Report No. 93-03

WATERSHED PLANNING IN THE ALBEMARLE-PAMLICO
ESTUARINE SYSTEM

A SUBBASIN PC DATABASE

August 1993

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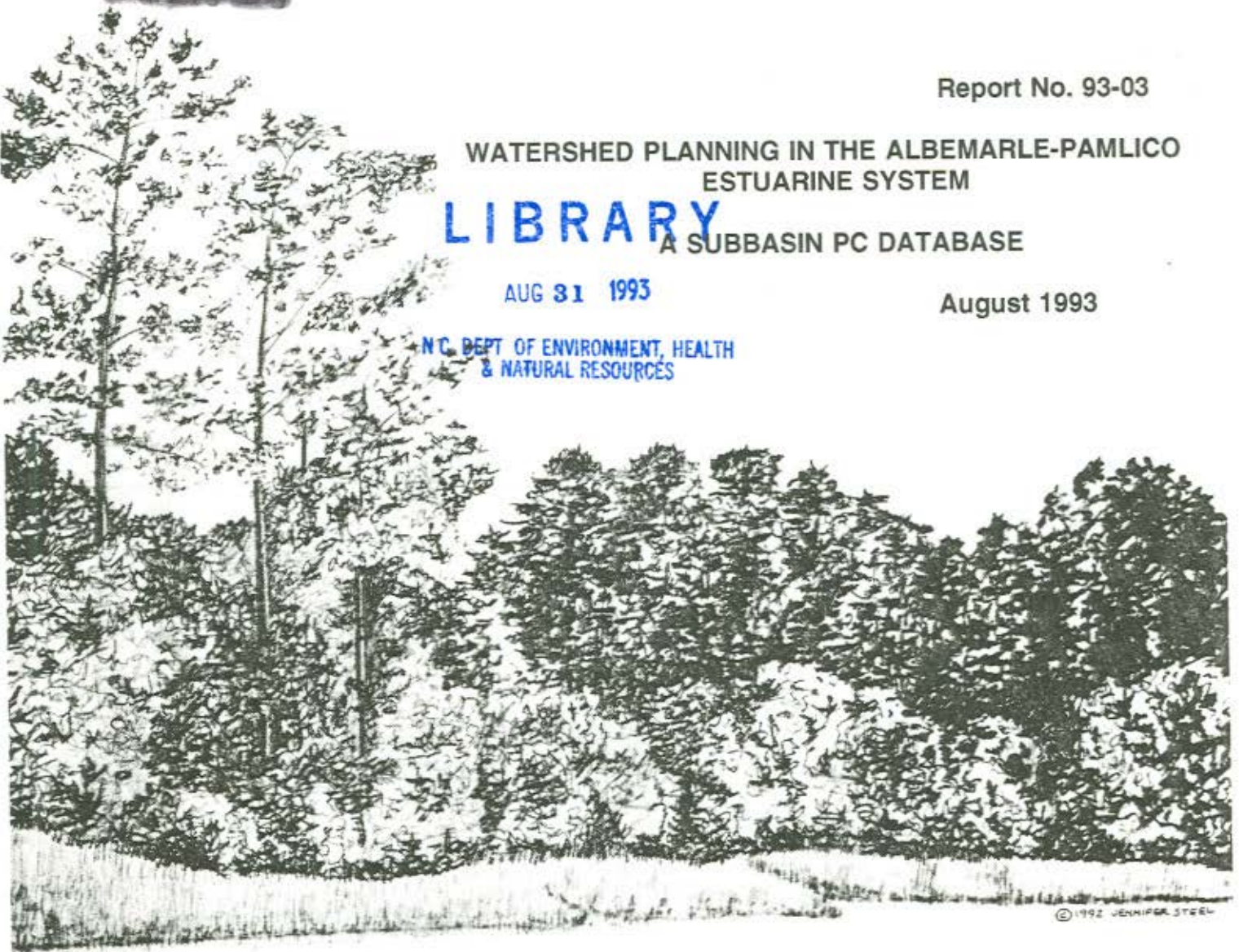
ALBEMARLE-PAMLICO
ESTUARINE STUDY

Department of
Environment, Health,
and Natural Resources

Environmental
Protection Agency
National Estuary Program

WATERSHED PLANNING IN THE ALBEMARLE-PAMLICO ESTUARINE SYSTEM

Report 4 - A Subbasin PC Database

by

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Research Triangle Park, NC 27709-2194

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Project No. 4873-04

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This report is the fourth in a series of nine reports by Research Triangle Institute (RTI)
to support watershed planning and the Comprehensive Conservation and Management Plan
for the Albemarle-Pamlico (A/P) Estuary Study Area. This work is being done under
Cooperative Agreement No. C-14010 between RTI and the U.S. Environmental Protection
Agency.

Current plans call for the report series to include the following, when completed later
in 1992:

Report #   Title

1) Annual Average Nutrient Budgets
2) Groundwater Discharge and Groundwater Quality
3) Toxics Analysis
4) A Subbasin PC Database
5) Fishing Practices Mapping
6) Subbasin Profiles and Critical Areas
7) Geographic Targeting for Nonpoint Source Programs
8) Riparian Buffers for Water Quality Enhancement in the Albemarle-Pamlico Area
9) Nutrient Mass Balances

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Part 1: System Overview

1.1 Introduction

> **data:** *factual information used as a basis for reasoning, discussion, or calculation*
>
> **information:** 1: *the communication or reception of knowledge or intelligence;* 2: *knowledge obtained from investigation, study, or instruction.*
>
> <u>Webster's New Collegiate Dictionary</u>

Webster's definitions reveal a subtle but important distinction between the words data and information and the concepts they embody. Data provide a foundation for further processing and analysis whereas information represents the results of this effort.

