SURFACE WATER QUALITY, TWIN PONIES WATERSHED, POTTAWATTAMIE AND MILLS COUNTIES, IOWA

U.S. GEOLOGICAL SURVEY

Open-File Report 81-679

Prepared in cooperation with the

U.S. SOIL CONSERVATION SERVICE

UNITED STATES DEPARTMENT OF THE INTERIOR

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UNITED STATES
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SURFACE WATER QUALITY, TWIN PONIES WATERSHED, POTTAWATTAMIE AND MILLS COUNTIES, IOWA

By Mark G. Detroy

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Iowa City, Iowa
1981

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ILLUSTRATIONS

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METRIC CONVERSIONS

Multiply inch-pound unit	By	To obtain metric unit
inch	25.40	millimeter
foot	0.3048	meter
mile	1.609	kilometer
acre	0.4047	hectare
acre-foot	0.001233	cubic hectometer
cubic foot per second	0.02832	cubic meter per second

Surface-Water Quality, Twin Ponies Watershed,

Pottawattamie and Mills Counties, Iowa

By Mark G. Detroy

ABSTRACT

Existing surface-water quality in the Twin Ponies watershed is significantly affected by runoff from agricultural lands that comprise most of the area. Runoff effects include the addition of phosphate, organic nitrogen, fecal bacteria, trace metals, pesticides and notably suspended sediment to streamflow, because runoff commonly is a transport mechanism for these constituents. Low-flow water quality generally is characterized by dissolved-oxygen concentrations near saturation, dissolved-solids concentrations of about 450 milligrams per liter, suspended-sediment concentrations less than 200 milligrams per liter, and a pH of 8.2. However, samples collected during runoff contained biological and chemical concentrations 10 to 30 times greater than concentrations obtained from samples collected during periods of low flow. Suspended-sediment concentrations obtained during runoff ranged from 1,000 to 7,000 milligrams per liter. Iowa Class "B" standards for dissolved oxygen, ammonia, fecal coliforms, chromium, copper, lead, and mercury in streams were exceeded in numerous samples collected during runoff.

It is probable that the variations between constituent concentrations in samples collected during runoff and those collected during low flow will be similar after grade-stabilization structures have been constructed on streams and after land-treatment measures have been implemented in the watershed as proposed by the U.S. Soil Conservation Service. Grade-stabilization structures should reduce gully and channel erosion in the watershed by dissipating the erosive energy of streamflow during significant runoff. Land-treatment measures to be implemented in conjunction with the project would help reduce sediment yield to stream channels. With the impoundments, a decrease in velocity of the in-flowing water should produce a decrease of both the suspended-sediment concentrations and the chemical and biological constituents associated with the suspended sediment in the impounded water.

INTRODUCTION

The Soil Conservation Service, U.S. Department of Agriculture is studying the feasibility of a grade-stabilization and land-treatment project in the Twin Ponies watershed. The proposed work would be done under the authority of the Watershed Protection and Flood Prevention Act (Public Law 566, U.S. 83rd Congress, 1954, 2d session, 68 stat. 666), as amended.

The proposed project would include grade-stabilization structures designed to alleviate gully damage in the watershed. These structures in conjunction with land-treatment measures would reduce sediment yield in the watershed and the subsequent transport and deposition of sediment into channels that cross the Missouri River floodplain. At least 75 percent of the drainage area of each proposed impoundment will be required to have land-treatment measures to control soil loss instituted before a structure is built. Land-treatment measures include level terraces, contouring, conservation tillage, and grassed waterways.

