Dissolved Oxygen and Ammonia TMDL Development for Kokomo Creek, Indiana

Final

Submitted by
The Indiana Department of Environmental Management
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TABLE OF CONTENTS

List of Tables

List of Figures

EXECUTIVE SUMMARY

Kokomo Creek is located in the Wildcat Creek watershed in north-central Indiana (see Figure 1). Kokomo Creek is approximately 16 miles long and its watershed drains 36 square miles. The stream was listed on Indiana's 1996 and 1998 section 303(d) lists due to impairments associated with low dissolved oxygen concentrations, high total ammonia concentrations, and a fish consumption advisory caused by polychlorinated biphenyl (PCB) contamination. As required by section 303(d) of the Clean Water Act, two Total Maximum Daily Loads (TMDLs) have been developed to address the dissolved oxygen and total ammonia listings for Kokomo Creek. The PCB impairment will be addressed at a later date.

Available water quality data and information on potential pollutant sources in the watershed were reviewed to develop the TMDLs. The low dissolved oxygen and high total ammonia nitrogen (NH3-N) concentrations at the downstream sampling sites were determined to be caused by wastewater treatment plant effluent and discharge from illicit septic system drainage tiles. The low dissolved oxygen concentrations at the upstream sites were determined to be due to the presence of nuisance attached algal growth associated with increased nutrient concentrations.

Instream numeric endpoints for the Kokomo Creek TMDLs were derived directly from Indiana's water quality criteria for dissolved oxygen and total ammonia nitrogen. In addition, a total phosphorus endpoint of 0.10 mg/L was identified based on an evaluation of the sampling data at "reference sites" in the watershed that had no apparent algae problem.

The magnitude of the point sources in the Kokomo Creek watershed were evaluated using a combination of instream sampling and discharge monitoring report (DMR) data. Effluent characteristics for the illicit and failing septic systems were estimated using literature values since no sampling data were available. To estimate the nutrient loads from the nonpoint sources in the watershed, the Generalized Watershed Loading Function (GWLF) model was used. The GWLF model is based on simple runoff, sediment, and groundwater relationships combined with empirical chemical parameters (Haith et al., 1992).

Because there are two inter-related problems affecting Kokomo Creek – the discharge from the point sources and the illicit septic systems and the extreme dissolved oxygen swings caused by the algal growths – a two-tiered approach was used for TMDL development. The QUAL2E model was used to assess the impact of the treatment plants and septic effluent during low-flow conditions, and the GWLF model was used to identify load reductions necessary to attain the total phosphorus endpoint. A margin of safety was incorporated into the analysis through the use of conservative analytical assumptions.

The results of the analysis indicated that the following load reductions will need to occur:

- The illicit septic system discharges must be eliminated.
- Loading from the point sources in the watershed must be reduced..
- Total phosphorus loadings from row crop agriculture will need to be reduced (by approximately 33%).

The elimination of the septic outfalls will be addressed by the formation of a Regional Sewer District (RSD) that will include the communities of Center, Oakford, and Hemlock. The wastes from these communities will be routed to a new plant that will replace the existing Taylor High School facility. The Kokomo Regency Mobile Home Park will be immediately connected to the new sewer system and the Timbernest Apartments will eventually be connected. Permit limits for the new facility will be implemented via the National Pollutant Discharge Elimination System (NPDES) program. An Indiana Department of Natural Resources Lake and River Enhancement project began in 1999 that addresses the total phosphorus reductions from row crops. This project includes the proposed installation of filter strips and other conservation measures to reduce nutrient loadings. A separate Sampling and Analysis Work Plan describes in detail the follow-up monitoring that will occur to ensure that the load reductions and instream water quality goals are met.

1.0 INTRODUCTION

1.1 Background

Section 303(d) of the Clean Water Act requires States, Territories, and authorized Tribes to identify waters for which technology-based effluent limitations are not stringent enough to achieve applicable water quality standards. Lists of these waters (the section 303(d) lists) are made available to the public and submitted to the U.S. Environmental Protection Agency (USEPA) in April of every even-numbered year. As part of the 1996 and 1998 303(d) listing processes, the Indiana Department of Environmental Management (IDEM) identified Kokomo Creek as an impaired stream. The parameters of concern for Kokomo Creek were ammonia, dissolved oxygen, and Polychlorinated Biphenyls (PCBs) (due to a fish consumption advisory).

The Clean Water Act and USEPA regulations require that Total Maximum Daily Loads (TMDLs) be developed for all waters on the section 303(d) lists. The requirements of a TMDL are described in 40 Code of Federal Regulations (CFR) 130.2 and 130.7 and section 303(d) of the Clean Water Act, as well as in various guidance documents (e.g., USEPA, 1991; USEPA, 1997a). A TMDL is defined as "the sum of the individual wasteload allocations for point sources and load allocations for nonpoint sources and natural background" such that the capacity of the waterbody to assimilate pollutant loadings is not exceeded. A TMDL is also required to be developed with seasonal variations and must include a margin of safety that addresses the uncertainty in the analysis. A TMDL is often expressed using the following equation:

$$TMDL = \sum WLA + \sum LA + (MOS)$$

where WLA = wasteload allocation, LA = load allocation, and MOS = margin of safety. The MOS is in parenthesis because it can be incorporated into the TMDL either explicitly or implicilty. Pursuant to the regulations at 40 CFR 130.6, States are to develop water quality management plans to implement water quality control measures such as TMDLs.

TMDLs for phosphorus, CBOD5, and NH3-N for Kokomo Creek have been developed that address the impairments caused by low dissolved oxygen and high total ammonia concentrations. (It is expected that a future TMDL will be developed to address the PCB impairment.) All available water quality data have been reviewed and the potential sources of oxygen-depleting pollutants and total ammonia have been estimated. The necessary loading reductions have also been calculated.

1.2 Problem Statement

Kokomo Creek is located in the Wildcat Creek watershed (U.S. Geological Survey (USGS) Cataloging Unit 05120107) in north-central Indiana (see Figure 1). Kokomo Creek is approximately 16 miles long and its watershed drains 36 square miles. The confluence of Kokomo Creek and Wildcat Creek is located in the industrial city of Kokomo. Most of the creek is located in Howard County, which has experienced a very slight (less than 1%/year) increase in population from 1990 to 1998 (80,827 persons to 83,452 persons (Bureau of the Census, 1999)). Population data for the Kokomo Creek watershed itself are not available.

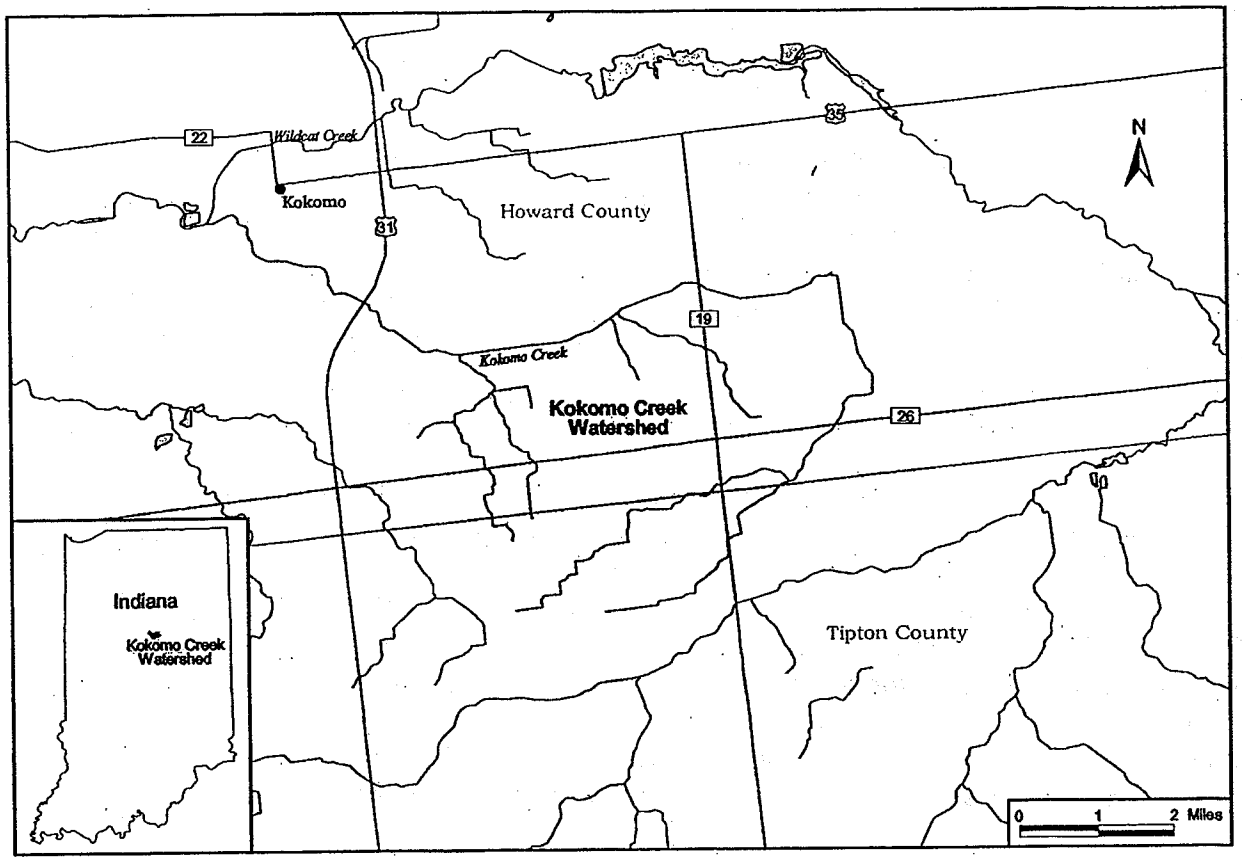

Figure 1. Location of Kokomo Creek watershed.

The upper portion of the watershed is predominantly agricultural with few residences located along the creek. The stream has been channelized in several places. A 1994 study of the creek indicated that "the riparian zone had various amounts of vegetative growth but most of the stream was exposed to sunlight. The water appeared muddy and turbid with moderate algae growth" (IDEM, 1996).

The lower portion of Kokomo Creek is more shaded and flow is typically characterized as pool-riffle-pool. The creek travels a meandering course through residential, commercial, and industrial areas. The 1994 study indicated that the "riparian zone varies from weeds, shrubs, and trees along the majority of this reach to open mowed grassy areas in Highland Park. The water varied from clear in riffle areas to turbid and greenish-brown in a small lake area created by a spillway in the city park" (IDEM, 1996).

Kokomo Creek is classified as a county regulated drain and, especially upstream, is periodically maintained for flood control purposes. Trees and other vegetation are removed when they threaten agricultural drainage tiles or might cause instream debris dams. This alteration of the natural channel precludes Kokomo Creek from providing certain levels of habitat structure.

Kokomo Creek was placed on the 1996 and 1998 section 303(d) lists of impaired waters because of sampling data showing violations of the 4.0 mg/L minimum dissolved oxygen criterion. Violations were observed at three sampling sites in 1994 and at one sampling site in 1998. It was determined that point source loadings of CBOD were primarily responsible for the downstream dissolved oxygen violations and nonpoint source loadings of phosphorus (and their affect on algal growths) were responsible for the upstream violations. Therefore the QUAL2E model was used to develop a CBOD TMDL for the downstream point sources and the GWLF model was used to develop a phosphorus TMDL for the upstream nonpoint sources (see section 4.0 below for more detail on the dual modeling effort).

Although there were no observed instream total NH3-N violations during the 1994 or 1998 sampling, one of the treatment plants in the watershed was found to be discharging total NH3-N at elevated concentrations; NH3-N limits were therefore calculated as part of the TMDL for the purpose of protecting for a potential threat to the water quality standard for ammonia toxicity. In addition, NH3-N was modeled along with CBOD to ensure that NH3-N would not contribute to violations of the instream dissolved oxygen standard. The remaining sections of this document explain how these problems were quantified and discuss the activities that are planned to address them.

Further investigations of these problems indicated that there were several interrelated causes of the dissolved oxygen impairment. The dissolved oxygen violation at the downstream sampling site was determined to be a result of organic enrichment caused by both wastewater treatment plant discharge and illicit septic system effluent. The septic system effluent results from the fact that several communities in the watershed have illegally connected their septic systems to a series of tiles which drain into Kokomo Creek. The dissolved oxygen concentrations at the upstream sites were determined to be due to the presence of nuisance attached algal growth, which in turn was thought to be a result of increased nutrient concentrations. The algal growth is also exacerbated by the altered morphology of the stream channel and reduced riparian shading. The primary source of the nutrients was believed to be runoff from the row crop agriculture in the watershed.

1.3 Applicable Water Quality Standards

States are responsible for setting water quality standards to protect the physical, biological, and chemical integrity of their waters. The three components of water quality standards include:

- Designated uses (such as drinking water supply, aquatic life protection, recreation, etc).
- Narrative and numeric criteria designed to protect these uses.
- An antidegradation policy that provides a method of assessing activities that might affect the integrity of waterbodies.

Kokomo Creek is designated for whole body contact recreation and maintenance of a warm water fish community. Indiana's water quality standards (Regulation 327 Indiana Administrative Code 2-1) establish the criteria that apply to these designated uses. The dissolved oxygen criteria for the creek are 4.0 mg/L minimum and 5.0 mg/L daily average. The total ammonia criterion for protection of warm water fish is narrative and reads as follows:

"(5) The following criteria will be used to regulate ammonia:

(A) Except for waters covered in clause (B), at all times, all waters outside of mixing zones shall be free of substances in concentrations which, on the basis of available scientific data, are believed to be sufficient to injure, be chronically toxic to, or be carcinogenic, mutagenic, or teratogenic to humans, animals, aquatic life, or plants."

Indiana has quantified this narrative criterion using EPA's 1992 guidance. Based on this guidance, the chronic criteria for total NH3-N, which vary by instream pH and temperature, are shown in Table 1.

Table 1. Criterion continuous concentrations for total NH3-N (mg/L).

	Temperature (°C)							
pH	**0**	**5**	**10**	**10**	**15**	**20**	**25**	**30**
6.5	2.504	2.339	2.217	2.217	2.131	2.076	1.450	1.025
7.0	2.505	2.341	2.220	2.220	2.135	2.081	1.455	1.030
7.2	2.506	2.342	2.222	2.222	2.138	2.086	1.460	1.035
7.4	2.508	2.345	2.226	2.226	2.144	2.094	1.468	1.043
7.6	2.511	2.349	2.232	2.232	2.152	2.106	1.480	1.055
7.8	2.118	1.983	1.887	1.887	1.823	1.789	1.261	0.904
8.0	1.499	1.406	1.341	1.341	1.299	1.280	0.908	0.656
8.2	0.950	0.894	0.855	0.855	0.833	0.826	0.591	0.432
8.4	0.604	0.570	0.548	0.548	0.538	0.539	0.391	0.290
8.6	0.386	0.366	0.355	0.355	0.352	0.358	0.265	0.201
8.8	0.248	0.237	0.233	0.233	0.235	0.244	0.185	0.145
9.0	0.161	0.156	0.156	0.156	0.161	0.172	0.135	0.109

2.0 TMDL ENDPOINT AND WATER QUALITY ASSESSMENT

2.1 Selection of a TMDL Endpoint

The establishment of instream numeric endpoints[1] is a significant component of the TMDL process. The numeric endpoints serve as a measure of comparison between observed instream conditions and conditions that are expected to restore the designated uses of the waterbody. The TMDL identifies the load reductions that are necessary to meet the endpoint, thus resulting in the attainment of applicable water quality standards.

Numeric endpoints are derived directly or indirectly from state narrative or numeric water quality standards. The applicable dissolved oxygen and total NH3-N endpoints and target values for the Kokomo Creek TMDL are available directly from the Indiana state water quality regulations (see section 1.2). That is, dissolved oxygen concentrations must stay above 4.0 mg/L and must average at least 5.0 mg/L per day. Total ammonia nitrogen concentrations cannot exceed the limits identified in Table 1.

In addition to the total NH3-N and dissolved oxygen endpoints, a supplementary total phosphorus endpoint has been selected for the Kokomo Creek TMDL. As discussed previously, the upstream portion of Kokomo Creek is impaired due to the nuisance growths of attached algae. It is believed that one of the reasons these algae have reached nuisance levels is nutrient (and specifically phosphorus) enrichment.

Many natural factors combine to determine rates of plant growth in a waterbody. First of these is whether sufficient phosphorus and nitrogen exist to support plant growth. The absence of one of these nutrients generally will restrict plant growth. A total phosphorus (TP) endpoint of 0.10 mg/L was selected as a target for the upstream portion of Kokomo Creek. This target was selected based on an evaluation of the sampling data showing that "reference sites" with no apparent algae problem had an average TP concentration of approximately 0.10 mg/L. Reference sites were those sites within the Wildcat Creek watershed (the larger watershed of which Kokomo Creek is a part) that had an average dissolved oxygen concentration of at least 7.0 mg/L and which had dissolved oxygen swings of less than 2.0 mg/L per day. A TP target of 0.10 mg/L has also been proposed by the Ohio Environmental Protection Agency for protection of warmwater habitat in 20 mi^2 to 200 mi^2 watersheds in the Eastern Corn Belt Plains ecoregion (the same ecoregion in which Kokomo Creek is located (OEPA, 1999)). USEPA (1986) has also proposed a TP target of 0.10 mg/L.

Phosphorus was selected as the TMDL endpoint rather than total nitrogen (TN) because the TN:TP ratio (based on the available sampling data) is 25:1; TN:TP ratios greater than 7.2

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[1]A TMDL endpoint is a target value for a water quality parameter, such as phosphorus, that is expected to result in the attainment of water quality standards. In some cases the TMDL endpoint is already specified by the numeric criterion that applies to the waterbody (e.g., a minimum dissolved oxygen concentration of 5.0 mg/L). In other cases site-specific TMDL endpoints are required.

typically imply that phosphorus is the limiting nutrient (Chapra, 1997). Although it would be preferable to select a dissolved phosphorus endpoint (because algae in streams are believed to respond more to readily bioavailable dissolved phosphorus) no dissolved phosphorus data for the watershed are available.

2.2 Discussion of Available Data Sources

2.2.1 Inventory and Analysis of Water Quality Monitoring Data

There are no long-term, fixed monitoring stations located on Kokomo Creek. However, IDEM conducted ambient stream monitoring of the creek on 6/17/94, 7/31/98, and 9/3/98. As part of the IDEM monitoring activities, stream samples were collected at 11 sites along Kokomo Creek (see Figure 2). The samples were collected as three-part composites to account for diurnal fluctuations and changes in stream chemistry that occur during a 24-hour sampling period. The stream samples were collected from the centroid of flow, just below the surface of the water. The samples were collected at mid-morning, late afternoon, and before dawn the following morning. The effluent from the five NPDES facilities that discharge to the creek were also sampled. Mile point locations of the sampling sites are given in Table 2.

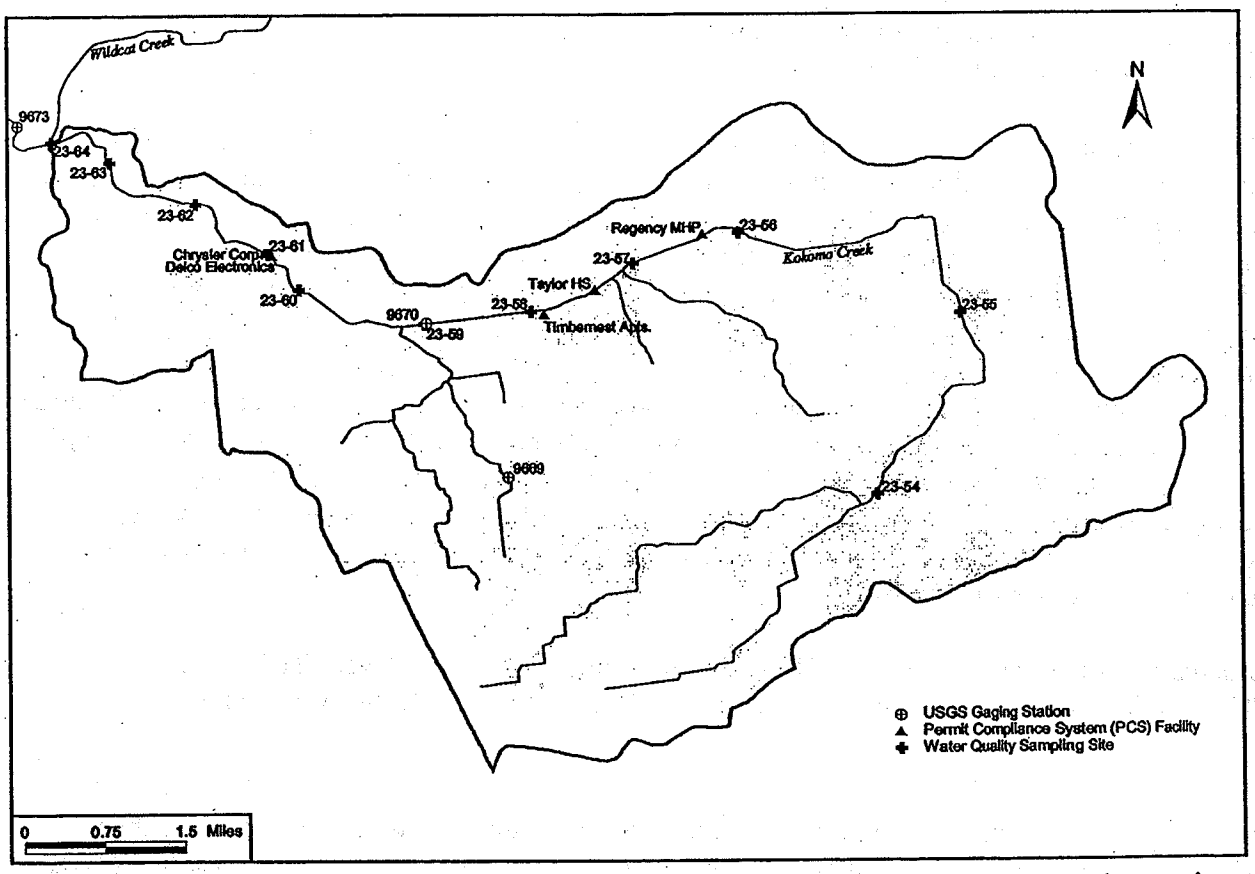

Figure 2. Location of IDEM sampling sites, point source dischargers, and USGS gaging station.

Table 2. Locations of Kokomo Creek sampling sites.

Sampling Site	Mile Point
23-64	0.09
23-63	0.81
23-62	1.65
Delphi Electronics (NPDES facility)	2.78
Chrysler Corp. (NPDES facility)	2.78
23-61	2.78
23-60	3.25
23-59	4.53
Timbernest Apartments. (NPDES facility)	5.64
23-58	5.64
Taylor High School (NPDES facility)	6.08
23-57	6.52
Regency Mobile Home Park (NPDES facility)	7.24
23-56	7.67
23-55	10.51
23-54	12.75

The parameters measured during the stream surveys included: total ammonia nitrogen, nitrate-nitrite nitrogen, organic nitrogen, total Kjeldahl nitrogen, total phosphorus, 5-day carbonaceous biochemical oxygen demand (CBOD5), chemical oxygen demand, dissolved oxygen, pH, temperature, turbidity, and conductivity. Appendix A contains the results of the sampling for all parameters for each sampling date.

Table 3 displays the dissolved oxygen measurements for the sampling. During the 6/17/94 survey three instream violations of the minimum dissolved oxygen criteria were observed. The flow at the USGS gage on Kokomo Creek was 4.3 cfs during the sampling. This is a relatively low flow condition since the average long-term flow at the gage is 23 cfs (see section 2.2.2 below). Sampling sites 23-54, 23-56, and 23-59 each had a dissolved oxygen measurement below the minimum of 4.0 mg/L. The measurements at two of these three sites (23-54 and 23-56) also displayed significant diurnal swings (i.e., fluctuations between the minimum and maximum measurements), indicating the presence of algal populations. Instream plant communities can cause diurnal fluctuations because photosynthesis contributes dissolved oxygen to the stream during the day but respiration depletes dissolved oxygen at night. No sites on Kokomo Creek violated the 5.0 mg/L average dissolved oxygen criterion during the 6/17/94 survey and the average dissolved oxygen concentrations for all of the sampling sites was 6.3 mg/L.

There were no observed instream total NH3-N violations during the 6/17/94 sampling. However, the Kokomo Regency mobile home park discharge effluent was 6.9 mg/L total NH3-N. Site 23-57, the site immediately downstream (0.6 miles) of the Kokomo Regency facility, was observed to have an instream total NH3-N concentration of 0.3 mg/L. The applicable criterion for the observed temperature (26°C) and pH (7.8) at that site is a total NH3N concentration equal to or less than 1.178 mg/L.

Table 3. Kokomo Creek dissolved oxygen concentrations for three sampling dates (listed from downstream to upstream).

Sampling Site	Sampling Date									
	6/17/94			7/31/98			9/03/98			
	Max DO (mg/L)	Mean DO (mg/L)	Min DO (mg/L)	Max DO (mg/L)	Mean DO (mg/L)	Min DO (mg/L)	Max DO (mg/L)	Mean DO (mg/L)	Min DO (mg/L)	Violations
23-64	7.5	6.5	5.0	8.3	8.0	7.7	8.8	8.0	7.0	
23-63	8.5	7.3	5.0	8.4	8.3	8.2	8.5	8.4	8.2	
23-62	7.9	6.6	4.5	8.6	8.2	7.8	10.2	8.6	6.9	
Delphi Electronics	N/A	8.6	N/A	N/A	N/A	N/A	8.0	8.0	8.0	
Chrysler Corp	N/A	7.1	N/A	N/A	6.0	N/A	6.1	6.1	6.1	
23-61	7.8	6.7	4.7	8.1	7.8	7.6	9.5	8.1	6.8	
23-60	7.3	6.8	6.2	8.0	7.7	7.5	9.0	8.1	7.2	
23-59	6.3	5.0	3.4	7.4	7.2	7.0	6.7	6.1	6.0	√
Timbernest Apts	N/A	4.8	N/A	N/A	N/A	N/A	3	3.0	2.9	
23-58	6.5	5.9	5.4	7.6	7.3	7.0	6.1	5.9	5.6	
Taylor High School	N/A	N/A	N/A	N/A	N/A	N/A	7.9	7.9	7.8	
23-57	6.6	5.8	5.1	8.0	7.3	6.7	6.1	5.3	4.4	
Regency MHP	N/A	4.9	N/A	7.3	5.3	3.9	2.3	2.1	1.9	
23-56	7.9	5.6	3.6	10.4	8.4	7.0	13.5	8.0	3.8	√√
23-55	11.6	6.8	4.3	8.3	7.1	6.5	11.3	8.4	6.6	
23-54	9.4	5.9	3.7	8.1	7.5	7.1	7.4	7.1	6.8	√

There were no observed instream dissolved oxygen or total NH3-N violations observed during the 7/31/98 sampling. The flow for this sampling event was 16 cfs (also below average but above the flow measured in 1994). The lowest observed instream dissolved oxygen concentration was 6.5 mg/L at site 23-55. The average instream dissolved oxygen measurements for all of the sampling sites was 7.7 mg/L.

The flow for the 9/3/98 sampling event was 2.9 cfs, the lowest of the three sampling dates. There was one violation of the instream minimum dissolved oxygen criterion (3.8 mg/L at site 23-56). The dissolved oxygen concentrations at this site fluctuated from a minimum of 3.8 mg/L to 13.5 mg/L, a strong indication of the presence of algae. The average dissolved oxygen concentration for all of the instream sampling sites during the 9/3/98 sampling was 7.5 mg/L. There were no violations of the total NH3-N criterion during the 9/3/98 sampling. The Kokomo Regency discharge was 10 mg/L total NH3-N and the observed concentration at site 23-57 was 0.34 mg/L (criterion is equal to or less than 2.08 mg/L at observed pH of 7.7 and 20°C).

2.2.2 Streamflow Data

There is one active gaging station on Kokomo Creek. Gage 03333600 is located at mile point 4.2 (see Figure 2) and drains approximately 24.7 mi^2 (68% of the watershed). Flow data from the station are available from 1959 to current. The average discharge, low-flow discharge, and flow conditions at the time of the IDEM sampling are shown in Table 4. Data from this gage show that flows are typically greatest in February, March, and April and lowest in August, September, and October.

Table 4. Kokomo Creek USGS Gage: Historic flow conditions and conditions at time of IDEM sampling.

Date	Flow at USGS Gage 03333600 (cfs)
6/17/94	4.3
7/31/98	16.0
9/03/98	2.9
Average long-term discharge	23.0
7Q10	0.3

Source: USGS, 1999; USGS, 1996

2.2.3 Selection of a Critical Condition

TMDL development must define the environmental conditions that will be used when defining allowable loads. Many TMDLs are designed around the concept of a "critical condition." The critical condition is defined as the set of environmental conditions that, if controls are designed to protect, will ensure attainment of objectives for all other conditions. For example, the critical condition for control of a continuous point source discharge is the drought stream flow. Point source pollution controls designed to meet water quality standards for drought flow conditions will ensure compliance with standards for all other conditions. The critical condition for a wet

weather-driven source may be a particular rainfall event, coupled with the stream flow associated with that event.

It is commonly understood that the critical conditions for point source dominated systems (such as the downstream portion of Kokomo Creek) occur during summer periods of low flow and low dilution of effluent outputs. The 7Q10 flow value is typically chosen as the critical condition for this situation. The 7Q10 flow value represents the 7-day low flow period that occurs on average every 10 years in a stream system. Although the reported 7Q10 flow for Kokomo Creek at the USGS gage is 0.2 cfs, IDEM recommended using 0.1 cfs as the 7Q10 because this flow was observed during the extremely dry summer of 1999. The critical pH and temperatures used for the modeling were 24 degrees Celsius and a pH value of 7.8 standard units in the summer and 10 degrees Celsius/pH 7.8 in the winter.

The critical condition for the upstream algal impairment is also expected to be the summer low-flow period because this is the period that is most conducive to algal growth. Therefore it is the observed summer concentrations of TP that are compared to the target concentrations of TP to estimate the necessary loading reductions (i.e., the goal of the TMDL is to reduce summer TP concentrations to the target levels). Since the load reductions will be protective of the summer condition they are also expected to be protective of all other conditions.

There are two types of problems in Kokomo Creek: (1) the discharge of total ammonia and oxygen-depleting substances from the point sources and septic outfalls and (2) high nutrient loading to the upstream portion of the watershed from agricultural sources. As mentioned above, the critical conditions for point source dominated systems occur during summer periods of low flow and low dilution of effluent outputs. The 7Q10 flow value is typically chosen as the critical condition for this situation. The 7Q10 flow value represents the 7-day low flow period that occurs on average every 10 years in a stream system. Critical conditions for instream temperature and pH were based on current IDEM guidelines (i.e., default temperatures of 24 degrees Celsius and pH values of 7.8 standard units in the summer and 10 degrees Celsius/pH 7.8 in the winter).

Nutrient sources to the upstream portion of Kokomo Creek arise from a mixture of continuous and wet weather-driven sources. For example, loading from failing septic systems is assumed to be relatively constant over time whereas agricultural runoff will be greatest during wet weather (and presumably higher river flow) periods. For this reason, and because algal growth is expected to respond more to long-term nutrient concentrations rather than to acute concentrations, no single critical condition exists. The TMDL will therefore examine the combined impact of both continuous and wet-weather sources on long-term nutrient concentrations in the upstream portion of the watershed (defined as subwatersheds 5, 6 and 7 (see Figure 4 below)).

3.0 SOURCE ASSESSMENT

The purpose of the source assessment is to demonstrate that all pollutant sources have been considered, and significant sources estimated, in order to help determine the degree of loading

reductions needed to meet the TMDL endpoints and allocation of loading allowances among sources.

3.1 Assessment of Point Sources

There have historically been five NPDES facilities located in the watershed: one school, one apartment complex, two industrial facilities, and a mobile home park. The permit for the Chrysler Transmission Plant was voided 4/7/99 and the facility now has a general stormwater permit. The location of each facility is shown in Figure 2 and the mile points are shown in Table 2. The standard industrial code, average flows, and type of treatment of each facility are listed in Table 5 and Table 6 lists the applicable permit limits.

Table 5. NPDES facilities located along Kokomo Creek.

Facility ID	Facility Name	Standard Industrial Code Description	Average Design Flow	Type of Treatment
IN0001422	Chrysler Transmission Plant	Wiring Harness Sets, Other than Ignition; Block Heaters	N/A	Individual permit was voided 4/7/99 and they now have a general stormwater permit.
IN0001830	Delphi[1] Electronics Corporation	Semiconductors and Related Devices	8.31 mgd (12.857 cfs)	Noncontact cooling water effluent.
IN0041131	Taylor Elementary and High School	Elementary and Secondary Schools	0.0284 mgd (0.044 cfs)	Extended aeration with effluent chlorination (chlorination to eventually be replacted with ultraviolet light disinfection).
IN0041912	Timbernest Apartments	Operators of Apartment Buildings	0.015 mgd (0.023 cfs)	Extended aeration with effluent chlorination followed by a 2-day terminal lagoon.
IN0031844	Kokomo Regency Mobile Home Park	Operators of Residential Mobile Home Sites	0.0914 mgd (0.141 cfs)	Extended aeration with secondary clarifier, effluent chlorination, and a two-cell terminal lagoon.

[1]Formerly Delco Electronics.

A review of the discharge monitoring reports (DMRs) for these facilities from 1993 to 1998 indicates that several of the facilities have been in violation of their permits for various parameters. For example, the Kokomo Regency Mobile Home Park and Timbernest Apartments have each recorded violations of their permit limits.

Table 6. Permit limits for Kokomo Creek NPDES facilities.

Facility Name	Total NH3-N	CBOD5	Dissolved Oxygen
Delphi Electronics Corporation	None	None	None
Taylor Elementary and High School	None	Summer: Monthly Avg 15 mg/L Maximum Weekly Avg 23 mg/L Winter: Monthly Avg 25 mg/L Maximum Weekly Avg 40 mg/L	Summer: Daily Minimum: 6 mg/l Winter: Daily Minimum: 5 mg/l
Timbernest Apartments	Summer: Monthly Avg: 3.9 mg/L Maximum Weekly Avg: 5.8 mg/L Winter: Monthly Avg: 6.0 mg/L Maximum Weekly Avg: 9.0 mg/L	Monthly Avg: 25 mg/L Maximum Weekly Avg: 40 mg/L	None
Kokomo Regency Mobile Home Park	Permit re-issued 4/23/99. Three year schedule of compliance to meet the following limits: Summer: Monthly Avg: 1.2 mg/l Maximum Weekly Avg: 1.8 mg/l Winter: Monthly Avg: 1.8 mg/l Maximum Weekly Avg: 2.7 mg/l	Interim Limits: Monthly Avg: 10 mg/l Maximum Weekly Avg: 15 mg/l Once they can meet the total NH3-N limits, the following CBOD5 limits become effective: Summer: Monthly Avg: 15 mg/l Weekly Avg: 23 mg/l Winter: Monthly Avg: 25 mg/l Weekly Avg: 40 mg/l	Summer: Daily Minimum: 6 mg/l Winter: Daily Minimum: 5 mg/l

Source: Comments forwarded by IDEM 11/18/99.

3.2 Assessment of Nonpoint Sources

The land uses in the Kokomo Creek watershed are listed in Table 7 and are shown in Figure 3. Land uses consist predominantly of row crops and pasture/hay land, although the lower portion of the watershed includes a significant percentage of residential and built-up land. The primary crops in the watershed are corn and soybeans.

Table 7. Land uses in the Kokomo Creek watershed.

Land Use	Acres	%
Row Crops	17,508.7	74.82
Pasture/Hay	1,937.9	8.28
Low Intensity Residential	1,761.5	7.53
Urban/Recreational Grasses	682.6	2.92
Deciduous Forest	506.5	2.16
Commercial/Industrial/Transportation	491.9	2.10
Woody Wetlands	401.4	1.72
High Intensity Residential	81.5	0.35
Open Water	19.6	0.08
Emergent Herbaceous Wetlands	9.2	0.04
Evergreen Forest	0.7	0.00
Mixed Forest	0.1	0.00
Total	**23,401.6**	**100.00%**

Source: Multi-resolution Land Characteristics land use data (MRLC, 1992).

Potential nonpoint sources of nutrients and oxygen-depleting substances from these land uses include crop production, fertilizer application, failing septic systems, urban runoff from residential areas, and animal feedlots. Further investigation also indicated that the sewage from several of the small communities (Oakford, Center, and Hemlock) in the watershed was being discharged to the creek untreated via a series of drainage tiles (Paulus, 1999; Howard County Health Department, 1995; 1996; 1998).

To estimate the nutrient loading from these sources the Generalized Watershed Loading Function (GWLF) model was used. The GWLF model is based on simple runoff, sediment, and groundwater relationships combined with empirical chemical parameters (Haith et al., 1992). It evaluates streamflow, nutrients, soil erosion, and sediment yield values from complex watersheds. Runoff is calculated by means of the Natural Resources Conservation Service (NRCS) curve number equation. The Universal Soil Loss Equation (USLE) is applied to simulate erosion. Urban nutrient loads are computed by exponential accumulation and wash-off functions and groundwater nutrient loads to the stream are determined as a function of the background nutrient concentration in groundwater, the watershed area, and the groundwater discharge to the stream. Appendix B includes a detailed explanation of the GWLF model.

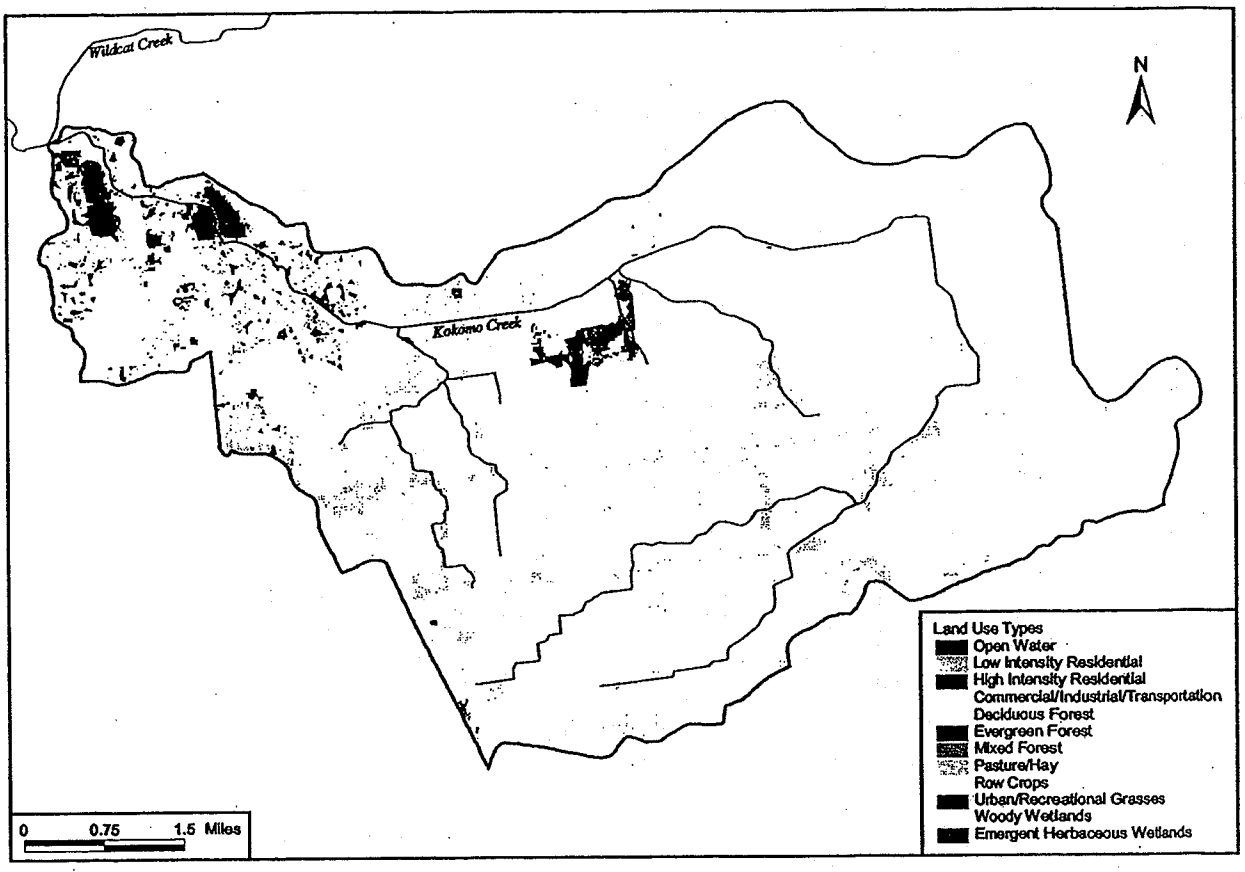

Figure 3. Kokomo Creek land uses.

To use the GWLF model the Kokomo Creek watershed was first delineated into seven subwatersheds (see Figure 4). The nutrient loading estimates focused on subwatersheds 5, 6, and 7 since this is the portion of the watershed where the increased nutrient loads are believed to have lead to increased algal populations and subsequent dissolved oxygen problems. Land use and soil characteristics data for these subwatersheds were input to the GWLF model. Daily precipitation and temperature data for the station at the Kokomo Post Office were obtained from the Midwestern Climate Center in Champaign, Illinois (MCC, 1999).

Nutrient transport characteristics and other information required to run the model were obtained from site-specific information where available and literature values otherwise. For example, the timing of fertilizer application was obtained from the Indiana Agricultural Statistics Fertilizer Usage Table (OARP, 1999) and the percentage of acres farmed using conservation tillage (approximately 20%) was obtained from the Howard County Soil and Water Conservation District (Howard County Soil and Water Conservation District, 1996). Soil and groundwater nitrogen and phosphorus concentrations were obtained from literature values available in the GWLF User's Manual (Haith et al., 1992). All of the model input values are available in Appendix B.

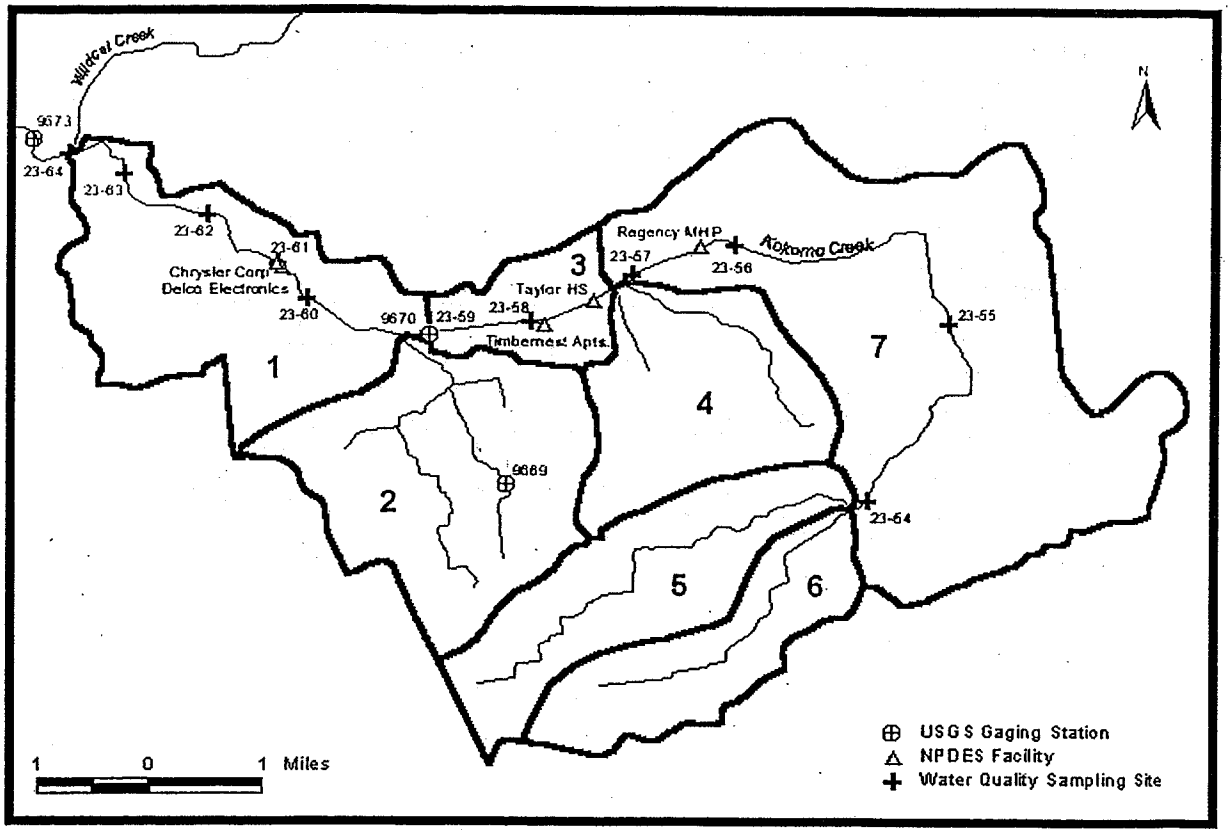

Figure 4. Kokomo Creek subwatersheds.

The model's streamflow parameters (seepage coefficient and evapotranspiration parameters) were modified within the acceptable limits so that the simulated streamflow adequately matched the observed streamflow for the time period 1994 to 1999. The model was then run to estimate annual nitrogen and phosphorus loadings. The results are shown in Table 8 and agree favorably with a separate estimate of total annual loadings made using the observed sampling and flow data.

It is apparent from Table 8 that the largest source of nutrient loading is from non-conservation tillage row crop agriculture. Conservation tillage row crop agriculture, and groundwater are the other significant sources of phosphorus in the upstream portion of the watershed.

Table 8. Estimated annual nutrient loadings for subwatersheds 5, 6, and 7.

Source	Area (ac)	Dis. P (t)	Tot. P (t)
Row Crop	8,871	2.73	5.31
Row Crop (with conservation tillage)	2,217	0.50	0.77
Groundwater	--	0.44	0.44
Point Source	--	0.24	0.24
Pasture/Hay	963	0.09	0.12
Wetlands	175	0.01	0.01
Low Intensity Residential	50	0.01	0.01
Deciduous Forest	141	0.01	0.01
Total	12,417	4.03	6.91

(t) = metric tons (1,000 kg)

4.0 MODELING PROCEDURE: LINKING THE SOURCES TO THE ENDPOINT

Modeling procedures are used to create a direct predictive relationship between external loadings and the resulting water quality condition. Once the model is developed, load allocations and wasteload allocations can be selected to define the conditions under which predicted water quality will meet water quality standards. Available modeling techniques include empirical relationships, analytical equations, and numerical (computer) models of a wide range of complexity.

As discussed previously there are two inter-related problems affecting Kokomo Creek – the discharge from the point sources and the straight pipe septic systems and the extreme dissolved oxygen swings caused by the algal growths. A two-tiered approach was selected to address these two problems. The QUAL2E model was used to address the downstream dissolved oxygen impairment because of its ability to simulate a variety of water quality constituents during steady-state low flow conditions. QUAL2E is a one-dimensional model that can simultaneously simulate hydrodynamics and the transport and transformation of water quality variables. QUAL2E was used in this application to identify point source permit limits that would be protective of water quality standards during critical low flow conditions.

The GLWF model was used to address the upstream dissolved oxygen impairment because it was determined that excessive phosphorus loadings were resulting in an overabundance of algae (and subsequently a negative impact on dissolved oxygen concentrations). The QUAL2E model was not suitable for modeling this scenario because QUAL2E does not simulate the nonpoint source loading of pollutants over land surfaces. The GWLF model was chosen because it provides a mechanistic but simplified simulation of precipitation-driven runoff and sediment delivery and can be used to estimate particulate and dissolved-phase pollutant delivery to a stream. GWLF was used to identify the magnitude of phosphorus loadings from the primary sources to facilitate the allocation of load reductions among the various sources.

4.1 QUAL2E Modeling

The EPA-supported QUAL2E model was chosen for simulating point source and straight pipe septic loadings in the Kokomo Creek watershed. QUAL2E is a one-dimensional model that can simultaneously simulate hydrodynamics and the transport and transformation of water quality variables. The model is applicable to dendritic stream systems, such as Kokomo Creek, that are well mixed. It allows for the inclusion of multiple waste discharges and withdrawals and is perhaps the most widely used computer model for simulating stream water quality (Chapra, 1997). It is capable of simulating up to 15 water-quality constituents (Table 9).

Table 9. Constituents Simulated by QUAL2E Model

Dissolved Oxygen Biochemical oxygen demand Temperature Algae as chlorophyll-*a* Organic nitrogen as N	Ammonia as N Nitrite as N Nitrate as N Organic phosphorus as P Dissolved phosphorus as P	Coliform bacteria Arbitrary nonconservative constituent Conservative constituent #1 Conservative constituent #2 Conservative constituent #3

QUAL2E represents the stream as a system of reaches of variable length, each of which is subdivided into computational elements that have the same incremental length in all reaches. The basic equation used in the model is the one-dimensional advection-dispersion mass transport equation. QUAL2E can operate as either a steady-state or dynamic model. In steady-state mode, the model can be used to examine the effects of waste loads on instream water quality. When used in conjunction with a field sampling program, the steady-state mode can be used to determine the magnitude and characteristics of point and nonpoint source loadings. Dynamic modeling with QUAL2E allows the modeler to examine the diurnal effects of variability in meteorological data on in-stream water quality and to evaluate diurnal DO variations due to floating algal growth and respiration.

4.1.1 Model Configuration

The following data are necessary to configure and calibrate the QUAL2E water quality model:

- Delineation of the stream into reaches having similar hydraulic characteristics
- Stream geometry or flow-depth and flow-velocity relationships for the stream reaches
- Point source locations and discharge loading data
- Tributary locations and discharge loading data
- Background concentrations of nutrients and dissolved oxygen
- Climatological data (air temperature, solar radiation, wind speed, cloud cover)
- Kinetic constants and rate coefficients for chemical transformations
- Instream water quality and flow data.

The study area for the QUAL2E model of Kokomo Creek extends from the confluence of Kokomo Creek and Wildcat Creek (mile 0.0) to the headwaters (mile 16.0). The study area was divided into 18 reaches based on hydraulic conditions; that is, each reach had similar flow, depth, and velocity characteristics. The reaches were further subdivided into computational elements. Each computational element in the model had a fixed length of 0.171 miles. The entire system consisted of 171 computational elements. The model reaches and locations of the tributary and point source discharges are shown in Figure 5.

The IDEM sampling data were used as input to the QUAL2E model for the point source facilities. The straight pipe septic outfalls from the three communities in the watershed were also input to the model; the locations and magnitude of the outfall pipes were based on the

information provided in several reports prepared by the Howard County Health Department (1995, 1996, and 1998). This information is summarized in Table 10.

Table 10. Location and magnitude of community septic system drain tiles.

Community	Location of outfall	Magnitude
Hemlock	"The elaborate network of drain tiles eventually connects to a main tile on the north side of State Road 26. This tile extends north... and eventually surfaces at the northeast corner of county road 300 south and 400 east. This drain tile then becomes Taylor Run Ditch and meanders through a subdivision known as Winding Brook. The ditch heads further northeast behind several homes along county road 400 east, eventually making its way to Kokomo Creek."	52 homes/ 54% illegal
Center	"The network of drain tiles eventually connects to a main tile on the north side of Center. This tile extends north approximately 2500 feet...eventually emptying into Kokomo Creek."	73 homes/ 25% illegal
Oakford	"The elaborate network of drain tiles eventually connects to two main tiles on the north side of Oakford which eventually empty into Martin-Youngman ditch. The Martin-Youngman ditch meanders through Izaak Walton Lake and eventually drains into Kokomo Creek."	73 homes/ 9% illegal

Source: Howard County Health Department (1995, 1996, 1998).

