DATA COLLECTION FOR THE HAZARDOUS WASTE IDENTIFICATION RULE

SECTION 9.0 HUMAN RECEPTOR DATA

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List of Acronyms

3MRA	multimedia, multiple-exposure pathway, multiple-receptor risk assessment
ASCII	American Standard Code for Information Interchange
AML	Arc Macro Language
AOI	area of interest for HWIR 3MRA
BNA	block numbering area
DOI	U.S. Department of Interior
ESDLS	EPA Spatial Data Library System
EPA	U.S. Environmental Protection Agency
FWS	U.S. Fish and Wildlife Service
GIRAS	Geographic Information Retrieval and Analysis System
GIS	geographic information system
HWIR	Hazardous Waste Identification Rule
NSFHWAR	National Survey of Fishing, Hunting, Wildlife, and Recreation
QA/QC	quality assurance/quality control
RCRA	Resource Conservation and Recovery Act
SDP	HWIR 3MRA site definition processor
SLP	HWIR 3MRA site layout processor
STF	summary tape file
SQL	Structured Query Language
UTM	Universal Transverse Mercator
WMU	waste management unit

9.0 Human Receptor Data

This Hazardous Waste Identification Rule (HWIR) risk analysis uses a site-based approach to characterizing, on a national basis, the human health and ecological risks that could result from management of hazardous wastes in industrial nonhazardous waste management units (WMUs). To represent the nonhazardous waste universe, U. S. Environmental Protection Agency (EPA) selected 201 industrial waste disposal sites across the United States from its 1985 screening survey of industrial Resource Conservation and Recovery Act (RCRA) Subtitle D facilities. In the HWIR human risk analysis, data on human receptor types, numbers, ages, and locations within a 2-km-radius area of interest (AOI) from each WMU at each of these 201 facilities (419 settings total[1]) were used to delineate exposure points of concern for individual human risk and to weight these points in terms of the population present.

Human receptor points, which include residences and farms, are one of the primary spatial data layers in this analysis. They enable human risk to be calculated spatially around a site where people are likely to be located. A geographic information system (GIS) was used to locate these points and collect human receptor numbers and characteristics (e.g., receptor types, age cohorts) for the 201 study sites. This allowed the HWIR risk analysis to develop individual risk distributions around a site that are weighted by population.

With a GIS, different data layers can be used together even though they may be at different scales (e.g., county-level agricultural census data, census block group data, census block data, and land use data). For HWIR, resident human receptor points were located and populated by census block. Farms were located and populated using census block group boundaries, subdivided by farm land use, along with county-level agricultural census data. Figure 9-1 illustrates these primary spatial data layers used in the collection of human receptor data.

9.1 Parameters Collected

Table 9-1 lists the human receptor variables collected for the HWIR modeling effort. These include all data necessary to locate and populate the points and areas for calculating human exposure and risk, including residences and farms. These data are used primarily by the human risk module, but location and site layout information is also used by the air, farm food chain, aquifer, and human exposure modules.

[1] A setting is defined for each unique WMU type/site combination. Thus, a site with a landfill and a waste pile would make up two settings. See Section 2 for additional information on the 419 settings used in this analysis.

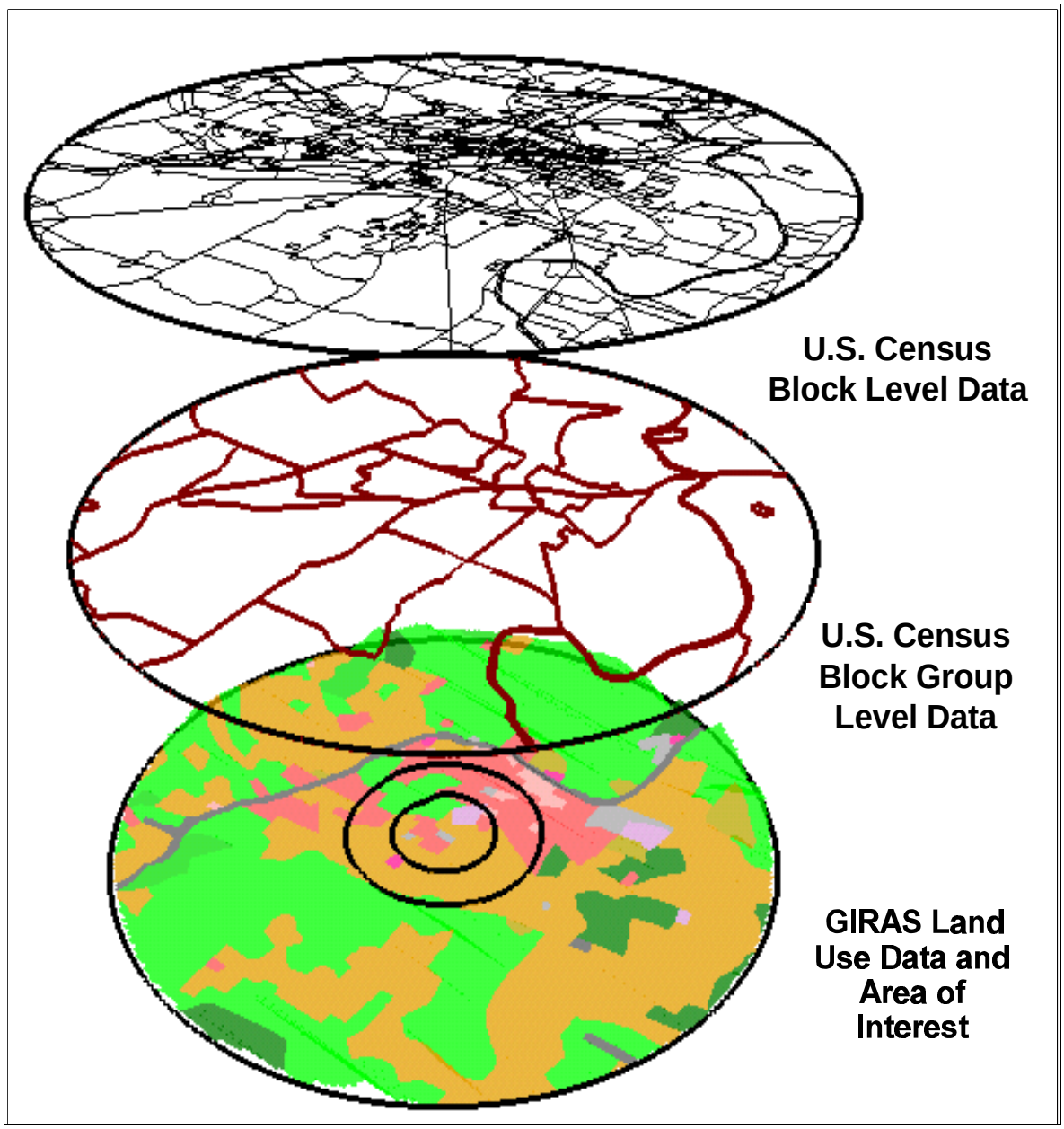

Figure 9-1. Primary spatial data layers for HWIR human receptor data.

Table 9-1. Human Receptor and Farm Input Variables Collected for HWIR

Variable Code	Description	Index 1	Index 2	Index 3
Human Receptor Inputs				
NumHumRcpType	number of residential receptor types			
HumRcpType	type of residential human receptor		NumHumRcpType	
NumHumRcp	number of human receptor points at a site			
HumRcpLocation	x,y coordinate of human receptor point	NumHumRcp		
HumRcpPopulation	human receptor population	NumHumRcp	NumHumRcpType (4)	age cohort (5)
NumAquWell	number of drinking water wells			
AquWellLocation	x,y coordinate of drinking water well	NumAquWell		
Farm Inputs				
NumFarmRcpType	number of farm receptor types			
FarmRcpType	type of farm receptor		NumFarmRcpType	
NumFarm	number of farm or crop areas			
FarmLocation	x,y coordinates of farm			
FarmPopulation	farm population	NumFarm	NumFarmRcpType (4)	age cohort (5)
FarmArea	farm area (m^2)	NumFarm		
FarmBlockGroup	census block group for each farm	NumFarm		
FarmNumAquWell	number of wells on farm	NumFarm		
FarmAquWellFrac	fraction of farm population on well	Num Farm	FarmNumAquWell	
Human Receptor Layout Inputs				
HumRcpAquWellIndex	index of well used by human receptor	NumHumRcp		
HumRepAquWellFrac	fraction of human receptor population on wells	NumHumRcp		
HumRcpWSSubIndex	index of watershed occupied by human receptor	NumHumRcp		
HumRcpLWSIndex	index of local watershed occupied by human receptor	NumHumRcp		
HumRcpLWSSubAreaInde	index of LWS subarea occupied by human receptor	NumHumRcp		
NumRing	number of rings to spatially average risk			
RingDistance	distance of ring from WMU	NumRing		
RingNumHumRcp	number of human receptor points in ring	no. of rings (3)		
RingHumRcpIndex	index of human receptor points in ring	no. of rings (3)	RingNumHumRcp	
Farm Layout Inputs				
FarmAquWellIndex	index of well used by farm	NumHumRcp		
FarmNumWSSub	number of watersheds on farm	NumFarm		
FarmWSSubFrac	fraction of each watershed on farm	NumFarm	FarmNumWSSub	
FarmWSSubIndex	index of watersheds on farm	NumFarm	FarmNumWSSub	
FarmNumLWS	number of local watersheds on farm	NumFarm		
FarmLWSIndex	local watershed indices on farm	NumFarm	FarmNumLWSSubArea	
FarmNumLWSSubArea	number of LWS subareas on farm	NumFarm		
FarmLWSSubAreaFrac	fraction of LWS subarea on farm	NumFarm	FarmNumLWSSubArea	
FarmLWSSubAreaIndex	index of LWS subareas on farm	NumFarm	FarmNumLWSSubArea	
FarmNumWBNRch	number of waterbodies used by farm	NumFarm		
FarmWBNIndex	index of waterbody network used by farm	NumFarm		
FarmWBNRchIndex	index of waterbody used by farm	NumFarm	FarmNumWBNRch	
FarmWBNRchFrac	fraction of farm or crop area impacted by reach	NumFarm	FarmNumWBNRch	
RingNumFarm	number of farms in a ring	NumRing		
RingFarmFrac	fraction of a farm in a ring	NumRing	RingNumFarm	
RingFarmIndex	index of a farm in a ring	NumRing	RingNumFarm	

Human resident and farmer population data are dimensioned on ring, receptor type, and age cohort. The HWIR analysis calculate human exposure and risk for three concentric rings selected by EPA and defined by their distance (Ring Distance) from the WMU boundary: 500 m, 1,000 m, and 2,000 m. For residents, the following receptor types (HumRcpType) were selected by EPA to characterize residential exposure and risk:

- Residents
- Resident home gardeners
- Resident recreational fishers
- Resident home gardener/recreational fishers.

For exposure and risk to farmers, the following receptor types (FarmRcpType) were selected, depending on whether they are present in the county agricultural census:

- Beef farmers
- Dairy farmers
- Beef farmer/recreational fishers
- Dairy farmer/recreational fishers.

For each of these eight receptor types, these five age cohorts were selected by EPA for use in the HWIR risk analysis:

- Child1 (infant): younger than 1 year
- Child2: 1 to 5 years
- Child3: 6 to 11 years
- Child4: 12 to 19 years
- Adult: 20 years or older.

This results in a total of 40 receptor type/age cohort combinations for the HWIR risk analysis.

Human receptor data were collected on a site-specific basis. Although site-specific data are available for most of the receptor type and land use information necessary to delineate and populate these areas, certain receptor type information (e.g., data on beef and dairy farmers, data on recreational fishers) were only available on the county or state level; these regional data were applied to the site-specific population and land use data to estimate receptor type/age cohort percentages for each subarea (as described in Section 9.3).

9.2 Data Sources

Human receptor data were assembled from the primary data sets shown in Table 9-2. For residents, U.S. census block data and boundary coverages were used because of their greater spatial resolution. When more detailed attributes were needed (e.g., number of people on public water vs. private wells), census block group level data were used. Table 9-3 summarizes data sources by HWIR input parameter.

Table 9-2. Primary Human Receptor Data Sets, Date, and Scale

Data/Receptor Type	Data Set	Date	Scale
Location	Industrial D Screening Survey (facilities); Envirofacts (locations)	1985 (Industrial D) 1996 (Envirofacts)	1:100,000 scale mapping
Residents	Census block data STF 1B attribute data Census TIGER/line block coverages	1990	1:100,000 scale mapping
Beef and dairy farmers, farm size	Census block group data STF 3A attribute data Census TIGER/line block group coverages	1990	1:100,000 scale mapping
	GIRAS land use data (USGS, 1990)	late 1970s to early 1980s	1:250,000 scale mapping
	Census of Agriculture	1987 and 1992	County level
Recreational fishers	National Survey of Fishing, Hunting, and Wildlife	1992	State level

9.2.1 1990 U.S. Census STF 1B Attribute Data

Summary Tape File 1B (STF 1B) is a national data set of 1990 population data collected by the U.S. Bureau of the Census (U.S. Bureau of the Census, 1992b). This STF 1B production process focused on the block level for the United States. Table 9-4 lists the STF 1B data fields used in the HWIR analysis. (STF 1B data are available online at http://www.census.gov/mp/www/rom/msrom6ac.html.)

9.2.2 1990 U.S. Census STF 3A Attribute Data

Summary Tape File 3A (STF 3A) is a national data set of 1990 population and housing data collected by the U.S. Bureau of the Census (U.S. Bureau of the Census, 1992b). It consists of approximately 70 tables of data for states, counties, county subdivisions, places, census tract/block numbering areas (BNAs), and block groups. This STF 3A production process focused on the block group level for the United States. Subject matter of the data covers population items such as age and citizenship, as well as housing items such as rent, age of householder, and number of rooms. Table 9-5 lists the STF 3A data fields used in the HWIR analysis. (STF 3A data are available online at http://www.census.gov/mp/www/rom/msrom6ae.html.)

9.2.3 1990 U.S. Census TIGER/Line Block and Block Group Coverages

The BL90 and BG90 layers in the EPA Spatial Data Library System (ESDLS) provide block and block group boundary coverages based on U.S. Bureau of the Census 1990 TIGER/line data in a polygon ARC/INFO coverage (U.S. EPA, 1995a,b). The 1990 TIGER/line data provide digital data for all 1990 Census map features and boundaries, the associated 1990 Census final tabulation of geographic area codes (such as 1990 Census block numbers), and the codes for the January 1, 1990, legal and statistical areas on both sides of each line segment of every mapped feature. (Additional information is available online at http://nsdi.epa.gov/nsdi/projects/bl90.htm and http://nsdi.epa.gov/nsdi/projects/bg90.htm.)

Table 9-3. Sources of Human Receptor Data by HWIR Input Parameter

Variable Code	Description	Data Source
Human Receptor Data		
NumHumRcp	number of human receptor points at a site	GIS overlay: census blocks and three risk rings (500 m; 1,000 m; 2,000 m)
HumRcpLocation	x,y coordinate of human receptor point	Centroid of each census block/ring polygon within AOI
HumRcpPopulation	human receptor population	U.S. Census STF 1B attribute data (block-level)
NumAquWell	number of drinking water wells	U.S. Census STF 3A source of water data (block group-level)
AquWellLocation	x,y coordinate of drinking water well	HumRcpLocation within block group with residential wells; farm centroid
Farm Data		
NumFarm	number of farm or crop areas	U.S. Census STF 3A: block groups with farms
FarmLocation	x,y coordinates of farm	GIS overlay: master (100 x 100 m) grid and farm coverages
FarmPopulation	farm population	U.S. Census STF 1B/STF 3A and census of agriculture data
FarmArea	farm area (m^2)	Census of agriculture: median farm size
FarmBlockGroup	census block group for each farm	U.S. Census TIGER/line block group coverage
Human Receptor Layout Data		
HumRcpAquWellIndex	index of well used by human receptor	GIS overlay: drinking water well and receptor point coverages
HumRcpWSSubIndex	index of watershed occupied by human receptor	GIS overlay: watershed and receptor point coverages
HumRcpLWSIndex	index of local watershed occupied by human receptor	GIS overlay: local watershed and receptor point coverages
HumRcpLWSSubAreaInde	index of LWS subarea occupied by human receptor	GIS overlay: local watershed and receptor point coverages
RingNumHumRcp	number of human receptor points in ring	GIS overlay: rings and receptor point coverages
RingHumRcpIndex	index of human receptor points in ring	GIS overlay: rings and receptor point coverages
Farm Receptor Layout Data		
FarmAquWellIndex	index of well used by farm	well at farm centroid
FarmNumWSSub	number of watersheds on farm	GIS overlay: watershed and farm coverages
FarmWSSubFrac	fraction of each watershed on farm	GIS overlay: watershed and farm coverages
FarmWSSubIndex	index of watersheds on farm	GIS overlay: watershed and farm coverages
FarmNumLWS	number of local watersheds on farm	GIS overlay: local watershed and farm coverages
FarmLWSIndex	local watershed indices on farm	GIS overlay: local watershed and farm coverages
FarmNumLWSSubArea	number of LWS subareas on farm	GIS overlay: local watershed and farm coverages
FarmLWSSubAreaFrac	fraction of LWS subarea on farm	GIS overlay: local watershed and farm coverages
FarmLWSSubAreaIndex	index of LWS subareas on farm	GIS overlay: local watershed and farm coverages
FarmNumWBNRch	number of waterbodies used by farm	GIS overlay: waterbody and farm coverages
FarmWBNIndex	index of waterbody network used by farm	GIS overlay: waterbody and farm coverages
FarmWBNRchIndex	index of waterbody used by farm	GIS overlay: waterbody and farm coverages
FarmWBNRchFrac	fraction of farm or crop area impacted by reach	GIS overlay: waterbody and farm coverages
RingNumFarm	number of farms in a ring	GIS overlay: rings and farm coverages
RingFarmFrac	fraction of a farm in a ring	GIS overlay: rings and farm coverages
RingFarmIndex	index of a farm in a ring	GIS overlay: rings and farm coverages

Table 9-4. Specific STF 1B Block-Level Census Items Used to Estimate HWIR Human Receptor Populations

Item Code	Item Description	Item Code	Item Description
BL0010001	total persons	BL0110014	persons 19 yr
BL0020001	total families	BL0110015	persons 20 yr
BL0030001	total households	BL0110016	persons 21 yr
BL0040001	inside urbanized area	BL0110017	persons 22 to 24 yr
BL0040002	outside urbanized area	BL0110018	persons 25 to 29 yr
BL0040003	rural	BL0110019	persons 30 to 34 yr
BL0110001	persons younger than 1 yr	BL0110020	persons 35 to 39 yr
BL0110002	persons 1 and 2 yr	BL0110021	persons 40 to 44 yr
BL0110003	persons 3 and 4 yr	BL0110022	persons 45 to 49 yr
BL0110004	persons 5 yr	BL0110023	persons 50 to 54 yr
BL0110005	persons 6 yr	BL0110024	persons 55 to 59 yr
BL0110006	persons 7 to 9 yr	BL0110025	persons 60 and 61 yr
BL0110007	persons 10 and 11 yr	BL0110026	persons 62 to 64 yr
BL0110008	persons 12 and 13 yr	BL0110027	persons 65 to 69 yr
BL0110009	persons 14 yr	BL0110028	persons 70 to 74 yr
BL0110010	persons 15 yr	BL0110029	persons 75 to 79 yr
BL0110011	persons 16 yr	BL0110030	persons 80 to 84 yr
BL0110012	persons 17 yr	BL0110031	persons 85 yr or older
BL0110013	persons 18 yr		

Table 9-5. Specific STF 3A Block Group-Level Census Items Used to Estimate HWIR Human Receptor Populations

Item Code	Item Description	Item Code	Item Description
P0010001	total persons	P0130011	total persons 16 yr
P0060001	persons inside urbanized area	P0130012	total persons 17 yr
P0060002	persons outside urbanized area	P0130013	total persons 18 yr
P0060003	persons in rural area on farm	P0130014	total persons 19 yr
P0060004	persons in rural area not on farm	P0130015	total persons 20 yr
H0010001	total housing units	P0130016	total persons 21 yr
H0050003	housing units, rural farm	P0130017	total persons 22 to 24 yr
H0230001	source of water: public system or private company	P0130018	total persons 25 to 29 yr
H0230002	source of water: drilled individual well	P0130019	total persons 30 to 34 yr
H0230003	source of water: dug individual well	P0130020	total persons 35 to 39 yr
H0230004	some other water source	P0130021	total persons 40 to 44 yr
P0130001	total persons younger than 1 yr	P0130022	total persons 45 to 49 yr
P0130002	total persons 1 and 2 yr	P0130023	total persons 50 to 54 yr
P0130003	total persons 3 and 4 yr	P0130024	total persons 55 to 59 yr
P0130004	total persons 5 yr	P0130025	total persons 60 and 61 yr
P0130005	total persons 6 yr	P0130026	total persons 62 to 64 yr
P0130006	total persons 7 to 9 yr	P0130027	total persons 65 to 69 yr
P0130007	total persons 10 and 11 yr	P0130028	total persons 70 to 74 yr
P0130008	total persons 12 and 13 yr	P0130029	total persons 75 to 79 yr
P0130009	total persons 14 yr	P0130030	total persons 80 to 84 yr
P0130010	total persons 15 yr	P0130031	total persons 85 yr or older

The 1990 Census TIGER/line block and block group coverages, a subset of 1:100,000 scale data, are derived from 1990 Census TIGER/line files (U.S. Bureau of the Census, 1990). The 1990 Census TIGER/line files provide digital data for all 1990 Census map features and boundaries and the associated 1990 Census final tabulation of geographic area codes. (Additional information is available online at http://www.census.gov/geo/www/tiger/.)