We live in an era in which we have access to an enormous amount of data but suffer from a relative paucity of information (as defined above). It is hoped that the effort reported on herein will help balance this inequity for the agency staff, researchers, private citizens, and industry representatives with water quality interests and management responsibilities.

The Albemarle-Pamlico (A/P) estuarine system is one of 22 estuaries identified nationwide under EPA's National Estuary Program. This report presents the results of a project to develop an accessible database of A/P pollution sources, one of several efforts by Research Triangle Institute (RTI) to support watershed planning in the A/P Study Area. The work was performed under contract to the North Carolina Department of Environment, Health, and Natural Resources and the U.S. Environmental Protection Agency (EPA), Region 4.

1.1.1 Purpose

Among the more important barriers to accessing information about known and potential pollution sources in the Albemarle-Pamlico Study Area are: 1) most of the data collected on spatial and temporal scales that are useful for areawide analysis are not currently centralized; 2) only in the past year have digital data become available that identify hydrologic unit boundaries; 3) much of the data of interest are calculated or aggregated on some basis other than hydrologic orientation; and 4) much of the data are available only in printed form or from mainframe computers. The power and widespread acceptance of personal computer technology provides an opportunity to begin to surmount these barriers.

This report documents RTI's efforts to develop a tool for accessing data/information related to both known and potential sources of pollution to surface waters in the A/P Study Area. It

is hoped that this effort will aid in the ongoing process of developing comprehensive, integrated strategies for providing better stewardship for these ecological resources.

The database developed under this task is designed to: (1) provide a central point for accessing diverse information related to point and nonpoint sources of pollution in the Study Area; (2) integrate data sources based on different units of data capture (countywide, LANDSAT pixels, etc.) to create a database based on hydrologic units (watersheds); and (3) serve as a potential model for a PC platform for managing point and nonpoint source-related information, within the framework of interagency information system development. The database does not attempt to provide information on the impacts or effects of pollutants. The decision to calculate data by hydrologic unit results in a tool that is more useful for areawide or cross-unit purposes than for local or within-unit purposes. The first part of this report provides background information on the development of the database and system capabilities. The second part is a manual for hands-on use of the system.

1.2 Database Development

The steps followed in database development were:

1) Data acquisition
2) Data processing and conversion
3) Database programming.

1.2.1 Data Acquisition

Data were acquired from several sources for inclusion in the database (Table 1). Key sources included: data generated as a result of a LANDSAT land use/land cover classification study; discharger compliance monitoring data maintained by the North Carolina Division of Environmental Management; annual county statistics calculated by the North Carolina Department of Agriculture; the 1987 Federal Agricultural Census for North Carolina, county data from the Conservation Tillage Information Center at Purdue University relating to land use and tillage practices; data generated by RTI on nutrient and toxics sources; and data from the North Carolina Division of Soil and Water dealing with implementation of cost-sharing efforts for installing best management practices.

Hydrologic unit boundaries for Virginia (an ARC/INFO coverage) were acquired during the late stages of the project and we have not attempted to convert parallel data (e.g., county-based data) for the Virginia portion of the study area. Therefore, data for Virginia are limited to LANDSAT land use/land cover estimates and nonpoint source nutrient inputs (very limited point source data are available).

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Table I A/P Database Data Types

Data Type	Source and Temporal Coverage (Reference #)	Original Level of Aggregation
Point Source Nutrients (NC)	NCDEM 1989-1990 (2)	Unaggregated point data
Point Source Toxics (NC)	NCDEM 1989-1990 (3)	Unaggregated point data
Land Use/Land Cover (NC & VA)	LANDSAT 1987-1988 (1)	Hydrologic Unit
Nutrient Runoff Loadings (NC & VA)	RTI 1987-1988 (2)	Hydrologic Unit
Atmospheric Nitrogen Deposition (NC & VA)	RTI, Regional Atmospheric Deposition Model, mid 1980s (2)	Hydrologic Unit
Ag Landuse by Category (NC)	1987 Federal Ag Census (4)	County
Animal Counts (NC)	1987 Federal Ag Census (4)	County
Other Animals Counts (NC)	North Carolina State Ag Statistics 1987-1989 (9)	County
Crop and Livestock Data 1980-1990 (NC)	North Carolina State Ag Statistics 1980-1990 (9)	County
Neuse River Ag Inventory - Percent BMP Implementation Data (NC)	North Carolina Division of Soil and Water projections 1992 (5)	County
CTIC Ag Survey Data 1984-1990 (NC)	Purdue University / USDA 1985-1990 (6)	County
Human Populations and Projections (NC)	NC Office of State Planning 1980-2020 (7)	County
NC Hydrologic Unit Boundaries	RTI/CGIA/DEM 1991 (2)	NC
VA Hydrologic Unit Boundaries	USDA/VADSCW (8)	VA
Percent of Each County in Each Hydrologic Unit	RTI 1992	N/A

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1.2.2 Data Processing and Conversion

Many of the data types in the database were originally aggregated by county and thus had to be converted to a hydrologic unit basis. This was accomplished by overlaying a coverage of hydrologic unit boundaries with a coverage of county boundaries in ARC/INFO. ARC/INFO was then used to calculate the percentage of each county in each hydrologic unit. (Appendix A). The resulting conversion table was used in a spreadsheet to convert the various county level data to the hydrologic unit level. These conversions assume that the parameters being converted are *evenly distributed across each county*. The user is advised that this is a significant assumption that could introduce substantial error in the data. Table I lists the data types compiled in the A/P database along with their sources and their original levels of aggregation.

