WATER QUALITY STANDARDS REVIEW AND EFFLUENT LIMIT DETERMINATION FOR THE HEADWATERS OF ISABELLE CREEK NEAR ELLSWORTH, WI

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The Ellsworth WWTP discharges continuously to a dry run tributary to Isabelle Creek. In 1975, the tributary was classified as marginal aquatic life for three stream miles, followed by about 3.3 miles of intermediate aquatic life. The classification was reviewed and affirmed in 1989. Isabelle Creek is listed in Wisconsin Trout Streams (1980) as a Class II brown trout stream starting about 0.75 miles below HWY V. This leaves a 0.75 mile reach without a listed classification. This unlisted reach becomes, by default, a warmwater fish and aquatic life reach (Figure 1).

The appropriateness of these classifications was reviewed in response to a request for effluent limitations for a renovation of the Ellsworth WWTP. The procedures used for this evaluation are summarized in *Stream Classification Guidelines for Wisconsin*, DNR 1982. This evaluation determines the appropriate use designation, assesses the way in which the receiving water assimilates waste and makes recommendations for effluent limitations necessary to protect the recommended uses.

Table 1. Data collection locations

STREAM MILES BELOW WWTP	EFFLUENT TRAVEL TIME (HOURS)	CLASSIFICATION	ROAD NAME
.6	4-4.2	LIMITED AQUATIC LIFE	HWY C
1.25	15-18	LIMITED AQUATIC LIFE	TOWN HALL RD (490TH AVE)
3	42-45	LIMITED FORAGE FISH	SLEEPY HOLLOW RD (450TH AVE)
3.9	64-90	LIMITED FORAGE FISH	PRIVATE DRIVEWAY
4.6	84-?	LIMITED FORAGE FISH	CLAYFIELD RD (410TH AVE)
6.6	?	COLDWATER*	HWY V

*RECOMMENDED, FORMERLY DEFAULT WARMWATER FISH & AQUATIC LIFE

HYDROLOGY

The continuously flowing natural headwater for Isabelle Creek is in the vicinity of HWY V, 6.6 stream miles below the outfall. The WWTP effluent normally maintains continuous flow all the way to the natural headwater. The single exception to this was an occasion when a sinkhole opened up about one mile above the natural spring origin and four miles below the WWTP outfall. The sinkhole was able to accept the entire effluent flow, which resulted in a reach of dry stream bed. The sinkhole was sealed by the city at the request of the Department within a year of its appearance. The estimated flow from the natural spring origin of Isabelle Creek is about 0.7 cfs (0.45 MGD). Relatively high slopes result in significant runoff from even small rain events upstream from HWY V.

The WWTP flow has increased from about 0.35 MGD in 1982 to about 0.45 MGD in 1995. The proposed new design average annual flow for the WWTP is 0.735 MGD. The Ellsworth Coop Creamery discharges a small quantity of non-contact cooling water to the stream channel upstream from the WWTP. This effluent seeps to groundwater before reaching the WWTP outfall. A milk-house drain from a dairy farm also enters the stream channel upstream from the WWTP. This wastewater also typically seeps into the stream bed before reaching the WWTP outfall.

LAND USE

The Isabelle Creek watershed upstream from HWY V is about 14.5 MI^2, 5% of which is urban (Ellsworth) and 14% of which is forest. The remainder was originally a combination of active pasture and row crops. Over time the watershed is experiencing conversion of agricultural and forest land to residential use. Also, some of the agricultural land has been removed from active cropping or pasture. Where this has happened along the stream corridor, a riparian buffer zone exists which would be expected to reduce impact of runoff events.

WWTP PERFORMANCE AND WASTELOAD ASSIMILATION

In the spring of 1996, the WWTP violated its effluent limits due to a combination of sludge handling problems and industrial overloading. These problems were corrected and by June the facility was producing adequate quality effluent. The weekly average BOD_5 was always below 15 mg/L in June through September of 1996. It was during this period that continuous monitoring of water quality was performed. Since that time, the facility has had additional problems complying with limits. The facility does not chlorinate its effluent. The facility does not regularly monitor for ammonia but is thought to currently be nitrifying at least part of the year based on the following effluent ammonia data: June, 1994, 2 mg/L; December, 1988 0.7 mg/L; February 11, 1997 11.5 mg/L; and May 6, 1997, 7.4 mg/L.

Effluent BOD_5 and the associated stream dissolved oxygen values on days when sampling occurred are summarized in Table 2. The table indicates that effluent BOD_5 levels of around 20 mg/L come close to meeting the DO standards associated with classified reaches above Hwy V. The coldwater standard of 6 mg/L (proposed) is not always attained at Hwy V, but this may be more related to effluent phosphorus and nonpoint sources than effluent BOD_5.

TABLE 2. RESPONSE OF ISABELLE CREEK DO TO EFFLUENT BOD5								
MILES BELOW WWTP			0.6	1.25	3	3.9	4.6	6.6
CLASSIFICATION- BASED DO STANDARD (MG/L)			1	1	3	3	3	6
DATE	MAX STREAM TEMP	WWTP BOD5	MINIMUM DO (MG/L)					
8/25-26/82	25.5	18	2.1	3.9	2.8	2.9	4.2	5.0
9/7-8/82	18	21	3.0	5.1	5.1	5.0	5.3	5.6
6/29/82	21	35	3.1	4.1	1.8		2.5	6.0
6/20-28/90	18.5	?						5.0
9/5--11/96	25.3	<15	4	4				
2/22/82	5	26	8.9		8.2			9.9
12/23/88	4	?		9.4			10.0	9.0

Ammonia was grab sampled in August 1982 and again in September 1982. The three mile reach immediately downstream from the WWTP was sampled in plug flow fashion in conjunction with a dye study. Samples from reaches further downstream were sampled irrespective of travel time due to the time intervals involved (>3.5 days of travel time). On February 12, 1997, a set of composite stream and effluent samples was collected by the wastewater plant operator at the request of the Department. Samples were collected at the outfall and at several other points downstream. The effluent sample was taken from the 24 hour flow proportional sampler at the WWTP. The downstream samples were equal volume composites of grab samples collected at 07:00, 11:00 and 15:00 hours (+/- 25 min). All samples were analyzed at the State Lab of Hygiene.

From this sampling, loss of ammonia in the stream channel under can be estimated (Figure 2). The similarity of the summer and winter rate of ammonia loss in Figure 2 is significant. The use of ammonia by biological organisms (bacteria and plants) is proportional to temperature. The loss of ammonia to the atmosphere also proceeds faster at warmer temperatures. The similarity of the rate of loss of ammonia at different temperatures suggests dilution with groundwater, rather than temperature-related processes. Due to diurnal variability of effluent flow, the existing, single-grab flow monitoring done to date cannot be used to confirm this possibility. Examination of the forms of nitrogen during sample periods (Figures 3-5) further indicates that loss of ammonia was due to dilution rather than conversion to another form of nitrogen. Chloride data (Figure 6) also suggests dilution with groundwater. The addition of groundwater to the stream within four miles of the Ellsworth outfall had not been previously suspected. A diurnal flow study would be needed to confirm the existence of groundwater input into the upper reaches of the creek.

Effluent chlorides were monitored for one year and shown to vary from 95 to 752 mg/L. Production increases by a contributing dairy may result in even higher effluent chloride levels in the future unless alternative processes are utilized. Grab sampling for chlorides under base flow conditions on September 23, 1996 found effluent chloride was 285 mg/L while a concentration of 90.6 mg/L was present at the 6.6 MI site. Grab sampling of the effluent on May 6, 1997 found chloride levels of 350 mg/L at the outfall and 235-288 mg/L between the outfall and the springs. The concentration below the springs (6.6MI site) was 88.5 mg/L. At these dilution ratios, when the effluent is discharging 750 mg/L chloride, the 6.6MI site would likely experience a concentration of about 214 mg/L. At the proposed design flow, this value could be over 300 mg/L. Wisconsin's interim chloride toxicity values are 395 mg/L in a chronic exposure and 757 mg/L in an acute exposure.

Toxicity tests were run on effluent collected at multiple points below the outfall on May 6, 1997. Acute toxicity to aquatic life was documented at the outfall and 1.25 miles below the outfall. No acute toxicity to fish or invertebrates was found at the other sites. However, a phytotoxic effect was indicated at the sites between the outfall and Hwy V (the 6.6MI site).

AQUATIC HABITAT

Due to the lack of continuous flow, aquatic habitat essentially does not exist above the WWTP outfall. Starting at the outfall and extending downstream about 1 mile, the WWTP flow and gradient (30'/MI) is sufficient to maintain shallow riffle and run habitat. Pools are absent in this reach. Habitat was measured as "poor" using the 1982 DNR technique.

The reach beginning about 1 mile below the WWTP and extending to 3 miles below the WWTP has a mix of run and pool habitats with an occasional riffle. The low flow coupled with a gradient of 18'/MI results in low stream velocities. A dye study in 1982 determined that the effluent flow rate through this reach was only one mile per day. The stagnant nature of the pools in this reach limit their suitability as aquatic habitat. However, the proposed design flow is double the flow which prevailed when the 1982 dye study was done. This could double the travel time and increase the stream aeration rate. Habitat was measured as "poor" using the 1982 DNR technique.

The reach beginning 3 miles below the WWTP and extending 3.6 MI downstream to HWY V has a mix of riffle and pool habitats and a gradient of 27'/MI. The upstream end of this reach was previously thought to carry only effluent flow under non-event conditions, while the lower end includes natural stream flow as well. As mentioned above, a limited amount of groundwater inflow may be present. While the physical habitat is similar throughout, the additional fresh water flow in the lower end shortens the turnover rate in the pools, decreases the summer water temperature 6-7 degrees C, and lessens the diurnal fluctuation of DO and pH. The reach was rated for warmwater habitat above the springs and for coldwater habitat below the springs. The habitat quality was rated as "poor" above springs and "fair" below the springs with low flow being the most limiting factor. This could improve as effluent flow increases.

CONTINUOUS WATER QUALITY MONITORING

Water quality was monitored continuously over several days in June of 1990 and again in September of 1996. The 1990 monitoring was done in a pool 6.6MI below the WWTP with a YSI 54 DO meter and thermistor rigged to a LICOR datalogger. A local cooperator also took occasional water level readings. In 1996, YSI6000 recording units were set out at locations .6MI, 3MI and 6.6MI below the WWTP and configured to record DO, temperature, pH, conductivity, turbidity and water level. Equipment problems prevented collection of DO at the 6.6MI site and turbidity at the .6MI site. All units were calibrated before deployment and the calibration was checked again at the end. The results are graphed and included in this report.

The .6MI and 3MI sites had diurnally fluctuating DO, pH, turbidity and conductivity (Figures 8&9). Due to groundwater additions, these fluctuations were reduced or not present at the 6.6MI site. Peak DO, pH and temperature occurred during the day while peak conductivity and turbidity occurred at night. The time of the peak for pH, DO and temperature at the 3MI site was four hours later than the other sites. The reason for this difference in the timing of the peaks is unknown.