9.2.4 Census of Agriculture

The Census of Agriculture (U. S. Bureau of the Census, 1987, 1992a) provides periodic and comprehensive statistics about agricultural operations, production, operators, and land use. It is conducted every 5 years, for years ending in 2 and 7. Its coverage includes all operators of U.S. farms or ranches (Division A, SIC 01-02) that sold or normally would have sold $1,000 worth of agricultural products during the census year. In 1992, approximately 1.9 million operators produced $162 billion in crops and livestock.

All operators provide crop acreage and quantities harvested, inventories of livestock and poultry, value of products sold, land use and ownership, irrigation activities, amount of commodity credit loans, number of hired laborers, federal program payments, and operator characteristics. Selected operators provide additional information on production expenses (including interest), fertilizer and chemical use, machinery and equipment, market value of land and buildings, and income from farm-related sources. (Additional information is available online at http://www.census.gov/econ/www/ag0100.html.) Census of Agriculture data used for the HWIR analysis included county-level data on beef and dairy farms (Table 9-6). For consistency with the 1990 population census data, data for 1987 and 1992 were averaged.

9.2.5 National Survey of Fishing, Hunting, Wildlife, and Recreation (NSFHWAR)

The 1996 National Survey of Fishing, Hunting, Wildlife, and Recreation (NSFHWAR) presents microdata records (with any information that might identify a specific person or household removed) on individuals involved in fishing, hunting, and other wildlife-associated recreational activities such as wildlife observation, photography, and feeding. Available data include the state in which these activities occurred; number of trips taken; duration of trips; and expenditures for food, lodging, transportation, and equipment. Data are broken out by urban and rural population categories. The U.S. Census Bureau conducted the survey for the U.S. Fish and Wildlife Service (FWS), Department of the Interior (DOI), which prepares printed reports in this field (U. S. DOI and U. S. DOC, 1997). (Additional information is available online at http://www.census.gov/prod/3/97pubs/fhw96nat.pdf).

9.2.6 Exposure Factors Handbook

Volume II of the *Exposure Factors Handbook* (U.S. EPA, 1997) provided the data used to estimate the national fraction of home gardeners. Based on National Gardening Association survey data, Table 13-1 of the handbook indicates 38 percent of U.S. households participated in vegetable gardening in 1986. Regional variability ranged from 29 percent (for the non-Deep South) to 53 percent for the Rocky Mountain region. Urban regions showed lower gardening

Table 9-6. Specific County-Level Census of Agriculture Items Used in Human/Farm Receptor Estimations

Item Code	Item Description
10001	Farms (number)
10002	Land in farms (acres)
10003	Average size of farm (acres)
10043	Milk cows (farms)
10044	Milk cows (number)
20084	SIC–Beef cattle, except feedlots (0212)
20085	SIC–Dairy farms (024)
60021	Size of farm–1 to 9 acres (acres)
60022	Size of farm–10 to 49 acres (farms)
60023	Size of farm–10 to 49 acres (acres)
60024	Size of farm–50 to 69 acres (farms)
60025	Size of farm–50 to 69 acres (acres)
60026	Size of farm–70 to 99 acres (farms)
60027	Size of farm–70 to 99 acres (acres)
60028	Size of farm–100 to 139 acres (farms)
60029	Size of farm–100 to 139 acres (acres)
60030	Size of farm–140 to 179 acres (farms)
60031	Size of farm–140 to 179 acres (acres)
60032	Size of farm–180 to 219 acres (farms)
60033	Size of farm–180 to 219 acres (acres)
60034	Size of farm–220 to 259 acres (farms)
60035	Size of farm–220 to 259 acres (acres)
60036	Size of farm–260 to 499 acres (farms)
60037	Size of farm–260 to 499 acres (acres)
60038	Size of farm–500 to 999 acres (farms)
60039	Size of farm–500 to 999 acres (acres)
60040	Size of farm–1,000 to 1,999 acres (farms)
60041	Size of farm–1,000 to 1,999 acres (acres)
60042	Size of farm–2,000 acres or more (farms)
60043	Size of farm–2,000 acres or more (acres)

percentages (26 percent for cities) than rural regions, where 61 percent of households had gardens.

9.3 Methodology

Human receptor points and farm data were placed and processed within one Arc Macro Language (AML) batch process program for each site/WMU setting to aid in processing efficiency and speed. In the following descriptions, GIS files are referred to as “coverages” – the proprietary GIS file format used by ARC/INFO GIS software. Coverages are self-contained GIS layers that hold graphic spatial information (points, lines, polygons) as well as attribute information. Figure 9-2 charts how farm and human receptors are placed around each of the 419 HWIR WMU/site settings and attributed with the information necessary to calculate exposure and risk in the model.

The programs used to process block and block group census data assumes that census data are uniformly distributed across a given block or block group area. They use area-weighting to calculate the census item numbers that fall within the AOI study area for a site. For example, if the AOI boundary clips a block group so that only 10 percent falls within the AOI, then the total for all census items for that block group are multiplied by 0.1. This area-weighting method was used to calculate census numbers within the study area for both block and block group data.

Similarly, because Census of Agriculture data are only available at the county level, the analysis assumes that the ratios of specific farm types to total farms at the county level apply uniformly across the entire county. This assumption allows the trends in specific farm family ratios (e.g., the percentage of farm families that are dairy farmers) to be applied to the portions of the study area that fall within a given county. In addition, the Census of Agriculture data from 1987 and 1992 were averaged together to best match the 1990 U.S. Census population data.

The following sections describe the preprocessing and AML program steps used to place and process human receptor points and farms. The primary AML programs used within the AML batch process are attached as Appendix 9-A and Appendix 9-B.

9.3.1 GIS Data Preparation/Preprocessing

Data preparation and preprocessing included the following steps:

- Downloading and processing needed block and block group coverages. Census coverages are kept by county and were downloaded from EPA's “valley” server. Census GIS coverages come with census data in separate tables and have no attributes attached, only a unique identifier for each polygon. Part of the preprocessing of the census GIS coverages included attaching the census items needed for processing to the GIS coverages. This was done with automated AML programs.

- Creating AOI and WMU coverages for each site/WMU setting using automated AML programs.

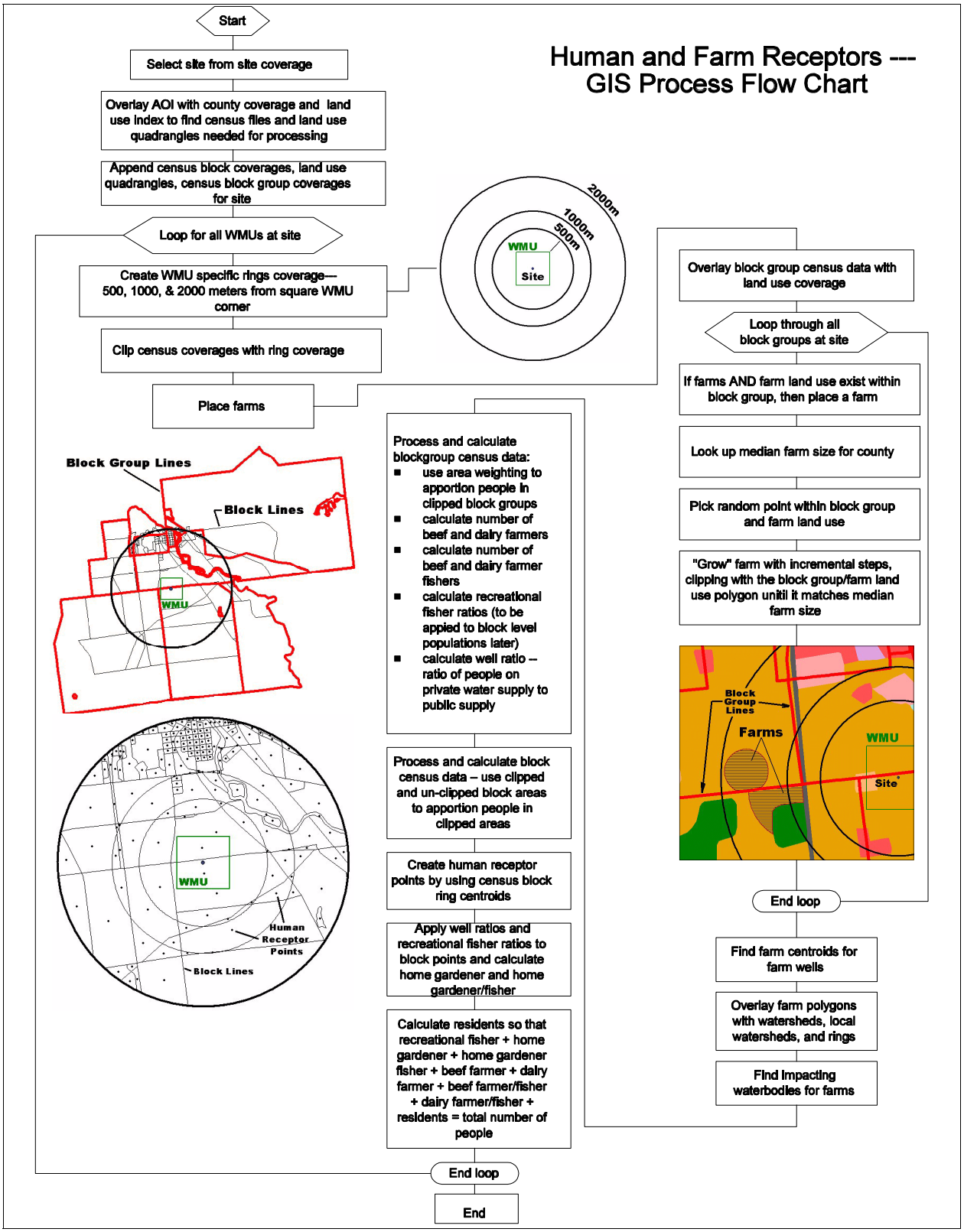

Figure 9-2. Human and farm receptor GIS process flow chart.

- Creating a lookup table from the 1996 NSFHWAR data that includes the percentage of residences with recreational fishing licenses in urban, rural, and rural farm areas by state. For each state, recreational fisher percentages were estimated using the NSFHWAR urban and rural population breakdowns and splitting the rural population into farm and nonfarm populations using farm/nonfarm population fractions calculated from 1990 U.S. Census data. This provided state-by-state estimates of urban, rural-farm, and rural-nonfarm recreational fishers as a percentage of the total state population.

- Importing watershed and waterbody coverages (see Section 5; note that all watershed and waterbody processing must be complete before processing a site).

- Creating a lookup table from averaged 1987 and 1992 Census of Agriculture data that includes the median farm size and beef and dairy farm ratios for each county. Beef and dairy farm ratios are calculated as the number of beef or dairy farms divided by the total number of farms in a county.

Median farm sizes were prepared for all counties containing farms for the entire country prior to human/farm processing. Median farm size was used rather than average farm size because of the general distribution of farm sizes in most counties. Large outlier farms caused the average farm size to be a poor representation of a typical, or central tendency, farm size. The Census of Agriculture represents farm sizes and numbers with irregularly sized groups and frequencies as follows:

Item #	Description–Size of Farm
60020	1 to 9 acres (farms)
60022	10 to 49 acres (farms)
60024	50 to 69 acres (farms)
60026	70 to 99 acres (farms)
60028	100 to 139 acres (farms)
60030	140 to 179 acres (farms)
60032	180 to 219 acres (farms)
60034	220 to 259 acres (farms)
60036	260 to 499 acres (farms)
60038	500 to 999 acres (farms)
60040	1,000 to 1,999 acres (farms)
60042	2,000 acres or more (farms)

Calculation of the median farm size was automated (Appendix 9-C) using a median estimation equation from Snedecor and Cochran (1967).

9.3.2 Human Receptor and Farm Placement and Processing

This program was designed to process all or a subset of all 201 HWIR sites one site/WMU setting at a time. A master point coverage of all 201 HWIR sites is maintained and holds the location of the site as well as information about the WMU sizes and types at the site. Initial steps include:

- Selecting a site from the site coverage.
- Using AOI coverage to find which census coverages and land use quadrangles were needed for processing. The AOI coverage was overlayed with the counties for the United States and an index of land use quadrangles. The selected counties and land use quadrangle identification numbers written to a list.
- Using census coverages and land use quadrangles to create data layers for a site. The necessary census block, block group coverages, and land use coverages were merged together to create seamless GIS data layers for the site.
- Creating ring coverage for the site/WMU setting. Rings were created at 500 m, 1,000 m and 2,000 m, starting from the diagonal corner of the square WMU and indexed as 1, 2, and 3, respectively.
- Clipping census coverages with ring coverage. The clipped and unclipped census coverages were both needed for the area-weighted reapportionment of census data. The clipped areas of the polygons were divided by the unclipped areas to produce the ratio applied to the census numbers.

9.3.2.1 <u>Place and Attribute Farms</u>. Steps in farm placement and attribution included the following:

- Overlaying the block group census coverage with the land use coverage.
- For every block group that had farmers and farm-type land use (i.e, Anderson Code 21, crop and pastureland), placing a farm as follows:
  - From a lookup table, finding the median farm size for the county being processed.
  - Checking to see if the block group/farm land use polygon was smaller in area than the median farm size. If so, then the entire polygon became the farm and the program moved to the next block group.

– If the block group/farm land use polygon was larger in area than the median farm size, then for the current block group, picking a random point inside the farm land use.

– Calculating a radius to produce a circle with an area matching that of the median farm size.

– Creating the circle and clipping it with the block group/farm land use polygon. If the resultant clipped circle still approximately matched the median farm area, then the farm was placed and the program moved to the next block group. If it didn't match, then the radius of the circle was increased by 100 m. This incremental process was repeated until the program produced a polygon that approximately matched the median farm area and was contained by the block group/farm land use polygon.

After processing all block groups, merging all farm polygons into one farm coverage.

Creating a coverage of farm centroids from the coverage of farm polygons. These were used as farm well points (i.e., the farms are assumed to have one well located at the farm centroid) and added to the drinking water well coverage (AquWell parameters in Tables 9-1 and 9-2).

Processing farm polygons with watersheds, local watersheds, and rings. The resultant files contained the farm index, the watershed, local watershed, or ring index and the area of their intersection. These indexes and areas were exported to the Microsoft Access database program that calculated the farm/watershed fractions, farm/local watershed fractions, and farm/ring fractions shown in Tables 9-1 and 9-2.

Overlaying farm polygons with the coverage of waterbodies at the site so that a nearest or impacting waterbody could be found. This was determined as the nearest second-order stream, pond, or lake to the farm.

Converting farm polygons to Universal Transverse Mercator (UTM) coordinates and overlaying with the master 100 by 100 m grid file to create the grid tables containing the farm x,y coordinates.

9.3.2.2 <u>Processing Block Group Census Data</u>. Block group data, including the farmer population and households with wells, were processed within the GIS according to the following steps:

Using area weighting to calculate census item totals with the AOI.

- Applying the beef-farms-to-total-farms ratio and the dairy-farms-to-total-farms ratio to the total number of farmers per block group to calculate the number of beef and dairy farmers in each block group. Ratios for beef and dairy farmers were derived from the lookup table created from Census of Agriculture data (see Section 9.3.1).

- Calculating fisher numbers using the lookup table created from NSFHWAR data (Section 9.3.2). This table included the percentage of residences with recreational fishing licenses in urban, rural, and rural farm areas by state (see Section 9.3.1). These percentages were applied to populations by category (persons in urban areas, persons in rural nonfarm areas, and persons in rural farm areas) to find total recreational fishers.

- Calculating beef and dairy farmers/fishers from the NSFHWAR lookup table by applying the percentage of residences with recreational fishing licenses in rural farm areas to the calculated number of beef and dairy farmers. The calculated number of beef and dairy farmers/fishers were then subtracted from the totals of beef and dairy farmers so that there was no overlap of the beef and dairy farmer populations with the beef and dairy farmer/fisher populations.

- Calculating ratio of people on private water supplies to people on public water supplies. This block group ratio was applied to block-based human receptor points within each block group to identify points with wells (i.e., points with a nonzero ratio). The ratio fraction was passed for each receptor point as HumRcpAquFrac, or the fraction of the population drinking from wells.[2]

9.3.2.3 <u>Processing Block Census Data</u>. Block census data were processed by applying the percentages and ratios calculated in the preceding steps to the U.S. Census block data. When census blocks extended across rings, the block data were fractionated into each ring/block combination based on the relative areas in each. GIS processing steps for census block data include:

- Creating human receptor points from the centroids of census blocks or census block/ring polygons created when merged block coverages were clipped by ring coverages (see Figure 9-2).

