CURRENT CONDITIONS REPORT

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APPENDIX F.1

CDM PRELIMINARY ENVIRONMENTAL ANALYSIS OF PLEASANT RUN CREEK

DRAFT

A Preliminary Environmental Analysis of Pleasant Run Creek

Prepared for

Barnes, Hickam, Pantzer & Boyd

July 1, 1977

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1.0 INTRODUCTION

CDM Environmental Sciences Division (ESD) conducted the study of Pleasant Run Creek at the request of Barnes, Hickam, Pantzer and Boyd of Indianapolis, Indiana. The study was strictly a quick, qualitative study of the polychlorinated biphenyl (PCB) concentrations in sediment and river water and benthic and fisheries communities.

CDM Environmental Engineering Division (EED) conducted an on-site study of Pleasant Run Creek followed by an analysis of alternatives for treating the environment for the alleged PCB pollution. An analysis of costs involved in environmental treatment is also included. This report has been divided into five sections: Introduction, Materials and Methods, Results and Discussion, Additional Studies, and Solid Waste Engineering.

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2.0 MATERIALS AND METHODS

2.1 General

The one day sampling effort was conducted on June 16, 1977 in the presence of two client affiliated personnel.

2.2 Chemistry

Two replicate sediment samples and a water sample were taken at each station for polychlorinated biphenyls (PCB) analysis. These samples were returned to CDM's Milwaukee laboratories for analysis. Analyses were performed according to approved USEPA procedures (Federal Register, 1973and USEPA, 1969).

2.3 Fisheries

A fisheries sample was obtained at Station B using a bag seine. The sample was photographed and released unharmed. At other stations, client affiliated and CDM personnel simply visually inspected the stream water for the presence of fish.

2.4 Benthos

Benthic sediment samples were taken at each station with an Ekman grab sampler. These were immediately preserved with formalin and returned to the laboratory for analysis. A visual description of the substrate was recorded at the time of each benthos sampling.

In the laboratory, the preservative was removed by placing the samples on a U.S. Standard no. 60 mesh sieve and gently washing with tap water. Each sample was sorted under a binocular dissecting microscope at 10x magnification. All organisms, except oligochaetes,

were removed from the sample and placed in vials containing 70 percent ethanol and five percent glycerin. Oligochaetes were placed in Amman's lactophenol to clear for several days. After the clearing, the oligochaetes were counted and randomly subsampled as follows:

Total in Sample	Subsample
1-50	all organisms
more than 50	50 organisms

The oligochaetes in the subsample were mounted in a commercial mounting medium on glass slides for identification. A subsample of chironomid larvae was selected randomly for slide preparation as follows:

Total in Sample	Subsample
1-50	10 organisms
more than 50	20%, up to a maximum of 25 organisms

The chironomids in the subsample were mounted in a commercial mounting medium on glass slides for identification.

Chironomid and oligochaete slides were identified using a Zeiss Compound Microscope with magnification ranging from 125x to 1250x (oil immersion). All other organisms were identified with a binocular dissecting microscope.

3.0 RESULTS AND DISCUSSION

3.1 General

Please note that in all cases only qualitative discussions can be given, due to the fact the correct sampling equipment, such as Ballchek corers should be used, and a more complete study should be made for quantitative judgments. However, the qualitative data which were obtained allow a reasonable assessment of the Pleasant Run Creek aquatic environment. The sampling locations are given in Figure 1.

3.2 Chemistry

The results for the polychlorinated biphenyls (PCB) analyses are given in Table 1 along with the percent dry weights for the sediments. Please note that the sediment values are the mean averages for two analyses.

As is evident from the data, the quality of substrate and water is better at Stations C and F, control and recovery control stations, respectively. As would also be expected, PCB concentrations are generally the highest in the discharge stream running into Pleasant Run Creek (Stations A and B). There is an interesting anomoly between concentrations of PCB at Station D just below the confluence of Pleasant Run Creek and the discharge stream and Station E by Peerless Road bridge. We found PCB concentrations to be an order of magnitude lower in the sediment at D as compared to E. In addition, the substrate was extremely mucky at E, while relatively much firmer

Table 1 Chemistry data for the June 16, 1977 survey of Pleasant Run Creek.

Station	PCB[a]-Water (mg/l)	PCB[a]-Sediment (mg/kg)[b]	Dry Weight (%)
A	0.055	1840	67.2
B	0.021	1120	60.3
C	<0.001	<0.5	57.5
D	0.013	76	57.2
E	0.027	800	36.0
F	0.007	1.0	70.0

a All concentrations of PCB are reported as Aroclor 1242
b on a dry weight basis

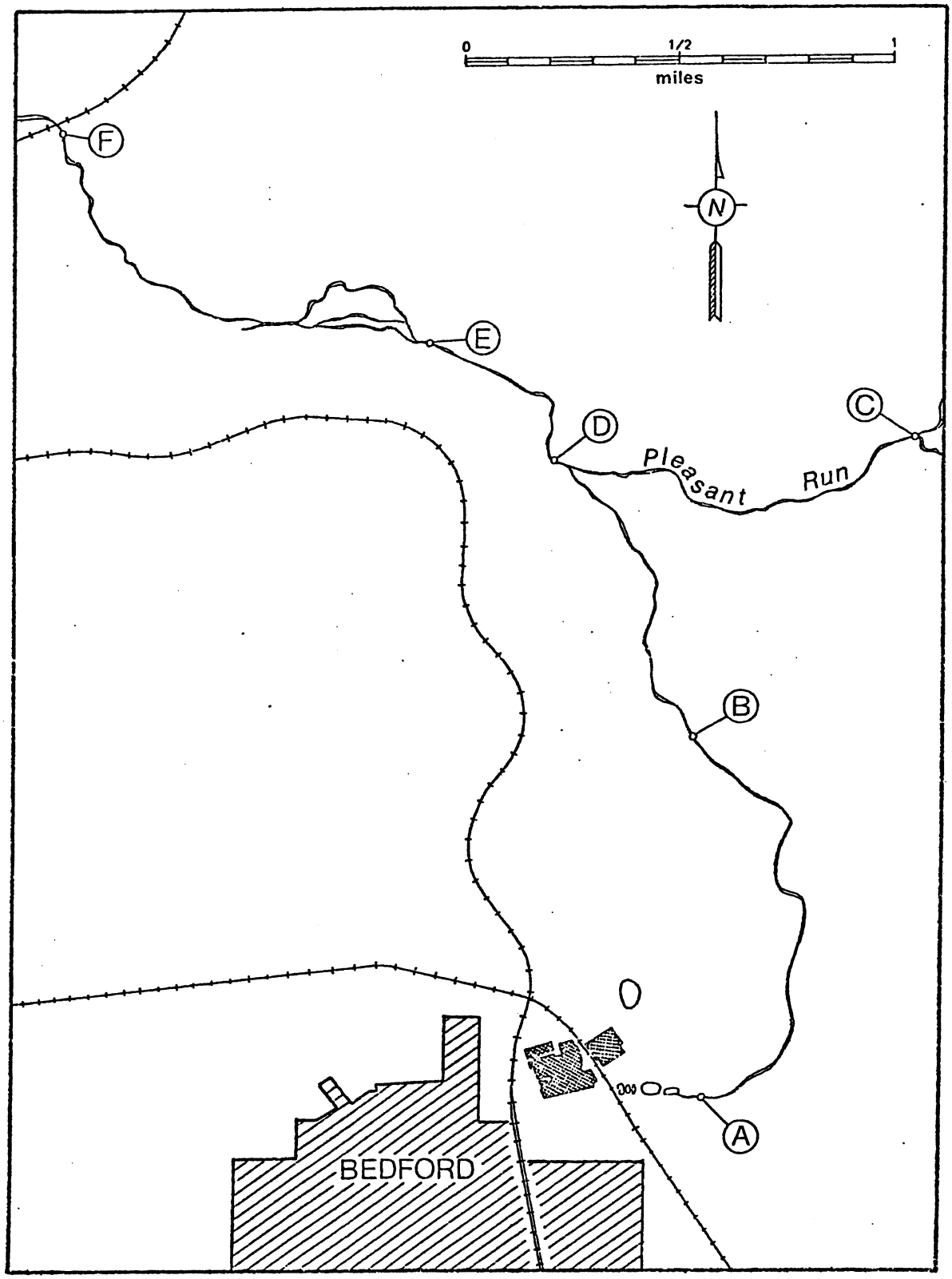

Figure 1 Sampling locations on Pleasant Run Creek, June 16, 1977.

at D. It appears that the bend in the river by Station E may have allowed the velocity of the river water to decrease and, thus, many entrained or suspended materials (such as PCB) would have been deposited in this area.

3.3 Fisheries

As mentioned in Section 2.3, fisheries seining operations were carried out only at Station B. It is important to note that, although the General Motors plant discharge provides 100% of the dry weather flow, we were still able to find fish in the stream. These fish, obviously, would not be there if there was no discharge. Although we did not seine at stations C and F, we did observe fish at these stations.

3.4 Benthos

The benthic samples were analyzed qualitatively to determine the "presence or absence of forms having varying degrees of tolerance to contaminants and to obtain information on 'richness of species'" (USEPA, 1973). The taxa present were represented by eight members of Subclass Oligochaeta, 12 members of the order Diptera and one member each of the Families Sphaeriidae and Lymnaeidae (Table 2). Stations, A,B, C,D,E, and F had 3,7,11,8,7 and 10 taxa respectively. Stations C (control) and F (recovery control) had relatively well balanced benthic structure with 5 taxa each of oligochaetes and dipterans. Stations A, and B (located in the discharge waters) and stations D, E (confluence) were dominated by species of oligochaetes with very few or no dipterans present. In a study by

Table 2 Species list and relative abundance of benthic macroinvertebrates collected on 16 May, 1977 from Pleasant Run Creek.

	Stations					
	A	B	C	D	E	F
Class Clitellata (12)						
Subclass Oligochaeta (7)						
Family Tubificidae (13)						
Ilyodrilus templetoni			*			
Limnodrilus hoffmeisteri	*	**	*	**	***	**
L. cervix						*
L. udekemianus		****	*		***	*
Immature oligochaete without capilliform chaetae		***	*	****	****	***
Immature oligochaete with capilliform chaetae			**			*
Family Naididae						
Aulophorus furcatus	*	***			**	
Family Enchytraeidae						
Enchytraeidae spp.	*	**				
Class Insecta (14)						
Order Diptera						
Diptera pupae		*				
Family Muscidae						
Muscidae spp.		*				
Family Culicidae						
Culicidae spp.					**	
Family Ceratopogonidae						
Ceratopogonidae spp.			*			

Table 2
(continued)

	Stations					
	A	B	C	D	E	F
(8)						
Family Chironomidae						
Chironomidae pupae			*			*
Subfamily Tanypodinae						
Procladius spp.					**	
Subfamily Chironominae						
Chironomus spp.			**	**		**
Stictochronomus spp.			***			
Paratendipes spp.			**			
Dicrotendipes spp.						*
Polypedilum (tripodura group) spp.						*
Subfamily Orthocladiinae						
Cricotopus bicinctus						*
(13)						
Class Pelecypoda						
Order Heterodonta						
Family Sphaeriidae						
Pisidium spp.			**			
(15)						
Class Gastropoda						
Order Pulmonata						
Family Lymnaeidae						
Physa spp.				**	**	

Codes:
* least abundant
** abundant
*** very abundant
**** most abundant

Ganfin and Tarzwell (1973) it was found that many organisms occurring in large numbers in extremely polluted water can be found in limited numbers in cleaner waters. In this study a similar pattern was found with oligochaete species being very abundant especially at Stations B,D, and E and less abundant at Stations C and F (control and recovery control). The introduction of contaminants can restrict "intolerant" species. Stations A and B (discharge canal) had no members of the Family Chironomidae. Of the chironomid species found only Stations C and F had a variety of species with Stictochironomus and Criotopus bicenctus being associated with cleaner waters. The species comparisons indicate differences in benthic populations between stations. However, differences in habitat preferences of certain species, unrelated to the effects of introduced contaminants, can influence their presence or absence in a particular area.

The results of the qualitative study show Stations C and F to have similar well balanced benthic communities. Stations A and B are suspect of some form of contamination that is having an influence on the benthic populations. Stations D and E show some signs of recovery, although their community structure is not as balanced as Stations C and F. A more detailed assessment of the condition of the Pleasant Run Creek area would be possible with an extensive quantitative sampling effort.

3.5 Conclusion

It is apparent that due to the nature of the substrate in several locations, it is questionable weather a diversified benthic community can exist. However, given the nature of the area of study, the question must be asked that with or without the past discharge problems, could a more balanced community have existed. Obviously, in the stream between the plant and Pleasant Run Creek, no balanced aquatic community would exist without the discharge, since the discharge supplies 100% of dry weather flow.

Pleasant Run Creek itself may not support a totally balanced aquatic community with or without the plant discharge. This is due to possible heavy nutrient loading of the stream due to non-point source (agricultrual) discharges.

Finally, we did observe life throughout the course of the study - from oligochaetes just below the initial plant discharge to fish swimming in their discharge (Station B). Thus, on the basis of this one-time qualitative study, the following points can be made:

1. Aquatic life exists in Pleasant Run Creek and the plant discharge waters
2. A balanced aquatic community may not exist
3. Given the nature of the surrounding countryside, it may be unlikely that a balanced community could exist
4. Given the nature of the creek system, any drastic

engineering operations on a wholesale basis, such as dredging, could cause more harm by destroying the present aquatic community.

4.0 PROPOSED ADDITIONAL STUDIES

4.1 General

The study discussed below is designed to answer two questions: 1. What is the effect of polychlorinated biphenyls (PCB) on the indigenous biota of Pleasant Run Creek and the discharge stream? 2. To what extent are PCB's incorporated downstream in Pleasant Run Creek from the confluence of the discharge stream and Pleasant Run Creek? This environmental study will encompass all important levels of the aquatic food chain, their relationship and stability. Since each trophic level of the aquatic food chain is interdependent on other members of trophic levels, the overall stability of an aquatic ecosystem will be reflected in the composition of the members occupying each trophic level. Trophic levels to be quantitatively studied are listed in Sections 4.2 - 4.6.

Water quality must also be assessed. Therefore, a number of water chemistry parameters, flow and periphyton will also be analyzed. Finally, due to the specific aspects of this survey, we have also designed some studies which will be unique to this program.

4.2 Bacteria

Bacteria samples will be collected at Stations A-F and analyzed for fecal coliform, total coliform and fecal streptococci. Fecal coliform to fecal streptococci ratios will be determined to assess the possible source of nutrients.

4.3 Phytoplankton Populations

Phytoplankton are the primary producers in the aquatic

ecosystem. Therefore, they serve as a food source for larval fish, zooplankton, and benthic macroinvertebrates. Phytoplankton samples will be collected in duplicate at Stations A-F. These samples will be analyzed for species identification and enumeration to determine population stability and variations between stations.

4.4 Zooplankton Populations

Zooplankton are the primary consumers in the aquatic system. Feeding primarily upon the phytoplankton, they in turn serve as a food source for larval and filter feeding fish. Zooplankton samples will be collected at Stations A-F. These samples will be analyzed for species identification and enumeration to determine population stability and variation between stations.

4.5 Benthic Macroinvertebrate Populations

Because of their sessile nature, benthic macroinvertebrate populations are excellent indicators of environmental conditions and therefore variations in species composition and abundance will reflect changes in the natural habitat due to effluent addition. Four samples will be collected and analyzed at each station (Stations A-F). Since substrate composition is one of the most important factors controlling the benthic macroinvertebrate distribution, samples will be collected from similar substrates. Therefore the quantitative sampling will consist of two sampling methods. In the softer bottom sediments, an Ekman grab sampler will be used while in riffle areas where rocky substrate predominates, a Surber square foot sampler will be employed.

4.6 Fisheries Populations

Fish are the secondary consumers in the aquatic food chain. The composition of species in the population and their respective abundance are excellent indicators of their associated environmental conditions. Fish populations will be sampled by electroshocking techniques. The total length of the discharge stream will be fished from Station A to the confluence with Pleasant Run Creek. On Pleasant Run Creek, sampling stations will be located in the immediate vicinity of locations C, D, E, and F. These respective locations will be fished until it is determined that sufficient numbers and representative species have been captured to assess the indigenous population. Representative species will be sexed, age, growth and condition factors determined. These fish will be photographed and a reference collection maintained.

4.7 Periphyton

Periphyton is an assemblage of a wide variety of organisms that grow on submerged substrates and include, but is not limited to, bacteria, molds, algae and protozoa. Periphyton is an excellent indicator of water quality (USEPA, 1973). Periphyton samples will be collected at Station A-F by taking selected submerged rocks, sticks and portions of vegetation from their environment and returning the sample to the laboratory for identification.

4.8 Chemistry

Due to the nature of the area which is drained by Pleasant Run Creek, CDM is proposing to analyze for the parameters listed in Table 3. The parameters include

Table 3 Water Quality Parameters

Parameter	Preservation[a]	Detection Limit (mg/l)	Reference
Organic nitrogen	$HgCl_2$	0.01	APHA[b], p.244
Ammonia nitrogen	$HgCl_2$	0.01	EPA[c], p.134
Nitrate nitrogen	$HgCl_2$	0.01	EPA, p.170
Nitrite nitrogen	$HgCl_2$	0.002	EPA, p.195
Total phosphorus	$HgCl_2$	0.005	EPA, p.235
Orthophosphorus	$HgCl_2$	0.005	EPA, p.235
BOD_5	-	1.0	APHA, p.489
Chloride	-	0.5	APHA, p.97
Total suspended solids	-	1.0	EPA, p.278
Total dissolved solids	-	1.0	EPA, p.275
Turbidity	-	1 JTU	APHA, p.350
Potassium	HNO_3	0.01	APHA, p.211
Dissolved oxygen	in situ	-	APHA, p.484
pH	in situ	-	EPA, p.230
Temperature	in situ	-	APHA, p.348
Oil and grease	H_2SO_4, glass	1.0	APHA, p.254
PCB	glass	0.001	Fed. Reg.[d], 1973
Organochlorine pesticides	glass	0.001	Fed. Reg., 1973

a United States Environmental Protection Agency, 1974. Methods for Chemical Analysis of Water and Wastes, Washington, D.C. 298 p.

b American Public Health Association et al, 1971. Standard Methods for the Examination of Water and Wastewater, Washington, D.C. 874 p.

c United States Environmental Protection Agency, 1971. Methods for Chemical Analysis of Water and Wastes, Washington, D.C. 312 p.

d Federal Register, 1973. 38 FR 125, June 29, 1973.

nutrients to be analyzed in order to determine effects of non-point source drainage. Two replicate samples will be taken at all stations. Preservation methods, detection limits, and reference citations are listed in Table 3. These samples will be returned to Milwaukee for analysis.

4.9 Physical

Flow measurements will be made at all stations. A Marsh-McBirney Model 301 Electromagnetic Current Meter will be used for all field measurements.

4.10 Statistical Analysis

All biological and chemical data will be treated statistically. Analysis of variance and Student Newman Keuls Multiple Range test will be conducted to determine statistically significant differences between sampling locations. Statistical results will assist in the emperical interpretation for variations among stations and determinations of cause and effect relationships in Pleasant Run Creek.

4.11 Mass Transport and Extent of PCB Composition for Bottom Sediments in Pleasant Run Creek - Special Studies

Based on data from the preliminary investigation conducted on June 16, 1977, it appears that the major contribution of PCB's entering Pleasant Run Creek are settling out between Stations D and F.

To determine the volume, rate and location of PCB's along this reach, several parameters should be measured. Sediment core samples should be taken at selected locations between Stations D and F and the concentration of PCB's

determined. These replicate core samples should be taken at not less than every 100 feet. Additional parameters for this site specific location should include replicate turbidity and PCB water quality samples at each site. Half of the PCB samples would be filtered in Bedford before shipment to Milwaukee. In this manner, the suspended and dissolved fractions of PCB can be determined. River velocity measurements should also be made at each sampling location.

The approximate rate of settling can be determined by velocity measurements in conjunction with turbidity and suspended and dissolved PCB concentrations. The mass transport and settling rate study should be conducted during low and high flow conditions.

4.12 Technical Summary

CDM has designed this study to determine the nature of the aquatic community in Pleasant Run Creek and its tributaries and further, to assess the impact of PCB's on this community and the PCB's present sediment location. This study, in conjunction with engineering recommendations will make it possible to discuss the alternatives which can be pursued by the client in maintaining and enhancing the local environment while being consistent with socio-economic and cost-benefit factors.

Although CDM has presented the proposed additional study as a one-time study, we strongly believe that, if such a study is undertaken, more than one field effort should be performed. Our logic is two-fold. More than one seasonal study would allow us to examine seasonal

aquatic community variations. Secondly, studies during high flow and low flow conditions would allow us to compare the nature of the system during hydrological extremes.

4.13 Cost Summary

A. Field Preparation	
Scientist III - 10 hrs @ $22/hr	$ 220.00
B. Field Effort	
1 Scientist VI - 20 hrs @ $40/hr	800.00
1 Scientist V - 20 hrs @ $35/hr	700.00
2 Scientist III - 40 hrs @ $22/hr	880.00
2 Trucks, 1000 miles @ $.25/mile	250.00
1 Boat, all other rental equipment	N/C
Per Diem - 4 men, 2 days @ $40/day	320.00
Field Subtotal	$2,950.00
C. Laboratory	
1. Benthos - 4 samples/site - 24 samples @ $110/sample	$2,640.00
2. Phytoplankton - 2 samples/site - 12 samples @ $80/sample	960.00
3. Zooplankton - 2 samples/site - 12 samples @ $44/sample	528.00
4. Fisheries - 1 Scientist III, 16 hrs @ $22/hr	352.00
5. Periphyton - 1 sample/site - 6 samples @ $80/sample	480.00
6. Bacteriology - 2 samples/site - 12 samples @ $50/sample	600.00
7. Flow Data Reduction - 1 Scientist III, 5 hrs @ $22/hr	110.00
8. Chemistry - 2 samples/site - 12 samples @ $200/sample	2,400.00

9. Statistical Analysis - 1 Scientist IV - 40 hrs @ $26/hr	$1,040.00
Computer Charges	150.00
10. Special Studies - Maximum of Seven Sites	
14 Sediment Samples @ $75/sample	1,050.00
14 Dissolved/Total PCB Water Samples @ $60/sample	840.00
14 Turbidity @ $2/sample	28.00
Laboratory Subtotal	$11,178.00

D. Report and Management

Secretary - 20 hrs @ $14/hr	280.00
Analysis of Special Studies and other Reporting Requirements:	
1 Scientist V - 40 hrs @ $35/hr	1,400.00
1 Scientist VI - 24 hrs @ $40/hr	960.00
Copying Charges	100.00
Management Subtotal	$ 2,740.00

E.	Total Cost/Per Effort	$17,088.00
F.	Total Cost - High Flow and Low Flow Conditions Only	$34,176.00
G.	Total Cost - Quarterly Seasonal Efforts	$68,352.00

5.0 SOLID WASTE ENGINEERING

5.1 General

The purpose of this section of the report is to identify possible clean-up measures likely to be recommended in a detailed environmental study of Pleasant Run Creek and the Central Foundry discharge creek into Pleasant Run Creek. The assumption that such clean-up measures will be recommended is based upon the identification of PCB contaminated sediments, existing and proposed legislation controlling such wastes, and an assumption that some adverse environmental impact is resulting from the sediments. At this time, it is too early to say such a recommendation will be made. A detailed environmental analysis is required to determine the extent of any existing or potential future environmental impact. Additionally, a determination must be made whether or not any such impacts identified are significant enough to justify undertaking corrective actions which will have relatively high costs and which may have adverse environmental impacts associated with their implementation.

5.2 Potential Clean-Up Measures

If a determination is made that PCB's in the sediments of Pleasant Run Creek and the plant discharge creek are causing or may in the future cause significant environmental impact,

there are two basic approaches that may be undertaken. The first approach involves "fixing" the sediments and associated PCB's in place effectively removing them or separating them from the environment. The second approach requires the physical removal of the sediments from the environment.

The first step in evaluating these measures is estimating the quantity of sediments involved. Based upon estimates of the length of the creeks, average widths and sediment depths, we estimate that there are 50,000 to 60,000 cubic yards of sediment in Pleasant Run Creek from its confluence with the plant discharge creek to Salt Creek, and 3,000 to 5,000 cubic yards of sediment in the plant discharge creek. The actual quantity of sediment requiring treatment is, of course, unknown. Treatment requirements, if any, should be based upon the results of a detailed environmental analysis including the determination of:

a. The location and concentration of the PCB's within the sediment profile.

b. The concentration of PCB at which a significant environmental impact occurs

c. The degree to which the PCB's may become re-suspended in the creeks and transported to a new location

Analysis of these data would indicate the locations and extent of required excavation or treatment. For the purposes

of this preliminary study we have assumed about 60,000 cubic yards of sediment will require treatment. This is probably a relatively conservative (high) assumtion, but a detailed study could result in even greater quantities. Rough estimates of the cost for treating various other quantities of sediments can be made from the general cost estimates given for the base quantity of 60,000 cubic yards.

The two basic approaches to treating the sediments are discussed below:

1. "Fixing the Sediments in-place - This approach involves the application of a binder to the sediments to retain them in-place. This approach is commonly used for embankment stabilization and the creation of impermeable soil layers. The simplest approach is to place a fabric netting over the sediments to physically hold them in place. This would assist the sediments in resisting resuspension and transport downstream. It would not significantly reduce the impact of existing PCB contamination. It also would not be applicable for use in the plant discharge creek where the sediment is distributed over a number of small areas.

The most appropriate method in this case, particularly for Pleasant Run Creek, would be the use of a cement or asphalt admixture physically mixed into the sediments in place to form a hard stable surface. The thickness of this layer is usually up to six inches but with special construction it can be mixed through the entire sediment layer. This would

result in a structural mass which would resist erosion by the stream and in which the PCB's would be bound. There are several problems associated with this method, however. First, the particular cement or binder would have to be selected to resist any chemical reactions which could occur from various constituents of the sediment. Secondly, the structure would be subject to weathering from freezing in the winter and other hydraulic forces. This could result in rapid deterioration of the structure. Finally, the sediments in Pleasant Run Creek appear to be uncosolidated and consist primarily of clays and silts. Such material is not readily adaptable to such treatment and large quantities of sands may have to be added to the mixture. Also, the application of binders to in-place sediment would pose phyisical difficulties due to the inaccessibility of some areas.

This procedure will also have several environmental impacts. By fixing the sediments, the hydraulic characteristics of Pleasant Run will be altered, probably with higher flood levels and lower low flow volumes. There also could be some impact upon the nearby groundwater table. During construction, the creek's ecosystem would be destroyed. The ecosystem would take a long time to reestablish itself and probably would not be representative of the current natural system. Also, during construction, some of the contaminated sediments would be resuspended and carried downstream potentially affecting uncontaminated areas. This could be reduced by restricting

construction to one section of the creek at a time, and restricting downstream silt movement by the use of bales of hay, for example. This work will also require the construction of access roads at various locations to reach the creek with heavy equipment and the removal of riparian vegetation where required.

The estimated cost for the work on all of Pleasant Run Creek is very difficult to determine but is probably in excess of several million dollars. This method is probably not feasible for this application except possibly in a few small isolated areas where special conditions may exist.

2. Sediment Removal - This approach involves the physical removal of sediments from the creeks. Although it can be done utilizing drag-lines, backhoes, or other heavy equipment, the most appropriate method in this application appears to be hydraulic dredging. The sediment would be pumped through a hose to a nearby truck for transport. The hydraulic dredging apparatus can be visualized as a large vacuum cleaner for removing the sediments. The sediments in Pleasant Run Creek and the plant discharge creek appear to be amenable to this type of operation. However, large quantities of water are required to produce the necessary fluidity in the sediments to allow them to be pumped. The availability of water in the creeks may dictate the time and rate of progress of the work.

As with the previous method discussed above, this work will produce its own environmental impacts. On Pleasant Run

Creek it may be possible to float the pump in the stream; however, on the plant discharge creek and at places on Pleasant Run Creek, it will be necessary to physically move the pump requiring the removal of riparian vegetation. Also, the trucks must be brought to within several hundred feet of the pump requiring the construction of a number of access roads to the creeks. This method will also destroy the existing ecosystem in the creeks which again may take a long time to reestablish. The existing hydraulic characteristics of the creek will be altered impacting upon local use of the creeks. Finally, with this method there will be resuspension of sediment occurring which may significantly impact downstream areas. Although measures can be taken to reduce these impacts, nonetheless, they will exist.

The estimated cost for hydraulically pumping the sediments from the two creeks is estimated to be about $1,000,000 to $1,500,000. This includes removing the sediments and trucking them to a disposal area within a ten mile radius. It also includes an allowance for measures to reduce the environmental impacts but these could change with more detailed study. As with the other alternative, this cost can be reduced if sediment removal is confined to specific reaches of the creek.

5.3 Disposal of Contaminated Sediments

Once the contaminated sediments have been removed from the streams, they must be disposed of in an economical and environmentally acceptable manner. The Federal Environmental Protection Agency (EPA) has recently proposed rules and regulations for the disposal of PCB wastes. A copy of these proposed regulations are appended. The proposed regulations are applicable to all wastes containing more than 500 parts PCB per million. Below this limit, the Federal government would not have any regulatory authority although the individual states could regulate wastes containing less than 500 parts PCB per million. The sediment samples taken on June 16, 1977 indicate concentrations exceeding this limit at stations A, B, and E. However, at this time, it is difficult to determine the quantity of material which exceeds this limit out of the total estimated sediment quantity. For the purposes of this work, we are assuming that all the sediment (i.e. 60,000 cubic yards) must be disposed of in accordance with the proposed EPA regulations. The proposed regulations describe this requirement as follows:

> "Some mixtures that may contain more than 500 parts per million PCB chemical substances will not be affected by these regulations until their use is altered. For example, this regulation would not require that bottom sediments in rivers and harbors be removed from the watercourses. If they are removed for any reason such as dredging or excavation, the disposal of these sediments would have to meet the disposal provisions of this regulation. Similar considerations apply to contaminated soils."

alternative and to document any additional requirements. Although it is difficult to estimate the cost of the dewatering step, it can probably be done for less than $100,000 excluding treatment of the supernatent. Treatment of this liquid is discussed later.

The transportation of these wastes would require the use of enclosed watertight vehicles. Other restrictions may be imposed by the regulatory agencies. Permits from the appropriate state(s) and Federal regulatory agencies will be required. The transportation cost, based upon some dewatering, is estimated to be about $400,000 to $700,000. The disposal fee is estimated to be about $100,000 to $200,000. Thus, total disposal costs for this alternative are estimated in the range of $600,000 to $1,000,000 based upon the previously stated assumptions.

2. Incineration - Incineration is the most acceptable manner of destroying PCB. The incinerator must meet State and Federal requirements for this type of facility. There are incinerator types on the market which can meet these requirements. The problems involved in this application concern the nature of the sediments themselves. For the most part, these sediments are inorganic and will not burn. Thus, most of the material put in the incinerator will exit as residue. The fine grain size of these materials may also cause mechanical problems in the unit by getting into moving parts, causing erosion on surfaces exposed to the materials passing through,

and increasing air pollution emissions. Finally, as this material will not burn, fuel, either gas or oil, will be required to maintain high operating temperatures. Dewatering of the sediments prior to incineration may also be required.

The anticipated very high costs and questions on the ability of the incinerator units to handle this waste lead to the conclusion that this method of disposal does not appear feasible at this time. Also, the method of procurement and operation for a one-time use has not been investigated and is uncertain.

3. Placement in a prepared and contained land disposal site - This alternative would require the preparation of a lagoon for disposal of the sediments. This lagoon would be lined with an impervious material to prevent the escape of contaminated fluids into the groundwater or nearby surface waters. The liner could be a plactic or rubber type liner, bentonite clay material, or a natural clay or soil available in the area. A detailed analysis of the sediment would be required to determine the best liner to use to resist any chemical reactions with materials in the sediment. However, it is anticipated that a locally available impervious material should be suitable. After placement of the liner, an under-drain system should be installed to collect any liquids collecting at the bottom and to assist in dewatering the material. Following filling of the lagoon, the excess water must be drawn off and the top sealed. Continuous monitoring

of the lagoon and nearby surface and groundwaters would be required to assure the continued integrity of the lagoon.

Approximately three to four acres would be required for this facility, depending upon its depth. The land could not be used afterwards except for recreational or other passive uses.

One problem associated with this alternative is treatment of the supernatent or excess water drawn off the lagoon. The concentration of the PCB's in this water will depend on many factors, as discussed in the previous section on resuspension of the PCB's, and some pilot plant work will be necessary. It may be possible to treat this water with the plant effluent, particularly if sophisticated equipment to remove current PCB discharges are installed. Otherwise, such equipment may be required, at least temporarily, for the lagoon discharge.

The estimated cost for this alternative is about $250,000 to $400,000 excluding land costs and treatment of the lagoon discharge.

Summary

From the above discussion, it is apparent that if the sediments in the plant discharge creek and Pleasant Run must be removed, that the most feasible alternative for disposal of the sediments is in a prepared contained lagoon constructed in the area. In addition to incineration, which is discussed above, other processing methods which could be used are energy irradiation to destroy the PCB's and fluidized bed and pyrolysis

units. Processing of the sediments with any of these systems is extremely costly and may pose many technical questions.

The alternatives outlined above are based upon disposing the estimated 60,000 cubic yards of sediment in compliance with proposed EPA regulations. As discussed in the preceding section, it may not be necessary to remove this much material. Also, much of the sediment may be disposed in another less rigorous manner if allowed by the State of Indiana. Further work with this problem should be directed towards determining the specific amount of sediment. At this time, all the alternatives should be reviewed and detailed costs developed for the most feasible alternatives.

5.4 Conclusions

From the results of our preliminary investigation, the most practical and economical method of corrective action to reduce the environmental impact of PCB in the sediments of Pleasant Run Creek and the plant discharge creek is removal from creeks and disposal in a contained lagoon. The total estimated cost for this alternative is in the range of $1,000,000 to $2,000,000. This cost estimate is for removing all the sediment in both creeks. The cost could be substantially lower if sediment removal can be restricted to "critical areas" and if additional information obtained from the detailed study is favorable to more efficient transportation or landfill operations.

Before an informed decision can be made relative to selection of alternatives, additional studies and investigations must be performed. The proposed environmental analysis will answer many questions about the extent and significance of the impact of PCB's on Pleasant Run Creek. This information, together with a detailed engineering evaluation of the alternatives, will allow the selection of the best alternative within environmental, economic, and social constraints. This engineering evaluation should include the following:

1. A determination of the quantities of sediment present in the creeks together with an analysis to determine the quantity of PCB's in the sediment and the physical properties of the sediment (i.e. consolidation, particle size distribution, dewatering characteristics) over depth and location along the creek. The underlying soils of the stream bed also would be determined.

2. A hydraulic investigation of Pleasant Run Creek and to a lesser extent the plant discharge creek to characterize sediment transport in the creeks and the conditions under which it occurs. The hydraulic investigation would also be used to determine the impact of various alternatives on the existing hydrology of the creeks.

3. A detailed analysis of sediment removal alternatives including hydraulic dredging and the use of mechanical equipment such as backhoes, end loaders, etc. This analysis would include the associated environmental impact of each alternative and estimated costs.

4. Evaluation of sediment disposal alternatives including a determination of all applicable parameters and associated costs of each alternative. Regulatory requirements would also be addressed.

5.0 BIBLIOGRAPHY

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2. Gaufin, A.R., Use of Aquatic Invertebrates in the Assessments of Water Quality. Biological Methods for the Assessment of Water Quality, ASTM STP 528, American Society for Testing and Materials, 1973 pp 96-116.

3. United States Environmental Protection Agency (FWQA), 1969. Chemistry Laboratory Manual - Bottom Sediments Chicago, Illinois, 10lp.

4. U.S. Environmental Protection Agency, 1973. Macro-invertebrates, pages 1-38 In: Biological field and laboratory methods for measuring the quality of surface waters and effluents. Office of Research and Development, U.S. Environmental Protection Agency, Cincinnati, Ohio.

APPENDIX

Federal Register

TUESDAY, MAY 24, 1977

PART V

THE NATIONAL ARCHIVES OF THE UNITED STATES • 1934 •

ENVIRONMENTAL PROTECTION AGENCY

POLYCHLORINATED BIPHENYLS (PCBS)

TSCA → Toxic Substances Control Act

RCRA → Resources Conservation & Recovery Act

ENVIRONMENTAL PROTECTION AGENCY

[40 CFR Part 761]

[FRL 722-3; OTS-068005]

)LYCHLORINATED BIPHENYLS (PCBS)

Toxic Substances Control

;ENCY: Environmental Protection ency.

:TION: Proposed Rule pursuant to the thority of section 6(e)(1), The Toxic bstances Control Act (Pub. L. 94-469; Stat. 2003; 15 U.S.C. 2601, et. seq., reinafter referred to as TSCA). Pro- le an opportunity for Informal Hear- ; pursuant to the Authority of section)(2) and 6(e)(4), TSCA.

IMMARY: These proposed regulations escribe disposal and marking require- nts for polychlorinated biphenyls CBs) and articles and equipment ich contain PCBs. Newly manufac- red PCBs, PCB articles, and PCB uipment, as well as PCBs, PCB articles, d PCB equipment presently in use. e covered by these requirements. ction 6(e) of TSCA requires the omulgation of rules prescribing mark- g and disposal of PCBs by July 1, 77. The intent of these regulations To protect the environment from rther contamination by PCBs result- g from improper handling and use d from release of PCBs to the environ- nt following disposal.

EARING PROCEDURE AND DATES: order to promulgate this rule as close possible to the deadline set by TSCA, e following compressed schedule for mments and informal hearing is nec- sary. To the extent specific changes e not set forth below, the proposed pro- dures for rulemaking under section 6 TSCA, (40 CFR Part 750) 42 FR 640 (April 21, 1977), will govern.

Comments on these proposed regula- ons must be received by EPA prior to e close of business on June 22, 1977. ie informal hearing on these proposed gulations will begin at 10:00 a.m. on ne 24, 1977, in room 3906, EPA Head- arters, 401 M Street, SW., Washington, .C. 20460. Requests for participation in ie informal hearing must be received EPA prior to the close of business on ne 14, 1977.

All requests for cross-examination ust be received by the Hearing Clerk thin two days after the completion of ie legislative part of the informal hear- g. Requests for cross-examination will e acted on by EPA as soon as possible id not later than the deadline in the oposed regulations of one week after ceipt. The cross-examinations granted EPA will begin as soon as possible ereafter. All reply comments must be ceived by EPA prior to the close of siness on the fifth working day after ie last day of cross-examination.

Rules on funding public participation the hearings related to this rulemak- g will be published in the FEDERAL REG- TER shortly. These rules will be based on ction 6(a)(4) of TSCA.

INFORMATION CONTACT:

David E. Wagner, Office of Toxic Substances (WH-557), Environmental Protection Agency, 401 M Street, SW., Washington, D.C. 20460, 202-426-9000. Joni T. Repasch is the Record and Hearing Clerk for this rulemaking. The official record of rulemaking is located in Room 725 WSME, EPA Headquarters, 401 M Street, SW., Washington, D.C. 20460, 202-426-9000, able for viewing and copying from 9 a.m. to 4 p.m., Monday through Friday excluding holidays. Hearing transcripts and other hearing material shall be added to the record as soon as feasible after they become available.

SUPPLEMENTARY INFORMATION: A support document titled, "PCB Marking and Disposal Regulations—Support Document," is available. Mrs. Joni T. Repasch, Room 713 WSME, 401 M Street, S.W., Washington, D.C. 20460, Telephone 202-426-9000, can provide information on obtaining copies of the document. This document contains PCB background information, PCB effects information, economic analyses of regulatory action, regulatory support information, and the list of documents contained in the official record of rulemaking.

Comments on these proposed regulations must be received by EPA prior to the close of business on June 22, 1977, and should be sent to the Environmental Protection Agency, Office of Toxic Substances (WH-557), 401 M Street, SW., Washington, D.C. 20460, Attn: Joni T. Repasch.

LEGAL AUTHORITY

Section 6(e) of TSCA states, "Polychlorinated Biphenyls

"(1) Within six months after the effective date of this Act the Administrator shall promulgate rules to

(A) Prescribe methods for the disposal of polychlorinated biphenyls, and

(B) require polychlorinated biphenyls to be marked with clear and adequate warnings and instructions with respect to their processing, distribution in commerce, use, or disposal or with respect to any combination of such activities.

Requirements prescribed by rules under this paragraph shall be consistent with the requirements of paragraphs (2) and (3).

Paragraphs (2) and (3) apply to bans on manufacturing, processing, and distributing in commerce and will be addressed at a later date. The definitions of polychlorinated biphenyls contained herein are consistent with definitions that EPA intends to use for rulemaking under paragraphs (2) and (3).

The legal authority contained in the Resource Conservation and Recovery Act (RCRA), Pub. L. 94-580, has not been used in the regulation. However, RCRA requires that by April 21, 1978, EPA identify hazardous wastes; establish a permit system for treatment, storage, and disposal of hazardous waste; and establish a manifest system for the disposition of wastes, as well as monitoring and recordkeeping requirements for hazardous waste management facilities. Thus, PCB-containing solid wastes that meet the criteria for "hazardous waste" may also be subject to broader regulations being developed under RCRA. If conflicts arise between the RCRA and TSCA approaches, the TSCA regulation could be amended or an exception to RCRA requirements could be granted.

DISCUSSION OF THE RULE:

BACKGROUND

Polychlorinated biphenyls (PCBs) are mixtures of the chemical compounds formed by the chemical bond of two benzene molecules into a biphenyl molecule with varying numbers of chlorine atoms attached to the biphenyl molecule. PCBs are among the most stable organic compounds known and exhibit other properties that render them useful as dielectric and heat transfer fluids. PCBs are currently used primarily in capacitors and transformers. They are also used in investment casting waxes and in the cooling systems of mining machinery.

Of the roughly 1.25 billion pounds of PCBs introduced into commerce in the United States since 1929, only 55 million pounds have been destroyed by incineration or by degradation in the environment. 290 million pounds are under varying degrees of control in landfills and dumps, and 150 million pounds are free in the environment. 758 million pounds are currently in service.

Of the approximately 758 million pounds currently in service, 750 million pounds are in electrical transformers and capacitors as follows:

- Transformers—140,000 items totalling 300,000,000 pounds of PCBs
- Large high voltage capacitors—6,000,000 items totalling 200,000,000 pounds of PCBs
- Large low voltage capacitors—20,000,000 items totalling 200,000,000 pounds of PCBs
- Small capacitors for highway lighting—25,000,000 items totalling 50,000,000 pounds of PCBs
- Small capacitors in small appliances—50,000,000 items totalling 50,000,000 pounds of PCBs
- Small capacitors in fluorescent light ballasts—800,000,000 items totalling 80,000,000 pounds of PCBs.

The transformers have a 40-year average life, and the other items have a 15- to 20-year average life. The relatively long life of these items will result in an equally long time period during which disposal of PCBs will be required.

Although PCBs have long been known to be extremely toxic, only in recent years have they been acknowledged to be a general threat to the environment. They have been found in significant concentrations in waterways and sediments throughout the world. They are a widely spread contaminant of fish and wildlife resources. Recently, they have been identified in the milk of nursing mothers throughout the United States.

PUBLIC PARTICIPATION IN THE DEVELOPMENT OF THE REGULATIONS

On December 20, 1976, a public panel meeting was held and representatives of key public and private organizations

were invited to participate in a discussion on the primary issues involved in these regulations. A notice of this meeting was published in the FEDERAL REGISTER prior to the meeting. (See 41 FR 53692I, December 8, 1976). On January 24, 1977, a public meeting was held the development of these regulations any interested person could request time to speak on any matter related to the regulations. A FEDERAL REGISTER notice (FR 3701 January 19, 1977) was published prior to the public meeting which contains a discussion of key issues and requested public comment on those issues.

GENERAL DEFINITION

The definitions of "Administrator", "Agency", "chemical substance", "distribute in commerce", "manufacture", and "process" are identical to the definitions of these terms in TSCA. The definitions of "mixture" and "person" are taken from the definitions in the proposed regulation 40 CFR Part 700, Toxic Substances Control, General Provisions.

CHEMICAL STRUCTURES INCLUDED IN DEFINITION OF PCBS

"PCB chemical substances" are defined as chemical substances which are limited to the biphenyl molecule that has been chlorinated to varying degrees. This definition is the basic building block for defining other forms of PCBs. Any modification other than chlorination to the molecule is sufficient to remove the resultant molecule from classification as a PCB.

One option considered was to broaden the definition of PCB chemical substances by altering the definition to read "* * * any chemical substance which includes the biphenyl molecule which has been chlorinated to varying degrees * * *" Such a broadening would include substances that have been altered by chemical reactions such as bromination, ammoniation, or hydroxylation. This would include a number of chemicals widely used in industry such as dichlorobenzidine, chloroterphenyls, and chlorinated solvents. This option is not proposed at this time because additional investigation is needed to determine the complete scope of chemical substances that would be included. Additionally, a more complete understanding of health, environmental, and economic effects of an expanded definition is necessary.

PCB MIXTURES, WASTE MATERIALS, AND SLUDGES

"PCB mixture" are defined to mean mixtures, except sludges from municipal sewage treatment facilities, that contain 0.05 percent or greater of PCB chemical substances (on a dry weight basis). The definition for PCB mixtures covers mixtures that will be found in commercial applications and as waste materials. Transformer coolants and liquid dielectrics such as Askarels may be a blend of several PCB chemical substances and may contain solvents such as trichlorobenzene. The resulting mixture is then the chemical to which these regulations apply. These commercial fluids always contain a concentration of PCB chemical substances well above the 0.05 percent level. Dielectric liquids in capacitors usually contain 99 percent PCB chemical substances, and the PCB coolant fluids in transformers range from 60 to 99 percent PCB chemical substances. Other commercial chemicals such as chlorinated solvents and polychlorinated terphenyls also contain PCB chemical substances as byproducts of the manufacture of these chemicals. Polychlorinated terphenyls are reported to contain from 0.5 to 5 percent PCB chemical substances,[1] and hexachlorobenzene may have a PCB chemical substance concentration of 0.4 percent or higher. As a consequence, the disposal of these chemicals would have to meet the conditions of this regulation. Another group of PCB mixtures are waste materials. This group includes chemical substances and mixtures that become contaminated with PCB chemical substances as a result of commercial uses of PCB chemical substances and PCB mixtures, incidental exposure to PCB chemical substances and PCB mixtures during commercial activities, and environmental exposure to PCB chemical substances and PCB mixtures as a result of accidents and spills. Examples of such waste material include contaminated solvents used in cleaning operations, contaminated dielectric liquids used as substitutes in PCB electrical articles previously containing PCB mixtures, contaminated machinery and equipment used in PCB activities, contaminated rags and clothing, and contaminated soils, gravel, or paving materials.

The level of 0.05 percent or 500 parts per million was selected because it draws a line between those commercial products which are generally called PCBs and used as such and other widely used commercial products which may contain PCBs produced as a side effect of the manufacturing process. Though these latter chemicals may eventually require regulation, their commercial uses and essentiality have not been adequately reviewed at this time. Accordingly they have been omitted from this regulation without prejudice to their possible regulation at some later date. Some parties believe that wastes with very low levels of PCBs may present risks and should be regulated as PCBs. However, present knowledge of the dimensions of the waste problem is fragmented. Many of the wastes of concern are not recognized primarily as PCB wastes, but rather as waste oils (contaminated with PCBs) or industrial sludges containing PCBs. Accordingly, at the present, wastes are being regulated on the same basis as commercial products. Comments on this approach are particularly invited.

Later this year, when additional regulations are proposed limiting the manufacturing, processing, and use of PCBs, it may be possible to distinguish more clearly when an item or material becomes a waste. Additionally, regulations being developed under the Resource Conservation and Recovery Act (RCRA), Pub. L. 94-580, will also refine waste materials. A possible consequence of these later regulations may be to lower the concentration of PCBs in the definition of waste materials. In the interim care must continue to be exercised in disposal of waste materials with lowed levels of PCB concentrations to avoid violating any water or air standards. Current water discharge standards for PCBs are very stringent ranging from zero discharge for capacitor and transformer manufacturing to one part per billion for other discharges.

Some mixtures that may contain more than 500 parts per million PCB chemical substances will not be affected by these regulations until their use is altered. For example, this regulation would not require that bottom sediments in rivers and harbors be removed from the watercourses. If they are removed for any reason such as dredging or excavation, the disposal of these sediments would have to meet the disposal provisions of this regulation. Similar considerations apply to contaminated soils.

In general, municipal sewage sludges seldom have contamination levels over 500 parts per million and, therefore, will not be affected by this regulation. Environmental management of these sludges is possible under a variety of Federal and State regulatory programs, and the effective integration of these programs is considered to be the most desirable approach to control this problem.

With regard to spills, more stringent requirements may be stipulated during a spill by spill-control personnel using other legislative and regulatory authority such as the Federal Water Pollution Control Act (Pub. L. 92-500) and the Safe Drinking Water Act (Pub. L. 93-523). Later regulations under TSCA or RCRA could also lower the concentrations limits that would be applicable to spills.

PERSONS AFFECTED BY THE REGULATION

The regulation applies to all persons who manufacture, process, distribute in commerce, use, or dispose of PCBs. Since persons include local, state, and Federal governments, the applicability is very broad.

Some of the most common commercial enterprises and activities that will be subject to the regulations are electric power utilities which operate PCB transformers and large capacitors, owners of buildings and industrial facilities that use PCB transformers and large capacitors, highway departments and industrial facilities that use special high intensity lighting systems, service shops that repair small appliances with PCB capacitors, service shops that repair and refill PCB transformers. Other categories of affected commercial enterprises include manufacturers that produce new electrical items containing PCBs and owners and

[1] USEP-OTS. "PCBs in the United States: Industrial Use and Environmental Distribution." Feb. 25, 1976, Versar, Inc.

orage facility and the name of the own- or operator of the facility.

(3) Total quantities of PCBs remaining in service at the end of the calendar ar using the following breakdown:

(i) Total weight in kilograms of any :B chemical substances and PCB mixres in PCB containers, including the ntification of container contents such liquids and capacitors.

(ii) Total number of PCB transform- and total weight in kilograms of any B chemical substances and PCB mixes contained in the transformers;

ii) Total number of PCB large high tage capacitors.

b) *Disposal and storage facilities.* Bening in 1979, each owner or operator a facility used for the storage or disal of PCBs shall by March 1 of each r prepare and maintain a document ch specifies the manner in which 3s were handled at the facility dur- the previous calendar year. Such ument shall be retained at each fay for at least five years after the fay is no longer used for the storage or osal of PCBs, except that in the case chemical waste landfills such docuts shall be maintained at least ty years after the chemical waste lfill is no longer used for the disl of PCBs. Such documents shall be lable at the facility for inspection by norized representatives of the Enviental Protection Agency. If the lity ceases to be used for PCB storage lisposal, the owner or operator of facility shall promptly notify the ncy Regional Administrator of the n in which the facility is located the facility has ceased storage or osal operations and shall specify e the documents required to be tained by this paragraph shall be ed. The following information shall ncluded in each document:

) The date when any PCBs are red by the facility during the previous dar year for storage or disposa:, and dentification of the person and fa- from whom such PCBs were ved.

) The date when any PCBs are dis- l of at the disposal facility or transd to another disposal or storage fa-, including the identification of the fic types of PCB chemical subes, PCB mixtures, or PCB articles ntainers; PCB transformers; and equipment or PCB articles not in containers which were stored or disposed of.

(3) Total weight in kilograms of any PCB containers and the total weight in kilograms of any PCB chemical substances or PCB mixtures contained in any PCB transformers, received during the calendar year, transferred to other storage or disposal facilities during the calendar year, and remaining on the disposal or storage facility site at the end of the calendar year, respectively, including, where applicable, the identification of PCB container contents such as liquids, capacitors, etc. When PCB containers or PCB chemical substances or PCB mixtures contained in a transformer are transferred to other storage or disposal facilities, the identification of the facility to which such PCBs were transferred shall be included.

(4) Total number of any PCB articles or PCB equipment, not in PCB containers, received during the calendar year, transferred to other storage or disposal facilities during the calendar year, and remaining on the facility site at the end of the calendar year, respectively, including the identification of the specific types of PCB articles and PCB equipment received, transferred, or remaining on the facility site. When PCB articles and PCB equipment are transferred to other storage or disposal facilities, the identification of the facility to which such PCB articles and PCB equipment were transferred must be included.

NOTE: Any requirements for weights in kilograms of PCBs may be calculated values if the internal volume of containers and transformers is known and included in the reports, together with any assumptions on the density of the PCB chemical substances or PCB mixtures contained in the containers or transformers.

(c) *Incineration facilities.* For each owner or operator of a PCB incinerator facility, the following information is required in addition to the information required in paragraph (b) of this section:

(1) When PCBs are being incinerated, the following continuous and short-interval data shall be collected and maintained for a period of five years from the date of collection:

(A) Rate and quantity of PCBs fed to the combustion system, as provided in Annex I—§ 761.40(a)(3).

(B) Temperature of the combustion process, as provided in Annex I—§ 761.40 (a)(4).

(C) Stack emission products to include O_2, CO, and CO_2, as provided in Annex I—§ 761.40(a)(7).

(2) When PCBs are being incinerated, data and records resulting from the monitoring of stack emissions as required in Annex I—§ 761.40(d)(2), shall be collected and maintained for five years.

(3) Total weight in kilograms of any solid residues generated by the incineration of PCBs during the calendar year, the total weight in kilograms of any solid residues disposed of by such facility in chemical waste landfills, and the total weight in kilograms of any solid residues remaining on the facility site shall be retained for five years.

(4) When PCBs are being incinerated, additional periodic data shall be collected and maintained as specified by the Regional Administrator pursuant to Annex I—§ 761.40(d)(4).

(5) A document shall be prepared on any suspension of the operation of any incinerator by the owner or operator thereof, as required in Annex I–§ 761.40 (a)(8). The document shall, at a minimum, include the date and time of the suspension and an explanation of the circumstances causing the suspension of operation.

(d) Retention of Special Records by Storage and Disposal Facilities. In addition to the information required to be maintained by pragraphs (b) and (c) of this section, each owner or operator of a PCB storage or disposal facility shall collect and maintain for the time period required in paragraph (c) of this section the following data:

(1) All documents, correspondence, and data provided to the owner or operator by any State or local government agency that pertain to the storage or disposal of PCBs at such facility.

(2) All documents, correspondence, and data provided by the owner or operator of such facility to any State or local government agency that pertain to the storage or disposal of PCBs at such facility.

(3) Any applications and related correspondence sent by the owner or operator of such facility to any local, State, or Federal authorities in regard to wastewater discharge permits, solid waste permits, building permits, or other permits or authorizations, such as those required by Annex I–§ 761.40(d) and Annex II–§.61.41(c).

[FR Doc.77-14663 Filed 5-23-77;8:45 am]

method. Water analysis shall be ided in subparagraph (5)(iii) of agraph. Acceptable leachate col- monitoring/collection systems one of the following designs un- w[illegible]r is obtained pursuant to l[illegible](4) of this section.

i[illegible] Leachate Collection. This consists of a gravity flow drain- stalled under the waste disposal liner. This design is recom- for use when semi-solid or leach- id wastes are placed in a lined vated into a relatively thick, un- ed, homogeneous layer of low oility soil.

Compound Leachate Collection. stem consists of a gravity flow ld installed under the waste dis- cility liner and above a second- alled liner. This design is recom- for use when semiliquid or leach- id wastes are placed in a lined ivated into relatively permeable

Suction Manometers. This system of a network of porous "stones" ed by hoses/tubing to a vacuum The porous "stones" or suction eters are installed along the sides ler the bottom of the waste dis- cility liner. This type of system best when installed in relatively ble unsaturated soil immediately it to the disposal facility's bottom sides.

Chemical Waste Landfill Opera- 1) PCBs shall be placed in the in a manner that will prevent to containers or articles. Other placed in the landfill that are not u[illegible]mpatible with PCBs or PCB c[illegible]all be segregated from the throughout the waste handling posal process.

An operations plan shall be devel- ed submitted to the Regional Ad- ator for approval as required in aph (c) of this section. This plan include detailed explanations of cedures to be used for record- , excavation and backfilling, segregation, burial coordinates, and equipment movement, use ways, leachate collection systems, ng and monitoring procedures, ring wells, and security measures ect against vandalism and unau- ed waste placements. EPA guide- ntitled "Thermal Processing and Disposal of Solid Waste" (39 FR of August 14, 1974) are a useful ce in preparation of this plan.

Records shall be maintained for disposal operations and shall in- he three dimensional burial co- es for PCBs. Additional records e developed and maintained as d in Annex VI.

Supporting Facilities. (1) A six oven mesh fence, wall, or similar shall be provided around the site vent unauthorized persons and s from entering.

Roads shall be maintained to and site which are adequate to operate t[illegible]n the site without causing safety or nuisance problems or hazardous conditions.

(iii) The site shall be operated and maintained in a manner to prevent safety problems or hazardous conditions resulting from spilled liquids and windblown materials.

(c) *Approval of chemical waste landfills.* Prior to the disposal of any PCBs in a chemical waste landfill, the owner or operator of the landfill shall receive written approval of the Agency Regional Administrator of the Region in which the landfill is located. Such approval shall be obtained in the following manner:

(1) *Initial Report.* The owner or operator shall submit to the Regional Administrator an initial report which contains:

(i) The location of the landfill.

(ii) A detailed description of the landfill including general site plans and design drawings.

(iii) An engineering report describing the manner in which the landfill complies with the requirements for chemical waste landfills in paragraph (b) of this section.

(iv) Sampling and monitoring equipment and facilities available.

(v) Expected waste volumes of PCBs.

(vi) General description of waste materials other than PCBs that are expected to be disposed of in the landfill.

(vii) Landfill operations plan as required in paragraph (b) of this section.

(viii) Any local, State, or Federal permits or approvals.

(ix) Any schedules or plans for complying with the approval requirements of these regulations.

(2) *Other Information.* In addition to the information contained in the report described in subparagraph (1) of this section, the Regional Administrator may require the owner or operator to submit such other information as the Regional Administrator finds to be reasonably necessary to determine whether a chemical waste landfill should be approved.

(3) *Contents of approval.* (i) Except as provided in subparagraph (4) of this paragraph, the Regional Administrator may not approve a chemical waste landfill for the disposal of PCBs unless he finds that the landfill meets all of the requirements of subparagraph (6) of this paragraph.

(ii) In addition to the requirements of paragraph (b) of this section, the Regional Administrator may include in an approval such other requirements as the Regional Administrator finds are necessary to ensure that operation of the chemical waste landfill does not present an unreasonable risk of injury to health or the environment from PCBs. Such requirements may include a fixed period of time for which the approval is valid.

(4) *Waivers.* An owner or operator of a chemical waste landfill may submit evidence to the Regional Administrator that operation of the landfill will not present an unreasonable risk of injury to health or the environment from PCBs, when one or more of the requirements of paragraph (b) of this section are not met. On the basis of such evidence and any other available information, the Regional Administrator may in his discretion find that any such requirements are not necessary to protect against such risk and may waive such requirements in any approval for that landfill. Such finding and waiver will be stated in writing and included as part of the approval.

(5) *Persons Approved.* Any approval will designate the persons who own and who are authorized to operate the chemical waste landfill, and will apply only to such persons.

(6) *Final Approval.* Approval of a chemical waste landfill will be in writing and will be signed by the Regional Administrator. The approval will state all requirements applicable to that landfill.

ANNEX III

§ 761.42 Storage for disposal.

(a) Any PCB article or PCB container stored for disposal before July 1, 1981, shall be removed from storage and disposed of before July 1, 1982. Any PCB article or PCB container stored for disposal after July 1, 1981, shall be removed from storage and disposed of within one year from the date when it was first placed into storage.

(b) Except as provided in paragraph (c) of this section, after October 1, 1977, owners or operators of any facilities used for the storage of PCBs designated for disposal shall comply with the following requirements:

(1) Such facilities shall have:

(i) An adequate roof to prevent rainwater from reaching the stored PCBs.

(ii) An adequate floor which has continuous curbing with a minimum six inch high curb. Such floor and curbing must provide a containment volume equal to at least two times the internal volume of the largest PCB equipment or PCB container stored therein or twenty-five percent of the total internal volume of all PCB equipment or containers stored therein, whichever is greater.

(iii) No drain valves, floor drains, sewer lines, or other openings that would permit liquids to flow from the curbed area.

(iv) Continuous, smooth, and impervious construction for floors and curbing such as Portland cement concrete.

(c)(1) After October 1, 1977, if the only PCBs stored at a particular facility are small capacitors which have an aggregate storage volume of not greater than two 55-gallon drums, the only storage requirement is to store such capacitors in sound, non-leaking containers within a building.

(2) The storage area shall be marked as required in Subpart C—§761.20(a)(6).

(3) No items of movable equipment used for handling PCBs in the storage facilities shall be removed from the areas unless decontaminated.

(4) All PCB containers shall be checked for leaks at least once every 30 days. All leaking containers and their contents shall be transferred immediately to properly marked nonleaking containers. Any spilled or leaked mate-

the person who submitted the report described in subparagraph (1) of this paragraph shall submit to the Regional Administrator a detailed plan for conducting and monitoring the trial burn. At a minimum, the plan must include:

(a) Date trial burn is to be conducted.

(b) Quantity and type of PCBs to be incinerated.

(c) Parameters to be monitored and location of sampling points.

(d) Sampling frequency and methods and schedules for sample analyses.

(e) Name, address, and qualifications of persons who will review analytical results and other pertinent data and who will perform a technical evaluation of the effectiveness of the trial burn.

(iii) Following receipt of the plan described in subdivision (ii) of this subparagraph, the Regional Administrator will approve the plan, require additions or modifications to the plan, or disapprove the plan. If the plan is disapproved, the Regional Administrator will notify the person who submitted the plan of such disapproval, together with the reasons why it was disapproved. That person may thereafter submit a new plan in accordance with subdivision (ii) of this subparagraph. If the plan is approved (with any additions or modifications which the Regional Administrator may prescribe), the Regional Administrator will notify the person who submitted the plan of such approval. Thereafter the trial burn shall take place at a date and time to be agreed upon between the Regional Administrator and the person who submitted the plan.

(3) *Other information.* In addition to the information contained in the report and plan described in subparagraphs (1) and (2) of this paragraph, the Regional Administrator may require the owner or operator to submit such other information as the Regional Administrator finds to be reasonably necessary to determine whether an incinerator shall be approved.

NOTE.—The Regional Administrator will have available for review and inspection an Agency manual containing information or sampling methods and analytical procedures for the parameters required in § 761.40(a)(3), (4), (6), and (7) plus any other parameters he may determine to be appropriate. Owners or operators are encouraged to review this manual prior to submitting any report required in this Annex.

(4) *Contents of Approval.* (i) Except as provided in subparagraph (5) of this paragraph, the Regional Administrator may not approve an incinerator for the disposal of PCBs unless he finds that the incinerator meets all of the requirements of paragraphs (a) and/or (b) of this section, whichever is applicable.

(ii) In addition to the requirements of paragraphs (a) and/or (b) of this section, the Regional Administrator may include in an approval such other requirements as the Regional Administrator finds are necessary to ensure that operation of the incinerator does not present an unreasonable risk of injury to health or the environment from PCBs. Such requirements may include a fixed period of time for which the approval is valid.

(5) *Waivers.* An owner or operator of the incinerator may submit evidence to the Regional Administrator that operation of the incinerator will not present an unreasonable risk of injury to health or the environment from PCBs, when one or more of the requirements of paragraphs (a) and/or (b) of this section are not met. On the basis of such evidence and any other available information, the Regional Administrator may in his discretion find that any such requirements are not necessary to protect against such risk and may waive such requirements in any approval for that incinerator. Any such finding and waiver must be stated in writing and included as part of the approval.

(6) *Persons Approved.* An approval will designate the persons who own and who are authorized to operate the incinerator, and will apply only to such persons.

(7) *Final Approval.* Approval of an incinerator will be in writing and signed by the Regional Administrator. The approval will state all requirements applicable to that incinerator.

ANNEX II

§ 761.41 Chemical waste landfills.

(a) *General.* A chemical waste landfill used for the disposal of PCBs shall be approved by the Agency Regional Administrator pursuant to paragraph (c) of this section. Such landfill shall meet all of the requirements specified in paragraph (b) of this section, unless a waiver from these requirements is obtained pursuant to paragraph (c)(4) of this section. In addition, the landfill shall meet any other requirements which may be prescribed pursuant to paragraph (c)(3) of this section.

(b) *Technical requirements.* Requirements for chemical waste landfills used for the disposal of PCBs are as follows:

(1) *Soils.* The landfill site shall be located in thick, relatively impermeable formations such as large-area clay pans. Where this is not possible, the soil shall have a high clay and silt content with the following parameters:

(i) In-place soil thickness, 4', or compacted soil liner thickness, 3'.
(ii) Permeability (cm/sec), $\leq 1 \times 10^{-7}$.
(iii) Percent soil passing No. 200 Sieve, ≥30.
(iv) Liquid Limit, ≥30.
(v) Plasticity Index, ≥15.
(vi) Artificial Liner Thickness, ≥30 mil.

NOTE.—In the event that an artificial liner is used at a landfill site, special precautions shall be taken to insure that its integrity is maintained and that it is chemically compatible with PCBs. Soil underlining shall be provided as well as a soil cover.

(2) *Hydrology.* The bottom of the landfill shall be substantially above the historical high groundwater table. Floodplains, shorelands, and groundwater recharge areas shall be avoided. There shall be no hydraulic connection between the site and standing or flowing surface water. The site shall have monitoring wells and leachate collection and shall be at least fifty feet from the nearest groundwater.

(3) *Flood protection.* (i) If the landfill site is below the 100-year floodwater elevation, the operator shall provide surface water diversion dikes around the perimeter of the landfill site with a minimum height equal to two feet above the 100-year floodwater elevation.

(ii) If the landfill site is above the 100-year floodwater elevation, the operators shall provide diversion structures capable of diverting all of the surface water runoff from a 24-hour, 25-year storm.

(4) *Topography.* The landfill site shall be located in an area of low to moderate relief to minimize erosion and to help prevent landslides or slumping.

(5) *Monitoring Systems*—(i) *Water Sampling.* (a) The ground and surface water from the disposal site area shall be sampled for use as baseline operations.

(b) Defined water sources shall be sampled at least monthly when the landfill is being used for disposal operations.

(c) Defined water sources shall be sampled indefinitely on a frequency of no less than once every six months after final closure of the disposal area.

(ii) *Groundwater Monitor Wells.* (a) If underlying earth materials are homogeneous, impermeable, and uniformly sloping in one direction, only three sampling points shall be necessary. These three points shall be equally spaced on a line through the center of the disposal area and extending from the area of highest water table elevation to the area of the lowest water table elevation on the property.

(b) All monitor wells shall be cased and the annular space between the monitor zone (zone of saturation) and the surface shall be completely backfilled or plugged with Portland cement to effectively prevent percolation of surface water into the well bore. The well opening at the surface shall have a removable cap to provide access and to prevent entrance of rainfall or stormwater runoff. The well shall be pumped to remove the volume of liquid initially contained in the well before obtaining a sample for analysis. The discharge shall be treated to meet applicable State or Federal discharge standards or recycled to the chemical waste landfill.

(iii) *Water analysis.* As a minimum, all samples shall be analyzed for the following parameters, and all data and records of the sampling and analysis shall be maintained as required in Annex VI. Sampling methods and analytical procedures for these parameters shall be as specified in 40 CFR Part 136 as amended in 41 FR 52779 of December 1, 1976.

(a) PCBs.
(b) pH.
(c) Specific Conductance.
(d) Chlorinated Organics.

(6) *Leachate Collection.* A leachate collection monitoring system shall be installed beneath the chemical waste landfill. Leachate collection systems shall be monitored monthly for quantity and quality of leachate produced. The leachate should be either treated to acceptable limits for discharge in accordance with a State or Federal permit or disposed of by another State or Federal ap-

APPENDIX F.2

CAUSE NO. B-416

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STATE OF INDIANA

STREAM POLLUTION CONTROL BOARD

INDIANAPOLIS 46206

1330 West Michigan Street

November 5, 1980

VIA CERTIFIED MAIL

Mr. David W. Graves, Jr., Attorney
General Motors Corporation
General Motors Building
3044 West Grand Boulevard
Detroit, MI 48202

Dear Mr. Graves:

Re: Adoption of Stipulation and Consent Order
Stream Pollution Control Board
of the State of Indiana
vs.
Central Foundary Division
General Motors Corporation
Bedford, Indiana
Cause No. B-416

This is to inform you that the Indiana Stream Pollution Control Board, at its regularly scheduled meeting of October 21, 1980, approved the Stipulation and Consent Order negotiated between yourself or your representatives and members of our staff. A copy of the Stipulation and Consent Order, executed by myself as Technical Secretary on behalf of the Board, is enclosed. You are no doubt familiar with the terms of the Consent Order necessary to insure future compliance.

Very truly yours,

Oral H. Hert

Oral H. Hert
Technical Secretary

Enclosure
cc: Hearing Officer
Mr. Floyd McCurdy, Plant Manager
Central Foundry Division
General Motors Corporation
U.S. EPA, Region V
Compliance Unit

STATE OF INDIANA)
) SS.
COUNTY OF MARION)

BEFORE THE STREAM POLLUTION CONTROL BOARD OF THE STATE OF INDIANA

IN THE MATTER OF THE STREAM POLLUTION CONTROL BOARD OF THE STATE OF INDIANA,

Petitioner,

vs.

CENTRAL FOUNDRY DIVISION, GENERAL MOTORS CORPORATION BEDFORD, INDIANA

Respondent

CAUSE NO. B-416

STIPULATION AND CONSENT ORDER

A Notice of Hearing having been filed herein on April 26, 1977, and Petitioner and Respondent being desirous of settling and compromising this action and having consented, without hearing or adjudication of any issue of fact or law herein, to the entry of this Stipulation and Consent Order, and without this Stipulation and Consent Order constituting any evidence or admission by either party with respect to any issue of fact or law herein, the parties do hereby stipulate as follows:

Stipulation

1. The Stream Pollution Control Board of the State of Indiana is an agency of the State of Indiana, duly empowered to hold administrative hearings to determine whether there are possible violations of IC 13-1-3, IC 13-7, and Board Regulations, including but not limited to, 330 IAC 1-1 (formerly SPC 1R-3, and SPC 1R-4), 330 IAC 3 (formerly SPC 15), and 330 IAC 1-6 (formerly SPC 16), and to enter an order requiring the taking of such action as is indicated by the circumstances to cause the abatement of such condition.

2. The Stream Pollution Control Board of the State of Indiana has jurisdiction over both the subject matter and the parties to this action.

3. Pursuant to the provisions of IC 13-7 and IC 4-22-1, notice of hearing was issued and served upon Respondent through its authorized agent:

C.T. Corporation System
1011 Merchants Bank Building
Indianapolis, IN 46204

4. Respondent owns and operates a foundry in Lawrence County, Indiana, which is authorized to discharge effluent from two outfalls (Outfalls 001 and 002) into the waters of the State of Indiana under the terms, conditions, and limitations in NPDES Permit No. IN 0003573 (the "NPDES Permit").

5. On December 28, 1976, Petitioner issued Public Notice No. 51-1496M stating its intent to modify the NPDES Permit by including therein an effluent limitation limiting the polychlorinated biphenyl ("PCB") content of the discharge from Outfall 002 to an interim concentration of 80 ppb and to a final concentration of 1 ppb (parts per billion).*

6. Prior to 1972, the hydraulic fluid used in machinery at Respondent's foundry contained PCBs. Since 1972 all new hydraulic fluid purchased by Respondent has been only PCB-free fluid, but the prior use of PCBs contaminated such machinery and the drains and wastewater treatment system at the foundry. Wastewaters contaminated with varying concentrations of PCBs have been regularly discharged from Respondent's foundry into a ditch which flows into Pleasant Run Creek in Lawrence County. Respondent has, in consultation with the Division of Water Pollution Control of the Indiana State Board of Health, and with its consent, exerted a considerable effort, within the bounds of technological and economic feasibility, in good faith to remove such contamination of the foundry facilities and has succeeded

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* As used in this Stipulation and Consent Order parts per billion means micro-grams per liter (ug/1).

to the extent that levels of PCBs within the foundry's hydraulic systems are in compliance with the limitations in IC 13-7-16.5. Due to the highly stable and persistent nature of PCBs, it appears to be impossible to entirely eradicate PCBs from the foundry, and other than the carbon adsorption treatment system mentioned in paragraph 2 of the following Consent Order, there is no demonstrated technologically feasible or economically reasonable means of reducing the PCB content of treated wastewater from the foundry below 1 ppb.

7. On November 12, 1976, an undetermined quantity of wastewater contaminated with PCBs and with concentrations of oil, grease, and suspended solids in excess of the effluent limitations of Respondent's NPDES Permit was discharged from Outfall 002 of Respondent's foundry. In a second incident, on or about February 21, 1977, an indeterminate quantity of hydraulic flushing fluids contaminated with PCBs escaped from a storage tank at Respondent's foundry. Upon discovery of the spill, Respondent immediately contained the fluids within a paved area of its foundry with a sand dam and vacuumed them up. Subsequently, the previously frozen ground thawed and a small amount of the fluids remaining in cracks and crevices of the pavement flowed off Respondent's premises with melted ice and snow. After leaving Respondent's premises, the contaminated fluid flowed through a storm sewer into a drainageway on adjoining property. With respect to the latter incident, Respondent has cleaned up and removed the spilled material from the drainageway and the soil on the banks thereof to the satisfaction of Petitioner.

8. During the course of negotiations on this Consent Order, Respondent's personnel discovered that water, erupting in a spring-like manner from the ground on its property near the Milwaukee railroad tracks and adjacent to Respondent's wastewater treatment plant, contained detectable amounts of oils and PCBs along with very high amounts of chlorides. A preliminary investigation into this situation by both Petitioner and Respondent has failed to disclose the source of the water or its contamination. Absent evidence establishing a causal link between Respondent's manufacturing operations and the contaminated spring water, Respondent disclaims any responsibility to treat said water. Petitioner disagrees, believing that

Respondent may be responsible for the impact of said water on public health and welfare or the environment by virtue of its ownership of the property. However, it is recognized that investigations are continuing into this situation and that neither party wishes to delay expeditious finalization of the agreements on other significant actions provided for in this Consent Order pending a resolution of this issue. Therefore, this Order does not impose any obligation on Respondent to treat the above-mentioned water, provided that Petitioner, notwithstanding any other provisions of this Stipulation and Consent Order, does not waive any legal rights that it may have against Respondent with respect to the continuing issuance of the above-mentioned water from Respondent's property.

9. Upon entry of the following Consent Order and provided Respondent thereafter fully complies with the terms and conditions of said Consent Order, Petitioner agrees to forebear from the initiation of any further civil or criminal action, administrative or judicial, against Respondent arising out of (1) the allegations in the April 26, 1977, Notice of Hearing issued in the above-entitled action or (2) the presence of PCBs in the Respondent's water discharges from its Bedford, Indiana, plant with the exception of (i) any presently undetected or future emission of PCB-contamination leachate from the Lawrence County Landfill which enters or threatens to enter waters of the State as a result of Respondent's disposal there of PCB-contaminated sludges and other wastes from its foundry, (ii) the possible contamination of the sediments of Salt Creek downstream from its confluence with Pleasant Run Creek or of the East Fork of White River downstream from its confluence with Salt Creek as a result of the discharge of PCB-contaminated wastewaters from Respondent's foundry, (iii) the presence of PCBs in the spring-like water emerging on Respondent's property as described in paragraph 8 of this Stipulation, (iv) the potential contamination by PCBs of groundwater in the area of Respondent's foundry as a result of the Respondent's use of PCBs in the foundry operations, (v) the presence of PCBs in Respondent's sanitary wastewater discharges to the municipal sewer system of the City of Bedford, and (vi) as provided in paragraph 10 of this Stipulation. Petitioner further

agrees to hereby withdraw those portions of the allegations of its Notice of Hearing (dated April 26, 1977), which in substance, set out above-described issue (i) and reserves the right to institute new proceedings on said issue if and when deemed warranted.

10. Nothing in this Stipulation or Consent Order shall be construed to preclude the Petitioner from enforcing any federal or state laws and regulations controlling the discharge of PCBs which become effective after the entry of this Order.

CONSENT ORDER

NOW, THEREFORE, upon the consent of the parties hereto, it is hereby ORDERED, ADJUDGED AND DECREED as follows:

1. The provisions of this Order shall apply to the Respondent, its directors, officers, agents, servants, employees, successors, and assigns, and to all persons, firms, and corporations acting through or for them.

2. Outfall 002--Process Wastewater and Stormwater--Interim Treatment. Prior to the effective date of this Order, Respondent shall complete installation and begin operation of a carbon adsorption wastewater treatment system for process wastewater effluent from Outfall 002. Said carbon adsorption system shall limit the PCB content of its treated effluent to no more than 1 ppb. The total effluent from Outfall 002 will not be limited for PCBs, but the PCB content of said total effluent shall be monitored periodically.

3. Outfall 001--Noncontact Cooling Water and Storm Runoff--Interim Treatment. Not later than one year from the effective date of this Order, Respondent shall eliminate the normal dry weather discharge from Outfall 001. However, when necessary due to stormwater conditions, Respondent may discharge stormwater and noncontact cooling water overflow from Outfall 001 with a PCB concentration not to exceed 50 ppb.

4. Outfall 001--Noncontact Cooling Water and Outfall 002--Process Wastewater--Final Treatment. Not later than December 31, 1983, Respondent shall minimize to the maximum extent technically feasible and economically reasonable the discharge of process wastewater, including noncontact cooling water from Outfalls 001 and 002, by increasing the degree of water reuse in its water recycle system. Within twelve months of the entry of this Consent Order, Respondent shall demonstrate to Petitioner the maximum extent of discharge reduction achievable under the above criteria. Not later than December 31, 1983, the discharge from Outfall 002 shall contain no more than 1 ppb of PCBs, as well as comply with such other effluent limitations as are applicable.

5. Outfall 001--Storm Runoff--Final Treatment.

(a) Not later than December 31, 1983, Respondent shall complete construction and commence use of a new stormwater retention lagoon of sufficient capacity to contain storm runoff from improved plant areas expected to result from the 25-year, 24 hour storm event for the area. Said lagoon shall be fully lined with a material whose permeability is no more than 10^{-7} cm/sec.

(b) (1) Respondent shall, by December 31, 1983, either by (i) utilization of the carbon adsorption system constructed for the process wastewater discharge at Outfall 002 or (ii) construction of a separate carbon adsorption system for the stormwater lagoon, promptly commence such treatment and discharge of stormwater from the lagoon (and, in the event alternative (i) is implemented, discharge of treated process wastewater and stormwater) any time a storm event reduces reserve capacity of the lagoon below that sufficient to contain the 15-year, 24 hour storm event and continue such treatment and discharge until a 15-year, 24 hour storm event reserve capacity is attained, at which

point, natural evaporative losses may be relied upon for further reduction of the lagoon's contents. The PCB concentration of said discharge shall be limited to 1 ppb except when a severe storm event or combination of storm events result in an overflow of the storm water lagoon, despite Respondent's reasonable efforts to maintain the storage capacity required under this paragraph.

(2) Subparagraph (b)(1) shall not apply if within 12 months of the entry of this Consent Order, it is demonstrated by Respondent's engineering consultants:

(i) that such treatment of stormwater collected in the lagoon would not be necessary to reduce the PCB concentration of any discharge therefrom to no more than 1 ppb and would not be effective in reducing said PCB concentration significantly below 1 ppb, or

(ii) that it is technically infeasible or not operationally maintainable to treat said stormwater in order to reduce the PCB concentration of any discharge from said lagoon to no more than 1 ppb.

(c) Nothing in subparagraph (b) shall preclude Respondent from utilizing stormwater from the lagoon as "make-up" water for its closed-cycle system described in paragraph 4, above, so long as 15-year, 24 hour storm event reserve capacity, at minimum, is maintained.

(d) In order to prevent further contamination from foundry operations of any waters surfacing on Respondent's property or flowing onto it from a subsurface conduit, Respondent shall, not later than December 31, 1983, provide a conduit

to convey these waters from their point of origin or surfacing on Respondent's property to their natural point of exit from Respondent's property.

6. Schedules of Compliance. Within six months of the entry of this Consent Order, Respondent shall provide and agree to reasonable schedules of compliance for the activities described in paragraphs 2 through 5 of this Order setting forth increments of progress for the completion of each activity. The schedules shall include a date for submission of plans and specifications which must be reviewed by the Petitioner's staff and approved prior to construction of facilities.

7. The terms or substances of paragraphs 2 through 6 of this Order shall be incorporated into the NPDES Permit or any subsequent NPDES Permit or any other permit required by Regulation 330 IAC 3 pertaining to Respondent's foundry, except to the extent the terms or substance of said paragraphs may be revised or superseded as a result of action which may be taken by Petitioner pursuant to paragraphs 9 and 10 of the above Stipulation.

8. Stream Study. Within two months after the Petitioner and Respondent obtain the requisite permission or make alternative arrangements in accordance with paragraph 9, below, Respondent shall cause to be commenced by a qualified firm of environmental consultants a study to determine whether, and to what extent, there exists a condition of PCB contamination of the waters of the State of Indiana downstream of its foundry outfalls. The study plan has been submitted to Petitioner's staff and amended in accordance with the staff's recommendations agreed to by Respondent prior to issuance of this Order. The outline of such study plan is as follows:

(a) Geographic Boundaries. The study shall cover the stream length beginning at the unnamed ditch into which the foundry discharges wastewater, to the confluence of the ditch with Pleasant Run Creek, downstream to the confluence of Pleasant Run Creek and Salt Creek, and ending at points on Salt Creek, upstream and

downstream of the latter confluence, identified in the study plan.

(b) Examinations to be made. The study shall include quantitative assessment over the above stream lengths of the presence of PCBs at representative points in the water, the stream sediment and the high and low floodplains.

(c) Conclusions to be drawn. The study shall state conclusions as to the quantities of PCBs contained in each of the above-mentioned media in the area under examination and shall investigate and report on potential remedial actions that may be warranted.

Eighteen months after commencement of this study, Respondent shall have completed the study and have reviewed the alternatives suggested by the above study and any other study the Respondent has had performed and shall propose to Petitioner or its staff the remedial action, if any, which is technologically reasonable, economically reasonable, and ecologically sound to be implemented by Respondent. If remedial action is proposed by the Respondent and concurred with by the Petitioner, or if Petitioner recommends an alternative remedial action and Respondent concurs therewith, Respondent agrees to implement such remedial action in accordance with a reasonable schedule of compliance to be established by agreement of the parties.

9. Staff of the Petitioner will accompany Respondent in obtaining from the owners and occupants of property abutting or adjacent to the streams identified in paragraph 8, above, permission for Respondent's consultants to enter upon such land and perform the stream study referenced in said paragraph. In the event the owners or occupants of certain of such properties refuse to grant such permission, Respondent and Petitioner may consult and agree to alternative sites for the stream study or, if the properties in

question are recognized by both parties as essential to the integrity of the study, Petitioner may agree to exercise its right of entry and perform the study activities pertaining to such properties.

10. If, after entry of this Consent Order, the technology contemplated by this Consent Order will not achieve the various effluent prohibitions and limitations set forth in the Order, or if events beyond the reasonable control of Respondent should cause delay in meeting interim or final dates set forth in the Order, Respondent may petition the Board to modify the terms and conditions of this Consent Order, and the Board's action or inaction on such petition shall be reviewable pursuant to IC 4-22-1-1 et seq.

11. Full and timely compliance with the terms of this Agreed Order shall constitute a final adjudication of this action.

CENTRAL FOUNDRY DIVISION GENERAL MOTORS CORPORATION	STREAM POLLUTION CONTROL BOARD OF THE STATE OF INDIANA
By [signature]	By [signature]
Title Plant Manager-Bedford Plant	Title Tech. Secretary
Date 10-20-80	Date Oct 21, 1980

MAY 25, 2001

APPENDIX F.3

CDM ENVIRONMENTAL STUDY REPORT

Central Foundry Division
General Motors Corporation
Bedford Plant
P. O. Box 271
Bedford, Indiana 47421

May 18, 1983

Mr. Earl A. Bohner
Technical Secretary
State of Indiana
Stream Pollution Control Board
1330 West Michigan Street
Indianapolis, Indiana 46206

Subject: Stream Study Report

Dear Mr. Bohner:

The enclosed report "An Environmental Study of a System of Streams Near Bedford, Indiana", dated December 27, 1982 by Camp, Dresser, and McKee is being submitted for your information as requested in your letter to me dated January 14, 1983.

We are confident that this report will provide the necessary information that you requested.

If you have any questions, please contact me.

W. A. Butler

W. A. Butler
Superintendent
Plant Engineering

slc

cc: J. C. Stallsmith, Chief (letter only)
Operations Branch
Division of Water Pollution Control
ISBH

bcc: R. Herr (letter only)
P. Murphy " "
T. Karnosky " "
W. Cheek " "
J. Medved " "
P. Gerwert " "
J. Hollis " "
P. Zavala " "
J. Chu " "
G. Ohl " "
R. Remmers " "

CDM
environmental engineers, scientists, planners, & management consultants

CAMP DRESSER & McKEE INC.
6132 West Fond du Lac Avenue
Milwaukee, Wisconsin 53218
414-~~461-9580~~
414-781-4590

December 27, 1982

Mr. Ron Remmers
Project Engineer
General Motors Corporation
Central Foundry Division
Post Office Box 271
Bedford, Indiana 47421

Dear Mr. Remmers:

Please find enclosed the final report entitled "An Environmental Study of a System of Streams Near Bedford, Indiana".

CDM has enjoyed working on this interesting project and appreciated the cooperation extended to us by the General Motors staff.

Please give me a call should you have any questions regarding the report or any other matters of which CDM can be of service.

Sincerely,

CAMP DRESSER & McKEE INC.

Daniel F. Buss, P.E.
Project Manager

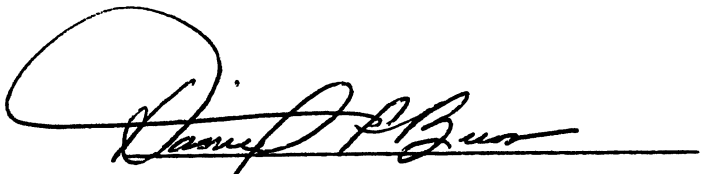
DFB:jf

1186/1/19

Prepared for
General Motors Corporation
Bedford, Indiana 47421

Prepared by
Camp Dresser & McKee Inc.
6132 W. Fond du Lac Avenue
Milwaukee, Wisconsin 53218

An Environmental Study of a System of Streams Near Bedford, Indiana



Daniel F. Buss, P.E.
Program Manager

December 27, 1982

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III. INTRODUCTION

The Environmental Planning and Sciences Division, Milwaukee Operations, of Camp Dresser & McKee Inc. (CDM) was contracted by General Motors Corporation to design and conduct an environmental study on segments of Pleasant Run Creek, and Salt Creek near Bedford, Indiana. The final study design and scope of work (Prepared March 1980) were developed from the original scope of work developed in June of 1978, following comments to revision by Dr. James Etzel of Purdue University, personnel with the Indiana State Board of Health, General Motors Corporation and Camp Dresser & McKee Inc. since initial study conception, all phases of work were performed under the management and guidance of Mr. Daniel F. Buss of CDM's Milwaukee office.

The environmental study was designed to ascertain:

- Whether or not a balanced, indigenous aquatic community exists in areas of PCB contamination;
- The concentration of PCBs in the flesh of various fish species;
- Sediment transport of PCBs;
- Concentrations of PCBs associated with river bottom sediments;
- Concentrations of PCBs in areas subject to flooding.

Also presented in this report, are recommendations for potential remedial actions that may be warranted. These recommendations are based upon the data gathered and reviewed during the course of this study.

The studies were conducted during May and September 1981. The May sampling was indicative of conditions during exceedingly high stream stage following heavy rains while the fall survey was conducted during low stream stage conditions. All aspects of work performed on this study were guided by strict quality assurance/quality control procedures. The following presents the findings of this study.

IV. AREAL DESCRIPTION OF SITE AND STUDY LOCATIONS

The study area lies within Sections 33, 34, 35 of Marshall township (T6N, R1W) and Shawswick township (T5N, R1W), between $86^{o}31'30"$ and $86^{o}27'30"$ west longitude and $38^{o}52'30"$ and $38^{o}55'30"$ north latitude in Lawrence County, Indiana (Figure 1).

The site lies within a horizontal bedrock bedding province dissected by streams, rivers and intermittent creeks forming a dendritic drainage network. The general drainage of the basin is to the south. Within the area, the more established rivers and streams have formed flood plains in which the streams have entered a meandering stage. This condition is characteristic of Pleasant Run Creek. The Bailey Branch of Pleasant Run Creek is cut into the bedrock at the headwaters with areas of sediment deposition being more pronounced near its confluence with the main stream. Salt Creek, in the area of study near the confluence with Pleasant Run is a conduit cut primarily in clay and bedrock. The bank is steeply sloping and the bed material consists of hard clay or rock with few areas of sediment deposition.

During the survey of Bailey's Branch of Pleasant Run Creek and the main branch of Pleasant Run Creek, it was found that coring of the bottom showed trapped sediment below a layer of coarser material which did not resuspend even at the high scouring conditions reached during flood stages typical of the spring of 1981. Core samples from reaches of Bailey Branch and Pleasant Run showed this layer to be a one to two inch zone of light colored sandy material overlaying the dark gray lower sediment layer. The fine grained underlayer of sediment was found by examination and calculation from data collected to be non-typical of materials of recent origin. It must therefore be concluded that this fine grained sediment is from time past and confirms the fact that it is a trapped rather than a dynamic one.

The study areas located on Salt Creek, Pleasant Run and its tributary are presented in Figure 2. This report will refer to the tributary from the Central Foundry to Pleasant Run as Bailey Branch. This is the name given to the tributary on the property maps. However this Bailey Branch should not be misconstrued with the tributary having the same name and entering Salt Creek in the Township of Marshall Section 26, T6N, R1W. The following presents a brief narrative of the study locations:

Station A

Located on Bailey Branch of Pleasant Run approximately 1,000 river feet downstream from the initiation of the Central Foundry discharge point in Section 11 Bedford, T5N, R1W. The stream is shallow, overlying areas of fractured limestone with numerous riffle areas. Deposition of sediment is primarily limited to small pools in stream bends.

Station B

Located on Bailey Branch approximately 1.2 river miles downstream from the initiation of the Central Foundry discharge point. It uncompassed an area in Section 2, S 1/2 Shawswick, T5N, R1W. At this location, the stream has widened and larger pool areas have formed in midstream. Riffle areas were less numerous. Sediment in the pool areas consisted of a fine grey-black material overlain by a lighter, usually coaser sand. The depth of sediment in the pools varied considerably.

Station C

Located on Pleasant Run approximately one river mile upstream of the confluence with Bailey Branch. Sampling was conducted immediately downstream from the intersection with East Road in Section 1, N 1/2 Shawswick, T5N, R1W. The stream consisted of riffle areas with pools at the bends of the stream. Sediment deposition in the pools was minor. The stream bottom primarily consisted of sand, gravel and larger cobble.

Station D

Located on Pleasant Run approximately 1,000 ft above the confluence with Bailey Branch. This segment of the stream passed through a flood plain area of Pleasant Run. The station is located in Section 2, N 1/2 Shawswick, T5N, R1W. The stream has widened significantly at this location. The bottom substrate consist of fine sand, silt and gravel.

Station E

Located immediately (with 100 ft) below the confluence of Pleasant Run with Bailey Branch in the zone of mixing. The station is located in Section 2, N 1/2 Shawswick, T5N, R1W. The bottom consisted of a very fine dark grey silt material mixed with detritus (leaves, twigs branches etc.).

Station F

Located on Pleasant Run approximately 0.5 river miles below the confluence with Bailey Branch in Section 2, N 1/2 Shawswick, T5N, R1W. The bottom substrate consisted of a fine dark grey silty material overlain by a thin layer of coaser material which was lighter in color. Considerable deposition had occurred in this area.

Station G

Located on Pleasant Run approximately two river miles below the confluence with Bailey Branch in Section 34, Marshall, T5N, R1W. Studies were conducted immediately upstream from the Louisville and Nashville railroad track. The streambed consisted primarily of sand and gravel and fractured limestone. Samples were collected in a riffle area. The sediment in the pool areas appeared to be a lighter grey as compared to the darker grey material near Station F.

Station H

Located on Pleasant Run immediately before its confluence with Salt Creek in Section 34, Marshall T6N, R1W. The bottom sediment consisted of fine soft brownish sand and clay. The banks were steep (estimated at 60^{o}) and barren. This location was a zone of deposition, probably due to the influence of backwater from Salt Creek and the very low current velocity.

Station I

Located on Salt Creek approximately 1,000 ft above the confluence with Pleasant Run in Section 34, N 1/2 Marshall, T6N, R1W. The bottom substrate consisted of hard clay. The banks were steep (approximately 60^{o}) and barren clay.

Station J

Located on Salt Creek approximately 50 ft above confluence with Pleasant Run in Section 34, N 1/2, T6N, R1W. The bottom was similar to Station I.

Station K

Located on Salt Creek within 50 ft and below confluence with Pleasant Run in Section 34, N 1/2 Marshall, T6N, R1W. Sediment samples were taken in soft sediment near the banks of Salt Creek. These locations had not been subjected to the severe scouring action as locations in the main current of the creek.

Station L

Located on Salt Creek approximately 2,500 ft below the confluence with Pleasant Run and above the crossing of the railroad spur from the quarry in Section 34, N 1/2 Marshall, T6N, R1W. Sediment samples were collected approximately 10 ft from each shore. The channel bottom at this location appeared to be hard clay and rock, similar to other Salt Creek stations with the exception of Station K which consisted of a softer, more penetrable material.

