INDEX PlanBuilder

Planning Support System
Release 9.2

User Notebook

CRITERION PLANNERS

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Getting Started Guide

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INTRODUCTION

INDEX PlanBuilder is an interactive GIS-based planning support system designed to assist in community planning and development, including measurement of existing conditions, creation of scenarios, evaluation of alternatives, and implementation of adopted plans.

Applications often begin with benchmark measurements of existing conditions to create a frame of reference and to identify problems and opportunities that merit attention in plans. INDEX can then be used to interactively design alternative scenarios, analyze and score their performance, and compare and rank the alternatives according to achievement of user objectives. Once plans are adopted, INDEX supports implementation by evaluating the consistency of development proposals against plan goals. Over time, goal achievement can be periodically measured with progress reports. Figure 1 illustrates these steps, which are discussed in greater detail in the accompanying Community Process Guide.

As a planning support tool, INDEX is distinguished by the following features:

- *Inclusion of stakeholder objectives.* INDEX contains a rating and weighting (RAW) tool that allows users to specify their planning objectives and priorities according to major policy topics and desired outcomes. Existing conditions and planning scenarios can then be evaluated and ranked according to achievement of stakeholder goals.

- *Case designer for digital charretting.* This tool gives users the ability to draw and edit spatial features on-the-fly, including street and sidewalk networks, bike and transit routes, parcel shapes and sizes, and land-use designations. Users are able to create and select from “palettes” of these features that are user-defined with local standards or design objectives.

- *Indicator mapping.* A unique strength of INDEX is its mapping of indicator results in addition to quantitative scoring. By mapping the spatial patterns of indicator results, INDEX is able to produce a clear picture of <u>where</u> objectives are and are not being achieved.

- *Multi-modal travel network.* INDEX achieves genuine land-use/transportation integration with a travel network for each transportation mode, thereby giving complete and accurate measurements of land-use and travel mode relationships.

- *Incremental development evaluation.* Once plans are adopted and incremental build-out starts occurring, INDEX has tool for evaluating proposed development projects’ consistency with plan goals.

Some users may choose to apply INDEX systematically in all stages of community planning and development, while some may find it helpful at one or two key points. Regardless of where in the process it is applied, it should be viewed as a support tool intended to inform rather than as a regulatory device intended to control.

The technical steps for applying INDEX are detailed in the other documents that makeup the User Notebook. Figure 2 summarizes typical major steps in a jurisdiction’s use of the tool. This includes initial set-up for the jurisdiction where the tool will be applied over time in various locations; and then steps that are normally followed in applying the tool at a particular location.

Figure 1. SUPPORT OF COMMUNITY PLANNING WITH INDEX PLANBUILDER

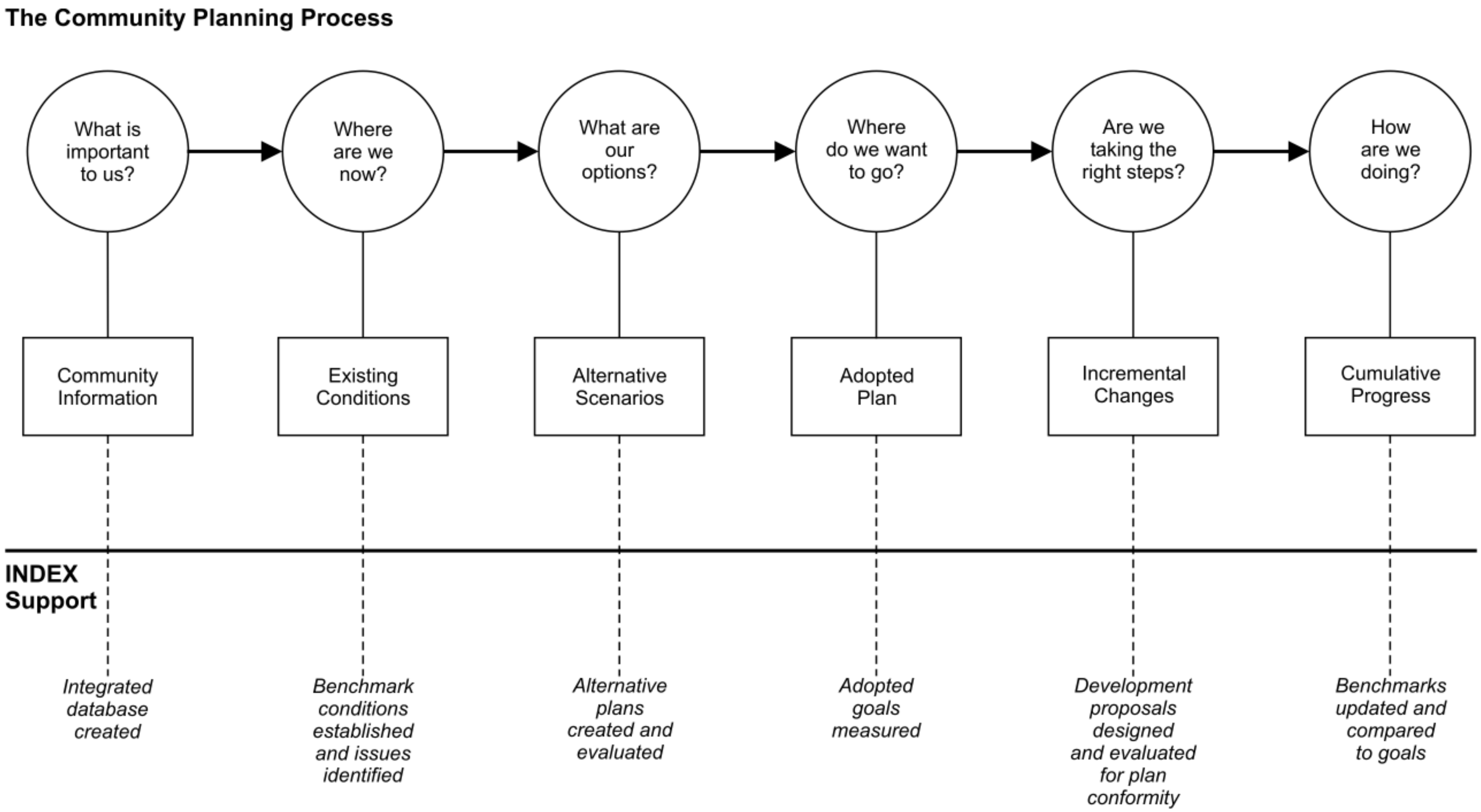
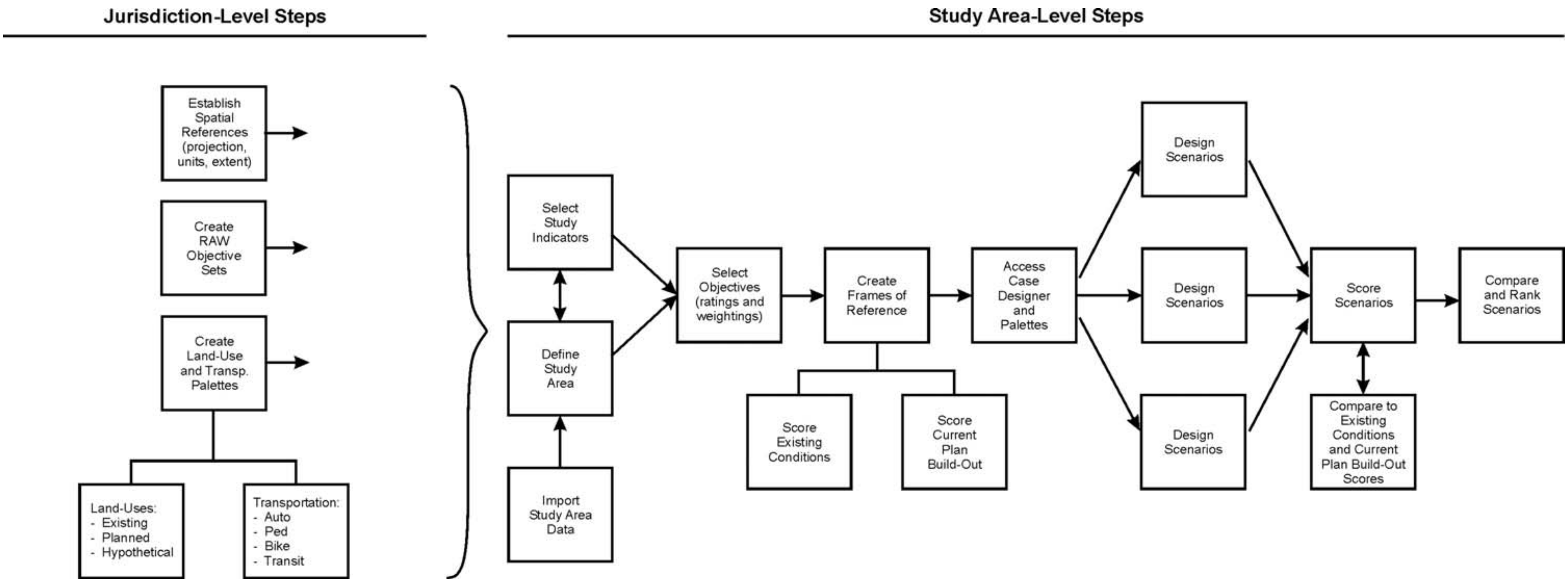


