

10: Working With ArcGIS and ArcView

Overview

As was pointed out in Chapter 1, What if? is a “bottom-up” model that begins with homogeneous land units or uniform analysis zones (UAZs) and allocates scenario-based land use demands to UAZs on the basis of their scenario-based suitability for different land uses. The model derives information for the study area and for sub-areas within the study area by aggregating information for the UAZs.

GIS spatial analysis functions are used to combine the GIS layers for your study area into a single shape file—the UAZ shape file—which contains information for all of the map layers that were used in the analysis. The UAZ shape file also contains all of the outputs generated by the suitability and allocation scenarios. What if? may also incorporate additional “display layers” that you can display with the UAZ layers to better understand the maps that are prepared by What if?.

What if? also generates shape files that store the projected land uses, population and employment by year for all political jurisdictions and other user-defined areas. The allocation shape contain the projections for the following variables:

- Land use by type;
- Total population, household population, group quarters population, number of households, number of housing units, number of vacant units, vacancy rate, and average household size; and
- Total employment and employment by sector.

The UAZ file, display layers, and projected land use, population and employment layers are all shape files which can easily be viewed with any version of ESRI’s ArcView and ArcGIS programs and any other program that can view shape files. As a result, all of the suitability and allocation scenario outputs and projected land use, population, and employment map layers can easily be viewed and analyzed with almost any GIS packages.

Using these files requires knowing an understanding of where the map layers are stored, what information is contained in the layers, and how the information is stored. The discussion in this chapter provides this information, allowing you to use the familiar display and analysis tools of your GIS to work with all of the What if? input and output layers.

In particular, the chapter describes the procedures for:

1. Locating What if? project files;
2. Reviewing the UAZ file structure;
3. Reviewing the UAZ Report;
4. Reviewing the allocation shape files.

10.1 Locating What if? Project Files

All of the What if? input and output files are stored in an organized structure of hierarchical directories. This structure is described in detail below.

Locating What if? Projects

10.1.1 Locating What if? Projects

The suitability, demand, control, and allocation scenario files that make up a What if? project are stored in a project directory whose name and location is specified in the **Create Project Files** option of the Setup program, as described in Section 4.17 Creating Project Files.

All of the What if? projects are normally stored in a single directory called “Projects” that is stored within the main What if? directory. All of the files that make up a project are stored in a directory whose name corresponds to the user-specified project name. Thus, for example, all of the files that make up the Demonstration project are stored in the *C:\Program Files\What if\Projects\Demonstration* directory if the files were installed in the default directory specified by the Install program.

Locating What if? Scenarios

10.1.2 Locating What if? Scenarios

All of the scenarios that make up a project are stored in subdirectories within the main “Projects” directory. That is,

- The Suitability scenarios are stored in a directory named “Suitability”;
- The Demand scenarios are stored in a directory named “Demand”;
- The Control scenarios are stored in a directory named “Control”; and
- The Allocation scenarios are stored in a directory named “Allocation.”

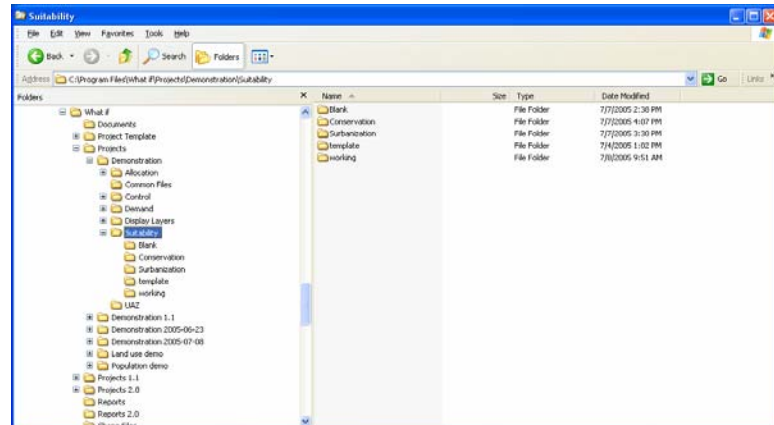
Thus, for example, all of the suitability scenarios for the Demonstration project are stored in the *C:\Program Files\What if\Projects*

Demonstration\Suitability directory if the files are installed in the default installation directory.

