apparently occasionally discharges highly toxic wastes. Impacts on the macroinvertebrate community were found 20 m downstream of the DuWel discharge point and were severe on one sampling date. (April 28, 1980) and intermediate to minor on the other three sampling occasions.
2. Impacts from the discharge may have been present 0.5 km downstream but were not found 3 km downstream of the discharge.
3. Heavy metals concentrations in stream sediments were elevated 20 m downstream of the DuWel discharge and classified as heavily polluted according to EPA (1977) guidelines.
4. Heavy metals were not detected in Pine Creek water samples taken on June 10, 1980.
5. The temperature regime of Pine Creek will support coldwater fish populations.

RECOMMENDATIONS

1. The DuWel Metal Protection plant should control discharges to non-toxic levels.
2. Fisheries Division should consider classifying Pine Creek as a coldwater stream.

BACKGROUND

Pine Creek, a short (10 km) second order tributary to the Paw Paw River, originates just south of Hartford in Van Buren County (T4S, R16W, S4) and flows north to its confluence with the Paw Paw River (Figure 1). Fisheries Division presently classifies the stream as a warmwater fish stream.

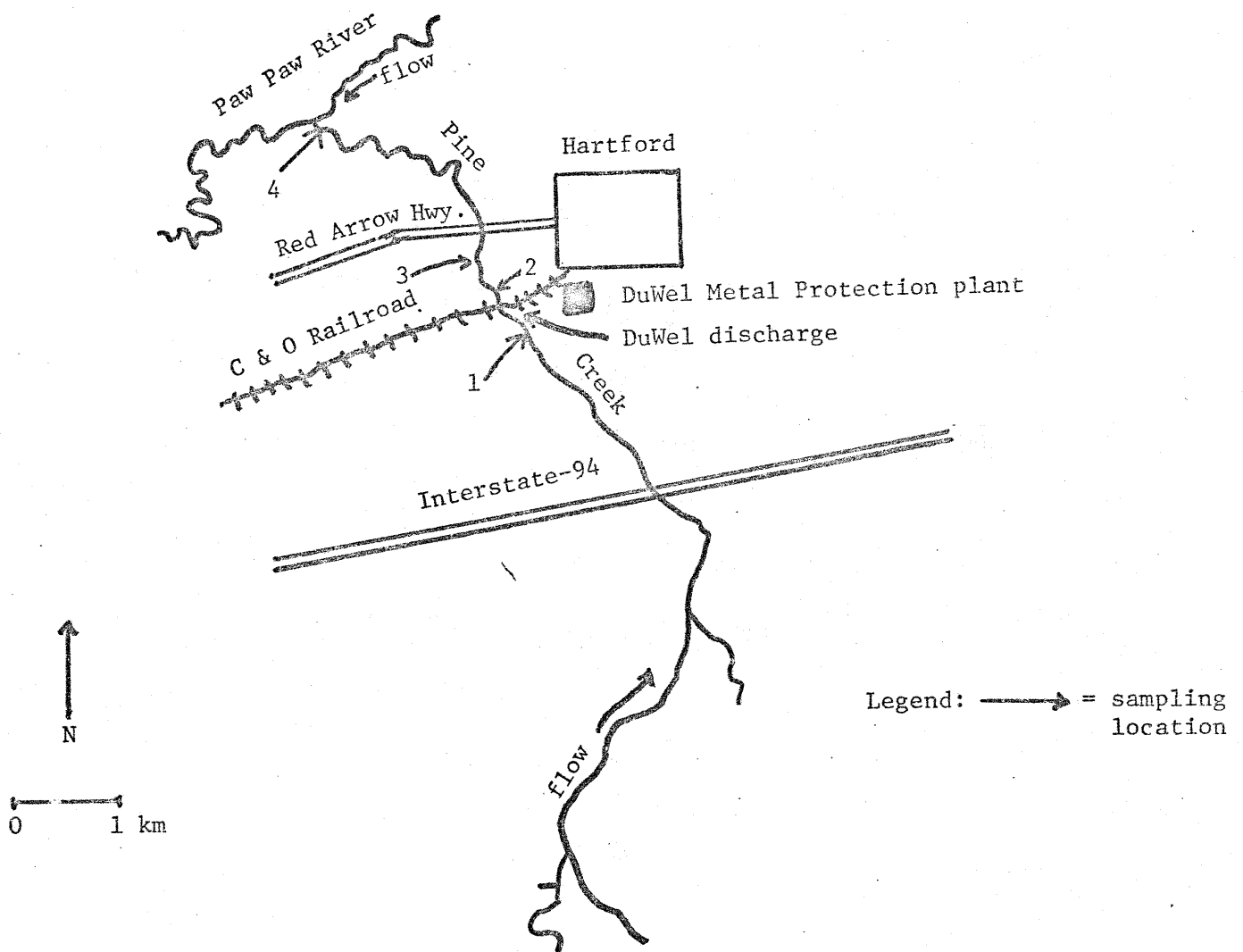


Figure 1. Pine Creek and sampling locations, Van Buren County, Michigan

Fetterolf and Carr (1962) found gross degradation of the Pine Creek macroinvertebrate community downstream of the DuWel Metal Protection plant (Hartford) discharge in 1962. Lundgren (1976; 1978) found significant improvements in stream quality in Pine Creek in 1976 and 1978. Although Lundgren found no adverse impacts from the DuWel discharge during the 1978 survey, DuWel was not discharging because of a plant strike.

Christensen and McDonald (1978) found high levels of copper (18.0 mg/l), chromium (2.1 mg/l), hexavalent chromium (1.9 mg/l) and cyanide (0.36 mg/l) in the DuWel discharge in June, 1978. Boersen and Erickson (1979) found much lower levels of copper (0.690 mg/l) chromium (0.160 mg/l), and cyanide (0.04 mg/l) in the discharge in October, 1979. Lee (1979) found an effluent 48 hr. LC 50 of 25 percent in static tests with Daphnia magna in October, 1979. In an on-site 72 hour flow-through bioassay conducted in May, 1980 (Lee, 1980) the effluent was not toxic to fathead minnows (Pimephales promelas) or to Daphnia magna in a concurrent 48-hour static test.

METHODS

Macroinvertebrate samples were taken qualitatively with fifteen to twenty man-minutes spent sampling all available habitats. Triangular dip nets with a 1.0 mm mesh were used in addition to handpicking organisms from available substrates. Organisms were identified in the field and relative abundance estimated.