1.2.3 Database Programming

The large number and size of the data files necessitated the development of a database management system for organizing and selectively retrieving the data. FoxPro 2.0 was chosen as the development software because of its speed and its powerful programming language. FoxPro uses an xBase type language, which is similar to dBase and other major databases. The features of the program are modular and are designed to facilitate future enhancements.

1.3 Capabilities of the System

The A/P Point and Nonpont Source PC Database can be used by modelers, planners, researchers, and decision makers for immediate desktop access to information that would otherwise require use of a GIS, mainframe systems, decentralized data sources, and/or non-digital reports. This version (1.0) of the database can produce hydrologic unit reports, descriptive statistics, and ranking lists.

1.3.1 Hydrologic Unit Reports

The system allows users to select a hydrologic unit (by number or drainage basin) and view reports on any type of data for that unit. The system can also be used to create a complete hydrologic unit "profile" by printing reports on all the data types for a selected hydrologic unit. Where appropriate, the system also calculates and prints a parameter's mean value (across all hydrologic units) and the percentile ranking of the hydrologic unit.

1.3.2 Hydrologic Unit Ranking Lists

The system can create ranking lists of hydrologic units ordered according to their value for a specified parameter. The ranking facility includes a feature that allows users to set criteria, thereby ranking only those hydrologic units that meet the specified criteria. The system also can display the median and mean of the parameter being ranked.

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1.3.3 Other Capabilities

The database offers a complete context-sensitive help system. In addition, all the features of the program are menu driven and can be accessed by both the keyboard and the mouse.

1.4 Future Enhancements

Listed below are recommendations for potential future enhancements to the A/P database. Users are encouraged to identify useful enhancements as well.

1.4.1 Programming Enhancements

1) The ability to extract and plot time series data from the agricultural data files.

2) The ability to set criteria based on any field within any of the data files. Currently, criteria can only be set on fields that are in the data file that contains the ranking field.

3) The ability to produce summary values for an entire river basin.

4) The ability to include percentile values in hydrologic unit reports that extract *more than one* record. Currently, when a report retrieves more than one record (for example, from the landuse file) the calculated percentile value would be accurate only for the first record.

1.4.2 Data Coverage Enhancements

1) Include additional data regarding implementation of both Federal and State agricultural conservation initiatives. Data could include data currently tracked by the Agricultural Conservation and Stabilization Service (ASCS) and the State Soil and Water Conservation Agencies. Because data are currently tracked by county and are generally not available electronically, this would require a substantial effort to capture and convert data to a hydrologic basis.

2) Integrate the database with waterbody-oriented data (i.e., data currently collected by NCDEM and VAWCB assessing surface water quality and current Federal databases; Waterbody System, RF3 and ARC/INFO capabilities can be used to accomplish this.)

3) Include data collected by SCS as part of the National Resources Inventory.

4) Restructure the database around hydrologic units currently being developed by SCS and NCGIA; this would allow for greater spatial resolution and better institutional integration among various State and Federal programs and would require data conversion.

5) Include data collected by USGS as part of the NAWQA project.

6) Include data regarding permitting of urban stormwater programs as they become available.

7) Include data from the 1992 Federal agricultural census as they become available.

8) Add an additional dimension to the database based on proximity of land/sources to surface waters; some data are currently being generated by RTI using LANDSAT data and GIS buffering capabilities.

9) Inclusion of parallel data (where available) for the Virginia portion of the study area.

Part 2: User's Manual

The Albemarle/Pamlico Point and Nonpoint Source PC Database

2.1 Overview of the Database

The Albemarle/Pamlico PC Database is an interactive computer program that manages data related to point and nonpoint pollution sources within the Albemarle/Pamlico Estuarine Study Area. The system contains approximately 140 data files that cover information pertaining to nutrient and toxics point source loadings, land use, nonpoint nutrient loading from runoff and atmospheric sources, and ancillary data. Table 2 contains a complete list of the system's data types.

The purpose of the database is to allow users to quickly access and analyze data at the hydrologic unit level. All of the data in the system are aggregated by hydrologic units. The North Carolina portion of the A/P Study Area contains 68 hydrologic units and the Virginia portion contains 44 units. Users of the Database can print out **hydrologic unit reports** which give the values for a specific data type (e.g. hay production in 1985) for a selected hydrologic unit. Where appropriate, the reports also include A/P-wide median and mean values as well as the percentile ranking of a hydrologic unit (as compared to the rest of the units in the Study Area).

The database can also produce **ranking lists** which display hydrologic units in order according to their values for a given data type. The ranking facility also allows users to specify extraction criteria (e.g., all hydrologic units with chromium dischargers). Both the hydrologic unit reports and the ranking lists can be sent to the screen, printer, or a disk file.

The database was developed using FoxPro 2.0 and is distributed as a run-time version that includes two FoxPro library files.

2.2 Installing the System

To install the database, you must have at least 7 megabytes of free disk space on your hard drive.