Comparison of the 1990 (Figure 7) and 1996 (Figure 8) datasets from the 6.6MI site show different temperature regimes. In 1990 significant diurnal fluctuation was present with temperatures of 12-18.5 degrees C. In 1996, less diurnal effect was present with temperatures at 12-15 degrees C. Ambient temperatures were hot during the 1996 monitoring as evidenced by stream temperatures above 25 degrees C and marked diurnal fluctuations at upstream sites. More information would be necessary to determine thermal trends for this stream segment.

DO showed diurnal fluctuation at the 6.6MI site in 1990 with diurnal minimum DO between 5-6PPM on most days (Figure 7). The 1990 data include a receding water level over the first few days followed by a couple days of baseflow and then a definite runoff event. The lack of a diurnal effect initially on Figure 7 could be attributed to flow induced repression of primary production as follows: The stream has been shown to experience high event flows which include high turbidity. Figure 7 suggests that a runoff event initially increases stream aeration and reduces diurnal effects (last 24HRS). This reduction in primary production could be caused by either washout of phytoplankton from pools or turbidity-related shading of periphyton. Under these circumstances, aeration and respiration control DO and little diurnal fluctuation exists. As the flow decreases, physical aeration declines but primary production remains depressed(first 24HRS). This results in low DO with little fluctuation. Eventually, either turbidity is reduced through sedimentation or phytoplankton grow back and primary production resumes (middle of graph).

In 1996, the DO at upstream sites showed very pronounced diurnal fluctuation but stayed above 4PPM most of the time (Figure 8). The graph of DO at the .6MI and 3MI sites shows evidence of a 4PPM aeration "floor" at the site. The "floor" is the point at which natural aeration is able to offset the prevailing respiratory demand and maintain a minimum DO. While this phenomenon was present in the two riffle environments monitored, it is probably not present in large pools. This means that lower DO values would be expected at night in the pools. Additional flow during a runoff event in the last 24HR of monitoring raised the aeration "floor" at the 3MI site slightly.

DO saturation values above 100% show that the stream experiences significant primary production (Figure 10). Since no aquatic macrophytes were observed, this is attributed to periphyton in runs and riffles or phytoplankton in pools. The baseline or "floor" saturation value for both sites monitored is around 50%.

Turbidity at the 3MI site also exhibited several short term spikes and two longer duration increases (Figure 9.). With the exception of the last 24 hours of monitoring, the stream water level was stable through the monitoring period. The short turbidity pulses which occurred during periods of stable water level were attributed to biological activity in the stream. The activity could be fish movement or outside influences (e.g. cattle, deer, etc). A longer turbidity pulse was associated with the runoff event on the last day of monitoring (Figure 11). This event was also associated with a drop in conductivity at the .6MI site. A half-day turbidity spike on the second day of monitoring was associated with a slight departure from the normal conductivity regime at the .6MI site and occurred at normal water levels. The cause of this is unknown.

FISHERY

Electrofishing with backpack DC equipment was conducted in September of 1982 and again in September of 1996. Equipment efficiency was limited due to the high conductivity of the water. On both occasions, no fish were found in the vicinity of the WWTP. In 1982, 68 fathead minnows and 3 brook stickleback were found in a 50' reach 1.25MI below the WWTP. In 1996, 183 fathead minnows, 38 white sucker and 5 brook stickleback were found in a 400' reach at the 3MI site. At the 6.6MI site in 1982 many white suckers, 22 brook stickleback and 2 fathead minnows were found in a 150' reach. In the same general area in 1996, white suckers (3'-10" in length) and brook stickleback were again abundant. Ten longnose dace and one blacknose dace were also found in the 450' reach shocked.

Electrofishing data was collected at 5 sites farther downstream in 1983 starting with a station 1.3 miles below HWY V (7.9 miles below the WWTP). The stream was found to contain stocked brown trout, some of which had over-wintered. Most headwater streams in the region originally consisted of brook trout fisheries prior to development of intense agriculture. As agricultural practices improve, many fisheries in the region have shown signs of improvement. Identification of a trend over time in the trout fishery of Isabelle Creek cannot be done until a more recent fishery assessment is done in the lower stream reaches.

MACROINVERTEBRATES

Macroinvertebrate samples were collected and processed utilizing the procedures for sampling and sorting adopted by the Department in 1983, which included sorting in the lab. The biometrics applied were the HBI (1) and the MMM (2,3). Table 3 lists Hilsenhoff's Biotic Index classification categories.

TABLE 3. HILSENHOFF WATER QUALITY CATEGORIES

BIOTIC INDEX	WATER QUALITY	DEGREE OF ORGANIC POLLUTION
0.00-3.50	EXCELLENT	NO APPARENT ORGANIC POLLUTION
3.51-4.50	VERY GOOD	POSSIBLE SLIGHT ORGANIC POLLUTION
4.51-5.50	GOOD	SOME ORGANIC POLLUTION
5.51-6.50	FAIR	FAIRLY SIGNIFICANT ORGANIC POLLUTION
6.51-7.50	FAIRLY POOR	SIGNIFICANT ORGANIC POLLUTION
7.51-8.50	POOR	VERY SIGNIFICANT ORGANIC POLLUTION
8.51-10.00	VERY POOR	SEVERE ORGANIC POLLUTION

The MMM (1,2) is a metric combining three community measures; the Biotic Index (3), Species Diversity (5) and Percent Ephemeroptera, Plecoptera and Trichoptera Species. As such, it is a measure sensitive to a variety of environmental perturbations besides organic pollution. The MMM value from an individual sample can be compared to a regional database to characterize its comparative quality. Each metric is expressed as a percent of the best value found in the region. The best is defined as the 95%ile in the database. The total range used for percentage calculation was the 5%ile value to the 95%ile value in the database. The MMM sum for an individual sample therefore receives a value between 0 and 3, depending on how favorably it compares with the best samples in the database using all three metrics.

A low MMM sum indicates a problem with the macroinvertebrate community, but not the cause. The individual metrics constituting the MMM sum are examined to see which are contributing the least to the sum. This identifies which metrics are measuring an effect. The sensitivity of individual metrics to specific perturbations are described elsewhere (6,7,8) and should be consulted to assess the cause of low values of the MMM and it's individual metrics.

The individual metric values for samples collected at HWY V over the years are listed in Table 4. The values for the HBI varied seasonally and fell in the "good" and "very good" categories. The values that constitute the MMM are displayed in Figure 12. The MMM in Figure 12 shows a drop in the quality of the macroinvertebrate population in 1995 vs previous years. Since the HBI component of the MMM was still in the "good" category, the impact was not likely associated with changes in organic waste loading.

TABLE 4. MACROINVERTEBRATE COMMUNITY OF ISABELLE CREEK AT HWY V											
								AVG.			
			TOTAL		%	SPECIES	MARGELEV	TOLER.	TFM	%	
SAMPLE #	DATE	REP	COUNT	HBI	EPT	RICHNESS	DIVERSITY	VALUE	COUNT	COLLECT	MMM
780330-48-04	3/78	1	221	5.77	25	16	3.07	6.3	188	84	1.50520652355
781004-48-08	10/78	1	250	4.32	88	8	1.10	4.6	248	98	1.50240515329
820929-48-04	9/82	1	139	5.39	59	16	2.79	5.7	138	72	1.75533837649
820420-48-04	4/82	1	73	3.87	51	11	2.45	4.2	58	88	1.96460247487
880413-48-01	4/88	1	139	4.03	14	18	2.29	5.2	139	94	1.46432040732
950420-48-06	4/95	1	184	4.95	4	15	1.19	5.1	182	94	0.443434099
950420-48-06	4/95	2	173	4.92	3	11	0.72	4.3	169	97	0.36221695066
950420-48-06	4/95	3	210	4.95	4	12	0.91	4.4	206	96	0.44319503311

The drop in the MMM is primarily related to the appearance of the Chironomid *Diamesa sp.* which was absent in previous samples but constituted the vast majority of the 1995 sample. This organism has an average tolerance to organic loading, began appearing in large numbers state-wide in the late 1980s and continues to occur at these sites to this date. At some of the sites, numbers of *Diamesa sp.* seem to be declining in recent years. No cause for the appearance of this organism has been identified. Other than the boom in *Diamesa sp,* the 1995 sample at Hwy V is similar to samples collected in the 1980s in terms of diversity. Although the sample size is small if *Diamesa sp.* is excluded, the resultant percent EPT after exclusion is more in line with previous sampling. As a result, no particular significance is attributed to the change in the MMM in 1995 versus previous years.

The overall low MMM, as compared to regional references, indicates impairment of the headwater of Isabelle Creek at HWY V. At similar sites elsewhere in the region, the macroinvertebrate population, as measured by the components of the MMM, is clearly better. The HBI, Average Tolerance Values and %EPT are poorer than expected and fluctuate between samplings, indicating sporadic organic loadings. Even before the arrival of *Diamesa sp,* species richness and diversity was less than reference sites with similar land use.

SUMMARY OF POLLUTANT SOURCES AND POSSIBLE FACTORS CONTROLLING STREAM BIOLOGY:

Low stream flow. This could be worse in years when a larger percent of effluent flow finds its way into the groundwater. When sinkholes open up, stream flow can disappear completely.

Turbidity pulses during runoff events. The source of the turbidity is a combination of runoff from village streets and the agricultural watershed. Suspended solids levels over 50 mg/L have been documented in the creek during runoff events.

High velocity surges during runoff events. It was observed that the majority of macroinvertebrates inhabiting rock substrate in the stream utilized the bottom of larger rocks. This could be an indication that, during runoff events, high velocities scour the substrate and exert a significant limiting influence on the living space for invertebrates and likely fish as well.

Habitat. The available aquatic habitat is poor in the four mile reach below the WWTP, a result of a combination of low flow and low stream gradient. Delivery of soil to the stream also contributes to filling of pool habitat.

Low stream aeration. While existing riffles and runs can maintain DO near 4 mg/L above HWY V, it is expected to be lower in pools. The very slow travel time for water through the pools in low gradient reaches limit the stream's aeration ability.

WWTP effluent quality. The WWTP effluent is capable of discharging toxic levels of chlorides and ammonia. Toxicity to aquatic life has been documented. The impact of chlorides could extend below HWY V, depending on wastewater trends in the future. The impact of ammonia appears to be confined to the reach above HWY V as of 1997. However, as flow increases, the zone of ammonia impact could extend further downstream as travel time is reduced. The WWTP currently does not have effluent limits for ammonia or chlorides and in the past has violated its BOD_5 limits. When BOD_5 levels stay below 15 mg/L, the DO water quality criteria associated with the existing designated uses are met, at least in riffles and runs.

Industrial NPS BOD_5 loads. A creamery in Ellsworth accumulates a significant amount of airborne waste dairy solids on its property. During runoff events, these high BOD_5 waste products are flushed into the headwaters of Isabelle Creek above the WWTP.

CONCLUSIONS

Despite continuously flowing water, no fish exist in the stream near the WWTP. The lack of fish near the WWTP is attributed to a combination of poor habitat, effluent chlorides, effluent ammonia, velocity surges and turbidity pulses. Starting about one mile below the WWTP, forage fish can be found in pools but the population is limited to a few tolerant species. The low diversity of fish in this reach is attributed to a combination of poor habitat, chlorides, ammonia, turbidity pulses, low stream aeration and large diurnal swings in water quality. More work would be needed to attribute relative significance to each of these contributing factors.