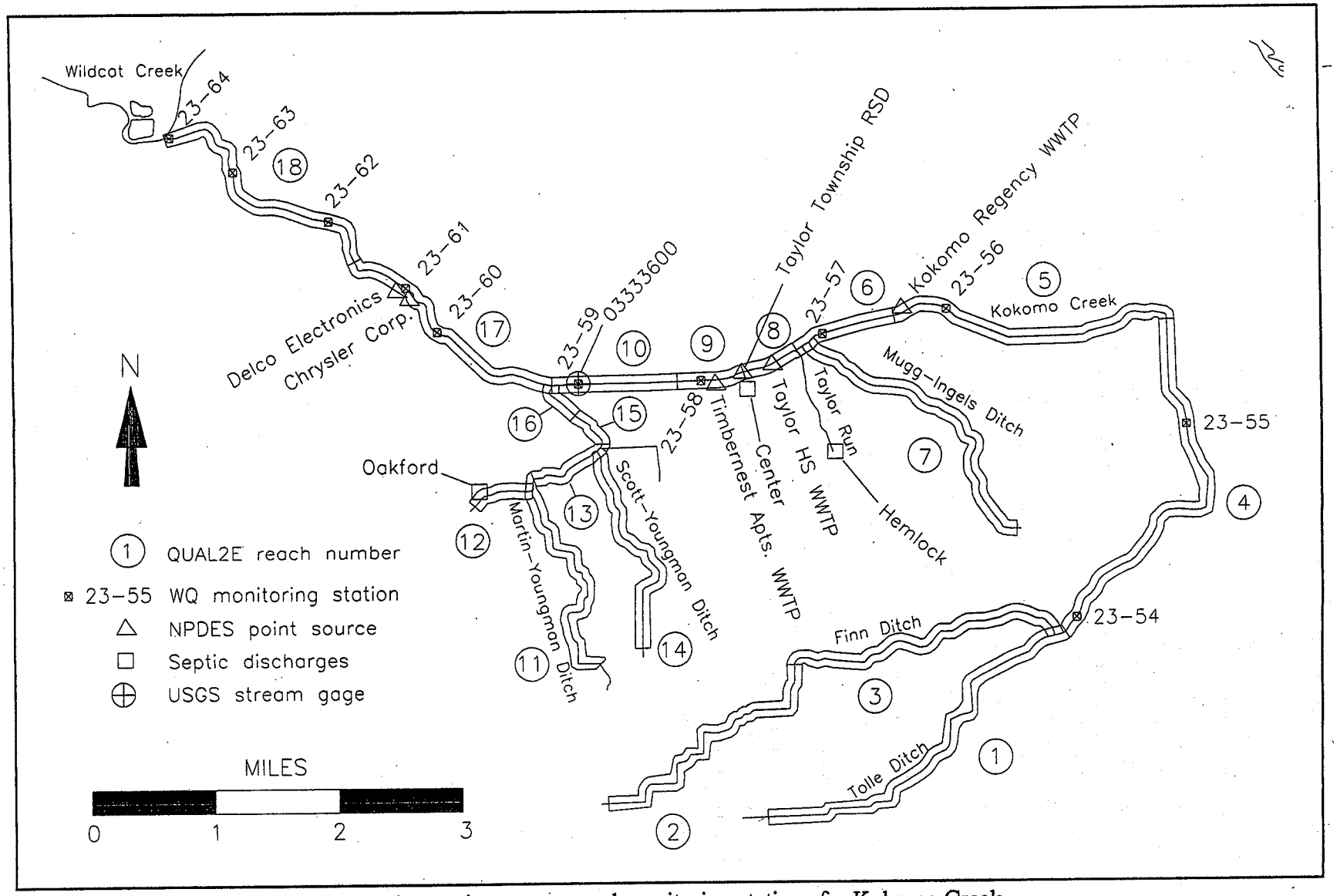

Figure 5. Locations of QUAL2E reaches, point sources, and monitoring stations for Kokomo Creek.

Effluent characteristics for the septic outfalls were obtained from literature values in the absence of sampling data (Thomann, 1972 as cited in USEPA, 1997b):

- CBODu: 220 mg/L
- Organic Nitrogen: 20 mg/L
- Total NH3-N: 28 mg/L
- NO3+NO2: 2 mg/L
- Total Phosphorus: 1 mg/L
- Average daily flow: 125 gallons/day/capita (average of 2.6 persons/household based on Howard County Census data (Bureau of the Census, 1990)).

4.1.2 Calibration of QUAL2E Model

In order to use a model as a predictive tool for water quality management, it is important that the model be calibrated to observed data. Calibration of the QUAL2E model requires an appropriate calibration condition determined from monitored instream water quality and point source discharge data. The IDEM instream water quality data set was available for Kokomo Creek from the sampling conducted in 1994 and 1998 (see section 2.2.1). In addition, DMR data for point source facilities along Kokomo Creek were available for 1993 to 1998.

The headwater boundary conditions and tributary conditions were estimated based on experience with past modeling studies since no data were available for these locations. The effluent discharge conditions used for model calibration were taken from the applicable monitoring data. All $CBOD_5$ concentrations were converted to ultimate CBOD ($CBOD_u$) for input to the model. A value of 2.84 was used for the $CBOD_u$:$CBOD_5$ ratio which is a recommended ratio for the type of treatment at these facilities (USEPA, 1997b). For the proposed new Taylor RSD facility, the $CBOD_u$:$CBOD_5$ ratio was assumed to be 2.3. For the headwater and tributaries, the $CBOD_u$:$CBOD_5$ ratio was assumed to be 1.0 (USEPA, 1997b).

The period selected for model calibration was September 3, 1998, which was characterized by low stream flow (2.9 cfs at the USGS stream gage on Kokomo Creek). The tributary stream flow and incremental flow along the stream network was determined by a ratio of contributing area of a given tributary to the contributing area at the USGS stream gage. The steady-state results of the QUAL2E model calibration run are presented in Appendix C (Figures C-01 to C-08). Reaeration was computed by the Melching and Flores (1999) method which was added to the QUAL2E model for this study and is a function of the stream velocity, slope, depth, width, flow rate, and temperature. The nitrate splits for the existing treatment facilities were 15% nitrite and 85% nitrate. The nitrate splits for the proposed new Taylor RSD facility were 10% nitrite and 90% nitrate. The model results for steady-state daily-average oxygen concentration match observed data reasonably well. The organic hydrolysis rates, ammonia oxidation rates, and nitrification rates were adjusted so that ammonia nitrogen, nitrate nitrogen, and total Kjeldahl nitrogen were in agreement with the limited instream data set. The biochemical oxygen demand (BOD) decay rate and BOD settling rate were adjusted to bring dissolved oxygen and BOD in agreement with

the data observed during the calibration period. The temperature calculated by the model is a function of solar radiation, wind speed, air temperature, relative humidity, and canopy cover and agrees closely with water temperatures observed during the calibration period. The nitrogen and phosphorus nutrients simulated by the model also agree reasonably well with the data observations on September 3, 1998. Note that the model CBOD shown in Figure C-02 is ultimate CBOD whereas the observed data values are 5-day CBOD.

4.1.3 Validation of QUAL2E Model

The purpose of model validation is to determine if the kinetic rate parameters selected during model calibration are valid for an independent set of stream conditions and monitoring data. The period chosen for model validation was July 31, 1998. This period was characterized by higher stream flow than the calibration period (16 cfs at the USGS stream gage on Kokomo Creek). The kinetic rate constants for the validation run were identical to those used in the calibration run. The steady-state results of the validation run are shown in Figures C-09 to C-16. The results for all parameters agree well with the observed data. Note that the model CBOD shown in Figure C-10 is ultimate CBOD whereas the observed data are 5-day CBOD. An interesting feature of both the calibration and validation periods is the stream water temperature. On both sampling dates the temperature profile shows a decrease from river mile 7.5 to 4.3 followed by an increasing temperatures to the mouth of Kokomo Creek. The model calibration and validation results indicate that the chosen kinetic parameters are reasonable for low-flow summer conditions.

4.2 Upstream Nutrient Approach

The dissolved oxygen impairments at sites 23-54 and 23-56 have been determined to be due to the presence of excessive attached algal growths, as observed by IDEM staff and as indicated by the extreme dissolved oxygen swings. Furthermore, it is expected that elevated nutrient concentrations, habitat alterations, and reduced riparian cover are contributing to these excessive algal growths. Based on the sampling data, phosphorus has been determined to be the limiting nutrient (see section 2.1).

One approach to addressing the algal problem would be to apply a computer model that would attempt to simulate the relationship between instream nutrient concentrations, weather conditions, algal growth, and dissolved oxygen conditions. However, there are relatively few models available that can adequately simulate the effects of attached algae on water quality. Although the QUAL2E model can be used to simulate the effects of phytoplankton (free-floating) algae, no algae sampling data for the 1994 and 1998 sampling events are available for Kokomo Creek with which to calibrate the model. Furthermore, the problem in Kokomo Creek is assumed to be more of a result of attached algae than phytoplankton and QUAL2E does not as yet include an attached algae component. The lack of appropriate data also precludes the use of more complex models (such as the Hydrological Simulation Program - Fortran (HSPF)) that do include an attached algae component.

Because of these limitations, a more simplified approach was taken. The observed phosphorus concentrations at relatively unimpaired sites in the watershed was chosen as the TMDL endpoint. As discussed in section 2.1 a concentration of 0.10 mg/L total phosphorus was chosen using this method. This value matches the 0.10 mg/L target identified in USEPA's 1986 guidance document (USEPA, 1986) and also matches a TP criterion proposed by the Ohio Environmental Agency for watersheds in the Eastern Corn Belt Plains ecoregion (OEPA, 1999).

The existing total phosphorus concentration at Kokomo Creek is estimated to be 0.14 mg/L (based on the 1994 and 1998 sampling). Assuming a constant assimilation factor and using the total phosphorus loads estimated above indicates the need for reducing total phosphorus loadings from 6.91 t/year (see Table 8) to 4.94 t/year (or approximately a 29% reduction).

$$\frac{\text{Existing Condition}}{\text{TMDL Endpoint}} \approx \frac{0.14\ \text{mg / L TP}}{0.10\ \text{mg / L TP}} \approx \frac{6.91\text{t / yr TP}}{4.94\text{t / yr TP}}$$

As mentioned previously, it would be preferable to select a TMDL endpoint based on dissolved phosphorus concentrations rather than total phosphorus. This is because algae in a stream environment are more likely to respond to the readily bioavailable dissolved phosphorus than they are to the total phosphorus concentration. However, because only total phosphorus concentrations have been measured, it is not possible to accurately identify existing dissolved phosphorus concentrations at the impaired or the reference sites.

5.0 ALLOCATION

5.1 Description of TMDL Allocation

TMDLs are composed of the sum of individual waste load allocations (WLAs) for point sources, load allocations (LAs) for nonpoint sources, and natural background levels. In addition, the TMDL must include a margin of safety (MOS), either implicitly or explicitly, that accounts for the uncertainty in the relationship between pollutant loads and the quality of the receiving waterbody. Conceptually, this definition is denoted by the equation

$$TMDL = \Sigma\ WLAs + \Sigma\ LAs + (MOS)$$

5.1.1 Description of Allocation for Downstream Sources

To address the downstream impairments a new wastewater treatment plant, to be managed by the Taylor Township Regional Sewer District (RSD), will be built. The permit limits identified in this TMDL will be used for the new plant. Initially the new plant will have a design capacity of 0.25 mgd. However, it is currently not yet known if the new plant will handle wastes from the existing Timbernest Apartments facility or if the Timbernest Apartments will continue to treat its own waste. Therefore permit limits and separate WLAs have been identified for either of these two alternatives (Alternatives 1 and 2). In addition, the Taylor Township RSD has requested information regarding potential future limits in the event the new plant expands to a design capacity of 0.50 mgd (Alternative 3). These permit limits are also provided in this report, but are not included as part of the current TMDL. Figures 6-9 below portray the predicted dissolved oxygen and NH3-N concentrations (during critical conditions) in relation to the appropriate standards for each of these three alternatives.

Alternative #0 - Existing Permit Limits. The calibrated and validated QUAL2E model was used to evaluate water quality for the existing critical condition. The critical conditions were assumed to be:

- Point sources discharging at permit limits or maximum observed values for non-permitted parameters. Table 12 identifies the existing permit limits.
- Point sources discharging at their design flows
- Septic outfalls in Hemlock, Center, and Oakford discharging at their estimated flows and concentrations (see section 4.1.2)
- Maximum summer instream temperature of 24°C summer and 10°C winter based on IDEM recommendations.
- Instream pH of 7.8 based on IDEM recommendations.
- 7Q10 flow in stream (0.1 cfs)

The results of this analysis indicated that violations of the dissolved oxygen and total ammonia nitrogen criteria would occur during these critical conditions. The minimum daily average dissolved oxygen concentration of 4.95 mg/L occurs at river mile 6.8, just downstream of Kokomo Regency WWTP.

Alternative #1 - Build New Taylor Regional Sewer District Plant (Design Capacity 0.25 mgd)

Under this alternative a new Taylor Regional Sewer District (RSD) would be formed and a new treatment plant would be built. This plant would treat waste from the existing septic outfalls, as well as waste from the Kokomo Regency Mobile Home Park and Taylor High School. The design capacity of the new plant under Alternative #1 is 0.25 mgd and the outfall would be located at mile point 5.73. The QUAL2E model was used to identify permit limits for this scenario and Table 13 identifies the limits that will eliminate any impairment at the critical condition, and therefore will also be protective of water quality standards at any other conditions.

Alternative #2 - Build New Taylor Regional Sewer District Plant (Design Capacity 0.25 mgd) and Remove Timbernext STP

For this alternative, the new Taylor RSD plant would also handle waste from Timbernest Apartments. The design capacity would continue to be 0.25 mgd. Table 14 shows the allocation for this alternative.

Alternative #3 - Build New Taylor Regional Sewer District Plant (Design Capacity 0.50 mgd) and Remove Timbernext STP

For this alternative, the new Taylor RSD plant would handle waste from Timbernest Apartments and the design capacity would be increased to 0.50 mgd. Table 15 shows the allocation for this alternative.

Since IDEM only allows 50% of the streamflow to be used for the ammonia toxicity allocation, the permit limits for ammonia nitrogen were computed separately outside the QUAL2E model. After allocating ammonia nitrogen to meet the ammonia toxicity criteria, the allowable total ammonia nitrogen concentrations were input to the QUAL2E model, and CBOD, ammonia nitrogen, and nitrate nitrogen were allocated to protect the dissolved oxygen water quality standard. The ammonia toxicity calculations were based on the following dilution equation:

$$C_d = \frac{(Q_{u/2} \times C_u + Q_e \times C_e)}{Q_{u/2} + Q_e}$$

where,

Q_u = upstream flow rate (0.1 cfs)

$Q_{u/2}$ = 50% of upstream flow rate (0.05 cfs)

C_u = upstream ammonia nitrogen concentration (0.2 mg/L)

Q_e = effluent flow rate (0.25 or 0.50 mgd)

Q_e = effluent flow rate (0.25 or 0.50 mgd)
C_e = effluent ammonia nitrogen concentration (solve for this)
C_d = allowable downstream ammonia nitrogen concentration (from criteria)

The water quality criteria for total ammonia nitrogen was 1.350 mg N/L for summer critical conditions (temperature 24°C and pH 7.8) and 1.887 mg/L for winter critical conditions (10°C and pH 7.8). The effluent concentration (C_e) was adjusted so that the downstream concentration (C_d) did not exceed the water quality criteria. The ammonia allocation for the upstream-most point source (Taylor Township RSD) was computed first and the ammonia concentration was entered into QUAL2E in order to determine the upstream concentration (C_u) for the next downstream source (Timbernest Apartments). The ammonia toxicity computations are summarized in Table 11 below.

Table 11. Ammonia nitrogen toxicity allocations for Kokomo Creek WWTPs.

Description	Taylor Township RSD (0.25 mgd)	Timbernest Apartments WWTP	Taylor Township RSD (0.50 mgd)
Qu = upstream flow (cfs)	0.10	0.4868	0.10
Qu/2 = 50% of upstream flow (cfs)	0.05	0.2434	0.05
Cu = summer upstream NH3-N conc. (mg N/L)	0.200	1.229	0.200
Cu = winter upstream NH3-N conc. (mg N/L)	0.200	1.710	0.200
Qe = effluent flow (cfs)	0.3868	0.0232	0.7736
Ce = summer effluent NH3-N conc (mg N/L)	1.50	2.61	1.42
Ce = winter effluent NH3-N conc. (mg N/L)	2.10	3.73	1.99
Qd = downstream flow (cfs)	0.4868	0.2666	0.8736
Cd = summer downstream NH3-N conc. (mg N/L)	1.347	1.349	1.346
Cd = winter downstream NH3-N conc. (mg N/L)	1.883	1.886	1.881

Table 12. Conditions used for Kokomo Creek low flow analysis.

Facility Name	Flow (mgd)	CBOD5 (mg/L)	NH3-N (mg N/L)	DO (mg/L)	NO2+NO3 (mg N/L)
Kokomo Regency	0.091 [0.1408 cfs]	15 (a)	1.2 (a)	6.0 (a)	3.3
Hemlock Septic	0.007 [0.0108 cfs]	220 (b)	28.0 (b)	2.0 (b)	2.0 (b)
Taylor High School	0.0284 [0.0439 cfs]	15	3.4 (c)	6.0	30.0
Center Septics	0.007 [0.0108 cfs]	220 (b)	28.0 (b)	2.0 (b)	2.0 (b)
Timbernest Apartments	0.015 [0.0232 cfs]	25	3.9	2.9 (d)	9.1
Oakford Septics	0.012 [0.0186 cfs]	220 (b)	28.0 (b)	2.0 (b)	2.0 (b)
Delphi (e)	-	-	-	-	-
Chrysler (f)	-	-	-	-	-

Notes:

(a) interim permit limits based on permit re-issued on 04/23/99

(b) values for septic discharges are estimated and CBOD values are ultimate instead of 5-day

(c) maximum observed ammonia nitrogen (12/93)

(d) minimum observed dissolved oxygen

(e) Delphi permit will be re-issued as a general stormwater permit and is not included in the low-flow TMDL analysis

(f) Chrysler permit is a general stormwater permit and is not included in the low-flow TMDL analysis

Table 13. Allocations for Alternative #1.

Facility Name	Flow (mgd)	CBOD5 (mg/L)	NH3-N (mg N/L)	DO (mg/L)
Taylor Township RSD	0.25 [0.3868 cfs]	15.0 summer 25.0 winter	1.50 summer 2.01 winter	6.0 summer 5.0 winter
Timbernest Apartments	0.015 [0.0232 cfs]	25.0 summer 25.0 winter	2.61 summer 3.73 winter	N/A (2.9)
Kokomo Regency	Connected to Taylor Township RSD			
Hemlock Septic	Connected to Taylor Township RSD			
Taylor High School	Connected to Taylor Township RSD			
Center Septics	Connected to Taylor Township RSD			
Oakford Septics	Connected to Taylor Township RSD			

Table 14. Allocations for Alternative #2.

Facility Name	Flow (mgd)	CBOD5 (mg/L)	NH3-N (mg N/L)	DO (mg/L)
Taylor Township RSD	0.25 [0.3868 cfs]	15.0 summer 25.0 winter	1.50 summer 2.10 winter	6.0 summer 5.0 winter
Timbernest Apartments	Connected to Taylor Township RSD.			
Kokomo Regency	Connected to Taylor Township RSD			
Hemlock Septic	Connected to Taylor Township RSD			
Taylor High School	Connected to Taylor Township RSD			
Center Septics	Connected to Taylor Township RSD			
Oakford Septics	Connected to Taylor Township RSD			

Table 15. Allocations for Alternative #3.

Facility Name	Flow (mgd)	CBOD5 (mg/L)	NH3-N (mg N/L)	DO (mg/L)
Taylor Township RSD	0.50 [0.7736 cfs]	10.0 summer 25.0 winter	1.42 summer 1.99 winter	6.0 summer 5.0 winter
Timbernest Apartments	Connected to Taylor Township RSD			
Kokomo Regency	Connected to Taylor Township RSD			
Hemlock Septic	Connected to Taylor Township RSD			
Taylor High School	Connected to Taylor Township RSD			
Center Septics	Connected to Taylor Township RSD			
Oakford Septics	Connected to Taylor Township RSD			

The Kokomo Creek dissolved oxygen and nutrient TMDL for the point and nonpoint sources in their present locations can also be expressed in terms of daily mass loading as follows:

$$TMDL = \sum WLA + \sum LA + MOS$$

The load allocation (nonpoint sources and natural background) shown in Table 16 are calculated based on the tributary headwater inflow and the lateral inflow components of the QUAL2E model. They represent the estimated loads entering Kokomo Creek during low-flow conditions.

Table 16. Daily mass load TMDL allocations for CBOD5 and total ammonia nitrogen.

Alternative	Season	CBOD5 (kg/day)			Total Ammonia Nitrogen (kg/day)		
		WLA	LA	MOS	WLA	LA	MOS
#1	summer	15.617	0.568	implicit	1.568	0.187	implicit
	winter	25.081	0.568	implicit	2.095	0.187	implicit
#2	summer	14.197	0.568	implicit	1.420	0.187	implicit
	winter	23.611	0.568	implicit	1.883	0.187	implicit
#3	summer	18.929	0.568	implicit	2.688	0.187	implicit
	winter	47.323	0.568	implicit	3.767	0.187	implicit

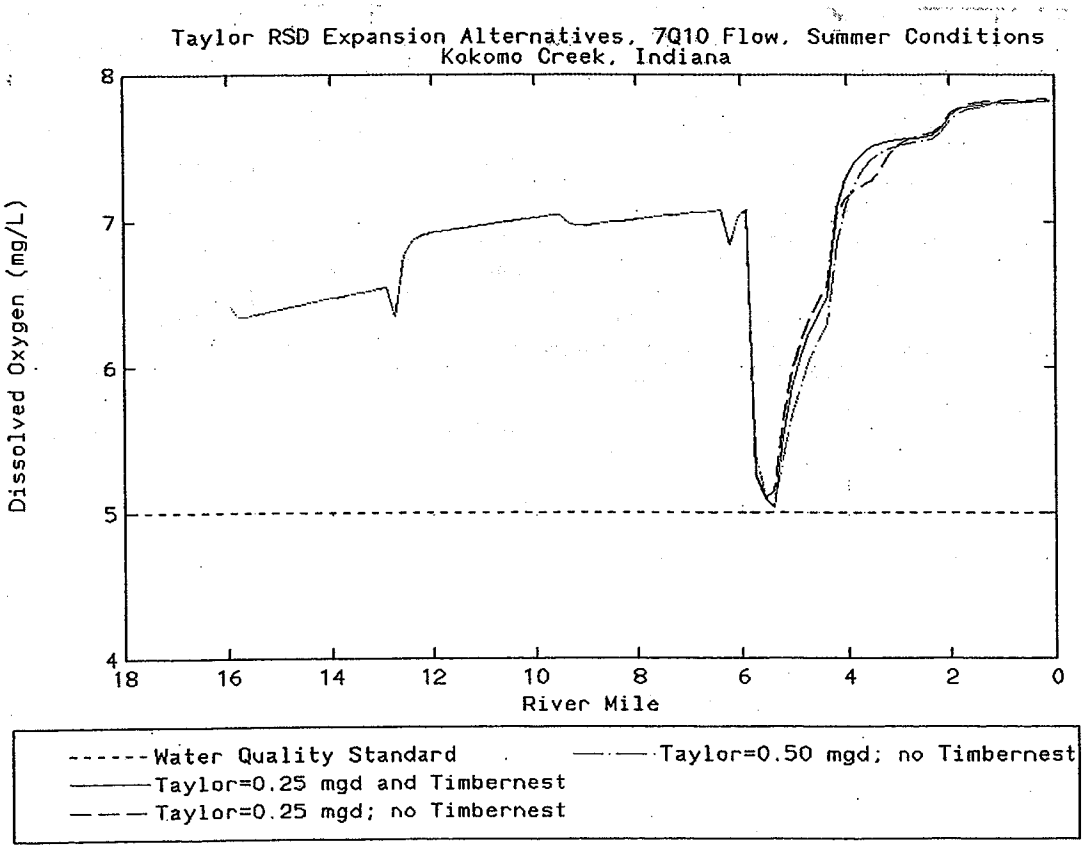

Figure 6. Expansion alternatives and impact on dissolved oxygen (summer). The dashed line indicates the standard. The new facility is located at mile point 5.73.

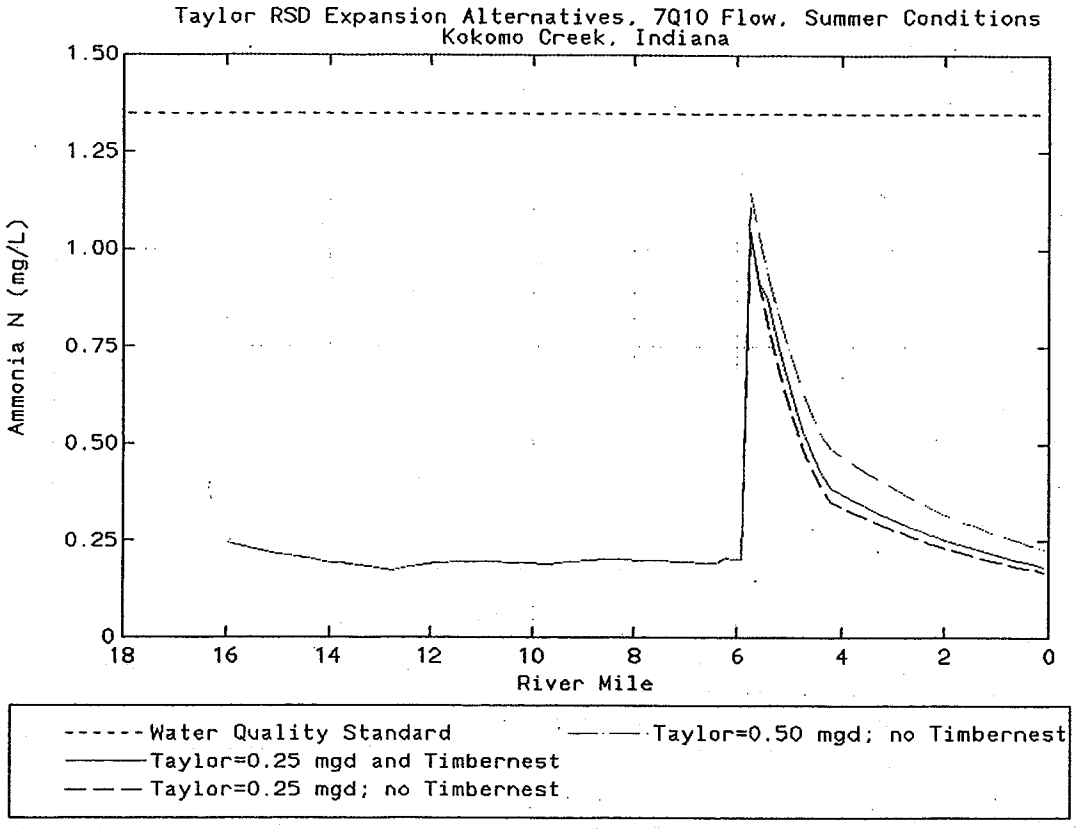

Figure 7. Expansion alternatives and impact on NH3-N (summer). The dashed line indicates the standard. The new facility is located at mile point 5.73.

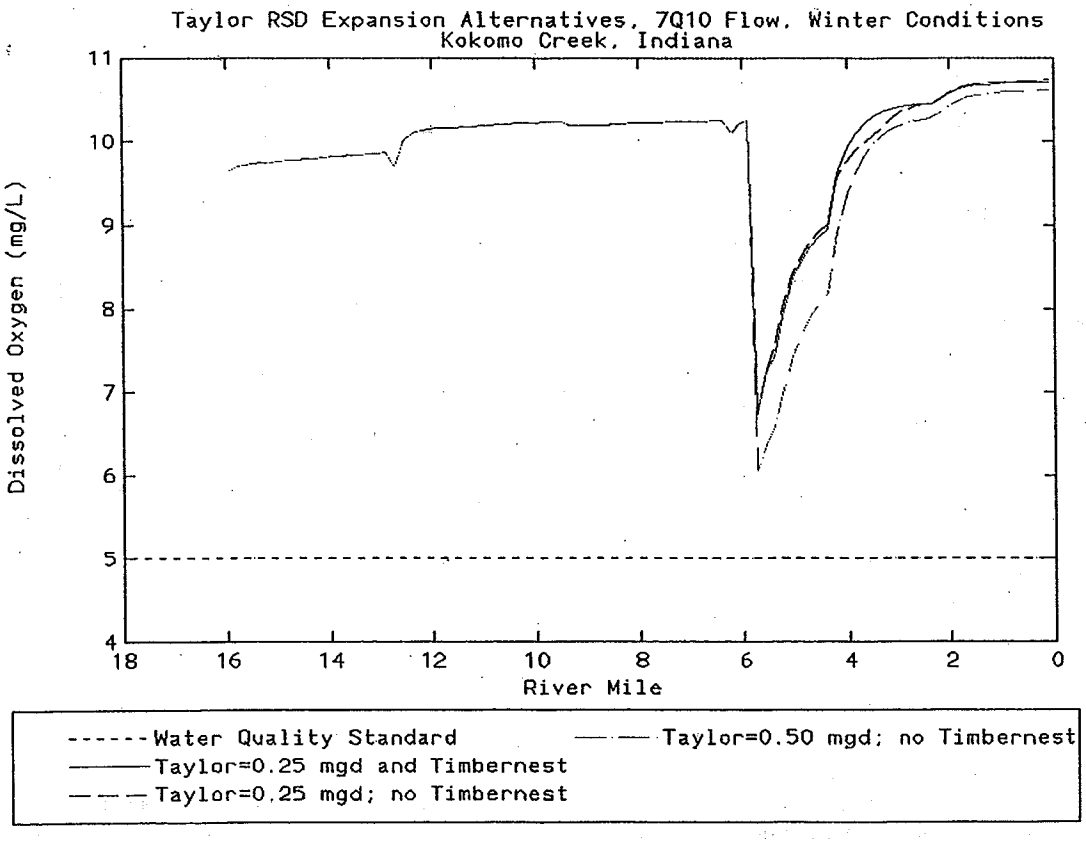

Figure 8. Expansion alternatives and impact on dissolved oxygen (winter). The dashed line indicates the standard. The new facility is located at mile point 5.73.

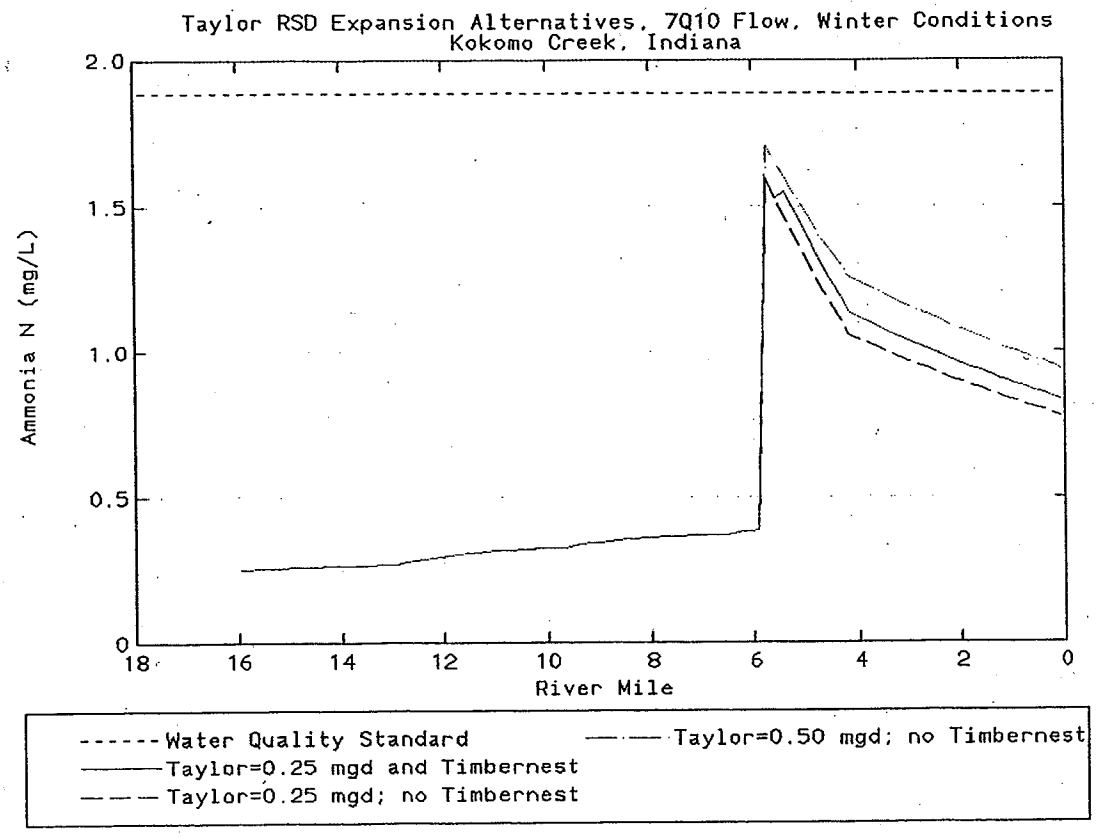

Figure 9. Expansion alternatives and impact on NH3-N (winter). The dashed line indicates the standard. The new facility is located at mile point 5.73.

5.1.2 Description of Allocation for Upstream Sources

Section 4.2 indicates that total phosphorus loads from subwatersheds 5, 6, and 7 need to be reduced approximately 29%, from 6.92 metric tons/year to 4.94 metric tons/year. The following allocation will achieve this reduction.

Table 17. TMDL allocation for upstream dissolved oxygen impairment.

Source	Area (ac)	Existing Phosphorus Loading (t/yr)	Allocation Phosphorus Loading (t/yr)	Reduction
Row Crop	8,871	5.31	3.58	-33%
Row Crop (with conservation tillage)	2,217	0.77	0.77	0%
Groundwater	--	0.44	0.44	0%
Point Source	--	0.24	0.00	-100%
Pasture/Hay	963	0.12	0.12	0%
Wetlands	175	0.01	0.01	0%
Low Intensity Residential	50	0.01	0.01	0%
Deciduous Forest	141	0.01	0.01	0%
Total	12,417	6.91	4.94	-29%

The TMDL can also be expressed as:

$$TMDL = \sum WLA + \sum LA + MOS$$

TMDL = 0.00 t/year TP + 4.50 t/year TP Nonpoint Sources + 0.44 t/yr TP Groundwater + Implicit MOS (See Section 5.2)

This allocation indicates the need for reducing TP loadings from row crop agriculture by 33% and eliminating the TP loadings from the Kokomo Regency Mobile Home Park. The TMDL is also shown graphically in Figure 10.5.2

5.2 Incorporating a Margin of Safety

Section 303(d) of the Clean Water Act and EPA's regulations at 40 CFR 130.7 require that "TMDLs shall be established at levels necessary to attain and maintain the applicable narrative and numerical water quality standards with seasonal variations and a margin of safety which takes into account any lack of knowledge concerning the relationship between effluent limitations and water quality." The margin of safety can either be incorporated into conservative assumptions used to develop the TMDL or added as a separate component of the TMDL (USEPA, 1991).

The margin of safety for this TMDL has been implicitly accounted for in three ways:

1) The assumptions for the low-flow critical condition for the QUAL2E model are very conservative (e.g., 7Q10 low flow, 24° C temperature, pH 7.8, facilities discharging at their design capacities and permit limits).
2) The total phosphorus endpoint of 0.10 mg/L TP was selecting using fairly rigorous criteria for identifying reference sites. This endpoint was chosen by identifying the sampling sites in the IDEM watershed that had very good dissolved oxygen conditions (an average dissolved oxygen concentration of at least 7.0 mg/L and dissolved oxygen swings of less than 2.0 mg/L per day) and calculating their average TP concentrations. If a less rigorous TMDL endpoint had been selected, the estimated necessary loading reductions would not have been as great. For example, if an endpoint of 0.12 mg/L TP had been chosen rather than 0.10 mg/L TP, the loading capacity would have been 5.77 metrics tons/year instead of 4.94 metric tons/year (an explicit MOS of 17%).
3) During the winter season, the margin of safety is incorporated by capping the allowable effluent CBOD5 concentrations at 25 mg/L for the Taylor Township RSD facility.

5.3 Seasonality

Section 303(d)(1)(C) of the Clean Water Act and EPA's regulations at 40 CFR 130.7(c)(1) require that a TMDL be established with seasonal variations. Seasonality is expressed in the Kokomo Creek TMDL in several ways. First, permit limits for the point sources have been identified for both the summer and winter periods. Taking this approach recognizes the different assimilative capacity of the stream for different climatic conditions. Secondly, seasonality is expressed in the TMDL by using the GWLF model to predict monthly loadings over a multi-year period using actual weather conditions and observed changes in watershed activities. The estimated existing and allocated loads are therefore reflective of seasonal changes in weather and other conditions that can vary over the course of a year (e.g., agricultural practices). Allowable loads are greater during wet weather months (recognizing that is when most of the nonpoint source loads occur) while still remaining protective of the chosen summer TP target (see Figure 10).

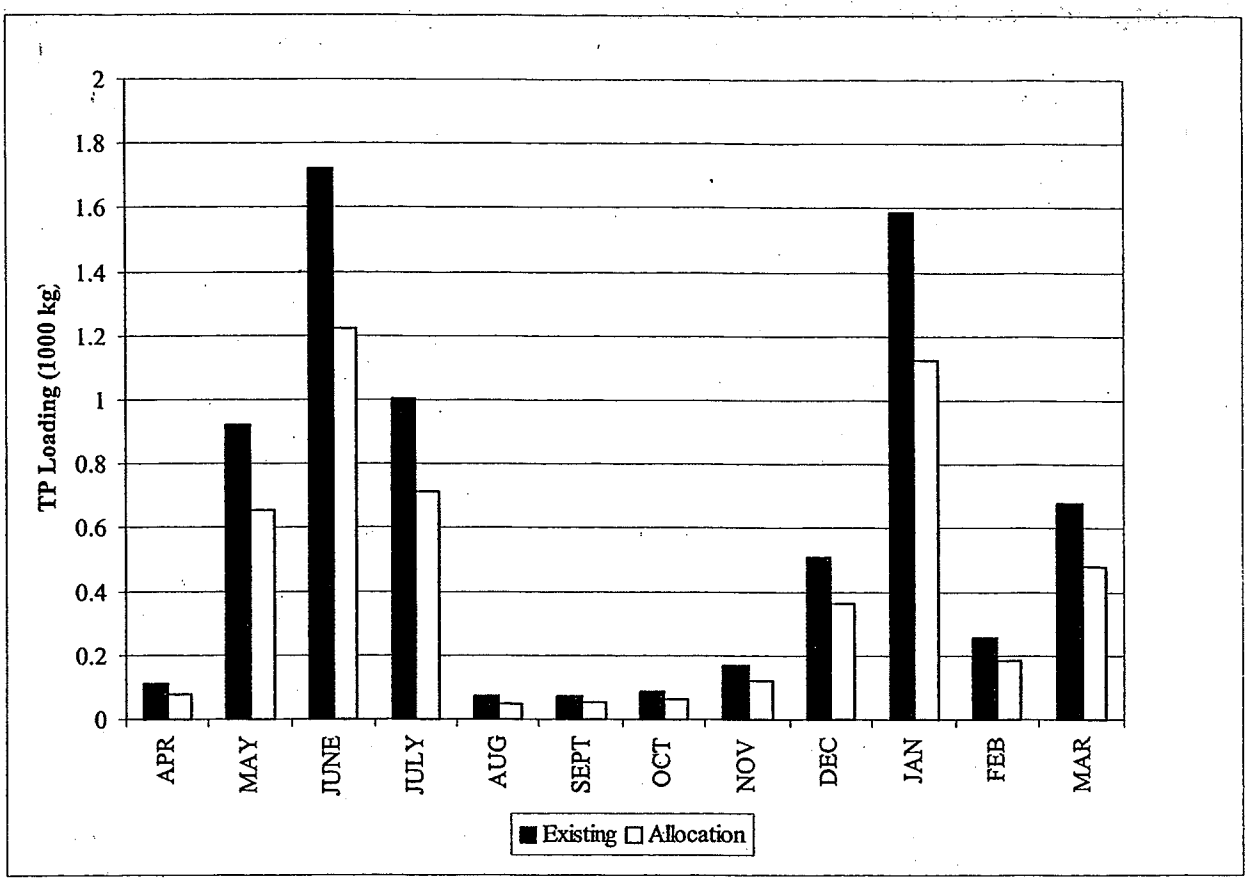

Figure 10. Existing average monthly TP loads and predicted loading following implementation of the TMDL.

6.0 IMPLEMENTATION

The load reductions from the point sources in the watershed will be implemented via the NPDES program and the construction of the new Taylor Township RSD wastewater treatment plant. The proposed plant will be an extended aeration/activated sludge plant with ultraviolet disinfection. The expected start date for construction of the treatment plant is July 2001; the expected completion date is December 31, 2002. The petition for Judicial Review of the RSD (which had been causing some uncertainty with regard to the start date) has been dropped. Although there is no reason to believe that the regional wastewater treatment facility will not be built, should that occur the TMDL will be re-evaluated.

The Indiana Department of Natural Resources initiated a Lake and River Enhancement project for the upstream portion of Kokomo Creek in 1999. The objective of the project is to work with land users (primarily agricultural) to reduce soil erosion and associated soil and nutrient movement into surface waters. This is to be accomplished by providing technical and financial assistance to land users voluntarily desiring to participate in the program. Cost-share funds will be offered to encourage the installation of vegetative filter strips, grassed waterways, grade stabilization structures, and other measures as well as to promote the adoption of practices such as livestock waste utilization, reduced tillage, and integrated pest (and nutrient) management. This project is in its early stage of development, and since participation is entirely voluntary, it is impossible to predict the ultimate level of land user involvement.

Filter strips have a reported 75% effectiveness for controlling total phosphorus (Pennsylvania State University, 1992 as cited in USEPA, 1993) and the other conservation measures included in the IDNR project are also very effective at reducing soil erosion and total phosphorus. Assuming the project goes forward as planned, the combination of the filter strips and other measures, as well as any increase in the use of conservation tillage in the watershed, should result in the necessary 33% reduction in total phosphorus loadings from row crop agriculture (see Table 17). In addition, the proposed conservation measures could potentially improve the health of the riparian corridor by re-vegetating the streambanks and improving instream and floodplain habitat.

6.1 Follow-up Monitoring

The surface water sampling for this project will take place in the year 2001 and will occur in phases as each part of the TMDL Implementation Plan is completed. The stream will be sampled three times annually during both high flow and low flow conditions for a period of three years to insure compliance with water quality standards. Samples will be collected three times between the months of March and October to reflect the effects of varying stream flow and weather conditions. Samples from the Taylor Township Regional Sewer District plant final effluent, once operational, will be collected as 2 part composites. All stream surface water samples will be collected as grab samples, and will be analyzed for ammonia-nitrogen and total phosphorus. At each location, when a water sample is taken, field tests for pH, temperature, turbidity, specific conductance, chlorophyll a, and dissolved oxygen will be conducted using a YSI™ multi-

parameter water chemistry analyses unit. The dissolved oxygen measurements will be collected late afternoon, (3:30 pm to 6:00 pm) (peak dissolved oxygen period), and before dawn the following morning (2:30 am to 4:30 am) (low dissolved oxygen period). The stream samples will be collected from the centroid of flow, just below the surface of the water. The nearby USGS stream gage on Wildcat Creek at Kokomo (03333700) will be monitored to estimate area stream flow levels. All water samples will be preserved as described in the Quality Assurance Program Plan. Water samples for the nutrients analysis will be preserved appropriately with sulfuric acid, on ice at 4°C +/- 2°, and delivered to the Indiana State Department of Health Laboratory for analysis within standard holding times.

6.2 Reasonable Assurance

The Taylor Township Regional Sewer District was formed on September 5, 2000, and they have applied for State Revolving Loan funds for construction of the plant and sewer lines. The sewer project will take in not only the Taylor High School wastewater treatment plant, but the Regency Mobile Home Park and the Timbernest Apartments, eliminating all of the small package wastewater treatment plants that have been contributing to the impairments in Kokomo Creek. Construction of the plant and sewer lines should begin sometime in 2001. IDEM's existing authority under the NPDES program will be used to implement any additional point source modifications necessary, should water quality improvements not be realized.

The Lake and River Enhancement Grant project is currently underway, with two of the three major landowners participating. Funds available for 1999 were $30,000; for 2000, $35,000; and an additional $18,350 has been requested for 2001 activities. Additionally, the Howard County Soil and Water Conservation District (SWCD) has the expertise of four employees to assist landowners in the watershed with LARE projects. In addition, technicians from the Howard County Soil and Water Conservation District, the Natural Resource Conservation Service (NRCS) and the Indiana Department of Natural Resources (IDNR) will provide the SWCD Board with a yearly progress report on each conservation practice installed in the program. Practices will be inspected to insure that they are meeting NRCS specifications and are working properly. Should the current and planned activities not be effective in reducing phosphorus loadings and improving dissolved oxygen levels, additional education and outreach activities will be undertaken.

6.3 Public Participation

The Indiana Department of Environmental Management has held three public meetings for the Kokomo Creek Watershed interested parties. All stakeholders were sent advanced notice of the meetings, and the notices appeared on IDEM's Calendar of Events and on the agency website. The first meeting was held in Kokomo at the government center on December 21, 1999 and had an attendance of 25. Staff from IDEM and the Howard County Health Department presented information about the water quality problems in Kokomo Creek, and described the TMDL process. The second meeting was held February 16, 2000 at the Taylor Township Volunteer Fire Department's Community Room located in the watershed. Twenty-five people were in

attendance, and the draft TMDL results were presented. The third meeting was held November 8, 2000 at the Taylor Township Volunteer Fire Department's Community Room, and copies of the TMDL were distributed for the official public comment period, which runs from November 10 through December 11, 2000. The public meeting and comment period announcement were placed on IDEM's website, advertised in the Kokomo newspaper, and mailed to all of the stakeholders in the area. The Kokomo Creek TMDL was placed on IDEM's website, and copies were placed at the Kokomo- Howard County Public Library, main branch, and the south branch, located in Taylor Township, as well as made available at the public meeting.

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Appendix A – Results of IDEM Sampling

Date	Sampling Site Number	NH3-N (mg/L)	NO3NO2-N (mg/L)	TKN (mg/L)	TP (mg/L)	CBOD5 (mg/L)	DO Max (mg/L)	DO Mean (mg/L)	DO Min (mg/L)	pHMax (s.u.)	pH Mean (s.u.)	pHMin (s.u.)	Temp Mean (C)	Flow (cfs)
12/03/1993	Regency MHP	5.4	3.3	5.9	1.0		7.5	7.1	6.6	7.8	7.7	7.6	4	0.100
12/03/1993	Regency MHP	12	0.4	33	3.4									
12/03/1993	Taylor HS	3.4	16	5.7	9.6		5.5	4.8	4.2	7.5	7.5	7.4	11	0.030
12/03/1993	Timbernest Apts	0.2	0.2	1.0	0.4								4	0.020
06/15/1994	23-64	0.2	1.5	0.6	0.13	1.5	7.4	6.5	5.7	8.4	8.0	7.6	24.0	8.460
06/17/1994	23-64	0.2	2.1	0.6	0.14	1.0	7.5	6.4	4.3	8.1	8.0	7.8	26.0	8.220
06/17/1994	23-63	0.2	2.2	0.7	0.17	1.3	8.5	7.3	5.0	8.1	8.0	7.8	26.0	
06/17/1994	23-62	0.1	2	0.6	0.16	1.1	7.9	6.6	4.5	8.1	8.0	7.8	25.0	11.160
06/17/1994	Delphi Electronics	0.1	1.9	0.5	0.28	1.0		8.6		7.7	7.7		26.0	3.270
06/17/1994	Chrysler Corp	0.2	1.4	0.6	0.18	1.0		7.1		7.7	7.7		29.0	0.380
06/17/1994	23-61	0.1	2.1	0.6	0.17	1.0	7.8	6.7	4.7	8.1	7.9	7.7	25.0	10.990
06/17/1994	23-60	0.1	2.6	0.5	0.13	1.0	7.3	6.8	6.2	7.9	7.8	7.6	25.0	5.450
06/17/1994	**23-59**	0.1	2.3	0.6	0.14	1.0	6.3	5.0	**3.4**	7.7	7.7	7.6	24.0	4.300
06/17/1994	Timbernest Apts	0.4	0.1	1.4	0.4	4.0		4.8		7.5	7.5		27.0	0.020
06/17/1994	23-58	0.2	2.4	0.7	0.18	1.0	6.5	5.9	5.4	7.8	7.8	7.7	25.0	3.070
06/17/1994	23-57	0.3	2.5	1.4	0.36	1.4	6.6	5.8	5.1	7.9	7.8	7.6	26.0	
06/17/1994	Regency MHP	6.9	1.5	9.1	2.6	4.2		4.9		7.5	7.5		27.0	0.050
06/17/1994	**23-56**	0.2	2.4	0.7	0.12	1.0	7.9	5.6	**3.6**	8.0	7.8	7.6	26.0	2.920
06/17/1994	23-55	0.2	2.3	0.7	0.14	1.5	11.6	6.8	4.3	8.3	8.0	7.6	25.0	
06/17/1994	**23-54**	0.2	1.7	0.9	0.18	1.0	9.4	5.9	**3.7**	8.1	7.8	7.5	26.0	1.030
07/31/1998	23-64	0.1	2.7	0.5	0.11	1.0	8.29	7.98	7.73	8.1	8.0	8.0	20.91	20.74
07/31/1998	23-63	0.1	2.8	0.4	0.09	1.0	8.38	8.27	8.17	8.2	7.1	6.1	21.24	21.48
07/31/1998	23-62	0.1	2.8	0.4	0.09	1.0	8.56	8.15	7.83	8.1	8.0	8.0	20.96	18.85
07/31/1998	Chrysler Corp	0.4	0.5	0.9	0.24	1.1		5.98		7.8	7.8		22.67	0.34
07/31/1998	23-61	0.1	3.1	0.5	0.01	1.0	8.13	7.84	7.58	8.0	8.0	7.9	20.85	17.26
07/31/1998	23-60	0.1	3.2	0.5	0.02	1.0	7.99	7.72	7.46	8.0	7.9	7.9	20.81	17.21
07/31/1998	23-59	0.1	3.4	0.5	0.09	1.0	7.37	7.24	7.03	7.8	7.8	7.8	20.63	16.0
07/31/1998	23-58	0.1	3.6	0.6	0.09	1.0	7.56	7.34	7.01	7.8	7.8	7.8	20.6	12.38
07/31/1998	23-57	0.1	3.8	0.6	0.09	1.1	8.03	7.33	6.73	7.9	7.8	7.7	20.78	10.32
07/31/1998	Regency MHP	3.7	0.1	7.7	1.03	14	7.33	5.26	3.88	7.8	7.7	7.5	22.19	0.039

Date	Sampling Site Number	NH3-N (mg/L)	NO3NO2-N (mg/L)	TKN (mg/L)	TP (mg/L)	CBOD5 (mg/L)	DO Max (mg/L)	DO Mean (mg/L)	DO Min (mg/L)	pHMax (s.u.)	pH Mean (s.u.)	pHMin (s.u.)	Temp Mean (C)	Flow (cfs)
07/31/1998	23-56	0.1	3.7	0.5	0.08	1.0	10.41	8.38	6.99	8.0	7.8	7.7	20.8	10.5
07/31/1998	23-55	0.1	3.9	0.6	0.11	1.0	8.32	7.14	6.5	7.8	7.7	7.6	20.28	6.66
07/31/1998	23-54	0.1	4.3	0.5	0.09	1.0	8.09	7.46	7.07	7.9	7.8	7.8	19.61	3.65
09/03/1998	23-64	0.1	0.58	0.38	0.2	2.0	9	8.3	7	8.2	8.1	8.1	20.45	4.18
09/03/1998	23-63	0.1	0.51	0.36	0.17	2.0	8.5	8.35	8.18	8.2	8.2	8.2	20.74	4.82
09/03/1998	23-62	0.1	0.65	0.24	0.19	2.0	10.2	8.59	6.9	8.2	8.1	8.0	19.86	4.18
09/03/1998	Delphi Electronics	0.1	0.63	0.1	0.42	2.0	8	8	8	7.9	7.9	7.9	23.4	5.681
09/03/1998	Chrysler Corp.	0.13	0.08	0.51	0.11	2.0	6.13	6.13	6.13	8.3	7.7	7.2	22.24	0.104
09/03/1998	23-61	0.12	0.82	0.36	0.26	2.0	9.5	8.1	6.75	8.1	8.0	8.0	19.85	4.74
09/03/1998	23-60	0.1	0.67	0.81	0.16	2.0	9	8.11	7.21	8.1	8.1	8.0	18.59	2.67
09/03/1998	23-59	0.1	0.74	0.1	0.19	2.0	6.7	6.28	5.95	7.9	7.8	7.8	18.18	2.9
09/03/1998	Timbernest Apts.	0.82	9.1	2.5	3.6	2.0	3	2.95	2.9	7.2	7.2	7.2	20.25	0.008
09/03/1998	23-58	0.14	0.88	0.69	0.22	2.0	6.1	5.86	5.61	7.9	7.7	7.5	18.75	1.8
09/03/1998	Taylor High School	0.12	30	0.56	4.1	2.0	7.9	7.85	7.8	8.1	8.1	8.1	23.6	0.03
09/03/1998	23-57	0.34	0.51	0.86	0.19	2.0	6.1	5.32	4.42	7.8	7.8	7.7	20.06	1.13
09/03/1998	Regency MHP	10	0.052	14	1.7	55.0	2.3	2.1	1.9	7.4	7.4	7.4	21	0.07
09/03/1998	23-56	0.18	0.14	0.87	0.15	2.0	13.5	8.02	3.77	8.3	8.0	7.7	21.84	0.81
09/03/1998	23-55	0.18	0.25	1	0.17	2.0	11.3	8.4	6.63	8.0	7.9	7.8	20.46	0.71
09/03/1998	23-54	0.18	0.34	0.7	0.2	2.0	7.4	7.1	6.8	8.0	7.9	7.9	19.08	0.12

Key to acronyms:

DO: Dissolved Oxygen
Temp: Temperature
NH3-N: Ammonia-Nitrogen
NO3-NO2N: Nitrate-Nitrite Nitrogen
TKN: Total Kjeldahl Nitrogen
TN: Total Nitrogen
TP: Total Phosphorus
COD: Chemical Oxygen Demand
CBOD5: Carbonaceous Biochemical Oxygen Demand (over a 5 day period)

Appendix B – GWLF Modeling

Loading of water, sediment, and nutrients in the Kokomo Creek watershed was simulated using the Generalized Watershed Loading Functions or GWLF model (Haith et al., 1992). The complexity of the loading functions model falls between that of detailed, process-based simulation models and simple export coefficient models which do not represent temporal variability. GWLF provides a mechanistic, but simplified simulation of precipitation-driven runoff and sediment delivery, yet is intended to be applicable without calibration. Solids load, runoff, and ground water seepage can then be used to estimate particulate and dissolved-phase pollutant delivery to a stream, based on pollutant concentrations in soil, runoff, and ground water.