The different scenarios for each type of analysis are stored in separate directories within the “Suitability,” “Demand,” “Control,” and “Allocation” directories. The names for the scenario directories correspond to the scenario names you defined when creating the scenarios.

Thus, for example, the two suitability scenarios for the sample project are stored in:

- *C:\Program Files\What if\Projects\Demonstration\Suitability\Conservation*; and
- *C:\Program Files\What if\Projects\Demonstration\Suitability\Development*.



10.1.3 Locating Display Layers

Locating Display Layers

The What if? display layers are stored in a directory named “Display Layers” located in each project directory. Thus, for instance, if the program has been installed in the default location, the display layers for the Demonstration project will be stored in the *C:\Program Files\What if\Projects\Demonstration\Shape Files* directory.

10.2 Reviewing UAZ File Structure

Reviewing UAZ File Structure

All of the information on existing land uses, the suitability factors, the area’s current population, housing, and employment, and the results of the suitability and allocation analyses are stored in the UAZ shape file.

As is true for all shape files, the UAZ shape file is actually made up of three or more files that share the UAZ root file name. At a minimum, the UAZ shape file must include the following files:

- *uaz.shp*, that stores information on the UAZ’s spatial geometry;

- *uaz.shx*, that stores indexes for the information stored in the *uaz.shp* files; and
- *uaz.dbf*, that stores the UAZ's attribute information.

The *uaz.shp* and *uaz.shx* files are created by the GIS software and are not modified in any way by What if?. The program works only with the *uaz.dbf* file which will be referred to as the "UAZ data file" in the remainder of this chapter.

UAZ Data File Contents

UAZ Data File Contents

Like all data tables, the UAZ data table can be conceptualized as consisting of a collection of data "records," or rows, and "fields," or columns.

The records (or rows) in the data table contain information for each of the polygons (UAZs) that make up the analysis region. That is, each row in the data base contains all of the information (area, current land use, and so on) for a single spatial unit or UAZ.

The fields (or columns) in the data base contain different types of information for all of the UAZs that make up the analysis region. That is, each column in the data base contains a single kind of information (e.g., the area or future land use) for all of the UAZs (or records) in the data base.

The UAZ data file stores the following information in one or more column of the data base:

1. Shape file information;
2. Existing land uses;
3. Sub-area boundary information;
4. Infrastructure control information;
5. Planned land uses;
6. Growth pattern information;
7. Suitability factor information;
8. Suitability factor scores;
9. Future land uses;
10. UAZ area;
11. Enumeration district label;
12. Population and housing information;
13. Employment information; and
14. Random number.

These different kinds of data and the fields that contain them are identified in the following table and described in detail below.

NOTE!

NOTE: Not all of these fields will be included in the UAZ files for the Suitability, Land Use, and Land Use/Population analysis options.

Field Type	Variable	Field Name(s)
1	Shape file information	Various
2	Existing land uses	ELU
3	Sub-area boundaries	BOUNDARY _x
4	Infrastructure controls	CONTROL _x
5	Planned land uses	PLU _x
6	Growth patterns	GROWTH _x
7	Suitability factors	FACTOR _x
8	Suitability factor scores	SCORE _x
9	Future land uses	ALU _x
10	UAZ Area	UAZ_AREA
11	Enumeration district label	ED_LABEL
12	Population information	Various
13	Employment information	UAZ_EMP _{xx}
14	Random number	RND_NUM

10.2.1 Shape File Information

Shape File Information

The first fields in the UAZ data file will generally be standard fields such as NAME, AREA, PERIMETER, UAZ_, and UAZ_ID, that are found in ESRI shape files and coverages. These values are not modified by What if? and should not be changed in any way.

10.2.2 Existing Land Uses

Existing Land Uses

The UAZ data files store information on a UAZ's existing land uses in a field called ELU (for existing land use). The information is used in the suitability and allocation portions of the analysis and to prepare maps of the area's current and future land use patterns.

The ELU values correspond to the existing land use labels defined on the **Setup** program's **Define Land Uses | Existing** sheet, as described in 4.6.3 Defining Existing Land Uses. The land uses associated with each ELU value are identified in the UAZ Report, described in Appendix I.

10.2.3 Sub-area Boundaries

Sub-area Boundaries

The UAZ data files store information on the boundaries for any sub-areas in fields labeled BOUNDARY_x. "BOUNDARY" stands for sub-area boundary; "x" refers to one of up to ten concurrently defined sub-area boundaries, i.e., BOUNDARY1, BOUNDARY2, and so on.