Surface water grab samples were collected in 500 ml plastic bottles on June 10 and September 4, 1980. Sediment samples were taken in glass jars on September 4, 1980 from silty stream substrate. All samples were cooled to 4°C and returned to the Environmental Protection Bureau laboratory in Lansing for analysis. General observations on Pine Creek were made and summarized in Table 1.

RESULTS AND DISCUSSION

On all sampling dates, similar macroinvertebrate communities were found at location 1, upstream of the DuWel discharge point (Table 2). Mayflies and caddisflies dominated the benthic community.

At location 2, directly downstream from the DuWel discharge, a severely reduced macroinvertebrate community was found on April 28, 1980 with only slight community reductions found on the other three sampling dates. On April 28, 1980 the macroinvertebrate community consisted primarily of midges and was devoid of mayflies, caddisflies and clams (Table 2). On the other three sampling dates the communities at locations 1 and 2 were similar except for a reduction or absence of mayflies, particularly Heptageniidae, and clams at location 2. Caddisflies were generally abundant on these three dates.

Heavy metals were not detected in water samples taken from Pine Creek at locations 1 and 2 on June 4, 1980 (Table 3) possibly due to fairly high detection levels employed. However, heavy metals were detected in sediments collected

at location 2 on September 4, 1980. This station was classified as heavily polluted according to EPA (1977) guidelines. The elevated metals in sediments indicated past discharges of heavy metals.

Pine Creek downstream of location 2 was habitat-limited with substrate comprised primarily of clay and sand, making an estimate of the extent of stream degradation difficult. The macroinvertebrate community at location 3 on August 2, 1979 was dominated by caddisflies with mayflies, crayfish, blackflies and midges also present. The benthos at location 3 was similar to the community found at location 2. At location 4 on August 2, 1979, abundant populations of mayflies, crayfish, dragonflies, blackflies and midges were found, with caddisflies also present and similar to the community found at location 1. Neither location was comparable to locations 1 and 2 due to the habitat differences. The macroinvertebrate communities indicated that DuWel's discharge did not impact location 4 but may have affected location 3, 0.5 km downstream from the discharge.