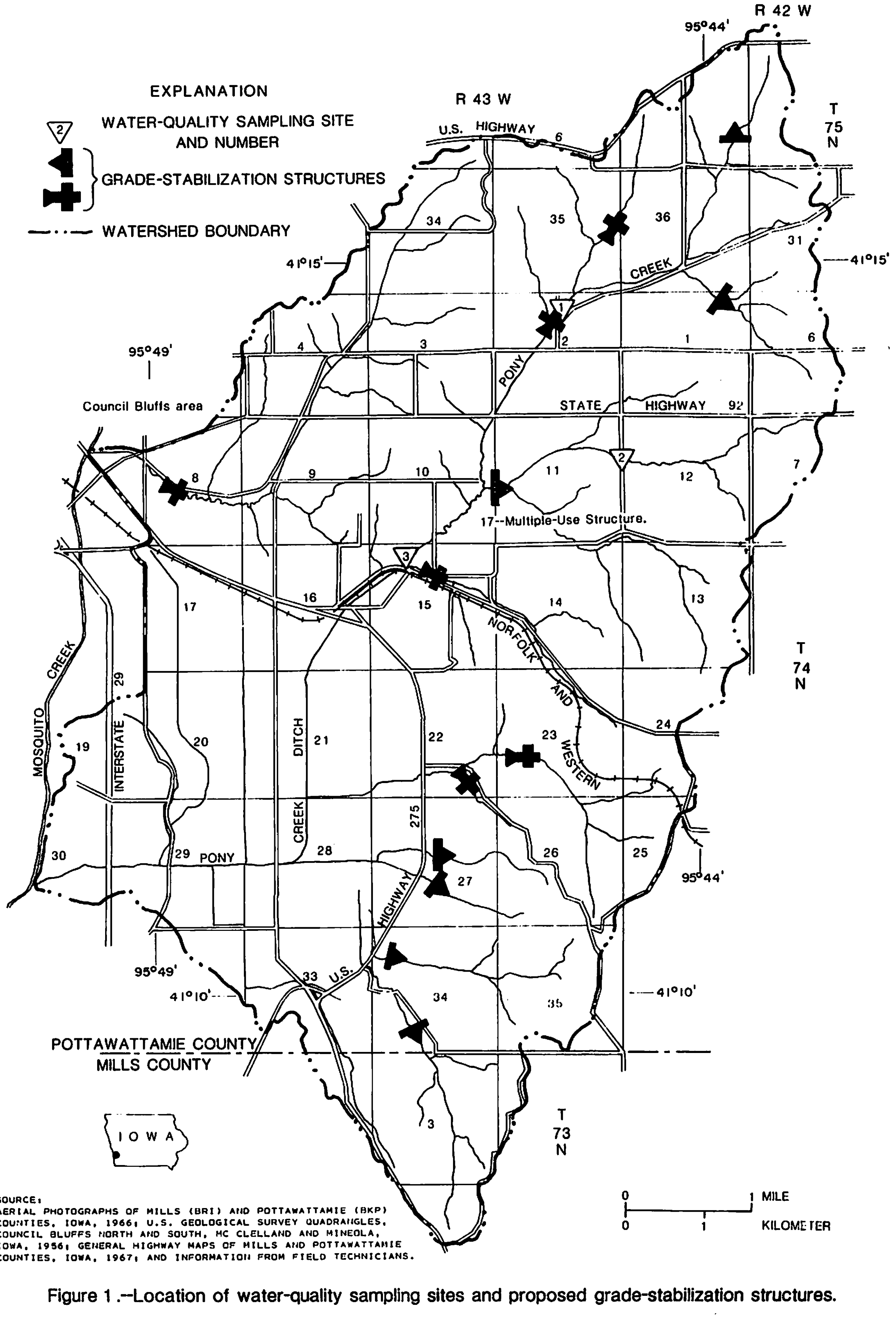

Figure 1.--Location of water-quality sampling sites and proposed grade-stabilization structures.

Only one structure is proposed for permanent water storage, this being a multiple purpose stucture (structure 17) located downstream from water-quality sampling site 2 (fig.1). The Pottawattamie County Conservation Board has indicated an interest in developing land near this impoundment for fishing, picnicking and hiking. The dam at structure 17 would create a 72-acre permanent pool initially storing 755 acre-feet of water and having a maximum initial depth of 48 feet. The remaining proposed structures (fig.1) will be full-flow pipe structures, which would form temporary pools that would likely fill with sediment within 5 years. All stuctures primarily are designed for grade stabilization; that is the alleviation, by grade-control structures, of steep channel grades that accelerate channel erosion. The U.S. Soil Conservation Service requested the U.S. Geological Survey, to assess the existing surface-water quality in the watershed for its adequacy toward meeting the project goals.

PURPOSE AND SCOPE

The primary purpose of this investigation was to assess the surface-water quality of the Twin Ponies watershed by: (1) Relating the existing surface-water quality of the watershed to the proposed water-resource uses; (2) describing water-quality changes in the watershed as a function of flow; and (3) estimating the water quality in stream reaches between the sampling sites. Other objectives were to evaluate the general effects of impoundment and land-treatment measures on future water quality. The data collection spanned 14 months, June 1978 to July 1979, and consisted of the collection and analysis of four sets of water samples at three sites within the Twin Ponies watershed.

Proposed structure 17 would contain water designated as Class "B" water by the State, which means it would be protected for wildlife, fish, aquatic and semiaquatic life, and secondary contact water uses. Comparison of Iowa Class "B" water-quality standards to the results of analyses presented in this report may be one basis for evaluating the potential water quality in the watershed. State and Federal water-quality standards and criteria are listed in table 1.

Table 1.--Water-quality standards and criteria.
[from Iowa Department Environmental Quality, Iowa Code, 1977 , Standards for Class B designated water; and United States Environmental Protection Agency, 1977 and 1980, Criteria to protect freshwater aquatic life; mg/L=milligrams per liter; colonies/100mL=colonies per 100 milliliters of water; ug/L=micrograms per liter]

CONSTITUENT	STANDARD	CRITERIA	CONSTITUENT	CRITERIA
pH, (units)	6.5-9.0	6.5-9.0	Aldrin, (ug/L)	3.0
Dissolved O_2, (mg/L)	>5	None	Chlordane, (ug/L)	2.4 .0043 [3]
Fecal Coliforms, (colonies/100mL)	<2,000	None	DDT, (ug/L)	1.1 .001 [3]
Ammonia, as N, (mg/L)	5.0 [1] 2.0 [2]	None	Dieldrin, (ug/L)	2.5 .0019 [3]
Chromium, (ug/L), as hexavalent Chromium	50	21 .29 [3]	Endosulfan, (ug/L)	.22 .0056 [3]
Copper, (ug/L)	1,000	@ 22-82 5.6 [3]	Endrin, (ug/L)	.18 .0023 [3]
Iron, (ug/L)	None	1000	Heptachlor, (ug/L)	.52 .0038 [3]
Lead, (ug/L)	100	@ 400-935 [3] @ 20-100 [3]	Lindane, (ug/L)	.01
Mercury, (ug/L)	.05	.0017 .00057 [3]	Malathion, (ug/L)	.10
Phenols, (ug/L)	50	None	Methoxychlor, (ug/L)	.03
PCB, (ug/L)		2.0 .014 [3]	Mirex, (ug/L)	.001
			Parathion, (ug/L)	.04
			Toxaphene, (ug/L)	1.6 .0013

1 - Applicable between November 1 to March 31

2 - Applicable between April 1 to October 31

3 - 24-hour average concentration that should not be exceeded, otherwise value denotes concentration that should not be exceeded at any time.

@ - derived from following equations:

exp[0.94(ln(hardness))--1.23] for copper

exp[1.22(ln(hardness))--0.47] for lead

exp[2.35(ln(hardness))--9.48] for lead [3]

(hardness range = 200-400 mg/L as $CaCO_3$)

DESCRIPTION OF TWIN PONIES WATERSHED

The Twin Ponies watershed is located in Pottawattamie and Mills Counties Iowa, 4.5 miles southeast of Council Bluffs (fig.1). The watershed has a total drainage area of 21,640 acres, 96 percent in Pottawattamie County and the remaining 4 percent in Mills County. Of the 21,640 acres, 12,133 acres (56 percent) presently (1981) is devoted to cropland, 4,661 acres (22 percent) to pasture, 1,376 acres (6 percent) to urban use, 950 acres (4 percent) designated wildlife habitat, which includes no forest acreage and the remaining 2,520 acres (12 percent) to miscellaneous uses such as roads and farmsteads. (Roger Link, U.S. Soil Conservation Service, oral commun., 1980).

The watershed consists of the area drained by Pony Creek, Pony Creek Ditch, and an unnamed stream west of Pony Creek. Pony Creek drains into Pony Creek Ditch near sampling site 3. Both Pony Creek Ditch and the unnamed stream drain into Mosquito Creek, a tributary of the Missouri River. Many homes are located throughout the upland area of the watershed. The bottomlands, which comprise about 20 percent or 4,348 acres of the watershed, are used principally for cropland. Of the bottomlands, 58 percent are considered prime agricultural lands. The principal soil types of the uplands are Ida and Monona soils; in the bottomlands, Luton and McPaul soils predominate (U.S. Soil Conservation Service, unpublished soil survey for Pottawatamie County). Pottawattamie County is one of the leading agricultural counties in Iowa ranking high in cattle, corn, and soybean production. In southwest Iowa the mean-average annual precipitation is 31.77 inches and the mean annual air temperature is 50.2 degrees Farenheit or 10.3 degrees Celsius (Iowa Development Commission, 1980).