The sub-area information can be used in the demand allocation portion of the analysis to prepare forecasts for political units, school districts, and

other sub-areas within the study area. The values the BOUNDARY_x field are defined in the **Setup** program's **Define Sub-Areas** sheet, as described in Section 4.16.3 Defining Sub-Areas. The sub-areas associated with each BOUNDARY_x value are identified in the UAZ Report, described in Appendix I.

10.2.4 Infrastructure Controls

Infrastructure Controls

As was pointed out in Chapter 4, What if? can provide up to ten different infrastructure controls that can be used to help shape future land use patterns. The UAZ data files store information on control layers in fields named CONTROL_x. "CONTROL" stands for land use control; "x" refers to one of up to 10 concurrent infrastructure control plans.

The different types of infrastructure controls and the values in the CONTROL_x fields are defined with the **Setup** program's **Define Allocation Controls | Infrastructure Sheet** option, described in Section 4.15.1 Defining Infrastructure Controls. The information corresponding to the CONTROL_x values is described in the UAZ Report, described in Appendix I.

10.2.5 Planned Land Uses

Planned Land Uses

The UAZ data file store information on any planned land uses (e.g., from a comprehensive plan or a zoning ordinance) in fields labeled PLU_x. "PLU" stands for planned land use; "x" refers to one of up to fifty concurrently defined alternative planned land uses.

One set of planned land uses (corresponding, for example, to the 2030 Land Use Plan for the Demonstration project) can be defined for the PLU₁ field; a second set of planned land uses (corresponding perhaps to the current zoning) can be defined for the PLU₂ field; and so on.

The values for the different planned land use values correspond to the order in which the planned land use labels were defined in the **Setup** program's **Define Allocation Controls | Land Use Controls | Planned Land Uses** sheet, as described in Section 4.15.2 Defining Land Use Controls. The planned land uses associated with the various PLU_x values are identified in the UAZ Report, described in Appendix I.

10.2.6 Growth Patterns

Growth Patterns

As was pointed out in Chapter 9, What if? allows users to use "growth pattern" layers specifying the order in which different areas will be developed. The growth pattern information is stored in UAZ data fields named GROWTH_x. "GROWTH" stands for growth pattern; "x" refers to one of up to five concurrently defined growth patterns. The values in the UAZ field are defined with the **Setup** program's **Define Allocation Controls | Growth Pattern** sheets, as described in Section 4.15.3 Defining Growth Patterns.

10.2.7 Suitability Factors

Suitability Factors

The UAZ data files stores information for up to 20 different suitability factors (e.g., slopes, soils, and so on) in the FACTOR_*x* fields. “FACTOR” stands for the suitability factor and “*x*” stands for one of up to twenty different suitability factors. The suitability factors are used during the suitability analysis to determine the relative suitability of different locations for each land use.

The suitability factors are defined in the **Setup** program’s **Define Suitability Factors** option, as described in Section 4.8 Defining Suitability Factors. The suitability factors associated with the FACTOR_*x* values are described in the UAZ Report, described in Appendix I.

10.2.8 Suitability Factor Scores

Suitability Factor Scores

As was pointed out in Chapter 7, What if? multiplies the user-specified suitability rating for each factor type by the user-specified importance weight and sums the products to compute a factor score that records the suitability of each UAZ for a given suitability land use.

The UAZ data file stores the UAZ’s factor scores in fields labeled SCORE_*x*. “SCORE” stands for the suitability score; “*x*” refers to one of the suitability land uses defined on the **Setup | Define Land Uses | Suitability** sheet described in Section 4.6.4 Defining Suitability Land Uses.

Thus, for example, the SCORE_1 field stores the suitability scores for the first suitability land use (Residential for the Demonstration projects); SCORE_2 stores the suitability scores for the second suitability land use; and so on. The suitability land uses associated with each SCORE_*x* field are identified in the UAZ Report, described in Appendix I.

10.2.9 Future Land Uses

Future Land Uses

The UAZ data file stores the projected land use values in each projection year in fields titled ALU_*x*. “ALU” stands for allocated land uses and “*x*” can take on values of 1 to 5 or 99. ALU_1 stores the projected land use allocations in the first projection year (e.g., 2010 for the Demonstration project); ALU_2 stores the projected land uses in the second projection year; and so on. The ALU_99 field stores the projected land uses for the build out scenario. The projection year labels are defined with the **Setup** program’s **Define Projection Years** option, as defined in Section 4.16.2 Defining Projection Years.