1. Copy all the files on the system disks to a new subdirectory on your hard drive.

2. Switch to the new subdirectory and type "install" at the DOS prompt. Press <Enter>.

3. To run the program, type AP at the DOS prompt. Press <Enter>. The database will create index files the first time it is run on a new system. This may take several minutes, but will not occur again.

2.3 Using the Database

The functions of the database are accessed through the *menu bar* located at the top of the screen. The three selections on the menu bar are *Help*, *Data*, and *System*.

2.3.1 Help

Selecting *Help* on the menu bar brings up two options: *Overview of the Database* and *Commands*. The overview is a brief discussion of the purpose and features of the database. The Commands selection will allow you to view a short tutorial on creating hydrologic unit reports or ranking lists.

A/P Database Data Types

Point Source Data
Nutrient Loading (NC)
Toxics Data (NC)

Nonpoint Source Data
Land Use/Land Cover Data
Atmospheric Nitrogen Deposition Data
Runoff Nutrient Loading

Federal Agricultural Census Data, 1987
Hectares planted by crop & agricultural
   land use by category
Animal Inventories

State Agricultural Statistics, 1980-1990
Barley
Corn
Cotton
Hay
Irish Potatoes
Beefcow, Milkcow, Hog, and Chickens
Oats
Peanuts
Sorghum
Soybeans

Nonpoint Source Data (cont'd)
Sweet Potatoes
Tobacco
Wheat
Hogs, Chickens, Broilers, Cattle, and
Turkeys , 1987-1989 only

CTIC Conservation Practice Data,
1984-1990

Neuse River Percent BMP
Implementation Data
Beefcattle Operations
Croplands
Dairy Operations
Horse Operations
Pasture Lands
Poultry Operations
Sheep Operations
Swine Operations

Other Data
Human Populations
Percent of each county in each
hydrologic unit

Table 2 A/P Database Data Types

NOTE: Context-sensitive help is available throughout the program by pressing <F1>. Press <Esc> to exit the help screens.

2.3.2 Data

Selecting *Data* on the menu bar brings up two options: *Hydrologic Unit Reports* and *Hydrologic Unit Rankings*. These are the two options for extracting and analyzing data in the database.

2.3.2.1 Hydrologic Unit Reports

The Hydrologic Unit Reports screen (Figure 1) is used to create reports containing data about a particular hydrologic unit. When you select this option another menu popup will appear with a choice between the *Entire Study Area* or a *Selected Receiving Waters*. The *Selected Receiving Waters* option allows you to select hydrologic units that only drain into certain large receiving waters (e.g., Albemarle Sound, Neuse River). The *Entire Study Area* option allows access to all hydrologic units in the A/P Study Area.

```
╔══════════════════════Hydrologic Unit Reports══════════════════════╗
║ ┌─< Select a Hydrologic Unit   >────────────────────────────────┐ ║
║ │                                                               │ ║
║ │ Hydrologic Unit        Major Drainage         Minor Drainage  │ ║
║ │ 3-02-02-01-11          NEUSE RIVER            LITTLE RIVER     │ ║
║ └───────────────────────────────────────────────────────────────┘ ║
║     Report on:          Select Year       Send Report To:         ║
║   (•) SELECTED Data      ┌──────┐          (•) Screen             ║
║   ( ) ALL Data           │      │          ( ) Printer            ║
║                          └──────┘          ( ) Disk               ║
║  ┌─< Select type of data to retrieve  >─────────────────────────┐ ║
║  │ ┌───────────────────────────────────────────────────────────┐│ ║
║  │ │*********************POINT SOURCE DATA********************* ▲││ ║
║  │ │Nutrient Data from NPDES Dischargers                       ◆││ ║
║  │ │Toxics Data from NPDES Dischargers                          ││ ║
║  │ │*********************NONPOINT SOURCE DATA****************** ││ ║
║  │ │Atmospheric Nitrogen Deposition (NC & VA)                  ││ ║
║  │ │Landuse / Land Cover Data   (NC & VA)                     ▼││ ║
║  │ └───────────────────────────────────────────────────────────┘│ ║
║  └───────────────────────────────────────────────────────────────┘║
║                «   OK   »        < Exit >                          ║
╚═══════════════════════════════════════════════════════════════════╝
```

Figure 1 Hydrologic Unit Reports Screen

When you enter the Hydrologic Unit Reports screen, the blue-green highlight will appear over the *Select Hydrologic Unit* push button. Click or press <Enter> on this button to bring up a list of hydrologic units. Use the arrow keys to highlight a desired hydrologic unit and the press <Enter>. You will return to the Reports screen and your selection will appear in the box below the push button.

The highlight will now advance to the radio buttons which allow you to select between retrieving *All Information* or *Selected Information*. The *All Information* option will extract data about the selected hydrologic unit from each of the data files in the system (Caution: this will produce approximately 140 pages of output). The *Selected Information* option will allow you to retrieve only one type of data for the selected hydrologic unit.

If you choose *Selected Information*, the scrollable list at the bottom of the screen will become activated. Press the down arrow or <Tab> to move the highlight into the list. The scrollable list contains short descriptions of all the data files that are available in the system. Use the arrow keys to highlight the type of data you wish to extract for the selected hydrologic unit. A vertical scroll bar is located on the right side of the scrollable list. To move quickly through the list, hold the left mouse button down on the marker (♦) and move up or down. Press <Enter> to select the highlighted data type.