The variable macroinvertebrate communities found at location 2 indicated that occasional toxic effluents were discharged by DuWel. Since Christensen and McDonald (1978) and Boersen and Erickson (1979) found relatively high levels of copper, chromium and cyanide in the discharge, the predicted effect levels of these toxicants were calculated following the Water Quality Division procedure of calculating water quality based effluent limits. Using the water hardness of 275 mg/l found on September 4, 1980, the predicted effect levels were:

	Acute Effect Level <u>(µg/l)</u>	Chronic Effect Level <u>(µg/l)</u>
Copper	721	41
Hexavalent Chromium	7400	110
Free Cyanide	100	5

The acute level represents the concentration (excluding additive or synergistic effects) at which 50% of the fish or important fish food organisms would die after 96 hours of exposure. The chronic level represents the highest concentration at which no lethal, reproductive or growth impacts occur after exposures of 28 days. Concentrations of copper and cyanide in the DuWel effluent exceeded the acute effect levels in June, 1978 (Christensen and McDonald, 1978).

Winner et al (1980), in studies of two streams receiving heavy metals, concluded that macroinvertebrates, other than midges and tubificid worms, were virtually eliminated from rock-rubble, riffle habitats in heavily stressed sections. They also concluded that caddisflies were present at intermediately polluted stations while mayflies were generally intolerant of heavy metal pollution. The only toxicant in one stream was copper. In this stream, copper concentrations ranged from 106 to 152 µg/l at 0.1 km from the source. The macroinvertebrate communities downstream of DuWel's discharge were impacted similar to the communities studied by Winner et al (1980). This suggests that

periodic heavy metal contamination from DuWel may be impacting stream quality.

The temperature regime of Pine Creek could support coldwater fish since temperatures, even in late summer, did not exceed 20°C.

REFERENCES CITED

- Boersen, G. and W. Erickson. 1979. Report of an industrial wastewater survey conducted at DuWel Metal Products, Hartford, Michigan, October 15-16, 1979. MDNR. 12 p.
- Christensen, R. and L. J. McDonald, 1978. Report of an industrial wastewater survey conducted at DuWel Products, Inc., Hartford Metal Production Division, Hartford, Michigan, June 12-13, 1978. MDNR. 12 p.
- Fetterolf, C. and R. Carr. 1962. Biological survey of Pine Creek, Hartford, Michigan, September 28, 1962. MDNR. 7 p.
- Lee, L. 1979. Report of a 48-hour acute toxicity screening test conducted on effluent DuWel Metal Products, Hartford, Michigan, October 17-19, 1979. MDNR. 3 p.
- _____. 1980. Report of a toxicity evaluation conducted at the DuWel Products, Inc., Hartford, Michigan, May 12-16, 1980. MDNR. 16 p.
- Lundgren, R. 1976. A biological survey of the Paw Paw River and Pine Creek in the vicinities of Hartford, Watervliet and Coloma, Michigan, July 27-28, 1976. MDNR. 19 p.
- _____. 1978. DuWel Metal Protection, Hartford. Memo to John Bohunsky.
- U.S. Environmental Protection Agency. 1977. Guidelines for the pollutional classification of Great Lakes harbor sediments. U.S. EPA Region V, Chicago.
- Winner, R. W., M. W. Boesel and M. P. Farrell. 1980. Insect community structure as a index of heavy-metal pollution on lotic ecosystem. Can. J. Fish. Aquatic Sci. 37:647-655.