DESCRIPTION OF SAMPLING SITES

The number and location of sampling sites were jointly determined by the U.S. Geological Survey and the U.S. Soil Conservation Service. Site 1 (fig.1) is located on Pony Creek upstream from the site of a proposed grade-stabilization structure, the drainage area upstream from this point is 1,536 acres. Site 2 is located on a tributary of Pony Creek, the drainage area upstream from this point is 768 acres. This site is upstream from a proposed multiple purpose structure (structure 17) where a permanent impoundment is proposed. Site 3 is located about 0.85 mile upstream from Pony Creek Ditch. The drainage area upstream from site 3 is 6,976 acres.

Water samples were collected at the sampling sites four times during the investigation; June 28 and August 30, 1978, May 2 and July 8, 1979. Analytical results are presented in table 2. The June 28 and August 30, 1978, samples are representative of seasonal low flow. The May 2, 1979, samples are representative of a spring runoff period. The July 8, 1979, samples were collected during runoff following scattered thunderstorms. Discharges during the May 2 and July 8, 1979, runoff periods were much higher than the flow measured on June 28 and August 30, 1978.

SURFACE-WATER QUALITY

Water-quality data collected for Twin Pony Creek and its tributary are shown in table 2. These data are summarized in table 3; the table also contains statistical analyses of the data although the sample size is small. The data are summarized for each site, for the basin and two flow ranges. The criteria of 1.5 cubic feet per second used in table 3 is an arbitrary value used only to separate the data collected at low flow from the data collected at the time of storm and spring runoff. The data show a direct relationship between greater concentrations of suspended sediment in samples collected during discharge from runoff (May 2 and July 8, 1979) and smaller concentrations in samples collected during low flow (June 28 and August 30, 1978). The concentration of suspended sediment commonly is proportional to the concentration of many constituents that have a tendency to adsorb on soil particles. Constituents that have this property are trace metals, organic compounds, bacteria, and nutrients. Among the constituents analyzed for in this study, which may be adsorbed are: (1) The trace metals; iron, copper, chromium, and less notably mercury; (2) pesticides such as Diazinon, Dieldrin, Lindane, Malathion, and Methoxychlor; (3) fecal coliform bacteria and fecal streptococcus bacteria and (4) the nutrients; ammonia and phosphate.

Meeting Iowa Class "B" standards will be particularly important at the permanent impoundment area downstream from site 2 where a 72-acre lake would result.

Table 2.-- Water-quality data for Pony Creek and tributary.
[FT3/S=cubic feet per second; MICROMHOS=micromhos per centimeter at 25 degrees Celsius; DEG C=degrees Celsius; NTU=nephelometric turbidity units; MG/L=milligrams per liter; COLS./100 ML=colonies per 100 milliliters of water; UG/L=micrograms per liter]

DATE	TIME	STREAM-FLOW, INSTANTANEOUS (FT3/S)	SPECIFIC CONDUCTANCE (MICROMHOS)	PH FIELD (UNITS)	TEMPERATURE, WATER (DEG C)	COLOR (PLATINUM COBALT UNITS)	TURBIDITY (NTU)	OXYGEN, DISSOLVED (MG/L)	OXYGEN, DISSOLVED (PERCENT SATURATION)	COLIFORM, FECAL, 0.7 UM-MF (COLS./100 ML)	STREPTOCOCCI FECAL, KF AGAR (COLS. PER 100 ML)
06610660 - PONY CREEK SITE 1, (LAT 41 14 39 LONG 095 45 19)											
JUN , 1978											
28...	0930	0.60	710	8.2	19.5	--	6	14.0	152	13,000	18,000
AUG											
30...	0930	.83	610	8.0	20.0	--	5	8.6	93	14,000	17,000
MAY , 1979											
02...	1015	15	775	7.5	12.0	--	400	6.3	58	540,000	>200,000
JUL											
08...	1000	4.7	800	7.5	18.5	--	1,400	4.3	47	>800,000	>1,000,000
06610663 - PONY CREEK TRIB. SITE 2, (LAT 41 13 39 LONG 095 44 46)											
JUN , 1978											
28...	0955	.20	700	8.0	19.5	5	70	8.0	90	4,100	5,900
AUG											
30...	1015	.14	680	8.1	18.0	6	31	8.0	84	9,700	26,000
MAY , 1979											
02...	0930	2.7	600	7.6	12.0	60	480	8.0	74	350,000	>200,000
JUL											
08...	0915	2.7	570	7.5	18.0	350	1,200	3.4	37	>800,000	>1,000,000
06610665 - PONY CREEK SITE 3, (LAT 41 12 56 LONG 095 46 47)											
JUN , 1978											
28...	1020	1.3	710	8.3	22.0	5	50	9.3	110	8,600	8,900
AUG											
30...	1050	.88	700	8.2	16.0	6	38	8.6	87	9,000	15,000
MAY , 1979											
02...	1115	19	625	7.7	12.0	60	580	6.9	64	890,000	>200,000
JUL											
08...	1050	18	400	7.8	18.5	50	1,800	6.7	74	630,000	860,000

Table 2.-- Water-quality for Pony Creek and tributary-- Continued.