Figure 2. BASIC STEPS IN APPLYING INDEX PLANBUILDER



Examples of INDEX applications around the country in recent years include:

- Smart growth and sustainable development evaluation of neighborhood and community plans.
- Comprehensive land-use plan updating.
- Regional growth visioning for multi-jurisdiction metropolitan areas.
- Light rail station area planning.
- Comparison of infill versus greenfield growth.
- Mid-point evaluation of 20-year community plan implementation.
- Comparative neighborhood design analysis of open space preservation versus transit orientation.
- Citywide pedestrian master planning.
- Evaluation of neighborhood design for global warming emissions reduction.

System Requirements

INDEX PlanBuilder requires Windows 2000/XP, Microsoft Office 2000 Professional or greater with MS-Access. INDEX PlanBuilder requires ESRI's ArcGIS desktop software 9.2 with the latest Service Pack. INDEX PlanBuilder supports all ArcGIS license types (ArcView, ArcEditor, ArcInfo). However ArcView users are limited in the kinds of indicators they can run, and therefore have reduced data requirements. Throughout the INDEX PlanBuilder documentation, where applicable the following highlights denote license-specific features or instructions:

ArcEditor/ArcInfo Users, or

ArcView Users

The minimum hardware configuration is a 1.2 GHz PC with at least 512 MB of RAM, a 17-inch or larger monitor capable of 1024x768 resolution with 32 bit color, and at least 1 GB of available hard disk space. A preferred PC specification is 1 GB of RAM and a 2.8 GHz processor.

The software consists of a stand-alone Visual Basic program (Study Manager) and an ArcMap Extension. It has been designed and tested to be a desktop application for use with a locally-installed version of ArcGIS, and must be installed on the workstation where it is being used. While thin-client installations are possible, they are not supported.

The tool is not a client-server application. While it is possible for an administrator to specially customize an INDEX installation with Criterion's assistance so that user-editable files such as studies and tutorial data are stored on a sharable network drive, care must be taken to ensure that multiple users do not access the same studies at the same time.

INDEX PlanBuilder is configured to support standard Windows 2000/XP best practices with regard to multiple user accounts and security policies. Therefore, the application can only be installed by a user with administrative privileges.

User Skills

INDEX has two levels of required user skills: 1) a model steward with advanced GIS experience, and 2) general users with basic GIS familiarity. Model stewards should have completed advanced ArcGIS instruction and have at least two years of experience using either package; general users must have familiarity with ArcMap. The ESRI ArcMap User Manual should be used to supplement the INDEX User Notebook. At least one ESRI-certified ArcMap course is highly recommended for all INDEX users.

Documentation

The User Notebook contains the following documents:

- *Getting Started Guide.* This explains the software's installation and gives a brief tour of the tool's features.

- *Indicator Dictionary.* This details each indicator by definition, units of measurement, calculation formula, required data, and applicable user-defined parameters.

- *Community Process Guide.* This describes techniques for integrating INDEX into community planning processes, and how the model can support typical planning tasks.

- *Initial Training Exercise.* This provides a initial walk-through of INDEX, including an introduction to data editing techniques and scenario analysis using indicators.

- *Tutorial 1 – Jurisdiction Set-up.* This covers the initial set-up of INDEX for use anywhere in a jurisdiction.

- *Tutorial 2 – Benchmark Existing Conditions.* This explains how to create study area base cases.

- *Tutorial 3 – Create And Evaluate Incremental Development Proposals.* This describes the process for creating alternative cases that are compared to base cases.

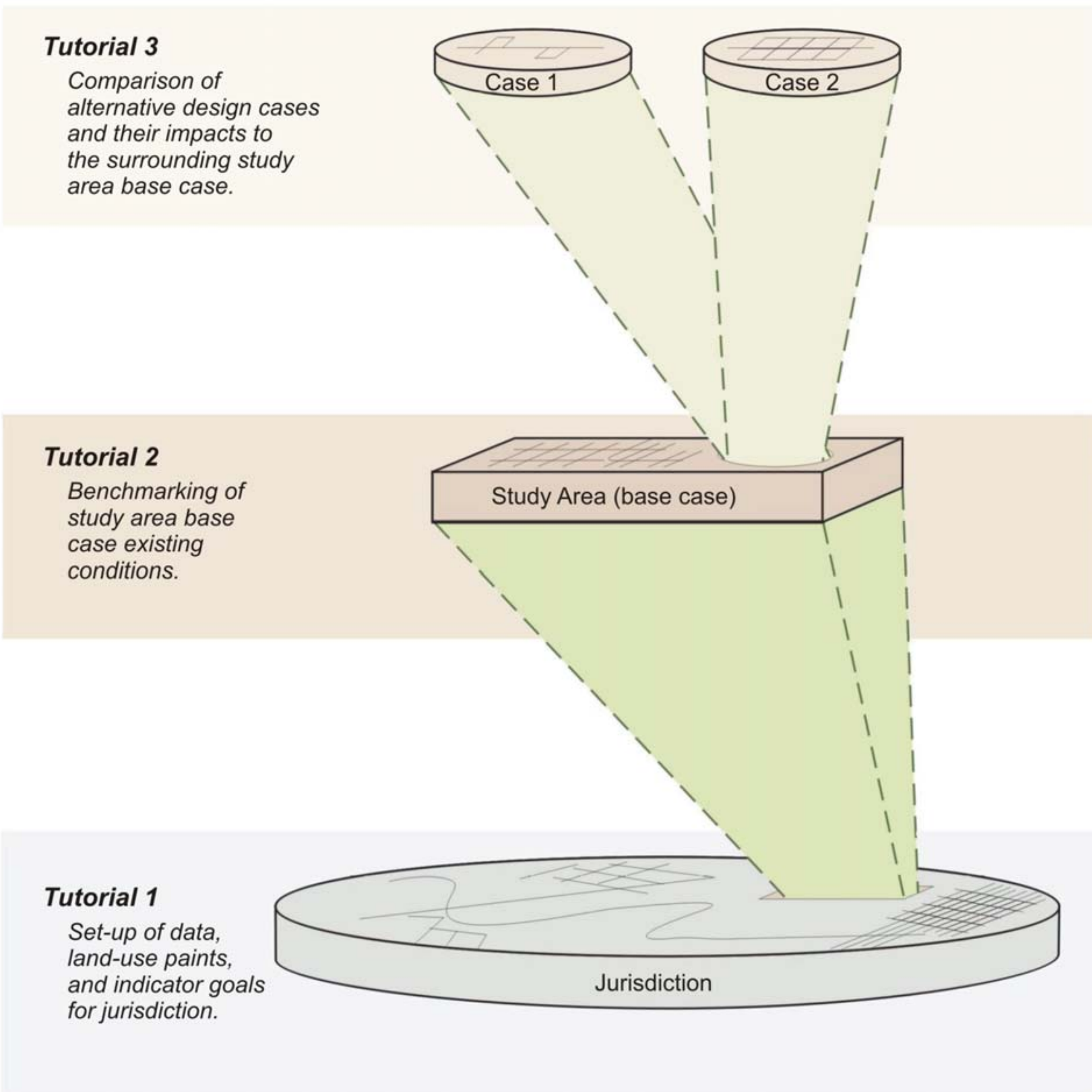
Figure 3 illustrates the tutorial sequence in relation to the geography being analyzed. In Tutorial 1, users set-up the jurisdiction's data for subsequent use in studies that can be located anywhere in the jurisdiction. This step also includes setting up palettes of land-uses available for "painting" during scenario building or digital charretting; entry of acceptable or desired indicator score ranges when rating scenarios; and selection of weights of importance to be given to indicators.

In Tutorial 2, users learn how to create a base case of existing conditions in a study area. This serves as a benchmark frame of reference for gauging proposed changes in the study area, e.g. evaluating new incremental development.

In Tutorial 3, users learn how to create alternative design cases, and compare their impacts to one another and to base case conditions.