Specific site characteristics will be discussed in the text in relation to the physical/chemical/biological parameters studied.

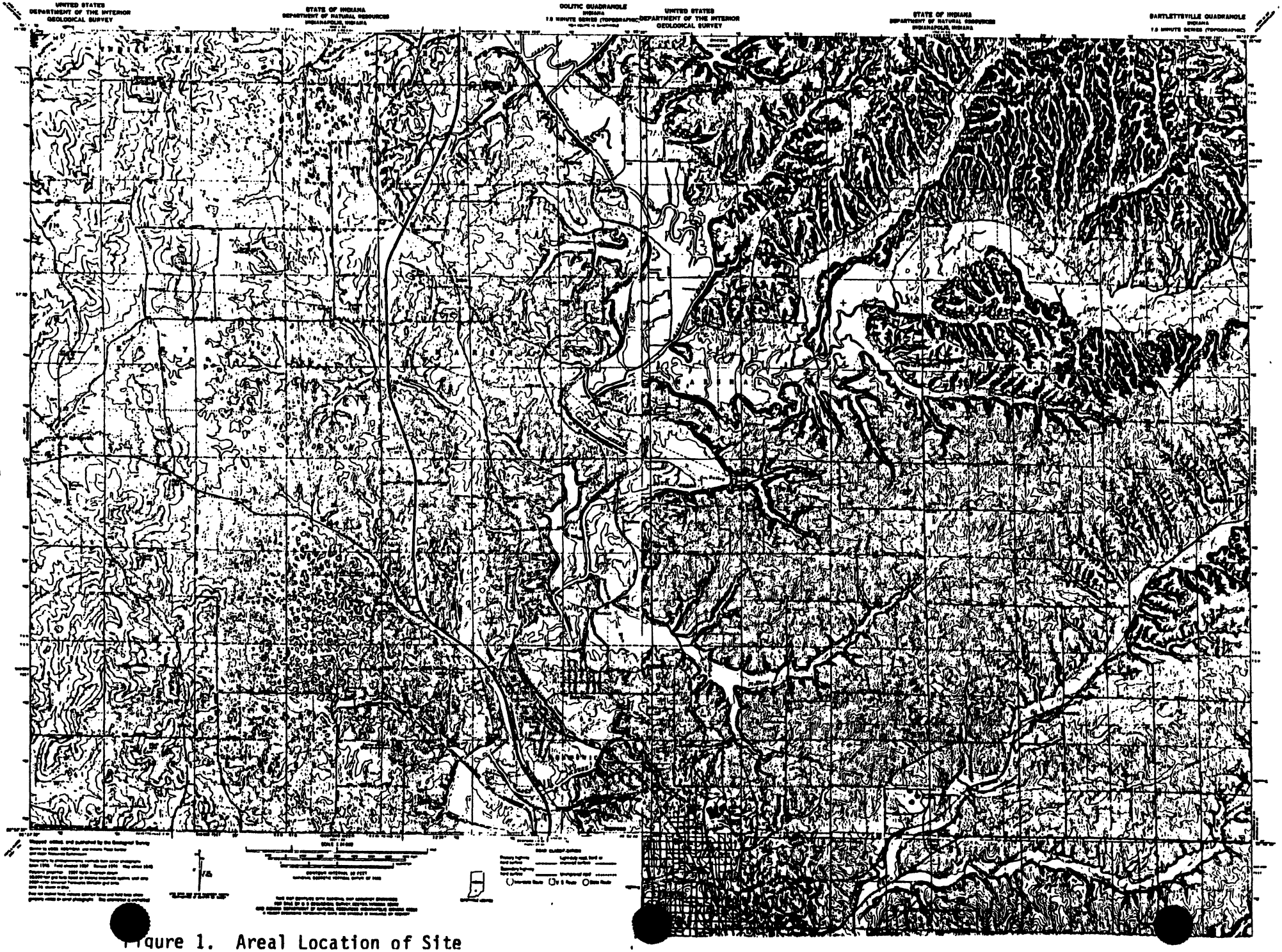

Figure 1. Areal Location of Site

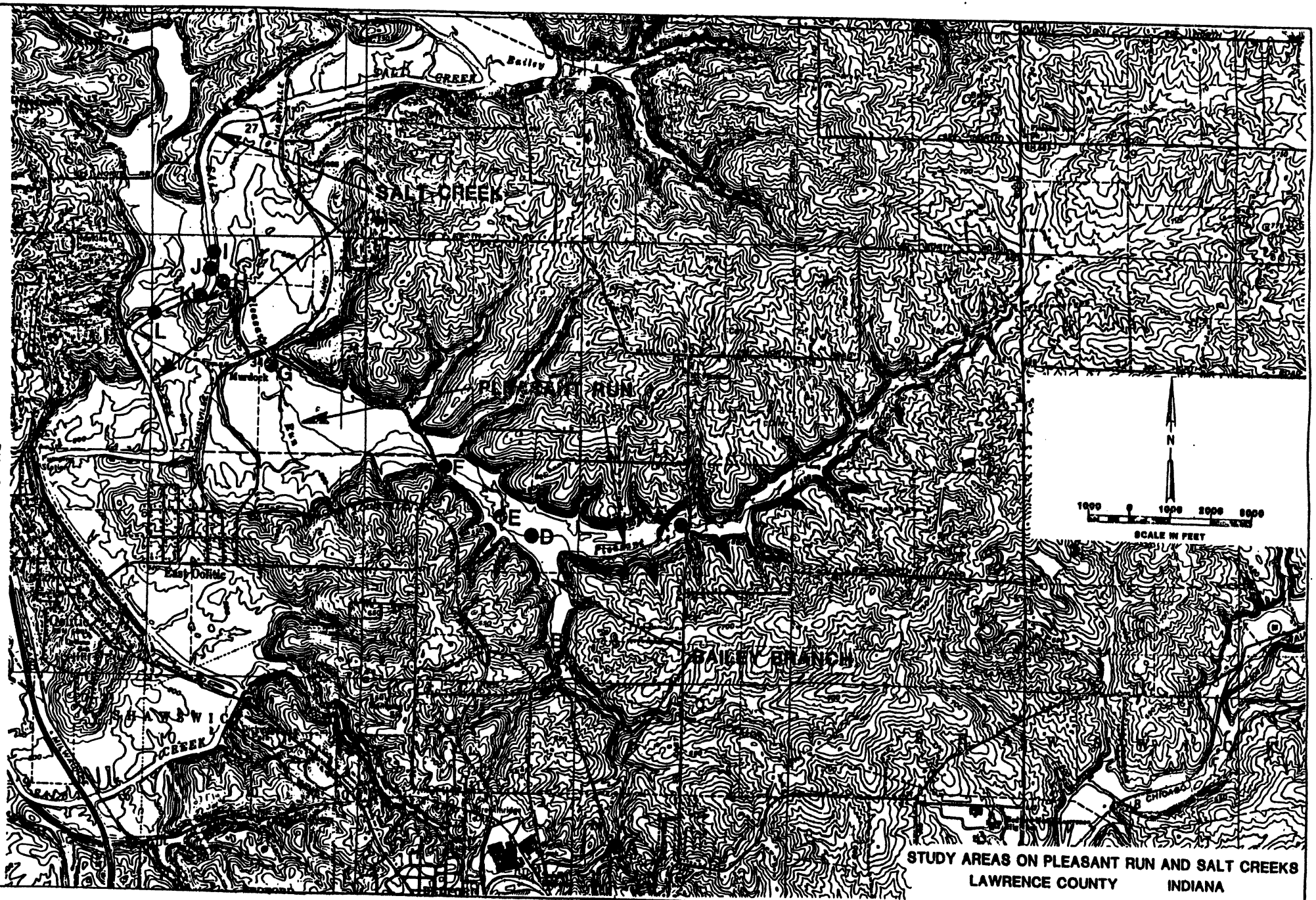

Figure 2. Study Locations at Site

V. WATER CHEMISTRY

1. Methodology

Water samples analyzed for chemical parameters were collected during the biological and physical/chemical water quality survey periods. During each sampling effort the samples were collected at mid-depth with a nonmetallic water sampler or in very shallow locations, by direct grab. Sampling was always first initiated at stations downstream and collections made progressively upstream to prevent agitation of bottom sediments and thus eliminating the possibility of contamination. A more descript sampling protocol used for collecting water samples is presented in Appendix A. The water samples were placed in labelled bottles containing the appropriate preservative. These samples were then immediately transferred to an ice cooler for transport. In situ measurements for dissolved oxygen, temperature, and pH were taken with a Yellow Springs dissolved oxygen/temperature meter and a Ecolab Model 102B pH/temperature meter. These instruments were calibrated in the laboratory and preceding field measurements taken on site. The field collection data information was transferred to chain-of-custody forms, and submitted with the samples to the contract laboratory performing the chemical analysis.

Raltech Scientific Services of Madison, Wisconsin conducted the analysis for polychlorinated biphenyls (PCBs). This laboratory was the Wisconsin Alumni Research Foundation Inc. before purchased by Ralston Purina Co. Swanson Environmental Inc. performed the analysis for the nitrogen, phosphorus, and solids determinations. Methodology for the PCB determination and QA/QC documentation for the chemical analysis are submitted as Appendix B.

Water quality parameters; the limit of detection; the reference citation for the analytical method employed; and the method of preserving or treating the sample in the field is presented in Table 1.

One of the objectives of the study was to determine the concentrations of PCBs associated with suspended materials in the water. Filtration was conducted initially as the means for solids/

Table 1. Chemical parameters analyzed in water, sediment and fish tissue.

Parameter	Preservation	Detection Limit (mg/l)	Reference
WATER QUALITY			
Organic Nitrogen	1,2	0.01 as N	APHA[1], pg. 437
Ammonia Nitrogen	1,2	0.01 as N	EPA[2], pg. 165
Nitrate Nitrogen	1,2	0.01 as N	APHA, pg. 427
Total Phosphorus	1,2	0.005 as P	EPA, pg. 249
Total Solids	1	1	EPA, pg. 270
Total Suspended Solids	1	1	EPA, pg. 268
Total Dissolved Solids	1	1	EPA, pg. 266
Dissolved Oxygen	In situ		APHA, pg. 484
pH	In situ		APHA, pg. 460
Temperature	In situ		APHA, pg. 348
PCB	1	0.0001	EPA[3], 1973
SEDIMENTS			
PCB	1	0.1 (mg/kg)	EPA[4], 1969
Sieve Analysis			FOLK[5], 1974
FISH TISSUE			
PCB	1	0.1 (mg/kg)	EPA, 1969

REFERENCES

1 American Public Health Association, et al., 1975. Standard Methods for the Examination of Water and Wastewater, 14th edition, Washington, D.C.

2 United States Environmental Protection Agency, 1974. Manual of Methods for Chemical Analysis of Water and Wastes, Washington, D.C.

3 United States Environmental Protection Agency, 1973. Methods for Polychlorinated Biphenyls in Industrial Effluents. Nat. Env. Res. Cent. Cinn., Ohio 45268.

4 United States Environmental Protection Agency, 1969. Great Lakes Region Committee on Analytical Methods. Chem. Lab. Manual. Bottom Sediments.

5 Folk, R.L. 1974. Petrology of Sedimentary Rocks. Hamphill Publ. Co., Austin, Texas. Pg. 16-17.

PRESERVATION TECHNIQUES

1 Refrigeration at 4 c.
2 H_2SO_4 to pH<2.

liquid phase separation on water samples collected in the spring. The water samples were filtered through a sintered glass funnel containing two Whatman #4 filter papers and through a 0.22u type GS millipore filter. However, the Milli-Q water spiked with PCBs showed that only five percent recovery of PCBs was attained through filtration. Also, the recoveries of PCBs from filtered tap water also indicated that the filtration procedure removes over 90 percent of the PCBs from the water. Assuming there is little or no suspended material in the water, it appears that the filters were removing the PCBs from the water itself; therefore the amount of PCBs associated with suspended material could not be determined by this method. The water samples were then centrifuged at 2500 rpm for five minutes and the supernatant taken for PCB measurement. One aliquot was analyzed uncentrifuged and another aliquot was centrifuged to remove suspended solids. Milli-Q water spiked with PCBs showed 60 percent PCB recovery after centrifugation. Therefore, this method was used to approximate the concentration of PCBs associated with suspended sediment.

A question that had arisen regarding the discussion of PCB analytical methodology was if the EPA, 1973 method was the same as the method employed by Raltech Scientific Services on the project. The extraction and clean-up procedures for determining PCB concentration in water by Raltech Scientific Services (EPA, 1979), "Chemistry Laboratory Manual for Bottom Sediments and Elutriate Testing") is the same as the method specified in the Scope of Work (EPA, 1973), "Methods for PCBs in Industrial Effluents"). The limit of detection shown in the EPA, (1973) Method, is approximately 1 mg/l for each Aroclor mixture when using microcoulometric or electrolytic conductivity detectors based on a 1 liter sample. However, if interference poses no problems, the sensitivity of the electron capture detector permits as little as 100 ml of the sample to be used (EPA, 1973, "Methods for PCBs in Industrial Effluents"). The limit of detection shown in the EPA, (1979) method is 0.1 ug/l when using electron capture detector based on a 1 liter water sample.

The following subsection of this report presents the analytical results of the spring high flow and fall low flow sampling programs and discusses the measured concentrations of these parameters in relation to water quality criterion concentrations established by the Environmental Protection Agency (EPA, 1976).

2. Results and Discussion

Water quality parameters measured at Stations A through L are presented in Tables 2, 3 and 4. In general, chemical constituents of the water did not vary significantly among stations and concentrations are typical of small warm water streams traversing a forest and agricultural environment.

The nitrogenous compounds enter the stream through runoff from agricultural land and the decomposition of organic matter. Organic nitrogen ranged from 1.52 to 0.19 mg/l in the spring and 1.32 to 0.33 mg/l during the fall survey. Ammonia nitrogen concentrations ranged from <0.01 to 0.49 mg/l in the spring and 0.01 to 0.58 mg/l in the fall. Ammonia concentrations for the stream system were generally higher in the fall. Levels of un-ionized ammonia in the range of 0.20 to 2 mg/l have been shown to be toxic to some species of freshwater aquatic life and a water quality criterion of 0.020 mg/l has been specified to provide safety for aquatic life (EPA, 1976).

Nitrate nitrogen concentrations were greater in samples collected during the spring, ranging from 3.56 to 1.04 mg/l and 0.335 to 0.935 mg/l in samples collected during the fall. Concentrations of nitrate-nitrogen were well below the 90 mg/l criterion of having an adverse effect on warm water fish (EPA, 1976). There were no discernible trends in nitrogen parameters being consistently higher or lower at stations on Salt Creek, Pleasant Run or Bailey Branch (discharge stream) and there was no pattern of nitrogen compounds increasing or decreasing through the system of streams.

Table 2. Water Quality of Pleasant Run and Salt Creek near Bedford, Indiana.

Station	Organic Nitrogen		Ammonia Nitrogen		Nitrate Nitrogen		Total Phosphorus		Total Solids		Total Suspended Solids		Total Dissolved Solids	
	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall
A-1	1.52	1.13	0.35	0.01	1.12	0.398	1.28	0.862	765	683	13.7	1.4	751	682
A-2	1.03	0.85	0.49	0.35	1.04	0.337	1.26	0.815	756	718	11.3	1.4	745	717
B-1	0.88	1.23	<0.01	0.22	3.56	0.856	0.219	0.598	472	2269	12.4	5.5	460	2263
B-2	0.74	0.58	<0.01	0.77	3.45	0.935	0.225	0.592	470	2231	13.0	7.0	457	2224
C-1	0.39	0.91	<0.01	0.26	3.07	0.538	0.070	0.050	294	296	16.0	2.2	278	294
C-2	1.36	0.78	<0.01	0.32	3.07	0.463	0.073	0.024	312	263	25.6	1.6	286	261
D-1	0.28	0.88	<0.01	0.46	2.77	0.335	0.066	0.108	306	266	7.1	3.6	299	262
D-2	1.18	0.75	<0.01	0.30	2.68	0.374	0.037	0.065	280	282	6.4	7.9	274	274
E-1	0.75	0.61	<0.01	0.78	3.04	0.636	0.050	0.462	375	1001	9.4	16.0	366	985
E-2	0.19	0.76	<0.01	0.13	3.11	0.650	0.044	0.475	373	927	7.7	6.6	365	920
F-1	0.77	1.32	0.11	0.57	3.02	0.718	0.076	0.407	328	590	10.3	10.6	318	579
F-2	0.94	0.62	0.26	0.58	3.06	0.783	0.089	0.404	318	586	10.5	9.9	307	576
G-1	1.03	-	0.26	-	2.48	-	0.099	-	407	-	25.5	-	381	-
G-2	1.16	-	0.05	-	2.42	-	0.083	-	384	-	23.1	-	361	-
H-1	0.71	0.94	0.11	0.18	2.62	0.658	0.073	0.329	354	680	22.5	30.2	331	650
H-2	0.37	1.00	0.03	0.58	2.59	0.632	0.060	0.352	354	625	17.4	30.0	337	595
I-1	1.11	0.89	0.03	0.22	1.38	0.849	0.128	0.287	209	534	35.4	38.8	174	495
I-2	1.08	0.91	0.16	0.22	1.41	0.875	0.096	0.293	201	459	34.0	43.3	167	416
J-1	0.91	0.74	0.09	0.46	1.29	0.827	0.112	0.280	205	550	31.2	41.6	174	508
J-2	0.25	0.72	0.19	0.33	2.26	0.775	0.099	0.274	272	490	26.2	37.8	246	452
K-1	0.39	0.74	0.09	0.16	1.34	0.804	0.084	0.264	228	637	22.9	45.4	205	592
K-2	0.48	0.33	0.11	0.48	1.43	0.814	0.134	0.264	224	647	23.2	42.1	201	605
L-1	1.04	1.00	0.21	0.01	1.23	0.811	0.271	0.245	250	562	86.4	40.1	164	522
L-2	0.63	0.76	0.30	0.36	1.25	0.811	0.238	0.258	176	451	86.0	11.3	90	440

All data are expressed as mg/l.

Table 3

In Situ Physical/Chemical Parameters of Pleasant Run and Salt Creek near Bedford, Indiana

Station	Spring Sampling			Fall Sampling		
	Dissolved Oxygen (mg/l)	pH (as pH Unit)	Temperature (^{o}C)	Dissolved Oxygen (mg/l)*	pH (as pH Unit)	Temperature (^{o}C)
A	8.8	7.3	16.2	*	7.6	21.0
B	10.6	7.5	12.5	*	7.6	20.0
C	11.7	6.7	11.5	*	7.1	21.0
D	11.2	6.9	12.0	*	7.3	21.0
E	10.5	7.3	10.8	*	7.6	20.0
F	11.0	7.6	11.5	*	7.4	20.0
G	9.6	6.9	12.0	*	-	-
H	9.2	7.4	14.0	*	7.6	22.5
I	8.3	7.1	13.0	*	7.3	22.0
J	8.8	7.1	13.0	*	7.4	22.0
K	8.4	7.1	13.0	*	7.4	22.0
L	7.3	7.6	14.0	*	7.2	21.5

* equipment malfunction

Table 4

PCB Levels in Water Samples (µg/l)[1]

Station	Spring Sampling		Fall Sampling	
	Uncentrifuged	Centrifuged[2]	Uncentrifuged	Centrifuged[2]
A	-	-	8.96	3.50, 3.65
B	5.6	2.2	10.3, 11.2	3.21
C	<0.10	<0.10	<0.10	<0.10
D	<0.10	<0.10	0.45	0.18
E	3.7	2.0	7.95	4.83
F	3.0	1.8	7.02	4.13
G	2.8	1.1	-	-
H	3.2	1.6	4.04	2.31
I	0.17	0.10	0.28	0.14
J	0.16	0.10	0.23	0.10
K	0.32	0.12	0.30	0.16
L	0.39	(3)	0.46	0.27

(1) PCB concentration is calculated as Aroclor 1242 and detection limit was 0.1 µg/l based on a 1 liter sample.

(2) The water samples were centrifuged at 2500 rpm for 5 minutes and supernatant was taken for PCB measurement.

(3) Sample extract could not be recovered.

- (Station A, sample lost).
- (Station G, location not accessible).

Phosphorus as phosphate is one of the major nutrients required for plant nutrition and therefore stimulate plant growth. Phosphorus is contributed to the stream system primarily through surface runoff and the addition of organic detritus. Total phosphorus concentrations were highest at Station A during the spring (1.26, 1.28 mg/l) and fall (0.862, 0.815 mg/l) survey. With the exception of stations A, C and L-1, total phosphorus concentrations were higher in the fall.

During the spring and fall surveys, solids primarily existed in the dissolved state. Concentrations of dissolved solids were generally higher at Stations A, B and E, and lowest at C and D. In the spring, dissolved solids concentrations ranged from 751 mg/l at Station A to 90 mg/l at Station L and in the fall from 2263 mg/l at Station B to 261 mg/l at Station C. During spring, dissolved solids concentrations were similar from Station E through H, while in the fall, dissolved solids increased substantially at the aforementioned stations. During both spring and fall, dissolved solids concentrations on Salt Creek were lower than Pleasant Run and Bailey Branch with the exception of Stations C and D above the confluence of the two Branches of Pleasant Run. Although not definitely known, limiting concentrations for freshwater fish may range from 5,000 to 10,000 mg/l (EPA, 1976). Concentrations of total dissolved solids were well below this concentration range at all stations during the spring and fall surveys (Table 2).

Total suspended solids concentrations were generally higher in Salt Creek than Pleasant Run. In natural waters, suspended solids consist normally of erosion silt, organic detritus and plankton. Highest concentrations of total suspended solids were measured at Station L during the spring survey (86.0, 86.4 mg/l) while lowest concentrations were measured at Station A (1.4 mg/l) during the fall collection period.

During each field study *in situ* measurements for dissolved oxygen, pH and temperature were taken (Table 3). Dissolved oxygen concentrations during the spring survey ranged from 11.7 mg/l at

Station C to 7.3 mg/l at Station L. Dissolved oxygen concentrations exceeded 9.0 mg/l during the spring on the main branch of Pleasant Run. During the fall survey, a malfunction in the circuitry of the dissolved oxygen meter occurred. Therefore this data was questionable and not tabulated or discussed in the report. During spring dissolved oxygen concentrations were well above the minimum concentration of five mg/l for maintaining good fish populations (EPA, 1976).

Based on present evidence, a pH range of 6.5 to 9.0 appears to provide adequate protection for the life of freshwater fish and bottom dwelling invertebrates (EPA, 1976). pH values did not differ greatly among stations on Pleasant Run and Salt Creek during the spring or fall period. pH values range from 6.7 during the spring at Station C to 7.6 at Station L in the spring and stations A, B, E and H in the fall (Table 3).

Polychlorinated biphenyls (PCBs) are a class of compounds produced by the chlorination of biphenyls and are registered in the United States under the trade name Aroclor^{R}. The degree of chlorination determines their chemical properties, and generally their composition can be identified by the numerical nomenclature e.g. aroclor 1242, 1254 etc. The first two digits represent the molecular type and the last two digits the average percentage by weight of chlorine (National Technical Information Service, 1972).

PCB concentrations in water samples on Pleasant Run and Salt Creeks were in the low ug/l (ppb) range (Table 4). Concentrations of PCBs generally decreased from Stations A and B on Bailey Branch and Pleasant Run, downstream to Salt Creek. Lower concentrations occurred above the confluence with Pleasant Run and Salt Creek, increasing slightly below the confluence at Stations K and L. During the spring sampling, PCBs in whole water samples ranged from 5.6 ug/l at Station B to 0.16 ug/l at Station J and were <0.10 ug/l detection limit as Stations C and D. During the fall sampling period, concentrations ranged from 10.3 and 11.2 ug/l at Station B

to 0.23 ug/l at Station J and <0.10 ug/l at Station C. PCBs were detected at Station D during the fall sampling at a concentration of 0.45 ug/l. This station is near the confluence with Bailey Branch of Pleasant Run in a flood area. Due to the heavy rains during the fall period, PCBs probably were contributed from the overland runoff of contaminated sediment in this area. The results of all samples collected and analyzed on Pleasant Run and Salt Creek were calculated as Aroclor 1242 because the PCB pattern for most of the samples resembled Aroclor 1242. In a few cases, there appeared to be some pattern shifts; however all PCB data presented were calculated as Aroclor 1242.

The relatively higher concentrations of PCBs in the fall was probably due to the much lower stream flow and lower dilution coupled with some PCB addition through runoff from the exposed banks during this period of heavy fall rains (Table 4).

Studies were conducted during the spring high flow and fall low flow periods to determine PCB concentrations associated with suspended sediment. To accomplish this task, PCBs were analyzed at each station in whole water samples and then in the supernatant from an aliquot taken from the respective whole water sample following centrifugation. Concentrations of PCBs in the supernatant are also presented in Table 4. To arrive at the determination we assumed that the difference in PCB concentrations in whole water and the concentration in the supernatant would indirectly approximate the concentration associated with the sediment. The concentrations of PCBs directly measured in the supernatant (liquid fraction) is presented in Table 4 and the calculated concentration of PCBs at the various stream locations is presented in Table 5. The concentration of PCBs associated with sediment in water samples collected during the spring and fall surveys ranged from 40 to 70 percent with an average of 49 percent calculated for each seasonal study. During the spring period, the sand particle size group was generally more prevalent in samples collected for suspended sediments analysis than

in the fall, although the silt size group was the dominant suspended particle size in the water samples (Table 6). A higher percentage of sand would be expected because of the greater flow and higher stream velocities in the spring. Although total sediment transport was generally greater in the spring, PCB concentrations were correspondingly lower during the spring period. It should be reiterated at this point, that surface runoff, due to heavy rains, accompanied both the spring and fall surveys. The difference in PCB concentrations between the spring and fall surveys appears to be primarily due to dilution effects during the spring. In addition it is hypothesized that PCBs may be added to the stream system through runoff effect and scouring of the exposed banks which consisted of silt and clay. It appears that PCBs are not significantly mobilized by the resuspension of bottom sediments. The aforementioned assumption is based upon the premise that if the streams have the energy to transport the sand fraction, the bed of streams should be scoured sufficiently to resuspend the particle sizes smaller than the sand fraction (silt and clay) and thus increasing significantly the concentrations of PCB associated with the suspended sediment in the water column. Therefore one would suspect, even with dilution, a greater PCB concentration associated with suspended sediment during the spring high flow conditions if PCBs were being mobilized from the stream bed to any great extent.

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VI. SEDIMENTS

1. Methodology

Sediment core samples were collected at Locations B, C, D, E, F, G, H, I, J, K, L (Figure 2). These samples were collected using a gravity type or manual coring device. The procedure document for collecting sediment cores (No. 3902023) is presented in Appendix A. Core samples were collected in replicate at opposite sides in the river channel at locations with similar stream velocities. These locations were established on the tag line during velocity measurements for current cross sections to determine stream flow. A different core sampler insert chamber was used for each sample to prevent contamination between stations. In addition, before use, all inserts were washed in the laboratory using EPA approved methods.

The core sampler was inserted as vertically as possible into the stream bed penetrating to a depth of approximately twelve inches. Because of the hard, clay/rock bottom of Salt Creek, core sample penetration was limited to approximately four inches. Following collection of the core, the sediment was extruded into laboratory cleaned glass sample containers, labeled with the project number, site number, station number, collection date and investigators initials. The sample was thoroughly mixed and then subsampled for particle size determinations and PCB analysis. These samples were immediately placed in an ice chest and delivered to the laboratory for analysis.

As with the water chemistry samples, a chain-of-custody form presented in the QA/QC section (Appendix A) accompanied the samples to the laboratory where the PCB analysis were performed. A subsample of this core was analyzed at CDM for particle size distribution. The laboratory procedures for particle-sizing sediment cores (No. 3902029) is presented in Appendix A. Field data forms, notes and chain-of-custody forms have been bound and submitted to General Motors Corporation under separate cover because of their voluminous nature.

The area subjected to flooding was also sampled and these samples analyzed for PCB concentrations. This area was within the boundary delineated by high water marks. Core samples were collected at locations in the areas studied and composited to form one sample per area. The study was designed to determine the presence of PCBs and not delineate the area of contamination. Core samples were collected by a laboratory cleaned sampling container to an approximate depth of four inches. A sufficient number of samples were collected to form the composite sample at each station to detect the presence or absence of PCB in the study area. The locations of these areas are presented in Figure 2. Samples were placed in laboratory cleaned glass containers, transferred to an ice chest and shipped to the laboratory for analysis.

Suspended sediment analysis for particle size distribution and associated PCB concentrations were performed on samples collected at stations B, C, D, E, F. G, H, I, J, K, and L. Suspended sediment samples were collected along the tag line where core samples were collected. A DH-48 suspended sediment sampler recommended by the U.S. Geological Survey and their procedure for depth-integrating samples for suspended sediment was used on this study. The procedure used for sampling suspended sediment in small streams and the determination of mass transport (No. 3902027) is presented in Appendix A. A Marsh-McBirney Model 210 electromagnetic current meter was used to take velocity measurements. At all stations velocity was measured at the 0.6 depth. The "partial section" method of flow measurement in streams was applied to calculate flow in cfs at the stream locations. The "partial section" method (No. 3902012) is presented in Appendix A.

2. Results and Discussion

There is a considerable variation in bottom configuration and substrate type between the station locations on Pleasant Run and Salt Creek. These differences can be noted by visual observation

and the variations in distribution of gravel/sand, silt and clay fractions in core samples. Table 7 presents the distribution of sand/gravel, silt, and clay. The sand and gravel fraction in samples were higher at the upstream stations of Bailey Branch and the main branch of Pleasant Run to the confluence with Bailey Branch at Station E. From Station F through H, in the slower moving segments, silt size particles became the dominant substrate type. In core samples taken on Salt Creek, the silt size particles were also the dominant size category. PCB concentrations determined in sediment cores at the stations are also presented in Table 7. The concentrations of PCBs varied considerably among stations and did not appear to have a direct relation to particle size distribution in the core. It appears that there are several interacting factors influencing the high variability of PCB concentration and the distribution of sediments in the core samples:

a. the compaction and inherent nature of the sediment;
b. the location of the station;
c. subsampling from a composite sample of the core;
d. the affinity for PCB's to be associated with the different particulate material.

Samples at stations on the branches of Pleasant Run were collected in areas of nonconsolidated sediment. In viewing the core before placing in the container, various lens thicknesses of coarser material and dark gray material were observed. The thickness of these layers varied as well as their boundary delineation from one another. It should be remembered here that the analysis of PCB was conducted on a composite of these various sediments lens. Therefore, if the different lens have different relative PCB concentrations, and analysis was conducted on a composite, then PCB concentrations would not necessarily reflect the particle size distribution, i.e., percentage of sand (which is assumed to have a lower affinity for PCB than the finer silt and clay) but the concen-

tration of contamination in one of the lens. The variability in PCB concentration can be seen that exist in core samples at the same location in the stream bed accounting for the large differences between cores taken at the same location and during different flow conditions (Table 8).

For the most part, the bed of Salt Creek in the areas of study consisted of rock or consolidated clay. From the nature of this substrate it appears that the material is mainly inherent to the natural stream bed with a minor amount of deposition occurring near the confluence with Pleasant Run (Station H and K). The high degree of consolidation of the sediment, low sediment deposition, and the sediment being inherent to the natural stream bed is a possible explanation for the relatively low PCB concentrations.

PCB concentrations in core samples ranged from 482 mg/kg at Station E to <0.1 mg/kg at Station C. On Salt Creek, PCB concentrations in core samples were less than 10 mg/kg PCB with the exception of core sample K-2, L-1 and L-2 which had respective concentrations of 103.0 mg/kg, 20.3 mg/kg and 19.3 mg/kg PCB on a dry weight basis (Table 8).

PCB concentrations in watershed samples ranged from 152 mg/kg at Station F to <0.10 mg/kg at Station C on a dry weight basis (Table 9). Samples were not collected at Station G since access to the property could not be attained. Upstream from Station B the channel is cut through rock and forest land and it appears that the flow is well channelized with minor flooding. The area subject to flooding is most pronounced from Station B to Station G. In this area PCB concentrations in samples ranged from 80 to 152 mg/kg on a dry weight basis. With the exception of Station K, PCB concentrations in Salt Creek samples were less than five mg/kg on a dry weight basis.

Stream discharge measurements and total sediment transport in the streams during the high flow and low flow periods are presented in Table 5. As discussed in the previous water chemistry section of

this report, high flow conditions in spring were primarily due to heavy rains. During the fall survey, periods of rain also probably contributed a substantial amount of sediment to the streams through surface runoff. PCB concentrations associated with suspended sediment were generally higher at gaging stations during fall while total sediment transport was consistently higher at stations in the spring. It appears that lower PCB concentrations in the spring were primarily due to dilution effect during significantly higher stream flow conditions.

Table 5. Summary Data of Flow, PCB Concentration for Suspended Sediment, and Sediment Transport.

Station	Spring Sampling (High Flow Study) Date	Flow(ft^3/sec)	S_T(kg/s)(1)	PCB Conc. for the Suspended Sediment (µg/l)(2)	Fall Sampling (Low Flow Study) Date	Flow(ft^3sec)	S_T(kg/s)(1)	PCB Conc. for the Suspended Sediment (µg/l)(2)
B	5/20/81	6	2.16×10^{-3}	3.4	9/2/81	1.7	3.0×10^{-4}	7.10
C	5/20/81	12	7.1×10^{-3}	<0.10	9/2/81	0.73	3.9×10^{-5}	<0.10
D	5/21/81	11	2.1×10^{-3}	<0.10	9/2/81	2.54	4.1×10^{-4}	0.27
E	5/21/81	17	4.1×10^{-3}	1.7	9/2/81	4.40	1.4×10^{-3}	3.12
F	5/21/81	30	8.8×10^{-3}	1.2	9/2/81	4.55	1.3×10^{-3}	2.89
G	5/20/81	35	2.41×10^{-2}	1.7	9/1/81	-		-
H	5/20/81	42	2.38×10^{-2}	1.6	9/1/81	8	6.8×10^{-3}	1.73
I	5/20/81	889	8.73×10^{-1}	0.07	9/1/81	105.	1.22×10^{-1}	0.14
J	5/19/81	1321	1.3	0.06	9/1/81	133	1.49×10^{-1}	0.13
K	5/19/81	1673	1.36	0.20	9/1/81	186	2.3×10^{-1}	0.14
L	5/19/81	1810	4.42	(3)	9/1/81	152	1.1×10^{-1}	0.19

(1) S_T is total sediment transport at the measured rate. And $S_T = S_C \times Q$, where S_C is mean concentration of total suspended solids, Q is stream discharge. Total suspended solids data is presented in table 2 page V-5.

(2) PCB concentration for the suspended sediment is calculated as the difference between uncentrifuged concentration and centrifuged concentration of water samples.

(3) Sample extract could not be recovered.

Table 6. Percent sand, silt and clay in water samples collected during the spring and fall surveys for total sediment transport (S_t) determinations.

Station	Spring Sampling			Fall Sampling		
	% Sand	% Silt	% Clay	% Sand	% Silt	% Clay
B	41	59	-	20	80	-
C	100	-	-	100	-	-
D	13.04	86.96	-	-	100	-
E	-	100	-	-	100	-
F	36.26	46.20	17.54	-	50	50
G	3.52	96.48	-	-	-	-
H	2.93	97.06	-	50	25	25
I	6.79	90.81	2.40	33.3	66.6	-
J	68.19	31.81	-	-	100	-
K	46.55	32.75	20.69	-	100	-
L	15.42	76.47	8.11	-	100	-

Table 7. Summary Data of the Distribution of Sediment Categories based on Phi Size and PCB Concentrations at various stations.

Station	Spring Sampling (High Flow Study)					Fall Sampling (Low Flow Study)				
	Date	Sand and Gravel (%)	Silt (%)	Clay (%)	PCB Conc. (mg/kg)*	Date	Sand and Gravel (%)	Silt (%)	Clay (%)	PCB Conc. (mg/kg)*
B	5/20/81	91.29	8.84	0.0	202.0, 109.0	9/2/81	98.05	1.57	0.38	24.1, 111.0
C	5/20/81	89.00	10.40	0.59	<0.1, 0.12	9/2/81	92.63	6.66	0.70	<0.1, <0.1
D	5/21/81	86.48	12.68	0.80	0.22, <0.1	9/2/81	46.29	37.05	16.66	32.7, 18.9
E	5/21/81	87.02	9.30	3.67	482.0, 99.9	9/2/81	50.78	41.06	8.15	344.0, 229.0
F	5/21/81	27.82	51.22	20.85	43.3, 11.4	9/2/81	49.02	36.78	14.20	209.0, 285.0
G	5/20/81	30.70	65.38	3.92	102.0, 107.0	-	-	-	-	-
H	5/20/81	17.64	80.04	2.31	113.0, 60.3	9/1/81	36.12	46.98	16.90	18.2, 39.7
I	5/20/81	23.86	71.63	4.51	0.87, 0.17	9/1/81	29.98	68.60	1.42	1.46, 0.75
J	5/19/81	30.72	48.82	20.45	0.40, 0.80	9/1/81	30.02	63.57	6.40	0.71, 0.65
K	5/19/81	37.85	52.66	9.44	3.62, 103.0	9/1/81	47.46	52.23	0.30	2.56, 7.85
L	5/19/81	32.16	58.53	9.30	2.87, 19.3	9/1/81	30.77	68.14	1.08	20.3, 4.44

*PCB concentration is calculated on dry weight basis and taken from Table 8.

Table 8

PCB Levels in Sediments

Station	Fall Sampling					
		Aroclor 1242 (mg/kg)*			Aroclor 1242 (mg/kg)*	
	% Moisture	Wet Weight Basis	Dry Weight Basis	% Moisture	Wet Weight Basis	Dry Weight Basis
B-1	0.70	201.0	202.0	0.1	24.1	24.1
B-2	0.60	108.0	109.0	0.3	111.0	111.0
C-1	0.70	<0.1	<0.1	2.1	<0.1	<0.1
C-2	0.70	0.12, 0.16	0.12, 0.16	1.1	<0.1	<0.1
D-1	0.90	0.22, 0.22	0.22, 0.22	1.9	32.1	32.7
D-2	1.10	<0.1	<0.1	2.6	18.4	18.9
E-1	1.09	477.0	482.0	1.3	340.0	344.0
E-2	0.59	99.3	99.9	1.6	225.0	229.0
F-1	1.00	42.9	43.3	2.1	205.0	209.0
F-2	27.8	8.23	11.4	1.8	280.0	285.0
G-1	1.36	101.0	102.0	-	-	-
G-2	0.98	106.0	107.0	-	-	-
H-1	0.88	112.0	113.0	2.2	17.8	18.2
H-2	0.58	59.9	60.3	1.4	39.1	39.7
I-1	39.1	0.53	0.87	1.6	1.44	1.46
I-2	29.1	0.12	0.17	1.5	0.74	0.75
J-1	0.80	0.40	0.40	1.5	0.70	0.71
J-2	36.3	0.51	0.80	1.5	0.64	0.65
K-1	1.19	3.58	3.62	1.7	2.52	2.56
K-2	0.98	102.0	103.0	5.5	7.42	7.85
L-1	35.8	1.84	2.87	1.8	19.9	20.3
L-2	1.42	19.0	19.3	1.9, 2.0	4.36, 4.22	4.44, 4.31

*PCB concentration is calculated as Aroclor 1242 and detection limit was 0.10 mg/kg based on a 20 g sample.

Table 9

PCB Levels in Watershed Composite Samples

Station	% Moisture	Aroclor 1242 (mg/kg)* Wet Weight Basis	Dry Weight Basis
A	0.8	38.4	38.7
B	0.4, 0.4	95.6, 92.4	96.0, 93.0
C	1.2	<0.10	<0.10
D	1.7	80.6	82.0
E	1.4	129.0	131.0
F	1.6	150.0	152.0
H	1.6	43.6	44.3
I	1.2	1.92	1.94
J	1.4	2.55	2.59
K	1.5	28.6	29.0
L	1.5	4.15	4.21

*PCB concentration is calculated as Aroclor 1242 and detection limit was 0.10 mg/kg based on a 20 g sample.

VII. PERIPHYTON

1. Methodology

Four replicate periphyton samples were collected from rock substrates (when possible) at Stations B, C, D, G, I, and K during spring and late summer (Figure 2). Samples were obtained by scoring rings into rocks with a No. 10 cork borer and scraping the periphyton enclosed by the ring (2.46 cm^2) into labeled sample containers. One ring (2.46 cm^2) was placed in each of four sampling bottles containing 10 mls of "M^3" fixative (Meyer 1971) and transported to the CDM laboratory. Periphyton were collected from rocks with maximum visible algal growth and from riffle areas with maximum estimated daily exposure to sunlight. The following information was recorded on one field data form (F0113 Rev E) per station for each sample collected: substrate, estimated percent daily exposure to sunlight, current velocity and depth. Also, the land use was recorded in the immediate area as cropland, pasture (with or without livestock access), forest, etc. so that the amount of disturbance to the periphyton community can be estimated.

Periphyton samples were analyzed for species composition and density using the inverted microscope method (Lund et al. 1958). The sample bottles were diluted or concentrated to workable volume depending on the concentrations of material in the samples. Each sample bottle was inverted several times and immediately subsampled with a volumetric pipette. The subsample was discharged from the pipette into a settling chamber, and distilled water was added to fill the chamber. The individual subsample volume was carefully selected to produce an optimum concentration of periphyton on the bottom coverslip. The chamber was then covered and left undisturbed for a sufficient time to allow the periphyton to settle on the bottom coverslip. After the appropriate settling time, the chamber was transferred to an inverted microscope and examined at high power magnification (1000X to 1250X). Periphyton in selected transects

were identified and counted for three hours or until the relative abundance of the species present was determined. Burnt mounts were used to evaluate the relative abundance and species composition of diatoms. Periphyton densities were calculated and expressed as reporting units per milliliter (units/ml) using the following criteria: each frustule, cell, filament or colony equals one unit.

Periphyton were identified to the lowest practical taxon (usually species) with the aid of the following taxomonic references: Collins and Kalinsky (1977), Desikarchary (1959), Geitler (1932), Huber-Pestalozzi (1938 and 1941), Huber-Pestalozzi and Hustedt (1942), Huber-Pestalozzi and Fott (1968), Hustedt (1930), Patrick and Reimer (1966 ad 1975), Prescott (1962), Skuja (1948, 1956 and 1963), Smith (1920 and 1950), Tiffany and Britton (1971), Walton (1915), Weber (1966), and Willen (1963). Burnt mount reference slides (Weber 1973) were used to aid in the identification of diatoms.

Voucher periphyton samples are retained for two years following project completion. All periphyton field and laboratory procedures followed CDM's existing Quality Assurance Program specifications. Computerized tables containing simple statistics such as numbers/cm^2, diversity and evenness indices are presented in Appendix C.

2. Results and Discussion

Periphyton include the assemblage of algal organisms that grow on free surfaces of submerged objects. They play an important role in flowing water because these organisms are the major primary producers in the aquatic environment. periphyton, in many instances, have been very useful toward indicating water quality. It is a well established fact that nutrition of algae is derived from the dissolved chemicals in the water and, therefore, their population dynamics should indicate the chemical environment of the surrounding water. However, there are physical factors such as light, current speed and temperature that influence the physiological state of algae.

Samples were collected from rock substrates in riffle areas where possible in Pleasant Run and Salt Creek. Differences in periphyton growth was primarily attributed to differences in habitat type. The number of different taxa and their abundance were greater in the rocky, shallower, faster stream head water locations at stations B, C, and D (Figure 3). Periphyton abundance and differences in species composition were generally lowest at Salt Creek. These periphyton population characteristics were attributed to the steep eroded banks, high turbidity and lack of suitable substrate. Diatoms were the major periphyton group in Pleasant Run while blue-green algae were the dominant group in Salt Creek. Green algae and Euglenoids comprised a minor part of the periphyton population (Figure 4).

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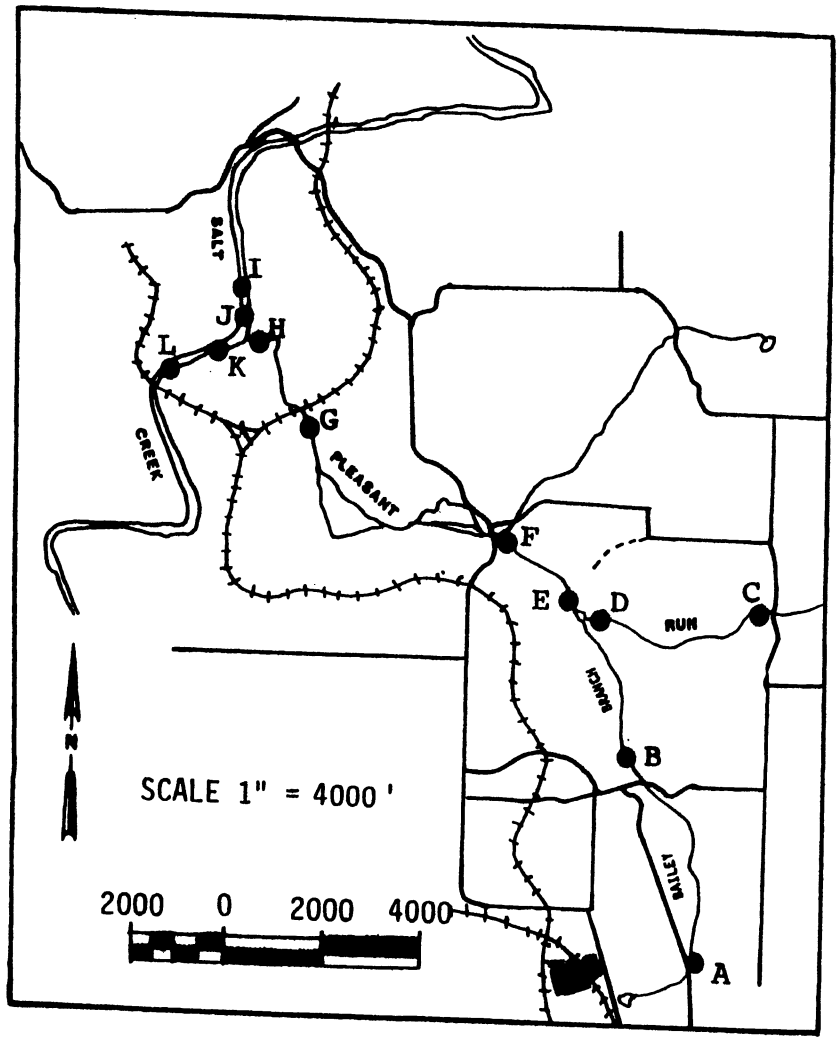
Figure 3. Total Periphyton and the number of Taxa collected at stations located on Pleasant Run and Salt Creeks.



STUDY AREAS ON PLEASANT RUN AND SALT CREEKS LAWRENCE COUNTY, INDIANA

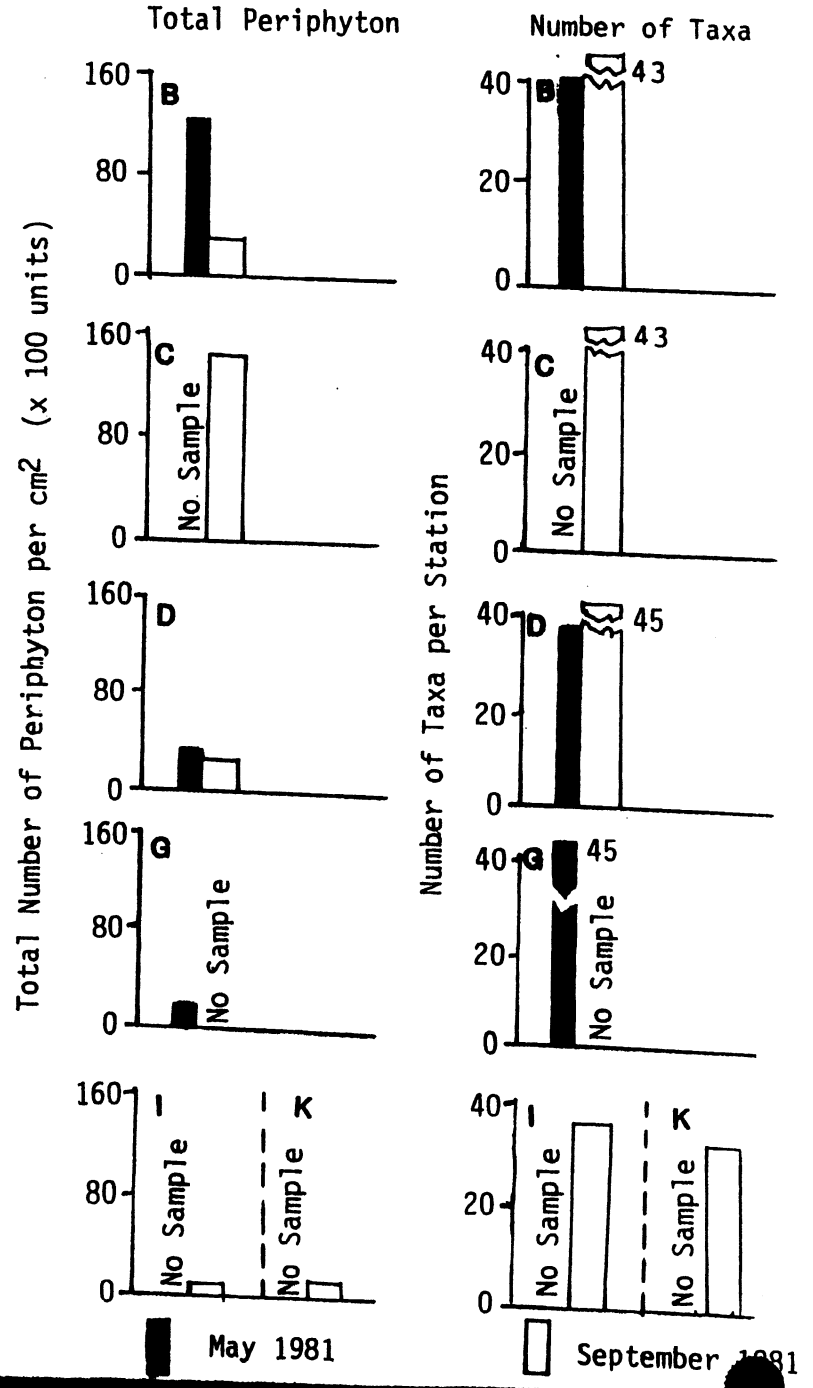
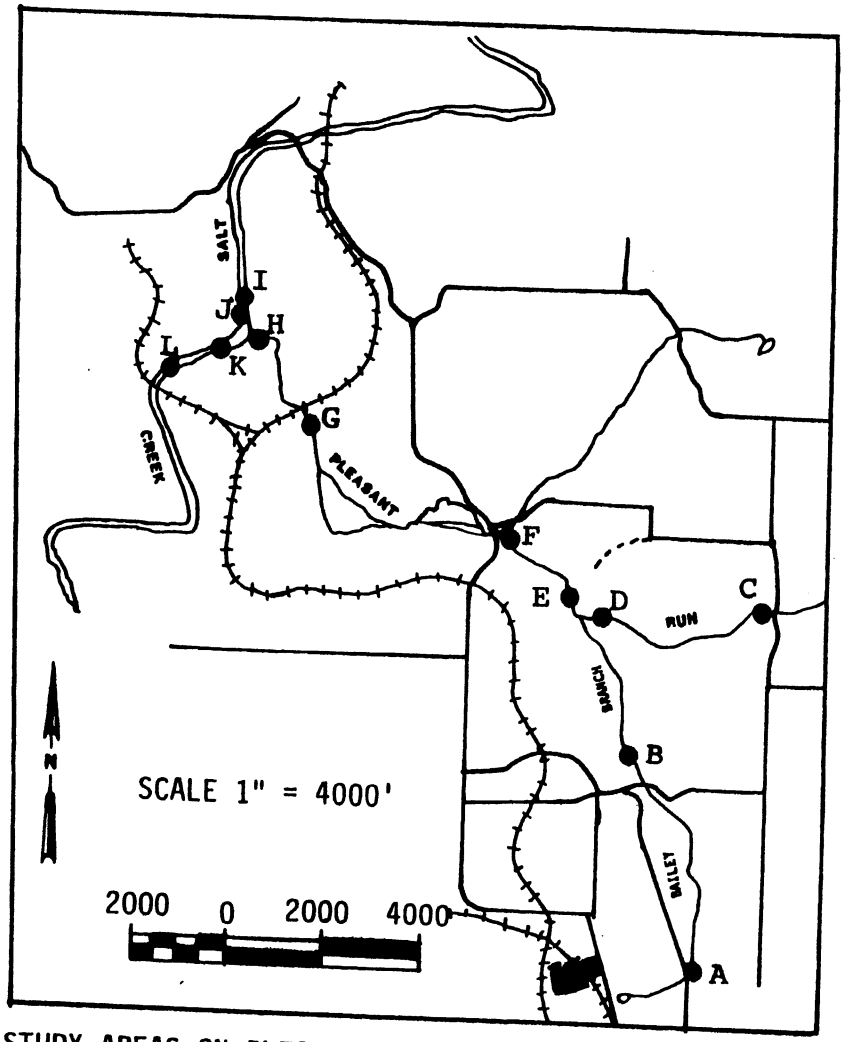


Figure 4. Percent composition of Periphyton on Pleasant Run and Salt Creeks.



STUDY AREAS ON PLEASANT RUN AND SALT CREEKS LAWRENCE COUNTY, INDIANA

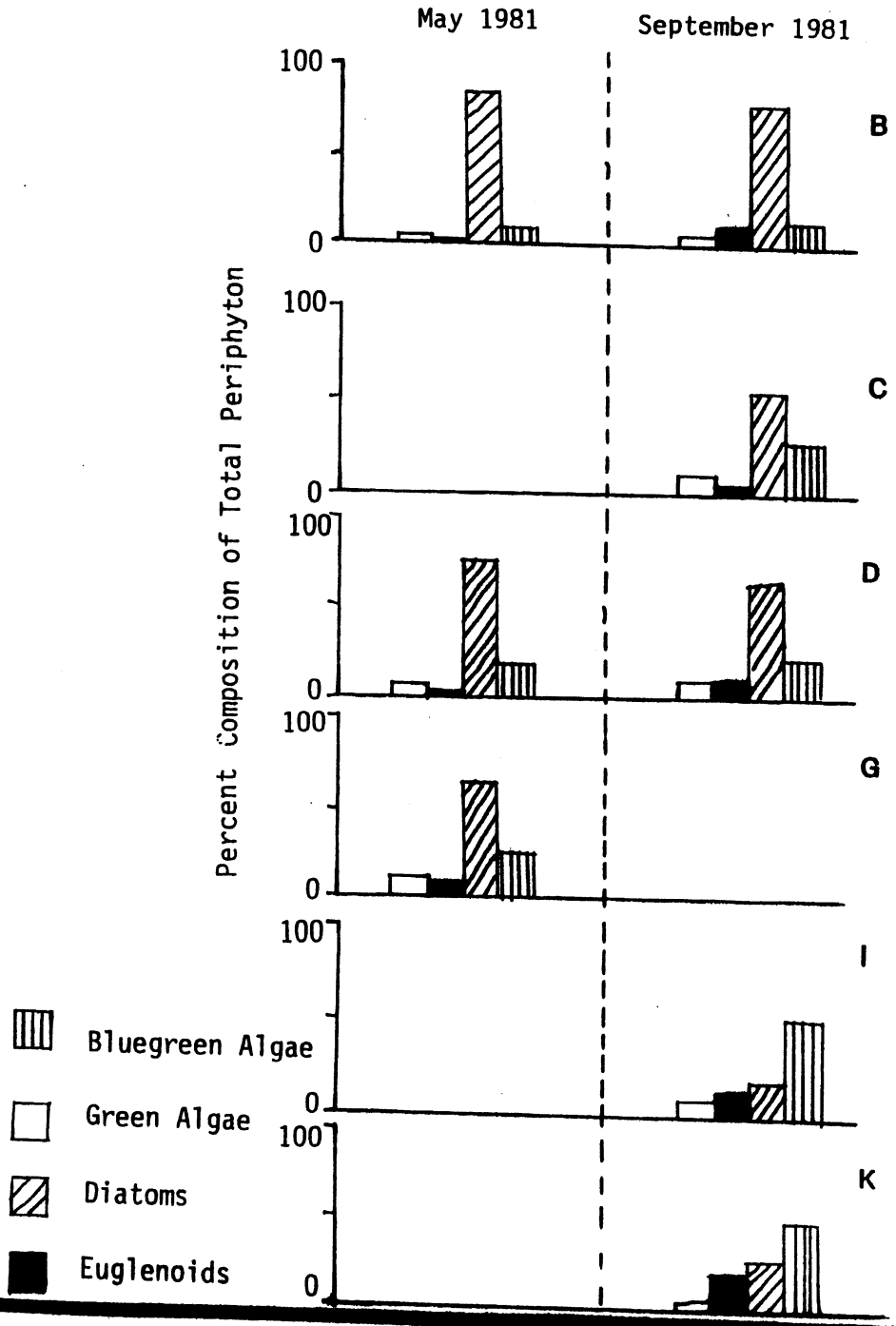
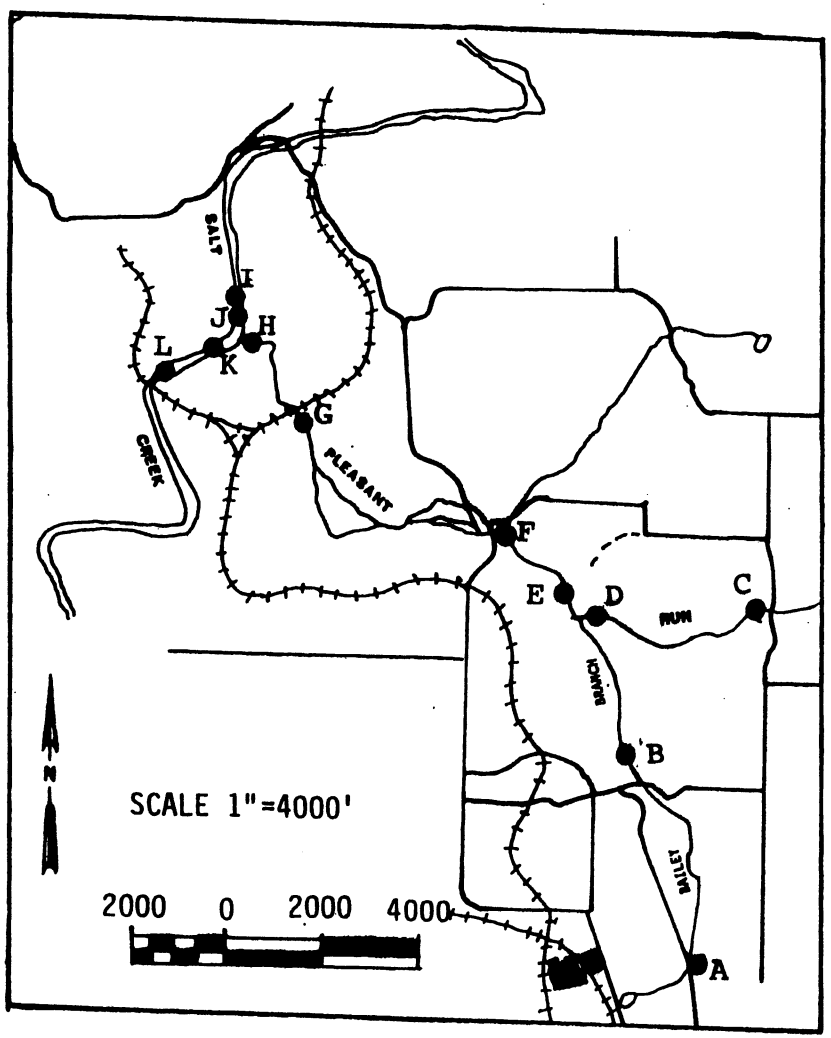


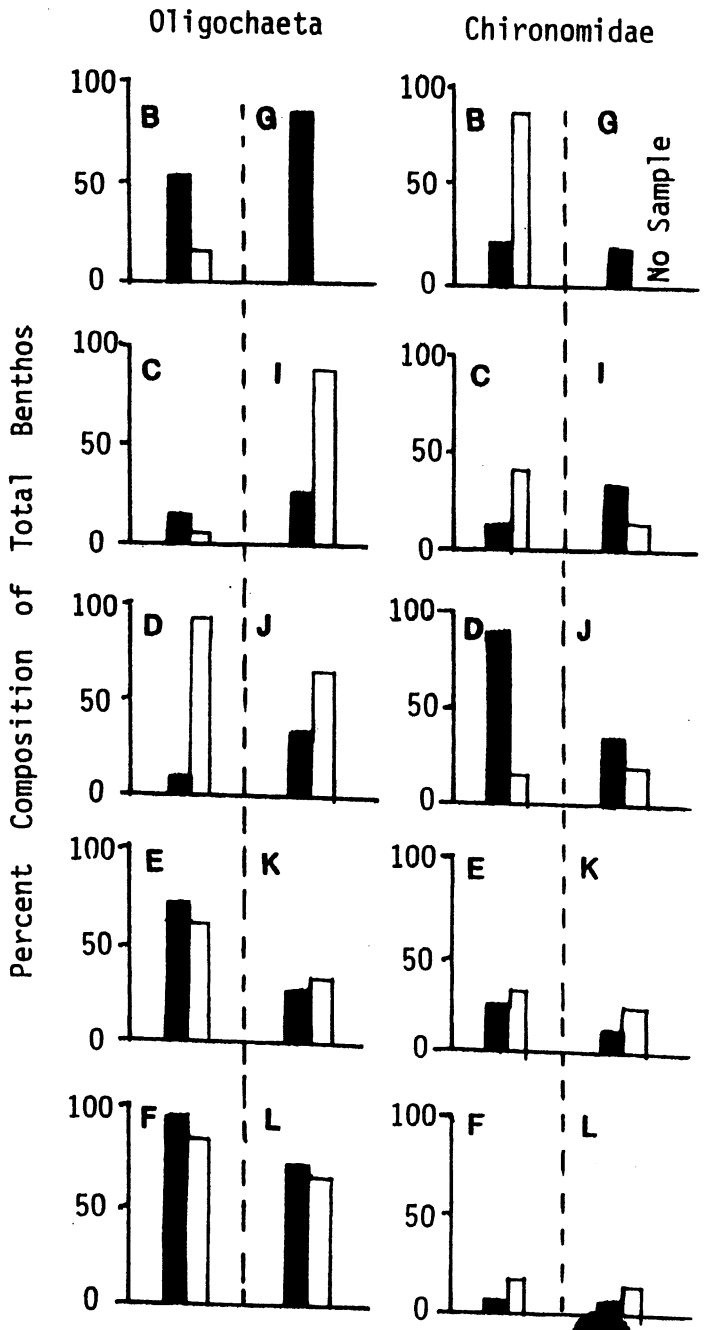
Figure 5. Percent composition of total Benthos, Oligochaeta and Chironomidae at Pleasant Run and Salt Creek locations.



STUDY AREAS ON PLEASANT RUN AND SALT CREEKS LAWRENCE COUNTY, INDIANA

May 1981

September 1981



VIII. BENTHOS

1. Methodology

Benthic macroinvertebrates were collected during the spring high water period and during the fall low water period. Four replicate samples were collected at Location B on Bailey Branch; Locations C, D, E, F and G on Pleasant Run; and Locations I, J, K and L on Salt Creek. Samples were collected using a petite Ponar (6 in x 6 in). Each sample was rinsed in the field on a U.S. Standard No. 30 mesh sieve (595u aperture), and the material retained on the sieve was rinsed into a labeled container, preserved with 10 percent formalin and transported to the laboratory for analysis.

In the laboratory, samples with excessive densities or an excessive volume of sediments were subsampled. The sample was rinsed onto a U.S. Standard No. 60 mesh sieve (250u aperture) and divided into quarters. If the density was still excessive, the quarter was further divided until a practical working density (approximately 200 organisms) was obtained. The unexamined portion was rinsed into a labeled jar and preserved with 10 percent formalin.

All benthic macroinvertebrates were sorted from the sediments using a dissecting microscope. All organisms, except worms and midges, were identified and enumerated when picked, then stored in 70 percent alcohol with five percent glycerin to prevent drying. Worms and midges were mounted and cleared in a nonresinous mounting medium on labeled microscope slides before being identified using a compound microscope. These slides were stored in labeled slide boxes. All benthic macroinvertebrates collected were stored by CDM and will be retained until further notification from General Motors Corp. All identification was to the lowest practical taxon using the following literature: Beck and Beck (1966 and 1969); Brinkhurst and Jamieson (1971); Brown (1976); Burch (1972); Edmondson (1959); Edmunds, Jensen and Berner (1976); Hamilton and Saether (undated);

Hilsenhoff (1975); Hiltunen (1967); Hiltunen and Klem (1980); Holsinger (1972); Klemm (1972); Merritt and Cummins (1978); Pennak (1978); Robak (1957); Saether (1969, 1971, 1976, 1977 and undated); Schuster and Etnier (1978); Sperber (1948); Usinger (1968); Wiggins (1977); and Williams (1972).

Benthic macroinvertebrate density was calculated using the equation:

$$D = N \times S \times C$$

where: D = density (number of organisms per square meter)
N = number of organisms counted
S = reciprocal of subsample fraction
C = collection device conversion factor (petite ponar = 43.06)

Shannon-Weaver (Zar 1974) species diversity index was applied to the data from each sample using the equation:

$$H' = \sum_{i=1}^{S} pi \log_2 pi$$

where: H' = species diversity index
S = number of species
pi = proportion of individuals found in taxon i

2. Results and Discussion

There is a scarcity of investigative studies involving the benthic macroinvertebrate community structures of the bodies of water in the immediate vicinity of the Bedford site. CDM (1980) has conducted an extensive Environmental Resource Inventory (ERI) near Francisco, Gibson County, Indiana and investigated the biology of Lost Creek in association with this inventory. Two water bodies, Lost Creek and the White River had physical characteristics that are

somewhat similar to Pleasant Run and Salt Creek. Therefore, a brief discussion of the general benthos for Lost Creek and the White River will be presented for comparative purposes to Pleasant Run and Salt Creek.

Lost Creek, the only water body in the general vicinity of the Francisco area, is a small creek ranging from one to two feet deep and one to five feet wide and reflected the physical characteristics of Pleasant Run at several locations. It has very few trees along the eight foot high clay banks. Although grass is present at the top of the banks, the sides are unprotected and highly susceptible to erosion. This is reflected in the substrate which is predominantly clay, mixed with sand, silt and gravel, the typical constituents comprising of the Pleasant Run and Salt Creek bottom substrates. The benthic macroinvertebrate fauna of Lost Creek was sparce, consisting of only five worm taxa, one sow bug, one true bug, and ten midge taxa. Other benthic macroinvertebrate studies in the immediate vicinity have been conducted in the White River located in the northern border of Gibson County. The White River has nearshore benthic habitats which were characterized by grassy shorelines; slow current; silt, clay and sandy substrates; and submerged vegetation (Whitaker et al. 1977). The silt and clay substrate resembles that of Salt Creek. Only qualitative sampling was conducted in the White River nearshore zone. The number of taxa qualitatively collected varied seasonally from 20 in winter to 47 in late spring. The most abundant groups in the qualitative samples were Oligochaeta, Collembola, Ephermeroptera, Trichoptera, Chironomidae and Sphaeriidae.

In the deeper, main channel of the White River, the benthic habitat was characterized by a fast current with clean, fine to coarse sand and no apparent detritus. Only quantitative samples were collected in the main channel. Chironomidae was the predominant group throughout most of the study period. On Pleasant Run and Salt Creek, Oligochaeta (worms) and Chironomidae (midge larvae) were the dominant benthos at all stations (Figures 5 and 6).

Total numbers of benthic macroinvertebrates, collected during May and September 1981 at the various locations were highest at Station D during the May and September sampling period, (>10,000 m2) and relatively low (<3,000 m^2) at Stations B, C, F, G, I, and J in May and at Stations B, C, J, and K in September. The total number of taxa at the various stations ranged from <10 m^2 at Station F in May to >30 m^2 at Station C in May (Figure 6). The number of taxa was relatively similar among Salt Creek stations. In addition, stations on Pleasant Run downstream from Station D were relatively similar in community structure. Computerized tables in Appendix D present the identification of the organisms, the number/sq meter, diversity and evenness statistics. At stations below the confluences of Pleasant Run and its tributary to the confluence with Salt Creek, Chironomidae and Oligochaeta were the dominant taxonomic groups. The stream bottom primarily consists of soft silt, sand and gravel throughout this segment, a suitable substrate for the worms and midge larvae that were consistently found. The substrate at Station C was primarily comprised of rock, cobble, sand and gravel. This substrate was an ideally suited habitat for the comparably larger populations of mayfly, beetle, fly and midge larvae, as well as species of Ispoda and Crustacea. Crustacea, primarly Lirceus fontinalis were relatively abundant at the Salt Creek Locations. Their abundance is largely influenced by the habitat of Salt Creek with its rock and hard clay bottom. Therefore, the benthos inhabiting Pleasant Run and Salt Creeks are primarily influenced by the physical characteristics of the Creeks and the associated type of substrate.

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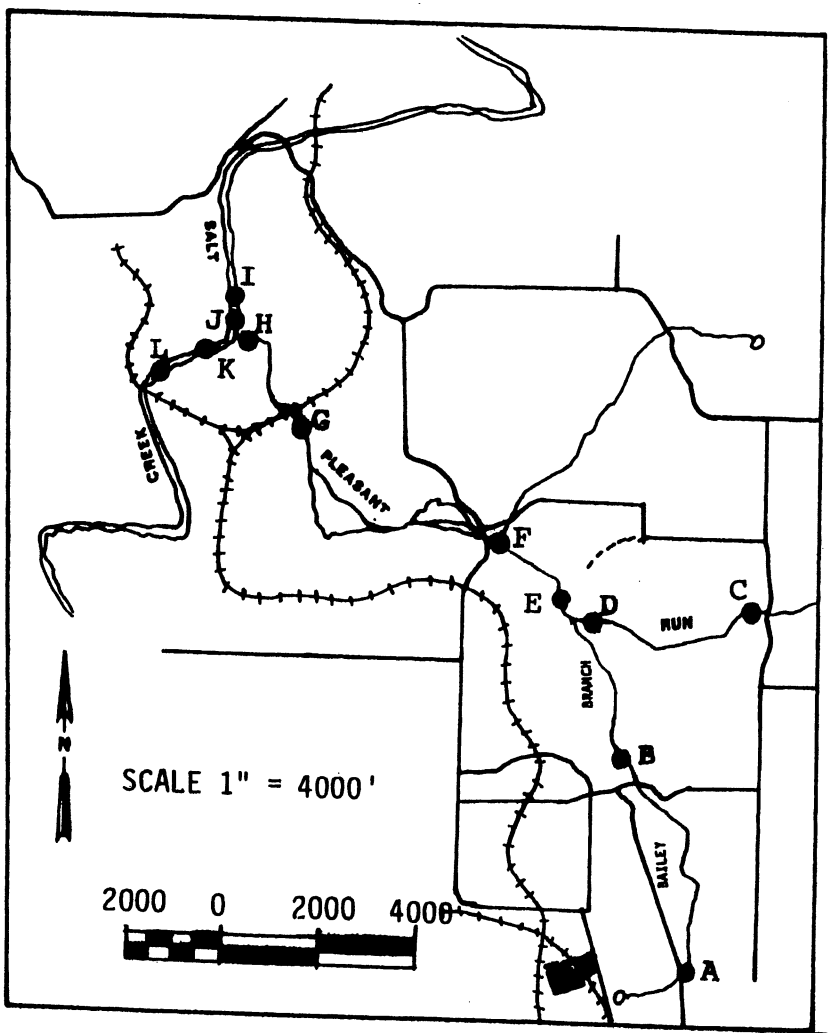
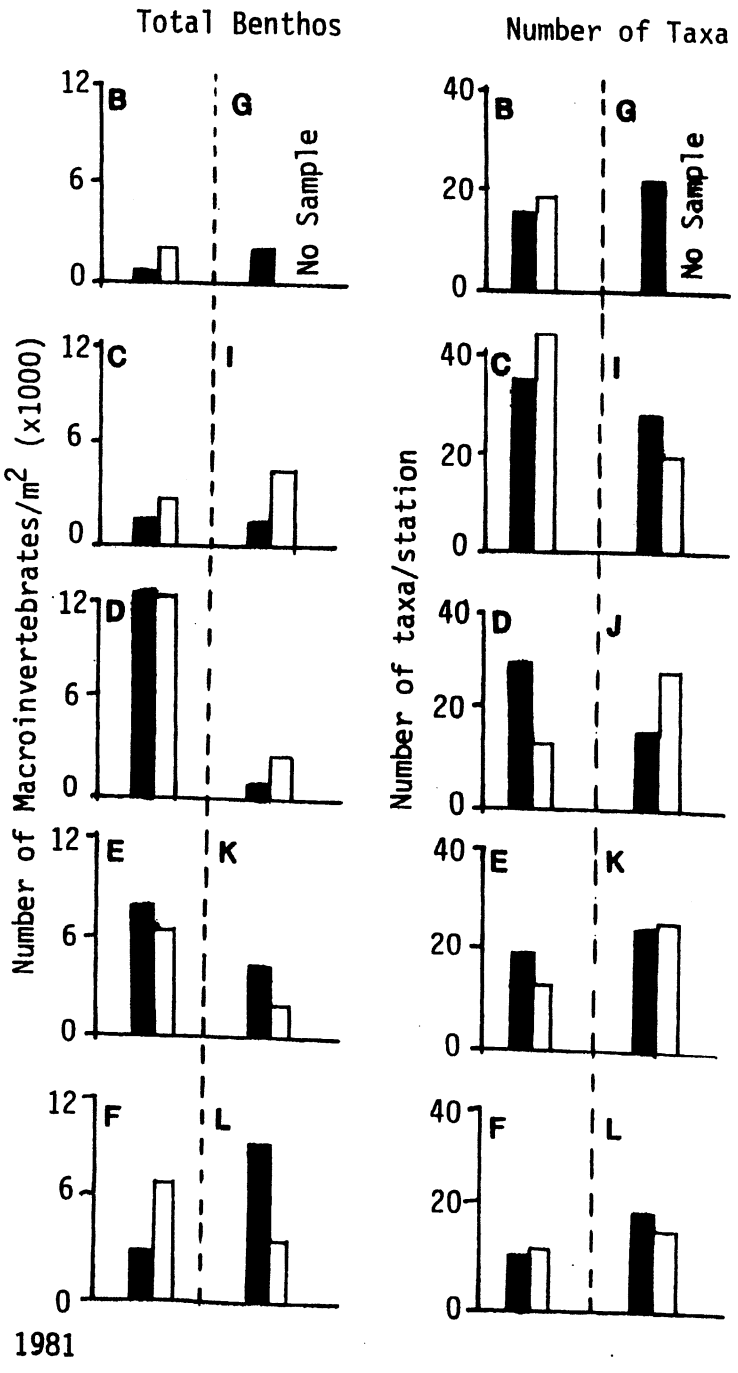
Figure 6. Total Benthos and number of Taxa at sampling stations located on Pleasant Run and Salt Creeks.



STUDY AREAS ON PLEASANT RUN AND SALT CREEKS LAWRENCE COUNTY, INDIANA



IX. FISH POPULATION STUDIES AND TISSUE ANALYSIS FOR PCBs

1. Methodology

Adult and juvenile fish were collected from Pleasant Run Creek and Salt Creek, Lawrence County from 19-21 May 1981 and 1-2 September 1982. Locations B, C, D, F, G, I, J, K, and L were sampled during each field effort (Figure 2). No seining was conducted at Location G in September due to low water levels in Pleasant Run Creek hampering boat access and blocked road access. Collection methods included backback electroshocking and minnow seine with habitat conditions dictating those methods employed at each sampling location. Both electroshocking and seining were conducted at Location B. Locations C, F, I, J, K and L were sampled only by electroshocker while Locations D and G were sampled only by minnow seine.

Minnow seining was conducted with a net measuring 25 ft x 6 ft constructed with 3/16 in Ace mesh. This seine was also used as a block net for electroshocking at Location C. Two to four seine hauls were made at each location during each sampling period. Electroshocking was conducted for 30 minutes at each location using a Coffelt Model BPI-C backpack electroshocker.

All fish collected were identified to species, enumerated, measured (total length in millimeters), and weighed (grams). Sex and spawning condition of representative specimens was determined by gross examination. Incidence of disease and physical abnormalities was also recorded. Scale samples for age determination were collected from the following specimens: 14 longear sunfish, 5 green sunfish, 2 largemouth bass, 1 white crappie, and 1 yellow bass.

As a general indicator of fish health within this stream system, condition factors were calculated for all species for which accurate weight data were available. Condition factors were calculated according to the following equation (Carlander 1969):

$$K_{tl} = \frac{W}{L^3} \times 10^5$$

where: W = weight in grams
L = total in millimeters

Fish Tissue Analysis for PCB

Representative fish captured during seining and electroshocking were tagged with the appropriate label, packed on ice, and delivered to Milwaukee and placed in a freezer until analysis commenced. Nineteen fish were analyzed for PCB concentration and percent lipid (Table 10). Preceding analysis, the fish gut was cleaned of sediment and detritus and the whole fish homogenized and analyzed. No game fish of a size to allow an adequate sample for PCB analysis following filleting were captured in Pleasant Run or Salt Creeks during either the spring or summer sampling periods. CDM attempted to obtain representative fish at all segments of the streams for PCB analysis. All PCB analysis were performed by Raltech Scientific Services of Madison, Wisconsin. The methodology for PCB analysis in fish tissue and the quality control results are presented in Appendix B.

2. Results and Discussion

A review of the literature yielded substantial data on the distribution of fishes in the watersheds near the study area. The majority of early records prior to 1900 were by Jordan (1878). The first extensive evaluation, encompassing over 412 locations in Indiana lakes and streams, was by Gerking (1945). The latest records have been compiled by the Indiana Department of Natural Resources district surveys and various universities. Whitaker and Gammon (in press) compiled the latest review of endangered and threatened fish species of Indiana. A review of the distribution of fish present in the waters near the study areas of Salt Creek and Pleasant Run encompassed the White River, Patoka River and its tributaries, the Wabash and Erie Canal, Muddy Fork and Lost Creek. A search was also made for literature involving species of special concern present in the lower White River that might be present in infringing areas or watersheds.

Gerking (1945) reported 170 species of fish from the waters of Indiana. Examination of the distribution of fish in recent literature reveals that at least 99 species may occur in the watersheds near the study area (Table 11). Threatened, endangered and special concern species of Indiana fish are presented in Table 12. The river darter and the blue sucker have been captured in the lower White River in recent years but were not present in collections of the survey on Salt Creek or Pleasant Run (Proffitt 1969, Proffitt and Benda 1971, Whitaker et al. 1973, CDM 1979, Nalco 1976, Hottell 1978).

A total of 664 fish representing 23 species was collected in the Pleasant Run and Salt Creek stream system during May and September 1981. Tables 13 and 14 present the total catch and percent composition of species at the sampling location and the mean length and size range of the species captured during May and September 1981. Species composition was considered typical of small warm-water midwestern streams having similar habitat and flow characteristics. The relative size of the fish captured was small, as expected in a lotic ecosystem of this type and size. The general condition (K_{tl}) of the fish was good but comparatively low condition for such species as green sunfish, largemouth bass and white crappie is probably due to their small size and lotic habitat (Carlander 1969 and 1977). Age determinations from a limited number of selected species indicate relatively good growth (Table 15). Incidence of disease and abornmalities was generally low. Blackspot (Neascus) was most common, affecting green suunfish (17.6%), creek chub (50%) and stoneroller (2.3%). Other diseases and abnormalities noted were spinal flexure (1 black bullhead), Lernaca (1 creek chub), fungus (1 white sucker) and open sores (1 bigmouth buffalo). None of the species collected during the spring and fall surveys were considered unique, with the exception of one yellow perch, undoubtedly introduced from upstream Lake Monroe. No threatened or endangered species were collected.

The most abundant groups of fish captured in Pleasant Run and Salt Creeks were minnows, sunfish and suckers. Few fish captured were large enough to be considered for human consumption. The number of fish species and total number of fish were highest at Stations C and D and lowest at Station B of Pleasant Run (Figure 7). The number of fish species and total number of fish captured on Salt Creek was comparatively low. Low catches in Salt Creek were primarily influenced by the nature of the stream habitat rather than water quality parameters. Within the study area, Salt Creek is deep, turbid, has steep banks and relatively swift current, all of which hampered sampling effectiveness. Location B bears close physical resemblance to Location C and general water quality parameters were similar. PCB concentrations in whole-water samples were highest at Location B, which may account for the paucity of fish; however, other factors not investigated could also be contributing.

Table 10 presents the fish species, station location where the fish were captured, concentration of PCB incorporated in the tissue and percent lipid. Fish analyzed were members of the minnow, sunfish and sucker families. These fish were selected for their potential as a source of food for human consumption as well as their size since many of the fish inhabiting these streams are very small (1-2 in) minnows and darters. PCB concentrations calculated as Aroclor 1242 ranged from 0.14 mg/kg (ppm) in a longear sunfish at Station C to 571.0 mg/kg in a white sucker collected at Station F. There was a very high variability in PCB concentration between fish species and the station where collected on Pleasant Run or Salt Creek. This variability is indicative of the fishes ability to migrate throughout the stream system thus feeding in different locations and substrates. At Location C, PCB concentrations were below 1 mg/kg (ppm) with the exception of striped shiner with a concentration of 1.42 mg/kg (ppm). PCB concentrations were higher in fish that predominately feed on bottom dwelling organisms. All

fish analyzed, with the exception of those fish captured at Station C, had PCB incorporated in tissue to concentrations that exceeded the five (5) ppm tolerance limit for PCB concentrations for fish and shellfish established by the Food and Drug Administration (FDA).

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Table 10. PCB concentrations in fish captured on Pleasant and Salt Creeks, Lawrence County, Indiana.

	Spring Sampling			Fall Sampling		
Station	Species	PCB Concentration (mg/kg)*	% Lipid	Species	PCB Concentration (mg/kg)	% Lipid
B	-	-	-	Creek chub	262.0	3.11
C	Striped shiner	1.42	2.46	White sucker	0.21	0.40
C	Creek chub	0.26	1.68	Longear sunfish	0.14	0.38
C	Green sunfish	0.44	0.98	Green sunfish	0.73	0.79
F	Creek chub	35.7	0.78	White sucker	571.0	3.79
F	Green sunfish	184.0	2.46	-	-	-
G	White sucker	9.28, 7.10	0.67, 0.61	-	-	-
I	Bigmouth buffalo	244.0	3.14	Longear sunfish	20.0	2.56
I	-	-	-	Golden redhorse	21.4	2.42
J	Longear sunfish	92.5	2.86	Longear sunfish	46.1	3.35
K	-	-	-	Golden redhorse	11.7	2.07
K	-	-	-	Longear sunfish	28.4, 31.9	1.75, 1.95
L	-	-	-	Longear sunfish	42.5	3.61

*PCB concentration is calculated as Aroclor 1242 and detection limit was 0.10 mg/kg based on a 25 g sample.

Table 11. Fish collected during previous research on streams near the Bedford site.

Family and Scientific Name	Common Name	White River[a]	Patoka River[b]	Keg Cre
Petromyzontidae (lampreys)				
Ichthyomyzon castaneus	Chestnut lamprey	x		
Ichthyomyzon unicuspis	Silver lamprey	x		
Acipenseridae (sturgeons)				
Scaphirhynchus platorynchus	Shovelnose sturgeon	x		
Polyodontidae (paddlefishes)				
Polyodon spathula	Paddlefish	x		
Lepisosteidae (gars)				
Lepisosteus osseus	Longnose gar	x	x	
Lepisosteus platostomus	Shortnose gar	x	x	x
Lepisosteus oculatus	Spotted gar		x	
Amiidae (bowfins)				
Amia calva	Bowfin	x	x	
Anguillidae (freshwater eels)				
Anguilla rostrata	American eel	x		
Clupeidae (herrings)				
Alosa chrysochloris	Skipjack herring	x		
Dorosoma cepedianum	Gizzard shad	x	x	x
Hiodontidae (mooneyes)				
Hiodon alosoides	Goldeye	x		
Hiodon tergisus	Mooneye	x		
Esocidae (pikes)				
Esox americanus	Grass pickerel	x	x	x
Esox lucius	Northern pike		x	
Cyprinidae (minnows and carps)				
Campostoma anomalum	Stoneroller	x	x	
Carassius auratus	Goldfish	x		
Cyprinus carpio	Carp	x	x	x
Ericymba buccata	Silverjaw minnow	x	x	
Hybognathus nuchalis	Silvery minnow	x	x	x
Hybopsis aestivalis	Speckled chub	x		
Hybopsis storeriana	Silver chub	x		
Notemigonus crysoleucas	Golden shiner	x	x	x
Notropis atherinoides	Emerald shiner	x	x	x
Notropis blennius	River shiner	x		
Notropis cornutus	Common shiner	x		
Notropis chrysocephalus	Striped shiner	x	x	
Notropis emiliae	Pugnose minnow	x	x	
Notropis rubellus	Rosyface shiner	x		

Table 11.
(Continued)

Family and Scientific Name	Common Name	White River[a]	Patoka River[b]	Keg Creek
Cyprinidae (continued)				
Notropis spilopterus	Spotfin shiner	x	x	
Notropis texanus	Weed shiner			
Notropis stramineus	Sand shiner	x	x	
Notropis umbratilis	Redfin shiner	x		
Notropis volucellus	Mimic shiner	x		
Notropis whipplei	Steelcolor shiner	x		
Phenacobius mirabilis	Suckermouth minnow	x	x	
Pimephales notatus	Bluntnose minnow	x	x	x
Pimephales promelas	Fathead minnow	x		
Pimephales vigilax	Bullhead minnow	x		
Semotilus atromaculatus	Creek chub	x	x	
Catostomidae (suckers)				
Carpiodes spp.	Carpsucker species	x		
Carpiodes carpio	River Carpsucker	x	x	
Carpiodes cyprinus	Quillback	x	x	x
Carpiodes velifer	Highfin carpsucker	x	x	
Catostomus commersoni	White sucker	x	x	
Cycleptus elongatus	Blue sucker	x		
Erimyzon oblongus	Creek chubsucker		x	
Hypentelium nigricans	Northern hog sucker	x		
Ictiobus bubalus	Smallmouth buffalo	x	x	
Ictiobus cyprinellus	Bigmouth buffalo	x	x	
Ictiobus niger	Black buffalo	x		
Minytrema melanops	Spotted sucker	x	x	
Moxostoma duquesnei	Black redhorse	x		
Moxostoma erythrurum	Golden redhorse	x	x	
Moxostoma anisurum	Silver redhorse	x		
Moxostoma carinatum	River redhorse	x		
Moxostoma macrolepidotum	Shorthead redhorse	x		
Moxostoma sp.	Redhorse species	x		
Ictaluridae (freshwater catfishes)				
Ictalurus furcatus	Blue catfish	x		
Ictalurus melas	Black bullhead	x	x	x
Ictalurus natalis	Yellow bullhead	x	x	x
Ictalurus nebulosus	Brown bullhead		x	
Ictalurus punctatus	Channel catfish	x	x	
Noturus eleutherus	Mountain madtom	x		
Noturus miurus	Brindled madtom	x		
Noturus gyrinus	Tadpole madtom		x	x
Pylodictus olivaris	Flathead catfish	x		
Aphredoderidae (pirate perches)				
Aphredoderus sayanus	Pirate perch	x	x	x

Table 11.
(Continued)

Family and Scientific Name	Common Name	White River[a]	Patoka River[b]	Keg C
Cyprinodontidae (killifishes)				
Fundulus notatus	Blackstripe topminnow	x	x	x
Poeciliidae (livebearers)				
Gambusia affinis	Mosquitofish	x		
Atherinidae (silversides)				
Labidesthes sicculus	Brook silverside	x		
Percichthyidae (temperate basses)				
Morone chrysops	White bass	x		
Morone saxatilis	Striped bass		x	
Centrarchidae (sunfishes)				
Centrarchus macropterus	Flier		x	x
Ambloplites rupestris	Rock bass	x		
Lepomis spp.	Sunfish species	x	x	
Lepomis cyanellus	Green sunfish	x	x	x
Lepomis gibbosus	Pumpkinseed	x		
Lepomis gulosus	Warmouth	x	x	x
Lepomis humilis	Orangespotted sunfish	x	x	x
Lepomis macrochirus	Bluegill	x	x	
Lepomis megalotis	Longear sunfish	x	x	x
Lepomis microlophus	Redear sunfish	x	x	
Lepomis punctatus	Spotted sunfish	x		
Micropterus dolomieui	Smallmouth bass	x		
Micropterus punctulatus	Spotted bass	x	x	
Micropterus salmoides	Largemouth bass	x	x	x
Pomoxis annularis	White crappie	x	x	
Pomoxis nigromaculatus	Black crappie	x	x	x
Percidae (perches)				
Ammocrypta clara	Western sand darter	x		
Ammocrypta pellucida[1]	Eastern sand darter	x		
Etheostoma asprigene	Mud darter	x		
Etheostoma gracile	Slough darter	x	x	
Etheostoma chlorosomun	Bluntnose darter		x	x
Etheostoma nigrum	Johnny darter	x	x	
Etheostoma spectabile	Orangethroat darter	x	x	
Percina caprodes	Logperch	x	x	
Percina phoxocephala	Slenderhead darter	x		
Percina sciera	Dusky darter	x		
Percina shumardi	River darter		x	x
Stizostedion canadense	Sauger	x	x	
Sciaenidae (drums)				
Aplodinotus grunniens	Freshwater drum	x	x	
Total number of taxa collected		92	59	

[a] Proffitt 1969, Proffitt and Benda 1971, Whitaker et al 1973, Nalco E.S. 1976, CDM 197
[b] Hottell 1978

[1] Indiana threatened Species

Table 12. Threatened, endangered and special concern species of Indiana fish (IDNR 1979a).

Scientific Name	Common Name	Status[1]
Acipenser fulvescens	Lake Sturgeon	E
Coregonus artedii	Cisco	T
Esox masquinongy ohiensis	Ohio Muskellunge	E
Esox masquinongy masquinongy	Northern Muskellunge	E
Clinostomus elongatus	Redside Dace	E
Notropis ardens	Rosefin Shiner	T
N. ariommus	Popeye Shiner	E
N. fumeus	Ribbon Shiner	S
N. shumardi	Silver Band Shiner	S
Cycleptus elongatus	Blue Sucker	T
Moxostoma valenciennesi	Greater Redhorse	E
Amblyopsis spelaea[2]	Northern Cavefish	E
Chologaster agassizi[2]	Spring Cavefish	S
Typhlichthys subterrancus	Southern Cavefish	E
Ammocrypta pellucida	Eastern Sand Darter	T
Etheostoma camurum	Bluebreast Darter	E
E. histrio	Harlequin Darter	E
E. maculatum	Spotted Darter	E
E. squamiceps	Spottail Darter	E
E. tippecanoe	Tippecanoe Darter	E
E. variatum	Variegate Darter	E
Percina evides	Gilt Darter	E
P. uranidea	Stargazing Darter	S

[1]Indiana protected status code:

E = Endangered
T = Threatened
S = Special Concern

[2]Species with no records for Indiana, records in adjacent states suggest that in the future this species may be recorded for Indiana.

Table 13. Summary of fish species collected by minnow seine and electroshocker in Pleasant Run and Salt Creeks, Lawrence County, Indiana during May 1981.

Species		Total Catch and Percent Composition/Species/Sampling Location											
		B		C		D		F		G		I	
Scientific Name	Common Name	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Campostoma anomalum	Stoneroller	0	-	10	10.3	7	3.4	3	30.0	0	-	0	-
Notropis crysocephalus	Striped shiner	0	-	11	11.3	36	17.6	1	10.0	0	-	0	-
Notropis umbratilis	Redfin shiner	0	-	0	-	4	2.0	0	-	0	-	0	-
Pimephales notatus	Bluntnose minnow	0	-	31	32.0	141	69.1	2	20.0	5	55.6	0	-
Semotilus atromaculatus	Creek chub	0	-	6	6.2	13	6.4	2	20.0	0	-	0	-
Catostomus commersoni	White sucker	0	-	1	1.0	0	-	0	-	1	11.1	0	-
Ictiobus cyprinellus	Bigmouth buffalo	0	-	0	-	0	-	0	-	0	-	1	33.3
Ictalurus melas	Black bullhead	0	-	1	1.0	0	-	0	-	0	-	0	-
Lepomis cyanellus	Green sunfish	0	-	4	4.1	0	-	2	20.0	0	-	0	-
Lepomis macrochirus	Bluegill	0	-	0	-	0	-	0	-	0	-	2	66.7
Lepomis megalotis	Longear sunfish	1	100	4	4.1	0	-	0	-	0	-	0	-
Etheostoma flabellare	Fantail darter	0	-	15	15.5	0	-	0	-	0	-	0	-
Etheostoma nigrum	Johnny darter	0	-	0	-	0	-	0	-	3	33.3	0	-
Etheostoma spectabile	Orangethroat darter	0	-	14	14.4	3	1.3	0	-	0	-	0	-
	Total	1		97		204		10		9		3	

Table 13.
(continued)

Species		Total Catch and Percent Composition/Species/Sampling Location									
		J		K		L		Total		Total Length (mm)	
Scientific Name	Common Name	No.	%	No.	%	No.	%	No.	%	Mean	Range
Campostoma anomalum	Stoneroller	0	-	0	-	0	-	20	6.1	67.6	41-112
Notropis crysocephalus	Striped shiner	0	-	0	-	0	-	48	14.6	76.1	49-153
Notropis umbratilis	Redfin shiner	0	-	0	-	0	-	4	1.2	50.0	40 - 50
Pimephales notatus	Bluntnose minnow	0	-	2	50.0	0	-	181	55.0	41.0	21 - 84
Semotilus atromaculatus	Creek chub	0	-	0	-	0	-	21	6.4	68.1	41-139
Catostomus commersoni	White sucker	0	-	0	-	0	-	2	0.6	229.5	224-235
Ictiobus cyprinellus	Bigmouth buffalo	0	-	0	-	0	-	1	0.3	282.0	-
Ictalurus melas	Black bullhead	0	-	0	-	0	-	1	0.3	203.0	-
Lepomis cyanellus	Green sunfish	0	-	0	-	0	-	6	1.8	81.3	62-110
Lepomis macrochirus	Bluegill	0	-	2	50.0	0	-	4	1.2	56.3	32 - 84
Lepomis megalotis	Longear sunfish	1	100	0	-	0	-	6	1.8	85.2	40-170
Etheostoma flabellare	Fantail darter	0	-	0	-	0	-	15	4.6	52.1	39 - 63
Etheostoma nigrum	Johnny darter	0	-	0	-	0	-	3	0.9	47.0	46 - 48
Etheostoma spectabile	Orangethroat darter	0	-	0	-	0	-	17	5.2	48.5	43 - 62
	Total	1		4		0		329			

Table 14. Summary of fish species collected by minnow seine and electroshocker in Pleasant Run and Salt Creek, Lawrence County, Indiana during September 1981.