DATE	HARD-NESS (MG/L AS CACO3)	CALCIUM DIS-SOLVED (MG/L AS CA)	MAGNE-SIUM, DIS-SOLVED (MG/L AS MG)	SOLIDS, RESIDUE AT 180 DEG. C DIS-SOLVED (MG/L)	SOLIDS, RESIDUE AT 105 DEG. C, SUS-PENDED (MG/L)	SOLIDS, RESIDUE AT 105 DEG. C, TOTAL (MG/L)	NITRO-GEN, NO2+NO3 TOTAL (MG/L AS N)	NITRO-GEN,AM-MONIA + ORGANIC TOTAL (MG/L AS N)	NITRO-GEN, TOTAL (MG/L AS N)	PHOS-PHORUS, TOTAL (MG/L AS P)	PHOS-PHORUS, ORTHOPH OSPHATE TOTAL (MG/L AS P)
06610660 - PONY CREEK SITE 1, (LAT 41 14 39 LONG 095 45 19)											
JUN , 1978 28...	400	110	31	--	--	506	6.8	--	--	--	0.190
AUG 30...	350	92	30	--	--	473	6.4	--	--	--	.260
MAY , 1979 02...	260	64	24	--	--	6,550	.04	--	--	--	4.300
JUL 08...	--	--	--	--	--	7,350	.09	--	--	--	8.200
06610663 - PONY CREEK TRIB. SITE 2, (LAT 41 13 39 LONG 095 44 46)											
JUN , 1978 28...	450	120	36	523	188	620	8.3	0.89	9.2	0.480	.180
AUG 30...	410	110	33	415	90	510	5.5	1.4	6.9	.390	.200
MAY , 1979 02...	260	68	22	387	924	1,510	3.1	13	16	2.200	1.400
JUL 08...	170	45	15	391	2,780	3,270	3.1	7.9	11	3.500	2.300
06610665 - PONY CREEK SITE 3, (LAT 41 12 56 LONG 095 46 47)											
JUN , 1978 28...	420	110	35	446	122	615	7.1	.72	7.8	.380	.200
AUG 30...	330	84	30	393	120	548	5.3	1.6	6.9	.400	.280
MAY , 1979 02...	260	68	23	300	4,480	3,400	2.3	24	26	4.800	2.000
JUL 08...	190	48	17	253	6,120	6,630	4.1	19	23	2.000	.320

Table 2.-- Water-quality for Pony Creek and tributary -- Continued.

DATE	CHRO- MIUM, TOTAL RECOV- ERABLE (UG/L AS CR)	COPPER, TOTAL RECOV- ERABLE (UG/L AS CU)	IRON, TOTAL RECOV- ERABLE (UG/L AS FE)	LEAD, TOTAL RECOV- ERABLE (UG/L AS PB)	MERCURY TOTAL RECOV- ERABLE (UG/L AS HG)	PHENOLS (UG/L)	NAPH- THA- LENES, POLY- CHLOR. TOTAL (UG/L)	PCB, TOTAL (UG/L)	ALDRIN, TOTAL (UG/L)	CHLOR- DANE, TOTAL (UG/L)
	06610660 - PONY CREEK SITE 1, (LAT 41 14 39 LONG 095 45 19)									
JUN , 1978 28...	--	--	--	--	--	--	--	--	--	--
AUG 30...	--	--	--	--	--	--	--	--	--	--
MAY , 1979 02...	--	--	--	--	--	--	--	--	--	--
JUL 08...	--	--	--	--	--	--	--	--	--	--
	06610663 - PONY CREEK TRIB. SITE 2, (LAT 41 13 39 LONG 095 44 46)									
JUN , 1978 28...	10	15	5,500	18	0.1	3	0.00	0.0	0.00	0.0
AUG 30...	10	27	3,000	150	.2	4	.00	.0	.00	.0
MAY , 1979 02...	30	60	25,000	61	.1	4	--	.0	.00	.0
JUL 08...	80	200	74,000	60	.4	7	--	.0	.00	.0
	06610665 - PONY CREEK SITE 3, (LAT 41 12 56 LONG 095 46 47)									
JUN , 1978 28...	10	18	4,000	300	.1	2	.00	.0	.00	.0
AUG 30...	0	7	3,100	4	.2	2	.00	.0	.00	.0
MAY , 1979 02...	100	23	100,000	130	.3	7	--	.0	.01	.0
JUL 08...	120	200	140,000	140	.6	1	--	.0	.00	.1

Table 2.-- Water quality for Pony Creek and tributary -- Continued.

DATE	DDD, TOTAL (UG/L)	DDE, TOTAL (UG/L)	DDT, TOTAL (UG/L)	DI-AZINON, TOTAL (UG/L)	DI-ELDRIN TOTAL (UG/L)	ENDO-SULFAN, TOTAL (UG/L)	ENDRIN, TOTAL (UG/L)	ETHION, TOTAL (UG/L)	HEPTA-CHLOR, TOTAL (UG/L)	HEPTA-CHLOR EPOXIDE TOTAL (UG/L)
06610660 - PONY CREEK SITE 1, (LAT 41 14 39 LONG 095 45 19)										
JUN , 1978										
28...	--	--	--	--	--	--	--	--	--	--
AUG										
30...	--	--	--	--	--	--	--	--	--	--
MAY , 1979										
02...	--	--	--	--	--	--	--	--	--	--
JUL										
08...	--	--	--	--	--	--	--	--	--	--
06610663 - PONY CREEK TRIB. SITE 2, (LAT 41 13 39 LONG 095 44 46)										
JUN , 1978										
28...	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0 .00	0.00	0.01
AUG										
30...	.00	.00	.00	.00	.00	.00	.00	.00	.00	.01
MAY , 1979										
02...	.00	.00	.00	.01	.03	.00	.00	.00	.00	.01
JUL										
08...	.00	.00	.00	.00	.09	.00	.00	.00	.00	.00
06610665 - PONY CREEK SITE 3, (LAT 41 12 56 LONG 095 46 47)										
JUN , 1978										
28...	.00	.00	.00	.17	.01	.00	.00	.00	.00	.00
AUG										
30...	.00	.00	.00	.00	.00	.00	.00	.00	.00	.01
MAY , 1979										
02...	.00	.00	.02	.00	.03	.00	.00	.00	.00	.01
JUL										
08...	.00	.00	.00	.79	.04	.00	.00	.00	.00	.02

Table 2.-- Water-quality for Pony Creek and tributary -- Continued.