- Applying well ratios and recreational fisher ratios to human receptor (census block centroid) points. Block group polygons were overlayed with the block points, and the attributes (ratios) calculated at the block group level were applied to each block point within a block group.

[2] This fraction was not used by the human risk module because of the potential for underestimating risk for rural blocks in largely urban/suburban block groups.

- Calculating home gardener, home gardener/fisher, and resident fisher so no overlap or double counting occurred across receptor types. This is a sample of pseudo-code:

  home gardener = total block population * 0.38 (national fraction of households with gardens)

  home gardener fisher = home gardener * recreational fisher ratio

  resident fisher = (total block population - home gardener) * recreational fisher ratio

  home gardener = home gardener - home gardener fisher.

  The national fraction of households with gardens (0.38) was obtained from National Gardening Association data provided in Table 13-1 in Volume 2 of the *Exposure Factors Handbook* (U.S. EPA, 1997).

- Calculating total residents so that all receptor types added up to the total population at the site:

  residents = total block population - (home gardeners + home gardeners/fishers + resident fishers + total farmers).

- Converting human receptor points to UTM coordinates to create the human receptor location grid tables.

After block data GIS processing, all data tables created were exported as Access data tables for further processing.

9.3.3 Database Processing

Following GIS processing, the resulting data tables were imported into Access databases, where Structured Query Language (SQL) and Visual Basic programs were used to prepare the final, HWIR model-ready data set according to HWIR 3MRA model system specifications. Database programs included the following processes:

- Converting x,y coordinates from UTM to the site coordinate system (i.e., facility centroid =0,0) and formatting grid input files for the HWIR 3MRA site layout processor (SLP).

- Calculating all required fractions (see Tables 9-1 and 9-2) using area data passed from GIS.

- Splitting all receptor type population data into age cohorts based on data for each U.S. Census block.

- Formatting and indexing all variables according to input data table specifications for the HWIR 3MRA site definition processor (SDP).

The resulting data were appended to the site_variable_distribution_data tables within the HWIR 3MRA input database. Grid files for farms and human receptor points were sent as a separate Access database.

9.3.4 Quality Assurance/Quality Control

Data sources (U.S. Census data, Census of Agriculture, Geographic Information Retrieval and Analysis System [GIRAS]) were derived from Federal data sets that have undergone quality control (QC) measures (see metadata citations in Section 9.2). QC checks performed on the HWIR data transfer and processing activities included the following:

- Automated programs were used to check individual block group population values in the census coverages for population outliers or mistakes in the data. The programs compared all census population type values against urban/rural status and polygon size. Values exceeding conservative threshold values were flagged and checked against other data sources and then fixed from alternate data sources.

- A few random checks were conducted against different sources for the same data (e.g. census CD, a commercial CD of census data).

- Manual calculations were conducted on a few test sites to verify the AML programs used in the automated processing. To expedite this QC, an Excel spreadsheet was created that repeated the calculations of the human-farm receptor GIS program (Figure 9-3). ArcView was used to extract raw data numbers for different data layers at a site: state, county, block group, and block. The raw data were manually input into the custom spreadsheet to check against the final numbers output by the GIS AMLs. Prior to application, the methodology and logic for the formulas in the spreadsheet were reviewed and checked by senior staff.

- Farm placement was visually inspected. Because of the variability of census data overlayed with land use data, visual inspection of each site was the safest way to ensure that farms were placed correctly at every site that had farm land use and farmers. Automated ArcView scripts were used to create a Web page of the farms, land use data, and block group census data so that the farm placement for each site could be visually inspected (Figure 9-4). The Web page shaded all block groups with beef or dairy farmers present; these could be quickly checked against the actual farm data to ensure that farms were correctly placed within each block group.

- HWIR 3MRA site-specific population totals (calculated by summing HWIR 3MRA receptor population data across receptor points, receptor types, and age cohorts) were compared against population totals within the 2-km AOI obtained from GIS census coverages.

Site 0312301 WMU Type LAU																	
Block Group Level Processing																	
for Block Group 51165011498_2																	
Bg Area clipped	3053047.0																
Bg Total area	12727946.4								Ratios from Ag_Census.dat								
Area Ratio	0.2399								Ratios from Fisher.dat								
									USER INPUT								
	P0060003		Area Ratio														
P0060003B	14	*	0.2399	=	3.358173947				P0010001 - Total persons at block group level								
									P0060001 - Persons Inside Urbanized Area								
	P0060003B		R_20084_1						P0060002 - Persons Outside Urbanized Area								
Beef_farmer	3.358173947	*	0.38298	=	1.286113458				P0060003 - Persons in rural area on farm								
									P0060004 - Persons in rural area not on farm								
	P0060003B		R_20085_1														
Dairy_farmer	3.358173947	*	0.12766	=	0.428704486												
									FISHER1P is the percentage of urban people who fished								
	Beef_farmer		fisher2p/100						FISHER2P is the percentage of rural/farm people who fished								
Beef_fisher	1.286113458	*	0.3261	=	**0.419401599**				FISHER3P is the percentage of rural/nonfarm people who fished								
	Dairy_farmer		fisher2p/100														
Dairy_fisher	0.428704486	*	0.3261	=	**0.139800533**												
							These numbers get applied to farms										
	Beef_farmer		Beef_fisher														
Beef_farmer	1.286113458	-	0.419402	=	**0.866712**												
	Dairy_farmer		Dairy_fisher														
Dairy_farmer	0.428704486	-	0.139800533	=	**0.288903953**		total		**1.71481794**								
	(((((P0060001 + P0060002) * $1FISHER1P) + (P0060003 * $1FISHER2P) + (P0060004 * $1FISHER3P)) / 100) / P0010001)																
	P0060001		P0060002		FISHER1P		P0060003		FISHER2P		P0060004		FISHER3P		P0010001		
rec_fisher_ratio	0		0		12.85		14		32.61		1511		17.96		1525		
					0				456.54				27137.56				
															27594.1		
															275.941		
															0.180945		

Figure 9-3. QC spreadsheet for human receptor data collection.

(continued)

Site 0312301 WMU Type LAU

Block Level Processing

for block 51165011498 213A

Bl Area clipped	1169137.7							
Bl Total area	2026919.1							
Area Ratio	0.5768							
	P0010001		Area Ratio					
BL0010001B	83	*	0.57680531	=	47.87484074			BL0010001B - Total persons at block level

CALC HOME_GARD = BL0010001B * .38
CALC GARD_FISHER = HOME_GARD * REC_FISHER_RATIO
CALC REC_FISHER = (BL0010001B - HOME_GARD) * REC_FISHER_RATIO
CALC HOME_GARD = HOME_GARD - GARD_FISHER
CALC RESIDENTS = BL0010001B - ((HOME_GARD + GARD_FISHER + REC_FISHER))
RESEL LUCODE = 21
CALC RESIDENTS = RESIDENTS - ((BEEF_FARMER + BEEF_FISHER + DAIRY_FARMER + DAIRY_FISHER) * (BL0010001B / $1BL0010001B))

	BL0010001B						
HOME_GARD	47.87484074	*	0.38	=	18.1924		
	HOME_GARD		Rec_fisher_ratio				
GARD_FISHER	18.1924	*	0.180944918	=			**3.2918**
	BL0010001B		HOME_GARD		Rec_fisher_ratio		
REC_FISHER	47.87484074	-	18.1924	*	0.180944918	=	**5.3709**
			29.68240126				
	HOME_GARD		GARD_FISHER				
HOME_GARD	18.1924	-	3.2918	=			**14.9006**
	BL0010001B		HOME_GARD		GARD_FISHER		REC_FISHER
RESIDENTS	47.87484074	-	14.9006	+	3.2918	+	5.3709
	47.87484074	-	23.56331914	=	24.31152159		
	RESIDENTS		(BEEF_FARMER + BEEF_FISHER + DAIRY_FARMER + DAIRY_FISHER)				
RESIDENTS	24.31152159	-					
							1.714817944
							0.352346077
						=	**23.9592**

	BL0010001B		total of all clipped blocks in block group	
	47.87484074	/	233	
	0.205471419			

Figure 9-3. (continued)

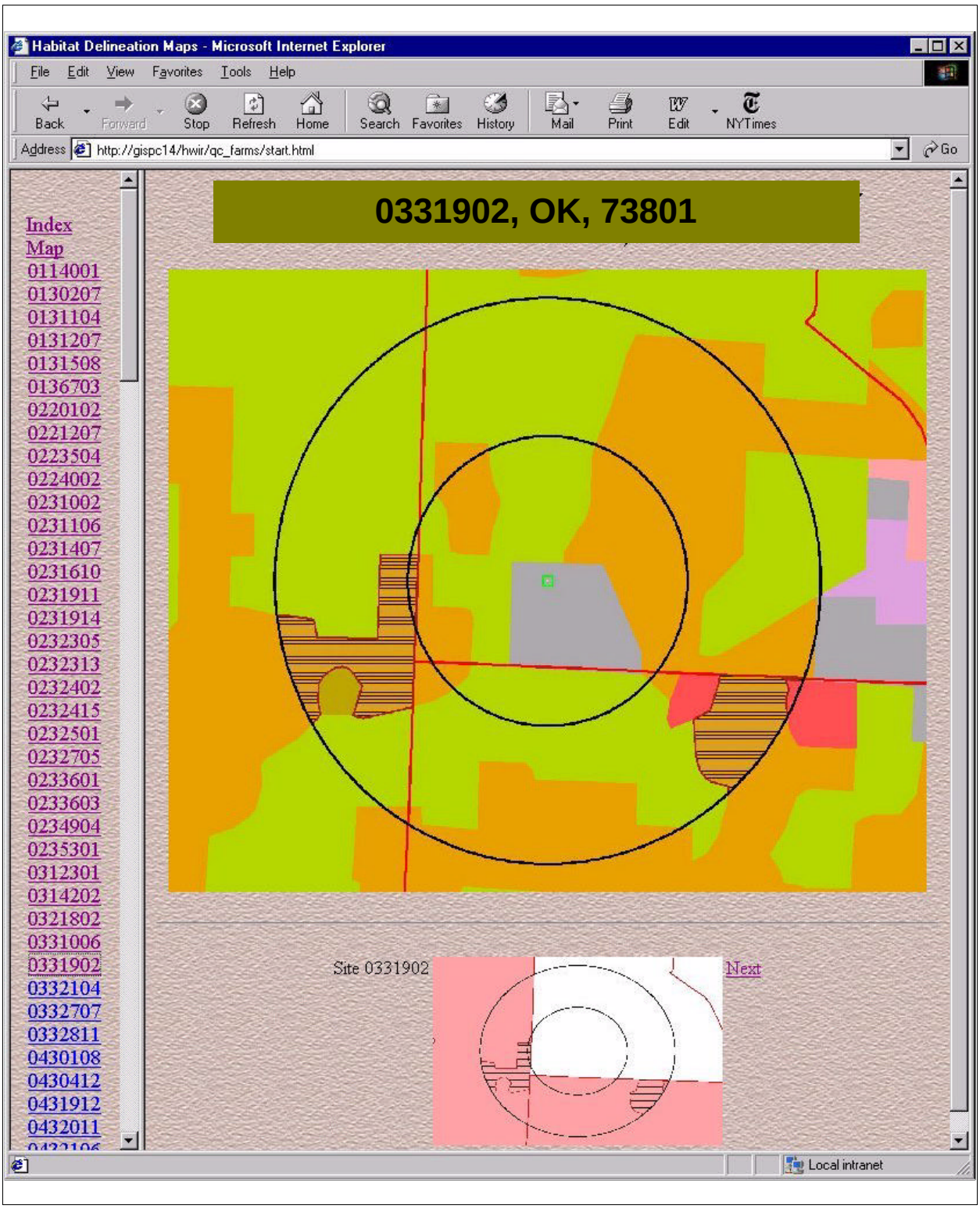

Figure 9-4. Web page for visual farm QC checks.

- Within the final data processing database, automated queries were applied to ensure all indexing was complete and correct, minimums and maximums were not violated, and other internal constraints were not violated (e.g., no negative receptors).

Quality assurance (QA) checks were conducted to ensure that the QC activities were correctly conducted and reported. QA/QC documentation is available on request.

9.4 Results

Results from the human receptor and farm data collection effort are summarized in Appendix 9-D, which provides the total resident and farm population and number of farms for each of the 419 HWIR site/WMU settings.

9.5 Issues and Uncertainties

In general, there are few data gap issues associated with human receptor data; consistent data of an appropriate scale for a national analysis were available for all 201 sites addressed in the analysis. The primary issues and uncertainties are associated with the age of the data and the mismatches based on date and geographic scale. Not all data sources used to estimate human receptors were created at the same time or at the same scale, and most of the data are 9 years old or older (see Table 9-2). More up-to-date national data sets were not available, however.

To the extent possible, scale and data discrepancies were addressed using spatial averaging and interpolation to minimize the errors incurred from using different data layers. For example, to better combine the 1990 U.S. Census data with the 1992/1987 Census of Agriculture data, the 1987 and 1992 data were averaged to create a hybrid 1990 data set. Larger scale (i.e., block group, county, and state) data were combined with the block data by assuming uniform characteristics across block groups, counties, and states. This step was necessary to allow automated processing of human receptor type and population data. Although this assumption does create some inaccuracies at individual sites, it is valid and appropriate for a national analysis.

From a time-frame perspective, the data are roughly contemporaneous with the 1980s, with data ranging from pre-1980 (certain GIRAS land use data) to 1985 (Industrial D Screening Survey data) to 1990 (U.S. Census, Census of Agriculture 1987-1992 averages). Although a comprehensive review of these data for temporal consistency was not conducted, the visual observation of the land use and census coverages conducted during farm placement QC uncovered no apparent inconsistencies. The general applicability of mid-1980s data to the 1999 HWIR analysis has been addressed elsewhere by EPA and also should be considered a significant uncertainty in the overall analysis.

The accuracy of location data of the WMU site was initially an issue, but steps were taken to find better WMU locations for the 201 sites, including address matching for 20 sites and visual inspection of all sites and their surrounding land use in order to move them to a more plausible location (i.e., moving a WMU out of a waterbody and into an industrial land use type).

9.6 References

U. S. Bureau of the Census. 1987. Census of Agriculture: Geographic Area Series State and County Data. Washington, DC.

U. S. Bureau of the Census. 1990. TIGER: The Coast-to-Coast Digital Map. Washington, DC.

U. S. Bureau of the Census. 1992a. Census of Agriculture: Geographic Area Series State and County Data. Washington, DC.

U. S. Bureau of the Census. 1992b. Census of Population and Housing: Summary Tape File on CD-ROM Technical Documentation. Washington, DC.

Snedecor, George W., and William G. Cochran. 1967. *Statistical Methods.* 6th Edition. The Iowa State University Press, Ames, IO.

U.S. DOI and U.S. DOC (Department of the Interior; Department of Commerce). 1997. *1996 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation.* FHW/96 NAT. U.S. Department of the Interior, Fish and Wildlife Service; U.S. Department of Commerce, Bureau of the Census. Washington, DC. Website at http://www.nctc.fws.gov/library/pubs3.html. November.

U.S. EPA (Environmental Protection Agency). 1995a. 1990 Census Block Boundaries in the Conterminous U.S. Office of Information Resources Management, Washington, DC.

U.S. EPA (Environmental Protection Agency). 1995b. 1990 Census Block Group Boundaries in the Conterminous U.S. Office of Information Resources Management, Washington, DC.

U.S. EPA (Environmental Protection Agency). 1997. *Exposure Factors Handbook.* EPA/600/P-95/002Fa. U.S. Environmental Protection Agency, Office of Research and Development, Washington, DC. August.

USGS (Geological Survey). 1990. *Land Use and Land Cover Digital Data from 1:250,000- and 1:100,000-Scale Maps. Data Users Guide 4.* U.S. Geological Survey, Reston, VA.