The impaired macroinvertebrate community at HWY V may be at least partially the result of violations of BOD_5 limits at the WWTP.

The fishery at HWY V is likely controlled by a combination of low flow, DO, chlorides and temperature. Dissolved oxygen levels at HWY V, as measured during one eight day period, were above 5PPM most of the time with diurnal minima falling between 5-6PPM. This situation will have to be improved before trout reproduction can be considered as a potential goal in the headwater. The effect of WWTP flow on stream temperature is unclear. While more effluent flow, in relation to spring flow, should cause higher stream temperatures, monitoring data do not seem to bear this out. The current condition of downstream trout fishery is unknown.

The WWTP has to consistently remain in compliance with BOD_5 limits before the stream will be able to sustain a stable biological community above and below HWY V.

The phosphorus limit pending at the WWTP has the potential to improve stream DO by reducing diurnal fluctuations. Maintenance of WWTP BOD_5 below 15 mg/L appears to be needed to ensure that the existing use designations are attained. There is a reasonable chance that keeping the effluent BOD_5 below 15 mg/L, in conjunction with phosphorus control, will maintain a DO of 6 mg/L at Hwy V. This action, in conjunction with control of ammonia and chlorides in the effluent, has potential to improve water quality and biology both above and below HWY V. However, this is a judgement call which can only be confirmed by doing it and seeing what happens. It is not clear that BOD_5 limitations lower than 15 mg/L would improve the aquatic community, given the additional limitations to use attainment besides the WWTP.

RECOMMENDED STREAM CLASSIFICATION

The aquatic use potential of the headwaters of Isabelle Creek is difficult to predict given the variety of cultural impairments. However, the information is sufficient to justify continuation of the existing classification. The only recommended change at this time is to begin the coldwater classification 200 yds upstream from HWY V rather than the location 0.75 mi downstream from HWY Z listed in Trout Streams of Wisconsin. This is done in recognition of the habitat and water quality documented at the site, as well as the existence of numerous coldwater springheads in the region.

RECOMMENDED EFFLUENT LIMITATIONS

As part of facility planning, compliance with the 1 PPM effluent phosphorus standard must be addressed as well as elimination of toxic levels of chlorides and ammonia. This will not be achieved by continuation of the existing effluent limitations. It is therefore recommended that the WPDES permit limitations be those listed in s. NR 104.02 (3) (a) (Limited Forage Fish Community). Compliance with this limit should ensure that the criteria associated with the recommended use classifications are met. However, in designing the WWTP, consideration should be given to the following factors:

1. The recommended limits rely on professional judgements regarding the likely response of the receiving water to the new pollutant loads. Actual stream response may be different than the response predicted above.

2. Wisconsin's water quality standards for ammonia are being revised. The recommended limits may be affected by this process.

3. The procedure Wisconsin uses for assigning designated uses to streams is being revised. The stream's designated use (and associated effluent limitations) may be affected by this process.

These factors should be sufficient to justify a conservative WWTP design and to point out the potential need to achieve lower limits in the future.

OTHER MANAGEMENT RECOMMENDATIONS

Follow-up stream monitoring is recommended after phosphorus, ammonia and chlorides have been dealt with at the WWTP. Additional temperature data should be collected at Hwy V as well as other points downstream. The fishery below Hwy V should be assessed.

Recommended NPS improvements are remediation of the stormwater problem at the Creamery and installation of BMPs in the urban and rural portions of the watershed.

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(8) Plafkin, J. et al 1989. Rapid Bioassessment Protocols for use in Streams and Rivers: Benthic Macroinvertebrates and Fish. USEPA/444/4-89-001, May 1989

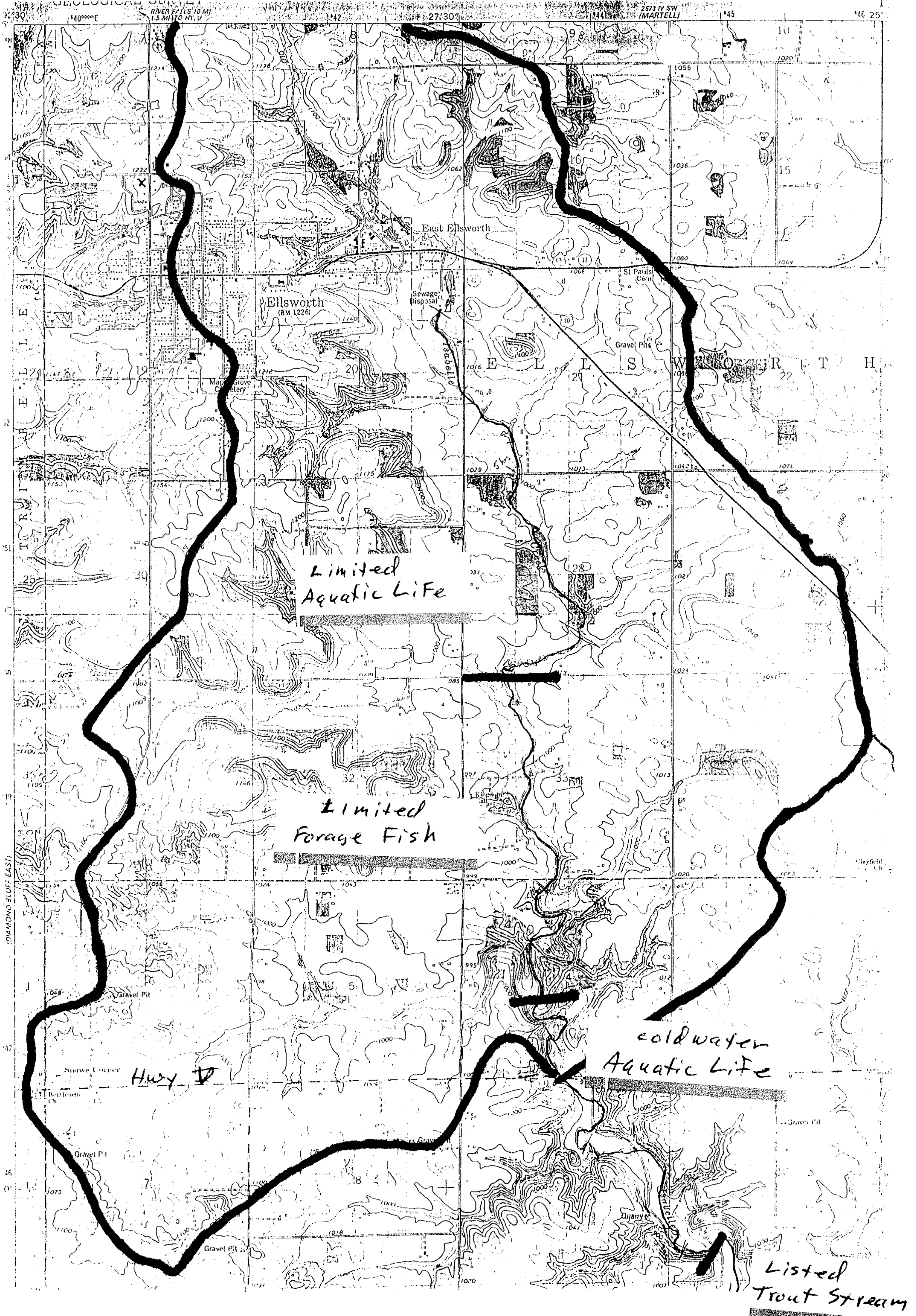
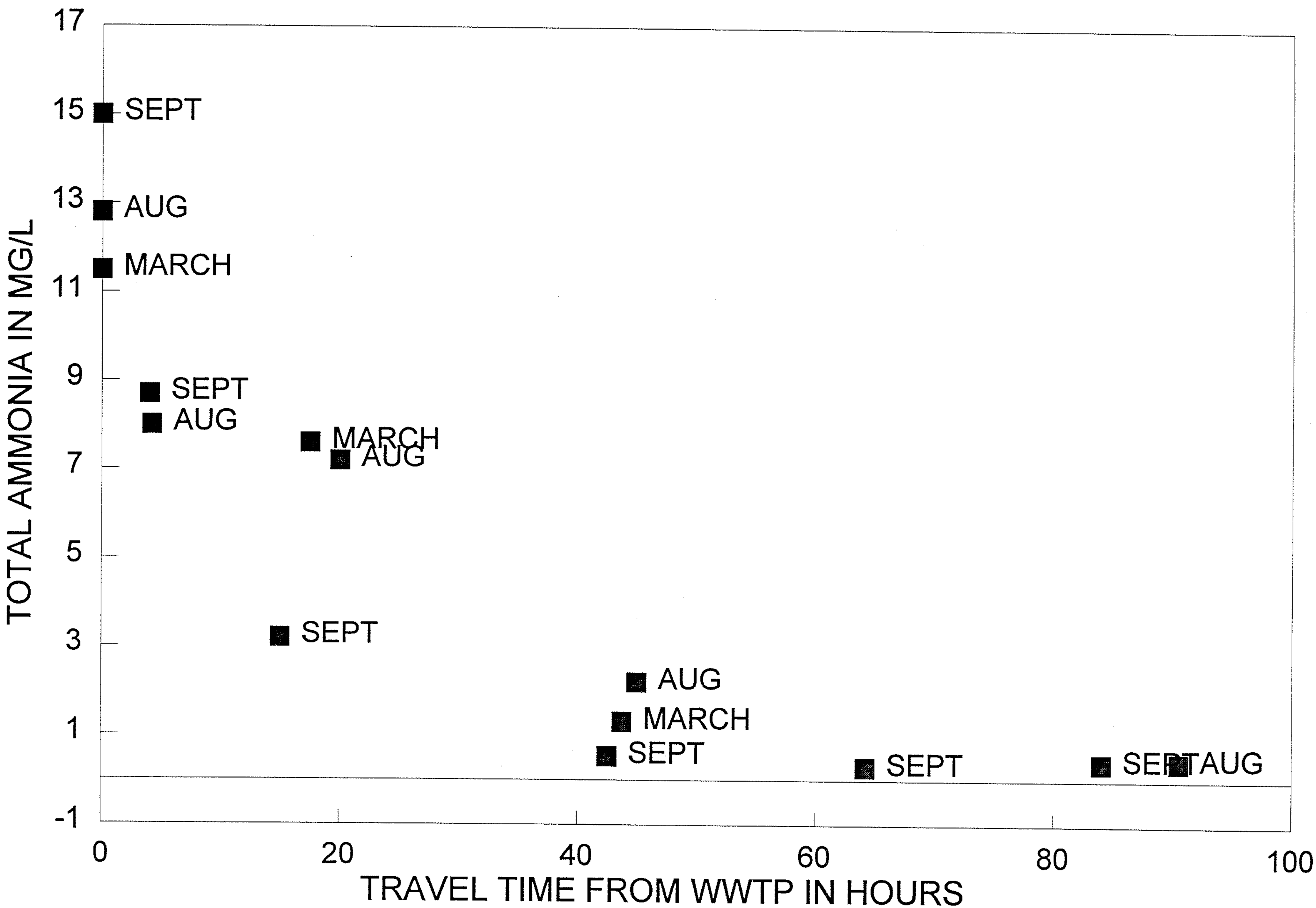