GWLF simulates runoff and streamflow by a water-balance method, based on measurements of daily precipitation and average temperature. Precipitation is partitioned into direct runoff and infiltration using a form of the Natural Resources Conservation Service's (NRCS) Curve Number method (SCS, 1986). The Curve Number determines the amount of precipitation that runs off directly, adjusted for antecedent soil moisture based on total precipitation in the preceding 5 days. A separate Curve Number is specified for each land use by hydrologic soil grouping. Infiltrated water is first assigned to unsaturated zone storage where it may be lost through evapotranspiration. When storage in the unsaturated zone exceeds soil water capacity, the excess percolates to the shallow saturated zone. This zone is treated as a linear reservoir that discharges to the stream or loses moisture to deep seepage, at a rate described by the product of the zone's moisture storage and a constant rate coefficient.

Flow in streams may derive from surface runoff during precipitation events or from ground water pathways. The amount of water available to the shallow ground water zone is strongly affected by evapotranspiration, which GWLF estimates from available moisture in the unsaturated zone, potential evapotranspiration, and a cover coefficient. Potential evapotranspiration is estimated from a relationship to mean daily temperature and the number of daylight hours.

The user of the GWLF model must divide land uses into "rural" and "urban" categories, which determines how the model calculates loading of sediment and nutrients. For the purposes of modeling, "rural" land uses are those with predominantly pervious surfaces, while "urban" land uses are those with predominantly impervious surfaces. It is often appropriate to divide certain land uses into pervious ("rural") and impervious ("urban") fractions for simulation. Monthly sediment delivery from each "rural" land use is computed from erosion and the transport capacity of runoff, whereas total erosion is based on the universal soil loss equation (USLE) (Wischmeier and Smith 1978), with a modified rainfall erosivity coefficient that accounts for the precipitation energy available to detach soil particles (Haith and Merrill, 1987). Thus, erosion can occur when there is precipitation, but no surface runoff to the stream; delivery of sediment, however, depends on surface runoff volume. Sediment available for delivery is accumulated over a year, although excess sediment supply is not assumed to carry over from one year to the next. Nutrient loads from rural land uses may be dissolved (in runoff) or solid-phase (attached to sediment loading as calculated by the USLE).

For "urban" land uses, soil erosion is not calculated, and delivery of nutrients to the water bodies is based on an exponential accumulation and washoff formulation. All nutrients loaded from urban land uses are assumed to move in association with solids.

GWLF Model Inputs

GWLF application requires information on land use, land cover, soil, and parameters that govern runoff, erosion, and nutrient load generation.

Land Use/Land Cover

Digital land use/land cover (LULC) data for the Kokomo Creek watershed were obtained from the National Land Cover Dataset (NLCD). The NLCD is a consistent representation of land cover for the conterminous United States generated from classified 30-meter resolution Landsat thematic mapper (TM) satellite imagery data. The NLCD is classified into urban, agricultural, forested, water, and transitional land cover subclasses. The imagery was acquired by the Multi-Resoultion Land Characterization (MRLC) Consortium, a partnership of federal agencies that produce or use land cover data. The imagery was taken between 1991-1993. Table 1 summarizes the acreage in each land use category in the Kokomo Creek watershed.

Table 1. Land uses in Kokomo Creek watershed, 1991-1993 (MRLC data).

Land Use	Acres	%
Row Crops	17,508.7	74.82
Pasture/Hay	1,937.9	8.28
Low Intensity Residential	1,761.5	7.53
Urban/Recreational Grasses	682.6	2.92
Deciduous Forest	506.5	2.16
Commercial/Industrial/Transportation	491.9	2.10
Woody Wetlands	401.4	1.72
High Intensity Residential	81.5	0.35
Open Water	19.6	0.08
Emergent Herbaceous Wetlands	9.2	0.04
Evergreen Forest	0.7	0.00
Mixed Forest	0.1	0.00
Total	**23,401.6**	**100.00%**

Soil data for the Kokomo Creek watershed were obtained from the NRCS State Soil and Geographic (STATSGO) database (http://www.ftw.nrcs.usda.gov/stat_data.html). Attribute data associated with soil map units were used to assign soil hydrologic groups and to estimate values for some of the USLE parameters, as described in sections below.

For the purposes of the GWLF modeling of runoff and erosion, the land use categories were grouped as summarized in Table 2.

Table 2. Land Use Groupings for GWLF Modeling

NLCD Land Use	Group Code	Pollutant Simulation
Deciduous Forest	FOREST	Rural
Evergreen Forest		
Mixed Forest		
Urban/Recreational Grasses	GRASS	Rural
Transitional (Barren)		
Low Intensity Residential	LDRES	Rural
Pasture/Hay	PASTURE	Rural
Row Crops	ROWCR	Rural
Commercial/Industrial/ Transportation	COMM	Urban
Woody Wetlands	WETLANDS	Rural
Emergent Herbaceous Wetlands		
High Intensity Residential	HDRES	Rural

Rainfall and Runoff Input Data and Parameters

Meteorology:

Hydrology in GWLF is simulated by a water-balance calculation, based on daily observations of precipitation and temperature. A search was made of available Midwestern Regional Climate Center reporting stations. Based on this review, the most appropriate available meteorological data appears to be that from the station at the Kokomo Post Office. This station supplies daily data on precipitation and minimum and maximum temperature. Daily mean temperature was estimated as the mean of the minimum and maximum values.

Runoff Curve Numbers:

The direct runoff fraction of precipitation in GWLF is calculated using the curve number method from the SCS TR55 method literature based on land-use and soil hydrologic group (SCS 1986). Curve numbers vary from 25 for undisturbed woodland with good soils, to, in theory, 100, for impervious surfaces. The hydrologic soil group was determined from available soils data. Curve numbers assigned for the Kokomo Creek watershed are summarized in Table 3. For each land use, the table also indicates whether GWLF simulates nutrient loading via the USLE equation ("rural" areas) or a buildup-washoff formulation ("urban" areas).

Table 3. Runoff Curve Numbers for Kokomo Creek Watershed.

GWLF Land Use Group	GWLF Loading Methodology	Curve Number
FOREST	USLE	73
PASTURE	USLE	74
LDRES	USLE	77
ROWCR	USLE	81
ROWCR (Conservation Tillage)	USLE	78
COMM	Buildup-Washoff	98
GRASS	USLE	71
WETLANDS	USLE	87
HDRES	USLE	81

Evapotranspiration Cover Coefficients:

The portion of rainfall returned to the atmosphere is determined by GWLF based on temperature and the amount of vegetative cover. For the Kokomo Creek watershed it was assumed that land had vegetative cover during the growing season (cover coefficient = 1) and limited vegetative cover during the dormant season (cover coefficient = 0.3).

Soil Water Capacity:

Water stored in soil may evaporate, be transpired by plants, or percolate to ground water below the rooting zone. The amount of water that can be stored in soil (the soil water capacity) varies by soil type and rooting depth. Based on soil water capacities reported in the STATSGO database, soil types present in the watershed, and GWLF user's manual recommendations, the GWLF default soil water capacity of 10 cm was used.

Recession and Seepage Coefficients:

The GWLF model has three subsurface zones: a shallow unsaturated zone, a shallow saturated zone, and a deep aquifer zone. Behavior of the second two stores is controlled by a ground water recession and a deep seepage coefficient. The recession coefficient was set to 0.03 per day and the deep seepage coefficient to 0.03, based on several calibration runs of the model.

Erosion Parameters

GWLF simulates rural soil erosion using the Universal Soil Loss Equation (USLE). [Note: For land uses indicated as "Buildup-Washoff" in Table 3, solids loads are generated separately, as described below in the section entitled Parameters Governing Nutrient Load Generation.] This method has been applied extensively, so parameter values are well established. This computes soil loss per unit area (sheet and rill erosion) at the field scale by

$$A = RE * K * LS * C * P$$

where

- A = rate of soil loss per unit area,
- RE = rainfall erosivity index,
- K = soil erodibility factor,
- LS = length-slope factor,
- C = cover and management factor, and
- P = support practice factor.

Soil loss or erosion at the field scale is not equivalent to sediment yield, as substantial trapping may occur, particularly during overland flow or in first-order tributaries or impoundments. GWLF accounts for sediment yield by (1) computing transport capacity of overland flow, and (2) employing a sediment delivery ratio (DR) which accounts for losses to sediment redeposition.

Rainfall Erosivity (RE):

Rainfall erosivity accounts for the impact of rainfall on the ground surface, which can make soil more susceptible to erosion and subsequent transport. Precipitation-induced erosion varies with rainfall intensity, which shows different average characteristics according to geographic region. The factor is used in the Universal Soil Loss Equation and is determined in the model as follows:

$$RE_t = 64.6 * a_t * R_t 1.81$$

where

- RE_t = Rainfall erosivity (in megajoules mm/ha-h),
- a_t = Location- and season-specific factor, and
- R_t = Rainfall on day t (in cm).

The erosivity coefficient (a_t) was assigned a value of 0.26 for the growing season and 0.14 for the dormant season, based on erosivity coefficients provided in the GWLF User's Manual.

Soil Erodibility (K) Factor:

The soil erodibility factor indicates the propensity of a given soil type to erode, and is a function of soil physical properties and slope. Soil erodibility factors were extracted from the STATSGO soil coverage and averaged 0.40.

Length-Slope (LS) Factor:

Erosion potential varies by slope as well as soil type. The LS factor is calculated following Wischmeier and Smith (1978):

$$LS = (0.0138 * x_k)b * (65.41 * \sin^2\phi_k + 4.56 * \sin\phi_k + 0.065)$$

where

ϕ_k = tan - 1(ps_k/100), where ps_k is percent slope
x_k = slope length (ft)
b = a factor of percent slope, as follows:

Percent Slope	b
0-1	0.2
1 - 3.5	0.3
3.5 - 5	0.4
5 +	0.5

Slopes were extracted from the STATSGO soils database. For each soil type, slope was assumed to be the mid-point of the minimum and maximum slope given by STATSGO. The slope length was assumed to be 500 feet based on a visual analysis of the land use/soils coverage but was artificially decreased to account for the fact much of the stream is bermed (thus reducing sediment loading to the stream).

Cover and Management (C) and Practice (P) Factors:
The mechanism by which soil is eroded from a land area and the amount of soil eroded depends on soil treatment resulting from a combination of land uses (e.g., forestry versus row-cropped agriculture) and the specific manner in which land uses are carried out (e.g., no-till agriculture versus non-contoured row cropping). Land use and management variations are represented by cover and management factors in the universal soil loss equation and in the erosion model of GWLF. Cover and management factors were drawn from several sources (Wischmeier and Smith, 1978; Haith et al., 1992; Novotny and Olem, 1994), and are summarized in Table 4.

Table 4. Cover and Management Factors for Kokomo Creek Watershed Land Uses*

GWLF Land Use Group	C	P
FOREST	0.003	1
PASTURE	0.040	1
ROWCR	0.430	1
ROWCR (Conservation Tillage)	0.180	1
GRASS	0.040	1
WETLAND	0.020	1
LDRES	0.013	1
HDRES	0.040	1

* C and P factors are not required for the "urban" land uses which are modeled in GWLF via a buildup-washoff formulation rather than USLE.

Sediment Delivery Ratio:

The sediment delivery ratio (DR) converts erosion to sediment yield, and indicates the portion of eroded soil that is carried to the watershed mouth from land draining to the watershed. The BasinSim program (a Windows version of GWLF) includes a built-in utility which calculates the sediment delivery ratio based an empirical relationship of DR to watershed area (SCS, 1973). The sediment delivery ratio for the entire Kokomo Creek watershed was calculated at 0.15 but was modified to 0.11 to account for the bermed nature of the watershed.

Parameters Governing Nutrient Load Generation

Groundwater Nutrient Concentrations:

The GWLF model requires input of groundwater nutrient concentrations excluding loads due to septic systems, which are accounted for separately. Even in the absence of septic system loads, groundwater concentrations are expected to increase with a shift from forest to either agriculture or development, due to the input of fertilizer on crops, lawns, and gardens. The effect is greatest for nitrate, which is highly soluble, but some elevation of groundwater concentrations of phosphorus is also expected with increased development.

Groundwater nutrient concentrations were estimated as an area-weighted average of concentrations expected for managed land (agriculture, and residential, commercial, and industrial development) and unmanaged land (e.g., forest). Groundwater concentrations for unmanaged land were assigned a value of 0.009 mg/l for phosphorus and 0.060 for nitrogen, consistent with values in Omernik (1977). Managed lands were assigned a groundwater phosphorus concentration of 0.04 mg/l and a groundwater nitrogen concentration of 0.65. The resulting groundwater concentrations for the watershed were 0.039 mg/L phosphorus and 0.52 mg/L nitrogen.

Dissolved and Solid Phase Nutrient Concentrations for Rural Land Uses:

GWLF requires a dissolved phase concentration for surface runoff from rural land uses. Particulate concentrations are taken as a general characteristic of area soils, determined by bulk soil concentration and an enrichment ratio indicating preferential association of nutrients with the more erodible soil fraction, and not varied by land use. The estimates of dissolved phase and

solid phase nutrient concentrations were selected from the GWLF User's Manual and are shown in Table 5.

Table 5. Dissolved and Solids Phase Nutrient Concentrations for Rural Land Uses.

GWLF Land Use Group	Phosphorus	
	Dissolved Phase (mg/L)	Solids Phase (mg/kg)
FOREST	0.01	650
PASTURE	0.25	650
ROWCR	0.28	650
ROWCR (Conservation Tillage)	0.20	650
GRASS	0.10	650
WETLAND	0.05	650
LDRES	0.12	650
HDRES	0.10	650

Buildup/Washoff Parameters for Urban Land Uses:

Nutrients and solids generated from urban land uses are described by a buildup/washoff formulation. Pollutant accumulation is summarized by an exponential buildup rate, and GWLF assumes that 95% of the limiting pollutant storage is reached in a 20-day period without washoff. The resulting buildup parameters are summarized in Table 6.

Table 6. Pollutant Buildup Rates for Urban Land Uses.

Land use	Phosphorus build up (kg/ha-d)
COMM	0.0112

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Appendix C - QUAL2E Modeling

The following items are contained in this appendix.

(1) Graphs of QUAL2E model calibration results for 03 Sep 1998.

(2) Graphs of QUAL2E model validation results for 31 Jul 1998.

(3) QUAL2E input data set for 03 Sep 1998 calibration.

(4) QUAL2E input data set for 31 Jul 1998 validation.

(5) Graphs of QUAL2E model results for Alternatives #1-3 (summer).

(6) Graphs of QUAL2E model results for Alternatives #1-3 (winter).

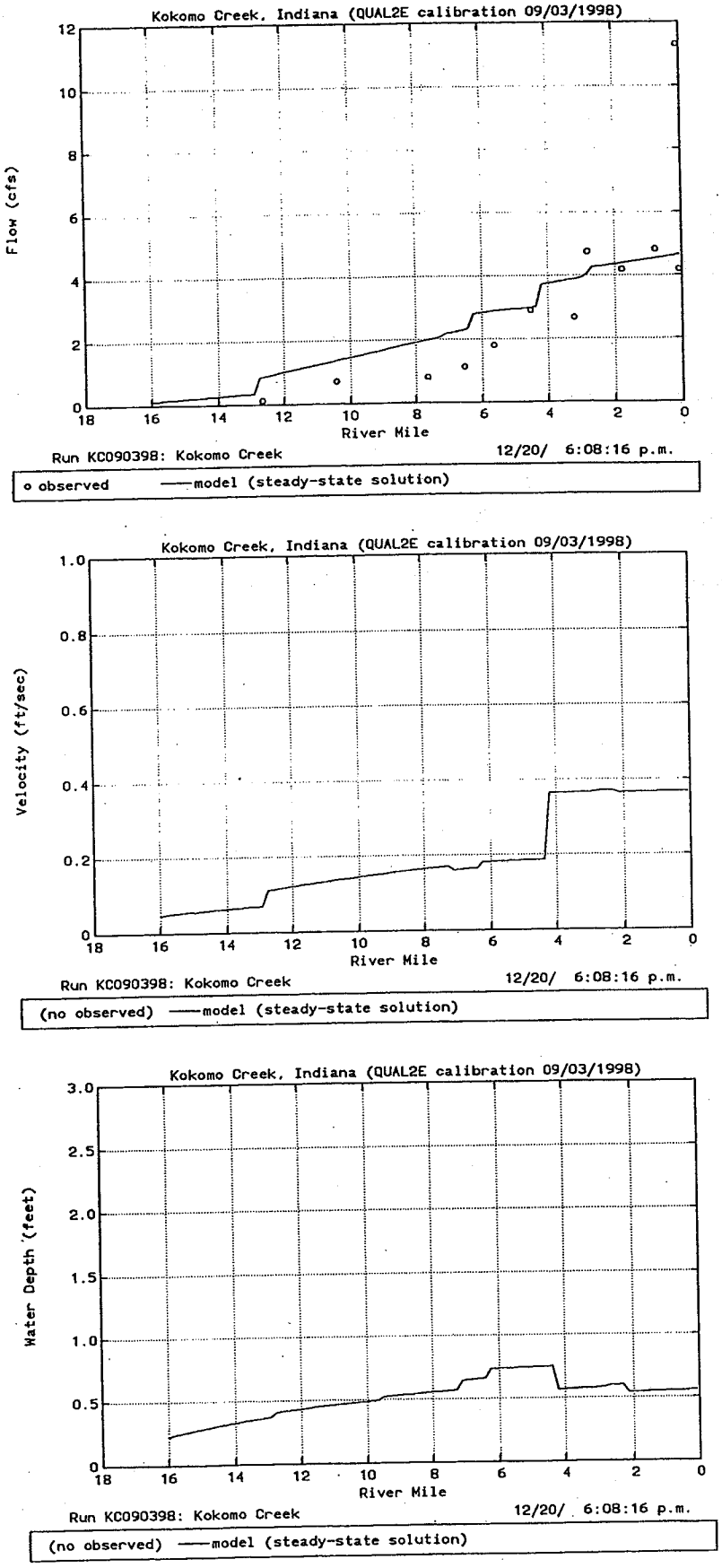
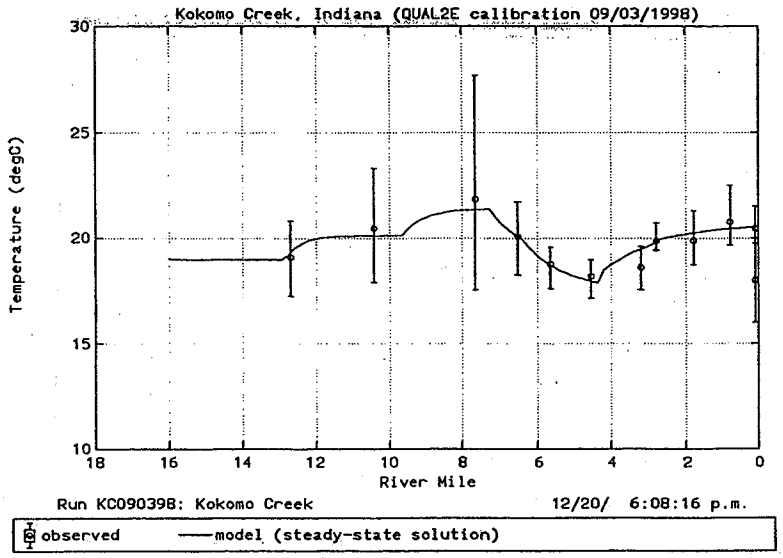
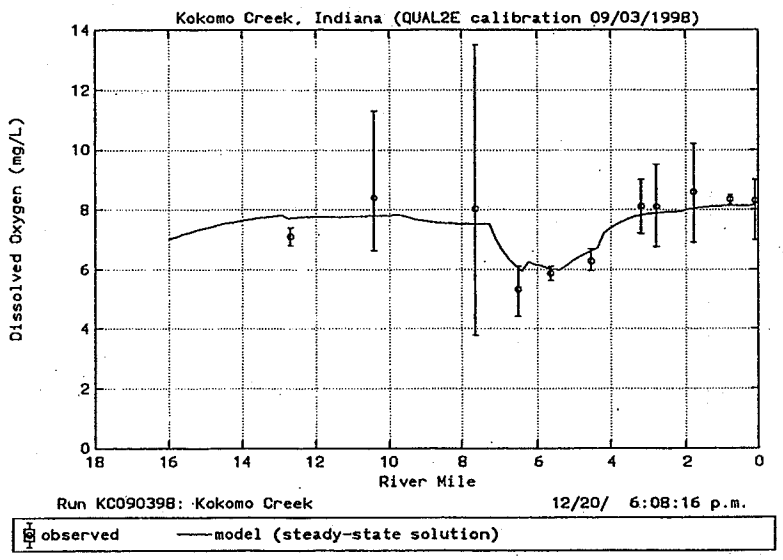


Figure C-01. Kokomo Creek QUAL2E calibration, Sep 3, 1998.





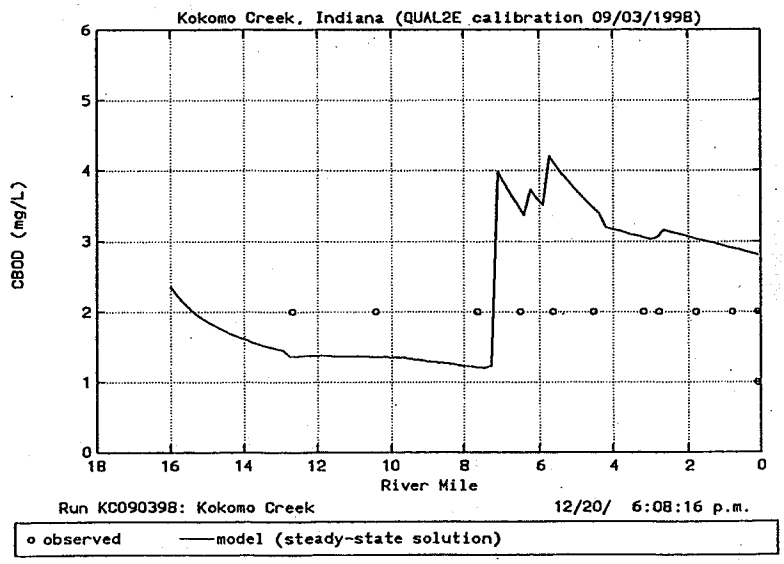
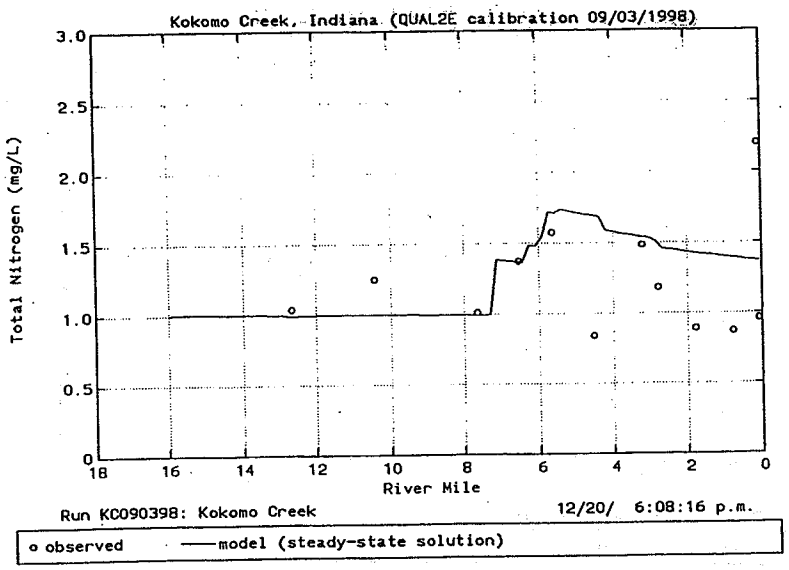
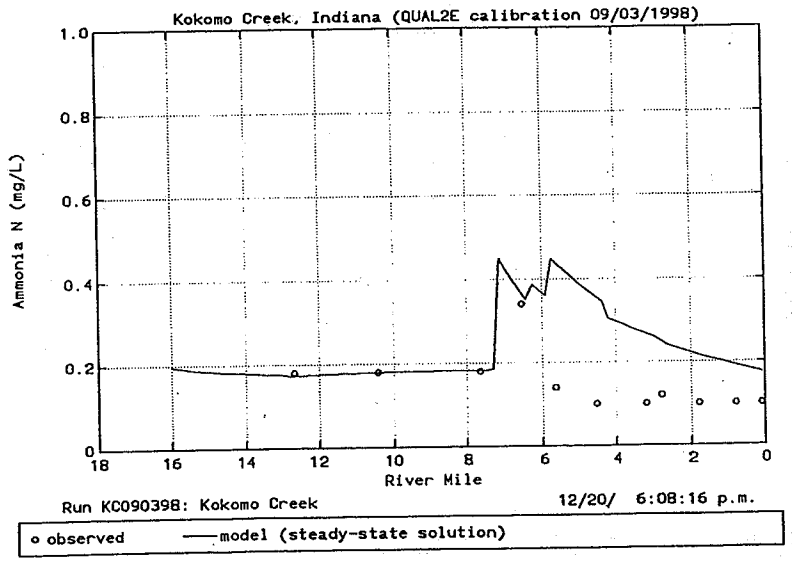


Figure C-02. Kokomo Creek QUAL2E calibration, Sep 3, 1998.





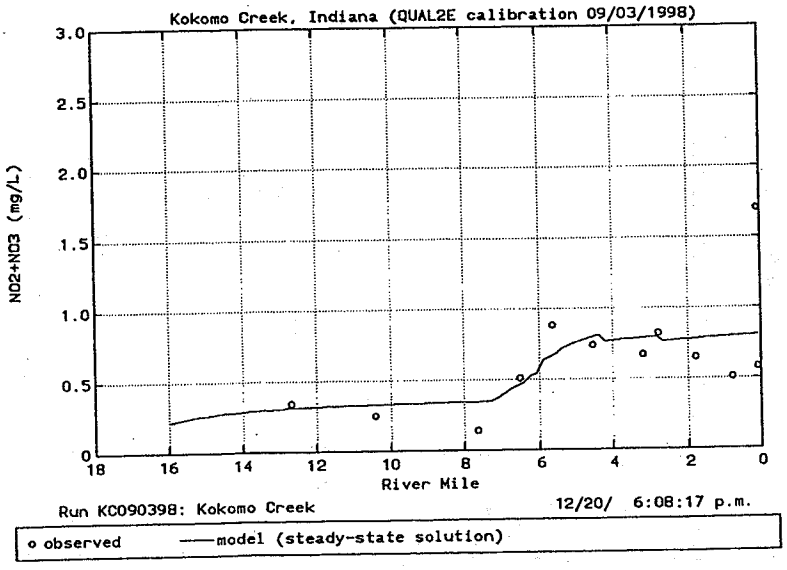
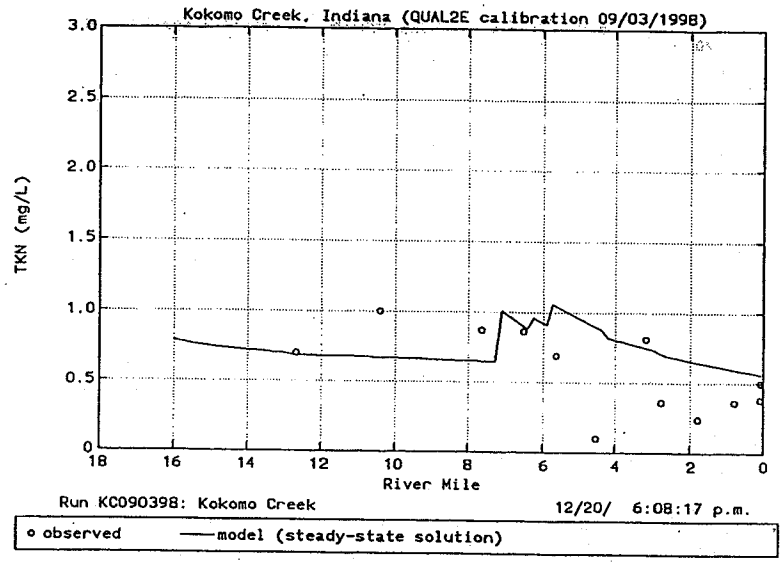
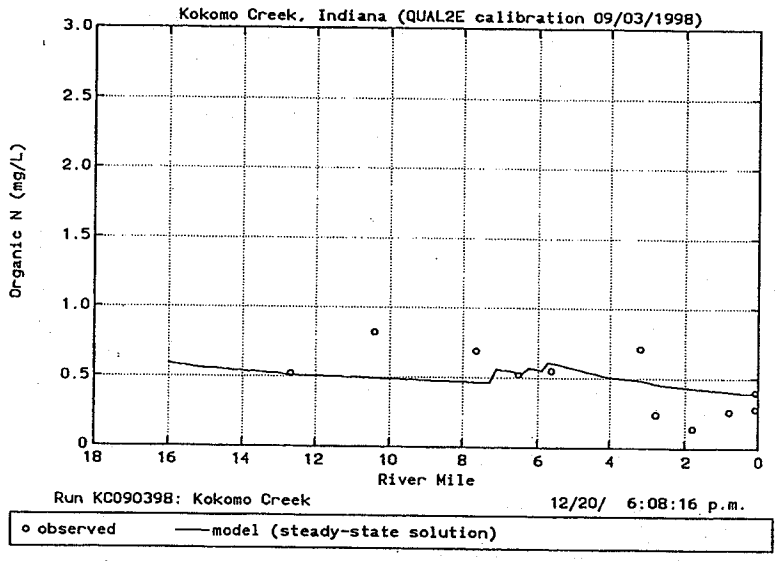


Figure C-03. Kokomo Creek QUAL2E calibration, Sep 3, 1998.





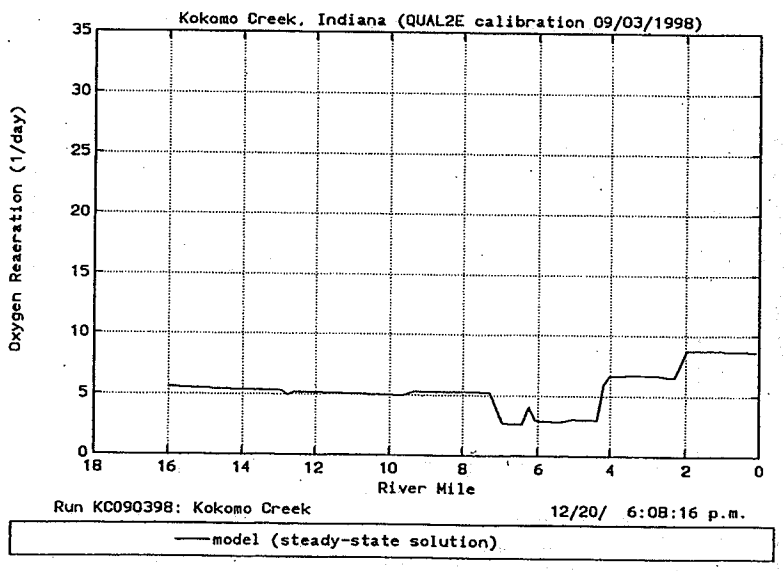


Figure C-04. Kokomo Creek QUAL2E calibration, Sep 3, 1998.

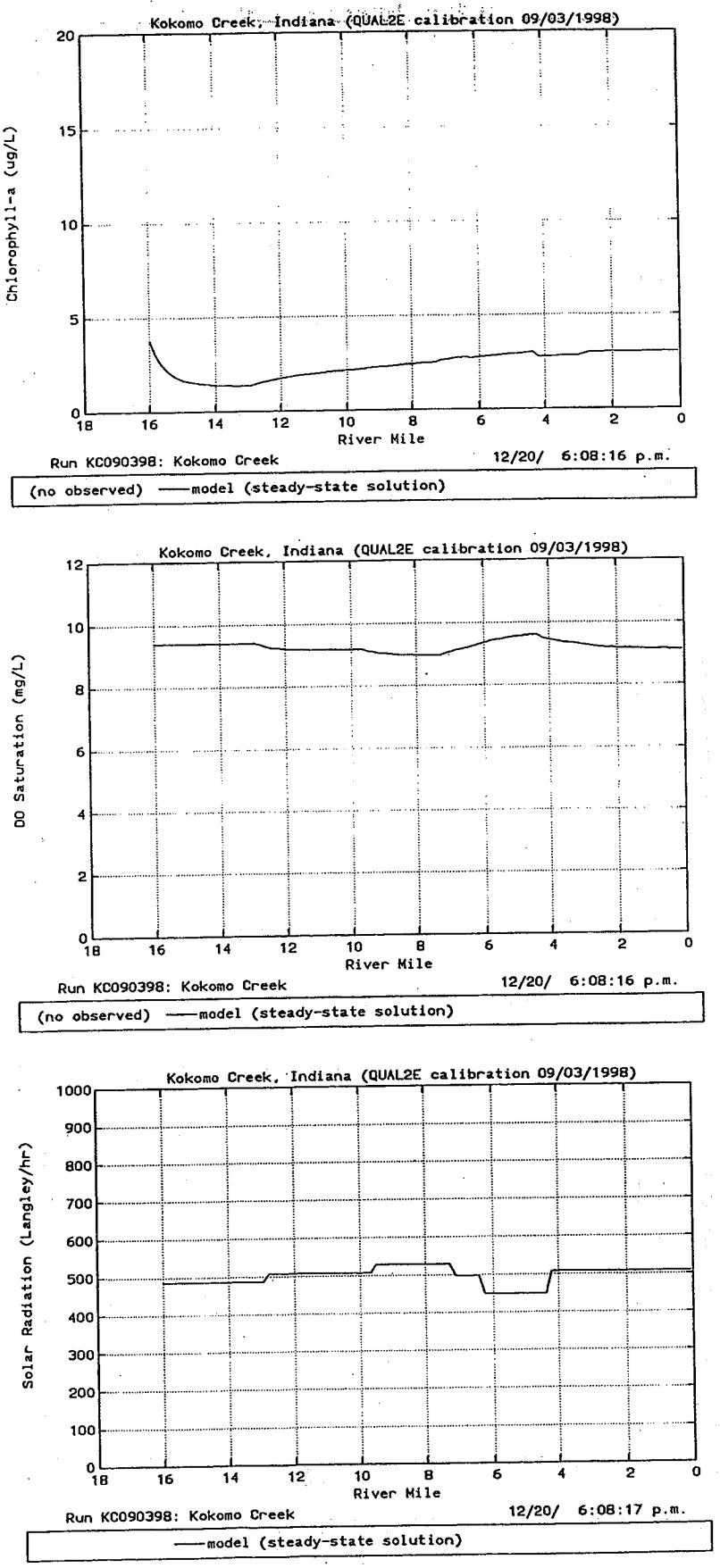
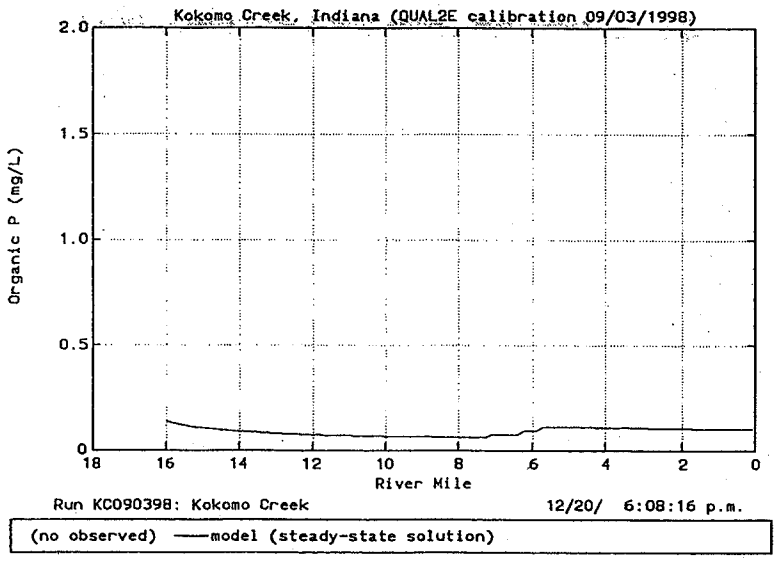
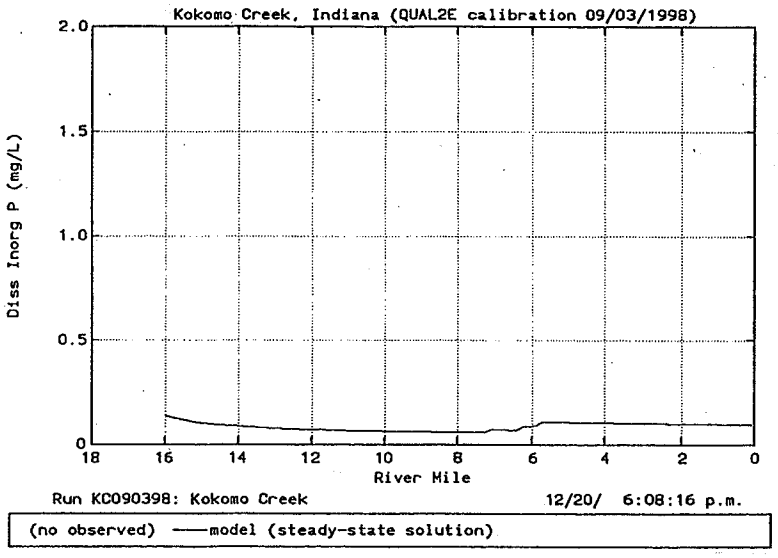


Figure C-05. Kokomo Creek QUAL2E calibration, Sep 3, 1998.





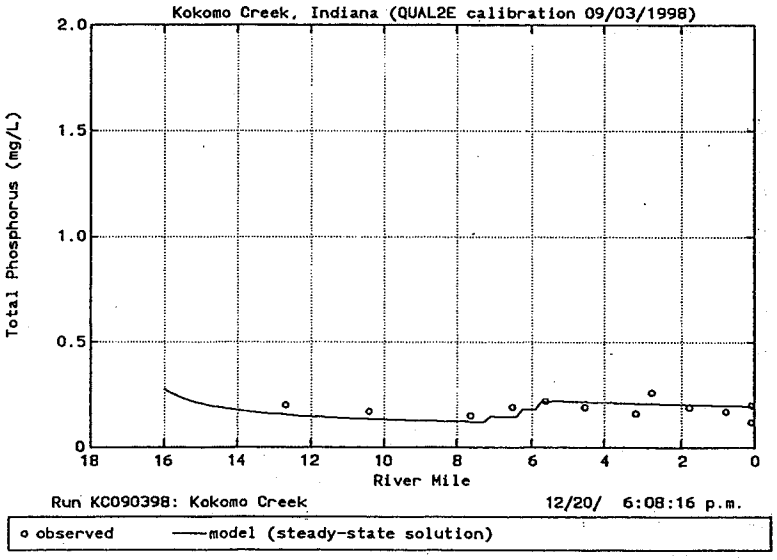
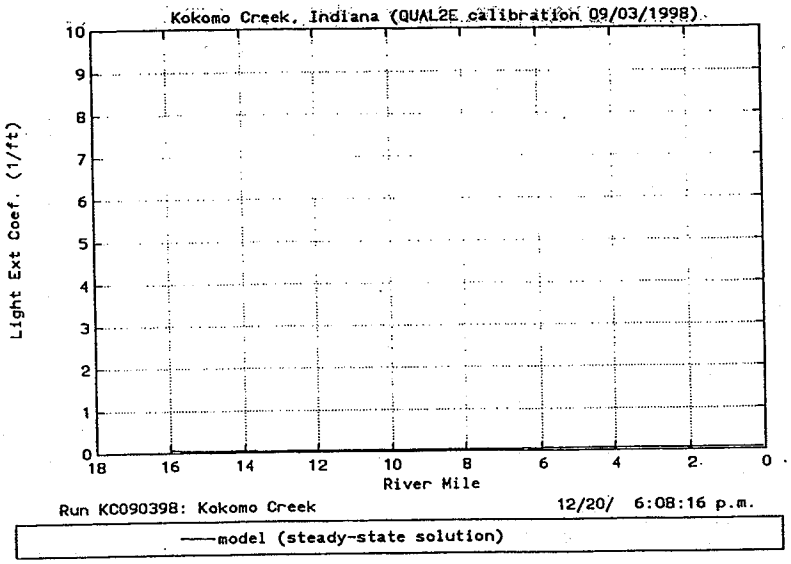
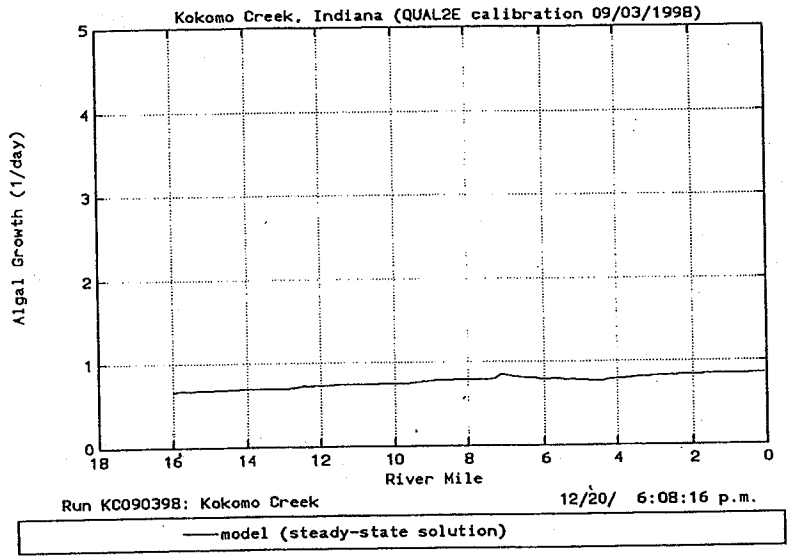


Figure C-06. Kokomo Creek QUAL2E calibration, Sep 3, 1998.





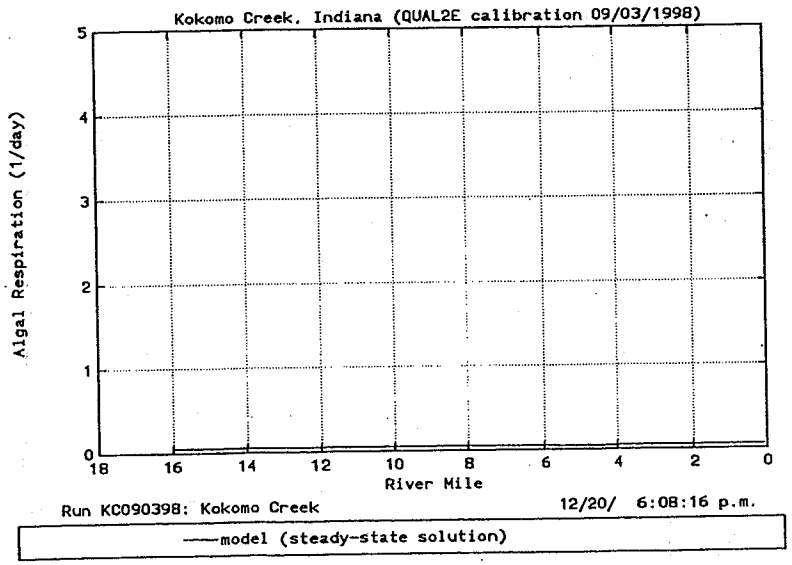


Figure C-07. Kokomo Creek QUAL2E calibration, Sep 3, 1998.

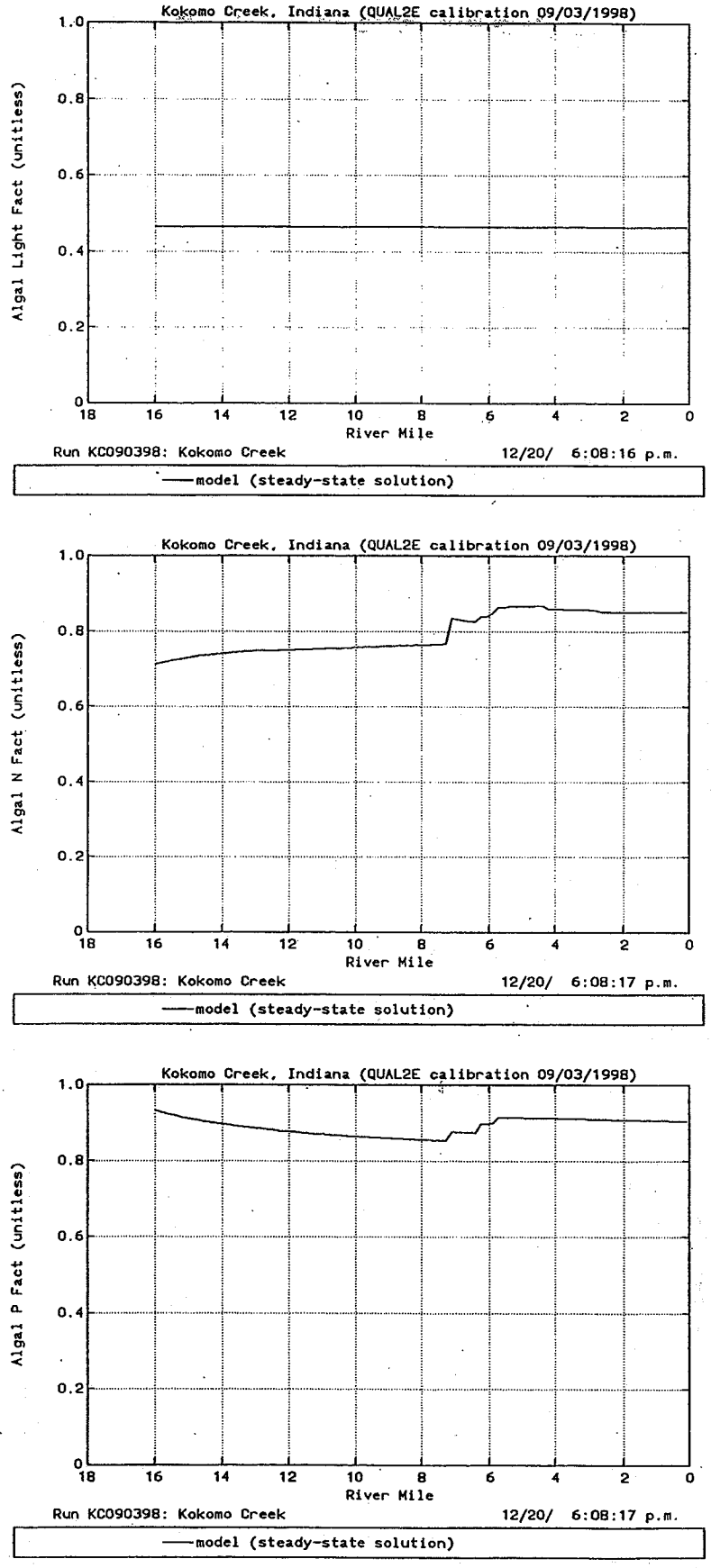


Figure C-08. Kokomo Creek QUAL2E calibration, Sep 3, 1998.

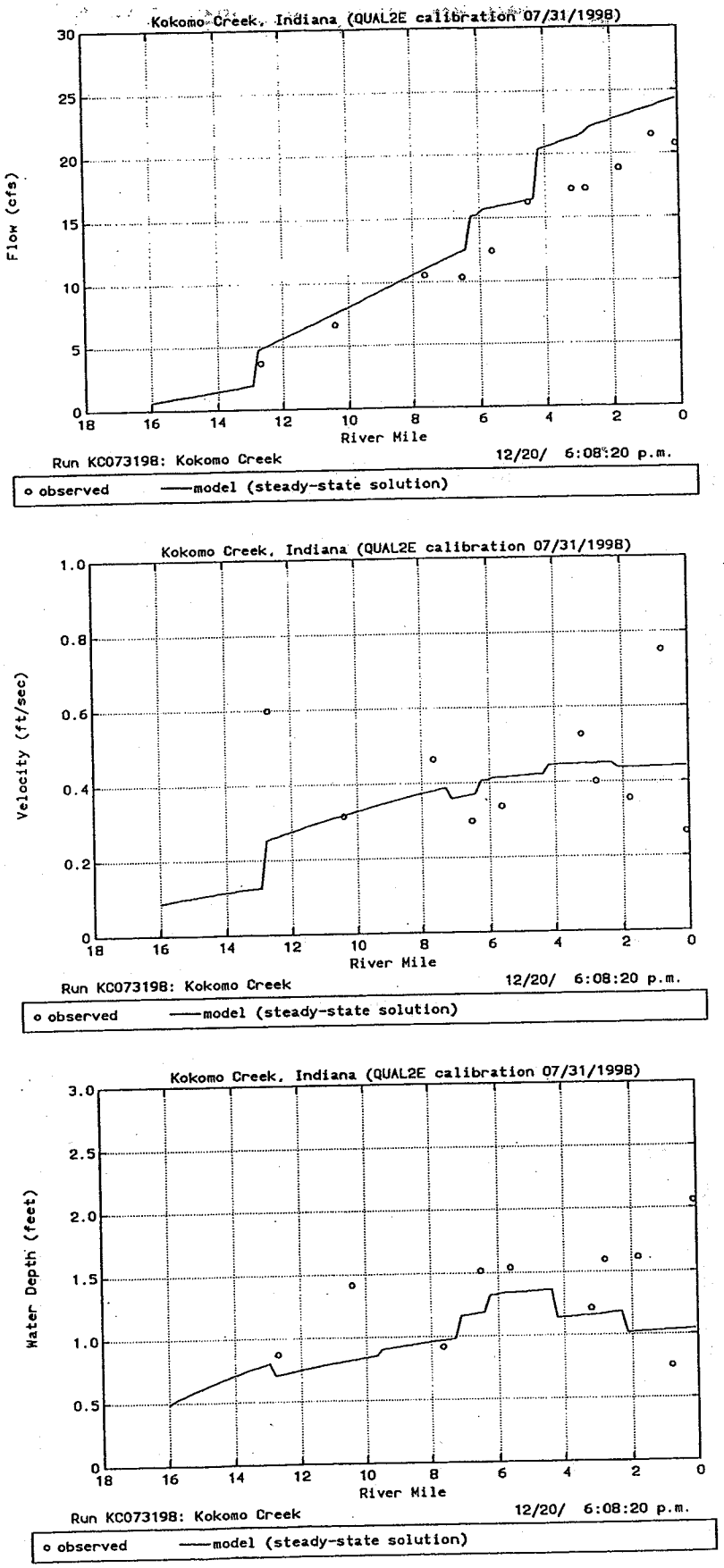


Figure C-09. Kokomo Creek QUAL2E validation, Jul 31, 1998.

