LAND USE/LAND COVER 1995
POLECAT CREEK WATERSHED

Prepared By:

Lowell D. Ballard
Darryl Glover
C. Scott Crafton

Chesapeake Bay Local Assistance Department
Environmental Engineering Section
805 East Broad Street, Suite 701
Richmond, Virginia 23219

October 25, 1996

This project was funded, in part, by a Virginia Coastal Resource Management Program grant.

TABLE OF CONTENTS

ACKNOWLEDGMENTS

This report was funded, in part, by the Virginia Coastal Resources Management Program at the Department of Environmental Quality through Grant #NA57OZ0561 of the National Oceanic and Atmospheric Administration , Office of Ocean and Coastal Resource Management (NOAA), under the Coastal Zone Management Act of 1972, as amended. The views expressed herein are those of the authors and do not necessarily reflect the views of NOAA or any of its subagencies.

The NOAA grant provided $34,000 in federal funds, or 95% of total cash, for this project. The grant recipient provided $1,806 state general funds, or 5% of total cash, plus $32,605 in-kind services, for this project.

The authors would like to thank a number of individuals for their assistance and technical expertise during the course of this project including: John Pemberton of the Virginia Department of Forestry, Ron Wood of the Caroline Hanover Soil and Water Conservation District, Adrienne Ferris and Jean Tingler of the Virginia Economic Development Partnership and Keith White and Christine Edwards from CBLAD. Finally, we would like to thank Jeannie Lewis at the Virginia Coastal Resource Management Program.

INTRODUCTION

The purpose of this grant project was to digitize a 1995 land use/land cover data set from 1:12000 scale color infrared digital orthophotography (Digital Orthophoto Quarter-Quadrangle; DOQQ) received in 1995, and to purchase a 1996 version of DOQQ. Both of these products will be used to support the Polecat Creek Water Quality Monitoring Project. The 1995 land use/ land cover data sets were developed in an ARC/Info based geographic information system (GIS). The DOQQ, for which source photography was flown in spring 1995, was used, in accord with existing land use/land cover data sets, to obtain the 1995 land use/land cover data set for the watershed. The DOQQ data obtained from fall 1996 flight by PhotoScience, Inc. will be used to generate the 1996 land use land cover data set. The Polecat Creek Water Monitoring Project GIS is used to link water quality data (in the form of surface and ground water chemistry, and fish and macroinvertebrate community data) to land use/land cover data and to ultimately develop a nonpoint source pollution model for the watershed.

Please note that in 1993 CBLAD submitted a grant proposal, through the Virginia Department of Conservation and Recreation's Division of Soil and Water Conservation, to the United States Environmental Protection Agency (EPA) 319 grant program. That proposal was to develop a land use/land cover classification system and digitize data for calendar year 1993. The proposal was funded and the work was completed. The land cover/land use work done in 1995, and the current land use/land cover work associated with the Polecat Creek Project, builds and relies on the deliverable from that first EPA 319 project.

This document includes a description of the digitizing process for obtaining digital data from aerial photography, metadata on the 1995 land use/land cover data set, the land use/land cover classification and definition system (Appendix A) and a description of how the DOQQ data were generated by the contractor (Appendix B).

BACKGROUND

When the Polecat Creek Water Quality Monitoring Project was in the design phase, a literature review was performed. This review looked at many different subjects pertaining to water quality monitoring. One of these reviews dealt with reasons for nonpoint source monitoring project failure. The National Rural Clean Water Program identified poorly developed and maintained land use records as a reason for failure of several of its nonpoint source water quality monitoring projects. At that time it was decided that land use/land cover data would be a priority during the Polecat Creek Project. A brief description of the Polecat Creek project follows.

In April 1993 CBLAD initiated a water quality monitoring program in the Polecat Creek drainage in Caroline County, Virginia. The primary goal of the monitoring program is to describe the efficacy of land use regulations and policies in protecting adjacent water quality in the presence

of urban development activities. The land use regulations and policies being tested are those developed by CBLAD and the county governments in response to the Chesapeake Bay Preservation Act. The Polecat Creek monitoring system will provide information about the background state of water quality and about trends in water quality responsive to local land use regulations. This will be accomplished by measuring baseline levels of chemical, physical, and biological parameters and statistically evaluating any changes as the drainage is developed.

The project is divided into three components: a system of water quality monitoring networks that will provide quantitative information about chemical, physical, and biological parameters; a database of land use activities and land cover characteristics in the watershed with a method to monitor changes in each over the life span of the project; and a geographic information system (GIS) which will link water quality data and land use/land cover data to a digital geographic base map. A fourth component, groundwater monitoring, will be added in 1997.

DIGITIZING AND PROCESSING GEOGRAPHICALLY REFERENCED DATA
Using ARC/INFO 7.0.4

Section 1. Process for creating data layers

The following is a description of the digitizing process developed for the Polecat Creek project. Specifically, the methodology was developed to obtain data from 1:12000 scale color infrared digital orthophotographs.

Digitizing is the process of converting the spatial features on a map into a digital format. Features on a map include points, lines, and polygons. During the digitizing process, these features are transformed to x/y coordinates, with a single coordinate being a point and a series of coordinates a line. Lines that outline an area define a polygon. It is necessary that the following terminology be understood prior to beginning the digitizing process.

Arc - a line feature or the border of a polygon. An arc is defined by a "from-node" and a "to-node" and additional vertices in between.

Environment - a set of parameters defining various display, editing, and data manipulation conditions that remain active during a session until explicitly changed by the user.