RIVER FALLS 10 MI.
2573 IV SW (MARTELL)
East Ellsworth
Ellsworth
Sewage Disposal
St Pauls Cem
Gravel Pits
E L L S W O R T H
Maple Grove Cemetery
Limited Aquatic Life
Limited Forage Fish
Coldwater Aquatic Life
Hwy V
Gravel Pit
Quarry
Listed Trout Stream

Figure 1

FIGURE 2. ISABELLE CREEK AMMONIA LEVELS



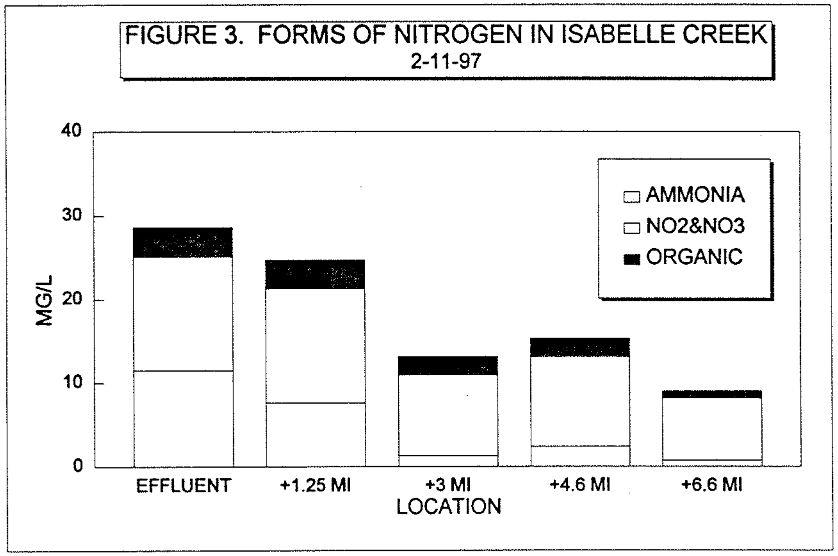


FIGURE 3. FORMS OF NITROGEN IN ISABELLE CREEK
2-11-97
AMMONIA
NO2&NO3
ORGANIC
MG/L
0
10
20
30
40
EFFLUENT
+1.25 MI
+3 MI
+4.6 MI
+6.6 MI
LOCATION

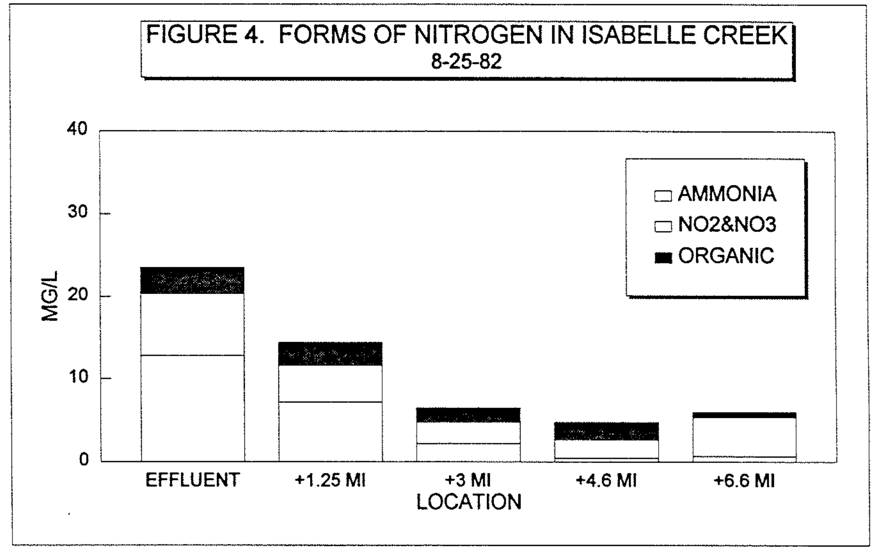


FIGURE 4. FORMS OF NITROGEN IN ISABELLE CREEK
8-25-82
AMMONIA
NO2&NO3
ORGANIC
MG/L
0
10
20
30
40
EFFLUENT
+1.25 MI
+3 MI
+4.6 MI
+6.6 MI
LOCATION

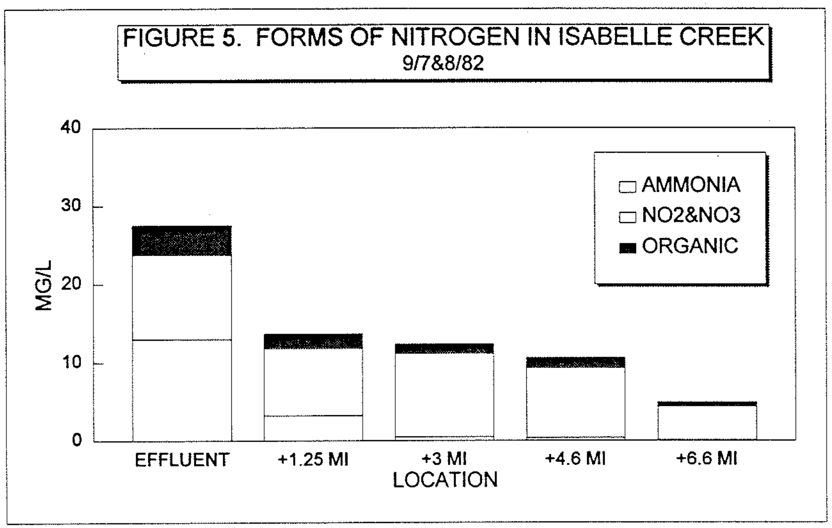


FIGURE 5. FORMS OF NITROGEN IN ISABELLE CREEK
9/7&8/82
AMMONIA
NO2&NO3
ORGANIC
MG/L
0
10
20
30
40
EFFLUENT
+1.25 MI
+3 MI
+4.6 MI
+6.6 MI
LOCATION

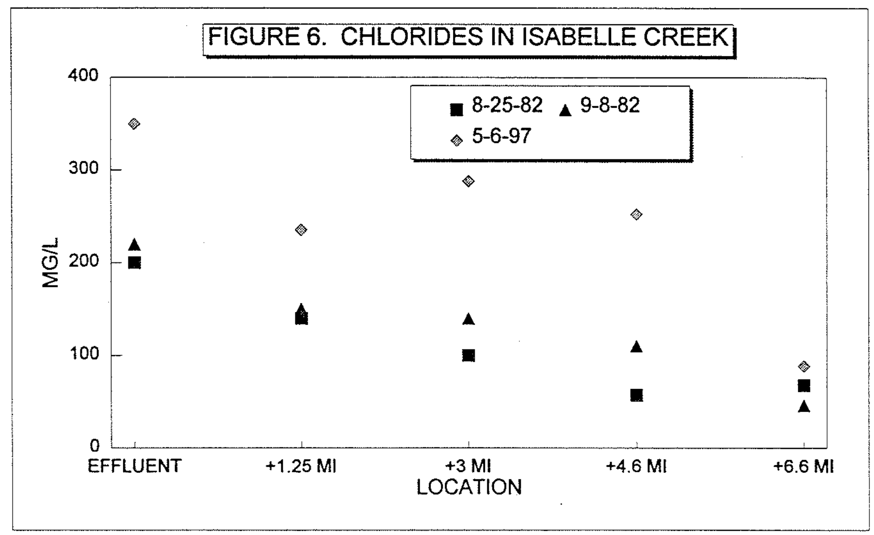


FIGURE 6. CHLORIDES IN ISABELLE CREEK
8-25-82
9-8-82
5-6-97
MG/L
0
100
200
300
400
EFFLUENT
+1.25 MI
+3 MI
+4.6 MI
+6.6 MI
LOCATION