Appendix 9A. GIS Arc Macro Language (AML) Program for Calculating Human Receptor Locations and Attributes

```
/*==========================================================
========
/*                RESEARCH TRIANGLE INSTITUTE
/*                   CEMQA - GIS Program
/*                     P.O. Box 12194
/*            Research Triangle Park, NC  27709-2194
/*==========================================================
========
/*
/*     PROGRAM: hwir_pop.aml
/*
/*     PURPOSE: calculates human and farm receptor locations and attributes
/*            from block, block group, landuse and ag census data.
/*
/*    INFO FILES NEEDED TO RUN:
/*            template_bg.dat
/*            template_bl.dat
/*            ag_census.dat
/*            fisher.dat
/*
/*    ROUTINES: main
/*              calls get_utm
/*              calls getcounties
/*              calls append
/*              calls make_landuse
/*                  calls rings      /* make rings coverage
/*                  calls clip       /* clip the county covs to the aoi/rings cov...
/*                  calls calc       /* call the overlay for this bg/county combo...
/*                  calls calc_bl    /* call the overlay for this block/county combo...
/*                  calls sumpop     /* call the routine that sums up pop for each county...
/*                  calls add_wmu    /* adds the WMU coverage to the site (after the
processing so people don't get put in the wmu)
/*                  calls wrap_up
/*
/*            getcounties
/*            append
/*              calls sum_farm
/*               clip
/*               place_farm
/*            farm_points
/*               process_farm
/*               calc
/*               calc_bl
```

```
/*              sumpop
/*              add_wmu
/*              wrap_up
/*             calls output or output_test
/*            output
/*            output_test
/*            clean
/*            sum_farm
/*            rings
/*
/*   CALLED BY:
/*
/*    CALLS TO:
/*
/* GLOBAL VAR'S:
/*
/*  INPUT FILES:
/*
/* OUTPUT FILES: numerous info files that get exported to Access
/*            cnty.txt - missing county covs
/*            fips.txt - fips by site-id
/*
/*      NOTES:
/*
/*     HISTORY: written by G. Conrad  6-10-98 originally called pigs.aml
/*                                    used in HWC project
/*     CONTACT: gtc@rti.org
/*
/*     PROJECT: HWIR
/*

/*==============================================================
===============

&args site

&echo &on

/* &if ^ [exists /files8/hwir/watershed_storage/s%site% -workspace] &then &do
/*    &sys echo Site %site% does not have complete watershed-waterbodies
/*    &return
/* &end

&sv ws_org = [show workspace]
&s work-dir = /files8/hwir/census/pop
&wo %work-dir%
```

```
&severity &warning &ignore
&severity &error &routine errorhandler

/* Check for arguments

&s cntypath /files8/hwir/census/stf3a/storage /* path to the block group coverages...
&s bl_cntypath /files8/hwir/census/stf1b/storage /* path to the block coverages...
&s data /files10/hwir/p6720-06a/data
&s amls /files10/hwir/p6720-06a/amllib/system
&s sitecov /files10/hwir/p6720-06a/data/site_pts_al83

&s aoi_path /files10/hwir/p6720-06a/data/aoi  /* path of aoi covers
&s wmu_path /files10/hwir/p6720-06a/data/sectors  /* path of wmu covers
&s cenpath /files8/hwir/census_storage/c%site% /* final output path for census files

&if [exists /files8/hwir/watershed_storage/s%site% -workspace] &then
   &s outpath /files8/hwir/watershed_storage/s%site%
&else &s outpath  /files10/hwir/p6720-06a/data/watershed_storage/s%site% /* final
output path waterbody watershed data

&s us_cov /data1/base/us_covers
&s storage /files10/hwir/p6720-06a/data/grids
&s utm_zones /data1/base/us_covers/utm_zone_al83

/* Initialize the x & y's and remake wmu and AOI
addxy %sitecov%
&r %amls%/run_gen_aoi %site%
&r %amls%/run_gen_wmu %site%
&wo %work-dir%
&echo &on

/* main loops that control program - site/wmu/ring loops
&sys touch progress.txt

cursor pop1 declare %sitecov% point ro id_num = [quote %site%]
cursor pop1 open
    &s site = %:pop1.id_num%
    &s sitex = %:pop1.x-coord%
    &s sitey = %:pop1.y-coord%
    &call get_utm /* finds utm zone for site
    &call getcounties /* for each site, find the counties that overlay it and run the
analysis..
    &call append  /* append the county covs...
    &call make_landuse /*  append the giras covs...

   &s type_list = lau_aver surface_imp_aver waste_pile_aver landfill_aver
```

```
  &do type &list %type_list%
    &if %type% = 'lau_aver' &then &s wmu_name = lau
    &if %type% = 'surface_imp_aver' &then &s wmu_name = si
    &if %type% = 'waste_pile_aver' &then &s wmu_name = wp
    &if %type% = 'landfill_aver' &then &s wmu_name = lf

    &s type_val = [value :pop1.[value type]]

    &sys echo %type_val%

    &if %type_val% > 0 &then
      &do
      &s rng_list = b /* a b c
      &do ring &list %rng_list%
        &call rings  /* make rings coverage
        &call clip /* clip the county covs to the aoi/rings cov...
        &call place_farm /* places farm polys in lu type 21
        &s i = 1
        &if [exists %cenpath%/farm%wmu_name%%i% -cover] &then &do
          &call farm_points /* make farm centroid point for wells and nearest reach
          &call process_farms /* overlay farms with ws and lws
          &call process_farm_rings /* places farm polys over the ring coverages
        &end
        &call calc  /* call the overlay for this bg/county combo...
        &call calc_bl  /* call the overlay for this block/county combo...
        &call sumpop  /* call the routine that sums up pop for each county...
        &call add_wmu /* adds the WMU coverage to the site (after the processing so
people don't get put in the wmu)
        &call wrap_up /* output to dbf files
      &end
      &end
  &end
  &call clean /* clean any leftover coverages
cursor pop1 remove
&wo %ws_org%

&s done [date -full]
&sys echo site %site% finished at %done% >> progress.txt
/*alert_me
&watch &off
&return /* main

/*==========================================================
=================
/*                    END   OF   PROGRAM
```

```
/*==========================================================
=================

/*  ROUTINE
errorhandler*****************************************************
&routine errorhandler

&severity &error &ignore
&severity &warning &ignore
&mess &on
&wo %ws_org%
cursor pop1 remove
cursor id1 remove
&watch &off
&return &error An error has occurred in hwir_pop13.aml on site %site%\~
Last Error: %AML$MESSAGE%\~
Thread: %AML$ERRORTHREAD%\~
File: %AML$ERRORFILE%\~
Line: %AML$ERRORLINE%

/*  ROUTINE
getcounties******************************************************
&routine getcounties

/* for each site, do the overlay for the county that touches the site....
display 0
arcplot

/* use arcplot reselect to get the list of counties..
reselect %us_cov%/us_cnty_al83 poly overlap %aoi_path%/aoi%site% poly

&sv fips_lst = [listunique %us_cov%/us_cnty_al83 -poly fips]

/* use arcplot reselect to get the list of landuse covers..
reselect %us_cov%/giras250 poly overlap %aoi_path%/aoi%site% poly

&sv giras_lst = [listunique %us_cov%/giras250 -poly covername]

quit /* out of arcplot

/* fix the leading zero problem
&s fips_list
&do fips &list %fips_lst%
  &if [length %fips%] = 4 &then
  &s fips_list = %fips_list% 0%fips%
  &else
```

```
  &s fips_list = %fips_list% %fips%
&end

&s num_cntys = [token %fips_list% -count]

&sys touch fips.txt
&sys echo %site% [date -full] >> fips.txt
&sys echo %fips_list% "                    " >> fips.txt

&return  /* end of routine

/*  ROUTINE
append*************************************************************
&routine append

&if [exists pop%site% -cover] &then kill pop%site% all
&if [exists bg_mrg -cover] &then kill bg_mrg all
&if [exists bl_mrg -cover] &then kill bl_mrg all

&sys echo %site% [date -full] >> cnty.txt

&call sum_farm

&if %num_cntys% = 1 &then
&do
  ap
  clearsel %cntypath%/bg9%fips_list% poly
  resel %cntypath%/bg9%fips_list% poly overlap %aoi_path%/aoi%site% poly
  writesel bg.sel
  q
  reselect %cntypath%/bg9%fips_list% bg_mrg poly bg.sel
  ap
  clearsel %bl_cntypath%/bl9%fips_list% poly
  resel %bl_cntypath%/bl9%fips_list% poly overlap %aoi_path%/aoi%site% poly
  writesel bl.sel
  q
  reselect %bl_cntypath%/bl9%fips_list% bl_mrg poly bl.sel
&end
&else
&do

/* do block groups

&s cnt = 0
&do cnty_name &list %fips_list%
  &s cnt = %cnt% + 1
```

```
  ap
  clearsel %cntypath%/bg9%cnty_name% poly
  resel %cntypath%/bg9%cnty_name% poly overlap %aoi_path%/aoi%site% poly
  writesel bg.sel
  q
  &if [exists bgtmp%cnt% -cover] &then kill bgtmp%cnt% all
  reselect %cntypath%/bg9%cnty_name% bgtmp%cnt% poly bg.sel
&end

/* make merge coverage of overlapping block groups

&if [exists bg_mrg -cover] &then kill bg_mrg all
mapjoin bg_mrg
  &do jj = 1 &to %cnt%
    bgtmp%jj%
  &end
  end

&do jj = 1 &to %cnt%
  kill bgtmp%jj% all
&end

/* do blocks

&s cnt = 0
&do cnty_name &list %fips_list%
  &s cnt = %cnt% + 1
  ap
  clearsel %bl_cntypath%/bl9%cnty_name% poly
  resel %bl_cntypath%/bl9%cnty_name% poly overlap %aoi_path%/aoi%site% poly
  writesel bl.sel
  q
  &if [exists bltmp%cnt% -cover] &then kill bltmp%cnt% all
  reselect %bl_cntypath%/bl9%cnty_name% bltmp%cnt% poly bl.sel
&end

&if [exists bl_mrg -cover] &then kill bl_mrg all
mapjoin bl_mrg
  &do jj = 1 &to %cnt%
    bltmp%jj%
  &end
  end

&do jj = 1 &to %cnt%
  kill bltmp%jj% all
&end
```

```
&end /* else

/* move merged blocks and block groups to census_storge for QC purposes
&if [exists %cenpath%/bg_mrg -cover] &then kill %cenpath%/bg_mrg all
&if [exists %cenpath%/bl_mrg -cover] &then kill %cenpath%/bl_mrg all
copy bg_mrg %cenpath%/bg_mrg
copy bl_mrg %cenpath%/bl_mrg


&return  /* end of routine

/*  ROUTINE
make_landuse*********************************************************
****
&routine make_landuse

/* select and merge giras landuse covers together...

display 0
ap

/* use arcplot reselect to get the list of landuse covers..
reselect %us_cov%/giras250 poly overlap bg_mrg poly
&sv lu_lst = [listunique %us_cov%/giras250 -poly covername]
q

&s num_lus = [token %lu_lst% -count]

&if [exists lu%site% -cover] &then kill lu%site% all

&if %num_lus% = 1 &then
  &do
    ap
    clearsel %us_cov%/giras_covers/%lu_lst% poly
    resel %us_cov%/giras_covers/%lu_lst% poly overlap bg_mrg poly
    writesel lu.sel
    q
    reselect %us_cov%/giras_covers/%lu_lst% lu%site% poly lu.sel
  &end
&else
  &do
    &s cnt = 0
    &do lu_num &list %lu_lst%
      &s cnt = %cnt% + 1
      ap
      clearsel %us_cov%/giras_covers/%lu_num% poly
```

```
      resel %us_cov%/giras_covers/%lu_num% poly overlap bg_mrg poly
      writesel lu.sel
      q
      &if [exists lutmp%cnt% -cover] &then kill lutmp%cnt% all
      reselect %us_cov%/giras_covers/%lu_num% lutmp%cnt% poly lu.sel
    &end

/* make merge coverage of overlapping landuse covers

    &if [exists lu%site% -cover] &then kill lu%site% all
    mapjoin lu%site%
      &do j = 1 &to %cnt%
        lutmp%j%
      &end
      end

    &do j = 1 &to %cnt%
      kill lutmp%j% all
    &end
  &end

&if [exists lu_temp -cover] &then kill lu_temp all
dissolve lu%site% lu_temp lucode poly
kill lu%site% all
rename lu_temp lu%site%

/* add a unique identifer to the landuse polys

additem lu%site%.pat lu%site%.pat lu_poly_id 4 4 I
&data arc info
  ARC
  SEL LU%site%.PAT
  CALC LU_POLY_ID = LU%site%#
  Q STOP
&end

&return  /* end of routine

/*  ROUTINE
clip*************************************************************
&routine clip

&if [exists bg_lu -cover] &then kill bg_lu all
&if [exists bgl%site% -cover] &then kill bgl%site% all
```

```
  identity bg_mrg lu%site% bg_lu poly .1 join /* bg_lu has landuse areas and is used
with bg%site%

  &if ^ [exists %cenpath%/bg_clp -cover] &then &do
      &if [exists big_aoi -cover] &then kill big_aoi all
      buffer %aoi_path%/aoi%site% big_aoi # # 1000 .1 poly
      clip bg_mrg big_aoi %cenpath%/bg_clp
      kill big_aoi all
  &end

  clip bg_lu rng%site% bgl%site% /* bgl%site% is used for farm numbers - has
landuse

  &if [exists bl%site% -cover] &then kill bl%site% all
  intersect bl_mrg rng%site% bl%site% poly .1 join

  &if [exists lu%site%b -cover] &then kill lu%site%b all
  clip lu%site% bg_mrg lu%site%b
  kill lu%site% all
  rename lu%site%b lu%site%

&return  /* end of routine

/*  ROUTINE
place_farm*****************************************************
&routine place_farm

&s iteration = 1
&do i = 1 &to %iteration%

&if ^ [exists %cenpath%/farm%wmu_name%%i% -cover] &then /* kill
%cenpath%/farm%wmu_name%%i% all
  &r place_farms %site% %wmu_name% %i% %sitex% %sitey%

  &wo %cenpath%
  &data arc info
  ARC
    SEL [translate farm%wmu_name%%i%.pat]
    CALC UTM_ZONE = %utmz%
    Q STOP
  &end
  &wo %ws_org%

&if [exists %cenpath%/info!arc!farm_grid_%wmu_name%%i%.dat -info] &then &s
d [delete %cenpath%/info!arc!farm_grid_%wmu_name%%i%.dat -info]
```

```
&if [exists %cenpath%/info!arc!farm_ws_%wmu_name%%i%.dat -info] &then &s d
[delete %cenpath%/info!arc!farm_ws_%wmu_name%%i%.dat -info]
&if [exists %cenpath%/info!arc!farm_lws_%wmu_name%%i%.dat -info] &then &s d
[delete %cenpath%/info!arc!farm_lws_%wmu_name%%i%.dat -info]
&if [exists %cenpath%/info!arc!farm_rng%ring%_%wmu_name%%i%.dat -info]
&then &s d [delete %cenpath%/info!arc!farm_rng%ring%_%wmu_name%%i%.dat
-info]

&end

&return  /* end of routine

/*  ROUTINE
process_farms*********************************************************
&routine process_farms

&do i = 1 &to %iteration%

/* convert to utm coords

&if [exists farm_utm -cover] &then kill farm_utm all
&if [exists farm_temp -cover] &then kill farm_temp all

project cover %cenpath%/farm%wmu_name%%i% farm_utm
/data1/base/prj_files/albers83-utm%utmz%_83.prj
build farm_utm

&if ^ [iteminfo %storage%/grd%site% -poly x-coord -exists] &then
  addxy %storage%/grd%site% point

identity %storage%/grd%site% farm_utm farm_temp point .001 join
pullitems farm_temp.pat farm_grd.dat
id_num
wmu
farmindex
iteration
cell_add
x-coord
y-coord
end

&data arc info
ARC
   SEL FARM_GRD.DAT
   RESEL FARMINDEX = 0
   PURGE
```

```
  Y
  Q STOP
&end

&if [exists %cenpath%/info!arc!farm_grid_%wmu_name%%i%.dat -info] &then &s
d [delete %cenpath%/info!arc!farm_grid_%wmu_name%%i%.dat -info]
copyinfo farm_grd.dat %cenpath%/farm_grid_%wmu_name%%i%.dat  /* export info
file to site directory

&s [delete farm_grd.dat -info]
&if [exists farm_utm -cover] &then kill farm_utm all
&if [exists farm_temp -cover] &then kill farm_temp all

/* process the farms with watersheds and local watersheds

/* watershed

&if [exists farm_ws -cover] &then kill farm_ws all
&if [exists %outpath%/v2_%site% -cover] &then &do
  &if ^ [iteminfo %outpath%/v2_%site% -poly ws_area -exists] &then &do
    additem %outpath%/v2_%site%.pat %outpath%/v2_%site%.pat ws_area 4 12 f 3
  &end
    &wo %outpath%
    &data arc info
    ARC
      SEL [translate v2_%site%.pat]
      CALC WS_AREA = AREA
      Q STOP
    &end
    &wo %work-dir%
  intersect %cenpath%/farm%wmu_name%%i% %outpath%/v2_%site% farm_ws

  pullitems farm_ws.pat farm_ws.dat
  id_num
  wmu
  iteration
  farmindex
  farmarea
  wshd_num
  ws_area
  area
  end
  &end

&data arc info
ARC
```

```
  SEL FARM_WS.DAT
  MOVEIT [quote %site%] TO ID_NUM
  RESEL FARMINDEX = 0
  PURGE
  Y
  Q STOP
&end

&if [exists %cenpath%/info!arc!farm_ws_%wmu_name%%i%.dat -info] &then &s d
[delete %cenpath%/info!arc!farm_ws_%wmu_name%%i%.dat -info]
copyinfo farm_ws.dat %cenpath%/farm_ws_%wmu_name%%i%.dat  /* export info
file to site directory

&if [exists farm_ws -cover] &then kill farm_ws all

/* local watershed

display 0
arcplot
clearselect %wmu_path%/cir%site%%wmu_name% poly
resel %outpath%/v2_%site% poly overlap %wmu_path%/cir%site%%wmu_name%
poly
&sv lwses = [listunique %outpath%/v2_%site% -poly wshd_num]
q

&if [exists frm_lws.dat -info] &then &s d [delete frm_lws.dat -info]

&do ws_num &list %lwses%

&if [exists farm_lws -cover] &then kill farm_lws all
&if [exists %outpath%/%wmu_name%%ws_num% -cover] &then &do
  &if ^ [iteminfo %outpath%/%wmu_name%%ws_num% -poly local_area -exists]
&then
    additem %outpath%/info!arc!%wmu_name%%ws_num%.pat
%outpath%/info!arc!%wmu_name%%ws_num%.pat local_area 4 12 f 3
    &wo %outpath%
    &data arc info
    ARC
      SEL [translate %wmu_name%%ws_num%.pat]
      CALC LOCAL_AREA = AREA
      Q STOP
    &end
    &wo %work-dir%
  &if ^ [iteminfo %outpath%/%wmu_name%%ws_num% -poly wshd_num -exists]
&then &do
```

```
    additem %outpath%/info!arc!%wmu_name%%ws_num%.pat
%outpath%/info!arc!%wmu_name%%ws_num%.pat wshd_num 3 3 i
    &wo %outpath%
    &data arc info
    ARC
      SEL [translate %wmu_name%%ws_num%.pat]
      CALC WSHD_NUM = %ws_num%
      Q STOP
    &end
    &wo %work-dir%
  &end
  intersect %cenpath%/farm%wmu_name%%i%
%outpath%/%wmu_name%%ws_num% farm_lws
  &if [exists farm_lws_tmp.dat -info] &then &s d [delete farm_lws_tmp.dat -info]
  pullitems farm_lws.pat farm_lws_tmp.dat
  id_num
  wmu
  iteration
  farmindex
  farmarea
  wshd_num
  local_num
  local_area
  area
  end
  &end

&data arc info
ARC
  SEL FARM_LWS_TMP.DAT
  MOVEIT [quote %site%] TO ID_NUM
  RESEL FARMINDEX = 0
  PURGE
  Y
  Q STOP
&end

&if ^ [exists frm_lws.dat -info] &then
  copyinfo farm_lws_tmp.dat frm_lws.dat
&else &do
  &data arc info
  arc
  SEL [translate farm_lws_tmp.dat]
  MERGE INTO [translate frm_lws.dat] ON ID_NUM UNSORTED
  Q STOP
  &end
```

```
&end

&end /* do

additem frm_lws.dat frm_lws.dat farm_lws_index 3 3 i # farmindex

/* redo index nums so there aren't any missing places *************************

&s i_cnt = 1

cursor id1 declare frm_lws.dat info rw
cursor id1 open
&do &while %:id1.AML$NEXT%
  &s :id1.farm_lws_index = %i_cnt%
  &s i_cnt = %i_cnt% + 1
  cursor id1 next
&end
cursor id1 remove

&if [exists %cenpath%/info!arc!farm_lws_%wmu_name%%i%.dat -info] &then &s d
[delete %cenpath%/info!arc!farm_lws_%wmu_name%%i%.dat -info]
copyinfo frm_lws.dat %cenpath%/farm_lws_%wmu_name%%i%.dat  /* export info
file to site directory

&if [exists farm_lws -cover] &then kill farm_lws all

&end

&return  /* end of routine

/*  ROUTINE
farm_points*************************************************************
&routine farm_points

&do i = 1 &to %iteration%

&if [exists farm_pts -cover] &then kill farm_pts all
&if [exists farm_pts_utm -cover] &then kill farm_pts_utm all
centroidlabels %cenpath%/farm%wmu_name%%i% inside
ae
ec %cenpath%/farm%wmu_name%%i% label
sel all
put farm_pts
q

/*&data arc info
```

```
/*ARC
/*SEL FARM_PTS.PAT
/*CALC INDEX = FARM_PTS-ID
/*Q STOP
/*&end

/* process imp_reach_idx

&if [exists tmp_re -cover] &then kill tmp_re all
&if [exists tmp_re_clp -cover] &then kill tmp_re_clp all
&if [exists farm%wmu_name%_re -cover] &then kill farm%wmu_name%_re all

ap
clearsel %outpath%/reaches line
resel %outpath%/reaches line value > 1
resel %outpath%/reaches line rch_num > 0
writesel reach.sel
q
reselect %outpath%/reaches tmp_re line reach.sel
clip tmp_re %aoi_path%/aoi%site% tmp_re_clp line
build tmp_re_clp line

kill tmp_re all

near farm_pts tmp_re_clp line 2000 farm%wmu_name%_re

&data arc info
ARC
SEL [translate farm%wmu_name%_re.pat]
RELATE TMP_RE_CLP.AAT 1 by TMP_RE_CLP#
CALC IMP_REACH_IDX = $1RCH_NUM
Q STOP
&end

&if [exists %cenpath%/farm%wmu_name%_re -cover] &then kill
%cenpath%/farm%wmu_name%_re all
copy farm%wmu_name%_re %cenpath%/farm%wmu_name%_re

&wo %cenpath%
&data arc info
ARC
SEL [translate farm%wmu_name%_re.pat]
LIST FARMINDEX
SEL [translate farm%wmu_name%%i%.pat]
LIST FARMINDEX
RELATE [translate farm%wmu_name%_re.pat] 2 by FARMINDEX
```

```
CALC IMP_REACH_IDX = $2IMP_REACH_IDX
Q STOP
&end

&if [exists tmp_re -cover] &then kill tmp_re all
&if [exists tmp_re_clp -cover] &then kill tmp_re_clp all
&if [exists farm%wmu_name%_re -cover] &then kill farm%wmu_name%_re all
&if [exists %cenpath%/farm%wmu_name%_re -cover] &then kill
%cenpath%/farm%wmu_name%_re all

&wo %ws_org%


/* convert to utm coords

project cover farm_pts farm_pts_utm
/data1/base/prj_files/albers83-utm%utmz%_83.prj
addxy farm_pts_utm
kill farm_pts all

&if [exists %cenpath%/farm_pts_%wmu_name%%i%.dat -info] &then &s d [delete
%cenpath%/farm_pts_%wmu_name%%i%.dat -info]

pullitems farm_pts_utm.pat %cenpath%/farm_pts_%wmu_name%%i%.dat
  id_num
  wmu
  iteration
  farmindex
  farmarea
  x-coord
  y-coord
  end

kill farm_pts_utm all
&end

&return  /* end of routine

/*  ROUTINE
process_farm_rings*****************************************************
**
&routine process_farm_rings

&do i = 1 &to %iteration%

&if [exists farm_rng -cover] &then kill farm_rng all
```

```
&if [exists rng%site% -cover] &then &do
  intersect %cenpath%/farm%wmu_name%%i% rng%site% farm_rng
  pullitems farm_rng.pat farm_rng.dat
  id_num
  wmu
  iteration
  farmindex
  farmarea
  ring_id
  area
  end
&end

&data arc info
ARC
  SEL FARM_RNG.DAT
  MOVEIT [quote %site%] TO ID_NUM
  RESEL FARMINDEX = 0
  PURGE
  Y
  Q STOP
&end

&if [exists %cenpath%/info!arc!farm_rng%ring%_%wmu_name%%i%.dat -info]
&then &s d [delete %cenpath%/info!arc!farm_rng%ring%_%wmu_name%%i%.dat
-info]
copyinfo farm_rng.dat %cenpath%/farm_rng%ring%_%wmu_name%%i%.dat  /*
export info file to site directory

&if [exists farm_rng -cover] &then kill farm_rng all

&end

&return  /* end of routine

/*  ROUTINE
calc_bl*************************************************************
&routine calc_bl

/* perform the calculations

joinitem bl%site%.pat template_bl.dat ~
bl%site%.pat $recno pop100

/* do a frequency on the original block groups so we have just one population
/* value for each block group...
```

```
&if [exists bl_mrg.frq -info] &then
&s d [delete bl_mrg.frq -info]

&sv alllist = 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 ~
 23 24 25 26 27 28 29 30 31

frequency bl_mrg.pat bl_mrg.frq
STCNTRBLK
P0010001
P0020001
P0030001
P0040001
P0040002
P0040003
P0040004
P0050001
P0050002
P0060001
P0060002
P0060003
P0060004
P0060005
&do t &list %alllist%
P01100%t%
&end
end
area
end

&data arc info
ARC
  SEL BL%site%.PAT
  RESELECT LW = '99'
  NSEL
  RELATE BL_MRG.FRQ 1 by STCNTRBLK ordered
  CALC BL0010001B = $1P0010001 * ( AREA / $1AREA )
  CALC BL0020001B = $1P0020001 * ( AREA / $1AREA )
  CALC BL0030001B = $1P0030001 * ( AREA / $1AREA )
  CALC BL0040001B = $1P0040001 * ( AREA / $1AREA )
  CALC BL0040002B = $1P0040002 * ( AREA / $1AREA )
  CALC BL0040003B = $1P0040003 * ( AREA / $1AREA )
  CALC BL0040004B = $1P0040004 * ( AREA / $1AREA )
  CALC BL0050001B = $1P0050001 * ( AREA / $1AREA )
  CALC BL0050002B = $1P0050002 * ( AREA / $1AREA )
  CALC BL0060001B = $1P0060001 * ( AREA / $1AREA )
  CALC BL0060002B = $1P0060002 * ( AREA / $1AREA )
```

```
  CALC BL0060003B = $1P0060003 * ( AREA / $1AREA )
  CALC BL0060004B = $1P0060004 * ( AREA / $1AREA )
  &do Z &list %alllist%
  CALC BL01100%Z%B = $1P01100%Z% * ( AREA / $1AREA )
  &end
  SEL BL%site%.PAT
  MOVEIT [quote %site%] TO SITE-ID
  MOVEIT [quote %wmu_name%] TO WMU_SETTING
  RESELECT LW = '99'
  NSEL
  MOVEIT STCNTRBLK TO BL-ID
  MOVEIT AREA TO P_AREA
  RESELECT LW = '99'
  MOVEIT 'W' TO BL-ID
  Q STOP
&end

&return  /* end of routine

/*  ROUTINE
calc*************************************************************
&routine calc

/* perform the calculations

joinitem bgl%site%.pat template_bg.dat ~
bgl%site%.pat $recno land/water

/* do a frequency on the original block groups so we have just one population
/* value for each block group...
&if [exists bg_lu.frq -info] &then
&s d [delete bg_lu.frq -info]

&sv alllist = 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 ~
 23 24 25 26 27 28 29 30 31
&sv tlist = 02 03 04 05 06 07 08 09 10 11 12 13 14

frequency bg_lu.pat bg_lu.frq
stcntrbg
p0010001  /* Total persons
p0060001  /* Persons Inside Urbanized Area
p0060002  /* Persons Outside Urbanized Area
p0060003  /* Persons in rural area on farm
p0060004  /* Persons in rural area not on farm
p0780009  /* Employed persons:  Farming, forestry, and Fishing Ocupations
h0010001  /* Total Housing Units
```

```
h0050003  /* Housing Units, Rural Farm
h0230001  /* Source of water: Public system or private company
h0230002  /* Source of water: Drilled individual well
h0230003  /* Source of water: Dug individual well
h0230004  /* Some other water source
&do t &list %alllist%
p01300%t%   /* Total Persons 1 through 85 & older
&end
end
area
end

&sv ag_list = 39 40 41 42 43 44 45 46 47 48 49 50

additem bgl%site%.pat bgl%site%.pat farm_rat 8 12 f 6

&do fip &list %fips_list%
  &s st [substr %fip% 1 2]
  &s cny [substr %fip% 3 3]
  &sys echo %st%
  &sys echo %cny%

  &data arc info
  ARC
  SEL BG_LU.FRQ
  SORT ON STCNTRBG
  SEL AG_CENSUS.DAT
  RESELECT ST = [QUOTE %st%] AND COU = [QUOTE %cny%]
  CALC $NUM1 = R_TOTFARM
  CALC $NUM2 = R_39_1
  CALC $NUM3 = R_41_1
  CALC $NUM4 = R_43_1
  CALC $NUM5 = R_45_1
  CALC $NUM6 = R_20084_1 /* Ratio SIC Beef cattle, except feedlots - was
R_47_1
  CALC $NUM7 = R_20085_1 /* Ratio SIC-Dairy farms - was R_49_1
  CALC $NUM8 = R_40_39
  CALC $NUM9 = R_42_41  /* Ratio Beef cows (number) to Beef cows (farms)
  CALC $NUM10 = R_44_43  /* Ratio Milk cows (number) to Milk cows (farms)
  CALC $NUM11 = R_46_45
  CALC $NUM12 = R_48_47
  CALC $NUM13 = R_50_49
  CALC $NUM14 = R_PROD
  SEL BGL%site%.PAT
  RESEL COUNTY = [QUOTE %cny%]
  RESELECT LAND/WATER = 'L'
```

```
RELATE BG_LU.FRQ 1 by STCNTRBG
CALC P0010001B = $1P0010001 * ( AREA / $1AREA )
CALC P0060001B = $1P0060001 * ( AREA / $1AREA )
CALC P0060002B = $1P0060002 * ( AREA / $1AREA )
CALC P0060003B = $1P0060003 * ( AREA / $1AREA )
CALC P0060004B = $1P0060004 * ( AREA / $1AREA )
CALC P0780009B = $1P0780009 * ( AREA / $1AREA )
CALC H0010001B = $1H0010001 * ( AREA / $1AREA )
CALC H0050003B = $1H0050003 * ( AREA / $1AREA )
CALC H0230001B = $1H0230001 * ( AREA / $1AREA )
CALC H0230002B = $1H0230002 * ( AREA / $1AREA )
CALC H0230003B = $1H0230003 * ( AREA / $1AREA )
CALC H0230004B = $1H0230004 * ( AREA / $1AREA )
SEL BGL%site%.PAT
CALC FARM_RAT = 0
RESELECT P0010001B GT 0
CALC FARM_RAT = P0060003B / P0010001B
SEL BGL%site%.PAT
RESELECT LAND/WATER = 'L'
RELATE BG_LU.FRQ 1 by STCNTRBG
&do z &list %alllist%
CALC P13%Z% = $1P01300%Z% * ( AREA / $1AREA )
&end
&do z &list %alllist%
CALC P13%Z%F = P13%Z% * FARM_RAT
&end
&do z &list %alllist%
CALC P13%Z%C = P13%Z%F * $NUM2
&end
&do z &list %alllist%
CALC P13%Z%B = P13%Z%F * $NUM6 /* USED TO BE $NUM3 OR R_41_1
&end
&do z &list %alllist%
CALC P13%Z%M = P13%Z%F * $NUM7 /* USED TO BE $NUM4 OR R_43_1
&end
&do z &list %alllist%
CALC P13%Z%P = P13%Z%F * $NUM14
&end
CALC TOT_FARM = H0050003B * $NUM1
CALC AG39 = TOT_FARM * $NUM2
CALC AG40 = TOT_FARM * $NUM8
CALC AG41 = TOT_FARM * $NUM3
CALC AG42 = TOT_FARM * $NUM9
CALC AG43 = TOT_FARM * $NUM4
CALC AG44 = TOT_FARM * $NUM10
CALC AG45 = TOT_FARM * $NUM5
```

```
   CALC AG46 = TOT_FARM * $NUM11
   CALC AG47 = TOT_FARM * $NUM6
   CALC AG48 = TOT_FARM * $NUM12
   CALC AG49 = TOT_FARM * $NUM7
   CALC AG50 = TOT_FARM * $NUM13
   CALC PROD_FARM = TOT_FARM * $NUM14
   CALC AG20084 = TOT_FARM * $NUM6
   CALC AG20085 = TOT_FARM * $NUM7
   RESELECT H0010001B GT 0
   CALC WELL_RAT = ( H0230002B + H0230003B + H0230004B ) / H0010001B
/* ratio of private wells to total households
   SEL BGL%site%.PAT
   RESELECT LAND/WATER = 'L'
   RELATE FISHER.DAT 3 by STATE
   CALC BEEF_FARMER = P0060003B * $NUM6
   CALC DAIRY_FARMER = P0060003B * $NUM7
   CALC BEEF_FISHER = ( ( P0060003B * $3FISHER2P ) / 100 ) * $NUM6
   CALC DAIRY_FISHER = ( ( P0060003B * $3FISHER2P )  / 100 ) * $NUM7
   CALC BEEF_FARMER = BEEF_FARMER - BEEF_FISHER
   CALC DAIRY_FARMER = DAIRY_FARMER - DAIRY_FISHER
   CALC P1301P = P0060001
   CALC P1302P = P0060002
   CALC P1303P = $3FISHER1P
   CALC P1304P = P0060003
   CALC P1305P = $3FISHER2P
   CALC P1306P = P0060004
   CALC P1307P = $3FISHER3P
   CALC P1308P = P0010001
   CALC P1309P = P0010001B
   RESELECT P0010001 GT 0
   CALC REC_FISHER = ( ( ( ( ( P0060001 + P0060002 ) * $3FISHER1P ) + (
P0060003 * $3FISHER2P ) + ( P0060004 * $3FISHER3P ) ) / 100 ) / P0010001 )
   SEL BGL%site%.PAT
   RESELECT H0010001B GT 0
   CALC WELL_RAT = ( H0230002B + H0230003B + H0230004B ) / H0010001B
/* ratio of private wells to total households
   Q STOP
   &end


&if [exists %cenpath%/bgl_%wmu_name% -cover] &then kill
%cenpath%/bgl_%wmu_name% all
copy bgl%site% %cenpath%/bgl_%wmu_name%

/*   cursor temp1 declare BGL%site%.PAT info ro stcntrbg = '420710111  4' and
lucode = 21
```

```
/*   cursor temp1 open
/*   &do &while %:temp1.AML$NEXT%
/*      &sys echo HOME_GARD %:temp1.HOME_GARD%
/*      &sys echo REC_FISHER %:temp1.REC_FISHER%
/*      &sys echo GARD_FISHER %:temp1.GARD_FISHER%
/*      &sys echo BEEF_FARMER %:temp1.BEEF_FARMER%
/*      &sys echo BEEF_FISHER %:temp1.BEEF_FISHER%
/*      &sys echo DAIRY_FARMER %:temp1.DAIRY_FARMER%
/*      &sys echo DAIRY_FISHER %:temp1.DAIRY_FISHER%
/*      &sys echo P0010001 %:temp1.P0010001%
/*      cursor temp1 next
/*   &end
/*   cursor temp1 remove

/* FISHER1P is the percentage of urban people who fished
/* FISHER2P is the percentage of rural/farm people who fished
/* FISHER3P is the percentage of rural/nonfarm people who fished

&end

&return  /* end of routine

/*  ROUTINE
sumpop*************************************************************
&routine sumpop

   &data arc info
   ARC
   SEL BGL%site%.PAT
   MOVEIT [quote %site%] TO SITE-ID
   MOVEIT [quote %wmu_name%] TO WMU_SETTING
   RESELECT LAND/WATER = 'L'
   MOVEIT STCNTRBG TO BG-ID
   CALC AGE1 = P1301
   CALC AGE1-5 = P1302 + P1303 + P1304
   CALC AGE6-11 = P1305 + P1306 + P1307
   CALC AGE12-19 = P1308 + P1309 + P1310 + P1311 + P1312 + P1313 + P1314
   CALC AGE20- = P1315 + P1316 + P1317 + P1318 + P1319 + P1320 + P1321 +
P1322 ~
      + P1323 + P1324 + P1325 + P1326 + P1327 + P1328 + P1329 + P1330 + P1331
   RESELECT LAND/WATER = 'W'
   MOVEIT 'W' TO BG-ID
   Q STOP
   &end

&s pop_list = C B M P
```

```
&do p &list %pop_list%

  &data arc info
  ARC
  SEL BGL%site%.PAT
  RESELECT LAND/WATER = 'L'
  CALC AGE1%p% = P1301%p%
  CALC AGE1-5%p% = P1302%p% + P1303%p% + P1304%p%
  CALC AGE6-11%p% = P1305%p% + P1306%p% + P1307%p%
  CALC AGE12-19%p% = P1308%p% + P1309%p% + P1310%p% + P1311%p% +
P1312%p% + P1313%p% + P1314%p%
  CALC AGE20-%p% = P1315%p% + P1316%p% + P1317%p% + P1318%p% +
P1319%p% + P1320%p% + P1321%p% + P1322%p% ~
      + P1323%p% + P1324%p% + P1325%p% + P1326%p% + P1327%p% +
P1328%p% + P1329%p% + P1330%p% + P1331%p%
  Q STOP
  &end

&end

&return  /* end of routine

/*  ROUTINE
add_wmu*************************************************************
&routine add_wmu

&s dolist = bl bgl
&do x &list %dolist%

  &if [exists %x%temp2 -cover] &then kill %x%temp2 all
  identity %x%%site% %wmu_path%/wmu%site%%wmu_name% %x%temp2 poly
.1 join
  dropitem %x%temp2.pat %x%temp2.pat
  %x%%site%#
  %x%%site%-id
  end
  kill %x%%site% all
  rename %x%temp2 %x%%site%

&end

&return  /* end of routine

/*  ROUTINE
wrap_up*************************************************************
&routine wrap_up
```

```
/* convert the labelpoints to a point cover, project it to UTM and add the coords to the
pat

&if [exists bl_points -cover] &then kill bl_points all
&if [exists bl_points_utm -cover] &then kill bl_points_utm all
&if [exists bl_pnts_tmp -cover] &then kill bl_pnts_tmp all

centroidlabels bl%site% inside
ae
ec bl%site% label
sel lw = 99
nsel
put bl_points
q

&data arc info
ARC
SEL BGL%site%.PAT
ALTER P0010001,TOTAL_BG_POP,,,,,,,
Q STOP
&end


/* add wells and rec fisher to receptor points

identity bl_points bgl%site% bl_pnts_tmp point
kill bl_points all
dropitem bl_pnts_tmp.pat bl_pnts_tmp.pat
bl_points#
bl_points-id
end
rename bl_pnts_tmp bl_points

/* add wshd ids to points

identity bl_points %outpath%/v2_%site% bl_pnts_tmp point
kill bl_points all
dropitem bl_pnts_tmp.pat bl_pnts_tmp.pat
bl_points#
bl_points-id
end
rename bl_pnts_tmp bl_points

/* add local wshd ids to points

display 0
```

```
arcplot
clearselect %wmu_path%/cir%site%%wmu_name% poly
resel %outpath%/v2_%site% poly overlap %wmu_path%/cir%site%%wmu_name%
poly
&sv lwses = [listunique %outpath%/v2_%site% -poly wshd_num]
q

&s good_lwses

&do ws_num &list %lwses%
&if [exists %outpath%/%wmu_name%%ws_num% -cover] &then &do

  &if ^ [iteminfo %outpath%/%wmu_name%%ws_num% -poly local_area -exists]
&then
    additem %outpath%/info!arc!%wmu_name%%ws_num%.pat
%outpath%/info!arc!%wmu_name%%ws_num%.pat local_area 4 12 f 3 local_num
    &wo %outpath%
    &data arc info
    ARC
      SEL [translate %wmu_name%%ws_num%.pat]
      CALC LOCAL_AREA = AREA
      Q STOP
    &end
    &wo %work-dir%
  &if ^ [iteminfo %outpath%/%wmu_name%%ws_num% -poly wshd_num -exists]
&then &do
    additem %outpath%/info!arc!%wmu_name%%ws_num%.pat
%outpath%/info!arc!%wmu_name%%ws_num%.pat wshd_num 3 3 i
    &wo %outpath%
    &data arc info
    ARC
      SEL [translate %wmu_name%%ws_num%.pat]
      CALC WSHD_NUM = %ws_num%
      Q STOP
    &end
    &wo %work-dir%
  &end
  &s good_lwses = %good_lwses% %ws_num%
&end
&end

&if [exists alllws -cover] &then kill alllws all
 mapjoin alllws
 &do j &list %good_lwses%
   %outpath%/%wmu_name%%j%
 &end
```

```
  end

identity bl_points alllws bl_pnts_tmp point
kill bl_points all
dropitem bl_pnts_tmp.pat bl_pnts_tmp.pat
bl_points#
bl_points-id
end
rename bl_pnts_tmp bl_points

&if [exists bl_points.frq -info] &then
&s d [delete bl_points.frq -info]

frequency BL_POINTS.PAT bl_points.frq
STCNTRBG
end
BL0010001B
end

&data arc info
ARC
SEL BL_POINTS.PAT
CALC BR_INDEX = BL_POINTS-ID
MOVEIT [quote %ring% ] TO RING_SCEN
CALC AGE1 = BL0110001B
CALC AGE1-5 = BL0110002B + BL0110003B + BL0110004B
CALC AGE6-11 = BL0110005B + BL0110006B + BL0110007B
CALC AGE12-19 = BL0110008B + BL0110009B + BL0110010B + BL0110011B +
BL0110012B + BL0110013B + BL0110014B
CALC AGE20- = BL0110015B + BL0110016B + BL0110017B + BL0110018B +
BL0110019B
CALC AGE20- = AGE20- + BL0110020B + BL0110021B + BL0110022B +
BL0110023B
CALC AGE20- = AGE20- + BL0110024B + BL0110025B + BL0110026B +
BL0110027B
CALC AGE20- = AGE20- + BL0110028B + BL0110029B + BL0110030B +
BL0110031B
RELATE BL_POINTS.FRQ 1 by STCNTRBG
RESEL BL0010001B GT 0
CALC HOME_GARD = BL0010001B * .38
CALC GARD_FISHER = HOME_GARD * REC_FISHER
CALC REC_FISHER = ( BL0010001B - HOME_GARD ) * REC_FISHER
CALC HOME_GARD = HOME_GARD - GARD_FISHER
CALC RESIDENTS = BL0010001B - ( ( HOME_GARD + GARD_FISHER +
REC_FISHER ) )
RESEL LUCODE = 21
```

```
CALC RESIDENTS = RESIDENTS - ( ( BEEF_FARMER + BEEF_FISHER +
DAIRY_FARMER + DAIRY_FISHER ) * ( BL0010001B / $1BL0010001B ) )
Q STOP
&end

  /*Help to check calcs for residents
/*   cursor temp1 declare BL_POINTS.PAT info ro bl-id = '482339509  553A'
/*   cursor temp1 open
/*   &do &while %:temp1.AML$NEXT%
/*     &sys echo HOME_GARD %:temp1.HOME_GARD%
/*     &sys echo REC_FISHER %:temp1.REC_FISHER%
/*     &sys echo GARD_FISHER %:temp1.GARD_FISHER%
/*     &sys echo BEEF_FARMER %:temp1.BEEF_FARMER%
/*     &sys echo BEEF_FISHER %:temp1.BEEF_FISHER%
/*     &sys echo DAIRY_FARMER %:temp1.DAIRY_FARMER%
/*     &sys echo DAIRY_FISHER %:temp1.DAIRY_FISHER%
/*     &sys echo BL0010001B %:temp1.BL0010001B%
/*     &sys echo P0010001 %:temp1.P0010001%
/*     &sys echo TOTAL_BG_POP %:temp1.TOTAL_BG_POP%
/*     &sys echo RESIDENTS %:temp1.RESIDENTS%
/*     cursor temp1 next
/*   &end
/*   cursor temp1 remove

/* convert to utm coords

project cover bl_points bl_points_utm
/data1/base/prj_files/albers83-utm%utmz%_83.prj
addxy bl_points_utm
kill bl_points all

&if [exists %cenpath%/p1%ring%%wmu_name%.pop -info] &then &s d [delete
%cenpath%/p1%ring%%wmu_name%.pop -info]

pullitems bl_points_utm.pat %cenpath%/p1%ring%%wmu_name%.pop
BR_INDEX
P_AREA
SITE-ID
WMU_SETTING
RING_SCEN
RING_ID
BL-ID
UTM_ZONE
X-COORD
Y-COORD
WELL_RAT
```

```
RESIDENTS
REC_FISHER
GARD_FISHER
HOME_GARD
WSHD_NUM
LOCAL_NUM
AGE1
AGE1-5
AGE6-11
AGE12-19
AGE20-
BL0010001B
BL0020001B
BL0030001B
BL0040001B
BL0040002B
BL0040003B
BL0040004B
BL0050001B
BL0050002B
BL0060001B
BL0060002B
BL0060003B
BL0060004B
BL0060005B
&do t &list %alllist%
BL01100%t%B
&end
end

kill bl_points_utm all

/* redo index nums so there aren't any missing places **************************
&wo %cenpath%

/* clean up point with no humans or watersheds
&data arc info
ARC
SEL [translate p1%ring%%wmu_name%.pop]
RESEL WSHD_NUM = 0
PURGE
Y
SEL [translate p1%ring%%wmu_name%.pop]
RESEL BL0010001B = 0
PURGE
Y
```

```
Q STOP
&end

&s i_cnt = 1

cursor id1 declare p1%ring%%wmu_name%.pop info rw
cursor id1 open
&do &while %:id1.AML$NEXT%
  &s :id1.br_index = %i_cnt%
  &s :id1.utm_zone = %utmz%
  &s i_cnt = %i_cnt% + 1
  cursor id1 next
&end
cursor id1 remove

&wo %work-dir%

/* &data arc info
/* ARC
/* SEL P1%site%.POP
/* RESEL $RECNO = 1
/* PURGE
/* Y
/* Q STOP
/* &end

/*********************************************************************
*************
/* add bgl numbers to farm polys

/* &call trim_bgl
echo %i%
&do i = 1 &to %iteration%
&if [exists %cenpath%/frmbl%wmu_name%%i% -cover] &then kill
%cenpath%/frmbl%wmu_name%%i% all

&if [exists %cenpath%/farm%wmu_name%%i% -cover] &then &do
identity %cenpath%/farm%wmu_name%%i% bgl%site%
%cenpath%/frmbl%wmu_name%%i%

/* process farm data

&wo %cenpath%

&if [exists frmbl%wmu_name%%i%.pop -info] &then &s d
[frmbl%wmu_name%%i%.pop -info]
```

```
pullitems frmbl%wmu_name%%i%.pat frmbl%wmu_name%%i%.pop
AREA
id_num
wmu
iteration
farmindex
farmarea
SITE-ID
WMU_SETTING
BG-ID
imp_reach_idx
P0010001B
P0060001B
P0060002B
P0060003B
P0060004B
P0780009B
H0010001B
H0050003B
well_rat
TOT_FARM
BEEF_FARMER
DAIRY_FARMER
BEEF_FISHER
DAIRY_FISHER
AGE1
AGE1-5
AGE6-11
AGE12-19
AGE20-
AGE1F
AGE1-5F
AGE6-11F
AGE12-19F
AGE20-F
/* AGE1C
/* AGE1-5C
/* AGE6-11C
/* AGE12-19C
/* AGE20-C
AGE1B
AGE1-5B
AGE6-11B
AGE12-19B
AGE20-B
AGE1M
```

```
AGE1-5M
AGE6-11M
AGE12-19M
AGE20-M
/* AGE1P
/* AGE1-5P
/* AGE6-11P
/* AGE12-19P
/* AGE20-P
/* AG39
/* AG40
/* AG41
AG42 /* NUM BEEF COWS
/* AG43
AG44 /* NUM DAIRY COWS
/* AG45
/* AG46
/* PROD_FARM
AG41 /* NUM BEEF FARMS - OLD WAY
AG43 /* NUM DAIRY FARMS - OLD WAY
AG20084 /* NUM BEEF FARMS
AG20085 /* NUM DAIRY FARMS
LAND/WATER
end

&data arc info
ARC
SEL [translate frmbl%wmu_name%%i%.pop]
RESEL LAND/WATER = 'W'
PURGE
Y
SEL [translate frmbl%wmu_name%%i%.pop]
RESEL AREA LT 0
PURGE
Y
Q STOP
&end

dropitem frmbl%wmu_name%%i%.pop frmbl%wmu_name%%i%.pop
LAND/WATER

&end

&wo %work-dir%
&end
```

```
&call output

&return  /* end of routine

/*  ROUTINE
output*************************************************************
&routine output

&if [exists %cenpath%/p1%ring%%site%%wmu_name% -cover] &then kill
%cenpath%/p1%ring%%site%%wmu_name% all
&if [exists p1%ring%%site%%wmu_name% -cover] &then kill
p1%ring%%site%%wmu_name% all

rename bl%site% p1%ring%%site%%wmu_name%

copy p1%ring%%site%%wmu_name%
%cenpath%/p1%ring%%site%%wmu_name%

&if [exists p1%ring%%site%%wmu_name% -cover] &then
kill p1%ring%%site%%wmu_name% all
&if [exists p2%ring%%site%%wmu_name% -cover] &then
kill p2%ring%%site%%wmu_name% all

/* output rings******************

&if [exists %cenpath%/r%ring%%site%%wmu_name% -cover] &then kill
%cenpath%/r%ring%%site%%wmu_name% all
copy rng%site% %cenpath%/r%ring%%site%%wmu_name%
kill rng%site% all

&return  /* end of routine

/*  ROUTINE
clean*************************************************************
&routine clean

&if [exists bg%site% -cover] &then kill bg%site% all
&if [exists bgl%site% -cover] &then kill bgl%site% all
&if [exists bl%site% -cover] &then kill bl%site% all
&if [exists lu%site% -cover] &then kill lu%site% all
&if [exists bg_mrg -cover] &then kill bg_mrg all
&if [exists bl_mrg -cover] &then kill bl_mrg all
&if [exists bg_lu -cover] &then kill bg_lu all
&if [exists cen_tmp -cover] &then kill cen_tmp all
&if [exists rng%site% -cover] &then kill rng%site% all
&if [exists cnty_temp.sum -info] &then &s d [delete  cnty_temp.sum -info]
```

```
&if [exists farm_utm -cover] &then kill farm_utm all
&if [exists farm_temp -cover] &then kill farm_temp all
&if [exists farm_rng -cover] &then kill farm_rng all
&if [exists farm_lws -cover] &then kill farm_lws all
&if [exists alllws -cover] &then kill alllws all
&if [exists farm_ws -cover] &then kill farm_ws all
&if [exists farm_pts -cover] &then kill farm_pts all
&if [exists farm_pts_utm -cover] &then kill farm_pts_utm all
  &s d [delete farm_grd.dat -info]
&if [exists big_aoi -cover] &then kill big_aoi all
&if [exists bl_points.frq -info] &then
  &s d [delete bl_points.frq -info]
&sys rm xx*

&return  /* end of routine

/*  ROUTINE
sum_farm*************************************************************
&routine sum_farm

&do fip &list %fips_list%

  &if ^ [exists %cntypath%/bg9%fip% -cover] &then &do
    &s message = There was a problem with site %site% in hwir_pop. Youre missing
%cntypath%/bg9%fip%
    &sys echo "missing the bg cover for county %fip%. re-do site %site%"
    &call alert

  &if [exists cnty_temp.sum -info] &then &s d [delete cnty_temp.sum -info]

  statistics %cntypath%/bg9%fip%.pat cnty_temp.sum LAND/WATER
  sum H0050003
  end

  &s st [substr %fip% 1 2]
  &s cny [substr %fip% 3 3]

  &data arc info
  ARC
  SELECT AG_CENSUS.DAT
  RESELECT ST = [QUOTE %st%] AND COU = [QUOTE %cny%]
  RELATE CNTY_TEMP.SUM 1 BY LAND/WATER
  CALC T_HU_FARM = $1SUM-H0050003
  Q STOP
  &end
```

```
  &data arc info
  ARC
  SELECT AG_CENSUS.DAT
  RESELECT T_HU_FARM GT 0
  CALC R_TOTFARM = AG010001 / T_HU_FARM
  Q STOP
  &end

  &if [exists cnty_temp.sum -info] &then &s d [delete  cnty_temp.sum -info]
&end

&return  /* end of routine

/*  ROUTINE
rings*************************************************************
&routine rings

&if [exists rng%site% -cover] &then
  kill rng%site% all
&if [exists rng%site%c -cover] &then
  kill rng%site%c all

&s area = %type_val%
&s x_cen = %:pop1.x-coord%
&s y_cen = %:pop1.y-coord%

/* get into arcedit
display 9
arcedit

/* find the side of the wmu based on area
&s hside = [sqrt %area%] / 2
&s corner = %hside% * [sqrt 2]

&if %ring% = 'a' &then
        &s ring_list = 100 200 300 500 750 1000 1500 2000

&if %ring% = 'b' &then
        &s ring_list = 500 1000 2000

&if %ring% = 'c' &then
        &s ring_list = 250 500 1000 2000

createcover rng%site% /files10/hwir/p6720-06a/amllib/system/template
ef arc
```

```
/* generate dce or circle
coord keyboard
arctype circle
add
  &do rings &list %ring_list%
  2,%x_cen%,%y_cen%
  2,%x_cen%,[calc %y_cen% + %corner% + %rings%]
  &end
  9

/* save the new coverage and quit ae
save
quit

/* clean the coverage
clean rng%site% rng%site%c 0 .1

/* create labels
createlabels rng%site%c 0
build rng%site%c

/* clean up
kill rng%site% all
rename rng%site%c rng%site%
additem rng%site%.pat rng%site%.pat ring_id 1 1 I

&s counter = 0
ae
ec rng%site% poly

&do rings &list %ring_list%
&s counter = %counter% + 1
sel
%x_cen%,[calc %y_cen% + %corner% + %rings% - 50]
calc ring_id = %counter%
&end

save
quit

&return  /* end of routine

/*  ROUTINE
alert*************************************************************
&routine alert
```

```
&sys touch test_mail
&sys echo "mailx gtc << EOF" >> test_mail
&sys echo %message% >> test_mail
&sys echo "EOF" >> test_mail

chmod +x test_mail
&if [exists /rti/gtc/bin/test_mail -file] &then rm /rti/gtc/bin/test_mail
mv test_mail /rti/gtc/bin/test_mail

test_mail

&return  /* end of routine

/*  ROUTINE
get_utm*************************************************************
&routine get_utm

display 0
arcplot
clearselect %utm_zones% poly
clearselect %sitecov% point
resel %sitecov% points id_num = [quote %site%]
resel %utm_zones% poly overlap %sitecov% point
&s utmz = [show select %utm_zones% poly 1 item utm_zone]
q

&return  /* end of routine
```