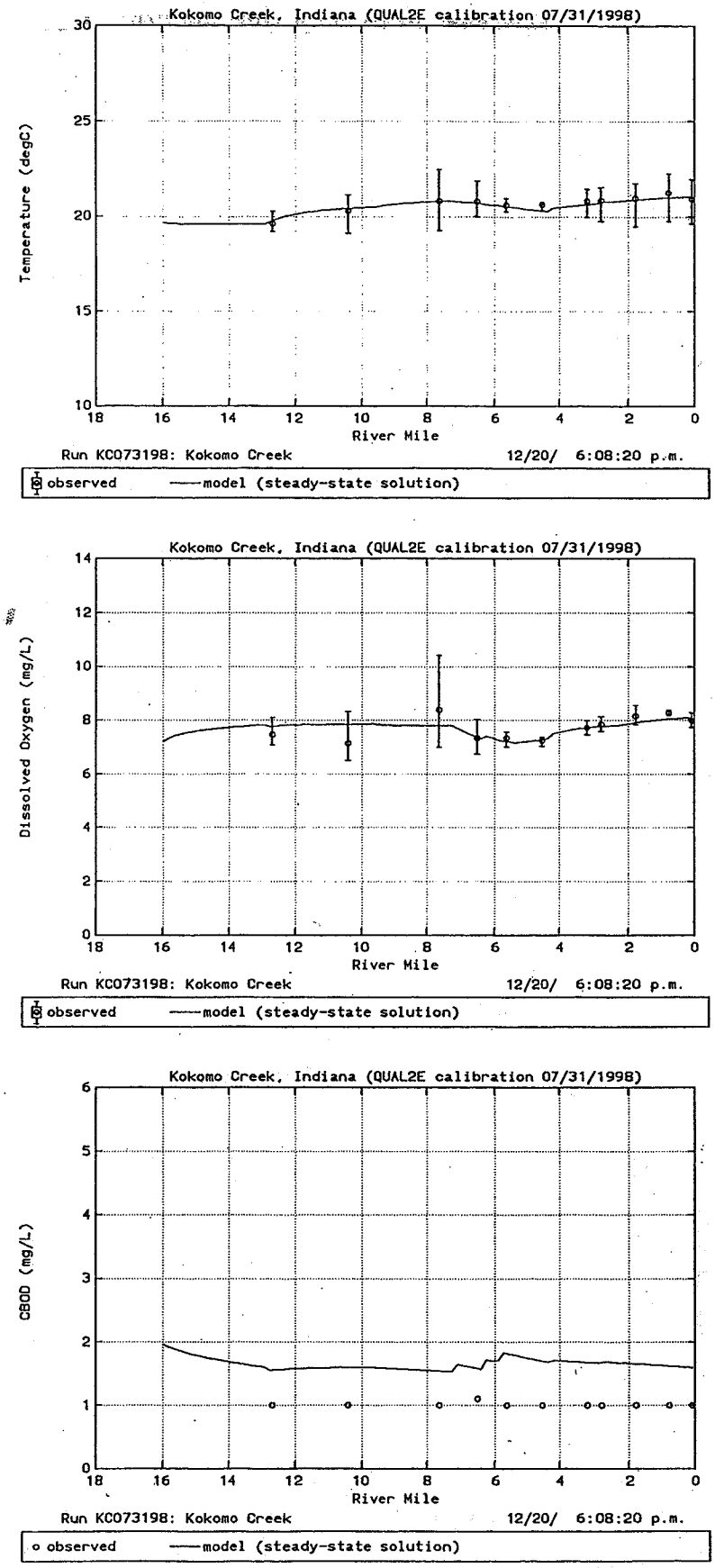
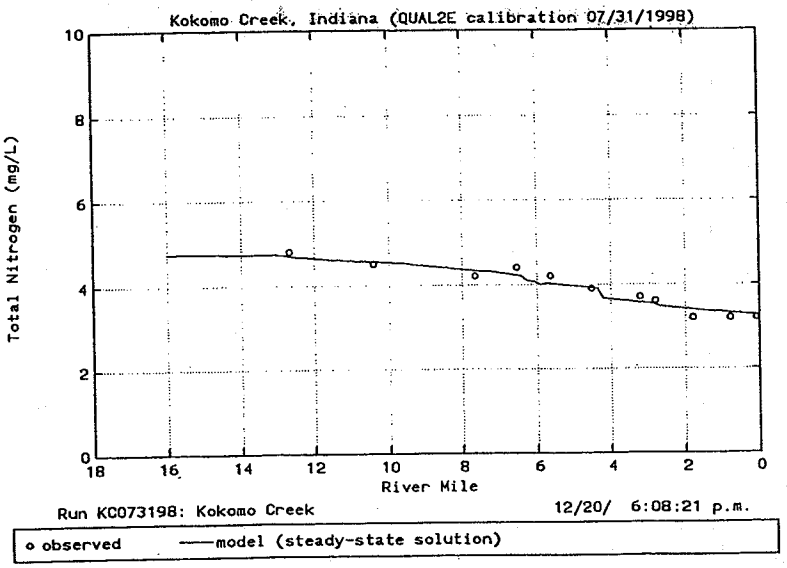
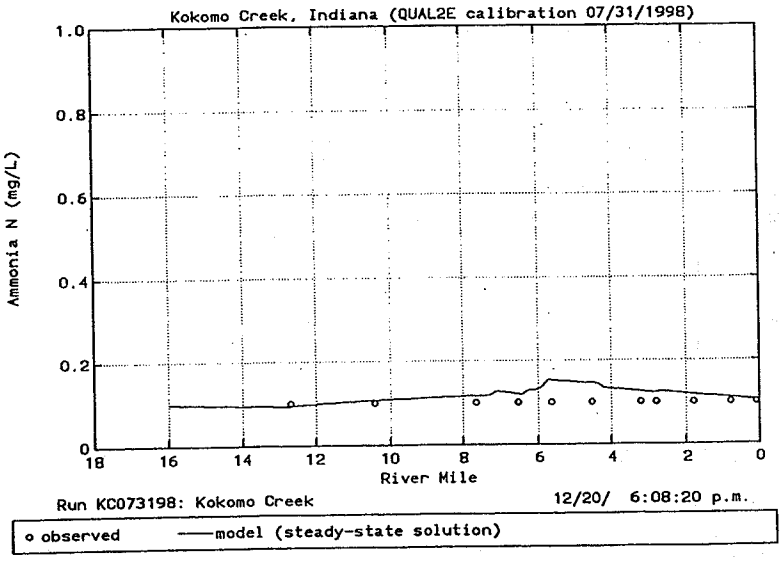


Figure C-10. Kokomo Creek QUAL2E validation, Jul 31, 1998.





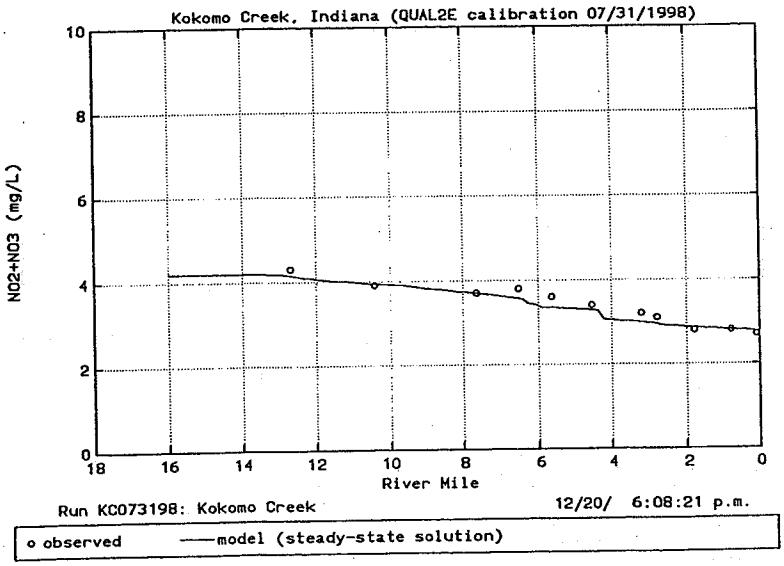
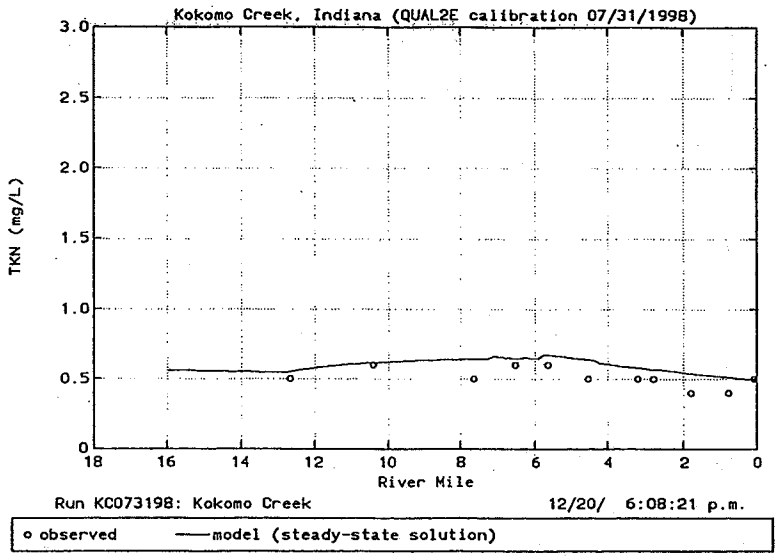
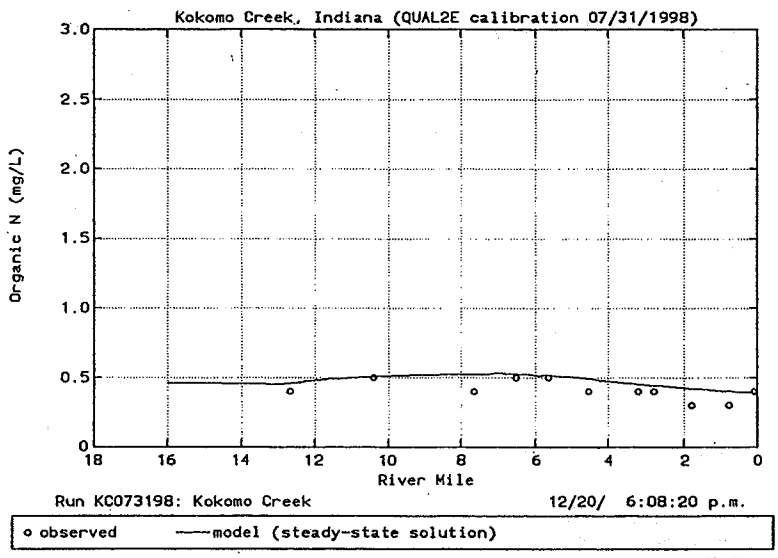


Figure C-11. Kokomo Creek QUAL2E validation, Jul 31, 1998.





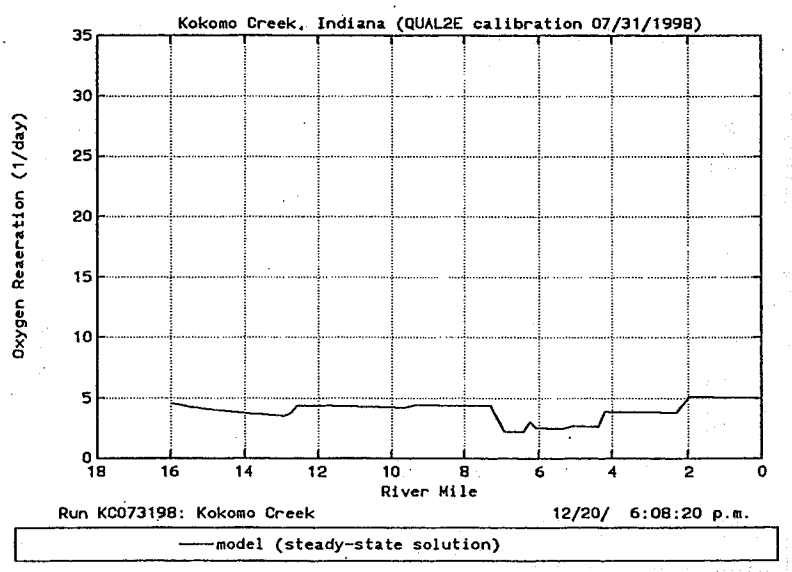
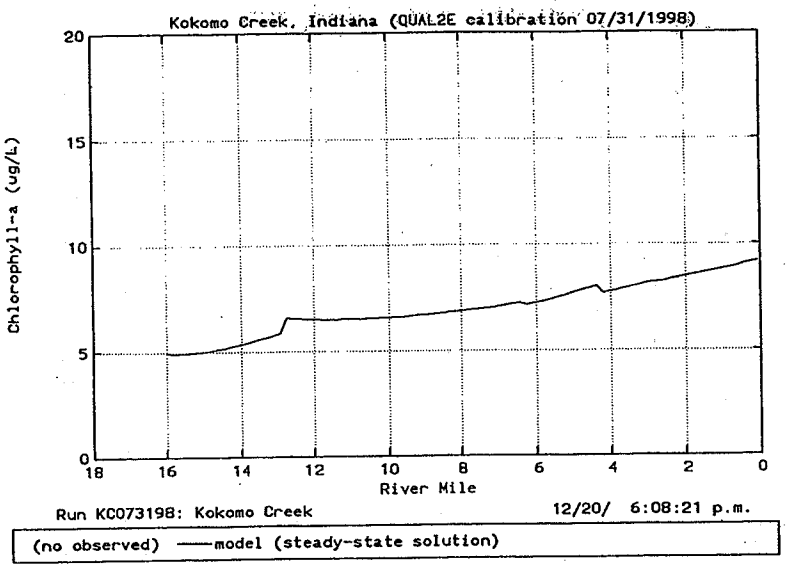
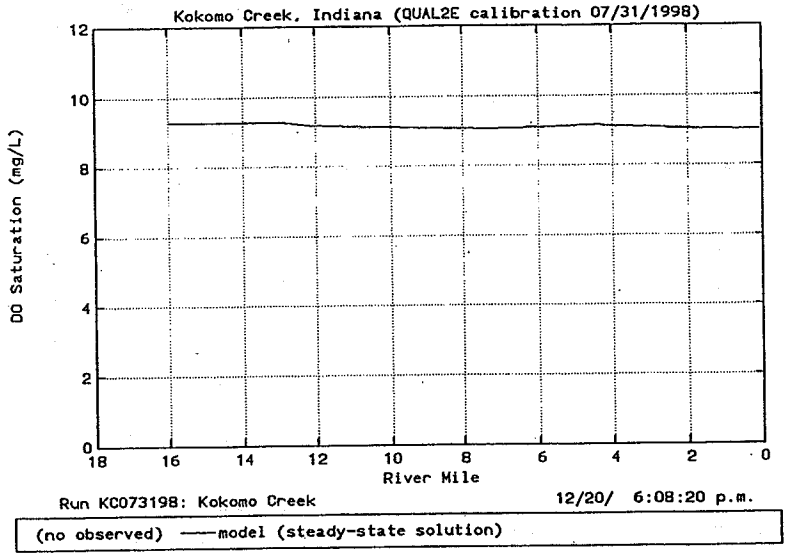


Figure C-12. Kokomo Creek QUAL2E validation, Jul 31, 1998.





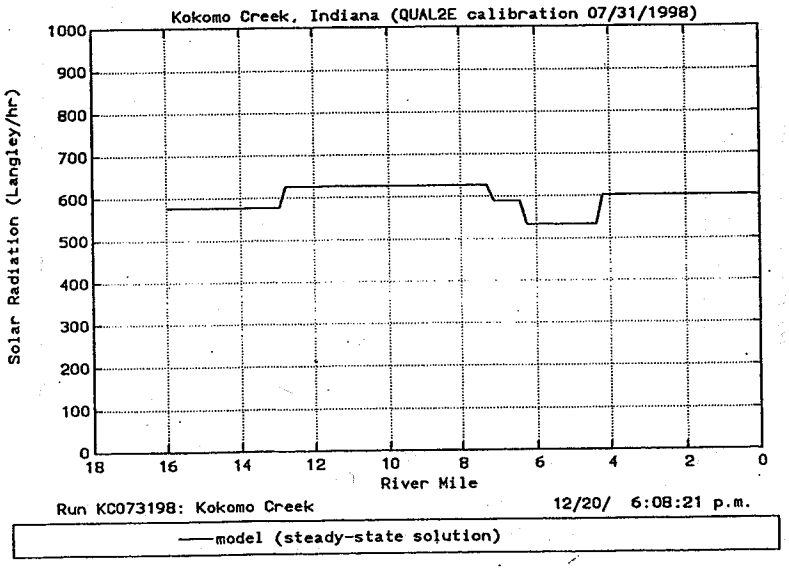
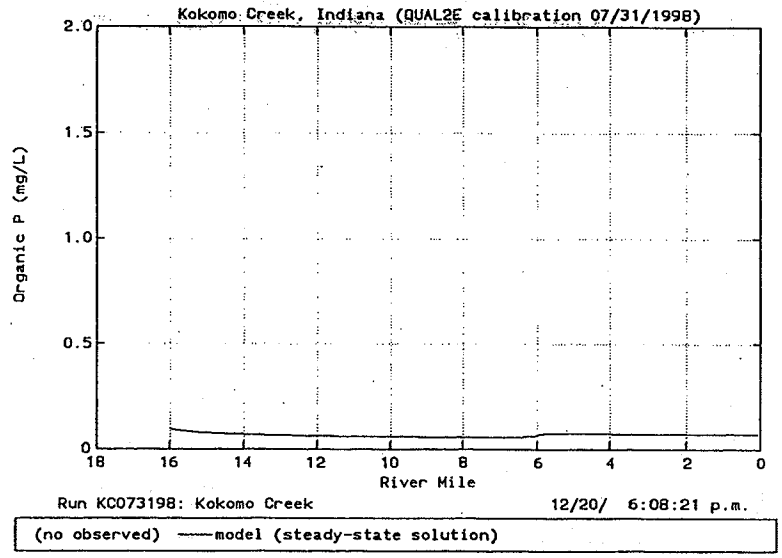
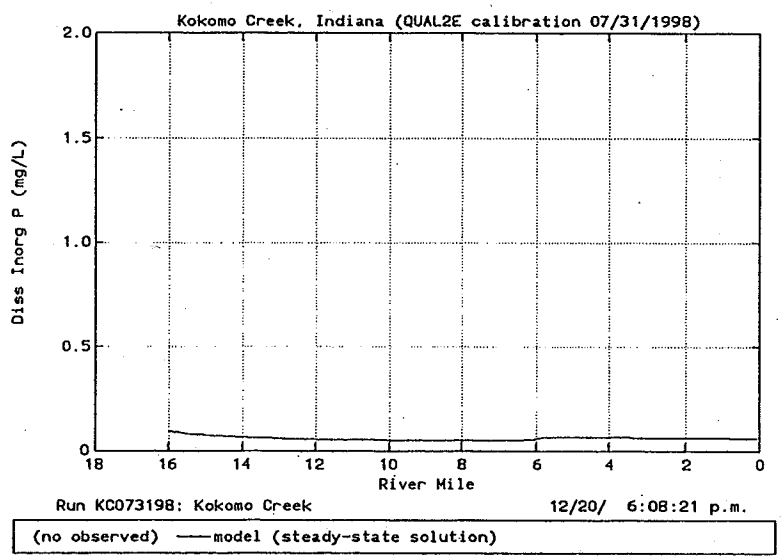


Figure C-13. Kokomo Creek QUAL2E validation, Jul 31, 1998.





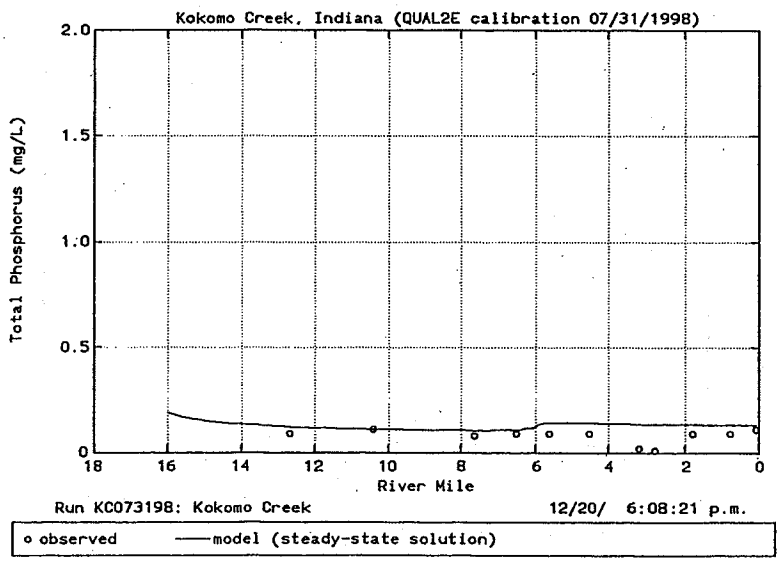
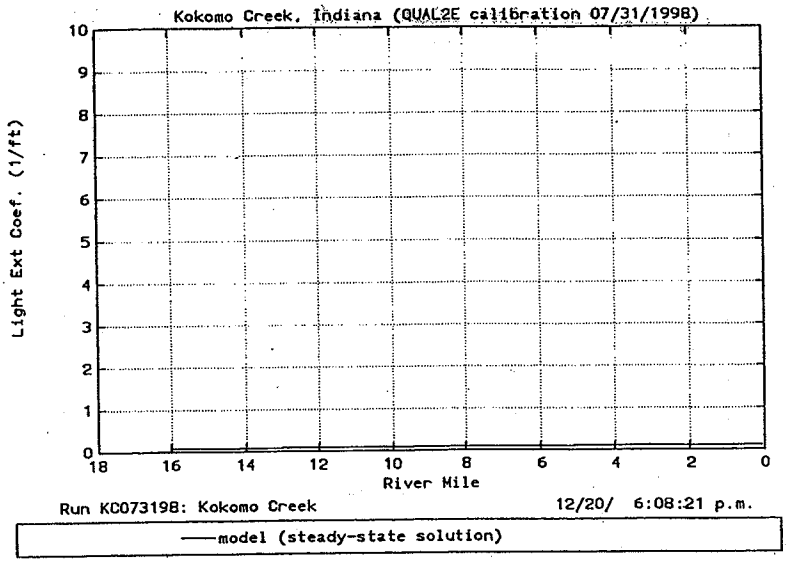
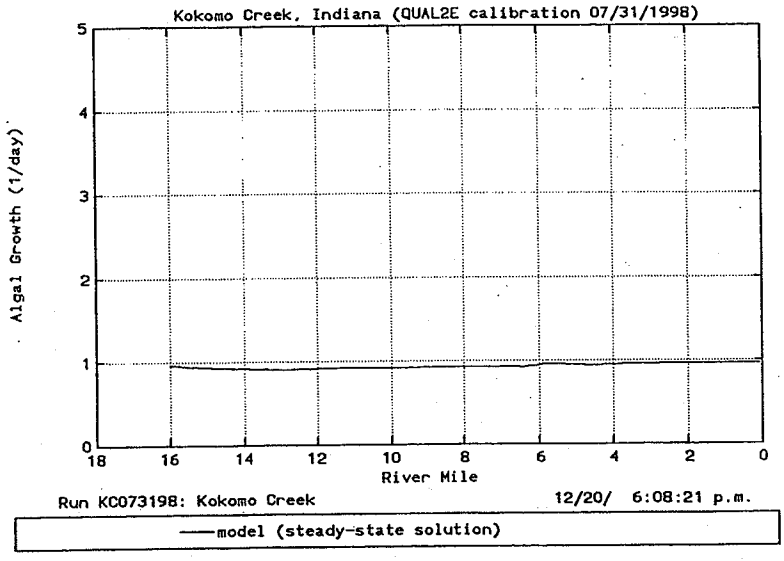


Figure C-14. Kokomo Creek QUAL2E validation, Jul 31, 1998.





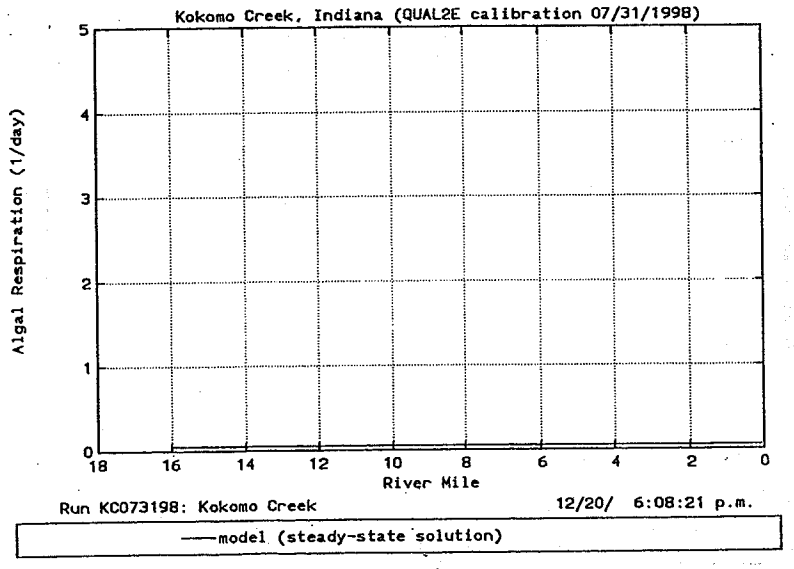


Figure C-15. Kokomo Creek QUAL2E validation, Jul 31, 1998.

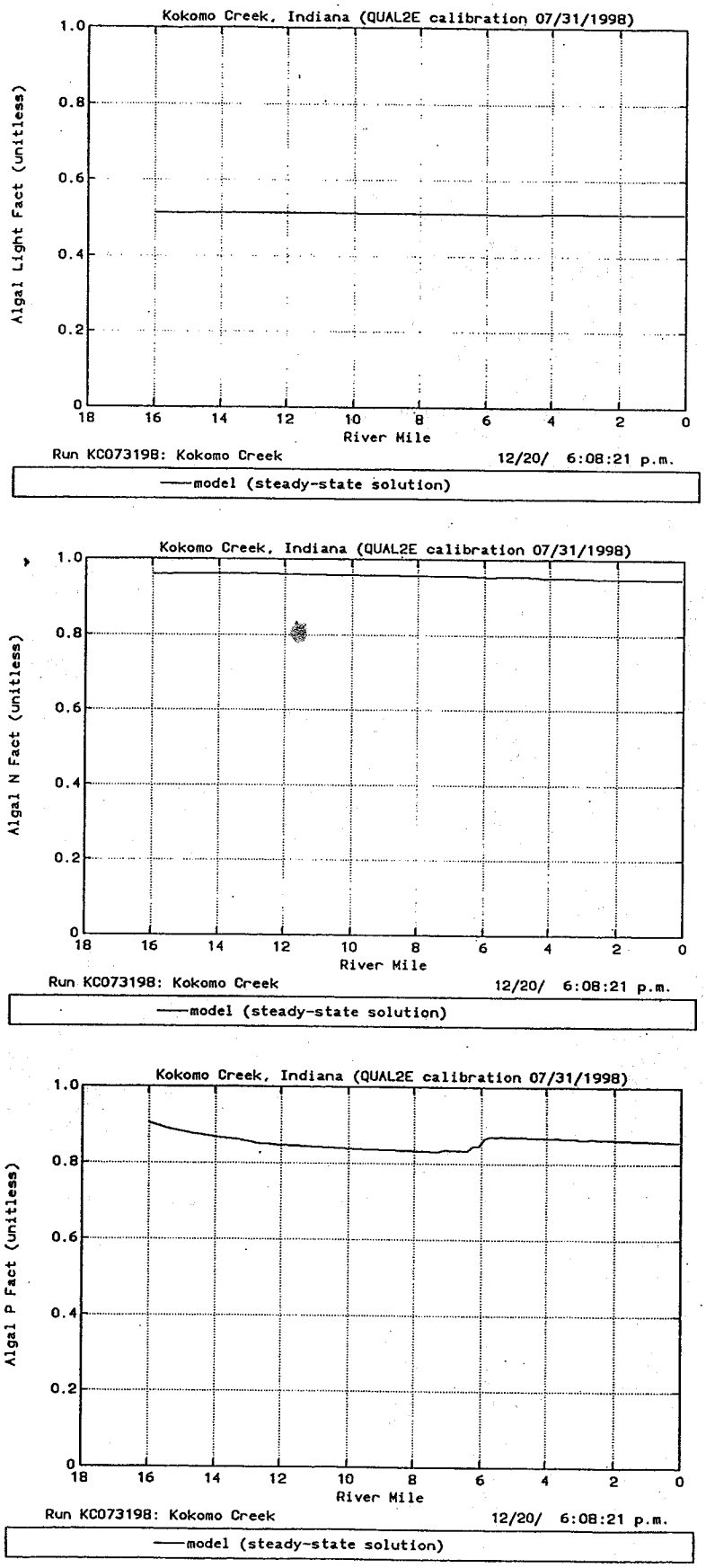


Figure C-16. Kokomo Creek QUAL2E validation, Jul 31, 1998.

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                                        * * * QUAL-2E  STREAM QUALITY ROUTING MODEL * * *
                                            Version 3.21  -  Feb. 1995

 $$$ (PROBLEM TITLES) $$$

CARD TYPE                                QUAL-2E PROGRAM TITLES
TITLE01                 Kokomo Creek, Indiana (09/03/1998): MORTON
TITLE02
TITLE03  NO             CONSERVATIVE MINERAL I
TITLE04  NO             CONSERVATIVE MINERAL II
TITLE05  NO             CONSERVATIVE MINERAL III
TITLE06  YES            TEMPERATURE
TITLE07  YES            BIOCHEMICAL OXYGEN DEMAND
TITLE08  YES            ALGAE AS CHL-A IN UG/L
TITLE09  YES            PHOSPHORUS CYCLE AS P IN MG/L
TITLE10                   (ORGANIC-P; DISSOLVED-P)
TITLE11  YES            NITROGEN CYCLE AS N IN MG/L
TITLE12                   (ORGANIC-N; AMMONIA-N; NITRITE-N;' NITRATE-N)
TITLE13  YES            DISSOLVED OXYGEN IN MG/L
TITLE14  NO             FECAL COLIFORM IN NO./100 ML
TITLE15  NO             ARBITRARY NON-CONSERVATIVE
ENDTITLE

 $$$ DATA TYPE 1 (CONTROL DATA) $$$

CARD TYPE                                          CARD TYPE
LIST DATA INPUT                  0.00000                                0.00000
NO WRITE OPTIONAL SUMMARY        0.00000                                0.00000
NO FLOW AUGMENTATION             0.00000                                0.00000
STEADY STATE                     0.00000                                0.00000
NO TRAP CHANNELS                 0.00000                                0.00000
NO PRINT LCD/SOLAR DATA          0.00000                                0.00000
NO PLOT DO AND BOD DATA          0.00000                                0.00000
FIXED DNSTM CONC (YES=1)=        0.00000          5D-ULT BOD CONV K COEF  =  0.23000
INPUT METRIC                =    0.00000          OUTPUT METRIC           =  0.00000
NUMBER OF REACHES           =   17.00000          NUMBER OF JUNCTIONS     =  5.00000
NUM OF HEADWATERS           =    6.00000          NUMBER OF POINT LOADS   =  8.00000
TIME STEP (HOURS)           =    1.00000          LNTH. COMP. ELEMENT (DX)=  0.17100
MAXIMUM ROUTE TIME (HRS)=       30.00000          TIME INC. FOR RPT2 (HRS)=  1.00000
LATITUDE OF BASIN (DEG)     =   40.45000          LONGITUDE OF BASIN (DEG)= 86.05000
STANDARD MERIDIAN (DEG)     =   90.00000          DAY OF YEAR START TIME  = 243.00000
EVAP. COEF.,(AE)            =    0.00103          EVAP. COEF.,(BE)        =  0.00016
ELEV. OF BASIN (ELEV)       =  825.00000          DUST ATTENUATION COEF.  =  0.06000
ENDATA1                          0.00000                                0.00000

 $$$ DATA TYPE 1A (ALGAE PRODUCTION AND NITROGEN OXIDATION CONSTANTS) $$$

CARD TYPE                                          CARD TYPE
O UPTAKE BY NH3 OXID(MG O/MG N)=     3.4300        O UPTAKE BY NO2 OXID(MG O/MG N)=     1.1400
O PROD  BY ALGAE (MG O/MG A)   =     1.6000        O UPTAKE BY ALGAE (MG O/MG A)  =     2.0000
N CONTENT OF ALGAE (MG N/MG A) =     0.0850        P CONTENT OF ALGAE (MG O/MG A) =     0.0140
ALG MAX SPEC GROWTH RATE(1/DAY)=     2.1000        ALGAE RESPIRATION RATE (1/DAY) =     0.0500
N HALF SATURATION CONST (MG/L) =     0.1500        P HALF SATURATION CONST (MG/L) =     0.0100
LIN ALG SHADE CO (1/FT-UGCHA/L=)     0.0027        NLIN SHADE(1/FT-(UGCHA/L)**2/3)=     0.0165
LIGHT FUNCTION OPTION (LFNOPT) =     1.0000        LIGHT SAT'N COEF (BTU/FT2-MIN) =     0.0833
DAILY AVERAGING OPTION (LAVOPT)=     3.0000        LIGHT AVERAGING FACTOR (AFACT) =     0.9200
NUMBER OF DAYLIGHT HOURS (DLH) =    12.5000        TOTAL DAILY SOLR RAD (BTU/FT-2)= 1300.0000
ALGY GROWTH CALC OPTION(LGROPT)=     2.0000        ALGAL PREF FOR NH3-N (PREFN)   =     0.9000
ALG/TEMP SOLR RAD FACTOR(TFACT)=     0.4400        NITRIFICATION INHIBITION COEF  =     0.5000
ENDATA1A                             0.0000                                       0.0000