Grain tolerance - a parameter controlling the distance between vertices on curves. Grain tolerance restricts the number of vertices and the distance between them on arcs representing curves. The smaller the grain tolerance, the closer vertices can be. The grain tolerance is different from a densify tolerance which has no effect on shape.

Label point - used to either represent a point feature or to identify a polygon.

Node - an arc endpoint. In many cases, the end of one arc marks the beginning of another, so it can be said that nodes also mark intersections.

- Pseudo node - the point at which an arc connects to itself (a loop) or to only one other arc.
- Dangling node - an arc endpoint not connected to another arc.

RMS Error - the calculated difference between recorded and specified tic locations, expressed as a residual of the means squared. Values are usually just slightly higher than 0.000 -the higher the value, the greater the error.

Snapping - the process of moving a feature to coincide exactly with coordinates of another feature within a specified distance or tolerance (called the snap distance).

Snap distance - the distance that a feature will move to coincide with coordinates of another feature. This is set during digitizing and ARC EDIT sessions.

Tic - a registration or geographic control point. These allow all coverage features to be registered to the same coordinate system.

Tic Match tolerance - the maximum distance allowed between an existing tic and a tic being digitized. If this distance is exceeded the digitizing error is considered unacceptable and the map must be registered over again. The tic match tolerance is used to ensure a low RMS error during map registration on a digitizer.

Topology - the spatial relationships between connecting or adjacent coverage features (e.g. arcs, nodes, polygons, and points). For example, the topology of an arc includes its from- and to- node, and its left and right polygons. Topological relationships are build from simple elements into complex elements: points (simplest elements), arcs (sets of connected points), areas (sets of connected arcs), and routes (sets of sections which are arcs or sections of arcs). Redundant data (coordinates) are eliminated because an arc may represent a linear feature, part of the boundary of an area feature or both. Topology is useful in GIS because may spatial modeling operations don't require coordinates, only topological information. For example, to find an optimal path between two points requires a list of the arcs that connect to each other and the cost to traverse each arc in each direction. Coordinates are only needed for drawing the path after it is calculated.

User-ID - a number assigned to each feature. These values should be unique. Once established, these values can be altered by the user, as needed.

Vertex - a point within an arc, providing shape.

Weed Tolerance - the minimum allowable distance between any two vertices along an arc. Weed tolerance is a parameter that can be set before adding arc features. When adding new arcs, if an input vertex is within the weed distance from

the last vertex it is disregarded. When weeding existing arcs, it is the tolerance used by the Douglas-Peucker algorithm.

Since all the data for the Polecat Creek project were taken from digital orthophotographs, a digitizing tablet was not required for this project. All data were digitized "on screen" in the ARCEDIT module using the 1:12000 scale color infrared orthophotograph as a back coverage. Tic files were originally generated from the contour coverages (which were generated from the digital terrain models) using the CREATE command. The proper usage of this command is:

CREATE <out_cover> <tic_bnd_cover>

Contour files were previously generated for each of the eleven color infrared orthophotographs (quarter quads), so there were eleven coverages initially developed with the CREATE command. To reduce the amount of work required later in the project, these coverages were joined using the MAPJOIN command. The proper usage of this command is:

MAPJOIN <out_cover> {feature_class} {all}

The software then prompts the user for the names of all coverages which need to be joined.

Both the land use coverage (PCLAND) and the hydrology coverage (PCWATR) are polygon coverages and were built and/or cleaned accordingly *. Also, several items were added to the polygon attribute table (PAT). The items added to the polygon coverages were land use code, land use name, owner name, USDA cropland identification number, and Department of Forestry logging identification number. These items were added using the ADDITEM command. The proper usage of this command is:

ADDITEM <in_info_file> <out_info_file> <item_name> <item_width> <output_width> <item_type> {decimal_places}

The roads, railroad, and miscellaneous transportation coverages are line coverages and were built and/or cleaned accordingly. The arc attribute table (AAT) for these coverage were modified to include several additional items. These items were land use code, name, and route number. The items were added using the ADDITEM command as described previously.

* the proper usage of the CLEAN command is:

CLEAN <in_cover> {out_cover} {dangle_length} {fuzzy_tolerance} {poly | line}
CLEAN <in_cover> out_cover .001 .001 poly
CLEAN <in_cover> out_cover .001 .001 line

Section 2. Process of Updating data layers

To annually update coverages, DOQQ data were once again used as back coverages. The data layer from the previous year (e.g., PCLAND94) was, copied to a new coverage for the current year (e.g, PCLAND95) then overlaid on top of the background images. This provides a template from which to work. Changes in the previous year's coverage (now copied to a coverage for the current year) are identified by the user (by examining the DOQQ defined as the background coverage) then updated. This is done on a DOQQ-by-DOQQ basis, working from the uppermost northwest corner of the watershed, progressing, row-by-row, until the southeastern most portion of the watershed is reached. For example, in creating the 1995 land use data layer (PCLAND95), the 1994 land use data layer (PCLAND94) was copied to PCLAND95. This creates an exact duplicate of the 1994 land use coverage which does not reflect and changes in land use that occurred during the 1994-1995 project year. Next the Ladysmith SE DOQQ was brought up in the background. The 1995 land use data layer was then superimposed on top of the DOQQ. After 'zooming' into an acceptable resolution, areas that differed in land use pattern on the DOQQ images from that which is reflected on the 1995 land use data layer (copied from 1994 but not updated) were identified. Once identified, they were updated in, by adding or deleting arcs, the 1995 land use data layer.