Scientific Name	Common Name	Total Catch and Percent Composition/Species/Sampling Location[a] B No.	B %	C No.	C %	D No.	D %	F No.	F %	I No.	I %	J No.	J %	K No.	K %	L No.	L %	Total No.	Total %	Total Length (mm) Mean	Total Length (mm) Range
Dorosoma cepedianum	Gizzard shad	0	-	0	-	0	-	0	-	0	-	1	7.7	0	-	0	-	1	0.3	151.0	-
Esox americanus	Grass pickerel	0	-	0	-	0	-	0	-	1	5.9	0	-	0	-	0	-	1	0.3	228.0	-
Campostoma anomalum	Stoneroller	0	-	62	42.5	6	5.4	0	-	0	-	0	-	0	-	0	-	68	20.3	53.9	33 - 114
Notropis chrysocephalus	Striped shiner	0	-	1	0.7	8	7.1	4	20.0	0	-	0	-	0	-	0	-	13	3.9	38.0	31 - 53
Notropis spilopterus	Spotfin shiner	0	-	0	-	0	-	0	-	1	5.9	1	7.7	1	6.3	3	30.0	6	1.8	76.5	65 - 95
Notropis umbratilis	Redfin shiner	0	-	0	-	3	2.7	1	5.0	0	-	0	-	0	-	0	-	4	1.2	55.5	48 - 63
Pimephales notatus	Bluntnose minnow	0	-	37	25.3	62	55.4	5	25.0	3	17.6	0	-	0	-	0	-	107	31.9	51.6	23 - 75
Semotilus atromaculatus	Creek chub	1	100	16	11.0	16	14.3	8	40.0	0	-	0	-	0	-	0	-	41	12.2	56.7	29 - 162
Catostomus commersoni	White sucker	0	-	1	0.7	1	0.9	1	5.0	0	-	0	-	0	-	0	-	3	0.9	164.0	48 - 241
Moxostoma erythrurum	Golden redhorse	0	-	0	-	0	-	0	-	1	5.9	0	-	1	6.3	0	-	2	0.6	215.5	194 - 237
Labidesthes sicculus	Brook silverside	0	-	0	-	0	-	0	-	6	35.3	1	7.7	6	37.5	2	20.0	15	4.5	52.6	43 - 59
Morone mississippiensis	Yellow bass	0	-	0	-	0	-	0	-	0	-	0	-	1	6.3	0	-	1	0.3	175.0	-
Lepomis sp.	Sunfish (Unidentified)	0	-	0	-	3	2.7	0	-	0	-	0	-	0	-	0	-	3	0.9	24.3	24 - 25
Lepomis cyanellus	Green sunfish	0	-	11	7.5	0	-	0	-	0	-	0	-	0	-	0	-	11	3.3	94.3	61 - 168
Lepomis megalotis	Longear sunfish	0	-	13	8.9	0	-	1	5.0	4	23.5	7	53.8	7	43.8	4	40.0	36	10.7	93.9	28 - 155
Micropterus salmoides	Largemouth bass	0	-	0	-	0	-	0	-	1	5.7	2	15.4	0	-	0	-	3	0.9	135.0	65 - 186
Pomoxis annularis	White crappie	0	-	0	-	0	-	0	-	0	-	1	7.7	0	-	0	-	1	0.3	192.0	-
Etheostoma flabellare	Fantail darter	0	-	1	0.7	0	-	0	-	0	-	0	-	0	-	0	-	1	0.3	54.0	-
Etheostoma nigrum	Johnny darter	0	-	0	-	10	8.9	0	-	0	-	0	-	0	-	0	-	10	3.0	40.6	31 - 58
Etheostoma spectabile	Orangethroat darter	0	-	4	2.7	3	2.7	0	-	0	-	0	-	0	-	0	-	7	2.1	44.4	28 - 63
Perca flavescens	Yellow perch	0	-	0	-	0	-	0	-	0	-	0	-	0	-	1	10.0	1	0.3	117.0	-
	Total	1		146		112		20		17		13		16		10		335			

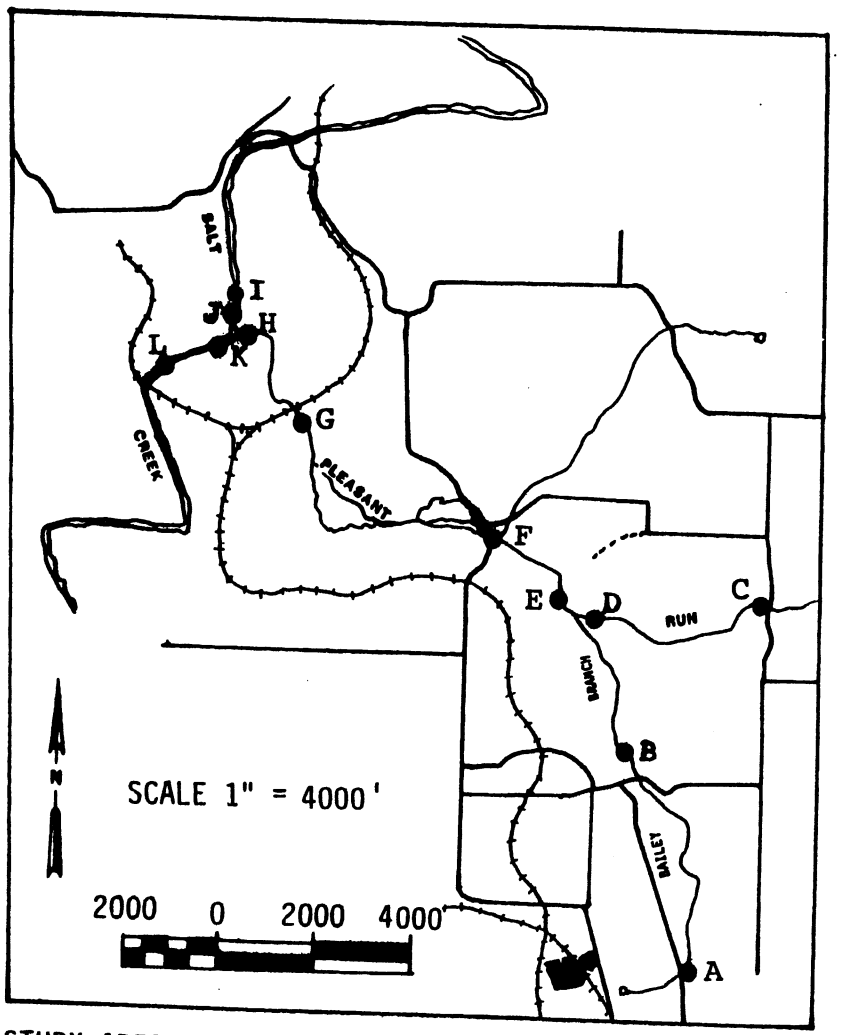
[a]No sample from Location G - access blocked.

Table 15. Age determination of selected fish species from Pleasant Run and Salt Creek, Lawrence County, Indiana, 1981.

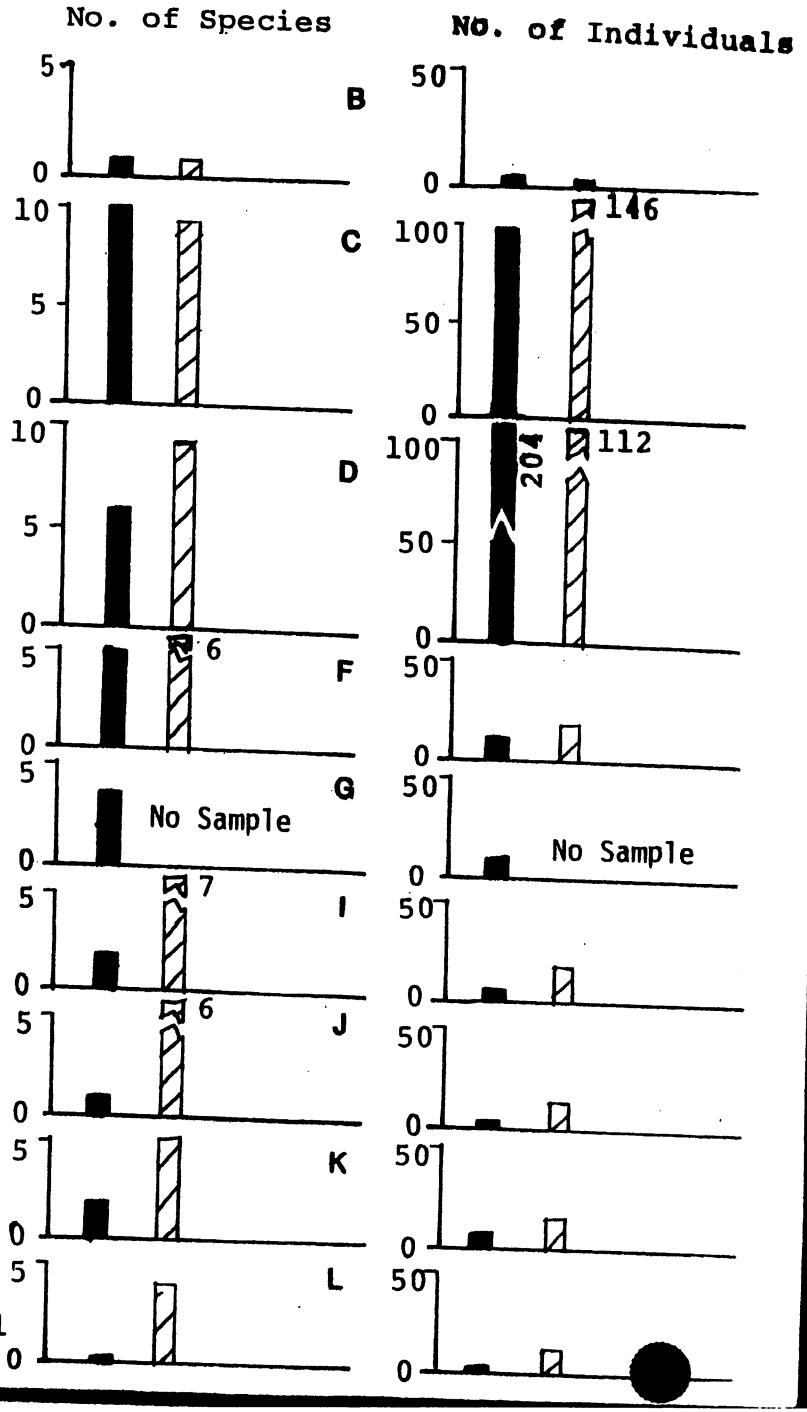
Species	No.	Mean Total Length[a]/Age Group			
		Age Group			
		I	II	III	IV
Longear sunfish	12	-	93	117	143
Green sunfish	7	-	96	115	168
Largemouth bass	2	170	-	-	-
White crappie	1	-	-	192	-
Yellow bass	1	-	175	-	-

[a]Total length (mm) at time of capture.

Figure 7. Numbers of species and numbers of individual fish collected at stations on Pleasant Run and Salt Creeks.



STUDY AREAS ON PLEASENT RUN AND SALT CREEKS LAWRENCE COUNTY, INDIANA



X. SUMMARY

Camp Dresser & McKee Inc. (CDM) was contracted by General Motors Corporation to design and conduct a study on Salt Creek, Pleasant Run and its tributary, Bailey Branch to ascertain:

- Whether or not a balanced, indigenous aquatic community exists in selected stream reaches;
- The concentration of PCBs in the flesh of fish;
- PCB content of mobile sediment;
- Concentrations of PCBs associated with bottom sediments;
- Concentrations of PCBs in areas subject to flooding.

This study was conducted during May and September 1981. The May sampling was conducted during high stream stage following heavy rains while the September sampling period was conducted during low stream conditions although limited heavy rains also accompanied this sampling period.

PCBs were not evenly distributed (patchy) throughout the bottom sediments of Salt Creek, Pleasant Run and its tributary, Bailey Branch (GM) discharge stream. The results of all samples were calculated as Aroclor^{R} 1242 since the PCB chromatographic pattern for most of the samples resembled Aroclor^{R} 1242. Because of the variable (patchy) nature of the PCB content of the sediments found in Bailey's Branch of Pleasant Run Creek and Pleasant Run Creek itself, no one number can be used to portray the overall data. In view of this it is necessary to refer to the PCB data on stream sediments to gain an appreciation of the situation.

Salt Creek PCB concentrations in sediments were generally less than 10 mg/kg with the exceptions being found in isolated pockets of sediment at Station K which is located immediately downstream from the confluence of Pleasant Run and in a pocket at Station L (located downstream from Station K).

During the spring high flow and fall low flow studies, PCB concentrations in the water ranged from less than detectable (quantifiable) at Station C to about 11 ppb at Station B on Bailey Branch of Pleasant Run. The average combined high and low flow PCB concentration in water samples

(excluding the Station C and D control stations) collected on Pleasant Run Creek was 5.5 ppb, which is below the solubility for Aroclor^{R} 1242. PCB concentrations associated with suspended sediment during the spring and fall surveys ranged from less than detectable at Station C to 7 ug/kg (ppb) at Station B in the fall. The average PCB concentration associated with suspended sediments for Pleasant Run Creek was 2.5 ug/kg (ppb). Based upon these relatively low concentrations of PCBs in the stream and those concentrations associated with the suspended sediment in comparison to the greater concentrations associated with the patch locations of bottom sediment below the coarser material layer, it appears that PCB mobilization from the previously deposited sediment areas in the stream has a small effect on water quality.

Soils containing PCB were found at various locations throughout the flood plain as delineated by high water marks. PCB concentrations greater than 50 mg/kg were found in composite samples taken at Locations B, D, E, and F. Concentrations of PCBs greater than 10 mg/kg and less than 50 mg/kg were measured at Locations A, H, and K. Locations I, J and L on Salt Creek had PCB concentrations in composite samples below 5 mg/kg.

The stream system supported a biotic community representative of small warm water midwestern streams with the exception of Bailey Branch and the segment of Pleasant Run from its confluence with Bailey Branch (Station E) to Station F. The benthic macroinvertebrate population consisted primarily of oligochaetes and chironomids on Pleasant Run Creek with the exception of Station C. The bottom substrate at Station C consisted primarily of gravel, and cobble with mayflies, beetle, fly and midge larvae being the most abundant benthic organisms. These organisms are commonly found associated with this type of substrate. Crustacea were relatively abundant at Salt Creek stations and are typically associated with rock and hard clay bottom materials characteristic to the bed of Salt Creek.

Periphyton were primarily collected from rock substrates in riffle areas. The number of different taxa and their relative abundance were greater in the rocky, shallower, higher velocity stream locations at Stations B, C, and D. Periphyton abundance and differences in species

composition were generally lowest at Salt Creek locations. Diatoms were the major periphyton group in Pleasant Run creek while blue-green algae were the dominant group in Salt Creek. Therefore, the spring and fall studies have shown that the assemblage and abundance of benthic macro-invertebrates and periphyton appear to be primarily influenced by the type of substrate at the particular stream location. All benthos and periphyton species appeared indigenous to their particular location in the stream system.

Fish were collected by minnow seine and electroshocking techniques. A concerted effort was made to obtain a representative sample of fish inhabiting all reaches of the stream system. A total of 664 fish representing 23 species were collected in the Pleasant Run and Salt Creek stream system during May and September. All fish captured were small ranging in length from 21 to 241 mm. Most fish captured in Pleasant Run and Salt Creek were forage species, primarily minnows and darters. Fish species composition and abundance in Pleasant Run and Salt Creeks were as expected in a lotic ecosystem of this type and size and were typical of small warm water midwestern streams having similar habitat and flow characteristics. None of the species collected during the spring and fall surveys were considered unique with the exception of one yellow perch, probably introduced from upstream Lake Monroe. No threatened or endangered species were collected.

Fish captured on Salt Creek, Bailey Branch and the main branch of Pleasant Run Creek had PCBs incorporated in their body tissue. Fish analyzed for PCBs that were captured at Station C (control station) had trace amounts of PCBs. These trace amounts of PCBs were probably incorporated into the fish when the fish migrated from contaminated segments of the stream system and while in this area fed on benthos and detritus associated with bottom sediment. Although fish were found to contain PCBs, essentially all fish captured were forage fish such as minnows, darters, suckers and very small sunfish and thus would not be considered a likely source of food.

Potential Remedial Actions

There are numerous alternatives that can be considered for a remedial action program involving PCB contamination problems in streams and their associated watersheds. The goal of the remedial action program should be minimize exposure of PCBs to humans, domestic animals and wildlife.

The major alternatives, some of which can be divided into subalternatives include:

- No action
- Complete PCB removal
- Selective PCB removal
- Restricting accesss to contaminated areas
- Rechannelization around pockets of contamination
- Sediment substrate stabilization and/or chemical fixation
- Combinations of the above.

APPENDIX A

Quality Assurance Procedural Documents

OPEN CHANNEL DISCHARGE CALCULATIONS

Current cross section measurements comprise the first phase in developing a discharge rating for a particular gaging station. When one or several rating curves have been developed for a site, the stage records from the stilling-well recorder may be converted to discharge.

CDM usually employs the "partial section" method of flow measurement in streams. With this method, a stream is divided up into sections small enough to assure that less than 10% of the total stream flow passes through each of these sections. This can only be estimated, since the flow obviously hasn't been measured yet. To assure that this criterion is met, a stream should be divided up into 15-25 sections. The 10 percent criterion is used only to reduce the error magnitude, since if an error occurs in one or two of the partial sections, its effect on total accuracy will be less if a large number of partial sections are used. Practical considerations, such as when stage is changing rapidly or the stream is very narrow as in the case of Pleasant Run Creek, may preclude the use of the ideal number of partial sections. The mean velocity of each partial section is then determined, and the flow through each partial section is calculated with the following formula (USGS 1969):

$$q_x = v_x \frac{b_{(x+1)} - b_{(x-1)}}{2} d_x$$

where: q_x = discharge through partial section x,
v_x = mean velocity at location x,
$b_{(x-1)}$ = distance from initial point to preceding location,
$b_{(x+1)}$ = distance from initial point to next location, and
d = depth of water at location x.

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APPROVED DNB DATE 3/24/82

This method is illustrated in Figure 1. For example, the discharge through partial section 4 would be calculated with the following formula:

$$q_4 = v_4 \frac{b_5 - b_3}{2} d_4$$

The endpoints, or whenever there is water on one side of an observation point, are treated somewhat differently. Here the depth and velocity may or may not be zero. The mean velocity at these points should be estimated when it is not possible to measure it with a current meter. For an endpoint near or coincident with the initial point, the calculation is as follows:

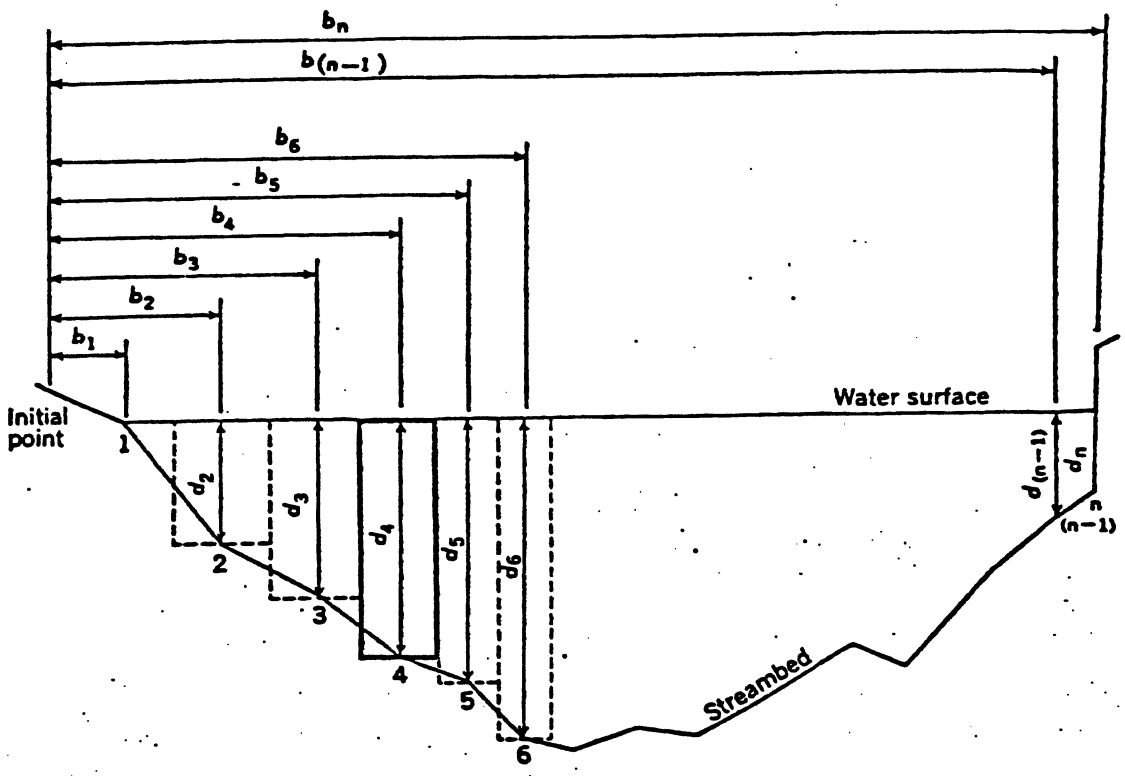
$$q_1 = v_1 \frac{b_2 - b_1}{2} d_1$$

For an endpoint nearest or coincident with the stream side opposite the initial point (the last station), it is:

$$q_n = v_n \frac{b_n - b_{(n-1)}}{2} d_n$$

The total discharge of the stream is calculated by summing the flows from all of the partial sections.

At least twenty of these cross section measurements are needed to construct an adequate relationship between stage and discharge. "The more the better" philosophy is applicable in this situation. Cross section measurements should be made at all different stream elevations or stages, and particular attention should be given to define the stage-discharge relationship at the higher stages, since this is the region where flooding may occur at various upstream areas, thereby altering an expected or estimated curve appearance. The flood stages are often the stages of most importance to engineers, planners, economists, and property owners, since property damage, structural damage, erosion, and water quality are more greatly affected at these flows. Discharge measurements are more difficult



EXPLANATION

1, 2, 3,.....n	Observation points
$b_1, b_2, b_3, \ldots\ldots b_n$	Distance, in feet, from the initial point to the observation point
$d_1, d_2, d_3, \ldots\ldots d_n$	Depth of water, in feet, at the observation point
Dashed lines	Boundary of partial sections; one heavily outlined discussed in text

Figure 1. Illustration of the partial-section method of measuring stream flows (USGS 1969).

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to make at the higher stages, since the stage may be changing rapidly. In such cases, it is important to make quick measurements, and to record the stage elevation at the beginning and end of the discharge measurements.

The location point of the cross section measuring point should be a permanent location, if possible, and should be located where the following criteria are met if possible:

1) Sediment scouring or sediment deposition are minimal over the length of the study period.
2) Sediment is fairly consolidated and easy to walk on if wading is required, or will allow solid detection of the streambed if measurements are from a bridge.
3) Channel dimensions will remain permanent over the study period. Avoid areas where bank erosion may occur at high stages.
4) Avoid areas where undercut banks are present, or where abrupt changes in stream bank geometry occur at high stages.
5) Choose a location where measurements can be made with relative ease during high stages, areas that will not present a hazard to personnel during measurements.
6) Avoid areas of turbulence. Attempt to find areas approaching uniform flow. Straight lengths of stream sections are desirable.
7) Avoid areas of heavy macrophyte growth.

In practice, cross section measurements are made with the aid of a "tag line" for measurements made by wading or by boat. The tag line should be strong enough for the particular application; a steel cable or large diameter rope if a boat is to be anchored to it, or a string if the stream is small and a boat is not needed. Known distances or intervals, that need not be equal, are marked off on the tag line denoting stations. If measurements are made from a bridge, the bridge railing can be conveniently marked off to denote the stations. Note from Figure 1 that with the exception of each endpoint, each station may be considered as the center point of each patial section when the partial section method is used.

Depth and velocity measurements are made at each station including both endpoints if possible. If the cross section is bounded by bridge abutments the velocity and depth must be measured or estimated at each endpoint since each will more than likely not be zero. If the cross section is bounded by streambanks, both depth and velocity may be zero. An endpoint may also be established at the edge of "dead water" if such a situation exists, since the dead water portion does not contribute to the stream flow and will only lead to error if an attempt is made to include it. If another type of situation exists where the velocity is below the "tolerance" level of the meter (to be discussed later) but the investigator feels it is necessary to include this volume of water, an estimate of the water velocity may be made. In this situation, the error caused by this estimation will probably be less than the error resulting from exclusion of this discharge.

The mean velocity at each station is what is desired. The velocity is usually measured at the 0.6 depth from the surface if the total depth is less than approximately 2.5 feet. If the total stream station depth is greater than 2.5 feet, the velocity is measured at the 0.2 and 0.8 depth from the surface, and then averaged (USGS 1969). Other variations of these methods are described in the literature (CHOW 1964, USGS 1969).

A Marsh McBirney Model 201 Current Meter was used for measuring velocity on this project because of anticipated low velocities. This is an electromagnetic type current meter where passage of fluid past two electrodes in the bulb-shaped probe causes a disturbance of the electromagnetic field around the electrodes. This disturbance generates a small voltage which is made proportional to actual fluid velocity by internal electronic circuitry. A direct velocity meter readout in feet per second is provided nearly instantaneously. Velocity range scales of 2.5, 5.0, and 10.0 fps are externally selectable, indicating that this meter cannot measure current velocities greater than 10 fps.

This type of meter also differs from the Price meters in that it is unidirectional in its measurement ability. It will measure only one velocity vector, the vector parallel to the probe longitidinal axis. This

is important to know, since the probe will not sense the velocity vector normal to the cross section, V_{NORM}, unless the probe longitudinal axis is also normal to the cross section. Since probe orientation cannot usually be seen beyond a particular depth, the staff to which it is attached must be capable of accurately determining this information.

This meter is an instantaneous readout meter, as mentioned earlier, and will not provide an average velocity reading. The meter reading will no doubt be varying to some degree and occasionally it will be quite erratic. It is the responsibility of the investigator to observe the meter fluctuation and to estimate an average velocity when the fluctuations are present. When meter readings are fluctuating, it could be an indication of eddying or turbulence, a condition that should have been avoided initially, if possible, when choosing the location for the cross section measurements.

This type of meter can be used where the Price meters cannot be used, such as in weedy streams or under any conditions that would affect the rotating mechanism of the Price type meters. Measurements can be made much quicker with the Marsh McBirney meter compared to the Price meters because of its nearly instantaneous readout capability.

All current meters discussed above require care and maintenance, since meter condition or deterioration will be reflected in the final results. Each of these meters have a periodic calibration schedule. The meters are periodically calibrated by the United States Geological Survey, and although they are fairly durable instruments, they should be treated as delicate instruments to avoid altering the calibration of each. A correction factor must be applied to each Marsh McBirney meter, where the correction is in the form of a linear regression equation attached to each meter. The observed meter reading is simply plugged into the equation to obtain the corrected value.

A step by step summary of a discharge or cross section measurement is as follows:

1. Assemble current meter and test for proper operation. Collect data form or notebook, pencil, stop watch, 50 ft tape, etc.

2. Partition stream into sections (with tag-line or bridge railing), visually observing the velocity and general flow of the stream. Remember, the partial section in question is not the same as the interval between two successive stations. Mark stations appropriately.
3. Record stream stage as indicated by one of the staff gages and record this value on the water level recorder chart at the point of pen contact.
4. Record on the data form or in the notebook the following items at a minimum:
   a.) Project
   b.) Site
   c.) Date
   d.) Time at start of measurements
   e.) Stage at start of measurements
   f.) Approximate wind direction and speed (if applicable)
   g.) General stream condition (e.g. turbid, clear, low level, floating debris, water temperature, type of streambed material, etc.)
   h.) Other factors having a bearing on discharge measurements
   i.) Location of initial point
   j.) Total width of stream to be measured
   k.) Type of current meter and conversion factor, if applicable

5. Determine the depth and mean velocity at the first station or "initial point" if the situation allows, and record.
6. Measure depth at the second station from initial point and record. Determine whether the velocity should be measured at the 0.6 depth from the surface (six-tenths depth method) or at the 0.2 and 0.8 depths (two-point method). Calculate respective depths from the surface, measure the velocity at each point, and record these values.
7. Continue on to each successive station as rapidly as possible, following the same procedure.

8. Determine the depth and mean velocity at the last station, or endpoint, and record.
9. Record on the data form the ending time of this series of measurements and the stage, since the stage may have been changing during the measurements.
10. Also enter the ending stage value on the recorder chart at the point of pen contact. This will illustrate the interval of time and stage variations during the cross section measurements. Also enter the date and indicate that a calibration has taken place over this interval.
11. Remove the tag line (if used), allow the current meter to dry, then pack it away in its respective carrying case.

There are a few other comments regarding stream calibrations that should be mentioned:

1) Measurements should be made with the investigator standing behind and well to the side of the meter.
2) Avoid disturbing or standing along the streambed beneath the cross section measuring points. This is part of the control area and should remain constant, if possible, from calibration to calibration of the stream. This is especially important if soft, mucky sediment is encountered somewhere along the cross section.
3) Try to use the same cross section throughout the study period and during all of the stream calibrations. However, the number and position of stations within the cross-section may be changed if necessary.
4) Always hold the wading rod nearly vertical, and be aware of how V_{NORM} is determined with each of the various types of meters, should it become necessary to switch meters during a calibration.

5) Try to make some of the stream calibrations throughout the study period to account for seasonal changes in streambank vegetation and streambed alterations. The variations in these and other factors may or may not have a significant impact on the rating curve, but if some of these factors do have an effect, it can be reflected in the rating curve.

FIELD OPERATING PROCEDURE

Equipment Identification: Marsh-McBirney, Model 201, water current meter.

1. Pre-survey
   a. Set selector switch to the "Cal" position. The meter should indicate in the "Cal" sector of the scale. If it does not, replace batteries with fresh ones. If it still does not indicate correctly, contact the manufacturer.
   b. Place the probe in a non-metalic bucket filled with water, and rotate the selector switch to the 2.5 ft/sec setting, moving the probe gently in the bucket, the meter should respond to the relative motion of the water and the probe. If it does not, then there is a malfunction and repairs are indicated. See: Instruction manual, model 201, Portable, water current meter, Marsh-McBirney, Inc. Rockville, MD.
2. Survey
   Depending on the type of study being conducted, attach the probe securely on either a wading rod, suspension cable with weight, or a fixed orientation mounting. Lower the sensor and mounting into the water and turn the instrument selector switch to the full scale range appropriate. The meter should be indicating water velocity past the sensor.
   If current direction is required then the instrument's current sensor must be attached to a rod that is marked in such a manner that the orientation of the sensor in the water is evident to the operator. To obtain current

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magnitude and direction:

1. lower the sensor to the required depth,
2. rotate the rod until the current indicated is a maximum,
3. record this current speed,
4. using a hand held compass measure the bearing (azimuth) of the sensor,
5. record this bearing.

EQUIPMENT SPECIFICATIONS

Equipment Identification: Marsh-McBirney, model 210, portable, water current meter.

Control Number: 1410036-1, 1410036-2

Calibration/Maintenance Schedule: Maintain before each use

Specifications:

1.0 General Description

General purpose, portable, single axis, electro-magnetic water current meter. It has two parts; the instrument case which contains circuits and batteries, and the sensor. They are connected by an electrical cable.

2.0 Physical Description

Instrument case - 7" by 4" by 10".

Sensor probe - 1" diameter.

The sensor probe is designed to fit Price type current meter hardware and is made of epoxy, stainless steel and PVC.

3.0 Electrical Description

Full scale ranges - 0-2.5, 0-5, and 0-10 ft/sec, switch selectable

Accuracy - ± 2.7% of reading, or ± 0.05 ft/sec. whichever is greater.

Reading time - 6 seconds standard

Power - 9 volts D.C.

Battery life - 100 hours minimum

A certificate of compliance stating that the equipment met the purchase specifications is on file in the Physical Department.

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PROCEDURE FOR SAMPLING SUSPENDED SEDIMENT IN SMALL STREAMS AND DETERMINATION OF MASS TRANSPORT

I Equipment Needed

1. DH-48 Suspended Sediment Sampler with wading rod.
2. Glass sample jars for DH-48 Sampler
3. Graduated Tag-line.
4. Current meter and accessories - for measuring stream discharge.

II Objectives

1. Measure and calculate stream discharge at an optimum cross-section location with a current meter[1] if sediment transport calculations are required for the project.
2. Collect a sufficient number of water samples in a discharge-weighted manner to represent total suspended sediment load of the stream, composite, and analyze for total suspended sediment.
3. Correlate mean concentration of suspended sediment with stream discharge at the time of sampling.

III Methods

1. Set up tag-line across the stream at a site most suitable for measuring stream discharge[1]. This site will also be satisfactory for suspended sediment sampling (i.e. little turbulence, uniform flow, etc.)
2. Measure velocities congruent with methods described in the current measurement procedure[1].
3. With tag still in place, collect a water sample with the DH-48 sampler throughout the water column at equally spaced intervals across the stream, where the number of intervals should be between 10 and 20 (reference EWI method in National Handbook of Recommended Methods for Water-Data Acquisition[2]). This number of intervals should be adhered to only if sediment transport information is desired. Fewer intervals are required if only suspended sediment information is desired. Sampling action throughout each vertical column should follow the procedure for "depth-integrating suspended sediment samplers" described in the handbook[2]. Specifically:
   a. A uniform speed must be used throughout each vertical water column and this speed must be consistent from station to station. Upon reaching the bottom, the sampling action must immediately reverse and resume the constant speed. The traversing speed of the water column will depend upon the amount of sample required but should always assure isokinetic conditions[2].

   b. The sampler nozzle should be orientated perpendicular to the X-sectional area being sampled. Ideally the flow lines will also be perpendicular to the X-sectional area.

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c. Record the number of stations, interval between each station (a constant), and the approximate speed of the sampler movement within the water column.

4. Composite the discrete samples and analyze for total suspended solids by acceptable laboratory methods, yielding a concentration in milligrams per liter.

The following steps should also be followed if sediment transport calculations are required:

5. Calculate stream discharge in cubic feet per second[1].
6. Calculate total sediment discharge at this stream discharge:

$$S_C \frac{mg}{\ell} \times Q \frac{ft^3}{s} \times \frac{28.32 \ell}{1\ ft^3} \times \frac{1\ kg}{1 \times 10^6 mg} = S_T \frac{kg}{s}$$

where S_C = mean conc. of total suspended solids.
Q = stream discharge
S_T = total sediment transport at the measured flow rate.

7. A sediment discharge curve may be constructed with a sufficient number of these measurements carried out over a range of stream discharge.

IV Conclusions

1. This procedure does not account for bed-load material.
2. With reference to step 1, part III, turbulence may be a desirable characteristic in a stream, since it would tend to distribute the coarser particles (>63 u) throughout the water column and allow collection of this size fraction that would ordinarily be transported primarily by bedload transport mechanisms. It may be better under certain situations to separate the sediment sampling X-section location from the flow measurement location to facilitate both types of measurements.
3. Even though "width between stations" has been emphasized in this procedure, it should be realized that each station represents the mid-point of effective width (and the X-sectional area), not an endpoint.
4. The DH-48 sampler cannot sample within 9 cm(3.54 inches) of the stream bottom nor can it be used at depths >4.9 m (16.0 ft) with a 4.8 mm nozzle size nor 2.7m (8.8 ft) with a 6.4 mm nozzle size.

References:

[1]Procedure for determing the discharge of small streams, Procedure No. 3410046 (CDM Quality Assurance Program)

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[2]U.S Geological Survey, 1978. Sediment. Chapter 3 of the National Handbook of Recommended Methods for Water-Data Acquisition, an interagency government publication. 17-31

Additional Reference:

U.S. Geological Survey, 1970. Field Methods for Measurement of Fluvial Sediment. TWRI Book 3, Chap. C2, 60 pp.

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PROCEDURE FOR OPERATING THE US DH-48 SUSPENDED SEDIMENT SAMPLER

1. General

The US DH-48 sampler was designed for collecting a depth-integrated suspended-sediment sample in shallow streams. The sampler is usually operated while wading.

2. Accessories for Sampler

2.1. Pint glass bottles w/caps
2.2. 1/2 in. O.D. wading rod
2.3. 3/16 and 1/4 in. PVC nozzles

3. Procedure

3.1. Fit a clean glass bottle into the sampler and fasten the spring-loaded clamp over the base of the glass bottle.
3.2. Choose the sampling location in the stream and lower the sampler at a uniform rate with nozzle pointing directly upstream. Upon reaching the bottom, instantly reverse the direction and maintain a uniform speed while raising the sampler.
3.3. Carefully remove the sample bottle from the sampler, if full, and cap. Repeat Step 2 if desired, without risking complete filling of the bottle.
3.4. Mark the bottle with any of the following applicable information:
   a. Name of stream
   b. Location of cross-section
   c. Location of vertical
   d. Stream depth covered by the sample
   e. Stage of stream
   f. Date
   g. Time of day
   h. Initials of investigator
   i. Sampling time
   j. Water temperature
   k. Sample number
3.5. Repeat Step 1, using a clean bottle if required.

4. Comments

4.1. Although a uniform speed must be maintained while raising or lowering the sampler, the "lowering speed" need not be the same as the "raising speed" for general sampling.
4.2. The sampler must not be allowed to fill completely because the "free-flowing" sampling process will cease after this point.
4.3. The sample volume is regulated by the lowering and raising speeds. Slower speeds will increase the amount of sample collected in one vertical. Different nozzle sizes will also effect the sample volume (See attachment).

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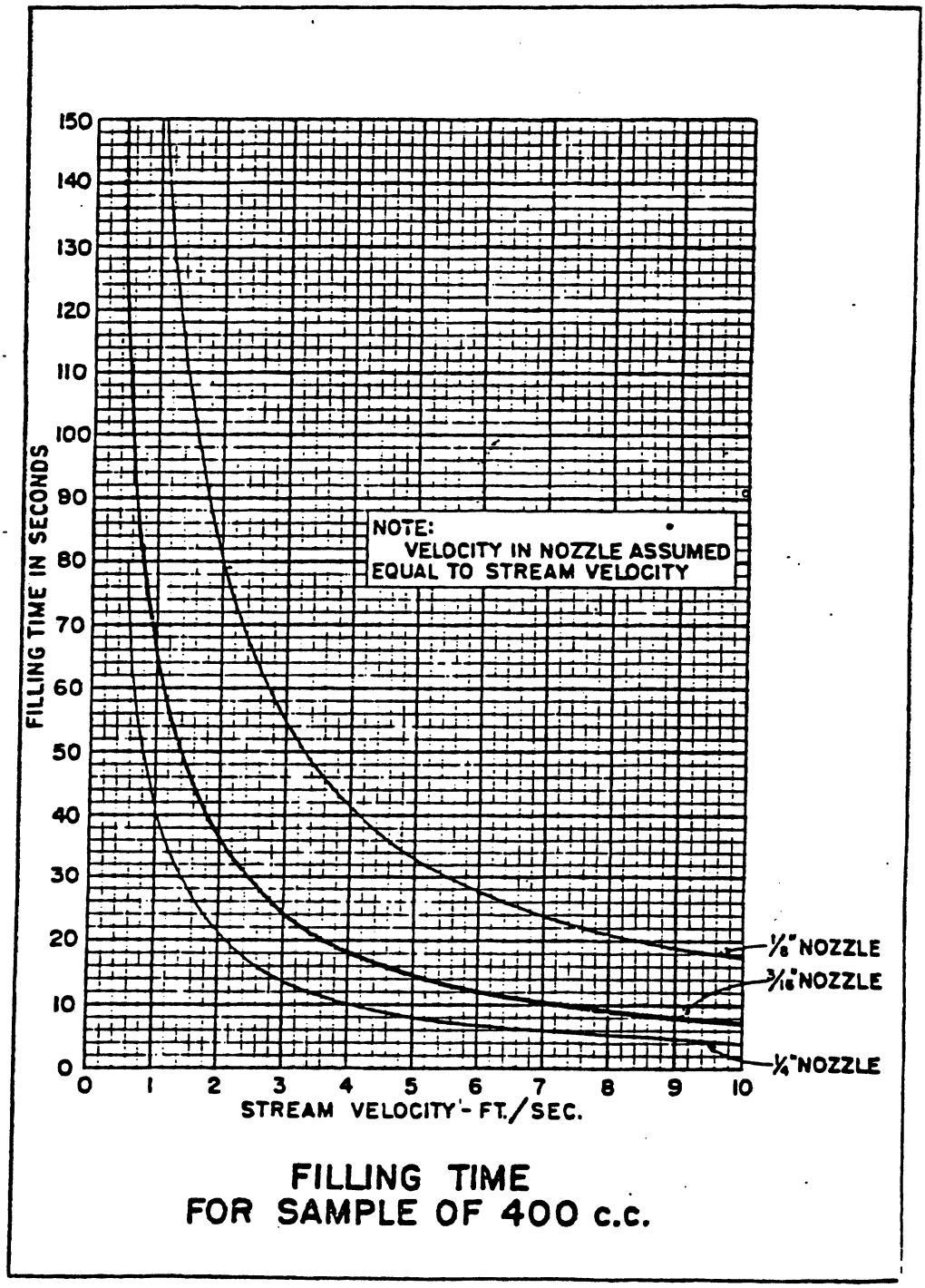

FILLING TIME
FOR SAMPLE OF 400 c.c.

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EQUIPMENT SPECIFICATIONS

Equipment Identification: US DH-48 Suspended Sediment Sampler; manufactured by Product Manufacturing Company.[1]

Control Number: No. 1900025

Calibration Schedule: Not Applicable

Maintenance Schedule: Daily, upon use.

Equipment Specifications:

General description - The sampler consists of a streamlined aluminum casting which partially encloses a round pint bottle sample container. A pvc intake nozzle extends horizontally from the nose of the sampler body. A streamlined projection, pointing toward the rear on the side of the sampler head, accommodates the air exhaust port from which air may escape from the bottle as the sample is being collected. The sample container is held in place and sealed against a rubber gasket in the sampler head by a hand-operated spring-tensioned clamp at the rear of the sampler.

Weight - 4 1/2 lbs. with sample bottle
Length - 13 inches long
Sampler nozzles - PVC, 3/16"I.D. and 1/4"I.D.

[1] Product Manufacturing Co., Maplewood Industrial Park, 2515 Highway 61 North, St. Paul, MN 55109.

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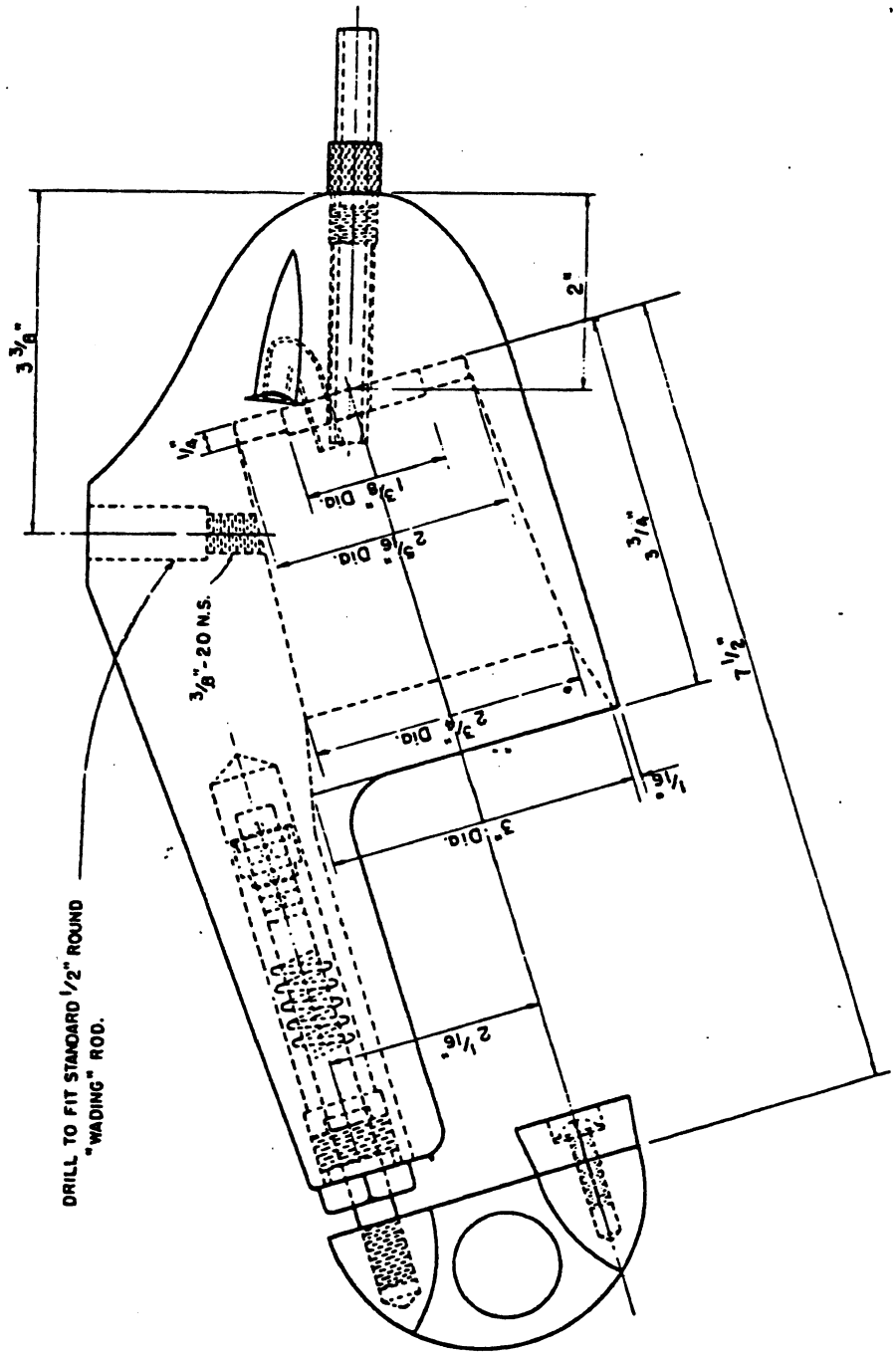

DEPTH-INTEGRATING SUSPENDED-SEDIMENT WADING-TYPE HAND SAMPLER, USDH-48

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PROCEDURE FOR DETERMINING PERCENT SAND, SILT, AND CLAY IN SUSPENDED SEDIMENT SAMPLES

1. General Principle

Each sample is filtered through a series of filters, and the non-filterable solids remaining on each filter are determined directly by the increase in weight over the tared weight of each crucible and filter. The three filter pore sizes chosen to represent the amount of sand, silt, and clay are 63 u, 4.0 u, amd 0.24 u respectively. Since this procedure is designed to represent insteam conditions, no correction for organic matter is made (except for large particles which are removed by hand) and no attempt is made to disaggregate the silt-clay particles if floculation exists.

2. Apparatus

a. Gooch crucibles, 30 ml capacity
b. Filtering apparatus
c. Drying oven
d. Dessicator with indicating dessicant
e. Analytical balance
f. Brass-cloth sieve material (63 u), 4.0 and 0.24 glass fiber filter disks.

3. Procedure

a. Cut concentric circles of filter material from a source of 63 u brass-cloth material, to fit the 30 ml Gooch Crucibles.

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b. Use distilled water with suction to fix filter material (63 u, 4 u, and 0.24 u) into Gooch crucibles.

c. Dry each crucible with filter at 105° C for one hour. Also dry dessicant for the dessicator.

d. Place dried dessicant (still warm) in dessicator, place crucibles in dessicator, seal with silicone grease, and let set for approximately one hour. Do not place more than 13 crucibles into each dessicator.

e. Weigh each crucible in an environmental chamber to the nearest 0.001 mg and record this weight. Note the order in which each crucible is weighed, since this order must be maintained when re-weighted with the filtered solids.

f. Using a graduated cylinder, measure out a well-mixed 250 ml subsample (or more if low suspended solids concentration is suspected) from the original suspended sediment water sample.

g. Under suction, filter the sample through each size filter in turn, beginning with the coarsest (63 u) filter and concluding with the finest (0.24 u) filter. Rinse the graduated cylinder and the sides of each crucible during the filtering process to assure that all particles have been filtered.

h. Transfer all crucibles to a drying oven at 105° C for at least one hour. Also re-dry the dessicant.

i. Place dessicant and crucibles in dessicator for one hour.

j. Weigh all crucibles again, for the final weight, in an environmental chamber and record. These weighings should be performed in the same

order as when initially weighed.

k. Two blank crucibles should be carried through the process to allow correction for slight variations in humidity.

4. Calculations

a. Calculate non-filterable residue as follows for each particle size range (each filtered amount):

$$\text{Total Suspended Solids, mg/l} = \frac{(A-B) \times 1000}{C}$$

where A = weight of filter and residue, mg.

B = weight of filter, mg.

C = ml of initial sample filtered

b. Express each sediment fraction as a percentage of the total suspended sediment in the sample.

Adapted in part from: Manual of Methods for Chemical Analysis of Water and Wastes. 1974. pp 268-269

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Procedure for Collecting Sediment Cores

1. Two cores must be collected at each location using a non-metallic gravity-type or manual coring device. Both core samples will undergo chemical analyses while only one will be subjected to particle sizing.

2. The corer is prepared for use following the manufacturer's instructions. If a gravity-type corer is used, the unit is lowered to a point above the river bottom and is allowed to free-fall for penetration into the sediment. If a manual coring device is used, the device is inserted into the sediment a distance sufficient to assure an adequate sample collection.

3. The coring device is retrieved, and if the device contains a plastic core liner, this liner is removed with the sample. The corer and sample should be kept in as near vertical orientation as possible during this operation to avoid disturbing the cored sediments.

4. Extrude the top several inches (project specific) of the core and place into a sample container labeled with the project number, site number, station number, collection data, and investigator's initials. If both chemical analyses and particle sizing must be performed on the cored sample, this sample must be thoroughly mixed and then subsampled. That portion of the sample for chemical analyses must be placed into a glass container if certain chemical parameters require this container material (review EPA methods for sample container material and holding times).

5. Ship all samples to the laboratory for analysis according to acceptable laboratory procedures.

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FIELD PROCEDURE FOR OBTAINING BOTTOM SAMPLES USING THE WILDCO-BALLCHEK CORE SAMPLER

a. Equipment:

1 Wildco-Ballchek core sampler
1 plastic liner, 2 in O.D. x 30 in long
1 eggshell core catcher
2 end caps for plastic liner
1 boat, motor, etc.
1 core sample removal tool

b. Procedure:

1. Locate sampling station and position survey boat over it.
2. Remove plastic nosepiece and insert plastic liner. Insert an eggshell core catcher and replace nosepiece.
3. Place the core sampler in the water, nose down and let it drop to the bottom. Retrieve the sampler and its core sample using the attached line.
4. When the sampler is in the boat, remove the core sample by unscrewing the nosepiece and sliding the plastic liner with its core sample out of the brass tube. Close the ends of the plastic liner with the end caps to protect the collected sample and ready the sampler for the next sample.
5. After the final sample is taken, clean the instrument of all contamination.

If the sampling station is deep and the bottom very soft, it may happen that the core sampler, when allowed to drop the total depth, will bury itself in the bottom. In such a case, lower the sampler part of the way by its attached line before letting it free-fall to the bottom. Generally, 12 to 15 feet of free-fall is sufficient to obtain a core sample.

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Core samples may be removed from the plastic liners in the field or in the laboratory by using the core sample removal tool to push the core sample from the plastic liner into a suitable container. Plastic liners should be washed before reuse.

The normal life of an eggshell core catcher is from six to 20 samplings and should be replaced when it is apparent that it is no longer operating properly.

MAINTENANCE PROCEDURE

Equipment Identification: Wildco-Ballchek Core Sampler, non-metalic version

Control Number: 1440005

Maintenance Schedule: Before and after each use

Maintenance Procedure:

1. Inspect inside of metal coring tube for contamination and clean if necessary.
2. Inspect retrieving line for frays. Replace if necessary
3. Inspect the plastic nose piece for contamination and clean if necessary.
4. Inspect the entire unit for damage that would prevent it from operating correctly. Repair as necessary.

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LABORATORY PROCEDURE FOR PARTICLE-SIZING SEDIMENT CORES

1. General Principle

The silt-clay fraction of a sediment sample is separated from the sand fraction. The silt-clay fraction is further separated into the clay fraction versus silt fraction, and the sand fraction is sieved through a series of nested sieves to characterize the sand-gravel size distribution.

2. Apparatus

a. Gooch crucibles, 30 ml capacity.

b. 4.0μ and 0.24μ glass fiber filter disks.

c. Filtering apparatus.

d. Drying oven.

e. Dessicator with indicating dessicant.

f. Analytical balance.

g. Sieve set for particle-sizing sand and gravel.

h. Ro-tap Shaker.

i. 1 liter beaker or larger, evaporating dishes, etc.

3. Procedure

a. Mix the core sample thoroughly and subsample an amount that will provide approximately 75 grams of sand-gravel (estimate amount) for sieving purposes, since using a sample of this size will minimize the percent error due to sand "lost on the sieves". Place the subsample in a tared evaporating dish.

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b. Oven-dry the subsample at a low oven temperature (~50°C) for a 24-hour period. A high oven temperature would bake the sediment and not allow adequate disaggregation of the silt-clay particles.

c. Allow the sample and container to cool somewhat, then weigh to the nearest 0.01 mg and record. Subtract the tare weight of the evaporating dish from this value to get the total initial sample weight.

d. Place the subsample into a 1000 ml beaker, add approximately 500 ml of distilled water, and stir with an electromagnetic stirring bar until thoroughly disaggregated.

e. Wet-sieve this sediment solution through a 63μ sieve, washing the sediment on the screen with a fine jet of distilled water, and saving all filtrate that passes through the sieve. Ideally, the amount of filtrate passing the screen, including wash water, should not exceed 1000 ml by volume. The filtrate now contains all silt and clay while the portion remaining on the screen is sand and gravel.

f. Temporarily put aside the filtrate. Wash the sand-gravel portion from the screen with distilled water into a tared beaker or evaporating dish. Allow to set for several minutes and then decant the clear supernatant. Place the container in a drying oven at 105°C and evaporate all moisture.

g. Remove the sand-gravel fraction from the oven, allow to cool, and then weigh the container and sample to the nearest 0.01mg. Subtract the container tare weight to get the total sand fraction weight.

Subtract this weight from the total sample weight to obtain the total silt-clay fraction weight.

h. Sieve the sand-gravel fraction through a series of nested sieves with the aid of a Ro-tap shaker. Be sure to include a pan at the very bottom to collect any silt-clay particles that were not washed through the 63μ sieve during the wet-sieving process. The sieve sizes within the nest will depend upon what sand or gravel fractions are desired, but sieving will always be from the coarsest sieve to the finest sieve.

i. Weigh each sand and gravel fraction retained on the screens to the nearest 0.01mg and record the weight for each fraction. The sum of these values plus the "pan weight" (weight of material in pan) should sum to within 2% of the total sand-gravel fraction weight. Re-sieving is in order if this accuracy is not achieved. Note that some material is always retained or "lost" on the screens.

j. The individual sand and gravel fractions may be disposed of, put keep the "pan material" and add this to the filtrate containing the rest of the silt-clay fraction.

k. A dispersing agent may now be added to this filtrate if flocculation between silt-clay particles is evident. This step is optional since the filtrate will be filtered under vacuum and it is not clear whether this flocculating condition is eliminated by the filtering action or not. A dispersing agent may be prepared by adding 40.0g of sodium metaphosphate and 8.0g of sodium biocarbonate in distilled water

diluted to one liter[1]. Then 10 ml of this "calgon solution" is added per gram of silt-clay sediment sample remaining in the filtrate from the wet-sieving process (calculated earlier).

l. Stir the filtrate (silt-clay solution) with an electromechanical stirrer for five minutes and analyze according to the methods in the Procedure for Determing Percent Sand, Silt, and Clay in Suspended Sediment Samples. The only difference will be that filtration through the 63u sieve has already been accomplished. It is only necessary to determine the silt fraction by filtering the filtrate through the 4.0u filter, and the clay fraction by filtering this secondary filtrate through the 0.24u filter.

m. Calculate the percent silt and percent clay by dividing the weight of each fraction by the total sediment sample weight and multiply by 100.

[1] National Handbook of Recommended Methods for Water-Data Acquisition, 1978. An Interagency Government Report. Chapter 3, Sediment, p 3-95. (Obtainable through U.S. Geological Survey).

WRITTEN KB DATE 3/6/81 QA KT DATE 3-9-81

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EQUIPMENT SPECIFICATIONS

Equipment Identification: Standard Sieve Set

Control Number: 1440003

Calibration/Maintenance Schedule: Maintenance daily when in use

Specifications:

1.0 Description: The standard sieve set is a set of thirteen, 8" diameter, 2 7/8" wide, nesting, brass sieves used to size classify sediments. The set also includes one wet sieve of 63 μm size, 8" diameter and 8" deep, one catch pan and one cover.

2.0 General: The standard sieves are Tyler mesh series, standard size sieves in the following sizes:

5 (4.00 mm)	42 (355 μm)
7 (2.80 mm)	60 (250 μm)
9 (2.00 mm)	80 (180 μm)
12 (1.40 mm)	115 (125 μm)
16 (1.00 mm)	170 (90 μm)
24 (710 μm)	250 (63 μm)
32 (500 μm)	

Specification Verification:

3.0 Inspection

The equipment will be inspected daily when in use per the Standard Sieve Set Maintenance Procedure.

4.0 Specifications From: Tyler Combustion Engineering Company "Specification tables for industrial wire cloth woven wire screens No. 74" 1973 edition.

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EQUIPMENT SPECIFICATIONS

Equipment Identification: Wildco - Ballchek Core Sampler, non-metalic version.

Control Number: 1440005

Maintenance Schedule: Before and after each use. (See 3440009)

Specifications:

1.0 Usage

This device is designed to obtain a 2 in diameter by 30 in. long sample of river, lake or ocean bottom material without metal contamination from the instrument itself.

2.0 Description

Weight: 25 lbs.

Core tube: Brass, 30" x 2" I.D.

Insert tube: Plastic, 30" x 2" O.D.

Diving weight: 10 lbs.

3.0 Reference

WILDCO catalog #74, page 16.

WRITTEN F.B. DATE 1/26/76 QA WN DATE 1-27-76

APPROVED RWC 26-I-76

MAINTENANCE PROCEDURE

Equipment Identification: Standard Sieve Set

Control Number: 1440003

Maintenance Schedule: Daily, when in use.

Maintenance Procedure:

A. Inspect each screen for integrity (no holes, etc.) or stretched, broken or displaced screen wire. Initial and date the soil data form following inspection. If the screen is found damaged, repair or replace before using. When damaged screens are found they will be logged in the maintenance record and the corrective action indicated.

B. Inspect screens for jammed grains between the screen wires, clean with soft brush and compressed air to remove as many grains as possible.

Inspection Records:

A. Nonconforming Equipment: If equipment does not meet the specified performance limits, a variance form is initiated. If the equipment cannot be adjusted to within specified limits, it is tagged "HOLD" to prevent inadvertent use.

WRITTEN FB DATE 1/26/76 QA [illegible] DATE 2-5-76

APPROVED [illegible] 26-I-76

Surface Water Sample Collection - Procedure

1.0 General

Collection of surface water samples for analysis of chemical parameters is the most frequently performed field task. Samples are collected in the majority of cases by taking a "grab sample" of the surface water, or in some cases by an automatic mechanical sampling device.

Grab samples are collected with a "general" or unpreserved container constructed out of material that will not later interfere with parameters to be analyzed in the sample. This collected sample is transferred to appropriately labeled and preserved sample bottles. These bottles must be of the correct material and contain the correct preservative for the parameters to be analyzed.

Samples gathered with an automatic mechanical sampling device, such as the ISCO Model 1680 sequential sampler, retain the sample until collected by the operator. This ISCO model is semi-programmable, programmed to collect a sample at pre-determined intervals, and to place the sample in discrete bottles or together as one composite sample. All material that comes in contact with the collected water sample, including the sample bottles, must not interfere with later analysis of parameters. Preservation of the samples should be made as soon as possible after retrieval by the operator.

On occasion integrated water samples are desired. A Kemmerer or similar type sampler is used to collect a sample over several feet of depth. A subsample is retained and preserved with the appropriate preservative.

All samples must be clearly labeled and kept on ice after collection, usually in ice-filled coolers, until transferal to refrigeration units at the laboratory.

2.0 Specific

When sampling from a stream at several stations, sampling begins with the lower station and proceeds to the upper station. This sequence will avoid alteration of downstream water quality resulting from upstream activities during the sampling process. Samples should be collected upstream of the investigator at the stream mid-point, or from the area of greatest velocity unless specified otherwise by project sampling criteria. In all cases, emphasis should be placed on obtaining a representative sample.

Samples should be collected with a general bottle and poured into preserved bottles. Sample bottles should be filled nearly to the top without losing any of the preservative, and should be clearly labeled with a waterproof marking pen. After returning to the laboratory from a field sampling effort, samples should be properly logged-in and custody relinquished to laboratory personnel, or refrigerated if laboratory personnel cannot immediately attend to them.

3.0 Records

Each sample collected should be labeled with the appropriate project and sample number, sampler's initials, time and date of collection, type of sample, and type of preservative. The appropriate field data form or record book should describe any other pertinent information such as sample color and odor, location of the collection point (station), and

unusual conditions or circumstances that may affect the subsequent chemical analyses. Sample "chain of custody" procedures must be followed (refer to CDM laboratory procedures).

WRITTEN KB DATE 800319 QA LT DATE 3-20-80

APPROVED DHB DATE 3/19/80

EQUIPMENT OPERATION PROCEDURE

Equipment Identification: pH/Temperature Recorder
Ecologic Model 302 B

Equipment Maufacturer: Ecologic Instrument Corporation, Bohemia, N.Y.

Control Number: 302

Operating Procedure: (reference owners manual)[1]

1. Prior to using the Model 302 B portable recorder, the condition of the internal batteries must be checked. If charging is required, plug the AC line cord into a 115 volt AC 60 cycle outlet and allow 18 hours for a full charge. At the end of the charging period, the function switch should be switched to the BAT CHECK position and the AC line cord removed. The meter should fall within the battery check limits, indicating the battery has been charged.

2. Set the meter function switch to TEMP and submerge the probe assembly into the buffer solution (a buffer solution is prepared by dissolving one tablet in four ounces of distilled or or deionized water). Allow 60 seconds to elapse, then note the measured temperature.

3. Set the meter function switch to either pH measurement position. If "pHm" is selected, set the TEMP control to the measured temperature of the solution. If "pHa" is selected, pH is automatically temperature compensated.

4. Adjust the CAL control for a reading on the meter which corresponds to the buffer pH selected.

5. The pH/temperature recorder is now ready for operation, depending upon the choice of operating mode (i.e., METER mode or RECORDER mode).

   a. In the METER mode selection there are three selector switches from which to choose from; pHa, pHm, and TEMP.

      pHa - the meter indicates pH which is autómatically temperature compensated;

      pHm - the meter reads manually temperature compensated pH. Temperature of the solution must be set on the TEMP dial.

      TEMP - the meter indicates the temperature in degrees centigrade being measured by the sensor assembly.

WRITTEN CTH DATE 5-1-80 QA RT DATE 5-6-80

APPROVED DRB DATE 5/6/80

b. In the RECORDER mode, the AC recorder will record automatic temperature compensated pH, or temperature, depending upon the position of the RECORDER function switch. While recording pH or temperature, instantaneous pH or temperature may be observed on the 3¼ inch meter movement.

6. Two flow cells are provided in the recorder package to be used in conjunction with the probe assembly; the submersible cell and the in-line flow cell.

[1]Ecologic Instrument Corporation, 1977. Instruction Manual-Model 302 B pH/Temperature Recorder. Ecol. Instr. Corp., Bohemia, New York.

CALIBRATION AND MAINTENANCE PROCEDURE

Equipment Identification: pH/Temperature Recorder
Ecologic Model 302 B

Equipment Manufacturer: Ecologic Instrument Corporation, Bohemia, N.Y.

Control Number: 302

Calibration Procedure:

1. Battery Check:
In the "battery check" position, the chart recorder is energized and the meter indicates relative strength of the internal battery. If the AC line cord is plugged in, the meter will read on or close to full scale, indicating the battery is charging. It is not recommended that the instrument be left in this position, as it will affect battery strength and charging time.

2. Meter Field Calibration:
Check before each use. Using a buffer in the expected region of pH measurement, adjust the calibration control for a reading on the meter which corresponds to the appropriate buffer being used. Three different buffer tablets are provided together with three four ounce wide-mouth bottles and stirrer stick. A buffer solution is prepared by thoroughly dissolving one buffer tablet in four ounces of distilled or deionized water.

3. DC Recorder Calibration: (reference instruction manual)[1]
All Calibration results (lab and field) should be noted and recorded.

Maintenance Procedure:

An adequate supply of support materials must be kept on hand (i.e. chart paper for the recorder and buffer tablets). Batteries should always be fully charged. The condition of the electrode should always be checked for any cracks or dirt, and must be kept clean when not in use. All wires, especially the power cord, should be checked for frayed ends or loose connections. The flow cells (submersible and in-line flow) must also be checked for proper fit and general condition.

[1]Ecologic Instrument Corporation, 1977. Instruction Manual - Model 302 B pH Temperature Recorder. Ecol. Instr. Corp, Bohemia, New York.

WRITTEN C.T.M. DATE 5-1-80 QA RT DATE 5-6-80

APPROVED DRB DATE 5/6/80

CHAIN OF CUSTODY
CAMP DRESSER & McKEE INC.

F0226

Date_____ Initial Sampler_____

Sample Number						Sampling Location	Volume to be Collected	Time Collection Began	Initials	Time Collection Completed	Initials	Comments
Project Number	Location Number	Anal. Type	Day	Month	Year							

Relinquished by
Name Company Received by
Name Company Date-Time

Relinquished by
Name Company Received by
Name Company Date-Time

Authorization for Disposal Date-Time Disposed by Date-Time

PERSONNEL TRAINING AND CERTIFICATION PROCEDURE

The fisheries group quality assurance procedures are read by the new employee and discussed with certified fisheries personnel. Emphasis is placed on those procedures pertinent to the work assigned. The new employee observes as certified fisheries personnel perform group tasks and then the new employee performs the same tasks while being supervised. All work done by the new employee is rechecked for accuracy.

New employees are acquainted with field procedures such as field trip preparation, sample collection and processing plus data form completion. They are also trained in laboratory procedures such as picking ichthyoplankton, pressing scales, sample analysis and fish identification. Included in the training process is the operation and maintenance of fisheries equipment.

Upon completion of the training period, a certification exam is arranged and administered. The exam content is dependent upon the employee catagory (e.g., fisheries technician, fisheries biologist). Each job description lists the minimum requirements necessary to hold that title and the work responsibilities associated with it. The test results are attached to the Personnel Certification Form and are filed in the quality assurance manager's office.

All group personnel are periodically reevaluated for certification.

WRITTEN FB DATE 11 August 78 QA ST DATE 8-11-78

APPROVED DRL DATE 8/11/78

PROCEDURE FOR REVIEWING AND CHECKING FISHERIES DATA

Field notes, concerning station locations, gear types, sampling intervals and other pertinent trip information, are initialed and dated by the investigator and filed by the fisheries group personnel.

All sample data are recorded on the appropriate fisheries data form. Upon completion of the field work, the forms are initialed and dated by the investigator and then checked for completeness, initialed and dated by a second person. If data are to be computerized, the field data portion of the forms are photocopied. The originals are filed by data analysis group personnel and the copies are filed by fisheries group personnel until the samples have been analyzed.

Upon completion of sampling processing, the laboratory analysis portion of the fisheries data forms are initialed and dated by both the analyst and a person who checks the data for correctness. Any discrepancies found in the data are either resolved by the fisheries group manager or samples are sent to a consultant for identification. A literature search for more information may be conducted. If data are to be computerized, the entire fisheries data forms are photocopied. The copies are filed by fisheries group personnel and the originals are filed by data analysis group personnel for keypunching.

WRITTEN _____ DATE 1/3/80 QA _____ DATE 1-10-80

PROCEDURE FOR SEINE USAGE

1. Record all pertinent physical information on Field Notes - Seine Forms.
2. The seine is unfolded, and if necessary, stretched to full length.
3. Depending upon seining requirements, appropriate number and length of seine hauls are taken.
4. Time start is noted on the data form. The seine is stretched and lowered as the haul commences.
5. After the appropriate amount of time has elapsed, the seine is drawn close to shore and stretched while the end poles are turned to a horizontal position.
6. The catch is shaken into the bag portion of the seine. From there, the fish are placed in suitable containers labelled with project code, site, station, and sample number and collection date. Formalin is added to the samples to obtain a 10% formalin solution.
7. Fish are analyzed per the Adult and Juvenile Fish Analysis Procedure.
8. Data forms are initialed and dated.
9. Data forms are photocopied. The originals are filed by the Data Analysis Group and the copies are filed by the Fisheries Group.

WRITTEN [signature] DATE 1 June 77 QA [signature] DATE 6-1-77

APPROVED [signature] DATE 7/26/01

PROCEDURE FOR FISH AGE DETERMINATION USING SCALE SAMPLES

1. Fish Age and Growth Data Form is used in recording aging data.
   a. Fish scales to be analyzed are grouped into species by station.
   b. Between five and ten scales (depending on size) are removed from an envolope and are placed convex surface down on a cellulose acetate slide.
   c. The slide is covered with a tin cover slide and fed through an Ann Arbor roll press.
   d. The cellulose acetate slide is returned to the appropriate slide envelope.
   e. The glass slide is placed on a micro-projector and a scale impression is displayed on a white backdrop.
   f. A strip of paper is placed on the projected image. Marks are made on the paper for the center of the scale, the edge and for each annulus.
   g. The strip of paper is labeled (species, fish, ID number, location).
   h. The strip of paper with the marks is placed on a meter stick.
   i. The radius and distances spanned by each annulus are noted and recorded on the Fish Age and Growth Data Form for the appropriate fish.
   j. The process is repeated for all scale samples.
2. Initial and date the Fish Age and Growth Data Forms.
3. Photocopy the data forms and file originals in Data Analysis Department and copies in Fisheries Department.

WRITTEN [signature] DATE 3-12-76 QA [signature] DATE 76-3-15

APPROVED [signature] 12-III-76

F 0249

Fish Gear Summary

CARD 1

COLLECTOR _____ DATE _____ CHECKED BY _____ DATE _____

1 2 3 4 5	6 7 | 8 9 | 10 11	12 13	14 15	16	17 18 19	20 21 22
PROJECT No.	YR | MON | DAY	SITE	STATION	REP	STATION DEPTH/ft	SAMPLING LEVEL/ft

TIME FISHED		TEMPERATURE °C	D. O.	GEAR TYPE	NET MEASURE		CURRENT SPEED	CARD No.
Hours	Minutes				Width	Mesh	Ft / Sec	
27 28	29 30	31 32 33 34	35 36 37 38	39 40 41	42 43 44	45 46	47 48 49 50	79

GEAR TYPE CODES

MESH CODES (Stretch)

NOTES

EQUIPMENT USED

FISH DATA

Card 2 (Duplicate Columns 1-22)

COLLECTOR | DATE | CHECKED BY | DATE

Project no. | Date | Site | Station | Rep | Samp. Level | Time Collected | Gear

SPECIES	Species Code 23 24 25 26	Fish No. 28 29 30 31	Length mm 33 34 35 36	Weight gm 38 39 40 41 42	Disease 45 46	Abnorm.	SEX 48	MAT 49	AGE 50 51	Mesh 53 54	TAG No. 56 57 58 59 60	RECAP 61	TOTAL NUMBER 63 64 65 66 67	TOTAL WEIGHT 69 70 71 72 73	NOTES	Card no 79	End Flg 80

ADULT AND JUVENILE FISH ANALYSIS PROCEDURE

1. The Adult and Juvenile Fish Analysis Data Form is used to record data on fish species analysis.
2. Field data for the sample being analyzed are transferred to the Adult and Juvenile Fish Analysis Data Form.
3. The catch is separated by species. If large numbers of any one species are collected, the sample may be subsampled. Subsampling methods will be determined on a case by case basis.
4. If subsampling of the catch is unnecessary, measure and weigh each individual fish. Determinations are routinely total length in millimeters and weight in grams. Different classifications are employed when specified (e.g. fork length, standard lengtl lengths in inches or weights in ounces).
5. If required, the sex and gonadal condition of each fish are determined. Determinations are either internal (dissection) or external (pressure applied to the body cavity to release sexual products).
6. If required, stomach samples are removed from individuals of each species and retained for later analysis. The exact number of stomachs retained is determined on a case by case basis.
7. Stomach samples are placed in Whirl-Pac bags and buffered formalin is added to obtain a 5-10% solution. The Whirl-Pac bags are labeled with project code, site, station and sample number, species code, fish I.D. number and collection date.
8. If required, ovaries and/or roe are removed from individuals of each species and retained for later analysis.
9. Ovaries and/or roe samples are placed in Whirl-Pac bags and buffered formalin is added to obtain a 5-10% solution. The Whirl-Pac bags are labeled with project code, site, station and sample number, species code, fish I.D. number and collection date.
10. If required, each species are examined externally for incidence of disease, parasitism, or physical abnormalities.

WRITTEN [signature] DATE 1/3/80 QA [signature] DATE 1-17-80

APPROVED [signature] DATE 1/10/80

11. If required, scale and/or spine samples are retained for age and growth analysis. Spine samples and scale samples are stored in appropriately labeled envelopes.
12. Spine and scale envelopes are kept on file by the Fisheries Group.
13. Data forms are initialed and dated by both the analyst and checker.
14. Data forms are photocopied with originals filed by the Data Analysis Group and copies filed by the Fisheries Group.

WRITTEN [signature] DATE 1/3/80 QA [signature] DATE 1-17-80

APPROVED [signature] DATE 1/10/80

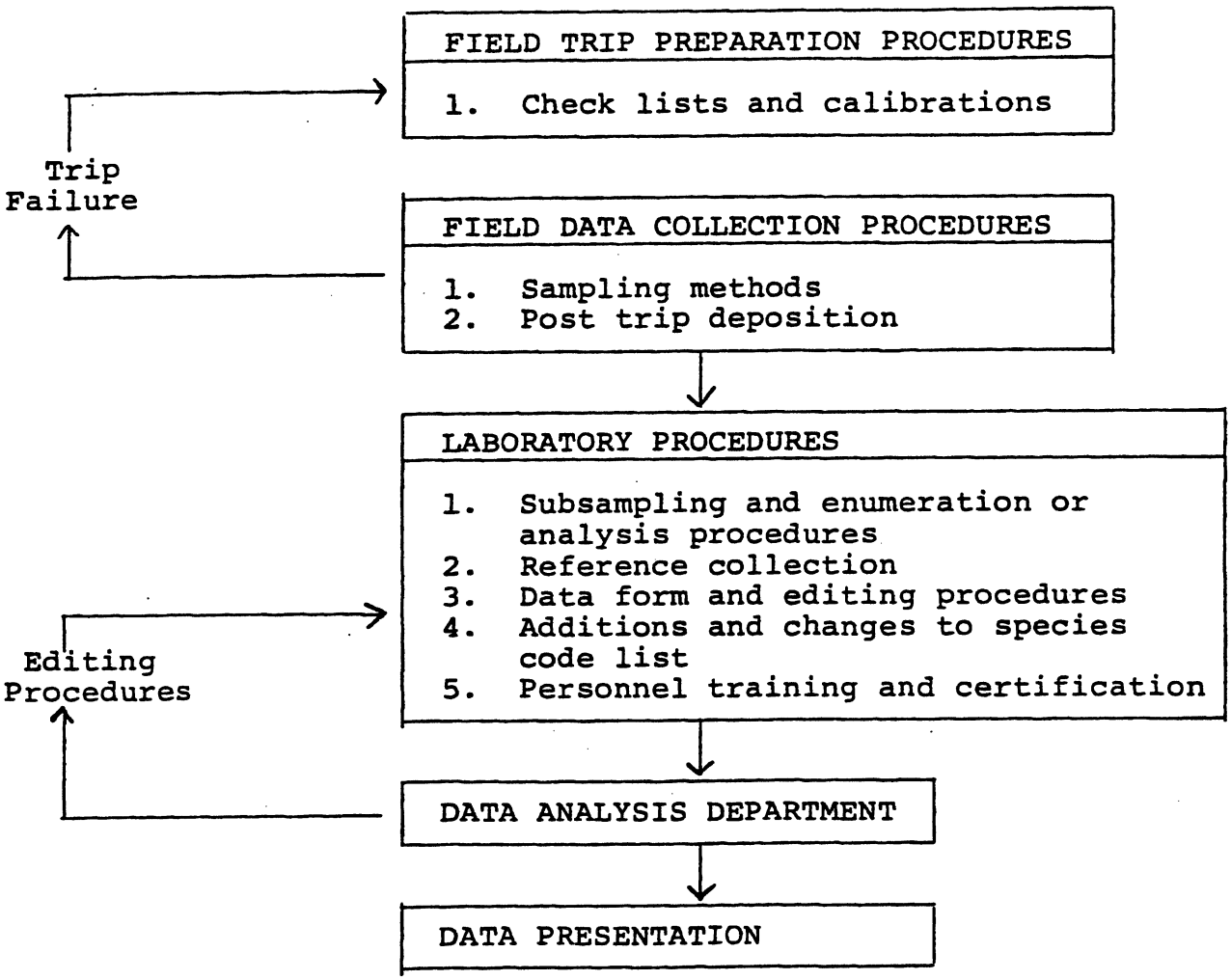
MAINTENANCE OF FISH REFERENCE Collections

Whenever possible, adult and juvenile fish are processed in the field and returned to the water alive. Occasional specimens and questionable specimens are returned to the laboratory for positive identification. Also, all small fishes (i.e. minnows, madtoms, killi fishes, and darters, etc.) are returned to the laboratory for analysis.

Representative specimens are used to establish project specific reference collections when these are required by the client. New species are added to the general Fisheries reference collection. When a specimen is removed from a project reference collection to the Fisheries reference collection, a note indicating the location of the transferred specimen is made.

Specimens are preserved in formalin. Inside each jar is placed a waterproof label containing the following information: species name, project number, place of capture, date of capture, and initials of the person responsible for the identification. Project reference collections are maintained for two years following completion of the project.

PHYCOLOGY DEPARTMENT DATA FLOW CHART



WRITTEN [signature] DATE April 21, 1977 QA [signature] DATE 4-22-77
APPROVED [signature] DATE 4-22-77

PHYCOLOGY DATA LOG

1. The Phycology Data Log contains the following information:
   a) Sample Type
   b) Date Collected
   c) Sample Number
   d) Date Reference Slides Made and Agent
   e) Date Counted and Agent
   f) Date Editing Completed and Agent
   g) Date Subsample Made and Agent

2. Every sample that comes to the Phycology Group is entered in the Data Log as to sample type, date collected and sample number.

3. As each operation is performed on a sample, the date is entered in the appropriate column space in the Data Log along with the initials of the agent performing the operation. When an operation does not apply to a sample, a horizontal line is drawn in the appropriate column space.

WRITTEN [signature] DATE 800110 QA [signature] DATE 1-10-80

APPROVED [signature] DATE 1/10/80

PERIPHYTON AND PHYTOPLANKTON DATA FORM (Card 1)

River/Lake:	Location:	Client:

(1) Proj. no. _ _ _ _ _ _	(32) Temp. code _	(56) Volume settled (ml.) _ _ _ _ . _
(7) Date _ _ _ _ _ _	(33) Temp. surf. _ _ . _	(62) Volume code _
(13) Time _ _ _ _	(37) Temp. bott. _ _ . _	(63) Volume of composite _ _ _ _ . _
(17) Area _ _	(41) Depth code _	(69) Area units _
(19) Station _ _	(42) Depth contour _ _ . _	(70) Area Scraped _ _ _ _ . _
(21) Sample no. _ _ _	(46) Depth sample _ _ . _	
(24) Coll. device code _ _	(50) Secchi code _	
(26) Coll. invest. _ _ _	(51) Secchi depth _ _ . _	
(29) Analyzed sample _ _ _	(55) Microscope code _	

Vol._____ Time_____

Investigators_____

Weather conditions_____

Light Meter_____ Code ____

Station	Reading	Units

Temperature Meter Control No._____

Comments:_____

Prepared by_____ Date_____ Checked by_____ Date_____

TRAINING AND CERTIFICATION PROCEDURES - PHYCOLOGY DEPARTMENT

The training of new personnel consists of the following:

The department quality assurance procedures are read and discussed with certified personnel; emphasis is placed on those procedures pertinent to the work assigned.

The new employee watches as a certified person performs department tasks and then performs these tasks while being supervised. All work done by the new employee is rechecked for accuracy.

Time is spent acquainting new counters with the algal species found in particular areas. All identifications are closely supervised by a certified phycologist. Identifications are aided by taxonomic keys, reference slides, drawings, and photographs.

The certification examination is arranged and administered by the Group Manager. The exam content is dependent upon the employee catagory (Scientist I-VI). The positions of Scientist I-VI are established under company policy. Each job description lists the minimum requirements necessary to hold that title, and the work responsibilities associated with it.

New employees are tested after an initial training period. All department personnel are reevaluated for certification periodically. Employees may also be certified to perform duties in other areas after cross-training has been successfully completed. The test results are attached to the Personnel Certification Form and filed in the Director's office.

WRITTEN KSC DATE 5/31/7 QA [illegible] DATE 6-1-77

APPROVED [illegible] DATE 770601

BENTHIC ALGAE (NATURAL PERIPHYTON)
QUANTITATIVE FIELD COLLECTION PROCEDURE

1. The equipment is readied, inventoried with the Periphyton Equipment Checklist and loaded into the truck.
2. At the site, the boat is launched, loaded with the equipment and motored to the sampling station. Suitable substrate (i.e. pilings, pier, rocks) is located.
3. With a calibrated cork borer, score two rings into the mass of periphyton on the surface of the substrate.
4. Clear the periphyton away from the areas around the rings with a scalpel and a small brush.
5. Scrape the rings of periphyton into a suitable container. Using distilled water from a wash bottle, the rings are cleaned of as much periphyton as possible. If required, the samples are preserved with the appropriate preservative.
6. Sample algae growing on particulate sediments with a calibrated flower bulb corer. The top inch of sediment within the corer is sampled. Place a plexiglass plate over the bottom of the corer, withdraw sample, and place in a metal tray. Wash sample from the tray into a bottle containing preservative.
7. Label the container with project code, station and sample number, collection date and investigator's initials.
8. The samples are returned to the laboratory for analysis.

WRITTEN WMM DATE 800117 QA KT DATE 1-18-80

APPROVED AM DATE 17 JAN 80

PREPARATION OF M^3 FIXATIVE

1. Prior to the sampling effort, Meyer's (M^3) fixative is added to each sample bottle so the phytoplankton and/or periphyton will be immediately preserved after collection.
2. The volume of preservative used is such that the final concentration in the sample will be approximately one percent.
3. The formula for Meyer's (M^3) fixative is as follows:

1g	I_2
0.5g	KI
5 ml	Glacial Acetic Acid
25 ml	Formalin
100 ml	H_2O

Notes: This fixative preserves cytological detail and precipitates blue-green algae. The flagella are retained, starch is stained and cell dimensions are not significantly altered. The specimens can be used for cytological study even after storage at room temperature for greater than five years.

Reference: Meyer, R.L. 1971. A study of phytoplankton dynamics in Lake Fayetteville as a means of assessing water quality. Arkansas Water Resources Research Center. University of Arkansas, Fayetteville. Publ. 10. 58 pp.

WRITTEN _____ DATE 780323 QA _____ DATE 3-23-78

APPROVED _____ DATE 780323

NATURAL PERIPHYTON QUANTITATIVE LABORATORY PROCEDURE

1. The natural periphyton samples are inventoried and stored with the Phycology Group.
2. If necessary, the samples are mixed in a blender until the clumps are broken up. The samples are then returned to their collection containers.
3. A plate chamber is prepared by securely attaching a clean bottom plate to the rectangular plate with a metal retaining ring.
4. The plate chamber is labelled in pencil on the right-hand side with the project name, station, site, and sample number, date of collection, date and exact time sample is set up, and the initials of the person setting up the sample. The subsample volume is selected to give a cell density on the bottom of the settling chamber which is optimum for identification.
5. A few drops of distilled water are placed around the edge of the large circular opening in the rectangular plate. The cylindrical chamber is set over the opening and held firmly in place to produce a water seal.
6. The periphyton sample is resuspended as described by Weber (1966). The sample is mixed by inverting the sample bottle no fewer than seven times and then a graduated pipet is immediately filled and discharged back into the bottle. The bottle is mixed again and the pipet is refilled, this time to be discharged into the combined chamber, while being swirled to prevent cells from clinging to the sides of the cylindrical chamber.
7. A jet of distilled water is added to the combined chamber until a convex surface forms at the top. This ensures a uniform cell distribution on the bottom plate.

WRITTEN KSC DATE 5/31/77 QA [illegible] DATE 6-1-77

APPROVED [illegible] DATE 770601

8. A circular cover plate is slid across the top of the cylindrical chamber to form a water seal. The combined chamber system is left undisturbed for at least 24 hours to allow the maximum amount of algae to settle to the bottom plate.
9. After the required settling time, a few drops of water are placed around the base of the cylindrical chamber and a rectangular cover plate is used to slowly and steadily push the cylindrical chamber to a hole in the plate chamber where it discharges. As the cylindrical chamber is moved sideways, the cover plate closes the plate chamber without resuspending the algae.
10. The cylindrical chamber and circular cover plate are rinsed with distilled water, washed with a mild detergent, rinsed again and dried.
11. If the plate chamber is not counted immediately after being taken down, it is stored in a refrigerator to prevent both evaporation and contamination.
12. The plate chamber is taken from the refrigerator 5 to 10 minutes before it is used, in order for the condensation on the chamber plates to evaporate.
13. Natural periphyton are identified using either a Zeiss Standard UPL inverted microscope, a Nikon Model M inverted microscope or a Wild M40 inverted microscope.
14. For information concerning the recording of data, refer to the Use of the Periphyton and Phytoplankton Data Form and Editing of Data Procedure.
15. A grid of known area is moved across the slide in a random manner to determine which cells will be identified and counted. The following criteria are used:
    1. All unbroken algal cells with intact chloroplasts (whether individual cells or cells of a colony or filament) lying completely within the grid area are counted. In some cases, where it is impossible to obtain the exact number of cells in a colony or filament, an estimate is made.

2. Algal cells which touch the top and/or left side of the grid are counted. Algal cells which touch the bottom and/or right side of the grid are not counted.
3. Algal cells which touch both the bottom and the left side of the grid are counted, while those which touch both the top and right of the grid are not counted.
4. Algal cells which touch the left and right of the grid are counted, while those which touch the top and bottom of the grid are not counted.

16. Counting units are defined by the client in the project work scope.
17. The magnification at which the plate chamber is examined and the number of units counted are as per client request and are stated in the project work scope.
18. The number of grids counted are recorded on the Periphyton and Phytoplankton Data Form.
19. The Phycology Data Log is initialed and dated in the appropriate place after the samples are analyzed.
20. The cover plate, retaining ring and bottom plate are removed from the Plexiglas plate and washed with 95% ethyl alcohol. The writing on the Plexiglas plate is removed with an eraser, and the plate is rinsed with water.
21. The samples are sealed with parafilm and the jar lids are tightened. The samples are retained at CDM for two years following the final collection date.
22. The Phycology Data Log is initialed and dated after each data set is stored.
23. The Periphyton and Phytoplankton Data Forms are handled according to the Data Set Editing and Correction Procedure and the Data Set Filing Procedure.
24. If required, cleared diatom slides are prepared as specified in the Procedure for Making Cleared Diatom Slides. These are stored with the Phycology Group in labelled, plastic slide boxes.

Sample No. ___
Date _____

PERIPHYTON AND PHYTOPLANKTON LABORATORY ANALYSIS

Duplicate cols. 1-25, Left zero all other fields
Cards 2 through End

DO NOT KEYPUNCH

Species	Count	Species Code 27-28	29-30	31-32	33-34	35-36	Unit Count 40-45	Fields Counted 50-55	Mag. 59	Grid Length 60-65	Mean Biovolume 70-77

Sta. No. _____ Collection Date _____ LABORATORY ANALYSIS (left zero all fields) Fraction subsampled _____

Samp. No. _____ Page ____ of ____ Method _____

Species Name (not keypunched)	Species Code 27 – 28	29 – 30	31 – 32	33 – 34	35 – 36	37	Number Counted 40 – 45	Number per Sample 50 – 55	Number per Subsample 60 – 65	Subsample Conversion Factor 70 – 75	Investigator 76 – 78	E Fl

Prepared By: _____

Midges: / ( ) Olig. frags

PROCEDURE FOR MAKING CLEARED DIATOM SLIDES

1. Centrifuge an adequate volume of suspended sample for 20 minutes at 2500 rpm (1000 x g) using head size number 320.
2. Decant the supernatant from the centrifuge tube with a suction tube.
3. When the water contains a high level of dissolved solids, these may crystalize when the sample dries, obscuring the diatoms on the finished slide. To avoid this, wash the sample by centrifuging with distilled water and decant the supernatant as directed previously. Washings may be repeated several times if necessary.
4. Thoroughly mix the algal concentrate in the centrifuge tube with a disposable pipet and deliver several drops to a coverslip. Dry the coverslips on a hot plate set on a low setting. When dry, examine the coverslips to determine if there is sufficient material for a diatom count. If not, repeat the process one to several times.
5. Transfer the coverslips to a muffled furnace. The cold muffled furnace is set at 550°C and left for one hour.
6. Place a 25 X 75-mm glass slide on a moderately warm hot-plate (setting number 3) and place a drop of Cargille's Carmount mounting medium at the center.
7. While the coverglass and slide are still hot, grasp the coverslip with a forceps, invert it so the side with the diatoms on it is face down, and place it on the drop of Carmount. It may be necessary to add additional Carmount at the margin of the coverslip.
8. Leave the glass slide and coverslip on the hot plate for 5-10 minutes to evaporate the solvent. When the bubbling ceases, remove the slide from the hot plate, place on a firm, flat surface, and cool until the Carmount hardens.

WRITTEN KSC DATE 5/31/77 QA [illegible] DATE 6-1-77

APPROVED [illegible] DATE 770601

9. Apply slight pressure to the coverglass with a blunt object (i.e., pencil eraser), if necessary, to drive off any additional air bubbles.
10. When the slide is cool, and the Carmount has hardened, use a razor to scrape the excess away from the cover-slip margin.
11. Include on each slide project name and code, sample number, sample type, and sample date.
12. The reference slides are filed in a slide box by the Phycology Group, and the Phycology Data Log is dated and initialed.

USE OF THE PERIPHYTON AND PHYTOPLANKTON DATA FORM AND EDITING OF DATA

1. Prior to counting each sample, the front page and some of the back page of a Periphyton and Phytoplankton Data Form are completed for that sample.

Steps in Process:

A. The correct sample type is circled (front page).
B. All other available data is filled in the proper spaces provided on the top of the front page of the data form. The bottom of the front page is initialed and dated.
C. The magnification code and grid length are filled in on the back page of the data form.

2. After the count is completed, the number of fields counted is recorded; any missing species codes are filled in, (Note: If a species is found for which a code does not exist (new species) follow the procedure outlined in Additions and Changes to the Species Code List). The count for each organism is tallied and recorded under unit count. When this is completed, the agent initials and dates the bottom of the back page of the data form.
3. After completion of the data form, it is turned over to a second person who checks both the front and back page to be sure all data have been filled in correctly and all counts have been tallied correctly. After the data form has been checked, it is initialed and dated and the Phycology Data Log is initialed and dated.

Steps in Checking Process:

A. Check all available data and be sure it is recorded correctly. Make proper changes after discussing them

with the person who prepared the data form or the Group Manager.

B. Check for addition errors in unit counts.

C. Check species code number and assign any that are missing or incorrect.

4. After the data forms have been checked, they are photocopied and the copies are filed by the Phycology Group. All pages for an individual sample are stapled together. The originals are placed in a properly marked folder which is placed in the "data to keypunch" basket in the Data Analysis Group. The Data Set Log is signed and dated.

5. The first computer output of data is checked against the Periphyton and Phytoplankton Data Forms. If a correction must be made, a Data Set Edit-Change Form is completed, approved and filed with the Data Analysis Group. This step is repeated until a perfect output of data is received. Each time data are edited, the Data Set Log is initialed and dated.

ADDITIONS AND CHANGES TO THE SPECIES CODE LIST

1. When a new species (one for which no code exists) is found, a code number is assigned to it. Note: Species codes must be assigned in the proper taxonomic area and the most recent species code list must be used when making these assignments.