Report By: William Creal, Aquatic Biologist
Biology Section
Water Quality Division
Department of Natural Resources

Table 1 Summary of Observations on Pine Creek, Vicinity of Hartford, Michigan

Location Number	Location	Date	Temperature (°C)	Stream Width (m)	Average Stream Depth (m)	Estimated Velocity (m/sec)	Substrate (%)
1	Pine Creek, 50 m upstream of C & O railroad crossing and Dukel discharge T3S, R16W, S21	8- 2-79	17.8	3	0.5	<0.3	Rubble
		4-28-80	7.2				Gravel
		6-10-80	14.4				Sand
2	Pine Creek, 20 m downstream of C & O railroad crossing and Dukel discharge T3S, R16W, S21	9- 4-80	20.0	5	0.3	0.3	Boulders
		8- 2-79	17.8				Silt
		4-28-80	7.2				Clay
3	Pine Creek, 0.5 km upstream of Red Arrow Highway, 0.5 km downstream of Dukel discharge T3S, R16W, S16	6-10-80	14.4	2	0.5	0.3	Rubble
		9- 4-80	20.0				Gravel
		8- 2-79	19.0				Sand
4	Pine Creek, 10 m upstream of confluence with Paw Paw River, 3 km downstream of Dukel discharge T3S, R16W, S16			7	0.3	0.2	Silt
							Muck-mud
							Log
3	Pine Creek, 0.5 km upstream of Red Arrow Highway, 0.5 km downstream of Dukel discharge T3S, R16W, S16			2	0.5	0.3	Rubble
							Gravel
							Sand
							Clay
4	Pine Creek, 10 m upstream of confluence with Paw Paw River, 3 km downstream of Dukel discharge T3S, R16W, S16			7	0.3	0.2	Sand
							Clay

Table 2. Summary of qualitative macroinvertebrate sampling of Pine Creek, vicinity of Hartford.
 AB = abundant, P = present, R = rare, only one found.

Taxa	Location:			
	1	2	3	4
Date:	8-2-79	4-28-80	6-10-80	9-4-80
	8-2-79	4-28-80	6-10-80	9-4-80
	8-2-79	4-28-80	6-10-80	9-4-80
	8-2-79	4-28-80	6-10-80	9-4-80
Turbellaria (flatworms)	P	-	P	AB
Hirudinea (leeches)	-	-	P	-
Gastropoda (snails)	-	-	P	-
Ferussia	P	-	-	-
Physa	-	-	-	-
Pelecypoda (clams)	-	-	-	-
Sphaerium	P	-	-	-
Isopoda (sowbugs)	-	-	-	-
Decapoda (crayfish)	-	-	-	-
Hydracarina (watermites)	AB	R	P	R
Ephemeroptera (mayflies)	-	-	-	-
Baetidae	AB	AB	-	-
Heptageniidae	AB	AB	-	-
Isonychia	P	-	-	-
Odonata (dragonflies)	-	-	-	-
Hemiptera (true bugs)	-	-	-	-
Trichoptera (caddisflies)	-	-	-	-
Brachycentridae	-	-	-	-
Hydropsychidae	AB	AB	-	-
Hydroptilidae	P	-	-	-
Limnephilidae	-	-	-	-
Coleoptera (beetles)	-	-	-	-
Elmidae (a)	P	-	-	-
(l)	P	-	-	-
Tipulidae (crane flies)	-	-	-	-
Simuliidae (blackflies)	P	-	-	-
Chironomidae (midges)	AB	AB	P	P

Table 3 Water and sediment sampling results, Pine Creek, vicinity of Hartford, June 10 and September 4, 1980.

Location Number	Location	Date	Water Sampling						
			Cadmium (µg/l)	Chromium (µg/l)	Nickel (µg/l)	Lead (µg/l)	Zinc (µg/l)	Copper (µg/l)	Hardness (mg/l)
1	50 m upstream of C & O railroad crossing and DuWet discharge T3S,R16W,S21	6-10-80	<20	<50	<50	<50	<50	<20	-
		9- 4-80	-	-	-	-	-	-	275
2	20 m downstream of C & O railroad crossing and DuWet discharge T3S,R16W,S21	6-10-80	<20	<50	<50	<50	<20	<20	-
		9- 4-80	-	-	-	-	-	-	-

Location Number	Location	Date	Sediment Sampling (results in dry weight basis)						
			Cadmium (mg/kg)	Chromium (mg/kg)	Copper (mg/kg)	Nickel (mg/kg)	Lead (mg/kg)	Zinc (mg/kg)	
1	50 m upstream of C & O railroad crossing and DuWet discharge T3S,R16W,S21	9- 4-80	<2	5	5	6	7	30	.
		9- 4-80	<2	85*	190*	140*	20	310*	

*Heavily polluted according to EPA (1977) guidelines.