FIGURE 7. ISABELLE CREEK AT CTH V

6/20/90-6/28/90

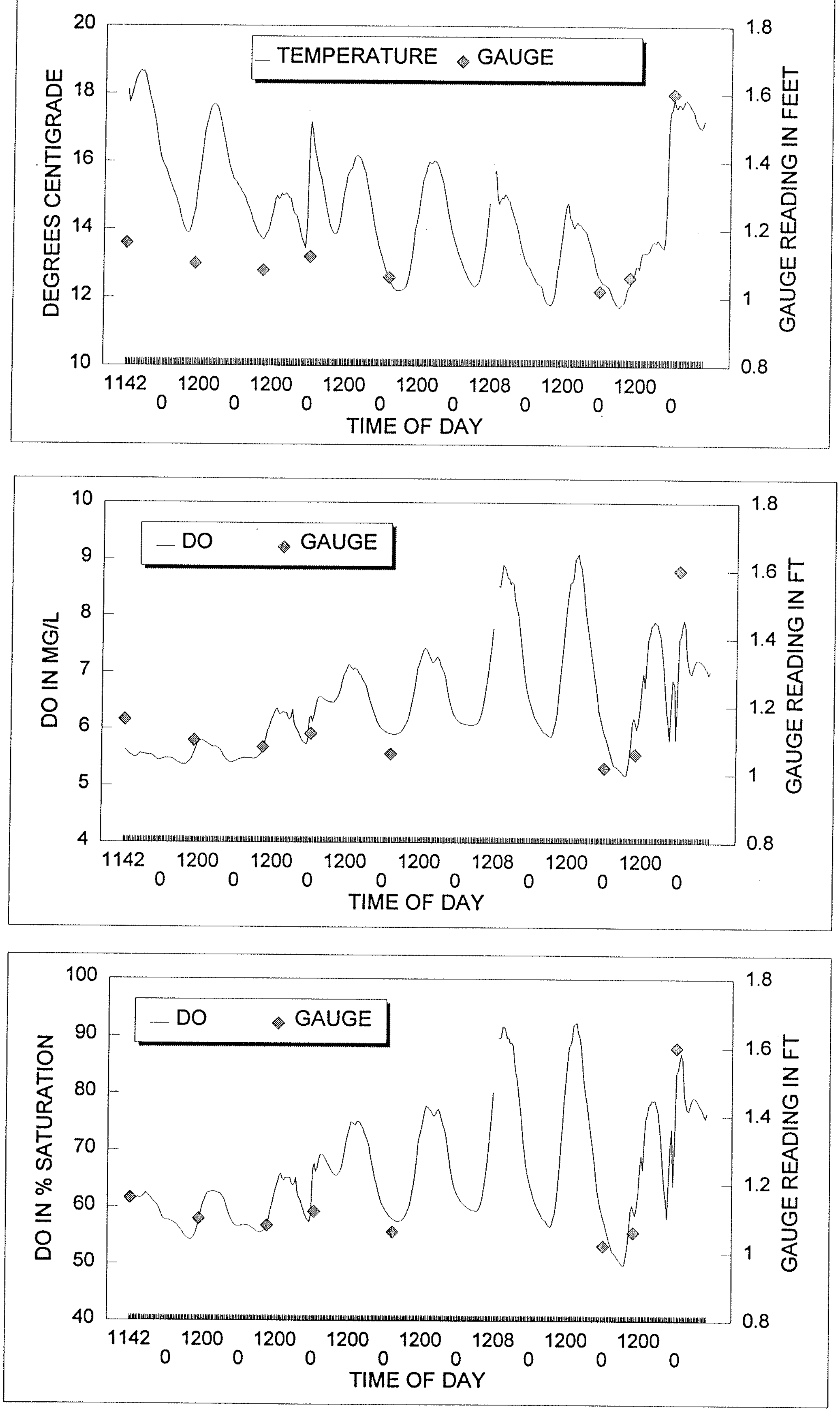
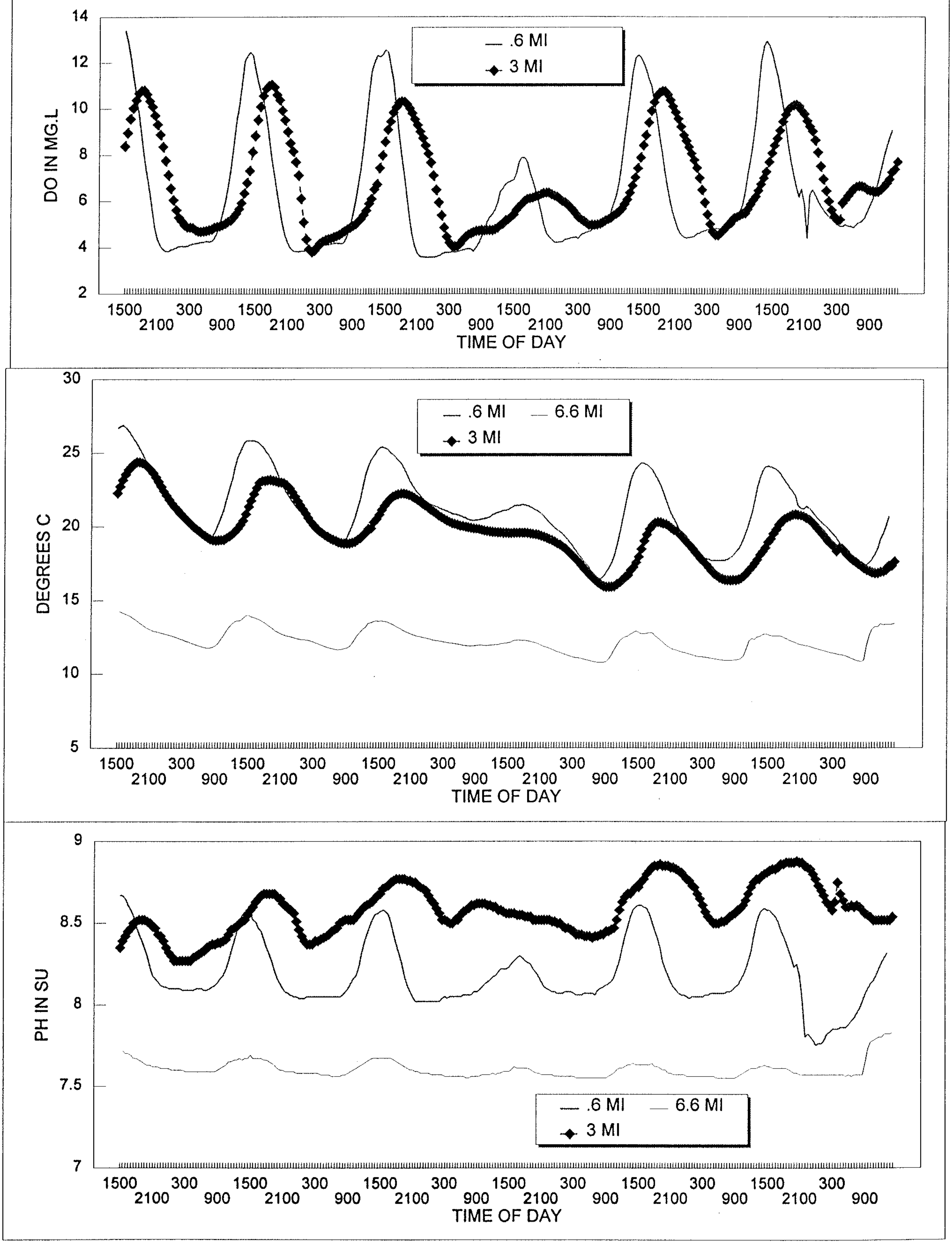


FIGURE 8. ISABELLE CREEK

9-5-96 TO 9-11-96



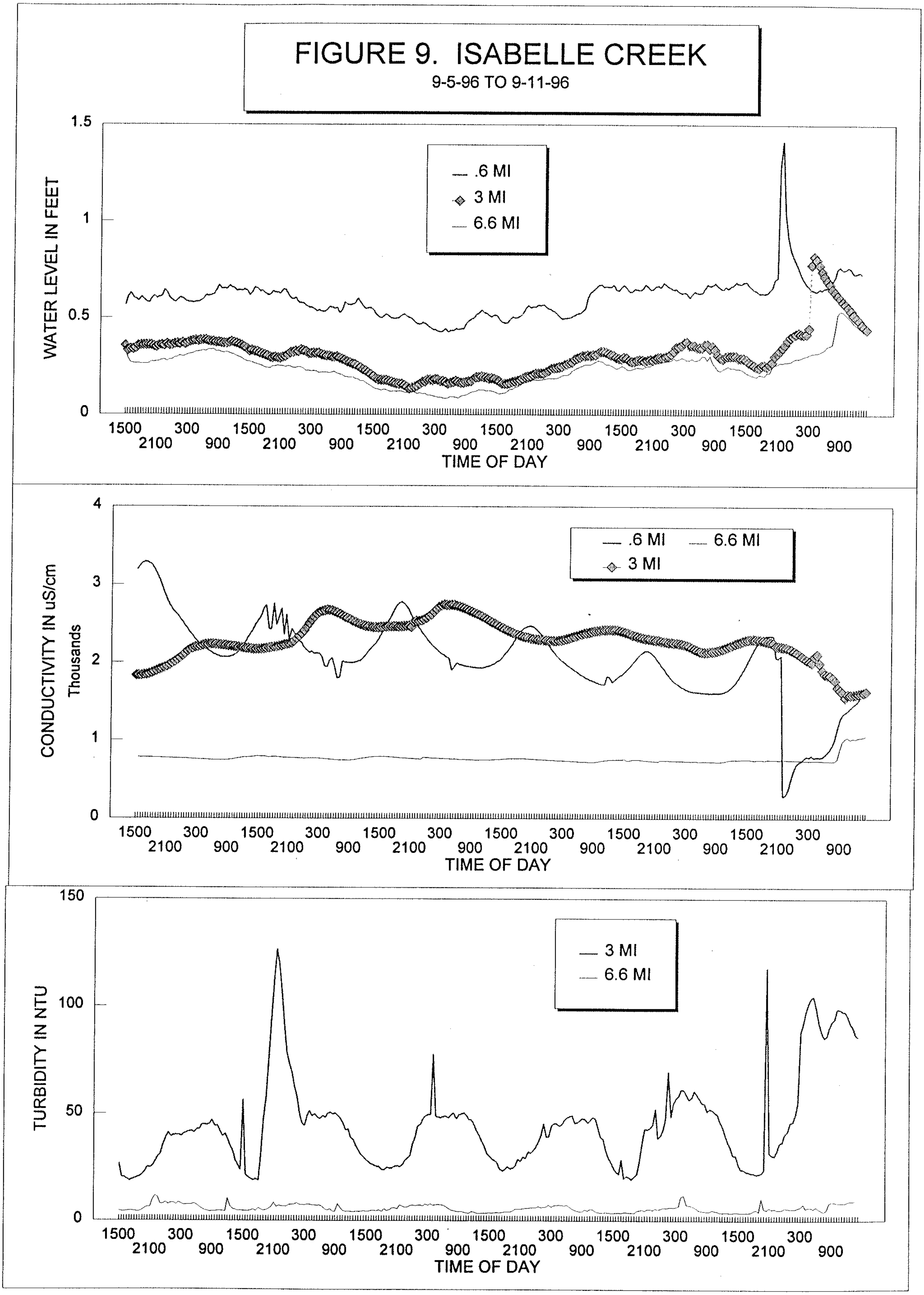


FIGURE 9. ISABELLE CREEK
9-5-96 TO 9-11-96
WATER LEVEL IN FEET
1.5
1
0.5
0
.6 MI
3 MI
6.6 MI
1500 300 1500 300 1500 300 1500 300 1500 300 1500 300
2100 900 2100 900 2100 900 2100 900 2100 900 2100 900
TIME OF DAY
CONDUCTIVITY IN uS/cm
Thousands
4
3
2
1
0
.6 MI
6.6 MI
3 MI
1500 300 1500 300 1500 300 1500 300 1500 300 1500 300
2100 900 2100 900 2100 900 2100 900 2100 900 2100 900
TIME OF DAY
TURBIDITY IN NTU
150
100
50
0
3 MI
6.6 MI
1500 300 1500 300 1500 300 1500 300 1500 300 1500 300
2100 900 2100 900 2100 900 2100 900 2100 900 2100 900
TIME OF DAY