 $$$ DATA TYPE 1B (TEMPERATURE CORRECTION CONSTANTS FOR RATE COEFFICIENTS) $$$

CARD TYPE      RATE CODE      THETA VALUE

THETA( 1)       BOD DECA        1.047      USER
THETA( 2)       BOD SETT        1.024      USER
THETA( 3)       OXY TRAN        1.028      USER
THETA( 4)       SOD RATE        1.047      USER
THETA( 5)       ORGN DEC        1.047      USER
THETA( 6)       ORGN SET        1.024      USER
THETA( 7)       NH3 DECA        1.083      USER
THETA( 8)       NH3 SRCE        1.074      USER
THETA( 9)       NO2 DECA        1.047      USER
THETA(10)       PORG DEC        1.047      USER
THETA(11)       PORG SET        1.024      USER
THETA(12)       DISP SRC        1.074      USER
THETA(13)       ALG GROW        1.047      USER
THETA(14)       ALG RESP        1.047      USER
THETA(15)       ALG SETT        1.024      USER
THETA(16)       COLI DEC        1.047      DFLT
THETA(17)       ANC DECA        1.000      DFLT
THETA(18)       ANC SETT        1.024      DFLT
THETA(19)       ANC SRCE        1.000      DFLT
ENDATA1B
```

$$$ DATA TYPE 2 (REACH IDENTIFICATION) $$$

CARD TYPE	REACH ORDER AND IDENT			R. MI/KM		R. MI/KM
STREAM REACH	1.0	RCH= Tolle Ditch	FROM	16.1	TO	12.8
STREAM REACH	2.0	RCH= Finn Ditch	FROM	17.6	TO	15.2
STREAM REACH	3.0	RCH= Finn Ditch	FROM	15.2	TO	12.8
STREAM REACH	4.0	RCH= Kokomo Creek	FROM	12.8	TO	9.6
STREAM REACH	5.0	RCH= Kokomo Creek	FROM	9.6	TO	7.2
STREAM REACH	6.0	RCH= Kokomo Creek	FROM	7.2	TO	6.3
STREAM REACH	7.0	RCH= Mugg-Ingels	FROM	8.9	TO	6.3
STREAM REACH	8.0	RCH= Kokomo Creek	FROM	6.3	TO	5.3
STREAM REACH	9.0	RCH= Kokomo Creek	FROM	5.3	TO	4.3
STREAM REACH	10.0	RCH= Martin-Youngman	FROM	7.7	TO	5.6
STREAM REACH	11.0	RCH= Oakford drain	FROM	6.2	TO	5.6
STREAM REACH	12.0	RCH= Martin-Youngman	FROM	5.6	TO	5.0
STREAM REACH	13.0	RCH= Scott-Youngman	FROM	6.8	TO	5.0
STREAM REACH	14.0	RCH= Martin-Youngman	FROM	5.0	TO	4.6
STREAM REACH	15.0	RCH= Martin-Youngman	FROM	4.6	TO	4.3
STREAM REACH	16.0	RCH= Kokomo Creek	FROM	4.3	TO	2.2
STREAM REACH	17.0	RCH= Kokomo Creek	FROM	2.2	TO	0.0
ENDATA2	0.0			0.0		0.0

$$$ DATA TYPE 3 (TARGET LEVEL DO AND FLOW AUGMENTATION SOURCES) $$$

CARD TYPE	REACH	AVAIL HDWS	TARGET	ORDER OF AVAIL SOURCES					
ENDATA3	0.	0.	0.0	0.	0.	0.	0.	0.	0.

$$$ DATA TYPE 4 (COMPUTATIONAL REACH FLAG FIELD) $$$

CARD TYPE	REACH	ELEMENTS/REACH	COMPUTATIONAL FLAGS
FLAG FIELD	1.	19.	1.2.2.2.2.2.2.2.2.2.2.2.2.2.2.2.2.3.0.
FLAG FIELD	2.	14.	1.2.2.2.2.2.2.2.2.2.2.2.2.0.0.0.0.0.0.
FLAG FIELD	3.	14.	2.2.2.2.2.2.2.2.2.2.2.2.2.0.0.0.0.0.0.
FLAG FIELD	4.	19.	4.2.2.2.2.2.2.2.2.2.2.2.2.2.2.2.2.2.0.
FLAG FIELD	5.	14.	2.2.2.2.2.2.2.2.2.2.2.2.2.0.0.0.0.0.0.
FLAG FIELD	6.	5.	6.2.2.2.3.0.0.0.0.0.0.0.0.0.0.0.0.0.0.
FLAG FIELD	7.	15.	1.2.2.2.2.2.2.2.2.2.2.2.2.6.0.0.0.0.0.
FLAG FIELD	8.	6.	4.2.6.6.2.6.0.0.0.0.0.0.0.0.0.0.0.0.0.
FLAG FIELD	9.	6.	2.2.2.2.2.3.0.0.0.0.0.0.0.0.0.0.0.0.0.
FLAG FIELD	10.	12.	1.2.2.2.2.2.2.2.2.2.2.3.0.0.0.0.0.0.0.
FLAG FIELD	11.	3.	1.2.6.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.
FLAG FIELD	12.	4.	4.2.2.3.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.
FLAG FIELD	13.	11.	1.2.2.2.2.2.2.2.2.2.0.0.0.0.0.0.0.0.0.
FLAG FIELD	14.	2.	4.2.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.
FLAG FIELD	15.	2.	2.2.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.
FLAG FIELD	16.	12.	4.2.2.2.2.2.2.2.6.6.2.2.0.0.0.0.0.0.0.
FLAG FIELD	17.	13.	2.2.2.2.2.2.2.2.2.2.2.2.5.0.0.0.0.0.0.
ENDATA4	0.	0.	0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.

$$$ DATA TYPE 5 (HYDRAULIC DATA FOR DETERMINING VELOCITY AND DEPTH) $$$

CARD TYPE	REACH	COEF-DSPN	COEFQV	EXPOQV	COEFQH	EXPOQH	CMANN
HYDRAULICS	1.	100.00	0.100	0.350	0.600	0.450	0.045
HYDRAULICS	2.	100.00	0.100	0.350	0.600	0.450	0.045
HYDRAULICS	3.	100.00	0.100	0.350	0.600	0.450	0.045
HYDRAULICS	4.	100.00	0.120	0.480	0.430	0.320	0.045
HYDRAULICS	5.	100.00	0.120	0.480	0.450	0.320	0.045
HYDRAULICS	6.	100.00	0.110	0.480	0.490	0.350	0.045
HYDRAULICS	7.	100.00	0.100	0.350	0.600	0.450	0.045
HYDRAULICS	8.	100.00	0.110	0.480	0.510	0.350	0.045
HYDRAULICS	9.	100.00	0.110	0.480	0.510	0.350	0.045
HYDRAULICS	10.	100.00	0.100	0.350	0.600	0.450	0.045
HYDRAULICS	11.	100.00	0.100	0.350	0.600	0.450	0.045
HYDRAULICS	12.	100.00	0.100	0.350	0.600	0.450	0.045
HYDRAULICS	13.	100.00	0.100	0.350	0.600	0.450	0.045
HYDRAULICS	14.	100.00	0.100	0.350	0.600	0.450	0.045
HYDRAULICS	15.	100.00	0.100	0.350	0.600	0.450	0.045
HYDRAULICS	16.	100.00	0.310	0.120	0.330	0.410	0.045
HYDRAULICS	17.	100.00	0.310	0.110	0.310	0.380	0.045
ENDATA5	0.	0.00	0.000	0.000	0.000	0.000	0.000

$$$ DATA TYPE 5A (STEADY STATE TEMPERATURE AND CLIMATOLOGY DATA) $$$

CARD TYPE	REACH	ELEVATION	DUST COEF	CLOUD COVER	DRY BULB TEMP	WET BULB TEMP	ATM PRESSURE	WIND	SOLAR RAD ATTENUATION
CLIMATOLOG	1.	825.00	0.06	0.50	65.00	52.00	30.26	8.50	0.92
CLIMATOLOG	2.	825.00	0.06	0.50	65.00	51.00	30.26	8.50	0.92
CLIMATOLOG	3.	825.00	0.06	0.50	65.00	51.00	30.26	8.50	0.92
CLIMATOLOG	4.	825.00	0.06	0.50	65.00	54.50	30.26	8.50	0.96
CLIMATOLOG	5.	825.00	0.06	0.50	65.00	57.40	30.26	8.50	1.00
CLIMATOLOG	6.	825.00	0.06	0.50	65.00	52.00	30.26	8.50	0.94
CLIMATOLOG	7.	825.00	0.06	0.50	65.00	53.50	30.26	8.50	0.95
CLIMATOLOG	8.	825.00	0.06	0.50	65.00	51.00	30.26	10.50	0.85

CLIMATOLOG	9.	825.00	0.06	0.50	65.00	51.00	30.26	10.50	0.85
CLIMATOLOG	10.	825.00	0.06	0.50	65.00	53.50	30.26	8.50	0.95
CLIMATOLOG	11.	825.00	0.06	0.50	65.00	53.50	30.26	8.50	0.95
CLIMATOLOG	12.	825.00	0.06	0.50	65.00	53.50	30.26	8.50	0.95
CLIMATOLOG	13.	825.00	0.06	0.50	65.00	53.50	30.26	8.50	0.95
CLIMATOLOG	14.	825.00	0.06	0.50	65.00	53.50	30.26	8.50	0.95
CLIMATOLOG	15.	825.00	0.06	0.50	65.00	53.50	30.26	8.50	0.95
CLIMATOLOG	16.	825.00	0.06	0.50	65.00	56.00	30.26	8.50	0.96
CLIMATOLOG	17.	825.00	0.06	0.50	65.00	56.00	30.26	8.50	0.96
ENDATA5A	0.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

$$$ DATA TYPE 6 (REACTION COEFFICIENTS FOR DEOXYGENATION AND REAERATION) $$$

CARD TYPE	REACH	K1	K3	SOD RATE	K2OPT	K2	COEQK2 TSIV COEF FOR OPT 8	OR OR	EXPQK2 SLOPE FOR OPT 8
REACT COEF	1.	0.20	0.00	0.080	11.	0.00	0.800		0.00134
REACT COEF	2.	0.20	0.00	0.080	11.	0.00	0.800		0.00095
REACT COEF	3.	0.20	0.00	0.080	11.	0.00	0.800		0.00071
REACT COEF	4.	0.20	0.00	0.080	11.	0.00	0.850		0.00105
REACT COEF	5.	0.30	0.00	0.100	11.	0.00	1.000		0.00079
REACT COEF	6.	0.55	0.00	0.148	11.	0.00	0.700		0.00044
REACT COEF	7.	0.20	0.00	0.080	11.	0.00	1.000		0.00229
REACT COEF	8.	0.55	0.00	0.150	11.	0.00	0.700		0.00074
REACT COEF	9.	0.45	0.00	0.100	11.	0.00	0.700		0.00092
REACT COEF	10.	0.20	0.00	0.080	11.	0.00	1.000		0.00323
REACT COEF	11.	0.20	0.00	0.080	11.	0.00	1.000		0.00443
REACT COEF	12.	0.20	0.00	0.080	11.	0.00	1.000		0.00249
REACT COEF	13.	0.20	0.00	0.080	11.	0.00	1.000		0.00443
REACT COEF	14.	0.20	0.00	0.080	11.	0.00	1.000		0.00332
REACT COEF	15.	0.20	0.00	0.080	11.	0.00	1.000		0.00332
REACT COEF	16.	0.20	0.00	0.100	11.	0.00	1.000		0.00083
REACT COEF	17.	0.20	0.00	0.100	11.	0.00	1.000		0.00179
ENDATA6	0.	0.00	0.00	0.000	0.	0.00	0.000		0.00000

$$$ DATA TYPE 6A (NITROGEN AND PHOSPHORUS CONSTANTS) $$$

CARD TYPE	REACH	CKNH2	SETNH2	CKNH3	SNH3	CKNO2	CKPORG	SETPORG	SPO4
N AND P COEF	1.	0.02	0.05	0.10	0.00	2.00	0.00	0.00	0.00
N AND P COEF	2.	0.02	0.05	0.10	0.00	2.00	0.00	0.00	0.00
N AND P COEF	3.	0.02	0.05	0.10	0.00	2.00	0.00	0.00	0.00
N AND P COEF	4.	0.10	0.10	0.15	0.00	2.00	0.00	0.00	0.00
N AND P COEF	5.	0.10	0.10	0.15	0.00	2.00	0.00	0.00	0.00
N AND P COEF	6.	0.15	0.10	1.00	0.00	2.00	0.00	0.00	0.00
N AND P COEF	7.	0.15	0.09	1.00	0.00	2.00	0.00	0.00	0.00
N AND P COEF	8.	0.25	0.10	1.00	0.00	2.00	0.00	0.00	0.00
N AND P COEF	9.	0.25	0.10	1.00	0.00	2.00	0.00	0.00	0.00
N AND P COEF	10.	0.15	0.09	0.90	0.00	2.00	0.00	0.00	0.00
N AND P COEF	11.	0.15	0.09	0.90	0.00	2.00	0.00	0.00	0.00
N AND P COEF	12.	0.15	0.09	0.90	0.00	2.00	0.00	0.00	0.00
N AND P COEF	13.	0.15	0.09	0.90	0.00	2.00	0.00	0.00	0.00
N AND P COEF	14.	0.15	0.09	0.90	0.00	2.00	0.00	0.00	0.00
N AND P COEF	15.	0.15	0.09	0.90	0.00	2.00	0.00	0.00	0.00
N AND P COEF	16.	0.25	0.10	1.00	0.00	2.00	0.00	0.00	0.00
N AND P COEF	17.	0.25	0.10	1.00	0.00	2.00	0.00	0.00	0.00
ENDATA6A	0.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

$$$ DATA TYPE 6B (ALGAE/OTHER COEFFICIENTS) $$$

CARD TYPE	REACH	ALPHAO	ALGSET	EXCOEF	CK5 CKCOLI	CKANC	SETANC	SRCANC
ALG/OTHER COEF	1.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	2.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	3.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	4.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	5.	15.00	0.50	0.01	0.00	0.00	0.00	0.00

ALG/OTHER COEF	6.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	7.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	8.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	9.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	10.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	11.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	12.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	13.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	14.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	15.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	16.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	17.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ENDATA6B	0.	0.00	0.00	0.00	0.00	0.00	0.00	0.00

$$$ DATA TYPE 7 (INITIAL CONDITIONS) $$$

CARD TYPE	REACH	TEMP	D.O.	BOD	CM-1	CM-2	CM-3	ANC	COLI
INITIAL COND-1	1.	67.40	6.00	3.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	2.	67.40	6.00	3.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	3.	67.40	6.00	3.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	4.	67.40	6.00	3.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	5.	67.40	6.00	3.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	6.	67.40	6.00	3.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	7.	67.40	6.00	3.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	8.	67.40	6.00	3.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	9.	67.40	6.00	3.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	10.	67.40	6.00	3.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	11.	67.40	6.00	3.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	12.	67.40	6.00	3.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	13.	67.40	6.00	3.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	14.	67.40	6.00	3.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	15.	67.40	6.00	3.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	16.	67.40	6.00	3.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	17.	67.40	6.00	3.00	0.00	0.00	0.00	0.00	0.00
ENDATA7	0.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

$$$ DATA TYPE 7A (INITIAL CONDITIONS FOR CHOROPHYLL A, NITROGEN, AND PHOSPHORUS) $$$

CARD TYPE	REACH	CHL-A	ORG-N	NH3-N	NO2-N	NO3-N	ORG-P	DIS-P
INITIAL COND-2	1.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	2.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	3.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	4.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	5.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	6.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	7.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	8.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	9.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	10.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	11.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	12.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	13.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	14.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	15.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	16.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	17.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
ENDATA7A	0.	0.00	0.00	0.00	0.00	0.00	0.00	0.00

$$$ DATA TYPE 8 (INCREMENTAL INFLOW CONDITIONS) $$$

CARD TYPE	REACH	FLOW	TEMP	D.O.	BOD	CM-1	CM-2	CM-3	ANC	COLI
INCR INFLOW-1	1.	0.240	67.40	7.00	2.00	0.00	0.00	0.00	0.00	0.00
INCR INFLOW-1	2.	0.164	67.40	7.00	2.00	0.00	0.00	0.00	0.00	0.00

	INCR INFLOW-1	3.	0.164	67.40	7.00	2.00	0.00	0.00	0.00
0.00	0.00								
	INCR INFLOW-1	4.	0.724	67.40	7.00	2.00	0.00	0.00	0.00
0.00	0.00								
	INCR INFLOW-1	5.	0.533	67.40	7.00	2.00	0.00	0.00	0.00
0.00	0.00								
	INCR INFLOW-1	6.	0.190	67.40	7.00	2.00	0.00	0.00	0.00
0.00	0.00								
	INCR INFLOW-1	7.	0.321	67.40	7.00	2.00	0.00	0.00	0.00
0.00	0.00								
	INCR INFLOW-1	8.	0.091	67.40	7.00	2.00	0.00	0.00	0.00
0.00	0.00								
	INCR INFLOW-1	9.	0.091	67.40	7.00	2.00	0.00	0.00	0.00
0.00	0.00								
	INCR INFLOW-1	10.	0.169	67.40	7.00	2.00	0.00	0.00	0.00
0.00	0.00								
	INCR INFLOW-1	11.	0.042	67.40	7.00	2.00	0.00	0.00	0.00
0.00	0.00								
	INCR INFLOW-1	12.	0.056	67.40	7.00	2.00	0.00	0.00	0.00
0.00	0.00								
	INCR INFLOW-1	13.	0.155	67.40	7.00	2.00	0.00	0.00	0.00
0.00	0.00								
	INCR INFLOW-1	14.	0.028	67.40	7.00	2.00	0.00	0.00	0.00
0.00	0.00								
	INCR INFLOW-1	15.	0.028	67.40	7.00	2.00	0.00	0.00	0.00
0.00	0.00								
	INCR INFLOW-1	16.	0.321	67.40	7.00	2.00	0.00	0.00	0.00
0.00	0.00								
	INCR INFLOW-1	17.	0.348	67.40	7.00	2.00	0.00	0.00	0.00
0.00	0.00								
	ENDATA8	0.	0.000	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00								

$$$ DATA TYPE 8A (INCREMENTAL INFLOW CONDITIONS FOR CHLOROPHYLL A, NITROGEN, AND PHOSPHORUS) $$$

CARD TYPE	REACH	CHL-A	ORG-N	NH3-N	NO2-N	NO3-N	ORG-P	DIS-P
INCR INFLOW-2	1.	5.00	0.60	0.20	0.20	0.10	0.05	0.05
INCR INFLOW-2	2.	5.00	0.60	0.20	0.20	0.10	0.05	0.05
INCR INFLOW-2	3.	5.00	0.60	0.20	0.20	0.10	0.05	0.05
INCR INFLOW-2	4.	5.00	0.70	0.15	0.20	0.10	0.05	0.05
INCR INFLOW-2	5.	5.00	0.70	0.15	0.20	0.10	0.05	0.05
INCR INFLOW-2	6.	5.00	0.60	0.10	0.30	0.30	0.05	0.05
INCR INFLOW-2	7.	5.00	0.60	0.15	0.20	0.10	0.05	0.05
INCR INFLOW-2	8.	5.00	0.50	0.10	0.20	0.10	0.05	0.05
INCR INFLOW-2	9.	5.00	0.50	0.10	0.20	0.10	0.05	0.05
INCR INFLOW-2	10.	5.00	0.60	0.15	0.20	0.10	0.05	0.05
INCR INFLOW-2	11.	5.00	0.60	0.15	0.20	0.10	0.05	0.05
INCR INFLOW-2	12.	5.00	0.60	0.15	0.20	0.10	0.05	0.05
INCR INFLOW-2	13.	5.00	0.60	0.15	0.20	0.10	0.05	0.05
INCR INFLOW-2	14.	5.00	0.60	0.15	0.20	0.10	0.05	0.05
INCR INFLOW-2	15.	5.00	0.60	0.15	0.20	0.10	0.05	0.05
INCR INFLOW-2	16.	5.00	0.40	0.00	0.20	0.10	0.05	0.05
INCR INFLOW-2	17.	5.00	0.40	0.00	0.20	0.10	0.05	0.05
ENDATA8A	0.	0.00	0.00	0.00	0.00	0.00	0.00	0.00

$$$ DATA TYPE 9 (STREAM JUNCTIONS) $$$

CARD TYPE	JUNCTION ORDER AND IDENT			UPSTRM	JUNCTION	TRIB
STREAM JUNCTION	1.	JNC=	1	19.	48.	47.
STREAM JUNCTION	2.	JNC=	2	85.	101.	100.
STREAM JUNCTION	3.	JNC=	3	124.	128.	127.
STREAM JUNCTION	4.	JNC=	4	131.	143.	142.
STREAM JUNCTION	5.	JNC=	5	112.	147.	146.
ENDATA9	0.			0.	0.	0.

$$$ DATA TYPE 10 (HEADWATER SOURCES) $$$

CARD TYPE	HDWTR ORDER	NAME	FLOW	TEMP	D.O.	BOD	CM-1	CM-2	CM-3
HEADWTR-1	1.	Tolle Ditch	0.10	66.20	7.00	2.50	0.00	0.00	0.00
HEADWTR-1	2.	Finn Ditch	0.14	67.40	7.00	2.50	0.00	0.00	0.00
HEADWTR-1	3.	Mugg-Ingels	0.14	67.40	7.00	2.50	0.00	0.00	0.00
HEADWTR-1	4.	Martin-Youngman	0.07	67.40	7.00	2.50	0.00	0.00	0.00
HEADWTR-1	5.	Oakford drain	0.07	67.40	7.00	2.50	0.00	0.00	0.00
HEADWTR-1	6.	Scott-Youngman	0.07	67.40	7.00	2.50	0.00	0.00	0.00
ENDATA10	0.		0.00	0.00	0.00	0.00	0.00	0.00	0.00

$$$ DATA TYPE 10A (HEADWATER CONDITIONS FOR CHLOROPHYLL, NITROGEN, PHOSPHORUS, COLIFORM AND SELECTED NON-CONSERVATIVE CONSTITUENT) $$$

CARD TYPE	HDWTR ORDER	ANC	COLI	CHL-A	ORG-N	NH3-N	NO2-N	NO3-N	ORG-P	DIS-P
HEADWTR-2	1.	0.00	0.00	5.00	0.60	0.20	0.03	0.17	0.15	0.15
HEADWTR-2	2.	0.00	0.00	5.00	0.60	0.20	0.03	0.17	0.15	0.15
HEADWTR-2	3.	0.00	0.00	5.00	0.60	0.20	0.09	0.51	0.15	0.15
HEADWTR-2	4.	0.00	0.00	5.00	0.60	0.20	0.01	0.09	0.15	0.15
HEADWTR-2	5.	0.00	0.00	5.00	0.60	0.20	0.01	0.09	0.15	0.15
HEADWTR-2	6.	0.00	0.00	5.00	0.60	0.20	0.01	0.09	0.15	0.15
ENDATA10A	0.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

$$$ DATA TYPE 11 (POINT SOURCE / POINT SOURCE CHARACTERISTICS) $$$

CARD TYPE	POINT LOAD ORDER	NAME	EFF	FLOW	TEMP	D.O.	BOD	CM-1	CM-2	CM-3
POINTLD-1	1.	Kokomo Regen	0.00	0.06	69.80	2.10	98.88	0.00	0.00	0.00
POINTLD-1	2.	Hemlock Sept	0.00	0.01	70.00	2.00	220.00	0.00	0.00	0.00
POINTLD-1	3.	Taylor HS	0.00	0.01	74.50	7.85	5.68	0.00	0.00	0.00
POINTLD-1	4.	Center Septi	0.00	0.01	70.00	2.00	220.00	0.00	0.00	0.00
POINTLD-1	5.	Timbernest A	0.00	0.01	68.50	2.95	5.68	0.00	0.00	0.00
POINTLD-1	6.	Oakford Sept	0.00	0.00	70.00	2.00	220.00	0.00	0.00	0.00
POINTLD-1	7.	Delco	0.00	0.09	74.10	8.00	5.68	0.00	0.00	0.00
POINTLD-1	8.	Chrysler	0.00	0.19	72.00	8.04	5.68	0.00	0.00	0.00
ENDATA11	0.		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

$$$ DATA TYPE 11A (POINT SOURCE CHARACTERISTICS - CHLOROPHYLL A, NITROGEN, PHOSPHORUS, COLIFORMS AND SELECTED NON-CONSERVATIVE CONSTITUENT) $$$

CARD TYPE	POINT LOAD ORDER	ANC	COLI	CHL-A	ORG-N	NH3-N	NO2-N	NO3-N	ORG-P	DIS-P
POINTLD-2	1.	0.00	0.00	5.00	4.00	10.00	0.01	0.04	0.50	0.50
POINTLD-2	2.	0.00	0.00	5.00	20.00	28.00	0.30	1.70	5.00	5.00
POINTLD-2	3.	0.00	0.00	5.00	0.44	0.12	4.50	25.50	0.50	0.50
POINTLD-2	4.	0.00	0.00	5.00	20.00	28.00	0.30	1.70	5.00	5.00
POINTLD-2	5.	0.00	0.00	5.00	1.68	0.82	1.36	7.74	0.50	0.50
POINTLD-2	6.	0.00	0.00	5.00	20.00	28.00	0.30	1.70	5.00	5.00
POINTLD-2	7.	0.00	0.00	5.00	0.00	0.10	0.09	0.54	0.10	0.10
POINTLD-2	8.	0.00	0.00	5.00	0.38	0.13	0.01	0.07	0.10	0.10
ENDATA11A	0.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

$$$ DATA TYPE 12 (DAM CHARACTERISTICS) $$$

	DAM	RCH	ELE	ADAM	BDAM	FDAM	HDAM
ENDATA12	0.	0.	0.	0.00	0.00	0.00	0.00

$$$ DATA TYPE 13 (DOWNSTREAM BOUNDARY CONDITIONS-1) $$$

CARD TYPE	TEMP	D.O.	BOD	CM-1	CM-2	CM-3	ANC	COLI

ENDATA13 DOWNSTREAM BOUNDARY CONCENTRATIONS ARE UNCONSTRAINED

$$$ DATA TYPE 13A (DOWNSTREAM BOUNDARY CONDITIONS-2) $$$

CARD TYPE	CHL-A	ORG-N	NH3-N	NO2-N	NH3-N	ORG-P	DIS-P

ENDATA13A DOWNSTREAM BOUNDARY CONCENTRATIONS ARE UNCONSTRAINED

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                                   * * * QUAL-2E  STREAM QUALITY ROUTING MODEL * * *
                                              Version 3.21  -  Feb. 1995

 $$$ (PROBLEM TITLES) $$$

CARD TYPE                                QUAL-2E PROGRAM TITLES
TITLE01                 Kokomo Creek, Indiana (07/31/1998): MORTON
TITLE02
TITLE03  NO             CONSERVATIVE MINERAL I
TITLE04  NO             CONSERVATIVE MINERAL II
TITLE05  NO             CONSERVATIVE MINERAL III
TITLE06  YES            TEMPERATURE
TITLE07  YES            BIOCHEMICAL OXYGEN DEMAND
TITLE08  YES            ALGAE AS CHL-A IN UG/L
TITLE09  YES            PHOSPHORUS CYCLE AS P IN MG/L
TITLE10                   (ORGANIC-P; DISSOLVED-P)
TITLE11  YES            NITROGEN CYCLE AS N IN MG/L
TITLE12                   (ORGANIC-N; AMMONIA-N; NITRITE-N;' NITRATE-N)
TITLE13  YES            DISSOLVED OXYGEN IN MG/L
TITLE14  NO             FECAL COLIFORM IN NO./100 ML
TITLE15  NO             ARBITRARY NON-CONSERVATIVE
ENDTITLE

 $$$ DATA TYPE 1 (CONTROL DATA) $$$

CARD TYPE                                          CARD TYPE
LIST DATA INPUT                  0.00000                                  0.00000
NO WRITE OPTIONAL SUMMARY        0.00000                                  0.00000
NO FLOW AUGMENTATION             0.00000                                  0.00000
STEADY STATE                     0.00000                                  0.00000
NO TRAP CHANNELS                 0.00000                                  0.00000
NO PRINT LCD/SOLAR DATA          0.00000                                  0.00000
NO PLOT DO AND BOD DATA          0.00000                                  0.00000
FIXED DNSTM CONC (YES=1)=        0.00000   SD-ULT BOD CONV K COEF   =     0.23000
INPUT METRIC                =    0.00000   OUTPUT METRIC            =     0.00000
NUMBER OF REACHES           =   17.00000   NUMBER OF JUNCTIONS      =     5.00000
NUM OF HEADWATERS           =    6.00000   NUMBER OF POINT LOADS    =     8.00000
TIME STEP (HOURS)           =    1.00000   LNTH. COMP. ELEMENT (DX)=     0.17100
MAXIMUM ROUTE TIME (HRS)=       30.00000   TIME INC. FOR RPT2 (HRS)=     1.00000
LATITUDE OF BASIN (DEG)     =   40.45000   LONGITUDE OF BASIN (DEG)=    86.05000
STANDARD MERIDIAN (DEG)     =   90.00000   DAY OF YEAR START TIME   =  212.00000
EVAP. COEF.,(AE)            =    0.00103   EVAP. COEF.,(BE)         =     0.00016
ELEV. OF BASIN (ELEV)       =  825.00000   DUST ATTENUATION COEF.   =     0.06000
ENDATA1                          0.00000                                  0.00000

 $$$ DATA TYPE 1A (ALGAE PRODUCTION AND NITROGEN OXIDATION CONSTANTS) $$$

CARD TYPE                                          CARD TYPE
O UPTAKE BY NH3 OXID(MG O/MG N)=     3.4300   O UPTAKE BY NO2 OXID(MG O/MG N)=     1.1400
O PROD  BY ALGAE (MG O/MG A)   =     1.6000   O UPTAKE BY ALGAE (MG O/MG A)  =     2.0000
N CONTENT OF ALGAE (MG N/MG A) =     0.0850   P CONTENT OF ALGAE (MG O/MG A) =     0.0140
ALG MAX SPEC GROWTH RATE(1/DAY)=     2.1000   ALGAE RESPIRATION RATE (1/DAY) =     0.0500
N HALF SATURATION CONST (MG/L) =     0.1500   P HALF SATURATION CONST (MG/L) =     0.0100
LIN ALG SHADE CO (1/FT-UGCHA/L=)     0.0027   NLIN SHADE(1/FT-(UGCHA/L)**2/3)=     0.0165
LIGHT FUNCTION OPTION (LFNOPT) =     1.0000   LIGHT SAT'N COEF (BTU/FT2-MIN) =     0.0833
DAILY AVERAGING OPTION (LAVOPT)=     3.0000   LIGHT AVERAGING FACTOR (AFACT) =     0.9200
NUMBER OF DAYLIGHT HOURS (DLH) =    14.0000   TOTAL DAILY SOLR RAD (BTU/FT-2)= 1300.0000
ALGY GROWTH CALC OPTION(LGROPT)=     2.0000   ALGAL PREF FOR NH3-N (PREFN)   =     0.9000
ALG/TEMP SOLR RAD FACTOR(TFACT)=     0.4400   NITRIFICATION INHIBITION COEF  =     0.5000
ENDATA1A                             0.0000                                          0.0000

 $$$ DATA TYPE 1B (TEMPERATURE CORRECTION CONSTANTS FOR RATE COEFFICIENTS) $$$

CARD TYPE      RATE CODE      THETA VALUE

THETA( 1)      BOD DECA         1.047     USER
THETA( 2)      BOD SETT         1.024     USER
THETA( 3)      OXY TRAN         1.028     USER
THETA( 4)      SOD RATE         1.047     USER
THETA( 5)      ORGN DEC         1.047     USER
THETA( 6)      ORGN SET         1.024     USER
THETA( 7)      NH3 DECA         1.083     USER
THETA( 8)      NH3 SRCE         1.074     USER
THETA( 9)      NO2 DECA         1.047     USER
THETA(10)      PORG DEC         1.047     USER
THETA(11)      PORG SET         1.024     USER
THETA(12)      DISP SRC         1.074     USER
THETA(13)      ALG GROW         1.047     USER
THETA(14)      ALG RESP         1.047     USER
THETA(15)      ALG SETT         1.024     USER
THETA(16)      COLI DEC         1.047     DFLT
THETA(17)      ANC DECA         1.000     DFLT
THETA(18)      ANC SETT         1.024     DFLT
THETA(19)      ANC SRCE         1.000     DFLT
ENDATA1B
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$$$ DATA TYPE 2 (REACH IDENTIFICATION) $$$

CARD TYPE	REACH ORDER AND IDENT			R. MI/KM		R. MI/KM
STREAM REACH	1.0	RCH= Tolle Ditch	FROM	16.1	TO	12.8
STREAM REACH	2.0	RCH= Finn Ditch	FROM	17.6	TO	15.2
STREAM REACH	3.0	RCH= Finn Ditch	FROM	15.2	TO	12.8
STREAM REACH	4.0	RCH= Kokomo Creek	FROM	12.8	TO	9.6
STREAM REACH	5.0	RCH= Kokomo Creek	FROM	9.6	TO	7.2
STREAM REACH	6.0	RCH= Kokomo Creek	FROM	7.2	TO	6.3
STREAM REACH	7.0	RCH= Mugg-Ingels	FROM	8.9	TO	6.3
STREAM REACH	8.0	RCH= Kokomo Creek	FROM	6.3	TO	5.3
STREAM REACH	9.0	RCH= Kokomo Creek	FROM	5.3	TO	4.3
STREAM REACH	10.0	RCH= Martin-Youngman	FROM	7.7	TO	5.6
STREAM REACH	11.0	RCH= Oakford drain	FROM	6.2	TO	5.6
STREAM REACH	12.0	RCH= Martin-Youngman	FROM	5.6	TO	5.0
STREAM REACH	13.0	RCH= Scott-Youngman	FROM	6.8	TO	5.0
STREAM REACH	14.0	RCH= Martin-Youngman	FROM	5.0	TO	4.6
STREAM REACH	15.0	RCH= Martin-Youngman	FROM	4.6	TO	4.3
STREAM REACH	16.0	RCH= Kokomo Creek	FROM	4.3	TO	2.2
STREAM REACH	17.0	RCH= Kokomo Creek	FROM	2.2	TO	0.0
ENDATA2	0.0			0.0		0.0

$$$ DATA TYPE 3 (TARGET LEVEL DO AND FLOW AUGMENTATION SOURCES) $$$

CARD TYPE	REACH	AVAIL HDWS	TARGET	ORDER OF AVAIL SOURCES					
ENDATA3	0.	0.	0.0	0.	0.	0.	0.	0.	0.

$$$ DATA TYPE 4 (COMPUTATIONAL REACH FLAG FIELD) $$$

CARD TYPE	REACH	ELEMENTS/REACH	COMPUTATIONAL FLAGS
FLAG FIELD	1.	19.	1.2.2.2.2.2.2.2.2.2.2.2.2.2.2.2.2.3.0.
FLAG FIELD	2.	14.	1.2.2.2.2.2.2.2.2.2.2.2.2.0.0.0.0.0.0.
FLAG FIELD	3.	14.	2.2.2.2.2.2.2.2.2.2.2.2.2.0.0.0.0.0.0.
FLAG FIELD	4.	19.	4.2.2.2.2.2.2.2.2.2.2.2.2.2.2.2.2.2.0.
FLAG FIELD	5.	14.	2.2.2.2.2.2.2.2.2.2.2.2.2.0.0.0.0.0.0.
FLAG FIELD	6.	5.	6.2.2.2.3.0.0.0.0.0.0.0.0.0.0.0.0.0.0.
FLAG FIELD	7.	15.	1.2.2.2.2.2.2.2.2.2.2.2.2.6.0.0.0.0.0.
FLAG FIELD	8.	6.	4.2.6.6.2.6.0.0.0.0.0.0.0.0.0.0.0.0.0.
FLAG FIELD	9.	6.	2.2.2.2.2.3.0.0.0.0.0.0.0.0.0.0.0.0.0.
FLAG FIELD	10.	12.	1.2.2.2.2.2.2.2.2.2.3.0.0.0.0.0.0.0.0.
FLAG FIELD	11.	3.	1.2.6.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.
FLAG FIELD	12.	4.	4.2.2.3.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.
FLAG FIELD	13.	11.	1.2.2.2.2.2.2.2.2.2.0.0.0.0.0.0.0.0.0.
FLAG FIELD	14.	2.	4.2.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.
FLAG FIELD	15.	2.	2.2.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.
FLAG FIELD	16.	12.	4.2.2.2.2.2.2.2.6.6.2.2.0.0.0.0.0.0.0.
FLAG FIELD	17.	13.	2.2.2.2.2.2.2.2.2.2.2.2.5.0.0.0.0.0.0.
ENDATA4	0.	0.	0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.

$$$ DATA TYPE 5 (HYDRAULIC DATA FOR DETERMINING VELOCITY AND DEPTH) $$$

CARD TYPE	REACH	COEF-DSPN	COEFQV	EXPOQV	COEFQH	EXPOQH	CMANN
HYDRAULICS	1.	100.00	0.100	0.350	0.600	0.450	0.045
HYDRAULICS	2.	100.00	0.100	0.350	0.600	0.450	0.045
HYDRAULICS	3.	100.00	0.100	0.350	0.600	0.450	0.045
HYDRAULICS	4.	100.00	0.120	0.480	0.430	0.320	0.045
HYDRAULICS	5.	100.00	0.120	0.480	0.450	0.320	0.045
HYDRAULICS	6.	100.00	0.110	0.480	0.490	0.350	0.045
HYDRAULICS	7.	100.00	0.100	0.350	0.600	0.450	0.045
HYDRAULICS	8.	100.00	0.110	0.480	0.510	0.350	0.045
HYDRAULICS	9.	100.00	0.110	0.480	0.510	0.350	0.045
HYDRAULICS	10.	100.00	0.100	0.350	0.600	0.450	0.045
HYDRAULICS	11.	100.00	0.100	0.350	0.600	0.450	0.045
HYDRAULICS	12.	100.00	0.100	0.350	0.600	0.450	0.045
HYDRAULICS	13.	100.00	0.100	0.350	0.600	0.450	0.045
HYDRAULICS	14.	100.00	0.100	0.350	0.600	0.450	0.045
HYDRAULICS	15.	100.00	0.100	0.350	0.600	0.450	0.045
HYDRAULICS	16.	100.00	0.310	0.120	0.330	0.410	0.045
HYDRAULICS	17.	100.00	0.310	0.110	0.310	0.380	0.045
ENDATA5	0.	0.00	0.000	0.000	0.000	0.000	0.000

$$$ DATA TYPE 5A (STEADY STATE TEMPERATURE AND CLIMATOLOGY DATA) $$$

CARD TYPE	REACH	ELEVATION	DUST COEF	CLOUD COVER	DRY BULB TEMP	WET BULB TEMP	ATM PRESSURE	WIND	SOLAR RAD ATTENUATION
CLIMATOLOG	1.	825.00	0.06	0.50	65.00	49.50	30.26	8.50	0.92
CLIMATOLOG	2.	825.00	0.06	0.50	65.00	49.50	30.26	8.50	0.92
CLIMATOLOG	3.	825.00	0.06	0.50	65.00	49.50	30.26	8.50	0.92
CLIMATOLOG	4.	825.00	0.06	0.50	65.00	51.00	30.26	8.50	1.00
CLIMATOLOG	5.	825.00	0.06	0.50	65.00	52.50	30.26	8.50	1.00
CLIMATOLOG	6.	825.00	0.06	0.50	65.00	52.00	30.26	8.50	0.94
CLIMATOLOG	7.	825.00	0.06	0.50	65.00	52.50	30.26	8.50	0.95
CLIMATOLOG	8.	825.00	0.06	0.50	65.00	53.50	30.26	10.50	0.85

CLIMATOLOG	9.	825.00	0.06	0.50	65.00	53.50	30.26	10.50	0.85
CLIMATOLOG	10.	825.00	0.06	0.50	65.00	53.50	30.26	8.50	0.95
CLIMATOLOG	11.	825.00	0.06	0.50	65.00	53.50	30.26	8.50	0.95
CLIMATOLOG	12.	825.00	0.06	0.50	65.00	53.50	30.26	8.50	0.95
CLIMATOLOG	13.	825.00	0.06	0.50	65.00	53.50	30.26	8.50	0.95
CLIMATOLOG	14.	825.00	0.06	0.50	65.00	53.50	30.26	8.50	0.95
CLIMATOLOG	15.	825.00	0.06	0.50	65.00	53.50	30.26	8.50	0.95
CLIMATOLOG	16.	825.00	0.06	0.50	65.00	54.00	30.26	8.50	0.96
CLIMATOLOG	17.	825.00	0.06	0.50	65.00	54.00	30.26	8.50	0.96
ENDATA5A	0.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

$$$ DATA TYPE 6 (REACTION COEFFICIENTS FOR DEOXYGENATION AND REAERATION) $$$

CARD TYPE	REACH	K1	K3	SOD RATE	K2OPT	K2	COEQK2 OR TSIV COEF FOR OPT 8	EXPQK2 OR SLOPE FOR OPT 8
REACT COEF	1.	0.20	0.00	0.080	11.	0.00	0.800	0.00134
REACT COEF	2.	0.20	0.00	0.080	11.	0.00	0.800	0.00095
REACT COEF	3.	0.20	0.00	0.080	11.	0.00	0.800	0.00071
REACT COEF	4.	0.20	0.00	0.080	11.	0.00	0.850	0.00105
REACT COEF	5.	0.30	0.00	0.100	11.	0.00	1.000	0.00079
REACT COEF	6.	0.55	0.00	0.148	11.	0.00	0.700	0.00044
REACT COEF	7.	0.20	0.00	0.080	11.	0.00	1.000	0.00229
REACT COEF	8.	0.55	0.00	0.150	11.	0.00	0.700	0.00074
REACT COEF	9.	0.45	0.00	0.100	11.	0.00	0.700	0.00092
REACT COEF	10.	0.20	0.00	0.080	11.	0.00	1.000	0.00323
REACT COEF	11.	0.20	0.00	0.080	11.	0.00	1.000	0.00443
REACT COEF	12.	0.20	0.00	0.080	11.	0.00	1.000	0.00249
REACT COEF	13.	0.20	0.00	0.080	11.	0.00	1.000	0.00443
REACT COEF	14.	0.20	0.00	0.080	11.	0.00	1.000	0.00332
REACT COEF	15.	0.20	0.00	0.080	11.	0.00	1.000	0.00332
REACT COEF	16.	0.20	0.00	0.100	11.	0.00	1.000	0.00083
REACT COEF	17.	0.20	0.00	0.100	11.	0.00	1.000	0.00179
ENDATA6	0.	0.00	0.00	0.000	0.	0.00	0.000	0.00000

$$$ DATA TYPE 6A (NITROGEN AND PHOSPHORUS CONSTANTS) $$$

CARD TYPE	REACH	CKNH2	SETNH2	CKNH3	SNH3	CKNO2	CKPORG	SETPORG	SPO4
N AND P COEF	1.	0.02	0.05	0.10	0.00	2.00	0.00	0.00	0.00
N AND P COEF	2.	0.02	0.05	0.10	0.00	2.00	0.00	0.00	0.00
N AND P COEF	3.	0.02	0.05	0.10	0.00	2.00	0.00	0.00	0.00
N AND P COEF	4.	0.10	0.10	0.15	0.00	2.00	0.00	0.00	0.00
N AND P COEF	5.	0.10	0.10	0.15	0.00	2.00	0.00	0.00	0.00
N AND P COEF	6.	0.15	0.10	1.00	0.00	2.00	0.00	0.00	0.00
N AND P COEF	7.	0.15	0.09	1.00	0.00	2.00	0.00	0.00	0.00
N AND P COEF	8.	0.25	0.10	1.00	0.00	2.00	0.00	0.00	0.00
N AND P COEF	9.	0.25	0.10	1.00	0.00	2.00	0.00	0.00	0.00
N AND P COEF	10.	0.15	0.09	0.90	0.00	2.00	0.00	0.00	0.00
N AND P COEF	11.	0.15	0.09	0.90	0.00	2.00	0.00	0.00	0.00
N AND P COEF	12.	0.15	0.09	0.90	0.00	2.00	0.00	0.00	0.00
N AND P COEF	13.	0.15	0.09	0.90	0.00	2.00	0.00	0.00	0.00
N AND P COEF	14.	0.15	0.09	0.90	0.00	2.00	0.00	0.00	0.00
N AND P COEF	15.	0.15	0.09	0.90	0.00	2.00	0.00	0.00	0.00
N AND P COEF	16.	0.25	0.10	1.00	0.00	2.00	0.00	0.00	0.00
N AND P COEF	17.	0.25	0.10	1.00	0.00	2.00	0.00	0.00	0.00
ENDATA6A	0.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

$$$ DATA TYPE 6B (ALGAE/OTHER COEFFICIENTS) $$$

CARD TYPE	REACH	ALPHAO	ALGSET	EXCOEF	CK5 CKCOLI	CKANC	SETANC	SRCANC
ALG/OTHER COEF	1.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	2.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	3.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	4.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	5.	15.00	0.50	0.01	0.00	0.00	0.00	0.00

ALG/OTHER COEF	6.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	7.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	8.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	9.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	10.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	11.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	12.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	13.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	14.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	15.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	16.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	17.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ENDATA6B	0.	0.00	0.00	0.00	0.00	0.00	0.00	0.00

$$$ DATA TYPE 7 (INITIAL CONDITIONS) $$$

CARD TYPE	REACH	TEMP	D.O.	BOD	CM-1	CM-2	CM-3	ANC	COLI
INITIAL COND-1	1.	67.40	6.00	3.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	2.	67.40	6.00	3.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	3.	67.40	6.00	3.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	4.	67.40	6.00	3.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	5.	67.40	6.00	3.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	6.	67.40	6.00	3.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	7.	67.40	6.00	3.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	8.	67.40	6.00	3.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	9.	67.40	6.00	3.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	10.	67.40	6.00	3.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	11.	67.40	6.00	3.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	12.	67.40	6.00	3.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	13.	67.40	6.00	3.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	14.	67.40	6.00	3.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	15.	67.40	6.00	3.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	16.	67.40	6.00	3.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	17.	67.40	6.00	3.00	0.00	0.00	0.00	0.00	0.00
ENDATA7	0.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

$$$ DATA TYPE 7A (INITIAL CONDITIONS FOR CHOROPHYLL A, NITROGEN, AND PHOSPHORUS) $$$

CARD TYPE	REACH	CHL-A	ORG-N	NH3-N	NO2-N	NO3-N	ORG-P	DIS-P
INITIAL COND-2	1.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	2.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	3.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	4.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	5.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	6.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	7.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	8.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	9.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	10.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	11.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	12.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	13.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	14.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	15.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	16.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	17.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
ENDATA7A	0.	0.00	0.00	0.00	0.00	0.00	0.00	0.00

$$$ DATA TYPE 8 (INCREMENTAL INFLOW CONDITIONS) $$$

CARD TYPE	REACH	FLOW	TEMP	D.O.	BOD	CM-1	CM-2	CM-3	ANC	COLI
INCR INFLOW-1	1.	1.326	67.40	7.00	2.00	0.00	0.00	0.00	0.00	0.00
INCR INFLOW-1	2.	0.907	67.40	7.00	2.00	0.00	0.00	0.00	0.00	0.00

	INCR INFLOW-1	3.	0.907	67.40	7.00	2.00	0.00	0.00	0.00
0.00	0.00								
	INCR INFLOW-1	4.	3.992	67.40	7.00	2.00	0.00	0.00	0.00
0.00	0.00								
	INCR INFLOW-1	5.	2.941	67.40	7.00	2.00	0.00	0.00	0.00
0.00	0.00								
	INCR INFLOW-1	6.	1.050	67.40	7.00	2.00	0.00	0.00	0.00
0.00	0.00								
	INCR INFLOW-1	7.	1.772	67.40	7.00	2.00	0.00	0.00	0.00
0.00	0.00								
	INCR INFLOW-1	8.	0.500	67.40	7.00	2.00	0.00	0.00	0.00
0.00	0.00								
	INCR INFLOW-1	9.	0.500	67.40	7.00	2.00	0.00	0.00	0.00
0.00	0.00								
	INCR INFLOW-1	10.	0.935	67.40	7.00	2.00	0.00	0.00	0.00
0.00	0.00								
	INCR INFLOW-1	11.	0.234	67.40	7.00	2.00	0.00	0.00	0.00
0.00	0.00								
	INCR INFLOW-1	12.	0.312	67.40	7.00	2.00	0.00	0.00	0.00
0.00	0.00								
	INCR INFLOW-1	13.	0.857	67.40	7.00	2.00	0.00	0.00	0.00
0.00	0.00								
	INCR INFLOW-1	14.	0.156	67.40	7.00	2.00	0.00	0.00	0.00
0.00	0.00								
	INCR INFLOW-1	15.	0.156	67.40	7.00	2.00	0.00	0.00	0.00
0.00	0.00								
	INCR INFLOW-1	16.	1.770	67.40	7.00	2.00	0.00	0.00	0.00
0.00	0.00								
	INCR INFLOW-1	17.	1.918	67.40	7.00	2.00	0.00	0.00	0.00
0.00	0.00								
	ENDATA8	0.	0.000	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00								

$$$ DATA TYPE 8A (INCREMENTAL INFLOW CONDITIONS FOR CHLOROPHYLL A, NITROGEN, AND PHOSPHORUS) $$$

CARD TYPE	REACH	CHL-A	ORG-N	NH3-N	NO2-N	NO3-N	ORG-P	DIS-P
INCR INFLOW-2	1.	5.00	0.50	0.10	2.10	2.10	0.05	0.05
INCR INFLOW-2	2.	5.00	0.50	0.10	2.10	2.10	0.05	0.05
INCR INFLOW-2	3.	5.00	0.50	0.10	2.10	2.10	0.05	0.05
INCR INFLOW-2	4.	5.00	0.70	0.10	1.80	1.80	0.05	0.05
INCR INFLOW-2	5.	5.00	0.70	0.10	1.50	1.50	0.05	0.05
INCR INFLOW-2	6.	5.00	0.60	0.10	1.20	1.20	0.05	0.05
INCR INFLOW-2	7.	5.00	0.60	0.10	1.10	1.10	0.05	0.05
INCR INFLOW-2	8.	5.00	0.50	0.10	0.80	0.80	0.05	0.05
INCR INFLOW-2	9.	5.00	0.50	0.10	0.50	0.50	0.05	0.05
INCR INFLOW-2	10.	5.00	0.60	0.10	0.60	0.60	0.05	0.05
INCR INFLOW-2	11.	5.00	0.60	0.10	0.60	0.60	0.05	0.05
INCR INFLOW-2	12.	5.00	0.60	0.10	0.60	0.60	0.05	0.05
INCR INFLOW-2	13.	5.00	0.60	0.10	0.60	0.60	0.05	0.05
INCR INFLOW-2	14.	5.00	0.60	0.10	0.60	0.60	0.05	0.05
INCR INFLOW-2	15.	5.00	0.60	0.10	0.60	0.60	0.05	0.05
INCR INFLOW-2	16.	5.00	0.40	0.00	0.50	0.50	0.05	0.05
INCR INFLOW-2	17.	5.00	0.40	0.00	0.50	0.50	0.05	0.05
ENDATA8A	0.	0.00	0.00	0.00	0.00	0.00	0.00	0.00

$$$ DATA TYPE 9 (STREAM JUNCTIONS) $$$

CARD TYPE	JUNCTION ORDER AND IDENT			UPSTRM	JUNCTION	TRIB
STREAM JUNCTION	1.	JNC=	1	19.	48.	47.
STREAM JUNCTION	2.	JNC=	2	85.	101.	100.
STREAM JUNCTION	3.	JNC=	3	124.	128.	127.
STREAM JUNCTION	4.	JNC=	4	131.	143.	142.
STREAM JUNCTION	5.	JNC=	5	112.	147.	146.
ENDATA9	0.			0.	0.	0.

$$$ DATA TYPE 10 (HEADWATER SOURCES) $$$

CARD TYPE	HDWTR ORDER	NAME	FLOW	TEMP	D.O.	BOD	CM-1	CM-2	CM-3
HEADWTR-1	1.	Tolle Ditch	0.57	67.50	7.00	2.00	0.00	0.00	0.00
HEADWTR-1	2.	Finn Ditch	0.78	67.50	7.00	2.00	0.00	0.00	0.00
HEADWTR-1	3.	Mugg-Ingels	0.76	67.50	7.00	2.00	0.00	0.00	0.00
HEADWTR-1	4.	Martin-Youngman	0.38	67.50	7.00	2.00	0.00	0.00	0.00
HEADWTR-1	5.	Oakford drain	0.38	67.50	7.00	2.00	0.00	0.00	0.00
HEADWTR-1	6.	Scott-Youngman	0.38	67.50	7.00	2.00	0.00	0.00	0.00
ENDATA10	0.		0.00	0.00	0.00	0.00	0.00	0.00	0.00

$$$ DATA TYPE 10A (HEADWATER CONDITIONS FOR CHLOROPHYLL, NITROGEN, PHOSPHORUS, COLIFORM AND SELECTED NON-CONSERVATIVE CONSTITUENT) $$$

CARD TYPE	HDWTR ORDER	ANC	COLI	CHL-A	ORG-N	NH3-N	NO2-N	NO3-N	ORG-P	DIS-P
HEADWTR-2	1.	0.00	0.00	5.00	0.46	0.10	0.63	3.57	0.10	0.10
HEADWTR-2	2.	0.00	0.00	5.00	0.46	0.10	0.63	3.57	0.10	0.10
HEADWTR-2	3.	0.00	0.00	5.00	0.46	0.10	0.63	3.57	0.10	0.10
HEADWTR-2	4.	0.00	0.00	5.00	0.46	0.10	0.63	3.57	0.10	0.10
HEADWTR-2	5.	0.00	0.00	5.00	0.46	0.10	0.63	3.57	0.10	0.10
HEADWTR-2	6.	0.00	0.00	5.00	0.46	0.10	0.63	3.57	0.10	0.10
ENDATA10A	0.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

$$$ DATA TYPE 11 (POINT SOURCE / POINT SOURCE CHARACTERISTICS) $$$