This list of commands used to accomplish the coverage updating process described above includes, but is not limited to:

ARCEDIT - Brings up the ArcEdit module of Arc/Info

DRAWENVIRONMENT - Sets up the attributes (e.g., arcs, nodes) that will be shown on the screen once the draw command is issued

DRAW - Draws to the screen the attributes defined by the DRAWENVIRONMENT command

EDITFEATURE - Specifies the attribute to be edited (e.g., arcs, nodes)

SELECT - Allows the user to define which specific items of the defined attribute (the type attribute being defined by the EDITFEATURE command) are to be edited.

BACKENVIRONMENT - Defines the attributes to drawn to the screen for the coverages listed with the BACKCOVERAGE command

BACKCOVERAGE - Defines the coverages that are to be drawn behind the coverage that is being edited (for our purposes we use DOQQ images as backcoverages)

SPLIT - Splits the SELECTed item into two distinct items

SAVE - Saves the work of the current EDITCOVERAGE

As stated earlier, all data were digitized "on screen" in the ARCEDIT module using the color infrared orthophotograph as a back coverage. The command to utilize and image in ARCEDIT is: **IMAGE** <image_name.bip> composite 1 2 3. The images that were used for

this digitizing project were:

lad_se.bip (ladysmith southeast)
hew_ne.bip (hewlett northeast)
wf_sw.bip (woodford southwest)
rg_nw.bip (ruther glen northwest)
rg_sw.bip (ruther glen southwest)
pen_sw.bip (penola southwest)
lad_sw.bip (ladysmith southwest)
hew_nw.bip (hewlett northwest)
rg_ne.bip (ruther glen northeast)
rg_se.bip (ruther glen southeast)
pen_nw.bip (penola northwest)

Section 3. Digitizing Environment (ARCEDIT)

The digitizing environment, which determines how items (points, arcs etc.) are processed once entered, was written in AML (Arc/Info Macro Language) and executed at the beginning of each digitizing session. This allowed uniform edit environments and reduced the amount of typing by the operator.

EDITIT.AML

```
Display 9999 3
Weed 20
Grain 20
Snaptype Closest 20
Intersectarcs all
Drawenvironment arcs tics nodes errors labels
Setd 2
```

NOTES:

1. Images were magnified to a scale of 1:1000 (at a minimum) before arcs were digitized.

2. Hydrology data were digitized from headwaters down stream.

3. Roads, railroads, and power lines were digitized at the center line.

4. Not all coverages are updated annually (e.g., streams).

Section 4. Description of Hardware and Software

Hardware:

Sun IPX workstation
Sun Sparc 10 workstation
CalComp TechJet GT Plotter
Win 486-50 PC

Software

Arc/Info Version 7.0.4
PC Arc 3.4.2 D
ArcView 2.4

Section 5. Source Data (Aerial Photography; DOQQ) - Origin and Preparation

PhotoScience, Inc.
45 West Watkins Mill Road
Gaithersburg, Maryland 20878
(301) 948-8550

See Appendix B for detailed description of DOQQ data

Metadata for Land Use/Land Cover Data Sets
Identification Information - Polecat Creek Land Use/Land Cover

Coverages: PCLAND95, PCROAD, PCRAIL, PCWATR, PCTRAN

Originator:

Lowell Dean Ballard
Environmental Engineer
Chesapeake Bay Local Assistance Department
805 East Broad Street, Suite 701
Richmond, Virginia
(804) 692-0429
FAX: (804) 225-3447

Publication Date:

October 1996

Publication Time

NA

Title:

PCLAND95
PCROAD
PCRAIL
PCWATR
PCTRAN

Edition:

First edition
Geospatial Data Presentation Form: digital map

Description of Data Sets:

PCLAND95 is a coverage of land use/land cover
PCROAD is a coverage of roads
PCRAIL is a coverage of railroads
PCWATR is a coverage of hydrology
PCTRAN is a coverage of transmission lines

Time Period of Content Information:

April 1995

Spatial Domain:

Polecat Creek watershed, Caroline County, Virginia

Access Constraints:

None

Use Constraints:

None

Contact Information:

C. Scott Crafton
Chief, Environmental Engineering
Chesapeake Bay Local Assistance Department
805 East Broad Street, Suite 701
Richmond, Virginia
(804) 225-3440
FAX: (804) 225-3447

Data Set Credit:

PhotoScience, Inc.
45 West Watkins Mill Road
Gaithersburg, Maryland 20878
(301) 948-8550

Virginia Department of Conservation and Recreation, Division of Soil and Water Conservation and the United States Environmental Protection Agency, Region III.

Virginia Department of Forestry

Hanover Caroline Soil and Water Conservation District

County of Caroline, Planning Office

Security Information:

No handling restrictions

Native Data Set Environment:

GIS software: ARC/INFO 7.0.4
Computer operating system: Solaris 2.5
File name: PCLAND95 Data set size: 1 megabyte

File name: PCROAD	Data set size: .5 megabyte
File name: PCRAIL	Data set size: .5 megabyte
File name: PCWATR	Data set size: .5 megabyte
File name: PCTRAN	Data set size: .5 megabyte

Cross Reference:

Virginia Department of Forestry, Caroline County
logging activity data base

Hanover Caroline Soil and Water Conservation District
agricultural tract identification data base

County of Caroline
tax parcel identification data base

Metadata for Land Use/Land Cover Data Sets
Quality Assurance Information - Polecat Creek Project

Coverages: PCLAND95, PCROAD, PCRAIL, PCWATR, PCTRAN

Attribute accuracy is an assessment of the accuracy of the identification of the entities and assignments of values in the data set and a description of the tests used.