DATE	LINDANE TOTAL (UG/L)	MALA- THION, TOTAL (UG/L)	METH- OXY- CHLOR, TOTAL (UG/L)	METHYL PARA- THION, TOTAL (UG/L)	METHYL TRI- THION, TOTAL (UG/L)	PARA- THION, TOTAL (UG/L)	PER- THANE TOTAL (UG/L)	MIREX, TOTAL (UG/L)	TOX- APHENE, TOTAL (UG/L)	TOTAL TRI- THION (UG/L)
06610660 - PONY CREEK SITE 1, (LAT 41 14 39 LONG 095 45 19)										
JUN , 1978										
28...	--	--	--	--	--	--	--	--	--	--
AUG										
30...	--	--	--	--	--	--	--	--	--	--
MAY , 1979										
02...	--	--	--	--	--	--	--	--	--	--
JUL										
08...	--	--	--	--	--	--	--	--	--	--
06610663 - PONY CREEK TRIB. SITE 2, (LAT 41 13 39 LONG 095 44 46)										
JUN , 1978										
28...	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	0	0.00
AUG										
30...	.00	.00	.00	.00	.00	.00	--	.00	0	.00
MAY , 1979										
02...	.05	.35	.09	.00	.00	.00	0.00	.00	0	.00
JUL										
08...	.01	.13	.25	.00	.00	.00	.00	.00	0	.00
06610665 - PONY CREEK SITE 3, (LAT 41 12 56 LONG 095 46 47)										
JUN , 1978										
28...	.00	.00	.00	.00	.00	.00	--	.00	0	.00
AUG										
30...	.00	.00	.00	.00	.00	.00	.00	.00	0	.00
MAY , 1979										
02...	.01	.05	.01	.00	.00	.00	.00	.00	0	.00
JUL										
08...	.02	.00	.00	.00	.00	.00	.00	.00	0	.00

Table 3.-- Summary of water-quality data.
[FT³/S=cubic feet per second; MICROMHOS=micromhos per centimeter at 25 degrees Celsius; DEG C=degrees Celsius; NTU=nephelometric turbidity units; MG/L=milligrams per liter; COLONIES/100 ML=colonies per 100 milliliters of water; UG/L=micrograms per liter]

	NUMBER OF SAMPLES	MEAN VALUE	MINIMUM VALUE	MAXIMUM VALUE
STATION 06610660 PONY CREEK SITE 1				
STREAMFLOW, INSTANTANEOUS (FT3/S)	4	5.35	0.60	15.20
SPECIFIC CONDUCTANCE (MICROMHOS)	4	725.	610.	800.
pH FIELD (UNITS)	4	8.0 (median)	7.5	8.2
TEMPERATURE, WATER (DEG C)	4	17.5	12.0	20.0
COLOR (PLATINUM COBALT UNITS)	0	-	-	-
TURBIDITY (NTU)	4	453.	5.	1,400.
OXYGEN, DISSOLVED (MG/L)	4	8.3	4.3	14.0
OXYGEN, DISSOLVED (PERCENT SATURATION)	4	87.	47.	152.
COLIFORM, FECAL, (COLONIES/100 ML)	4	342,000.	13,000.	800,000.
STREPTOCOCCI FECAL, (COLONIES/100 ML)	4	309,000.	17,000.	>1,000,000.
HARDNESS (MG/L AS CACO3)	3	337.	260.	400.
CALCIUM DISSOLVED (MG/L AS CA)	3	89.	64.	110.
MAGNESIUM, DISSOLVED (MG/L AS MG)	3	28.	24.	31.
SOLIDS, DISSOLVED, (MG/L)	0	-	-	-
SOLIDS, SUSPENDED, (MG/L)	0	-	-	-
SOLIDS, TOTAL, (MG/L)	4	3,720.	473.	7,350.
NITROGEN, NO2+NO3 TOTAL (MG/L AS N)	4	3.33	0.04	6.80
NITROGEN,NH4 + ORG., TOTAL (MG/L AS N)	0	-	-	-
NITROGEN, TOTAL (MG/L AS N)	0	-	-	-
PHOSPHORUS, TOTAL (MG/L AS P)	0	-	-	-
PHOSPHORUS, ORTHO., TOTAL (MG/L AS P)	4	3.24	0.19	8.20
CHROMIUM, TOTAL (UG/L AS CR)	0	-	-	-
COPPER, TOTAL (UG/L AS CU)	0	-	-	-
IRON, TOTAL (UG/L AS FE)	0	-	-	-
LEAD, TOTAL (UG/L AS PB)	0	-	-	-
MERCURY TOTAL (UG/L AS HG)	0	-	-	-
PHENOLS (UG/L)	0	-	-	-
STATION 06610663 PONY CREEK TRIBUTARY SITE 2				
STREAMFLOW, INSTANTANEOUS (FT3/S)	4	1.44	0.14	2.70
SPECIFIC CONDUCTANCE (MICROMHOS)	4	640.	570.	700.
PH FIELD (UNITS)	4	7.75 (median)	7.5	8.1
TEMPERATURE, WATER (DEG C)	4	16.9	12.0	19.5
COLOR (PLATINUM COBALT UNITS)	4	105.	5.	350.
TURBIDITY (NTU)	4	445.	31.	1,200.
OXYGEN, DISSOLVED (MG/L)	4	6.9	3.4	8.0
OXYGEN, DISSOLVED (PERCENT SATURATION)	4	71.	37.	90.
COLIFORM, FECAL, (COLONIES/100 ML)	4	291,000.	4,100.	>800,000.
STREPTOCOCCI FECAL, (COLONIES/100 ML)	4	308,000.	5,900.	>1,000,000.
HARDNESS (MG/L AS CACO3)	4	322.	170.	450.
CALCIUM DISSOLVED (MG/L AS CA)	4	86.	45.	120.
MAGNESIUM, DISSOLVED (MG/L AS MG)	4	26.5	15.	36.
SOLIDS, DISSOLVED, (MG/L)	4	429.	387.	523.
SOLIDS, SUSPENDED, (MG/L)	4	995.	90.	2,780.
SOLIDS, TOTAL, (MG/L)	4	1,477.	510.	3,270.
NITROGEN, NO2+NO3 TOTAL (MG/L AS N)	4	5.00	3.10	8.30
NITROGEN,NH4 + ORG., TOTAL (MG/L AS N)	4	5.80	0.89	13.00
NITROGEN, TOTAL (MG/L AS N)	4	10.78	6.90	16.00
PHOSPHORUS, TOTAL (MG/L AS P)	4	1.64	0.39	3.50
PHOSPHORUS, ORTHO., TOTAL (MG/L AS P)	4	1.02	0.18	2.30
CHROMIUM, TOTAL (UG/L AS CR)	4	32.5	10.	80.
COPPER, TOTAL (UG/L AS CU)	4	75.5	15.	200.
IRON, TOTAL (UG/L AS FE)	4	25,875.	3,000.	74,000.
LEAD, TOTAL (UG/L AS PB)	4	72.	18.	150.
MERCURY TOTAL (UG/L AS HG)	4	0.2	0.1	0.4
PHENOLS (UG/L)	4	4.5	3.	7.