10.2.10 UAZ Area

UAZ Area

The area for each UAZ polygon is stored in a field called UAZ_AREA. The units in which the area is expressed—acres or hectares—are specified in the **Setup | Define Measurement Units** form, described in Section 4.16.5 Specifying Measurement Units.

10.2.11 Enumeration District Label

Enumeration District Label

The label for the census enumeration district (e.g., the block group number for the Demonstration projects) in which UAZ is located is stored in a field called “ED_LABEL,” for enumeration district label. The information needed to determine the enumeration district label is obtained from the **Setup** program’s **Define Enumeration District Information**, as described in Section 4.11 Defining Enumeration District Information.

10.2.12 Population and Housing Information

Population and Housing Information

The current population and housing information for each UAZ is stored in the following fields:

- **Population.** The estimated residential population in each UAZ is stored in the UAZ_POP field;
- **Number of Households.** The estimated number of households in each UAZ is stored in the UAZ_HH field;
- **Number of Housing Units.** The estimated number of housing units in each UAZ is stored in the UAZ_HU field;
- **Number of Vacant Units.** The estimated number of vacant housing units in each UAZ is stored in the UAZ_VAC field; and
- **Group Quarters Population.** The estimated group quarters population in each UAZ is stored in the UAZ_GQ field.

NOTE!

NOTE: The population information is not required for the Suitability and Land Use analysis options.

10.2.13 Employment Information

Employment Information

The current employment in each UAZ for each employment sector is stored in a set of fields labeled UAZ_EMPxx, i.e., UAZ_EMP01, UAZ_EMP02, and so on.

The employment sectors corresponding to the UAZ_EMPxx fields are defined on the **Setup** program’s **Define Employment Information | Employment Sectors** sheet, described in Section 4.13.1 Defining Employment Sectors. The employment sectors associated with each UAZ_EMPxx value are identified in the What if? Setup Report, described in Appendix G.

NOTE!

NOTE: The employment information is not required for the Suitability, Land Use, and Land Use/Population analysis options.

10.2.14 Random Number

Random Number

The final field in the UAZ data file, RND_NUM, contains a series of random numbers that were created by the Setup program and can be used to specify that the projected land use demands are allocated to UAZs in the order of these values, i.e., in random order.

10.3 Reviewing the UAZ Report

Reviewing the UAZ Report

The What if? UAZ Report provides a detailed description of the contents of the UAZ shape file for your project. The contents of this report are particularly useful if you wish to display the results of the What if? suitability and allocation analyses in ArcView, ArcGIS, or another program that can display shape files.

You can view a project's UAZ Report by:

1. Running the What if? program;
2. Opening the project whose UAZ report you'd like to view; and
3. Selecting the **Project | Reports | UAZ** option.

The contents of the UAZ Report are described in detail in Appendix I.

10.4 Reviewing Allocation Shape Files

Viewing Allocation Shape Files

In addition to preparing the maps and reports described in Section 9.7 Viewing Allocation Outputs, the What if? allocation option produces a series of shape files reporting the projected land uses, residential population and employment for the study area and for user-defined sub-areas within the study area.

Land Use Shape Files

What if? generates two types of shape files for each allocation scenario. The first type of allocation shape files—the land use shape files—contain the projected land uses for all of the UAZs in your study area. These files are useful for creating allocation maps similar to those generated by the What if? **Allocation | Maps** option.

Sub-area Shape Files

The second type of allocation shape files—the sub-area shape files—record the total projected land uses, population and employment in each projection year for all political jurisdictions and other user-defined sub-areas. These files are particularly useful for generating maps reporting record the changes over time in each sub-areas land uses, population and employment.

The location and contents of the land use and sub-area shape files are described in detail below.