   Newly assigned species code numbers are sent to the Data Analysis Group where they will be included in a updated species code listing.

Steps in Process:

A. When a species is found that does not have a species code, assign a code to it that places it in the correct taxonomic area. Write the code and species name on the most recent species code list.

B. Write the name of the species, line numbers between which the new species belongs, and the code assigned to that name on a Data Set Edit - Change Form.

C. After all new species for a particular data set have been written on a Data Set Edit - Change Form, the change form is given to the Group Manager for approval.

D. The Group Manager initials the Data Set Edit - Change Form and the form is taken to the Data Analysis Group and placed in the "edited data" basket.

E. The Data Set Log is initialed and dated.

F. When the new species have been added to the list, an updated copy of the list is given to the Phycology Group where it is checked.

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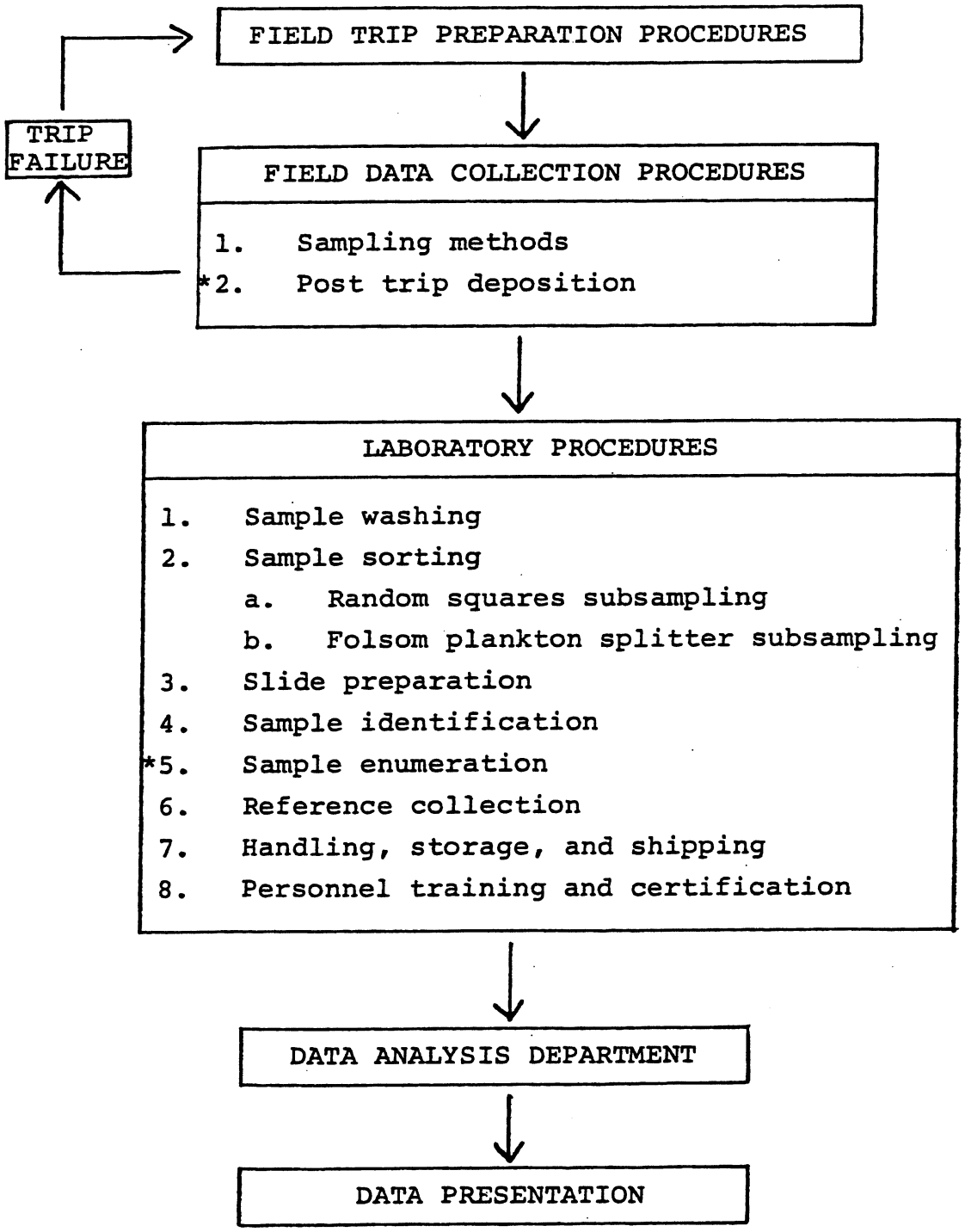
G. After the updated list is approved, the old list is filed in the archives and the most recent species list is used when adding any new species to the code list.

2. Rarely, a species will be misidentified and the name will be corrected by a consultant. When this occurs, the name on the species code list is changed to the correct name, but the code number remains the same. This change is handled in the same way as adding a species to the code list (see above).

BENTHOS DEPARTMENT DATA FLOW CHART



*Inspection points

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APPROVED RWC 2-II-76

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BENTHOS FIELD TRIP PREPARATION PROCEDURE

1. Prepare the Benthos Data Forms and place them in the field notebook which accompanies the investigator into the field.
2. Examine and maintain sampling equipment. Update maintenance labels and initial and date the Benthos Equipment Log Book.
3. Make all necessary calibrations. Update calibration labels and initial and date the Benthos Equipment Log Book.
4. As the sampling equipment is assembled and loaded into the truck, check it off on the Benthos Equipment Checklist. Place the completed checklist in the field notebook with the data forms.

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Limnetics, Inc.
732 West Fond du Lac Avenue
Milwaukee, Wisconsin 53218

Prepared by_____ Date_____

Checked by_____ Date_____

BENTHOS DATA FORM

River/Lake:	Location:	Client:

(1) Proj. no. ___ ___ ___ ___ ___ ___	(31) Temp. Code ___	(57) Sub. type ___
(7) Date ___ ___ ___ ___ ___ ___ (Yr. Mo. D)	(32) Temp. surf. ___ ___ . ___	(59) Coll. dev. ___
(13) Time ___ ___ ___ ___	(36) Temp. bott. ___ ___ . ___	(61) Sieve code ___
(17) Area ___ ___	(40) O_2 surf. ___ ___ . ___	(63) Preservative ___
(19) Station ___ ___	(44) O_2 bott. ___ ___ . ___	(64) Secchi code ___
(21) Sample no. ___ ___ ___	(48) pH surf. ___ ___ . ___	(65) Secchi depth ___ ___ . ___
(24) Investigator ___ ___ ___	(52) pH bott. ___ ___ . ___	(69) Current code ___
(27) Depth (meters) ___ ___ . ___	(56) Data type ___	(70) Current ___ ___ . ___ ___
		(75) Conv. factor ___ ___ ___ ___

Investigators_____

Total no. of samples collected at this station_____

Samples collected for H_2O chem._____

Sed. chem._____

Biomass_____

Sed. size_____

Weather conditions:_____

Comments:_____

Container No.	Sample No.	Substrate

PERSONNEL TRAINING AND CERTIFICATION

1. Minimum Qualifications and Responsibilities
   a. Personnel employed as benthologists must comply with the minimum qualifications and responsibilities listed in the company policy manual.
2. Training
   a. All personnel involved in the analysis of benthic samples undergo a period of training during which they are assisted and supervised by certified personnel. The training period length is not formalized, but depends on the progress of the individual being trained.
   b. The trainee is instructed in the importance and use of quality assurance documents and forms, the use of taxonomic keys and recognition of important anatomical characters, and the identification of any taxonomic groups which he/she will be required to enumerate.
   c. The trainee makes a series of independent identifications from training samples. Permanent reference slides and vials are available for examination and can be used as aides in identification.
   d. Each identification made by the trainee is verified by the instructor. Training continues until the trainee can identify with ease the majority of organisms encountered. At no time, is a trainee allowed to work on project samples without the supervision of an instructor.
3. Certification
   a. Benthos personnel are required to take a certification exam upon completion of the training period.
   b. Upon satisfactory completion of a practical exam, benthos personnel are certified in writing to identify and enumerate particular groups of benthic organisms.
   c. Recertifications may be required periodically.

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BENTHOS SAMPLE INVENTORY

1. All benthos samples received in the laboratory are inventoried to ensure that all samples collected in the field are accounted for in the laboratory and all samples are received in good condition.
2. Results of the inventory, initials of the person conducting the inventory and the date are recorded on the Inventory and Deposition Form.
3. Sample condition, at time of receipt, is recorded on the Inventory and Deposition Form. If samples were not received in good condition, an explanation is given in the space provided.
4. If a Variance Form is required, this is also indicated on the Inventory and Deposition Form.
5. When completed, the Inventory and Deposition Form is filed by the benthos group with the appropriate data forms.

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BENTHOS HANDLING, SHIPPING AND STORAGE

1. Upon completion of laboratory analysis, all slides are prepared for long-term storage.
   a. Slides are arranged in numerical order (according to sample number) when possible, in slide boxes labeled with project number and collection date. The number of boxes in each series is indicated on the label.
   b. The appropriate space on the Inventory and Desposition Form is marked to indicate that all slides are in order.
2. Upon completion of laboratory analysis, all vials are prepared for long-term storage.
   a. Vials are arranged in boxes labeled with project number and collection date.
   b. The appropriate space on the Inventroy and Deposition Form is marked to indicate that all vials are in order.
   c. Once annually, vials are waxed to prevent alcohol evaporation. Vials are inverted and dunked into melted paraffin until a sufficient seal between the vial and cover is formed.
   d. The appropriate space on the Inventory and Deposition Form is checked to indicate that all vials are waxed.
3. All organisms placed in the reference collection are retained indefinitely.
4. Organisms not placed in the reference collection are retained for two years dating from project completion. Excluded are samples which are physically altered or destroyed due to the nature of analysis (e.g. biomass determinations).

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5. Slides and vials are temporarily stored by the benthos group in the biology laboratory. Demands of space may eventually require that samples be transferred to the field equipment building. When such a transfer occurs, the appropriate space on the Inventory Deposition Form is marked to indicate where the samples have been deposited.

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BENTHOS SAMPLE WASHING PROCEDURE

1. A U.S. Standard No. 60 or No. 30 sieve (as per scope of work) is used to wash each sample. The sieve size selected is recorded at the top of the Sorting and Slide Preparation Form.
2. Prior to each use, the sieve is visually inspected to ensure that it is taut, free of holes and in otherwise good condition. Corrective maintenance, if required, is performed per the Tyler Sieve Maintenance Procedure.
3. When substrate samples are collected, each sample is emptied individually into the appropriate sieve and gently rinsed with tap water to remove the preservative.
4. When artificial substrates, such as the Hester-Dendy multiple plate artificial substrate samplers, are used, these are returned to the laboratory intact. The water in the container is poured through the appropriate sieve and each apparatus is disassembled over the sieve under slowly running tap water. All parts are gently brushed clean.
5. The sieve screen is rinsed and carefully brushed after each use as an extra precaution against cross contamination of samples.

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BENTHOS SAMPLE SORTING PROCEDURE

1. After the sample is washed, the residue is carefully sorted to remove all benthic organisms.
2. If necessary, samples may be subsampled (as per scope of work). The method used and the fraction subsampled are recorded in the appropriate spaces on the Benthos Data Form.
3. Samples or subsamples are sorted using either a dazor or binocular dissecting microscope.
   a. dazor sorting procedure:
      The sample or subsample is distributed thinly in any suitable shallow pan or dish and examined through the magnifying lens.
   b. microscope sorting procedure:
      Small portions of the sample or subsample are placed in a square integrid petri dish for examination under a binocular dissecting microscope at 10X magnification,
4. All benthic organisms are removed with forceps and placed in vials. Some organisms require larger containers because of their size.
5. All organisms,except worms and midges, are placed in 70 percent ethyl alcohol and five percent glycerin solution. Glycerin is included to prevent drying of the organism in the event of accidental alcohol evalporation. Glycerin may be omitted when biomass determinations are to be made on the organisms. Worms and midges may need to be stored in other preservatives such as formalin, depending on the type of mounting medium to be used.
6. Each vial or container is labeled with project number, collection date and sample number to maintain sample identity.

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7. Vials belonging to each set of samples are stored together in boxes labeled with project number and collection date.
8. The major catagories of organisms found in the sample, excluding extra-large organisms, are indicated on the Sorting and Slide Preparation Form to provide a record of all organisms found.
9. When sample sorting is complete, the investigator initials and dates the Sorting and Slide Preparation Form.
10. The substrate remaining, after the sample has been sorted, is discarded. Where only a subsample was sorted, the remaining fraction of the sample may be retained or discarded (as per scope of work).

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BENTHOS SLIDE PREPARATION

Two groups of benthic organisms, the Chironomidae (midges) and the Oligochaeta (aquatic worms) must be mounted on slides before identifications can be made for most taxa.

Chironomidae Slide Preparation

1. Empty midges into a petri dish.
2. Whole organisms are counted, plus all intact anterior portions are counted as whole organisms. Posterior portions and other fragments are discarded.
3. Of the total number of chironomids in the sample, a subsample is randomly selected for slide preparation unless otherwise specified in project work scope.

total in sample	subsample
1-50	10 organisms
>50	20% to a maximum of 25 organisms

4. Chironomids are mounted in a suitable commercial mounting medium such as Turtox CMC, Euparol or Hydramount.
5. The larva is placed ventral side up in a drop of mountant on the slide. A cover glass is placed over the midge and is pressed gently to better expose the parts needed for identification. Two chironomid larvae may be mounted on the same slide under separate cover glasses. Large specimens may require that the head capsule and body be mounted under separate cover glasses on the same slide.
6. All slides are appropriately labeled with waterproof ink.
7. All organisms not mounted on slides are returned to the vial.

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Oligochaeta Slide Preparation

1. The oligochaetes are cleared either by storing in Ammon's lactophenol for three to five days until enough muscle tissue is digested to expose the parts necessary for identification, or by mounting in a medium with clearing action.
2. Oligochaetes are then emptied from the vial into a dish and counted. For purposes of slide preparation, it is standard policy to count every oligochaete, or portion thereof, as one organism, if a subsample is to be removed.
3. A subsample of the total number of oligochaetes in the sample is randomly selected for the slide preparation if the project workscope specifies sub-sampling.

total in sample	subsample
1-50	all
>50	50 organisms

4. Several oligochaetes may be mounted on each slide using appropriate media and cover glasses as described previously.
5. When the appropriate number of oligochaetes have been mounted on slides, the remaining specimens, if any, are stored in the appropriate vial.
6. Each vial is labeled with sufficient information to maintain sample identity.
7. For both Chironomidae and Oligochaeta, the total number of organisms in the sample and the number of organisms subsampled for slide preparation are recorded on the Benthos Data Form using the following format:

   taxonomic group: no. of organisms on slides/no. of organisms in sample

   Example: If there were a total number of 75 oligochaetes in a sample and 50 were mounted, the notation would read, oligochaetes: 50/75.

General Procedure

1. All chironomid and oligochaete slides are allowed to dry before being stored in slide boxes labeled with project number and collection date.
2. Occasionally, organisms other than chironomids and oligochaetes must be dissected and mounted on slides. A note must be included on the Benthos Data Form to indicate that the organism, or parts of it, has been removed from the vial and placed on a slide. The slides, if not added to the reference collection, are stored in the labeled slide boxes with the oligochaetes and chironomids.
3. The mounting medium, used in slide preparation, is recorded on the Sorting and Slide Preparation Form.
4. The person (s) responsible for slide preparation initials and dates the Sorting and Slide Preparation Form to indicate that the slides have been made.
5. When complete, the Sorting and Slide Preparation Form is filed with the appropriate Benthos Data Forms by the benthos group.

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BENTHOS IDENTIFICATION PROCEDURES

1. All Slide mounted specimens are examined with a compound microscope while unmounted macroinvertebrates are identified with a binocular dissecting microscope.
2. All organisms are identified by certified personnel trained in the taxonomy of specific genera.
3. Organisms are identified to the lowest practical taxonomic level with the aid of a reference library and a reference collection.
4. Specimens are sent to experts, recognized in the field of macroinvertebrates, for confirmation when a species has not been previously collected or available keys do not adequately identify the organism. A file containing correspondence with consultants is maintained by the benthos group.
5. Identification of Slide Mounted Organisms
   a. The names of the slide mounted organisms and the number counted are recorded in the appropriate spaces on the laboratory analysis portion of the Benthos Data Form.
   b. The investigator responsible for the identification(s) initials the appropriate space on the laboratory analysis portion of the Benthos Data Form.
6. Identification of Unmounted Organisms
   a. The names of unmounted organisms and the number counted in the sample are recorded in the appropriate spaces on the laboratory analysis portion of the Benthos Data Form.
   b. The investigator responsible for the identification(s) initials the appropriate space on the laboratory analysis portion of the Benthos Data Form.

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c. When no vial is present for a sample (apparently indicating the absence of any organisms), the Sorting and Slide Preparation Form is consulted to ensure that organisms are actually absent, rather than having been overlooked.

7. An identification Checklist Form is maintained to ensure that all groups of organisms in a sample have been identified and to provide a record of the personnel responsible for those identifications.

8. When each group of organisms has been completely identified, the investigator responsible for the identification(s) initials and dates the appropriate space on the Identification Checklist Form. If more than one investigator works on an identification, both sets of initials must appear on the Identification Checklist Form.

9. When organisms of a major taxonomic group are not present, the word "none" or a dash appears in the appropriate space on the Identification Checklist Form.

10. When complete, the Identification Checklist Form is filed with the appropriate Benthos Data Forms by the benthos group.

BENTHOS SAMPLE ENUMERATION

1. The names of all organisms identified in a sample are listed on the laboratory analysis portion of the Benthos Data Form.
2. Each organism is assigned a unique species code number which is recorded on the Benthos Data Form. Code number files are maintained by the benthos group and by the data analysis group.
3. In addition, the following information must be supplied on the laboratory analysis portion of the Benthos Data Form.
   a. number counted
   b. number per sample - total number of organisms in each major category from which a subsample was selected for identification
   c. number per subsample - number of organisms in the subsample which were selected for identification
   d. sample conversion factor - if sample was subsampled the reciprocal of sample fraction sorted (equals one (1) if sample is not subsampled)
4. The collection device calibration conversion factor, calculated from the actual measured dimensions of the device, is recorded on the field data portion of the Benthos Data From.
5. All numerical conversions from the number of organisms counted to the number of organisms per square meter are done by the computer using the information previously described.
6. Upon completion of the laboratory analysis portion of the Benthos Data Form, the number one (1) is placed in the "end flag" column at the end of the last horizontal row of information.

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7. If the sample contains no organisms, all spaces on the laboratory analysis portion of the Benthos Data Form remain "blank", except an "end flag" is noted as previously described.
8. The person(s) responsible for completing the data form information intitals and dates the appropriate space to indicate that the work has been completed.
9. All Benthos Data Forms are reviewed by a second person who initials and dates the appropriate space to indicate that the data has been checked.
10. If data are to be computerized, the Benthos Data Forms are xeroxed. The originals are filed by the data analysis group and the copies are filed by the benthos group with related sample set data.

BENTHOS POST-TRIP DEPOSITION PROCEDURE

1. Samples are returned to the laboratory under prescribed environmental conditions.
2. All equipment is checked to ensure that it has been returned in good working condition.
3. The Benthos Equipment Checklist is filed in the group file.
4. The Benthos Data Forms are reviewed for completeness and proper coding by the investigator who then initials and dates the "prepared by" space on the field data side of each form.
5. The completed Benthos Data Forms are reviewed for correctness by a second person who initials and dates the "checked-by" space on the field data side of each form.
6. If the data are to be computerized, the field data side of each form is xeroxed. The originals are retained by the benthos group for use during laboratory analysis of samples and the copies are filed by the data analysis group.

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EQUIPMENT OPERATION PROCEDURE

Equipment Identification: Surber Square Foot Sampler

Control Number: FE-11

Operation Procedure:

1. The surber square foot sampler is designed to sample a specific area of the bottom in a lotic (flowing water) habitat and can only be used in a stream shallow enough for the operator to stand with the sampler and handle rocks on the bottom.
2. Unfold the device and place it on the bottom rocks so that the water flows over the foot-square quadrat into the catch net supported by the verticle frame.
3. Gently, but thoroughly, clean rocks within the square-foot frame in the water so that the debris and organisms removed can flow into the net. More rocks than those on the surface of the substrate should be cleaned.
4. Rocks that lie under the quadrat frame, half in and half out of the frame, are either all included or all disregarded or a percentage are taken and cleaned. Consistency on the part of the investigator is the important consideration.
5. Remove sampler from water and transfer collected debris to an appropriately labeled container. Preserve sample with ten percent buffered formalin.

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EQUIPMENT OPERATION PROCEDURE

Equipment Identification: Ponar Grab and Petersen Grab

Control Number: FE-1, FE-2, FE-3, FE-4, FE-10

Operation Procedure:

1. Inspect the instrument to ascertain that all parts are in good working condition and that the grab is securely fastened to its line.
2. Keeping clear of the jaws, and other working edges of the grab, move the jaws to the open position. Bring the free end of the horizontal locking bar into position in the locking notch on the upper bar. The closing mechanism will release when the sampler is on the bottom.
3. Lower the sampler smoothly through the water to a depth of a few feet above the bottom. When sure that the grab will fall properly to the bottom, allow it to descend the rest of the way.
4. Once the sampler is on the bottom, allow a moment for it to sink into the sediment, then slack off on the cable. This releases the tension on the upper bar which permits the lower bar to drop out of the locking notch. As tension is resumed on the cable, the jaws enclose the sediment.
5. Gently pull the grab out of the substrate and retrieve it with a constant upward motion. Jerky retrieval might cause the sediment to wash over the top of the sampler.
6. When the grab arrives at the surface, immediately place it into a bucket or pan. The bucket or pan is held at the water surface to catch the grab.
7. If rock, pieces of wood, or any hard materials have prevented the jaws of the grab from closing, recollect the sample.

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8. If the sample is acceptable, empty the grab into the bucket or pan. Hands should be used to ensure that all of the sediment is removed from the grab.
9. Add some water to the bucket or pan and gently mix the sample into a slurry. Pour the slurry into the appropriate mesh screening box (as per work scope) and "pan" the surface of the water to wash the smaller sized sediment through.
10. Empty the residue into an appropriately labeled container and add ten percent buffered formalin. If glass containers are used, rocks should not be stored with the screened sample. They should be washed or gently brushed clean of attached material.
11. At the conclusion of sampling operation, replace the safety pin to prevent accidential closing of the grab jaws in handling or shipping.

APPENDIX B

PCB Chemistry Methodology and Quality Assurance Quality Control Documents for Water Analysis, Fish Tissue Analysis and Sediment Analysis

Raltech SCIENTIFIC SERVICES

P.O. Box 7545 • Madison, Wisconsin 53707 • 608/241-4471

A Division of Ralston Purina Company

Other Raltech Scientific Services Laboratories:
St. Louis MO
Gray Summit MO

DRAFT REPORT

Determination of PCBs in Sediment, Fish, and Water Samples

for

Camp Dresser & McKee Inc.
Milwaukee, Wisconsin

by

Raltech Scientific Services
A Division of Ralston Purina Company
3301 Kinsman Boulevard
Madison, Wisconsin 53704

July 27, 1981
Revised August 21, 1981

Reports are submitted to clients on a confidential basis. No reference to the work, the results or to Raltech Scientific Services in any form of advertising, news release or other public announcement may be made without written authorization from Raltech Scientific Services.

INTRODUCTION

The purpose of this study was to determine the polychlorinated biphenyl (PCB) levels in fish, sediment, and water samples collected by Camp Dresser & McKee. The percentage of PCB associated with the suspended solids in the water also was to be determined.

Twenty-two sediment samples and 11 water samples were received from Camp Dresser & McKee on May 27, 1981. Eight fish samples were received on June 9, 1981. All samples were received in good condition.

SAMPLE PREPARATION

Sediment

The excess water was decanted from the sediment samples. All samples except F-2, I-1, I-2, J-2, and L-1 were placed in an aluminum foil-lined pan and allowed to air dry at room temperature for 2-3 days. The air-dried samples were passed through a #10 sieve. The unsieved material was discarded and the sieved samples were placed in 8-oz glass bottles. Sieves were cleaned between samples with water, acetone, and hexane. Samples F-2, I-1, I-2, J-2, and L-1 did not contain any large particles. Therefore, these samples were mixed mechanically using a spatula prior to subsampling for analysis.

Fish

Fish samples were ground as received in a Hobart food grinder. The ground homogenate was placed in a suitable sized, acetone-rinsed glass jar, and the jar was capped with aluminum foil.

Water

Approximately 1200 mL of water were filtered through a sintered glass funnel containing two Whatman #4 filter papers, and through a 0.22-μ Type GS Millipore filter. This represented the filtered water to be analyzed for PCBs. An aliquot of the unfiltered water also was analyzed for PCBs.

PROCEDURES

Sediment

After sample preparation, 20-g aliquots of the soil were weighed into 150-mL beakers. Wet samples were allowed to air dry in a hood for 2-3 days. After drying, the samples were transferred to a Soxhlet extractor with a glass wool plug. A plug of glass wool was placed on top of the soil and the extractor was fitted with a 250-mL Erlenmeyer flask. The beaker was rinsed with 200 mL of 50:50 hexane:acetone (v:v) and transferred carefully through the top of the extractor. Two to three boiling chips were added to the Erlenmeyer flask. The apparatus was fitted with a condenser and allowed to reflux for 8 hours, after which the Erlenmeyer flask was removed and the solvent concentrated on a steam bath to 1-2 mL. The extract was transferred to a 25-mL volumetric flask and made to volume with petroleum ether.

A Florisil column was prepared by placing approximately 6 in. of PR Grade Florisil (previously standardized) into a 19 mm id x 300 mm column with a 300-mL reservoir. The column was topped with approximately 1/4 in. of sodium sulfate, prewetted with 150 mL of petroleum ether, and the eluate discarded. Just as the petroleum ether reached the top of the sodium sulfate, a 5-mL aliquot of the sample extract was placed on the column, the receiver was changed, and the column eluted with 200 mL of petroleum ether. The resulting solution was concentrated on a steam bath to 3-5 mL, transferred to a 25-mL volumetric flask, and made to volume. Appropriate aliquots were injected onto a gas chromatograph equipped with an electron capture detector (see Appendix I for instrument conditions and calculations).[1]

A separate 10-g sample was placed in a preweighed aluminum foil dish. The sample and dish were placed in a 110°C oven overnight. The aluminum dish was removed from the oven, desiccated, reweighed, and the percentage moisture was calculated.

Fish

After sample preparation, 25 g or the entire sample was weighed into a 150-mL beaker. The sample was mixed with approximately 150 g of anyhydrous sodium sulfate. The mixture was transferred to a 1-qt Waring blender cup containing 50 mL of petroleum ether. Approximately 50-60 g of sodium sulfate were added to the beaker and transferred to the Waring blender cup; this step was repeated. Petroleum ether (150 mL) was added to the beaker and transferred to the blender cup. The mixture in the blender cup was blended at medium speed for 2-4 minutes. After blending, the petroleum ether was decanted into a 500-mL Erlenmeyer flask through a 60-mL powder funnel lined with glass wool. The mixture in the blender was re-extracted with two 1-L portions of petroleum ether, and decanted after each addition of petroleum ether. After the third extraction, the solid material was transferred to the powder funnel and rinsed with 50 mL of petroleum ether. The resulting solution was concentrated on a steam bath to 3-5 mL, transferred to a 25-mL volumetric flask, and made to volume with petroleum ether. A 5-mL aliquot was transferred to a tared vial.

The solvent was removed and the vial placed in a 40°C oven for approximately 16 hours, after which the vial was removed from the oven, desiccated, reweighed, and the percentage lipid calculated. A separate 5-mL aliquot was transferred to a Florisil column as described for sediments. The resulting solution was concentrated on a steam bath to 3-5 mL, transferred to a 25-mL volumetric flask, and made to volume. Appropriate aliquots were injected onto a gas chromatograph equipped with an electron capture detector (see Appendix I for instrument conditions and calculation).[2]

Water

One liter of water was transferred to a 2-L separatory funnel. The graduated cylinder in which the water was measured was rinsed with 150 mL of 15% dichloromethane in petroleum ether (v:v) and the rinse transferred to the 2-L separatory funnel. The separatory funnel was shaken for 2 minutes and the layers allowed to separate for 5-10 minutes. The lower layer was drained into the graduated cylinder. The top layer was transferred through a powder funnel (lined with glass wool and topped with 50-100 g of sodium sulfate) into a 500-mL round bottom flask. The above steps were repeated twice, each time transferring the top layer to the round bottom flask. After the final extraction the separatory funnel was rinsed with 50 mL of 15% dichloromethane in petroleum ether and the rinse transferred through the powder funnel into the round bottom flask. The combined extracts were concentrated to approximately 2 mL on a flash evaporator with a water bath at 40-50°C. The extract was transferred quantitatively with three 5-mL rinses of petroleum ether to a Florisil column and eluted as previously described. The resulting solution was concentrated on a steam bath to 2-3 mL, transferred to a 10-mL volumetric flask, and made to volume with petroleum ether. An appropriate aliquot was injected onto a gas chromatograph equipped with an electron capture detector (see Appendix I for instrument conditions and calculations).[3]

RESULTS AND DISCUSSION

The results for all samples were calculated as Aroclor 1242 because the PCB pattern for most of the samples resembled Aroclor 1242. In a few cases there appeared to be some pattern shifts; however, all data presented in the attached tables were calculated as Aroclor 1242.

Sediment

The PCB results for the sediment samples are presented in Table 1. Three samples were analyzed in duplicate and the results fall within the expected range of the analysis (less than 20% relative standard error).

Three laboratory soils which had previously been shown to contain no detectable levels of PCB were spiked with various levels of PCB. The results are presented in Table 2. After discussion with Mr. Ronald Wenn of Camp Dresser & McKee) two samples were selected for reanalyses and recoveries.

Samples C-2, and D-1 were reanalyzed and also spiked with Aroclor 1242. Sample C-2 was spiked at 0.10 mg/kg and D-1 at 0.20 mg/kg. The results are presented in Table 2. The recoveries generally fall within the expected range (70-130%). A 160% recovery was obtained on sample C-2 when spiked with Aroclor 1242. However, because the spiking level was at the detection limit, this variation is not unusual.

A reagent blank analyzed with the samples contained less than 0.10 mg/kg PCB (the limit of detection) calculated as Aroclor 1242.

Fish

The PCB results for the fish are presented in Table 3. Sample G was analyzed in duplicate. Aroclor 1242 was added to laboratory control fish which was free of PCB's. The results are presented in Table 4. A reagent blank analyzed with the sample contained less than 0.10 ppm PCB (the limit of detection) calculated as Aroclor 1242.

Water

The PCB results for the unfiltered and filtered water are presented in Table 5. The recoveries of PCBs in unfiltered and filtered water are presented in Table 6.

The recovery data indicate that the filtration procedure removes over 90% of the PCB from water. One of the objectives of this experiment was to determine the amount of PCB associated with the suspended material in the water. It was anticipated that the filtration procedure would provide the required data. However, Milli-Q water spiked with PCB also showed a loss of over 90% through filtration. Assuming there is little or no suspended material in this water, it appeared that the filters were removing the PCB from the water itself; therefore, the amount of PCB associated with the suspended material could not be determined. After discussion with Mr. Ronald Wenn of Camp Dresser & McKee, it was decided to reanalyze the water from location F. One aliquot was analyzed uncentrifuged, and another aliquot was centrifuged to remove the suspended solids. The results are presented in Table 5, and indicate a 0.8-µg/L reduction in PCBs following centrifugation. At this point it was agreed with Mr. Wenn that several additional samples would be centrifuged and analyzed, and that recoveries would be run on a sample and on Milli-Q-filtered water. Appendix II details these analyses.

A blank analyzed with samples indicated levels of less than 0.10 µg/L PCB (the limit of detection) calculated as Aroclor 1242.

References.

1. U.S. Environmental Protection Agency, "Chemistry Laboratory Manual for Bottom Sediment and Elutriate Testing," Chicago, Illinois, March 1979, CRL Method No. 198 through 207.

2. U.S. Department of Health Education and Welfare, Food and Drug Administration, Pesticide Analytical Manual Vol. I, "Methods Which Detect Multiple Residues," Second Edition, 1966, Revisions 1969-1979. Section 211.13F.

3. U.S. Environmental Protection Agency, "Chemistry Laboratory Manual for Bottom Sediment and Elutriate Testing," Chicago, Illinois, March 1979, CRL Method No. 144 to 183, 651 to 732, 210 and 219.

Donald Hughes — 8/21/81

Donald Hughes
Manager, Pesticide Residue

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Robert M. Lusskin — 8/21/81

Robert M. Lusskin, PhD
Director, Analytical Services

Date

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Table 1

Polychlorinated Biphenyl Levels in Sediments

Raltech Number	Sample Identification Location	Day	Month	Year	Moisture (%)	PCB Calculated as Aroclor 1242 (mg/kg)* Wet Weight Basis	Dry Weight Basis
867508	B-1	20	5	81	0.70	201.0	202.0
867509	B-2	20	5	81	0.60	108.0	109.0
867509	Duplicate				0.58	128.0	129.0
867510	C-1	20	5	81	0.70	<0.10	<0.10
867511	C-2	20	5	81	0.70	0.12	0.12
867512	D-1	21	5	81	0.90	0.22	0.22
867513	D-2	21	5	81	1.10	<0.10	<0.10
867514	E-1	21	5	81	1.09	477.0	482.0
867515	E-2	21	5	81	0.59	99.3	99.9
867516	F-1	21	5	81	1.00	42.9	43.3
867517	F-2	21	5	81	27.8	8.23	11.4
867517	Duplicate				28.1	7.01	9.75
867518	G-1	20	5	81	1.36	101.0	102.0
867519	G-2	20	5	81	0.98	106.0	107.0
867520	H-1	20	5	81	0.88	112.0	113.0
867521	H-2	20	5	81	0.58	59.9	60.3
867522	I-1	20	5	81	39.1	0.53	0.87
867523	I-2	20	5	81	29.1	0.12	0.17
867524	J-1	19	5	81	0.80	0.40	0.40
867524	Duplicate				0.98	0.39	0.39
867525	J-2	19	5	81	36.3	0.51	0.80
867526	K-1	19	5	81	1.19	3.58	3.62
867527	K-2	19	5	81	0.98	102.0	103.0
867528	L-1	19	5	81	35.8	1.84	2.87
867529	L-2	19	5	81	1.42	19.0	19.3

* Reagent blank analyzed with samples contained less than 0.10 mg/kg PCB calculated as Aroclor 1242. Limit of detection was 0.10-mg/kg based on a 20-g sample.

Table 2

Recovery of Polychlorinated Biphenyl from PCB-Free Sediments

Aroclor Added	Level Added (mg/kg)	Level Found (mg/kg)	Percent Recovery
Aroclor 1254	1.00	0.89	89
Aroclor 1254	3.00	2.06	69
Aroclor 1242	2.00	1.78	89

Recovery of Polychlorinated Biphenyl (Aroclor 1242) from Field Samples

Sample Code	Level Added (mg/kg)	Level in Sample (mg/kg)	Level Found (mg/kg)	Percent Recovery
C-2	0	0.16	0.16	---
C-2	0.10	0.16	0.32	160
D-1	0	0.22	0.22	---
D-1	0.20	0.22	0.45	115

Table 3

Polychlorinated Biphenyl Levels in Fish

Raltech Number	Sample Identification					PCB Calculated as Aroclor 1242 (mg/kg)*	Percent Lipid
	Location	Day	Month	Year	Species		
872777	F	19	5	81	Creek Chub	35.7	0.78
872778	F	19	F	81	Green Sun Fish	184.0	2.46
872779	C	19	5	81	Striped Shiner	1.42	2.46
872780	C	19	5	81	Creek Chub	0.26	1.68
872781	C	19	5	81	Green Sun Fish	0.44	0.98
872782	G	21	5	81	White Sucker	9.28	0.67
872782	Duplicate					7.10	0.61
872783	J	21	5	81	Lougeur Sun Fish	92.5	2.86
872784	I	21	5	81	Big Mouth Buffalo	244.0	3.14

* Reagent blank analyzed with samples contained less than 0.10 mg/kg PCB calculated as Aroclor 1242. Limit of detection was 0.10 mg/kg based on a 25-g sample.

Table 4

Recovery of Polychlorinated Biphenyls from PCB-Free Fish

Aroclor Added	Level Added mg/kg	Level Found mg/kg	Percent Recovery
Aroclor 1242	0.80	0.75	94.0

Table 5

Polychlorinated Biphenyl Levels
in Unfiltered and Filtered Water (µg/L)

Raltech Number	Sample Identification				PCB Calculated as Aroclor 1242 (µg/L)*	
	Location	Day	Month	Year	Unfiltered	Filtered
867497	B	20	5	81	5.6	0.11
867498	C	20	5	81	<0.10	<0.10
867499	D	21	5	81	<0.10	<0.10
867500	E	21	5	81	3.7	0.11
867501	F	21	5	81	3.0	0.18
867502	G	20	5	81	2.8	<0.10
867503	H	20	5	81	3.2	<0.10
867504	I	20	5	81	0.17	<0.10
867505	J	19	5	81	0.16	<0.10
867506	K	19	5	81	0.32	<0.10
867507	L	19	5	81	0.39	a

Polychlorinated Biphenyl Level
in Centrifuged and Uncentrifuged Water

Raltech Number	Sample Identification				PCB Calculated on Aroclor 1242 (µg/L)	
	Location	Day	Month	Year	UnCentrifuged	Centrifuged
867501	F	21	5	81	2.6	1.8

* Reagent blank analyzed with the sample contained less than 0.10 µg/L PCB calculated as Aroclor 1242. Limit of detection was 0.10 µg/L based on a 1-L sample.

a Sample extract could not be recovered.

Table 6

Recovery of PCBs from Filtered and Unfiltered Tap Water

Level Added (µg/L)	Level Found (µg/L)		Percent Recovery	
	Unfiltered	Filtered	Unfiltered	Filtered
0.20	0.21	<0.10	105	0
5.0	4.6	0.21	92	4.2

Recovery of PCB from Filtered Milli-Q Water

Level Added (µg/L)	Level Found (µg/L)	Percent Recovery
3.33	0.16	5.0

APPENDIX I

Instrument Conditions and Calculations

All sample extracts were injected after cleanup onto a gas chromatograph equipped with a linearized electron capture detector, automatic liquid sampler, and interfaced to a Hewlett Packard 3356C data acquisition system.

The following instrument conditions were used:

Instrument: Hewlett Packard Model 5713A
Column: 6 ft x 4 mm id glass
Column packing: 3% OV-1 on 80/100 mesh Gas Chrom Q
Column temperature: 220°C
Injector temperature: 250°C
Detector temperature: 300°C
Carrier gas: 95% argon/5% methane.
Column flow: 33 mL/minute
Injection volume: nominal 4 µL.

The PCBs were calculated against standard Aroclor 1242 by comparing retention times and peak areas. The areas of the 15 major peaks observed in the Aroclor 1242 standard were compared to the areas of the same peaks in the samples. Sample PCB concentrations greater than the equivalent of 0.40 µg/mL were diluted and re-injected.

The calculations were as follows:

Soils and Fish

A = Sample weight (grams)
B = Initial volume (milliliters)
C = A/B
D = Concentration of standard (microgram/milliliter)
E = Area of peaks in standard (summation)
F = Area of peaks in sample (summation)
G = Dilution factor - $\frac{X1 \times X2 \quad Xn}{Z1 \times Z2 \quad Zn}$

Where:

X_1 = Volume of first dilution (milliliters)
$X_2 - X_n$ = Subsequent volume of each dilution (milliliters)
Z_1 = Aliquot taken for first dilution (milliliters)
$Z_2 - Z_n$ = Subsequent aliquot taken for each dilution (milliliters)

$\frac{D/E \times F \times G}{C}$ = microgram/gram = milligrams/kilogram = Amount of Aroclor present on an as is basis (ppm).

To correct from an as is basis to a dry weight basis, the milligram/kilogram or parts per million value is multiplied by 100 and divided by 100 minus the percent moisture value.

To correct from an as is basis to a lipid or fat basis, the milligram/kilogram or parts per million value is multiplied by 100 and divided by the percentage lipid.

Water

A = Sample volume (milliliters)
B = Initial volume (milliliters)
C = A/B
D = Concentration of standard (microgram per milliliter)
E = Area of peaks in standard (summation)
F = area of peaks in sample (summation)
G = Dilution factor - $\frac{X1 \times X2 \quad\quad Xn}{Z1 \quad Z2 \quad\quad Zn}$

Where:

X_1 = Volume of first dilution (milliliters)
X_2 - X_n = Subsequent values of each dilution (milliliters)
Z_1 = Aliquot taken for first dilution (milliliters)
Z_2 - Z_n = Subsequent aliquot taken for each dilution milliliters).

$\frac{D/E \times F \times G}{C} \times 1000$ = micrograms per liter of Aroclor present.

APPENDIX II

Background

After review of the data presented in the July 27 report to Camp Dresser, it was agreed with Mr. Ronald Wenn that samples coded B, E, G, H, I, and K contained enough sample to determine the PCB content using the centrifugation method. Also, to determine recoveries, sample L was split; one portion was analyzed uncentrifuged and the remaining portion was spiked with PCB and centrifuged. A sample of Milli-Q-filtered water was spiked with PCB and analyzed for PCB content both centrifuged and uncentrifuged.

Methodology

The sample containers were mixed by shaking vigorously for approximately 30 seconds. The samples were transferred to clean 8-oz jars and centrifuged at 2500 rpm for 5 minutes. The water was decanted carefully into a 1-L graduated cylinder. Additional water was centrifuged until at least 500 mL of centrifuged water were obtained. The water was extracted and the amount of PCB determined as described in the report.

Results

The PCB results are presented in Table I and recovery data are contained in Table II.

Table I

Polychlorinated Biphenyl Levels
in Centrifuged Water (µg/L)

Raltech Number	Sample Identification				PCB Calculated as Aroclor 1242 (µg/L)
	Location	Day	Month	Year	
867497	B	20	5	81	2.2
867500	E	21	5	81	2.0
867502	G	20	5	81	1.1
867503	H	20	5	81	1.6
867504	I	20	5	81	0.10
867506	K	19	5	81	0.12

Table II

Recovery of PCB Added to Test Water
and Milli-Q-Filtered Water

Sample Identification: Sample L; Day 19; Month 5; year 81

Level of PCB in uncentrifuged portion - 0.22 µg/L
Level of PCB added - 2.5 µg/L
Level of PCB after centrifugation - 1.4 µg/L
Percent recovery - 47.2%

Sample Identification: Milli-Q-Water

Level of PCB added - 5.0 µg/L
Level of PCB before centrifugation - 3.8 µg/L
Percent recovery - 76.0%
Level of PCB after centrifugation - 3.0 µg/L
Percent recovery - 60.0%

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DRAFT REPORT

Determination of PCBs in Sediment, Fish, and Water Samples

(Camp Dresser & McKee Project 1186)

for

Camp Dresser & McKee Inc.
Milwaukee, Wisconsin

by

Raltech Scientific Services
A Division of Ralston Purina Company
3301 Kinsman Boulevard
Madison, Wisconsin 53704

October 6, 1981

Reports are submitted to clients on a confidential basis. No reference to the work, the results or to Raltech Scientific Services in any form of advertising, news release or other public announcement may be made without written authorization from Raltech Scientific Services.

INTRODUCTION

The purpose of this study was to determine the polychlorinated biphenyl (PCB) levels in fish, sediment, and water samples collected by Camp Dresser & McKee. The amount of PCB associated with the suspended solids in the water was to be determined by analyzing the water as received and after centrifugation.

Thirty-one sediment samples, 11 water samples, and 11 fish samples were received from Camp Dresser & McKee on September 4, 1981. All samples were received in good condition.

SAMPLE PREPARATION

Sediment

The excess water was decanted from the sediment samples. All samples were placed in an aluminum foil-lined pan and allowed to air dry at room temperature for 4-6 days. The air-dried samples were passed through a #10 sieve. The unsieved material was discarded and the sieved samples were placed in 32-oz glass bottles. Sieves were cleaned between samples with water, acetone, and hexane.

Fish

Fish samples were ground as received in a Hobart food grinder. The ground homogenate was placed in a suitable sized, acetone-rinsed glass jar, and the jar was capped with aluminum foil.

Water

The sample containers were mixed by shaking vigorously for approximately 30 seconds. An aliquot equivalent to approximately 1 L was transferred to an 8-oz glass bottle and centrifuged at 2500 rpm for 5 minutes.

PROCEDURES

Sediment

After sample preparation, 20-g aliquots of the soil were weighed into 150-mL beakers. After drying, the samples were transferred to a Soxhlet extractor with a glass wool plug. A plug of glass wool was placed on top of the soil

and the extractor was fitted with a 250-mL Erlenmeyer flask. The beaker was rinsed with 200 mL of 50:50 hexane:acetone (v:v) and transferred carefully through the top of the extractor. Two to three boiling chips were added to the Erlenmeyer flask. The apparatus was fitted with a condenser and allowed to reflux for 8 hours, after which the Erlenmeyer flask was removed and the solvent concentrated on a steam bath to 1-2 mL. The extract was transferred to a 25-mL volumetric flask and made to volume with petroleum ether.

A Florisil column was prepared by placing approximately 6 in. of PR Grade Florisil (previously standardized) into a 19 mm id x 300 mm column with a 300-mL reservoir. The column was topped with approximately 1/4 in. of sodium sulfate, prewetted with 150 mL of petroleum ether, and the eluate discarded. Just as the petroleum ether reached the top of the sodium sulfate, a 5-mL aliquot of the sample extract was placed on the column, the receiver was changed, and the column eluted with 200 mL of petroleum ether. The resulting solution was concentrated on a steam bath to 3-5 mL, transferred to a 25-mL volumetric flask, and made to volume. Appropriate aliquots were injected onto a gas chromatograph equipped with an electron capture detector (see Appendix I for instrument conditions and calculations).[1]

A separate 10-g sample was placed in a preweighed aluminum foil dish. The sample and dish were placed in a 110°C oven overnight. The aluminum dish was removed from the oven, desiccated, reweighed, and the percentage moisture was calculated.

Fish

After sample preparation, 25 g or the entire sample was weighed into a 150-mL beaker. The sample was mixed with approximately 150 g of anyhydrous sodium sulfate. The mixture was transferred to a 1-qt Waring blender cup containing 50 mL of petroleum ether. Approximately 50-60 g of sodium sulfate were added to the beaker and transferred to the Waring blender cup; this step was repeated. Petroleum ether (150 mL) was added to the beaker and transferred to the blender cup. The mixture in the blender cup was blended at medium speed for 2-4 minutes. After blending, the petroleum ether was decanted into a 500-mL Erlenmeyer flask through a 60-mL powder funnel lined with glass wool. The mixture in the blender was re-extracted with two 1-L portions of petroleum ether, and decanted after each addition of petroleum ether. After the third extraction, the solid material was transferred to the powder funnel and rinsed with 50 mL of petroleum ether. The resulting solution was concentrated on a steam bath to 3-5 mL, transferred to a 25-mL volumetric flask, and made to volume with petroleum ether. A 5-mL aliquot was transferred to a tared vial. The solvent was removed and the vial placed in a 40°C oven for approximately 16 hours, after which the vial was removed from the oven, desiccated, reweighed, and the percentage lipid calculated. A separate 5-mL aliquot was transferred to a Florisil column as described for sediments. The resulting solution was concentrated on a steam bath to 3-5 mL, transferred to a 25-mL volumetric flask, and made to volume. Appropriate aliquots were injected onto a gas chromatograph equipped with an electron capture detector (see Appendix I for instrument conditions and calculation).[2]

Water

One liter of water was transferred to a 2-L separatory funnel. The graduated cylinder in which the water was measured was rinsed with 150 mL of 15% dichloromethane in petroleum ether (v:v) and the rinse transferred to the 2-L separatory funnel. The separatory funnel was shaken for 2 minutes and the layers allowed to separate for 5-10 minutes. The lower layer was drained into the graduated cylinder. The top layer was transferred through a powder funnel (lined with glass wool and topped with 50-100 g of sodium sulfate) into a 500-mL round bottom flask. The above steps were repeated twice, each time transferring the top layer to the round bottom flask. After the final extraction the separatory funnel was rinsed with 50 mL of 15% dichloromethane in petroleum ether and the rinse transferred through the powder funnel into the round bottom flask. The combined extracts were concentrated to approximately 2 mL on a flash evaporator with a water bath at 40-50°C. The extract was transferred quantitatively with three 5-mL rinses of petroleum ether to a Florisil column and eluted as previously described. The resulting solution was concentrated on a steam bath to 2-3 mL, transferred to a 10-mL volumetric flask, and made to volume with petroleum ether. An appropriate aliquot was injected onto a gas chromatograph equipped with an electron capture detector (see Appendix I for instrument conditions and calculations).[3]

RESULTS AND DISCUSSION

The results for all samples were calculated as Aroclor 1242 because the PCB pattern for most of the samples resembled Aroclor 1242. In a few cases there appeared to be some pattern shifts; however, all data presented in the attached tables were calculated as Aroclor 1242.

Sediment

The PCB results for the sediment samples are presented in Table 1. Two samples were analyzed in duplicate and the results fall within the expected range of the analysis (less than 20% relative standard error).

Two laboratory soils which had previously been shown to contain no detectable levels of PCB were spiked with various levels of PCB. The results are presented in Table 2.

Two control soil blanks analyzed with the samples contained less than 0.10 mg/kg PCB (the limit of detection) calculated as Aroclor 1242. The results are presented in Table 1.

Fish

The PCB results for the fish are presented in Table 3. Sample K was analyzed in duplicate. Aroclor 1242 was added to laboratory control fish which was

free of PCBs. The results are presented in Table 4. A control blank fish analyzed with the sample contained less than 0.10 ppm PCB (the limit of detection) calculated as Aroclor 1242.

Water

The PCB results for the uncentrifuged and centrifuged water are presented in Table 5. The recoveries of PCBs in uncentrifuged and centrifuged water are presented in Table 6.

A blank analyzed with samples indicated levels of less than 0.10 µg/L PCB (the limit of detection) calculated as Aroclor 1242.

References.

1. U.S. Environmental Protection Agency, "Chemistry Laboratory Manual for Bottom Sediment and Elutriate Testing," Chicago, Illinois, March 1979, CRL Method No. 198 through 207.

2. U.S. Department of Health Education and Welfare, Food and Drug Administration, Pesticide Analytical Manual Vol. I, "Methods Which Detect Multiple Residues," Second Edition, 1966, Revisions 1969-1979. Section 211.13F.

3. U.S. Environmental Protection Agency, "Chemistry Laboratory Manual for Bottom Sediment and Elutriate Testing," Chicago, Illinois, March 1979, CRL Method No. 144 to 183, 651 to 732, 210 and 219.

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10/6/81
Date

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Date

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(472F/tt)

Table 1

Polychlorinated Biphenyl Levels in Sediments (mg/kg)

Raltech Number	Sample Identification					Moisture (%)	PCB Calculated as Aroclor 1242 (mg/kg)	
	Location	Day	Month	Year	Comments		Wet Weight Basis	Dry Weight Basis
393798	B	2 & 3	9	81	Right Bank	0.1	24.1	24.1
393799	C	2 & 3	9	81	Right Bank	2.1	<0.10	<0.10
893800	D	2 & 3	9	81	Right Bank	1.9	32.1	32.7
393801	E	2 & 3	9	81	Right Bank	1.3	340.0	344.0
393802	F	2 & 3	9	81	Right Bank	2.1	205.0	209.0
893803	H	2 & 3	9	81	Right Bank	2.2	17.8	18.2
893804	I	2 & 3	9	81	Right Bank	1.6	1.44	1.46
393805	J	2 & 3	9	81	Right Bank	1.5	0.70	0.71
393806	K	2 & 3	9	81	Right Bank	1.7	2.52	2.56
893807	L	2 & 3	9	81	Right Bank	1.8	19.9	20.3
393808	B	2 & 3	9	81	Left Bank	0.3	111.0	111.0
393809	C	2 & 3	9	81	Left Bank	1.1	<0.10	<0.10
893810	D	2 & 3	9	81	Left Bank	2.6	18.4	18.9
893811	E	2 & 3	9	81	Left Bank	1.6	225.0	229.0
393812	F	2 & 3	9	81	Left Bank	1.8	280.0	285.0
393813	H	2 & 3	9	81	Left Bank	1.4	39.1	39.[illegible]
893814	I	2 & 3	9	81	Left Bank	1.5	0.74	0.7[illegible]
393815	J	2 & 3	9	81	Left Bank	1.5	0.64	0.65
393816	K	2 & 3	9	81	Left Bank	5.5	7.42	7.85
893817	L	2 & 3	9	81	Left Bank	1.9	4.36	4.44
896509	L	2 & 3	9	81	Left Bank	2.0	4.22	4.31*
393818	B	2 & 3	9	81	Water Shed Composite	0.4	95.6	96.0
396510	B	2 & 3	9	81	Water Shed Composite	0.4	92.4	93.0*
893819	C	2 & 3	9	81	Water Shed Composite	1.2	<0.10	<0.10
393820	D	2 & 3	9	81	Water Shed Composite	1.7	80.6	82.0
393821	E	2 & 3	9	81	Water Shed Composite	1.4	129.0	131.0
893822	F	2 & 3	9	81	Water Shed Composite	1.6	150.0	152.0
893823	H	2 & 3	9	81	Water Shed Composite	1.6	43.6	44.3
393824	I	2 & 3	9	81	Water Shed Composite	1.2	1.92	1.94
393825	J	2 & 3	9	81	Water Shed Composite	1.4	2.55	2.59
893826	K	2 & 3	9	81	Water Shed Composite	1.5	28.6	29.0
393827	L	2 & 3	9	81	Water Shed Composite	1.5	4.15	4.21
393828	A	2 & 3	9	81	Water Shed Composite	0.8	38.4	38.7
896511		Control Soil Blank				0.5	<0.10	<0.10
896512		Control Soil Blank				0.5	<0.10	<0.10

* Duplicate.

Table 2

Recovery of Polychlorinated Biphenyl (Aroclor 1242)
from PCB-Free Sediments

Raltech Number	Level Added (mg/kg)	Level Found (mg/kg)	Percent Recovery
896513	0.49	0.51	104
896514	0.49	0.54	110

Table 3

Polychlorinated Biphenyl Levels in Fish
(mg/kg)

Raltech Number	Sample Identification					PCB Calculated as Aroclor 1242 (mg/kg)	Percent Lipid
	Location	Day	Month	Year	Species		
893829	C	1 & 2	9	81	Sunfish	0.73	0.79
893830	C	1 & 2	9	81	Sucker	0.21	0.40
893831	C	1 & 2	9	81	Longeared Sunfish	0.14	0.38
893832	K	1 & 2	9	81	Grenter Redhorse	11.7	2.07
893833	K	1 & 2	9	81	Longeared Sunfish	28.4	1.75
896515	K	1 & 2	9	81	Longeared Sunfish	31.9	1.95*
893834	I	1 & 2	9	81	Longeared Sunfish	20.0	2.56
893835	L	1 & 2	9	81	Longeared Sunfish	42.5	3.61
893836	J	1 & 2	9	81	Longeared Sunfish	46.1	3.35
893837	I	1 & 2	9	81	Grenter Redhorse	21.4	2.42
893838	C	1 & 2	9	81	Creek Chub	262.0	3.11
893839	F	1 & 2	9	81	W. Sucker	571.0	3.79
896516	Control Blank Fish					<0.10	0.94

* Duplicate.

Table 4

Recovery of Polychlorinated Biphenyl (Aroclor 1242)
from PCB-Free Fish

Raltech Number	Level Added (mg/kg)	Level Found (mg/kg)	Percent Recovery
896517	0.40	0.36	90

Table 5

Polychlorinated Biphenyl Levels
in Centrifuged and Uncentrifuged Water (µg/L)

Raltech Number	Sample Identification				PCB Calculated as Aroclor 1242 (µg/L)	
	Location	Day	Month	Year	Uncentrifuged	Centriguged
893840	A	2 & 3	9	81	9.0	
893841	A	2 & 3	9	81		3.5
895434	A	2 & 3	9	81		3.6*
893842	B	2 & 3	9	81	10.3	
895435	B	2 & 3	9	81	11.2*	
893843	B	2 & 3	9	81		3.2
893844	C	2 & 3	9	81	<0.10	
893845	C	2 & 3	9	81		<0.10
893846	D	2 & 3	9	81	0.45	
893847	D	2 & 3	9	81		0.18
893848	E	2 & 3	9	81	8.0	
893849	E	2 & 3	9	81		4.8
893850	F	2 & 3	9	81	7.0	
893851	F	2 & 3	9	81		4.1
893852	H	2 & 3	9	81	4.0	
893853	H	2 & 3	9	81		2.3
893854	I	2 & 3	9	81	0.28	
893855	I	2 & 3	9	81		0.14
893856	J	2 & 3	9	81	0.23	
893857	J	2 & 3	9	81		0.10
893858	K	2 & 3	9	81	0.30	
893859	K	2 & 3	9	81		0.16
894860	L	2 & 3	9	81	0.46	
893861	L	2 & 3	9	81		0.27
895438		Water Blank			<0.10	
895439		Water Blank				<0.10

* Duplicate.

Table 6

Recovery of PCBs from Uncentrifuged
and Centrifuged Milli-Q-Water

Raltech Number	Level Added (µg/L)	Level Found (µg/L)		Percent Recovery
		Uncentrifuged	Centrifuged	
895436	3.33	2.8	-	84.4
895437	-	-	2.0	61.3

APPENDIX I

Instrument Conditions and Calculations

All sample extracts were injected after cleanup onto a gas chromatograph equipped with a linearized electron capture detector, automatic liquid sampler, and interfaced to a Hewlett Packard 3356C data acquisition system.

The following instrument conditions were used:

Instrument: Hewlett Packard Model 5713A
Column: 6 ft x 4 mm id glass
Column packing: 3% OV-1 on 80/100 mesh Gas Chrom Q
Column temperature: 220°C
Injector temperature: 250°C
Detector temperature: 300°C
Carrier gas: 95% argon/5% methane.
Column flow: 33 mL/minute
Injection volume: nominal 4 µL.

The PCBs were calculated against standard Aroclor 1242 by comparing retention times and peak areas. The areas of the 15 major peaks observed in the Aroclor 1242 standard were compared to the areas of the same peaks in the samples. Sample PCB concentrations greater than the equivalent of 0.40 µg/mL were diluted and re-injected.

The calculations were as follows:

Soils and Fish

A = Sample weight (grams)
B = Initial volume (milliliters)
C = A/B
D = Concentration of standard (microgram/milliliter)
E = Area of peaks in standard (summation)
F = Area of peaks in sample (summation)
G = Dilution factor - $\frac{X1 \times X2 \quad Xn}{Z1 \times Z2 \quad Zn}$

Where:

X_1 = Volume of first dilution (milliliters)
$X_2 - X_n$ = Subsequent volume of each dilution (milliliters)
Z_1 = Aliquot taken for first dilution (milliliters)
$Z_2 - Z_n$ = Subsequent aliquot taken for each dilution (milliliters)

$\frac{D/E \times F \times G}{C}$ = microgram/gram = milligrams/kilogram = Amount of Aroclor present on an as is basis (ppm).

To correct from an as is basis to a dry weight basis, the milligram/kilogram or parts per million value is multiplied by 100 and divided by 100 minus the percent moisture value.

To correct from an as is basis to a lipid or fat basis, the milligram/kilogram or parts per million value is multiplied by 100 and divided by the percentage lipid.

Water

A = Sample volume (milliliters)
B = Initial volume (milliliters)
C = A/B
D = Concentration of standard (microgram per milliliter)
E = Area of peaks in standard (summation)
F = area of peaks in sample (summation)
G = Dilution factor - $\frac{X1 \times X2 \quad\quad Xn}{Z1 \quad Z2 \quad\quad Zn}$

Where:

X_1 = Volume of first dilution (milliliters)
$X_2 - X_n$ = Subsequent values of each dilution (milliliters)
Z_1 = Aliquot taken for first dilution (milliliters)
$Z_2 - Z_n$ = Subsequent aliquot taken for each dilution milliliters).

$\frac{D/E \times F \times G}{C} \times 1000$ = micrograms per liter of Aroclor present.

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Table 9

Quality Control Data - Water Quality

A. Duplicate Analysis from Spring Field Samples

Station	Level in Samples (mg/l)					
	Organic Nitrogen	Ammonia Nitrogen	Nitrate-Nitrite Nitrogen	Total Phosphorus	Total Solids	Total Suspended Solids
A-1	1.36 1.68	--	1.10 1.19	1.27 1.28	--	13.3 14.0
B-1	--	--	--	--	472 472	--
B-2	--	--	3.65 3.28	--	--	--
D-1	--	--	--	--	316 296	--
D-2	--	--	2.70 2.67	--	--	--
E-1	--	--	--	--	--	10.3 8.5
F-1	--	--	3.09 3.00	0.076 0.076	--	--
G-2	1.20 1.12	0.01 0.09	--	--	--	--
I-1	1.04 1.13	0.20 0.11	--	--	--	34.3 33.7
J-2	0.20 0.29	--	2.26 2.28	--	--	--
K-1	--	--	1.33 1.42	0.096 0.073	--	--
L-1	0.95 1.13	0.30 0.12	--	--	--	--

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B. Recovery of Reference Standards Analyses

Paremeter	Concentration Known (mg/l)	Concentration Found (mg/l)	Percent Recovery
Ammonia Nitrogen	2.00	1.95	97.5
	5.00	4.89	97.8
	10.00	9.96	99.6
Nitrate Nitrogen	0.050	0.049	98.0
	0.100	0.098	98.0
	0.200	0.194	97.0
	0.250	0.249	99.6
Total Phosphorus	0.250	0.251	100.4
	0.750	0.750	100.0
	1.25	1.25	100.0
	1.75	1.75	100.0

Table 10

Quality Control Data - Water Quality

A. Duplicate Analysis from Fall Field Samples

Station	Level in Samples (µg/l) Ammonia Nitrogen	Nitrate-Nitrite Nitrogen	Total Phosphorus	Total Solids	Total Suspended Solids
A-1	<0.01 0.02	-	-	-	-
C-1	-	-	-	-	3.0 1.4
C-2	-	-	-	257 269	-
D-1	-	-	-	-	4.5 2.7
D-2	-	-	0.067 0.063	-	-
E-1	-	-	-	1000 1002	-
E-2	-	-	0.485 0.465	-	-
F-1	-	0.739 0.711	-	-	-
H-2	0.63 0.54	-	-	-	-
J-2	-	0.824 0.748	-	-	-

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B. Percent Recovery of Spiked Fall Field Samples

Parameter	Station	Level Added (mg/l)	Level in Sample (mg/l)	Percent % Recovery
Ammonia Nitrogen	B-1	2.00	0.22	116
	D-1	5.00	0.46	111
Nitrate-Nitrite	B-2	0.050	-	112
Nitrogen	D-2	0.100	-	110
Total Phosphorus	A-1	1.00	0.862	97
	B-1	0.50	0.598	99

C. Percent Recover of Reference Standards

Parameter	Concentration Known (mg/l)	Concentration Found (mg/l)	Percent Recovery
Ammonia Nitrogen	2.00	2.06	103
	5.00	5.16	103
Nitrate-Nitrite	0.050	0.059	118
Nitrogen	0.200	0.208	104
Total Phosphorus	0.250	0.225	90
	1.00	1.04	104

APPENDIX C

Computerized Periphyton Data Analysis

GENERAL MOTORS PERIPHYTON DATA TABLE

SAMPLE NO. 1 MAY 19, 1981, 1400 HOURS

COLLECTED AT LOCATION: B-DISCHARGE , STATION 1 , DEPTH RANGE FROM .5 FEET TO .0 FEET

TAXONOMIC IDENTIFICATION		NO. COUNTED	ORGANISMS PER CM2
DIATOMACEAE			
PENNALES			
SYNEDRA	SPECIES	2.	1353.84
SYNEDRA	RUMPENS	1.	641.29
SYNEDRA	ULNA	1.	712.55
ACHNANTHES	SPECIES	41.	29428.22
ACHNANTHES	LANCEOLATA	6.	3990.27
COCCONEIS	PLACENTULA	1.	641.29
PHOICOSPHENIA	CURVATA	4.	2850.19
NAVICULA	CRYPTOCEPHALA	2.	1353.84
NAVICULA	VIRIDULA	3.	1995.13
NAVICULA	LUZONENSIS	3.	1995.13
GOMPHONEMA	SPECIES	5.	3348.97
GOMPHONEMA	OLIVACEUM	2.	1353.84
GOMPHONEMA	PARVULUM	2.	1353.84
CYMBELLA	SINUATA	1.	712.55
NITZSCHIA	ACICULARIS	3.	2137.64
NITZSCHIA	APICULATA	8.	5344.11
NITZSCHIA	PALEA	1.	641.29
NITZSCHIA	FRUSTULUM	38.	27433.09
SURIRELLA	ANGUSTATA	14.	10046.92
CYANOPHYTA			
CHROOCOCCALES			
CHROOCOCCUS	DISPERSUS	1.	712.55
OSCILLATORIALES			
OSCILLATORIA	SPECIES	1.	712.55
OSCILLATORIA	LIMNETICA	3.	2137.64
PHORMIDIUM	SPECIES	1.	712.55
UNIDENTIFIED ALGAE			
FLAGELLATED			
LESS THAN 5 U		1.	712.55
UNICELLULAR			
5 TO 10 MICRONS		7.	4987.83

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL ORGANISMS PER CM2	PERCENT
DIATOMACEAE	137.	97334.03	90.70
CYANOPHYTA	6.	4275.29	3.98
UNKNOWN FLAGELLATE	1.	712.55	.66
UNKNOWN UNICELLULA	7.	4987.83	4.65
TOTALS	151.	107309.69	100.00

TAXA IN SAMPLE 25

GENERAL MOTORS PERIPHYTON DATA

TABLE

SAMPLE NO. 1

MAY 19, 1981, 1400 HOURS

COLLECTED AT LOCATION: B-DISCHARGE , STATION 1 , DEPTH RANGE FROM .5 FEET TO .0 FEET

TAXONOMIC IDENTIFICATION	NO. COUNTED	ORGANISMS PER CM2

DIVERSITY CALCULATED IN LOG BASE 2

SHANNONS DIVERSITY	3.4058	EVENNESS	.7334	REDUNDANCY	.2668
MAX. DIVERSITY	4.6439	MIN. DIVERSITY	.0041	INFORMATIONAL CONTENT	.36547+06

TABLE

GENERAL MOTORS PERIPHYTON DATA — MAY 19, 1981, — 1400 HOURS

SAMPLE NO. 2

COLLECTED AT LOCATION: B-DISCHARGE , STATION 1 , DEPTH RANGE FROM .5 FEET TO .0 FEET

TAXONOMIC IDENTIFICATION		NO. COUNTED	ORGANISMS PER CM2
CHLOROPHYTA		1.	267.70
CHLOROCOCCALES			
CHARACIUM	SPECIES	1.	267.70
CHAETOPHORALES			
STIGEOCLONIUM	SPECIES	1.	267.70
CLADOPHORACEAE			
CLADOPHORA	SPECIES	4.	1070.79
EUGLENOPHYTA		1.	267.70
DIATCHACEAE			
PENNALES			
MERIDION	CIRCULARE	1.	267.70
SYNEDRA	ACUS	21.	5621.65
ACHNANTHES	SPECIES	35.	9262.33
ACHNANTHES	LANCEOLATA	5.	1472.34
RHOICOSPHENIA	CURVATA	7.	1873.88
NAVICULA	CRYPTOCEPHALA	5.	1231.41
NAVICULA	VIRIDULA	2.	481.86
NAVICULA	LUZONENSIS	1.	240.93
NAVICULA	MUTICA	3.	722.78
GOMPHONEMA	SPECIES	12.	3185.60
GOMPHONEMA	PARVULUM	15.	3908.38
NITZSCHIA	APICULATA	2.	481.86
NITZSCHIA	FONTICOLA	6.	1713.26
NITZSCHIA	PALEA	2.	481.86
NITZSCHIA	FRUSTULUM	30.	8057.70
SURIRELLA	ANGUSTATA	4.	963.71
CYANOPHYTA			
CHROOCOCCALES		1.	267.70
CHROOCOCCUS	SPECIES	8.	2141.58
OSCILLATORIALES			
OSCILLATORIA	LIMNETICA	1.	267.70
PHORMIDIUM	SPECIES	1.	267.70

GENERAL MOTORS PERIPHYTON DATA

TABLE

SAMPLE NO. 2 MAY 19, 1981, 1400 HOURS

COLLECTED AT LOCATION: B-DISCHARGE , STATION 1 , DEPTH RANGE FROM .5 FEET TO .0 FEET

TAXONOMIC IDENTIFICATION	NO. COUNTED	ORGANISMS PER CM2
UNIDENTIFIED ALGAE		
UNICELLULAR		
5 TO 10 MICRONS	7.	1873.88

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL ORGANISMS PER CM2	PERCENT
CHLOROPHYTA	7.	1873.88	3.99
EUGLENOPHYTA	1.	267.70	.57
DIATOMACEAE	149.	39967.24	85.17
CYANOPHYTA	11.	2944.67	6.27
UNKNOWN UNICELLULA	7.	1873.88	3.99
TOTALS	175.	46927.37	100.00

TAXA IN SAMPLE 26

DIVERSITY CALCULATED IN LOG BASE 2

SHANNONS DIVERSITY	3.7855	EVENNESS	.8054	REDUNDANCY	.1950
MAX. DIVERSITY	4.7004	MIN. DIVERSITY	.0090	INFORMATIONAL CONTENT	.17764+06

GENERAL MOTORS PERIPHYTON DATA

TABLE

SAMPLE NO. 3 MAY 19, 1981, 1400 HOURS

COLLECTED AT LOCATION: B-DISCHARGE , STATION 1 , DEPTH RANGE FROM .5 FEET TO .0 FEET

TAXONOMIC IDENTIFICATION		NO. COUNTED	ORGANISMS PER CM2
CHLOROPHYTA			
CHAETOPHORALES			
STIGEOCLONIUM	SPECIES	2.	1490.87
DIATOMACEAE			
PENNALES			
SYNEDRA	ACUS	2.	1490.87
ACHNANTHES	SPECIES	125.	93552.05
ACHNANTHES	LANCEOLATA	4.	2981.74
NAVICULA	CRYPTOCEPHALA	1.	745.43
NAVICULA	VIRIDULA	2.	1490.87
NAVICULA	LUZONENSIS	6.	4472.61
NAVICULA	MUTICA	11.	8199.78
GOMPHONEMA	SPECIES	9.	6708.91
GOMPHONEMA	PARVULUM	3.	2236.30
NITZSCHIA	PALEA	4.	2981.74
NITZSCHIA	FRUSTULUM	58.	43458.84
SURIRELLA	ANGUSTATA	4.	2981.74
CYANOPHYTA			
CHROOCOCCALES			
CHROOCOCCUS	SPECIES	3.	2236.30
OSCILLATORIALES			
PHORMIDIUM	SPECIES	8.	5963.48
UNIDENTIFIED ALGAE			
UNICELLULAR			
LESS THAN 5 U		3.	2236.30
5 TO 10 MICRONS		2.	1490.87

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL ORGANISMS PER CM2	PERCENT
CHLOROPHYTA	2.	1490.87	.81
DIATOMACEAE	230.	171300.87	92.74
CYANOPHYTA	11.	8199.78	4.44
UNKNOWN UNICELLULA	5.	3727.17	2.02
TOTALS	248.	184718.69	100.00

TAXA IN SAMPLE 17

GENERAL MOTORS PERIPHYTON DATA

TABLE

SAMPLE NO. 3 MAY 19, 1981, 1400 HOURS

COLLECTED AT LOCATION: B-DISCHARGE , STATION 1 , DEPTH RANGE FROM .5 FEET TO .0 FEET

TAXONOMIC IDENTIFICATION	NO. COUNTED	ORGANISMS PER CM2

DIVERSITY CALCULATED IN LOG BASE 2

SHANNONS DIVERSITY	2.4274	EVENNESS	.5939	REDUNDANCY	.4063
MAX. DIVERSITY	4.0875	MIN. DIVERSITY	.0016	INFORMATIONAL CONTENT	.44839+06

TABLE

GENERAL MOTORS PERIPHYTON DATA

SAMPLE NO. 4 MAY 19, 1981, 1400 HOURS

COLLECTED AT LOCATION: B-DISCHARGE , STATION 1 , DEPTH RANGE FROM .5 FEET TO .0 FEET

TAXONOMIC IDENTIFICATION		NO. COUNTED	ORGANISMS PER CM2
CHLOROPHYTA		7.	5515.00
TETRASPORALES			
GLOECCYSTIS	SPECIES	1.	787.86
ULOTRICHALES			
ULOTHRIX	SPECIES	1.	787.86
CHAETOPHORALES			
STIGEOCLONIUM	SPECIES	1.	787.86
CLADOPHORACEAE			
CLADOPHORA	SPECIES	4.	3151.43
EUGLENOPHYTA		1.	787.86
DIATOMACEAE			
PENNALES			
SYNEDRA	ACUS	1.	787.86
ACHNANTHES	SPECIES	36.	28362.88
ACHNANTHES	LANCEOLATA	4.	3151.43
RHOICOSPHENIA	CURVATA	16.	12605.72
NAVICULA	CRYPTOCEPHALA	5.	3939.29
NAVICULA	VIRIDULA	1.	787.86
NAVICULA	LUZONENSIS	3.	2363.57
GOMPHONEMA	SPECIES	21.	16545.01
GOMPHONEMA	PARVULUM	12.	9454.29
NITZSCHIA	SPECIES	3.	2363.57
NITZSCHIA	PALEA	1.	787.86
NITZSCHIA	FRUSTULUM	36.	28362.88
SURIRELLA	ANGUSTATA	10.	7878.58
SURIRELLA	OVATA	22.	17332.87
CYANOPHYTA			
CHROOCOCCALES			
CHROOCOCCUS	SPECIES	3.	2363.57
OSCILLATORIALES		5.	3939.29
OSCILLATORIA	SPECIES	1.	787.86
PHORMIDIUM	SPECIES	4.	3151.43

TABLE

GENERAL MOTORS PERIPHYTON DATA — MAY 19, 1981, — 1400 HOURS

SAMPLE NO. 4

COLLECTED AT LOCATION: B-DISCHARGE , STATION 1 , DEPTH RANGE FROM .5 FEET TO .0 FEET

TAXONOMIC IDENTIFICATION	NO. COUNTED	ORGANISMS PER CM2
UNIDENTIFIED ALGAE		
UNICELLULAR		
5 TO 10 MICRONS	1.	787.86

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL ORGANISMS PER CM2	PERCENT
CHLOROPHYTA	14.	11030.01	7.00
EUGLENOPHYTA	1.	787.86	.50
DIATOMACEAE	171.	134723.67	85.50
CYANOPHYTA	13.	10242.15	6.50
UNKNOWN UNICELLULA	1.	787.86	.50
TOTALS	200.	157571.54	100.00

TAXA IN SAMPLE 25

DIVERSITY CALCULATED IN LOG BASE 2

SHANNONS DIVERSITY	3.7241	EVENNESS	.8019	REDUNDANCY	.1982
MAX. DIVERSITY	4.6439	MIN. DIVERSITY	.0028	INFORMATIONAL CONTENT	.58681+06

TABLE

GENERAL MOTORS PERIPHYTON DATA — MAY 20, 1981, — 1000 HOURS

SAMPLE NO. 1

COLLECTED AT LOCATION: D-PLEASANT R, STATION 1 , DEPTH RANGE FROM .3 FEET TO .0 FEET

TAXONOMIC IDENTIFICATION		NO. COUNTED	ORGANISMS PER CM2
CHLOROPHYTA			
CHLOROCOCCALES			
SCENEDESMUS	ABUNDANS	1.	397.16
CRYPTOPHYTA		1.	397.16
DIATOMACEAE			
PENNALES			
SYNEDRA	SPECIES	1.	198.58
SYNEDRA	ACUS	1.	436.87
ACHNANTHES	SPECIES	110.	43687.36
COCCONEIS	PEDICULUS	1.	198.58
NAVICULA	CRYPTOCEPHALA	4.	1747.49
NAVICULA	TRIPUNCTATA	1.	198.58
GOMPHONEMA	SPECIES	2.	635.45
AMPHORA	PERPUSILLA	6.	2382.95
CYMBELLA	SPECIES	1.	436.87
CYMBELLA	MINUTA	2.	635.45
CYMBELLA	AFFINIS	17.	6711.97
DENTICULA	TENUIS	1.	436.87
NITZSCHIA	DISSIPATA	6.	2581.53
NITZSCHIA	PALEA	1.	198.58
SURIRELLA	ANGUSTATA	1.	198.58
SURIRELLA	OVATA	1.	397.16
CYANOPHYTA			
CHROOCOCCALES		2.	794.32
APHANOTHECE	SPECIES	1.	397.16
CHROOCOCCUS	SPECIES	2.	794.32
CHROOCOCCUS	DISPERSUS	1.	397.16
OSCILLATORIALES			
LYNGBYA	SPECIES	3.	1191.47
OSCILLATORIA	SPECIES	8.	3177.26
UNIDENTIFIED ALGAE			
UNICELLULAR			
LESS THAN 5 U		2.	794.32

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL ORGANISMS PER CM2	PERCENT
CHLOROPHYTA	1.	397.16	.57
CRYPTOPHYTA	1.	397.16	.57
DIATOMACEAE	154.	61082.87	87.99
CYANOPHYTA	17.	6751.68	9.73

GENERAL MOTORS PERIPHYTON DATA

TABLE

SAMPLE NO. 1

MAY 20, 1981, 1000 HOURS

COLLECTED AT LOCATION: D-PLEASANT R, STATION 1 , DEPTH RANGE FROM .3 FEET TO .0 FEET

TAXONOMIC IDENTIFICATION	NO. COUNTED	ORGANISMS PER CM2

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL ORGANISMS PER CM2	PERCENT
UNKNOWN UNICELLULA	2.	794.32	1.14
TOTALS	175.	69423.18	100.00

TAXA IN SAMPLE 25

DIVERSITY CALCULATED IN LOG BASE 2

SHANNONS DIVERSITY	2.3453	EVENNESS	.5050	REDUNDANCY	.4956
MAX. DIVERSITY	4.6439	MIN. DIVERSITY	.0061	INFORMATIONAL CONTENT	.16282+06

GENEPAL MOTORS PERIPHYTON DATA TABLE

SAMPLE NO. 2 MAY 20, 1981, 1000 HOURS

COLLECTED AT LOCATION: D-PLEASANT R, STATION 1 , DEPTH RANGE FROM .3 FEET TO .0 FEET

TAXONOMIC IDENTIFICATION			NO. COUNTED	ORGANISMS PER CM2
CHLOROPHYTA				
CHLOROCOCCALES			1.	123.29
DICTYOSPHAERIUM	PULCHELLUM		2.	246.58
DIATOMACEAE			3.	369.87
CENTRALES			1.	123.29
PENNALES				
ACHNANTHES	SPECIES		26.	3205.56
NAVICULA	CRYPTOCEPHALA		4.	480.83
GOMPHONEMA	SPECIES		8.	961.67
GOMPHONEMA	PARVULUM		8.	961.67
GOMPHONEMA	OLIVACEOIDES		1.	160.28
CYMBELLA	SPECIES		13.	1602.78
CYMBELLA	MINUTA		8.	961.67
CYMBELLA	AFFINIS		49.	6090.56
NITZSCHIA	DISSIPATA		6.	801.39
NITZSCHIA	PALEA		3.	320.56
CYANOPHYTA				
CHROOCOCCALES				
CHROOCOCCUS	SPECIES		1.	123.29
CHROOCOCCUS	DISPERSUS	MINOR	3.	369.87
UNIDENTIFIED ALGAE				
FLAGELLATED				
5 TO 10 MICRONS			2.	246.58
UNICELLULAR				
LESS THAN 5 U			1.	123.29

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL ORGANISMS PER CM2	PERCENT
CHLOROPHYTA	6.	739.74	4.28
DIATOMACEAE	127.	15670.25	90.72
CYANOPHYTA	4.	493.16	2.86
UNKNOWN FLAGELLATE	2.	246.58	1.43
UNKNOWN UNICELLULA	1.	123.29	.71
TOTALS	140.	17273.03	100.00

TAXA IN SAMPLE 18

TABLE

GENERAL MOTORS PERIPHYTON DATA

SAMPLE NO. 2

MAY 20, 1981, 1000 HOURS

COLLECTED AT LOCATION: D-PLEASANT R, STATION 1 , DEPTH RANGE FROM .3 FEET TO .0 FEET

TAXONOMIC IDENTIFICATION	NO. COUNTED	ORGANISMS PER CM2

DIVERSITY CALCULATED IN LOG BASE 2

SHANNONS DIVERSITY	3.1303	EVENNESS	.7507	REDUNDANCY	.2502
MAX. DIVERSITY	4.1699	MIN. DIVERSITY	.0153	INFORMATIONAL CONTENT	.54069+05

GENERAL MOTORS PERIPHYTON DATA TABLE

SAMPLE NO. 3 MAY 20, 1981, 1000 HOURS

COLLECTED AT LOCATION: D-PLEASANT R, STATION 1 , DEPTH RANGE FROM .3 FEET TO .0 FEET

TAXONOMIC IDENTIFICATION		NO. COUNTED	ORGANISMS PER CM2
CHLOROPHYTA			
CHLOROCOCCALES			
CHARACIUM	SPECIES	5.	678.62
DIATOMACEAE		2.	271.45
PENNALES			
SYNEDRA	SPECIES		
ACHNANTHES	SPECIES	1.	122.15
NAVICULA	CRYPTOCEPHALA	7.	950.06
NAVICULA	TRIPUNCTATA	2.	244.30
GOMPHONEMA	SPECIES	1.	122.15
GOMPHONEMA	PARVULUM	1.	122.15
CYMBELLA	SPECIES	2.	244.30
CYMBELLA	MINUTA	8.	1072.21
CYMBELLA	AFFINIS	4.	597.18
NITZSCHIA	DISSIPATA	91.	12391.55
NITZSCHIA	PALEA	3.	475.03
SURIRELLA	OVATA	7.	950.06
CYANOPHYTA		2.	244.30
CHROOCOCCALES			
CHROOCOCCUS	SPECIES		
UNIDENTIFIED ALGAE		1.	135.72
FLAGELLATED			
5 TO 10 MICRONS		3.	407.17
UNICELLULAR			
5 TO 10 MICRONS		1.	135.72

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL ORGANISMS PER CM2	PERCENT
CHLOROPHYTA	7.	950.06	4.96
DIATOMACEAE	129.	17535.46	91.50
CYANOPHYTA	1.	135.72	.71
UNKNOWN FLAGELLATE	3.	407.17	2.12
UNKNOWN UNICELLULA	1.	135.72	.71
TOTALS	141.	19164.14	100.00

TAXA IN SAMPLE 17

GENERAL MOTORS PERIPHYTON DATA

TABLE

SAMPLE NO. 3

MAY 20, 1981, 1000 HOURS

COLLECTED AT LOCATION: D-PLEASANT R, STATION 1 , DEPTH RANGE FROM .3 FEET TO .0 FEET

TAXONOMIC IDENTIFICATION	NO. COUNTED	ORGANISMS PER CM2

DIVERSITY CALCULATED IN LOG BASE 2

SHANNONS DIVERSITY	2.2144	EVENNESS	.5418	REDUNDANCY	.4597
MAX. DIVERSITY	4.0875	MIN. DIVERSITY	.0131	INFORMATIONAL CONTENT	.42437+05

TABLE

GENEPAL MOTORS PERIPHYTON DATA — MAY 20, 1981, — 1000 HOURS

SAMPLE NO. 4

COLLECTED AT LOCATION: D-PLEASANT R, STATION 1 , DEPTH RANGE FROM .3 FEET TO .0 FEET

TAXONOMIC IDENTIFICATION			NO. COUNTED	ORGANISMS PER CM2
CHLOROPHYTA			2.	629.26
EUGLENOPHYTA			1.	314.63
DIATOMACEAE				
PENNALES				
ACHNANTHES	SPECIES		17.	5317.27
NAVICULA	CRYPTOCEPHALA		3.	943.89
NAVICULA	MINIMA		1.	346.09
GOMPHONEMA	SPECIES		2.	597.80
GOMPHONEMA	PARVULUM		1.	251.71
AMPHORA	PERPUSILLA		3.	818.04
CYMBELLA	SPECIES		2.	597.80
CYMBELLA	MINUTA		2.	597.80
CYMBELLA	AFFINIS		9.	2831.68
DENTICULA	TENUIS		0.	125.85
NITZSCHIA	SPECIES		0.	125.85
NITZSCHIA	DISSIPATA		1.	346.09
NITZSCHIA	PALEA		1.	251.71
SURIPELLA	ANGUSTATA		0.	125.85
CYANOPHYTA			3.	943.89
CHROOCOCCALES			34.	10697.47
CHROOCOCCUS	SPECIES		11.	3460.95
OSCILLATORIALES				
PHORMIDIUM	SPECIES		6.	1887.79
UNIDENTIFIED ALGAE				
UNICELLULAR				
LESS THAN 5 U			1.	314.63

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL ORGANISMS PER CM2	PERCENT
CHLOROPHYTA	2.	629.26	2.00
EUGLENOPHYTA	1.	314.63	1.00
DIATOMACEAE	42.	13277.45	42.12
CYANOPHYTA	54.	16990.10	53.89
UNKNOWN UNICELLULA	1.	314.63	1.00
TOTALS	100.	31526.07	100.00

TAXA IN SAMPLE 21

GENERAL MOTORS PERIPHYTON DATA

TABLE

SAMPLE NO. 4 MAY 20, 1981, 1000 HOURS

COLLECTED AT LOCATION: D-PLEASANT R, STATION 1 , DEPTH RANGE FROM .3 FEET TO .0 FEET

TAXONOMIC IDENTIFICATION	NO. COUNTED	ORGANISMS PER CM2

DIVERSITY CALCULATED IN LOG BASE 2

SHANNONS DIVERSITY	3.2278	EVENNESS	.7349	REDUNDANCY	.2657
MAX. DIVERSITY	4.3923	MIN. DIVERSITY	.0104	INFORMATIONAL CONTENT	.10176+06

GENERAL MOTORS PERIPHYTON DATA TABLE

SAMPLE NO. 1 MAY 21, 1981, 930 HOURS

COLLECTED AT LOCATION: F-PLEASANT R, STATION 1 , DEPTH RANGE FROM .5 FEET TO .0 FEET

PHYSICAL PARAMETERS: TEMPERATURE C F

UPPER 12.0 53.6

TAXONOMIC IDENTIFICATION		NO. COUNTED	ORGANISMS PER CM2
CHLOROPHYTA			
CHLOROCOCCALES		2.	257.05
CLADOPHORACEAE			
CLADOPHORA	SPECIES	4.	514.09
EUGLENOPHYTA		3.	385.57
EUGLENALES			
PHACUS	SPECIES	1.	128.52
TRACHELOMONAS	SPECIES	3.	385.57
DIATOMACEAE			
PENNALES			
ACHNANTHES	SPECIES	2.	269.90
ACHNANTHES	LANCEOLATA	1.	192.78
RHOICOSPHENIA	CURVATA	4.	526.95
NAVICULA	SPECIES	1.	64.26
NAVICULA	CRYPTOCEPHALA	8.	1053.89
NAVICULA	TRIPUNCTATA	3.	334.16
NAVICULA	VIRIDULA	1.	64.26
GOMPHONEMA	SPECIES	6.	732.58
GOMPHONEMA	ANGUSTATUM	7.	861.11
GOMPHONEMA	OLIVACEUM	2.	269.90
GOMPHONEMA	PARVULUM	1.	128.52
CYMBELLA	SPECIES	1.	192.78
CYMBELLA	AFFINIS	4.	526.95
DENTICULA	TENUIS	1.	128.52
NITZSCHIA	DISSIPATA	3.	398.42
NITZSCHIA	FONTICOLA	1.	128.52
NITZSCHIA	LINEARIS	1.	64.26
NITZSCHIA	PALEA	1.	128.52
SURIPELLA	ANGUSTATA	1.	128.52
SURIRELLA	OVATA	1.	192.78
CYANOPHYTA			
CHROOCOCCALES		2.	257.05
CHROOCOCCUS	SPECIES	23.	2956.03

GENERAL MOTORS PERIPHYTON DATA TABLE .