Table 3.-- Summary of water-quality data -- Continued .

	NUMBERS OF SAMPLES	MEAN VALUE	MINIMUM VALUE	MAXIMUM VALUE
	STATION 06610665 PONY CREEK SITE 3			
STREAMFLOW, INSTANTANEOUS (FT3/S)	4	9.93	0.88	19.00
SPECIFIC CONDUCTANCE (MICROMHOS)	4	610.	400.	710.
PH FIELD (UNITS)	4	8.0 (median)	7.7	8.3
TEMPERATURE, WATER (DEG C)	4	17.1	12.0	22.0
COLOR (PLATINUM COBALT UNITS)	4	30.	5.	60.
TURBIDITY (NTU)	4	617.	38.	1,800.
OXYGEN, DISSOLVED (MG/L)	4	7.91	6.71	9.31
OXYGEN, DISSOLVED (PERCENT SATURATION)	4	84.	64.	110.
COLIFORM, FECAL, (COLONIES/100 ML)	4	384,000.	8,600.	890,000.
STREPTOCOCCI FECAL, (COLONIES/100 ML)	4	271,000.	8,900.	860,000.
HARDNESS (MG/L AS CACO3)	4	300.	190.	420.
CALCIUM DISSOLVED (MG/L AS CA)	4	77.5	48.	110.
MAGNESIUM, DISSOLVED (MG/L AS MG)	4	26.	17.	35.
SOLIDS, DISSOLVED, (MG/L)	4	348.	253.	446.
SOLIDS, SUSPENDED, (MG/L)	4	2,710.	120.	6,120.
SOLIDS, TOTAL, (MG/L)	4	2,798.	548.	6,630.
NITROGEN, NO2+NO3 TOTAL (MG/L AS N)	4	4.70	2.30	7.10
NITROGEN,NH4 + ORG., TOTAL (MG/L AS N)	4	11.33	0.72	24.00
NITROGEN, TOTAL (MG/L AS N)	4	15.93	6.90	26.00
PHOSPHORUS, TOTAL (MG/L AS P)	4	1.90	0.38	4.80
PHOSPHORUS, ORTHO., TOTAL (MG/L AS P)	4	0.70	0.20	2.00
CHROMIUM, TOTAL (UG/L AS CR)	4	57.5	0.	120.
COPPER, TOTAL (UG/L AS CU)	4	62.	7.	200.
IRON, TOTAL (UG/L AS FE)	4	61,775.	3,100.	140,000.
LEAD, TOTAL (UG/L AS PB)	4	143.5	4.	300.
MERCURY TOTAL (UG/L AS HG)	4	0.3	0.1	0.6
PHENOLS (UG/L)	4	3.	1.	7.
	DATA FROM ALL THREE STATIONS			
STREAMFLOW, INSTANTANEOUS (FT3/S)	12	5.57	0.14	19.00
SPECIFIC CONDUCTANCE (MICROMHOS)	12	657.	400.	800.
PH FIELD (UNITS)	12	7.9 (median)	7.5	8.3
TEMPERATURE, WATER (DEG C)	12	17.2	12.0	22.0
COLOR (PLATINUM COBALT UNITS)	8	68.	5.	350.
TURBIDITY (NTU)	12	505.	5.	1,800.
OXYGEN, DISSOLVED (MG/L)	12	7.7	3.4	14.0
OXYGEN, DISSOLVED (PERCENT SATURATION)	12	81.	37.	152.
COLIFORM, FECAL, (COLONIES/100 ML)	12	339,000.	4,100.	>800,000.
STREPTOCOCCI FECAL, (COLONIES/100 ML)	12	5,900.	17,000.	>1,000,000.
HARDNESS (MG/L AS CACO3)	11	318.	170.	450.
CALCIUM DISSOLVED (MG/L AS CA)	11	84.	45.	120.
MAGNESIUM, DISSOLVED (MG/L AS MG)	11	27.	15.	36.
SOLIDS, DISSOLVED, (MG/L)	8	389.	253.	523.
SOLIDS, SUSPENDED, (MG/L)	8	1,853.	90.	6,120.
SOLIDS, TOTAL, (MG/L)	12	2,665.	473.	7,350.
NITROGEN, NO2+NO3 TOTAL (MG/L AS N)	12	4.34	0.04	8 30
NITROGEN,NH4 + ORG., TOTAL (MG/L AS N)	8	8.56	.72	24.00
NITROGEN, TOTAL (MG/L AS N)	8	13.35	6.90	26.00
PHOSPHORUS, TOTAL (MG/L AS P)	8	1.77	.38	4.80
PHOSPHORUS, ORTHO., TOTAL (MG/L AS P)	12	1.65	0.18	8.20
CHROMIUM, TOTAL (UG/L AS CR)	8	45.	0.	120.
COPPER, TOTAL (UG/L AS CU)	8	69.	7.	200.
IRON, TOTAL (UG/L AS FE)	8	44,325.	3,000.	140,000.
LEAD, TOTAL (UG/L AS PB)	8	103.	4.	150.
MERCURY TOTAL (UG/L AS HG)	8	.25	.1	.6
PHENOLS (UG/L)	8	4.	1.	7.

Table 3.-- Summary of water-quality data -- Continued.