Several of the agricultural data files listed in the scrollable list contain data for the years 1980-1990. If you select one of these files, the *Select Year* popup will become activated. Click or press <Enter> on the popup and select a year. When using the *Selected Information* option, you may only report on data for one year at a time.

The highlight will then advance to the radio buttons which allow you to select an *Output Device* for the hydrologic unit report. To select, click or press <Enter> on the desired option. If you select *Disk* as your desired output device, a field will pop up in which you must type the destination file name (e.g., *output*.txt or *C:\data\output*) Press <Enter> after typing in the file name.

The highlight will then advance to the *OK* and *Cancel* push buttons. The *OK* push button extracts the data and calculates descriptive statistics. The hydrologic unit report will be sent to the specified output device. If you specified *Screen* as the output device, a report will be displayed to the screen. To page through the report, click or press <Enter> on the *More* push button at the bottom left of the report screen. When you are finished, select the *Done* push button. To exit the Hydrologic Unit Reports screen, click or press <Enter> on the *Cancel* push button. An example hydrologic unit report is shown in Table 3.

Note on Descriptive Statistics: Where appropriate, the program calculates mean, median, and percentile values for the data types in the output. The mean and median refer to the specified parameter over all the hydrologic units in the North Carolina portion of the Study Area. (For data files specifying *NC & VA* , the entire Study Area is used.) Similarly, the percentile is the percentile ranking of that hydrologic unit, for the specified parameter, as compared with the rest of the hydrologic units in the Study Area (or portion thereof).

```
                    Hydrologic Unit Report
                  North Carolina Population Data

                  Hydrologic Unit:3-01-02-03-01
                  Major Drainage:CHOWAN RIVER
                  Minor Drainage:AHOSKIE CREEK


                                  Value     Mean Value    Percentile

1980 Population                   3268        21474           34
1990 Population                   3141        24910           32
2000 Population                   3086        29973           24
2010 Population                   3014        32218           24
2020 Population                   2940        35625           22

1980 Population Density (#/km²)    21           37            9
1990 Population Density (#/km²)    20           43            9
2000 Population Density (#/km²)    20           51            7
2010 Population Density (#/km²)    19           55            6
2020 Population Density (#/km²)    19           61            6
```

Table 3 Example Hydrologic Unit Report

2.3.2.2 Hydrologic Unit Ranking

The Ranking Screen is used to rank all the hydrologic units in the Study Area according to a specific parameter. You select the ranking field and then have the option to specify *sorting criteria*, *sort order*, and *output fields*.

When you enter the Hydrologic Un Ranking Screen (Figure 2), the highlight will be in the scrollable list at the top of the screen. This list contains brief descriptions of all the data types in the system. Use the arrow keys to move the highlight to the type of data you wish to select. Press <Enter> to select.

```
┌──────────────────────Hydrologic Unit Ranking──────────────────────┐
│                                                                    │
│  Select Database      (Highlight and Hit <ENTER>)                  │
│                                                                    │
│   ┌────────────────────────────────────────────────────────────┐■ │
│   │ Nutrient Data from NPDES Dischargers                       │▲ │
│   │ Flow Data from Point Source Dischargers                    │♦ │
│   │ ▸Toxics Data from NPDES Dischargers                        │▼ │
│   └────────────────────────────────────────────────────────────┘■ │
│                                                                    │
│  Rank on Which Field?          Description of Database Fields       │
│                                                                    │
│   ┌──────────────────────────┐■  ┌──────────────────────────────┐▲│
│   │                          │▲  │This file contains toxics loading data│
│   │ AVGLB_DY                 │   │from NPDES dischargers.       │♦│
│   │ AVGKG_DY                 │♦  │                              │ │
│   │ ▸AVGKG_YR                │▼  │Fields:                       │ │
│   └──────────────────────────┘■  │                              │ │
│                                  │SUBBASIN: Subbasin number     │ │
│   Set <Criteria>                 │HYDUNIT: Hydrologic unit      │ │
│   Set <Sort> Order               │NPDES: NPDES number           │ │
│   Select Output <Fields>         │FACILITY: Facility name       │ │
│   Select Output <Device>         │PARAMETER: STORET number      │ │
│                                  │POLLUTANT: Pollutant chemical name│
│       «  OK  »       <Cancel>    └──────────────────────────────┘▼│
│                                                                    │
└────────────────────────────────────────────────────────────────────┘
```

Figure 2   Hydrologic Unit Ranking Screen

Once you have selected the data file from the first scrollable list, the two fields below will become activated. The scrollable list to the left of the screen contains the names of all the data fields that are in the data file that you selected above. To the right of the screen, a large memo field contains short descriptions of each of the fields in the scrollable list. Hit <Tab> to move out of the memo field and then use the arrow keys to highlight the field (parameter) that you want to rank. Hit <Enter> to select the field.