SAMPLE NO. 1 MAY 21, 1981, 930 HOURS

COLLECTED AT LOCATION: F-PLEASANT R, STATION 1 , DEPTH RANGE FROM .5 FEET TO .0 FEET

PHYSICAL PARAMETERS: TEMPERATURE C F

UPPER 12.0 53.6

TAXONOMIC IDENTIFICATION	NO. COUNTED	ORGANISMS PER CM2
UNIDENTIFIED ALGAE		
FLAGELLATED		
5 TO 10 MICRONS	1.	128.52

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL ORGANISMS PER CM2	PERCENT
CHLOROPHYTA	6.	771.14	6.76
EUGLENOPHYTA	7.	899.66	7.89
DIATOMACEAE	50.	6387.60	56.03
CYANOPHYTA	25.	3213.08	28.18
UNKNOWN FLAGELLATE	1.	128.52	1.13
TOTALS	89.	11400.01	100.00

TAXA IN SAMPLE 29

DIVERSITY CALCULATED IN LOG BASE 2

SHANNONS DIVERSITY 4.0570 EVENNESS .8439 REDUNDANCY .1572

MAX. DIVERSITY 4.8074 MIN. DIVERSITY .0353 INFORMATIONAL CONTENT .46250+05

GENERAL MOTORS PERIPHYTON DATA TABLE

SAMPLE NO. 2 MAY 21, 1981, 930 HOURS

COLLECTED AT LOCATION: F-PLEASANT R, STATION 1 , DEPTH RANGE FROM .5 FEET TO .0 FEET

PHYSICAL PARAMETERS: TEMPERATURE C F

UPPER 12.0 53.6

TAXONOMIC IDENTIFICATION		NO. COUNTED	ORGANISMS PER CM2
CHLOROPHYTA		2.	889.05
TETRASPORALES		2.	889.05
GLOEOCYSTIS	SPECIES	1.	444.53
CHLOROCOCCALES		1.	444.53
EUGLENOPHYTA		1.	444.53
EUGLENALES		2.	889.05
TRACHELOMONAS	SPECIES		
DIATOMACEAE		1.	444.53
PENNALES		4.	1778.10
SYNEDRA	ULNA	2.	889.05
ACHNANTHES	SPECIES	3.	1333.58
RHOICOSPHENIA	CURVATA	8.	3556.20
NAVICULA	SPECIES	4.	1778.10
NAVICULA	CRYPTOCEPHALA	2.	889.05
NAVICULA	TRIPUNCTATA	4.	1778.10
COMPHONEMA	SPECIES	1.	444.53
GOMPHONEMA	ANGUSTATUM	1.	444.53
CYMBELLA	SPECIES	1.	444.53
CYMBELLA	MINUTA	1.	444.53
CYMBELLA	AFFINIS	4.	1778.10
NITZSCHIA	APICULATA	2.	889.05
NITZSCHIA	DISSIPATA	1.	444.53
NITZSCHIA	LINEARIS	3.	1333.58
NITZSCHIA	PALEA	1.	444.53
SURIRELLA	OVATA	1.	444.53
CYANOPHYTA		1.	444.53
CHROOCOCCALES		1.	444.53
OSCILLATORIALES		1.	444.53
LYNGBYA	SPECIES	21.	9335.03
OSCILLATORIA	AGARDHII		
PHORMIDIUM	SPECIES		

GENERAL MOTORS PERIPHYTON DATA TABLE

SAMPLE NO. 2 MAY 21, 1981, 930 HOURS

COLLECTED AT LOCATION: F-PLEASANT R, STATION 1 , DEPTH RANGE FROM .5 FEET TO .0 FEET

PHYSICAL PARAMETERS: TEMPERATURE C F

UPPER 12.0 53.6

TAXONOMIC IDENTIFICATION	NO. COUNTED	ORGANISMS PER CM2
UNIDENTIFIED ALGAE		
UNICELLULAR		
5 TO 10 MICRONS	1.	444.53

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL ORGANISMS PER CM2	PERCENT
CHLOROPHYTA	5.	2222.63	6.67
EUGLENOPHYTA	3.	1333.58	4.00
DIATOMACEAE	42.	18670.06	56.00
CYANOPHYTA	24.	10668.61	32.00
UNKNOWN UNICELLULA	1.	444.53	1.33
TOTALS	75.	33339.39	100.00

TAXA IN SAMPLE 26

DIVERSITY CALCULATED IN LOG BASE 2

SHANNONS DIVERSITY 3.9655 EVENNESS .8436 REDUNDANCY .1568

MAX. DIVERSITY 4.7004 MIN. DIVERSITY .0123 INFORMATIONAL CONTENT .13221+06

TABLE

GENERAL MOTORS PERIPHYTON DATA SAMPLE NO. 3 MAY 21, 1981, 930 HOURS

COLLECTED AT LOCATION: F-PLEASANT R, STATION 1 , DEPTH RANGE FROM .5 FEET TO .0 FEET

PHYSICAL PARAMETERS: TEMPERATURE C F

UPPER 12.0 53.6

TAXONOMIC IDENTIFICATION		NO. COUNTED	ORGANISMS PER CM2
CHLOROPHYTA		2.	122.98
CHLOROCOCCALES			
ANKISTRODESMUS	SPECIES	1.	61.49
EUGLENOPHYTA			
EUGLENALES			
TRACHELOMONAS	SPECIES	1.	61.49
DIATOMACEAE			
PENNALES		1.	61.49
SYNEDRA	SPECIES	2.	122.98
NAVICULA	CRYPTOCEPHALA	12.	737.87
NAVICULA	TRIPUNCTATA	2.	122.98
NAVICULA	PELLICULOSA	1.	61.49
NAVICULA	VIRIDULA	4.	245.96
GOMPHONEMA	SPECIES	3.	184.47
CYMBELLA	SPECIES	5.	307.44
CYMBELLA	MINUTA	1.	61.49
CYMBELLA	AFFINIS	1.	61.49
NITZSCHIA	SPECIES	1.	61.49
NITZSCHIA	DISSIPATA	3.	184.47
NITZSCHIA	PALEA	11.	676.38
SURIRELLA	OVALIS	1.	61.49
SURIRELLA	OVATA	3.	184.47
CYANOPHYTA			
CHROOCOCCALES			
CHROOCOCCUS	SPECIES	11.	676.38
OSCILLATORIALES			
OSCILLATORIA	PSEUDOGEMINATA	1.	61.49
PHORMIDIUM	SPECIES	11.	676.38
UNIDENTIFIED ALGAE			
FLAGELLATED			
5 TO 10 MICRONS		1.	61.49
UNICELLULAR			
5 TO 10 MICRONS		3.	184.47

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL ORGANISMS PER CM2	PERCENT
CHLOROPHYTA	3.	184.47	3.66
EUGLENOPHYTA	1.	61.49	1.22
DIATOMACEAE	51.	3135.93	62.20
CYANOPHYTA	23.	1414.24	28.05

GENERAL MOTORS PERIPHYTON DATA TABLE

SAMPLE NO. 3 MAY 21, 1981, 930 HOURS

COLLECTED AT LOCATION: F-PLEASANT R, STATION 1 , DEPTH RANGE FROM .5 FEET TO .0 FEET

PHYSICAL PARAMETERS: TEMPERATURE C F

UPPER 12.0 53.6

TAXONOMIC IDENTIFICATION NO. COUNTED ORGANISMS PER CM2

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL ORGANISMS PER CM2	PERCENT
UNKNOWN FLAGELLATE	1.	61.49	1.22
UNKNOWN UNICELLULA	3.	184.47	3.66
TOTALS	82.	5042.09	100.00

TAXA IN SAMPLE 23

DIVERSITY CALCULATED IN LOG BASE 2

SHANNONS DIVERSITY 3.8965 EVENNESS .8614 REDUNDANCY .1405

MAX. DIVERSITY 4.5236 MIN. DIVERSITY .0599 INFORMATIONAL CONTENT .19646+05

GENERAL MOTORS PERIPHYTON DATA

TABLE

SAMPLE NO. 4 MAY 21, 1981, 930 HOURS

COLLECTED AT LOCATION: F-PLEASANT R, STATION 1 , DEPTH RANGE FROM .5 FEET TO .0 FEET

PHYSICAL PARAMETERS: TEMPERATURE C F

UPPER 12.0 53.6

TAXONOMIC IDENTIFICATION		NO. COUNTED	ORGANISMS PER CM2
CHLOROPHYTA			
CHLOROCOCCALES			
CHARACIUM	SPECIES	1.	814.34
EUGLENOPHYTA			
EUGLENALES			
TRACHELOMONAS	SPECIES	1.	814.34
DIATOMACEAE			
PENNALES			
NAVICULA	CRYPTOCEPHALA	1.	814.34
NAVICULA	TRIPUNCTATA	1.	814.34
NAVICULA	VIRIDULA	1.	814.34
NITZSCHIA	DISSIPATA	8.	6514.72
NITZSCHIA	PALEA	1.	814.34
SURIRELLA	OVATA	1.	814.34

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL ORGANISMS PER CM2	PERCENT
CHLOROPHYTA	2.	1628.68	12.50
EUGLENOPHYTA	1.	814.34	6.25
DIATOMACEAE	13.	10586.42	81.25
TOTALS	16.	13029.45	100.00

TAXA IN SAMPLE 9

DIVERSITY CALCULATED IN LOG BASE 2

SHANNONS DIVERSITY 2.5000 EVENNESS .7887 REDUNDANCY .2120

MAX. DIVERSITY 3.1699 MIN. DIVERSITY .0093 INFORMATIONAL CONTENT .32574+05

TABLE

MEAN, MINIMUM, AND MAXIMUM DENSITY OF PERIPHYTON SPECIES AND GROUPS WITH PERCENT COMPOSITION AND DIVERSITY

DATA COLLECTED MAY 20-21, 1981 IN PLEASANT RUN AND SALT CREEK

SPECIES NAME		STATION B-DISCHARGE 1 ORGANISMS PER CM2 MEAN	MIN.	MAX.	PERCENT	STATION D-PLEASANT R 1 ORGANISMS PER CM2 MEAN	MIN.	MAX.	PERCENT
CHLOROPHYTA									
CHLOROPHYTA		1445.68	.00	5515.00	1.16	188.14	.00	629.26	.55
GLOEOCYSTIS	SPECIES	196.96	.00	787.86	.16	.00	.00	.00	.00
CHLOROCOCCALES		.00	.00	.00	.00	231.30	.00	678.62	.67
CHARACIUM	SPECIES	66.92	.00	267.70	.05	67.86	.00	271.45	.20
ANKISTRODESMUS	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
DICTYOSPHAERIUM	PULCHELLUM	.00	.00	.00	.00	92.47	.00	369.87	.27
SCENEDESMUS	ABUNDANS	.00	.00	.00	.00	99.29	.00	397.16	.29
ULOTHRIX	SPECIES	196.96	.00	787.86	.16	.00	.00	.00	.00
STIGEOCLONIUM	SPECIES	636.61	.00	1490.87	.51	.00	.00	.00	.00
CLADOPHORA	SPECIES	1055.56	.00	3151.43	.85	.00	.00	.00	.00
TOTAL OF CHLOROPHYTA		3598.69	.00	11030.01	2.90	679.06	.00	950.06	1.98
EUGLENOPHYTA									
EUGLENOPHYTA		263.89	.00	787.86	.21	78.66	.00	314.63	.23
PHACUS	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
TRACHELOMONAS	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
TOTAL OF EUGLENOPHYTA		263.89	.00	787.86	.21	78.66	.00	314.63	.23
CRYPTOPHYTA									
CRYPTOPHYTA		.00	.00	.00	.00	99.29	.00	397.16	.29
TOTAL OF CRYPTOPHYTA		.00	.00	.00	.00	99.29	.00	397.16	.29
DIATOMACEAE									
CENTRALES		.00	.00	.00	.00	30.82	.00	123.29	.09

TABLE

MEAN, MINIMUM, AND MAXIMUM DENSITY OF PERIPHYTON SPECIES AND GROUPS WITH PERCENT COMPOSITION AND DIVERSITY

DATA COLLECTED MAY 20-21, 1981 IN PLEASANT RUN AND SALT CREEK

SPECIES NAME		STATION B-DISCHARGE 1 ORGANISMS PER CM2				STATION D-PLEASANT R 1 ORGANISMS PER CM2			
		MEAN	MIN.	MAX.	PERCENT	MEAN	MIN.	MAX.	PERCENT
PENNALES									
MERIDION	CIRCULARE	.00	.00	.00	.00	.00	.00	.00	.00
SYNEDRA	SPECIES	66.92	.00	267.70	.05	.00	.00	.00	.00
SYNEDRA	ACUS	338.46	.00	1353.84	.27	80.18	.00	198.58	.23
SYNEDRA	RUMPENS	1975.09	.00	5621.65	1.59	109.22	.00	436.87	.32
SYNEDRA	ULNA	160.32	.00	641.29	.13	.00	.00	.00	.00
ACHNANTHES	SPECIES	178.14	.00	712.55	.14	.00	.00	.00	.00
ACHNANTHES	LANCEOLATA	40151.37	9262.33	93552.05	32.35	13290.06	950.06	43687.36	38.69
COCCONEIS	PEDICULUS	2898.94	1472.34	3990.27	2.34	.00	.00	.00	.00
COCCONEIS	PLACENTULA	.00	.00	.00	.00	49.64	.00	198.58	.14
RHOICOSPHENIA	CURVATA	160.32	.00	641.29	.13	.00	.00	.00	.00
NAVICULA	SPECIES	4332.45	.00	12605.72	3.49	.00	.00	.00	.00
NAVICULA	CRYPTOCEPHALA	.00	.00	.00	.00	.00	.00	.00	.00
NAVICULA	TRIPUNCTATA	1817.49	745.43	3939.29	1.46	854.13	244.30	1747.49	2.49
NAVICULA	MINIMA	.00	.00	.00	.00	80.18	.00	198.58	.23
NAVICULA	PELLICULOSA	.00	.00	.00	.00	86.52	.00	346.09	.25
NAVICULA	VIRIDULA	.00	.00	.00	.00	.00	.00	.00	.00
NAVICULA	LUZONENSIS	1188.93	481.86	1995.13	.96	.00	.00	.00	.00
NAVICULA	MUTICA	2268.06	240.93	4472.61	1.83	.00	.00	.00	.00
GOMPHONEMA	SPECIES	2230.64	.00	8199.78	1.80	.00	.00	.00	.00
GOMPHONEMA	ANGUSTATUM	7447.12	3185.60	16545.01	6.00	579.27	122.15	961.67	1.69
GOMPHONEMA	OLIVACEUM	.00	.00	.00	.00	.00	.00	.00	.00
GOMPHONEMA	PARVULUM	338.46	.00	1353.84	.27	.00	.00	.00	.00
GOMPHONEMA	OLIVACEOIDES	4238.21	1353.84	9454.29	3.41	364.42	.00	961.67	1.06
AMPHORA	PERPUSILLA	.00	.00	.00	.00	40.07	.00	160.28	.12
CYMBELLA	SPECIES	.00	.00	.00	.00	800.25	.00	2382.95	2.33
CYMBELLA	MINUTA	.00	.00	.00	.00	927.42	436.87	1602.78	2.70
CYMBELLA	AFFINIS	.00	.00	.00	.00	698.03	597.18	961.67	2.03
CYMBELLA	SINUATA	.00	.00	.00	.00	7006.44	2831.68	12391.55	20.40
DENTICULA	TENUIS	178.14	.00	712.55	.14	.00	.00	.00	.00
NITZSCHIA	SPECIES	.00	.00	.00	.00	140.68	.00	436.87	.41
NITZSCHIA	ACICULARIS	590.89	.00	2363.57	.48	31.46	.00	125.85	.09
NITZSCHIA	APICULATA	534.41	.00	2137.64	.43	.00	.00	.00	.00
		1456.49	.00	5344.11	1.17	.00	.00	.00	.00

TABLE

MEAN, MINIMUM, AND MAXIMUM DENSITY OF PERIPHYTON SPECIES AND GROUPS WITH PERCENT COMPOSITION AND DIVERSITY

DATA COLLECTED MAY 20-21, 1981 IN PLEASANT RUN AND SALT CREEK

SPECIES NAME		STATION B-DISCHARGE 1 ORGANISMS PER CM2				STATION D-PLEASANT R 1 ORGANISMS PER CM2			
		MEAN	MIN.	MAX.	PERCENT	MEAN	MIN.	MAX.	PERCENT
NITZSCHIA	DISSIPATA	.00	.00	.00	.00	1051.01	346.09	2581.53	3.06
NITZSCHIA	FONTICOLA	428.32	.00	1713.26	.35	.00	.00	.00	.00
NITZSCHIA	LINEARIS	.00	.00	.00	.00	.00	.00	.00	.00
NITZSCHIA	PALEA	1223.19	481.86	2981.74	.99	430.23	198.58	950.06	1.25
NITZSCHIA	FRUSTULUM	26828.13	8057.70	43458.84	21.61	.00	.00	.00	.00
SURIRELLA	ANGUSTATA	5467.74	963.71	10046.92	4.40	81.11	.00	198.58	.24
SURIRELLA	OVALIS	.00	.00	.00	.00	.00	.00	.00	.00
SURIRELLA	OVATA	4333.22	.00	17332.87	3.49	160.36	.00	397.16	.47
TOTAL OF DIATOMACEAE		110831.45	39967.24	171300.87	89.29	26891.51	13277.45	61082.87	78.29
CYANOPHYTA									
CYANOPHYTA		.00	.00	.00	.00	235.97	.00	943.89	.69
CHROOCOCCALES		657.82	.00	2363.57	.53	2872.95	.00	10697.47	8.36
APHANOTHECE	SPECIES	.00	.00	.00	.00	99.29	.00	397.16	.29
CHROOCOCCUS	SPECIES	2079.29	.00	3939.29	1.68	1128.57	123.29	3460.95	3.29
CHROOCOCCUS	DISPERSUS	178.14	.00	712.55	.14	191.76	.00	397.16	.56
LYNGBYA	SPECIES	.00	.00	.00	.00	297.87	.00	1191.47	.87
OSCILLATORIA	SPECIES	375.10	.00	787.86	.30	794.32	.00	3177.26	2.31
OSCILLATORIA	AGARDHII	.00	.00	.00	.00	.00	.00	.00	.00
OSCILLATORIA	LIMNETICA	601.34	.00	2137.64	.48	.00	.00	.00	.00
OSCILLATORIA	PSEUDOGEMINATA	.00	.00	.00	.00	.00	.00	.00	.00
PHORMIDIUM	SPECIES	2523.79	267.70	5963.48	2.03	471.95	.00	1887.79	1.37
TOTAL OF CYANOPHYTA		6415.47	2944.67	10242.15	5.17	6092.67	135.72	16990.10	17.74
UNKNOWN FLAGELLATE									
LESS THAN 5 U		178.14	.00	712.55	.14	.00	.00	.00	.00
5 TO 10 MICRONS		.00	.00	.00	.00	163.44	.00	407.17	.48

TABLE

MEAN, MINIMUM, AND MAXIMUM DENSITY OF PERIPHYTON SPECIES AND GROUPS WITH PERCENT COMPOSITION AND DIVERSITY

DATA COLLECTED MAY 20-21, 1961 IN PLEASANT RUN AND SALT CREEK

SPECIES NAME	STATION B-DISCHARGE 1 ORGANISMS PER CM2 MEAN	MIN.	MAX.	PERCENT	STATION D-PLEASANT R 1 ORGANISMS PER CM2 MEAN	MIN.	MAX.	PERCENT
TOTAL OF UNKNOWN FLAGELLATE	178.14	.00	712.55	.14	163.44	.00	407.17	.48
UNKNOWN UNICELLULA								
LESS THAN 5 U	559.08	.00	2236.30	.45	308.06	.00	794.32	.90
5 TO 10 MICRONS	2285.11	787.86	4987.83	1.84	33.93	.00	135.72	.10
TOTAL OF UNKNOWN UNICELLULA	2844.19	787.86	4987.83	2.29	341.99	.00	794.32	1.00
STATION MEAN TOTAL	124131.81			100.00	34346.60			100.00
TOTAL NUMBER OF SAMPLES	4				4			
NUMBER OF SPECIES	41				39			
MAXIMUM NUMBER OF SPECIES AT ALL STATIONS	71							
DIVERSITY CALCULATED IN LOG BASE 2								
SHANNONS DIVERSITY	3.3357				2.7294			
ASSOCIATED EVENNESS	.7336				.6331			
REDUNDANCY	.2666				.3678			

MEAN, MINIMUM, AND MAXIMUM DENSITY OF PERIPHYTON SPECIES AND GROUPS WITH PERCENT COMPOSITION AND DIVERSITY

TABLE

DATA COLLECTED MAY 20-21, 1981 IN PLEASANT RUN AND SALT CREEK

STATION F-PLEASANT R 1

ORGANISMS PER CM2

SPECIES NAME		MEAN	MIN.	MAX.	PERCENT
CHLOROPHYTA					
CHLOROPHYTA					
GLOEOCYSTIS	SPECIES	456.59	.00	889.05	2.91
CHLOROCOCCALES		222.26	.00	889.05	1.42
CHARACIUM	SPECIES	175.39	.00	444.53	1.12
ANKISTRODESMUS	SPECIES	203.59	.00	814.34	1.30
DICTYOSPHAERIUM	PULCHELLUM	15.37	.00	61.49	.10
SCENEDESMUS	ABUNDANS	.00	.00	.00	.00
ULOTHRIX	SPECIES	.00	.00	.00	.00
STIGEOCLONIUM	SPECIES	.00	.00	.00	.00
CLADOPHORA	SPECIES	.00	.00	.00	.00
TOTAL OF CHLOROPHYTA		128.52	.00	514.09	.82
		1201.73	.00	2222.63	7.65
EUGLENOPHYTA					
EUGLENOPHYTA					
PHACUS	SPECIES	207.52	.00	444.53	1.32
TRACHELOMONAS	SPECIES	32.13	.00	128.52	.20
TOTAL OF EUGLENOPHYTA		537.61	61.49	889.05	3.42
		777.27	61.49	1333.58	4.95
CRYPTOPHYTA					
CRYPTOPHYTA		.00	.00	.00	.00
TOTAL OF CRYPTOPHYTA		.00	.00	.00	.00
DIATOMACEAE					
CENTRALES		.00	.00	.00	.00

TABLE

MEAN, MINIMUM, AND MAXIMUM DENSITY OF PERIPHYTON SPECIES AND GROUPS WITH PERCENT COMPOSITION AND DIVERSITY

DATA COLLECTED MAY 20-21, 1981 IN PLEASANT RUN AND SALT CREEK

STATION F-PLEASANT R 1

ORGANISMS PER CM2

SPECIES NAME		MEAN	MIN.	MAX.	PERCENT
PENNALES		15.37	.00	61.49	.10
MERIDION	CIRCULARE	.00	.00	.00	.00
SYNEDRA	SPECIES	30.74	.00	122.98	.20
SYNEDRA	ACUS	.00	.00	.00	.00
SYNEDRA	RUMPENS	.00	.00	.00	.00
SYNEDRA	ULNA	111.13	.00	444.53	.71
ACHNANTHES	SPECIES	512.00	.00	1778.10	3.26
ACHNANTHES	LANCEOLATA	48.20	.00	192.78	.31
COCCONEIS	PEDICULUS	.00	.00	.00	.00
COCCONEIS	PLACENTULA	.00	.00	.00	.00
RHOICOSPHENIA	CURVATA	354.00	.00	889.05	2.25
NAVICULA	SPECIES	349.46	.00	1333.58	2.23
NAVICULA	CRYPTOCEPHALA	1540.57	737.87	3556.20	9.81
NAVICULA	TRIPUNCTATA	762.39	122.98	1778.10	4.86
NAVICULA	MINIMA	.00	.00	.00	.00
NAVICULA	PELLICULOSA	15.37	.00	61.49	.10
NAVICULA	VIRIDULA	281.14	.00	814.34	1.79
NAVICULA	LUZONENSIS	.00	.00	.00	.00
NAVICULA	MUTICA	.00	.00	.00	.00
GOMPHONEMA	SPECIES	451.52	.00	889.05	2.88
GOMPHONEMA	ANGUSTATUM	659.80	.00	1778.10	4.20
GOMPHONEMA	OLIVACEUM	67.47	.00	269.90	.43
GOMPHONEMA	PARVULUM	32.13	.00	128.52	.20
GOMPHONEMA	OLIVACEOIDES	.00	.00	.00	.00
AMPHORA	PERPUSILLA	.00	.00	.00	.00
CYMBELLA	SPECIES	236.19	.00	444.53	1.50
CYMBELLA	MINUTA	126.50	.00	444.53	.81
CYMBELLA	AFFINIS	258.24	.00	526.95	1.64
CYMBELLA	SINUATA	.00	.00	.00	.00
DENTICULA	TENUIS	32.13	.00	128.52	.20
NITZSCHIA	SPECIES	15.37	.00	61.49	.10
NITZSCHIA	ACICULARIS	.00	.00	.00	.00
NITZSCHIA	APICULATA	111.13	.00	444.53	.71

TABLE

MEAN, MINIMUM, AND MAXIMUM DENSITY OF PERIPHYTON SPECIES AND GROUPS WITH PERCENT COMPOSITION AND DIVERSITY

DATA COLLECTED MAY 20-21, 1981 IN PLEASANT RUN AND SALT CREEK

STATION F-PLEASANT R 1

ORGANISMS PER CM2

SPECIES NAME		MEAN	MIN.	MAX.	PERCENT
NITZSCHIA	DISSIPATA	2218.93	184.47	6514.72	14.13
NITZSCHIA	FONTICOLA	32.13	.00	128.52	.20
NITZSCHIA	LINEARIS	238.33	.00	889.05	1.52
NITZSCHIA	PALEA	515.94	128.52	814.34	3.29
NITZSCHIA	FRUSTULUM	.00	.00	.00	.00
SURIRELLA	ANGUSTATA	32.13	.00	128.52	.20
SURIRELLA	OVALIS	15.37	.00	61.49	.10
SURIRELLA	OVATA	631.29	184.47	1333.58	4.02
TOTAL OF DIATOMACEAE		9695.00	3135.93	18670.06	61.74
CYANOPHYTA					
CYANOPHYTA		.00	.00	.00	.00
CHROOCOCCALES		175.39	.00	444.53	1.12
APHANOTHECE	SPECIES	.00	.00	.00	.00
CHROOCOCCUS	SPECIES	908.10	.00	2956.03	5.78
CHROOCOCCUS	DISPERSUS	.00	.00	.00	.00
LYNGBYA	SPECIES	111.13	.00	444.53	.71
OSCILLATORIA	SPECIES	.00	.00	.00	.00
OSCILLATORIA	AGARDHII	111.13	.00	444.53	.71
OSCILLATORIA	LIMNETICA	.00	.00	.00	.00
OSCILLATORIA	PSEUDOGEMINATA	15.37	.00	61.49	.10
PHORMIDIUM	SPECIES	2502.85	.00	9335.03	15.94
TOTAL OF CYANOPHYTA		3823.98	.00	10668.61	24.35
UNKNOWN FLAGELLATE					
LESS THAN 5 U		.00	.00	.00	.00
5 TO 10 MICRONS		47.50	.00	128.52	.30

TABLE

MEAN, MINIMUM, AND MAXIMUM DENSITY OF PERIPHYTON SPECIES AND GROUPS WITH PERCENT COMPOSITION AND DIVERSITY

DATA COLLECTED MAY 21-22, 1981 IN PLEASANT RUN AND SALT CREEK

STATION F-PLEASANT R 1

ORGANISMS PER CM2

SPECIES NAME	MEAN	MIN.	MAX.	PERCENT
TOTAL OF UNKNOWN FLAGELLATE	47.50	.00	128.52	.30
UNKNOWN UNICELLULA				
LESS THAN 5 U	.00	.00	.00	.00
5 TO 10 MICRONS	157.25	.00	444.53	1.00
TOTAL OF UNKNOWN UNICELLULA	157.25	.00	444.53	1.00
STATION MEAN TOTAL	15702.73			100.00
TOTAL NUMBER OF SAMPLES	4			
NUMBER OF SPECIES	45			
MAXIMUM NUMBER OF SPECIES AT ALL STATIONS	71			
DIVERSITY CALCULATED IN LOG BASE 2				
SHANNONS DIVERSITY	3.6047			
ASSOCIATED EVENNESS	.8344			
REDUNDANCY	.1666			

TABLE

GENERAL MOTORS PERIPHYTON DATA SEPTEMBER 2, 1981, 1600 HOURS

SAMPLE NO. 1

COLLECTED AT LOCATION: B-DISCHARGE , STATION 1 , DEPTH RANGE FROM SURFACE TO .000000#

TAXONOMIC IDENTIFICATION		NO. COUNTED	ORGANISMS PER CM2
CRYPTOPHYTA			
CRYPTOCHRYSIDACEAE			
RHODOMONAS	SPECIES	1.	515.46
CHRYSOPHYCEAE		1.	515.46
CHROMULINALES			
KEPHYRION	SPECIES	2.	1030.92
DIATOMACEAE			
CENTRALES		2.	1030.92
PENNALES		1.	515.46
ACHNANTHES	SPECIES	1.	515.46
ACHNANTHES	MINUTISSIMA	2.	1030.92
GOMPHONEMA	SPECIES	4.	2061.84
GOMPHONEMA	PARVULUM	2.	1030.92
NITZSCHIA	SPECIES	3.	1546.38
NITZSCHIA	PALEA	11.	5670.06
NITZSCHIA	FRUSTULUM	14.	7216.44
SURIRELLA	ANGUSTATA	2.	1030.92
SURIRELLA	OVALIS	2.	1030.92
SURIRELLA	OVATA	2.	1030.92
CYANOPHYTA		1.	515.46
CHROOCOCCALES			
CHROOCOCCUS	SPECIES	4.	2061.84
MERISMOPEDIA	TENUISSIMA	1.	515.46
OSCILLATORIALES			
PHORMIDIUM	SPECIES	1.	515.46
UNIDENTIFIED ALGAE			
FLAGELLATED			
5 TO 10 MICRONS		1.	515.46
UNICELLULAR			
LESS THAN 5 U		2.	1030.92

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL ORGANISMS PER CM2	PERCENT
CRYPTOPHYTA	1.	515.46	1.67
CHRYSOPHYCEAE	3.	1546.38	5.00
DIATOMACEAE	46.	23711.17	76.67
CYANOPHYTA	7.	3608.22	11.67

TABLE

GENERAL MOTORS PERIPHYTON DATA — SEPTEMBER 2, 1981, — 1600 HOURS

SAMPLE NO. 1

COLLECTED AT LOCATION: B-DISCHARGE , STATION 1 , DEPTH RANGE FROM SURFACE TO .000000#

TAXONOMIC IDENTIFICATION	NO. COUNTED	ORGANISMS PER CM2

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL ORGANISMS PER CM2	PERCENT
UNKNOWN FLAGELLATE	1.	515.46	1.67
UNKNOWN UNICELLULA	2.	1030.92	3.33
TOTALS	60.	30927.61	100.00

TAXA IN SAMPLE 21

DIVERSITY CALCULATED IN LOG BASE 2

SHANNONS DIVERSITY	3.7717	EVENNESS	.8587	REDUNDANCY	.1416
MAX. DIVERSITY	4.3923	MIN. DIVERSITY	.0106	INFORMATIONAL CONTENT	.11665+06

GENERAL MOTORS PERIPHYTON DATA

TABLE

SAMPLE NO. 2

SEPTEMBER 2, 1981, 1600 HOURS

COLLECTED AT LOCATION: B-DISCHARGE , STATION 1 , DEPTH RANGE FROM SURFACE TO .000000#

TAXONOMIC IDENTIFICATION		NO. COUNTED	ORGANISMS PER CM2
CHLOROPHYTA			
CLADOPHORACEAE			
CLADOPHORA	GLOMERATA	4.	812.63
EUGLENOPHYTA		3.	609.47
CHRYSOPHYCEAE		3.	609.47
DIATOMACEAE			
CENTRALES		1.	203.16
PENNALES		3.	609.47
ACHNANTHES	SPECIES	8.	1625.27
ACHNANTHES	MINUTISSIMA	6.	1218.95
NAVICULA	SPECIES	1.	203.16
GOMPHONEMA	SPECIES	20.	4063.17
GOMPHONEMA	ANGUSTATUM	2.	406.32
GOMPHONEMA	PARVULUM	11.	2234.74
NITZSCHIA	SPECIES	1.	203.16
NITZSCHIA	FILIFORMIS	1.	203.16
NITZSCHIA	LINEARIS	1.	203.16
NITZSCHIA	PALEA	15.	3047.37
NITZSCHIA	FRUSTULUM	11.	2234.74
SURIRELLA	ANGUSTATA	6.	1218.95
SURIRELLA	OVALIS	1.	203.16
SURIRELLA	OVATA	1.	203.16
CYANOPHYTA			
CHROOCOCCALES			
CHROOCOCCUS	SPECIES	9.	1828.42
OSCILLATORIALES			
OSCILLATORIA	SPECIES	1.	203.16
UNIDENTIFIED ALGAE			
FLAGELLATED			
5 TO 10 MICRONS		1.	203.16
UNICELLULAR			
5 TO 10 MICRONS		3.	609.47

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL ORGANISMS PER CM2	PERCENT
CHLOROPHYTA	4.	812.63	3.54
EUGLENOPHYTA	3.	609.47	2.65

GENERAL MOTORS PERIPHYTON DATA

TABLE

SAMPLE NO. 2

SEPTEMBER 2, 1981, 1600 HOURS

COLLECTED AT LOCATION: B-DISCHARGE , STATION 1 , DEPTH RANGE FROM SURFACE TO .000000#

TAXONOMIC IDENTIFICATION NO. COUNTED ORGANISMS PER CM2

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL ORGANISMS PER CM2	PERCENT
CHRYSOPHYCEAE	3.	609.47	2.65
DIATOMACEAE	89.	18081.09	78.76
CYANOPHYTA	10.	2031.58	8.85
UNKNOWN FLAGELLATE	1.	203.16	.88
UNKNOWN UNICELLULA	3.	609.47	2.65
TOTALS	113.	22956.89	100.00

TAXA IN SAMPLE 23

DIVERSITY CALCULATED IN LOG BASE 2

SHANNONS DIVERSITY	3.666°	EVENNESS	.8548	REDUNDANCY	.1457
MAX. DIVERSITY	4.5236	MIN. DIVERSITY	.0153	INFORMATIONAL CONTENT	.88773+05

TABLE

GENERAL MOTORS PERIPHYTON DATA — SEPTEMBER 2, 1981, — 1600 HOURS

SAMPLE NO. 3

COLLECTED AT LOCATION: B-DISCHARGE , STATION 1 , DEPTH RANGE FROM SURFACE TO .000000#

TAXONOMIC IDENTIFICATION		NO. COUNTED	ORGANISMS PER CM2
CHLOROPHYTA			
TETRASPORALES			
GLOEOCYSTIS	SPECIES	3.	975.57
CLADOPHORACEAE			
CLADOPHORA	GLOMERATA	1.	325.19
EUGLENOPHYTA			
EUGLENALES			
EUGLENA	SPECIES	2.	650.38
LEPOCINCLIS	SPECIES	5.	1625.95
TRACHELOMONAS	SPECIES	2.	650.38
CHRYSOPHYCEAE		1.	325.19
DIATOMACEAE			
PENNALES		1.	325.19
ACHNANTHES	SPECIES	13.	4064.87
ACHNANTHES	LANCEOLATA	4.	1430.83
ACHNANTHES	LINEARIS	10.	3349.45
ACHNANTHES	MINUTISSIMA	4.	1235.72
GOMPHONEMA	SPECIES	11.	3447.01
GOMPHONEMA	PARVULUM	8.	2731.59
CYMBELLA	SPECIES	1.	325.19
NITZSCHIA	APICULATA	1.	325.19
NITZSCHIA	PALEA	9.	2926.71
NITZSCHIA	FRUSTULUM	12.	3902.28
SURIRELLA	OVALIS	1.	325.19
SURIRELLA	OVATA	1.	325.19
CYANOPHYTA			
CHROOCOCCALES			
CHROOCOCCUS	SPECIES	14.	4552.65
OSCILLATORIALES			
PHORMIDIUM	SPECIES	1.	325.19
NOSTOCALES		2.	650.38
UNIDENTIFIED ALGAE			
UNICELLULAR			
5 TO 10 MICRONS		3.	975.57

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL ORGANISMS PER CM2	PERCENT
CHLOROPHYTA	4.	1300.76	3.64
EUGLENOPHYTA	9.	2926.71	8.18

TABLE

GENERAL MOTORS PERIPHYTON DATA SEPTEMBER 2, 1981, 1600 HOURS

SAMPLE NO. 3

COLLECTED AT LOCATION: B-DISCHARGE , STATION 1 , DEPTH RANGE FROM SURFACE TO .000000#

TAXONOMIC IDENTIFICATION NO. COUNTED ORGANISMS PER CM2

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL ORGANISMS PER CM2	PERCENT
CHRYSOPHYCEAE	1.	325.19	.91
DIATOMACEAE	76.	24714.41	69.09
CYANOPHYTA	17.	5528.22	15.45
UNKNOWN UNICELLULA	3.	975.57	2.73
TOTALS	110.	35770.85	100.00

TAXA IN SAMPLE 23

DIVERSITY CALCULATED IN LOG BASE 2

SHANNONS DIVERSITY	3.9560	EVENNESS	.8745	REDUNDANCY	.1258
MAX. DIVERSITY	4.5236	MIN. DIVERSITY	.0102	INFORMATIONAL CONTENT	.14151+06

GENERAL MOTORS PERIPHYTON DATA

TABLE

SAMPLE NO. 4

SEPTEMBER 2, 1981, 1600 HOURS

COLLECTED AT LOCATION: B-DISCHARGE , STATION 1 , DEPTH RANGE FROM SURFACE TO .000000#

TAXONOMIC IDENTIFICATION		NO. COUNTED	ORGANISMS PER CM2
CHLOROPHYTA		2.	484.53
TETRASPORALES			
GLOEOCYSTIS	SPECIES	1.	242.27
CLADOPHORACEAE			
CLADOPHORA	GLOMERATA	2.	484.53
EUGLENOPHYTA		2.	484.53
EUGLENALES			
EUGLENA	SPECIES	1.	242.27
PHACUS	SPECIES	6.	1453.60
DIATOMACEAE			
PENNALES		2.	484.53
ACHNANTHES	SPECIES	44.	10732.40
ACHNANTHES	LANCEOLATA	6.	1574.73
ACHNANTHES	LINEARIS	9.	2204.62
GOMPHONEMA	SPECIES	38.	9157.66
GOMPHONEMA	ANGUSTATUM	5.	1187.10
GOMPHONEMA	PARVULUM	8.	1986.58
AMPHORA	SPECIES	1.	242.27
CYMBELLA	MINUTA	1.	242.27
NITZSCHIA	SPECIES	2.	484.53
NITZSCHIA	PALEA	8.	1938.13
NITZSCHIA	FRUSTULUM	21.	5087.59
SURIRELLA	ANGUSTATA	2.	484.53
SURIRELLA	OVATA	2.	484.53
CYANOPHYTA			
CHROOCOCCALES			
CHROOCOCCUS	SPECIES	14.	3391.73
OSCILLATORIALES			
PHORMIDIUM	SPECIES	3.	726.80
UNIDENTIFIED ALGAE			
FLAGELLATED			
LESS THAN 5 U		2.	484.53

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL ORGANISMS PER CM2	PERCENT
CHLOROPHYTA	5.	1211.33	2.74
EUGLENOPHYTA	9.	2180.40	4.92
DIATOMACEAE	150.	36291.48	81.95

GENERAL MOTORS PERIPHYTON DATA TABLE

SAMPLE NO. 4 SEPTEMBER 2, 1981, 1600 HOURS

COLLECTED AT LOCATION: B-DISCHARGE , STATION 1 , DEPTH RANGE FROM SURFACE TO .000000#

TAXONOMIC IDENTIFICATION NO. COUNTED ORGANISMS PER CM2

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL ORGANISMS PER CM2	PERCENT
CYANOPHYTA	17.	4118.53	9.30
UNKNOWN FLAGELLATE	2.	484.53	1.09
TOTALS	183.	44286.27	100.00

TAXA IN SAMPLE 23

DIVERSITY CALCULATED IN LOG BASE 2

SHANNONS DIVERSITY 3.5270 EVENNESS .7797 REDUNDANCY .2207

MAX. DIVERSITY 4.5236 MIN. DIVERSITY .0084 INFORMATIONAL CONTENT .15620+06

TABLE

GENERAL MOTORS PERIPHYTON DATA

SAMPLE NO. 1

SEPTEMBER 2, 1981, 1500 HOURS

COLLECTED AT LOCATION: C-PLEASANT R, STATION 1 , DEPTH RANGE FROM SURFACE TO .0aaaaa#

TAXONOMIC IDENTIFICATION		NO. COUNTED	ORGANISMS PER CM2
CHLOROPHYTA			
TETRASPORALES			
GLOEOCYSTIS	SPECIES	8.	5498.24
CHLOROCOCCALES		1.	687.28
SCENEDESMUS	ABUNDANS	1.	687.28
ULOTRICHALES			
ULOTHRIX	SPECIES	2.	1374.56
CHAETOPHORALES		7.	4810.96
DESMIDIACEAE			
COSMARIUM	SPECIES	2.	1374.56
EUGLENOPHYTA		2.	1374.56
EUGLENALES			
PHACUS	SPECIES	1.	687.28
TRACHELOMONAS	SPECIES	4.	2749.12
DIATOMACEAE			
CENTRALES			
CYCLOTELLA	MENEGHINIANA	5.	3436.40
PENNALES		1.	687.28
SYNEDRA	ULNA	1.	687.28
ACHNANTHES	LANCEOLATA	2.	1374.56
ACHNANTHES	LINEARIS	21.	14432.88
NAVICULA	CRYPTOCEPHALA	15.	10309.20
GOMPHONEMA	SPECIES	2.	1374.56
CYMBELLA	AFFINIS	4.	2749.12
DENTICULA	TENUIS	3.	2061.84
NITZSCHIA	PALEA	5.	3436.40
DIPLONEIS	PUELLA	1.	687.28
CYANOPHYTA			
CHROOCOCCALES			
CHROOCOCCUS	SPECIES	25.	17182.00
OSCILLATORIALES			
LYNGBYA	SPECIES	6.	4123.68
OSCILLATORIA	SPECIES	2.	1374.56

GENERAL MOTORS PERIPHYTON DATA

TABLE

SAMPLE NO. 1 SEPTEMBER 2, 1981, 1500 HOURS

COLLECTED AT LOCATION: C-PLEASANT R, STATION 1 , DEPTH RANGE FROM SURFACE TO .0######

TAXONOMIC IDENTIFICATION	NO. COUNTED	ORGANISMS PER CM2
NOSTOCALES	2.	1374.56
UNIDENTIFIED ALGAE		
UNICELLULAR		
LESS THAN 5 U	1.	687.28

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL ORGANISMS PER CM2	PERCENT
CHLOROPHYTA	21.	14432.88	16.94
EUGLENOPHYTA	7.	4810.96	5.65
DIATOMACEAE	60.	41236.81	48.39
CYANOPHYTA	35.	24054.81	28.23
UNKNOWN UNICELLULA	1.	687.28	.81
TOTALS	124.	85222.73	100.00

TAXA IN SAMPLE 25

DIVERSITY CALCULATED IN LOG BASE 2

SHANNONS DIVERSITY 3.8568 EVENNESS .8305 REDUNDANCY .1697

MAX. DIVERSITY 4.6439 MIN. DIVERSITY .0050 INFORMATIONAL CONTENT .32869+06

TABLE

GENERAL MOTORS PERIPHYTON DATA — SEPTEMBER 2, 1981, — 1500 HOURS

SAMPLE NO. 2

COLLECTED AT LOCATION: C-PLEASANT R, STATION 1 , DEPTH RANGE FROM SURFACE TO .0@@@@@#

TAXONOMIC IDENTIFICATION		NO. COUNTED	ORGANISMS PER CM2
CHLOROPHYTA			
TETRASPORALES			
GLOEOCYSTIS	SPECIES	6.	8945.22
CHLOROCOCCALES			
SCENEDESMUS	SPECIES	3.	4472.61
SCENEDESMUS	ABUNDANS	1.	1490.87
CHAETOPHORALES		6.	8945.22
EUGLENOPHYTA			
EUGLENALES			
PHACUS	SPECIES	2.	2981.74
CHRYSOPHYCEAE			
CHROMULINALES			
KEPHYRION	SPECIES	1.	1490.87
DIATOMACEAE			
PENNALES		1.	1490.87
ACHNANTHES	LINEARIS	100.	149086.93
NAVICULA	CRYPTOCEPHALA	5.	7454.35
GOMPHONEMA	SPECIES	2.	2981.74
CYMBELLA	MICROCEPHALA	1.	1490.87
CYMBELLA	MINUTA	1.	1490.87
DENTICULA	TENUIS	1.	1490.87
CYANOPHYTA			
CHROOCOCCALES			
CHROOCOCCUS	SPECIES	8.	11926.95
CHROOCOCCUS	MINOR	8.	11926.95
OSCILLATORIALES			
LYNGBYA	SPECIES	7.	10436.08
OSCILLATORIA	SPECIES	1.	1490.87
OSCILLATORIA	TENUIS	9.	13417.82
PHORMIDIUM	SPECIES	24.	35780.86
UNIDENTIFIED ALGAE			
UNICELLULAR			
5 TO 10 MICRONS		2.	2981.74

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL ORGANISMS PER CM2	PERCENT
CHLOROPHYTA	16.	23853.91	8.47
EUGLENOPHYTA	2.	2981.74	1.06
CHRYSOPHYCEAE	1.	1490.87	.53
DIATOMACEAE	111.	165486.49	58.73
CYANOPHYTA	57.	84979.55	30.16

TABLE

GENERAL MOTORS PERIPHYTON DATA SEPTEMBER 2, 1981, 1500 HOURS

SAMPLE NO. 2

COLLECTED AT LOCATION: C-PLEASANT R, STATION 1 , DEPTH RANGE FROM SURFACE TO .000000M

TAXONOMIC IDENTIFICATION NO. COUNTED ORGANISMS PER CM2

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL ORGANISMS PER CM2	PERCENT
UNKNOWN UNICELLULA	2.	2961.74	1.06
TOTALS	169.	281774.28	100.00

TAXA IN SAMPLE 20

DIVERSITY CALCULATED IN LOG BASE 2

SHANNONS DIVERSITY	2.6734	EVENNESS	.6186	REDUNDANCY	.3815
MAX. DIVERSITY	4.3219	MIN. DIVERSITY	.0013	INFORMATIONAL CONTENT	.75330+06

GENERAL MOTORS PERIPHYTON DATA

TABLE

SAMPLE NO. 3

SEPTEMBER 2, 1981, 1500 HOURS

COLLECTED AT LOCATION: C-PLEASANT R, STATION 1 , DEPTH RANGE FROM SURFACE TO .0000000

TAXONOMIC IDENTIFICATION		NO. COUNTED	ORGANISMS PER CM2
CHLOROPHYTA			
TETRASPORALES			
GLOEOCYSTIS	SPECIES	5.	5100.34
CHLOROCOCCALES			
TETRAEDRON	MINIMUM	1.	1020.07
CHAETOPHORALES		1.	1020.07
EUGLENOPHYTA			
EUGLENALES			
PHACUS	SPECIES	2.	2040.14
DIATOMACEAE			
PENNALES			
ACHNANTHES	LINEARIS	115.	117307.87
COCCONEIS	PLACENTULA	2.	2040.14
NAVICULA	SPECIES	1.	1020.07
NAVICULA	CRYPTOCEPHALA	5.	5100.34
GOMPHONEMA	SPECIES	1.	1020.07
CYMBELLA	MICROCEPHALA	2.	2040.14
CYMBELLA	MINUTA	0.	102.01
CYMBELLA	AFFINIS	3.	3162.21
CYMBELLA	TUMIDA	1.	816.05
DENTICULA	TENUIS	2.	2040.14
NITZSCHIA	SPECIES	1.	1020.07
NITZSCHIA	PALEA	2.	2040.14
CYANOPHYTA			
CHROOCOCCALES			
CHROOCOCCUS	SPECIES	26.	26521.78
OSCILLATORIALES			
LYNGBYA	SPECIES	12.	12240.82
OSCILLATORIA	TENUIS	8.	8160.55
UNIDENTIFIED ALGAE			
FLAGELLATED			
5 TO 10 MICRONS		1.	1020.07
UNICELLULAR			
5 TO 10 MICRONS		2.	2040.14

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL ORGANISMS PER CM2	PERCENT
CHLOROPHYTA	7.	7140.48	3.63
EUGLENOPHYTA	2.	2040.14	1.04
DIATOMACEAE	135.	137709.24	69.95
CYANOPHYTA	46.	46923.15	23.83
UNKNOWN FLAGELLATE	1.	1020.07	.52

TABLE

GENERAL MOTORS PERIPHYTON DATA SEPTEMBER 2, 1981, 1500 HOURS

SAMPLE NO. 3

COLLECTED AT LOCATION: C-PLEASANT R, STATION 1 , DEPTH RANGE FROM SURFACE TO .000000#

TAXONOMIC IDENTIFICATION	NO. COUNTED	ORGANISMS PER CM2

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL ORGANISMS PER CM2	PERCENT
UNKNOWN UNICELLULA	2.	2040.14	1.04
TOTALS	193.	196873.20	100.00

TAXA IN SAMPLE 21

DIVERSITY CALCULATED IN LOG BASE 2

SHANNONS DIVERSITY	2.3274	EVENNESS	.5299	REDUNDANCY	.4703
MAX. DIVERSITY	4.3923	MIN. DIVERSITY	.0019	INFORMATIONAL CONTENT	.45821+06

TABLE

GENERAL MOTORS PERIPHYTON DATA SEPTEMBER 2, 1981, 1500 HOURS

SAMPLE NO. 4

COLLECTED AT LOCATION: C-PLEASANT R, STATION 1 , DEPTH RANGE FROM SURFACE TO .000000#

TAXONOMIC IDENTIFICATION		NO. COUNTED	ORGANISMS PER CM2
CHLOROPHYTA			
TETRASPORALES			
GLOEOCYSTIS	SPECIES	8.	3126.02
CHLOROCOCCALES		1.	390.75
SCENEDESMUS	SPECIES	1.	390.75
EUGLENOPHYTA			
EUGLENALES			
PHACUS	SPECIES	10.	3907.52
CHRYSOPHYCEAE		1.	390.75
DIATOMACEAE			
PENNALES			
NAVICULA	CRYPTOCEPHALA	4.	1563.01
CYMBELLA	SPECIES	2.	781.50
CYMBELLA	MICROCEPHALA	1.	390.75
CYMBELLA	AFFINIS	1.	390.75
NITZSCHIA	PALEA	3.	1172.26
DIPLONEIS	PUELLA	1.	390.75
CYANOPHYTA			
CHROOCOCCALES			
CHROOCOCCUS	SPECIES	11.	4298.27
CHROOCOCCUS	MINOR	28.	10941.06
DACTYLOCOCCOPSIS	SPECIES	1.	390.75
OSCILLATORIALES			
LYNGBYA	SPECIES	1.	390.75
OSCILLATORIA	SPECIES	1.	390.75
PHORMIDIUM	SPECIES	21.	8205.79
UNIDENTIFIED ALGAE			
FLAGELLATED			
LESS THAN 5 U		1.	390.75
UNICELLULAR			
5 TO 10 MICRONS		2.	781.50

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL ORGANISMS PER CM2	PERCENT
CHLOROPHYTA	10.	3907.52	10.10
EUGLENOPHYTA	10.	3907.52	10.10
CHRYSOPHYCEAE	1.	390.75	1.01
DIATOMACEAE	12.	4689.02	12.12
CYANOPHYTA	63.	24617.38	63.64
UNKNOWN FLAGELLATE	1.	390.75	1.01

GENEPAL MOTORS PERIPHYTON DATA TABLE

SAMPLE NO. 4 SEPTEMBER 2, 1981, 1500 HOURS

COLLECTED AT LOCATION: C-PLEASANT R, STATION 1 , DEPTH RANGE FROM SURFACE TO .0######

TAXONOMIC IDENTIFICATION NO. COUNTED ORGANISMS PER CM2

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL ORGANISMS PER CM2	PERCENT
UNKNOWN UNICELLULA	2.	781.50	2.02
TOTALS	99.	38684.45	100.00

TAXA IN SAMPLE 19

DIVERSITY CALCULATED IN LOG BASE 2

SHANNONS DIVERSITY	3.2064	EVENNESS	.7548	REDUNDANCY	.2456
MAX. DIVERSITY	4.2479	MIN. DIVERSITY	.0078	INFORMATIONAL CONTENT	.12404+06

TABLE

GENERAL MOTORS PERIPHYTON DATA SEPTEMBER 2, 1981, 1130 HOURS

SAMPLE NO. 1

COLLECTED AT LOCATION: D-PLEASANT R, STATION 1 , DEPTH RANGE FROM SURFACE TO .000000M

TAXONOMIC IDENTIFICATION		NO. COUNTED	ORGANISMS PER CM2
CHLOROPHYTA		1.	299.09
TETRASPORALES			
GLOEOCYSTIS	SPECIES	4.	1196.38
CHLOROCOCCALES		1.	299.09
TETRAEDRON	MINIMUM	1.	299.09
SCENEDESMUS	SPECIES	6.	1794.56
SCENEDESMUS	ABUNDANS	1.	299.09
EUGLENOPHYTA		7.	2093.66
EUGLENALES			
TRACHELOMONAS	SPECIES	4.	1196.38
CHRYSOPHYCEAE		5.	1495.47
DIATOMACEAE			
PENNALES		1.	299.09
ACHNANTHES	LINEARIS	34.	10318.75
GYROSIGMA	SPECIES	1.	299.09
AMPHORA	PERPUSILLA	10.	3140.49
DENTICULA	TENUIS	1.	299.09
NITZSCHIA	PALEA	2.	598.19
DIPLONEIS	PUELLA	1.	299.09
CYANOPHYTA			
CHROOCOCCALES			
CHROOCOCCUS	SPECIES	14.	4187.32
CHROOCOCCUS	MINOR	13.	3888.22
DACTYLOCOCCOPSIS	SPECIES	1.	299.09
OSCILLATORIALES			
LYNGBYA	SPECIES	1.	299.09
PHORMIDIUM	SPECIES	8.	2392.75
UNIDENTIFIED ALGAE			
FLAGELLATED			
5 TO 10 MICRONS		1.	299.09

GENERAL MOTORS PERIPHYTON DATA

TABLE

SAMPLE NO. 1

SEPTEMBER 2, 1981, 1130 HOURS

COLLECTED AT LOCATION: D-PLEASANT R, STATION 1 , DEPTH RANGE FROM SURFACE TO .000000#

TAXONOMIC IDENTIFICATION	NO. COUNTED	ORGANISMS PER CM2
UNICELLULAR 5 TO 10 MICRONS	3.	897.28

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL ORGANISMS PER CM2	PERCENT
CHLOROPHYTA	14.	4187.32	11.48
EUGLENOPHYTA	11.	3290.04	9.02
CHRYSOPHYCEAE	5.	1495.47	4.10
DIATOMACEAE	51.	15253.80	41.80
CYANOPHYTA	37.	11066.48	30.33
UNKNOWN FLAGELLATE	1.	299.09	.82
UNKNOWN UNICELLULA	3.	897.28	2.46
TOTALS	122.	36489.48	100.00

TAXA IN SAMPLE 23

DIVERSITY CALCULATED IN LOG BASE 2

SHANNONS DIVERSITY 3.5963 EVENNESS .7950 REDUNDANCY .2054

MAX. DIVERSITY 4.5236 MIN. DIVERSITY .0100 INFORMATIONAL CONTENT .13123+06

GENERAL MOTORS PERIPHYTON DATA TABLE

SAMPLE NO. 2 SEPTEMBER 2, 1981, 1130 HOURS

COLLECTED AT LOCATION: D-PLEASANT R, STATION 1 , DEPTH RANGE FROM SURFACE TO .000000#

TAXONOMIC IDENTIFICATION		NO. COUNTED	ORGANISMS PER CM2
EUGLENOPHYTA		2.	253.68
EUGLENALES			
EUGLENA	SPECIES	2.	253.68
PHACUS	SPECIES	6.	761.05
TRACHELOMONAS	SPECIES	2.	253.68
PYRRHOPHYTA			
DINOKONTAE			
GYMNODINIUM	SPECIES	1.	126.84
DIATOMACEAE			
PENNALES			
SYNEDRA	ULNA	2.	253.68
ACHNANTHES	SPECIES	4.	532.73
ACHNANTHES	LANCEOLATA	6.	748.36
ACHNANTHES	LINEARIS	41.	5149.74
CALONEIS	SPECIES	1.	101.47
GYROSIGMA	SPECIES	3.	380.52
NAVICULA	SPECIES	2.	215.63
NAVICULA	CRYPTOCEPHALA	3.	317.10
NAVICULA	TRIPUNCTATA	2.	215.63
NEIDIUM	DUBIUM	1.	101.47
AMPHORA	PERPUSILLA	6.	748.36
CYMBELLA	AFFINIS	1.	101.47
DENTICULA	TENUIS	1.	101.47
NITZSCHIA	DISSIPATA	1.	126.84
NITZSCHIA	PALEA	7.	887.89
DIPLONEIS	PUELLA	1.	126.84
CYANOPHYTA			
CHROOCOCCALES			
CHROOCOCCUS	SPECIES	7.	887.89
CHROOCOCCUS	MINOR	9.	1141.57
OSCILLATORIALES			
PHORMIDIUM	SPECIES	24.	3044.18
UNIDENTIFIED ALGAE			
FLAGELLATED			
5 TO 10 MICRONS		1.	126.84
UNICELLULAR			
5 TO 10 MICRONS		2.	253.68

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL ORGANISMS PER CM2	PERCENT
EUGLENOPHYTA	12.	1522.09	8.84

GENERAL MOTORS PERIPHYTON DATA TABLE

SAMPLE NO. 2 SEPTEMBER 2, 1981, 1130 HOURS

COLLECTED AT LOCATION: D-PLEASANT R, STATION 1 , DEPTH RANGE FROM SURFACE TO .0aaaaaa

TAXONOMIC IDENTIFICATION NO. COUNTED ORGANISMS PER CM2

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL ORGANISMS PER CM2	PERCENT
PYRRHOPHYTA	1.	126.84	.74
DIATOMACEAE	80.	10109.22	58.73
CYANOPHYTA	40.	5073.64	29.48
UNKNOWN FLAGELLATE	1.	126.84	.74
UNKNOWN UNICELLULA	2.	253.68	1.47
TOTALS	136.	17212.32	100.00

TAXA IN SAMPLE 26

DIVERSITY CALCULATED IN LOG BASE 2

SHANNONS DIVERSITY 3.6291 EVENNESS .7721 REDUNDANCY .2290

MAX. DIVERSITY 4.7004 MIN. DIVERSITY .0225 INFORMATIONAL CONTENT .62465+05

GENERAL MOTORS PERIPHYTON DATA TABLE

SAMPLE NO. 3 SEPTEMBER 2, 1981, 1130 HOURS

COLLECTED AT LOCATION: D-PLEASANT R, STATION 1 , DEPTH RANGE FROM SURFACE TO .000000M

TAXONOMIC IDENTIFICATION		NO. COUNTED	ORGANISMS PER CM2
CHLOROPHYTA		1.	213.45
TETRASPORALES			
GLOEOCYSTIS	SPECIES	1.	213.45
DIATOMACEAE			
PENNALES			
DIATOMA	VULGARE	11.	2411.99
ACHNANTHES	LINEARIS	104.	22241.54
GYROSIGMA	SPECIES	1.	213.45
NAVICULA	CRYPTOCEPHALA	6.	1280.70
NAVICULA	RHYNCHOCEPHALA	1.	234.80
AMPHORA	PERPUSILLA	18.	3863.45
CYMBELLA	SINUATA	2.	490.94
NITZSCHIA	DISSIPATA	3.	640.35
NITZSCHIA	PALEA	3.	640.35
DIPLONEIS	PUELLA	2.	426.90
CYANOPHYTA			
CHROOCOCCALES			
CHROOCOCCUS	SPECIES	2.	426.90
OSCILLATORIALES			
OSCILLATORIA	SPECIES	2.	426.90
PHORMIDIUM	SPECIES	17.	3628.66
UNIDENTIFIED ALGAE			
UNICELLULAR			
5 TO 10 MICRONS		1.	213.45

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL ORGANISMS PER CM2	PERCENT
CHLOROPHYTA	2.	426.90	1.14
DIATOMACEAE	152.	32444.47	86.36
CYANOPHYTA	21.	4482.46	11.93
UNKNOWN UNICELLULA	1.	213.45	.57
TOTALS	176.	37567.28	100.00

TAXA IN SAMPLE 16

GENERAL MOTORS PERIPHYTON DATA TABLE

SAMPLE NO. 3 SEPTEMBER 2, 1981, 1130 HOURS

COLLECTED AT LOCATION: D-PLEASANT R, STATION 1 , DEPTH RANGE FROM SUPFACE TO .000000M

TAXONOMIC IDENTIFICATION	NO. COUNTED	ORGANISMS PER CM2

DIVERSITY CALCULATED IN LOG BASE 2

SHANNONS DIVERSITY	2.2489	EVENNESS	.5622	REDUNDANCY	.4385
MAX. DIVERSITY	4.0000	MIN. DIVERSITY	.0066	INFORMATIONAL CONTENT	.84487+05

GENERAL MOTORS PERIPHYTON DATA TABLE

SAMPLE NO. 4 SEPTEMBER 2, 1981, 1130 HOURS

COLLECTED AT LOCATION: D-PLEASANT R, STATION 1 , DEPTH RANGE FROM SURFACE TO .000000M

TAXONOMIC IDENTIFICATION		NO. COUNTED	ORGANISMS PER CM2
CHLOPOPHYTA		1.	89.23
EUGLENOPHYTA		2.	178.47
EUGLENALES			
EUGLENA	SPECIES	2.	178.47
PHACUS	SPECIES	1.	89.23
DIATOMACEAE			
CENTRALES			
CYCLOTELLA	MENEGHINIANA	1.	89.23
PENNALES		1.	62.46
ACHNANTHES	LANCEOLATA	3.	312.31
ACHNANTHES	LINEARIS	58.	5157.64
COCCONEIS	PLACENTULA	1.	62.46
NAVICULA	SPECIES	1.	124.93
NAVICULA	CRYPTOCEPHALA	2.	187.39
AMPHORA	SPECIES	8.	758.48
AMPHORA	PERPUSILLA	6.	499.70
AMPHORA	SUBMONTANA	3.	249.85
DENTICULA	TENUIS	1.	62.46
NITZSCHIA	SPECIES	1.	124.93
NITZSCHIA	DISSIPATA	1.	89.23
NITZSCHIA	PALEA	2.	178.47
DIPLONEIS	PUELLA	1.	62.46
CYANOPHYTA			
CHROOCOCCALES			
CHROOCOCCUS	SPECIES	8.	713.86
OSCILLATORIALES			
OSCILLATORIA	SPECIES	1.	89.23
PHORMIDIUM	SPECIES	5.	446.16
UNIDENTIFIED ALGAE			
FLAGELLATED			
5 TO 10 MICRONS		1.	89.23
UNICELLULAR			
5 TO 10 MICRONS		2.	178.47

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL ORGANISMS PER CM2	PERCENT
CHLOPOPHYTA	1.	89.23	.89
EUGLENOPHYTA	5.	446.16	4.43

TABLE

GENERAL MOTORS PERIPHYTON DATA SEPTEMBER 2, 1981, 1130 HOURS

SAMPLE NO. 4

COLLECTED AT LOCATION: D-PLEASANT R, STATION 1 , DEPTH RANGE FROM SURFACE TO .0@@@@@#

TAXONOMIC IDENTIFICATION NO. COUNTED ORGANISMS PER CM2

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL ORGANISMS PER CM2	PERCENT
DIATOMACEAE	90.	8022.00	79.63
CYANOPHYTA	14.	1249.26	12.40
UNKNOWN FLAGELLATE	1.	89.23	.89
UNKNOWN UNICELLULA	2.	178.47	1.77
TOTALS	113.	10074.35	100.00

TAXA IN SAMPLE 24

DIVERSITY CALCULATED IN LOG BASE 2
SHANNONS DIVERSITY 2.9684 EVENNESS .6474 REDUNDANCY .3552
MAX. DIVERSITY 4.5950 MIN. DIVERSITY .0337 INFORMATIONAL CONTENT .29904+05

GENERAL MOTORS PERIPHYTON DATA

TABLE

SAMPLE NO. 1

SEPTEMBER 1, 1981, 1118 HOURS

COLLECTED AT LOCATION: I-SALT CREEK, STATION 1 , DEPTH RANGE FROM SURFACE TO .000000M

TAXONOMIC IDENTIFICATION		NO. COUNTED	ORGANISMS PER CM2
CHLOROPHYTA		2.	240.76
TETRASPORALES			
GLOEOCYSTIS	SPECIES	5.	601.90
CHLOROCOCCALES			
COCYSTIS	PUSILLA	1.	120.38
EUGLENOPHYTA			
EUGLENALES			
EUGLENA	SPECIES	1.	120.38
DIATOMACEAE			
PENNALES			
ACHNANTHES	SPECIES	1.	144.46
ACHNANTHES	LINEARIS	2.	276.88
RHOICOSPHENIA	CURVATA	0.	48.15
GYROSIGMA	SPECIES	1.	120.38
NAVICULA	SPECIES	1.	144.46
NAVICULA	CRYPTOCEPHALA	1.	144.46
NAVICULA	TRIPUNCTATA	0.	48.15
AMPHORA	SPECIES	0.	48.15
AMPHORA	SUBMONTANA	0.	48.15
CYMBELLA	MINUTA	0.	48.15
NITZSCHIA	DISSIPATA	1.	96.30
NITZSCHIA	PALEA	1.	180.57
CYANOPHYTA			
CHROOCOCCALES			
CHROOCOCCUS	SPECIES	1.	120.38
OSCILLATORIALES			
OSCILLATORIA	SPECIES	4.	481.52
UNIDENTIFIED ALGAE			
UNICELLULAR			
5 TO 10 MICRONS		1.	120.38

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL ORGANISMS PER CM2	PERCENT
CHLOROPHYTA	8.	963.05	30.53
EUGLENOPHYTA	1.	120.38	3.82
DIATOMACEAE	11.	1348.26	42.75
CYANOPHYTA	5.	601.90	19.08
UNKNOWN UNICELLULA	1.	120.38	3.82
TOTALS	26.	3153.98	100.00

TAXA IN SAMPLE 19

GENERAL MOTORS PERIPHYTON DATA

TABLE

SAMPLE NO. 1

SEPTEMBER 1, 1981, 1118 HOURS

COLLECTED AT LOCATION: I-SALT CREEK, STATION 1 , DEPTH RANGE FROM SURFACE TO .000000#

TAXONOMIC IDENTIFICATION	NO. COUNTED	ORGANISMS PER CM2

DIVERSITY CALCULATED IN LOG BASE 2

SHANNONS DIVERSITY	3.8223	EVENNESS	.8998	REDUNDANCY	.1020
MAX. DIVERSITY	4.2479	MIN. DIVERSITY	.0745	INFORMATIONAL CONTENT	.12056+05

GENERAL MOTORS PERIPHYTON DATA TABLE

SAMPLE NO. 2 SEPTEMBER 1, 1981, 1118 HOURS

COLLECTED AT LOCATION: I-SALT CREEK, STATION 1 , DEPTH RANGE FROM SURFACE TO .0@@@@@#

TAXONOMIC IDENTIFICATION		NO. COUNTED	ORGANISMS PER CM2
EUGLENOPHYTA		3.	282.80
EUGLENALES			
LEPOCINCLIS	SPECIES	7.	659.87
DIATOMACEAE			
PENNALES		0.	28.28
ACHNANTHES	SPECIES	1.	47.13
ACHNANTHES	LINEARIS	1.	47.13
COCCONEIS	PLACENTULA	0.	28.28
NAVICULA	SPECIES	1.	122.55
NAVICULA	CRYPTOCEPHALA	1.	75.41
NAVICULA	PUPULA	0.	28.28
AMPHORA	SUBMONTANA	1.	47.13
DENTICULA	TENUIS	0.	28.28
NITZSCHIA	PALEA	0.	28.28
CYMATOPLEURA	SOLEA	1.	94.27
CYANOPHYTA			
CHROOCOCCALES			
CHROOCOCCUS	SPECIES	5.	471.34
OSCILLATORIALES			
OSCILLATORIA	SPECIES	4.	377.07
UNIDENTIFIED ALGAE			
FLAGELLATED			
LESS THAN 5 U		2.	188.53
UNICELLULAR			
5 TO 10 MICRONS		2.	188.53

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL ORGANISMS PER CM2	PERCENT
EUGLENOPHYTA	10.	942.67	34.36
DIATOMACEAE	6.	575.03	20.96
CYANOPHYTA	9.	848.40	30.93
UNKNOWN FLAGELLATE	2.	188.53	6.87
UNKNOWN UNICELLULA	2.	188.53	6.87
TOTALS	29.	2743.17	100.00

TAXA IN SAMPLE 17

GENERAL MOTORS PERIPHYTON DATA

TABLE

SAMPLE NO. 2

SEPTEMBER 1, 1981, 1118 HOURS

COLLECTED AT LOCATION: I-SALT CREEK, STATION 1 , DEPTH RANGE FROM SURFACE TO .000000#

TAXONOMIC IDENTIFICATION	NO. COUNTED	ORGANISMS PER CM2

DIVERSITY CALCULATED IN LOG BASE 2

SHANNONS DIVERSITY	3.3459	EVENNESS	.8186	REDUNDANCY	.1848
MAX. DIVERSITY	4.0875	MIN. DIVERSITY	.0750	INFORMATIONAL CONTENT	.91785+04

GENERAL MOTORS PERIPHYTON DATA TABLE

SAMPLE NO. 3 SEPTEMBER 1, 1981, 1118 HOURS

COLLECTED AT LOCATION: I-SALT CREEK, STATION 1 , DEPTH RANGE FROM SURFACE TO .0aaaaaN

TAXONOMIC IDENTIFICATION		NO. COUNTED	ORGANISMS PER CM2
CHLOROPHYTA			
VOLVOCALES			
CHLAMYDOMONAS	SPECIES	3.	359.80
EUGLENOPHYTA			
EUGLENALES			
EUGLENA	SPECIES	1.	119.93
LEPOCINCLIS	SPECIES	5.	599.67
TRACHELOMONAS	SPECIES	1.	119.93
CHRYSOPHYCEAE		1.	119.93
DIATOMACEAE			
CENTRALES			
MELOSIRA	DISTANS	2.	239.87
PENNALES			
ACHNANTHES	SPECIES	1.	131.93
ACHNANTHES	LINEARIS	1.	59.97
GYROSIGMA	SPECIES	1.	59.97
NAVICULA	SPECIES	0.	23.99
NAVICULA	CRYPTOCEPHALA	1.	59.97
NAVICULA	TRIPUNCTATA	1.	155.91
GOMPHONEMA	SPECIES	1.	71.96
GOMPHONEMA	PARVULUM	0.	23.99
AMPHORA	SPECIES	0.	23.99
CYMBELLA	SPECIES	1.	83.95
DENTICULA	TENUIS	2.	191.89
NITZSCHIA	SPECIES	0.	23.99
NITZSCHIA	DISSIPATA	0.	23.99
NITZSCHIA	PALEA	2.	227.87
CYANOPHYTA			
OSCILLATORIALES			
LYNGBYA	SPECIES	33.	3957.82
PHORMIDIUM	SPECIES	3.	359.80
UNIDENTIFIED ALGAE			
UNICELLULAR			
5 TO 10 MICRONS		1.	119.93

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL ORGANISMS PER CM2	PERCENT
CHLOROPHYTA	3.	359.80	5.03
EUGLENOPHYTA	7.	839.54	11.73
CHRYSOPHYCEAE	1.	119.93	1.68
DIATOMACEAE	12.	1403.23	19.60

TABLE

GENERAL MOTORS PERIPHYTON DATA — SEPTEMBER 1, 1981, — 1118 HOURS

SAMPLE NO. 3

COLLECTED AT LOCATION: I-SALT CREEK, STATION 1 , DEPTH RANGE FROM SURFACE TO .000000#

TAXONOMIC IDENTIFICATION — NO. COUNTED — ORGANISMS PER CM2

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL ORGANISMS PER CM2	PERCENT
CYANOPHYTA	36.	4317.62	60.30
UNKNOWN UNICELLULA	1.	119.93	1.68
TOTALS	60.	7160.05	100.00

TAXA IN SAMPLE 23

DIVERSITY CALCULATED IN LOG BASE 2

SHANNONS DIVERSITY	2.7431	EVENNESS	.6064	REDUNDANCY	.3974
MAX. DIVERSITY	4.5236	MIN. DIVERSITY	.0438	INFORMATIONAL CONTENT	.19641+05

GENERAL MOTORS PERIPHYTON DATA TABLE

SAMPLE NO. 4 SEPTEMBER 1, 1981, 1118 HOURS

COLLECTED AT LOCATION: I-SALT CREEK, STATION 1 , DEPTH RANGE FROM SURFACE TO .000000#

TAXONOMIC IDENTIFICATION		NO. COUNTED	ORGANISMS PER CM2
EUGLENOPHYTA		2.	148.18
EUGLENALES			
EUGLENA	SPECIES	1.	74.09
DIATOMACEAE			
PENNALES			
NAVICULA	CRYPTOCEPHALA	2.	148.18
NITZSCHIA	PALEA	3.	222.26
CYANOPHYTA			
CHROOCOCCALES			
CHROOCOCCUS	SPECIES	2.	148.18
OSCILLATORIALES			
LYNGBYA	SPECIES	58.	4297.08
OSCILLATORIA	SPECIES	1.	74.09
UNIDENTIFIED ALGAE			
UNICELLULAR			
5 TO 10 MICRONS		1.	74.09

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL ORGANISMS PER CM2	PERCENT
EUGLENOPHYTA	3.	222.26	4.29
DIATOMACEAE	5.	370.44	7.14
CYANOPHYTA	61.	4519.34	87.14
UNKNOWN UNICELLULA	1.	74.09	1.43
TOTALS	70.	5186.13	100.00

TAXA IN SAMPLE 8

DIVERSITY CALCULATED IN LOG BASE 2

SHANNONS DIVERSITY	1.1219	EVENNESS	.3740	REDUNDANCY	.6299
MAX. DIVERSITY	3.0000	MIN. DIVERSITY	.0186	INFORMATIONAL CONTENT	.58182+04

GENERAL MOTORS PERIPHYTON DATA

TABLE

SAMPLE NO. 1

SEPTEMBER 1, 1981, 930 HOURS

COLLECTED AT LOCATION: K-SALT CREEK, STATION 1 , DEPTH RANGE FROM SURFACE TO .0######

TAXONOMIC IDENTIFICATION		NO. COUNTED	ORGANISMS PER CM2
CHLOROPHYTA			
TETRASPORALES			
GLOEOCYSTIS	SPECIES	1.	61.18
CHLOROCOCCALES		1.	61.18
EUGLENOPHYTA		9.	550.61
EUGLENALES			
EUGLENA	SPECIES	1.	61.18
LEPOCINCLIS	SPECIES	14.	856.50
DIATOMACEAE			
PENNALES			
ACHNANTHES	MICROCEPHALA	17.	1040.03
RHOICOSPHENIA	CURVATA	1.	61.18
NAVICULA	SPECIES	2.	122.36
NAVICULA	CRYPTOCEPHALA	5.	305.89
GOMPHONEMA	TRUNCATUM	1.	61.18
NITZSCHIA	PALEA	1.	61.18
CYANOPHYTA			
CHROOCOCCALES			
CHROOCOCCUS	SPECIES	2.	122.36
OSCILLATORIALES			
LYNGBYA	SPECIES	28.	1712.99
OSCILLATORIA	SPECIES	2.	122.36
PHORMIDIUM	SPECIES	1.	61.18
UNIDENTIFIED ALGAE			
FLAGELLATED			
5 TO 10 MICRONS		1.	61.18

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL ORGANISMS PER CM2	PERCENT
CHLOROPHYTA	2.	122.36	2.30
EUGLENOPHYTA	24.	1468.28	27.59
DIATOMACEAE	27.	1651.82	31.03
CYANOPHYTA	33.	2018.89	37.93
UNKNOWN FLAGELLATE	1.	61.18	1.15
TOTALS	87.	5322.52	100.00

TAXA IN SAMPLE 16

GENERAL MOTORS PERIPHYTON DATA

TABLE

SAMPLE NO. 1 SEPTEMBER 1, 1981, 930 HOURS

COLLECTED AT LOCATION: K-SALT CREEK, STATION 1 , DEPTH RANGE FROM SURFACE TO .000000

TAXONOMIC IDENTIFICATION	NO. COUNTED	ORGANISMS PER CM2

DIVERSITY CALCULATED IN LOG BASE 2

SHANNONS DIVERSITY	2.9540	EVENNESS	.7385	REDUNDANCY	.2641
MAX. DIVERSITY	4.0000	MIN. DIVERSITY	.0389	INFORMATIONAL CONTENT	.15723+05

GENERAL MOTORS PERIPHYTON DATA

TABLE

SAMPLE NO. 2 SEPTEMBER 1, 1981, 930 HOURS

COLLECTED AT LOCATION: K-SALT CREEK, STATION 1 , DEPTH RANGE FROM SURFACE TO .0aaaaa#

TAXONOMIC IDENTIFICATION		NO. COUNTED	ORGANISMS PER CM2
EUGLENOPHYTA		1.	124.08
EUGLENALES			
LEPOCINCLIS	SPECIES	3.	372.24
DIATOMACEAE			
CENTRALES		2.	248.16
PENNALES			
ACHNANTHES	SPECIES	3.	310.20
GYROSIGMA	SPECIES	1.	124.08
NAVICULA	SPECIES	4.	459.10
NAVICULA	CRYPTOCEPHALA	1.	148.90
NAVICULA	TRIPUNCTATA	3.	310.20
PINNULARIA	SPECIES	1.	124.08
GOMPHONEMA	SPECIES	4.	459.10
GOMPHONEMA	PARVULUM	1.	148.90
AMPHORA	SUBMONTANA	1.	148.90
DENTICULA	TENUIS	1.	148.90
NITZSCHIA	SPECIES	1.	124.08
NITZSCHIA	PALEA	1.	124.08
SURIRELLA	OVATA	1.	148.90
CYANOPHYTA			
CHROOCOCCALES			
CHROOCOCCUS	SPECIES	3.	372.24
OSCILLATORIALES			
LYNGBYA	SPECIES	49.	6079.92
PHORMIDIUM	SPECIES	2.	248.16

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL ORGANISMS PER CM2	PERCENT
EUGLENOPHYTA	4.	496.32	4.85
DIATOMACEAE	24.	3027.55	29.61
CYANOPHYTA	54.	6700.32	65.53
TOTALS	82.	10224.19	100.00

TAXA IN SAMPLE 19

TABLE

GENERAL MOTORS PERIPHYTON DATA SEPTEMBER 1, 1981, 930 HOURS

SAMPLE NO. 2

COLLECTED AT LOCATION: K-SALT CREEK, STATION 1 , DEPTH RANGE FROM SURFACE TO .Caaaaa#

TAXONOMIC IDENTIFICATION	NO. COUNTED	ORGANISMS PER CM2

DIVERSITY CALCULATED IN LOG BASE 2

SHANNONS DIVERSITY	2.5929	EVENNESS	.6104	REDUNDANCY	.3920
MAX. DIVERSITY	4.2479	MIN. DIVERSITY	.0260	INFORMATIONAL CONTENT	.26510+05

TABLE

GENERAL MOTORS PERIPHYTON DATA SAMPLE NO. 3 SEPTEMBER 1, 1981, 930 HOURS

COLLECTED AT LOCATION: K-SALT CREEK, STATION 1 , DEPTH RANGE FROM SURFACE TO .0aaaaaa#

TAXONOMIC IDENTIFICATION		NO. COUNTED	ORGANISMS PER CM2
CHLOROPHYTA			
TETRASPORALES			
GLOEOCYSTIS	SPECIES	1.	142.09
EUGLENOPHYTA			
EUGLENALES			
LEPOCINCLIS	SPECIES	19.	2699.74
DIATOMACEAE			
CENTRALES		1.	142.09
PENNALES			
ACHNANTHES	SPECIES	2.	284.18
GYROSIGMA	SPECIES	1.	142.09
NAVICULA	SPECIES	2.	241.56
NAVICULA	CRYPTOCEPHALA	0.	56.84
NAVICULA	PUPULA	0.	56.84
NAVICULA	RHYNCHOCEPHALA	2.	298.39
NAVICULA	TRIPUNCTATA	4.	596.78
GOMPHONEMA	SPECIES	1.	113.67
GOMPHONEMA	PARVULUM	0.	56.84
CYMBELLA	AFFINIS	0.	56.84
NITZSCHIA	PALEA	4.	568.37
SURIRELLA	ANGUSTATA	0.	56.84
CYANOPHYTA			
CHROOCOCCALES			
CHROOCOCCUS	SPECIES	3.	426.27
OSCILLATORIALES			
PHORMIDIUM	SPECIES	7.	994.64

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL ORGANISMS PER CM2	PERCENT
CHLOROPHYTA	1.	142.09	2.05
EUGLENOPHYTA	19.	2699.74	38.93
DIATOMACEAE	19.	2671.32	38.52
CYANOPHYTA	10.	1420.92	20.49
TOTALS	49.	6934.07	100.00

TAXA IN SAMPLE 17

TABLE

GENERAL MOTORS PERIPHYTON DATA

SAMPLE NO. 3

SEPTEMBER 1, 1981, 930 HOURS

COLLECTED AT LOCATION: K-SALT CREEK, STATION 1 , DEPTH RANGE FROM SURFACE TO .000000#

TAXONOMIC IDENTIFICATION	NO. COUNTED	ORGANISMS PER CM2

DIVERSITY CALCULATED IN LOG BASE 2

SHANNONS DIVERSITY	3.0584	EVENNESS	.7482	REDUNDANCY	.2538
MAX. DIVERSITY	4.0875	MIN. DIVERSITY	.0328	INFORMATIONAL CONTENT	.21207+05

GENERAL MOTORS PERIPHYTON DATA

TABLE

SAMPLE NO. 4 SEPTEMBER 1, 1981, 930 HOURS

COLLECTED AT LOCATION: K-SALT CREEK, STATION 1 , DEPTH RANGE FROM SURFACE TO .000000M

TAXONOMIC IDENTIFICATION		NO. COUNTED	ORGANISMS PER CM2
CHLOROPHYTA			
VOLVOCALES		1.	99.70
CHLAMYDOMONAS	SPECIES	1.	99.70
EUGLENOPHYTA		6.	598.19
EUGLENALES			
EUGLENA	SPECIES	1.	99.70
LEPOCINCLIS	SPECIES	10.	996.98
DIATOMACEAE			
PENNALES			
ACHNANTHES	SPECIES	1.	49.85
RHOICOSPHENIA	CURVATA	1.	49.85
NAVICULA	TRIPUNCTATA	1.	49.85
GOMPHONEMA	SPECIES	1.	99.70
NITZSCHIA	PALEA	1.	49.85
CYANOPHYTA			
CHROOCOCCALES			
CHROOCOCCUS	SPECIES	1.	99.70
OSCILLATORIALES			
LYNGBYA	SPECIES	62.	6181.28

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL ORGANISMS PER CM2	PERCENT
CHLOROPHYTA	2.	199.40	2.35
EUGLENOPHYTA	17.	1694.87	20.00
DIATOMACEAE	3.	299.09	3.53
CYANOPHYTA	63.	6280.98	74.12
TOTALS	85.	8474.33	100.00

TAXA IN SAMPLE 12

DIVERSITY CALCULATED IN LOG BASE 2

SHANNONS DIVERSITY	1.5166	EVENNESS	.4230	REDUNDANCY	.5800
MAX. DIVERSITY	3.5850	MIN. DIVERSITY	.0188	INFORMATIONAL CONTENT	.12852+05

TABLE
MEAN, MINIMUM, AND MAXIMUM DENSITY OF PERIPHYTON SPECIES AND GROUPS WITH PERCENT COMPOSITION AND DIVERSITY
DATA COLLECTED SEPTEMBER 1-2, 1981 IN PLEASANT RUN ANDSALT CREEK

SPECIES NAME		STATION B-DISCHARGE 1 ORGANISMS PER CM2 MEAN	MIN.	MAX.	PERCENT	STATION C-PLEASANT R 1 ORGANISMS PER CM2 MEAN	MIN.	MAX.	PERCENT
CHLOROPHYTA									
CHLOROPHYTA		121.13	.00	484.53	.36	.00	.00	.00	.00
CHLAMYDOMONAS	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
GLOEOCYSTIS	SPECIES	304.46	.00	975.57	.91	5667.45	3126.02	8945.22	3.76
CHLOROCOCCALES		.00	.00	.00	.00	269.51	.00	687.28	.18
TETRAEDRON	MINIMUM	.00	.00	.00	.00	255.02	.00	1020.07	.17
OOCYSTIS	PUSILLA	.00	.00	.00	.00	.00	.00	.00	.00
SCENEDESMUS	SPECIES	.00	.00	.00	.00	1215.84	.00	4472.61	.81
SCENEDESMUS	ABUNDANS	.00	.00	.00	.00	544.54	.00	1490.87	.36
ULOTHRIX	SPECIES	.00	.00	.00	.00	343.64	.00	1374.56	.23
CHAETOPHORALES		.00	.00	.00	.00	3694.06	.00	8945.22	2.45
CLADOPHORA	GLOMERATA	405.59	.00	812.63	1.21	.00	.00	.00	.00
COSMARIUM	SPECIES	.00	.00	.00	.00	343.64	.00	1374.56	.23
TOTAL OF CHLOROPHYTA		831.18	.00	1300.76	2.48	12333.70	3907.52	23853.91	8.19
EUGLENOPHYTA									
EUGLENOPHYTA		273.50	.00	609.47	.82	343.64	.00	1374.56	.23
EUGLENA	SPECIES	223.16	.00	650.38	.67	.00	.00	.00	.00
LEPOCINCLIS	SPECIES	406.49	.00	1625.95	1.21	.00	.00	.00	.00
PHACUS	SPECIES	363.40	.00	1453.60	1.09	2404.17	687.28	3907.52	1.60
TRACHELOMONAS	SPECIES	162.59	.00	650.38	.49	687.28	.00	2749.12	.46
TOTAL OF EUGLENOPHYTA		1429.14	.00	2926.71	4.27	3435.09	2040.14	4810.96	2.28
PYRRHOPHYTA									
GYMNODINIUM	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00

TABLE
MEAN, MINIMUM, AND MAXIMUM DENSITY OF PERIPHYTON SPECIES AND GROUPS WITH PERCENT COMPOSITION AND DIVERSITY
DATA COLLECTED SEPTEMBER 1-2, 1981 IN PLEASANT RUN ANDSALT CREEK

SPECIES NAME		STATION B-DISCHARGE 1 ORGANISMS PER CM2 MEAN	MIN.	MAX.	PERCENT	STATION C-PLEASANT R 1 ORGANISMS PER CM2 MEAN	MIN.	MAX.	PERCENT
TOTAL OF PYRRHOPHYTA		.00	.00	.00	.00	.00	.00	.00	.00
CRYPTOPHYTA									
RHODOMONAS	SPECIES	128.87	.00	515.46	.38	.00	.00	.00	.00
TOTAL OF CRYPTOPHYTA		128.87	.00	515.46	.38	.00	.00	.00	.00
CHRYSOPHYCEAE									
CHRYSOPHYCEAE		362.53	.00	609.47	1.08	97.69	.00	390.75	.06
KEPHYRION	SPECIES	257.73	.00	1030.92	.77	372.72	.00	1490.87	.25
TOTAL OF CHRYSOPHYCEAE		620.26	.00	1546.38	1.85	470.41	.00	1490.87	.31
DIATOMACEAE									
CENTRALES		308.52	.00	1030.92	.92	.00	.00	.00	.00
MELOSIRA	DISTANS	.00	.00	.00	.00	.00	.00	.00	.00
CYCLOTELLA	MENEGHINIANA	.00	.00	.00	.00	859.10	.00	3436.40	.57
PENNALES		483.66	325.19	609.47	1.44	544.54	.00	1490.87	.36
DIATOMA	VULGARE	.00	.00	.00	.00	.00	.00	.00	.00
SYNEDRA	ULNA	.00	.00	.00	.00	171.82	.00	687.28	.11
ACHNANTHES	SPECIES	4234.50	515.46	10732.40	12.65	.00	.00	.00	.00
ACHNANTHES	LANCEOLATA	751.39	.00	1574.73	2.24	343.64	.00	1374.56	.23
ACHNANTHES	LINEARIS	1388.52	.00	3349.45	4.15	70206.92	.00	149086.93	46.61
ACHNANTHES	MINUTISSIMA	871.40	.00	1235.72	2.60	.00	.00	.00	.00
ACHNANTHES	MICROCEPHALA	.00	.00	.00	.00	.00	.00	.00	.00
COCCONEIS	PLACENTULA	.00	.00	.00	.00	510.03	.00	2040.14	.34

TABLE

MEAN, MINIMUM, AND MAXIMUM DENSITY OF PERIPHYTON SPECIES AND GROUPS WITH PERCENT COMPOSITION AND DIVERSITY
DATA COLLECTED SEPTEMBER 1-2, 1981 IN PLEASANT RUN ANDSALT CREEK

SPECIES NAME		STATION B-DISCHARGE 1 ORGANISMS PER CM2				STATION C-PLEASANT R 1 ORGANISMS PER CM2			
		MEAN	MIN.	MAX.	PERCENT	MEAN	MIN.	MAX.	PERCENT
RHOICOSPHENIA	CURVATA	.00	.00	.00	.00	.00	.00	.00	.00
CALONEIS	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
GYROSIGMA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
NAVICULA	SPECIES	50.79	.00	203.16	.15	255.02	.00	1020.07	.17
NAVICULA	CRYPTOCEPHALA	.00	.00	.00	.00	6106.72	1563.01	10309.20	4.05
NAVICULA	PUPULA	.00	.00	.00	.00	.00	.00	.00	.00
NAVICULA	RHYNCHOCEPHALA	.00	.00	.00	.00	.00	.00	.00	.00
NAVICULA	TRIPUNCTATA	.00	.00	.00	.00	.00	.00	.00	.00
NEIDIUM	DUBIUM	.00	.00	.00	.00	.00	.00	.00	.00
PINNULARIA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
GOMPHONEMA	SPECIES	4682.42	2061.84	9157.66	13.98	1344.09	.00	2981.74	.89
GOMPHONEMA	ANGUSTATUM	398.36	.00	1187.10	1.19	.00	.00	.00	.00
GOMPHONEMA	PARVULUM	1995.96	1030.92	2731.59	5.96	.00	.00	.00	.00
GOMPHONEMA	TRUNCATUM	.00	.00	.00	.00	.00	.00	.00	.00
AMPHORA	SPECIES	60.57	.00	242.27	.18	.00	.00	.00	.00
AMPHORA	PERPUSILLA	.00	.00	.00	.00	.00	.00	.00	.00
AMPHORA	SUBMONTANA	.00	.00	.00	.00	.00	.00	.00	.00
CYMBELLA	SPECIES	81.30	.00	325.19	.24	195.38	.00	781.50	.13
CYMBELLA	MICROCEPHALA	.00	.00	.00	.00	980.44	.00	2040.14	.65
CYMBELLA	MINUTA	60.57	.00	242.27	.18	398.22	.00	1490.87	.26
CYMBELLA	AFFINIS	.00	.00	.00	.00	1575.52	.00	3162.21	1.05
CYMBELLA	TUMIDA	.00	.00	.00	.00	204.01	.00	816.05	.14
CYMBELLA	SINUATA	.00	.00	.00	.00	.00	.00	.00	.00
DENTICULA	TENUIS	.00	.00	.00	.00	1398.21	.00	2061.84	.93
NITZSCHIA	SPECIES	558.52	.00	1546.38	1.67	255.02	.00	1020.07	.17
NITZSCHIA	APICULATA	81.30	.00	325.19	.24	.00	.00	.00	.00
NITZSCHIA	DISSIPATA	.00	.00	.00	.00	.00	.00	.00	.00
NITZSCHIA	FILIFORMIS	50.79	.00	203.16	.15	.00	.00	.00	.00
NITZSCHIA	LINEARIS	50.79	.00	203.16	.15	.00	.00	.00	.00
NITZSCHIA	PALEA	3395.57	1938.13	5670.06	10.14	1662.20	.00	3436.40	1.10
NITZSCHIA	FRUSTULUM	4610.26	2234.74	7216.44	13.77	.00	.00	.00	.00
CYMATOPLEURA	SOLEA	.00	.00	.00	.00	.00	.00	.00	.00
SURIRELLA	ANGUSTATA	683.60	.00	1218.95	2.04	.00	.00	.00	.00

TABLE
MEAN, MINIMUM, AND MAXIMUM DENSITY OF PERIPHYTON SPECIES AND GROUPS WITH PERCENT COMPOSITION AND DIVERSITY
DATA COLLECTED SEPTEMBER 1-2, 1981 IN PLEASANT RUN ANDSALT CREEK

SPECIES NAME		STATION B-DISCHARGE 1 ORGANISMS PER CM2 MEAN	MIN.	MAX.	PERCENT	STATION C-PLEASANT R 1 ORGANISMS PER CM2 MEAN	MIN.	MAX.	PERCENT
SURIRELLA	OVALIS	389.82	.00	1030.92	1.16	.00	.00	.00	.00
SURIRELLA	OVATA	510.95	203.16	1030.92	1.53	.00	.00	.00	.00
DIPLONEIS	PUELLA	.00	.00	.00	.00	269.51	.00	687.28	.18
TOTAL OF DIATOMACEAE		25699.54	18081.09	36291.48	76.75	87280.39	4689.02	165486.49	57.94
CYANOPHYTA									
CYANOPHYTA		128.87	.00	515.46	.38	.00	.00	.00	.00
CHROOCOCCUS	SPECIES	2958.66	1828.42	4552.65	8.84	14982.25	4298.27	26521.78	9.95
CHROOCOCCUS	MINOR	.00	.00	.00	.00	5717.00	.00	11926.95	3.80
MERISMOPEDIA	TENUISSIMA	128.87	.00	515.46	.38	.00	.00	.00	.00
DACTYLOCOCCOPSIS	SPECIES	.00	.00	.00	.00	97.69	.00	390.75	.06
LYNGBYA	SPECIES	.00	.00	.00	.00	6797.83	390.75	12240.82	4.51
OSCILLATORIA	SPECIES	50.79	.00	203.16	.15	814.05	.00	1490.87	.54
OSCILLATORIA	TENUIS	.00	.00	.00	.00	5394.59	.00	13417.82	3.58
PHORMIDIUM	SPECIES	391.86	.00	726.80	1.17	10996.66	.00	35780.86	7.30
NOSTOCALES		162.59	.00	650.38	.49	343.64	.00	1374.56	.23
TOTAL OF CYANOPHYTA		3821.64	2031.58	5528.22	11.41	45143.72	24054.81	84979.55	29.97
UNKNOWN FLAGELLATE									
LESS THAN 5 U		121.13	.00	484.53	.36	97.69	.00	390.75	.06
5 TO 10 MICRONS		179.65	.00	515.46	.54	255.02	.00	1020.07	.17
TOTAL OF UNKNOWN FLAGELLATE		300.79	.00	515.46	.90	352.71	.00	1020.07	.23
UNKNOWN UNICELLULA									
LESS THAN 5 U		257.73	.00	1030.92	.77	171.82	.00	687.28	.11

TABLE

MEAN, MINIMUM, AND MAXIMUM DENSITY OF PERIPHYTON SPECIES AND GROUPS WITH PERCENT COMPOSITION AND DIVERSITY
DATA COLLECTED SEPTEMBER 1-2, 1961 IN PLEASANT RUN ANDSALT CREEK

SPECIES NAME	STATION B-DISCHARGE 1 ORGANISMS PER CM2 MEAN	MIN.	MAX.	PERCENT	STATION C-PLEASANT R 1 ORGANISMS PER CM2 MEAN	MIN.	MAX.	PERCENT
5 TO 10 MICRONS	396.26	.00	975.57	1.18	1450.84	.00	2981.74	.96
TOTAL OF UNKNOWN UNICELLULA	653.99	.00	1030.92	1.95	1622.66	.00	2981.74	1.08
STATION MEAN TOTAL	33485.40			100.00	150638.63			100.00
TOTAL NUMBER OF SAMPLES	4				4			
NUMBER OF SPECIES	43				43			
MAXIMUM NUMBER OF SPECIES AT ALL STATIONS	83							
DIVERSITY CALCULATED IN LOG BASE 2								
SHANNONS DIVERSITY	3.7804				3.0160			
ASSOCIATED EVENNESS	.8419				.6834			
REDUNDANCY	.1584				.3168			

TABLE

MEAN, MINIMUM, AND MAXIMUM DENSITY OF PERIPHYTON SPECIES AND GROUPS WITH PERCENT COMPOSITION AND DIVERSITY
DATA COLLECTED SEPTEMBER 1-2, 1981 IN PLEASANT RUN ANDSALT CREEK

SPECIES NAME		STATION D-PLEASANT R 1 ORGANISMS PER CM2 MEAN	MIN.	MAX.	PERCENT	STATION I-SALT CREEK 1 ORGANISMS PER CM2 MEAN	MIN.	MAX.	PERCENT
CHLOROPHYTA									
CHLOROPHYTA		150.44	.00	299.09	.59	60.19	.00	240.76	1.32
CHLAMYDOMONAS	SPECIES	.00	.00	.00	.00	89.95	.00	359.80	1.97
GLOEOCYSTIS	SPECIES	352.46	.00	1196.38	1.39	150.48	.00	601.90	3.30
CHLOROCOCCALES		74.77	.00	299.09	.30	.00	.00	.00	.00
TETRAEDRON	MINIMUM	74.77	.00	299.09	.30	.00	.00	.00	.00
OOCYSTIS	PUSILLA	.00	.00	.00	.00	30.10	.00	120.38	.66
SCENEDESMUS	SPECIES	448.64	.00	1794.56	1.77	.00	.00	.00	.00
SCENEDESMUS	ABUNDANS	74.77	.00	299.09	.30	.00	.00	.00	.00
ULOTHRIX	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
CHAETOPHORALES		.00	.00	.00	.00	.00	.00	.00	.00
CLADOPHORA	GLOMERATA	.00	.00	.00	.00	.00	.00	.00	.00
COSMARIUM	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
TOTAL OF CHLOROPHYTA		1175.86	.00	4187.32	4.64	330.71	.00	963.05	7.25
EUGLENOPHYTA									
EUGLENOPHYTA		631.45	.00	2093.66	2.49	107.74	.00	282.80	2.36
EUGLENA	SPECIES	108.04	.00	253.68	.43	78.60	.00	120.38	1.72
LEPOCINCLIS	SPECIES	.00	.00	.00	.00	314.88	.00	659.87	6.90
PHACUS	SPECIES	212.57	.00	761.05	.84	.00	.00	.00	.00
TRACHELOMONAS	SPECIES	362.51	.00	1196.38	1.43	29.98	.00	119.93	.66
TOTAL OF EUGLENOPHYTA		1314.57	.00	3290.04	5.19	531.21	.00	942.67	11.65
PYRRHOPHYTA									
GYMNODINIUM	SPECIES	31.71	.00	126.84	.13	.00	.00	.00	.00