Appendix 9B. GIS Arc Macro Language (AML) Program for Placing Farms

```
/*==========================================================
========
/*                RESEARCH TRIANGLE INSTITUTE
/*                   CEMQA - GIS Program
/*                     P.O. Box 12194
/*            Research Triangle Park, NC  27709-2194
/*==========================================================
========
/*
/*     PROGRAM: place_farms.aml
/*
&echo &on

&args fsite fwmu_name fi fx fy

&severity &warning &ignore
&severity &error &routine errorhandler

&sv ws_org = [show workspace]
&s work-dir = /files8/hwir/census/pop
&wo %work-dir%

&s cenpath /files8/hwir/census_storage/c%fsite%
&s wmu_path /files10/hwir/p6720-06a/data/sectors  /* path of wmu covers
&s aoi_path /files10/hwir/p6720-06a/data/aoi  /* path of aoi covers

&call place_farm

&return

/*****************************************************************
**********
/*  ROUTINE
errorhandler*****************************************************
&routine errorhandler

&severity &error &ignore
&severity &warning &ignore
&mess &on
&wo %ws_org%
cursor frm1 remove
cursor frm2 remove
cursor frm3 remove
cursor tmp remove
```

```
&sys echo An error has occured on site %fsite%
&return &error An error has occurred in place_farms.aml. \~
Last Error: %AML$MESSAGE%\~
Thread: %AML$ERRORTHREAD%\~
File: %AML$ERRORFILE%\~
Line: %AML$ERRORLINE%

/*****************************************************************
**********
/*****************************************************************
**********
/*****************************************************************
**********
/*  ROUTINE
place_farm*********************************************************
&routine place_farm

&sys touch test.txt

/* test for land application unit - add wmu if not lau
&if %fwmu_name% <> 'lau' &then &do
  &if [exists bgl_tmp -cover] &then kill bgl_tmp all
  erase bgl%fsite% %wmu_path%/wmu%fsite%%fwmu_name% bgl_tmp poly .1
  &end
&else &do
  &if [exists bgl_tmp -cover] &then kill bgl_tmp all
  copy bgl%fsite% bgl_tmp
  &end


&call make_points

/******************************remove later
&do j = 1 &to 40
&if [exists frm%j% -cover] &then
kill frm%j% all
&end

/* make the farms here
&if [exists %cenpath%/farm%fwmu_name%%fi% -cover] &then
kill %cenpath%/farm%fwmu_name%%fi% all

&if [exists bg_frq.dat -info] &then &s [delete bg_frq.dat -info]
frequency bgl_tmp.pat bg_frq.dat
stcntrbg
end
```

```
end

&s index = 0
&s farms_exist = .false.

cursor frm1 declare bg_frq.dat info ro
cursor frm1 open
&do &while %:frm1.AML$NEXT%

  &s tmp = %:frm1.stcntrbg%
  &if ^ [null %tmp%] &then &do
    &sys echo %tmp%
    &s sta = [substr [extract 1 %tmp%] 1 2]
    &s cnt = [substr [extract 1 %tmp%] 3 3]

    cursor frm2 declare us_size_ct.dat info ro st = [quote %sta%] and cou = [quote
%cnt%]
    cursor frm2 open
      &s med = %:frm2.median%
    cursor frm2 remove

    cursor frm3 declare ag_census.dat info ro st = [quote %sta%] and cou = [quote
%cnt%]
    cursor frm3 open
      &s beef_farms = %:frm3.AG020084%
      &s dairy_farms = %:frm3.AG020085%
    cursor frm3 remove

    &if %beef_farms% > 0 or %dairy_farms% > 0 &then &do

      /* figure radius from median acreage (meters)
      &s r = %med% * 43560
      &s r = %r% / 10.76391
      &s aream = %r%
      &s r = %r% / 3.1415927
      &s r = [sqrt %r%]
      &ty %r%

      ap
      clearsel bgl_tmp poly
      resel bgl_tmp poly area > [calc %aream% / 2]
      resel bgl_tmp poly stcntrbg = [quote %tmp%]
      resel bgl_tmp poly lucode = 21
      resel bgl_tmp poly land/water = 'L'
      resel bgl_tmp poly h0050003 > 0
```

```
&s selected = [before [show select bgl_tmp poly] ,]

&if %selected% > 1 &then
  resel bgl_tmp poly random 1

&if %selected% < 1 &then &do
  clearsel bgl_tmp poly
  resel bgl_tmp poly area > 50000
  resel bgl_tmp poly stcntrbg = [quote %tmp%]
  resel bgl_tmp poly lucode = 21
  resel bgl_tmp poly land/water = 'L'
  resel bgl_tmp poly h0050003 > 0

  &s selected = [before [show select bgl_tmp poly] ,]

  &if %selected% > 1 &then
    resel bgl_tmp poly random 1
&end

&if %selected% < 1 &then &do
  clearsel bgl_tmp poly
  resel bgl_tmp poly stcntrbg = [quote %tmp%]
  resel bgl_tmp poly lucode = 21
  resel bgl_tmp poly land/water = 'L'
  resel bgl_tmp poly h0050003 > 0

  &s selected = [before [show select bgl_tmp poly] ,]
  &if %selected% > 1 &then
    resel bgl_tmp poly random 1

  &s selected = [before [show select bgl_tmp poly] ,]

&end

writesel farm.sel
q
&if [exists farm_tmp -cover] &then kill farm_tmp all
&if %selected% > 0 &then &do
  reselect bgl_tmp farm_tmp poly farm.sel
  &s index = %index% + 1
  &s farms_exist = .true.
&end
/* &else &s farms_exist = .false.

&if [exists farm_tmp.pat -info] &then &do
  cursor frm2 declare farm_tmp.pat info ro $recno = 2
```

```
cursor frm2 open
  &s farea = %:frm2.area%
cursor frm2 remove

/* test for smaller
&if %farea% < %aream% &then &do
   copy farm_tmp frm%index%
   &sys echo created frm%index% >> test.txt
&end

&else &do
   ap
   clearsel tmp_pts point
   resel tmp_pts point overlap farm_tmp poly
   resel tmp_pts point random 1
   writesel farmpt.sel
   q
   &if [exists farm_pt -cover] &then kill farm_pt all
   reselect tmp_pts farm_pt point farmpt.sel

   ap
   clearsel farm_tmp poly
   resel farm_tmp poly overlap tmp_pts point
   writesel onefarm.sel
   q
   &if [exists farm_tmp2 -cover] &then kill farm_tmp2 all
   reselect farm_tmp farm_tmp2 poly onefarm.sel
   kill farm_tmp all
   rename farm_tmp2 farm_tmp

   &s right_size = .false.
   &s tmp_r = %r%

   &do &until %right_size%

      &if [exists farm_pt_buf -cover] &then kill farm_pt_buf all
      &if [exists farm_pt_buf2 -cover] &then kill farm_pt_buf2 all
      buffer farm_pt farm_pt_buf # # %tmp_r% .1 point
      build farm_pt_buf
      clip farm_pt_buf farm_tmp farm_pt_buf2
      cursor frm2 declare farm_pt_buf2.pat info ro $recno = 2
      cursor frm2 open
         &s buf_area = %:frm2.area%
      cursor frm2 remove
      &if [calc %buf_area% + 100] > %aream% &then
         &s right_size = .true.
```

```
            &s tmp_r = %tmp_r% + 10
          &end
          copy farm_pt_buf2 frm%index%
          &sys echo created frm%index% >> test.txt
        &end
      &end
    &end /* check for beef and dairy exist
  &end /* bg not null
  cursor frm1 next
&end /* do loop
cursor frm1 remove

/* put all farm polys into 1 file

lc
&listlocal

&if [exists farm%fwmu_name%%fi% -cover] &then kill farm%fwmu_name%%fi%
all

/* combine all the farms into 1 coverage
&s it_exists = .false.

&if %index% > 0 &then &do
  &if %index% = 1 &then
    copy frm1 farm%fwmu_name%%fi%
  &else &do
    &do j = 1 &to %index%
      &if [exists frm%j% -cover] &then &do
        &if %j% = 1 &then
          copy frm1 farm%fwmu_name%%fi%
        &else &do
         ae
         &if [exists farm%fwmu_name%%fi% -cover] &then
           &s it_exists = .true.
         ec frm%j% poly
         sel all
         put farm%fwmu_name%%fi%
         &if %it_exists% &then
         y
         quit
        &end
      &end
    &end
  &end /* 236
&end /* 233
```

```
&if %farms_exist% &then &do
  clean farm%fwmu_name%%fi%
  &call attribute_farm
&end

/* clean
&do j = 1 &to 20
&if [exists frm%j% -cover] &then
kill frm%j% all
&end

&if [exists farm_pt -cover] &then kill farm_pt all
&if [exists farm_pt_buf -cover] &then kill farm_pt_buf all
&if [exists farm_pt_buf2 -cover] &then kill farm_pt_buf2 all
&if [exists bgl_tmp -cover] &then kill bgl_tmp all
&if [exists farm_tmp -cover] &then kill farm_tmp all
&if [exists farm_tmp2 -cover] &then kill farm_tmp2 all
&if [exists tmp_pts -cover] &then kill tmp_pts all

&return  /* end of routine

/*  ROUTINE
attribute_farm*********************************************************
&routine attribute_farm

&if ^ [iteminfo farm%fwmu_name%%fi% -poly farmindex -exists] &then &do

  additem farm%fwmu_name%%fi%.pat farm%fwmu_name%%fi%.pat farmindex 3
3 i
  additem farm%fwmu_name%%fi%.pat farm%fwmu_name%%fi%.pat farmarea 4
12 f 3
  additem farm%fwmu_name%%fi%.pat farm%fwmu_name%%fi%.pat iteration 3 3
i
  additem farm%fwmu_name%%fi%.pat farm%fwmu_name%%fi%.pat id_num 7 7
c
  additem farm%fwmu_name%%fi%.pat farm%fwmu_name%%fi%.pat wmu 3 3 c
  additem farm%fwmu_name%%fi%.pat farm%fwmu_name%%fi%.pat utm_zone 3
3 i
  additem farm%fwmu_name%%fi%.pat farm%fwmu_name%%fi%.pat
imp_reach_idx 4 4 I
  additem farm%fwmu_name%%fi%.pat farm%fwmu_name%%fi%.pat ratio 4 12 f 4

/*  &data arc info
/*  ARC
/*     SEL [translate farm%fwmu_name%%fi%.pat]
/*     CALC RATIO = AREA / PERIMETER
```

```
/*     RESEL AREA LT 0
/*     PURGE
/*     Y
/*     SEL [translate farm%fwmu_name%%fi%.pat]
/*     CALC FARMAREA = AREA
/*     CALC ITERATION = %fi%
/*     MOVEIT [quote %fsite%] TO ID_NUM
/*     MOVEIT [quote %fwmu_name%] TO WMU
/*     Q STOP
/*   &end

  &s i_cnt = 1
  cursor tmp declare farm%fwmu_name%%fi% poly rw area > 0
  cursor tmp open
  &do &while %:tmp.AML$NEXT%
    &s :tmp.ratio = %:tmp.area% / ( %:tmp.perimeter% / 4 ) ** 2
    &if %:tmp.area% > 20000 &then &do /* ( ^ ( %:tmp.ratio% < .4 and
%:tmp.area% < 40000 ) ) or ( %:tmp.area% > 20000 )
      &s :tmp.farmindex = %i_cnt%
      &s i_cnt = %i_cnt% + 1
    &end
    cursor tmp next
  &end
  cursor tmp remove

  ap
  clearsel farm%fwmu_name%%fi%  poly
  resel farm%fwmu_name%%fi%  poly farmindex < 1 and area > 0
  &s selected = [before [show select farm%fwmu_name%%fi%  poly] ,]
  clearsel farm%fwmu_name%%fi%  poly
  resel farm%fwmu_name%%fi%  poly farmindex > 0
  &s pselected = [before [show select farm%fwmu_name%%fi%  poly] ,]
  q

  ae
  display 0
  ec farm%fwmu_name%%fi% poly
  sel farmindex > 0
  nsel
  &if %selected% > 0 &then
    delete
  sel all
  &if %pselected% > 0 &then &do
    calc farmarea = area
    calc iteration = %fi%
    moveit [quote %fsite%] to id_num
```

```
    moveit [quote %fwmu_name%] to wmu
  &end
  save
  q

&end

&if %pselected% > 0 &then
copy farm%fwmu_name%%fi% %cenpath%/farm%fwmu_name%%fi%

&return  /* end of routine


/*  ROUTINE
make_points*********************************************************
&routine make_points

  &if [exists tmp_pts -cover] &then kill tmp_pts all

  ae
  display 0
  ec /files10/hwir/p6720-06a/data/supergrid/grd_at00 labels
  coo key
  sel all
  put tmp_pts
  ec tmp_pts labels
  sel all
  move
  1,0,0
  1,%fx%,%fy%
  save
  q

  build tmp_pts point

&return  /* end of routine
```