These tutorials describe the tool's basic operations and typical application cases. In addition to the tutorial examples, INDEX users can apply the tool to a wide variety of land-based planning decisions that are discussed in the Community Process Guide.

Figure 3
TUTORIAL SEQUENCE AND GEOGRAPHIC RELATIONSHIPS



INSTALLING THE SOFTWARE

The installation of INDEX PlanBuilder follows Microsoft Best Practices for Windows 2000 and XP to insure ease of installation, maximum security, system stability, and reliable uninstallation.

An individual designated as the model steward is typically responsible for installing the application. This person may be a member of the IT, GIS or planning staff, but must have a user account with administrative privileges on the computer where INDEX will be installed. The end users of the application do not need to be administrative users.

If a different user other than the installing user will be accessing INDEX, they will need to boot into the same OS to which INDEX was installed.

Installation

There are two separate INDEX CDs to install, always in the following order:

1. The core INDEX program CD
2. The INDEX user data files and generic/customized settings CD

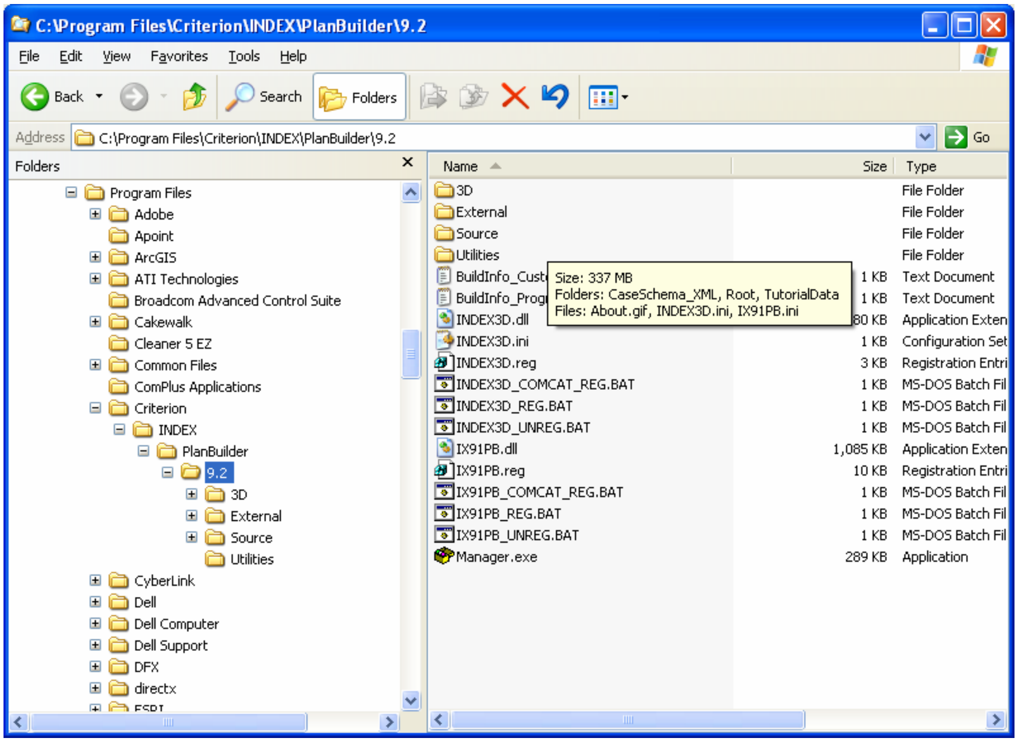
Both CD installation programs have standard Windows installer interfaces. In both cases, choose the "Typical" installation type to install all files from the CD to the target machine.

Files

Once installed on the computer, INDEX will have three types of files stored in three separate locations: 1) program executable files (and supporting files), 2) user data files, and 3) user settings.

Program Executables

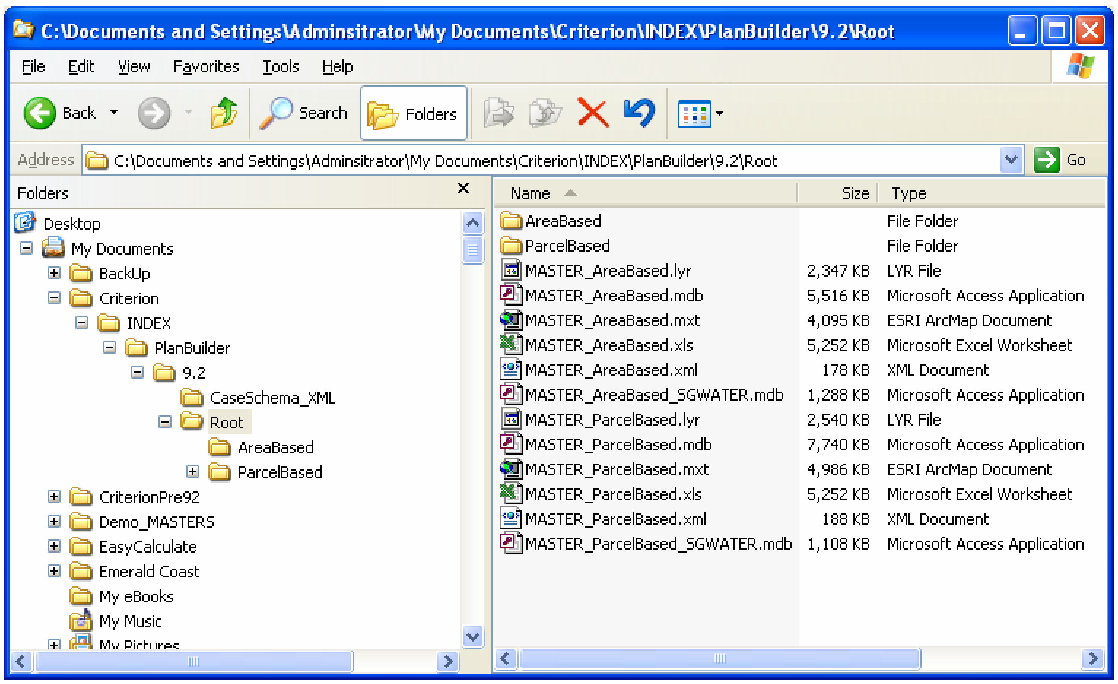
The application's program executables and supporting files are installed to a subfolder of the Program Files folder for the current OS. The Study Manager application is installed in this directory, as is the INDEX ArcMap extension. A source folder used for creating user data, including master copies of the study templates (as well as Tutorial and User Guide files, if these have also been installed) will be stored in this location. A typical location for these executable files is: C:\Progam Files\Criterion\INDEX\PlanBuilder\9.2.



User Data

Each INDEX user will have a user data folder. This folder will be created for the user the first time they run the INDEX Study Manager. The folder will be created as a subfolder of the user's My Documents folder. Since the My Documents folder is not truly a file folder on a physical drive, but acts as a sort of shortcut to a real folder, the INDEX user data folder will get created in a different location depending on the configuration of the My Documents target. The default location for a My Documents target folder is in the current user's profile folder. The current user's profile folder is typically found at C:\Documents and Settings\<*UserName*>. Therefore, the INDEX user data folder will typically be created at:

C:\Documents and Settings\<*UserName*>\My Documents\Criterion\INDEX\PlanBuilder\ 9.2.