PCLAND95: all designations were field verified. Agricultural cropland was checked against USDA tract identification data. Commercial names were checked by field verification or telephone conversation.

PCROAD: all designations were checked against county road maps, E-911 names (field verified) and 1990 Census files. All road routes and names are correct.

PCRAIL: all designations were field verified and checked against USGS 7 ½ minute quad maps.

PCTRAN: all designations were field verified and checked against USGS 7 1/2 minute quad maps.

PCWATR: all designations were field verified and checked against USGS 7 1/2 minute quad maps and 1990 Census hydrology files.

Positional accuracy: +/- 3 feet

Horizontal accuracy: +/- 40 feet

Vertical accuracy: +/- 20 feet

Source information:

The source document for the digital data set was a 1:12000 scale color infrared digital orthophotograph developed by PhotoScience, Inc. A complete description of the orthophotograph is provided in Appendix B.

Horizontal coordinate system: State Plane (North)

Geodetic Model: NAD 1983

Vertical coordinate system - NA

Metadata for Land Use/Land Cover Data Sets
Entity and Attribute Information- Polecat Creek Project

Coverages: PCLAND95, PCROAD, PCRAIL, PCWATR, PCTRAN

PCLAND95.PAT

ITEM		IN WIDTH	OUT WIDTH	TYPE	N.DEC	ALTERNATE NAME
1.	AREA	8	18	F	5	
2.	PERIMETER	8	18	F	5	
3.	PCLAND95# 4	5	B	-		
4.	PCLAND95-ID	4	5	B	-	
5.	LU_CODE	5	5	N	0	
6.	NAME	30	30	C	-	
7.	USDA_ID	15	15	C		
8.	DOF_ID	15	15	C		

Item #1, AREA
this item is generated by the ARC software and describes the area of the polygon.

Item #2, PERIMETER
this item is generated by the ARC software and provides length of the perimeter of the polygon.

Item #3, PCLAND95#-1
this item is generated by the ARC software and provides a unique number for each polygon.

Item #4, PCLAND95-ID
this item is generated by the ARC software and provides a unique identification number for the polygon. This number may be changed by the user, but must remain unique.

Item #5, LU_CODE
this item is input by the operator and reflects the land use code number. Land use codes are documented in a previous section of this document.

Item #6, NAME
this item is input by the operator and reflects the name of the given land use. Names are documented in a previous section of this document.

Item # 7, USDA_ID

this item is input by the operator and reflects the United States Department of Agriculture Tract Identification Number.

Item # 8, DOF_ID

this item is input by the operator and reflects the Virginia Department of Forestry logging activity identification number.

PCROAD.AAT

ITEM		IN WIDTH	OUT WIDTH	TYPE	N.DEC	ALT. NAME
1.	FNODE#	4	5	B	-	
2.	TNODE#	4	5	B	-	
3.	LPOLY#	4	5	B	-	
4.	RPOLY#	4	5	B	-	
5.	LENGTH	8	18	F	5	
6.	PCROAD#	4	5	B	-	
7.	PCROAD-ID	4	5	B	-	
8.	LU_CODE	5	5	N	0	
9.	ROUTE	10	10	C	-	
10.	NAME	30	30	C	-	

Item #1, FNODE#

this item is generated by the ARC software and defines the node from which an arc starts.

Item #2, TNODE#

this item is generated by the ARC software and defines the node at which an arc ends.

Item #3, LPOLY#

this item is generated by the ARC software and provides the number of the polygon to the left of an arc.

Item #4, RPOLY#

this item is generated by the ARC software and provides the number of the polygon to the right of an arc.

Item #5, LENGTH

this item is generated by the ARC software and describes the arc length.

Item #6, PCROAD#

this item is generated by the ARC software and provides a unique number for an arc.

Item #7, PCROAD-ID

this item is generated by the ARC software and provides a unique identification number for an arc. This number may be changed by the user, but must remain unique.

Item #8, LU_CODE

this item is input by the operator and reflects the land use code number. Land use codes are documented in a previous section of this document.

Item #9, ROUTE

this item is input by the operator and reflects the state route number as assigned by the Virginia Department of Transportation.

Item #10, NAME

this item is input by the operator and reflects the name of a road. Names are consistent with the E-911 system recently developed by Caroline County.

PCRAIL.AAT

ITEM		IN WIDTH	OUT WIDTH	TYPE	N.DEC	ALT. NAME
1.	FNODE#	4	5	B	-	
2.	TNODE#	4	5	B	-	
3.	LPOLY#	4	5	B	-	
4.	RPOLY#	4	5	B	-	
5.	LENGTH	8	18	F	5	
6.	PCRAIL#	4	5	B	-	
7.	PCRAIL-ID	4	5	B	-	
8.	LU_CODE	5	5	N	0	
9.	NAME	30	30	C	-	

Item #1, FNODE#

this item is generated by the ARC software and defines the node from which an arc starts.

Item #2, TNODE#

this item is generated by the ARC software and defines the node at which an arc ends.

Item #3, LPOLY#

this item is generated by the ARC software and provides the number of the polygon to the

left of an arc.

Item #4, RPOLY#

this item is generated by the ARC software and provides the number of the polygon to the right of an arc.

Item #5, LENGTH

this item is generated by the ARC software and describes the arc length.

Item #6, PCRAIL#

this item is generated by the ARC software and provides a unique number for an arc.

Item #7, PCRAIL-ID

this item is generated by the ARC software and provides a unique identification number for an arc. This number may be changed by the user, but it must remain unique.