After selecting a ranking field, the highlight will move to the *Criteria* push button. Selecting this button will bring up a screen that allows you to define criteria for any or all of the fields in the scrollable list (Figure 3). The bottom box of the Criteria Screen is for "building" criteria. Click on the leftmost popup to bring up a list of fields on which you can create a criteria. Likewise, click on the middle popup to select the *operator* for the criteria. The available operators are: less than ($<$), greater than ($>$), equal to ($=$), not equal to ($<>$), less than or equal to ($<=$), greater than or equal to($>=$), exactly equal to ($==$), and "in the list" (IN). The "in the list" operator should be followed by a list, separated by commas. In the blank field to the right of the operator popup, type in a *criteria value*. In Figure 3, the selected field is "YR1980", the operator is "$>$" and the criteria value is "5000".

```
┌═══════════════════════════════Set Criteria═══════════════════════════════┐
│                                                                           │
│   Database  ┌───────────┐              Order  ┌───────────┐               │
│             │   POP     │                     │  Record#  │               │
│             └───────────┘                     └───────────┘               │
│   ┌─────────────────────────────────────────────────────────┐ ┌─┐        │
│   │  YR1980 > 5000                                           │ │▲│        │
│   │ ►                                                        │ │♦│        │
│   │                                                          │ │ │        │
│   │                                                          │ │ │        │
│   │                                                          │ │ │        │
│   │                                                          │ │▼│        │
│   └─────────────────────────────────────────────────────────┘ └─┘        │
│        <Delete >     <   ↑   >    <   ↓   >     < Group >                  │
│   ┌─────────────────────────────────────────────────────────────┐        │
│   │  ┌───────────┐   ┌───────┐                                   │        │
│   │  │  YR1980   │   │   >   │   5000              < Add  >       │        │
│   │  └───────────┘   └───────┘                                   │        │
│   └─────────────────────────────────────────────────────────────┘        │
│                                                                           │
│          « Continue »    < Reset >    < Quit >                            │
└───────────────────────────────────────────────────────────────────────────┘
```

Figure 3 Set Criteria Screen

When you have built a criteron, click on the *Add* push button to add the criteria to the criteria list. You may add as many criteria as needed. To clear all criteria, click on the *Reset* push button. To keep the criteria and return to the ranking screen, click on the *Continue* push button. Only hydrologic units that meet the criteria will be present in the final ranking output.

When you return to the Ranking Screen, press <Tab> to move to the *Sort Order* push button. The sort order push button selects the order in which the hydrologic units will appear in the output. The hydrologic units are ordered according to the value in the Ranking Field. The default sort order is Ascending.

Next is the *Output Fields* push button. Click on this push button to bring up a screen for selecting the fields to appear in the output (Figure 4). The large box on the left box contains all of the fields relating to the data type you have selected. To select a field for output, double click on it with the mouse, or highlight the field and press <Enter>. **You must select the Ranking Field as an output field.** The selected fields will appear in the right box. Note that the hydrologic unit, major drainage, and minor drainage fields are automatically included in the output. You may select up to five additional fields.   To include descriptive statistics in the output, select the *Include Descriptive Statistics* check box at the bottom of the screen. This will calculate the median and mean values for the Ranking Field and display them in a report before the ranking output. The descriptive statistics are only displayed when *Screen* is selected as the output device.

```
  Database Fields:                                    Selected Fields:

   SUBBASIN    N   10   0  ▲  <   Move    >    POP.HECTARES
   HYDUNIT     C   13   0  ♦                  ►POP.DEN1980
   HECTARES    N   11   0  ▓  < Move All >
   YR1980      N    7   0  ▓
   DEN1980     N    8   2  ▓
  ►YR1990      N    7   0     <  Remove   >
   DEN1990     N    8   2
   YR2000      N    7   0  ▼  <Remove All>

  Database:
                                                         «   OK   »
     POP            [X] Include descriptive statistics
                                                        < Cancel >
```

Figure 4 Select Fields Screen

Finally, use the *Device* push button to select the destination of the output. You may select Screen, Printer, or Disk. If you select Disk, a field will pop up allowing you to enter the destination file name. Press <Enter> to submit the file name.

At the bottom of the screen are the *OK* and *Cancel* push buttons. Choose OK to process the ranking. Cancel will return you to the menu bar.

Table 4 shows a ranking list which was generated by the program. To generate this list the parameters were set as follows:

```
Data Type (Top Scrollable List):   Human Populations
Ranking Field (Left Scrollable List):       DEN2020 (Population density in the year 2020)
Criteria:                                   DEN2020 > 100
Sort Order:                                 Descending
Output Fields:                              DEN2020
```

DEN2020	HYDUNIT	Majdrain	Mindrain
344	3-02-02-01-07	Neuse River	Middle Creek
303	3-02-02-01-05	Neuse River	Unnamed
250	3-02-02-01-04	Neuse River	Falls Lake
237	3-02-02-01-06	Neuse River	Swift Creek
189	3-02-02-01-02	Neuse River	Little River
174	3-02-02-01-03	Neuse River	Eno River
160	3-02-02-01-11	Neuse River	Little River
115	3-02-01-06-06	Bogue Sound	Unnamed

Table 4 Example Hydrologic Unit Ranking List

References

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Appendix A
Portion of each county in each A/P hydrologic unit