	NUMBER OF SAMPLES	MEAN VALUE	MINIMUM VALUE	MAXIMUM VALUE
	DATA FOR STREAMFLOWS > 1.5 FT3/S			
STREAMFLOW, INSTANTANEOUS (FT3/SEC)	6	10.48	2.70	19.00
SPECIFIC CONDUCTANCE (MICROMHOS)	6	630.	400.	800.
PH FIELD (UNITS)	6	7.55 (median)	7.5	7.8
TEMPERATURE, WATER (DEG C)	6	15.2	12.0	18.5
COLOR (PLATINUM COBALT UNITS)	4	130.	50.	350.
TURBIDITY (NTU)	6	976.	400.	1,600.
OXYGEN, DISSOLVED (MG/L)	6	5.91	3.41	8.01
OXYGEN, DISSOLVED (PERCENT SATURATION)	6	59.	37.	74.
COLIFORM, FECAL, (COLONIES/100 ML)	6	668,000.	350,000.	890,000.
STREPTOCOCCI FECAL, (COLONIES/100 ML)	6	580,000.	200,000.	>1,000,000.
HARDNESS (MG/L AS CACO3)	5	228.	170.	260.
CALCIUM DISSOLVED (MG/L AS CA)	5	59.	45.	68.
MAGNESIUM, DISSOLVED (MG/L AS MG)	5	20.	15.	24.
SOLIDS, DISSOLVED, (MG/L)	4	333.	253.	391.
SOLIDS, SUSPENDED, (MG/L)	4	3,576.	924.	6,120.
SOLIDS, TOTAL, (MG/L)	6	4,785.	1,510.	7,350.
NITROGEN, NO2+NO3 TOTAL (MG/L AS N)	6	2.12	0.04	4.10
NITROGEN,NH4 + ORG., TOTAL (MG/L AS N)	4	15.98	7.90	24.00
NITROGEN, TOTAL (MG/L AS N)	4	19.00	11.00	26.00
PHOSPHORUS, TOTAL (MG/L AS P)	4	3.13	2.00	4.80
PHOSPHORUS, ORTHO., TOTAL (MG/L AS P)	6	3.09	0.32	8.20
CHROMIUM, TOTAL (UG/L AS CR)	4	82.5	30.	120.
COPPER, TOTAL (UG/L AS CU)	4	121.	23.	200.
IRON, TOTAL (UG/L AS FE)	4	84,750.	25,000.	140,000.
LEAD, TOTAL (UG/L AS PB)	4	98.	60.	140.
MERCURY TOTAL (UG/L AS HG)	4	0.35	0.1	0.6
PHENOLS (UG/L)	4	5.	1.	7.
	DATA FOR STREAMFLOWS < 1.5 FT3/S			
STREAMFLOW, INSTANTANEOUS (FT3/S)	6	0.66	0.14	1.34
SPECIFIC CONDUCTANCE (MICROMHOS)	6	685.	610.	710.
PH FIELD (UNITS)	6	8.15 (median)	8.0	8.3
TEMPERATURE, WATER (DEG C)	6	19.2	16.0	22.0
COLOR (PLATINUM COBALT UNITS)	4	5.	5.	6.
TURBIDITY (NTU)	6	33.	5.	70.
OXYGEN, DISSOLVED (MG/L)	6	9.4	8.0	14.0
OXYGEN DISSOLVED (PERCENT SATURATION)	6	102.	84.	152.
COLIFORM, FECAL, (COLONIES/100 ML)	6	9,700.	4,100.	14,000.
STREPTOCOCCI FECAL, (COLONIES/100 ML)	6	15,100.	5,900.	2,6000.
HARDNESS (MG/L AS CACO3)	6	393.	330.	450.
CALCIUM DISSOLVED (MG/L AS CA)	6	104.	84.	120.
MAGNESIUM, DISSOLVED (MG/L AS MG)	6	32.	30.	36.
SOLIDS, DISSOLVED, (MG/L)	4	444.	393.	523.
SOLIDS, SUSPENDED, (MG/L)	4	130.	90.	188.
SOLIDS, TOTAL, (MG/L)	6	545.	473.	620.
NITROGEN, NO2+NO3 TOTAL (MG/L AS N)	6	6.57	5.30	8.30
NITROGEN,NH4 + ORG., TOTAL (MG/L AS N)	4	1.15	0.72	1.60
NITROGEN, TOTAL (MG/L AS N)	4	7.70	6.90	9.20
PHOSPHORUS, TOTAL (MG/L AS P)	4	0.41	0.38	0.48
PHOSPHORUS, ORTHO., TOTAL (MG/L AS P)	6	0.22	0.18	0.28
CHROMIUM, TOTAL (UG/L AS CR)	4	7.5	0.	10.
COPPER, TOTAL (UG/L AS CU)	4	17.	7.	27.
IRON, TOTAL (UG/L AS FE)	4	3,900.	3,000.	5,500.
LEAD, TOTAL (UG/L AS PB)	4	118.	4.	300.
MERCURY TOTAL (UG/L AS HG)	4	0.15	.1	0.2
PHENOLS (UG/L)	8	3.	2.	4.

This small lake may be developed for recreational purposes, therefore it is important that Iowa Class "B" standards be met following impoundment. Settling out of much of the suspended sediment delivered to the impoundment area would likely occur (Love 1961), however only after the planned structure is constructed and the impoundment filled could explicit chemical-quality data be obtained. The chemical quality of the impounded water would depend on many factors, the most important including: (1) Thermal stratification, (2) trap efficiency of the structure, (3) degree of dissolution of suspended constituents as they settle to the lake bottom, (4) nutrient concentrations related to biological growth, and (5) residence time of inflowing water.

Trace Metals and Pesticides

Comparison of flow during runoff to low flow for trace metals shows iron concentrations increased from low-flow concentrations of 3.0 to 5.5 mg/L (milligrams per liter) to concentrations of 25 to 140 mg/L, an increase of 10 to 30 times that of low-flow concentrations. Chromium concentrations increased to approximately 10 times more than low-flow concentrations. The pesticides Lindane, Malathion and Methoxychlor were detectable only during runoff periods.

Class "B" water-quality standards for trace metals were exceeded in three samples for chromium, five samples for copper, four samples for lead, and all eight samples for mercury. The majority of concentrations in excess of the standards were found in samples collected during the runoff periods when suspended-sediment concentrations were relatively large. Trace concentrations of the pesticides Diazinon, Dieldrin, and Heptachlor Epoxide were found in samples collected during low flow.

Fecal Bacteria

Concentrations of fecal bacteria in samples during runoff were found to be greater than in low flow samples by factors of 10 for fecal coliform and 30 for fecal streptococcus. Fecal-coliform concentrations greatly exceeded the Iowa Administrative Code "B" standard (table 1). Concentrations of fecal coliforms ranged from 4,000 to 14,000 colonies per 100 milliliters of water sample during low flow and from 350,000 to 890,000 colonies per 100 milliliters of water sample during runoff. Concentrations of fecal streptococci ranged from 6,000 to 26,000 colonies per 100 milliliters of water sample during low flow and from 200,000 to more than 1 million colonies per 100 milliliters of water sample during runoff. The fecal densities reported may be attributed to animal wastes. Onsite observations noted animals grazing near the streams during sampling. These animal wastes can enter the stream directly, or indirectly via surface runoff.