Item #8, LU_CODE

this item is input by the operator and reflects the land use code number. Land use codes are documented in a previous section of this document.

Item #9, NAME

this item is input by the operator and reflects the name of the railroad.

PCTRAN.AAT

ITEM		IN WIDTH	OUT WIDTH	TYPE	N.DEC	ALT. NAME
1.	FNODE#	4	5	B	-	
2.	TNODE#	4	5	B	-	
3.	LPOLY#	4	5	B	-	
4.	RPOLY#	4	5	B	-	
5.	LENGTH	8	18	F	5	
6.	PCTRAN#	4	5	B	-	
7.	PCTRAN-ID	4	5	B	-	
8.	LU_CODE	5	5	N	0	
9.	NAME	30	30	C	-	

Item #1, FNODE#

this item is generated by the ARC software and defines the node from which an arc starts.

Item #2, TNODE#

this item is generated by the ARC software and defines the node at which an arc ends.

Item #3, LPOLY#

this item is generated by the ARC software and provides the number of the polygon to the left of an arc.

Item #4, RPOLY#

this item is generated by the ARC software and provides the number of the polygon to the right of an arc.

Item #5, LENGTH

this item is generated by the ARC software and describes the arc length.

Item #6, PCTRAN#

this item is generated by the ARC software and provides a unique number for an arc.

Item #7, PCTRAN-ID

this item is generated by the ARC software and provides a unique identification number for an arc. This number may be changed by the user, but must remain unique.

Item #8, LU_CODE

this item is input by the operator and reflects the land use code number. Land use codes are documented in a previous section of this document.

Item #9, NAME

this item is input by the operator and reflects the name of the land use. Names are documented previously in this document.

PCWATR.PAT

ITEM	IN WIDTH	OUT WIDTH	TYPE	N.DEC	ALT. NAME
1. AREA	8	18	F	5	
2. PERIMETER	8	18	F	5	
3. PCWATR#	4	5	B	-	
4. PCWATR-ID	4	5	B	-	
5. LU_CODE	5	5	N	0	
6. NAME	30	30	C	-	
7. OWNER	30	30	C		

Item #1, AREA

this item is generated by the ARC software and describes the area of the polygon.

Item #2, PERIMETER

this item is generated by the ARC software and provides length of the perimeter of the polygon.

Item #3, PCWATR#-1

this item is generated by the ARC software and provides a unique internal polygon number for a polygon.

Item #4, PCWATR-ID

this item is generated by the ARC software and provides a unique identification number for the polygon.

Item #5, LU_CODE

this item is input by the operator and reflects the land use code number. Land use codes are documented in a previous section of this document.

Item #6, NAME

this item is input by the operator and reflects the name of the given land use. Names are documented in a previous section of this document.

Item #7, OWNER

this item is input by the operator and reflects the name of the owner of the impoundment.

Metadata for Land Use/Land Cover Data Sets
Cross Reference Data Sets - Polecat Creek Project

Virginia Department of Forestry - Logging Activities Data Base

Field #	Field Name	Type	Width	Decimal	Index
1	OWNER	C	25		Y
2	TRACT#	C	10		Y
3	ACREA	N	50		N
4	YEAR	N	50		N
5	TYPE_CUT	C	10		N
6	BMP	C	5		N
7	REFOREST	C	5		N
8	LATITUDE	N	10	2	N
9	LONGITUDE	N	10	2	N

Field Number 1, OWNER.
This is the land owner's name as provided by the Virginia Department of Forestry.

Field Number 2, TRACT#
This is the unique tract identification number assigned by the Virginia Department of Forestry. This is made up of the first three letters of the county followed by the last two digits of the year in which the activities occur, with the final three digits representing the chronological number of the logging event.

Field Number 3, ACREA
The total acreage involved in the logging operation.

Field Number 4, YEAR
The year in which the logging event occurred.

Field Number 5, TYPE_CUT
This is the type of cutting involved. Acceptable entries are: "Clearcut", "Selective cut", "thinning", or "seed tree".

Field Number 6, BMP
This refers to the use of BMP's during the logging operation. Acceptable entries are: "NO" or "OK". There is a separate data base concerning utilization and type BMPS implemented during logging operations.

Field Number 7, REFOREST

This describes whether or not reforestation occurs. Acceptable entries are: "YES", "NO", or "DEV" (developed).

Field Number 8, LATITUDE

This is the latitude coordinate of the centroid of the logging operation in degrees and minutes.

Field Number 9, LONGITUDE

This is the longitude coordinate in degrees and minutes.

<u>Caroline County Tax Parcel Maps Data Base</u>

Field #	Field Name	Type	Width	Decimal	Index
1	MAPNUMBER	C	20		Y
2	NAME1	C	36		Y
3	NAME2	C	36		Y
4	STREET	C	36		N
5	CITY	C	36		N
6	STATE	C	2		N
7	ZIP CODE	N	5	0	Y
8	BASIN	N	20	0	Y
9	PERMISSION	C	1		Y
10	PHONE	N	12	0	N
11	SPEC_INSTR	C	50		N
12	CONTACTED	C	1		N
13	CONT_DATE	C	15		N

Field Number 1, MAPNUMBER

This is the Caroline County tax map parcel number. This is the key to which everything in the system will be attached.

Field Number 2, NAME1

This is the land owner's name and is the first name that appears on the Caroline County tax parcel data base.

Field Number 3, NAME2

This is the land owner's name and is the second name that appears on the Caroline County

tax parcel data base.