FIGURE 10. ISABELLE CREEK DISSOLVED OXYGEN
9-5-96 TO 9-11-96

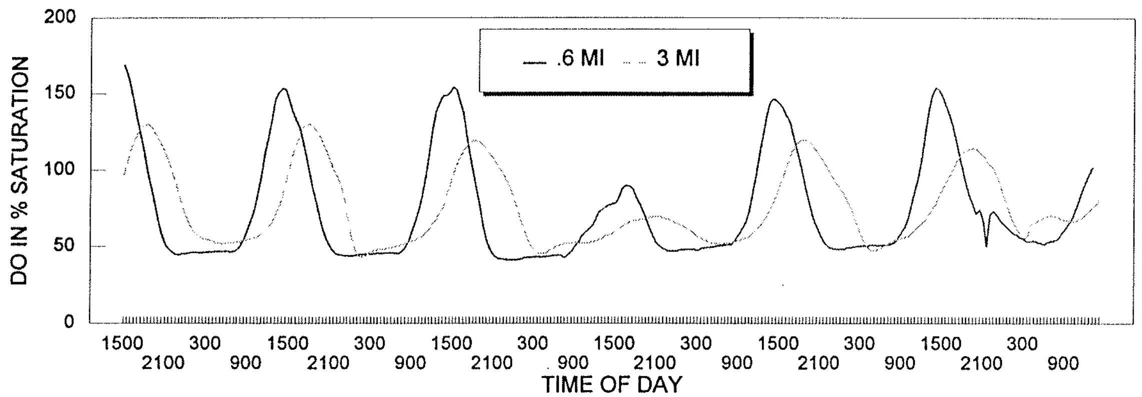


FIGURE 11. RUNOFF EVENT RESULTS
.6 MI ON 9-10-96 & 9-11-96

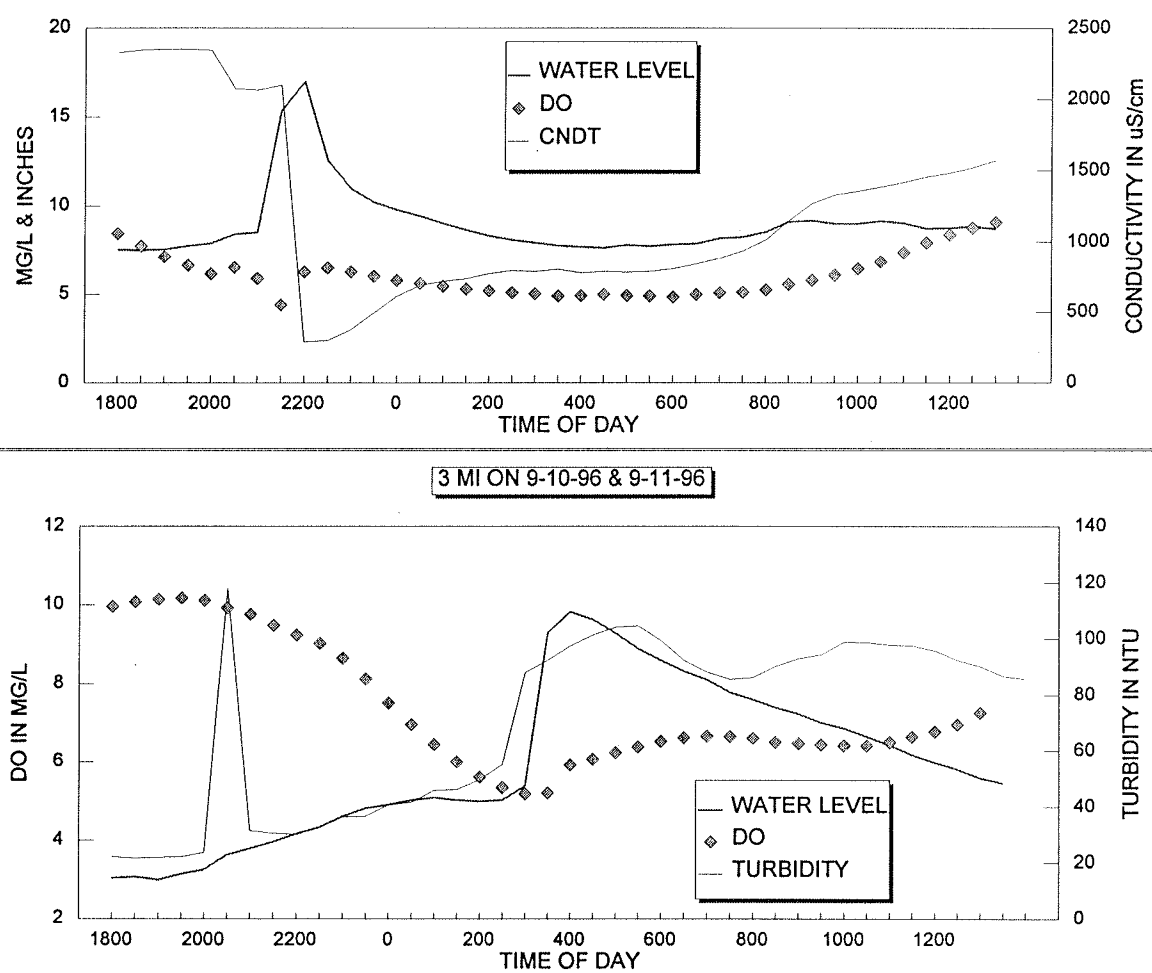
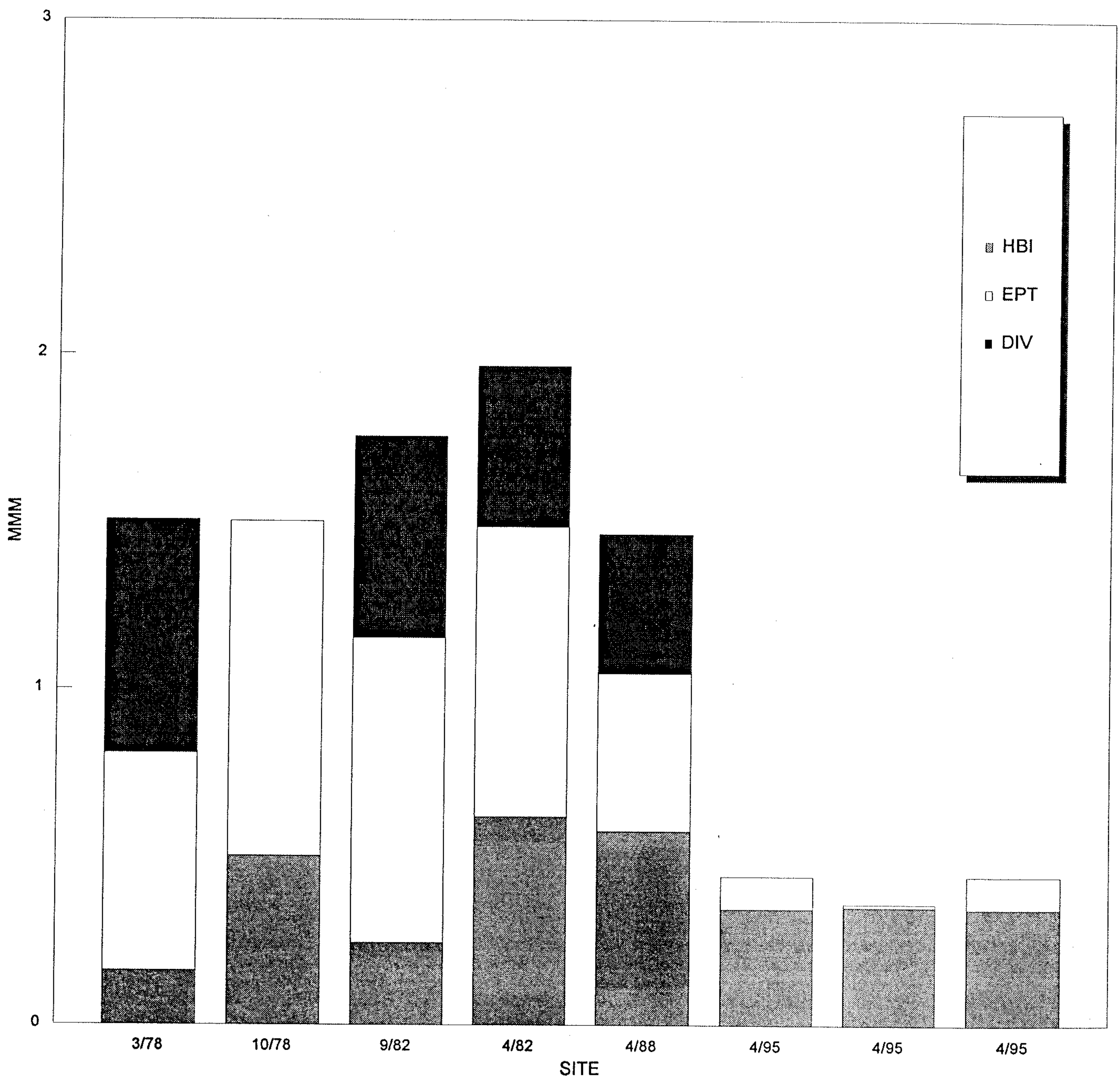


FIGURE 12. ISABELLE CR. MACROINVERTEBRATE COMMUNITY @ HWY V
COMBINED METRIC USING HBI, EPT AND DIVERSITY



MMM SCALE IS 0 (POOR) TO 3 (GOOD)

WEST CENTRAL District Biotic Index Report

HBI _4.030 Rep1 _ Rep2 _ Rep3 ______

Sample ID # _880413-48-01 Waterbody Name _ISABELLE CR.

Water Temp (Celsius) _11.0___ Dissolved Oxygen (mg/l) _14.0 _

Sample Location: S O T ON R O _ Master Waterbody # _

Project Name _ELLSWORTH POSTOP Storet Station # _483006

Ave. Stream Width (Ft.) at Site _12.0 Ave. Stream Depth (Ft.) at Site _0.5

Collector _LA LIBERTE, P. Field # 01 Rep 1_

Measured Velocity (fps) _

Sorter _DIMICK, J. Est. Velocity (fps)

Est % of sample sorted _2 _Fast (1.5- >)

Taxonomist _DIMICK, J. Sampled Habitat

Location Description _RIFFLE AT BASE OF POOL BELOW HWY V _1. Riffle

_BRIDGE ___________

_ ___________

Est. Time Spent Sampling (Min.) _ 5__

Sampling Device _1. D Frame ___________

Substrate at Site Location (%)

0.0 Bedrock	50.0 Rubble	0.0 Sand	0.0 Clay	0.0 Muck
0.0 Boulders	50.0 Gravel	0.0 Silt	0.0 Detritus	0.0 Debris/Veg

Substrate Sampled (%) (Same as above Yes)

0.0 Bedrock	0.0 Rubble	0.0 Sand	0.0 Clay	0.0 Muck
0.0 Boulders	0.0 Gravel	0.0 Silt	0.0 Detritus	0.0 Debris/Veg

Aquatic Vegetation 0 % of Total Stream Channel at Sampling Site

Observed Instream Water Quality Indicators (Perceived WQ __________)

	Not Present	Insig-nificant	Sig-nificant	Comments
Turbidity	1			
Chlorine or Toxic Scour	1			
Macrophytes	1			
Filamentous Algae		2		
Planktonic Algae			3	
Slimes			3	
Iron Bacteria	1			

Factors Which May Be Affecting Habitat Quality

Sludge Deposits	1			
Silt and Sediment	1			
Channel Ditching	1			
Down/Up Stream Impoundment	1			
Low Flows	1			
Wetlands	1			

Pollutant Sources

Livestock Pasturing			3	
Barnyard Runoff			3	
Cropland Runoff		2		
Tile Drains	1			
Septic Systems		2		
Stream Bank Erosion		2		
Urban Runoff		2		
Construction Runoff		2		
Point Source(Specify Type)	1			POTW, CREAMERY?
Other (Specify)				