TABLE
MEAN, MINIMUM, AND MAXIMUM DENSITY OF PERIPHYTON SPECIES AND GROUPS WITH PERCENT COMPOSITION AND DIVERSITY
DATA COLLECTED SEPTEMBER 1-2, 1981 IN PLEASANT RUN ANDSALT CREEK

SPECIES NAME		STATION D-PLEASANT R 1 ORGANISMS PER CM2 MEAN	MIN.	MAX.	PERCENT	STATION I-SALT CREEK 1 ORGANISMS PER CM2 MEAN	MIN.	MAX.	PERCENT
TOTAL OF PYRRHOPHYTA		31.71	.00	126.84	.13	.00	.00	.00	.00
CRYPTOPHYTA									
RHODOMONAS	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
TOTAL OF CRYPTOPHYTA		.00	.00	.00	.00	.00	.00	.00	.00
CHRYSOPHYCEAE									
CHRYSOPHYCEAE		373.87	.00	1495.47	1.48	29.98	.00	119.93	.66
KEPHYRION	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
TOTAL OF CHRYSOPHYCEAE		373.87	.00	1495.47	1.48	29.98	.00	119.93	.66
DIATOMACEAE									
CENTRALES									
MELOSIRA	DISTANS	.00	.00	.00	.00	.00	.00	.00	.00
CYCLOTELLA	MENEGHINIANA	.00	.00	.00	.00	59.97	.00	239.87	1.31
PENNALES		22.31	.00	89.23	.09	.00	.00	.00	.00
DIATOMA	VULGARE	90.39	.00	299.09	.36	7.07	.00	28.28	.16
SYNEDRA	ULNA	603.00	.00	2411.99	2.38	.00	.00	.00	.00
ACHNANTHES	SPECIES	63.42	.00	253.68	.25	.00	.00	.00	.00
ACHNANTHES	LANCEOLATA	133.18	.00	532.73	.53	80.88	.00	144.46	1.77
ACHNANTHES	LINEARIS	265.17	.00	748.36	1.05	.00	.00	.00	.00
ACHNANTHES	MINUTISSIMA	10716.92	5149.74	22241.54	42.30	95.99	.00	276.88	2.10
ACHNANTHES	MICROCEPHALA	.00	.00	.00	.00	.00	.00	.00	.00
COCCONEIS	PLACENTULA	.00	.00	.00	.00	.00	.00	.00	.00
		15.62	.00	62.46	.06	7.07	.00	28.28	.16

TABLE

MEAN, MINIMUM, AND MAXIMUM DENSITY OF PERIPHYTON SPECIES AND GROUPS WITH PERCENT COMPOSITION AND DIVERSITY
DATA COLLECTED SEPTEMBER 1-2, 1981 IN PLEASANT RUN ANDSALT CREEK

SPECIES NAME		STATION D-PLEASANT R 1 ORGANISMS PER CM2				STATION I-SALT CREEK 1 ORGANISMS PER CM2			
		MEAN	MIN.	MAX.	PERCENT	MEAN	MIN.	MAX.	PERCENT
RHOICOSPHENIA	CURVATA	.00	.00	.00	.00	12.04	.00	48.15	.26
CALONEIS	SPECIES	25.37	.00	101.47	.10	.00	.00	.00	.00
GYROSIGMA	SPECIES	223.27	.00	380.52	.88	45.09	.00	120.38	.99
NAVICULA	SPECIES	85.14	.00	215.63	.34	72.75	.00	144.46	1.60
NAVICULA	CRYPTOCEPHALA	446.30	.00	1280.70	1.76	107.00	59.97	148.18	2.35
NAVICULA	PUPULA	.00	.00	.00	.00	7.07	.00	28.28	.16
NAVICULA	RHYNCHOCEPHALA	58.70	.00	234.80	.23	.00	.00	.00	.00
NAVICULA	TRIPUNCTATA	53.91	.00	215.63	.21	51.02	.00	155.91	1.12
NEIDIUM	DUBIUM	25.37	.00	101.47	.10	.00	.00	.00	.00
PINNULARIA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
GOMPHONEMA	SPECIES	.00	.00	.00	.00	17.99	.00	71.96	.39
GOMPHONEMA	ANGUSTATUM	.00	.00	.00	.00	.00	.00	.00	.00
GOMPHONEMA	PARVULUM	.00	.00	.00	.00	6.00	.00	23.99	.13
GOMPHONEMA	TRUNCATUM	.00	.00	.00	.00	.00	.00	.00	.00
AMPHORA	SPECIES	189.62	.00	758.48	.75	18.03	.00	48.15	.40
AMPHORA	PERPUSILLA	2063.00	499.70	3863.45	8.14	.00	.00	.00	.00
AMPHORA	SUBMONTANA	62.46	.00	249.85	.25	23.82	.00	48.15	.52
CYMBELLA	SPECIES	.00	.00	.00	.00	20.99	.00	83.95	.46
CYMBELLA	MICROCEPHALA	.00	.00	.00	.00	.00	.00	.00	.00
CYMBELLA	MINUTA	.00	.00	.00	.00	12.04	.00	48.15	.26
CYMBELLA	AFFINIS	25.37	.00	101.47	.10	.00	.00	.00	.00
CYMBELLA	TUMIDA	.00	.00	.00	.00	.00	.00	.00	.00
CYMBELLA	SINUATA	122.73	.00	490.94	.48	.00	.00	.00	.00
DENTICULA	TENUIS	115.76	.00	299.09	.46	55.04	.00	191.89	1.21
NITZSCHIA	SPECIES	31.23	.00	124.93	.12	6.00	.00	23.99	.13
NITZSCHIA	APICULATA	.00	.00	.00	.00	.00	.00	.00	.00
NITZSCHIA	DISSIPATA	214.11	.00	640.35	.85	30.07	.00	96.30	.66
NITZSCHIA	FILIFORMIS	.00	.00	.00	.00	.00	.00	.00	.00
NITZSCHIA	LINEARIS	.00	.00	.00	.00	.00	.00	.00	.00
NITZSCHIA	PALEA	576.22	178.47	887.89	2.27	164.75	28.28	227.87	3.61
NITZSCHIA	FRUSTULUM	.00	.00	.00	.00	.00	.00	.00	.00
CYMATOPLEURA	SOLEA	.00	.00	.00	.00	23.57	.00	94.27	.52
SURIRELLA	ANGUSTATA	.00	.00	.00	.00	.00	.00	.00	.00

TABLE
MEAN, MINIMUM, AND MAXIMUM DENSITY OF PERIPHYTON SPECIES AND GROUPS WITH PERCENT COMPOSITION AND DIVERSITY
DATA COLLECTED SEPTEMBER 1-2, 1981 IN PLEASANT RUN ANDSALT CREEK

SPECIES NAME		STATION D-PLEASANT R 1 ORGANISMS PER CM2 MEAN	MIN.	MAX.	PERCENT	STATION I-SALT CREEK 1 ORGANISMS PER CM2 MEAN	MIN.	MAX.	PERCENT
SURIRELLA	OVALIS	.00	.00	.00	.00	.00	.00	.00	.00
SURIRELLA	OVATA	.00	.00	.00	.00	.00	.00	.00	.00
DIPLONEIS	PUELLA	228.82	62.46	426.90	.90	.00	.00	.00	.00
TOTAL OF DIATOMACEAE		16457.37	8022.00	32444.47	64.96	924.24	370.44	1403.23	20.26
CYANOPHYTA									
CYANOPHYTA		.00	.00	.00	.00	.00	.00	.00	.00
CHROOCOCCUS	SPECIES	1553.99	426.90	4187.32	6.13	184.97	.00	471.34	4.06
CHROCOCCUS	MINOR	1257.45	.00	3888.22	4.96	.00	.00	.00	.00
MERISMOPEDIA	TENUISSIMA	.00	.00	.00	.00	.00	.00	.00	.00
DACTYLOCOCCOPSIS	SPECIES	74.77	.00	299.09	.30	.00	.00	.00	.00
LYNGBYA	SPECIES	74.77	.00	299.09	.30	2063.72	.00	4297.08	45.25
OSCILLATORIA	SPECIES	129.03	.00	426.90	.51	233.17	.00	481.52	5.11
OSCILLATORIA	TENUIS	.00	.00	.00	.00	.00	.00	.00	.00
PHORMIDIUM	SPECIES	2377.94	446.16	3628.66	9.39	89.95	.00	359.80	1.97
NOSTOCALES		.00	.00	.00	.00	.00	.00	.00	.00
TOTAL OF CYANOPHYTA		5467.96	1249.26	11066.48	21.58	2571.82	.00	4519.34	56.39
UNKNOWN FLAGELLATE									
LESS THAN 5 U		.00	.00	.00	.00	47.13	.00	188.53	1.03
5 TO 10 MICRONS		128.79	.00	299.09	.51	.00	.00	.00	.00
TOTAL OF UNKNOWN FLAGELLATE		128.79	.00	299.09	.51	47.13	.00	188.53	1.03
UNKNOWN UNICELLULA									
LESS THAN 5 U		.00	.00	.00	.00	.00	.00	.00	.00

TABLE

MEAN, MINIMUM, AND MAXIMUM DENSITY OF PERIPHYTON SPECIES AND GROUPS WITH PERCENT COMPOSITION AND DIVERSITY
DATA COLLECTED SEPTEMBER 1-2, 1981 IN PLEASANT RUN ANDSALT CREEK

SPECIES NAME	STATION D-PLEASANT R 1 ORGANISMS PER CM2 MEAN	MIN.	MAX.	PERCENT	STATION I-SALT CREEK 1 ORGANISMS PER CM2 MEAN	MIN.	MAX.	PERCENT
5 TO 10 MICRONS	385.72	178.47	897.28	1.52	125.73	74.09	188.53	2.76
TOTAL OF UNKNOWN UNICELLULA	385.72	178.47	897.28	1.52	125.73	74.09	188.53	2.76
STATION MEAN TOTAL	25335.85			100.00	4560.83			100.00
TOTAL NUMBER OF SAMPLES	4				4			
NUMBER OF SPECIES	45				37			
MAXIMUM NUMBER OF SPECIES AT ALL STATIONS	83							
DIVERSITY CALCULATED IN LOG BASE 2								
SHANNONS DIVERSITY	3.1107				2.7583			
ASSOCIATED EVENNESS	.6942				.6747			
REDUNDANCY	.3070				.3285			

TABLE

MEAN, MINIMUM, AND MAXIMUM DENSITY OF PERIPHYTON SPECIES AND GROUPS WITH PERCENT COMPOSITION AND DIVERSITY
DATA COLLECTED SEPTEMBER 1-2, 1981 IN PLEASANT RUN ANDSALT CREEK

STATION K-SALT CREEK 1
ORGANISMS PER CM2

SPECIES NAME		MEAN	MIN.	MAX.	PERCENT
CHLOROPHYTA					
CHLOROPHYTA		24.92	.00	99.70	.32
CHLAMYDOMONAS	SPECIES	24.92	.00	99.70	.32
GLOEOCYSTIS	SPECIES	50.82	.00	142.09	.66
CHLOROCOCCALES		15.29	.00	61.18	.20
TETRAEDRON	MINIMUM	.00	.00	.00	.00
OOCYSTIS	PUSILLA	.00	.00	.00	.00
SCENEDESMUS	SPECIES	.00	.00	.00	.00
SCENEDESMUS	ABUNDANS	.00	.00	.00	.00
ULOTHRIX	SPECIES	.00	.00	.00	.00
CHAETOPHORALES		.00	.00	.00	.00
CLADOPHORA	GLOMERATA	.00	.00	.00	.00
COSMARIUM	SPECIES	.00	.00	.00	.00
TOTAL OF CHLOROPHYTA		115.96	.00	199.40	1.50
EUGLENOPHYTA					
EUGLENOPHYTA		318.22	.00	598.19	4.11
EUGLENA	SPECIES	40.22	.00	99.70	.52
LEPOCINCLIS	SPECIES	1231.36	372.24	2699.74	15.91
PHACUS	SPECIES	.00	.00	.00	.00
TRACHELOMONAS	SPECIES	.00	.00	.00	.00
TOTAL OF EUGLENOPHYTA		1589.80	496.32	2699.74	20.54
PYRRHOPHYTA					
GYMNODINIUM	SPECIES	.00	.00	.00	.00

TABLE
MEAN, MINIMUM, AND MAXIMUM DENSITY OF PERIPHYTON SPECIES AND GROUPS WITH PERCENT COMPOSITION AND DIVERSITY
DATA COLLECTED SEPTEMBER 1-2, 1981 IN PLEASANT RUN ANDSALT CREEK

STATION K-SALT CREEK 1
ORGANISMS PER CM2

SPECIES NAME		MEAN	MIN.	MAX.	PERCENT
TOTAL OF PYRRHOPHYTA		.00	.00	.00	.00
CRYPTOPHYTA					
RHODOMONAS	SPECIES	.00	.00	.00	.00
TOTAL OF CRYPTOPHYTA		.00	.00	.00	.00
CHRYSOPHYCEAE					
CHRYSOPHYCEAE		.00	.00	.00	.00
KEPHYRION	SPECIES	.00	.00	.00	.00
TOTAL OF CHRYSOPHYCEAE		.00	.00	.00	.00
DIATOMACEAE					
CENTRALES		97.56	.00	248.16	1.26
MELOSIRA	DISTANS	.00	.00	.00	.00
CYCLOTELLA	MENEGHINIANA	.00	.00	.00	.00
PENNALES		.00	.00	.00	.00
DIATOMA	VULGARE	.00	.00	.00	.00
SYNEDRA	ULNA	.00	.00	.00	.00
ACHNANTHES	SPECIES	161.06	.00	310.20	2.08
ACHNANTHES	LANCEOLATA	.00	.00	.00	.00
ACHNANTHES	LINEARIS	.00	.00	.00	.00
ACHNANTHES	MINUTISSIMA	.00	.00	.00	.00
ACHNANTHES	MICROCEPHALA	260.01	.00	1040.03	3.36
COCCONEIS	PLACENTULA	.00	.00	.00	.00

TABLE

MEAN, MINIMUM, AND MAXIMUM DENSITY OF PERIPHYTON SPECIES AND GROUPS WITH PERCENT COMPOSITION AND DIVERSITY
DATA COLLECTED SEPTEMBER 1-2, 1981 IN PLEASANT RUN ANDSALT CREEK

STATION K-SALT CREEK 1
ORGANISMS PER CM2

SPECIES NAME		MEAN	MIN.	MAX.	PERCENT
RHOICOSPHENIA	CURVATA	27.76	.00	61.18	.36
CALONEIS	SPECIES	.00	.00	.00	.00
GYROSIGMA	SPECIES	66.54	.00	142.09	.86
NAVICULA	SPECIES	205.75	.00	459.10	2.66
NAVICULA	CRYPTOCEPHALA	127.91	.00	305.89	1.65
NAVICULA	PUPULA	14.21	.00	56.84	.18
NAVICULA	RHYNCHOCEPHALA	74.60	.00	298.39	.96
NAVICULA	TRIPUNCTATA	239.21	.00	596.78	3.09
NEIDIUM	DUBIUM	.00	.00	.00	.00
PINNULARIA	SPECIES	31.02	.00	124.08	.40
GOMPHONEMA	SPECIES	168.12	.00	459.10	2.17
GOMPHONEMA	ANGUSTATUM	.00	.00	.00	.00
GOMPHONEMA	PARVULUM	51.43	.00	148.90	.66
GOMPHONEMA	TRUNCATUM	15.29	.00	61.18	.20
AMPHORA	SPECIES	.00	.00	.00	.00
AMPHORA	PERPUSILLA	.00	.00	.00	.00
AMPHORA	SUBMONTANA	37.22	.00	148.90	.48
CYMBELLA	SPECIES	.00	.00	.00	.00
CYMBELLA	MICROCEPHALA	.00	.00	.00	.00
CYMBELLA	MINUTA	.00	.00	.00	.00
CYMBELLA	AFFINIS	14.21	.00	56.84	.18
CYMBELLA	TUMIDA	.00	.00	.00	.00
CYMBELLA	SINUATA	.00	.00	.00	.00
DENTICULA	TENUIS	37.22	.00	148.90	.48
NITZSCHIA	SPECIES	31.02	.00	124.08	.40
NITZSCHIA	APICULATA	.00	.00	.00	.00
NITZSCHIA	DISSIPATA	.00	.00	.00	.00
NITZSCHIA	FILIFORMIS	.00	.00	.00	.00
NITZSCHIA	LINEARIS	.00	.00	.00	.00
NITZSCHIA	PALEA	200.87	49.85	568.37	2.60
NITZSCHIA	FRUSTULUM	.00	.00	.00	.00
CYMATOPLEURA	SOLEA	.00	.00	.00	.00
SURIRELLA	ANGUSTATA	14.21	.00	56.84	.18

TABLE

MEAN, MINIMUM, AND MAXIMUM DENSITY OF PERIPHYTON SPECIES AND GROUPS WITH PERCENT COMPOSITION AND DIVERSITY
DATA COLLECTED SEPTEMBER 1-2, 1961 IN PLEASANT RUN ANDSALT CREEK

STATION K-SALT CREEK 1
ORGANISMS PER CM2

SPECIES NAME		MEAN	MIN.	MAX.	PERCENT
SURIRELLA	OVALIS	.00	.00	.00	.00
SURIRELLA	OVATA	37.22	.00	148.90	.48
DIPLONEIS	PUELLA	.00	.00	.00	.00
TOTAL OF DIATOMACEAE		1912.45	299.09	3027.55	24.71
CYANOPHYTA					
CYANOPHYTA		.00	.00	.00	.00
CHROOCOCCUS	SPECIES	255.14	99.70	426.27	3.30
CHROOCOCCUS	MINOR	.00	.00	.00	.00
MERISMOPEDIA	TENUISSIMA	.00	.00	.00	.00
DACTYLOCOCCOPSIS	SPECIES	.00	.00	.00	.00
LYNGEYA	SPECIES	3493.55	.00	6181.28	45.14
OSCILLATORIA	SPECIES	30.59	.00	122.36	.40
OSCILLATORIA	TENUIS	.00	.00	.00	.00
PHORMIDIUM	SPECIES	325.99	.00	994.64	4.21
NOSTOCALES		.00	.00	.00	.00
TOTAL OF CYANOPHYTA		4105.28	1420.92	6700.32	53.05
UNKNOWN FLAGELLATE					
LESS THAN 5 U		.00	.00	.00	.00
5 TO 10 MICRONS		15.29	.00	61.18	.20
TOTAL OF UNKNOWN FLAGELLATE		15.29	.00	61.18	.20
UNKNOWN UNICELLULA					
LESS THAN 5 U		.00	.00	.00	.00

TABLE
MEAN, MINIMUM, AND MAXIMUM DENSITY OF PERIPHYTON SPECIES AND GROUPS WITH PERCENT COMPOSITION AND DIVERSITY
DATA COLLECTED SEPTEMBER 1-2, 1981 IN PLEASANT RUN ANDSALT CREEK

STATION K-SALT CREEK 1
ORGANISMS PER CM2

SPECIES NAME	MEAN	MIN.	MAX.	PERCENT
5 TO 10 MICRONS	.00	.00	.00	.00
TOTAL OF UNKNOWN UNICELLULA	.00	.00	.00	.00
STATION MEAN TOTAL	7738.78			100.00
TOTAL NUMBER OF SAMPLES	4			
NUMBER OF SPECIES	33			
MAXIMUM NUMBER OF SPECIES AT ALL STATIONS	83			
DIVERSITY CALCULATED IN LOG BASE 2				
SHANNONS DIVERSITY	2.5305			
ASSOCIATED EVENNESS	.6300			
REDUNDANCY	.3725			

TABLE
MEAN, MINIMUM, AND MAXIMUM DENSITY OF PERIPHYTON SPECIES AND GROUPS WITH PERCENT COMPOSITION AND DIVERSITY
DATA COLLECTED SEPTEMBER 1-2, 1981 IN PLEASANT RUN ANDSALT CREEK

STATION K-SALT CREEK 1
ORGANISMS PER CM2

SPECIES NAME	MEAN	MIN.	MAX.	PERCENT
5 TO 10 MICRONS	.00	.00	.00	.00
TOTAL OF UNKNOWN UNICELLULA	.00	.00	.00	.00
STATION MEAN TOTAL	7738.78			100.00
TOTAL NUMBER OF SAMPLES	4			
NUMBER OF SPECIES	33			
MAXIMUM NUMBER OF SPECIES AT ALL STATIONS	83			
DIVERSITY CALCULATED IN LOG BASE 2				
SHANNONS DIVERSITY	2.5305			
ASSOCIATED EVENNESS	.6300			
REDUNDANCY	.3725			

TABLE

BENTHIC DATA FROM GENERAL MOTORS, BEDFORD, INDIANA — MAY 19, 1981, 1330 HOURS

SAMPLE NO. 2

COLLECTED AT LOCATION: C-PLEASANT R, STATION , DEPTH .2 M, SUBSTRATE ROCK, COBBLE, GRAVEL

PHYSICAL PARAMETERS:

	TEMPERATURE C	F	OXYGEN MG/L	PH
SURFACE	11.5	52.7	11.7	6.7

TAXONOMIC IDENTIFICATION			NO./SAMPLE	NUMBER/SQ M
PLATYHELMINTHES				
TURBELLARIA				
PLANARIIDAE			1.	10.76
ANNELIDA				
OLIGOCHAETA				
TUBIFICIDAE				
	UNIDENT. TUBIFICID WITH CAP. CHAETAE		1.	10.76
	UNIDENT. TUBIFICID WITHOUT CAP. CHAET		3.	32.28
NAIDIDAE				
	PRISTINA	IDRENSIS	2.	21.52
	SLAVINA	APPENDICULATA	1.	10.76
	NAIS	BRETSCHERI	1.	10.76
	NAIS	PARDALIS	1.	10.76
CRUSTACEA				
ISOPODA				
ASELLIDAE				
	LIRCEUS	FONTINALIS	11.	118.36
EPHEMEROPTERA				
CAENIDAE				
	CAENIS	SPECIES	2.	21.52
LEPTOPHLEBIIDAE				
	PARALEPTOPHLEBIA	SPECIES	2.	21.52
COLEOPTERA				
ELMIDAE				
	STENELMIS	SPECIES	8.	86.08
DIPTERA				
CHIRONOMIDAE				
CHIRONOMINAE				
	MICROTENDIPES	SPECIES	1.	10.76
	TANYTARSUS	SPECIES	2.	21.52
ORTHOCLADIINAE				
	CRICOTOPUS	SPECIES	11.	118.36
	RHEOCRICOTOPUS	SPECIES	1.	10.76

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL NUMBER/SQ M	PERCENT
MISCELLANEOUS	1.	10.76	2.08
TUBIFICIDAE	4.	43.04	8.33
NAIDIDAE	5.	53.80	10.42
CRUSTACEA	11.	118.36	22.92

TABLE

BENTHIC DATA FROM GENERAL MOTORS, BEDFORD, INDIANA — MAY 19, 1981, 1330 HOURS

SAMPLE NO. 2

COLLECTED AT LOCATION: E-PLEASANT R, STATION , DEPTH .2 M, SUBSTRATE ROCK, COBBLE, GRAVEL

PHYSICAL PARAMETERS:	TEMPERATURE C	F	OXYGEN MG/L	PH
SURFACE	11.5	52.7	11.7	6.7

TAXONOMIC IDENTIFICATION — NO./SAMPLE — NUMBER/SQ M

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL NUMBER/SQ M	PERCENT
EPHEMEROPTERA	4.	43.04	8.33
COLEOPTERA	8.	86.08	16.67
CHIRONOMIDAE	15.	161.40	31.25
TOTALS	48.	516.48	100.00

TAXA IN SAMPLE 15

DIVERSITY CALCULATED IN LOG BASE 2

SHANNONS DIVERSITY	3.2737	EVENNESS	.8277	REDUNDANCY	.1658
MAX. DIVERSITY	3.9069	MIN. DIVERSITY	.2829	INFORMATIONAL CONTENT	.16701+04

TABLE

BENTHIC DATA FROM GENERAL MOTORS, BEDFORD, INDIANA MAY 19, 1981, 1330 HOURS
SAMPLE NO. 3

COLLECTED AT LOCATION: C-PLEASANT R, STATION , DEPTH .2 M, SUBSTRATE ROCK, COBBLE, GRAVEL

PHYSICAL PARAMETERS:

	TEMPERATURE C	F	OXYGEN MG/L	PH
SURFACE	11.5	52.7	11.7	6.7

TAXONOMIC IDENTIFICATION			NO./SAMPLE	NUMBER/SQ M
PLATYHELMINTHES				
TURBELLARIA				
PLANARIIDAE			1.	10.76
NEMATODA			2.	21.52
ANNELIDA				
OLIGOCHAETA				
TUBIFICIDAE				
	LIMNODRILUS	HOFFMEISTERI	2.	21.52
	UNIDENT. TUBIFICID	WITH CAP. CHAETAE	1.	10.76
NAIDIDAE				
	PRISTINA	IDRENSIS	7.	75.32
	PRISTINA	FOREL I	1.	10.76
	SLAVINA	APPENDICULATA	16.	172.16
	NAIS	COMMUNIS	18.	193.68
	NAIS	PARDALIS	4.	43.04
ENCHYTRAEIDAE			1.	10.76
CRUSTACEA				
ISOPODA				
ASELLIDAE				
	LIRCEUS	FONTINALIS	188.	2022.88
AMPHIPODA				
GAMMARIDAE				
	CRANGONYX	SPECIES	1.	10.76
EPHEMEROPTERA				
BAETIDAE				
	BAETIS	SPECIES	2.	21.52
CAENIDAE				
	CAENIS	SPECIES	5.	53.80
LEPTOPHLEBIIDAE				
	PARALEPTOPHLEBIA	SPECIES	3.	32.28
SIPHLONURIDAE				
	ISONYCHIA	SPECIES	1.	10.76

TABLE

BENTHIC DATA FROM GENERAL MOTORS, PLDFORD, INDIANA — MAY 19, 1981, 1330 HOURS

SAMPLE NO. 3

COLLECTED AT LOCATION: C-PLEASANT R, STATION , DEPTH .2 M, SUBSTRATE ROCK, COBBLE, GRAVEL

PHYSICAL PARAMETERS:

	TEMPERATURE C	F	OXYGEN MG/L	PH
SURFACE	11.5	52.7	11.7	6.7

TAXONOMIC IDENTIFICATION			NO./SAMPLE	NUMBER/SQ M
TRICHOPTERA				
HYDROPSYCHIDAE			1.	10.76
COLEOPTERA				
ELMIDAE				
	STENELMIS	SPECIES	3.	32.28
PSEPHENIDAE				
	ECTOPRIA	NERVOSA	1.	10.76
	PSEPHUS	HERRICKI	1.	10.76
DIPTERA				
TIPULIDAE			1.	10.76
CHIRONOMIDAE				
TANYPODINAE				
	LARSIA	SPECIES	1.	10.76
CHIRONOMINAE				
	CHIRONOMUS	SPECIES	3.	32.28
	MICROTENDIPES	SPECIES	1.	10.76
	TANYTARSUS	SPECIES	5.	53.80
ORTHOCLADIINAE				
	PUPA		1.	10.76
	CORYNONEURA	SPECIES	1.	10.76
	CRICOTOPUS	SPECIES	21.	225.96
	EUKIEFFERIELLA	SPECIES	6.	64.56
MOLLUSCA				
GASTROPODA				
LYMNAEIDAE				
	LYMNAEA	SPECIES	2.	21.52

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL NUMBER/SQ M	PERCENT
MISCELLANEOUS	3.	32.28	1.00
TUBIFICIDAE	3.	32.28	1.00
NAIDIDAE	46.	494.96	15.28
OTHER ANNELIDA	1.	10.76	.33
CRUSTACEA	189.	2033.64	62.79
EPHEMEROPTERA	11.	118.36	3.65
TRICHOPTERA	1.	10.76	.33
COLEOPTERA	5.	53.80	1.66
DIPTERA GRP I	1.	10.76	.33
CHIRONOMIDAE	39.	419.64	12.96
GASTROPODA	2.	21.52	.66

TOTALS	391.	3238.76	100.00

TAXA IN SAMPLE 30

TABLE

BENTHIC DATA FROM GENERAL MOTORS, BEDFORD, INDIANA — MAY 19, 1981, 1330 HOURS
SAMPLE NO. 3

COLLECTED AT LOCATION: C-PLEASANT R, STATION , DEPTH .2 M, SUBSTRATE ROCK, COBBLE, GRAVEL

PHYSICAL PARAMETERS:	TEMPERATURE C	F	OXYGEN MG/L	PH
SURFACE	11.5	52.7	11.7	6.7

TAXONOMIC IDENTIFICATION	NO./SAMPLE	NUMBER/SQ M

DIVERSITY CALCULATED IN LOG BASE 2

SHANNONS DIVERSITY	2.4522	EVENNESS	.4997	REDUNDANCY	.5125
MAX. DIVERSITY	4.9069	MIN. DIVERSITY	.1173	INFORMATIONAL CONTENT	.79421+04

TABLE

BENTHIC DATA FROM GENERAL MOTORS, BEDFORD, INDIANA — MAY 19, 1981, 1330 HOURS

SAMPLE NO. 4

COLLECTED AT LOCATION: C-PLEASANT R, STATION , DEPTH .2 M, SUBSTRATE ROCK, COBBLE, GRAVEL

PHYSICAL PARAMETERS:

	TEMPERATURE C	F	OXYGEN MG/L	PH
SURFACE	11.5	52.7	11.7	6.7

TAXONOMIC IDENTIFICATION			NO./SAMPLE	NUMBER/SQ M
ANNELIDA				
OLIGOCHAETA				
NAIDIDAE				
	NAIS	COMMUNIS	1.	10.76
CRUSTACEA				
ISOPODA				
ASELLIDAE				
	LIRCEUS	FONTINALIS	12.	129.12
EPHEMEROPTERA				
CAENIDAE				
	CAENIS	SPECIES	4.	43.04
DIPTERA				
CHIRONOMIDAE				
CHIRONOMINAE				
	CHIRONOMUS	SPECIES	1.	10.76
	MICROTENDIPES	SPECIES	2.	21.52
	POLYPEDILUM	SPECIES	1.	10.76
	POLYPEDILUM	(SCALAENUM GROUP)	1.	10.76
	TANYTARSUS	SPECIES	3.	32.28
	RHEOTANYTARSUS	SPECIES	1.	10.76
ORTHOCLADIINAE				
	CRICOTOPUS	SPECIES	2.	21.52
	RHEOCRICOTOPUS	SPECIES	1.	10.76

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL NUMBER/SQ M	PERCENT
NAIDIDAE	1.	10.76	3.45
CRUSTACEA	12.	129.12	41.38
EPHEMEROPTERA	4.	43.04	13.79
CHIRONOMIDAE	12.	129.12	41.38
TOTALS	29.	312.04	100.00

TAXA IN SAMPLE 11

DIVERSITY CALCULATED IN LOG BASE 2

SHANNONS DIVERSITY	2.7968	EVENNESS	.8085	REDUNDANCY	.2105
MAX. DIVERSITY	3.4594	MIN. DIVERSITY	.3110	INFORMATIONAL CONTENT	.87271+03

TABLE

BENTHIC DATA FROM GENERAL MOTORS, BEDFORD, INDIANA — MAY 20, 1981, 1050 HOURS
SAMPLE NO. 1

COLLECTED AT LOCATION: D-PLEASANT R, STATION , DEPTH 1.0 M, SUBSTRATE GRAVEL, SAND, SILT

PHYSICAL PARAMETERS:

	TEMPERATURE C	F	OXYGEN MG/L	PH
SURFACE	12.0	53.6	11.2	6.9

TAXONOMIC IDENTIFICATION			NO./SAMPLE	NUMBER/SQ M
COELENTERATA				
HYDROZOA				
HYDRIDAE				
	HYDRA	SPECIES	2.	86.12
ANNELIDA				
OLIGOCHAETA				
NAIDIDAE				
	NAIS	PARDALIS	11.	473.66
EPHEMEROPTERA				
CAENIDAE				
	CAENIS	SPECIES	2.	86.12
DIPTERA				
CERATOPOGONIDAE			1.	43.06
CHIRONOMIDAE				
CHIRONOMINAE				
	CHIRONOMUS	SPECIES	13.	576.45
	MICROTENDIPES	SPECIES	5.	230.58
	STICTOCHIRONOMUS	SPECIES	8.	345.87
	TANYTARSUS	SPECIES	32.	1383.48
	LICROTENDIPES	SPECIES	5.	230.58
	CLADOTANYTARSUS	SPECIES	5.	230.58
ORTHOCLADIINAE				
	CRICOTOPUS	SPECIES	13.	576.45

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL NUMBER/SQ M	PERCENT
MISCELLANEOUS	2.	86.12	2.02
NAIDIDAE	11.	473.66	11.11
EPHEMEROPTERA	2.	86.12	2.02
DIPTERA CHF I	1.	43.06	1.01
CHIRONOMIDAE	83.	3573.98	83.84
TOTALS	99.	4262.94	100.00

TAXA IN SAMPLE 11

TABLE

BENTHIC DATA FROM GENERAL MOTORS, BEDFORD, INDIANA
SAMPLE NO. 1

MAY 20, 1981, 1050 HOURS

COLLECTED AT LOCATION: D-PLEASANT R, STATION , DEPTH 1.0 M, SUBSTRATE GRAVEL, SAND, SILT

PHYSICAL PARAMETERS:

	TEMPERATURE C	F	OXYGEN MG/L	PH
SURFACE	12.0	53.6	11.2	6.9

TAXONOMIC IDENTIFICATION	NO./SAMPLE	NUMBER/SQ M

DIVERSITY CALCULATED IN LOG BASE 2

SHANNONS DIVERSITY	2.5311	EVENNESS	.8473	REDUNDANCY	.1541
MAX. DIVERSITY	3.4594	MIN. DIVERSITY	.0317	INFORMATIONAL CONTENT	.12495+05

TABLE

BENTHIC DATA FROM GENERAL MOTORS, BEDFORD, INDIANA — MAY 20, 1981, 1050 HOURS

SAMPLE NO. 2

COLLECTED AT LOCATION: D-PLEASANT R, STATION , DEPTH 1.0 M, SUBSTRATE GRAVEL, SAND, SILT

PHYSICAL PARAMETERS:

	TEMPERATURE C	F	OXYGEN MG/L	PH
SURFACE	12.0	53.6	11.2	6.9

TAXONOMIC IDENTIFICATION			NO./SAMPLE	NUMBER/SQ M
NEMATODA			2.	86.12
ANNELIDA				
OLIGOCHAETA				
TUBIFICIDAE				
	LIMNODRILUS	HOFFMEISTERI	6.	258.36
	AULODRILUS	PIGUETI	2.	86.12
	UNIDENT. TUBIFICID	WITHOUT CAP. CHAET	6.	258.36
NAIDIDAE				
	NAIS	PARDALIS	8.	344.48
CRUSTACEA				
ISOPODA				
ASELLIDAE				
	LIRCEUS	FONTINALIS	6.	258.36
EPHEMEROPTERA				
CAENIDAE				
	CAENIS	SPECIES	8.	344.48
DIPTERA				
CHIRONOMIDAE				
TANYPODINAE				
	PROCLADIUS	SPECIES	12.	504.76
CHIRONOMINAE				
	CHIRONOMUS	SPECIES	129.	5552.35
	PARATENDIPES	SPECIES	12.	504.76
	STICTOCHIRONOMUS	SPECIES	70.	3028.55
	TANYTARSUS	SPECIES	152.	6561.87
	DICROTENDIPES	SPECIES	12.	504.76
	CLADOTANYTARSUS	SPECIES	23.	1009.52
ORTHOCLADIINAE				
	CRICOTOPUS	SPECIES	12.	504.76

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL NUMBER/SQ M	PERCENT
MISCELLANEOUS	2.	86.12	.43
TUBIFICIDAE	14.	602.84	3.04
NAIDIDAE	8.	344.48	1.74
CRUSTACEA	6.	258.36	1.30
EPHEMEROPTERA	8.	344.48	1.74
CHIRONOMIDAE	422.	18171.32	91.74
TOTALS	460.	19807.60	100.00

TAXA IN SAMPLE 15

TABLE

BENTHIC DATA FROM GENERAL MOTORS, BEDFORD, INDIANA — MAY 20, 1981, 1050 HOURS

SAMPLE NO. 2

COLLECTED AT LOCATION: D-PLEASANT R, STATION , DEPTH 1.0 M, SUBSTRATE GRAVEL, SAND, SILT

PHYSICAL PARAMETERS:

	TEMPERATURE C	F	OXYGEN MG/L	PH
SURFACE	12.0	53.6	11.2	6.9

TAXONOMIC IDENTIFICATION	NO./SAMPLE	NUMBER/SQ M

DIVERSITY CALCULATED IN LOG BASE 2

SHANNONS DIVERSITY	2.7217	EVENNESS	.6992	REDUNDANCY	.3017
MAX. DIVERSITY	3.8969	MIN. DIVERSITY	.0111	INFORMATIONAL CONTENT	.54108+05

TABLE

BENTHIC DATA FROM GENERAL MOTORS, BEDFORD, INDIANA — MAY 20, 1981, 1050 HOURS

SAMPLE NO. 3

COLLECTED AT LOCATION: D-PLEASANT R, STATION , DEPTH 1.0 M, SUBSTRATE GRAVEL, SAND, SILT

PHYSICAL PARAMETERS:

	TEMPERATURE C	F	OXYGEN MG/L	PH
SURFACE	12.C	53.6	11.2	6.9

TAXONOMIC IDENTIFICATION			NO./SAMPLE	NUMBER/SQ M
ANNELIDA				
OLIGOCHAETA				
TUBIFICIDAE				
	UNIDENT. TUBIFICID WITHOUT CAP. CHAET	.....	1.	43.06
NAIDIDAE				
	PRISTINA	IDRENSIS	2.	86.12
	NAIS	COMMUNIS	3.	129.18
	NAIS	PARDALIS	17.	732.02
CRUSTACEA				
ISOPODA				
ASELLIDAE				
	LIRCEUS	FONTINALIS	5.	215.30
EPHEMEROPTERA				
CAENIDAE				
	CAENIS	SPECIES	18.	775.08
DIPTERA				
CHIRONOMIDAE				
CHIRONOMINAE				
	CHIRONOMUS	SPECIES	40.	1725.84
	POLYPEDILUM	(SCALAENUM GROUP)	13.	575.28
	TANYTARSUS	SPECIES	67.	2876.41
	DICROTENDIPES	SPECIES	13.	575.28
ORTHOCLADIINAE				
	CRICOTOPUS	SPECIES	33.	1438.20
MOLLUSCA				
GASTROPODA				
PHYSIDAE				
	PHYSA	SPECIES	1.	43.06

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL NUMBER/SQ M	PERCENT
TUBIFICIDAE	1.	43.06	.47
NAIDIDAE	22.	947.32	10.28
CRUSTACEA	5.	215.30	2.34
EPHEMEROPTERA	18.	775.08	8.41
CHIRONOMIDAE	167.	7191.02	78.04
GASTROPODA	1.	43.06	.47
TOTALS	214.	9214.24	100.00

TAXA IN SAMPLE 12

TABLE

BENTHIC DATA FROM GENERAL MOTORS, BEDFORD, INDIANA
SAMPLE NO. 3

MAY 20, 1981, 1050 HOURS

COLLECTED AT LOCATION: D-PLEASANT R, STATION , DEPTH 1.0 M, SUBSTRATE GRAVEL, SAND, SILT

PHYSICAL PARAMETERS:

	TEMPERATURE C	F	OXYGEN MG/L	PH
SURFACE	12.0	53.6	11.2	6.9

TAXONOMIC IDENTIFICATION	NO./SAMPLE	NUMBER/SQ M

DIVERSITY CALCULATED IN LOG BASE 2

SHANNONS DIVERSITY	2.8238	EVENNESS	.7905	REDUNDANCY	.2106
MAX. DIVERSITY	3.5850	MIN. DIVERSITY	.0174	INFORMATIONAL CONTENT	.26113+05

TABLE

BENTHIC DATA FROM GENERAL MOTORS, BEDFORD, INDIANA — MAY 20, 1981, 1050 HOURS
SAMPLE NO. 4

COLLECTED AT LOCATION: D-PLEASANT R, STATION , DEPTH 1.0 M, SUBSTRATE GRAVEL, SAND, SILT

PHYSICAL PARAMETERS:

	TEMPERATURE C	F	OXYGEN MG/L	PH
SURFACE	12.0	53.6	11.2	6.9

TAXONOMIC IDENTIFICATION			NO./SAMPLE	NUMBER/SQ M
COELENTERATA				
HYDROZOA				
HYDRIDAE				
	HYDRA	SPECIES	12.	516.72
NEMATODA			2.	86.12
ANNELIDA				
OLIGOCHAETA				
TUBIFICIDAE				
	LIMNODRILUS	HOFFMEISTERI	6.	258.36
	UNIDENT. TUBIFICID	WITHOUT CAP. CHAET	8.	344.48
NAIDIDAE				
	DERO	DIGITATA	4.	172.24
	NAIS	COMMUNIS	2.	86.12
	NAIS	PARDALIS	36.	1550.16
ARACHNOIDEA				
HYDRACARINA			2.	86.12
EPHEMEROPTERA				
CAENIDAE				
	CAENIS	SPECIES	16.	688.96
DIPTERA				
CHIRONOMIDAE				
TANYPODINAE				
	PROCLADIUS	SPECIES	10.	428.50
CHIRONOMINAE				
	CHIRONOMUS	SPECIES	30.	1285.50
	CRYPTOCHIRONOMUS	SPECIES	10.	428.50
	PARACLADOPELMA	SPECIES	10.	428.50
	STICTOCHIRONOMUS	SPECIES	30.	1285.50
	TANYTARSUS	SPECIES	259.	11140.99
	DICROTENDIPES	SPECIES	30.	1285.50
	CLADOTANYTARSUS	SPECIES	10.	428.50
	STEMPELLINELLA	SPECIES	10.	428.50

TABLE

BENTHIC DATA FROM GENERAL MOTORS, BEDFORD, INDIANA — MAY 20, 1981, 1050 HOURS

SAMPLE NO. 4

COLLECTED AT LOCATION: D-PLEASANT R, STATION , DEPTH 1.0 M, SUBSTRATE GRAVEL, SAND, SILT

PHYSICAL PARAMETERS:

	TEMPERATURE C	F	OXYGEN MG/L	PH
SURFACE	12.C	53.6	11.2	6.9

TAXONOMIC IDENTIFICATION				NO./SAMPLE	NUMBER/SQ M
ORTHOCLADIINAE					
	CRICOTOPUS	SPECIES	.....	10.	428.50
MOLLUSCA					
PELECYPODA					
SPHAERIIDAE					
	SPHAERIUM	STRIATINIUM	.....	6.	258.36

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL NUMBER/SQ M	PERCENT
MISCELLANEOUS	14.	602.84	2.79
TUBIFICIDAE	14.	602.84	2.79
NAIDIDAE	42.	1808.52	8.37
HYDRACARINA	2.	86.12	.40
EPHEMEROPTERA	16.	686.96	3.19
CHIRONOMIDAE	408.	17568.48	81.27
PELECYPODA	6.	258.36	1.20
TOTALS	502.	21616.12	100.00

TAXA IN SAMPLE 20

DIVERSITY CALCULATED IN LOG BASE 2

SHANNONS DIVERSITY	2.8506	EVENNESS	.6596	REDUNDANCY	.3415
MAX. DIVERSITY	4.3219	MIN. DIVERSITY	.0139	INFORMATIONAL CONTENT	.61618+05

TABLE

BENTHIC DATA FROM GENERAL MOTORS, BEDFORD, INDIANA
SAMPLE NO. 1

MAY 20, 1981, 900 HOURS

COLLECTED AT LOCATION: E-PLEASANT R, STATION , DEPTH 1.0 M, SUBSTRATE GRAVEL, SAND

PHYSICAL PARAMETERS:

	TEMPERATURE C	F	OXYGEN MG/L	PH
SURFACE	10.8	51.4	10.5	7.3

TAXONOMIC IDENTIFICATION			NO./SAMPLE	NUMBER/SQ M
ANNELIDA				
OLIGOCHAETA				
TUBIFICIDAE				
	LIMNODRILUS	HOFFMEISTERI	1.	43.06
	UNIDENT. TUBIFICID	WITHOUT CAP. CHAET.....	4.	172.24
NAIDIDAE				
	NAIS	PARDALIS	1.	43.06
DIPTERA				
CHIRONOMIDAE				
TANYPODINAE				
	THIENEMANNIMYIA	GROUP	1.	43.06
CHIRONOMINAE				
	CHIRONOMUS	SPECIES	3.	129.18
	POLYPEDILUM	(CONVICTUM GROUP)	1.	43.06
	TANYTARSUS	SPECIES	6.	258.36
	DICROTENDIPES	SPECIES	3.	129.18
	CONSTEMPELLINA	SPECIES	1.	43.06
ORTHOCLADIINAE				
	CRICOTOPUS	SPECIES	29.	1248.74

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL NUMBER/SQ M	PERCENT
TUBIFICIDAE	5.	215.30	10.00
NAIDIDAE	1.	43.06	2.00
CHIRONOMIDAE	44.	1894.64	88.00
TOTALS	50.	2153.00	100.00

TAXA IN SAMPLE 10

DIVERSITY CALCULATED IN LOG BASE 2
SHANNONS DIVERSITY 2.1693 EVENNESS .6520 REDUNDANCY .3536
MAX. DIVERSITY 3.3219 MIN. DIVERSITY .0523 INFORMATIONAL CONTENT .46630+04

TABLE

BENTHIC DATA FROM GENERAL MOTORS, BEDFORD, INDIANA — MAY 20, 1981, 900 HOURS

SAMPLE NO. 2

COLLECTED AT LOCATION: E-PLEASANT R, STATION , DEPTH 1.0 M, SUBSTRATE GRAVEL, SAND

PHYSICAL PARAMETERS:

	TEMPERATURE C	F	OXYGEN MG/L	PH
SURFACE	10.8	51.4	10.5	7.3

TAXONOMIC IDENTIFICATION			NO./SAMPLE	NUMBER/SQ M
NEMATODA			2.	86.12
ANNELIDA				
OLIGOCHAETA				
TUBIFICIDAE				
	LIMNODRILUS	HOFFMEISTERI	128.	5526.03
	LIMNODRILUS	UDEKEMIANUS	9.	368.40
	UNIDENT. TUBIFICID	WITHOUT CAP. CHAET	154.	6631.24
EPHEMEROPTERA				
CAENIDAE				
	CAENIS	SPECIES	2.	86.12
DIPTERA				
CHIRONOMIDAE				
CHIRONOMINAE				
	MICROTENDIPES	SPECIES	5.	206.07
	TANYTARSUS	SPECIES	5.	206.07
	DICROTENDIPES	SPECIES	38.	1648.58
ORTHOCLADIINAE				
	CRICOTOPUS	SPECIES	81.	3503.24
	HETEROTRISSOCLAD.	SPECIES	5.	206.07

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL NUMBER/SQ M	PERCENT
MISCELLANEOUS	2.	86.12	.47
TUBIFICIDAE	291.	12525.68	67.82
EPHEMEROPTERA	2.	86.12	.47
CHIRONOMIDAE	134.	5770.04	31.24
TOTALS	429.	18467.95	100.00

TAXA IN SAMPLE 10

DIVERSITY CALCULATED IN LOG BASE 2

SHANNONS DIVERSITY	2.2195	EVENNESS	.0661	REDUNDANCY	.3326
MAX. DIVERSITY	3.3219	MIN. DIVERSITY	.0076	INFORMATIONAL CONTENT	.40990+05

TABLE

BENTHIC DATA FROM GENERAL MOTORS, OLDFORD, INDIANA — MAY 20, 1981, 900 HOURS

SAMPLE NO. 2

COLLECTED AT LOCATION: E-PLEASANT R, STATION , DEPTH 1.0 M, SUBSTRATE GRAVEL, SAND

PHYSICAL PARAMETERS:

	TEMPERATURE C	F	OXYGEN MG/L	PH
SURFACE	10.8	51.4	10.5	7.3

TAXONOMIC IDENTIFICATION			NO./SAMPLE	NUMBER/SQ M
NEMATODA			3.	129.18
ANNELIDA				
OLIGOCHAETA				
TUBIFICIDAE				
	LIMNODRILUS	HOFFMEISTERI	20.	880.34
	LIMNODRILUS	UDEKEMIANUS	2.	73.36
	UNIDENT. TUBIFICID	WITHOUT CAP. CHAET	29.	1247.15
DIPTERA				
CHIRONOMIDAE				
CHIRONOMINAE				
	CHIRONOMUS	SPECIES	1.	43.06
	TANYTARSUS	SPECIES	1.	43.06
	DICROTENDIPES	SPECIES	4.	172.24
ORTHOCLADIINAE				
	CRICOTOPUS	SPECIES	4.	172.24
	PARAKIEFFERIELLA	SPECIES	2.	86.12

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL NUMBER/SQ M	PERCENT
MISCELLANEOUS	3.	129.18	4.54
TUBIFICIDAE	51.	2200.84	77.31
CHIRONOMIDAE	12.	516.72	18.15
TOTALS	66.	2846.74	100.00

TAXA IN SAMPLE 6

DIVERSITY CALCULATED IN LOG BASE 2

SHANNONS DIVERSITY	1.2090	EVENNESS	.6969	REDUNDANCY	.3066
MAX. DIVERSITY	2.1699	MIN. DIVERSITY	.0363	INFORMATIONAL CONTENT	.62886+04

TABLE

BENTHIC DATA FROM GENERAL MOTORS, BEDFORD, INDIANA — MAY 20, 1981, 900 HOURS
SAMPLE NO. 4

COLLECTED AT LOCATION: E-PLEASANT R, STATION , DEPTH 1.0 M, SUBSTRATE GRAVEL, SAND

PHYSICAL PARAMETERS:

	TEMPERATURE C	F	OXYGEN MG/L	PH
SURFACE	10.8	51.4	10.5	7.3

TAXONOMIC IDENTIFICATION			NO./SAMPLE	NUMBER/SQ M
NEMATODA			1.	43.06
ANNELIDA				
OLIGOCHAETA				
TUBIFICIDAE				
	LIMNODRILUS	HOFFMEISTERI	79.	3406.52
	LIMNODRILUS	UDEKEMIANUS	5.	212.91
	UNIDENT. TUBIFICID	WITH CAP. CHAETAE	5.	212.91
	UNIDENT. TUBIFICID	WITHOUT CAP. CHAET	114.	4896.88
COLEOPTERA				
ELMIDAE				
	STENELMIS	SPECIES	1.	43.06
DIPTERA				
CHIRONOMIDAE				
TANYPODINAE				
	PROCLADIUS	SPECIES	2.	86.12
CHIRONOMINAE				
	CHIRONOMUS	SPECIES	2.	86.12
	TANYTARSUS	SPECIES	1.	43.06
	DICROTENDIPES	SPECIES	2.	86.12
ORTHOCLADIINAE				
	CRICOTOPUS	SPECIES	8.	344.48

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL NUMBER/SQ M	PERCENT
MISCELLANEOUS	1.	43.06	.46
TUBIFICIDAE	203.	8729.22	92.26
COLEOPTERA	1.	43.06	.46
CHIRONOMIDAE	15.	645.90	6.83
TOTALS	220.	9461.24	100.00

TAXA IN SAMPLE 11

DIVERSITY CALCULATED IN LOG BASE e

SHANNONS DIVERSITY	1.7241	EVENNESS	.5013	REDUNDANCY	.5010
MAX. DIVERSITY	3.4594	MIN. DIVERSITY	.0155	INFORMATIONAL CONTENT	.16407+05

TABLE

BENTHIC DATA FROM GENERAL MOTORS, ELDFORD, INDIANA — MAY 19, 1981, 1150 HOURS
SAMPLE NO. 1

COLLECTED AT LOCATION: E-PLEASANT R, STATION , DEPTH 1.0 M, SUBSTRATE SAND, CLAY

PHYSICAL PARAMETERS:

	TEMPERATURE C	F	OXYGEN MG/L	PH
SURFACE	11.5	52.7	11.0	7.6

TAXONOMIC IDENTIFICATION			NO./SAMPLE	NUMBER/SQ M
ANNELIDA				
OLIGOCHAETA				
TUBIFICIDAE				
	LIMNODRILUS	HOFFMEISTERI	6.	258.36
	UNIDENT. TUBIFICID	WITHOUT CAP. CHAET.....	46.	1980.76
DIPTERA				
CHIRONOMIDAE				
CHIRONOMINAE				
	CHIRONOMUS	SPECIES	1.	43.06
	DICROTENDIPES	SPECIES	1.	43.06
MOLLUSCA				
PELECYPODA				
SPHAERIIDAE				
	SPHAERIUM	STRIATINIUM	1.	43.06

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL NUMBER/SQ M	PERCENT
TUBIFICIDAE	52.	2239.12	94.55
CHIRONOMIDAE	2.	86.12	3.64
PELECYPODA	1.	43.06	1.82
TOTALS	55.	2368.30	100.00

TAXA IN SAMPLE 5

DIVERSITY CALCULATED IN LOG BASE 2

SHANNONS DIVERSITY	.3797	EVENNESS	.3788	REDUNDANCY	.6269
MAX. DIVERSITY	2.3219	MIN. DIVERSITY	.0214	INFORMATIONAL CONTENT	.20833+04

TABLE

BENTHIC DATA FROM GENERAL MOTORS, BEDFORD, INDIANA — MAY 19, 1981, 1150 HOURS

SAMPLE NO. 2

COLLECTED AT LOCATION: E-PLEASANT R, STATION , DEPTH 1.0 M, SUBSTRATE CLAY

PHYSICAL PARAMETERS:

	TEMPERATURE C	F	OXYGEN MG/L	PH
SURFACE	11.5	52.7	11.0	7.6

TAXONOMIC IDENTIFICATION			NO./SAMPLE	NUMBER/SQ M
ANNELIDA				
OLIGOCHAETA				
TUBIFICIDAE				
	LIMNODRILUS	HOFFMEISTERI	5.	215.30
	UNIDENT. TUBIFICID	WITHOUT CAP. CHAET.....	13.	559.78
DIPTERA				
CHIRONOMIDAE				
TANYPODINAE				
	PROCLADIUS	SPECIES	1.	43.06
CHIRONOMINAE				
	POLYPEDILUM	(CONVICTUM GROUP)	1.	43.06
	DICROTENDIPES	SPECIES	3.	129.18
ORTHOCLADIINAE				
	CRICOTOPUS	SPECIES	1.	43.06

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL NUMBER/SQ M	PERCENT
TUBIFICIDAE	18.	775.08	75.00
CHIRONOMIDAE	6.	258.36	25.00
TOTALS	24.	1033.44	100.00

TAXA IN SAMPLE 6

DIVERSITY CALCULATED IN LOG BASE 2

SHANNONS DIVERSITY	1.5987	EVENNESS	.7345	REDUNDANCY	.2713
MAX. DIVERSITY	2.5850	MIN. DIVERSITY	.0554	INFORMATIONAL CONTENT	.19622+04

TABLE

BENTHIC DATA FROM GENERAL MOTORS, BEDFORD, INDIANA — MAY 19, 1981, 1150 HOURS

SAMPLE NO. 3

COLLECTED AT LOCATION: F-PLEASANT R, STATION , DEPTH 1.0 M, SUBSTRATE CLAY, DETRITUS

PHYSICAL PARAMETERS:

	TEMPERATURE C	F	OXYGEN MG/L	PH
SURFACE	11.5	52.7	11.0	7.6

TAXONOMIC IDENTIFICATION			NO./SAMPLE	NUMBER/SQ M
ANNELIDA				
OLIGOCHAETA				
TUBIFICIDAE				
	LIMNODRILUS	HOFFMEISTERI	93.	4004.58
	UNIDENT. TUBIFICID WITHOUT CAP. CHAET		12.	533.94
DIPTERA				
CHIRONOMIDAE				
TANYPODINAE				
	PROCLADIUS	SPECIES	1.	43.06
CHIRONOMINAE				
	CHIRONOMUS	SPECIES	2.	86.12
ORTHOCLADIINAE				
	PARAKIEFFERIELLA	SPECIES	1.	43.06

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL NUMBER/SQ M	PERCENT
TUBIFICIDAE	105.	4538.52	96.34
CHIRONOMIDAE	4.	172.24	3.66
TOTALS	109.	4710.76	100.00

TAXA IN SAMPLE 5

DIVERSITY CALCULATED IN LOG BASE 2

SPECIES DIVERSITY	.7946	EVENNESS	.3379	REDUNDANCY	.6654
MAX. DIVERSITY	2.3219	MIN. DIVERSITY	.0116	INFORMATIONAL CONTENT	.36961+04

TABLE

BENTHIC DATA FROM GENERAL MOTORS, BEDFORD, INDIANA — MAY 19, 1981, 1150 HOURS
SAMPLE NO. 4

COLLECTED AT LOCATION: E-PLEASANT R, STATION , DEPTH 1.0 M, SUBSTRATE CLAY

PHYSICAL PARAMETERS:

	TEMPERATURE C	F	OXYGEN MG/L	PH
SURFACE	11.5	52.7	11.0	7.6

TAXONOMIC IDENTIFICATION	NO./SAMPLE	NUMBER/SQ M
ANNELIDA		
OLIGOCHAETA		
TUBIFICIDAE		
LIMNODRILUS HOFFMEISTERI	18.	780.46
UNIDENT. TUBIFICID WITHOUT CAP. CHAET.....	17.	728.43

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL NUMBER/SQ M	PERCENT
TUBIFICIDAE	35.	1508.89	100.00
TOTALS	35.	1508.89	100.00

TAXA IN SAMPLE 2

DIVERSITY CALCULATED IN LOG BASE 2

SHANNONS DIVERSITY	.9991	EVENNESS	.9991	REDUNDANCY	.0009
MAX. DIVERSITY	1.0000	MIN. DIVERSITY	.0000	INFORMATIONAL CONTENT	.15076+04

TABLE

BENTHIC DATA FROM GENERAL MOTORS, BEDFORD, INDIANA — MAY 21, 1981, 900 HOURS

SAMPLE NO. 1

COLLECTED AT LOCATION: G-PLEASANT R, STATION , DEPTH .2 M, SUBSTRATE LIMESTONE, COBBLE, SILT

PHYSICAL PARAMETERS:

	TEMPERATURE C	F	OXYGEN MG/L	PH
SURFACE	12.C	53.6	9.6	6.9

TAXONOMIC IDENTIFICATION				NO./SAMPLE	NUMBER/SQ M
ANNELIDA					
OLIGOCHAETA					
TUBIFICIDAE					
	LIMNODRILUS	HOFFMEISTERI	.....	20.	215.20
	ILYODRILUS	TEMPLETONI	.....	5.	53.80
	UNIDENT. TUBIFICID	WITH CAP. CHAETAE	.....	1.	10.76
	UNIDENT. TUBIFICID	WITHOUT CAP. CHAET	.....	12.	129.12
CRUSTACEA					
DECAPODA					
ASTACIDAE	.....		.....	8.	86.08
DIPTERA					
CHIRONOMIDAE					
TANYPODINAE					
CHIRONOMINAE	PROCLADIUS	SPECIES	.....	1.	10.76
	CHIRONOMUS	SPECIES	.....	3.	32.28
	TANYTARSUS	SPECIES	.....	1.	10.76

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL NUMBER/SQ M	PERCENT
TUBIFICIDAE	39.	408.88	74.51
CRUSTACEA	8.	86.08	15.69
CHIRONOMIDAE	5.	53.80	9.80
TOTALS	51.	548.76	100.00

TAXA IN SAMPLE 3

DIVERSITY CALCULATED IN LOG BASE 2

SHANNONS DIVERSITY 2.3424 EVENNESS .7809 REDUNDANCY .2294

MAX. DIVERSITY 3.0000 MIN. DIVERSITY .1344 INFORMATIONAL CONTENT .12855+04

TABLE

BENTHIC DATA FROM GENERAL MOTORS, BEDFORD, INDIANA — MAY 21, 1981, 900 HOURS
SAMPLE NO. 2

COLLECTED AT LOCATION: G-PLEASANT R, STATION , DEPTH .2 M, SUBSTRATE LIMESTONE, COBBLE, SILT

PHYSICAL PARAMETERS:

	TEMPERATURE C	F	OXYGEN MG/L	PH
SURFACE	12.0	53.6	9.6	6.9

TAXONOMIC IDENTIFICATION			NO./SAMPLE	NUMBER/SQ M
ANNELIDA				
OLIGOCHAETA				
TUBIFICIDAE				
	LIMNODRILUS	HOFFMEISTERI	105.	1124.62
	ILYODRILUS	TEMPLETONI	6.	66.15
	UNIDENT. TUBIFICID	WITH CAP. CHAETAE	18.	198.46
	UNIDENT. TUBIFICID	WITHOUT CAP. CHAET.....	123.	1323.08
DIPTERA				
CHIRONOMIDAE				
TANYTODINAE				
	PROCLADIUS	SPECIES	4.	45.73
CHIRONOMINAE				
	CHIRONOMUS	SPECIES	42.	457.30
	CRYPTOCHIRONOMUS	SPECIES	4.	45.73
MOLLUSCA				
PELECYPODA				
SPHAERIIDAE				
	SPHAERIUM	STRIATINIUM	1.	10.76

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL NUMBER/SQ M	PERCENT
TUBIFICIDAE	252.	2712.32	82.90
CHIRONOMIDAE	51.	548.76	16.77
PELECYPODA	1.	10.76	.33
TOTALS	304.	3271.84	100.00

TAXA IN SAMPLE 5

DIVERSITY CALCULATED IN LOG BASE 2

SHANNONS DIVERSITY	2.0130	EVENNESS	.6710	REDUNDANCY	.3321
MAX. DIVERSITY	3.0000	MIN. DIVERSITY	.0281	INFORMATIONAL CONTENT	.65861+04

TABLE

BENTHIC DATA FROM GENERAL MOTORS, BEDFORD, INDIANA — MAY 21, 1981, 900 HOURS
SAMPLE NO. 3

COLLECTED AT LOCATION: G-PLEASANT R, STATION , DEPTH .2 M, SUBSTRATE LIMESTONE, COBBLE, SILT

PHYSICAL PARAMETERS:

	TEMPERATURE C	F	OXYGEN MG/L	PH
SURFACE	12.0	53.6	9.6	6.9

TAXONOMIC IDENTIFICATION				NO./SAMPLE	NUMBER/SQ M
ANNELIDA					
OLIGOCHAETA					
TUBIFICIDAE					
	LIMNODRILUS	HOFFMEISTERI	.....	59.	632.08
	ILYODRILUS	TEMPLETONI	.....	2.	21.80
	UNIDENT. TUBIFICID	WITH CAP. CHAETAE	.....	6.	65.39
	UNIDENT. TUBIFICID	WITHOUT CAP. CHAET	.....	43.	457.71
DIPTERA					
CHIRONOMIDAE					
TANYPODINAE					
	PROCLADIUS	SPECIES	.....	1.	10.76
CHIRONOMINAE					
	CHIRONOMUS	SPECIES	.....	1.	10.76
	POLYPEDILUM	(SCALAENUM GROUP)	.....	1.	10.76
ORTHOCLADIINAE					
	CRICOTOPUS	SPECIES	.....	10.	107.60

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL NUMBER/SQ M	PERCENT
TUBIFICIDAE	109.	1176.98	89.38
CHIRONOMIDAE	13.	139.88	10.62
TOTALS	122.	1316.86	100.00

TAXA IN SAMPLE 8

DIVERSITY CALCULATED IN LOG BASE 2

SHANNONS DIVERSITY	1.8165	EVENNESS	.6055	REDUNDANCY	.4029
MAX. DIVERSITY	3.0000	MIN. DIVERSITY	.0627	INFORMATIONAL CONTENT	.2392D+04

TABLE

BENTHIC DATA FROM GENERAL MOTORS, BEDFORD, INDIANA — MAY 21, 1981, 900 HOURS
SAMPLE NO. 4

COLLECTED AT LOCATION: G-PLEASANT R, STATION , DEPTH .2 M, SUBSTRATE LIMESTONE, COBBLE, SILT

PHYSICAL PARAMETERS:

	TEMPERATURE C	F	OXYGEN MG/L	PH
SURFACE	12.C	53.6	9.6	6.9

TAXONOMIC IDENTIFICATION			NO./SAMPLE	NUMBER/SQ M
ANNELIDA				
OLIGOCHAETA				
TUBIFICIDAE				
	LIMNODRILUS	HOFFMEISTERI	16.	172.16
	UNIDENT. TUBIFICID	WITHOUT CAP. CHAET	13.	139.88
ENCHYTRAEIDAE	.....	.....	2.	21.52
EPHEMEROPTERA				
HEPTAGENIIDAE	.....	.....	1.	10.76
DIPTERA				
CHIRONOMIDAE				
TANYPODINAE				
CHIRONOMIDAE	EPOCLADIUS	SPECIES	1.	10.76
	CHIRONOMUS	SPECIES	11.	118.36
	PHAENOPSECTRA	SPECIES	3.	32.28
	POLYPEDILUM	(FALLAX GROUP)	1.	10.76
	POLYPEDILUM	(SCALAENUM GROUP)	1.	10.76
	DICROTENDIPES	SPECIES	1.	10.76
	PARATANYTARSUS	SPECIES	1.	10.76
ORTHOCLADIINAE				
	CORYNONEURA	SPECIES	2.	21.52
	CRICOTOPUS	SPECIES	4.	43.04
	SYMTTIA	SPECIES	1.	10.76
	BRILLIA	SPECIES	2.	21.52
	NANOCLADIUS	SPECIES	1.	10.76

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL NUMBER/SQ M	PERCENT
TUBIFICIDAE	29.	312.04	47.54
OTHER ANNELIDA	2.	21.52	3.28
EPHEMEROPTERA	1.	10.76	1.64
CHIRONOMIDAE	29.	312.04	47.54
TOTALS	61.	656.36	100.00

TAXA IN SAMPLE 16

TABLE

BENTHIC DATA FROM GENERAL MOTORS, BEDFORD, INDIANA MAY 21, 1981, 900 HOURS
SAMPLE NO. 4

COLLECTED AT LOCATION: G-PLEASANT R, STATION , DEPTH .2 M, SUBSTRATE LIMESTONE, COBBLE, SILT

PHYSICAL PARAMETERS:

	TEMPERATURE C	F	OXYGEN ME/L	PH
SURFACE	12.0	53.6	9.6	6.9

TAXONOMIC IDENTIFICATION	NO./SAMPLE	NUMBER/SQ M

DIVERSITY CALCULATED IN LOG BASE 2

SHANNONS DIVERSITY	3.1616	EVENNESS	.7904	REDUNDANCY	.2223
MAX. DIVERSITY	4.0000	MIN. DIVERSITY	.2465	INFORMATIONAL CONTENT	.20752+04

TABLE

BENTHIC DATA FROM GENERAL MOTORS, BEDFORD, INDIANA — MAY 20, 1981, 1430 HOURS
SAMPLE NO. 1

COLLECTED AT LOCATION: I-SALT CREEK, STATION , DEPTH 4.0 M, SUBSTRATE CLAY

PHYSICAL PARAMETERS:

	TEMPERATURE C	F	OXYGEN MG/L	PH
SURFACE	13.0	55.4	8.3	7.1

TAXONOMIC IDENTIFICATION			NO./SAMPLE	NUMBER/SQ M
ANNELIDA				
OLIGOCHAETA				
TUBIFICIDAE				
	ILYODRILUS	TEMPLETONI	4.	172.24
	UNIDENT. TUBIFICID	WITHOUT CAP. CHAET.....	1.	43.06
NAIDIDAE				
	NAIS	PARDALIS	1.	43.06
CRUSTACEA				
ISOPODA				
ASELLIDAE				
	LIRCEUS	FONTINALIS	1.	43.06
COLEOPTERA				
ELMIDAE				
	DUBIRAPHIA	SPECIES	1.	43.06
MOLLUSCA				
PELECYPODA				
SPHAERIIDAE				
	SPHAERIUM	STRIATINIUM	2.	86.12

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL NUMBER/SQ M	PERCENT
TUBIFICIDAE	5.	215.30	50.0C
NAIDIDAE	1.	43.06	10.0C
CRUSTACEA	1.	43.06	10.0C
COLEOPTERA	1.	43.06	10.0C
PELECYPODA	2.	86.12	20.0C
TOTALS	10.	430.60	100.0C

TAXA IN SAMPLE 6

DIVERSITY CALCULATED IN LOG BASE 2

SHANNONS DIVERSITY	2.3219	EVENNESS	.8962	REDUNDANCY	.1066
MAX. DIVERSITY	2.5850	MIN. DIVERSITY	.1163	INFORMATIONAL CONTENT	.99982+03

TABLE

BENTHIC DATA FROM GENERAL MOTORS, BEDFORD, INDIANA — MAY 20, 1981, 1430 HOURS

SAMPLE NO. 2

COLLECTED AT LOCATION: I-SALT CREEK, STATION , DEPTH 4.0 M, SUBSTRATE CLAY

PHYSICAL PARAMETERS:

	TEMPERATURE C	F	OXYGEN MG/L	PH
SURFACE	13.C	55.4	8.3	7.1

TAXONOMIC IDENTIFICATION			NO./SAMPLE	NUMBER/SQ M
ANNELIDA				
OLIGOCHAETA				
TUBIFICIDAE				
	LIMNODRILUS	HOFFMEISTERI	1.	43.06
	ILYODRILUS	TEMPLETONI	1.	43.06
	BRANCHIURA	SOWERBYI	1.	43.06
	UNIDENT. TUBIFICID	WITH CAP. CHAETAE	1.	43.06
	UNIDENT. TUBIFICID	WITHOUT CAP. CHAET.....	1.	43.06
CRUSTACEA				
ISOPODA				
ASELLIDAE				
	LIRCEUS	FONTINALIS	4.	172.24
EPHEMEROPTERA				
EPHEMERIDAE				
	HEXAGENIA	SPECIES	1.	43.06
MEGALOPTERA				
SIALIDAE				
	SIALIS	SPECIES	2.	86.12
DIPTERA				
CHIRONOMIDAE				
TANYPODINAE				
	THIENEMANNIMYIA	GROUP	1.	43.06
CHIRONOMINAE				
	CRYPTOCHIRONOMUS	SPECIES	1.	43.06
	PARACLADOPELMA	SPECIES	1.	43.06
	CLADOPELMA	SPECIES	5.	215.30
ORTHOCLADIINAE				
	CORYNONEURA	SPECIES	1.	43.06
	NANOCLADIUS	SPECIES	1.	43.06
MOLLUSCA				
PELECYPODA				
SPHAERIIDAE				
	SPHAERIUM	STRIATINIUM	9.	387.54

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL NUMBER/SQ M	PERCENT
TUBIFICIDAE	5.	215.30	16.13
CRUSTACEA	4.	172.24	12.90
EPHEMEROPTERA	1.	43.06	3.23
MEGALOPTERA-NEUROP	2.	86.12	6.45

CHIRONOMIDAE	10.	430.60	32.26

TABLE

BENTHIC DATA FROM GENERAL MOTORS, BEDFORD, INDIANA MAY 20, 1981, 1430 HOURS
SAMPLE NO. 2

COLLECTED AT LOCATION: I-SALT CREEK, STATION , DEPTH 4.0 M, SUBSTRATE CLAY

PHYSICAL PARAMETERS:

	TEMPERATURE C	F	OXYGEN MG/L	PH
SURFACE	13.C	55.4	8.3	7.1

TAXONOMIC IDENTIFICATION	NO./SAMPLE	NUMBER/SQ M

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL NUMBER/SQ M	PERCENT
PELECYPODA	9.	387.54	29.03
TOTALS	31.	1334.86	100.00

TAXA IN SAMPLE 1?

DIVERSITY CALCULATED IN LOG BASE 2

SHANNONS DIVERSITY	3.?76?	EVENNESS	.8541	REDUNDANCY	.1507
MAX. DIVERSITY	3.9069	MIN. DIVERSITY	.1239	INFORMATIONAL CONTENT	.44542+04

TABLE

BENTHIC DATA FROM GENERAL MOTORS, BEDFORD, INDIANA — MAY 20, 1981, 1430 HOURS
SAMPLE NO. 3

COLLECTED AT LOCATION: I-SALT CREEK, STATION , DEPTH 4.0 M, SUBSTRATE CLAY

PHYSICAL PARAMETERS:

	TEMPERATURE C	F	OXYGEN MG/L	PH
SURFACE	13.0	55.4	8.3	7.1

TAXONOMIC IDENTIFICATION				NO./SAMPLE	NUMBER/SQ M
COELENTERATA					
HYDROZOA					
HYDRIDAE					
	HYDRA	SPECIES	.....	1.	43.06
ANNELIDA					
OLIGOCHAETA					
TUBIFICIDAE					
	BRANCHIURA	SOWERBYI	.....	1.	43.06
	UNIDENT. TUBIFICID	WITH CAP. CHAETAE	.....	1.	43.06
	UNIDENT. TUBIFICID	WITHOUT CAP. CHAET	.....	1.	43.06
CRUSTACEA					
ISOPODA					
ASELLIDAE					
	LIRCEUS	FONTINALIS	.....	4.	172.24
EPHEMEROPTERA					
EPHEMERIDAE					
	HEXAGENIA	SPECIES	.....	1.	43.06
DIPTERA					
TIPULIDAE	.....		.....	1.	43.06
CERATOPOGONIDAE	.....		.....	1.	43.06
CHIRONOMIDAE					
CHIRONOMINAE					
	POLYPEDILUM	PUPA	.....	1.	43.06
	POLYPEDILUM	(SCALAENUM GROUP)	.....	2.	86.12
	POLYPEDILUM	(SIMULANS GROUP)	.....	2.	86.12
	TANYTARSUS	SPECIES	.....	1.	43.06
	CLADOTANYTARSUS	SPECIES	.....	1.	43.06
MOLLUSCA					
PELECYPODA					
SPHAERIIDAE					
	SPHAERIUM	STRIATINIUM	.....	3.	129.18
CORBICULIDAE					
	CORBICULA	MANILENSIS	.....	1.	43.06

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL NUMBER/SQ M	PERCENT
MISCELLANEOUS	1.	43.06	4.55
TUBIFICIDAE	3.	129.18	13.64

TABLE

BENTHIC DATA FROM GENERAL MOTORS, BEDFORD, INDIANA
SAMPLE NO. 3

MAY 20, 1981, 1430 HOURS

COLLECTED AT LOCATION: I-SALT CREEK, STATION , DEPTH 4.0 M, SUBSTRATE CLAY

PHYSICAL PARAMETERS:

	TEMPERATURE C	F	OXYGEN MG/L	PH
SURFACE	13.0	55.4	8.3	7.1

TAXONOMIC IDENTIFICATION	NO./SAMPLE	NUMBER/SQ M

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL NUMBER/SQ M	PERCENT
CRUSTACEA	4.	172.24	18.18
EPHEMEROPTERA	1.	43.06	4.55
DIPTERA GRP I	2.	86.12	9.09
CHIRONOMIDAE	7.	301.42	31.82
PELECYPODA	4.	172.24	18.18
TOTALS	22.	947.32	100.00

TAXA IN SAMPLE 15

DIVERSITY CALCULATED IN LOG BASE 2

SHANNONS DIVERSITY	3.697=	EVENNESS	.9465	REDUNDANCY	.0559
MAX. DIVERSITY	3.9069	MIN. DIVERSITY	.1673	INFORMATIONAL CONTENT	.35030+04

TABLE

BENTHIC DATA FROM GENERAL MOTORS, BEDFORD, INDIANA
SAMPLE NO. 4

MAY 20, 1981, 1430 HOURS

COLLECTED AT LOCATION: I-SALT CREEK, STATION , DEPTH 4.0 M, SUBSTRATE CLAY

PHYSICAL PARAMETERS:

	TEMPERATURE C	F	OXYGEN MG/L	PH
SURFACE	13.0	55.4	8.3	7.1

TAXONOMIC IDENTIFICATION				NO./SAMPLE	NUMBER/SQ M
ANNELIDA					
OLIGOCHAETA					
TUBIFICIDAE					
	UNIDENT. TUBIFICID WITHOUT CAP. CHAET		.....	1.	43.06
CRUSTACEA					
ISOPODA					
ASELLIDAE					
	LIRCEUS	FONTINALIS	.....	1.	43.06
DIPTERA					
CHIRONOMIDAE					
CHIRONOMIDAE					
	POLYPEDILUM	(SIMULANS GROUP)	.....	2.	86.12
	CLADOTANYTARSUS	SPECIES	.....	1.	43.06
	PAGASTIELLA	SPECIES	.....	1.	43.06

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL NUMBER/SQ M	PERCENT
TUBIFICIDAE	1.	43.06	16.67
CRUSTACEA	1.	43.06	16.67
CHIRONOMIDAE	4.	172.24	66.67
TOTALS	6.	258.36	100.00

TAXA IN SAMPLE 3

DIVERSITY CALCULATED IN LOG BASE 2

SHANNONS DIVERSITY	2.2516	EVENNESS	.9697	REDUNDANCY	.0323
MAX. DIVERSITY	2.3219	MIN. DIVERSITY	.1462	INFORMATIONAL CONTENT	.58173+03

TABLE

BENTHIC DATA FROM GENERAL MOTORS, BEDFORD, INDIANA — MAY 20, 1981, 1505 HOURS

SAMPLE NO. 1

COLLECTED AT LOCATION: J-SALT CREEK, STATION , DEPTH 4.0 M, SUBSTRATE CLAY

PHYSICAL PARAMETERS:

	TEMPERATURE C	F	OXYGEN MG/L	PH
SURFACE	13.0	55.4	8.8	7.1

TAXONOMIC IDENTIFICATION			NO./SAMPLE	NUMBER/SQ M
CRUSTACEA				
ISOPODA				
ASELLIDAE				
	LIRCEUS	FONTINALIS	1.	43.06
DIPTERA				
CHIRONOMIDAE				
CHIRONOMINAE				
	CHIRONOMUS	SPECIES	1.	43.06
MOLLUSCA				
PELECYPODA				
SPHAERIIDAE				
	SPHAERIUM	STRIATINIUM	4.	172.24

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL NUMBER/SQ M	PERCENT
CRUSTACEA	1.	43.06	16.67
CHIRONOMIDAE	1.	43.06	16.67
PELECYPODA	4.	172.24	66.67
TOTALS	6.	258.36	100.00

TAXA IN SAMPLE 3

DIVERSITY CALCULATED IN LOG BASE 2

SHANNONS DIVERSITY	1.2516	EVENNESS	.7897	REDUNDANCY	.2205
MAX. DIVERSITY	1.5850	MIN. DIVERSITY	.0732	INFORMATIONAL CONTENT	.32337+03

TABLE

BENTHIC DATA FROM GENERAL MOTORS, BEDFORD, INDIANA — MAY 20, 1981, 1505 HOURS

SAMPLE NO. 2

COLLECTED AT LOCATION: J-SALT CREEK, STATION , DEPTH 4.0 M, SUBSTRATE BED ROCK

PHYSICAL PARAMETERS:	TEMPERATURE C	F	OXYGEN MG/L	PH
SURFACE	13.0	55.4	8.8	7.1

TAXONOMIC IDENTIFICATION	NO./SAMPLE	NUMBER/SQ M
NO ORGANISMS IN SAMPLE		

TABLE

BENTHIC DATA FROM GENERAL MOTORS, BEDFORD, INDIANA — MAY 20, 1981, 1505 HOURS
SAMPLE NO. 3

COLLECTED AT LOCATION: J-SALT CREEK, STATION , DEPTH 4.0 M, SUBSTRATE BED ROCK

PHYSICAL PARAMETERS:

	TEMPERATURE C	F	OXYGEN MG/L	PH
SURFACE	13.C	55.4	E.8	7.1

TAXONOMIC IDENTIFICATION				NO./SAMPLE	NUMBER/SQ M
ANNELIDA					
OLIGOCHAETA					
TUBIFICIDAE					
	UNIDENT. TUBIFICID WITHOUT CAP. CHAET.....			3.	129.18
EPHEMEROPTERA					
EPHEMERIDAE					
	HEXAGENIA	SPECIES	.....	2.	86.12
DIPTERA					
CHIRONOMIDAE					
CHIRONOMINAE					
	CHIRONOMUS	SPECIES	.....	6.	258.36
	HARNISCHIA	SPECIES	.....	3.	129.18
	PHAENOPSECTRA	SPECIES	.....	2.	86.12
	POLYPEDILUM	(SIMULANS GROUP)	.....	1.	43.06
MOLLUSCA					
PELECYPODA					
SPHAERIIDAE					
	SPHAERIUM	STRIATINIUM	.....	1.	43.06
CORBICULIDAE					
	CORBICULA	MANILENSIS	.....	1.	43.06

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL NUMBER/SQ M	PERCENT
TUBIFICIDAE	3.	129.18	15.79
EPHEMEROPTERA	2.	86.12	10.53
CHIRONOMIDAE	12.	516.72	63.16
PELECYPODA	2.	86.12	10.53
TOTALS	19.	818.14	100.00

TAXA IN SAMPLE 8

DIVERSITY CALCULATED IN LOG BASE e
SHANNONS DIVERSITY 2.7204 EVENNESS .9069 REDUNDANCY .0962
MAX. DIVERSITY 3.0000 MIN. DIVERSITY .0951 INFORMATIONAL CONTENT .2225E+04

TABLE

BENTHIC DATA FROM GENERAL MOTORS, BLDFORD, INDIANA — MAY 20, 1981, 1505 HOURS

SAMPLE NO. 4

COLLECTED AT LOCATION: J-SALT CREEK, STATION , DEPTH 4.0 M, SUBSTRATE CLAY

PHYSICAL PARAMETERS:

	TEMPERATURE C	F	OXYGEN MG/L	PH
SURFACE	13.C	55.4	8.8	7.1

TAXONOMIC IDENTIFICATION				NO./SAMPLE	NUMBER/SQ M
COELENTERATA					
HYDROZOA					
HYDRIDAE					
	HYDRA	SPECIES	.....	1.	43.06
ANNELIDA					
OLIGOCHAETA					
TUBIFICIDAE					
	ILYODRILUS	TEMPLETONI	.....	2.	86.12
	UNIDENT. TUBIFICID	WITH CAP. CHAETAE	.....	4.	172.24
	UNIDENT. TUBIFICID	WITHOUT CAP. CHAET	.....	2.	86.12
NAIDIDAE					
	NAIS	PARDALIS	.....	3.	129.18
CRUSTACEA					
ISOPODA					
ASELLIDAE					
	LIRCEUS	FONTINALIS	.....	8.	344.48
DIPTERA					
CHIRONOMIDAE					
CHIRONOMINAE					
	MICROTENDIPES	SPECIES	.....	1.	43.06
	POLYPEDILUM	(SCALAENUM GROUP)	.....	2.	86.12

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL NUMBER/SQ M	PERCENT
MISCELLANEOUS	1.	43.06	4.35
TUBIFICIDAE	8.	344.48	34.78
NAIDIDAE	3.	129.18	13.04
CRUSTACEA	8.	344.48	34.78
CHIRONOMIDAE	3.	129.18	13.04
TOTALS	23.	990.38	100.00

TAXA IN SAMPLE 5

DIVERSITY CALCULATED IN LOG BASE 2

SHANNONS DIVERSITY	2.2647	EVENNESS	.8882	REDUNDANCY	.1149
MAX. DIVERSITY	2.3000	MIN. DIVERSITY	.0805	INFORMATIONAL CONTENT	.26390+04

TABLE

BENTHIC DATA FROM GENERAL MOTORS, BEDFORD, INDIANA — MAY 20, 1981, 1525 HOURS

SAMPLE NO. 1

COLLECTED AT LOCATION: K-SALT CREEK, STATION , DEPTH 1.0 M, SUBSTRATE CLAY, DETRITUS

PHYSICAL PARAMETERS:

	TEMPERATURE C	F	OXYGEN MG/L	PH
SURFACE	13.0	55.4	8.4	7.1

TAXONOMIC IDENTIFICATION				NO./SAMPLE	NUMBER/SQ M
ANNELIDA					
OLIGOCHAETA					
TUBIFICIDAE					
	LIMNODRILUS	HOFFMEISTERI	.....	2.	85.48
	UNIDENT. TUBIFICID	WITH CAP. CHAETAE	.....	2.	85.48
	UNIDENT. TUBIFICID	WITHOUT CAP. CHAET	.....	6.	256.44
ENCHYTRAEIDAE	.....		.....	4.	170.96
CRUSTACEA					
ISOPODA					
ASELLIDAE					
	LIRCEUS	FONTINALIS	.....	16.	683.84
DIPTERA					
CHIRONOMIDAE					
CHIRONOMINAE					
	CHIRONOMUS	SPECIES	.....	6.	256.44
	POLYPEDILUM	(SCALAENUM GROUP)	.....	2.	85.48
	POLYPEDILUM	(SIMULANS GROUP)	.....	4.	170.96

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL NUMBER/SQ M	PERCENT
TUBIFICIDAE	10.	427.40	23.81
OTHER ANNELIDA	4.	170.96	9.52
CRUSTACEA	16.	683.84	38.10
CHIRONOMIDAE	12.	512.88	28.57
TOTALS	42.	1795.08	100.00

TAXA IN SAMPLE 6

DIVERSITY CALCULATED IN LOG BASE 2

SHANNONS DIVERSITY	2.0061	EVENNESS	.8687	REDUNDANCY	.1314
MAX. DIVERSITY	3.0000	MIN. DIVERSITY	.0479	INFORMATIONAL CONTENT	.46782+04

TABLE

BENTHIC DATA FROM GENERAL MOTORS, BLDFORD, INDIANA
SAMPLE NO. 2

MAY 20, 1981, 1525 HOURS

COLLECTED AT LOCATION: K-SALT CREEK, STATION , DEPTH 1.0 M, SUBSTRATE CLAY, DETRITUS

PHYSICAL PARAMETERS:

	TEMPERATURE C	F	OXYGEN MG/L	PH
SURFACE	13.0	55.4	8.4	7.1

TAXONOMIC IDENTIFICATION			NO./SAMPLE	NUMBER/SQ M
NEMATODA			2.	85.48
ANNELIDA				
OLIGOCHAETA				
TUBIFICIDAE				
	LIMNODRILUS	HOFFMEISTERI	6.	256.44
	UNIDENT. TUBIFICID	WITHOUT CAP. CHAET	4.	170.96
NAIDIDAE				
	NAIS	PARDALIS	6.	256.44
ENCHYTRAEIDAE			4.	170.96
HIRUDINEA				
ERPOBDELLIDAE				
	MOORECOBDELA	MICROSTOMA	2.	85.48
CRUSTACEA				
ISOPODA				
ASELLIDAE				
	ASELLUS	SPECIES	2.	85.48
	LIRCEUS	FONTINALIS	102.	4359.48
AMPHIPODA				
GAMMARIDAE				
	CRANGONYX	SPECIES	18.	769.32
COLEOPTERA				
ELMIDAE				
	DUBIRAPHIA	SPECIES	2.	85.48
DIPTERA				
CHIRONOMIDAE				
CHIRONOMINAE				
	CHIRONOMUS	SPECIES	2.	85.48
	POLYPEDILUM	(SCALAENUM GROUP)	4.	170.96
	POLYPEDILUM	(SIMULANS GROUP)	4.	170.96
	TRIBELOS	SPECIES	2.	85.48

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL NUMBER/SQ M	PERCENT
MISCELLANEOUS	2.	85.48	1.25
TUBIFICIDAE	10.	427.40	6.25
NAIDIDAE	6.	256.44	3.75
OTHER ANNELIDA	6.	256.44	3.75
CRUSTACEA	122.	5214.28	76.25

TABLE

BENTHIC DATA FROM GENERAL MOTORS, BEDFORD, INDIANA MAY 20, 1981, 1525 HOURS
SAMPLE NO. 2

COLLECTED AT LOCATION: K-SALT CREEK, STATION , DEPTH 1.0 M, SUBSTRATE CLAY, DETRITUS

PHYSICAL PARAMETERS:

	TEMPERATURE C	F	OXYGEN MG/L	PH
SURFACE	13.0	55.4	8.4	7.1

TAXONOMIC IDENTIFICATION NO./SAMPLE NUMBER/SQ M

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL NUMBER/SQ M	PERCENT
COLEOPTERA	2.	85.48	1.25
CHIRONOMIDAE	12.	512.98	7.50
TOTALS	160.	6838.40	100.00

TAXA IN SAMPLE 14

DIVERSITY CALCULATED IN LOG BASE 2

SHANNONS DIVERSITY	2.1703	EVENNESS	.5595	REDUNDANCY	.4436
MAX. DIVERSITY	3.8074	MIN. DIVERSITY	.0270	INFORMATIONAL CONTENT	.14568+05

TABLE

BENTHIC DATA FROM GENERAL MOTORS, BEDFORD, INDIANA MAY 20, 1981, 1525 HOURS
SAMPLE NO. 3

COLLECTED AT LOCATION: K-SALT CREEK, STATION , DEPTH 1.0 M, SUBSTRATE CLAY, DETRITUS

PHYSICAL PARAMETERS:

	TEMPERATURE C	F	OXYGEN MG/L	PH
SURFACE	13.C	55.4	8.4	7.1

TAXONOMIC IDENTIFICATION			NO./SAMPLE	NUMBER/SQ M
NEMATODA			2.	85.48
ANNELIDA				
OLIGOCHAETA			2.	85.48
TUBIFICIDAE				
	LIMNODRILUS	HOFFMEISTERI	14.	598.36
	UNIDENT. TUBIFICID	WITH CAP. CHAETAE	2.	85.48
	UNIDENT. TUBIFICID	WITHOUT CAP. CHAET	18.	769.32
NAIDIDAE				
	NAIS	PARDALIS	2.	85.48
CRUSTACEA				
ISOPODA				
ASELLIDAE				
	ASELLUS	SPECIES	4.	170.96
	LIRCEUS	FONTINALIS	96.	4103.04
DECAPODA				
AESTACIDAE			8.	341.92
EPHEMEROPTERA				
CAENIDAE				
	CAENIS	SPECIES	2.	85.48
DIPTERA				
CHIRONOMIDAE				
CHIRONOMINAE				
	TRIBELOS	SPECIES	2.	85.48
MOLLUSCA				
GASTROPODA				
PHYSIDAE				
	PHYSA	SPECIES	2.	85.48
PELECYPODA				
SPHAERIIDAE				
	SPHAERIUM	STRIATINIUM	2.	85.48

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL NUMBER/SQ M	PERCENT
MISCELLANEOUS	2.	85.48	1.2E
TUBIFICIDAE	36.	1538.64	23.0E
NAIDIDAE	2.	85.48	1.2E

TABLE

BENTHIC DATA FROM GENERAL MOTORS, BEDFORD, INDIANA — MAY 20, 1981, 1525 HOURS

SAMPLE NO. 3

COLLECTED AT LOCATION: K-SALT CREEK, STATION , DEPTH 1.0 M, SUBSTRATE CLAY, DETRITUS

PHYSICAL PARAMETERS:	TEMPERATURE C	F	OXYGEN MG/L	PH
	SURFACE	13.0	55.4	8.4	7.1

TAXONOMIC IDENTIFICATION	NO./SAMPLE	NUMBER/SQ M

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL NUMBER/SQ M	PERCENT
CRUSTACEA	108.	4615.92	69.23
EPHEMEROPTERA	2.	85.48	1.28
CHIRONOMIDAE	2.	85.48	1.28
GASTROPODA	2.	85.48	1.28
PELECYPODA	2.	85.48	1.28
TOTALS	156.	6667.44	100.00

TAXA IN SAMPLE 13

DIVERSITY CALCULATED IN LOG BASE 2

SHANNONS DIVERSITY	2.1026	EVENNESS	.5682	REDUNDANCY	.4348
MAX. DIVERSITY	3.7004	MIN. DIVERSITY	.0255	INFORMATIONAL CONTENT	.14019+05

TABLE

BENTHIC DATA FROM GENERAL MOTORS, BEDFORD, INDIANA — MAY 20, 1981, 1525 HOURS
SAMPLE NO. 4

COLLECTED AT LOCATION: K-SALT CREEK, STATION , DEPTH 1.0 M, SUBSTRATE CLAY, DETRITUS

PHYSICAL PARAMETERS:

	TEMPERATURE C	F	OXYGEN MG/L	PH
SURFACE	13.0	55.4	8.4	7.1

TAXONOMIC IDENTIFICATION			NO./SAMPLE	NUMBER/SQ M
ANNELIDA				
OLIGOCHAETA				
TUBIFICIDAE				
	LIMNODRILUS	HOFFMEISTERI	8.	341.92
	LIMNODRILUS	CERVIX	2.	85.48
	ILYODRILUS	TEMPLETONI	4.	170.96
	UNIDENT. TUBIFICID	WITH CAP. CHAETAE	4.	170.96
	UNIDENT. TUBIFICID	WITHOUT CAP. CHAET	18.	769.32
NAIDIDAE				
	NAIS	PARDALIS	2.	85.48
ENCHYTRAEIDAE			2.	85.48
CRUSTACEA				
ISOPODA				
ASELLIDAE				
	ASELLUS	SPECIES	2.	85.48
	LIRCEUS	FONTINALIS	30.	1282.20
ODONATA				
ANISOPTERA				
GOMPHIDAE				
	GOMPHUS	SPECIES	2.	85.48
DIPTERA				
CHIRONOMIDAE				
CHIRONOMINAE				
	CHIRONOMUS	SPECIES	2.	85.48
	TANYTARSUS	SPECIES	4.	170.96