Field Number 4, STREET

This is the street, P.O. Box, or rural route address that appears with the land owner's name in the Caroline County tax parcel data base.

Field Number 5, CITY

This is the city that appears with the land owner's name in the Caroline County tax parcel data base.

Field Number 6, STATE

This is the state that appears in the address of the land owner in the Caroline County tax parcel data base.

Field Number 7, ZIP CODE

This is the 5-digit zip code that appears in the address of the land owner in the Caroline County tax parcel data base.

Field Number 8, BASIN

This the HUC (hydrologic unit code) basin. The number reflects the USDA/DCR hydrologic unit designation.

Field Number 9, PERMISSION

Options for this field are "Y" (yes) or "N" (no), and indicated whether CBLAD has written permission to access the property.

Field Number 10, PHONE

This is the telephone number of the primary land owner (or his/her representative) and include the area code.

Field Number 11, SPEC_INSTR

This is a short description of any special instructions from the land owner.

Field Number 12, CONTACTED

Options for this field are "Y" (yes) or "N" (no), and indicated whether CBLAD has requested permission to access this property.

Field Number 13, CONT_DATE

This is a date and represents when the land owner was contacted by CBLAD.

CONTACTS

John Scrivanni, Forester
Virginia Department of Forestry
P.O. Box 3758
Charlottesville, Virginia 22903
Phone: 804-977-6555

Samuel Austin, Forest Hydrologist
Virginia Department of Forestry
P.O. Box 3758
Charlottesville, Virginia 22903
Phone: 804-977-6555

James Copony, Director of Communications
Virginia Department of Forestry
P.O. Box 3758
Charlottesville, Virginia 22903
Phone: 804-977-6555

Rei Liu, GIS Specialist
Virginia Department of Forestry
P.O. Box 3758
Charlottesville, Virginia 22903
Phone: 804-977-6555

William (Bill) Saunders, Regional Forester
Virginia Department of Forestry
P.O. Box 759
Tappahannock, Virginia 22560
Phone: 804-443-2211

Mr. John Pemberton, County Forester - Caroline County
Virginia Department of Forestry
P.O. Box
Bowling Green, Virginia
Phone: 804-633-6992

Noel Cost
USDA Forest Service- Forest Inventory and Analysis
USDA Forest Service
Ashville, North Carolina

Ron Wood, Water Quality Specialist
Hanover-Caroline Soil and Water Conservation District
Ashland, Virginia
Phone: 804-798-8107

Mike Finchum, Director
Caroline County Office of Planning and Community Development
P.O. Box 424
Bowling Green, Virginia 22427
Phone: 804-633-4303

Brent Elam, Director
Caroline County Public Works
Bowling Green, Virginia 22427
Phone: 804-633-4386

Charles A. Lunsford, NPS Program Planner
Virginia Department of Conservation and Recreation
Division of Soil and Water Conservation
203 Governor Street, Suite 206
Richmond, Virginia 23219-2094
Phone: 804-371-8984

Jean Tingler
Virginia Economic Development Partnership
P.O. Box 798
Richmond, Va. 23218-0798
Phone: 804-371-0340

REFERENCES REVIEWED
Land Use/Land Cover

Aronoff, Stan. 1985. The minimum accuracy value as an index of classification accuracy. Photogrammetric Engineering and Remote Sensing. 51(1): 99-111.

Band, Lawrence E. 1986. Topographic partition of watersheds with digital elevation models. Water Resources Research. 22(1): 15-24.

Eyre, F.H. (ed.). 1980. *Forest Cover Types of the United States and Canada.* Society of American Foresters. Washington, D.C.

FDOT. 1985. *Florida Land Use, Cover and Forms Classification System.* Florida Department of Transportation, State Topographic Bureau, Thematic Mapping Section. Procedure No. 550-010-001-a. Tallahassee, Florida. 79 pp.

FGDC. 1994. Content Standards for Digital Geospatial Metadata (June 8). Federal Geographic Data Committee. Washington, D.C.

Khorram, S., J. Cheshire, K. Siderelis, and Z. Nagy. 1991. *Mapping and GIS Implementation of Land Use and Land Cover Categories for the Albemarle-Pamlico Drainage Basin.* Project Report to North Carolina Department of Environment, Health, and Natural Resources. Ashville, North Carolina. 53 pp.

USDA 1992. *Forest Statistics for Virginia, 1992.* United States Department of Agriculture, Forest Service, Southeastern Forest Experiment Station. Resource Bulletin SE-131. Ashville, North Carolina.

USDA 1991. *Forest Statistics for the Coastal Plain of Virginia, 1991.* United States Department of Agriculture, Forest Service, Southeastern Forest Experiment Station. Resource Bulletin SE-122. Ashville, North Carolina.

APPENDIX A

LAND USE/ LAND COVER CLASSIFICATION SYSTEM
CLASSIFICATION SYSTEM FOR PCLAND95 COVERAGE

100 URBAN

100 - 149 RESIDENTIAL

110-119 Residential Low Density

- 111 Fixed single family units
- 112 Mobile home units
- 113 Mixed units (fixed and mobile)
- 114 Low density under construction

120-129 Residential Medium Density

- 121 Fixed single family units
- 122 Mobile home units
- 123 Mixed units (fixed and mobile)
- 124 Medium density under construction

130-139 Residential High Density

- 131 Fixed single family units
- 132 Mobile home units
- 133 Mixed units
- 134 High density under construction
- 135 Apartment Complex