*** WEST CENTRAL DISTRICT BIOTIC INDEX REPORT ***

SAMPLE ID# 880413-48-01

*** TAXA ***	SPECIES	TAXONOMIC KEY USED	TOL VAL	ORGANISM ID	ORGANISM COUNT REP1	REP2	REP3
EPHEMEROPTERA							
BAETIDAE		*1		02010000	2	0	0
BAETIS	**UNIDENTIFIED**	*1		02010100	1	0	0
	TRICAUDATUS	*2	2.00	02010116	8	0	0
TRICHOPTERA							
HYDROPSYCHIDAE							
CHEUMATOPSYCHE	**UNIDENTIFIED**	*1	5.00	04040100	1	0	0
CERATOPSYCHE	SLOSSONAE	*3	4.00	04040706	8	0	0
COLEOPTERA							
DRYOPIDAE							
HELICHUS	LITHOPHILUS	*4	5.00	07010101	2	0	0
DIPTERA							
CHIRONOMIDAE							
CHAETOCLADIUS	**UNIDENTIFIED**	*1	6.00	08050500	1	0	0
	SP.B	*5	6.00	08050501	3	0	0
	SP.C	*5	6.00	08050502	1	0	0
CLADOTANYTARSUS	SP.A	*5	7.00	08050801	2	0	0
CRICOTOPUS	NR.BICINCTUS	*5	6.00	08051301	3	0	0
	NR.TRIFASCIA	*5	7.00	08051303	2	0	0
	SP.A	*5	6.00	08051304	1	0	0
EUKIEFFERIELLA	SP.A	*5	8.00	08052301	3	0	0
NANOCLADIUS	**UNIDENTIFIED**	*1	3.00	08053600	1	0	
ORTHOCLADIUS	SP.A	*5	6.00	08054001	9	0	0
	SP.B	*5	3.00	08054002	54	0	0
	SP.D	*5	5.00	08054004	11	0	0
TVETENIA	SP.B	*5	5.00	08058002	1	0	0
ORTHOCLADINAE	**POOR SPECIMEN**	*1		08059101	1	0	0
SIMULIIDAE							
SIMULIUM	LONGISTYLATUM	*6		08110243	1	0	0
AMPHIPODA							
GAMMARIDAE							
GAMMARUS	PSEUDOLIMNAEUS	*7	4.00	09010201	23	0	0
	*** TOTALS: ***				139	0	0
	*** BIOTIC INDEX: ***				4.030		

Taxonomic Key Code References

*1 HILSENHOFF 1981
*2 HILSENHOFF 1981,82
*3 HILSENHOFF 1981,86
*4 BROWN 1972
*5 HILSENHOFF 1981,85
*6 HILSENHOFF 1985
*7 HOLSINGER 1972

WESTERN DISTRICT District Biotic Index Report

HBI-Rep1: 4.950 Rep2: 4.924 Rep3: 4.951 Rep4: Rep5:
Sample ID # _950420-48-06 Waterbody Name _ISABELLE CREEK
W--er Temp (Celsius) _7.4 ___ Dissolved Oxygen (mg/l) _11.3 _
S ple Location: SE SW S 4 T25N R17W_ Master Waterbody # _2445000
Lat./Long.: N44deg 0min 0.0sec W 92deg 0min 0.0sec
Lat./Long. Method _
Project Name _ELLSWORTH WWTP Storet Station # _
Ave. Stream Width (Ft.) at Site _10.0 Ave. Stream Depth (Ft.) at Site _0.5
Collector _HAZUGA, M. Field # 06 Rep 3_
Measured Velocity (fps) _
Sorter _ROOST, B. Est. Velocity (fps)
Est % of sample sorted _13,13,20 _Fast (1.5- >)
Taxonomist _DIMICK, J. Sampled Habitat
Location Description _50 M. ABOVE BRIDGE ON CTH V _1. Riffle
_
_
Est. Time Spent Sampling (Min.) _ 3 ea.
Sampling Device _1. D Frame

==

Substrate at Site Location (%)

0.0 Bedrock	60.0 Rubble	10.0 Sand	0.0 Clay	0.0 Muck
0.0 Boulders	20.0 Gravel	0.0 Silt	10.0 Detritus	0.0 Debris/Veg

Substrate Sampled (%) (Same as above Yes)

0.0 Bedrock	0.0 Rubble	0.0 Sand	0.0 Clay	0.0 Muck
0.0 Boulders	0.0 Gravel	0.0 Silt	0.0 Detritus	0.0 Debris/Veg

==

Aquatic Vegetation 0 % of Total Stream Channel at Sampling Site
Observed Instream Water Quality Indicators (Perceived WQ _Fair____)

	Not Present	Insignificant	Significant	Comments
Turbidity			3	
Chlorine or Toxic Scour	1			
Macrophytes	1			
Filamentous Algae		2		
Planktonic Algae			3	WATER GREEN FROM PLANKTONIC ALGAE
Slimes	1			
Iron Bacteria	1			

FACTORS WHICH MAY BE AFFECTING HABITAT QUALITY

Sludge Deposits	1		
Silt and Sediment	1		
Channel Ditching	1		
Down/Up Stream Impoundment	1		
Low Flows	1		
Wetlands	1		

POLLUTANT SOURCES

Livestock Pasturing	1		
Barnyard Runoff	1		
Cropland Runoff		2	
Tile Drains	1		
Septic Systems	1		
St-eam Bank Erosion		2	
U an Runoff	1		
Construction Runoff	1		
Point Source(Specify Type)			3
Other (Specify)			

*** WESTERN DISTRICT DISTRICT BIOTIC INDEX REPORT ***

SAMPLE ID# 950420-48-06

*** TAXA ***	SPECIES	TAXONOMIC KEY USED	TOL VAL	ORGANISM ID	ORGANISM COUNT REP1	REP2	REP3
EPHEMEROPTERA							
CAENIDAE							
CAENIS	**UNIDENTIFIED**	*1	7.00	02030200	1	0	1
EPHEMERELLIDAE							
EPHEMERELLA	INERMIS (sp.A)	*2	1.00	02040411	1	1	1
TRICHOPTERA							
HYDROPSYCHIDAE							
CHEUMATOPSYCHE	**UNIDENTIFIED**	*1	5.00	04040100	1	0	0
CERATOPSYCHE	SLOSSONAE	*3	4.00	04040706	4	5	7
COLEOPTERA							
DRYOPIDAE							
HELICHUS	STRIATUS	*4	5.00	07010103	5	0	0
ELMIDAE							
DUBIRAPHIA	**UNIDENTIFIED**	*4	6.00	07020200	0	1	0
OPTIOSERVUS	**UNIDENTIFIED**	*4	4.00	07020500	0	2	0
	FASTIDITUS	*4	4.00	07020501	1	0	0
STENELMIS	**UNIDENTIFIED**	*4	5.00	07020600	0	1	0
	CRENATA	*4	5.00	07020601	1	1	1
DIPTERA							
CHIRONOMIDAE		*1		08050000	2	1	2
	PUPAE	*5		08050002	0	2	2
CHAETOCLADIUS	SP.B	*6	6.00	08050501	1	0	0
CRICOTOPUS	**UNIDENTIFIED**	*1	7.00	08051300	0	1	
	NR.BICINCTUS	*6	6.00	08051301	0	0	6
	SP.A	*6	6.00	08051304	1	0	0
DIAMESA	**UNIDENTIFIED**	*1	5.00	08051700	152	154	179
EUKIEFFERIELLA	SP.A	*6	8.00	08052301	1	0	0
ORTHOCLADIUS	SP.C	*6	3.00	08054003	0	1	1
	SP.D	*6	5.00	08054004	1	1	2
TANYTARSUS	**UNIDENTIFIED**	*1	6.00	08056800	1	0	0
TVETENIA	SP.A	*6	4.00	08058001	0	0	1
ORTHOCLADINAE		*1		08059100	0	0	1
TIPULIDAE							
ANTOCHA	**UNIDENTIFIED**	*1	3.00	08140100	0	1	0
AMPHIPODA							
GAMMARIDAE							
GAMMARUS	PSEUDOLIMNAEUS	*7	4.00	09010201	8	1	4
ACARI		*5		11000000	3	0	1
GASTROPODA							
PHYSIDAE							
PHYSA	**UNIDENTIFIED**	*5		14040200	0	0	1

*** WESTERN DISTRICT DISTRICT BIOTIC INDEX REPORT ***

SAMPLE ID# 950420-48-06

*** TAXA *** SPECIES	TAXONOMIC KEY USED	TOL VAL	ORGANISM ID	ORGANISM COUNT REP1	REP2	REP3
	*** TOTALS: ***			184	173	210
	*** BIOTIC INDEX: ***			4.950	4.924	4.951
				83%	89%	85%

Taxanomic Key Code References
*1 Hilsenhoff 1981
*2 Hilsenhoff 1981,82
*3 Hilsenhoff 1981,86
*4 Hilsenhoff 1992
*5 Pennak 1978
*6 Hilsenhoff 1981,85
*7 Holsinger 1972

3

Department of Natural R[illegible]rces

[illegible]REAM SYSTEM HABITAT RATING FORM
Form 3200-68 1-85

Stream Isabelle Reach Location 3 mi reach below WWTP Reach Score/Rating 234

County ______ Date 9-6-96 Evaluator LaLiberte Classification Poor

Rating Item	Category: Excellent	Good	Fair	Poor
Watershed Erosion	No evidence of significant erosion. Stable forest or grass land. Little potential for future erosion. 8	Some erosion evident. No significant "raw" areas. Good land mgmt. practices in area. Low potential for significant erosion. 10	Moderate erosion evident. Erosion from heavy storm events obvious. Some "raw" areas. Potential for significant erosion. 14	Heavy erosion evident. Probable erosion from any run off. 16
Watershed Nonpoint Source	No evidence of significant source. Little potential for future problem. 8	Some potential sources (roads, urban area, farm fields). 10	Moderate sources (small wetlands, tile fields, urban area, intense agriculture). 14	Obvious sources (major wetland drainage, high use urban or industrial area, feed lots, impoundment). 16
Bank Erosion, Failure	No evidence of significant erosion or bank failure. Little potential for future problem. 4	Infrequent, small areas, mostly healed over. Some potential in extreme floods. 8	Moderate frequency and size. Some "raw" spots. Erosion potential during high flow. 16	Many eroded areas. "Raw" areas frequent along straight sections and bends. 20
Bank Vegetative Protection	90% plant density. Diverse trees, shrubs, grass. Plants healthy with apparently good root system. 6	70-90% density. Fewer plant species. A few barren or thin areas. Vegetation appears generally healthy. 9	50-70% density. Dominated by grass, sparse trees and shrubs. Plant types and conditions suggest poorer soil binding. 15	<50% density. Many raw areas. Thin grass, few if any trees and shrubs. 18
Lower Bank Channel Capacity	Ample for present peak flow plus some increase. Peak flow contained. W/D ratio <7. 8	Adequate. Overbank flows rare. W/D ratio 8-15. 10	Barely contains present peaks. Occasional overbank flow. W/D ratio 15-25. 14	Inadequate, overbank flow common. W/D ratio >25. 16
Lower Bank Deposition	Little or no enlargement of channel or point bars. 6	Some new increase in bar formation, mostly from coarse gravel. 9	Moderate deposition of new gravel and coarse sand on old and some new bars. 15	Heavy deposits of fine material, increased bar development. [illegible]
Bottom Scouring and Deposition	Less than 5% of the bottom affected by scouring and deposition. 4	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools. 8	30-50% affected. Deposits and scour at obstructions, constrictions and bends. Some filling of pools. 16	More than 50% of the bottom changing nearly year long. Pools almost absent due to deposition. 20
Bottom Substrate/ Available Cover	Greater than 50% rubble, gravel or other stable habitat. 2	30-50% rubble, gravel or other stable habitat. Adequate habitat. 7	10-30% rubble, gravel or other stable habitat. Habitat availability less than desirable. 17	Less than 10% rubble gravel or other stable habitat. Lack of habitat is obvious. 22
Avg. Depth Riffles and Runs	Cold >1' 0 Warm >1.5' 0	6" to 1' 6 10" to 1.5' 6	3" to 6" 18 6" to 10" 18	<3" 24 <6" 24
Avg. Depth of Pools	Cold >4' 0 Warm >5' 0	3' to 4' 6 4' to 5' 6	2' to 3' 18 3' to 4' 18	<2' 24 <3' 24
Flow, at Rep. Low Flow	Cold >2 cfs 0 Warm >5 cfs 0	1-2 cfs 6 2-5 cfs 6	.5-1 cfs 18 1-2 cfs 18	<.5 cfs 24 <1 cfs 24
Pool/Riffle, Run/Bend Ratio (distance between riffles ÷ stream width)	5-7. Variety of habitat. Deep riffles and pools. 4	7-15. Adequate depth in pools and riffles. Bends provide habitat. 8	15-25. Occasional riffle or bend. Bottom contours provide some habitat. 16	>25. Essentially a straight stream. Generally all flat water or shallow riffle. Poor habitat. 20
Aesthetics	Wilderness characteristics, outstanding natural beauty. Usually wooded or unpastured corridor. 8	High natural beauty. Trees, historic site. Some development may be visible. 10	Common setting, not offensive. Developed but uncluttered area. 14	Stream does not inhance aesthetics. Condition of stream is offensive. 16