CARD TYPE	POINT LOAD ORDER	NAME	EFF	FLOW	TEMP	D.O.	BOD	CM-1	CM-2	CM-3
POINTLD-1	1.	Kokomo Regen	0.00	0.04	71.90	5.26	39.76	0.00	0.00	0.00
POINTLD-1	2.	Hemlock Sept	0.00	0.01	70.00	2.00	220.00	0.00	0.00	0.00
POINTLD-1	3.	Taylor HS	0.00	0.34	72.80	5.98	3.12	0.00	0.00	0.00
POINTLD-1	4.	Center Septi	0.00	0.01	70.00	2.00	220.00	0.00	0.00	0.00
POINTLD-1	5.	Timbernest A	0.00	0.02	80.60	4.80	11.36	0.00	0.00	0.00
POINTLD-1	6.	Oakford Sept	0.00	0.00	70.00	2.00	220.00	0.00	0.00	0.00
POINTLD-1	7.	Delco	0.00	0.09	78.80	8.60	2.84	0.00	0.00	0.00
POINTLD-1	8.	Chrysler	0.00	0.34	72.80	5.98	3.12	0.00	0.00	0.00
ENDATA11	0.		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

$$$ DATA TYPE 11A (POINT SOURCE CHARACTERISTICS - CHLOROPHYLL A, NITROGEN, PHOSPHORUS, COLIFORMS AND SELECTED NON-CONSERVATIVE CONSTITUENT) $$$

CARD TYPE	POINT LOAD ORDER	ANC	COLI	CHL-A	ORG-N	NH3-N	NO2-N	N03-N	ORG-P	DIS-P
POINTLD-2	1.	0.00	0.00	5.00	4.00	3.70	0.01	0.09	0.50	0.50
POINTLD-2	2.	0.00	0.00	5.00	20.00	28.00	0.30	1.70	5.00	5.00
POINTLD-2	3.	0.00	0.00	5.00	0.50	0.40	0.08	0.43	0.50	0.50
POINTLD-2	4.	0.00	0.00	5.00	20.00	28.00	0.30	1.70	5.00	5.00
POINTLD-2	5.	0.00	0.00	5.00	1.00	0.40	0.01	0.09	0.50	0.50
POINTLD-2	6.	0.00	0.00	5.00	20.00	28.00	0.30	1.70	5.00	5.00
POINTLD-2	7.	0.00	0.00	5.00	0.40	0.10	0.28	1.62	0.10	0.10
POINTLD-2	8.	0.00	0.00	5.00	0.50	0.40	0.08	0.43	0.10	0.10
ENDATA11A	0.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

$$$ DATA TYPE 12 (DAM CHARACTERISTICS) $$$

	DAM	RCH	ELE	ADAM	BDAM	FDAM	HDAM
ENDATA12	0.	0.	0.	0.00	0.00	0.00	0.00

$$$ DATA TYPE 13 (DOWNSTREAM BOUNDARY CONDITIONS-1) $$$

CARD TYPE	TEMP	D.O.	BOD	CM-1	CM-2	CM-3	ANC	COLI
ENDATA13	DOWNSTREAM BOUNDARY CONCENTRATIONS ARE UNCONSTRAINED							

$$$ DATA TYPE 13A (DOWNSTREAM BOUNDARY CONDITIONS-2) $$$

CARD TYPE	CHL-A	ORG-N	NH3-N	NO2-N	NH3-N	ORG-P	DIS-P
ENDATA13A	DOWNSTREAM BOUNDARY CONCENTRATIONS ARE UNCONSTRAINED						

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                                        * * * QUAL-2E  STREAM QUALITY ROUTING MODEL * * *
                                                  Version 3.21  -  Feb. 1995

$$$ (PROBLEM TITLES) $$$

CARD TYPE                                QUAL-2E PROGRAM TITLES
TITLE01                 Kokomo Creek, Indiana (7Q10 flows)
TITLE02                 TMDL Run 100 - Existing permit loads
TITLE03   NO            CONSERVATIVE MINERAL I
TITLE04   NO            CONSERVATIVE MINERAL II
TITLE05   NO            CONSERVATIVE MINERAL III
TITLE06   YES           TEMPERATURE
TITLE07   YES           BIOCHEMICAL OXYGEN DEMAND
TITLE08   YES           ALGAE AS CHL-A IN UG/L
TITLE09   YES           PHOSPHORUS CYCLE AS P IN MG/L
TITLE10                   (ORGANIC-P; DISSOLVED-P)
TITLE11   YES           NITROGEN CYCLE AS N IN MG/L
TITLE12                   (ORGANIC-N; AMMONIA-N; NITRITE-N;' NITRATE-N)
TITLE13   YES           DISSOLVED OXYGEN IN MG/L
TITLE14   NO            FECAL COLIFORM IN NO./100 ML
TITLE15   NO            ARBITRARY NON-CONSERVATIVE
ENDTITLE

$$$ DATA TYPE 1 (CONTROL DATA) $$$

CARD TYPE                                          CARD TYPE
LIST DATA INPUT                0.00000                                  0.00000
NO WRITE OPTIONAL SUMMARY      0.00000                                  0.00000
NO FLOW AUGMENTATION           0.00000                                  0.00000
STEADY STATE                   0.00000                                  0.00000
NO TRAP CHANNELS               0.00000                                  0.00000
NO PRINT LCD/SOLAR DATA        0.00000                                  0.00000
NO PLOT DO AND BOD DATA        0.00000                                  0.00000
FIXED DNSTM CONC (YES=1)=      0.00000   5D-ULT BOD CONV K COEF   =     0.23000
INPUT METRIC                =  0.00000   OUTPUT METRIC            =     0.00000
NUMBER OF REACHES           =  17.00000  NUMBER OF JUNCTIONS      =     5.00000
NUM OF HEADWATERS           =   6.00000  NUMBER OF POINT LOADS    =     8.00000
TIME STEP (HOURS)           =   1.00000  LNTH. COMP. ELEMENT (DX)=      0.17100
MAXIMUM ROUTE TIME (HRS)=      30.00000  TIME INC. FOR RPT2 (HRS)=       1.00000
LATITUDE OF BASIN (DEG)     =  40.45000  LONGITUDE OF BASIN (DEG)=      86.05000
STANDARD MERIDIAN (DEG)     =  90.00000  DAY OF YEAR START TIME   =   243.00000
EVAP. COEF.,(AE)            =   0.00103  EVAP. COEF.,(BE)         =     0.00016
ELEV. OF BASIN (ELEV)       = 825.00000  DUST ATTENUATION COEF.    =     0.06000
ENDATA1                        0.00000                                  0.00000

$$$ DATA TYPE 1A (ALGAE PRODUCTION AND NITROGEN OXIDATION CONSTANTS) $$$

CARD TYPE                                          CARD TYPE
O UPTAKE BY NH3 OXID(MG O/MG N)=     3.4300   O UPTAKE BY NO2 OXID(MG O/MG N)=     1.1400
O PROD  BY ALGAE (MG O/MG A)   =     1.6000   O UPTAKE BY ALGAE (MG O/MG A)  =     2.0000
N CONTENT OF ALGAE (MG N/MG A) =     0.0850   P CONTENT OF ALGAE (MG O/MG A) =     0.0140
ALG MAX SPEC GROWTH RATE(1/DAY)=     2.1000   ALGAE RESPIRATION RATE (1/DAY) =     0.0500
N HALF SATURATION CONST (MG/L) =     0.1500   P HALF SATURATION CONST (MG/L) =     0.0100
LIN ALG SHADE CO (1/FT-UGCHA/L=)     0.0027   NLIN SHADE(1/FT-(UGCHA/L)**2/3)=     0.0165
LIGHT FUNCTION OPTION (LFNOPT) =     1.0000   LIGHT SAT'N COEF (BTU/FT2-MIN) =     0.0833
DAILY AVERAGING OPTION (LAVOPT)=     3.0000   LIGHT AVERAGING FACTOR (AFACT) =     0.9200
NUMBER OF DAYLIGHT HOURS (DLH) =    12.5000   TOTAL DAILY SOLR RAD (BTU/FT-2)= 1300.0000
ALGY GROWTH CALC OPTION(LGROPT)=     2.0000   ALGAL PREF FOR NH3-N (PREFN)   =     0.9000
ALG/TEMP SOLR RAD FACTOR(TFACT)=     0.4400   NITRIFICATION INHIBITION COEF  =     0.5000
ENDATA1A                             0.0000                                          0.0000

$$$ DATA TYPE 1B (TEMPERATURE CORRECTION CONSTANTS FOR RATE COEFFICIENTS) $$$

CARD TYPE      RATE CODE      THETA VALUE

THETA( 1)      BOD DECA         1.047      USER
THETA( 2)      BOD SETT         1.024      USER
THETA( 3)      OXY TRAN         1.028      USER
THETA( 4)      SOD RATE         1.047      USER
THETA( 5)      ORGN DEC         1.047      USER
THETA( 6)      ORGN SET         1.024      USER
THETA( 7)      NH3 DECA         1.083      USER
THETA( 8)      NH3 SRCE         1.074      USER
THETA( 9)      NO2 DECA         1.047      USER
THETA(10)      PORG DEC         1.047      USER
THETA(11)      PORG SET         1.024      USER
THETA(12)      DISP SRC         1.074      USER
THETA(13)      ALG GROW         1.047      USER
THETA(14)      ALG RESP         1.047      USER
THETA(15)      ALG SETT         1.024      USER
THETA(16)      COLI DEC         1.047      DFLT
THETA(17)      ANC DECA         1.000      DFLT
THETA(18)      ANC SETT         1.024      DFLT
THETA(19)      ANC SRCE         1.000      DFLT
ENDATA1B
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$$$ DATA TYPE 2 (REACH IDENTIFICATION) $$$

CARD TYPE	REACH ORDER AND IDENT			R. MI/KM		R. MI/KM
STREAM REACH	1.0	RCH= Tolle Ditch	FROM	16.1	TO	12.8
STREAM REACH	2.0	RCH= Finn Ditch	FROM	17.6	TO	15.2
STREAM REACH	3.0	RCH= Finn Ditch	FROM	15.2	TO	12.8
STREAM REACH	4.0	RCH= Kokomo Creek	FROM	12.8	TO	9.6
STREAM REACH	5.0	RCH= Kokomo Creek	FROM	9.6	TO	7.2
STREAM REACH	6.0	RCH= Kokomo Creek	FROM	7.2	TO	6.3
STREAM REACH	7.0	RCH= Mugg-Ingels	FROM	8.9	TO	6.3
STREAM REACH	8.0	RCH= Kokomo Creek	FROM	6.3	TO	5.3
STREAM REACH	9.0	RCH= Kokomo Creek	FROM	5.3	TO	4.3
STREAM REACH	10.0	RCH= Martin-Youngman	FROM	7.7	TO	5.6
STREAM REACH	11.0	RCH= Oakford drain	FROM	6.2	TO	5.6
STREAM REACH	12.0	RCH= Martin-Youngman	FROM	5.6	TO	5.0
STREAM REACH	13.0	RCH= Scott-Youngman	FROM	6.8	TO	5.0
STREAM REACH	14.0	RCH= Martin-Youngman	FROM	5.0	TO	4.6
STREAM REACH	15.0	RCH= Martin-Youngman	FROM	4.6	TO	4.3
STREAM REACH	16.0	RCH= Kokomo Creek	FROM	4.3	TO	2.2
STREAM REACH	17.0	RCH= Kokomo Creek	FROM	2.2	TO	0.0
ENDATA2	0.0			0.0		0.0

$$$ DATA TYPE 3 (TARGET LEVEL DO AND FLOW AUGMENTATION SOURCES) $$$

CARD TYPE	REACH	AVAIL HDWS	TARGET	ORDER OF AVAIL SOURCES					
ENDATA3	0.	0.	0.0	0.	0.	0.	0.	0.	0.

$$$ DATA TYPE 4 (COMPUTATIONAL REACH FLAG FIELD) $$$

CARD TYPE	REACH	ELEMENTS/REACH	COMPUTATIONAL FLAGS
FLAG FIELD	1.	19.	1.2.2.2.2.2.2.2.2.2.2.2.2.2.2.2.3.0.
FLAG FIELD	2.	14.	1.2.2.2.2.2.2.2.2.2.2.2.2.0.0.0.0.0.
FLAG FIELD	3.	14.	2.2.2.2.2.2.2.2.2.2.2.2.2.0.0.0.0.0.
FLAG FIELD	4.	19.	4.2.2.2.2.2.2.2.2.2.2.2.2.2.2.2.2.0.
FLAG FIELD	5.	14.	2.2.2.2.2.2.2.2.2.2.2.2.2.0.0.0.0.0.
FLAG FIELD	6.	5.	6.2.2.2.3.0.0.0.0.0.0.0.0.0.0.0.0.0.
FLAG FIELD	7.	15.	1.2.2.2.2.2.2.2.2.2.2.2.2.6.0.0.0.0.
FLAG FIELD	8.	6.	4.2.6.6.2.6.0.0.0.0.0.0.0.0.0.0.0.0.
FLAG FIELD	9.	6.	2.2.2.2.2.3.0.0.0.0.0.0.0.0.0.0.0.0.
FLAG FIELD	10.	12.	1.2.2.2.2.2.2.2.2.2.3.0.0.0.0.0.0.0.
FLAG FIELD	11.	3.	1.2.6.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.
FLAG FIELD	12.	4.	4.2.2.3.0.0.0.0.0.0.0.0.0.0.0.0.0.0.
FLAG FIELD	13.	11.	1.2.2.2.2.2.2.2.2.2.0.0.0.0.0.0.0.0.
FLAG FIELD	14.	2.	4.2.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.
FLAG FIELD	15.	2.	2.2.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.
FLAG FIELD	16.	12.	4.2.2.2.2.2.2.2.6.6.2.2.0.0.0.0.0.0.
FLAG FIELD	17.	13.	2.2.2.2.2.2.2.2.2.2.2.5.0.0.0.0.0.0.
ENDATA4	0.	0.	0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.

$$$ DATA TYPE 5 (HYDRAULIC DATA FOR DETERMINING VELOCITY AND DEPTH) $$$

CARD TYPE	REACH	COEF-DSPN	COEFQV	EXPOQV	COEFQH	EXPOQH	CMANN
HYDRAULICS	1.	100.00	0.100	0.350	0.600	0.450	0.045
HYDRAULICS	2.	100.00	0.100	0.350	0.600	0.450	0.045
HYDRAULICS	3.	100.00	0.100	0.350	0.600	0.450	0.045
HYDRAULICS	4.	100.00	0.120	0.480	0.430	0.320	0.045
HYDRAULICS	5.	100.00	0.120	0.480	0.450	0.320	0.045
HYDRAULICS	6.	100.00	0.110	0.480	0.490	0.350	0.045
HYDRAULICS	7.	100.00	0.100	0.350	0.600	0.450	0.045
HYDRAULICS	8.	100.00	0.110	0.480	0.510	0.350	0.045
HYDRAULICS	9.	100.00	0.110	0.480	0.510	0.350	0.045
HYDRAULICS	10.	100.00	0.100	0.350	0.600	0.450	0.045
HYDRAULICS	11.	100.00	0.100	0.350	0.600	0.450	0.045
HYDRAULICS	12.	100.00	0.100	0.350	0.600	0.450	0.045
HYDRAULICS	13.	100.00	0.100	0.350	0.600	0.450	0.045
HYDRAULICS	14.	100.00	0.100	0.350	0.600	0.450	0.045
HYDRAULICS	15.	100.00	0.100	0.350	0.600	0.450	0.045
HYDRAULICS	16.	100.00	0.310	0.120	0.330	0.410	0.045
HYDRAULICS	17.	100.00	0.310	0.110	0.310	0.380	0.045
ENDATA5	0.	0.00	0.000	0.000	0.000	0.000	0.000

$$$ DATA TYPE 5A (STEADY STATE TEMPERATURE AND CLIMATOLOGY DATA) $$$

CARD TYPE	REACH	ELEVATION	DUST COEF	CLOUD COVER	DRY BULB TEMP	WET BULB TEMP	ATM PRESSURE	WIND	SOLAR RAD ATTENUATION
CLIMATOLOG	1.	825.00	0.06	0.50	85.00	63.50	30.26	8.50	0.92
CLIMATOLOG	2.	825.00	0.06	0.50	85.00	63.50	30.26	8.50	0.92
CLIMATOLOG	3.	825.00	0.06	0.50	85.00	63.50	30.26	8.50	0.92
CLIMATOLOG	4.	825.00	0.06	0.50	85.00	63.50	30.26	8.50	1.00
CLIMATOLOG	5.	825.00	0.06	0.50	85.00	64.70	30.26	8.50	1.00
CLIMATOLOG	6.	825.00	0.06	0.50	85.00	63.50	30.26	8.50	0.94
CLIMATOLOG	7.	825.00	0.06	0.50	85.00	63.50	30.26	8.50	0.95
CLIMATOLOG	8.	825.00	0.06	0.50	85.00	63.50	30.26	10.50	0.85

CLIMATOLOG	9.	825.00	0.06	0.50	85.00	63.50	30.26	10.50	0.85
CLIMATOLOG	10.	825.00	0.06	0.50	85.00	63.50	30.26	8.50	0.95
CLIMATOLOG	11.	825.00	0.06	0.50	85.00	63.50	30.26	8.50	0.95
CLIMATOLOG	12.	825.00	0.06	0.50	85.00	63.50	30.26	8.50	0.95
CLIMATOLOG	13.	825.00	0.06	0.50	85.00	63.50	30.26	8.50	0.95
CLIMATOLOG	14.	825.00	0.06	0.50	85.00	63.50	30.26	8.50	0.95
CLIMATOLOG	15.	825.00	0.06	0.50	85.00	63.50	30.26	8.50	0.95
CLIMATOLOG	16.	825.00	0.06	0.50	85.00	65.60	30.26	8.50	0.96
CLIMATOLOG	17.	825.00	0.06	0.50	85.00	65.50	30.26	8.50	0.96
ENDATA5A	0.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

$$$ DATA TYPE 6 (REACTION COEFFICIENTS FOR DEOXYGENATION AND REAERATION) $$$

CARD TYPE	REACH	K1	K3	SOD RATE	K2OPT	K2	COEQK2 TSIV COEF FOR OPT 8	OR OR	EXPQK2 SLOPE FOR OPT 8
REACT COEF	1.	0.20	0.00	0.080	11.	0.00	1.600		0.00134
REACT COEF	2.	0.20	0.00	0.080	11.	0.00	1.600		0.00095
REACT COEF	3.	0.20	0.00	0.080	11.	0.00	1.600		0.00071
REACT COEF	4.	0.20	0.00	0.080	11.	0.00	1.600		0.00105
REACT COEF	5.	0.30	0.00	0.100	11.	0.00	1.600		0.00079
REACT COEF	6.	0.55	0.00	0.148	11.	0.00	1.600		0.00044
REACT COEF	7.	0.20	0.00	0.080	11.	0.00	1.600		0.00229
REACT COEF	8.	0.55	0.00	0.150	11.	0.00	1.600		0.00074
REACT COEF	9.	0.45	0.00	0.100	11.	0.00	1.600		0.00092
REACT COEF	10.	0.20	0.00	0.080	11.	0.00	1.600		0.00323
REACT COEF	11.	0.20	0.00	0.080	11.	0.00	1.600		0.00443
REACT COEF	12.	0.20	0.00	0.080	11.	0.00	1.600		0.00249
REACT COEF	13.	0.20	0.00	0.080	11.	0.00	1.600		0.00443
REACT COEF	14.	0.20	0.00	0.080	11.	0.00	1.600		0.00332
REACT COEF	15.	0.20	0.00	0.080	11.	0.00	1.600		0.00332
REACT COEF	16.	0.20	0.00	0.100	11.	0.00	1.600		0.00083
REACT COEF	17.	0.20	0.00	0.100	11.	0.00	1.600		0.00179
ENDATA6	0.	0.00	0.00	0.000	0.	0.00	0.000		0.00000

$$$ DATA TYPE 6A (NITROGEN AND PHOSPHORUS CONSTANTS) $$$

CARD TYPE	REACH	CKNH2	SETNH2	CKNH3	SNH3	CKNO2	CKPORG	SETPORG	SPO4
N AND P COEF	1.	0.02	0.05	0.10	0.00	2.00	0.00	0.00	0.00
N AND P COEF	2.	0.02	0.05	0.10	0.00	2.00	0.00	0.00	0.00
N AND P COEF	3.	0.02	0.05	0.10	0.00	2.00	0.00	0.00	0.00
N AND P COEF	4.	0.10	0.10	0.15	0.00	2.00	0.00	0.00	0.00
N AND P COEF	5.	0.20	0.10	0.15	0.00	2.00	0.00	0.00	0.00
N AND P COEF	6.	0.20	0.10	1.00	0.00	2.00	0.00	0.00	0.00
N AND P COEF	7.	0.15	0.09	1.00	0.00	2.00	0.00	0.00	0.00
N AND P COEF	8.	0.25	0.10	1.00	0.00	2.00	0.00	0.00	0.00
N AND P COEF	9.	0.25	0.10	1.00	0.00	2.00	0.00	0.00	0.00
N AND P COEF	10.	0.15	0.09	0.90	0.00	2.00	0.00	0.00	0.00
N AND P COEF	11.	0.15	0.09	0.90	0.00	2.00	0.00	0.00	0.00
N AND P COEF	12.	0.15	0.09	0.90	0.00	2.00	0.00	0.00	0.00
N AND P COEF	13.	0.15	0.09	0.90	0.00	2.00	0.00	0.00	0.00
N AND P COEF	14.	0.15	0.09	0.90	0.00	2.00	0.00	0.00	0.00
N AND P COEF	15.	0.15	0.09	0.90	0.00	2.00	0.00	0.00	0.00
N AND P COEF	16.	0.25	0.10	1.00	0.00	2.00	0.00	0.00	0.00
N AND P COEF	17.	0.25	0.10	1.00	0.00	2.00	0.00	0.00	0.00
ENDATA6A	0.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

$$$ DATA TYPE 6B (ALGAE/OTHER COEFFICIENTS) $$$

CARD TYPE	REACH	ALPHAO	ALGSET	EXCOEF	CK5 CKCOLI	CKANC	SETANC	SRCANC
ALG/OTHER COEF	1.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	2.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	3.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	4.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	5.	15.00	0.50	0.01	0.00	0.00	0.00	0.00

ALG/OTHER COEF	6.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	7.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	8.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	9.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	10.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	11.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	12.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	13.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	14.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	15.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	16.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	17.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ENDATA6B	0.	0.00	0.00	0.00	0.00	0.00	0.00	0.00

$$$ DATA TYPE 7 (INITIAL CONDITIONS) $$$

CARD TYPE	REACH	TEMP	D.O.	BOD	CM-1	CM-2	CM-3	ANC	COLI
INITIAL COND-1	1.	77.40	6.00	2.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	2.	77.40	6.00	2.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	3.	77.40	6.00	2.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	4.	77.40	6.00	2.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	5.	77.40	6.00	2.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	6.	77.40	6.00	2.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	7.	77.40	6.00	2.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	8.	77.40	6.00	2.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	9.	77.40	6.00	2.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	10.	77.40	6.00	2.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	11.	77.40	6.00	2.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	12.	77.40	6.00	2.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	13.	77.40	6.00	2.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	14.	77.40	6.00	2.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	15.	77.40	6.00	2.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	16.	77.40	6.00	2.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	17.	77.40	6.00	2.00	0.00	0.00	0.00	0.00	0.00
ENDATA7	0.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

$$$ DATA TYPE 7A (INITIAL CONDITIONS FOR CHOROPHYLL A, NITROGEN, AND PHOSPHORUS) $$$

CARD TYPE	REACH	CHL-A	ORG-N	NH3-N	NO2-N	NO3-N	ORG-P	DIS-P
INITIAL COND-2	1.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	2.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	3.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	4.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	5.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	6.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	7.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	8.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	9.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	10.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	11.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	12.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	13.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	14.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	15.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	16.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	17.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
ENDATA7A	0.	0.00	0.00	0.00	0.00	0.00	0.00	0.00

$$$ DATA TYPE 8 (INCREMENTAL INFLOW CONDITIONS) $$$

CARD TYPE	REACH	FLOW	TEMP	D.O.	BOD	CM-1	CM-2	CM-3	ANC	COLI
INCR INFLOW-1	1.	0.025	77.40	7.00	0.50	0.00	0.00	0.00	0.00	0.00
INCR INFLOW-1	2.	0.017	77.40	7.00	0.50	0.00	0.00	0.00	0.00	0.00

	INCR INFLOW-1	3.	0.017	77.40	7.00	0.50	0.00	0.00	0.00
0.00	0.00								
	INCR INFLOW-1	4.	0.075	77.40	7.00	0.50	0.00	0.00	0.00
0.00	0.00								
	INCR INFLOW-1	5.	0.055	77.40	7.00	0.50	0.00	0.00	0.00
0.00	0.00								
	INCR INFLOW-1	6.	0.020	77.40	7.00	0.50	0.00	0.00	0.00
0.00	0.00								
	INCR INFLOW-1	7.	0.033	77.40	7.00	0.50	0.00	0.00	0.00
0.00	0.00								
	INCR INFLOW-1	8.	0.009	77.40	7.00	0.50	0.00	0.00	0.00
0.00	0.00								
	INCR INFLOW-1	9.	0.009	77.40	7.00	0.50	0.00	0.00	0.00
0.00	0.00								
	INCR INFLOW-1	10.	0.018	77.40	7.00	0.50	0.00	0.00	0.00
0.00	0.00								
	INCR INFLOW-1	11.	0.004	77.40	7.00	0.50	0.00	0.00	0.00
0.00	0.00								
	INCR INFLOW-1	12.	0.006	77.40	7.00	0.50	0.00	0.00	0.00
0.00	0.00								
	INCR INFLOW-1	13.	0.016	77.40	7.00	0.50	0.00	0.00	0.00
0.00	0.00								
	INCR INFLOW-1	14.	0.003	77.40	7.00	0.50	0.00	0.00	0.00
0.00	0.00								
	INCR INFLOW-1	15.	0.003	77.40	7.00	0.50	0.00	0.00	0.00
0.00	0.00								
	INCR INFLOW-1	16.	0.033	77.40	7.00	0.50	0.00	0.00	0.00
0.00	0.00								
	INCR INFLOW-1	17.	0.036	77.40	7.00	0.50	0.00	0.00	0.00
0.00	0.00								
	ENDATA8	0.	0.000	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00								

$$$ DATA TYPE 8A (INCREMENTAL INFLOW CONDITIONS FOR CHLOROPHYLL A, NITROGEN, AND PHOSPHORUS) $$$

CARD TYPE	REACH	CHL-A	ORG-N	NH3-N	NO2-N	NO3-N	ORG-P	DIS-P
INCR INFLOW-2	1.	5.00	0.60	0.20	0.20	0.10	0.05	0.05
INCR INFLOW-2	2.	5.00	0.60	0.20	0.20	0.10	0.05	0.05
INCR INFLOW-2	3.	5.00	0.60	0.20	0.20	0.10	0.05	0.05
INCR INFLOW-2	4.	5.00	0.70	0.20	0.20	0.10	0.05	0.05
INCR INFLOW-2	5.	5.00	0.70	0.20	0.20	0.10	0.05	0.05
INCR INFLOW-2	6.	5.00	0.60	0.20	0.30	0.30	0.05	0.05
INCR INFLOW-2	7.	5.00	0.60	0.20	0.20	0.10	0.05	0.05
INCR INFLOW-2	8.	5.00	0.50	0.20	0.20	0.10	0.05	0.05
INCR INFLOW-2	9.	5.00	0.50	0.20	0.20	0.10	0.05	0.05
INCR INFLOW-2	10.	5.00	0.60	0.15	0.20	0.10	0.05	0.05
INCR INFLOW-2	11.	5.00	0.60	0.15	0.20	0.10	0.05	0.05
INCR INFLOW-2	12.	5.00	0.60	0.15	0.20	0.10	0.05	0.05
INCR INFLOW-2	13.	5.00	0.60	0.15	0.20	0.10	0.05	0.05
INCR INFLOW-2	14.	5.00	0.60	0.15	0.20	0.10	0.05	0.05
INCR INFLOW-2	15.	5.00	0.60	0.15	0.20	0.10	0.05	0.05
INCR INFLOW-2	16.	5.00	0.40	0.00	0.20	0.10	0.05	0.05
INCR INFLOW-2	17.	5.00	0.40	0.00	0.20	0.10	0.05	0.05
ENDATA8A	0.	0.00	0.00	0.00	0.00	0.00	0.00	0.00

$$$ DATA TYPE 9 (STREAM JUNCTIONS) $$$

CARD TYPE	JUNCTION ORDER AND IDENT			UPSTRM	JUNCTION	TRIB
STREAM JUNCTION	1.	JNC=	1	19.	48.	47.
STREAM JUNCTION	2.	JNC=	2	85.	101.	100.
STREAM JUNCTION	3.	JNC=	3	124.	128.	127.
STREAM JUNCTION	4.	JNC=	4	131.	143.	142.
STREAM JUNCTION	5.	JNC=	5	112.	147.	146.
ENDATA9	0.			0.	0.	0.

$$$ DATA TYPE 10 (HEADWATER SOURCES) $$$

CARD TYPE	HDWTR ORDER	NAME	FLOW	TEMP	D.O.	BOD	CM-1	CM-2
CM-3								
HEADWTR-1	1.	Tolle Ditch	0.03	77.40	7.00	0.50	0.00	0.00
0.00								
HEADWTR-1	2.	Finn Ditch	0.03	77.40	7.00	0.50	0.00	0.00
0.00								
HEADWTR-1	3.	Mugg-Ingels	0.01	77.40	7.00	0.50	0.00	0.00
0.00								
HEADWTR-1	4.	Martin-Youngman	0.01	77.40	7.00	0.50	0.00	0.00
0.00								
HEADWTR-1	5.	Oakford drain	0.01	77.40	7.00	0.50	0.00	0.00
0.00								
HEADWTR-1	6.	Scott-Youngman	0.01	77.40	7.00	0.50	0.00	0.00
0.00								
ENDATA10	0.		0.00	0.00	0.00	0.00	0.00	0.00
0.00								

$$$ DATA TYPE 10A (HEADWATER CONDITIONS FOR CHLOROPHYLL, NITROGEN, PHOSPHORUS, COLIFORM AND SELECTED NON-CONSERVATIVE CONSTITUENT) $$$

CARD TYPE	HDWTR ORDER	ANC	COLI	CHL-A	ORG-N	NH3-N	NO2-N	NO3-N	ORG-P	DIS-P
HEADWTR-2	1.	0.00	0.00	5.00	0.60	0.20	0.03	0.17	0.15	0.15
HEADWTR-2	2.	0.00	0.00	5.00	0.60	0.20	0.03	0.17	0.15	0.15
HEADWTR-2	3.	0.00	0.00	5.00	0.60	0.20	0.09	0.51	0.15	0.15
HEADWTR-2	4.	0.00	0.00	5.00	0.60	0.20	0.01	0.09	0.15	0.15
HEADWTR-2	5.	0.00	0.00	5.00	0.60	0.20	0.01	0.09	0.15	0.15
HEADWTR-2	6.	0.00	0.00	5.00	0.60	0.20	0.01	0.09	0.15	0.15
ENDATA10A	0.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

$$$ DATA TYPE 11 (POINT SOURCE / POINT SOURCE CHARACTERISTICS) $$$

CARD TYPE	POINT LOAD ORDER	NAME	EFF	FLOW	TEMP	D.O.	BOD	CM-1	CM-2	CM-3
POINTLD-1	1.	Kokomo Regen	0.00	0.14	77.40	6.00	42.60	0.00	0.00	0.00
POINTLD-1	2.	Hemlock Sept	0.00	0.01	77.40	2.00	220.00	0.00	0.00	0.00
POINTLD-1	3.	Taylor HS	0.00	0.04	77.40	6.00	42.60	0.00	0.00	0.00
POINTLD-1	4.	Center Septi	0.00	0.01	77.40	2.00	220.00	0.00	0.00	0.00
POINTLD-1	5.	Timbernest A	0.00	0.02	77.40	2.90	71.00	0.00	0.00	0.00
POINTLD-1	6.	Oakford Sept	0.00	0.00	77.40	2.00	220.00	0.00	0.00	0.00
POINTLD-1	7.	Delco	0.00	0.00	74.10	8.00	5.68	0.00	0.00	0.00
POINTLD-1	8.	Chrysler	0.00	0.00	72.00	8.00	5.68	0.00	0.00	0.00
ENDATA11	0.		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

$$$ DATA TYPE 11A (POINT SOURCE CHARACTERISTICS - CHLOROPHYLL A, NITROGEN, PHOSPHORUS, COLIFORMS AND SELECTED NON-CONSERVATIVE CONSTITUENT) $$$

CARD TYPE	POINT LOAD ORDER	ANC	COLI	CHL-A	ORG-N	NH3-N	NO2-N	N03-N	ORG-P	DIS-P
POINTLD-2	1.	0.00	0.00	5.00	4.00	1.20	0.50	2.80	0.50	0.50
POINTLD-2	2.	0.00	0.00	5.00	20.00	28.00	0.30	1.70	5.00	5.00
POINTLD-2	3.	0.00	0.00	5.00	0.44	3.40	4.50	25.50	0.50	0.50
POINTLD-2	4.	0.00	0.00	5.00	20.00	28.00	0.30	1.70	5.00	5.00
POINTLD-2	5.	0.00	0.00	5.00	1.68	3.90	1.36	7.74	0.50	0.50
POINTLD-2	6.	0.00	0.00	5.00	20.00	28.00	0.30	1.70	5.00	5.00
POINTLD-2	7.	0.00	0.00	5.00	0.00	0.10	0.09	0.54	0.10	0.10
POINTLD-2	8.	0.00	0.00	5.00	0.38	0.13	0.01	0.07	0.10	0.10
ENDATA11A	0.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

$$$ DATA TYPE 12 (DAM CHARACTERISTICS) $$$

	DAM	RCH	ELE	ADAM	BDAM	FDAM	HDAM
ENDATA12	0.	0.	0.	0.00	0.00	0.00	0.00

$$$ DATA TYPE 13 (DOWNSTREAM BOUNDARY CONDITIONS-1) $$$

CARD TYPE	TEMP	D.O.	BOD	CM-1	CM-2	CM-3	ANC	COLI

ENDATA13 DOWNSTREAM BOUNDARY CONCENTRATIONS ARE UNCONSTRAINED

$$$ DATA TYPE 13A (DOWNSTREAM BOUNDARY CONDITIONS-2) $$$

CARD TYPE	CHL-A	ORG-N	NH3-N	NO2-N	NH3-N	ORG-P	DIS-P

ENDATA13A DOWNSTREAM BOUNDARY CONCENTRATIONS ARE UNCONSTRAINED

* * * QUAL-2E STREAM QUALITY ROUTING MODEL * * *
Version 3.21 - Feb. 1995

$$$ (PROBLEM TITLES) $$$

QUAL-2E PROGRAM TITLES

CARD TYPE		
TITLE01		Kokomo Creek, Indiana (7Q10 flows)
TITLE02		TMDL Run 101 - Alt#1, remove septics, expand Taylor WWTP
TITLE03	NO	CONSERVATIVE MINERAL I
TITLE04	NO	CONSERVATIVE MINERAL II
TITLE05	NO	CONSERVATIVE MINERAL III
TITLE06	YES	TEMPERATURE
TITLE07	YES	BIOCHEMICAL OXYGEN DEMAND
TITLE08	YES	ALGAE AS CHL-A IN UG/L
TITLE09	YES	PHOSPHORUS CYCLE AS P IN MG/L
TITLE10		(ORGANIC-P; DISSOLVED-P)
TITLE11	YES	NITROGEN CYCLE AS N IN MG/L
TITLE12		(ORGANIC-N; AMMONIA-N; NITRITE-N;' NITRATE-N)
TITLE13	YES	DISSOLVED OXYGEN IN MG/L
TITLE14	NO	FECAL COLIFORM IN NO:/100 ML
TITLE15	NO	ARBITRARY NON-CONSERVATIVE
ENDTITLE		

$$$ DATA TYPE 1 (CONTROL DATA) $$$

CARD TYPE		CARD TYPE	
LIST DATA INPUT	0.00000		0.00000
NO WRITE OPTIONAL SUMMARY	0.00000		0.00000
NO FLOW AUGMENTATION	0.00000		0.00000
STEADY STATE	0.00000		0.00000
NO TRAP CHANNELS	0.00000		0.00000
NO PRINT LCD/SOLAR DATA	0.00000		0.00000
NO PLOT DO AND BOD DATA	0.00000		0.00000
FIXED DNSTM CONC (YES=1) =	0.00000	5D-ULT BOD CONV K COEF =	0.23000
INPUT METRIC =	0.00000	OUTPUT METRIC =	0.00000
NUMBER OF REACHES =	17.00000	NUMBER OF JUNCTIONS =	5.00000
NUM OF HEADWATERS =	6.00000	NUMBER OF POINT LOADS =	8.00000
TIME STEP (HOURS) =	1.00000	LNTH. COMP. ELEMENT (DX) =	0.17100
MAXIMUM ROUTE TIME (HRS) =	30.00000	TIME INC. FOR RPT2 (HRS) =	1.00000
LATITUDE OF BASIN (DEG) =	40.45000	LONGITUDE OF BASIN (DEG) =	86.05000
STANDARD MERIDIAN (DEG) =	90.00000	DAY OF YEAR START TIME =	243.00000
EVAP. COEF.,(AE) =	0.00103	EVAP. COEF.,(BE) =	0.00016
ELEV. OF BASIN (ELEV) =	825.00000	DUST ATTENUATION COEF. =	0.06000
ENDATA1	0.00000		0.00000

$$$ DATA TYPE 1A (ALGAE PRODUCTION AND NITROGEN OXIDATION CONSTANTS) $$$

CARD TYPE		CARD TYPE	
O UPTAKE BY NH3 OXID(MG O/MG N) =	3.4300	O UPTAKE BY NO2 OXID(MG O/MG N) =	1.1400
O PROD BY ALGAE (MG O/MG A) =	1.6000	O UPTAKE BY ALGAE (MG O/MG A) =	2.0000
N CONTENT OF ALGAE (MG N/MG A) =	0.0850	P CONTENT OF ALGAE (MG O/MG A) =	0.0140
ALG MAX SPEC GROWTH RATE(1/DAY) =	2.1000	ALGAE RESPIRATION RATE (1/DAY) =	0.0500
N HALF SATURATION CONST (MG/L) =	0.1500	P HALF SATURATION CONST (MG/L) =	0.0100
LIN ALG SHADE CO (1/FT-UGCHA/L=)	0.0027	NLIN SHADE(1/FT-(UGCHA/L)**2/3) =	0.0165
LIGHT FUNCTION OPTION (LFNOPT) =	1.0000	LIGHT SAT'N COEF (BTU/FT2-MIN) =	0.0833
DAILY AVERAGING OPTION (LAVOPT) =	3.0000	LIGHT AVERAGING FACTOR (AFACT) =	0.9200
NUMBER OF DAYLIGHT HOURS (DLH) =	12.5000	TOTAL DAILY SOLR RAD (BTU/FT-2) =	1300.0000
ALGY GROWTH CALC OPTION(LGROPT) =	2.0000	ALGAL PREF FOR NH3-N (PREFN) =	0.9000
ALG/TEMP SOLR RAD FACTOR(TFACT) =	0.4400	NITRIFICATION INHIBITION COEF =	0.5000
ENDATA1A	0.0000		0.0000

$$$ DATA TYPE 1B (TEMPERATURE CORRECTION CONSTANTS FOR RATE COEFFICIENTS) $$$

CARD TYPE	RATE CODE	THETA VALUE	
THETA(1)	BOD DECA	1.047	USER
THETA(2)	BOD SETT	1.024	USER
THETA(3)	OXY TRAN	1.028	USER
THETA(4)	SOD RATE	1.047	USER
THETA(5)	ORGN DEC	1.047	USER
THETA(6)	ORGN SET	1.024	USER
THETA(7)	NH3 DECA	1.083	USER
THETA(8)	NH3 SRCE	1.074	USER
THETA(9)	NO2 DECA	1.047	USER
THETA(10)	PORG DEC	1.047	USER
THETA(11)	PORG SET	1.024	USER
THETA(12)	DISP SRC	1.074	USER
THETA(13)	ALG GROW	1.047	USER
THETA(14)	ALG RESP	1.047	USER
THETA(15)	ALG SETT	1.024	USER
THETA(16)	COLI DEC	1.047	DFLT
THETA(17)	ANC DECA	1.000	DFLT
THETA(18)	ANC SETT	1.024	DFLT
THETA(19)	ANC SRCE	1.000	DFLT
ENDATA1B			

$$$ DATA TYPE 2 (REACH IDENTIFICATION) $$$

CARD TYPE	REACH ORDER AND IDENT			R. MI/KM		R. MI/KM
STREAM REACH	1.0	RCH= Tolle Ditch	FROM	16.1	TO	12.8
STREAM REACH	2.0	RCH= Finn Ditch	FROM	17.6	TO	15.2
STREAM REACH	3.0	RCH= Finn Ditch	FROM	15.2	TO	12.8
STREAM REACH	4.0	RCH= Kokomo Creek	FROM	12.8	TO	9.6
STREAM REACH	5.0	RCH= Kokomo Creek	FROM	9.6	TO	7.2
STREAM REACH	6.0	RCH= Kokomo Creek	FROM	7.2	TO	6.3
STREAM REACH	7.0	RCH= Mugg-Ingels	FROM	8.9	TO	6.3
STREAM REACH	8.0	RCH= Kokomo Creek	FROM	6.3	TO	5.3
STREAM REACH	9.0	RCH= Kokomo Creek	FROM	5.3	TO	4.3
STREAM REACH	10.0	RCH= Martin-Youngman	FROM	7.7	TO	5.6
STREAM REACH	11.0	RCH= Oakford drain	FROM	6.2	TO	5.6
STREAM REACH	12.0	RCH= Martin-Youngman	FROM	5.6	TO	5.0
STREAM REACH	13.0	RCH= Scott-Youngman	FROM	6.8	TO	5.0
STREAM REACH	14.0	RCH= Martin-Youngman	FROM	5.0	TO	4.6
STREAM REACH	15.0	RCH= Martin-Youngman	FROM	4.6	TO	4.3
STREAM REACH	16.0	RCH= Kokomo Creek	FROM	4.3	TO	2.2
STREAM REACH	17.0	RCH= Kokomo Creek	FROM	2.2	TO	0.0
ENDATA2	0.0			0.0		0.0

$$$ DATA TYPE 3 (TARGET LEVEL DO AND FLOW AUGMENTATION SOURCES) $$$

CARD TYPE	REACH	AVAIL HDWS	TARGET	ORDER OF AVAIL SOURCES					
ENDATA3	0.	0.	0.0	0.	0.	0.	0.	0.	0.

$$$ DATA TYPE 4 (COMPUTATIONAL REACH FLAG FIELD) $$$

CARD TYPE	REACH	ELEMENTS/REACH	COMPUTATIONAL FLAGS
FLAG FIELD	1.	19.	1.2.2.2.2.2.2.2.2.2.2.2.2.2.2.2.2.3.0.
FLAG FIELD	2.	14.	1.2.2.2.2.2.2.2.2.2.2.2.2.0.0.0.0.0.0.
FLAG FIELD	3.	14.	2.2.2.2.2.2.2.2.2.2.2.2.2.0.0.0.0.0.0.
FLAG FIELD	4.	19.	4.2.2.2.2.2.2.2.2.2.2.2.2.2.2.2.2.2.0.
FLAG FIELD	5.	14.	2.2.2.2.2.2.2.2.2.2.2.2.2.0.0.0.0.0.0.
FLAG FIELD	6.	5.	6.2.2.2.3.0.0.0.0.0.0.0.0.0.0.0.0.0.0.
FLAG FIELD	7.	15.	1.2.2.2.2.2.2.2.2.2.2.2.2.6.0.0.0.0.0.
FLAG FIELD	8.	6.	4.2.6.6.2.6.0.0.0.0.0.0.0.0.0.0.0.0.0.
FLAG FIELD	9.	6.	2.2.2.2.2.3.0.0.0.0.0.0.0.0.0.0.0.0.0.
FLAG FIELD	10.	12.	1.2.2.2.2.2.2.2.2.2.3.0.0.0.0.0.0.0.0.
FLAG FIELD	11.	3.	1.2.6.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.
FLAG FIELD	12.	4.	4.2.2.3.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.
FLAG FIELD	13.	11.	1.2.2.2.2.2.2.2.2.2.0.0.0.0.0.0.0.0.0.
FLAG FIELD	14.	2.	4.2.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.
FLAG FIELD	15.	2.	2.2.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.
FLAG FIELD	16.	12.	4.2.2.2.2.2.2.6.6.2.2.0.0.0.0.0.0.0.0.
FLAG FIELD	17.	13.	2.2.2.2.2.2.2.2.2.2.2.5.0.0.0.0.0.0.0.
ENDATA4	0.	0.	0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.

$$$ DATA TYPE 5 (HYDRAULIC DATA FOR DETERMINING VELOCITY AND DEPTH) $$$

CARD TYPE	REACH	COEF-DSPN	COEFQV	EXPOQV	COEFQH	EXPOQH	CMANN
HYDRAULICS	1.	100.00	0.100	0.350	0.600	0.450	0.045
HYDRAULICS	2.	100.00	0.100	0.350	0.600	0.450	0.045
HYDRAULICS	3.	100.00	0.100	0.350	0.600	0.450	0.045
HYDRAULICS	4.	100.00	0.120	0.480	0.430	0.320	0.045
HYDRAULICS	5.	100.00	0.120	0.480	0.450	0.320	0.045
HYDRAULICS	6.	100.00	0.110	0.480	0.490	0.350	0.045
HYDRAULICS	7.	100.00	0.100	0.350	0.600	0.450	0.045
HYDRAULICS	8.	100.00	0.110	0.480	0.510	0.350	0.045
HYDRAULICS	9.	100.00	0.110	0.480	0.510	0.350	0.045
HYDRAULICS	10.	100.00	0.100	0.350	0.600	0.450	0.045
HYDRAULICS	11.	100.00	0.100	0.350	0.600	0.450	0.045
HYDRAULICS	12.	100.00	0.100	0.350	0.600	0.450	0.045
HYDRAULICS	13.	100.00	0.100	0.350	0.600	0.450	0.045
HYDRAULICS	14.	100.00	0.100	0.350	0.600	0.450	0.045
HYDRAULICS	15.	100.00	0.100	0.350	0.600	0.450	0.045
HYDRAULICS	16.	100.00	0.310	0.120	0.330	0.410	0.045
HYDRAULICS	17.	100.00	0.310	0.110	0.310	0.380	0.045
ENDATA5	0.	0.00	0.000	0.000	0.000	0.000	0.000

$$$ DATA TYPE 5A (STEADY STATE TEMPERATURE AND CLIMATOLOGY DATA) $$$

CARD TYPE	REACH	ELEVATION	DUST COEF	CLOUD COVER	DRY BULB TEMP	WET BULB TEMP	ATM PRESSURE	WIND	SOLAR RAD ATTENUATION
CLIMATOLOG	1.	825.00	0.06	0.50	85.00	63.50	30.26	8.50	0.92
CLIMATOLOG	2.	825.00	0.06	0.50	85.00	63.50	30.26	8.50	0.92
CLIMATOLOG	3.	825.00	0.06	0.50	85.00	63.50	30.26	8.50	0.92
CLIMATOLOG	4.	825.00	0.06	0.50	85.00	63.50	30.26	8.50	1.00
CLIMATOLOG	5.	825.00	0.06	0.50	85.00	64.70	30.26	8.50	1.00
CLIMATOLOG	6.	825.00	0.06	0.50	85.00	63.50	30.26	8.50	0.94
CLIMATOLOG	7.	825.00	0.06	0.50	85.00	63.50	30.26	8.50	0.95
CLIMATOLOG	8.	825.00	0.06	0.50	85.00	63.50	30.26	10.50	0.85

CLIMATOLOG	9.	825.00	0.06	0.50	85.00	63.50	30.26	10.50	0.85
CLIMATOLOG	10.	825.00	0.06	0.50	85.00	63.50	30.26	8.50	0.95
CLIMATOLOG	11.	825.00	0.06	0.50	85.00	63.50	30.26	8.50	0.95
CLIMATOLOG	12.	825.00	0.06	0.50	85.00	63.50	30.26	8.50	0.95
CLIMATOLOG	13.	825.00	0.06	0.50	85.00	63.50	30.26	8.50	0.95
CLIMATOLOG	14.	825.00	0.06	0.50	85.00	63.50	30.26	8.50	0.95
CLIMATOLOG	15.	825.00	0.06	0.50	85.00	63.50	30.26	8.50	0.95
CLIMATOLOG	16.	825.00	0.06	0.50	85.00	65.60	30.26	8.50	0.96
CLIMATOLOG	17.	825.00	0.06	0.50	85.00	65.50	30.26	8.50	0.96
ENDATA5A	0.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

$$$ DATA TYPE 6 (REACTION COEFFICIENTS FOR DEOXYGENATION AND REAERATION) $$$

CARD TYPE	REACH	K1	K3	SOD RATE	K2OPT	K2	COEQK2 OR TSIV COEF FOR OPT 8	EXPQK2 OR SLOPE FOR OPT 8
REACT COEF	1.	0.20	0.00	0.080	11.	0.00	1.600	0.00134
REACT COEF	2.	0.20	0.00	0.080	11.	0.00	1.600	0.00095
REACT COEF	3.	0.20	0.00	0.080	11.	0.00	1.600	0.00071
REACT COEF	4.	0.20	0.00	0.080	11.	0.00	1.600	0.00105
REACT COEF	5.	0.30	0.00	0.100	11.	0.00	1.600	0.00079
REACT COEF	6.	0.55	0.00	0.148	11.	0.00	1.600	0.00044
REACT COEF	7.	0.20	0.00	0.080	11.	0.00	1.600	0.00229
REACT COEF	8.	0.55	0.00	0.150	11.	0.00	1.600	0.00074
REACT COEF	9.	0.45	0.00	0.100	11.	0.00	1.600	0.00092
REACT COEF	10.	0.20	0.00	0.080	11.	0.00	1.600	0.00323
REACT COEF	11.	0.20	0.00	0.080	11.	0.00	1.600	0.00443
REACT COEF	12.	0.20	0.00	0.080	11.	0.00	1.600	0.00249
REACT COEF	13.	0.20	0.00	0.080	11.	0.00	1.600	0.00443
REACT COEF	14.	0.20	0.00	0.080	11.	0.00	1.600	0.00332
REACT COEF	15.	0.20	0.00	0.080	11.	0.00	1.600	0.00332
REACT COEF	16.	0.20	0.00	0.100	11.	0.00	1.600	0.00083
REACT COEF	17.	0.20	0.00	0.100	11.	0.00	1.600	0.00179
ENDATA6	0.	0.00	0.00	0.000	0.	0.00	0.000	0.00000

$$$ DATA TYPE 6A (NITROGEN AND PHOSPHORUS CONSTANTS) $$$

CARD TYPE	REACH	CKNH2	SETNH2	CKNH3	SNH3	CKNO2	CKPORG	SETPORG	SPO4
N AND P COEF	1.	0.02	0.05	0.10	0.00	2.00	0.00	0.00	0.00
N AND P COEF	2.	0.02	0.05	0.10	0.00	2.00	0.00	0.00	0.00
N AND P COEF	3.	0.02	0.05	0.10	0.00	2.00	0.00	0.00	0.00
N AND P COEF	4.	0.10	0.10	0.15	0.00	2.00	0.00	0.00	0.00
N AND P COEF	5.	0.20	0.10	0.15	0.00	2.00	0.00	0.00	0.00
N AND P COEF	6.	0.20	0.10	1.00	0.00	2.00	0.00	0.00	0.00
N AND P COEF	7.	0.15	0.09	1.00	0.00	2.00	0.00	0.00	0.00
N AND P COEF	8.	0.25	0.10	1.00	0.00	2.00	0.00	0.00	0.00
N AND P COEF	9.	0.25	0.10	1.00	0.00	2.00	0.00	0.00	0.00
N AND P COEF	10.	0.15	0.09	0.90	0.00	2.00	0.00	0.00	0.00
N AND P COEF	11.	0.15	0.09	0.90	0.00	2.00	0.00	0.00	0.00
N AND P COEF	12.	0.15	0.09	0.90	0.00	2.00	0.00	0.00	0.00
N AND P COEF	13.	0.15	0.09	0.90	0.00	2.00	0.00	0.00	0.00
N AND P COEF	14.	0.15	0.09	0.90	0.00	2.00	0.00	0.00	0.00
N AND P COEF	15.	0.15	0.09	0.90	0.00	2.00	0.00	0.00	0.00
N AND P COEF	16.	0.25	0.10	1.00	0.00	2.00	0.00	0.00	0.00
N AND P COEF	17.	0.25	0.10	1.00	0.00	2.00	0.00	0.00	0.00
ENDATA6A	0.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

$$$ DATA TYPE 6B (ALGAE/OTHER COEFFICIENTS) $$$

CARD TYPE	REACH	ALPHAO	ALGSET	EXCOEF	CK5 CKCOLI	CKANC	SETANC	SRCANC
ALG/OTHER COEF	1.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	2.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	3.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	4.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	5.	15.00	0.50	0.01	0.00	0.00	0.00	0.00

ALG/OTHER COEF	6.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	7.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	8.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	9.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	10.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	11.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	12.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	13.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	14.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	15.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	16.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	17.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ENDATA6B	0.	0.00	0.00	0.00	0.00	0.00	0.00	0.00

$$$ DATA TYPE 7 (INITIAL CONDITIONS) $$$

CARD TYPE	REACH	TEMP	D.O.	BOD	CM-1	CM-2	CM-3	ANC	COLI
INITIAL COND-1	1.	77.40	6.00	2.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	2.	77.40	6.00	2.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	3.	77.40	6.00	2.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	4.	77.40	6.00	2.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	5.	77.40	6.00	2.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	6.	77.40	6.00	2.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	7.	77.40	6.00	2.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	8.	77.40	6.00	2.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	9.	77.40	6.00	2.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	10.	77.40	6.00	2.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	11.	77.40	6.00	2.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	12.	77.40	6.00	2.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	13.	77.40	6.00	2.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	14.	77.40	6.00	2.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	15.	77.40	6.00	2.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	16.	77.40	6.00	2.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	17.	77.40	6.00	2.00	0.00	0.00	0.00	0.00	0.00
ENDATA7	0.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

$$$ DATA TYPE 7A (INITIAL CONDITIONS FOR CHOROPHYLL A, NITROGEN, AND PHOSPHORUS) $$$

CARD TYPE	REACH	CHL-A	ORG-N	NH3-N	NO2-N	NO3-N	ORG-P	DIS-P
INITIAL COND-2	1.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	2.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	3.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	4.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	5.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	6.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	7.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	8.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	9.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	10.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	11.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	12.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	13.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	14.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	15.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	16.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	17.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