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL NUMBER/SQ M	PERCENT
TUBIFICIDAE	36.	1538.64	45.0C
NAIDIDAE	2.	85.48	2.5C
OTHER ANNELIDA	2.	85.48	2.5C
CRUSTACEA	32.	1367.68	40.0C
ODONATA	2.	85.48	2.5C
CHIRONOMIDAE	6.	256.44	7.5C
TOTALS	80.	3419.20	100.0C

TAXA IN SAMPLE 12

TABLE

BENTHIC DATA FROM GENERAL MOTORS, BEDFORD, INDIANA — MAY 20, 1981, 1525 HOURS

SAMPLE NO. 4

COLLECTED AT LOCATION: K-SALT CREEK, STATION , DEPTH 1.0 M, SUBSTRATE CLAY, DETRITUS

PHYSICAL PARAMETERS:	TEMPERATURE C	F	OXYGEN MG/L	PH
	SURFACE 13.0	55.4	8.4	7.1

TAXONOMIC IDENTIFICATION	NO./SAMPLE	NUMBER/SQ M

DIVERSITY CALCULATED IN LOG BASE 2

SHANNONS DIVERSITY	2.7936	EVENNESS	.7793	REDUNDANCY	.2234
MAX. DIVERSITY	3.5850	MIN. DIVERSITY	.0424	INFORMATIONAL CONTENT	.95519+04

TABLE

BENTHIC DATA FROM GENERAL MOTORS, BEDFORD, INDIANA — MAY 20, 1981, 1540 HOURS

SAMPLE NO. 1

COLLECTED AT LOCATION: L-SALT CREEK, STATION , DEPTH 1.0 M, SUBSTRATE CLAY

PHYSICAL PARAMETERS: TEMPERATURE C F PH

SURFACE 14.C 57.2 7.6

TAXONOMIC IDENTIFICATION			NO./SAMPLE	NUMBER/SQ M
ANNELIDA				
OLIGOCHAETA				
TUBIFICIDAE				
	LIMNODRILUS	PROFUNDICOLA	5.	229.11
	LIMNODRILUS	HOFFMEISTERI	27.	1145.56
	LIMNODRILUS	UDEKEMIANUS	5.	229.11
	UNIDENT. TUBIFICID	WITH CAP. CHAETAE	11.	458.22
	UNIDENT. TUBIFICID	WITHOUT CAP. CHAET.....	229.	9851.80
NAIDIDAE				
	NAIS	COMMUNIS	5.	229.11
EPHEMEROPTERA				
EPHEMERIDAE				
	HEXAGENIA	SPECIES	6.	258.36
COLEOPTERA				
ELMIDAE				
	DUBIRAPHIA	SPECIES	2.	86.12
DIPTERA				
CHIRONOMIDAE				
CHIRONOMINAE				
	HARNISCHIA	SPECIES	2.	86.12
	POLYPEDILUM	(SCALAENUM GROUP)	4.	172.24
	POLYPEDILUM	(SIMULANS GROUP)	2.	86.12
MOLLUSCA				
PELECYPODA				
SPHAERIIDAE				
	SPHAERIUM	STRIATINIUM	4.	172.24

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL NUMBER/SQ M	PERCENT
TUBIFICIDAE	277.	11913.81	91.62
NAIDIDAE	5.	229.11	1.76
EPHEMEROPTERA	6.	258.36	1.99
COLEOPTERA	2.	86.12	.66
CHIRONOMIDAE	8.	344.48	2.65
PELECYPODA	4.	172.24	1.32
TOTALS	302.	13004.12	100.00

TAXA IN SAMPLE 12

TABLE

BENTHIC DATA FROM GENERAL MOTORS, BLDFORD, INDIANA MAY 20, 1981, 1540 HOURS
SAMPLE NO. 1

COLLECTED AT LOCATION: L-SALT CREEK, STATION , DEPTH 1.0 M, SUBSTRATE CLAY

PHYSICAL PARAMETERS:

	TEMPERATURE C	F	PH
SURFACE	14.0	57.2	7.6

TAXONOMIC IDENTIFICATION	NO./SAMPLE	NUMBER/SQ M

DIVERSITY CALCULATED IN LOG BASE 2

SHANNONS DIVERSITY	1.5116	EVENNESS	.4217	REDUNDANCY	.5804
MAX. DIVERSITY	3.5850	MIN. DIVERSITY	.0128	INFORMATIONAL CONTENT	.19657+05

TABLE

BENTHIC DATA FROM GENERAL MOTORS, REDFORD, INDIANA — MAY 20, 1981, 1540 HOURS

SAMPLE NO. 2

COLLECTED AT LOCATION: L-SALT CREEK, STATION , DEPTH 1.0 M, SUBSTRATE CLAY, DETRITUS

PHYSICAL PARAMETERS: TEMPERATURE C F PH

SURFACE 14.0 57.2 7.6

TAXONOMIC IDENTIFICATION			NO./SAMPLE	NUMBER/SQ M
ANNELIDA				
OLIGOCHAETA				
TUBIFICIDAE				
	LIMNODRILUS	HOFFMEISTERI	5.	205.63
	UNIDENT. TUBIFICID	WITH CAP. CHAETAE	19.	822.53
	UNIDENT. TUBIFICID	WITHOUT CAP. CHAET.....	205.	8842.24
ENCHYTRAEIDAE	.....	.....	5.	205.63
CRUSTACEA				
ISOPODA				
ASELLIDAE				
	LIRCEUS	FONTINALIS	2.	86.12
DIPTERA				
CHIRONOMIDAE				
CHIRONOMINAE				
	POLYPEDILUM	(SCALAENUM GROUP)	4.	172.24
ORTHOCLADIINAE				
	NANOCLADIUS	SPECILS	4.	172.24
MOLLUSCA				
PELECYPODA				
SPHAERIIDAE				
	SPHAERIUM	STRIATINIUM	8.	344.48

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL NUMBER/SQ M	PERCENT
TUBIFICIDAE	229.	9870.41	90.96
OTHER ANNELIDA	5.	205.63	1.90
CRUSTACEA	2.	86.12	.79
CHIRONOMIDAE	8.	344.48	3.17
PELECYPODA	8.	344.48	3.17
TOTALS	252.	10851.12	100.00

TAXA IN SAMPLE 5

DIVERSITY CALCULATED IN LOG BASE 2

SHANNONS DIVERSITY 1.1427 EVENNESS .3809 REDUNDANCY .6211

MAX. DIVERSITY 3.0000 MIN. DIVERSITY .0096 INFORMATIONAL CONTENT .12400+05

TABLE

BENTHIC DATA FROM GENERAL MOTORS, OLDFORD, INDIANA MAY 20, 1981, 1540 HOURS
SAMPLE NO. 2

COLLECTED AT LOCATION: L-SALT CREEK, STATION , DEPTH 1.0 M, SUBSTRATE CLAY, DETRITUS

PHYSICAL PARAMETERS: TEMPERATURE C F PH

SURFACE 14.C 57.2 7.6

TAXONOMIC IDENTIFICATION			NO./SAMPLE	NUMBER/SQ M
ANNELIDA				
OLIGOCHAETA				
TUBIFICIDAE				
	LIMNODRILUS	HOFFMEISTERI	4.	170.96
	LIMNODRILUS	CLAPAREDIANUS	4.	170.96
	UNIDENT. TUBIFICID	WITH CAP. CHAETAE	4.	170.96
	UNIDENT. TUBIFICID	WITHOUT CAP. CHAET	16.	683.84
ENCHYTRAEIDAE	.....	.....	20.	854.80
CRUSTACEA				
ISOPODA				
ASELLIDAE				
	ASELLUS	SPECIES	40.	1709.60
	LIRCEUS	FONTINALIS	96.	4103.04
AMPHIPODA				
GAMMARIDAE				
	CRANGONYX	SPECIES	4.	170.96
EPHEMEROPTERA				
EPHEMERIDAE				
	HEXAGENIA	SPECIES	8.	341.92
DIPTERA				
CHIRONOMIDAE				
CHIRONOMINAE				
	CHIRONOMUS	SPECIES	4.	170.96
	POLYPEDILUM	(SCALAENUM GROUP)	4.	170.96
LEPIDOPTERA	.....	.....	12.	512.88
MOLLUSCA				
PELECYPODA				
SPHAERIIDAE				
	SPHAERIUM	STRIATINIUM	4.	170.96

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL NUMBER/SQ M	PERCENT
TUBIFICIDAE	28.	1196.72	12.73
OTHER ANNELIDA	20.	854.80	9.09
CRUSTACEA	140.	5983.60	63.64
EPHEMEROPTERA	8.	341.92	3.64
CHIRONOMIDAE	8.	341.92	3.64
COLLEMBOLA-LEPIDOP	12.	512.88	5.45

TABLE

BENTHIC DATA FROM GENERAL MOTORS, BEDFORD, INDIANA MAY 20, 1981, 1540 HOURS
SAMPLE NO. 3

COLLECTED AT LOCATION: L-SALT CREEK, STATION , DEPTH 1.0 M, SUBSTRATE CLAY, DETRITUS

PHYSICAL PARAMETERS: TEMPERATURE C F PH

SURFACE 14.0 57.2 7.6

TAXONOMIC IDENTIFICATION NO./SAMPLE NUMBER/SQ M

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL NUMBER/SQ M	PERCENT
PELECYPODA	4.	170.96	1.82
TOTALS	220.	9402.80	100.00

TAXA IN SAMPLE 13

DIVERSITY CALCULATED IN LOG BASE 2
SHANNONS DIVERSITY 2.6973 EVENNESS .7289 REDUNDANCY .2725
MAX. DIVERSITY 3.7004 MIN. DIVERSITY .0187 INFORMATIONAL CONTENT .25362+05

TABLE

BENTHIC DATA FROM GENERAL MOTORS, BEDFORD, INDIANA — MAY 20, 1981, 1540 HOURS
SAMPLE NO. 4

COLLECTED AT LOCATION: L-SALT CREEK, STATION , DEPTH 1.0 M, SUBSTRATE CLAY, DETRITUS

PHYSICAL PARAMETERS: TEMPERATURE C F PH

SURFACE 14.0 57.2 7.6

TAXONOMIC IDENTIFICATION				NO./SAMPLE	NUMBER/SQ M
ANNELIDA					
OLIGOCHAETA					
TUBIFICIDAE					
	LIMNODRILUS	HOFFMEISTERI	.....	6.	256.44
	UNIDENT. TUBIFICID	WITHOUT CAP. CHAET	.....	26.	1111.24
ENCHYTRAEIDAE	.....		.....	12.	512.88
CRUSTACEA					
ISOPODA					
ASELLIDAE					
	LIRCEUS	FONTINALIS	.....	14.	598.36
DIPTERA					
CHIRONOMIDAE					
CHIRONOMINAE					
	CHIRONOMUS	SPECIES	.....	6.	256.44
MOLLUSCA					
PELECYPODA					
SPHAERIIDAE					
	SPHAERIUM	STRIATINIUM	.....	6.	256.44

TAXONOMIC GROUP	TOTAL NO./SAMPLE	TOTAL NUMBER/SQ M	PERCENT
TUBIFICIDAE	32.	1367.68	45.71
OTHER ANNELIDA	12.	512.88	17.14
CRUSTACEA	14.	598.36	20.00
CHIRONOMIDAE	6.	256.44	8.57
PELECYPODA	6.	256.44	8.57
TOTALS	70.	2991.80	100.00

TAXA IN SAMPLE 6

DIVERSITY CALCULATED IN LOG BASE 2

SHANNONS DIVERSITY	2.3427	EVENNESS	.9063	REDUNDANCY	.0945
MAX. DIVERSITY	2.5850	MIN. DIVERSITY	.0217	INFORMATIONAL CONTENT	.70086+04

TABLE

MEAN, MINIMUM, MAXIMUM, AND PERCENT COMPOSITION OF BENTHIC MACROINVERTEBRATE TAXA FROM THE DISCHAGE STREAM, PLEASANT RUN AND SALT CREEK, FOR GENERAL MOTORS, BEDFORD, INDIANA, MAY 19-20,1981

SPECIES NAME		STATION B-DISCHARGE NUMBER/SQ M				STATION C-PLEASANT R NUMBER/SQ M			
		MEAN	MIN.	MAX.	PERCENT	MEAN	MIN.	MAX.	PERCENT
NAIS	COMMUNIS	.00	.00	.00	.00	51.11	.00	193.68	5.01
NAIS	BRETSCHERI	.00	.00	.00	.00	2.69	.00	10.76	.26
NAIS	PARDALIS	.00	.00	.00	.00	13.45	.00	43.04	1.32
TOTAL OF NAIDIDAE		.00	.00	.00	.00	139.88	.00	494.96	13.72
OTHER ANNELIDA									
ENCHYTRAEIDAE									
MOOREODRILA	MICROSTOMA	13.45	.00	43.04	8.47	2.69	.00	10.76	.26
		.00	.00	.00	.00	.00	.00	.00	.00
TOTAL OF OTHER ANNELIDA		13.45	.00	43.04	8.47	2.69	.00	10.76	.26
CRUSTACEA									
ASELLUS	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
LIRCEUS	FONTINALIS	16.14	.00	43.04	10.17	567.59	.00	2022.68	55.67
CRANGONYX	SPECIES	.00	.00	.00	.00	2.69	.00	10.76	.26
AESTACIDAE		.00	.00	.00	.00	.00	.00	.00	.00
TOTAL OF CRUSTACEA		16.14	.00	43.04	10.17	570.28	.00	2033.64	55.94
HYDRACARINA									
HYDRACARINA		5.38	.00	10.76	3.39	.00	.00	.00	.00
TOTAL OF HYDRACARINA		5.38	.00	10.76	3.39	.00	.00	.00	.00
EPHEMEROPTERA									
HEPTAGENIIDAE		.00	.00	.00	.00	.00	.00	.00	.00

TABLE

MEAN, MINIMUM, MAXIMUM, AND PERCENT COMPOSITION OF BENTHIC MACROINVERTEBRATE TAXA FROM THE DISCHAGE STREAM, PLEASANT RUN AND SALT CREEK, FOR GENERAL MOTORS, BEDFORD, INDIANA, MAY 19-20,1951

SPECIES NAME		STATION B-DISCHARGE NUMBER/SQ M				STATION C-PLEASANT R NUMBER/SQ M			
		MEAN	MIN.	MAX.	PERCENT	MEAN	MIN.	MAX.	PERCENT
MISCELLANEOUS									
HYDRA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
PLANARIIDAE		.00	.00	.00	.00	5.38	.00	10.76	.53
NEMATODA		2.69	.00	10.76	1.69	5.38	.00	21.52	.53
TOTAL OF MISCELLANEOUS		2.69	.00	10.76	1.69	10.76	.00	32.28	1.06
TUBIFICIDAE									
OLIGOCHAETA		.00	.00	.00	.00	.00	.00	.00	.00
LIMNODRILUS	PROFUNDICOLA	.00	.00	.00	.00	.00	.00	.00	.00
LIMNODRILUS	HOFFMEISTERI	10.76	.00	43.04	6.78	5.38	.00	21.52	.53
LIMNODRILUS	CLAPAREDIANUS	.00	.00	.00	.00	.00	.00	.00	.00
LIMNODRILUS	UDEKEMIANUS	40.35	21.52	64.56	25.42	.00	.00	.00	.00
LIMNODRILUS	CERVIX	.00	.00	.00	.00	.00	.00	.00	.00
ILYODRILUS	TEMPLETONI	.00	.00	.00	.00	.00	.00	.00	.00
AULODRILUS	PIGUETI	.00	.00	.00	.00	.00	.00	.00	.00
BRANCHIURA	SOWERBYI	.00	.00	.00	.00	.00	.00	.00	.00
UNIDENT. TUBIFICID	WITH CAP. CHAETAE	.00	.00	.00	.00	.00	.00	.00	.00
UNIDENT. TUBIFICID	WITHOUT CAP. CHAET	24.21	.00	53.80	15.25	5.38	.00	10.76	.53
TOTAL OF TUBIFICIDAE		75.32	21.52	139.68	47.46	8.07	.00	32.28	.79
NAIDIDAE						18.83	.00	43.04	1.85
PRISTINA	IDRENSIS	.00	.00	.00	.00	24.21	.00	75.32	2.37
PRISTINA	FORELI	.00	.00	.00	.00	2.69	.00	10.76	.26
DERO	DIGITATA	.00	.00	.00	.00	.00	.00	.00	.00
SLAVINA	APPENDICULATA	.00	.00	.00	.00	45.73	.00	172.16	4.49

TABLE

MEAN, MINIMUM, MAXIMUM, AND PERCENT COMPOSITION OF BENTHIC MACROINVERTEBRATE TAXA FROM THE DISCHAGE STREAM, PLEASANT RUN AND SALT CREEK, FOR GENERAL MOTORS, BEDFORD, INDIANA, MAY 19-20,1981

SPECIES NAME		STATION B-DISCHARGE NUMBER/SQ M				STATION C-PLEASANT R NUMBER/SQ M			
		MEAN	MIN.	MAX.	PERCENT	MEAN	MIN.	MAX.	PERCENT
BAETIS	SPECIES	.00	.00	.00	.00	5.38	.00	21.52	.53
CAENIS	SPECIES	.00	.00	.00	.00	29.59	.00	53.80	2.90
PARALEPTOPHLEBIA	SPECIES	.00	.00	.00	.00	13.45	.00	32.28	1.32
HEXAGENIA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
ISONYCHIA	SPECIES	.00	.00	.00	.00	2.69	.00	10.76	.26
TOTAL OF EPHEMEROPTERA		.00	.00	.00	.00	51.11	.00	119.36	5.01
ODONATA									
GOMPHUS	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
LESTES	SPECIES	2.69	.00	10.76	1.69	.00	.00	.00	.00
TOTAL OF ODONATA		2.69	.00	10.76	1.69	.00	.00	.00	.00
MEGALOPTERA-NEUROP									
SIALIS	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
TOTAL OF MEGALOPTERA-NEUROP		.00	.00	.00	.00	.00	.00	.00	.00
TRICHOPTERA									
HYDROPSYCHIDAE		.00	.00	.00	.00	2.69	.00	10.76	.26
TOTAL OF TRICHOPTERA		.00	.00	.00	.00	2.69	.00	10.76	.26
COLEOPTERA									
DUBIRAPHIA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00

TABLE

MEAN, MINIMUM, MAXIMUM, AND PERCENT COMPOSITION OF BENTHIC MACROINVERTEBRATE TAXA FROM THE DISCHAGE STREAM, PLEASANT RUN AND SALT CREEK, FOR GENERAL MOTORS, BLDFORD, INDIANA, MAY 19-20,1981

SPECIES NAME		STATION B-DISCHARGE NUMBER/SQ M				STATION C-PLEASANT R NUMBER/SQ M			
		MEAN	MIN.	MAX.	PERCENT	MEAN	MIN.	MAX.	PERCENT
STENELMIS	SPECIES	.00	.00	.00	.00	29.59	.00	86.08	2.90
ECTOPRIA	NERVOSA	.00	.00	.00	.00	2.69	.00	10.76	.26
PSEPHUS	HERRICKI	.00	.00	.00	.00	2.69	.00	10.76	.26
TOTAL OF COLEOPTERA		.00	.00	.00	.00	34.97	.00	86.08	3.43
DIPTERA GRP I									
TIPULIDAE									
PSYCHODA	SPECIES	.00	.00	.00	.00	2.69	.00	10.76	.26
CERATOPOGONIDAE		2.69	.00	10.76	1.69	.00	.00	.00	.00
TOTAL OF DIPTERA GRP I		5.38	.00	21.52	3.39	.00	.00	.00	.00
CHIRONOMIDAE		8.07	.00	32.28	5.08	2.69	.00	10.76	.26
THIENEMANNIMYIA	GROUP	2.69	.00	10.76	1.69	.00	.00	.00	.00
PROCLADIUS	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
LARSIA	SPECIES	.00	.00	.00	.00	2.69	.00	10.76	.26
CHIRONOMUS	SPECIES	2.69	.00	10.76	1.69	10.76	.00	32.28	1.06
CRYPTOCHIRONOMUS	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
HARNISCHIA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
MICROTENDIPES	SPECIES	.00	.00	.00	.00	10.76	.00	21.52	1.06
PARACLADOPELMA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
PARATENDIPES	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
PHAENOPSECTRA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
POLYPEDILUM	SPECIES	.00	.00	.00	.00	2.69	.00	10.76	.26
POLYPEDILUM	(FALLAX GROUP)	.00	.00	.00	.00	.00	.00	.00	.00
POLYPEDILUM	(CONVICTUM GROUP)	5.38	.00	21.52	3.39	.00	.00	.00	.00
POLYPEDILUM	(SCALAENUM GROUP)	.00	.00	.00	.00	2.69	.00	10.76	.26
POLYPEDILUM	(SIMULANS GROUP)	.00	.00	.00	.00	.00	.00	.00	.00

TABLE

MEAN, MINIMUM, MAXIMUM, AND PERCENT COMPOSITION OF BENTHIC MACROINVERTEBRATE TAXA FROM THE DISCHAGE STREAM, PLEASANT RUN AND SALT CREEK, FOR GENERAL MOTORS, BEDFORD, INDIANA, MAY 19-20,1981

SPECIES NAME		STATION B-DISCHARGE NUMBER/SQ M				STATION C-PLEASANT R NUMBER/SQ M			
		MEAN	MIN.	MAX.	PERCENT	MEAN	MIN.	MAX.	PERCENT
STICTOCHIRONOMUS	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
TANYTARSUS	SPECIES	.00	.00	.00	.00	26.90	.00	53.80	2.64
RHEOTANYTARSUS	SPECIES	.00	.00	.00	.00	2.69	.00	10.76	.26
TRIFELOS	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
CLADOPELMA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
DICROTENDIPES	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
CLADOTANYTARSUS	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
PARATANYTARSUS	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
STEMPELLINELLA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
PAGASTIELLA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
CONSTEMPELLINA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
ORTHOCLADIINAE	PUPA	.00	.00	.00	.00	.00	.00	.00	.00
CORYNONEURA	SPECIES	.00	.00	.00	.00	2.69	.00	10.76	.26
CRICOTOPUS	SPECIES	.00	.00	.00	.00	2.69	.00	10.76	.26
HETEROTRISSOCLAD.	SPECIES	21.52	.00	64.56	13.56	94.15	10.76	225.96	9.23
EUKIEFFERIELLA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
SMITTIA	SPECIES	.00	.00	.00	.00	16.14	.00	64.56	1.58
PARAMIEFFERIELLA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
RHEOCRICOTOPUS	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
BRILLIA	SPECIES	.00	.00	.00	.00	5.38	.00	10.76	.53
NANOCLADIUS	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
PARAMETRIOCNEMUS	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
		2.69	.00	10.76	1.69	.00	.00	.00	.00
TOTAL OF CHIRONOMIDAE		34.97	.00	86.08	22.03	180.23	129.12	419.64	17.68
COLLEMBOLA-LEPIDOP									
LEPIDOPTERA		.00	.00	.00	.00	.00	.00	.00	.00
TOTAL OF COLLEMBOLA-LEPILOP		.00	.00	.00	.00	.00	.00	.00	.00
GASTROPODA									
LYMNAEA	SPECIES	.00	.00	.00	.00	5.38	.00	21.52	.53

TABLE

MEAN, MINIMUM, MAXIMUM, AND PERCENT COMPOSITION OF BENTHIC MACROINVERTEBRATE TAXA FROM THE DISCHAGE STREAM, PLEASANT RUN AND SALT CREEK, FOR GENERAL MOTORS, BEDFORD, INDIANA, MAY 19-20,1981

SPECIES NAME		STATION B-DISCHARGE NUMBER/SQ M MEAN	MIN.	MAX.	PERCENT	STATION C-PLEASANT R NUMBER/SQ M MEAN	MIN.	MAX.	PERCENT
PHYSA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
TOTAL OF GASTROPODA		.00	.00	.00	.00	5.38	.00	21.52	.53
PELECYPODA									
SPHAERIUM	STRIATINUM	.00	.00	.00	.00	.00	.00	.00	.00
CORBICULA	MANILENSIS	.00	.00	.00	.00	.00	.00	.00	.00
TOTAL OF PELECYPODA		.00	.00	.00	.00	.00	.00	.00	.00
STATION MEAN TOTAL		158.71			100.00	1019.51			100.00
TOTAL NUMBER OF SAMPLES		4				4			
NUMBER OF SPECIES		15				36			
MAXIMUM NUMBER OF SPECIES AT ALL STATIONS		87							
DIVERSITY CALCULATED IN LOG BASE 2									
SHANNONS DIVERSITY		2.2771				2.1207			
ASSOCIATED EVENNESS		.9176				.5340			
REDUNDANCY		.0944				.2272			

TABLE

MEAN, MINIMUM, MAXIMUM, AND PERCENT COMPOSITION OF BENTHIC MACROINVERTEBRATE TAXA FROM THE DISCHAGE STREAM, PLEASANT RUN AND SALT CREEK, FOR GENERAL MOTORS, BEDFORD, INDIANA, MAY 19-20,1981

SPECIES NAME		STATION D-PLEASANT R NUMBER/SQ M MEAN	MIN.	MAX.	PERCENT	STATION E-PLEASANT R NUMBER/SQ M MEAN	MIN.	MAX.	PERCENT
NAIS	COMMUNIS	52.32	.00	129.16	.39	.00	.00	.00	.00
NAIS	BRETSCHERI	.00	.00	.00	.00	.00	.00	.00	.00
NAIS	PARDALIS	773.08	344.48	1550.16	5.65	10.76	.00	43.06	.13
TOTAL OF NAIDIDAE		893.49	344.48	1808.52	6.51	10.76	.00	43.06	.13
OTHER ANNELIDA									
ENCHYTRAEIDAE		.00	.00	.00	.00	.00	.00	.00	.00
MOOREODRILA	MICROSTOMA	.00	.00	.00	.00	.00	.00	.00	.00
TOTAL OF OTHER ANNELIDA		.00	.00	.00	.00	.00	.00	.00	.00
CRUSTACEA									
ASELLUS	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
LIRCEUS	FONTINALIS	115.41	.00	258.76	.86	.00	.00	.00	.00
CRANGONYX	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
AESTACIDAE		.00	.00	.00	.00	.00	.00	.00	.00
TOTAL OF CRUSTACEA		115.41	.00	258.36	.86	.00	.00	.00	.00
HYDRACARINA									
HYDRACARINA		21.53	.00	86.12	.16	.00	.00	.00	.00
TOTAL OF HYDRACARINA		21.53	.00	86.12	.16	.00	.00	.00	.00
EPHEMEROPTERA									
HEPTAGENIIDAE		.00	.00	.00	.00	.00	.00	.00	.00

TABLE

MEAN, MINIMUM, MAXIMUM, AND PERCENT COMPOSITION OF BENTHIC MACROINVERTEBRATE TAXA FROM THE DISCHAGE STREAM, PLEASANT RUN AND SALT CREEK, FOR GENERAL MOTORS, BEDFORD, INDIANA, MAY 19-20,1981

SPECIES NAME		STATION D-PLEASANT R NUMBER/SQ M				STATION E-PLEASANT R NUMBER/SQ M			
		MEAN	MIN.	MAX.	PERCENT	MEAN	MIN.	MAX.	PERCENT
MISCELLANEOUS									
HYDRA	SPECIES	150.71	.00	516.72	1.10	.00	.00	.00	.00
PLANARIIDAE		.00	.00	.00	.00	.00	.00	.00	.00
NEMATODA		43.06	.00	86.12	.31	64.59	.00	129.18	.78
TOTAL OF MISCELLANEOUS		193.77	.00	602.84	1.41	64.59	.00	129.18	.78
TUBIFICIDAE									
OLIGOCHAETA		.00	.00	.00	.00	.00	.00	.00	.00
LIMNODRILUS	PROFUNDICOLA	.00	.00	.00	.00	.00	.00	.00	.00
LIMNODRILUS	HOFFMEISTERI	129.18	.00	258.36	.94	2463.99	43.06	5526.03	29.93
LIMNODRILUS	CLAPAREDIANUS	.00	.00	.00	.00	.00	.00	.00	.00
LIMNODRILUS	UDEKEMIANUS	.00	.00	.00	.00	163.67	.00	368.40	1.99
LIMNODRILUS	CERVIX	.00	.00	.00	.00	.00	.00	.00	.00
ILYODRILUS	TEMPLETONI	.00	.00	.00	.00	.00	.00	.00	.00
AULODRILUS	PIGUETI	21.53	.00	86.12	.16	.00	.00	.00	.00
BRANCHIURA	SOWERBYI	.00	.00	.00	.00	.00	.00	.00	.00
UNIDENT. TUBIFICID WITH CAP. CHAETAE		.00	.00	.00	.00	53.23	.00	212.91	.65
UNIDENT. TUBIFICID WITHOUT CAP. CHAET		161.47	.00	344.48	1.18	3236.89	172.24	6631.24	39.32
TOTAL OF TUBIFICIDAE		312.18	.00	602.84	2.27	5917.76	215.30	12525.68	71.89
NAIDIDAE									
PRISTINA	ISPENSIS	21.53	.00	86.12	.16	.00	.00	.00	.00
PRISTINA	FOREL I	.00	.00	.00	.00	.00	.00	.00	.00
DERO	DIGITATA	43.06	.00	172.24	.31	.00	.00	.00	.00
SLAVINA	APPENDICULATA	.00	.00	.00	.00	.00	.00	.00	.00

TABLE

MEAN, MINIMUM, MAXIMUM, AND PERCENT COMPOSITION OF BENTHIC MACROINVERTEBRATE TAXA FROM THE DISCHAGE STREAM, PLEASANT RUN AND SALT CREEK, FOR GENERAL MOTORS, BEDFORD, INDIANA, MAY 19-20,1981

SPECIES NAME		STATION D-PLEASANT R NUMBER/SQ M				STATION E-PLEASANT R NUMBER/SQ M			
		MEAN	MIN.	MAX.	PERCENT	MEAN	MIN.	MAX.	PERCENT
BAETIS	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
CAENIS	SPECIES	473.66	86.12	775.08	3.45	21.53	.00	86.12	.26
PARALEPTOPHLEBIA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
HEXAGENIA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
ISONYCHIA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
TOTAL OF EPHEMEROPTERA		473.66	86.12	775.08	3.45	21.53	.00	86.12	.26
ODONATA									
GOMPHUS	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
LESTES	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
TOTAL OF ODONATA		.00	.00	.00	.00	.00	.00	.00	.00
MEGALOPTERA-NEUROP									
SIALIS	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
TOTAL OF MEGALOPTERA-NEUROP		.00	.00	.00	.00	.00	.00	.00	.00
TRICHOPTERA									
HYDROPSYCHIDAE		.00	.00	.00	.00	.00	.00	.00	.00
TOTAL OF TRICHOPTERA		.00	.00	.00	.00	.00	.00	.00	.00
COLEOPTERA									
DUBIRAPHIA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00

TABLE

MEAN, MINIMUM, MAXIMUM, AND PERCENT COMPOSITION OF BENTHIC MACROINVERTEBRATE TAXA FROM THE DISCHAGE STREAM, PLEASANT RUN AND SALT CREEK, FOR GENERAL MOTORS, BLDFORD, INDIANA, MAY 19-20,1981

SPECIES NAME		STATION D-PLEASANT R NUMBER/SQ M				STATION E-PLEASANT R NUMBER/SQ M			
		MEAN	MIN.	MAX.	PERCENT	MEAN	MIN.	MAX.	PERCENT
STENELMIS	SPECIES	.00	.00	.00	.00	10.76	.00	43.06	.13
ECTOPRIA	NERVOSA	.00	.00	.00	.00	.00	.00	.00	.00
PSEPHUS	HERRICKI	.00	.00	.00	.00	.00	.00	.00	.00
TOTAL OF COLEOPTERA		.00	.00	.00	.00	10.76	.00	43.06	.13
DIPTERA ORD I									
TIPULIDAE		.00	.00	.00	.00	.00	.00	.00	.00
PSYCHODA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
CERATOPOGONIDAE		10.76	.00	43.06	.08	.00	.00	.00	.00
TOTAL OF DIPTERA ORD I		10.76	.00	43.06	.08	.00	.00	.00	.00
CHIRONOMIDAE									
THIENEMANNIMYIA	GROUP	.00	.00	.00	.00	10.76	.00	43.06	.13
PROCLADIUS	SPECIES	237.31	.00	564.76	1.70	21.53	.00	86.12	.26
LARSIA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
CHIRONOMUS	SPECIES	2269.03	576.45	5552.35	16.65	64.59	.00	129.18	.78
CRYPTOCHIRONOMUS	SPECIES	107.12	.00	429.50	.78	.00	.00	.00	.00
HARNISCHIA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
MICROTENDIPES	SPECIES	57.64	.00	230.58	.42	51.52	.00	206.07	.63
PARACLADOPELMA	SPECIES	107.12	.00	429.50	.78	.00	.00	.00	.00
PARATENDIPES	SPECIES	126.19	.00	564.76	.92	.00	.00	.00	.00
PHAENOPSECTRA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
POLYPEDILUM	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
POLYPEDILUM	(FALLAX GROUP)	.00	.00	.00	.00	.00	.00	.00	.00
POLYPEDILUM	(CONVICTUM GROUP)	.00	.00	.00	.00	10.76	.00	43.06	.13
POLYPEDILUM	(SCALAENUM GROUP)	143.82	.00	575.28	1.05	.00	.00	.00	.00
POLYPEDILUM	(SIMULANS GROUP)	.00	.00	.00	.00	.00	.00	.00	.00

TABLE

MEAN, MINIMUM, MAXIMUM, AND PERCENT COMPOSITION OF BENTHIC MACROINVERTEBRATE TAXA FROM THE DISCHAGE STREAM, PLEASANT RUN AND SALT CREEK, FOR GENERAL MOTORS, BEDFORD, INDIANA, MAY 19-20,1981

SPECIES NAME		STATION D-PLEASANT R NUMBER/SQ M				STATION E-PLEASANT R NUMBER/SQ M			
		MEAN	MIN.	MAX.	PERCENT	MEAN	MIN.	MAX.	PERCENT
STICTOCHIRONOMUS	SPECIES	1164.98	.00	3028.55	8.49	.00	.00	.00	.00
TANYTARSUS	SPECIES	5490.68	1393.48	11140.99	40.00	137.64	43.06	258.36	1.67
RHECTANYTARSUS	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
TRIPELOS	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
CLADOPELMA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
DICROTENDIPES	SPECIES	649.03	230.58	1265.50	4.73	509.03	86.12	1648.58	6.16
CLADOTANYTARSUS	SPECIES	417.15	.00	1009.52	3.04	.00	.00	.00	.00
PARATANYTARSUS	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
STEMPELLINELLA	SPECIES	107.12	.00	428.50	.78	.00	.00	.00	.00	.00
PAGASTIELLA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
CONSTEMPELLINA	SPECIES	.00	.00	.00	.00	10.76	.00	43.06	.13
ORTHOCLADIINAE	PUPA	.00	.00	.00	.00	.00	.00	.00	.00
CORYNONEURA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
CRICOTOPUS	SPECIES	736.98	428.50	1438.20	5.37	1317.17	172.24	3503.24	16.00
HETEROTRISSOCLAD.	SPECIES	.00	.00	.00	.00	51.52	.00	206.07	.63
EUKIEFFERIELLA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
SMITTIA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
PARAMETRIOCNEMUS	SPECIES	.00	.00	.00	.00	21.53	.00	86.12	.26
RHEOCRICOTOPUS	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
BRILLIA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
NANOCLADIUS	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
PARAMETRIOCNEMUS	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
TOTAL OF CHIRONOMIDAE		11626.20	3573.98	19171.32	84.71	2206.82	516.72	5770.04	26.81
COLLEMBOLA-LEPIDOP									
LEPIDOPTERA		.00	.00	.00	.00	.00	.00	.00	.00
TOTAL OF COLLEMBOLA-LEPIDOP		.00	.00	.00	.00	.00	.00	.00	.00
GASTROPODA									
LYMNAEA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00

TABLE

MEAN, MINIMUM, MAXIMUM, AND PERCENT COMPOSITION OF BENTHIC MACROINVERTEBRATE TAXA FROM THE DISCHAGE STREAM, PLEASANT RUN AND SALT CREEK, FOR GENERAL MOTORS, BEDFORD, INDIANA, MAY 19-20,1981

SPECIES NAME		STATION D-PLEASANT R NUMBER/SQ M				STATION E-PLEASANT R NUMBER/SQ M			
		MEAN	MIN.	MAX.	PERCENT	MEAN	MIN.	MAX.	PERCENT
PHYSA	SPECIES	10.76	.00	43.06	.08	.00	.00	.00	.00
TOTAL OF GASTPOPODA		10.76	.00	43.06	.08	.00	.00	.00	.00
PELECYPODA									
SPHAERIUM	STRIATINIUM	64.59	.00	258.36	.47	.00	.00	.00	.00
CORBICULA	MANILENSIS	.00	.00	.00	.00	.00	.00	.00	.00
TOTAL OF PELECYPODA		64.59	.00	258.36	.47	.00	.00	.00	.00
STATION MEAN TOTAL		13725.37			100.00	8232.23			100.00
TOTAL NUMBER OF SAMPLES		4				4			
NUMBER OF SPECIES		28				19			
MAXIMUM NUMBER OF SPECIES AT ALL STATIONS		37							
DIVERSITY CALCULATED IN LOG BASE 2									
SHANNONS DIVERSITY		2.8368				2.0821			
ASSOCIATED EVENNESS		.7491				.6296			
REDUNDANCY		.2520				.3735			

TABLE

MEAN, MINIMUM, MAXIMUM, AND PERCENT COMPOSITION OF BENTHIC MACROINVERTEBRATE TAXA FROM THE DISCHAGE STREAM, PLEASANT RUN AND SALT CREEK, FOR GENERAL MOTORS, BEDFORD, INDIANA, MAY 19-20,1981

SPECIES NAME		STATION F-PLEASANT R NUMBER/SQ M MEAN	MIN.	MAX.	PERCENT	STATION G-PLEASANT R NUMBER/SQ M MEAN	MIN.	MAX.	PERCENT
MISCELLANEOUS									
HYDRA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
PLANARIIDAE		.00	.00	.00	.00	.00	.00	.00	.00
NEMATODA		.00	.00	.00	.00	.00	.00	.00	.00
TOTAL OF MISCELLANEOUS		.00	.00	.00	.00	.00	.00	.00	.00
TUBIFICIDAE									
OLIGOCHAETA		.00	.00	.00	.00	.00	.00	.00	.00
LIMNODRILUS	PROFUNDICOLA	.00	.00	.00	.00	.00	.00	.00	.00
LIMNODRILUS	HOFFMEISTERI	1314.68	215.32	4004.58	54.66	536.02	172.16	1124.62	37.01
LIMNODRILUS	CLAPAREDIANUS	.00	.00	.00	.00	.00	.00	.00	.00
LIMNODRILUS	UDEKEMIANUS	.00	.00	.00	.00	.00	.00	.00	.00
LIMNODRILUS	CERVIX	.00	.00	.00	.00	.00	.00	.00	.00
ILYODRILUS	TEMPLETONI	.00	.00	.00	.00	35.44	.00	66.15	2.45
AULODRILUS	PIGUETI	.00	.00	.00	.00	.00	.00	.00	.00
BRANCHIURA	SOWERBYI	.00	.00	.00	.00	.00	.00	.00	.00
UNIDENT. TUBIFICID	WITH CAP. CHAETAE	.00	.00	.00	.00	68.65	.00	198.46	4.74
UNIDENT. TUBIFICID	WITHOUT CAP. CHAET	950.73	533.94	1980.76	39.53	512.45	129.12	1323.08	35.38
TOTAL OF TUBIFICIDAE		2265.40	775.08	4538.52	94.18	1152.55	312.04	2712.32	79.57
NAIDIDAE									
PRISTINA	IDRENSIS	.00	.00	.00	.00	.00	.00	.00	.00
PRISTINA	FORELI	.00	.00	.00	.00	.00	.00	.00	.00
DERO	DIGITATA	.00	.00	.00	.00	.00	.00	.00	.00
SLAVINA	APPENDICULATA	.00	.00	.00	.00	.00	.00	.00	.00

TABLE

MEAN, MINIMUM, MAXIMUM, AND PERCENT COMPOSITION OF BENTHIC MACROINVERTEBRATE TAXA FROM THE DISCHAGE STREAM, PLEASANT RUN AND SALT CREEK, FOR GENERAL MOTORS, BEDFORD, INDIANA, MAY 19-20,1981

SPECIES NAME		STATION F-PLEASANT R NUMBER/SQ M MEAN	MIN.	MAX.	PERCENT	STATION G-PLEASANT R NUMBER/SQ M MEAN	MIN.	MAX.	PERCENT
NAIS	COMMUNIS	.00	.00	.00	.00	.00	.00	.00	.00
NAIS	BRETSCHERI	.00	.00	.00	.00	.00	.00	.00	.00
NAIS	PAPDALIS	.00	.00	.00	.00	.00	.00	.00	.00
TOTAL OF NAIDIDAE		.00	.00	.00	.00	.00	.00	.00	.00
OTHER ANNELIDA									
ENCHYTRAEIDAE		.00	.00	.00	.00	5.38	.00	21.52	.37
MOOREOBDELA	MICROSTOMA	.00	.00	.00	.00	.00	.00	.00	.00
TOTAL OF OTHER ANNELIDA		.00	.00	.00	.00	5.38	.00	21.52	.37
CRUSTACEA									
ASELLUS	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
LIRCEUS	FONTINALIS	.00	.00	.00	.00	.00	.00	.00	.00
CRANGONYX	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
AESTACIDAE		.00	.00	.00	.00	21.52	.00	86.08	1.49
TOTAL OF CRUSTACEA		.00	.00	.00	.00	21.52	.00	86.08	1.49
HYDRACARINA									
HYDRACARINA		.00	.00	.00	.00	.00	.00	.00	.00
TOTAL OF HYDRACARINA		.00	.00	.00	.00	.00	.00	.00	.00
EPHEMEROPTERA									
HEPTAGENIIDAE		.00	.00	.00	.00	2.69	.00	10.76	.19

TABLE

MEAN, MINIMUM, MAXIMUM, AND PERCENT COMPOSITION OF BENTHIC MACROINVERTEBRATE TAXA FROM THE DISCHAGE STREAM, PLEASANT RUN AND SALT CREEK, FOR GENERAL MOTORS, BEDFORD, INDIANA, MAY 19-20,1951

SPECIES NAME		STATION F-PLEASANT R NUMBER/SQ M				STATION G-PLEASANT R NUMBER/SQ M			
		MEAN	MIN.	MAX.	PERCENT	MEAN	MIN.	MAX.	PERCENT
BAETIS	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
CAENIS	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
PARALEPTOPHLEBIA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
HEXAGENIA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
ISONYCHIA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
TOTAL OF EPHEMEROPTERA		.00	.00	.00	.00	2.69	.00	10.76	.19
ODONATA									
GOMPHUS	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
LESTES	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
TOTAL OF ODONATA		.00	.00	.00	.00	.00	.00	.00	.00
MEGALOPTERA-NEUROP									
SIALIS	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
TOTAL OF MEGALOPTERA-NEUROP		.00	.00	.00	.00	.00	.00	.00	.00
TRICHOPTERA									
HYDROPSYCHIDAE		.00	.00	.00	.00	.00	.00	.00	.00
TOTAL OF TRICHOPTERA		.00	.00	.00	.00	.00	.00	.00	.00
COLEOPTERA									
DUBIRAPHIA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00

TABLE

MEAN, MINIMUM, MAXIMUM, AND PERCENT COMPOSITION OF BENTHIC MACROINVERTEBRATE TAXA FROM THE DISCHAGE STREAM, PLEASANT RUN AND SALT CREEK, FOR GENERAL MOTORS, BEDFORD, INDIANA, MAY 19-20,1951

SPECIES NAME		STATION F-PLEASANT R NUMBER/SQ M				STATION G-PLEASANT R NUMBER/SQ M			
		MEAN	MIN.	MAX.	PERCENT	MEAN	MIN.	MAX.	PERCENT
STENELMIS	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
ECTOPRIA	NERVOSA	.00	.00	.00	.00	.00	.00	.00	.00
PSEPHUS	HERRICKI	.00	.00	.00	.00	.00	.00	.00	.00
TOTAL OF COLEOPTERA		.00	.00	.00	.00	.00	.00	.00	.00
DIPTERA GRP I									
TIPULIDAE									
PSYCHODA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
CERATOPOGONIDAE		.00	.00	.00	.00	.00	.00	.00	.00
TOTAL OF DIPTERA GRP I		.00	.00	.00	.00	.00	.00	.00	.00
CHIRONOMIDAE									
THIENEMANNIMYIA	GROUP	.00	.00	.00	.00	.00	.00	.00	.00
PROCLADIUS	SPECIES	21.53	.00	43.06	.90	19.50	10.76	45.73	1.35
LARSIA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
CHIRONOMUS	SPECIES	32.29	.00	86.12	1.34	154.67	10.76	457.30	10.68
CRYPTOCHIRONOMUS	SPECIES	.00	.00	.00	.00	11.43	.00	45.73	.79
HARNISCHIA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
MICROTENDIPES	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
PARACLADOPELMA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
PARATENDIPES	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
PHAENOPSECTRA	SPECIES	.00	.00	.00	.00	8.07	.00	32.28	.56
POLYPEDILUM	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
POLYPEDILUM	(FALLAX GROUP)	.00	.00	.00	.00	2.69	.00	10.76	.19
POLYPEDILUM	(CONVICTUM GROUP)	10.76	.00	43.06	.45	.00	.00	.00	.00
POLYPEDILUM	(SCALAENUM GROUP)	.00	.00	.00	.00	5.38	.00	10.76	.37
POLYPEDILUM	(SIMULANS GROUP)	.00	.00	.00	.00	.00	.00	.00	.00

TABLE

MEAN, MINIMUM, MAXIMUM, AND PERCENT COMPOSITION OF BENTHIC MACROINVERTEBRATE TAXA FROM THE DISCHAGE STREAM, PLEASANT RUN AND SALT CREEK, FOR GENERAL MOTORS, BEDFORD, INDIANA, MAY 19-20,1981

SPECIES NAME		STATION F-PLEASANT R NUMBER/SQ M				STATION G-PLEASANT R NUMBER/SQ M			
		MEAN	MIN.	MAX.	PERCENT	MEAN	MIN.	MAX.	PERCENT
STICTOCHIRONOMUS	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
TANYTARSUS	SPECIES	.00	.00	.00	.00	2.69	.00	10.76	.19
PHEOTANYTARSUS	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
TRIBELOS	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
CLADOPELMA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
DICROTENDIPES	SPECIES	42.06	.00	129.18	1.79	2.69	.00	10.76	.19
CLADOTANYTARSUS	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
PARATANYTARSUS	SPECIES	.00	.00	.00	.00	2.69	.00	10.76	.19
STEMPELLINELLA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
PAGASTIELLA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
CONSTEMPELLINA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00	.00
ORTHOCLADIINAE	PUPA	.00	.00	.00	.00	.00	.00	.00	.00
CORYNONEURA	SPECIES	.00	.00	.00	.00	5.38	.00	21.52	.37
CRICOTOPUS	SPECIES	10.76	.00	43.06	.45	37.66	.00	107.60	2.60
HETEROTRISSOCLAD.	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
EUKIEFFERIELLA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
SMITTIA	SPECIES	.00	.00	.00	.00	2.69	.00	10.76	.19
PARAMEIFFERIELLA	SPECIES	10.76	.00	43.06	.45	.00	.00	.00	.00
RHEOCRICOTOPUS	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
BRILLIA	SPECIES	.00	.00	.00	.00	5.38	.00	21.52	.37
NANOCLADIUS	SPECIES	.00	.00	.00	.00	2.69	.00	10.76	.19
PARAMITRICHNEMUS	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
TOTAL OF CHIRONOMIDAE		129.18	.00	256.36	5.37	263.62	53.80	548.76	18.20
COLLEMBOLA-LEPIDOP									
LEPIDOPTERA		.00	.00	.00	.00	.00	.00	.00	.00
TOTAL OF COLLEMBOLA-LEPIDOP		.00	.00	.00	.00	.00	.00	.00	.00
GASTROPODA									
LYMNAEA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00

TABLE

MEAN, MINIMUM, MAXIMUM, AND PERCENT COMPOSITION OF BENTHIC MACROINVERTEBRATE TAXA FROM THE DISCHAGE STREAM, PLEASANT RUN AND SALT CREEK, FOR GENERAL MOTORS, BEDFORD, INDIANA, MAY 19-20,1981

SPECIES NAME		STATION F-PLEASANT R NUMBER/SQ M MEAN	MIN.	MAX.	PERCENT	STATION G-PLEASANT R NUMBER/SQ M MEAN	MIN.	MAX.	PERCENT
PHYSA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
TOTAL OF GASTROPODA		.00	.00	.00	.00	.00	.00	.00	.00
PELECYPODA									
SPHAERIUM	STRIATINIUM	10.76	.00	43.06	.45	2.69	.00	10.76	.19
CORBICULA	MANILLENSIS	.00	.00	.00	.00	.00	.00	.00	.00
TOTAL OF PELECYPODA		10.76	.00	43.06	.45	2.69	.00	10.76	.19
STATION MEAN TOTAL		2405.35			100.00	1448.45			100.00
TOTAL NUMBER OF SAMPLES		4				4			
NUMBER OF SPECIES		9				22			
MAXIMUM NUMBER OF SPECIES AT ALL STATIONS		87							
DIVERSITY CALCULATED IN LOG BASE 2									
SHANNONS DIVERSITY		1.1405				2.3334			
ASSOCIATED EVENNESS		.6126				.7119			
REDUNDANCY		.3911				.2970			

TABLE

MEAN, MINIMUM, MAXIMUM, AND PERCENT COMPOSITION OF BENTHIC MACROINVERTEBRATE TAXA FROM THE DISCHAGE STREAM, PLEASANT RUN AND SALT CREEK, FOR GENERAL MOTORS, BEDFORD, INDIANA, MAY 19-20,1981

SPECIES NAME		STATION I-SALT CREEK NUMBER/SQ M MEAN	MIN.	MAX.	PERCENT	STATION J-SALT CREEK NUMBER/SQ M MEAN	MIN.	MAX.	PERCENT
MISCELLANEOUS									
HYDRA	SPECIES	10.76	.00	43.06	1.45	10.76	.00	43.06	2.08
PLANARIIDAE		.00	.00	.00	.00	.00	.00	.00	.00
NEMATODA		.00	.00	.00	.00	.00	.00	.00	.00
TOTAL OF MISCELLANEOUS		10.76	.00	43.06	1.45	10.76	.00	43.06	2.08
TUBIFICIDAE									
OLIGOCHAETA		.00	.00	.00	.00	.00	.00	.00	.00
LIMNODRILUS	PROFUNDICOLA	.00	.00	.00	.00	.00	.00	.00	.00
LIMNODRILUS	HOFFMEISTERI	10.76	.00	43.06	1.45	.00	.00	.00	.00
LIMNODRILUS	CLAPAREDIANUS	.00	.00	.00	.00	.00	.00	.00	.00	.00
LIMNODRILUS	UDEKEMIANUS	.00	.00	.00	.00	.00	.00	.00	.00
LIMNODRILUS	CERVIX	.00	.00	.00	.00	.00	.00	.00	.00
ILYODRILUS	TEMPLETONI	53.82	.00	172.24	7.25	21.53	.00	86.12	4.17
AULODRILUS	PIGUETI	.00	.00	.00	.00	.00	.00	.00	.00
BRANCHIURA	SOWERBYI	21.53	.00	43.06	2.90	.00	.00	.00	.00
UNIDENT. TUBIFICID	WITH CAP. CHAETAE	21.53	.00	43.06	2.90	43.06	.00	172.24	8.33
UNIDENT. TUBIFICID	WITHOLT CAP. CHAET	43.06	43.06	43.06	5.80	53.82	.00	129.18	10.42
TOTAL OF TUBIFICIDAE		150.71	43.06	215.30	20.29	118.41	.00	344.48	22.92
NAIDIDAE									
PRISTINA	IDRENSIS	.00	.00	.00	.00	.00	.00	.00	.00
PRISTINA	FOREL I	.00	.00	.00	.00	.00	.00	.00	.00
DERO	DIGITATA	.00	.00	.00	.00	.00	.00	.00	.00
SLAVINA	APPENDICULATA	.00	.00	.00	.00	.00	.00	.00	.00

TABLE

MEAN, MINIMUM, MAXIMUM, AND PERCENT COMPOSITION OF BENTHIC MACROINVERTEBRATE TAXA FROM THE DISCHAGE STREAM, PLEASANT RUN AND SALT CREEK, FOR GENERAL MOTORS, BLDFORD, INDIANA, MAY 19-20,1981

SPECIES NAME		STATION I-SALT CREEK NUMBER/SQ M				STATION J-SALT CREEK NUMBER/SQ M			
		MEAN	MIN.	MAX.	PERCENT	MEAN	MIN.	MAX.	PERCENT
NAIS	COMMUNIS	.00	.00	.00	.00	.00	.00	.00	.00
NAIS	PRETSCHERI	.00	.00	.00	.00	.00	.00	.00	.00
NAIS	PARDALIS	10.76	.00	43.06	1.45	32.29	.00	129.18	6.25
TOTAL OF NAIDIDAE		10.76	.00	43.06	1.45	32.29	.00	129.18	6.25
OTHER ANNELIDA									
ENCHYTRAEIDAE		.00	.00	.00	.00	.00	.00	.00	.00
MOOREODRILA	MICROSTOMA	.00	.00	.00	.00	.00	.00	.00	.00
TOTAL OF OTHER ANNELIDA		.00	.00	.00	.00	.00	.00	.00	.00
CRUSTACEA									
ASELLUS	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
LIRCEUS	FONTINALIS	107.65	43.06	172.24	14.49	96.88	.00	344.48	18.75
CRANGONYX	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
AESTACIDAE		.00	.00	.00	.00	.00	.00	.00	.00
TOTAL OF CRUSTACEA		107.65	43.06	172.24	14.49	96.88	.00	344.48	18.75
HYDRACARINA									
HYDRACARINA		.00	.00	.00	.00	.00	.00	.00	.00
TOTAL OF HYDRACARINA		.00	.00	.00	.00	.00	.00	.00	.00
EPHEMEROPTERA									
HEPTAGENIIDAE		.00	.00	.00	.00	.00	.00	.00	.00

TABLE

MEAN, MINIMUM, MAXIMUM, AND PERCENT COMPOSITION OF BENTHIC MACROINVERTEBRATE TAXA FROM THE DISCHAGE STREAM, PLEASANT RUN AND SALT CREEK, FOR GENERAL MCTOPS, BEDFORD, INDIANA, MAY 19-20,1981

SPECIES NAME		STATION I-SALT CREEK NUMBER/SQ M				STATION J-SALT CREEK NUMBER/SQ M			
		MEAN	MIN.	MAX.	PERCENT	MEAN	MIN.	MAX.	PERCENT
BAETIS	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
CAENIS	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
PARALEPTOPHLEBIA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
HEXAGENIA	SPECIES	21.53	.00	43.06	2.90	21.53	.00	86.12	4.17
ISONYCHIA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
TOTAL OF EPHEMEROPTERA		21.53	.00	43.06	2.90	21.53	.00	86.12	4.17
ODONATA									
GOMPHUS	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
LESTES	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
TOTAL OF ODONATA		.00	.00	.00	.00	.00	.00	.00	.00
MEGALOPTERA-NEUROP									
SIALIS	SPECIES	21.53	.00	86.12	2.90	.00	.00	.00	.00
TOTAL OF MEGALOPTERA-NEUROP		21.53	.00	86.12	2.90	.00	.00	.00	.00
TRICHOPTERA									
HYDROPSYCHIDAE		.00	.00	.00	.00	.00	.00	.00	.00
TOTAL OF TRICHOPTERA		.00	.00	.00	.00	.00	.00	.00	.00
COLEOPTERA									
DUBIRAPHIA	SPECIES	10.76	.00	43.06	1.45	.00	.00	.00	.00

TABLE

MEAN, MINIMUM, MAXIMUM, AND PERCENT COMPOSITION OF BENTHIC MACROINVERTEBRATE TAXA FROM THE DISCHAGE STREAM, PLEASANT RUN AND SALT CREEK, FOR GENERAL MOTORS, BEDFORD, INDIANA, MAY 19-20,1981

SPECIES NAME		STATION I-SALT CREEK NUMBER/SQ M				STATION J-SALT CREEK NUMBER/SQ M			
		MEAN	MIN.	MAX.	PERCENT	MEAN	MIN.	MAX.	PERCENT
STENELMIS	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
ECTOPRIA	NERVOSA	.00	.00	.00	.00	.00	.00	.00	.00
PSEPHUS	HERRICKI	.00	.00	.00	.00	.00	.00	.00	.00
TOTAL OF COLEOPTERA		10.76	.00	43.06	1.45	.00	.00	.00	.00
DIPTERA ORD I									
TIPULIDAE		10.76	.00	43.06	1.45	.00	.00	.00	.00
PSYCHODA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
CERATOPOGONIDAE		10.76	.00	43.06	1.45	.00	.00	.00	.00
TOTAL OF DIPTERA ORD I		21.53	.00	86.12	2.90	.00	.00	.00	.00
CHIRONOMIDAE									
THIENEMANNIMYIA	GROUP	10.76	.00	43.06	1.45	.00	.00	.00	.00
PROCLADIUS	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
LARSIA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
CHIRONOMUS	SPECIES	.00	.00	.00	.00	75.35	.00	258.36	14.58
CRYPTOCHIRONOMUS	SPECIES	10.76	.00	43.06	1.45	.00	.00	.00	.00
HARNISCHIA	SPECIES	.00	.00	.00	.00	32.29	.00	129.18	6.25
MICROTENDIPES	SPECIES	.00	.00	.00	.00	10.76	.00	43.06	2.08
PARACLADOPELMA	SPECIES	10.76	.00	43.06	1.45	.00	.00	.00	.00
PARATENDIPES	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
PHAENOPSECTRA	SPECIES	.00	.00	.00	.00	21.53	.00	86.12	4.17
POLYPEDILUM	SPECIES	10.76	.00	43.06	1.45	.00	.00	.00	.00
POLYPEDILUM	(FALLAX GROUP)	.00	.00	.00	.00	.00	.00	.00	.00
POLYPEDILUM	(CONVICTUM GROUP)	.00	.00	.00	.00	.00	.00	.00	.00
POLYPEDILUM	(SCALAENUM GROUP)	21.53	.00	86.12	2.90	21.53	.00	86.12	4.17
POLYPEDILUM	(SIMULANS GROUP)	43.06	.00	86.12	5.80	10.76	.00	43.06	2.08

TABLE

MEAN, MINIMUM, MAXIMUM, AND PERCENT COMPOSITION OF BENTHIC MACROINVERTEBRATE TAXA FROM THE DISCHAGE STREAM, PLEASANT RUN AND SALT CREEK, FOR GENERAL MOTORS, BEDFORD, INDIANA, MAY 19-20,1981

SPECIES NAME		STATION I-SALT CREEK NUMBER/SQ M				STATION J-SALT CREEK NUMBER/SQ M			
		MEAN	MIN.	MAX.	PERCENT	MEAN	MIN.	MAX.	PERCENT
STICTOCHIRONOMUS	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
TANYTARSUS	SPECIES	10.76	.00	43.06	1.45	.00	.00	.00	.00
RHEOTANYTARSUS	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
TRIELLOS	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
CLADOPELMA	SPECIES	53.82	.00	215.30	7.25	.00	.00	.00	.00
DICROTENDIPES	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
CLADOTANYTARSUS	SPECIES	21.53	.00	43.06	2.90	.00	.00	.00	.00
PARATANYTARSUS	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
STEMPELLINELLA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
PAGASTIELLA	SPECIES	10.76	.00	43.06	1.45	.00	.00	.00	.00
CONSTEMPELLINA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
ORTHOCLADIINAE	PUPA	.00	.00	.00	.00	.00	.00	.00	.00
CORYNONEURA	SPECIES	10.76	.00	43.06	1.45	.00	.00	.00	.00
CRICOTOPUS	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
HETEROTRISSOCLAD.	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
EUKIEFFERIELLA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
SMITTIA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
PARAKIEFFERIELLA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
RHEOCRICOTOPUS	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
BRILLIA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
NANOCLADIUS	SPECIES	10.76	.00	43.06	1.45	.00	.00	.00	.00
PARAMETRIOCNEMUS	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
TOTAL OF CHIRONOMIDAE		226.06	.00	430.60	30.43	172.24	.00	516.72	33.33
COLLEMBOLA-LEPIDOP									
LEPIDOPTERA		.00	.00	.00	.00	.00	.00	.00	.00
TOTAL OF COLLEMBOLA-LEPIDOP		.00	.00	.00	.00	.00	.00	.00	.00
GASTROPODA									
LYMNAEA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00

TABLE

MEAN, MINIMUM, MAXIMUM, AND PERCENT COMPOSITION OF BENTHIC MACROINVERTEBRATE TAXA FROM THE DISCHAGE STREAM, PLEASANT RUN AND SALT CREEK, FOR GENERAL MOTORS, BEDFORD, INDIANA, MAY 19-20,1981

SPECIES NAME		STATION 1-SALT CREEK NUMBER/SQ M MEAN	MIN.	MAX.	PERCENT	STATION J-SALT CREEK NUMBER/SQ M MEAN	MIN.	MAX.	PERCENT
PHYSA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
TOTAL OF GASTROPODA		.00	.00	.00	.00	.00	.00	.00	.00
PELECYPODA									
SPHAERIUM	STRIATINIUM	150.71	.00	387.54	20.29	53.82	.00	172.24	10.42
CORBICULA	MANILENSIS	10.76	.00	43.06	1.45	10.76	.00	43.06	2.08
TOTAL OF PELECYPODA		161.47	.00	387.54	21.74	64.59	.00	172.24	12.50
STATION MEAN TOTAL		742.78			100.00	516.72			100.00
TOTAL NUMBER OF SAMPLES		4				4			
NUMBER OF SPECIES		27				15			
MAXIMUM NUMBER OF SPECIES AT ALL STATIONS		27							
DIVERSITY CALCULATED IN LOG BASE 2									
SHANNONS DIVERSITY		2.9021				1.6592			
ASSOCIATED EVENNESS		.9171				.6462			
REDUNDANCY		.0864				.1079			

TABLE

MEAN, MINIMUM, MAXIMUM, AND PERCENT COMPOSITION OF BENTHIC MACROINVERTEBRATE TAXA FROM THE DISCHAGE STREAM, PLEASANT RUN AND SALT CREEK, FOR GENERAL MOTORS, BEDFORD, INDIANA, MAY 19-20,1981

SPECIES NAME		STATION K-SALT CREEK NUMBER/SQ M				STATION L-SALT CREEK NUMBER/SQ M			
		MEAN	MIN.	MAX.	PERCENT	MEAN	MIN.	MAX.	PERCENT
MISCELLANEOUS									
HYDRA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
PLANARIIDAE		.00	.00	.00	.00	.00	.00	.00	.00
NEMATODA		42.74	.00	85.48	.91	.00	.00	.00	.00
TOTAL OF MISCELLANEOUS		42.74	.00	85.48	.91	.00	.00	.00	.00
TUBIFICIDAE									
OLIGOCHAETA		21.37	.00	85.48	.46	.00	.00	.00	.00
LIMNODRILUS	PROFUNDICOLA	.00	.00	.00	.00	57.28	.00	229.11	.63
LIMNODRILUS	HOFFMEISTERI	320.55	85.48	599.36	6.85	444.65	170.96	1145.56	4.91
LIMNODRILUS	CLAPAREDIANUS	.00	.00	.00	.00	42.74	.00	170.96	.47
LIMNODRILUS	UDEKEMIANUS	.00	.00	.00	.00	57.28	.00	229.11	.63
LIMNODRILUS	CLPVIX	21.37	.00	85.48	.46	.00	.00	.00	.00
ILYODRILUS	TEMPLETONI	42.74	.00	170.96	.91	.00	.00	.00	.00
AULODRILUS	PIGUETI	.00	.00	.00	.00	.00	.00	.00	.00
BRANCHIURA	SOWERBYI	.00	.00	.00	.00	.00	.00	.00	.00
UNIDENT. TUBIFICID	WITH CAP. CHAETAE	85.48	.00	170.96	1.83	362.93	.00	822.53	4.00
UNIDENT. TUBIFICID	WITHOUT CAP. CHAET	491.51	170.96	769.32	10.50	5122.28	683.84	9851.80	56.52
TOTAL OF TUBIFICIDAE		983.02	427.40	1538.64	21.00	6087.15	1196.72	11913.81	67.17
NAIDIDAE									
PRISTINA	IDRENSIS	.00	.00	.00	.00	.00	.00	.00	.00
PRISTINA	FOREL I	.00	.00	.00	.00	.00	.00	.00	.00
DERO	DIGITATA	.00	.00	.00	.00	.00	.00	.00	.00
SLAVINA	APPENDICULATA	.00	.00	.00	.00	.00	.00	.00	.00

TABLE

MEAN, MINIMUM, MAXIMUM, AND PERCENT COMPOSITION OF BENTHIC MACROINVERTEBRATE TAXA FROM THE DISCHAGE STREAM, PLEASANT RUN AND SALT CREEK, FOR GENERAL MOTORS, BEDFORD, INDIANA, MAY 19-20,1981

		STATION K-SALT CREEK NUMBER/SQ M				STATION L-SALT CREEK NUMBER/SQ M			
SPECIES NAME		MEAN	MIN.	MAX.	PERCENT	MEAN	MIN.	MAX.	PERCENT
NAIS	COMMUNIS	.00	.00	.00	.00	57.28	.00	229.11	.63
NAIS	BRETSCHERI	.00	.00	.00	.00	.00	.00	.00	.00
NAIS	PARDALIS	106.85	.00	256.44	2.28	.00	.00	.00	.00
TOTAL OF NAIDIDAE		106.85	.00	256.44	2.28	57.28	.00	229.11	.63
OTHER ANNELIDA									
ENCHYTRAEIDAE		106.85	.00	170.96	2.28	393.33	.00	854.80	4.34
MOOREOBDELA	MICROSTOMA	21.37	.00	85.48	.46	.00	.00	.00	.00
TOTAL OF OTHER ANNELIDA		128.22	.00	256.44	2.74	393.33	.00	854.80	4.34
CRUSTACEA									
ASELLUS	SPECIES	85.46	.00	170.96	1.83	427.40	.00	1709.60	4.72
LIRCEUS	FONTINALIS	2607.14	683.84	4359.48	55.71	1196.88	.00	4103.04	13.21
CRANGONYX	SPECIES	192.33	.00	769.32	4.11	42.74	.00	170.96	.47
AESTACIDAE		85.46	.00	341.92	1.83	.00	.00	.00	.00
TOTAL OF CRUSTACEA		2970.43	683.84	5214.28	63.47	1667.02	.00	5983.60	18.39
HYDRACARINA									
HYDRACARINA		.00	.00	.00	.00	.00	.00	.00	.00
TOTAL OF HYDRACARINA		.00	.00	.00	.00	.00	.00	.00	.00
EPHEMEROPTERA									
HEPTAGENIIDAE		.00	.00	.00	.00	.00	.00	.00	.00

TABLE

MEAN, MINIMUM, MAXIMUM, AND PERCENT COMPOSITION OF BENTHIC MACROINVERTEBRATE TAXA FROM THE DISCHAGE STREAM, PLEASANT RUN AND SALT CREEK, FOR GENERAL MOTORS, BEDFORD, INDIANA, MAY 19-20,1981

SPECIES NAME		STATION K-SALT CREEK NUMBER/SQ M				STATION L-SALT CREEK NUMBER/SQ M			
		MEAN	MIN.	MAX.	PERCENT	MEAN	MIN.	MAX.	PERCENT
BAETIS	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
CAENIS	SPECIES	21.37	.00	85.48	.46	.00	.00	.00	.00
PARALEPTOPHLEBIA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
HEXAGENIA	SPECIES	.00	.00	.00	.00	150.07	.00	341.92	1.66
ISONYCHIA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
TOTAL OF EPHEMEROPTERA		21.37	.00	85.48	.46	150.07	.00	341.92	1.66
ODONATA									
GOMPHUS	SPECIES	21.37	.00	85.48	.46	.00	.00	.00	.00
LESTES	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
TOTAL OF ODONATA		21.37	.00	85.48	.46	.00	.00	.00	.00
MEGALOPTERA-NEUROP									
SIALIS	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
TOTAL OF MEGALOPTERA-NEUROP		.00	.00	.00	.00	.00	.00	.00	.00
TRICHOPTERA									
HYDROPSYCHIDAE		.00	.00	.00	.00	.00	.00	.00	.00
TOTAL OF TRICHOPTERA		.00	.00	.00	.00	.00	.00	.00	.00
COLEOPTERA									
DUBIRAPHIA	SPECIES	21.37	.00	85.48	.46	21.53	.00	86.12	.24

TABLE

MEAN, MINIMUM, MAXIMUM, AND PERCENT COMPOSITION OF BENTHIC MACROINVERTEBRATE TAXA FROM THE DISCHAGE STREAM, PLEASANT RUN AND SALT CREEK, FOR GENERAL MOTORS, BEDFORD, INDIANA, MAY 19-20,1981

SPECIES NAME		STATION K-SALT CREEK NUMBER/SQ M				STATION L-SALT CREEK NUMBER/SQ M			
		MEAN	MIN.	MAX.	PERCENT	MEAN	MIN.	MAX.	PERCENT
STENELMIS	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
ECTOPRIA	NERVOSA	.00	.00	.00	.00	.00	.00	.00	.00
PSEPHUS	HERRICKI	.00	.00	.00	.00	.00	.00	.00	.00
TOTAL OF COLEOPTERA		21.37	.00	85.48	.46	21.53	.00	86.12	.24
DIPTERA GRP I									
TIPULIDAE		.00	.00	.00	.00	.00	.00	.00	.00
PSYCHODA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
CERATOPOGONIDAE		.00	.00	.00	.00	.00	.00	.00	.00
TOTAL OF DIPTERA GRP I		.00	.00	.00	.00	.00	.00	.00	.00
CHIRONOMIDAE									
THIENEMANNIMYIA	GROUP	.00	.00	.00	.00	.00	.00	.00	.00
PROCLADIUS	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
LARSIA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
CHIRONOMUS	SPECIES	106.85	.00	256.44	2.28	106.85	.00	256.44	1.18
CRYPTOCHIRONOMUS	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
HARNISCHIA	SPECIES	.00	.00	.00	.00	21.53	.00	86.12	.24
MICROTENDIPES	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
PARACLADOPELMA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
PARATENDIPES	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
PHAENOPSECTRA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00	.00
POLYPEDILUM	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
POLYPEDILUM	(FALLAX GROUP)	.00	.00	.00	.00	.00	.00	.00	.00
POLYPEDILUM	(CONVICTUM GROUP)	.00	.00	.00	.00	.00	.00	.00	.00
POLYPEDILUM	(SCALAENUM GROUP)	64.11	.00	170.96	1.37	128.66	.00	172.24	1.42
POLYPEDILUM	(SIMULANS GROUP)	85.48	.00	170.96	1.83	21.53	.00	86.12	.24

TABLE

MEAN, MINIMUM, MAXIMUM, AND PERCENT COMPOSITION OF BENTHIC MACROINVERTEBRATE TAXA FROM THE DISCHAGE STREAM, PLEASANT RUN AND SALT CREEK, FOR GENERAL MOTORS, BLDFORD, INDIANA, MAY 19-20,1981

SPECIES NAME		STATION K-SALT CREEK NUMBER/SQ M				STATION L-SALT CREEK NUMBER/SQ M			
		MEAN	MIN.	MAX.	PERCENT	MEAN	MIN.	MAX.	PERCENT
STICTOCHIRONOMUS	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
TANYTARSUS	SPECIES	42.74	.00	170.96	.91	.00	.00	.00	.00
RHEOTANYTARSUS	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
TRIBELOS	SPECIES	42.74	.00	85.48	.91	.00	.00	.00	.00
CLADOPELMA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
DICROTENDIPES	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
CLADOTANYTARSUS	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
PARATANYTARSUS	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
STEMPELLINELLA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
PAGASTIELLA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
CONSTEMPELLINA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
ORTHOCLADIINAE	PUPA	.00	.00	.00	.00	.00	.00	.00	.00
CORYNONEURA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
CRICOTOPUS	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
METRICNEMIA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
EUKIEFFERIELLA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
SMITTIA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
PARAMETRIOCNEMUS	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
RHEOCRICOTOPUS	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
BRILLIA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
NANOCLADIUS	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00
PARAMETRIOCNEMUS	SPECIES	.00	.00	.00	.00	43.06	.00	172.24	.48
						.00	.00	.00	.00
TOTAL OF CHIRONOMIDAE		341.92	.00	512.88	7.31	321.83	.00	344.48	3.55
COLLEMBOLA-LEPIDOP									
LEPIDOPTERA		.00	.00	.00	.00	128.22	.00	512.88	1.41
TOTAL OF COLLEMBOLA-LEPIDOP		.00	.00	.00	.00	128.22	.00	512.88	1.41
GASTROPODA									
LYMNAEA	SPECIES	.00	.00	.00	.00	.00	.00	.00	.00

MEAN, MINIMUM, MAXIMUM, AND PERCENT COMPOSITION OF BENTHIC MACROINVERTEBRATE TAXA FROM THE DISCHAGE STREAM, PLEASANT RUN AND SALT CREEK, FOR GENERAL MOTORS, BEDFORD, INDIANA, MAY 19-20,1981

TABLE

SPECIES NAME	STATION K-SALT CREEK NUMBER/SQ M				STATION L-SALT CREEK NUMBER/SQ M			
	MEAN	MIN.	MAX.	PERCENT	MEAN	MIN.	MAX.	PERCENT
PHYSA SPECIES	21.37	.00	85.48	.46	.00	.00	.00	.00
TOTAL OF GASTROPODA	21.37	.00	85.48	.46	.00	.00	.00	.00
PELECYPODA								
SPHAERIUM CORNICULA	21.37	.00	85.48	.46	236.03	170.96	344.48	2.60
STRIATINIUM MANILENSIS	.00	.00	.00	.00	.00	.00	.00	.00
TOTAL OF PELECYPODA	21.37	.00	85.48	.46	236.03	170.96	344.48	2.60
STATION MEAN TOTAL	4680.03			100.00	9062.46			100.00
TOTAL NUMBER OF SAMPLES	4				4			
NUMBER OF SPECIES	24							
MAXIMUM NUMBER OF SPECIES AT ALL STATIONS	87				20			
DIVERSITY CALCULATED IN LOG BASE 2								
SHANNONS DIVERSITY	2.4032				1.9236			
ASSOCIATED EVENNESS	.6939				.6094			
REDUNDANCY	.3088				.3921			

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MAY 25, 2001

APPENDIX F.4

U.S.EPA ENVIRONMENTAL CRITERIA AND ASSESSMENT OFFICE REPORT

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
CINCINNATI, OHIO 45268

DATE: January 12, 1983

SUBJECT: Preliminary Health Risk Asessment for Salt Creek, Indiana

FROM: Randall J.F. Bruins RJFBruins
Environmental Scientist, ECAO-Cin

TO: Barbara Magel
Assistant Regional Counsel, Region V

THRU: Jerry F. Stara, Director, ECAO-Cin JFStara

THRU: Elizabeth Anderson, Director, OHEA 1-24-83

The attached report is provided in response to your request for an assessment of potential human health risks from PCBs in Salt Creek, Indiana. As stated in the introduction to the report, this is not an assessment of actual risks, because actual consumption of water, fish or sediments from the stream and the changes in contaminant levels which have occurred over time are not known. Instead, the report suggests risks which could occur if consumption at present (i.e., 1980) contaminant levels occurred over a lifetime. Given our limitations of time and resources, we were not able to perform the requested analyses of time trends and source contribution.

This report has received limited review within the Office of Health and Environmental Assessment (OHEA). It has not received peer and administrative review clearance under Executive Order 2200 and therefore should not be cited, quoted or copied.

I hope that this report assists your efforts.

RJFB:sf

Attachment

cc: C. Riordan
V. Adamkus

United States
Environmental Protection
Agency

Final
ECAO-CIN-307
January, 1983

EPA

Research and Development

Preliminary Health Risk Assessment for Salt Creek, Indiana

Prepared for

Region V Enforcement

FOR INTERNAL USE ONLY:
DO NOT CITE, QUOTE OR COPY

Prepared by

Environmental Criteria and
Assessment Office
Cincinnati OH 45268

DISCLAIMER

This report has been reviewed by the Environmental Criteria and Assessment Office, U.S. Environmental Protection Agency. It is an internal draft for review purposes only and does not constitute Agency policy. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

AVAILABILITY NOTICE

This document has received limited review and is for internal use only. For information regarding release or data contained in the document, please contact Randall Bruins, Project Officer, at (513) 684-7573.

Preliminary Health Risk Assessment for Salt Creek, Indiana

1. INTRODUCTION

This report provides a preliminary assessment of health risks which may result from the contamination of Salt Creek, Indiana by polychlorinated biphenyls (PCBs). Monitoring data are available for several streams in this drainage basin for 1976, 1977 and 1980. However, no analysis of temporal or geographic trends of contamination has been attempted in this report. Rather, 1980 data from Salt Creek alone are used to suggest potential risks to human health associated with recent levels of PCBs in this stream. These risks should not be considered actual risks, since data on stream use (e.g., annual catch, drinking water use, etc.) are not available, and because human exposure probably has varied over time. This information is presented only to assist decision-makers in judging the adequacy of measures currently in force and the need (if any) for additional measures to be taken. This assessment should be considered preliminary; a more detailed analysis could alter the results.

2. EXPOSURE

2.1. EXPOSURE VIA FISH CONSUMPTION

The 1980 monitoring data include fish tissue levels of total PCBs for fish species in Clear Creek, Salt Creek and East Fork White River. Some analyses were made on the basis of whole fish and some on the basis of fish fillets. In either case, the fat content of the tissue analyzed was reported, and PCB content on a fat basis was also given.

The fat content of a fish tissue sample is an important determinant of PCB content. The level of a lipophilic contaminant in fatty tissues tends to be at equilibrium with the level in the surrounding water in a manner

influenced by its lipid-water partitioning coefficient (K_{ow}) (Kenaga and Goring, 1980). PCBs are among the most highly lipophilic substances with K_{ow} ranging from 760,000-8,130,000 depending on degree of chlorination (Veith et al., 1979). When measured equilibrium bioconcentration factors (BCFs) for various Aroclors in several fish species were normalized by fat content, a mean, normalized BCF of 10,400 per 1% fat content resulted (U.S. EPA, 1980).

Fat content of a fish may vary widely according to season and nutritional status as well as by species. This variability can be observed in the monitoring data provided. Much of the fat is excluded when the fish is filleted. However, in many species the skin or eggs are often consumed, and therefore PCB analysis of a fillet (which presumably excludes the skin) may underestimate likely human exposure. For example, the PCB level in "flesh plus skin" was 1.4 times that of "flesh" in pinfish exposed to Aroclor 1016 (Kenaga and Goring, 1980).

Another source of variability is the movement of fish into and out of areas where PCB accumulation can occur. Therefore, fish taken in a particular area may not be representative of the local population, unless a large number are sampled. In Salt Creek, only 1-5 individuals of each species were sampled in a given location, and pooled analyses were usually done so that variability is difficult to examine.

For these reasons, and because species sampled also varied, it is difficult to compare tissue PCB levels from different areas. Data for longear sunfish and largemouth bass, the species most frequently sampled, showed that tissue PCB levels at Salt Creek station 5 tended to be higher than those at Salt Creek stations 2 or 3, which are above the entrance of Pleas-

ant Run. This finding would be consistent with the idea, but does not conclusively show, that Pleasant Run is an important source of contamination to the lower portion of Salt Creek.

For the purpose of estimating average PCB levels in consumed tissues from Salt Creek using the few data available, 1980 data for the three Salt Creek sites were combined for each species to give an average value for PCB contamination of fat (Table 1). Data on fat content, which was assumed to vary independently of fat contamination level, was combined over all three streams and all years of sampling to give representative means for fat content of fillet and whole-body for these species in this drainage basin. Values for fat content were then multiplied by values for fat contamination to arrive at mean PCB content for each species. The fillet PCB values were taken as averages for consumed tissue, and whole-body PCB values were taken as an upper limit, to allow for consumption of other parts.

The resulting estimates for average PCB content of fillets for Salt Creek are as follows: 1.38 mg/kg for bluegill, 2.30 mg/kg for longear sunfish, 6.06 mg/kg for largemouth bass. Since data are not available on relative size of catch for these species, the values were weighted by number of each species sampled to give a combined average of 3.29 mg/kg. The whole-body value of 17.3 mg/kg for largemouth bass was used as a maximum value. The variability in these calculations was carried through to illustrate the range of PCB levels likely to be observed in fish from this stream (see Table 1).

Since actual catch and consumption of fish from Salt Creek is not known, several values will be used to assess various levels of exposure. Per capita consumption of fish caught recreationally in the United States has been estimated to be between 3 and 4 lb/year (SRI International, 1980). An

TABLE 1

Summary Statistics for PCB Content of Fish Tissues from Salt Creek, Indiana, 1980

Species	Site	PCB Content of Fat (mg/kg)[a]	Mean PCB Content of Fat (mg/kg)[b]	Fat Content of Fillet (%)[b,c]	Fat Content of Whole Body (%)[b,c]	Mean PCB Content of Fillets (mg/kg)[d]	Mean PCB Content of Whole Body (mg/kg)[d]
Bluegill	SC-2	91.3(3)	91.3 (NA)	1.51 (1.18-4.24)	5.05 (1.47-6.98)	1.38 (1.08-3.87)	4.61 (1.34-6.37)
Longear Sunfish	SC-2	176(2)	255 (176-406)	0.90 (0.04-1.44)	5.70 (4.18-8.08)	2.30 (0.07-5.85)	14.5 (7.36-32.8)
	SC-3	198(2)					
	SC-3	210(2)					
	SC-5	406(5)					
Largemouth Bass	SC-3	101(1)	659 (101-928)	0.92 (0.09-3.29)	2.62 (1.04-4.2)	6.06 (0.09-30.5)	17.3 (1.05-39.0)
	SC-3	173(1)					
	SC-5	911(2)					
	SC-5	928(2)					
Mean[e]						3.29	

[a]Number in parentheses is number of fish in sample

[b]Numbers in parentheses are observed range

[c]Weighted mean of 1976, 1977 and 1980 data from Clear Creek, Salt Creek and East Fork White River

[d]Numbers in parentheses are calculated range

[e]Weighted mean of three species

NA = Not available

average of 1.6 kg/year (3.5 lb/year) would correspond to 4.3 g/day. If Salt Creek were taken to be the primary source of recreational fish for local residents, the average exposure would be 0.0043 kg/day x 3.29 mg PCB/kg = 0.014 mg/day, or 0.2 µg/kg body weight (bw) per day for a man of 70 kg bw. At the higher contaminant level (17.3 mg/kg) exposure would be 1.1 µg/kg bw/day.

At the level of one fish-containing meal per week recommended as a maximum for this area by the Indiana State Board of Health (Blankenbaker, 1981), assuming that one meal is 0.25 kg (≈0.5 lb) of fish, daily exposure would be as follows:

$$\frac{0.25 \text{ kg}}{7 \text{ day}} \times \frac{3.29 \text{ mg PCB}}{\text{kg}} \times \frac{1}{70 \text{ kg bw}} = 1.7 \text{ µg/kg bw/day}$$

At the higher contaminant level, exposure would be 8.8 µg/kg bw/day.

2.2. EXPOSURE VIA WATER CONSUMPTION

The PCB concentration (as Aroclor 1242) in Salt Creek water in 1980 was at or below the detection limit of 0.1 µg/ℓ in four analyses from three sites. The detection limit was therefore used as the maximum level in estimating potential human exposure from drinking water. The U.S. EPA uses 2 ℓ/day as an estimate of water intake for a 70 kg man. Maximum exposure from this route would therefore be 0.2 µg/day or 0.003 µg/kg bw/day.

2.3. EXPOSURE VIA CONSUMPTION OF SEDIMENTS

Three analyses of sediments from Salt Creek in 1980 gave similar values (range, 1.9-2.2 mg/kg) with a mean of 2.1 mg/kg. A fourth value (0.15 mg/kg) from the short stretch above the confluence with Clear Creek was not included.

Children playing in or near Salt Creek could conceivably disturb the sediments and swallow turbid water. A highly turbid water may contain suspended sediments at up to ≈50,000 mg/ℓ (Wallen et al., 1957). Using 60

mℓ (≈2 fl. oz.) as an estimate of a large swallow of water, a contact of this type could result in ingestion of ≈3 g of sediment containing ≈6 µg PCB. Exposure once a week for a small (20 kg) child could conceivably result in an average intake level of 0.043 µg/kg bw/day.

Consumption of dirt from the hands by children exhibiting frequent mouthing behavior ("pica") has been estimated to be at least 100 mg/day (Lepow et al., 1975). For children playing in daily contact with Salt Creek sediments, PCB ingestion was therefore estimated to be ≈0.2 µg/day, or 0.01 µg/kg bw/day for a 20 kg child.

3. HEALTH EFFECTS

PCBs are a class of compounds which vary in their physical, chemical and toxicological properties. Because both sampling data and toxicological data on PCBs are inadequate to permit assessment of effects for individual isomers or even for given commercial preparations (i.e., Aroclors), the PCBs have been treated as a group in the following discussion.

PCBs have been found in the human diet; typical consumption decreased from 15 µg/day in 1971 to 8.7 µg/day (or 0.12 µg/kg bw/day) in 1975. PCBs have low acute toxicity. With the exception of a well-known incident of acute poisoning in Japan (Yusho disease) in which an average of 2 g PCB was ingested, most instances of human toxicity have resulted from long-term exposure and accumulation in the body. Occupational exposure by inhalation and dermal contact may result, after months or years, in problems such as chloracne, irritation of eye, nose or throat or gastrointestinal disturbance. Fat metabolism and liver function have also been affected. Studies with mammals have shown various metabolic, hormonal and immunosuppressive effects of PCBs. Cancer and reproductive effects have also been demonstrated (U.S. EPA, 1980). These latter effects form the basis for the assessments which follow.

3.1. CANCER RISK ESTIMATE

The International Agency for Research on Cancer (IARC, 1980) has classified PCBs as a "group 2B" carcinogen, or a "probable" human carcinogen based on suggestive evidence. This classification derives from "sufficient" evidence of animal carcinogenicity and "inadequate" evidence of human carcinogenicity. The U.S. EPA used a presumption of human carcinogenicity in deriving water quality criteria for PCBs.

The data used in the Ambient Water Quality Criteria Document on PCBs (U.S. EPA, 1980) for determining cancer potency at low doses consist of two dose groups (including the control) from a study in which rats were fed Aroclor 1260 (Kimbrough et al., 1975):

Dose (mg/kg/day)	No. responses/No. animals
0	1/173
4.42	170/184

The upper limit on lifetime excess cancer risk to humans is calculated assuming that the fitted extrapolation model (the linearized multistage model) is a fair approximation of the true dose-response curve; and that the dose-per-surface-area conversion from animal to man is appropriate. Table 2 presents the exposure estimates from Section 2 and their associated, upper-bound estimates of expected excess cancer risk. Included for comparison is the 1975 estimate for typical dietary consumption in the United States (current levels of consumption may be somewhat lower). The upper confidence limit on risk is used because of its superior numerical stability over the MLE.

Some qualifications must accompany these risk estimates:

- Expected risk estimates based on maximum likelihood estimation are extremely sensitive to model selection and data uncertainties. No method has yet been approved by the U.S. EPA for the estimation of expected cancer cases.

TABLE 2

Possible Levels of Human Exposure to PCBs from
Salt Creek and Associated Estimates of Excess Cancer Risk[a]

Exposure Source	Assumed Consumption	Estimated Daily Exposure (µg/kg bw/day)	Upper 95% Limit on Excess Cancer Risk
Salt Creek water	PCB detection limit, 2 ℓ/day	0.003	1.3×10^{-5}
Salt Creek sediment	Daily ingestion by child of 100 mg sediment ("pica")	0.01	NC[b]
	Weekly ingestion by child of 60 mℓ turbid water	0.043	NC[b]
Typical U.S. diet in 1975[c]		0.12	5.2×10^{-4}
Salt Creek fish	Average fillet, 1.6 kg/yr	0.20	8.7×10^{-4}
	Whole largemouth bass, 1.6 kg/yr	1.1	4.8×10^{-3}
	Average fillet, 0.25 kg/wk	1.7	7.4×10^{-3}
	Whole largemouth bass, 0.25 kg/wk	8.8	3.8×10^{-2}

[a]Based on 1980 monitoring data. See text for full explanation of exposure and risk estimates.

[b]Risk not computed since exposure not reasonably expected to occur over lifetime.

[c]Source: U.S. EPA, 1980

- The data set used for calculating cancer potency for PCB consists of only two points, a control group and one exposed group. The exposed group had nearly 100% response while the control group had near zero, so no midrange data exist.

- As discussed previously, the human carcinogenicity of PCBs is considered "probable" but has not been demonstrated.

In spite of these qualifications, the risk estimates could serve as a rough guide for regulatory purposes. For each exposure estimate given in Table 2, there is 95% confidence that the true risks are not greater than the risks presented, bearing in mind the other qualitative uncertainties discussed previously. See also Appendix A for further explanation of cancer risk calculations.

The lowest risk estimate in Table 2 is that based on consumption of Salt Creek water. It cannot be stated whether or not this estimated risk level (1.3×10^{-5}) is acceptable, but it is well below that estimated for typical United States dietary exposure. Risk estimates for exposure via sediments were not given since such exposure, as described in Section 2.3, was not reasonably expected to occur over a lifetime. PCB exposure and consequent cancer risk for occasional or regular consumers of Salt Creek fish were higher than the typical dietary exposure, and the highest consumption level gives an upper limit on excess cancer risk of 3.8×10^{-2} or ≈4%.

3.2. TOXICITY-BASED PREDICTION OF SAFE AND EFFECTIVE LEVELS

Acceptable daily intake levels (ADIs) are determined from human or animal studies by adjusting no-observed-adverse-effect levels (NOELs), no-observed-adverse-effect levels (NOAELs) or lowest-observed-adverse-effect levels (LOAELs), the latter being the lowest level (not the lowest effect) at which adverse effects were observed. The term "acceptable" applies only with respect to toxic effects, since cancer risk is considered to exist even at levels below the ADI. The toxicity studies presented in the following

discussion were also discussed in the Ambient Water Quality Criteria Document for PCBs (U.S. EPA, 1980), but the derived ADI and effect levels given here were not presented in that document.

Two animal studies are available that evaluate the toxicity of PCBs after oral administration of low concentrations (Allen and Barsotti, 1976; Aulerich and Ringer, 1977). A perusal of the latter study indicates a chronic LOAEL in mink at 2 ppm in diet. This LOAEL is supported by a chronic adverse-effect level (AEL) in monkeys (Allen and Barsotti, 1976) at 2.5 ppm in diet. Both effect levels caused decreased reproductive performance in adults and toxicity to the offspring. The LOAEL is also supported by a subchronic NOAEL in mink at 1 ppm.

The chronic LOAEL in ppm can be converted to mg/kg bw/day units by the following equation:

$$\text{Chronic LOAEL} = \frac{2 \text{ mg/kg diet (ppm)} \times 0.15 \text{ kg diet/day}}{1 \text{ kg bw}}$$

$$= 0.30 \text{ mg/kg bw/day}$$

where 0.15 kg of diet/day is the assumed amount of food consumed by adult female mink (Aulerich and Ringer, 1977) and 1 kg bw is the assumed adult female mink weight (U.S. EPA, 1980).

The human ADI, considered a protective level, can be found by the following equation:

$$\text{ADI} = \frac{0.30 \text{ mg/kg bw/day}}{1000}$$

$$= 0.3 \text{ µg/kg bw/day}$$

where the 1000-fold uncertainty factor represents the standard 100-fold factor used to extrapolate chronic animal data to the human (45 FR 79353) and an additional 10-fold factor because a LOAEL, rather than a NOAEL, was used in the derivation of the ADI (in this latter case, 10-fold is recommended due to the severity of the adverse effects observed).*

The chronic LOAEL for mink (0.30 mg/kg bw/day) can also be adjusted by a predictive, rather than protective, approach to estimate a LOAEL for the average human. This approach, unlike ADI estimation does not incorporate a margin of uncertainty as required for protection of sensitive individuals. The adjustment may be done by dividing by 4.1, the mink-to-human conversion based on respective body surface areas. The resulting estimated human LOAEL is 73 µg/kg bw/day.

The subchronic NOAEL for mink similarly may be adjusted to an estimated human NOAEL, but in this case an additional factor of 10 must be added as a subchronic-to-chronic conversion:

$$\text{Subchronic NOAEL} = \frac{1 \text{ mg/kg diet} \times 0.15 \text{ kg diet/day}}{1 \text{ kg bw}}$$

$$= 0.15 \text{ mg/kg bw/day}$$

$$\text{Estimated human NOAEL} = \frac{0.15 \text{ mg/kg bw/day}}{4.1 \times 10}$$

$$= 3.7 \text{ µg/kg bw/day}$$

The ADI, NOAEL and LOAEL are compared with the various PCB exposure levels in Table 3. The exposure levels postulated for consumption of Salt Creek water and sediments and the typical United States dietary exposure were below the ADI calculated above. However, the possible range for expo-

---

*See 45 FR 79353 for a discussion of this area of uncertainty. Note that if the subchronic NOAEL was chosen instead of the chronic LOAEL the total uncertainty factor would still be 1000. This is because an additional 10-fold factor would be required due to the shorter "subchronic" exposure period of the NOAEL. (The 10-fold because of the LOAEL, of course, would not be used.) Since the NOAEL is lower than the LOAEL, and the assumptions are the same, using the NOAEL would result in a protective water level of 0.05 µg/ℓ.