Locating Allocation Shape Files

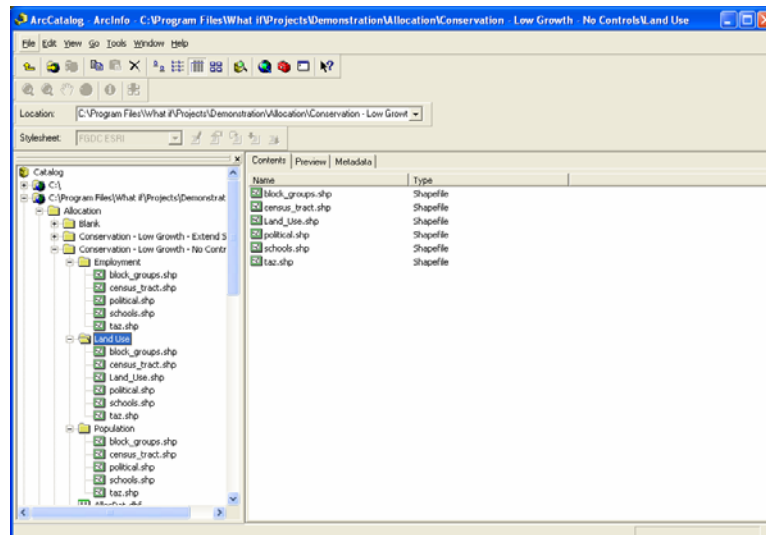
10.4.1 Locating Allocation Shape Files

The allocation shape files are stored within the project's allocation scenario directory. As described in Section 10.1 Locating What if? Project Files, these files are stored in the "Allocation" directory within the project directory, whose name corresponds to the user-specified project name.

The land use shape file, named *Land_Use*, is located in the main allocation scenario directory. The sub-area shape files are located in the following subdirectories within the main allocation scenario:

- **Employment**, that contains the employment shape files;
- **Land Use**, that contains the land use shape files; and
- **Population**, that contains the population shape files.

Each of these directories contains a shape file for each of the sub-area types defined on the **Setup | Define Sub-Areas** option described in Section 4.16.3 Defining Sub-Areas. Thus, for instance, as the ArcCatalog directory shown below indicates, the *What if?Projects\ Demonstration\Allocation\Conservation - Low Growth - No Controls\Population* directory contains the five sub-area shape files—*block_groups*, *census_tracts*, etc.—that were specified on the **Setup | Define Sub-Areas | Shape Files** sheet.



10.4.2 Land Use Shape File

Land Use Shape Files

The land use shape file contains a record for every UAZ in the study area and two kinds of data fields—the *ALU_xxxx* fields and *LU_xxxx* fields—that are described below.

10.4.2.1 ALU_xxxx Fields

ALU_xxxx Fields

The *ALU_xxxx* fields names, e.g., *ALU_2005*, *ALU_2010*, and so on through *ALU_9999* refer to the allocation land use (ALU) for the current year (*ALU_2005*), the various projection years (*ALU_2010*, *ALU_2015*, and so on), and for build out (*ALU_9999*).

The values in these fields correspond to the current or projected land use code for each UAZ in each projection year. The current and future land use codes are identified in the UAZ Report, described in Appendix I. Values less than 200 correspond to existing land uses that were not converted to other uses during the allocation process. Values greater than 200 correspond to new land uses.

Thus, for instance, a value of “1” in the *ALU_2010* field for the Demonstration project indicates that the UAZ had an initial land use of low density residential and this use had not been converted to another use in 2010. A value of “201” in the *ALU_2010* field indicates that the UAZ’s land use was been converted to low density residential on or before 2010.

10.4.2.2 LU_xxxx Fields

LU_xxxx Fields

The *LU_xxxx* fields names, e.g., *LU_2005*, *LU_2010*, and so on through *LU_9999* refer to land use for the current year (*LU_2005*), the various projection years (*LU_2010*, *LU_2015*, and so on), and for build out (*LU_9999*).

The values in each of these fields correspond to the label for each UAZ’s land use in each projection year. The land use may be either a current land use or a new land use. Thus, for example, the values in the *LU_2010* for the records that have an *ALU_xxxx* value of “1” or “201” will be “Low Density Res.” The land use labels are defined in the Setup program’s **Define Land Uses | Existing** option, described in Section 4.6.3 Defining Existing Land Uses.

10.4.3 Sub-area Shape Files

Sub-area Shape Files

As was pointed out above, What if? generates a set of shape files reporting the projected land uses, population, and employment in each projection year for all of the political jurisdictions and user-defined sub-areas in the study area. The contents of these shape files are described briefly below.