Appendix 9C. GIS Arc Macro Language (AML) Program for Calculating Median Farm Size

```
/*==========================================================
========
/*                RESEARCH TRIANGLE INSTITUTE
/*                   CEMQA - GIS Program
/*                     P.O. Box 12194
/*            Research Triangle Park, NC  27709-2194
/*==========================================================
========
/*
/*     PROGRAM: make_median.aml
/*
/*     PURPOSE: calculates the median from irregularly grouped farm size
/*              catagories for each county in the ag census.
/*
/*    INFO FILES NEEDED TO RUN:
/*              us_size_ct.dat
/*              FARM_SIZE_ITEMS.DAT
/*
/*    ROUTINES:
/*
/*   CALLED BY:
/*
/*    CALLS TO:
/*
/* GLOBAL VAR'S:
/*
/*  INPUT FILES:
/*
/* OUTPUT FILES: us_size_ct.dat
/*
/*       NOTES:
/*
/*     HISTORY: written by G. Conrad  10-25-98
/*
/*     CONTACT: gtc@rti.org
/*
/*     PROJECT: HWIR
/*

/*==========================================================
===============

&echo &on
```

```
/* &args site

&sv ws_org = [show workspace]

&severity &warning &ignore
&severity &error &routine errorhandler

&sys touch errors_med.txt

cursor pnt1 declare us_size_ct.dat info rw /* fips = [quote %site%]
cursor pnt1 open
&do &while %:pnt1.AML$NEXT%

  &s g = %:pnt1.P010001% / 2
  &s cum_freq = 0.0
  cursor pnt2 declare FARM_SIZE_ITEMS.DAT info ro
  cursor pnt2 open
  &s count = 1
  &do &while %:pnt2.AML$NEXT%
    &sys echo [value :pnt1.[value :pnt2.ag_item]]
    &s cum_freq = %cum_freq% + [value :pnt1.[value :pnt2.ag_item]]
    &s tmp = %cum_freq% - %g% /*
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
    &if %cum_freq% gt %g% and %:pnt2.lower% gt 1 &then
    &do
        &s low = %:pnt2.lower%
        &s up = %:pnt2.upper%
        &s intv = %:pnt2.interval%
        &s prev = %cum_freq% - [value :pnt1.[value :pnt2.ag_item]]
        &s g = %g% - %prev%
        &s f = [value :pnt1.[value :pnt2.ag_item]]
      &if %f% gt 0 &then
        &s :pnt1.median =  %low% + ( ( %g% * %intv% ) / %f% )
        &else &sys echo Problem with %:pnt1.st% %:pnt1.cou% >> errors_med.txt
      cursor pnt2 12
      cursor pnt2 next
   &end
   &else cursor pnt2 next
   &s count = %count% + 1
  &end
  cursor pnt2 remove
  cursor pnt1 next
&end
cursor pnt1 remove
&wo %ws_org%
```

```
/*alert_me
&return /* main


ITEMS in us_size_ct.dat
/* 60001  Farms, (number)
/* 60002  Land in farms, (acres)
/* 60003  Average size of farm, (acres)
/* 60020  Size of farm-1 to 9 acres, (farms)
/* 60021  Size of farm-1 to 9 acres, (acres)
/* 60022  Size of farm-10 to 49 acres, (farms)
/* 60023  Size of farm-10 to 49 acres, (acres)
/* 60024  Size of farm-50 to 69 acres, (farms)
/* 60025  Size of farm-50 to 69 acres, (acres)
/* 60026  Size of farm-70 to 99 acres, (farms)
/* 60027  Size of farm-70 to 99 acres, (acres)
/* 60028  Size of farm-100 to 139 acres, (farms)
/* 60029  Size of farm-100 to 139 acres, (acres)
/* 60030  Size of farm-140 to 179 acres, (farms)
/* 60031  Size of farm-140 to 179 acres, (acres)
/* 60032  Size of farm-180 to 219 acres, (farms)
/* 60033  Size of farm-180 to 219 acres, (acres)
/* 60034  Size of farm-220 to 259 acres, (farms)
/* 60035  Size of farm-220 to 259 acres, (acres)
/* 60036  Size of farm-260 to 499 acres, (farms)
/* 60037  Size of farm-260 to 499 acres, (acres)
/* 60038  Size of farm-500 to 999 acres, (farms)
/* 60039  Size of farm-500 to 999 acres, (acres)
/* 60040  Size of farm-1,000 to 1,999 ac,(farms)
/* 60041  Size of farm-1,000 to 1,999 ac,(acres)
/* 60042  Size of farm-2,000 ac or more, (farms)
/* 60043  Size of farm-2,000 ac or more, (acres)


/* FARM_SIZE_ITEMS.DAT
/* Ag_item     Lower  Upper  Interval
/* P060020     1      9      9
/* P060022     10     49     39
/* P060024     50     69     19
/* P060026     70     99     29
/* P060028     100    139    39
/* P060030     140    179    39
/* P060032     180    219    39
/* P060034     220    259    39
/* P060036     260    499    239
/* P060038     500    999    499
```

```
/* P060040     1000    1999    999
/* P060042     2000    2999    999


/*==========================================================
==============
/*                  END   OF   PROGRAM
/*==========================================================
==============

/*  ROUTINE errorhandler*************************************
&routine errorhandler

&severity &error &ignore
&severity &warning &ignore
&mess &on
&wo %ws_org%
cursor pnt1 remove
cursor pnt2 remove
&return &error An error has occurred in make_median.aml. \~
Last Error: %AML$MESSAGE%\~
Thread: %AML$ERRORTHREAD%\~
File: %AML$ERRORFILE%\~
Line: %AML$ERRORLINE%
```