Column Totals: ______ ______ ______ ______

Column Scores E ______ +G ______ +F ______ +P ______ = 234 = Score

250

<70 = Excellent, 71-129 = Good, 130-200 = Fair, >200 = Poor

Department of Natural Resources

STREAM S[...]EM HABITAT RATING FORM
Form 3200-68
1-85

Stream ____ Reach Location *East twn rd to 400' upstream* Reach Score/Rating *215*

[...]unty ____ Date ____ Evaluator *Laliberte* Classification *Poor*

Rating Item	Excellent	Good	Fair	Poor
Watershed Erosion	No evidence of significant erosion. Stable forest or grass land. Little potential for future erosion. 8	Some erosion evident. No significant "raw" areas. Good land mgmt. practices in area. Low potential for significant erosion. **10**	Moderate erosion evident. Erosion from heavy storm events obvious. Some "raw" areas. Potential for significant erosion. 14	Heavy erosion evident. Probable erosion from any run off. **16** *upper watershed*
Watershed Nonpoint Source	No evidence of significant source. Little potential for future problem. 8	Some potential sources (roads, urban area, farm fields). **10**	Moderate sources (small wetlands, tile fields, urban area, intense agriculture). **14**	Obvious sources (major wetland drainage, high use urban or industrial area, feed lots, impoundment). 16
Bank Erosion, Failure	No evidence of significant erosion or bank failure. Little potential for future problem. 4	Infrequent, small areas, mostly healed over. Some potential in extreme floods. **8**	Moderate frequency and size. Some "raw" spots. Erosion potential during high flow. 16	Many eroded areas. "Raw" areas frequent along straight sections and bends. 20
Bank Vegetative Protection	90% plant density. Diverse trees, shrubs, grass. Plants healthy with apparently good root system. 6	70-90% density. Fewer plant species. A few barren or thin areas. Vegetation appears generally healthy. **9**	50-70% density. Dominated by grass, sparse trees and shrubs. Plant types and conditions suggest poorer soil binding. 15	<50% density. Many raw areas. Thin grass, few if any trees and shrubs. 18
Lower Bank Channel Capacity	Ample for present peak flow plus some increase. Peak flow contained. W/D ratio <7. 8	Adequate. Overbank flows rare. W/D ratio 8-15. **10**	Barely contains present peaks. Occasional overbank flow. W/D ratio 15-25. 14	Inadequate, overbank flow common. W/D ratio >25. 16
Lower Bank Deposition	Little or no enlargement of channel or point bars. 6	Some new increase in bar formation, mostly from coarse gravel. 9	Moderate deposition of new gravel and coarse sand on old and some new bars. 15	Heavy deposits of fine material, increased bar development. **18**
Bottom Scouring and Deposition	Less than 5% of the bottom affected by scouring and deposition. 4	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools. 8	30-50% affected. Deposits and scour at obstructions, constrictions and bends. Some filling of pools. 16	More than 50% of the bottom changing nearly year long. Pools almost absent due to deposition. **20**
Bottom Substrate/ Available Cover	Greater than 50% rubble, gravel or other stable habitat. 2	30-50% rubble, gravel or other stable habitat. Adequate habitat. 7	10-30% rubble, gravel or other stable habitat. Habitat availability less than desirable. 17	Less than 10% rubble gravel or other stable habitat. Lack of habitat is obvious. **22**
Avg. Depth Riffles and Runs	Cold >1' 0 Warm >1.5' 0	6" to 1' 6 10" to 1.5' 6	3" to 6" 18 6" to 10" 18	<3" 24 <6" **24**
Avg. Depth of Pools	Cold >4' 0 Warm >5' 0	3' to 4' 6 4' to 5' 6	2' to 3' 18 3' to 4' 18	<2' 24 <3' **24**
Flow, at Rep. Low Flow	Cold >2 cfs 0 Warm >5 cfs 0	1-2 cfs 6 2-5 cfs 6	.5-1 cfs 18 1-2 cfs **18**	<.5 cfs 24 <1 cfs 24
Pool/Riffle, Run/Bend Ratio (distance between riffles ÷ stream width)	5-7. Variety of habitat. Deep riffles and pools. 4	7-15. Adequate depth in pools and riffles. Bends provide habitat. 8	15-25. Occasional riffle or bend. Bottom contours provide some habitat. 16	>25. Essentially a straight stream. Generally all flat water or shallow riffle. Poor habitat. **20**
Aesthetics	Wilderness characteristics, outstanding natural beauty. Usually wooded or unpastured corridor. 8	High natural beauty. Trees, historic site. Some development may be visible. 10	Common setting, not offensive. Developed but uncluttered area. **14**	Stream does not inhance aesthetics. Condition of stream is offensive. 16

Column Totals: ____ ____ ____ ____

Column Scores E ____ +G ____ +F ____ +P ____ = ________ = Score

<70 = Excellent, 71-129 = Good, 130-200 = Fair, >200 = Poor

EHM 183

Department of Natural Re...urces

STREAM SYSTEM HABITAT RATING FORM
Form 3200-68 1-85

Stream Scheller Cr Reach Location 1 mile reach above Hwy V Reach Score/Rating 157/187

County ______ Date 4-6-96 Evaluator Laliberte Classification Fair

Rating Item	Excellent	Good	Fair	Poor
Watershed Erosion (low WS)	No evidence of significant erosion. Stable forest or grass land. Little potential for future erosion. 8	Some erosion evident. No significant "raw" areas. Good land mgmt. practices in area. Low potential for significant erosion. 10	Moderate erosion evident. Erosion from heavy storm events obvious. Some "raw" areas. Potential for significant erosion. 14	(upper WS) Heavy erosion evident. Probable erosion from any run off. 16
Watershed Nonpoint Source	No evidence of significant source. Little potential for future problem. 8	Some potential sources (roads, urban area, farm fields). 10	Moderate sources (small wetlands, tile fields, urban area, intense agriculture). 14	Obvious sources (major wetland drainage, high use urban or industrial area, feed lots, impoundment). 16
Bank Erosion, Failure	No evidence of significant erosion or bank failure. Little potential for future problem. 4	Infrequent, small areas, mostly healed over. Some potential in extreme floods. 8	Moderate frequency and size. Some "raw" spots. Erosion potential during high flow. 16	Many eroded areas. "Raw" areas frequent along straight sections and bends. 20
Bank Vegetative Protection	90% plant density. Diverse trees, shrubs, grass. Plants healthy with apparently good root system. 6	70-90% density. Fewer plant species. A few barren or thin areas. Vegetation appears generally healthy. 9	50-70% density. Dominated by grass, sparse trees and shrubs. Plant types and conditions suggest poorer soil binding. 15	<50% density. Many raw areas. Thin grass, few if any trees and shrubs. 18
Lower Bank Channel Capacity	Ample for present peak flow plus some increase. Peak flow contained. W/D ratio <7. 8	Adequate. Overbank flows rare. W/D ratio 8-15. 10	Barely contains present peaks. Occasional overbank flow. W/D ratio 15-25. 14	Inadequate, overbank flow common. W/D ratio >25. 16
Lower Bank Deposition	Little or no enlargement of channel or point bars. 6	Some new increase in bar formation, mostly from coarse gravel. 9	Moderate deposition of new gravel and coarse sand on old and some new bars. 15	Heavy deposits of fine material, increased bar development.
Bottom Scouring and Deposition	Less than 5% of the bottom affected by scouring and deposition. 4	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools. 8	30-50% affected. Deposits and scour at obstructions, constrictions and bends. Some filling of pools. 16	More than 50% of the bottom changing nearly year long. Pools almost absent due to deposition. 20
Bottom Substrate/ Available Cover	Greater than 50% rubble, gravel or other stable habitat. 2	30-50% rubble, gravel or other stable habitat. Adequate habitat. 7	10-30% rubble, gravel or other stable habitat. Habitat availability less than desirable. 17	Less than 10% rubble gravel or other stable habitat. Lack of habitat is obvious. 22
Avg. Depth Riffles and Runs	Cold >1' 0 Warm >1.5' 0	6" to 1' 6 10" to 1.5' 6	3" to 6" 18 6" to 10" 18	<3" 24 <6" 24
Avg. Depth of Pools	Cold >4' 0 Warm >5' 0	3' to 4' 6 4' to 5' 6	2' to 3' 18 3' to 4' 18	<2' 24 <3' 24
Flow, at Rep. Low Flow	Cold >2 cfs 0 Warm >5 cfs 0	1-2 cfs 6 2-5 cfs 6	.5-1 cfs 18 1-2 cfs 18	<.5 cfs 24 <1 cfs 24
Pool/Riffle, Run/Bend Ratio (distance between riffles ÷ stream width)	5-7. Variety of habitat. Deep riffles and pools. 4	7-15. Adequate depth in pools and riffles. Bends provide habitat. 8	15-25. Occasional riffle or bend. Bottom contours provide some habitat. 16	>25. Essentially a straight stream. Generally all flat water or shallow riffle. Poor habitat. 20
Aesthetics	Wilderness characteristics, outstanding natural beauty. Usually wooded or unpastured corridor. 8	High natural beauty. Trees, historic site. Some development may be visible. 10	Common setting, not offensive. Developed but uncluttered area. 14	Stream does not inhance aesthetics. Condition of stream is offensive. 16

Column Totals: ______ ______ ______ ______

Column Scores E _____ +G _____ +F _____ +P _____ = __________ = Score

below springs 115 + 42 = 157
above springs 115 + 72 = 187

<70 = Excellent, 71-129 = Good, 130-200 = Fair, >200 = Poor