140-142 Religious Structures

- 141 Church
- 142 Cemetery

143 Public Schools
144 Public Library

145 Post Office
146 Health Care Providers
149 Open Space

150 - 179 COMMERCIAL

150-164 Retail Sales and Services

151 Service Stores
152 Convenience Stores
153 Restaurants
154 Builders Supplies
155 Commercial Under Construction
156 Gas Station
157 Specialty Stores
158 Plaza or Shopping Mall
159 Abandoned Commercial Structures
160 Automobile Sales
161 Truck Stop
162 Garage
163 Real Estate Sales
164 Office Park

165-169 Tourist Services

166 Hotels/Motels
167 Bed and Breakfast Inn

170-179 Oil and Gas Storage

171-174 Underground Storage Tanks
172 High Octane Fuels
173 Oil
174 Petroleum Fuels

175-179 Above Ground Storage Tanks
176 High Octane Fuels
177 Oil
178 Petroleum Fuels

180 INDUSTRIAL

190-199 EXTRACTIVE

191 Sand and Gravel Pits
192 Rock Quarries

200 TRANSPORTATION

210-219 Railroads

211 Tracks
212 Holding and Trans-shipment Yards
213 Associated Buildings

220-229 Roads and Highways

221 Limited Access (Interstate System)
222 Divided Highways (Federal-State)
223 Two-Lane Highways (State)
224 County Maintained
225 Graded and Drained
226 Primitive/Trails
227 Privately Maintained Roads

230-239 Oil Long Distance Transmission Lines

231 Pipelines
232 Pump Stations

240-249 Gas Long Distance Transmission Lines

241 Pipelines
242 Pump Stations

250-259 Transportation Lines Under Construction

251 Highways
252 Railroads
253 Pipe Lines
254 Electrical Lines

260-269 Transportation Support

261 State Police Headquarters
265 Virginia Department of Transportation Area Headquarters
268 Park and Ride Facility
269 Rest Stop

300 COMMUNICATION

310 Transmission Towers
320 Communication Facilities
330 Navigational Systems

400 UTILITIES

410-419 Electrical Power Transmission Lines
411 Trunk
412 Feeder

420-429 Sewage Treatment

421 Treatment Plant
422 Lift Stations
423 Pump Station
424 Transmission Lines

430-439 Solid Waste Disposal

431 Tire Piles
432 Landfills
433 Abandoned Cars/Trucks
434 Garbage Collection Stations

440 Stormwater Management Facilities

500 AGRICULTURAL

510-549 Cropland
511-529 Row Crops

512 Corn
513 Soybeans
514 Cotton
515 Peanuts
516 Sorghum

530-549 Field Crops

531 Wheat
532 Oats
533 Grass/Hay
544 Barley
545 Fallow Cropland

550-569 Pastureland

551 Improved
560 Unimproved
565 Woodland Pastures

570-579 Feeding Operations

571 Beef Cattle
572 Poultry
573 Swine

580-589 Specialty Farms

581 Dairy
582 Horse
583 Berry/Pick Your Own

590-594 Orchards and Vineyards

591 Apple

595 Agricultural Pollution Management - Best Management Practice (BMP)

600 FOREST COVER

610-619 Loblolly-shortleaf pine

611 Old-field loblolly plantations
612 Cutover loblolly plantations (pines planted in cutover forest land)
613 Natural loblolly stands
614 Natural Virginia Pine stands

620 Oak-pine

630 Upland Hardwood (Oak-hickory)

640 Bottomland Hardwood (Oak-gum-cypress and/or elm-ash-cottonwood)
650-659 Forest Industry Land
651 Forest Industry Leased Land

660 Timberland

670 Woodland

680 Logging (harvesting) activities

800 WATER

800-819 Streams

801 Perennial Stream

810 Intermittent Stream

820 Lakes

850 Reservoirs

851 Larger than 500 acres (202 hectares)
852 Larger than 100 acres (40 hectares)
853 Larger than 10 acres (4 hectares)
854 Smaller than 10 acres (4 hectares)

860 Bays and Estuaries

LAND USE CLASS DEFINITIONS FOR PCLAND95 COVERAGE

URBAN - This category of land use is made up of areas of intensive use by man. These include residential, commercial, institutional, and recreational facilities.

RESIDENTIAL - This category includes several sub-categories each representing a different level of occupancy by humans.

Low Density - less than two dwelling units per acre. These can consist of fixed single family units, mobile home units, or mixed units (fixed and mobile). Also, included in this category are housing units under construction.

Medium Density - two to five dwelling units per acre. These can consist of fixed single family units, mobile home units, or mixed units (fixed and mobile). This includes housing units under construction.

High Density - six or more dwelling units per acre. These can consist of fixed single family units, mobile home units, mixed units (fixed and mobile). Also, included are units under construction.

Religious Structures - this includes churches, tabernacles, synagogues, and cemetery's.

Public Structures - this category consists of public school buildings, libraries, courthouses, government office buildings, and post offices.

Open Space - open grass, weed or bare earth spaces in urban areas.

COMMERCIAL - This category includes all land use types related to the sale or purchase of commercial products

Retail Sales and Services - this category includes the following:
Service Stores - grocery stores, variety stores, video rental stores,
Convenience Stores - 24-hour grocery stores,
Restaurants - business whose primary purpose is serving prepared food,
Builders Supplies - tool and hardware stores,
Feed/Grain Stores - provides feed, seed, and nursery stock,

Commercial Under Construction, and
Specialty Stores - craft and antique stores,
Plaza/Mall - multiple stores under on roof,
Automobile Sales - primary purpose is to sell cars/trucks/trailers,
Truck Stop - services large trucks (gas, maintenance, and truck wash),
Garage - truck/car/trailer/boat repair,
Real Estate Sales,
Office Park - more than one business in a single building.