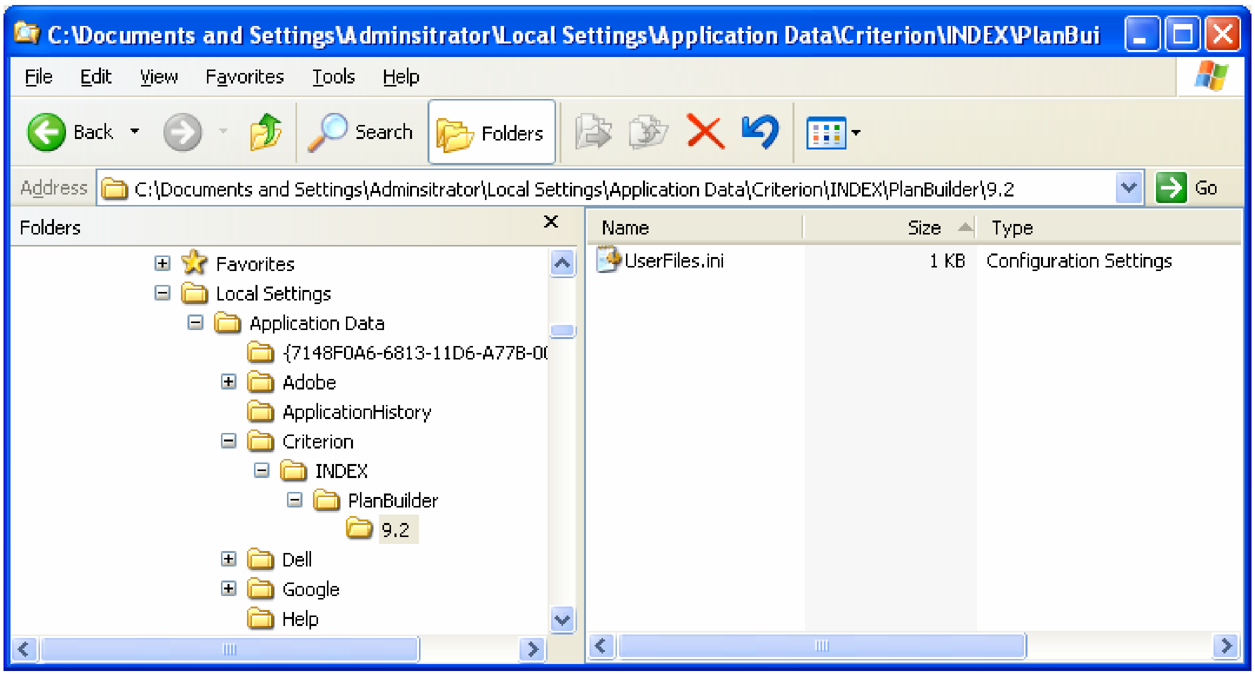


User Settings

The user settings for each INDEX user are stored in a file called UserFiles.ini, which is created when the user data folder is created for the first time. This file will also be created if it is ever found to be missing. This file is stored in the current user profile folder in a subfolder under the Local Settings\Application Data folder. The typical location for this file is

C:\Documents and Settings\<UserName>\Local Settings\Application Data\Criterion\INDEX\PlanBuilder\9.2\UserFiles.ini.

The full file path to the INDEX user data folder is stored in this file in the CurrentFolderPath setting. This file path will become the permanent location for the INDEX user data folder unless the CurrentFolderPath setting is changed.



Changing the target folder of My Documents after the INDEX user data folder has been created will not change the path stored in UserFiles.ini. If the UserFiles.ini file is deleted, it will be recreated the next time Study Manager is run. The file will be re-created with the CurrentFolderPath pointing at a path based on the new My Documents folder target. If this occurs, the entire user data folder will also be re-created from the installed master copies.

If the model steward chooses to change the UserFiles.ini settings or to allow other users to do so, then the following convention should be followed. The new folder location must be identical to the location automatically created upon first running Study Manager from the point of the Criterion folder downwards. This part of the path is called the “product subpath”. For example, if the new user data location is to be a dedicated drive with the drive letter of “I:” and individual folders for each user, the proper path to the user data folder for a user named “Sue” would be:
I:\Sue\Criterion\INDEX\PlanBuilder\9.2.

Uninstalling INDEX

<u>Uninstalling Multi-Disk Installations</u>

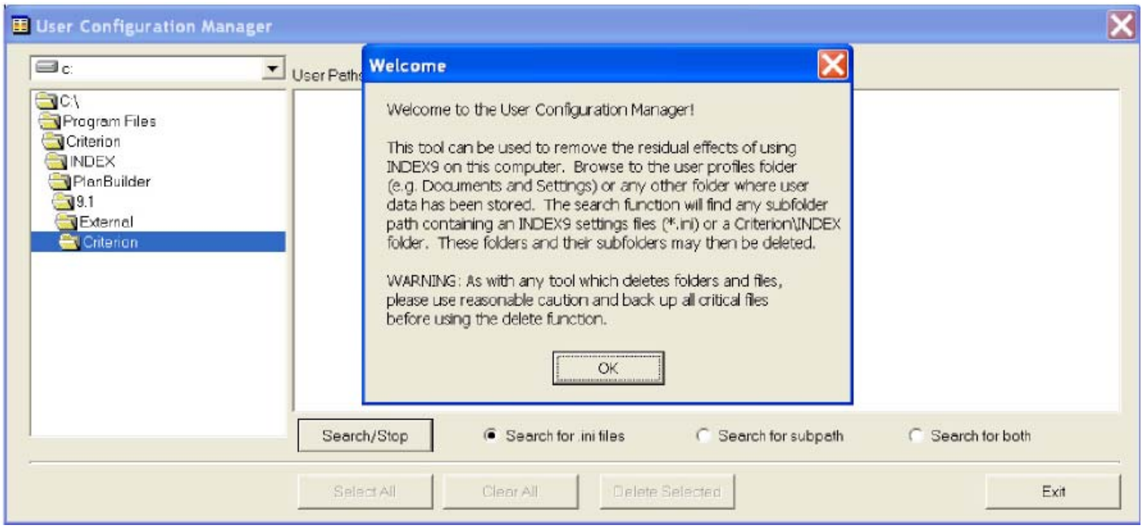
It is strongly recommended that you uninstall in the reverse order of installation. An example installation order and uninstallation order would be:

INSTALLATION
    Disk 1: Core program files
    Disk 2: User data files and generic/customized settings

UNINSTALLATION
    Disk 2: User data files and generic/customized settings
    Disk 1: Core program files

<u>Using the User Configuration Manager</u>

If at any time the model steward wishes to remove parts of the INDEX application, the steward may do so using the Modify option from the Add/Remove Programs control panel. The entire application can be uninstalled from this location also. Even if the whole application is uninstalled, it will leave behind user data and settings. For this reason, a tool called the User Configuration Manager appears during uninstallation. This tool allows the steward to find and remove user data and settings from any area of the computer. This tool can also be used at any time to clean up after removing specific users. It may be found in the External\Criterion subfolder in the program installation folder, which is typically found at C:\Program Files\Criterion\INDEX\PlanBuilder\9.2\ External\Criterion.



Common Questions

How much disk space will a typical INDEX installation take up?

All users share the program executables and supporting files. The program executables do not take up a great deal of room and that space is essentially fixed. The supporting files will take up significant additional room (especially if Tutorial, User Guide or Client Customization files have also been installed), but are also essentially fixed in size once installed. However, since each user will have their own user data folder, the size of an INDEX project will depend primarily on the number of users, as well as on each user's level of activity. It is recommended that the model steward insure that each user have at least 2 GB of hard drive space for study files, and that an additional 2-4 GB be available for the program executables and supporting files.

Can INDEX PlanBuilder be installed on the same computer with other INDEX products?

Yes, however, there may be some usability issues, since all INDEX projects register at least one ArcMap extension and this can lead to confusion in the ArcMap menus and toolbars. This is not a recommended or supported configuration.

How do INDEX users share studies they have created?

Because the typical location for the user data folder is not in a location visible to other users, users who wish to share studies must copy the study files to a shared location. A useful folder for this purpose is `Shared Documents`. The second user can then copy the study data from the shared location to their own user data folder.

Can users share a user data folder?

It is technically possible for an administrator to customize multiple users' `UserFiles.ini` path to point to a shared location, either on a network or on the local machine. However, since INDEX is not a client-server application, multiple users can not access the same studies at the same time. Therefore, it is not recommended.

Can INDEX be installed on a network server?

At this time INDEX only supports a local installation of the program and its supporting files. Thin-client installations are possible, but not supported. The user data files, however, will be created on a network folder automatically if that is the target folder of `My Documents` (as is the case with some IT office PC configurations) when Study Manager is run for the first time.

How do I change the My Documents target folder without losing access to my INDEX studies?

This is not supported. When the `My Documents` target is changed the INDEX users will not find that their data moves with it. Their data will remain in the location pointed to in each user's UserFiles.ini file. A suggested workaround is as follows:

1) Copy the user data folder tree for each user to the new My Documents target folder location.
2) Delete each user's UserFiles.ini file.
3) Run Study Manager for each user. This will allow INDEX to re-create the UserFiles.ini file with the correct CurrentFolderPath setting based on the new location.

How do I fix my INDEX installation if it is appears broken or I have deleted some key files by accident?

The standard Windows Installer Repair option is available from the Add/Remove Programs control panel. If this fails to fix the problem, you will need to uninstall and reinstall the application.

Program files that are accidentally deleted from the working directory will be replaced by the application when the Study Manager is activated.