ENDATA7A	0.	0.00	0.00	0.00	0.00	0.00	0.00	0.00

$$$ DATA TYPE 8 (INCREMENTAL INFLOW CONDITIONS) $$$

CARD TYPE	REACH	FLOW	TEMP	D.O.	BOD	CM-1	CM-2	CM-3	ANC	COLI
INCR INFLOW-1	1.	0.025	77.40	7.00	0.50	0.00	0.00	0.00	0.00	0.00
INCR INFLOW-1	2.	0.017	77.40	7.00	0.50	0.00	0.00	0.00	0.00	0.00

	INCR INFLOW-1	3.	0.017	77.40	7.00	0.50	0.00	0.00	0.00
0.00	0.00								
	INCR INFLOW-1	4.	0.075	77.40	7.00	0.50	0.00	0.00	0.00
0.00	0.00								
	INCR INFLOW-1	5.	0.055	77.40	7.00	0.50	0.00	0.00	0.00
0.00	0.00								
	INCR INFLOW-1	6.	0.020	77.40	7.00	0.50	0.00	0.00	0.00
0.00	0.00								
	INCR INFLOW-1	7.	0.033	77.40	7.00	0.50	0.00	0.00	0.00
0.00	0.00								
	INCR INFLOW-1	8.	0.009	77.40	7.00	0.50	0.00	0.00	0.00
0.00	0.00								
	INCR INFLOW-1	9.	0.009	77.40	7.00	0.50	0.00	0.00	0.00
0.00	0.00								
	INCR INFLOW-1	10.	0.018	77.40	7.00	0.50	0.00	0.00	0.00
0.00	0.00								
	INCR INFLOW-1	11.	0.004	77.40	7.00	0.50	0.00	0.00	0.00
0.00	0.00								
	INCR INFLOW-1	12.	0.006	77.40	7.00	0.50	0.00	0.00	0.00
0.00	0.00								
	INCR INFLOW-1	13.	0.016	77.40	7.00	0.50	0.00	0.00	0.00
0.00	0.00								
	INCR INFLOW-1	14.	0.003	77.40	7.00	0.50	0.00	0.00	0.00
0.00	0.00								
	INCR INFLOW-1	15.	0.003	77.40	7.00	0.50	0.00	0.00	0.00
0.00	0.00								
	INCR INFLOW-1	16.	0.033	77.40	7.00	0.50	0.00	0.00	0.00
0.00	0.00								
	INCR INFLOW-1	17.	0.036	77.40	7.00	0.50	0.00	0.00	0.00
0.00	0.00								
	ENDATA8	0.	0.000	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00								

$$$ DATA TYPE 8A (INCREMENTAL INFLOW CONDITIONS FOR CHLOROPHYLL A, NITROGEN, AND PHOSPHORUS) $$$

CARD TYPE	REACH	CHL-A	ORG-N	NH3-N	NO2-N	NO3-N	ORG-P	DIS-P
INCR INFLOW-2	1.	5.00	0.60	0.20	0.20	0.10	0.05	0.05
INCR INFLOW-2	2.	5.00	0.60	0.20	0.20	0.10	0.05	0.05
INCR INFLOW-2	3.	5.00	0.60	0.20	0.20	0.10	0.05	0.05
INCR INFLOW-2	4.	5.00	0.70	0.20	0.20	0.10	0.05	0.05
INCR INFLOW-2	5.	5.00	0.70	0.20	0.20	0.10	0.05	0.05
INCR INFLOW-2	6.	5.00	0.60	0.20	0.30	0.30	0.05	0.05
INCR INFLOW-2	7.	5.00	0.60	0.20	0.20	0.10	0.05	0.05
INCR INFLOW-2	8.	5.00	0.50	0.20	0.20	0.10	0.05	0.05
INCR INFLOW-2	9.	5.00	0.50	0.20	0.20	0.10	0.05	0.05
INCR INFLOW-2	10.	5.00	0.60	0.15	0.20	0.10	0.05	0.05
INCR INFLOW-2	11.	5.00	0.60	0.15	0.20	0.10	0.05	0.05
INCR INFLOW-2	12.	5.00	0.60	0.15	0.20	0.10	0.05	0.05
INCR INFLOW-2	13.	5.00	0.60	0.15	0.20	0.10	0.05	0.05
INCR INFLOW-2	14.	5.00	0.60	0.15	0.20	0.10	0.05	0.05
INCR INFLOW-2	15.	5.00	0.60	0.15	0.20	0.10	0.05	0.05
INCR INFLOW-2	16.	5.00	0.40	0.00	0.20	0.10	0.05	0.05
INCR INFLOW-2	17.	5.00	0.40	0.00	0.20	0.10	0.05	0.05
ENDATA8A	0.	0.00	0.00	0.00	0.00	0.00	0.00	0.00

$$$ DATA TYPE 9 (STREAM JUNCTIONS) $$$

CARD TYPE	JUNCTION ORDER AND IDENT			UPSTRM	JUNCTION	TRIB
STREAM JUNCTION	1.	JNC=	1	19.	48.	47.
STREAM JUNCTION	2.	JNC=	2	85.	101.	100.
STREAM JUNCTION	3.	JNC=	3	124.	128.	127.
STREAM JUNCTION	4.	JNC=	4	131.	143.	142.
STREAM JUNCTION	5.	JNC=	5	112.	147.	146.
ENDATA9	0.			0.	0.	0.

$$$ DATA TYPE 10 (HEADWATER SOURCES) $$$

CARD TYPE	HDWTR ORDER	NAME	FLOW	TEMP	D.O.	BOD	CM-1	CM-2	CM-3
HEADWTR-1	1.	Tolle Ditch	0.03	77.40	7.00	0.50	0.00	0.00	0.00
HEADWTR-1	2.	Finn Ditch	0.03	77.40	7.00	0.50	0.00	0.00	0.00
HEADWTR-1	3.	Mugg-Ingels	0.01	77.40	7.00	0.50	0.00	0.00	0.00
HEADWTR-1	4.	Martin-Youngman	0.01	77.40	7.00	0.50	0.00	0.00	0.00
HEADWTR-1	5.	Oakford drain	0.01	77.40	7.00	0.50	0.00	0.00	0.00
HEADWTR-1	6.	Scott-Youngman	0.01	77.40	7.00	0.50	0.00	0.00	0.00
ENDATA10	0.		0.00	0.00	0.00	0.00	0.00	0.00	0.00

$$$ DATA TYPE 10A (HEADWATER CONDITIONS FOR CHLOROPHYLL, NITROGEN, PHOSPHORUS, COLIFORM AND SELECTED NON-CONSERVATIVE CONSTITUENT) $$$

CARD TYPE	HDWTR ORDER	ANC	COLI	CHL-A	ORG-N	NH3-N	NO2-N	NO3-N	ORG-P	DIS-P
HEADWTR-2	1.	0.00	0.00	5.00	0.60	0.20	0.03	0.17	0.15	0.15
HEADWTR-2	2.	0.00	0.00	5.00	0.60	0.20	0.03	0.17	0.15	0.15
HEADWTR-2	3.	0.00	0.00	5.00	0.60	0.20	0.09	0.51	0.15	0.15
HEADWTR-2	4.	0.00	0.00	5.00	0.60	0.20	0.01	0.09	0.15	0.15
HEADWTR-2	5.	0.00	0.00	5.00	0.60	0.20	0.01	0.09	0.15	0.15
HEADWTR-2	6.	0.00	0.00	5.00	0.60	0.20	0.01	0.09	0.15	0.15
ENDATA10A	0.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

$$$ DATA TYPE 11 (POINT SOURCE / POINT SOURCE CHARACTERISTICS) $$$

CARD TYPE	POINT LOAD ORDER	NAME	EFF	FLOW	TEMP	D.O.	BOD	CM-1	CM-2	CM-3
POINTLD-1	1.	Kokomo Regen	0.00	0.14	77.40	6.00	42.60	0.00	0.00	0.00
POINTLD-1	2.	Hemlock Sept	0.00	0.00	77.40	2.00	220.00	0.00	0.00	0.00
POINTLD-1	3.	Taylor HS	0.00	0.23	77.40	6.00	42.60	0.00	0.00	0.00
POINTLD-1	4.	Center Septi	0.00	0.00	77.40	2.00	220.00	0.00	0.00	0.00
POINTLD-1	5.	Timbernest A	0.00	0.02	77.40	2.90	71.00	0.00	0.00	0.00
POINTLD-1	6.	Oakford Sept	0.00	0.00	77.40	2.00	220.00	0.00	0.00	0.00
POINTLD-1	7.	Delco	0.00	0.00	74.10	8.00	5.68	0.00	0.00	0.00
POINTLD-1	8.	Chrysler	0.00	0.00	72.00	8.00	5.68	0.00	0.00	0.00
ENDATA11	0.		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

$$$ DATA TYPE 11A (POINT SOURCE CHARACTERISTICS - CHLOROPHYLL A, NITROGEN, PHOSPHORUS, COLIFORMS AND SELECTED NON-CONSERVATIVE CONSTITUENT) $$$

CARD TYPE	POINT LOAD ORDER	ANC	COLI	CHL-A	ORG-N	NH3-N	NO2-N	NO3-N	ORG-P	DIS-P
POINTLD-2	1.	0.00	0.00	5.00	4.00	1.20	0.50	2.80	0.50	0.50
POINTLD-2	2.	0.00	0.00	5.00	20.00	28.00	0.30	1.70	5.00	5.00
POINTLD-2	3.	0.00	0.00	5.00	0.44	3.40	4.50	25.50	0.50	0.50
POINTLD-2	4.	0.00	0.00	5.00	20.00	28.00	0.30	1.70	5.00	5.00
POINTLD-2	5.	0.00	0.00	5.00	1.68	3.90	1.36	7.74	0.50	0.50
POINTLD-2	6.	0.00	0.00	5.00	20.00	28.00	0.30	1.70	5.00	5.00
POINTLD-2	7.	0.00	0.00	5.00	0.00	0.10	0.09	0.54	0.10	0.10
POINTLD-2	8.	0.00	0.00	5.00	0.38	0.13	0.01	0.07	0.10	0.10
ENDATA11A	0.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

$$$ DATA TYPE 12 (DAM CHARACTERISTICS) $$$

	DAM	RCH	ELE	ADAM	BDAM	FDAM	HDAM
ENDATA12	0.	0.	0.	0.00	0.00	0.00	0.00

$$$ DATA TYPE 13 (DOWNSTREAM BOUNDARY CONDITIONS-1) $$$

CARD TYPE	TEMP	D.O.	BOD	CM-1	CM-2	CM-3	ANC	COLI
ENDATA13	DOWNSTREAM BOUNDARY CONCENTRATIONS ARE UNCONSTRAINED							

$$$ DATA TYPE 13A (DOWNSTREAM BOUNDARY CONDITIONS-2) $$$

CARD TYPE	CHL-A	ORG-N	NH3-N	NO2-N	NH3-N	ORG-P	DIS-P
ENDATA13A	DOWNSTREAM BOUNDARY CONCENTRATIONS ARE UNCONSTRAINED						

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                                        * * * QUAL-2E  STREAM QUALITY ROUTING MODEL * * *
                                                  Version 3.21  -  Feb. 1995

 $$$ (PROBLEM TITLES) $$$

CARD TYPE                                QUAL-2E PROGRAM TITLES
TITLE01                 Kokomo Creek, Indiana (7Q10 flows)
TITLE02                 TMDL Run 102 - Alt#2, expand Taylor STP, reduce NH3, CBOD
TITLE03   NO            CONSERVATIVE MINERAL I
TITLE04   NO            CONSERVATIVE MINERAL II
TITLE05   NO            CONSERVATIVE MINERAL III
TITLE06   YES           TEMPERATURE
TITLE07   YES           BIOCHEMICAL OXYGEN DEMAND
TITLE08   YES           ALGAE AS CHL-A IN UG/L
TITLE09   YES           PHOSPHORUS CYCLE AS P IN MG/L
TITLE10                   (ORGANIC-P; DISSOLVED-P)
TITLE11   YES           NITROGEN CYCLE AS N IN MG/L
TITLE12                   (ORGANIC-N; AMMONIA-N; NITRITE-N;' NITRATE-N)
TITLE13   YES           DISSOLVED OXYGEN IN MG/L
TITLE14   NO            FECAL COLIFORM IN NO./100 ML
TITLE15   NO            ARBITRARY NON-CONSERVATIVE
ENDTITLE

 $$$ DATA TYPE 1 (CONTROL DATA) $$$

CARD TYPE                                          CARD TYPE
LIST DATA INPUT                0.00000                                    0.00000
NO WRITE OPTIONAL SUMMARY      0.00000                                    0.00000
NO FLOW AUGMENTATION           0.00000                                    0.00000
STEADY STATE                   0.00000                                    0.00000
NO TRAP CHANNELS               0.00000                                    0.00000
NO PRINT LCD/SOLAR DATA        0.00000                                    0.00000
NO PLOT DO AND BOD DATA        0.00000                                    0.00000
FIXED DNSTM CONC (YES=1)=      0.00000          5D-ULT BOD CONV K COEF  =  0.23000
INPUT METRIC                =  0.00000          OUTPUT METRIC           =  0.00000
NUMBER OF REACHES           =  17.00000         NUMBER OF JUNCTIONS     =  5.00000
NUM OF HEADWATERS           =   6.00000         NUMBER OF POINT LOADS   =  8.00000
TIME STEP (HOURS)           =   1.00000         LNTH. COMP. ELEMENT (DX)=  0.17100
MAXIMUM ROUTE TIME (HRS)=  30.00000             TIME INC. FOR RPT2 (HRS)=  1.00000
LATITUDE OF BASIN (DEG) =  40.45000             LONGITUDE OF BASIN (DEG)=  86.05000
STANDARD MERIDIAN (DEG) =  90.00000             DAY OF YEAR START TIME  = 243.00000
EVAP. COEF.,(AE)        =   0.00103             EVAP. COEF.,(BE)        =  0.00016
ELEV. OF BASIN (ELEV)   = 825.00000             DUST ATTENUATION COEF.  =  0.06000
ENDATA1                        0.00000                                    0.00000

 $$$ DATA TYPE 1A (ALGAE PRODUCTION AND NITROGEN OXIDATION CONSTANTS) $$$

CARD TYPE                                          CARD TYPE
O UPTAKE BY NH3 OXID(MG O/MG N)=   3.4300          O UPTAKE BY NO2 OXID(MG O/MG N)=   1.1400
O PROD  BY ALGAE (MG O/MG A)   =   1.6000          O UPTAKE BY ALGAE (MG O/MG A)  =   2.0000
N CONTENT OF ALGAE (MG N/MG A) =   0.0850          P CONTENT OF ALGAE (MG O/MG A) =   0.0140
ALG MAX SPEC GROWTH RATE(1/DAY)=   2.1000          ALGAE RESPIRATION RATE (1/DAY) =   0.0500
N HALF SATURATION CONST (MG/L) =   0.1500          P HALF SATURATION CONST (MG/L) =   0.0100
LIN ALG SHADE CO (1/FT-UGCHA/L=)   0.0027          NLIN SHADE(1/FT-(UGCHA/L)**2/3)=   0.0165
LIGHT FUNCTION OPTION (LFNOPT) =   1.0000          LIGHT SAT'N COEF (BTU/FT2-MIN) =   0.0833
DAILY AVERAGING OPTION (LAVOPT)=   3.0000          LIGHT AVERAGING FACTOR (AFACT) =   0.9200
NUMBER OF DAYLIGHT HOURS (DLH) =  12.5000          TOTAL DAILY SOLR RAD (BTU/FT-2)= 1300.0000
ALGY GROWTH CALC OPTION(LGROPT)=   2.0000          ALGAL PREF FOR NH3-N (PREFN)   =   0.9000
ALG/TEMP SOLR RAD FACTOR(TFACT)=   0.4400          NITRIFICATION INHIBITION COEF  =   0.5000
ENDATA1A                           0.0000                                             0.0000

 $$$ DATA TYPE 1B (TEMPERATURE CORRECTION CONSTANTS FOR RATE COEFFICIENTS) $$$

CARD TYPE      RATE CODE      THETA VALUE

THETA( 1)      BOD DECA         1.047      USER
THETA( 2)      BOD SETT         1.024      USER
THETA( 3)      OXY TRAN         1.028      USER
THETA( 4)      SOD RATE         1.047      USER
THETA( 5)      ORGN DEC         1.047      USER
THETA( 6)      ORGN SET         1.024      USER
THETA( 7)      NH3 DECA         1.083      USER
THETA( 8)      NH3 SRCE         1.074      USER
THETA( 9)      NO2 DECA         1.047      USER
THETA(10)      PORG DEC         1.047      USER
THETA(11)      PORG SET         1.024      USER
THETA(12)      DISP SRC         1.074      USER
THETA(13)      ALG GROW         1.047      USER
THETA(14)      ALG RESP         1.047      USER
THETA(15)      ALG SETT         1.024      USER
THETA(16)      COLI DEC         1.047      DFLT
THETA(17)      ANC DECA         1.000      DFLT
THETA(18)      ANC SETT         1.024      DFLT
THETA(19)      ANC SRCE         1.000      DFLT
ENDATA1B
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$$$ DATA TYPE 2 (REACH IDENTIFICATION) $$$

CARD TYPE	REACH ORDER AND IDENT			R. MI/KM		R. MI/KM
STREAM REACH	1.0	RCH= Tolle Ditch	FROM	16.1	TO	12.8
STREAM REACH	2.0	RCH= Finn Ditch	FROM	17.6	TO	15.2
STREAM REACH	3.0	RCH= Finn Ditch	FROM	15.2	TO	12.8
STREAM REACH	4.0	RCH= Kokomo Creek	FROM	12.8	TO	9.6
STREAM REACH	5.0	RCH= Kokomo Creek	FROM	9.6	TO	7.2
STREAM REACH	6.0	RCH= Kokomo Creek	FROM	7.2	TO	6.3
STREAM REACH	7.0	RCH= Mugg-Ingels	FROM	8.9	TO	6.3
STREAM REACH	8.0	RCH= Kokomo Creek	FROM	6.3	TO	5.3
STREAM REACH	9.0	RCH= Kokomo Creek	FROM	5.3	TO	4.3
STREAM REACH	10.0	RCH= Martin-Youngman	FROM	7.7	TO	5.6
STREAM REACH	11.0	RCH= Oakford drain	FROM	6.2	TO	5.6
STREAM REACH	12.0	RCH= Martin-Youngman	FROM	5.6	TO	5.0
STREAM REACH	13.0	RCH= Scott-Youngman	FROM	6.8	TO	5.0
STREAM REACH	14.0	RCH= Martin-Youngman	FROM	5.0	TO	4.6
STREAM REACH	15.0	RCH= Martin-Youngman	FROM	4.6	TO	4.3
STREAM REACH	16.0	RCH= Kokomo Creek	FROM	4.3	TO	2.2
STREAM REACH	17.0	RCH= Kokomo Creek	FROM	2.2	TO	0.0
ENDATA2	0.0			0.0		0.0

$$$ DATA TYPE 3 (TARGET LEVEL DO AND FLOW AUGMENTATION SOURCES) $$$

CARD TYPE	REACH	AVAIL HDWS	TARGET	ORDER OF AVAIL SOURCES					
ENDATA3	0.	0.	0.0	0.	0.	0.	0.	0.	0.

$$$ DATA TYPE 4 (COMPUTATIONAL REACH FLAG FIELD) $$$

CARD TYPE	REACH	ELEMENTS/REACH	COMPUTATIONAL FLAGS
FLAG FIELD	1.	19.	1.2.2.2.2.2.2.2.2.2.2.2.2.2.2.2.2.3.0.
FLAG FIELD	2.	14.	1.2.2.2.2.2.2.2.2.2.2.2.2.0.0.0.0.0.0.
FLAG FIELD	3.	14.	2.2.2.2.2.2.2.2.2.2.2.2.2.0.0.0.0.0.0.
FLAG FIELD	4.	19.	4.2.2.2.2.2.2.2.2.2.2.2.2.2.2.2.2.2.0.
FLAG FIELD	5.	14.	2.2.2.2.2.2.2.2.2.2.2.2.2.0.0.0.0.0.0.
FLAG FIELD	6.	5.	6.2.2.2.3.0.0.0.0.0.0.0.0.0.0.0.0.0.0.
FLAG FIELD	7.	15.	1.2.2.2.2.2.2.2.2.2.2.2.2.6.0.0.0.0.0.
FLAG FIELD	8.	6.	4.2.6.6.2.6.0.0.0.0.0.0.0.0.0.0.0.0.0.
FLAG FIELD	9.	6.	2.2.2.2.2.3.0.0.0.0.0.0.0.0.0.0.0.0.0.
FLAG FIELD	10.	12.	1.2.2.2.2.2.2.2.2.2.2.3.0.0.0.0.0.0.0.
FLAG FIELD	11.	3.	1.2.6.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.
FLAG FIELD	12.	4.	4.2.2.3.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.
FLAG FIELD	13.	11.	1.2.2.2.2.2.2.2.2.2.2.0.0.0.0.0.0.0.0.
FLAG FIELD	14.	2.	4.2.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.
FLAG FIELD	15.	2.	2.2.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.
FLAG FIELD	16.	12.	4.2.2.2.2.2.2.2.6.6.2.2.0.0.0.0.0.0.0.
FLAG FIELD	17.	13.	2.2.2.2.2.2.2.2.2.2.2.2.5.0.0.0.0.0.0.
ENDATA4	0.	0.	0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.

$$$ DATA TYPE 5 (HYDRAULIC DATA FOR DETERMINING VELOCITY AND DEPTH) $$$

CARD TYPE	REACH	COEF-DSPN	COEFQV	EXPOQV	COEFQH	EXPOQH	CMANN
HYDRAULICS	1.	100.00	0.100	0.350	0.600	0.450	0.045
HYDRAULICS	2.	100.00	0.100	0.350	0.600	0.450	0.045
HYDRAULICS	3.	100.00	0.100	0.350	0.600	0.450	0.045
HYDRAULICS	4.	100.00	0.120	0.480	0.430	0.320	0.045
HYDRAULICS	5.	100.00	0.120	0.480	0.450	0.320	0.045
HYDRAULICS	6.	100.00	0.110	0.480	0.490	0.350	0.045
HYDRAULICS	7.	100.00	0.100	0.350	0.600	0.450	0.045
HYDRAULICS	8.	100.00	0.110	0.480	0.510	0.350	0.045
HYDRAULICS	9.	100.00	0.110	0.480	0.510	0.350	0.045
HYDRAULICS	10.	100.00	0.100	0.350	0.600	0.450	0.045
HYDRAULICS	11.	100.00	0.100	0.350	0.600	0.450	0.045
HYDRAULICS	12.	100.00	0.100	0.350	0.600	0.450	0.045
HYDRAULICS	13.	100.00	0.100	0.350	0.600	0.450	0.045
HYDRAULICS	14.	100.00	0.100	0.350	0.600	0.450	0.045
HYDRAULICS	15.	100.00	0.100	0.350	0.600	0.450	0.045
HYDRAULICS	16.	100.00	0.310	0.120	0.330	0.410	0.045
HYDRAULICS	17.	100.00	0.310	0.110	0.310	0.380	0.045
ENDATA5	0.	0.00	0.000	0.000	0.000	0.000	0.000

$$$ DATA TYPE 5A (STEADY STATE TEMPERATURE AND CLIMATOLOGY DATA) $$$

CARD TYPE	REACH	ELEVATION	DUST COEF	CLOUD COVER	DRY BULB TEMP	WET BULB TEMP	ATM PRESSURE	WIND	SOLAR RAD ATTENUATION
CLIMATOLOG	1.	825.00	0.06	0.50	85.00	63.50	30.26	8.50	0.92
CLIMATOLOG	2.	825.00	0.06	0.50	85.00	63.50	30.26	8.50	0.92
CLIMATOLOG	3.	825.00	0.06	0.50	85.00	63.50	30.26	8.50	0.92
CLIMATOLOG	4.	825.00	0.06	0.50	85.00	63.50	30.26	8.50	1.00
CLIMATOLOG	5.	825.00	0.06	0.50	85.00	64.70	30.26	8.50	1.00
CLIMATOLOG	6.	825.00	0.06	0.50	85.00	63.50	30.26	8.50	0.94
CLIMATOLOG	7.	825.00	0.06	0.50	85.00	63.50	30.26	8.50	0.95
CLIMATOLOG	8.	825.00	0.06	0.50	85.00	63.50	30.26	10.50	0.85

CLIMATOLOG	9.	825.00	0.06	0.50	85.00	63.50	30.26	10.50	0.85
CLIMATOLOG	10.	825.00	0.06	0.50	85.00	63.50	30.26	8.50	0.95
CLIMATOLOG	11.	825.00	0.06	0.50	85.00	63.50	30.26	8.50	0.95
CLIMATOLOG	12.	825.00	0.06	0.50	85.00	63.50	30.26	8.50	0.95
CLIMATOLOG	13.	825.00	0.06	0.50	85.00	63.50	30.26	8.50	0.95
CLIMATOLOG	14.	825.00	0.06	0.50	85.00	63.50	30.26	8.50	0.95
CLIMATOLOG	15.	825.00	0.06	0.50	85.00	63.50	30.26	8.50	0.95
CLIMATOLOG	16.	825.00	0.06	0.50	85.00	65.60	30.26	8.50	0.96
CLIMATOLOG	17.	825.00	0.06	0.50	85.00	65.50	30.26	8.50	0.96
ENDATA5A	0.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

$$$ DATA TYPE 6 (REACTION COEFFICIENTS FOR DEOXYGENATION AND REAERATION) $$$

CARD TYPE	REACH	K1	K3	SOD RATE	K2OPT	K2	COEQK2 OR TSIV COEF FOR OPT 8	EXPQK2 OR SLOPE FOR OPT 8
REACT COEF	1.	0.20	0.00	0.080	11.	0.00	1.600	0.00134
REACT COEF	2.	0.20	0.00	0.080	11.	0.00	1.600	0.00095
REACT COEF	3.	0.20	0.00	0.080	11.	0.00	1.600	0.00071
REACT COEF	4.	0.20	0.00	0.080	11.	0.00	1.600	0.00105
REACT COEF	5.	0.30	0.00	0.100	11.	0.00	1.600	0.00079
REACT COEF	6.	0.55	0.00	0.148	11.	0.00	1.600	0.00044
REACT COEF	7.	0.20	0.00	0.080	11.	0.00	1.600	0.00229
REACT COEF	8.	0.55	0.00	0.150	11.	0.00	1.600	0.00074
REACT COEF	9.	0.45	0.00	0.100	11.	0.00	1.600	0.00092
REACT COEF	10.	0.20	0.00	0.080	11.	0.00	1.600	0.00323
REACT COEF	11.	0.20	0.00	0.080	11.	0.00	1.600	0.00443
REACT COEF	12.	0.20	0.00	0.080	11.	0.00	1.600	0.00249
REACT COEF	13.	0.20	0.00	0.080	11.	0.00	1.600	0.00443
REACT COEF	14.	0.20	0.00	0.080	11.	0.00	1.600	0.00332
REACT COEF	15.	0.20	0.00	0.080	11.	0.00	1.600	0.00332
REACT COEF	16.	0.20	0.00	0.100	11.	0.00	1.600	0.00083
REACT COEF	17.	0.20	0.00	0.100	11.	0.00	1.600	0.00179
ENDATA6	0.	0.00	0.00	0.000	0.	0.00	0.000	0.00000

$$$ DATA TYPE 6A (NITROGEN AND PHOSPHORUS CONSTANTS) $$$

CARD TYPE	REACH	CKNH2	SETNH2	CKNH3	SNH3	CKNO2	CKPORG	SETPORG	SPO4
N AND P COEF	1.	0.02	0.05	0.10	0.00	2.00	0.00	0.00	0.00
N AND P COEF	2.	0.02	0.05	0.10	0.00	2.00	0.00	0.00	0.00
N AND P COEF	3.	0.02	0.05	0.10	0.00	2.00	0.00	0.00	0.00
N AND P COEF	4.	0.10	0.10	0.15	0.00	2.00	0.00	0.00	0.00
N AND P COEF	5.	0.20	0.10	0.15	0.00	2.00	0.00	0.00	0.00
N AND P COEF	6.	0.20	0.10	1.00	0.00	2.00	0.00	0.00	0.00
N AND P COEF	7.	0.15	0.09	1.00	0.00	2.00	0.00	0.00	0.00
N AND P COEF	8.	0.25	0.10	1.00	0.00	2.00	0.00	0.00	0.00
N AND P COEF	9.	0.25	0.10	1.00	0.00	2.00	0.00	0.00	0.00
N AND P COEF	10.	0.15	0.09	0.90	0.00	2.00	0.00	0.00	0.00
N AND P COEF	11.	0.15	0.09	0.90	0.00	2.00	0.00	0.00	0.00
N AND P COEF	12.	0.15	0.09	0.90	0.00	2.00	0.00	0.00	0.00
N AND P COEF	13.	0.15	0.09	0.90	0.00	2.00	0.00	0.00	0.00
N AND P COEF	14.	0.15	0.09	0.90	0.00	2.00	0.00	0.00	0.00
N AND P COEF	15.	0.15	0.09	0.90	0.00	2.00	0.00	0.00	0.00
N AND P COEF	16.	0.25	0.10	1.00	0.00	2.00	0.00	0.00	0.00
N AND P COEF	17.	0.25	0.10	1.00	0.00	2.00	0.00	0.00	0.00
ENDATA6A	0.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

$$$ DATA TYPE 6B (ALGAE/OTHER COEFFICIENTS) $$$

CARD TYPE	REACH	ALPHAO	ALGSET	EXCOEF	CK5 CKCOLI	CKANC	SETANC	SRCANC
ALG/OTHER COEF	1.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	2.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	3.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	4.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	5.	15.00	0.50	0.01	0.00	0.00	0.00	0.00

ALG/OTHER COEF	6.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	7.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	8.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	9.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	10.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	11.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	12.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	13.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	14.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	15.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	16.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ALG/OTHER COEF	17.	15.00	0.50	0.01	0.00	0.00	0.00	0.00
ENDATA6B	0.	0.00	0.00	0.00	0.00	0.00	0.00	0.00

$$$ DATA TYPE 7 (INITIAL CONDITIONS) $$$

CARD TYPE	REACH	TEMP	D.O.	BOD	CM-1	CM-2	CM-3	ANC	COLI
INITIAL COND-1	1.	77.40	6.00	2.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	2.	77.40	6.00	2.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	3.	77.40	6.00	2.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	4.	77.40	6.00	2.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	5.	77.40	6.00	2.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	6.	77.40	6.00	2.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	7.	77.40	6.00	2.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	8.	77.40	6.00	2.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	9.	77.40	6.00	2.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	10.	77.40	6.00	2.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	11.	77.40	6.00	2.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	12.	77.40	6.00	2.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	13.	77.40	6.00	2.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	14.	77.40	6.00	2.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	15.	77.40	6.00	2.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	16.	77.40	6.00	2.00	0.00	0.00	0.00	0.00	0.00
INITIAL COND-1	17.	77.40	6.00	2.00	0.00	0.00	0.00	0.00	0.00
ENDATA7	0.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

$$$ DATA TYPE 7A (INITIAL CONDITIONS FOR CHOROPHYLL A, NITROGEN, AND PHOSPHORUS) $$$

CARD TYPE	REACH	CHL-A	ORG-N	NH3-N	NO2-N	NO3-N	ORG-P	DIS-P
INITIAL COND-2	1.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	2.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	3.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	4.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	5.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	6.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	7.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	8.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	9.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	10.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	11.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	12.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	13.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	14.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	15.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	16.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
INITIAL COND-2	17.	5.00	0.50	0.20	0.20	0.20	0.05	0.05
ENDATA7A	0.	0.00	0.00	0.00	0.00	0.00	0.00	0.00

$$$ DATA TYPE 8 (INCREMENTAL INFLOW CONDITIONS) $$$

CARD TYPE	REACH	FLOW	TEMP	D.O.	BOD	CM-1	CM-2	CM-3	ANC	COLI
INCR INFLOW-1	1.	0.025	77.40	7.00	0.50	0.00	0.00	0.00	0.00	0.00
INCR INFLOW-1	2.	0.017	77.40	7.00	0.50	0.00	0.00	0.00	0.00	0.00

INCR INFLOW-1	3.	0.017	77.40	7.00	0.50	0.00	0.00	0.00	0.00
INCR INFLOW-1	4.	0.075	77.40	7.00	0.50	0.00	0.00	0.00	0.00
INCR INFLOW-1	5.	0.055	77.40	7.00	0.50	0.00	0.00	0.00	0.00
INCR INFLOW-1	6.	0.020	77.40	7.00	0.50	0.00	0.00	0.00	0.00
INCR INFLOW-1	7.	0.033	77.40	7.00	0.50	0.00	0.00	0.00	0.00
INCR INFLOW-1	8.	0.009	77.40	7.00	0.50	0.00	0.00	0.00	0.00
INCR INFLOW-1	9.	0.009	77.40	7.00	0.50	0.00	0.00	0.00	0.00
INCR INFLOW-1	10.	0.018	77.40	7.00	0.50	0.00	0.00	0.00	0.00
INCR INFLOW-1	11.	0.004	77.40	7.00	0.50	0.00	0.00	0.00	0.00
INCR INFLOW-1	12.	0.006	77.40	7.00	0.50	0.00	0.00	0.00	0.00
INCR INFLOW-1	13.	0.016	77.40	7.00	0.50	0.00	0.00	0.00	0.00
INCR INFLOW-1	14.	0.003	77.40	7.00	0.50	0.00	0.00	0.00	0.00
INCR INFLOW-1	15.	0.003	77.40	7.00	0.50	0.00	0.00	0.00	0.00
INCR INFLOW-1	16.	0.033	77.40	7.00	0.50	0.00	0.00	0.00	0.00
INCR INFLOW-1	17.	0.036	77.40	7.00	0.50	0.00	0.00	0.00	0.00
ENDATA8	0.	0.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00

$$$ DATA TYPE 8A (INCREMENTAL INFLOW CONDITIONS FOR CHLOROPHYLL A, NITROGEN, AND PHOSPHORUS) $$$

CARD TYPE	REACH	CHL-A	ORG-N	NH3-N	NO2-N	NO3-N	ORG-P	DIS-P
INCR INFLOW-2	1.	5.00	0.60	0.20	0.20	0.10	0.05	0.05
INCR INFLOW-2	2.	5.00	0.60	0.20	0.20	0.10	0.05	0.05
INCR INFLOW-2	3.	5.00	0.60	0.20	0.20	0.10	0.05	0.05
INCR INFLOW-2	4.	5.00	0.70	0.20	0.20	0.10	0.05	0.05
INCR INFLOW-2	5.	5.00	0.70	0.20	0.20	0.10	0.05	0.05
INCR INFLOW-2	6.	5.00	0.60	0.20	0.30	0.30	0.05	0.05
INCR INFLOW-2	7.	5.00	0.60	0.20	0.20	0.10	0.05	0.05
INCR INFLOW-2	8.	5.00	0.50	0.20	0.20	0.10	0.05	0.05
INCR INFLOW-2	9.	5.00	0.50	0.20	0.20	0.10	0.05	0.05
INCR INFLOW-2	10.	5.00	0.60	0.15	0.20	0.10	0.05	0.05
INCR INFLOW-2	11.	5.00	0.60	0.15	0.20	0.10	0.05	0.05
INCR INFLOW-2	12.	5.00	0.60	0.15	0.20	0.10	0.05	0.05
INCR INFLOW-2	13.	5.00	0.60	0.15	0.20	0.10	0.05	0.05
INCR INFLOW-2	14.	5.00	0.60	0.15	0.20	0.10	0.05	0.05
INCR INFLOW-2	15.	5.00	0.60	0.15	0.20	0.10	0.05	0.05
INCR INFLOW-2	16.	5.00	0.40	0.00	0.20	0.10	0.05	0.05
INCR INFLOW-2	17.	5.00	0.40	0.00	0.20	0.10	0.05	0.05
ENDATA8A	0.	0.00	0.00	0.00	0.00	0.00	0.00	0.00

$$$ DATA TYPE 9 (STREAM JUNCTIONS) $$$

CARD TYPE	JUNCTION ORDER AND IDENT			UPSTRM	JUNCTION	TRIB
STREAM JUNCTION	1.	JNC=	1	19.	48.	47.
STREAM JUNCTION	2.	JNC=	2	85.	101.	100.
STREAM JUNCTION	3.	JNC=	3	124.	128.	127.
STREAM JUNCTION	4.	JNC=	4	131.	143.	142.
STREAM JUNCTION	5.	JNC=	5	112.	147.	146.
ENDATA9	0.			0.	0.	0.

$$$ DATA TYPE 10 (HEADWATER SOURCES) $$$

CARD TYPE	HDWTR ORDER	NAME	FLOW	TEMP	D.O.	BOD	CM-1	CM-2	CM-3
HEADWTR-1	1.	Tolle Ditch	0.03	77.40	7.00	0.50	0.00	0.00	0.00
HEADWTR-1	2.	Finn Ditch	0.03	77.40	7.00	0.50	0.00	0.00	0.00
HEADWTR-1	3.	Mugg-Ingels	0.01	77.40	7.00	0.50	0.00	0.00	0.00
HEADWTR-1	4.	Martin-Youngman	0.01	77.40	7.00	0.50	0.00	0.00	0.00
HEADWTR-1	5.	Oakford drain	0.01	77.40	7.00	0.50	0.00	0.00	0.00
HEADWTR-1	6.	Scott-Youngman	0.01	77.40	7.00	0.50	0.00	0.00	0.00
ENDATA10	0.		0.00	0.00	0.00	0.00	0.00	0.00	0.00

$$$ DATA TYPE 10A (HEADWATER CONDITIONS FOR CHLOROPHYLL, NITROGEN, PHOSPHORUS, COLIFORM AND SELECTED NON-CONSERVATIVE CONSTITUENT) $$$

CARD TYPE	HDWTR ORDER	ANC	COLI	CHL-A	ORG-N	NH3-N	NO2-N	NO3-N	ORG-P	DIS-P
HEADWTR-2	1.	0.00	0.00	5.00	0.60	0.20	0.03	0.17	0.15	0.15
HEADWTR-2	2.	0.00	0.00	5.00	0.60	0.20	0.03	0.17	0.15	0.15
HEADWTR-2	3.	0.00	0.00	5.00	0.60	0.20	0.09	0.51	0.15	0.15
HEADWTR-2	4.	0.00	0.00	5.00	0.60	0.20	0.01	0.09	0.15	0.15
HEADWTR-2	5.	0.00	0.00	5.00	0.60	0.20	0.01	0.09	0.15	0.15
HEADWTR-2	6.	0.00	0.00	5.00	0.60	0.20	0.01	0.09	0.15	0.15
ENDATA10A	0.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

$$$ DATA TYPE 11 (POINT SOURCE / POINT SOURCE CHARACTERISTICS) $$$

CARD TYPE	POINT LOAD ORDER	NAME	EFF	FLOW	TEMP	D.O.	BOD	CM-1	CM-2	CM-3
POINTLD-1	1.	Kokomo Regen	0.00	0.14	77.40	6.00	42.60	0.00	0.00	0.00
POINTLD-1	2.	Hemlock Sept	0.00	0.00	77.40	2.00	220.00	0.00	0.00	0.00
POINTLD-1	3.	Taylor HS	0.00	0.23	77.40	6.00	42.60	0.00	0.00	0.00
POINTLD-1	4.	Center Septi	0.00	0.00	77.40	2.00	220.00	0.00	0.00	0.00
POINTLD-1	5.	Timbernest A	0.00	0.02	77.40	2.90	71.00	0.00	0.00	0.00
POINTLD-1	6.	Oakford Sept	0.00	0.00	77.40	2.00	220.00	0.00	0.00	0.00
POINTLD-1	7.	Delco	0.00	0.00	74.10	8.00	5.68	0.00	0.00	0.00
POINTLD-1	8.	Chrysler	0.00	0.00	72.00	8.00	5.68	0.00	0.00	0.00
ENDATA11	0.		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

$$$ DATA TYPE 11A (POINT SOURCE CHARACTERISTICS - CHLOROPHYLL A, NITROGEN, PHOSPHORUS, COLIFORMS AND SELECTED NON-CONSERVATIVE CONSTITUENT) $$$

CARD TYPE	POINT LOAD ORDER	ANC	COLI	CHL-A	ORG-N	NH3-N	NO2-N	N03-N	ORG-P	DIS-P
POINTLD-2	1.	0.00	0.00	5.00	4.00	1.20	0.50	2.80	0.50	0.50
POINTLD-2	2.	0.00	0.00	5.00	20.00	28.00	0.30	1.70	5.00	5.00
POINTLD-2	3.	0.00	0.00	5.00	0.44	1.30	4.50	25.50	0.50	0.50
POINTLD-2	4.	0.00	0.00	5.00	20.00	28.00	0.30	1.70	5.00	5.00
POINTLD-2	5.	0.00	0.00	5.00	1.68	3.90	1.36	7.74	0.50	0.50
POINTLD-2	6.	0.00	0.00	5.00	20.00	28.00	0.30	1.70	5.00	5.00
POINTLD-2	7.	0.00	0.00	5.00	0.00	0.10	0.09	0.54	0.10	0.10
POINTLD-2	8.	0.00	0.00	5.00	0.38	0.13	0.01	0.07	0.10	0.10
ENDATA11A	0.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

$$$ DATA TYPE 12 (DAM CHARACTERISTICS) $$$

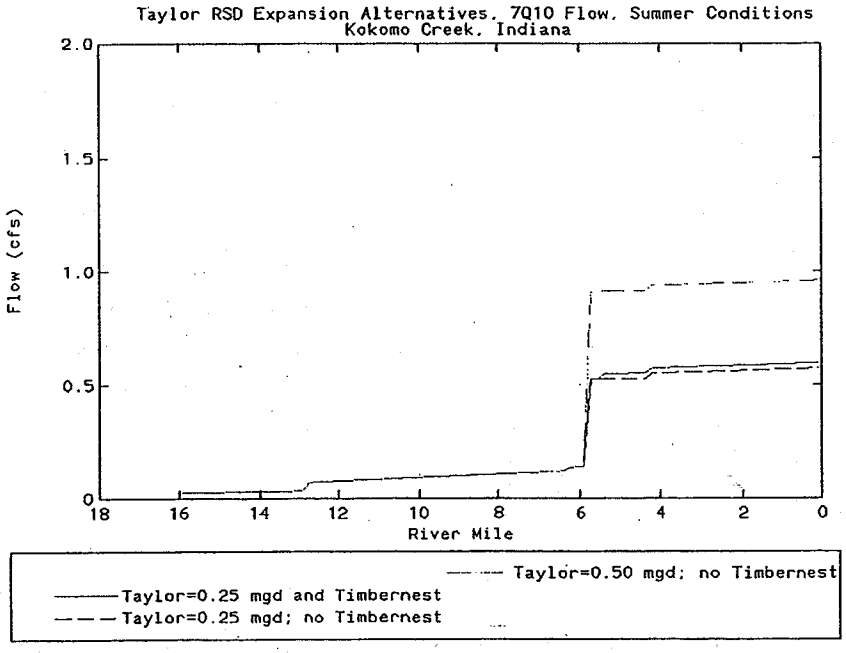
	DAM	RCH	ELE	ADAM	BDAM	FDAM	HDAM
ENDATA12	0.	0.	0.	0.00	0.00	0.00	0.00

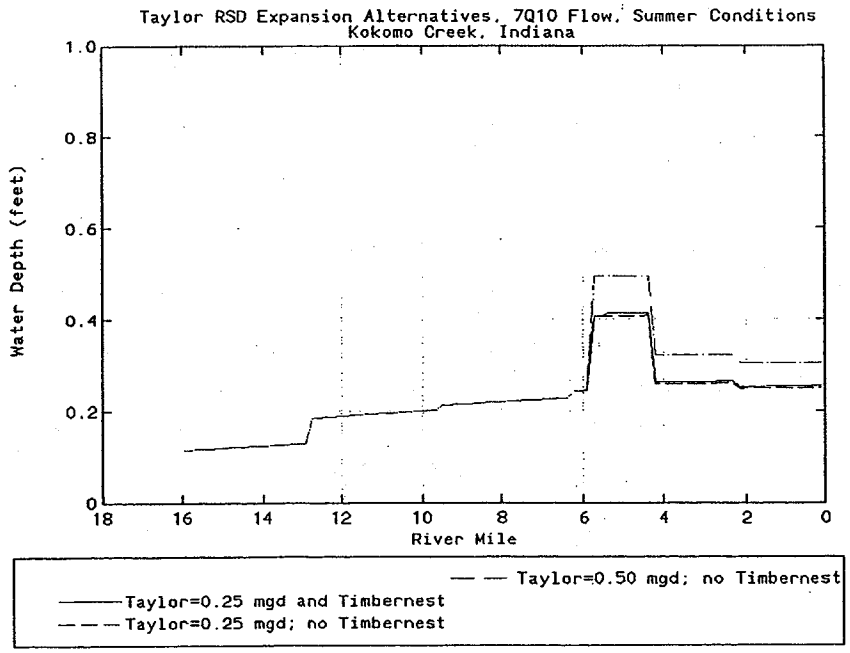
$$$ DATA TYPE 13 (DOWNSTREAM BOUNDARY CONDITIONS-1) $$$

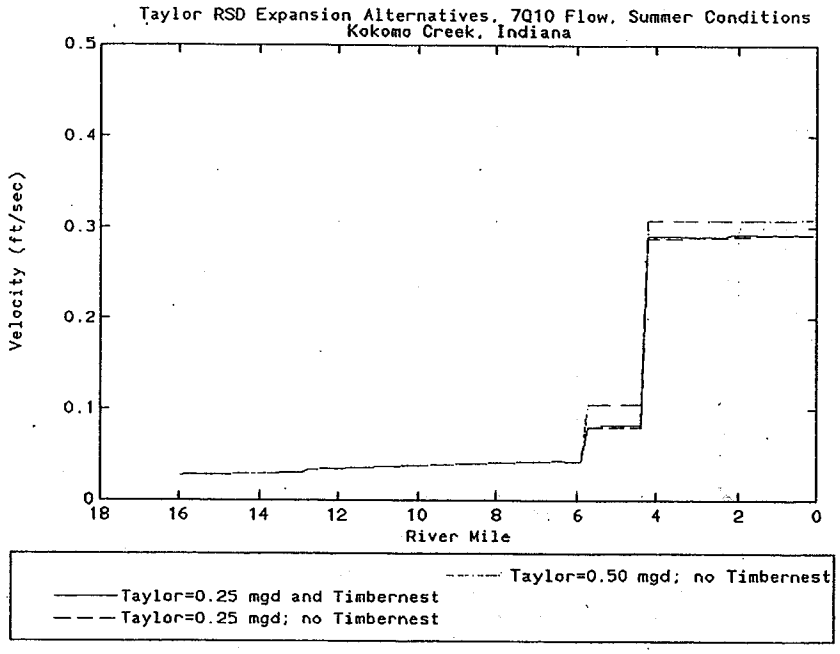
CARD TYPE	TEMP	D.O.	BOD	CM-1	CM-2	CM-3	ANC	COLI
ENDATA13	DOWNSTREAM BOUNDARY CONCENTRATIONS ARE UNCONSTRAINED							

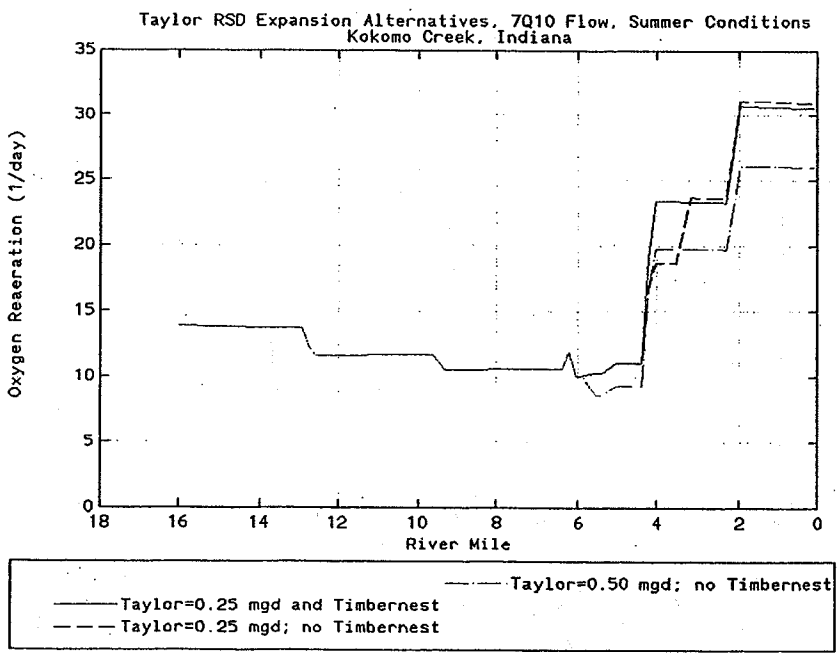
$$$ DATA TYPE 13A (DOWNSTREAM BOUNDARY CONDITIONS-2) $$$

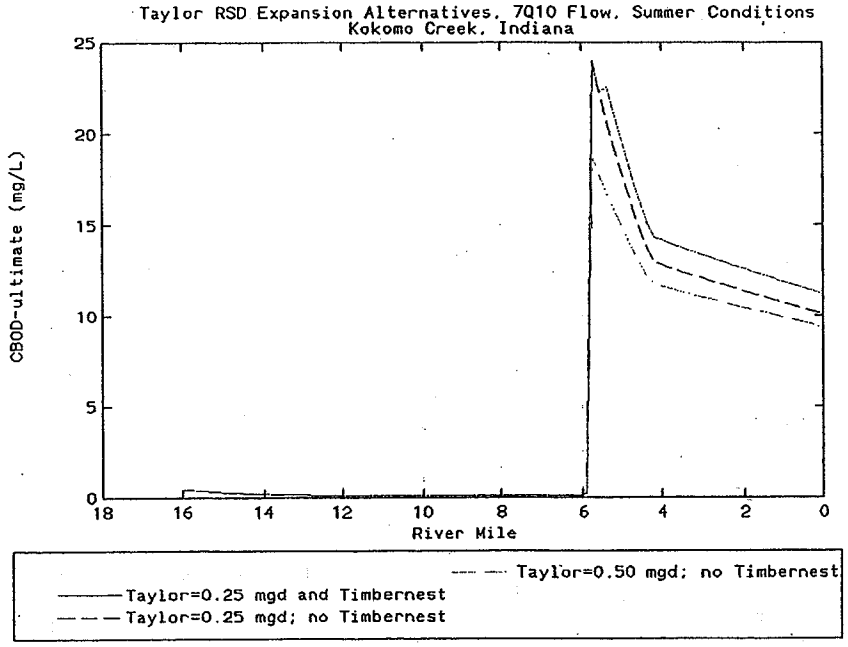
CARD TYPE	CHL-A	ORG-N	NH3-N	NO2-N	NH3-N	ORG-P	DIS-P
ENDATA13A	DOWNSTREAM BOUNDARY CONCENTRATIONS ARE UNCONSTRAINED						

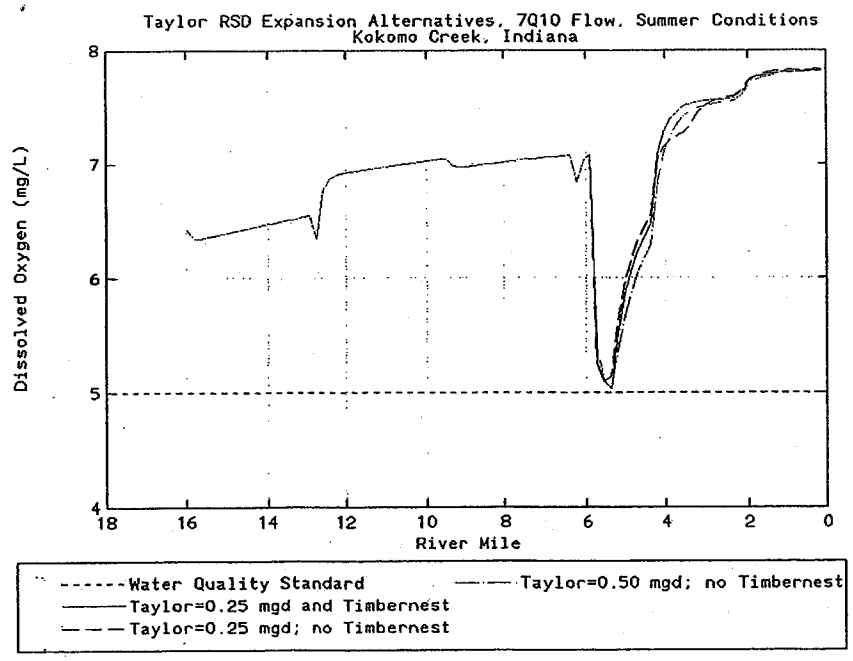

Taylor RSD Expansion Alternatives, 7Q10 Flow, Summer Conditions
Kokomo Creek, Indiana
Flow (cfs)
2.0
1.5
1.0
0.5
0
18
16
14
12
10
8
6
4
2
0
River Mile
Taylor=0.50 mgd; no Timbernest
Taylor=0.25 mgd and Timbernest
Taylor=0.25 mgd; no Timbernest

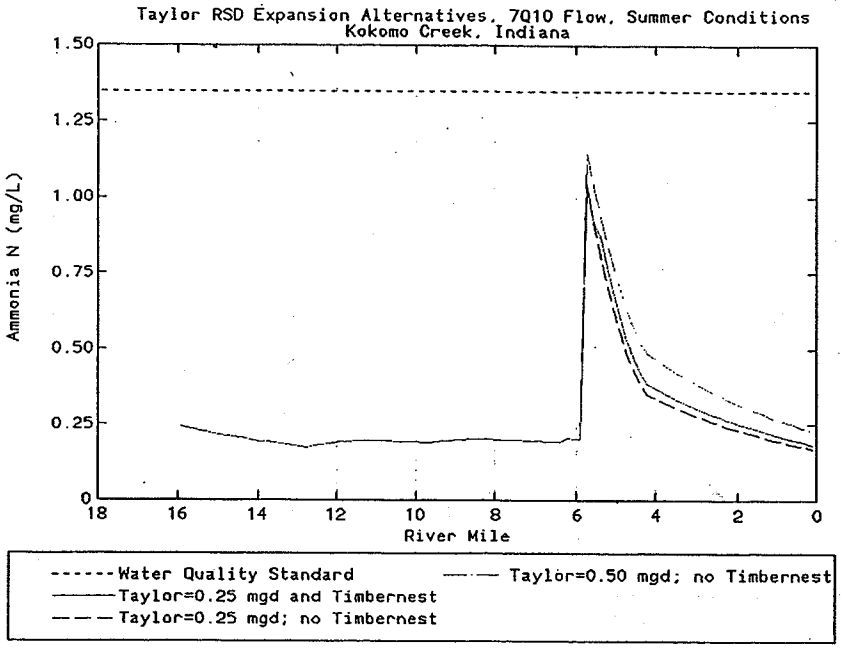

Taylor RSD Expansion Alternatives, 7Q10 Flow, Summer Conditions
Kokomo Creek, Indiana
Water Depth (feet)
1.0
0.8
0.6
0.4
0.2
0
18
16
14
12
10
8
6
4
2
0
River Mile
Taylor=0.50 mgd; no Timbernest
Taylor=0.25 mgd and Timbernest
Taylor=0.25 mgd; no Timbernest

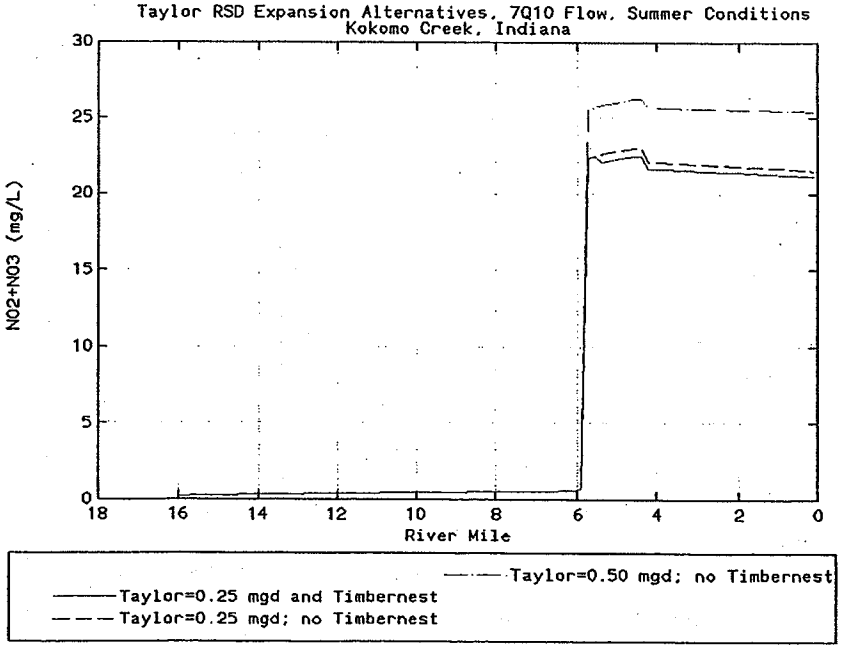

Taylor RSD Expansion Alternatives, 7Q10 Flow, Summer Conditions
Kokomo Creek, Indiana
Velocity (ft/sec)
0.5
0.4
0.3
0.2
0.1
0
18
16
14
12
10
8
6
4
2
0
River Mile
Taylor=0.50 mgd; no Timbernest
Taylor=0.25 mgd and Timbernest
Taylor=0.25 mgd; no Timbernest

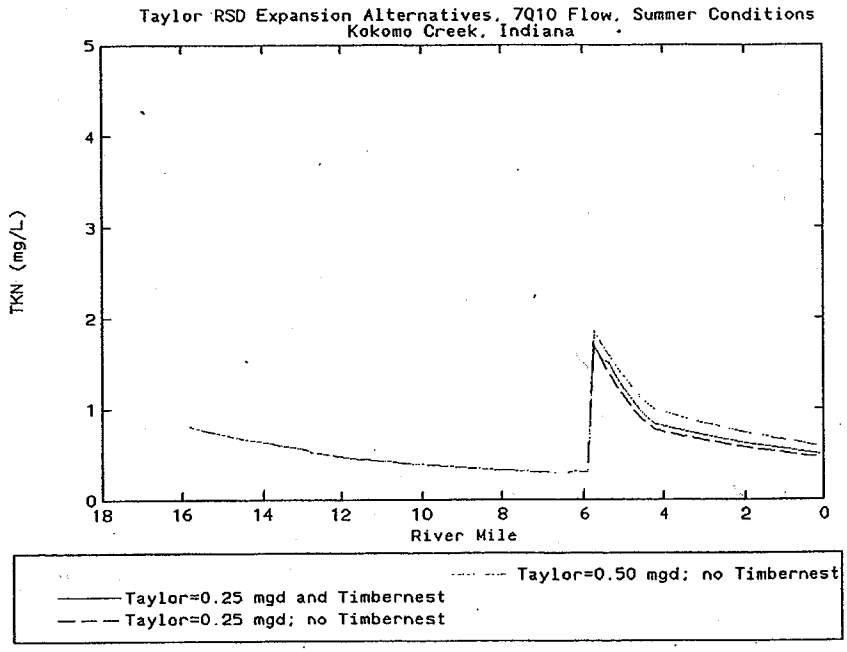

Taylor RSD Expansion Alternatives, 7Q10 Flow, Summer Conditions
Kokomo Creek, Indiana
Oxygen Reaeration (1/day)
35
30
25
20
15
10
5
0
18
16
14
12
10
8
6
4
2
0
River Mile
Taylor=0.50 mgd; no Timbernest
Taylor=0.25 mgd and Timbernest
Taylor=0.25 mgd; no Timbernest

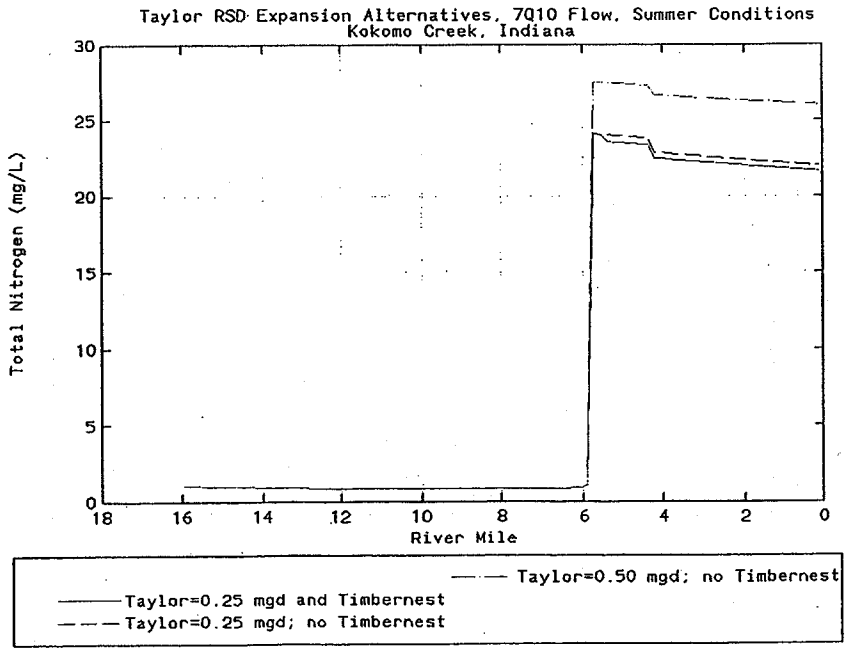

Taylor RSD Expansion Alternatives, 7Q10 Flow, Summer Conditions
Kokomo Creek, Indiana
CBOD-ultimate (mg/L)
25
20
15
10
5
0
18
16
14
12
10
8
6
4
2
0
River Mile
Taylor=0.50 mgd; no Timbernest
Taylor=0.25 mgd and Timbernest
Taylor=0.25 mgd; no Timbernest

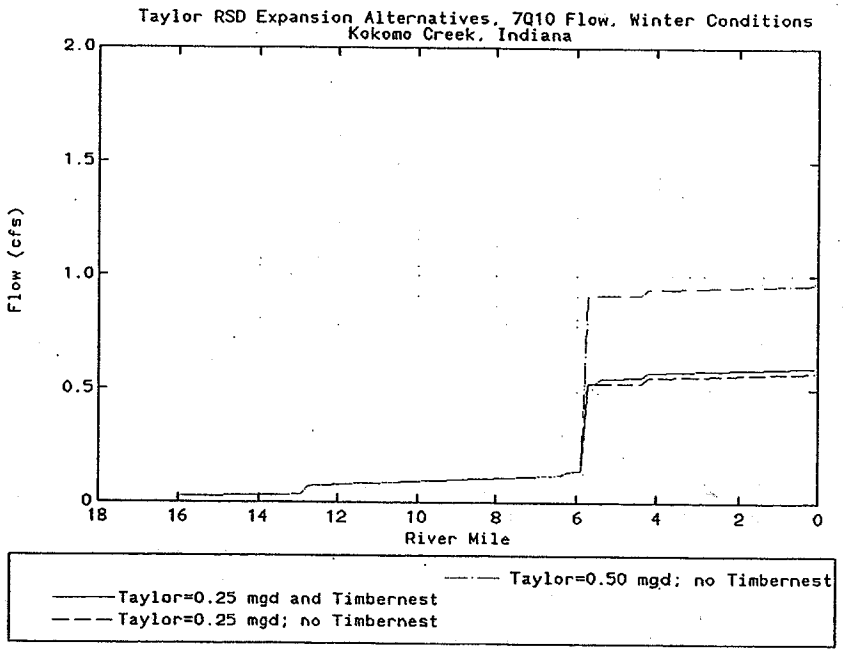

Taylor RSD Expansion Alternatives, 7Q10 Flow, Summer Conditions
Kokomo Creek, Indiana
Dissolved Oxygen (mg/L)
8
7
6
5
4
18
16
14
12
10
8
6
4
2
0
River Mile
Water Quality Standard
Taylor=0.50 mgd; no Timbernest
Taylor=0.25 mgd and Timbernest
Taylor=0.25 mgd; no Timbernest

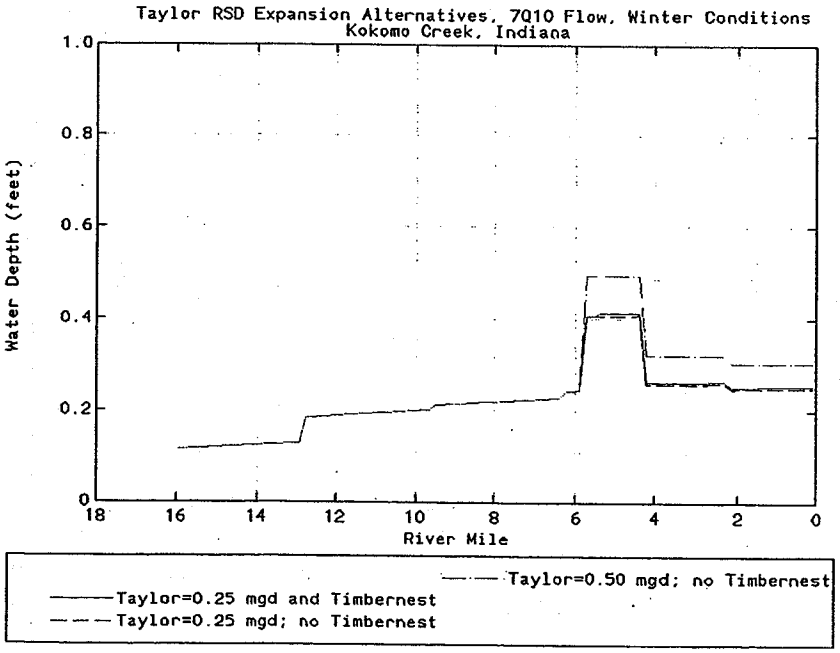

Taylor RSD Expansion Alternatives, 7Q10 Flow, Summer Conditions
Kokomo Creek, Indiana
Ammonia N (mg/L)
1.50
1.25
1.00
0.75
0.50
0.25
0
18
16
14
12
10
8
6
4
2
0
River Mile
Water Quality Standard
Taylor=0.50 mgd; no Timbernest
Taylor=0.25 mgd and Timbernest
Taylor=0.25 mgd; no Timbernest

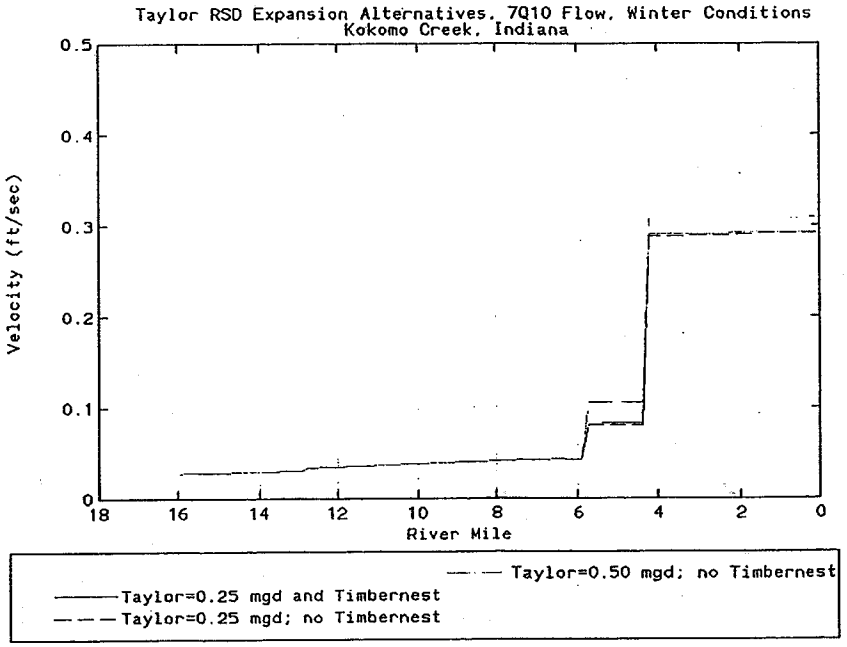

Taylor RSD Expansion Alternatives, 7Q10 Flow, Summer Conditions
Kokomo Creek, Indiana
NO2+NO3 (mg/L)
30
25
20
15
10
5
0
18
16
14
12
10
8
6
4
2
0
River Mile
Taylor=0.50 mgd; no Timbernest
Taylor=0.25 mgd and Timbernest
Taylor=0.25 mgd; no Timbernest

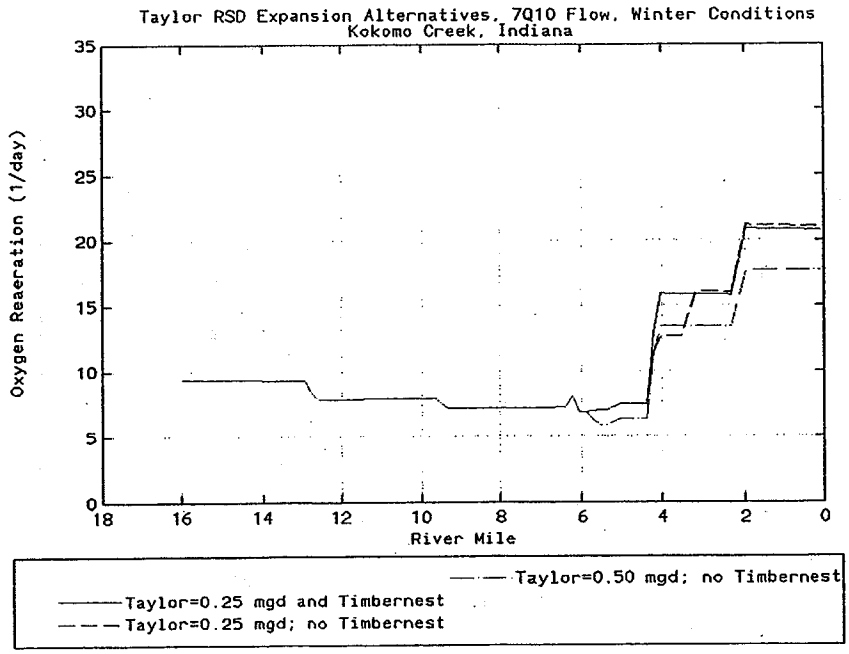

Taylor RSD Expansion Alternatives, 7Q10 Flow, Summer Conditions
Kokomo Creek, Indiana
TKN (mg/L)
River Mile
Taylor=0.50 mgd; no Timbernest
Taylor=0.25 mgd and Timbernest
Taylor=0.25 mgd; no Timbernest

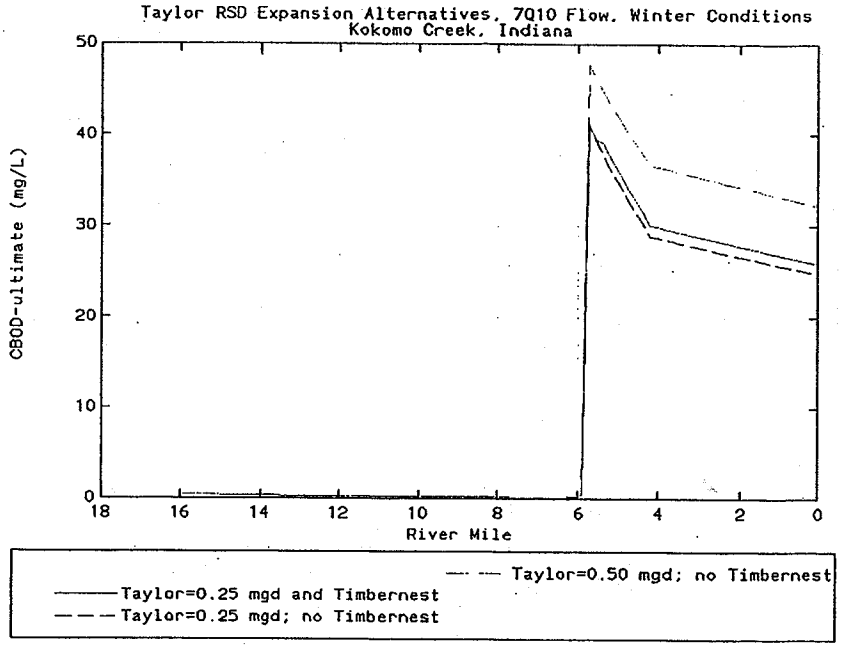

Taylor RSD Expansion Alternatives, 7Q10 Flow, Summer Conditions
Kokomo Creek, Indiana
Total Nitrogen (mg/L)
River Mile
Taylor=0.50 mgd; no Timbernest
Taylor=0.25 mgd and Timbernest
Taylor=0.25 mgd; no Timbernest

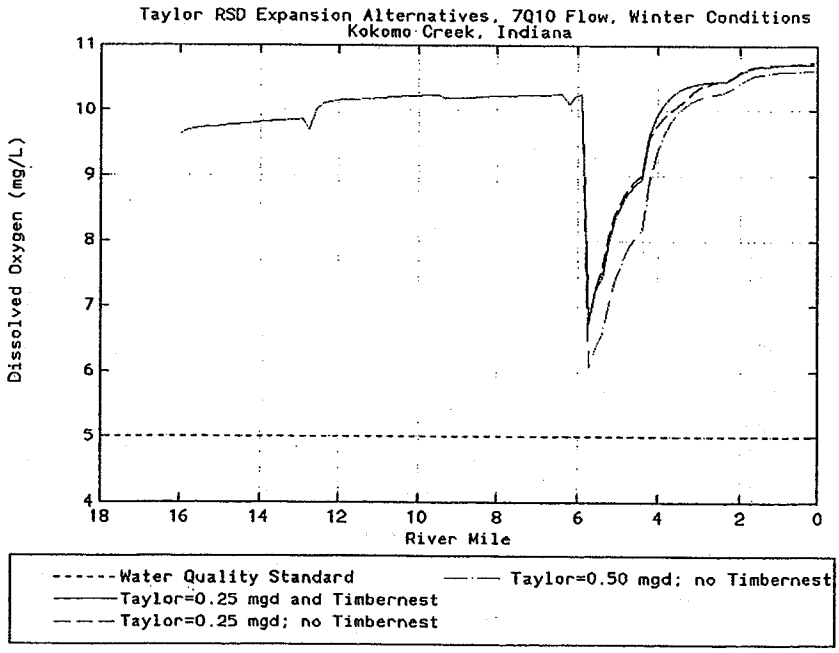

Taylor RSD Expansion Alternatives, 7Q10 Flow, Winter Conditions
Kokomo Creek, Indiana
Flow (cfs)
2.0
1.5
1.0
0.5
0
18
16
14
12
10
8
6
4
2
0
River Mile
Taylor=0.50 mgd; no Timbernest
Taylor=0.25 mgd and Timbernest
Taylor=0.25 mgd; no Timbernest

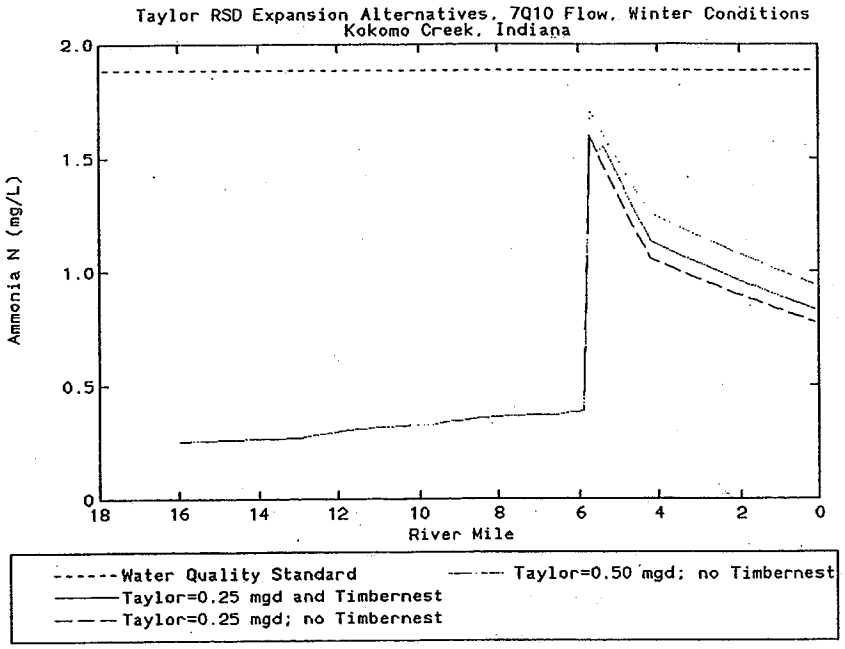

Taylor RSD Expansion Alternatives, 7Q10 Flow, Winter Conditions
Kokomo Creek, Indiana
Water Depth (feet)
1.0
0.8
0.6
0.4
0.2
0
18
16
14
12
10
8
6
4
2
0
River Mile
Taylor=0.50 mgd; no Timbernest
Taylor=0.25 mgd and Timbernest
Taylor=0.25 mgd; no Timbernest

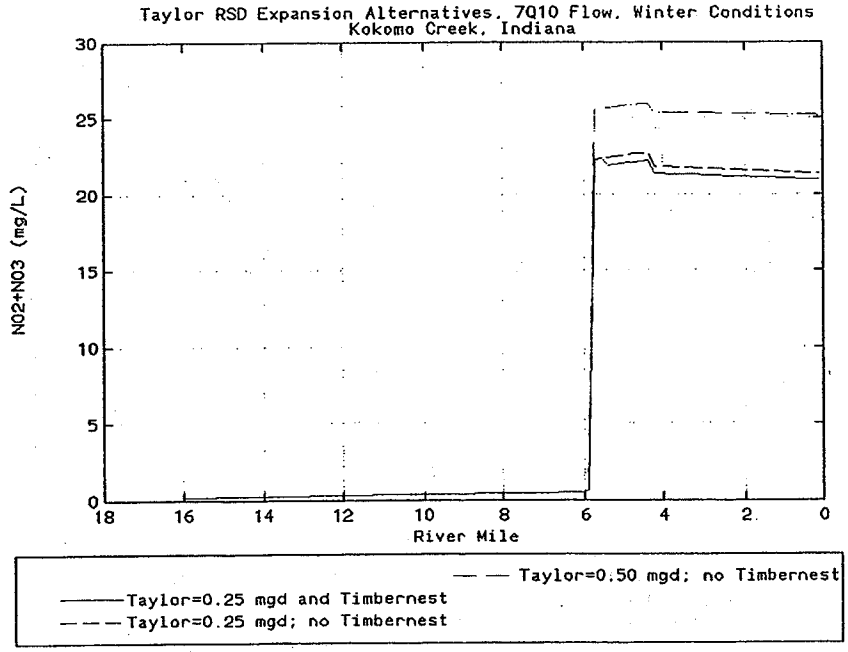

Taylor RSD Expansion Alternatives, 7Q10 Flow, Winter Conditions
Kokomo Creek, Indiana
Velocity (ft/sec)
0.5
0.4
0.3
0.2
0.1
0
18
16
14
12
10
8
6
4
2
0
River Mile
Taylor=0.50 mgd; no Timbernest
Taylor=0.25 mgd and Timbernest
Taylor=0.25 mgd; no Timbernest

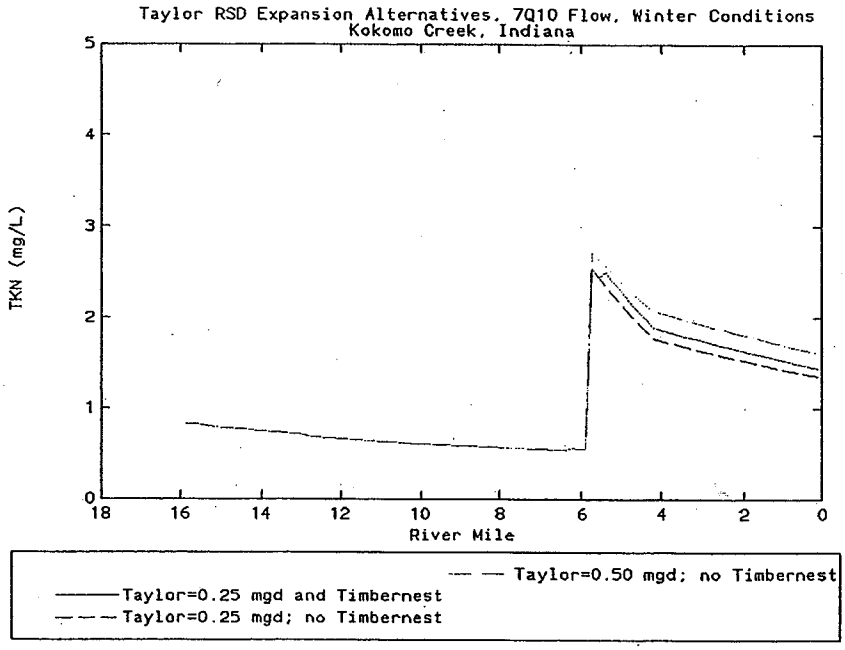

Taylor RSD Expansion Alternatives, 7Q10 Flow, Winter Conditions
Kokomo Creek, Indiana
Oxygen Reaeration (1/day)
35
30
25
20
15
10
5
0
18
16
14
12
10
8
6
4
2
0
River Mile
Taylor=0.50 mgd; no Timbernest
Taylor=0.25 mgd and Timbernest
Taylor=0.25 mgd; no Timbernest

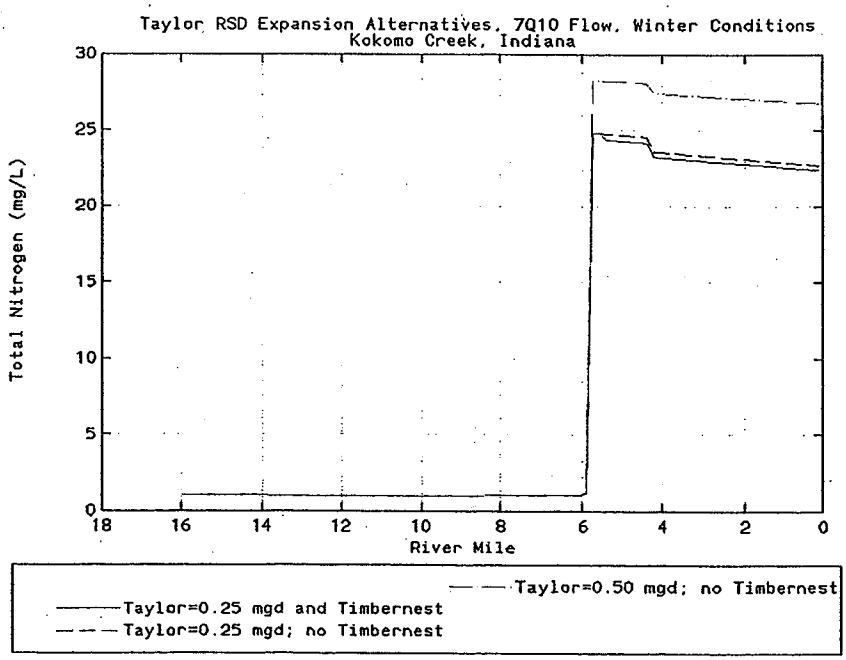

Taylor RSD Expansion Alternatives, 7Q10 Flow, Winter Conditions
Kokomo Creek, Indiana
CBOD-ultimate (mg/L)
River Mile
Taylor=0.50 mgd; no Timbernest
Taylor=0.25 mgd and Timbernest
Taylor=0.25 mgd; no Timbernest


Taylor RSD Expansion Alternatives, 7Q10 Flow, Winter Conditions
Kokomo Creek, Indiana
Dissolved Oxygen (mg/L)
River Mile
Water Quality Standard
Taylor=0.50 mgd; no Timbernest
Taylor=0.25 mgd and Timbernest
Taylor=0.25 mgd; no Timbernest


Taylor RSD Expansion Alternatives, 7Q10 Flow, Winter Conditions
Kokomo Creek, Indiana
Ammonia N (mg/L)
2.0
1.5
1.0
0.5
0
18
16
14
12
10
8
6
4
2
0
River Mile
Water Quality Standard
Taylor=0.50 mgd; no Timbernest
Taylor=0.25 mgd and Timbernest
Taylor=0.25 mgd; no Timbernest


Taylor RSD Expansion Alternatives, 7Q10 Flow, Winter Conditions
Kokomo Creek, Indiana
NO2+NO3 (mg/L)
30
25
20
15
10
5
0
18
16
14
12
10
8
6
4
2
0
River Mile
Taylor=0.50 mgd; no Timbernest
Taylor=0.25 mgd and Timbernest
Taylor=0.25 mgd; no Timbernest


Taylor RSD Expansion Alternatives, 7Q10 Flow, Winter Conditions
Kokomo Creek, Indiana
TKN (mg/L)
River Mile
Taylor=0.50 mgd; no Timbernest
Taylor=0.25 mgd and Timbernest
Taylor=0.25 mgd; no Timbernest


Taylor RSD Expansion Alternatives, 7Q10 Flow, Winter Conditions
Kokomo Creek, Indiana
Total Nitrogen (mg/L)
River Mile
Taylor=0.50 mgd; no Timbernest
Taylor=0.25 mgd and Timbernest
Taylor=0.25 mgd; no Timbernest

APPENDIX D (Comments Received on October 2000 Draft and Agency Responses)

Commenters

Miles: Sandra S. Miles, Conservation Chair, Sierra Club, Heartlands Group
Arvin: Michelle Arvin, Howard County Health Department
Kadlec: Richard and Marguerite Kadlec
Bailey: Tony Bailey, USDA NRCS, Nutrient and Pest Management Specialist
Pratt: Glenn Pratt
Rule/Brichford: Jolene Rule, President, Wildcat Guardians and Sarah Brichford, Director of Water Quality Monitoring, Wildcat Guardians
Frank: Richard M. Van Frank

COMMENTER	#	COMMENT	RESPONSE
Miles	1	Comments 1 - 6 refer to the perceived lack of appropriate water quality data for Kokomo Creek: "Effluent for the characteristics for the illicit and failing septic systems were estimated using literature values since no sampling data were available." "Effluent characteristics for the septic outfalls were obtained from literature values in the absence of sampling data."	This is standard practice for TMDL development when site-specific sampling data from septic systems are not available. There have been numerous studies upon which these literature values are based. Furthermore, the recommendations regarding the illicit septic system connections would not change regardless of the data used (i.e., the discharges will be eliminated because they will be connected to the new treatment plant).
Miles	2	"To estimate the nutrient loads from the nonpoint sources in the watershed, the GWLF model was used."	Models are often used in this way for TMDL development because of the practical difficulties of sampling frequently enough to fully characterize nonpoint source loadings.
Miles	3	"The headwater boundary conditions and tributary conditions were estimated since no data were available for these locations."	The assumptions for these conditions were based on similar data found elsewhere in the Wildcat Creek watershed.
Miles	4	"It would be preferable to select a TMDL endpoint based on dissolved phosphorus concentrations rather than total phosphorus.. However, since only total phosopherus concentrations have been measured, it is not possible to accurately identify existing dissolved	Although it would be preferable to have information on dissolved phosphorus, basing the TMDL on total phosphorus is still a valid approach and has been done in numerous nutrient TMDLs nationwide.

		phosophorus concentrations at the impaired or the reference sites."	
Miles	5	No algae sampling data for the 1994 and 1998 sampling events are available for Kokomo Creek, with which to calibrate the model."	Again, it would be preferable to have these data but it is not unusual to develop nutrient TMDLs without them. Very few state environmental agencies have historically sampled these data and are only now beginning to include them in their sampling programs.
Miles	6	"Maximum summer instream temperatures were based on IDEM recommendations." "Instream pH based on IDEM recommendations."	The model was run for the worst-case conditions which are very difficult to monitor because they rarely occur. IDEM has therefore adopted predetermined values for these worst-case conditions.
Miles	7	In addition, much of the sampling data are old, coming from at least 6 years ago. The document did not address changes in population, housing patterns, septic versus sewage useage, changes in farming practices or other land use issues that have occurred since then. Why were no macroinvertebrate studies done? No mention is made of other testing for life in the Creek.	The best available data were used. Most of the water quality data used for the analysis were from 1998. Based on the comments received at the public meeting the consultant downloaded aerial photographs of the Kokomo area that were taken in March/April 1998. (These photographs were only recently made available). The photographs confirmed the 1992 land use data and show almost no new housing in the upper portions of the watershed (the focus of the nonpoint source portion of the TMDL). The new development that the residents are referring to appears to be concentrated in other parts of the county.