TABLE 3

Comparison of PCB Exposure Levels and Various Protective or Predictive Levels Based on Toxic (i.e., noncancer) Effects[a]

Exposure Level (µg/kg bw/day)	Description
0.003	Salt Creek water consumption
0.01-0.043	Salt Creek sediment consumption
0.12	Typical U.S. diet in 1975
0.3	ADI (human)
3.7	NOAEL (adjusted for average human)
0.20-8.8	Salt Creek fish consumption
73	LOAEL (adjusted for average human)

[a]See Table 2 and text for explanation of levels and acronyms.

sure via fish consumption extended above the ADI and adjusted NOAEL. Although the assumed exposure did not exceed the adjusted LOAEL, exposures exceeding the ADI, and especially those exceeding the adjusted NOAEL, cannot be assumed to be sufficiently low to preclude adverse reproductive or other toxic effects. While a numerical risk level cannot be assigned, it can be stated qualitatively that there is a risk of noncancer, adverse effects associated with consumption of Salt Creek fish when the ADI for PCBs is exceeded. Note again that exposure levels below the toxicity-based ADI may pose a carcinogenic risk.

4. ENVIRONMENTAL PARTITIONING OF PCBs

The respective equilibrium concentrations of PCBs in the water, biota and sediments of an ecosystem tend to be interrelated according to the physicochemical property of the compound(s) (Kenaga and Goring, 1980; Neely, 1982). It is worthwhile to be aware of these interrelationships when concerned about the level in a particular medium.

The relationship between concentration in biota, especially in fat, and concentration in water (i.e., the BCF) has been mentioned. A BCF of 10,400 per 1% fat has been derived (U.S. EPA, 1980). A weighted mean for fish sampled in Salt Creek gives an average PCB content of 352 mg PCB/kg fat. The mean water concentration can be estimated as follows:

$$\frac{352 \text{ mg PCB/kg}}{100 \text{ \% fat}} \times \frac{1\% \text{ fat}}{10{,}400 \text{ ℓ/kg}} = 0.34 \text{ µg/ℓ}$$

The relationship between concentrations in sediment and water may be estimated from the organic carbon-water partitioning coefficient (K_{oc}) if the amount of organic carbon in the sediments is known. K_{oc} was estimated from reported values for K_{ow} and BCF (Veith et al., 1979) and water solubility (Kenaga and Goring, 1980), using regression equations from Kenaga and

Goring (1980). Values for Aroclor 1016 were used because of its similarity to Aroclor 1242, for which sediment and water concentrations were given. The resulting estimates of K_{OC} ranged from 17,000-1,040,000. Since no information was available on organic content of the 1980 sediment samples, a value of 10% was used as an approximation. Organic matter (OM) was assumed related to organic carbon (OC) by a factor of 1.72 (Kenaga and Goring, 1980). By the equation:

$$\text{Water concentration} = \frac{2.1 \text{ mg PCB}}{\text{kg sediment}} \times \frac{100\% \text{ sediment}}{10\% \text{ OM}} \times \frac{1.72 \text{ OM}}{\text{OC}} \times \frac{1}{K_{OC}}$$

values for water concentration based on various estimates of K_{OC} ranged from 0.035-2.1 µg/ℓ. If sediment organic content were higher, these values would be proportionately lower, and vice versa. These values define a range of two orders of magnitude containing the estimate based on BCF (0.34 µg/ℓ). The latter estimate slightly exceeds the measured water concentration, which was at or below the detection limit of 0.1 µg/ℓ.

The above calculations are based on a superficial treatment of environmental partitioning concepts and do not comprise an indepth examination of the monitoring data. Nor do they consider imports and exports from the system via the various media. However, the estimates appear to be in rough agreement with the measured water concentration, and therefore tend to support the notion that observed PCB concentrations in water, biota and sediments of Salt Creek are in dynamic equilibrium, and that changes in one would reflect or be reflected by changes in the others. This fact is important since the water concentration is usually below detection. Over time, improvements in terms of the water concentration may be undetectable, whereas changes in fish and sediment concentrations should be measurable and interrelated. This also indicates that mitigation of hazard due to fish

consumption cannot be predicted by considering the depuration rate of any organism, but will depend on the depuration of PCB from the system as a whole, including the sediments.

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APPENDIX A

Some Notes on Cancer Risk Calculations

- Potency = slope of dose-response curve.
- We use the upper 95% confidence limit on slope, which we call q_1^*. Eventually this can be converted to an equivalent human potency.
- Note that q_1^* depends on the risk level or dose, i.e., it is <u>not</u> constant for all doses, unless (unlikely) the dose-response curve is a straight line through all doses. Likewise a "unit-risk" estimate is dose-dependent.
- The conversion from animal data to equivalent human data can be done at any time. Thus the multistage model can use human equivalent doses, or the animal q_1^* can be converted to a human equivalent potency.
- The use of the 95% confidence limit means that we cannot <u>predict</u> the likely number of cases from a given exposure. We can only give an upper bound.
- The resultant risk estimate can be interpreted equally well as the risk or probability of a randomly chosen individual contracting cancer (from continuous lifetime exposure) or as the incidence rate in the population. Remember that the risk estimates are upper bounds on actual risk.
- The maximum likelihood estimate on the dose is not used by EPA for risk estimation because of its strong sensitivity to slight changes in the original data set and its strong dependence on the choice of mathematical model.
- Excess risk is conditional risk, conditioned on surviving the background exposure. If total (excess plus background) risk at dose d is P(d), then

$$\text{excess risk} = \frac{P(d) - P(0)}{1 - P(0)}$$

The calculation is roughly as follows. Assume the data are on animals.

Define: R = risk level (e.g., 1/100, 10^{-5}, etc.)
d_R = lower 95% confidence limit on dose at risk R from the computer output.

Then, potency = R/d_R. The conversion to human potency requires several adjustments. The dose must be expressed as average daily dose over lifetime, and the risk must be based on this assumed average daily exposure. The potency or dose is then adjusted for differences between the test animal and humans.

Define: l_e = length of exposure
L_e = length of observation or experiment
L = length of lifetime of test animal

Then, the adjusted animal potency is:

$$q_1^* = (\text{potency})/[(l_e/L_e)(L_e/L)^3].$$

The first adjustment (l_e/L_e) averages the exposure over the length of the experiment. This reduces the effective daily dose, and thus is a divisor here to increase the potency estimate. The second divisor $(L_e/L)^3$ also increases the potency estimate. The belief is that the incidence should increase as the cube of the duration of exposure, so this term adjusts the potency based on the expected incidence had the exposure been continued for a lifetime.

Conversion to human equivalent potency is accomplished using the assumption that equitoxic "dose" is represented by

$$(\text{exposure level})/(\text{body surface area}).$$

One can use the approximation of

$$\text{body surface area} \simeq (K)\ (bw)^{2/3}$$

and assume K is constant across species. Then the human potency B is, in $(mg/kg\text{-}d)^{-1}$,

$$B = q_1^*\ (W_h/W_a)^{1/3},$$

Where W_h and W_a are human and animal body weights in kg. Keep in mind that any multiplicative adjustment to dose becomes a division adjustment to potency.

MAY 25, 2001

APPENDIX F.5

CDM 1985 STREAM STUDY

CDM

environmental engineers, scientists, planners, & management consultants

CAMP DRESSER & McKEE INC.

3489 North 124th Street
Brookfield, Wisconsin 53005
414 781-4890

August 26, 1985

Mr. Gregory Etzel
General Motors Corporation
Central Foundry Division
901 North Jackson Street
Bedford Plant
Bedford, Indiana 47421

Dear Mr. Etzel:

Please find enclosed the final report for the Static Acute Toxicity Testing Program at various streams near Bedford, Indiana. It was enjoyable getting to Bedford again and working on the streams.

Do not hesitate to contact me if you have any questions or require any assistance in the future.

Sincerely,

CAMP DRESSER & McKEE INC.

Daniel F. Buss, P.E.
Environmental Affairs

DFB:jf

File: 8001-804-SS-AD

EA ENGINEERING,
SCIENCE, AND
TECHNOLOGY, INC.

Corporate Headquarters
Hunt Valley/Loveton Center
15 Loveton Circle
Sparks, Maryland 21152
(301) 771-4950

22 August 1985

Mr. Dan Buss
Camp, Dresser and McKee
3489 North 124th Street
Brookfield, Wisconsin 53005

Dear Dan:

Enclosed is a revised copy of EA Engineering, Science, and Technology, Inc. (EA) report entitled "Daphnia pulex 48-hour acute toxicity tests". Please do not hesitate to contact me if you should have any questions or require additional information regarding this report.

Thank you again.

Sincerely,

W. L. Goodfellow, Jr.

William L. Goodfellow, Jr.
Associate Scientist

WLG:cam

cc: Wayne L. McCulloch
EAB 52

Daphnia pulex

48-HOUR ACUTE TOXICITY TESTS

Prepared for

Camp, Dresser and McKee
3489 North 124th Street
Brookfield, Wisconsin 53005

Prepared by

EA Engineering, Science, and Technology, Inc.
Hunt Valley/Loveton Center
15 Loveton Circle
Sparks, Maryland 21152

AUGUST 1985

1. INTRODUCTION

At the request of Camp, Dresser and McKee, EA Engineering, Science, and Technology, Inc. (EA) performed static acute toxicity tests using samples relevant to the General Motors Foundry process with Daphnia pulex. The objective of the tests were to determine the 48-hour median lethal concentration of the effluents to the test species using lethality as the end point.

2. METHODS AND MATERIALS

2.1 SAMPLE DESCRIPTION

Samples were shipped to EA via Federal Express next day service, and were received at EA at 11:30 on 20 July 1985. Samples were received in containers labeled with client, date sampled (19 July), and sample source (type). The four samples were labeled Salt Creek intake, Pleasant Run confluence, below confluence with GM, and GM discharge (two containers for each sample location). The samples were logged in and assigned EA toxicology laboratory accession numbers. Tests were initiated on the same day as the samples were received.

2.2 TEST ORGANISMS

The test species, Daphnia pulex, is cultured in EA's laboratory in dechlorinated tap water at 20 C with a 16-hour light, 8-hour dark photoperiod. The cultures are fed three times weekly in a manner described in the Draft ASTM (1985) Standard Method and thinned as necessary to inhibit ephippia production.

Gravid adults from these cultures were segregated into 20 cm culture bowls with dechlorinated tap water several days before test initiation. Twenty-four (24) hours before each test initiation, all neonates (young) were removed leaving only adults. This ensured that neonates used in testing the next day were a maximum of 24 hours old. In addition to the normal feeding regime, the adults were supplemented with the algae Selenastrum capricornutum. The organisms were not fed during the test.

2.3 DILUTION WATER

Dilution water for D. pulex test solutions was dechlorinated tap water obtained at EA.

2.4 TOXICITY TEST OPERATIONS AND PERFORMANCE

General toxicity test methods were performed in accordance to those described in EA's protocols (Attachment I). The concentrations were 1, 3, 10, 30 and 100 percent effluent diluted with dechlorinated tap water as well as a dilution water control.

Definitive 48-hour static tests were run with D. pulex neonates in 400 ml beakers containing 200 ml of test solution. All test concentrations were measured using Class A glassware. Neonates (less than 24 hours) were then randomly added to each beaker until there were 10 neonates per test vessel.

Water quality determination during testing was performed on the following schedule: dissolved oxygen and pH were measured in one replicate of each concentration at 0, 24 and 48 hours. Temperature was measured in each replicate of each concentration at 0, 24 and 48 hours. Test vessels were

kept at 20 $\pm$ 2 C on a 16-hour light, 8-hour dark photoperiod cycle at a light intensity of 100 fc (foot candle). Analytical methods were conducted according to APHA et al. (1981).

Observations were made at 0, 24 and 48 hours to determine the number of survivors in each replicate and recorded on the data sheet. A slight prodding of an organism was occasionally necessary to distinguish between those animals which were dead and those which were immobilized.

Calculation of LC50 values at 48 hours by the binomial, moving average, and probit analysis methods were performed as described by Stephan (1977). Data sheets and summary sheets are presented in Attachment II.

3. RESULTS AND DISCUSSION

Results of the four Daphnia pulex 48-hour static acute toxicity tests are presented in Table 1. The LC50's for all samples were greater than 100 percent sample. In no case did more than 30 percent of the organisms die in a 100 percent effluent treatment. Overall percent survival was greatest at the Salt Creek Intake (95.8 percent) and lowest at the GM discharge (83.3 percent) when control survival is included. A similar trend exists when control survival is not included in the calculation.

Over the testing period, temperature ranged from 18.7 to 21.4 C, dissolved oxygen from 6.5 to 8.7 mg/l, and pH from 7.6 to 8.5 S.U. Conductivity, hardness and alkalinity are shown in Table 2. The Salt Creek Intake samples had markedly different conductivity, hardness and alkalinity values from the other three samples which were similar to one another.

4. REFERENCES

American Public Health Association, American Water Work Association, Water Pollution Control Federation. 1980. Standard Methods for the Examination of Water and Wastewater, 15th edition. APHA, Washington.

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EA Engineering, Science, and Technology, Inc. (EA). 1984. Aquatic Toxicological Studies Quality Control and Standard Operating Procedures Manual. Revised editing of 1981 publications. EA, Sparks, MD.

Stephan, C.E. 1977. Methods for Calculating an LC50 in Aquatic Toxicology and Hazard Evaluation, pp 65-84. ASTM STP 634. American Society of Testing and Materials, Philadelphia.

TABLE 1 Results of 48-Hour *Daphnia pulex* Static Acute Toxicity Tests

	Percent Survival After 48-Hour Exposure				
Percent Effluent	Salt Creek Intake	Pleasant Run Confluence	Below Confluence	GM Discharge	$\bar{X}$ % Survival
0 (control)	100	90	100	100	97.5
1	95	95	95	95	95.0
3	95	90	80	75	85.0
10	90	95	80	90	88.8
30	95	100	85	70	87.5
100	100	70	95	70	83.8
$\bar{X}$ Percent Survival Including Controls	95.8	90.0	89.2	83.3	
$\bar{X}$ Percent Survival Excluding Controls	95.0	90.0	87.0	80.0	
48-hour LC50 Values Expressed as percent effluent	>100	>100	>100	>100	

TABLE 2 Final Measurements for Conductivity, Hardness and Alkalinity of GM Samples

Parameter Measured	Salt Creek Intake	Pleasant Run Confluence	Below Confluence	Discharge
Conductivity (umhos/cm)	109	2,000	2,850	2,350
Hardness (mg/l $CaCO_3$)	96	521	592	548
Alkalinity (mg/l $CaCO^3$)	82	222	201	171

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

REPORT/ANALYSIS REVIEW RECORD

LEVEL NO. C2

CLIENT Camp, Dresser and McKee — DATE SUBMITTED _____

PROJECT NUMBER EA552R — DATE DUE TO CLIENT _____

PROGRAM Aquatic Toxicology — QC TEST NO. 8-5-85-181, 182, 183, 184

AUTHOR J.A. Berg — TYPE ANALYSIS STATIC ACUTE

REPORT/ANALYSIS CHECKLIST

QA/QC ITEM	REVIEWER	DATE
1. Samples/data collected, transported, and received according to study plan requirements.	W.J. Grosfeld Jr.	21 July 85
2. Samples prepared and processed according to study plan requirements.	W.J. Grosfeld Jr.	21 July 85
3. Samples and data collected and analyzed using calibratedquipment.	W.J. Grosfeld Jr.	30 July 85
4. Quality control activities completed.	W.J. Grosfeld Jr.	30 July 85
5. Data checked for correctness, source identification, and data confirmation.		
6. Calculations checked: - Hand calculations checked by reviewer		
- Documented and verified computer programs used.		
7. Results reviewed for compliance with study plan requirements.		
8. Reported results and facts checked against original sources.		
9. Figures and tables checked for correct presentation of data.		

	AUTHOR	DATE
10. Commentary reviewed and resolved.		

11. All study plan and quality assurance/control requirements have been met and the Report/Analysis is approved:

William J. Grosfeld Jr. — PROGRAM MANAGER	15 August 85 — DATE
Wayne McCulloch — PROJECT MANAGER	15 Aug 85 — DATE
QC OFFICER	21 August 1985 — DATE

FILED BY PROJECT MANAGER

Aquatic Toxicology Sample Custody Form

Species to be tested:

___ D. magna
N D. pulex
___ Ceriodaphnia sp.
___ P. promelas
___ Other _____

___ M. menidia
___ P. pugio
___ M. mercenaria
___ C. variegatus
___ M. bahia
___ Other _____

Federal Airbill no. 273814822

Client	Sample Number	Collection Date	Collection Time	Sample Description	Number of Containers
M ATS-351	1	7/19	7:30	SAN Creek Intake	2
M ATS-352	2	7/19	10 AM	Pleasant Run Confluence with Cedar Bayou Basin	2
M ATS-353	3	7/19	12:40	Below Confluence Outfall	2
M ATS-354	4	7/19	11:30	GM Discharge Pump #3	2

Relinquished by:	Date/Time	Received by:	Date/Time
Drew Parsons	7/19 2:15PM	M. A. Hodelka Jr.	7/20/95 11:30
Relinquished by:	Date/Time	Received by:	Date/Time

ATTACHMENT I

Protocol for 48-Hour Static Acute Toxicity Test Using *Daphnia pulex*

STATIC ACUTE 48-HOUR LC50 STUDY WITH *Daphnia*

1. TEST OBJECTIVE

To assess the toxicity of a test article to *Daphnia* and determine the 48-hour LC50 or EC50 using lethality or immobilization, respectively, as the test end point.

2. TEST ARTICLE

2.1 Description/Identification

Unless otherwise specified, the test article will be supplied by the sponsor. Adequate chemical specifications with special reference to hazardous properties and storage conditions also will be supplied by the sponsor.

2.2 Methods of Synthesis

If the test article is a pesticide, it is subject to applicable regulations of the Environmental Protection Agency. Information on the methods of synthesis, stability, and data on composition or other characteristics which define the test article are on file with the sponsor.

3. EXPERIMENTAL DESIGN

3.1 Test Organisms

Cladoceran water fleas will constitute the test species.

3.2 Source

Daphnia used for acute toxicity tests are obtained from stock cultures maintained in Ecological Analysts Environmental Toxicology Laboratory.

3.3 Culture Conditions

Daphnia cultures are maintained at 20 C and a 16-hour light, 8-hour dark photoperiod cycle in environmental growth chambers. Cultures are contained in 1.5-gal all-glass aquaria, and fed a food suspension in the manner described in the Draft ASTM (1981) Standard Method. Cultures are initiated on a routine basis, and organisms from cultures producing ephippia are not used for toxicity tests.

3.4 Age of Test Organism at Test Initiation

Zero to 24-hour old neonates are obtained for testing by segregating adult females from the mass cultures on the day before a test is initiated. On the day of the test, neonates are segregated from the parent organisms prior to test initiation.

3.5 Dilution Water

The source of dilution water is the City of Baltimore Municipal Water System. Upon entry to the laboratory, the water is passed through a high-capacity, activated-carbon filtration system to remove chlorine, detergents, and hexane soluble organic materials. This water source has proven safe for aquatic organism toxicity testing as evidenced by maintenance of the multigeneration Daphnia cultures, with no evident loss of fecundity. If requested, reconstituted fresh water may be used.

3.6 Test Concentration Series

The test concentration series to be used for definitive toxicity tests will be selected following preliminary tests to bracket appropriate concentration ranges. A minimum of five concentrations and diluent water controls will be used. If it proves necessary to use a carrier solvent to disperse the test article in aqueous solution, an additional set of solvent controls will be used. All test concentrations and controls will normally be conducted with two replicates. Additional replicates or concentrations may be used.

3.7 Test Concentration Preparation

Test concentrations will be prepared by standard serial dilution (APHA et al. 1975) using Class A volumetric glassware and dilution water. Test organisms will be added to prepared test solutions.

3.8 Test Vessels and Test Volume

Test vessels will consist of 400-ml pyrex beakers and the final test volume of each replicate will be 0.2 L.

3.9 Test Organism Number

A minimum of 10 test organisms will be used in each test replicate, constituting a minimum number of 20 Daphnia per treatment group. Neonates will be randomly assigned to each test replicate.

3.10 Test Environment

The test vessels will be maintained in environmental growth chambers at 20 C and a 16-hour light, 8-hour dark photoperiod cycle.

3.11 Analysis of Test Concentrations for Test Article

If required, test solution replicates may be analyzed for chemical analytical verification of achieved test concentrations. The analytical method and number of determinations will be formulated after consultation with the sponsor. Where chemical analyses are necessary, both nominal and actual measured test solution concentrations will be reported.

3.12 Test Observations

Test organisms will be observed at a minimum of 24 and 48 hours after test initiation to determine number of animals killed by the test article concentrations. The study will terminate after completion of the 2-day observation period. The study may be extended, however, at the request of the sponsor.

Water quality characteristics of the test concentrations and diluent water controls are recorded in the following manner: dissolved oxygen, temperature, and pH will be measured in each test replicate at test initiation and at 24-hour intervals until test termination. Specific conductance, total alkalinity, and total hardness will be measured in one control, one high concentration, one medium concentration, and one low concentration replicate at test initiation and at 24-hour intervals thereafter. Test solutions will not be aerated. Analytical methods will be conducted according to APHA et al. (1975) and EPA (1979).

3.13 Data Analysis

The LC50 or EC50 values and associated statistics will be derived by the probit analysis (SAS) or moving average, and binomial test methods as described by Stephan (1977). Depending on the nature of the data, other methods may be used including the probit approximation method of Litchfield and Wilcoxon (1949), or by graphical interpolation using the log concentration vs. percent lethality as described by APHA et al. (1975). The methods used will be specified in the report.

4. FINAL REPORT

The final report will be prepared to contain the following information:

- Objectives and procedures stated in the approved protocol, including any changes made to the original protocol
- Identity of the test articles by name or code number and their strength (quality/purity)
- Source of the dilution water, its chemical characteristics, and a description of any pretreatment

- Test concentration series used and duration of treatment
- Average lengths and weights of test fish, the respective ranges, and approximate loadings of fish to test volume (g/L)
- Water quality characteristics of dilution water and selected test concentrations
- Any unforeseen circumstances that may have affected the quality or integrity of the study
- Signature of the project manager and director as authorization of the report.
- Location of all raw data and the original copy of the final report at EA

Items of data to be included in the report consist of: experimental design; effects on general appearance; morbidity and mortality; tabular presentation and appropriate statistical evaluation of water quality characteritics, and survival data where necessary.

5. QUALITY ASSURANCE

5.1 Amendments to Protocol

Amendments to the authorized protocol instigated by EA or by the client will only be made after proper authorization. Such authorization is achieved by completion of the Amendment to Protocol form by EA and the client.

5.2 Standard Operating Procedures

Unless otherwise specified all procedures mentioned in the protocol are subject to detailed Standard Operating Procedures which are contained in the SOP manuals of the participating departments.

5.3 Quality Assurance Evaluation

The study described in this protocol may be subject to internal audit by the Quality Assurance Unit.

5.4 Inspection by Regulatory Authorities

In the event of an inspection of EA by an outside authority during the course of the study, the client will be consulted before the inspectors are permitted access to any of the project records or the experimental areas.

5.5 Archives

Original project-specific records shall be transferred to the client promptly after the project is completed or as negotiated and budgeted with each client. Primary data will be retained for a period of five years. Primary data include laboratory data sheets, records, memoranda, notes, photographs, microfilm, and computer printout that are a result of the original observations and activities of the study and which are necessary for the reconstruction and evaluation of the report of the study.

5.6 Location

This study will be conducted by the Environmental Toxicology Services Department of the Scientific Operations Division of Ecological Analysts, Inc. at the Mid-Atlantic Regional Offices, Sparks, Md. 21152.

6. DAPHNIA ACUTE TOXICITY TEST SPECIFICATIONS

6.1 Basic Reference

American Society for Testing and Materials. 1981. Standard Practice for Conducting Acute Toxicity tests on Wastewaters with Daphnia. ASTM, Philadelphia. Draft, February 1981.

6.2 Test Specifications

Test organism	Daphnia magna or D. pulex
Age:	Less than 24 hours old
Temperature:	20±2 C
Light quality:	Wide-spectrum fluorescent light
Light intensity:	50-100 f.c.
Photoperiod:	16-hour light, 8-hour dark
Aeration:	None
Dilution water:	Dechlorinated municipal water or reconstituted water
Test container:	400-ml beaker
Test volume:	200 ml
No. of concentrations:	Minimum of 5 test concentrations and a control

No. of replicates:	Two, unless otherwise specified
No. of animals per replicate:	10
Feeding regime:	Animals will not be fed during test
Test type and duration:	Range-finding--24 hours Definitive--48 hours Reference toxicant--24 hours
End points:	Immobilization (EC50)--defined as inability to move except for minor activity of appendages Lethality (LC50)--all movements cease for periods of at least 5 seconds even when test container is tapped or rotated

ATTACHMENT II

Data Sheets for Toxicity Tests Conducted on Four Samples
with Associated Water Quality Measurements

SALT CREEK INTAKE

FAB52T

Test Article: AE-351

Client: General Motors

OC Test No.: SA 01-10 85 101

Test Container: 400 ml

Test Volume: 200 ml

Test Duration: 96 hr

Common Name: Water flea

Scientific Name: Daphnia pulex

Lot No.: N/A

Source: EA stocks less than 24 hrs old

Acclimation: N/A days

Beginning Date: 20 July 95 Time: 1300

Ending Date: 24 July 95 Time: 1105

Test Temperature Range: 18.7-20.8

Mean Acclimation Temperature: 20 °C

Acclimation Temperature Range: 19-21 C

CONC. or %	TEST CONTAINER NUMBER	NUMBER OF LIVE ORGANISMS 0	24	48	72	96	ALL TESTS TEMPERATURE (C) 0	24	48	72	96	DISSOLVED OXYGEN (mg/liter) 0	24	48	72	96	pH 0	24	48	72	96	FRESHWATER TESTS TOTAL ALKALINITY (mg/liter as CaCO3) 0	24	48	72	96	TOTAL HARDNESS (mg/liter as CaCO3) 0	24	48	72	96	SALT OR BRACKISH WATER TESTS SALINITY (ppt) 0	24	48	72	96	Control Toxicity 0	24	48	72	96
Control	A	10	10	10			20.1	20.0	20.4			9.2	8.3	7.9			7.6	8.1	8.2			46					78											
	B	10	10	10			20.1	20.1	20.8			9.5		7.9			7.7		8.2																			
1%	A	10	10	10			20.6	20.0	20.7			9.5	8.2	8.0			7.9	8.1	8.2																			
	B	10	9	9			20.4	20.0	20.7			9.5		8.1			7.9		8.2																			
3%	A	10	10	9			20.4	20.0	20.7			9.5		8.1			7.8		8.2																			
	B	10	10	10			20.2	20.0	20.7			9.5		8.0			7.8		8.1																			
10%	A	10	10	10			20.2	20.0	20.7			9.5	8.2	8.1			7.8	8.1	8.2																			
	B	10	8	8			20.1	20.0	20.5			9.5		8.1			7.6		8.2																			
30%	A	10	10	9			19.9	20.0	20.5			7.9		8.0			7.7		8.2																			
	B	10	10	10			19.9	20.0	20.4			7.7		8.0			7.7		8.1																			
100%	A	10	10	10			19.9	20.0	20.4			10.5	8.0	8.0			7.6	8.0	8.2																			
	B	10	10	10			18.7	20.0	20.2			6.4		8.0			7.6		8.2			92					96										10%	

INSTRUMENT NUMBER	N.A.						2	2	2			2	2	2			231	231	231																			
CALIBRATION VALUE	N.A.						RL	RL	RL			9.18	9.16	8.08			7/10	7/10	7/10																			
CORRECTION FACTOR (if applicable)	N.A.						NA	NA	NA			NA	NA	NA			NA	NA	NA																			
INVESTIGATOR SIGNATURE & INITIALS							[illegible]	[illegible]	[illegible]			[illegible]	[illegible]	KMG			[illegible]	[illegible]	KMG																			

NA - NOT APPLICABLE

EA 10020 12/1/91

PLEASANT RUN CONFLUENCE

EA852T

Test Article: ATS-352

Client: General Motors

QC Test No.: 39-07-20-85-182

Test: (Static) / Flow-through, renewal

Test Container: 2 L

Test Volume: 2 L

Test Duration: 48 h

TEST ORGANISM:

Common Name: Water flea

Scientific Name: Daphnia pulex

Lot No.: 4/4

Source: Ecotox Stock / Less than 24 hrs old

Acclimation: N/A days

Beginning Date: 26 July 85 Time: 1008

Ending Date: 28 July 85 Time: 1007

Test Temperature Range: 19.9 - 21.2C

Mean Acclimation Temperature: 20.5C

Acclimation Temperature Range: 19-21C

CONC. or %	TEST CONTAINER NUMBER	NUMBER OF LIVE ORGANISMS 0	24	48	72	96	ALL TESTS: TEMPERATURE (C) 0	24	48	72	96	DISSOLVED OXYGEN (mg/liter) 0	24	48	72	96	pH 0	24	48	72	96	FRESHWATER TESTS: TOTAL ALKALINITY (mg/liter as CaCO3) 0	24	48	72	96	TOTAL HARDNESS (mg/liter as CaCO3) 0	24	48	72	96	SALT OR BRACKISH WATER TESTS: SALINITY (ppt) 0	24	48	72	96	Control/Dilution Water 0	24	48	72	96
Ctrl	A	10	10	9			20.3	20.0	20.1			8.7	8.3	9.0			7.9	8.2	8.2			46					78														
	B	10	9	9			20.2	20.0	20.3			8.7		8.1			7.9		8.2																						
1%	A	10	9	9			20.0	20.0	20.1			8.7	8.3	8.1			7.9	8.1	8.2																						
	B	10	10	10			20.0	20.0	20.5			8.7		8.2			7.9		8.2																						
3%	A	10	10	10			19.9	20.0	20.5			8.7		8.1			7.9		8.2																						
	B	10	9	8			19.9	20.0	20.5			8.7		8.1			8.0		8.2																						
10%	A	10	10	10			19.9	20.0	20.1			8.7	8.3	8.2			8.0	8.1	8.2																						
	B	10	10	9			19.5	20.0	20.1			8.7		8.2			8.0		8.2																						
30%	A	10	10	10			20.0	20.0	20.4			8.6		8.1			8.1		8.3																						
	B	10	10	10			20.0	20.0	20.3			8.6		8.1			8.1		8.3																						
100%	A	10	8	6			21.2	20.0	20.2			8.4	8.3	7.7			8.2	8.4	8.5																						
	B	10	9	8			21.0	20.0	20.2			8.1		7.8			8.2		8.5			228					221												20°C				
INSTRUMENT NUMBER		N.A.					2	2	2			2	2	2			231	231	231																						
CALIBRATION VALUE		N.A.					RL	RL	RL			9.80	8.6	8.05			7.00	7.00	7.00																						
CORRECTION FACTOR (if applicable)		N.A.					NA	NA	NA			NA	NA	NA			NA	NA	NA																						
INVESTIGATOR SIGNATURE & INITIALS							MDS	MDS	KAB			MDS	MDS	KAB			MDS	MDS	KAB																						

N.A. NOT APPLICABLE

EA 852T 12/84

BELOW CONFLUENCE

Project no.: EMB521
Test Article: AES-353
Client: Gulfeam Moores
QC Test No.: S1 67-20-85-183

TEST: (Static, Flow through, Renewal
Test Container: 4000 L
Test Volume: 1000 L
Test Duration: 48-hrs

TEST ORGANISM:
Common Name: Cyclo. fla.
Scientific Name: Daphnia pulex
Lot No.: A-1
Source: [illegible] 24 hr old
Acclimation: N/A days

Beginning Date 24 July 85 Time 1530
Ending Date 29 July 85 Time 1505
Test Temperature Range: 20.0 - 21.4 C
Mean Acclimation Temperature: 20.5 C
Acclimation Temperature Range: 19 - 21 C

CONC. or %	TEST ENTRANCE NUMBER	NUMBER OF LIVE ORGANISMS 0	24	48	72	96	ALL TESTS TEMPERATURE (C) 0	24	48	72	96	DISSOLVED OXYGEN (mg/liter) 0	24	48	72	96	pH 0	24	48	72	96	FRESHWATER TESTS TOTAL ALKALINITY (mg/liter as $CaCO_3$) 0	24	48	72	96	TOTAL HARDNESS (mg/liter as $CaCO_3$) 0	24	48	72	96	SALT OR BRACKISH WATER TESTS SALINITY (ppt) 0	24	48	72	96	Cyclo. fla. 0	24	48	72	96
Cntl	A	10	10	10			20.5	20.6	20.6			8.5	8.1	8.0			7.9	8.1	8.2			410				420	420												
	B	10	10	10			20.1	20.0	20.8			8.5		8.1			7.9		8.2								428											
1%	A	10	10	10			20.1	20.0	20.8			8.5	8.2	8.1			7.9	8.0	8.2																			
	B	10	9	9			20.1	20.0	20.8			8.6		8.2			7.9		8.2																			
3%	A	10	10	10			20.1	20.2	20.1			8.5		8.2			7.9		8.2																			
	B	10	7	6			20.1	20.0	20.5			7.5		8.2			7.9		8.2																			
10%	A	10	8	8			20.1	20.0	20.5			8.5	8.2	8.2			7.8	8.0	8.2																			
	B	10	8	8			20.1	20.0	20.5			8.5		8.2			7.8		8.2																			
30%	A	10	8	9			20.3	20.0	20.4			8.1		8.1			7.9		8.2																			
	B	10	8	8			20.1	20.0	20.3			8.0		8.1			7.8		8.3																			
100%	A	10	10	10			20.1	20.0	20.2			7.9	7.7	7.6			7.8	8.1	8.1																			
	B	10	9	9			20.1	20.0	20.2			7.7		7.6			7.8		8.2			201					382											
INSTRUMENT NUMBER		N.A.					3	2	2			2	2	2			221	211	231																			
CALIBRATION VALUE		N.A.					NA	RL	RL			8.90	8.66	8.68			7.14	7.00	7.10																			
CORRECTION FACTOR (if applicable)		N.A.					NA	NA	NA			NA	NA	NA			NA	NA	NA																			
INVESTIGATOR SIGNATURE & INITIALS							MW	MW	KDS			MW	KDS	KDS			MW	KDS	KDS																			

N.A. NOT APPLICABLE

EA 0820 12/1/84

DISCHARGE

EPA 3.27

Test Article: 415-354

Client: Grace & Mirons

QC Test No.: SC-20-85-154

Test (Static) Flow through, Renewal

Test Container: 1000 ml

Test Volume: 1000 ml

Test Duration: 96 hrs

TEST ORGANISM:

Common Name: Lab C. flea

Scientific Name: Daphnia pulex

Lot No.: N/A

Source: Stock 10% TAW 24 hrs old

Acclimation: 4/P days

Beginning Date 4-26-85 Time 1545

Ending Date 4-30-85 Time 1545

Test Temperature Range: 19.5 - 21.2C

Mean Acclimation Temperature: 20.5C

Acclimation Temperature Range: 19 - 21C

CONC. or %	TEST CONTAINER NUMBER	NUMBER OF LIVE ORGANISMS 0	24	48	72	96	TEMPERATURE (C) 0	24	48	72	96	DISSOLVED OXYGEN (mg/liter) 0	24	48	72	96	pH 0	24	48	72	96	FRESHWATER TESTS TOTAL ALKALINITY (mg/liter as $CaCO_3$) 0	24	48	72	96	TOTAL HARDNESS (mg/liter as $CaCO_3$) 0	24	48	72	96	SALT OR BRACKISH WATER TESTS SALINITY (ppt) 0	24	48	72	96	Control Validity 0	24	48	72	96
Control	A	10	10	10			19.2	19.5	20.1			9.6	9.3	8C			8.0	7.1	8.2			116						76											
	B	10	10	10			20.3	19.5	20.3			8.5		9.2			9.0		8.2																			
1%	A	10	10	9			20.2	19.5	20.2			9.5	9.3	8.1			7.9	8.1	8.2																			
	B	10	10	10			20.3	19.5	20.2			9.0		8.2			7.9		8.2																			
3%	A	10	8	8			20.2	19.5	20.1			8.6		8.1			7.9		8.2																			
	B	10	8	7			20.2	19.5	20.2			8.6		8.2			7.9		8.2																			
10%	A	10	8	9			20.2	19.5	20.2			8.6	8.4	8.2			7.9	8.0	8.2																			
	B	10	10	10			20.2	19.5	20.2			8.6		8.2			7.9		8.2																			
30%	A	10	7	6			20.5	19.5	20.3			8.6		7.9			7.8		8.2																			
	B	10	8	8			20.1	19.5	20.2			8.5		8.0			7.9		8.2																			
100%	A	10	10	8			21.2	19.5	20.1			8.2	8.4	8.0			7.6	8.0	8.3						548										83.0				
	B	10	8	6			21.2	19.5	20.1			8.2		8.1			7.7		8.3			171																
INSTRUMENT NUMBER		N.A.					3	2	2			0	2	2			231	231	231			1108																
CALIBRATION VALUE		N.A.					PL	PL	PL			8.4	8.4	8.1.8			7.10	7.10	7.10			173																
CORRECTION FACTOR (if applicable)		N.A.					NA	NA	NA			NA	NA	NA			NA	NA	NA																			
INVESTIGATOR SIGNATURE & INITIALS							[illegible]	[illegible]	[illegible]			[illegible]	[illegible]	[illegible]			[illegible]	[illegible]	[illegible]																			

N.A. - NOT APPLICABLE

EA 8020-12 (7/77)

APPENDIX F.6

COMPLIANCE SAMPLING INSPECTION REPORT DATED NOVEMBER 28, 1989

B. Schoonmaker Please answer & please watch and MW 11-14-89

INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

105 South Meridian Street
P.O. Box 6015
Indianapolis 46206-6015
Telephone 317/232-8603

November 28, 1989

Mr. Robert W. Herr, Plant Manager
Central Foundry Division
General Motors Corporation
North Jackson Street
Bedford, Indiana 47421-0271

Re: Compliance Sampling Inspection Report
GMC-Central Foundry
NPDES Permit No. IN 003573
July 25-26, 1989

Dear Mr. Herr:

Enclosed are laboratory results of the Compliance Sampling Inspection conducted at your facility on July 25-26, 1989. This information will supplement the inspection portion of the report previously sent to you.

Based on statistical evaluation on sampling analyses data from U.S. EPA in comparison of split samples, your analyses for copper is considered unsatisfactory, and your zinc analysis is considered marginal. We suggest that your laboratory personnel check their analytical procedures for these parameters.

Please respond in writing within twenty (20) days of the receipt of this letter concerning your success in reevaluation of laboratory techniques, or your plans for further reevaluation.

Although no permit limits were exceeded, significant levels of PCBs were found in the receiving stream water and sediment samples during this survey.

If you have any questions regarding this matter, please contact Mr. J. Larry McFall at 317/243-5064.

Very truly yours,

Stephen H Boswell

Stephen H. Boswell, Chief
Surveys Section
Office of Water Management

JLM/bs
Enclosure
cc: Lawrence County Health Department
Tim Galloway
U.S. E.P.A. - Water Division
Mr. Donald Schregardus, Chief

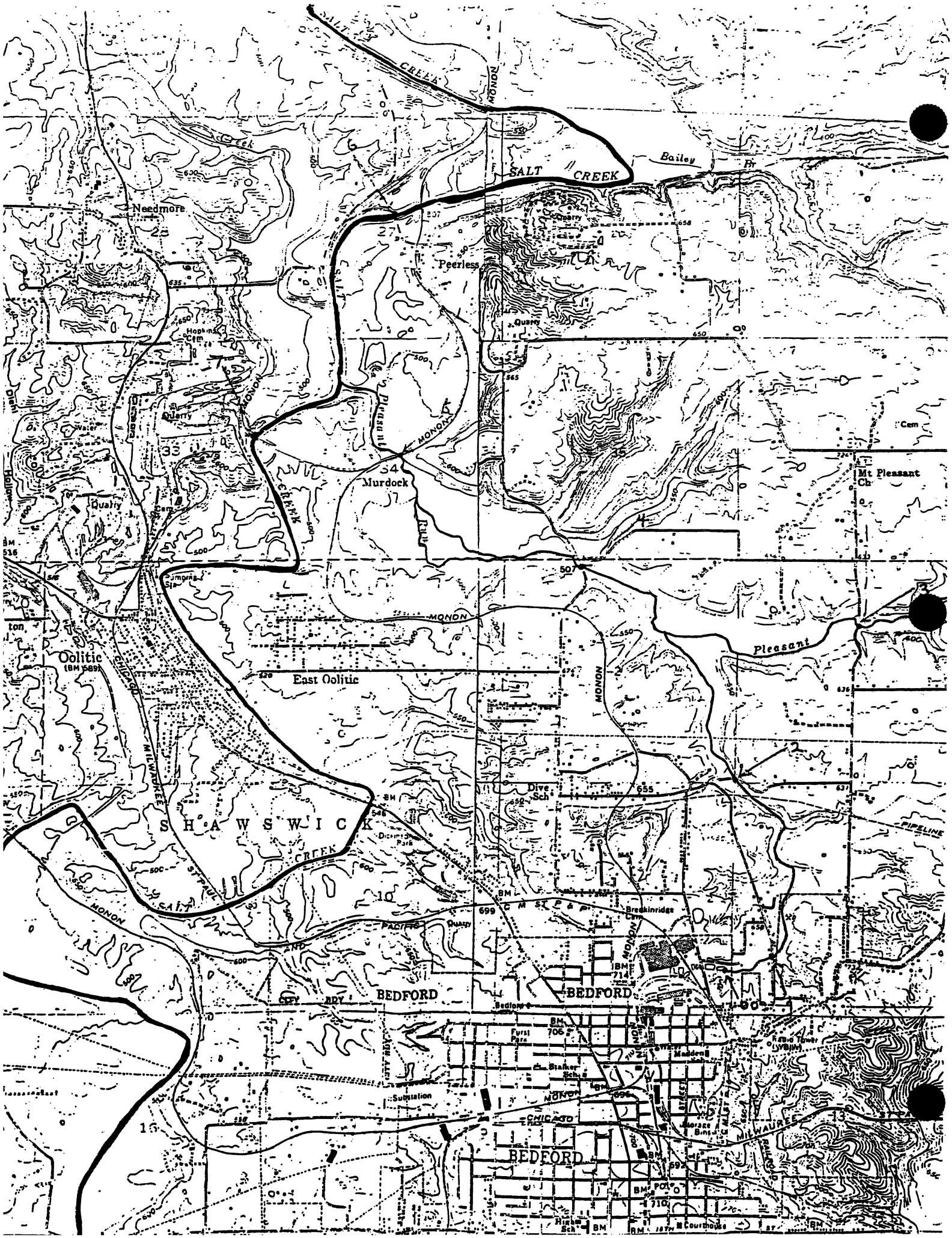

SALT CREEK
Needmore
Peerless
Quarry
Hopkins Cem
Pleasant
MONON
Murdock
Mt Pleasant Ch
Cem
Oolitic
(BM 589)
East Oolitic
CHICAGO
MILWAUKEE
S H A W S W I C K
SAINT PAUL
PACIFIC
Dive Sch
Breckinridge Cem
PIPELINE
BEDFORD
Bedford
Substation
Stalker Sch
Madden
Courthouse
Bailey
Dr

TABLE I
PCBs IN GMC - CENTRAL FOUNDRY
EFFLUENT AND RECIEVING STREAM
UNIT IN PPB

CSI Date	GMC Outfall 002	GMC Sludge	#1 WQ/Sed	#2 WQ/Sed	#3 WQ/Sed	#4 WQ/Sed	#5 WQ/Sed	#6 WQ/Sed	#7 WQ/Sed
10/25-26/83	6.7	NC	NC	NC	NC	NC	NC	NC	NC
6/11-12/85	< D.L.	750,000	16.3/NC	11.0/NC	NC	6.6/NC	NC	NC	NC
11/6-7/86	< D.L.	61,000	4.0/NC	< D.L./3,200	NC	1.6/NC	NC	NC	NC
7/25-26/89	<5.0	120,000	8.1/33,000	3.7/67,000	< D.L./< D.L.	0.61/96.00	NC/5,500	NC/55.	NC/770

NC - not collected

0698b

IDEM - WATER MANAGEMENT

COMPARISON OF IDEM LABORATORY AND FACILITY LABORATORY RESULTS

Date of Sampling: July 25-26, 1989

Facility: GMC Central Foundry Permit No: IN0003573

Location: Bedford, In Receiving Stream: Baily Branch to Pleasant Run Creek

	*NPDES Parameters	NPDES Limits In (lbs/day) mg/l	IDEM Results Outfall 002	Facility Results outfall 002				
*	Flow (mgd) Monitor	5 X weekly		.389 mgd				
*	Ammonia-N Daily Max. mg/l	3.6	1.2	0.9				
	Arsenic ug/l		0.4					
*	BOD_5 Daily Max. mg/l	30.	1.1	5.0				
	Magnesium mg/l		24.					
	Cadmium ug/l		<2.					
	Chlorides mg/l		1,500.					
	Chrom.- Hex ug/l		<10.					
	Chrom. - Tot ug/l		<4.					
	COD mg/l		420.					
*	Copper Daily Max. ug/l	140.	16.	30.				
	Cyanide - CN mg/l		.006					
	Fluoride mg/l		1.2					
	Diss. Reac. Silica ug/l		5.					
*	Lead Daily Max. ug/l	200.	14.	<50.				
	Manganese ug/l		80.					
	Mercury ug/l		<0.1					
	Nickel ug/l		10.					
	$NO_2 + NO_3$ - N mg/l		7.4					
*	Oil and Grease Daily Max. mg/l	10.	3.0	10.				
F	pH (lab) S.U.	6.0 to 9.0	7.7	7.8				
k	Phenol (4AAP) Daily Max. ug/l	0.76 (lbs/day)	(.036)	(.065)				
	Phos. - P mg/l		0.45					
	Surfactants mg/l		0.2					
*	Susp. Solids mg/l	15.	2.0	<1.0				
	Total Solids mg/l		3,320.					
	Sulfate mg/l		135.					
	TKN mg/l		2.2					
	TOC mg/l		87.					
	Zinc Daily Max. ug/l	1.62 (lbs/day)	(.42)	(.55)				
	E. Coli./100 ml		<10.					
	Potassium		45.					
	Chlorine Residue Daily Max. mg/l	0.2	0.1					
	PCB ug/l	1.0	1.0 Aroclor 1260	<0.5				
	Spec. Cond.		5,400					
	Alkaline/Hardness ($CaCO_3$)		138/474					

GMC Central Foundry CSI with Stream Samples July 25-26, 1989

INTENSIVE SURVEY DATA

STATION NO.	D/S #4 Third D/S Bridge 2.46 mi. D/S	#3 Pleasant Run Creek	D/S #2 Second D/S Bridge 1.14 mi. D/S	D/S #1 First D/S Bridge .19 mi. D/S	GMC 002 Outfall
FIELD					
Flow cfs	Approx. 3.2	2.27	.848	.69	.389 mgd
Temp — High		23°	23°	26°	28°
Temp — Avg		21°	22°	25°	26°
Temp — Low		20°	20°	23°	26°
D.O. — High		7.0	6.4	5.8	6.5
D.O. — Avg		6.1	5.5	5.8	5.9
D.O. — Low		5.6	4.8	5.2	5.4
pH — High		7.6	8.3	7.7	7.3
pH — Avg		7.4	7.4	7.5	7.0
pH — Low		7.4	7.9	7.7	7.8
LABORATORY ANALYSES					
Alkalinity	234.	221.	183.	124.	138.
Ammonia - N	<0.1	<0.1	0.2	<0.1	1.2
Arsenic	1.0	0.4	0.9	0.5	0.4
BOD_5	<1.0	<1.0	1.2	1.6	1.1
Cadmium	<2.	<2.	<2.	2.0	<2.
Chlorides	100.	10.	585.	860.	1,500
Chromium - Hex			<10.		<10.
Chromium - Tot	<4.	<4.	<4.	<4.	<4.
COD	80.	9.	290.	380.	420.
Copper	<4.	<4.	8.	13.	16.
Cyanide - CN	<.005	<.005	<.005	<.005	.006
Fluoride	0.2	<0.1	0.7	0.9	1.2
Hardness	280.	243.	376.	376.	474.
Lead	<6.	<6.	11.	14.	14.
Manganese	130.		90.	40.	80.
Mercury	0.2	0.2	0.1	0.1	<0.1
Nickel	<4.	<0.4	6.0	8.0	10.
$NO_2 + NO_3$ - N	1.4	1.6	4.1	6.4	7.4
Oil & Grease	<1.	<1.	2.0	5.0	3.0
pH (lab)	7.9	8.0	8.0	8.0	7.7
Phenol					11.
Phosphorus - P	0.13	<0.03	0.37	0.40	0.45
Solids - Susp	6.	7.	9.0	5.0	2.0
Solids (total)	540.	302.	1,590	2,050.	3,320.
Sulfate	45.	22.	130.	140.	135.
TKN	0.7	0.4	1.0	1.2	2.2
TOC	17.5	2.2	69.	98.	87.
Zinc	20.	10.	80.	130.	130.
E. coliform	600.	7,000.	2,600	170.	<10.

GMC Natural Foundry CSI Sludge and Sediment Samples : July 25 & 26, 1989

INTENSIVE SURVEY DATA	STATION NO.	GMC Sludge	D/s #1 First D/s Bridge .19 mi D/s	D/s #2 Second D/s Bridge 1.14 mi D/s	#3 Pleasant Run Creek	D/s #4 Third D/s Bridge 2.46 mi D/s	D/s #5 RR Bridge 3.6 mi D/s	#6 Salt Creek Bridge at Peerless D/s	D/s #7 Salt Cr. RR Bridge 4.7 mi D/s
FIELD	Flow								
	Temp								
	D.O.								
	pH								
LABORATORY ANALYSES	Alkalinity								
	Ammonia - N								
	Arsenic	2,300.	5,000.	26,000	28,000	4,900.	7,800.	5,900.	5,800.
	BOD_5								
	Cadmium	3,800.	680.	730.	570.	<2000.	<1,300.	<1,300.	<1,200.
	Chlorides								
	Chromium - Hex								
	Chromium - Tot	70,000.	32,000.	69,000	79,000	12,000.	18,000.	12,000.	14,000.
	COD								
	Copper	830,000	39,000	27,000	13,000	18,000.	17,000.	12,000.	12,000
	Cyanide - CN mg/kg Wet Basis	.56	.50	2.4	1.2	.18	1.2	9.6	1.2
	Fluoride								
	Iron								
	Lead	76,000	49,000	40,000.	43,000.	14,000.	17,000.	15,000	11,000.
	Manganese	290,000	300,000	2,700,000	2,900,000	750,000	960,000	1,000,000	1,100,000
	Mercury	88.	36.	77.	23.	60.	68.	74.	54.
	Nickel	25,000	10,000	27,000	31,000	10,000.	14,000.	14,000	17,000.
	$NO_2 + NO_3$ - N								
	Oil & Grease								
	pH (lab)								
	Phenol								
	Phosphorus - P								
	Solids - Susp								
	Solids (total) Vol.	42.34%	2.53%	2.71%	1.82%	8.12%	4.84%	3.12%	6.77%
	Solids, Total	38.76%	79.13%	80.48%	80.68%	52.08%	62.22%	68.29%	57.15%
	TKN								
	TOC								
	Zinc	400,000	120,000	110,000	130,000	59,000.	70,000.	64,000	61,000
	Fecal coliform								

ug/kg

Survey Summary
GMC - Central Foundry
July 25-26, 1989

A Compliance Sampling Inspection (CSI) was conducted at GMC-Central Foundry located in Bedford, Indiana on July 25-26, 1989. This facility produces aluminum die, permanent and semi-permanent mold castings and is serviced by a Class D industrial wastewater treatment plant. The main process water outfall, 002 (carbon column effluent), discharges to an unnamed tributary of Pleasant Run Creek which in turn flows into Salt Creek. A second outfall 003 (overflow from a stormwater retention lagoon) seldom flows except during prolonged rainfall events. This outfall was not flowing at the time of the survey.

This survey was performed in conjuction with an inspection by Kevin Hotz of the Inspection Group. Mr. Tim Galloway represented GMC-Central Foundry during the inspection.

This 24 hour CSI was conducted along with a stream survey which included water quality and sediment sampling at four downstream locations. (See attached map.) These sampling sites were located on the unnamed receiving stream at .19 miles (#1) and 1.14 miles (#2), on Pleasant Run Creek upstream of the confluence with the unnamed tributary (#3), and 2.46 miles downstream in Pleasant Run Creek (#4). The outfall and stream samples were composited manually on a two hour basis except for VOA samples which were collected as three discreet grab samples. Due to the logistics of compositing every two hours, no water quality samples were taken further downstream than station #4. Additionally, oil and grease and E. coli samples were grabbed at the end of the 24 hour compositing period.

Previous CSIs conducted on October 25-26, 1983, June 11-12, 1985, and November 6-7, 1986 have documented PCB contamination in either the outfall and/or the recieving stream. See table I. In order to further document the extent of this contamination, sediment samples were collected at seven downstream locations. Additionally, a sludge sample was collected from the wastewater treatment facility to determine the level of PCBs and metals being removed in the treatment process.

Laboratory analyses indicated that GMC-Central Foundry was meeting permit limits for all parameters. Although not limited by the permit, chlorides were found at 1500 mg/l in the final effluent. Chlorides have been found at elevated levels in previous surveys. This situation was explained in the November 6-7, 1986 CSI report. In short, this problem is caused by drainage from railroad property adjacent to the GMC-Central Foundry treatment plant. This drainage is then routed through the treatment system. These levels are causing no apparent acute aquatic life toxicities. This was evidenced in a bioassay test of the effluent which caused no significant mortalities of the test organism (daphnia magna) over the 48 hour test period.

PCBs were found at very elevated levels in the recieving stream water and in the sediment samples. This has been the case during the two previous CSIs. The elevated levels found in the composite water samples could be due in part to continual leaching from PCB build-up in the sediments. PCB removal within the treatment system must still be a major concern of GMC-Central Foundry as can be seen by the levels (120,000 ppb) found in the sludge sample from this most recent CSI.

As documented in Table I, PCB levels are of serious concern at all sampling sites except for station #3 on Pleasant Run Creek which is upstream of the confluence with the receiving stream. Station #5 (3.6 miles downstream) was found to have 5,500 ug/kg PCBs in the sediment. This site is bordered by pastureland where cattle were observed to be disturbing the sediment while wading instream for drinking. Station #7 (4.7 miles downstream in Salt Creek) was found to have 770 ug/kg PCBs in the sediment. Due to the height of the railroad bridge and high stream velocity at this location making mid stream sampling impossible, the sediment sample was taken near the bank. Significantly, the Bedford standby water intake pumping station is approximately .8 miles downstream of this site. The upstream sampling site on Salt Creek (Station #6) also revealed significant levels of PCBs (55. mg/kg). This indicates a contributary source from upstream in Salt Creek to the levels found at station #7.

Cyanide was also found unexpectedly in the sediment at Station #6 on Salt Creek. Again due to the high river stage, this sample was collected close to the bank instead of midstream. The results revealed a level of 9.6 mg/kg which appeared high compared to maximum natural background concentrations in Indiana lakes and streams. Cyanide breaks down over time in soil and water from bacterial action. As is the case with the PCB contamination, further sampling would be justified to identify the source of this problem.

The full toxics scan for metals, base neutrals, phenols, pesticides, and VOAs (volatile organic aromatics) revealed no significant levels for any of these parameters in the water or sediment.

Based on sampling analyses data from U.S. EPA in comparisons of split samples the GMC-Central Foundry analysis for zinc was considered marginal and the analysis for copper was considered unacceptable.

Comparative flow measurement was not attainable due to the lack of a primary device. This facility monitors flow by means of a magnetic meter located near the final discharge. Facility personnel were able to maintain a constant flow rate throughout the entire sampling period to facilitate flow weighting of samples. The total plant flow for the 24 hour sampling period was .389 mgd. All flow monitoring totalizers, charts, and controls appeared to be state of the art and in good working order.

In general, the wastewater treatment facility appears to be well operated and maintained. Public Water Supply and Solid and Hazardous Waste Staff should be apprised of findings from this study.

MAY 25, 2001

APPENDIX F.7

COMMONWEALTH BIOMONITORING 1990 REPORT

COMPANY BACKGROUND

Central Foundry is an aluminum die casting facility. Water used by the company in air scrubbers and the cooling of dies and castings is treated by oil separation, aerobic digestion, chemical coagulation, flocculation, and clarification, and by filtration and activated carbon adsorption. The treated wastewater and stormwater runoff are discharged through outfall 002. More than 80% of the water used in the die casting process is recycled within the system. Water softeners are used to facilitate the use of recycled water. The wastewater normally contains elevated concentrations of calcium, magnesium, sodium, and chlorides originating from the water softening process. Small amounts of copper, lead, and zinc in the wastewater are thought to originate from the air pollution scrubbing process.

Recent toxicity testing by IDEM has shown that no acute toxicity to Daphnia magna was present in effluent samples collected on July 25-26, 1989. Additional testing by Central Foundry since that time has determined that there is also little or no acute or chronic effluent toxicity to fathead minnows (100% survival and no growth inhibition in 4 of 5 tests). Ceriodaphnia dubia appear to be the organisms most sensitive to the effluent. Three of six samples have exhibited acute toxicity and all six have exhibited some degree of chronic toxicity.

Will this statement hurt us in change type of organism we want to use.

SECTION 2
Summary of Objectives and Methods

Site-specific Criteria

The objective of this part of the study was to determine whether copper, lead, or zinc cause acute or chronic toxicity in the Central Foundry effluent. This was done in several ways. First, toxicity tests were conducted using "laboratory" and "site" waters as dilution waters. If there is a "site water" effect observable for several species, an appropriate correction factor can be used to adjust the aquatic toxicity criterion (EPA Water Quality Standards Handbook, 1983).

A second method was to conduct whole effluent toxicity tests and measure metals concentrations concurrently. Endpoints observed in these tests were compared to endpoints observed in laboratory tests reported in the scientific literature. If levels of metals in the effluent were less toxic than those observed to be toxic in laboratory tests, the results confirm that a "site effect" has occurred and provide additional evidence that a "site-specific criterion" is justified.

Third, "artificial effluents" were created using reagent grade chemicals in receiving stream water and a "laboratory" water. These artificial effluents contained ions of calcium, magnesium, sodium, chlorides, and metals in concentrations matching maximum values presently observed in the effluent. The objective was to observed whether the chemicals interacted to modify toxicity expected with single chemicals. A second objective was to determine whether receiving stream water had an effect on toxicity.

REVIEW OF AQUATIC TOXICITY DATABASE FOR LEAD

The objective of this part of the study was to review the recent scientific literature on lead toxicity. The EPA Gold Book states that "confidence in a criterion usually increases as the amount of available pertinent data increases. Thus, additional data are usually desirable" (Appendix A, II,E). EPA's 1984 water quality criteria document for lead contains toxicity data on only 10 species for acute toxicity and 3 species for chronic toxicity. If this data base is updated, new criteria can be calculated which are more accurate than the original criteria. These criteria were re-calculated using techniques described by EPA in the Gold Book. Alternative permit limits were re-calculated using these new criteria and IDEM's methods for translating criteria to permits.

Biosurveys

The objective was to observe the numbers and kinds of fish and benthic invertebrates within Bailey Branch and to determine whether the Central Foundry discharge is adversely affecting the aquatic community of the stream. Fish were collected by seine and dipnet. Benthos was collected by kick samples from riffle areas.

Sampling dates - 12/28/89 (benthos only)

SECTION 3
Physical Description of Bailey Branch and its Watershed

Bailey Branch is a small tributary of Pleasant Run Creek in Lawrence County, Indiana. Pleasant Run flows into Salt Creek, a major tributary of the East Fork of White River Basin. The entire watershed lies in the Mitchell Plain physiographic region of Indiana, an area characterized by its karst topography of caves and sinkholes.

Central Foundry discharges wastewater to the extreme headwaters of an unnamed tributary of Bailey Branch. At this site, the stream has a drainage area of less than 100 hectares, most of which is Central Foundry property. Estimated Q7,10 of the stream is 0.0 cfs, and it is probable that during extended rainless periods each year, flow in the receiving stream consists entirely of treated effluent from Central Foundry.

Near Central Foundry's outfall, Bailey Branch is 1-2 meters wide and has a maximum depth of 15 centimeters. The substrate consists almost entirely of limestone bedrock, cobble, gravel and sand. Riffles are common and current speed within the riffle areas is about 30 cm/sec. There are no pools in the upper sections of the stream. The slope of the stream is very steep (it drops approximately 45 meters over its entire 2.7 km course between Central Foundry property and Pleasant Run Creek). Because of this, small waterfalls with abrupt drops of 30 cm or more are common in the upper reaches of the stream.

Riparian habitat is excellent along most of the stream's banks. Second-growth forest lines much of the stream, and a shading canopy exists in most areas. Most of the Bailey Branch watershed (consisting of approximately 6.5 square kilometers) is heavily wooded and the stream channel is natural.

Site-specific Criteria

Since Central Foundry discharges to a zero-flow stream, there is no dilution water available during portions of each year. This means that in order to meet Indiana water quality standards for toxicity, the effluent must be neither acutely or chronically toxic before dilution. Comparison to a "site" water is impossible in this case. Therefore, to study the interactions of effluent chemistry on metals toxicity, reagent-grade chemicals containing the various metal ions were added directly to the effluent. The concentrations causing acute toxicity were compared to concentrations causing toxicity in "laboratory" water or to toxicity predicted by the LC50-hardness relationship established by EPA in individual water quality criteria documents. A "site-specific effect" was then determined from these results.

Toxicity tests with Daphnia magna initiated on effluent samples collected on January 10, 1990 showed the following results:

Initial 48-hr LC50 = >100% effluent (no mortalities)

lead = <50 ug/l
zinc =
copper = <20 ug/l

need explain on what this mean

LC50 values (ug/l) with metals additions

	zinc	copper	hardness
effluent	2748	>240	524 mg/l
predicted	781	101	
"site effect"	3.5	>2.4	

REVIEW OF LEAD TOXICITY DATA AND RE-CALCULATION OF CRITERIA

Since the publication of EPA's criteria document for lead in 1984, several new studies on lead toxicity have been published. These studies appear to have been conducted according to EPA requirements (acceptable dilution waters, control mortalities, etc.). Results of these tests are as follows:

Ceriodaphnia reticulata 48-hr LC50 = 1878 ug/l (hardness 240)
Environ. Toxicol. Chem. 5: 393-398
Crangonyx pseudogracilis 96-hr LC50 = 27.6 mg/l (hardness 50)
Water Res. 20:1137-1147.
Pimephales promelas chronic value = 329 ug/l (hardness 44)
P. promelas acute/chronic ratio = 6.4
Environ. Toxicol. Chem. 5:917-931.

By adding the acute toxicity results above to the existing EPA database, the new acute criterion for lead becomes:

$$AAC = e^{1.273\,(\ln \text{hardness}) - 1.110}$$

(see Appendix A for calculations)

By adding the new A/C ratio to the EPA database, the requirement that the ratios not differ by a factor of 10 is not met. However, one of the A/C ratios used in the EPA calculations was for mysid shrimp, a saltwater species. If the data for this species is dropped from the calculations and the data for fathead minnows is added in its place, the A/C ratios still lie within a factor of 10 and are all from freshwater species. The geometric mean of these A/C ratios is 24. By substituting this value into the chronic equation, the chronic equation becomes:

$$CAC = e^{1.273\,(\ln \text{hardness}) - 3.594}$$

(see Appendix A for calculations)

Biosurvey Results

Benthic invertebrate sample results are shown in Table 2. The benthic community downstream from the Central Foundry discharge was dominated by dipteran larvae, primarily midges and blackflies. Environmentally sensitive forms such as caddisflies, mayflies, stoneflies, and amphipods were present in each sample, but in reduced numbers compared to those found in similar, unimpacted streams in the area. It is unlikely that the benthic community was negatively affected by low dissolved oxygen or suspended solids, since organisms sensitive to these stresses (megalopterans, plecopterans, and certain coleopterans) were present in all samples in normal numbers.

The reduced numbers and kinds of ephemeropterans (mayfly larvae) in the samples suggests that the benthos was negatively affected by a toxicant. However, it is unlikely that the toxicant responsible for this effect was a heavy metal such a lead, copper, or zinc. Metals toxicity is often accompanied by a predictable increase in metals-tolerant forms such as the midge larva Cricotopus bicinctus. Samples collected from Bailey Branch contained few of this species. Instead, the midge fauna consisted mostly of the relatively pollution sensitive species Orthocladius obumbratus. Other metals-sensitive organisms such as amphipods and snails were present in normal numbers.

A more likely toxicant responsible for the relatively mild impact of the Central Foundry outfall on the benthos of Bailey Branch is chloride. Chloride ions are known to have a chronic impact to freshwater organisms at concentrations less than 500 mg/l (EPA Water Quality Criteria Document for Chloride, 1989). IDEM measured chloride concentrations as high as 860 mg/l in Bailey Branch during July 1989 (CSI sample results). The EPT taxa (especially mayflies) are among the most highly affected groups, disappearing from the benthic community when chloride concentrations exceed 600 mg/l. (Call et al. 1988. NABS Bulletin. p.43).

Fish collected from Bailey Branch downstream from the Central Foundry outfall are shown in Table 3. (Data not yet collected)

SECTION 6
Application to the
NPDES Permit

REVISED LEAD LIMITS DERIVED FROM THE NEW LEAD CRITERIA

When the new, proposed criteria for lead are substituted into IDEM's method for calculating permit limits, the new proposed limits are as follows:

	Monthly Average	Daily Maximum
Pb (total recoverable)		

That these limits will be protective to designated uses of Bailey Branch (aquatic life) is supported by the following evidence:

Need more samples?

Table 2
RESULTS OF BENTHOS BIOSURVEYS

Bailey Branch at Bailey Scales Rd., first bridge 0.3 km downstream from the Central Foundry outfall. Kick sample from cobble in a riffle. 12/28/89.

Diptera	
Chironomidae	33
Simuliidae	69
Trichoptera	
Hydropsychidae	3
Coleoptera (Elmidae)	3
Odonata	
Argia	3
Calopteryx	1
Oligochaeta	
Tubificidae	5
Lumbricidae	1
Isopoda (Asellidae)	4
Amphipoda (Hyalella azteca)	1
Gastropoda	
Physa	1
Helisoma	1

Bailey Branch, at second bridge, 1.8 km downstream from the Central Foundry outfall. Kick sample from cobble in a riffle. 12/28/89.

Diptera	
Chironomidae	75
Simuliidae	27
Trichoptera	
Hydropsychidae	5
Hydroptilidae	1
Ephemeroptera (Baetidae)	1
Plecoptera	1
Megaloptera	2
Coleoptera (Elmidae)	4
Isopoda (Asellidae)	29
Amphipoda (Hyalella azteca)	6
Gastropoda	
Physa	3
others	3
Oligochaeta	
Tubificidae	4
Lumbricidae	1

TABLE 3.
RESULTS OF FISH COLLECTIONS

Fish collected from Bailey Branch Seining time = minutes
(Data not yet collected)

APPENDIX F.8

IDEM FIELD INSPECTION FORM – 1996 STREAM STUDY

Post-it® Fax Note 7671	Date 1-4-96	# of pages ▶ 4
To GREG BRIGHT	From BILL SCHOONHAKER	
Co./Dept. COMM RICHMOND	Co. GMPTG - BEDFORD	
Phone # 317-887-5855	Phone # 812-279-7308	
Fax # 317-887-8641	Fax # 812-279-7258	

State Form 4336

DEPARTMENT OF ENVIR

INDIANAPOLIS

OFFICE MEMORANDUM

Date: December 7, 1995

To: Kevin Hotz
OWM-Inspector, Area 13

Thru:

From: Anthony R. Branam ARB
OWM-Biological Studies

Subject: Request for Inspection/Investigation of Stream Impairment

While performing site reconnaissance and sample collections members of the OWM-Biological Studies Section, BSS, occasionally encounter streams exhibiting signs of impairment by point or non-point sources. Stream impairment reported by the BSS are either water quality or stream quality problems.

Listed below are those streams and locations observed by the BSS during the 1995 field season as having degraded water quality and/or degraded stream habitat quality attributed to probable point sources. Conditions observed at each site by the BSS should warrant further investigation by the Water Quality Surveillance and Standards Branch to determine if Indiana Water Standards are being violated, and by whom.

Area 13

Lawrence County; Pleasant Run; upstream of Peerless Road; topo H-34, T1W, R5N, Section 6; fish tissue and sediment samples were collected; impairment was observed by Eric Edberg, Tony Branam, and Lisa Ritter, at 1:00pm on December 5, 1995;

> "eutrophication obvious, there is an odor of detergent in the water, water foams easily when stirred or agitated, eight dead fish were observed and few live fish were collected."

INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF WATER MANAGEMENT: INSPECTION SECTION

Complaint Report Form

A. Complaint Date Reported: 6 DEC 95

Received by _____ via ( ) phone; ( ) letter; ( ) in person; (✓) by referral

"Confidential Information"
yes____ no✓

Complaintant: A.R. Branam County: _____
Address: Biological Studies
City: _____ Phone: 243-5061

Nature of Complaint: Very eutrophic conditions; odor of effluent/detergent; water foamed easily when agitated; few fish were observed while sampling; & dead (recent) were observed.

Site Location (directions): Pleasant Run at Peerless Road, north of Bedford, IN

Responsible Party Most likely the General Motors Corporation

B. Report of Investigation

Inspector: _____ Investigation Date: _____

1. Nature of pollution found: _____

samples taken (?)_____; pictures taken (?)_____
2. Is condition a State Water Quality violation? _____
3. Name (& title) of individuals contacted: _____
Address: _____
4. Corrective action taken: _____
5. ( ) written or ( ) verbal orders issued. (Attached copy of written order, or give brief summary of verbal order). _____

C. Follow-up

Pollution abated _____ (date) by _____ (action)

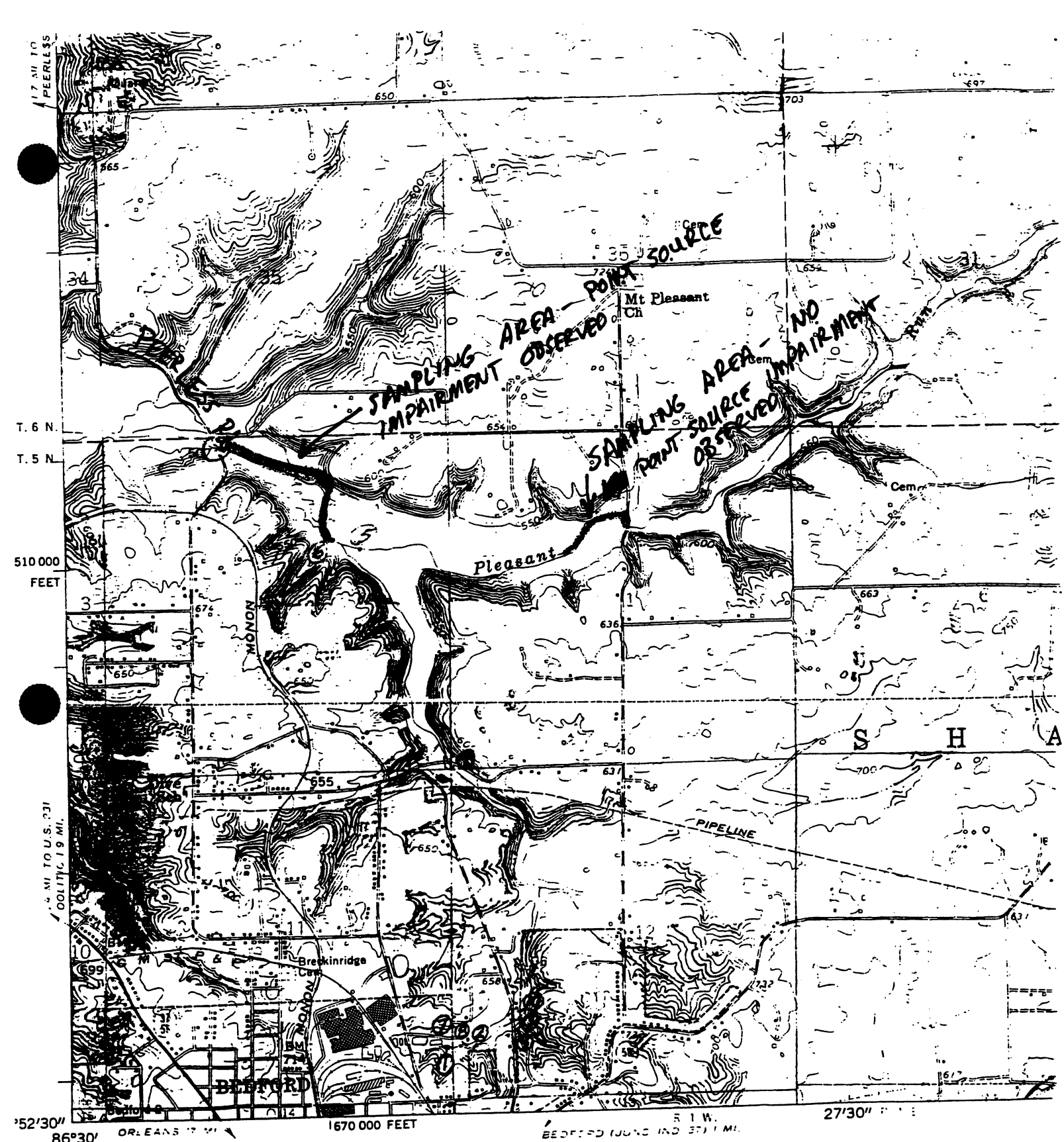
Re-inspection dates: _____ _____ _____
Findings: _____

Other/action/taken: _____

Signature: _____

D. Referred To:

0096b



Mapped, edited, and published by the Geological Survey

Control by USGS, USC&GS, and Indiana Flood Control and Water Resources Commission

Topography from aerial photographs by photogrammetric methods
Aerial photographs taken 1956. Field check 1958

Polyconic projection. 1927 North American datum
10,000-foot grid based on Indiana coordinate system, west zone
1000-meter Universal Transverse Mercator grid ticks, zone 16, shown in blue

Red tint indicates areas in which only landmark buildings are shown

1000 0 1

TRUE NORTH
MAGNETIC NORTH

APPROXIMATE MEAN DECLINATION, 1958

THI
FOR SA
AND INDIAN

STREAM Pleasant Run

LOCATION Peerless Road d/s GMC

SAMPLED? ✓ YES ___ NO SEGMENT NO. 84

INDIANA DEPARTMENT OF ENVIRONMENTAL MGMT.
OWM - BIOLOGICAL MONITORING SECTION
STREAM SURVEY RECORD

COUNTY Lawrence DATE 5 DEC 95

EVALUATOR ARB, EDE TIME 1:00 am

TIW, RSN LMR
TWNSHP SEC. Sect. 2 TOPO H-34

RIPARIAN DEVELOPMENT

U/S L	U/S R	D/S L	D/S R	*
○	○	○	○	EXCELLENT
○	○	✓	✓	GOOD
✓	✓	○	○	FAIR
○	○	○	○	POOR

RIPARIAN WIDTH

○	○	>50 m
○	✓	10-50m
✓	○	5-10m
○	○	<5m

SLOPING BANK COVER**

○	○	TREE
○	○	SHRUB
○	○	GRASS
✓	✓	BARE
○	○	ARTIFICIAL

FLOOD PLAIN LAND USE

✓	✓	WOODLAND
○	○	ROWCROP
✓	✓	FIELD/PASTURE
○	○	RESIDENTIAL/INDUSTRIAL

BANK EROSION

U/S L	U/S R	D/S L	D/S R	
○	○	○	○	LITTLE OR NONE
✓	✓	✓	✓	MODERATE
○	○	○	○	SEVERE

CHANNELIZATION

U/S	D/S	
○	✓	NONE
○	○	RECOVERED
✓	○	RECOVERING
○	○	RECENT

SINUOSITY

○	○	HIGH
✓	✓	MODERATE
○	○	LOW
○	○	NONE

POOLS PRESENT?

✓	✓	YES
○	○	NO

VELOCITY

- ○ TORRENTIAL
- ○ FAST
- ○ MODERATE
- ✓ SLOW

TURBIDITY

- ○ CLEAR
- ✓ SLIGHTY TURBID
- ○ TURBID
- ○ MUDDY/OPAQUE

SILTATION

- ○ HEAVY
- ✓ MODERATE
- ○ NORMAL
- ○ NONE

POTENTIAL NPS?

U/S	D/S	
✓	✓	YES
○	○	NO

POINT SOURCE DISCHARGE IMPACT?

✓	○	YES
○	✓	NO

KICK SAMPLABILITY

- ○ EXCELLENT
- ○ GOOD
- ○ FAIR
- ✓ POOR

KICK AREA**

- ○ ARTIFICIAL DAM
- ○ RIFFLE
- ✓ RUN

CPOM SAMPLABILITY

- ✓ EXCELLENT
- ○ GOOD
- ○ FAIR
- ○ POOR

CPOM QUALITY**

- ✓ LEAVES
- ✓ WOODY DEBRIS
- ✓ FORBS
- ○ FPOM

* LOOKING D/S

** CHECK ALL THAT APPLY

COMMENTS: Eutrophic, odor of detergent; water foams easily when agitated; 8 dead fish observed; very few fish observed fish had blackspot.

ESTIMATED STREAM DEPTH: .5 m

ESTIMATED STREAM WIDTH: 3 m

ESTIMATED BANK HEIGHT: 1.5 m

MAY 25, 2001

APPENDIX F.9

COMMONWEALTH BIOMONITORING WATER QUALITY INVESTIGATION FEBRUARY 22, 1996

COMMONWEALTH BIOMONITORING

Water Quality Investigation
Bailey Branch (Bedford, Indiana)
February 22, 1996

INTRODUCTION

On December 5, 1995, field biologists with the Indiana Department of Environmental Management (IDEM) observed a small fish kill and evidence of degraded water quality ("eutrophic, odor of detergent, water foams easily") in Pleasant Run at Peerless Road near Bedford. Bailey Branch, the receiving stream for GM Powertrain's effluent discharge, enters Pleasant Run upstream from this location and IDEM identified GM Powertain as the most likely source of degraded conditions.

GM Powertrain personnel reviewed their discharge monitoring reports for several months prior to the complaint and observed no signs of abnormal plant conditions during this time. Because IDEM identified GM as the most likely source of observed stream conditions, GM commissioned an investigation of all potential water quality impacts within the Bailey Branch watershed.

METHODS

Greg Bright of Commonwealth Biomonitoring conducted a stream investigation on February 22, 1996. After determining that no visual signs of degraded water quality were present in Pleasant Run near Peerless Road downstream from Bailey Branch, he also examined Pleasant Run at one upstream site (Mt. Pleasant Road). Again, he saw no obvious signs of degraded water quality, but a small amount of foam was present in the water (Photo 2).

At Bailey Branch, he walked most of the stream from Pleasant Run to the GM Powertrain outfall. As he looked for obvious physical signs of degradation (sludge deposits, discolored water, unusual odors, etc.) he also examined the stream for biological indicators (lack of fish, dominance of pollution-tolerant macroinvertebrates, Sphaerotilus ["sewage fungus"] growth, and algae blooms). He took pictures at sites where degraded conditions were observed.

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RESULTS

Figure 1 shows the Bailey Branch watershed, including sites where visual signs of degraded water quality were found. Numerous live minnows were observed at all sites downstream from the "second bridge" and no sources of degraded water quality were observed downstream from this bridge. However, a PVC pipe from an unknown source extended into Bailey Branch from the west bank just upstream of the bridge (see photo 3). Also near this site, a small tributary enters Bailey Branch on the west bank. This tributary appeared to carry a very heavy silt load at times. Every hard surface on the bottom of this small stream was covered by a 1/4 inch layer of light-colored sediment. Sediment deposits from the stream were visually observed in downstream areas of Bailey Branch as well.

Upstream from the "second bridge" increased evidence of water quality degradation was present. Several dead creek chubs were observed and the numbers of fish declined. Macroinvertebrate communities were dominated by air-breathing snails (Physa spp.) and blackfly larvae (Simulium spp.), two groups which are usually tolerant to organic (sewage-related) pollution. A few caddisfly larvae, which are more intolerant to pollution, were also present but their numbers declined upstream from the "second bridge".

Photo 4 shows another small tributary entering Bailey Branch from the west, about 800 yards upstream from the "second bridge." This stream does not appear on the USGS topographic map, but the amount of water flowing from it was greater than any other Bailey Branch tributary. There was a heavy algae growth in this little stream, indicating nutrient enrichment. Numerous horse footprints and droppings were present in the area.

Photo 5 shows a lift station near the east bank of Bailey Branch about 1000 yards upstream from the "second bridge." Although no overflows from this lift station were observed, there was abundant evidence of past raw sewage overflows (toilet paper, sanitary napkins, etc. [photo 6]). Nearby, abundant Sphaerotilus growths were present on the stream bottom. Another 100 yards upstream from this lift station, several manholes were present on the west bank of Bailey Branch. There were pools of raw sewage on the ground between these manholes, indicating a leaking underground sewer. Sewage was flowing into Bailey Branch from this site (photo 7). Water quality conditions upstream from this leaking sewer were much improved and no additional physical evidence of degraded water quality was observed at any point up to and including the GM Powertrain outfall.

In the process of determining the exact location of the lift station shown in photo 5, a second lift station was discovered. This lift station also showed signs of recent raw sewage overflows to a small tributary of Bailey Branch. The location of both lift stations is shown in Figure 1.

SUMMARY

During his investigation, Greg Bright of Commonwealth Biomonitoring saw potential signs of water quality impacts entering Bailey Branch from two small tributaries. An even more obvious source of degraded water quality originated from faulty sewers and lift station overflows along the stream. These sources are more likely to be the cause of degraded stream conditions observed by IDEM on December 5, 1995 than the treated wastewater discharge from GM Powertrain.

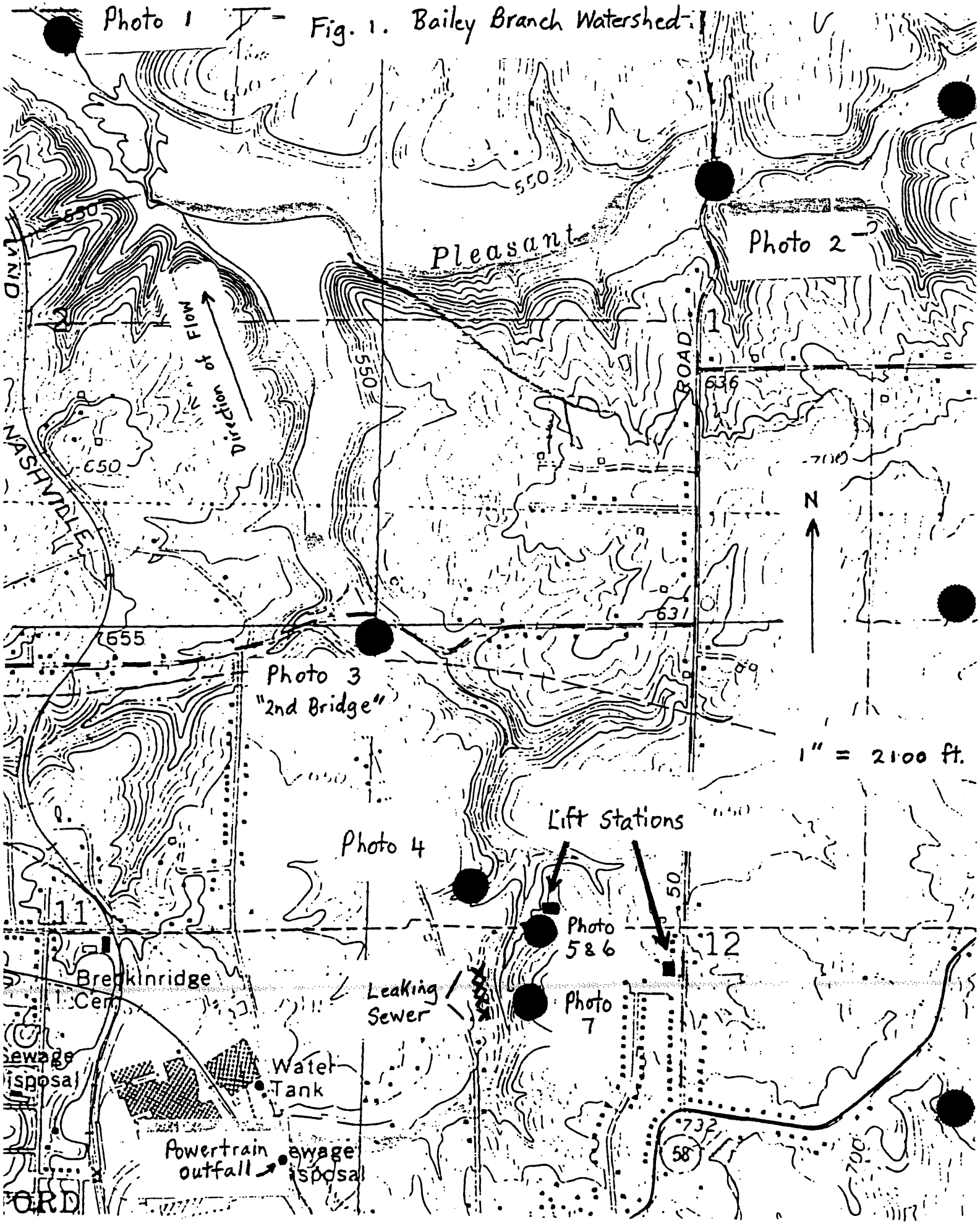
Photo 1
Fig. 1. Bailey Branch Watershed
Pleasant
Photo 2
ROAD
Direction of Flow
NASHVILLE
550
650
655
636
631
N
1" = 2100 ft.
Photo 3
"2nd Bridge"
Photo 4
Lift Stations
Photo 5&6
Photo 7
Leaking Sewer
Breckinridge
Cem.
Water Tank
Powertrain outfall
sewage disposal
732
58
11
12
1
50

Photo 3 - Bailey Branch at the "second bridge"
Photo 4 - Bailey Branch tributary showing algae growth

Photo 1 - Pleasant Run at Peerless Road
Photo 2 - Pleasant Run at Mt. Pleasant Road

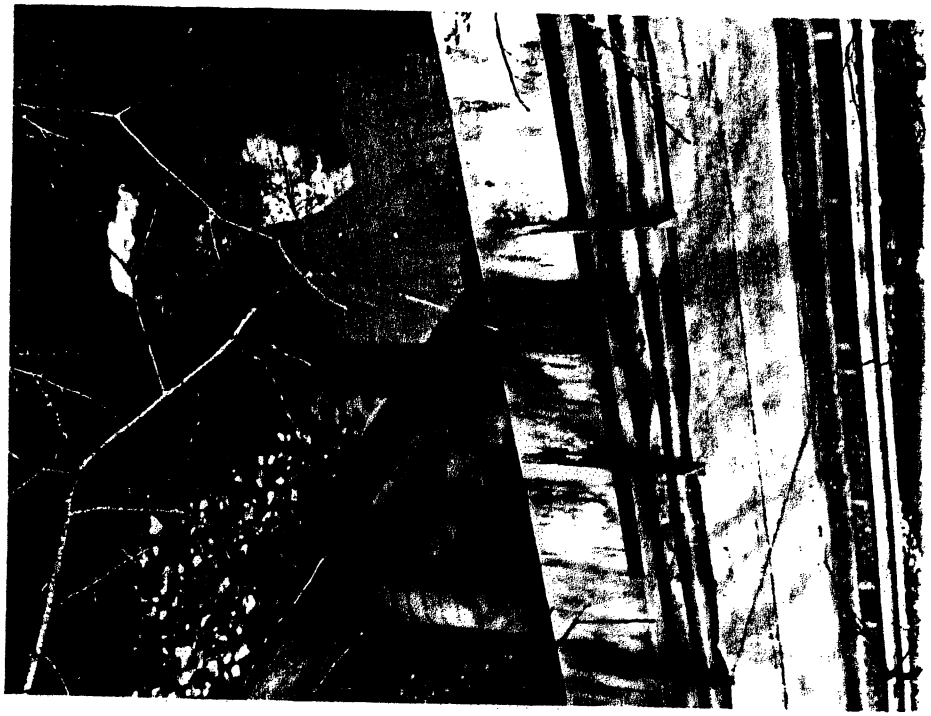

Photo 7 - Leaking sewer line into Bailey Branch

Photo 5 - Lift Station along Bailey Branch
Photo 6 - Evidence of lift station overflows

APPENDIX F.10

ISPCB AND ISBH LETTERS DATED JANUARY 1973

cc: Herr, Tamzarro, Pearson, Beatty, Schneider, & Illuminati

STATE of INDIANA

INDIANAPOLIS 46206

1330 West Michigan Street
633-4420

STREAM POLLUTION CONTROL BOARD

follow-up 11-1-73

RF 1-22-73

January 16, 1973

Mr. R. V. Stumph, General Superintendent
General Motors Corporation
Central Foundries Division
Bedford, Indiana 47421

Dear Mr. Stumph:

Re: Wastewater Treatment
Central Foundries Division

You are hereby notified that the Stream Pollution Control Board of the State of Indiana has, this 16th day of January, 1973, approved plans for a waste treatment facility to be located at Central Foundries Division, Bedford.

The company proposes a complete separation of storm and process water flows from the manufacturing plant area. The storm sewer will flow directly to the fourth pond of the existing five pond system south of the plant while the process water will flow to a new treatment facility prior to discharge to the third pond of that system. Ponds one and two will be drained and filled.

The new wastewater treatment system will include a 280-gallon diversion chamber controlling the flow to either or both of two identical clarifiers of 40-foot diameter by 11-foot SWD, Eimco Corporation Type C2T (or equal) clarithickeners. Each clarithickener can take the total 450-gpm maximum flow and provide four hours of detention with a surface settling rate of 520 gallons per day per square foot or can be operated in parallel to provide twice the detention time. Each clarithickener has a sludge storage and thickening capacity of 2,100 gallons which will contain an anticipated three days of storage at a 700-gallon per day accumulation rate. The thickened sludge will be essentially hydraulic oil in combination with colloidal graphite. Blowdown from the sludge compartment of the clarithickeners will have density monitoring as it is transferred to a 19,700-gallon hydraulic oil storage tank that will provide an anticipated 28 days of storage capacity at a maximum blowdown rate of 700 gallons per day. Hydraulic oil will be heated and centrifuged to remove gross solids with oil fractions returned to the hydraulic storage tank.

The plans were approved with the following conditions:

1. That additional wastewater treatment facilities will be provided if the proposed facilities fail to provide adequate treatment.

2. That the Board will be notified of the completion of these facilities prior to the start of their operation.

3. That a certified wastewater treatment operator will be in responsible charge of the operation.

WP

4. That the company shall submit monthly reports of the effluent from these facilities covering daily determinations of flow and pH and once per week determinations of oil and suspended solids.

5. That sludges shall be disposed of in a manner that is approved by the Board.

The plans were prepared by Environmental Consultants, Inc., Clarksville, and submitted for consideration on December 7, 1972.

Very truly yours,

Oral H. Hert

Oral H. Hert
Technical Secretary

I. W. Approval No. 825
CLGough/lbw
cc: Lawrence County Health Department
Environmental Consultants, Inc.

STATE OF INDIANA

INDIANAPOLIS

STATE BOARD OF HEALTH

Address Reply to:
Indiana State Board of Health
1330 West Michigan Street
Indianapolis, IN 46206

January 17, 1973

Mr. R. V. Stumph, General Superintendent
General Motors Corporation
Central Foundries Division
Bedford, Indiana 47421

Dear Mr. Stumph:

Re: Wastewater Treatment
Central Foundries Division

You are hereby notified that the State Health Commissioner of the State of Indiana has, this 17th day of January, 1973, approved plans for a waste treatment facility to be located at Central Foundries Division, Bedford.

The company proposes a complete separation of storm and process water flows from the manufacturing plant area. The storm sewer will flow directly to the fourth pond of the existing five pond system south of the plant while the process water will flow to a new treatment facility prior to discharge to the third pond of that system. Ponds one and two will be drained and filled.

The new wastewater treatment system will include a 280-gallon diversion chamber controlling the flow to either or both oftwo identical clarifiers of 40-foot diameter by 11-foot SWD, Eimco Corporation Type C2T (or equal) clarithickeners. Each clarithickener can take the total 450-gpm maximum flow and provide four hours of detention with a surface settling rate of 520 gallons per day per square foot or can be operated in parallel to provide twice the detention time. Each clarithickener has a sludge storage and thickening capacity of 2,100 gallons which will contain an anticipated three days of storage at a 700-gallon per day accumulation rate. The thickened sludge will be essentially hydraulic oil in combination with colloidal graphite. Blowdown from the sludge compartment of the clarithickeners will have density monitoring as it is transferred to a 19,700-gallon hydraulic oil storage tank that will provide an anticipated 28 days of storage capacity at a maximum blowdown rate of 700 gallons per day. Hydraulic oil will be heated and centrifuged to remove gross solids with oil fractions returned to the hydraulic storage tank.

The plans were approved with the following conditions:

1. That additional wastewater treatment facilities will be provided if the proposed facilities fail to provide adequate treatment.

2. That the Board will be notified of the completion of these facilities prior to the start of their operation.

3. That a certified wastewater treatment operator will be in responsible charge of the operation.

4. That the company shall submit monthly reports of the effluent from these facilities covering daily determinations of flow and pH and once per week determinations of oil and suspended solids.

5. That sludges shall be disposed of in a manner that is approved by the Board.

The plans were prepared by Environmental Consultants, Inc., Clarksville, and submitted for consideration on December 7, 1972.

Sincerely,

A. C. OFFUTT, M.D.
STATE HEALTH COMMISSIONER
INDIANA STATE BOARD OF HEALTH

I. W. Approval No. 825
cc: Lawrence County Health Department
Environmental Consultants, Inc.