Hydrologic Unit	County	Percent of County in Hydrologic Unit
3-01-02-05-06	CAMDEN	30%
3-01-02-05-06	CURRITUCK	97%
3-01-02-05-06	DARE	<1%
3-01-02-05-02	CAMDEN	70%
3-01-02-05-02	CURRITUCK	<1%
3-01-02-05-02	GATES	17%
3-01-02-05-02	PASQUOTANK	58%
3-01-02-05-02	PERQUIMANS	<1%
3-01-02-03-02	BERTIE	15%
3-01-02-03-02	GATES	70%
3-01-02-03-02	HERTFORD	45%
3-01-02-04-01	HERTFORD	25%
3-01-02-04-01	NORTHAMPTON	34%
3-01-01-06-01	HALIFAX	<1%
3-01-01-06-01	NORTHAMPTON	2%
3-01-01-07-01	BERTIE	7%
3-01-01-07-01	HALIFAX	31%
3-01-01-07-01	MARTIN	2%
3-01-01-07-01	NORTHAMPTON	26%
3-01-02-04-02	HERTFORD	17%
3-01-02-04-02	NORTHAMPTON	30%
3-02-01-02-01	HALIFAX	12%
3-02-01-02-01	WARREN	20%
3-02-01-02-02	EDGECOMBE	<1%
3-02-01-02-02	FRANKLIN	6%
3-02-01-02-02	HALIFAX	11%
3-02-01-02-02	NASH	9%
3-02-01-02-02	VANCE	4%
3-02-01-02-02	WARREN	40%
3-01-02-05-04	CHOWAN	33%
3-01-02-05-04	GATES	4%
3-01-02-05-04	PASQUOTANK	42%
3-01-02-05-04	PERQUIMANS	100%
3-01-02-05-04	TYRRELL	<1%
3-01-02-05-04	WASHINGTON	<1%
3-01-02-03-03	BERTIE	3%
3-01-02-03-03	CHOWAN	26%
3-01-02-03-03	GATES	9%

Hydrologic Unit	County	Percent of County in Hydrologic Unit
3-01-02-03-03	HERTFORD	3%
3-01-02-03-03	PERQUIMANS	<1%
3-02-01-01-01	FRANKLIN	18%
3-02-01-01-01	GRANVILLE	43%
3-02-01-01-01	PERSON	8%
3-02-01-01-01	VANCE	31%
3-02-01-02-03	EDGECOMBE	18%
3-02-01-02-03	HALIFAX	37%
3-02-01-02-03	MARTIN	<1%
3-02-01-02-03	NASH	1%
3-02-02-01-01	DURHAM	4%
3-02-02-01-01	ORANGE	3%
3-02-02-01-01	PERSON	31%
3-02-01-01-03	FRANKLIN	18%
3-02-01-01-03	NASH	6%
3-02-01-01-03	VANCE	13%
3-02-01-01-03	WARREN	1%
3-01-02-03-01	BERTIE	2%
3-01-02-03-01	HERTFORD	11%
3-01-02-03-01	NORTHAMPTON	2%
3-02-02-01-04	DURHAM	52%
3-02-02-01-04	FRANKLIN	2%
3-02-02-01-04	GRANVILLE	25%
3-02-02-01-04	PERSON	1%
3-02-02-01-04	WAKE	12%
3-01-02-05-07	CURRITUCK	<1%
3-01-02-05-07	DARE	9%
3-01-02-03-04	BERTIE	8%
3-01-02-03-04	CHOWAN	14%
3-02-02-01-02	DURHAM	6%
3-02-02-01-02	ORANGE	16%
3-02-02-01-02	PERSON	<1%
3-01-01-07-03	BERTIE	41%
3-01-01-07-03	NORTHAMPTON	<1%
3-02-02-01-03	DURHAM	7%
3-02-02-01-03	ORANGE	30%
3-01-02-05-01	BERTIE	3%
3-01-02-05-01	CHOWAN	27%
3-01-02-05-01	WASHINGTON	<1%
3-02-01-01-02	FRANKLIN	43%
3-02-01-01-02	NASH	3%
3-01-01-07-02	BEAUFORT	1%

Hydrologic Unit	County	Percent of County in Hydrologic Unit
3-01-01-07-02	BERTIE	20%
3-01-01-07-02	HALIFAX	<1%
3-01-01-07-02	MARTIN	73%
3-01-01-07-02	WASHINGTON	12%
3-01-02-05-03	CURRITUCK	3%
3-01-02-05-03	DARE	35%
3-01-02-05-03	HYDE	10%
3-01-02-05-03	TYRRELL	68%
3-02-01-01-06	EDGECOMBE	26%
3-02-01-01-06	NASH	13%
3-02-01-01-05	EDGECOMBE	<1%
3-02-01-01-05	FRANKLIN	4%
3-02-01-01-05	NASH	24%
3-01-02-05-05	BERTIE	<1%
3-01-02-05-05	CHOWAN	<1%
3-01-02-05-05	HYDE	<1%
3-01-02-05-05	PASQUOTANK	<1%
3-01-02-05-05	PERQUIMANS	<1%
3-01-02-05-05	TYRRELL	32%
3-01-02-05-05	WASHINGTON	64%
3-02-02-01-05	DURHAM	4%
3-02-02-01-05	FRANKLIN	1%
3-02-02-01-05	JOHNSTON	10%
3-02-02-01-05	WAKE	39%
3-02-02-01-11	FRANKLIN	3%
3-02-02-01-11	JOHNSTON	17%
3-02-02-01-11	WAKE	9%
3-02-02-01-11	WILSON	2%
3-02-01-01-04	NASH	22%
3-02-01-01-04	WILSON	<1%
3-02-01-03-02	EDGECOMBE	10%
3-02-01-03-02	MARTIN	2%
3-02-01-03-02	PITT	2%
3-02-01-03-01	EDGECOMBE	5%
3-02-02-03-01	FRANKLIN	5%
3-02-02-03-01	JOHNSTON	3%
3-02-02-03-01	NASH	13%
3-02-02-03-01	WAKE	2%
3-02-02-03-01	WILSON	4%
3-02-01-03-03	EDGECOMBE	41%
3-02-01-03-03	NASH	2%
3-02-01-03-03	PITT	6%