Optional Pre-Installation Steps for Existing INDEX Users

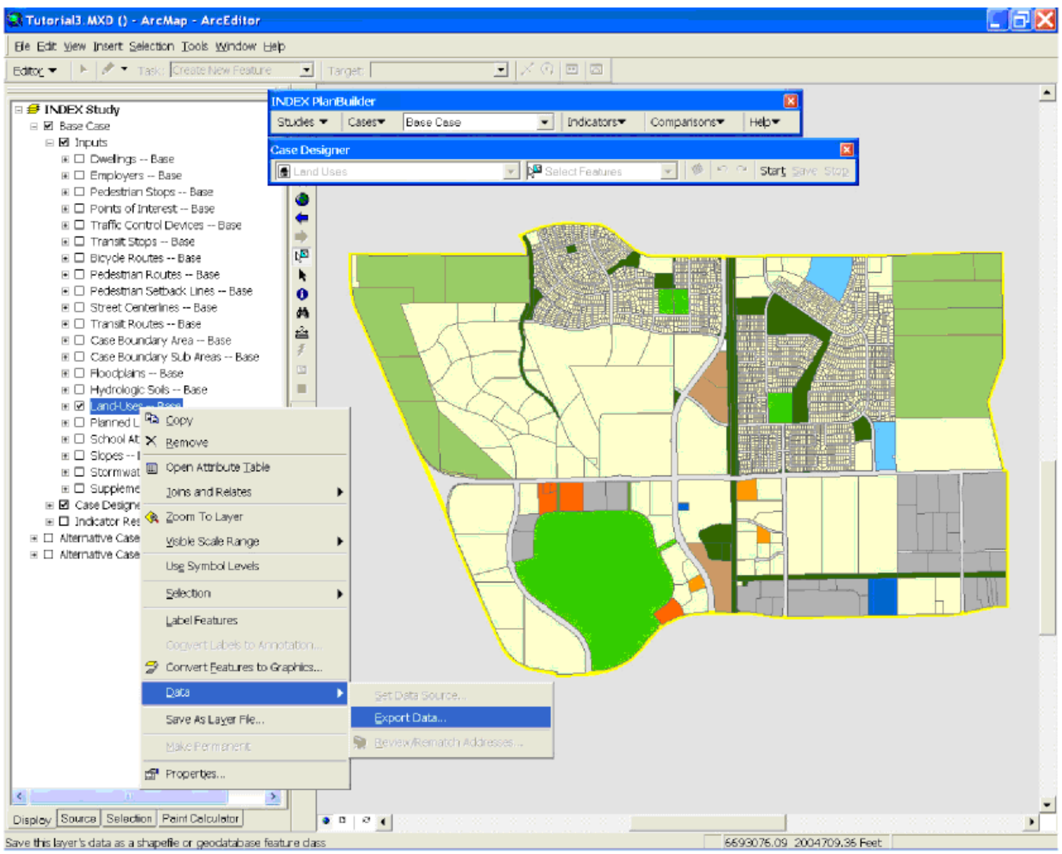
In general, INDEX studies created before ArcGIS 9.2 are not compatible with the current 9.2 geodatabase and software. If you wish to bring data from older version studies forward into INDEX 9.2 studies, you must export old feature class data to shapefiles. These shapefiles can then be used as the source data for the new study Geoload process (see Case Setup in Tutorial 1).

IMPORTANT: You must complete this process before uninstalling your old version of INDEX. If you wish to export spatial data from any INDEX study, follow these steps:

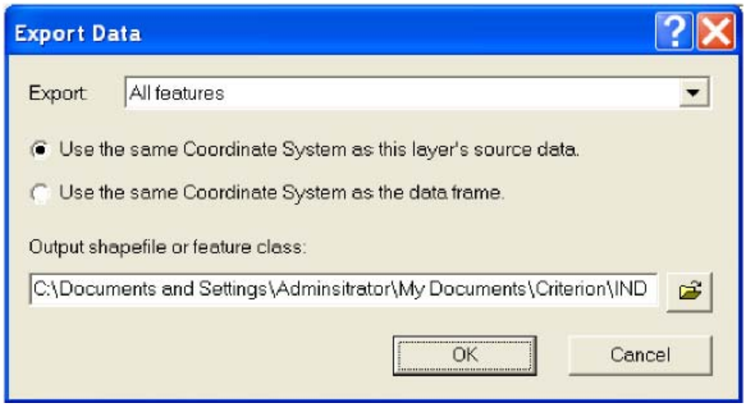
1. Run INDEX Study Manager and open the target study.

2. In the ArcMap Table of Contents window, expand the target case's "Inputs" node, and locate the target feature class containing the data you wish to export.

3. Right-click the target "Inputs" layer and choose the "Data > Export Data" option:



4. The following dialog appears:



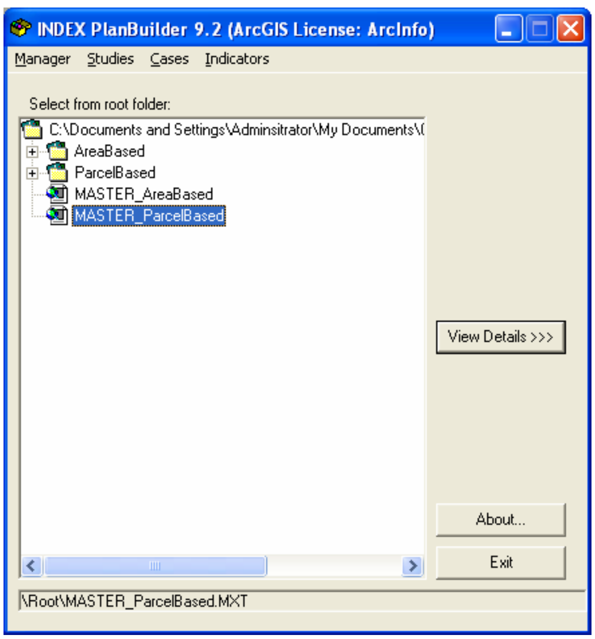
5. Select the desired options and click OK.
6. Repeat this process for all desired feature class targets.

STUDY MANAGER

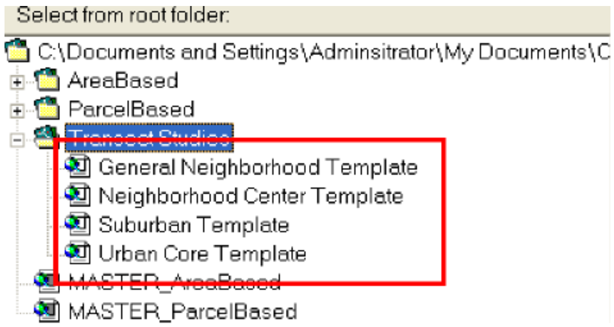
A "study" is the basic unit of analysis performed with INDEX PlanBuilder. A study is composed of a user-defined boundary (all or any part of the jurisdiction) and a user-selected indicator set for characterizing the area and any changes contemplated within it. The Study Manager is an administrative tool that allows you to create and organize studies, and adapt INDEX to local geographic and planning standards including: spatial reference, land-use classification schemes, and indicator objectives. These customizations can be saved in a master template and inherited by all newly created studies, or they can be made specific to individual studies.

Templates

Master Templates are ArcMap template files that house default properties for INDEX studies. The default properties can be set for each template using the tools accessed from the Study Manager dialog: Spatial Reference, Paint Editor, and Run Set Manager.