All fecal coliform concentrations exceeded the Iowa "B" standard that states that all fecal coliform counts shall not exceed 2,000 colonies per 100 milliliters of water sample except when waters are materially affected by surface runoff.

The May 2 and July 8, 1979, samples were collected during surface runoff and are exempt from the standard, but the concentrations from the June 28 and August 30, 1978, samples were significantly greater than the standard of 2,000 colonies per 100 milliliters of water sample. Love (1961) reports a beneficial effect of impoundment to be a decrease of coliform bacteria.

Nutrients and Dissolved Oxygen

Concentrations of ammonia and phosphate during periods of runoff were approximately 10 times those obtained from samples collected at low flow. Total ammonia concentrations during runoff (8 to 12 mg/L) exceeded "B" standards and ranged from 0.7 to 1.6 mg/L during low flow. Phosphate concentrations, while not included in Class "B" standards, also were greater during runoff creating a nutrient rich water. The U.S. Environmental Protection Agency recommends that the concentration of phosphate not exceed 0.05 mg/L for water flowing into a reservoir. This recommendation is made to minimize the probability of seasonal algal blooms (U.S. Environmental Protection Agency 1977). Algal blooms can cause odor problems as well as being esthetically undesirable.

Dissolved-oxygen concentrations at site 1 and site 2 in the July, 1979, samples exceeded the Iowa Class "B" Standard. It has been reported by Fish (1959), Love (1961) and Hull (1961) that impoundment tends to: (1) Decrease dissolved-oxygen concentrations and increase carbon-dioxide concentrations in the deeper parts of the reservoir if thermal stratification occurs, (2) create much greater variations in dissolved-oxygen concentrations, and (3) cause the increased growth of algae if the impounded waters become nutrient rich. The water released from the oxygen rich surface waters of an impoundment would be beneficial to aquatic life downstream.

Water quality during low-flow (June 28 and August 30, 1978) was characterized by dissolved-solids concentrations of approximately 450 mg/L, a pH of 8.2, and dissolved-oxygen concentrations of 85 to 95 percent saturation. Nitrate concentrations were greatest at low flow, ranging from 5.3 to 8.3 mg/L.

Suspended Sediment

The data obtained for this study show a direct relationship between greater concentrations of suspended sediment in samples collected during runoff and smaller concentrations in samples collected during low flow. In this study the primary source of suspended sediment is assumed to be sheet and gully erosion of agricultural lands. Sediment in streams and lakes involves two water-quality conditions: the sediment itself and the constituents adsorbed on to it. Sediment build-up in lakes, reservoirs, and streams decreases the storage capacity of lakes and reservoirs and clogs stream channels, commonly affecting the public use of the waters.

Sediment is one of the primary transport mechanisms for constituents such as trace metals, organic compounds, bacteria, and nutrients (Iowa Department of Environmental Quality 1977a).

In the Twin Ponies watershed the suspended-sediment concentrations in samples collected during runoff ranged from 4,480 to 6,120 mg/L at site 3, 924 to 2,780 mg/L at site 2 and were estimated to be 6,000 to 7,000 mg/L at site 1 (samples collected at site 1 were not analyzed for suspended-sediment concentrations). Suspended-sediment concentrations in samples collected during low flow were less than 200 mg/L at all sites. No inference about the deposition of suspended sediment can be made because the data indicate only sediment concentrations, not sediment loads. Based on concentration data of total solids, it appears that streamflow at site 1 contains more sediment than streamflow at sites 2 and 3.

It can be assumed that if a reduction in the velocity of the in-flowing turbid water occurs, there would then be lower concentrations of suspended sediment and therefore both lower concentrations and less variation of constituents that are associated with suspended sediment (Churchill 1947 and 1957). This effect may be produced in part by impoundment and may ultimately help decrease the concentrations of trace metals, pesticides, and nutrients in the water. However, the loss of these constituents from the water also would produce lake sediments enriched with these same constituents.

A logical and direct approach to solving a sediment problem is the stabilization of the sediment source by controlling soil erosion through the use of proper land and water management practices or structures (Amemiya 1970). To minimize sediment yield, soil erosion needs to be minimized. The proposed grade-stabilization structures throughout the watershed would decrease channel erosion by dissapating, at critical areas, the erosive energy of runoff waters. The water released from all structures would be from the surface of the permanent or temporary pool and would be oxygen rich and contain minimum concentrations of suspended sediment thus improving downstream water quality.

SUMMARY

The water quality of Pony Creek is affected significantly by the amount of suspended sediment that the stream transports. In this study the source of suspended sediment is assumed to be sheet and gully erosion from agricultural lands, which comprise 78 percent of the watershed acreage. Excessive suspended-sediment yields in the Pony Creek watershed are responsible for the increased concentrations of chemical and biological constituents that were significantly greater in samples collected during runoff than in samples taken during low flow. Constituents showing marked increases attributable to increased suspended sediment in the stream include: (1) Iron, copper, chromium and mercury; (2) Lindane, Malathion and Methoxychlor; (3) fecal coliforms and streptococci; and (4) ammonia and phosphate.

Iowa Class "B" water-quality standards were exceeded in numerous samples collected during runoff. Constituents exceeding Class "B" standards for selected samples included: (1) Chromium, copper, lead and mercury; (2) fecal coliforma bacteria; (3) ammonia; and (4) dissolved oxygen. However, following impoundment, water quality could change significantly due to a reduction in sediment delivery to the stream. Variations in constituent concentrations would be less prominent.

The future chemical quality of the impounded water at structure 17 would depend on many factors, the most important including: (1) Thermal stratification, (2) trap efficiency of the structure, (3) degree of dissolution of suspended constituents as they settle to the lake bottom, (4) nutrient concentrations related to biological growth, and (5) residence time of inflowing water. Only after the impoundment has filled can explicit chemical-quality data be obtained.

With land-treatment measures, such as tillage methods that deter soil erosion, slope modification to control erosion, grassed waterways and efficient contouring methods, in conjunction with the proposed engineering structures, the source of sediment in the watershed area can be stabilized. The grade-stabilization structures and land-treatment measures should help decrease channel and gully erosion that is presently a problem in the project area. The subsequent decrease in the delivery of suspended sediment to Pony Creek should have positive effect on the water quality of the stream.

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