Hydrologic Unit	County	Percent of County in Hydrologic Unit
3-02-01-03-03	WILSON	19%
3-02-01-03-05	BEAUFORT	9%
3-02-01-03-05	MARTIN	22%
3-02-01-03-05	PITT	8%
3-02-02-03-02	EDGECOMBE	<1%
3-02-02-03-02	GREENE	51%
3-02-02-03-02	JOHNSTON	1%
3-02-02-03-02	NASH	7%
3-02-02-03-02	WAYNE	10%
3-02-02-03-02	WILSON	72%
3-02-01-04-02	BEAUFORT	85%
3-02-01-04-02	CRAVEN	1%
3-02-01-04-02	HYDE	14%
3-02-01-04-02	PAMLICO	12%
3-02-01-04-02	WASHINGTON	23%
3-02-01-03-04	BEAUFORT	2%
3-02-01-03-04	EDGECOMBE	<1%
3-02-01-03-04	MARTIN	<1%
3-02-01-03-04	PITT	42%
3-02-01-05-02	DARE	40%
3-02-01-05-02	HYDE	<1%
3-02-02-01-06	JOHNSTON	8%
3-02-02-01-06	WAKE	11%
3-02-01-05-01	DARE	5%
3-02-01-05-01	HYDE	<1%
3-02-01-04-01	BEAUFORT	<1%
3-02-01-04-01	WASHINGTON	2%
3-02-02-01-07	JOHNSTON	1%
3-02-02-01-07	WAKE	9%
3-02-02-03-04	EDGECOMBE	<1%
3-02-02-03-04	GREENE	42%
3-02-02-03-04	LENOIR	9%
3-02-02-03-04	PITT	17%
3-02-02-03-04	WILSON	3%
3-02-01-05-03	CARTERET	1%
3-02-01-05-03	DARE	11%
3-02-01-05-03	HYDE	76%
3-02-01-05-03	PAMLICO	5%
3-02-02-01-08	JOHNSTON	6%
3-02-02-01-08	WAKE	<1%
3-02-02-01-12	JOHNSTON	5%
3-02-02-01-12	WAYNE	9%

Hydrologic Unit	County	Percent of County in Hydrologic Unit
3-02-02-01-09	HARNETT	<1%
3-02-02-01-09	JOHNSTON	30%
3-02-02-01-09	SAMPSON	<1%
3-02-02-01-09	WAKE	3%
3-02-02-01-09	WAYNE	1%
3-02-02-02-04	BEAUFORT	2%
3-02-02-02-04	CRAVEN	22%
3-02-02-02-04	PITT	23%
3-02-02-01-10	JOHNSTON	16%
3-02-02-01-10	WAYNE	1%
3-02-02-03-03	GREENE	3%
3-02-02-03-03	JOHNSTON	<1%
3-02-02-03-03	WAYNE	12%
3-02-02-01-13	DUPLIN	<1%
3-02-02-01-13	JOHNSTON	<1%
3-02-02-01-13	SAMPSON	<1%
3-02-02-01-13	WAYNE	32%
3-02-02-02-01	GREENE	1%
3-02-02-02-01	LENOIR	32%
3-02-02-02-01	WAYNE	21%
3-02-02-02-02	GREENE	3%
3-02-02-02-02	LENOIR	3%
3-02-02-02-02	WAYNE	6%
3-02-02-02-05	CRAVEN	26%
3-02-02-02-05	JONES	3%
3-02-02-02-05	PITT	3%
3-02-02-02-03	CRAVEN	4%
3-02-02-02-03	DUPLIN	<1%
3-02-02-02-03	JONES	3%
3-02-02-02-03	LENOIR	37%
3-02-02-02-03	PITT	0%
3-02-01-05-04	BEAUFORT	<1%
3-02-01-05-04	CARTERET	3%
3-02-01-05-04	HYDE	<1%
3-02-01-05-04	PAMLICO	43%
3-02-02-04-03	CARTERET	16%
3-02-02-04-03	CRAVEN	42%
3-02-02-04-03	JONES	1%
3-02-02-04-03	PAMLICO	37%
3-02-02-04-02	CRAVEN	1%
3-02-02-04-02	JONES	53%
3-02-02-04-02	LENOIR	4%

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Hydrologic Unit	County	Percent of County in Hydrologic Unit
3-02-01-06-01	CARTERET	31%
3-02-01-06-01	HYDE	<1%
3-02-01-06-01	PAMLICO	3%
3-02-02-04-01	DUPLIN	<1%
3-02-02-04-01	JONES	21%
3-02-02-04-01	LENOIR	14%
3-02-02-04-01	ONSLOW	1%
3-02-01-06-02	CARTERET	9%
3-02-01-06-02	CRAVEN	4%
3-02-01-06-02	JONES	19%
3-02-01-06-02	ONSLOW	13%
3-02-01-06-03	CARTERET	16%
3-02-01-06-04	CARTERET	5%
3-02-01-06-05	CARTERET	19%
3-02-01-06-05	ONSLOW	<1%
3-02-01-06-06	CARTERET	<1%
3-02-01-06-06	ONSLOW	8%