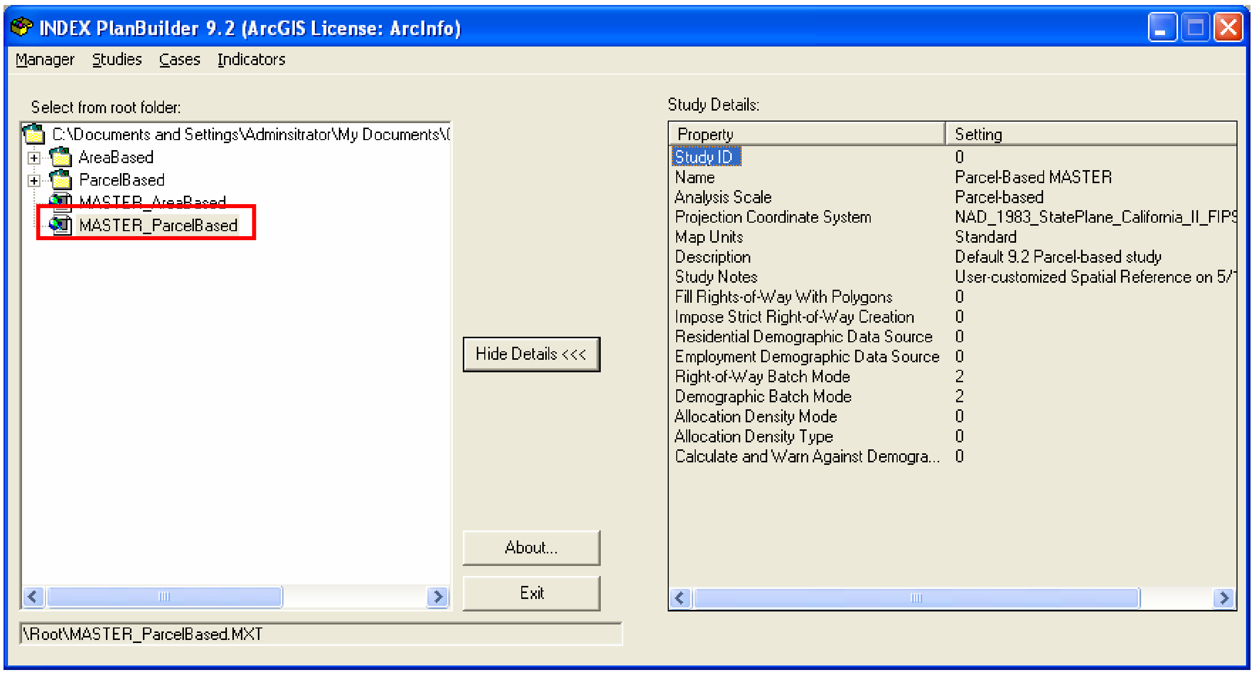


Secondary templates can also be created with properties specific to certain types of studies.



Parcel Based Studies

INDEX PlanBuilder is designed to execute studies at the parcel level for a fine grained, pedestrian scale analysis. INDEX is capable of executing studies at a coarser area-based level using land units larger than parcels, e.g. traffic analysis zones, but the complexities of area-based studies require consultation with Criterion staff before undertaking them. Assistance with area-based studies is outside the scope of standard INDEX technical support included with PlanBuilder purchases.



Spatial Reference

INDEX's data-storage medium is the ArcGIS personal geodatabase. This format offers general performance advantages, and supports land-use topology and advanced transportation and pedestrian networking functions. All data in an INDEX personal geodatabase must share the same projection and geographic extent, which together are referred to as the geodatabase's "spatial reference".

INDEX supports almost any geographic extent and any projection, as long as the map units are in meters or feet. Your only post-installation task is to customize the default study template(s) shipped with INDEX to your own organization's spatial reference specifications.

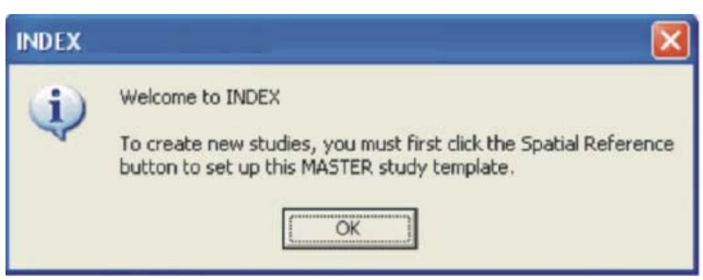
From the Windows Start menu, select Programs, INDEX – Planning Support System, Study Manager (start here). The first time your run Study Manager, the following dialog may appear:

This message is a reminder that you can only create new studies after you have completed the initial customization of your MASTER templates. Once you complete MASTER template spatial reference customization, this message will no longer appear.

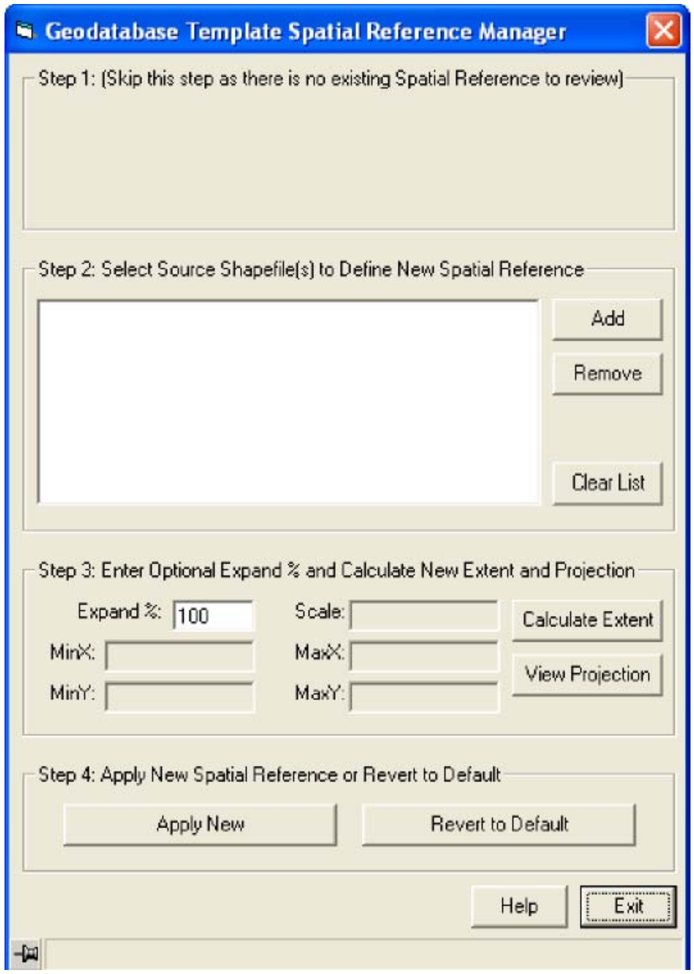
To finish customizing the MASTER Templates, you will require at least one shapefile that includes a valid projection (.prj) file. Valid .prj files have both a "Geographic Coordinate System" and a "Projected Coordinate System" in either meters or feet.

When you have such a shapefile, open Study Manager and proceed with the following steps:

1. Click the Studies > Spatial Reference menu option. The following informational dialog appears:



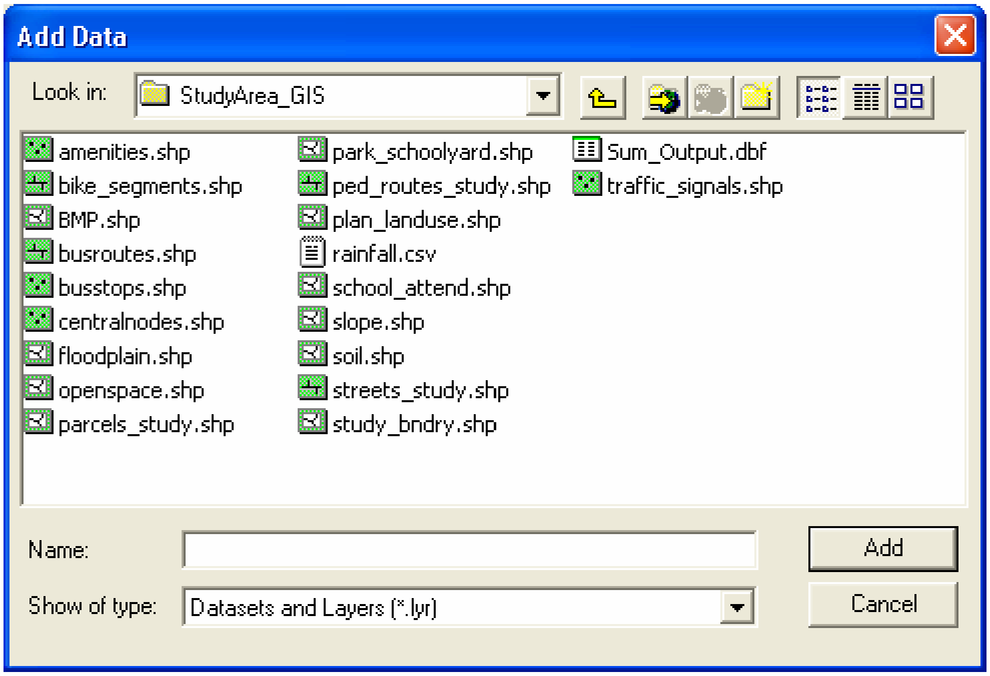
2. Click OK. The Spatial Reference Manager form appears:



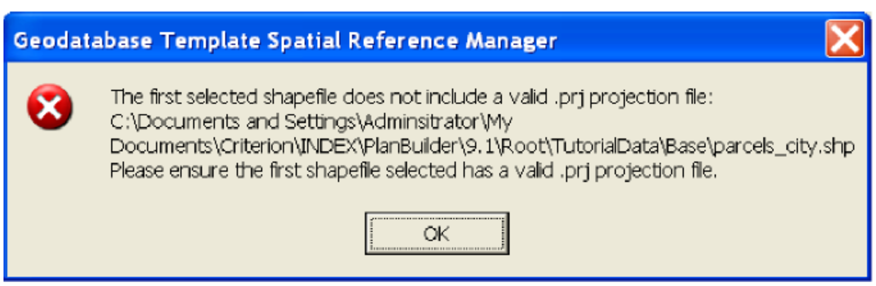
There are four steps to follow: 1) review the existing spatial reference (if any); 2) select a shapefile or several shapefiles from which INDEX will devise an appropriate spatial reference; 3) optionally, supply a buffering percent that INDEX will use to increase the overall height and width of the rectangular extent derived from the supplied shapefile; and 4) apply the new calculated extent and projection to the INDEX MASTER templates. When getting started, there is no need to review the existing spatial reference since none exists.