Appendix 9D. Human Receptor Data for HWIR: 201 Sites and 419 Settings

SiteID	Setting_ID	Number of Human Receptor Points	Total Human Receptor Population	Number of Beef and Dairy Farms	Total Beef and Dairy Farm Population
114001	WP0114001	320	15,295	0	
130207	WP0130207	134	3,232	5	0.87
131104	SI0131104	226	7,065	2	0.86
131104	AT0131104	226	7,065	2	0.86
131207	SI0131207	139	7,188	0	
131207	AT0131207	139	7,188	0	
131508	LF0131508	280	11,453	0	
131508	WP0131508	195	7,378	0	
131508	SI0131508	210	7,851	0	
131508	AT0131508	210	7,851	0	
136703	LA0136703	128	1,346	2	2.26
136703	SI0136703	94	864	2	2.06
136703	AT0136703	94	864	2	2.06
220102	WP0220102	122	9,010	0	
221207	WP0221207	345	13,692	2	0.13
223504	LF0223504	186	6,088	1	2.49
223504	WP0223504	203	6,493	1	2.79
223504	LA0223504	201	6,432	1	2.74
224002	WP0224002	164	6,020	0	
231002	LF0231002	101	1,957	3	2.07
231106	LF0231106	221	7,691	0	
231407	LF0231407	30	308	2	4.37
231610	SI0231610	321	35,125	0	
231610	AT0231610	321	35,125	0	
231911	WP0231911	302	9,236	0	
231914	SI0231914	340	21,982	0	
231914	AT0231914	340	21,982	0	

(continued)

Table 9D. (continued)

SiteID	Setting_ID	Number of Human Receptor Points	Total Human Receptor Population	Number of Beef and Dairy Farms	Total Beef and Dairy Farm Population
232305	WP0232305	20	154	1	1.99
232313	LF0232313	62	859	1	6.40
232313	WP0232313	54	744	1	4.89
232313	SI0232313	54	723	1	4.71
232313	AT0232313	54	723	1	4.71
232402	LF0232402	327	12,868	1	0.14
232402	SI0232402	302	12,036	1	0.06
232402	AT0232402	302	12,036	1	0.06
232415	WP0232415	280	21,342	0	
232415	SI0232415	279	21,313	0	
232415	AT0232415	279	21,313	0	
232501	LF0232501	220	6,340	0	
232501	WP0232501	218	6,260	0	
232705	SI0232705	206	5,937	4	5.34
232705	AT0232705	206	5,937	4	5.34
233601	SI0233601	282	7,513	0	
233601	AT0233601	282	7,513	0	
233603	LF0233603	237	5,081	1	0.34
234904	LF0234904	173	4,086	0	
235301	LF0235301	472	13,525	3	2.54
312301	LA0312301	88	1,614	6	49.73
312301	SI0312301	85	1,518	4	44.45
312301	AT0312301	85	1,518	4	44.45
314202	LF0314202	259	16,715	0	
321802	WP0321802	17	794	0	
321802	SI0321802	16	773	0	
321802	AT0321802	16	773	0	

(continued)

Table 9D. (continued)

SiteID	Setting_ID	Number of Human Receptor Points	Total Human Receptor Population	Number of Beef and Dairy Farms	Total Beef and Dairy Farm Population
331006	SI0331006	123	4,240	3	0.14
331006	AT0331006	123	4,240	3	0.14
331902	WP0331902	26	357	2	0.65
331902	SI0331902	26	364	2	0.43
331902	AT0331902	26	364	2	0.43
332104	WP0332104	71	2,220	0	
332104	LA0332104	117	3,670	0	
332104	SI0332104	75	2,384	0	
332104	AT0332104	75	2,384	0	
332707	LF0332707	48	572	0	
332707	WP0332707	57	809	0	
332811	WP0332811	334	16,011	0	
430108	WP0430108	9	10	2	0.69
430108	SI0430108	9	10	2	0.68
430108	AT0430108	9	10	2	0.68
430412	LF0430412	37	1,061	1	0.82
430412	SI0430412	36	986	1	0.76
430412	AT0430412	36	986	1	0.76
431912	LF0431912	16	13	2	2.71
431912	SI0431912	16	23	2	3.52
431912	AT0431912	16	23	2	3.52
432011	LF0432011	6	59	2	0.60
432106	SI0432106	56	519	3	5.93
432106	AT0432106	56	519	3	5.93
432716	SI0432716	9	8	2	0.27
432716	AT0432716	9	8	2	0.27
433201	LF0433201	14	143	1	0.17