10.4.3.1 Sub-area Land Use Shape Files

Sub-area Land Use Shape Files

The *Land Use* directory contains a set of shape files corresponding to the different sub-areas that were defined in the Setup program’s **Define Sub-Areas** option, described in Section 4.16.3 Defining Sub-Areas.

The sub-area land use shape files contain a record for each sub-area for the corresponding sub-area type. For example, the political unit shape—named “political” for the Demonstration project—contains a separate record for the three political jurisdictions in the Edge City study area.

Similarly, the census tract shape files—named “census_tract”—contain a record for each of the 12 census tracts in the Demonstration project’s study area.

The sub-area land use shape files contain the following data fields:

- **First Field.** The first field (named POLITICAL for the Demonstration project) records the label for each sub-area, as defined in the Setup program’s **Define Sub-Areas** option.
- **AREA_NUM, BNDY_NUM and AREA_TYPE Fields.** These fields store the What if? program’s codes for identifying sub-areas and can be ignored.
- **Lyy_xxxx Fields .** These fields record the total area (measured in acres or hectares) in each sub-area that is devoted to a particular land use in a projection year. The first part of each field name (i.e., Lyy) corresponds to the identification numbers assigned to each land use by the What if? program. These numbers are identified in the What if? Setup Report, described in Appendix G. The second part of each field name, i.e., xxxx, records the projection year for each projected land use.

For example, for the Demonstration project, the L01_2005 fields record the amount of Low Density Res. land (measured in acres) in each sub-area in 2005.

10.4.3.2 Sub-area Population Shape Files

Sub-area Population Shape Files

The Population directory contains a set of shape files corresponding to the different sub-areas areas that were defined in the Setup program’s Define Sub-Areas option. The organization of the shape files corresponds in exactly to the sub-area land use shape files described in the previous section.

The sub-area population shape files contain the first four data fields described in conjunction with the sub-area land use shape files described above. In addition, they contain the following data fields:

- **HU_xxxx.** These fields store the current and projected number of housing units in each sub-area in a particular year. For example, the HU_2005 field reports the number of housing units in each sub-area in 2005.
- **POP_xxxx.** These fields store the current and projected total residential population in each sub-area in a particular year. For example, the POP_2005 field reports the total population in each sub-area in 2005.
- **HH_xxxx.** These fields store the current and projected number of households in each sub-area in a particular year. For example, the HH_2005 field reports the number of households in each sub-area in 2005.
- **HPOP_xxxx.** These fields store the current and projected household population (i.e., the residential population that does

not reside in group quarters) in each sub-area in a particular year. For example, the HPOP_2005 field reports the household population in each sub-area in 2005.

- **GRP_xxx**. These fields store the current and projected group quarters population in each sub-area in a particular year. For example, the GRP_2005 field reports the group quarters population in each sub-area in 2005.
- **VAC_xxx**. These fields store the current and projected number of vacant housing units in each sub-area in a particular year. For example, the VAC_2005 field reports the number of vacant housing units in each sub-area in 2005.
- **VRAT_xxx**. These fields store the current and projected vacancy rate for each sub-area in a particular year. For example, the VRAT_2005 field reports the vacancy rate for each sub-area in 2005.
- **AHS_xxx**. These fields store the current and projected average household size (persons per household) for each sub-area in a particular year. For example, the AHS_2005 field reports the average household size for each sub-area in 2005.

10.4.3.3 Sub-area Employment Shape Files

Sub-area Employment Shape Files

The *Employment* directory contains a set of shape files corresponding to the different sub-areas areas that were defined in the Setup program's Define Sub-Areas option. The organization of the shape files corresponds exactly to the sub-area land use and population shape files.

The sub-area employment shape files contain the first four data fields described in conjunction with the sub-area land use shape files described above. They also contain a series of *Eyy_xxx* fields that record the employment by employment sector in each sub-area in a projection year

The first part of each field name (i.e., *Eyy*) corresponds to the identification numbers assigned to employment sector by the What if? program. These numbers are identified in the Employment Sectors section of the What if? Setup Report, described in Appendix G. The second part of each field name, i.e., *xxx*, records the projection year for each projected land use. The *E99_xxx* value records the total employment in each projection year.

For example, , the E01_2005 field for the Demonstration project records the employment in NAICS 11, Agricultural, Forestry, Fishing and Hunting, in each sub-area in 2005.