Miles	8	IDEM knew even prior to this report that there were bacterial problems in the creek. The report clearly states that "several of the facilities have been in violation of their (npdes) permits for various parameters." Since these permit holders included a mobile home park and apartments, one must surely conclude that bacterial counts might be impacted. Why were bacterial samples not included in the design of the Kokomo Creek project? Sierra Club objected when coliform counts were removed from the criteria for Kokomo Creek 303(d) listing. If the original samples were tainted, more samples should have been taken and included in the TMDL plan. Did IDEM check with the county health department to determine if they had sampled the Creek for e-coli?	This TMDL dealt with the dissolved oxygen and ammonia impairments to the creek as identified in the 1998 303(d) List . Previous bacteriological sampling did not meet holding times according to the Quality Assurance Program Plan. New information generated after the 1998 list will be used to list impairments on the 2002 list.
Miles	9	PCBs were listed as an impairment of Kokomo Creek on the 303d list. Yet no data were included to show whether the source of the PCBs was in the past, or if there continue to be discharges. Why was	This TMDL study was designed to address the impairments of the conventional parameters of dissolved oxygen and ammonia. IDEM is following EPA's guidance in delaying TMDLs dealing with legacy

		the PCB problem not addressed in this plan? When will it be addressed? It has been rumored that IDEM plans to wait for EPA to issue guidelines for handling PCB's. There is no need to wait such guidelines. The pollution is present at this time and should be addressed now. Dates certain should be included for when the issue will be addressed if no solution is proposed at this time.	pollutants until guidance can be developed to deal with these problems. IDEM will not dismiss the importance or relevance of the PCB impairment, however it will be addressed at a more appropriate time in the future.
Miles	10	The executive summary states that the septic outfalls will be addressed by the formation of a Regional Sewer District. No final recommendation is made for the size of the treatment plant. (alternatives of .25 and .50 mgd were included.)	The RSD is in a better position to estimate the required size of the treatment plant. The report recommends alternative permit limits that will protect water quality at a design flow of either 0.25 mgd or 0.50 mgd.
Miles	11	No timeline, or even an estimate, is stated for completion of these hook-ups to the RSD, other than to state that the RSD has applied for state revolving funds and that construction "should" begin "sometime" in 2001. Explicit dates should be included to indicate when new permits will be issued, construction completed, and hook-ups performed.	Explicit dates are not available at this time.
Miles	12	The report notes that the Regency Mobile Home Park and Timbernest Apartments, which operate under npdes permits, have a record of multiple violations of those permits. They should not be allowed to continue these violations. Regency and Timbernest should hook up to the RSD within less than 3 years, or they should be forced to upgrade their current facilities in the meantime. The executive summary states that "loading from the point source in the watershed must be reduced." I was unable to find data on the number, frequency, or amount of exceedances of NPDES permits on the Creek. No record is found her that indicates what fines or other corrective action been taken by IDEM against these permit holders in the past in order to attempt to improve water quality.	The RSD is expected to eliminate these wastewater treatment plants. The current Regency Mobil Home Park permit is a result of a compliance action, and the Timbernest Apartment permit is being developed.
Miles	13	The NPDES permit for Delco is for "noncontact cooling water effluent." I was unable to discover whether this water discharge significantly elevated the temperature of the stream (which would have effects on the creek habitat and chemistry).	This TMDL dealt with the dissolved oxygen and ammonia impairments to the creek as identified in the 1998 303(d) List . No impairments were noted relative to this segment of the creek.
Miles	14	In the agricultural pollutant section: "Kokomo Creek is classified as a county regulated drain, and, especially upstream, is periodically	This section of the report was not meant to preclude the use of the identified best management practices. Grassed waterways,

		maintained for flood control purposes. Trees and other vegetation are removed when they threaten agricultural drainage tiles or might cause instream debris dams. This alteration of the natural channel precludes Kokomo Creek from providing certain levels of habitat structure." Removing trees that impact drainage tiles surely does not preclude the use of best management practices along a creek. The creek channel does not have to be scoured, and buffer strips other than trees can still be used without inhibiting agriculture. Grassed waterways prevent erosion and filter pollutants. Windbreaks reduce wind damage to crops as well as reducing erosion. Conservation buffers also reduce flood damage to crops, according to many respected agricultural experts. The document should include a plan for implementing these best management practices and state what desired final level of habitat is expected.	windbreaks, and conservation buffers are all excellent options for protecting the stream and should be considered by the Lake and River Enhancement project. Several of these were mentioned in Section 6.0 of the report.
Miles	15	Page 29 states "the need for reducing total phosphorus loadings from row crop agriculture by 34%." Will follow-up monitoring at the 3 year mark be the determination of whether the plan was successful? What are the dates for monitoring? They are not listed in the document. "Two of the three major landowners are participating" in the LARE project. What % of the waterfront property does this include? The back-up plan is for "additional education and outreach activities" if voluntary measures do not improve water quality. This is totally inadequate! Alternative plans (other than public education) should be included for use if the voluntary program does not improve water quality to a specific level within the 3 year time frame.	Follow-up monitoring begins in the spring of 2001 and will continue for a minimum of three years. Detailed sampling plans are under development. IDEM will support the work of the Howard County Soil and Water Conservation District in implementing the LARE projects.
Miles	16	Identification and notification of stakeholders seems entirely inadequate. A public notice buried in the newspaper want ad section is not "public notification." Most citizens do not read public notices. This was a common complaint of those who attended the public meeting. We were told a notice of the meetings goes to IDEM's media department and that department determines whether or not to do any further follow-up. Good faith efforts must be made to identify and invite all stakeholders to the meetings. Does IDEM contact the local newspapers requesting coverage; or issue a press release to local media? Does IDEM ask the newspaper, school, and public library for names of local stakeholders? Do they use the phone	The stakeholder list was developed from the Wildcat Creek Watershed Initiative stakeholder list, and a list of landowners in the Kokomo Creek watershed as provided by the Howard County Soil and Water Conservation District. Notice of the meetings was also provided to IDEM's Media and Communication Services office for further distribution.

		book? How does an organization get placed on the notification list for future TMDL projects?	
Arvin	17	p. iii - Total phosphorus needs to be reduced by 33% (row crops) but page 29 states the reduction needed is only 29%. Table 17 (page 29) states that the reduction of TP needed is 34% with the total reduction calculated as 29%. I believe there needs to be some clarification on how 34% becomes 29% in table 17 and how 33% on one page becomes 29% on another.	It is estimated that total phosphorus loadings in subwatersheds 5, 6, and 7 need to be reduced by 29%. This can be accomplished by reducing total phosphorus loading from row crop agriculture by 33% and by eliminating the Kokomo Regency loadings from this portion of the watershed. We have attempted to clarify this issue in the final report.
Arvin	18	p. iv - The DNR Lake and River Enhancement Project (LARE) began in 1999 for Howard County.	Correction made in final report.
Arvin	19	Delco Electronics is cited several times within the document. It is now Delphi Electronics. I wasn't sure for legality reasons how important this is.	Correction made in final report.
Arvin	20	p. 13 - Urban nutrient loads are computed exponentially, but there is no information or numerical values provided in tables.	Phosphorus loading from urban sources are included in Table 8. The estimated loads from urban sources are very small due to their limited land area in subwatersheds 5, 6, and 7 (less than 1% of the total area).
Arvin	21	p. 10 -"...all pollutant sources have been considered..." However, there are zero values for urban/commercial and high intensity residential. Also, why does the low intenstity residential have a value of 0.01 for TN when high intensity has nothing. I would like to see a value - no matter how small - placed on these sources. If they are left blank IDEM is giving them the impression their actions do not affect the health of the watershed.	Phosphorus loading from urban sources are included in Table 8. The estimated loads from urban sources are very small due to their limited land area in subwatersheds 5, 6, and 7 (less than 1% of the total area).
Arvin	22	I am concerned about construction sites and their impact on the creek. In a recent IDEM Water Column publication, it is stated that Soil loss from new development can range from 20 to 150 [COMMENT CUT OFF]	The focus of the TMDL is on long-term nutrient loading to the stream. Construction sits can indeed have a significant, short-term impact on sediment loading to the stream but were not considered during this analysis.
Kadlec	23	Table of Contents It is limited to the first 2 digits of the organization hierarchy, while it is organized around a 3 digit system. Tables 1 - 17 are not listed. Figures 1 - 5 are not listed. Appendix C - QUAL2E Modeling is the last item in the Table of Contents. Does this mean that the remaining 80 pages are part of the	Corrections made in final report. Yes, the final 80 pages are part of the QUAL2E appendix.

		QUAL2E model?	
Kadlec	24	Executive Summary The PCB impairment will be addressed at a later date is a vague schedule and does not seem to meet the requirements of the Clean Water goals. The Continental Steel Superfund site is currently being evaluated as to the best method for dealing with PCBs in its portion of the Kokomo Creek. The evaluation should be completed in a year.	This TMDL study was designed to address the impairments of the conventional parameters of dissolved oxygen and ammonia. IDEM is following EPA's guidance in delaying TMDLs dealing with legacy pollutants until guidance can be developed to deal with these problems. IDEM will not dismiss the importance or relevance of the PCB impairment, however it will be addressed at a more appropriate time in the future.
Kadlec	25	1.0 Introduction Table 1 lacks unit identification (e.g., mg/L) 1.2 Problem Statement The stated population growth is for the entire county and does not represent that of the watershed. Perhaps Center and Taylor Township data arent= available. 1.3 Applicable Water Quality Standards Table 1 are these values indices without units or mg/L?	Corrections made to final report. Population growth information for the townships within the watershed are not available.
Kadlec	26	2.2.1 Inventory and analysis of Water Quality Monitoring Data. Table 2 why are there three sampling sites at mile point 2.78 and two at 5.64? If it is because of the proximity to NPDES sites, why aren't mile points 6.08 and 7.24 treated the same?	The additional sites are the outfalls from the wastewater treatment plants.
Kadlec	27	Table 3: what does the infinity sign to the left of the Chrysler Corp indicate? This table would be more meaningful if the listings were in mile point order instead of the alphabetic and numeric order.	The infinity sign is actually the page number (8). Corrections made to final report.
Kadlec	28	Is site 23-58 the USGS gaging station?	Site 23-59 is located at the USGS gaging station.
Kadlec	29	Are field tile outflows considered point sources?	No, not in a regulatory sense. In the words of the Clean Water Act (Section 502(14)) the term point source means any discernible, confined, and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged. <u>This term does not include agricultural storm water discharges and return flows from agriculture.</u>
Kadlec	30	3.1 Assessment of Point Sources Table 5's titles indicate all point sources, but only lists NPDES facilities. Table 10 lists only those located in subwatersheds 2, 3,	The title of Table 5 will be changed to clarify that it includes all NPDES facilities.

		and 4. Where are all the point sources listed?	
Kadlec	31	3.2 Assessment of Nonpoint Sources Figure 4, how does one cross reference this map to test sites? Table 8, why was the modeling limited to half the watershed (subwatersheds 5, 6, and 7)?	The sampling sites have been added to Figure 4 in the final report. The modeling was limited to half the watershed because this is the portion of the watershed exhibiting the algae problem.
Kadlec	32	4.0 Modeling Procedure Is this modeling limited to only half of the entire watershed (i.e., subwatersheds 5, 6, and 7)?	No, the QUAL2E model was run for the entire watershed.
Kadlec	33	4.1.2 Model Configuration. Climatological Data Wasn't precipitation used? What was the source for solar radiation, windspeed, and cloud cover? The MCC supplied only the precipitation and temperature.	QUAL2E is a steady-state model which means that it is run for one set of climatic conditions (e.g., flow, temperature, solar radiation, etc.) The model does not simulate time-varying conditions such as precipitation.
Kadlec	34	4.1.3. Model Configuration The study area is divided into 17 reaches conflicts with Figure 5 where 18 reaches are shown?	Correction made in final report.
Kadlec	35	6.0 Implementation Lacks implementation details and schedules for meeting the clean water goals. The Taylor Township RSD project is now in litigation. All illicit septic system effluents are not located in Taylor Township. There is no TMDL analysis for two golf courses and many parking lots within the watershed.	Detailed implementation plans are not required for submitting the TMDL for EPA approval. IDEM will continue to work on the details of the implementation plan. The Chippendale and Wildcat Creek golf courses are not located in the Kokomo Creek watershed (they are located in the Little Wildcat Creek watershed).
Kadlec	36	References There is no way to relate the references to the text. The MCC designation of Kokomo Creek Post Office is incorrect. It should be Kokomo Post Office.	Each of the references is cited within the main report. Correction made to final report.
Kadlec	37	Appendix A There are three unidentified sites listed for 6/17/94. There is no apparent order beyond dates for the order of sampling sites. Mile point order would make it more meaningful.	Corrections made in final report.
	38	How can a single creek point, the sampling sites of Chrysler, Delco,	The flows refer to the outflows from the facility, not the streamflow.

Kadlec		and 23-61, have such different flow rates? The measurements were at mile point 2.78.	
Kadlec	39	Appendix B: GWLF Modeling Previous modeling text referenced EPA-supported QUAL2E; how is GWLF related? Where was precipitation entered?	GWLF is also an EPA-supported model. QUAL2E is a water quality model (meaning it can predicting instream water quality conditions) whereas GWLF is a watershed loading model (meaning it predicts sediment and nutrient loading to a stream). Precipitation is used in the GWLF model to estimate nonpoint source loading; precipitation is not used in the QUAL2E model.
Kadlec	40	Appendix C: QUAL2E modeling Does Appendix C include all of the last 80 pages? There are 18 calibration charts; only 9 have observed data, and some indicate poor correlation. This calibration and validation information lack any error analysis information such as correlation coefficient, margin of error, or confidence factor. I suspect a high margin of error because of the limited sampling.	Yes, appendix C includes all of the last 80 pages of the report. The model has been calibrated and validated using the best available data. The nature of water quality modeling makes it very difficult to exactly simulate real world conditions. The QUAL2E model has proven itself to be extremely reliable in hundreds of studies and in this instance was applied by a senior engineer with more than 22 years of experience in this field.
Kadlec	41	The data entitled "QUAL2E Stream Quality Routing Model" is repeated five times. Each set of data consists of five pages and there is no explanation of how the data is being used.	These are the raw input files for the QUAL2E modeling. They admittedly are difficult to interpret if one is not familiar with the model. Section 4.1 of the report attempts to explain the modeling in more understandable terms.
Kadlec	42	The charts entitled "Taylor RSD Expansion Alternative, 7Q10, Flow Summer and Winter consists of 10 pages each. What causes the discontinuity at about mile point 5.9?	This is the location of the discharge of the new treatment plant.
Kadlec	43	How do the last 8 pages relate to the Kokomo Creek watershed?	Not clear what this comment refers to; the last 8 pages of Appendix C include modeling output graphs.
Bailey	44	#1 What is the estimated soil loss per acre in the watershed?	The estimated soil loss per acre for subwatersheds 5, 6, and 7 is 3.56 tons per acre.
Bailey	45	#2 In a row crop (non-conservation tillage) where is the phosphorus coming from and what percent is attributed to each transport factor? (sediment, runoff, leaching)	The phosphorus is coming from both sediment and runoff. Runoff is calculated according to the curve number associated with the row crop land use and sediment is calculated according to the Universal Soil Loss Equation. Groundwater loadings (i.e., leaching) are actually included as a separate source and are lumped with groundwater contributions from the entire watershed.
Bailey	46	#3 What is the phosphorus loss amount per acre (agriculture)?	The estimated soil loss per acre for the conservation tillage lands is

			approximately 1.9 tons/acre and for non-conservation tillage it is 4.5 tons/acre.
Bailey	47	#4 What is the average phosphorus soil test used for the watershed and used in the model?	Several inquiries were made to NRCS and local universities regarding current soil test phosphorus levels for the watershed but no information was received. The value used in the model is 650 mg/kg (ppm) which was based on a study suggesting that the phosphate content of soils in the Kokomo area should be in the range of 0.10 to 0.19%. The average of these values was used, keeping in mind that phosphate is 44% phosphorus. However, this value is not directly equivalent to soil test phosphorus. Soil phosphorus in the model is related to, but not equivalent to the actual phosphorus in soil. In the model, it is the potency factor for load to streams - that is, the mass of phosphorus per mass of sediment delivered to streams. Because phosphorus preferentially binds to small particles this is enriched relative to soil phosphorus concentrations. Also, what the model needs is the basin-averaged potency factor relative to all solids delivered to the stream. Agricultural field values may again be low relative to this if (1) phosphorus has been depleted and (2) because the mineral sediment values do not account for the portion of delivery associated with organic detritus.
Bailey	48	#5 What is the average phosphorus application rate used in the model?	The GWLF model does not directly use fertilizer application rates but does include dissolved phosphorus runoff from fertilized agricultural lands. This value was set at 1.0 mg/L. The key to managing fertilizer application is to not overapply and to try to time the application such that as much fertilizer as possible is incorporated by the crops and is not available for washoff to the stream.
Bailey	49	#6 Does anyone have an idea on the livestock numbers in the watershed?	The IDEM sampling team did not report the presence of any significant livestock numbers in the watershed.
Bailey	50	#7 What is the estimated lag time for a response from the implementation of various BMPs?	Various BMPs are expected to have different lag times depending on their particular nature. Several of the proposed BMPs (e.g., filter strips, grassed waterways) would be expected to be immediately effective once they are fully installed. The effects of other potential BMPs, such as reduced tillage or integrated pest and nutrient management, might not be as immediate.

Pratt	51	Previous control plans have moved industrial and municipal dischargers from primary to secondary to tertiary levels of waste treatment. The considerable work and expenditures for these treatment facilities/process modifications has resulted in dramatic improvements in our waters. The focus now must turn to the needed remaining treatment by point sources, but with the major emphasis on agricultural, construction and urban runoff, municipal combined sewer overflows, failing septic tanks, contaminated sediment, etc. Some sources of airborne contamination, such mercury, are not easily addressed in this and similar reports. Therefore, the state needs to actively address these issues through separate parallel efforts. However, an evaluation and proposed remediation of contaminated sediment from previous discharges which may impact water quality must be included in the present TMDL effort.	This TMDL study was designed to address the impairments of the conventional parameters of dissolved oxygen and ammonia. IDEM is following EPA's guidance in delaying TMDLs dealing with legacy pollutants until guidance can be developed to deal with these problems. IDEM will not dismiss the importance or relevance of the PCB impairment, however it will be addressed at a more appropriate time in the future.
Pratt	52	The proposed TMDL plan must clearly address known and likely sources that may impair the waters in the basin. Issues such as PCB contaminated sediment and bacterial problems must be adequately addressed in the plan. The plan also needs to address (page 16) loadings from urban runoff, feedlots, failing septics, etc. that will not be part of the Regional system.	This TMDL study was designed to address the impairments of the conventional parameters of dissolved oxygen and ammonia. IDEM is following EPA's guidance in delaying TMDLs dealing with legacy pollutants until guidance can be developed to deal with these problems. IDEM will not dismiss the importance or relevance of the PCB impairment, however it will be addressed at a more appropriate time in the future. The significant loadings appropriate to the subwatershed impacted by nonpoint source problems have been evaluated and addressed.
Pratt	53	IDEM (and others) has collected data several times that documents significant bacterial water quality problems in the basin. The proposed Regional plant will address a large portion of the bacterial/viral problem. The necessary IDEM, municipal and county data should be included in the report along with the needed evaluation and control plan to address failing septic systems, urban and rural runoff, etc., to assure that	This TMDL dealt with the dissolved oxygen and ammonia impairments to the creek as identified in the 1998 303(d) List. New information generated after the 1998 list will be used to list impairments on the 2002 list if still appropriate. The RSD should eliminate some of the bacterial problems caused by the towns of Center, Hemlock and Oakford.

		bacterial water quality standard are met. This issue needs to be addressed now, not put off until some future time.	
Pratt	54	PCBs have long been identified as a water quality problem in the lower Kokomo Creek Basin. It is believed that the major present source is in the sediment from previous discharges. Some local residents believe that there are still current point source discharges. IDEM needs to assure that PCBs are not presently being discharged. Also, a PCB sediment and water evaluation must be completed to determine if dredging or other controls are needed to meet water quality standards. IDEM's proposal to await EPA policy serves no need other than to procrastinate. Either there is or is not a problem or potential problem.	This TMDL study was designed to address the impairments of the conventional parameters of dissolved oxygen and ammonia. IDEM is following EPA's guidance in delaying TMDLs dealing with legacy pollutants until guidance can be developed to deal with these problems. IDEM will not dismiss the importance or relevance of the PCB impairment, however it will be addressed at a more appropriate time in the future.
Pratt	55	Explicit proposed loadings and/or actions must be included along with a detailed schedule to obtain compliance. The schedules should include proposed dates for drafting and noticing NPDES permits. Facilities such as Timberline Apartments, Kokomo Regency Mobile Home Park, etc. need explicit short "drop dead" schedules where they are required to either sign a binding connection agreement to the proposed new Regional system or submit approvable separate construction plans to IDEM.	IDEM will work within the established framework and procedures for the formation of regional sewer districts and the use of state revolving loan funds to accomplish their construction.
Pratt	56	The draft report includes loadings and evaluations as monthly averages and/or weekly maximums. The Clean Water Act requires that TOTAL MAXIMUM DAILY loads must be established. These are not, as of yet, included in IDEM's implementation plan and must be added.	USEPA's guidance to the states on implementing the TMDL Program specifies that TMDLs can be expressed in terms of either mass per time, toxicity, or other appropriate measures (USEPA. 1991. Guidance for water quality-based decisions: The TMDL process. EPA 440/4-91-001). Many TMDLs do not specify maximum daily loads because the episodic nature of wet weather events makes this term very difficult to practically implement.
Pratt	57	The land use data utilized in the report is from	Based on these comments the consultant downloaded aerial

		1992. At the winter 2000 public meeting several local residents stated that the land use data utilized by IDEM's consultant was not representative of the existing residential development in the watershed. They also reported increased problems with failing septic tanks in these areas. This information must be updated in the report.	photographs of Kokomo Creek that were taken in March/April 1998 (these photographs were only recently made available). These photographs confirmed the 1992 land use data and show very little new housing in the upper portions of the Kokomo Creek watershed. The new development that the residents are referring to does not appear to have occurred within the specific boundaries of the watershed.
Pratt	58	The issue of identification of "existing water uses (1975 CWA definition)" is important in this watershed. A listing of "existing" and proposed water uses needs to be included.	Section 1.3 of the report states that the designated uses for Kokomo Creek are whole body contact recreation and maintenance of a warmwater fishery.
Pratt	59	No macro invertebrate or other similar biological evaluations are contained in the report. These are a critical part of the evaluation and need to be added.	No biological data were available at the time of the study.
Pratt	60	Some form of toxicity evaluation needs to be included which could include fish tissue evaluation, toxicity tests, etc. The evaluation should look to additional toxicants beyond PCBs and mercury.	This TMDL dealt with the dissolved oxygen and ammonia impairments to the creek as identified in the 1998 303(d) List .
Pratt	61	The report raises the significant nutrient problem known to exist in the watershed. The report propose a general solution that two people are doing something and we hope it works. The report needs to propose a more detailed alternative solutions that establishes a priority for what area and what practices are the most critical. Significant money could be spent without adequate return. Certainly an initial attempt at voluntary compliance, based on established priorities, should be attempted. However, alternates need to be laid out if voluntary does not work since IDEM	IDEM will support the work of the Howard County Soil and Water Conservation District in implementing the LARE projects. Those projects are targeted toward the same portion of the watershed where the problems have been observed.

		does have the authority to bring action against nonpoint sources if water quality standard violations exist.	
Pratt	62	Some of the modeling work seems to have questionable validity and is not within acceptable limits. The work at several stations for several chemical parameters (CBOD, nitrogen, etc.) and water depth must be reevaluated.	The model has been calibrated and validated using the best available data. The nature of water quality modeling makes it very difficult to exactly simulate real world conditions. The QUAL2E model has proven itself to be extremely reliable in hundreds of studies and in this instance was applied by a senior engineer with more than 22 years of experience in this field.
Pratt	63	An evaluation needs to be included to look at potential downstream impacts on Wildcat Creek by the Kokomo watershed so that final total loading controls can be determined.	It is highly unlikely that the loading analysis for the entire Wildcat Creek watershed will require greater loading reductions from Kokomo Creek than is already specified by the TMDL (29%reduction). Kokomo Creek contributes only a small percentage of the overall loadings to Wildcat Creek and this TMDL will lead to improved water quality contributions from Kokomo Creek to Wildcat Creek.
Pratt	64	The report (page 2) states that the alteration of the natural channel precludes Kokomo Creek from providing certain levels of habitat structure. This may well represent present conditions. However, IDEM needs to lay out in the plan what is needed to reestablish stream bank plantings to address stream temperature and other problems. In general grassed waterways should be implemented within farm fields and along the side of fields, brush or shrubs utilized to control temperature and to provide habitat.	IDEM will support the work of the Howard County Soil and Water Conservation District in implementing the LARE projects. Those projects are targeted toward the same portion of the watershed where the problems have been observed. The project specifically mentions working with landowners to establish the items noted.
Pratt	65	The Delco facility is listed with a discharge of non contact cooling water. Does this facility add significant temperature that might violate temperature water quality standards under low flow summer conditions? Are any chemicals added as anti fouling agents?	This TMDL dealt with the impairments to the creek as identified in the 1998 303(d) List .
Rule/Brichford	66	1) Are the three sets of data collected for the modeling program (one	Although it would be preferable to have more sampling data there

		in 1994 and two in 1998) sufficient to represent the "real" condition of the creek? It seems that this small sampling over a span of several years would not be enough data to verify seasonal variations in stream conditions and water quality.	was a need to move forward with the TMDL given what was available. Waiting to collect more data for every listed stream in the state would delay development of any TMDLs and conceivably could lead to greater deterioration of already impaired streams. The available data for Kokomo Creek were deemed sufficient to document an impairment and to provide information regarding potential solutions. Continued monitoring will be done to evaluate the success or failure of the recommended management actions and future conditions in the creek.
Rule/Brichford	67	2) The GWLF model was used to assess total phosphorus loadings in the upstream portions of Kokomo Creek. It would be helpful to include more information on assumptions about row crop agriculture, specifically the phosphorus fertilizer application rate. This is a variable that is easily placed in context for potential change by the land users.	The GWLF model does not directly use fertilizer application rates but does include dissolved phosphorus runoff from agricultural lands. This value was set to 1.0 mg/L. The key to managing fertilizer application is to not overapply and to try to time the application such that as much fertilizer as possible is incorporated by the crops and is not available for washoff to the stream.
Rule/Brichford	68	3) Another variable missing from the discussion is soil erosion rates. Where is the greatest contribution of total phosphorus from row crop agriculture - gullies or sheet erosion? Does the GWLF model combine land slope and erosion rate to show the "critical areas" for phosphorus delivery to the stream? A map of these areas would be helpful to guide the LARE project implementation, and it could significantly improve the potential for success.	The greatest contribution is from sheet and rill erosion. A map of critical areas has not been developed but those portions of the watershed closest to streams would be expected to be the most critical because of the higher sediment delivery ratio. Furthermore, the BMPs should be targeted toward areas of the riparian corridor where there are gaps in the berms because these are the areas where most of the loading are expected to enter the stream.
Van Frank	69	It is apparent from the data, and stated in the document, that the creek is impacted by illicit and failing septic systems. Yet, no data were collected to determine E. coli levels in the creek but estimates were made of the impact using literature values. What were the criteria used in the selection of the literature data? Unless selected data very closely approximated the conditions in Kokomo Creek, the modeling could be significantly erroneously impacted.	The literature values used in the model are based on numerous studies and are expected to be representative of the systems in the watershed. Regardless of the values used, however, the conclusion regarding implementation will be the same (i.e., the loadings from the illicit systems must be eliminated through the formation of the regional sewer district.).
Van Frank	70	It would appear that sewage contamination is a significant factor and that unless the appropriate E. coli sampling is done, the recommendations in the TMDL report could be significantly in error.	This TMDL dealt with the impairments to the creek as identified by the 1998 303(d) List . New information generated after the 1998 list will be used to list impairments on the 2002 list.
Van Frank	71	In 6.0 Implementation, sec.6.1 there is no requirement for	Consideration is being given to including E. coli in the follow-up

		monitoring E. coli. This should be a requirement.	monitoring plan.
Van Frank	72	Examination of the modeling data in Appendix C shows numerous graphs where the observed data and the modeled values reveal great discrepancies. Some examples are: C-02, CBOD, no relationship of observed vs. model; C-03, Nitrogen, observed could be bimodal, model does not show this; C-09 water depth, observed and modeled are not even close. If water depth can not be modeled with more accuracy than this, it raises significant questions about the accuracy of the model. If models are going to be used in the development of TMDLs there has to be some assurance that the model is valid.	The model has been calibrated and validated using the best available data. The nature of water quality modeling makes it very difficult to exactly simulate real world conditions. The QUAL2E model has proven itself to be extremely reliable in hundreds of studies and in this instance was applied by a senior engineer with more than 22 years of experience in this field.