(continued)

Table 9D. (continued)

SiteID	Setting_ID	Number of Human Receptor Points	Total Human Receptor Population	Number of Beef and Dairy Farms	Total Beef and Dairy Farm Population
433201	SI0433201	19	192	2	0.17
433201	AT0433201	19	192	2	0.17
433204	SI0433204	23	468	0	
433204	AT0433204	23	468	0	
433404	LF0433404	50	373	2	7.70
433404	SI0433404	49	384	2	7.86
433404	AT0433404	49	384	2	7.86
433408	SI0433408	102	3,284	0	
433408	AT0433408	102	3,284	0	
434505	SI0434505	178	4,819	2	1.35
434505	AT0434505	178	4,819	2	1.35
434804	SI0434804	37	992	3	0.23
434804	AT0434804	37	992	3	0.23
435510	LA0435510	43	569	2	0.26
435510	SI0435510	48	616	3	0.29
435510	AT0435510	48	616	3	0.29
436007	SI0436007	36	145	2	0.10
436007	AT0436007	36	145	2	0.10
436108	SI0436108	63	1,593	0	
436108	AT0436108	63	1,593	0	
530901	LA0530901	74	1,912	4	0.18
530901	SI0530901	67	1,665	2	0.10
530901	AT0530901	67	1,665	2	0.10
531301	SI0531301	33	412	1	0.03
531301	AT0531301	33	412	1	0.03
531502	SI0531502	165	3,841	3	0.31
531502	AT0531502	165	3,841	3	0.31

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Table 9D. (continued)

SiteID	Setting_ID	Number of Human Receptor Points	Total Human Receptor Population	Number of Beef and Dairy Farms	Total Beef and Dairy Farm Population
531702	LF0531702	87	2,469	0	
531902	SI0531902	5	126	0	
531902	AT0531902	5	126	0	
534504	SI0534504	147	11,159	0	
534504	AT0534504	147	11,159	0	
613402	SI0613402	62	3,912	0	
613402	AT0613402	62	3,912	0	
620401	SI0620401	101	3,099	0	
620401	AT0620401	101	3,099	0	
620604	SI0620604	18	106	0	
620604	AT0620604	18	106	0	
621603	SI0621603	17	1,166	0	
621603	AT0621603	17	1,166	0	
621902	SI0621902	37	625	2	1.13
621902	AT0621902	37	625	2	1.13
622902	SI0622902	32	851	0	
622902	AT0622902	32	851	0	
625002	LF0625002	1	7	0	
625002	SI0625002	1	7	0	
625002	AT0625002	1	7	0	
625501	LA0625501	18	53	1	6.81
631701	LA0631701	5	78	0	
631903	LF0631903	37	599	0	
631903	SI0631903	61	1,165	0	
631903	AT0631903	61	1,165	0	
632003	LF0632003	12	147	2	0.27
632003	SI0632003	13	159	2	0.27

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Table 9D. (continued)

SiteID	Setting_ID	Number of Human Receptor Points	Total Human Receptor Population	Number of Beef and Dairy Farms	Total Beef and Dairy Farm Population
632003	AT0632003	13	159	2	0.27
632606	LF0632606	12	52	1	0.61
632606	SI0632606	13	53	1	0.64
632606	AT0632606	13	53	1	0.64
632608	LF0632608	215	6,403	0	
632608	SI0632608	180	5,372	0	
632608	AT0632608	180	5,372	0	
634001	SI0634001	45	1,052	2	1.17
634001	AT0634001	45	1,052	2	1.17
635301	SI0635301	133	7,527	0	
635301	AT0635301	133	7,527	0	
713618	SI0713618	209	5,856	0	
713618	AT0713618	209	5,856	0	
713705	LF0713705	25	279	0	
713705	SI0713705	25	271	0	
713705	AT0713705	25	271	0	
715007	WP0715007	208	13,385	0	
715216	WP0715216	182	13,225	0	
716701	SI0716701	110	3,289	1	0.12
716701	AT0716701	110	3,289	1	0.12
720506	WP0720506	35	267	1	0.01
720803	LF0720803	147	6,518	1	0.02
720803	LA0720803	138	6,341	1	0.02
720803	SI0720803	131	6,045	1	0.02
720803	AT0720803	131	6,045	1	0.02
721305	WP0721305	266	15,554	0	
722107	WP0722107	54	986	2	0.13

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Table 9D. (continued)

SiteID	Setting_ID	Number of Human Receptor Points	Total Human Receptor Population	Number of Beef and Dairy Farms	Total Beef and Dairy Farm Population
722503	SI0722503	165	5,709	0	
722503	AT0722503	165	5,709	0	
722505	SI0722505	395	22,261	0	
722505	AT0722505	395	22,261	0	
722705	LF0722705	379	23,693	0	
723607	SI0723607	102	934	1	0.02
723607	AT0723607	102	934	1	0.02
724206	WP0724206	41	430	1	3.59
724206	SI0724206	42	441	1	3.68
724206	AT0724206	42	441	1	3.68
724301	WP0724301	92	4,168	1	0.06
724804	WP0724804	307	12,470	3	1.31
724909	WP0724909	177	4,622	0	
730407	LF0730407	19	365	3	0.46
730407	SI0730407	19	344	2	0.27
730407	AT0730407	19	344	2	0.27
730502	WP0730502	361	6,839	3	0.68
730502	SI0730502	362	6,830	3	0.67
730502	AT0730502	362	6,830	3	0.67
730914	LF0730914	36	387	4	8.37
730914	WP0730914	38	387	4	7.94
730914	SI0730914	35	376	4	8.08
730914	AT0730914	35	376	4	8.08
731111	SI0731111	350	9,329	0	
731111	AT0731111	350	9,329	0	
731405	SI0731405	100	2,337	3	3.90
731405	AT0731405	100	2,337	3	3.90

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Table 9D. (continued)

SiteID	Setting_ID	Number of Human Receptor Points	Total Human Receptor Population	Number of Beef and Dairy Farms	Total Beef and Dairy Farm Population
731411	WP0731411	36	153	2	4.67
731412	WP0731412	75	1,943	1	0.05
731412	SI0731412	102	2,457	2	0.09
731412	AT0731412	102	2,457	2	0.09
731501	SI0731501	259	14,092	0	
731501	AT0731501	259	14,092	0	
731507	WP0731507	14	165	2	0.03
731507	SI0731507	19	296	3	0.04
731507	AT0731507	19	296	3	0.04
731514	LF0731514	71	3,024	0	
731514	SI0731514	46	1,855	0	
731514	AT0731514	46	1,855	0	
731703	LF0731703	261	12,461	4	1.03
732110	LF0732110	406	11,978	0	
732405	WP0732405	335	17,883	3	2.25
732510	WP0732510	119	3,550	1	0.23
733203	SI0733203	22	174	2	0.08
733203	AT0733203	22	174	2	0.08
733210	LF0733210	60	235	2	6.46
733210	SI0733210	57	258	2	7.22
733210	AT0733210	57	258	2	7.22
733302	WP0733302	143	6,166	3	3.98
733302	SI0733302	143	6,160	3	3.97
733302	AT0733302	143	6,160	3	3.97
733404	LF0733404	122	4,563	0	
733404	WP0733404	107	3,891	0	
733501	SI0733501	108	3,508	1	0.77

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Table 9D. (continued)

SiteID	Setting_ID	Number of Human Receptor Points	Total Human Receptor Population	Number of Beef and Dairy Farms	Total Beef and Dairy Farm Population
733501	AT0733501	108	3,508	1	0.77
733606	WP0733606	118	5,156	0	
733606	SI0733606	93	3,685	0	
733606	AT0733606	93	3,685	0	
734604	WP0734604	192	6,488	1	0.003
735309	LF0735309	222	4,099	4	5.72
735309	SI0735309	203	3,780	4	5.47
735309	AT0735309	203	3,780	4	5.47
826707	SI0826707	126	11,258	0	
826707	AT0826707	126	11,258	0	
830601	LF0830601	22	133	1	0.32
830903	LF0830903	20	30	0	
830903	SI0830903	16	17	0	
830903	AT0830903	16	17	0	
831102	WP0831102	297	12,528	0	
831406	LF0831406	6	27	2	0.14
831406	SI0831406	7	23	2	0.10
831406	AT0831406	7	23	2	0.10
831904	LF0831904	62	804	2	0.07
831904	LA0831904	89	1,248	2	0.96
831904	SI0831904	69	930	2	0.66
831904	AT0831904	69	930	2	0.66
832304	LF0832304	616	28,951	0	
832304	WP0832304	292	12,380	0	
832510	WP0832510	43	900	2	0.24
832510	SI0832510	41	926	2	0.29
832510	AT0832510	41	926	2	0.29

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Table 9D. (continued)

SiteID	Setting_ID	Number of Human Receptor Points	Total Human Receptor Population	Number of Beef and Dairy Farms	Total Beef and Dairy Farm Population
832903	WP0832903	7	10	1	0.06
832903	SI0832903	9	15	1	0.07
832903	AT0832903	9	15	1	0.07
832904	SI0832904	47	987	3	4.41
832904	AT0832904	47	987	3	4.41
832909	SI0832909	329	13,261	3	2.36
832909	AT0832909	329	13,261	3	2.36
833001	LF0833001	148	2,388	4	5.90
833007	LF0833007	74	1,396	2	0.31
833007	SI0833007	50	893	2	0.23
833007	AT0833007	50	893	2	0.23
834009	SI0834009	86	4,303	0	
834009	AT0834009	86	4,303	0	
923004	WP0923004	69	3,331	4	3.44
930205	WP0930205	86	1,612	3	0.36
930205	SI0930205	88	1,623	3	0.39
930205	AT0930205	88	1,623	3	0.39
930301	LF0930301	10	12	0	
930301	WP0930301	10	12	0	
930301	SI0930301	11	13	0	
930301	AT0930301	11	13	0	
930702	LF0930702	7	8	1	0.12
930702	SI0930702	8	9	1	0.14
930702	AT0930702	8	9	1	0.14
932103	LF0932103	46	469	1	0.18
932103	WP0932103	45	457	1	0.18
932103	SI0932103	46	458	1	0.18

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Table 9D. (continued)

SiteID	Setting_ID	Number of Human Receptor Points	Total Human Receptor Population	Number of Beef and Dairy Farms	Total Beef and Dairy Farm Population
932103	AT0932103	46	458	1	0.18
932507	WP0932507	261	7,911	0	
932507	SI0932507	262	7,940	0	
932507	AT0932507	262	7,940	0	
932509	LF0932509	45	419	3	0.34
932509	WP0932509	41	383	2	1.28
932509	SI0932509	48	394	2	1.30
932509	AT0932509	48	394	2	1.30
932903	LF0932903	16	519	0	
932903	SI0932903	18	662	0	
932903	AT0932903	18	662	0	
933704	SI0933704	55	1,396	3	7.21
933704	AT0933704	55	1,396	3	7.21
1010805	LA1010805	299	7,546	3	1.75
1012203	LF1012203	69	2,041	2	0.02
1012203	WP1012203	69	2,041	2	0.02
1012203	SI1012203	69	2,079	2	0.02
1012203	AT1012203	69	2,079	2	0.02
1013209	SI1013209	48	174	2	2.02
1013209	AT1013209	48	174	2	2.02
1014805	LF1014805	50	1,289	1	0.05
1015510	LF1015510	12	54	1	0.03
1023705	SI1023705	118	3,100	2	2.53
1023705	AT1023705	118	3,100	2	2.53
1031503	LA1031503	68	2,281	2	0.17
1031507	SI1031507	331	11,409	3	2.44
1031507	AT1031507	331	11,409	3	2.44

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Table 9D. (continued)

SiteID	Setting_ID	Number of Human Receptor Points	Total Human Receptor Population	Number of Beef and Dairy Farms	Total Beef and Dairy Farm Population
1032715	SI1032715	123	2,282	1	1.04
1032715	AT1032715	123	2,282	1	1.04
1032802	LF1032802	46	344	2	0.01
1032802	LA1032802	51	426	2	0.01
1032802	SI1032802	46	344	2	0.01
1032802	AT1032802	46	344	2	0.01
1033107	SI1033107	143	5,089	0	
1033107	AT1033107	143	5,089	0	
1033114	SI1033114	39	401	1	0.01
1033114	AT1033114	39	401	1	0.01
1033202	LA1033202	161	4,578	1	0.44
1033602	LA1033602	147	3,819	3	1.10
1033602	SI1033602	56	1,368	2	0.17
1033602	AT1033602	56	1,368	2	0.17
1034005	WP1034005	43	884	3	1.10
1034005	LA1034005	51	1,053	3	1.58
1034210	LA1034210	63	677	2	0.63
1034210	SI1034210	50	401	2	0.61
1034210	AT1034210	50	401	2	0.61
1034406	SI1034406	21	299	0	0.00
1034406	AT1034406	21	299	0	0.00
1034805	SI1034805	288	4,465	2	7.38
1034805	AT1034805	288	4,465	2	7.38
1035117	SI1035117	224	10,023	1	1.68
1035117	AT1035117	224	10,023	1	1.68
1035405	SI1035405	87	2,279	2	4.58
1035405	AT1035405	87	2,279	2	4.58

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Table 9D. (continued)

SiteID	Setting_ID	Number of Human Receptor Points	Total Human Receptor Population	Number of Beef and Dairy Farms	Total Beef and Dairy Farm Population
1035508	LA1035508	99	2,158	2	9.61
1035508	SI1035508	88	1,965	2	6.99
1035508	AT1035508	88	1,965	2	6.99
1120904	SI1120904	94	4,744	1	0.07
1120904	AT1120904	94	4,744	1	0.07
1122705	SI1122705	37	390	0	
1122705	AT1122705	37	390	0	
1131103	SI1131103	647	44,352	0	
1131103	AT1131103	647	44,352	0	
1131802	LA1131802	4	10	0	
1133902	LA1133902	260	6,376	0	
1134405	LA1134405	115	2,010	2	2.68
1212301	SI1212301	99	5,899	0	
1212301	AT1212301	99	5,899	0	
1221704	WP1221704	275	17,833	0	
1221704	SI1221704	264	17,621	0	
1221704	AT1221704	264	17,621	0	
1223404	SI1223404	274	13,441	0	
1223404	AT1223404	274	13,441	0	
1230111	SI1230111	41	451	3	3.09
1230111	AT1230111	41	451	3	3.09
1230206	SI1230206	33	430	1	1.71
1230206	AT1230206	33	430	1	1.71
1230517	SI1230517	47	2,004	4	1.55
1230517	AT1230517	47	2,004	4	1.55
1230919	WP1230919	306	23,989	0	
1231101	LA1231101	141	7,728	0	

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Table 9D. (continued)

SiteID	Setting_ID	Number of Human Receptor Points	Total Human Receptor Population	Number of Beef and Dairy Farms	Total Beef and Dairy Farm Population
1231101	SI1231101	136	7,293	0	
1231101	AT1231101	136	7,293	0	
1231705	LA1231705	35	494	1	0.05
1231705	SI1231705	33	482	1	0.05
1231705	AT1231705	33	482	1	0.05
1233101	SI1233101	146	18,106	0	
1233101	AT1233101	146	18,106	0	
1235205	WP1235205	60	1,200	2	3.49
1235205	SI1235205	60	1,202	2	3.51
1235205	AT1235205	60	1,202	2	3.51
1236637	SI1236637	135	5,913	0	
1236637	AT1236637	135	5,913	0	
1236652	SI1236652	70	3,288	1	0.02
1236652	AT1236652	70	3,288	1	0.02
1236732	WP1236732	157	7,614	0	
1236810	WP1236810	184	23,054	0	
1236820	SI1236820	29	378	2	0.35
1236820	AT1236820	29	378	2	0.35
1331103	SI1331103	250	7,584	0	
1331103	AT1331103	250	7,584	0	
1333001	LA1333001	30	177	3	0.11
1333701	WP1333701	373	16,604	0	
1415407	WP1415407	409	26,816	0	
1421506	WP1421506	266	13,733	0	
1430107	LF1430107	93	6,611	0	
1430107	SI1430107	63	5,222	0	
1430107	AT1430107	63	5,222	0	

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Table 9D. (continued)

SiteID	Setting_ID	Number of Human Receptor Points	Total Human Receptor Population	Number of Beef and Dairy Farms	Total Beef and Dairy Farm Population
1430404	SI1430404	157	5,345	0	
1430404	AT1430404	157	5,345	0	
1430602	SI1430602	77	10,089	0	
1430602	AT1430602	77	10,089	0	
1431515	SI1431515	8	7	0	
1431515	AT1431515	8	7	0	
1434022	SI1434022	252	32,104	0	
1434022	AT1434022	252	32,104	0	
1434802	SI1434802	441	15,558	0	
1434802	AT1434802	441	15,558	0	
1435317	LF1435317	195	3,650	0	
1522504	LA1522504	42	1,088	2	1.29
1530605	LF1530605	21	165	1	5.30
1530605	SI1530605	20	145	1	4.78
1530605	AT1530605	20	145	1	4.78
1530808	SI1530808	76	4,351	0	
1530808	AT1530808	76	4,351	0	
1532401	WP1532401	35	833	1	0.20
1621808	LA1621808	95	1,032	1	1.40
1621808	SI1621808	81	920	1	1.25
1621808	AT1621808	81	920	1	1.25
1630106	LF1630106	46	305	3	0.09
1630106	WP1630106	45	275	3	0.08
1630106	SI1630106	46	287	3	0.08
1630106	AT1630106	46	287	3	0.08
1630401	WP1630401	493	17,343	0	
1631701	LA1631701	150	3,340	3	0.09

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Table 9D. (continued)

SiteID	Setting_ID	Number of Human Receptor Points	Total Human Receptor Population	Number of Beef and Dairy Farms	Total Beef and Dairy Farm Population
1631701	SI1631701	73	1,586	2	0.02
1631701	AT1631701	73	1,586	2	0.02
1632106	LA1632106	222	13,509	3	0.25
1632106	SI1632106	200	11,669	3	0.15
1632106	AT1632106	200	11,669	3	0.15
1632703	LF1632703	117	2,271	0	
1633404	SI1633404	151	10,553	2	0.69
1633404	AT1633404	151	10,553	2	0.69
1633405	SI1633405	85	4,321	2	0.49
1633405	AT1633405	85	4,321	2	0.49
1635404	SI1635404	167	3,316	1	0.10
1635404	AT1635404	167	3,316	1	0.10
1721603	SI1721603	111	3,384	3	5.15
1721603	AT1721603	111	3,384	3	5.15