Tourist Services - Hotels, Motels, and Bed and Breakfast Inns are included in this category.

Oil and Gas Storage - both above ground and underground storage of high octane fuels, oil, and petroleum products. This does not include storage of home heating fuel at single or multi-family dwellings.

INDUSTRIAL - This category includes areas where building, processing, assembling or storing products are accomplished.

EXTRACTIVE - This category consists of mining and extraction operations. In Caroline County, these include sand and gravel pits and rock quarries.

TRANSPORTATION - This category includes all forms of transportation. Railroads, roads and highways, long distance transmission of oil and gas as well as facilities under construction account for the components.

COMMUNICATION - Support facilities for communication activities. Radio, television, telephone, and navigation systems are included in the category.

UTILITIES - These are public or privately owned operations which provide power or waste disposal. These facilities include electrical power transmission lines, sewage treatment plants (and associated structures), and solid waste disposal including household garbage, tires, and automobiles. Also, stormwater management facilities are include in this category.

AGRICULTURE - These include all land use activities related to the cultivation and harvesting of agricultural products.

Cropland - This includes land which is managed for production of row or field crops. Cropland includes land from which crops are harvested other than tree and bush crops and horticultural crops. Row crops are defined as fields on which rows remain well defined even after crops have been harvested (corn, soybeans, cotton, peanuts, sorghum are examples). Field crops are fields on which rows are not defined (examples include hay, grasses, wheat, and oats).

Tree Crops - Orchards and groves not associated with timber industry. Examples include apple, peach, and pecan.

Fallow Cropland - Harvested agricultural land not currently in crop production.

Pastureland - Land on which live stock graze. The categories of pastureland are improved, unimproved and woodland pastures.

Feeding Operations - These are specialized operations defined by having large animal populations in a relatively small area. This results in a concentration of animal waste material. Beef cattle, poultry, and swine are examples of feeding operation.

Specialty Farms - Special or unique farming activities.

Dairy - A commercial establishment which feeds and milks dairy cattle and processes and distributes milk and dairy products.

Horse - Farms which breed or train horses for sport uses.

Pick-Your-Own - These are farming operations which grow a variety of crops (berries, pumpkins, grapes, strawberries, etc.) which are sold to individuals straight in the field.

Vineyards - farming operation whose primary purpose is to grow grapes for wine production.

Nurseries - Specialty farming operations which retail or wholesale landscape plants (trees or ornamental shrubs or flowers)

Agricultural Pollution Management -
This category include structures which are put in place to control or reduce nonpoint source pollution from farming operation.

FOREST COVER/ SILVICULTURAL ACTIVITIES -

This includes all land use or land cover associated with forest management activities or forest cover.

Loblolly-shortleaf pine -

Forests in which loblolly pine, shortleaf pine, or other southern yellow pines, except longleaf or slash pine, singly or in combination, constitute a plurality of the stocking. Common associates include oak, hickory, and gum. Several subcategories will be recognized including: old-field loblolly plantations, cutover loblolly plantations (pines planted in cutover forest land), natural loblolly stands and natural Virginia Pine stands

oak-pine- Forests in which hardwoods (usually upland oaks) constitute a plurality of the stocking but in which pines account for 25 to 50 percent of the stocking. Common associates include gum, hickory, and yellow poplar.

Upland hardwood (Oak-hickory)-

Forests in which upland oaks or hickory, singly or in combination constitute a plurality of the stocking except where pines account for 25 to 50 percent, in which case the stand would be classified oak-pine. Common associates include yellow poplar, elm, maple and black walnut.

Bottomland Hardwood (Oak-gum-cypress and/or elm-ash-cottonwood) -

Bottom-land forests in which tupelo, blackgum, sweetgum, oaks or southern cypress, singly or in combination constitute a plurality of the stocking, except where pines account for 25 to 50 percent, in which case the stand would be classified oak-pine. Common associates include cottonwood, willow, ash, elm, hackberry, and maple. Or, forests in which elm, ash, or cottonwood, singly or in combination, constitute a plurality of the stocking. Common associates include willow, sycamore, beech and maple.

Forest industry land -

Land owned by companies or individuals operating wood using plants.

Forest Industry Leased Land -

Land leased or under management contracts to forest industry from

other owners for periods of one forest rotation or longer. Land under cutting contracts is not included.

Timberland - Land at least 16.7 percent stocked by forest trees of any size, or formerly having had such tree cover, not currently developed for nonforest use, capable of producing 20 cubic feet of industrial wood per acre per year and not withdrawn from timber utilization by legislative action.

Woodland - Forest land incapable of producing 20 cubic feet per acre per year of industrial wood under natural conditions, because of adverse site conditions.

WATER - This includes all water bodies

Streams * - This includes rivers, creeks, and other linear water bodies separated into two distinct categories.

perennial - defined as a solid blue line (persists for the entire year) stream on a USGS 7 ½ minute quadrangle map

intermittent - defined as a dashed blue line (experiences no flow at some point during the year) stream on a USGS 7 ½ minute quadrangle map

Lakes - Naturally occurring inland water bodies.

Reservoirs - These are artificial impoundments of water. They are divided into several categories depending upon the surface area of the impoundment. The categories are described previously in this document.

*Note: The boundary between streams and lakes or reservoirs is the straight line across the mouth of the stream.

APPENDIX B

Project Workplan
Color Infrared Digital Orthophotography