3. Click the Add button. The following instructional dialog appears:

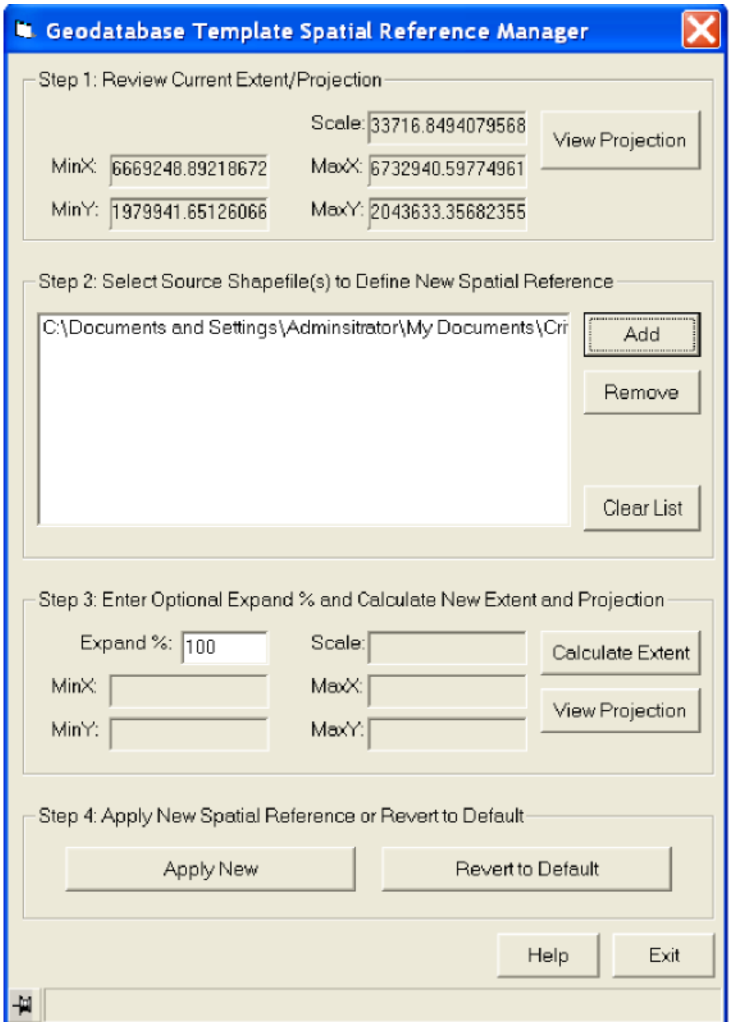
4. Click OK. The following ArcCatalog file selection dialog appears:



If the shapefile you select does not have a valid projection (.prj) file, the following error message appears:

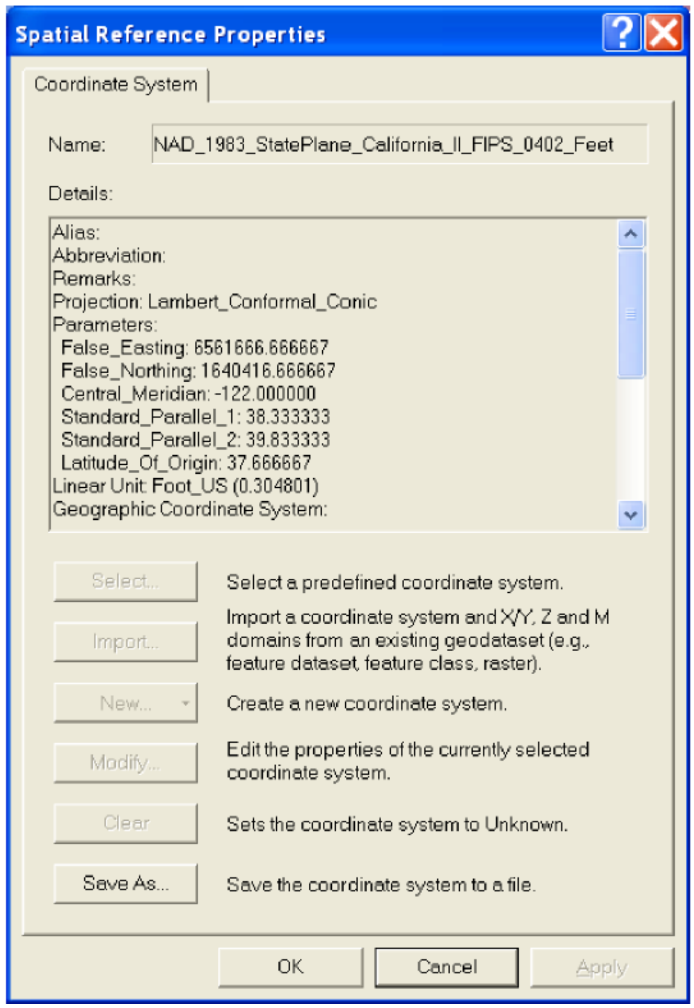


5. Choose at least one shapefile that includes a valid projection (.prj) file, and click Select. The selected shapefile is added to the form's list box:

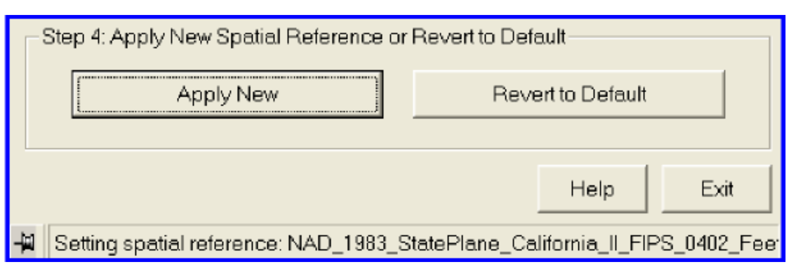


6. Enter a generous Expand % that will cover the extent of all possible shapefiles you might add. If in doubt, enter a large Expand %, e.g. 500 or 1000.

7. Click the Calculate Extent button, which completes the Max/Min X/Y and scale boxes. To review the projection extracted from the .prj file you supplied, click the View Projection button. The following dialog appears:



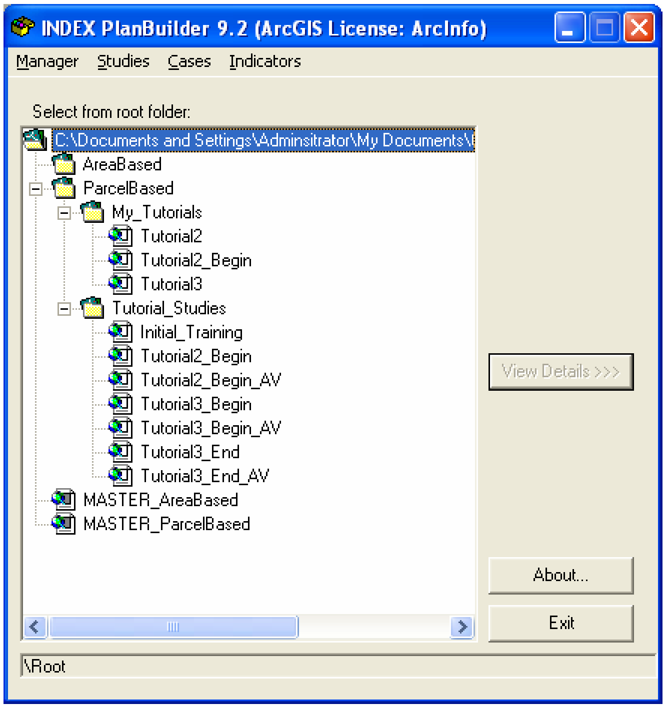
8. To complete your task and initiate the customization process, return to the Spatial Reference Manager form and click the Apply New Extent/Projection button. The progress of this customization is reported at the bottom of the form:



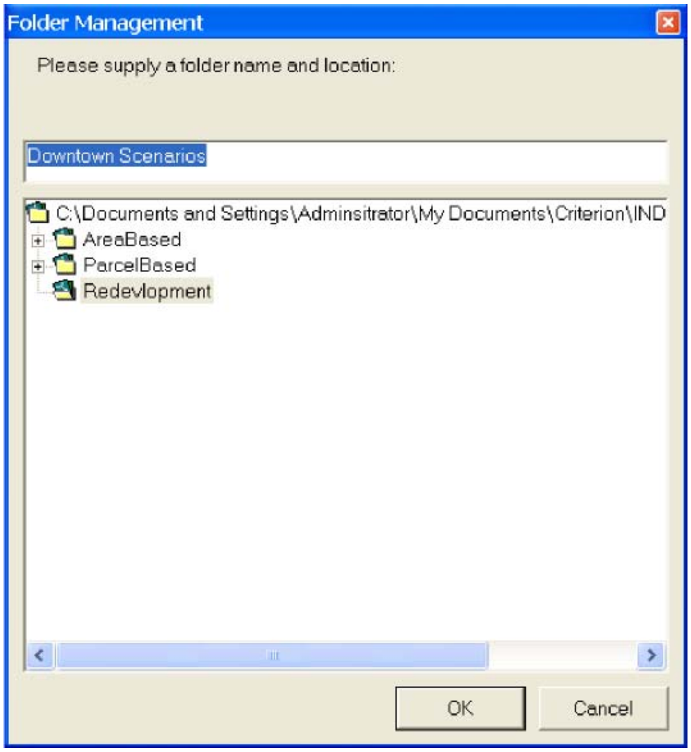
9. When the process is complete, click the Exit button to return to Study Manager.

Study Folders

Studies folders are located inside the Root directory and are created in order to organize studies.

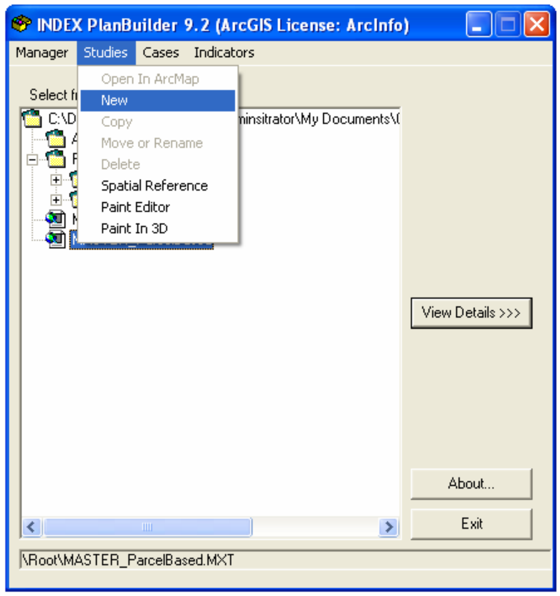


A typical folder structure would include nested folders used to organize study types and/or study area locations.

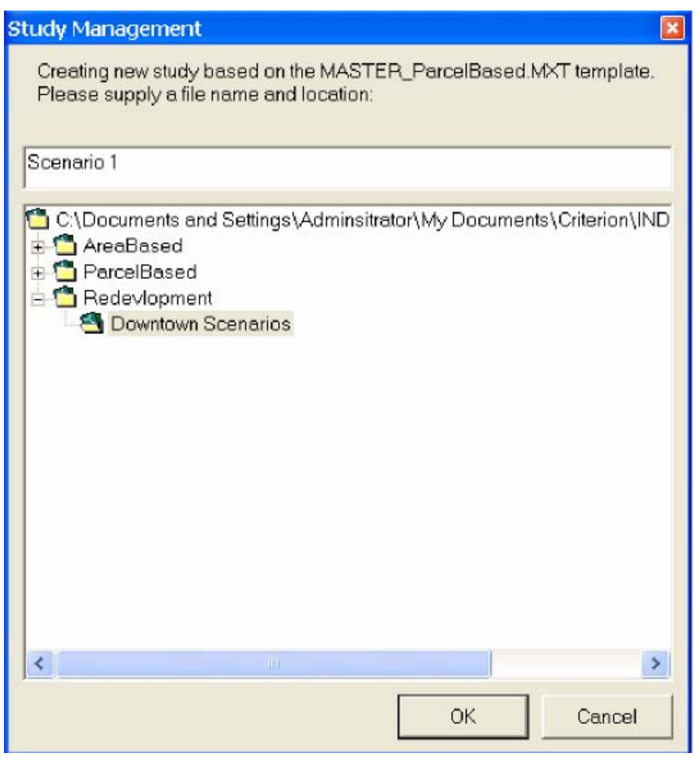


New Studies

New studies are created by selecting a MASTER template and clicking the New menu option.

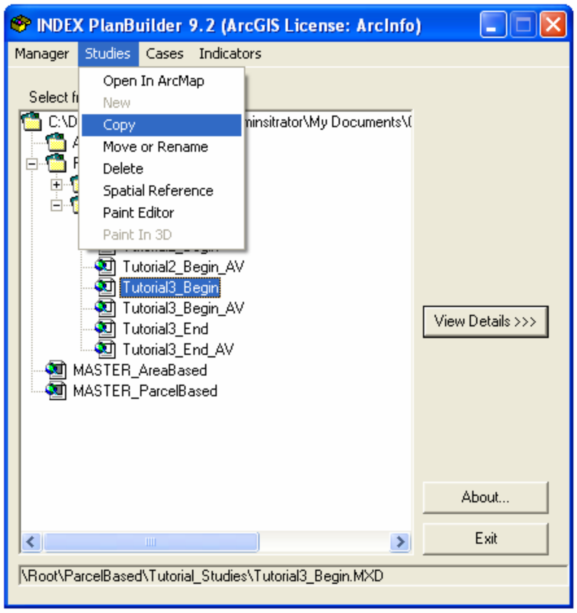


The destination folder must be expanded and selected before the new study is created.



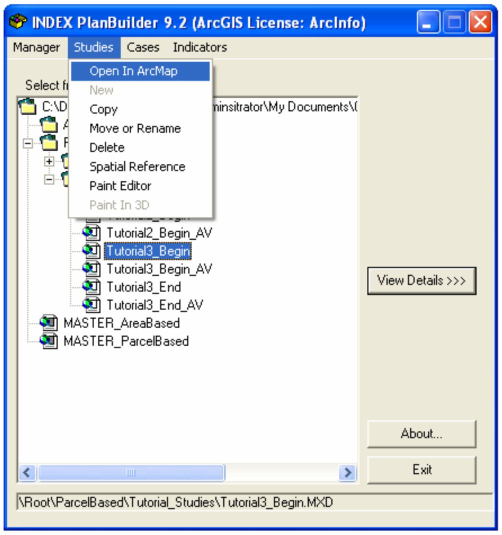
Copied Studies

Studies can also be created by copying an existing study.



Opening a Study

To open a study, select one of the existing studies and click the Open in ArcMap menu option.

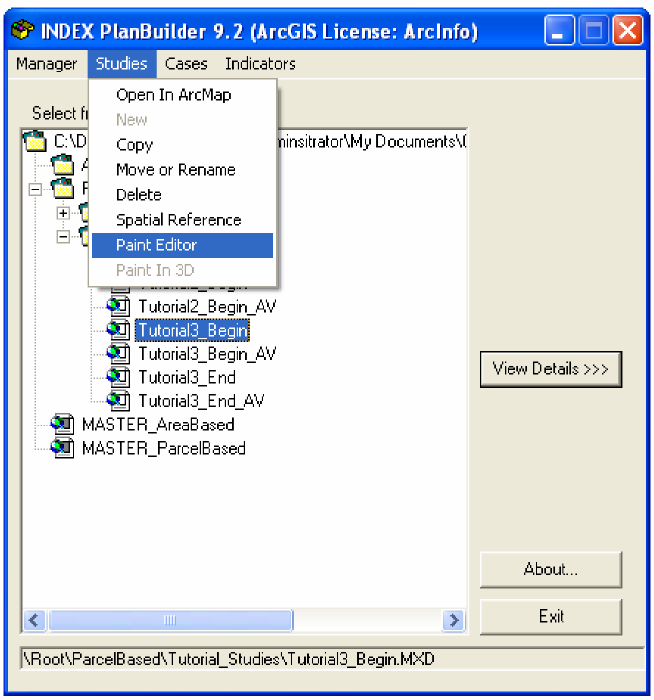


To improve INDEX performance, when opening any Study for the first time on a particular computer, or copying any Study or Case to create a new Study or Case, always click Save before proceeding with the application. Once this has been done on a particular computer, it isn't necessary to repeat the Save procedure during subsequent work on the Study or Case.

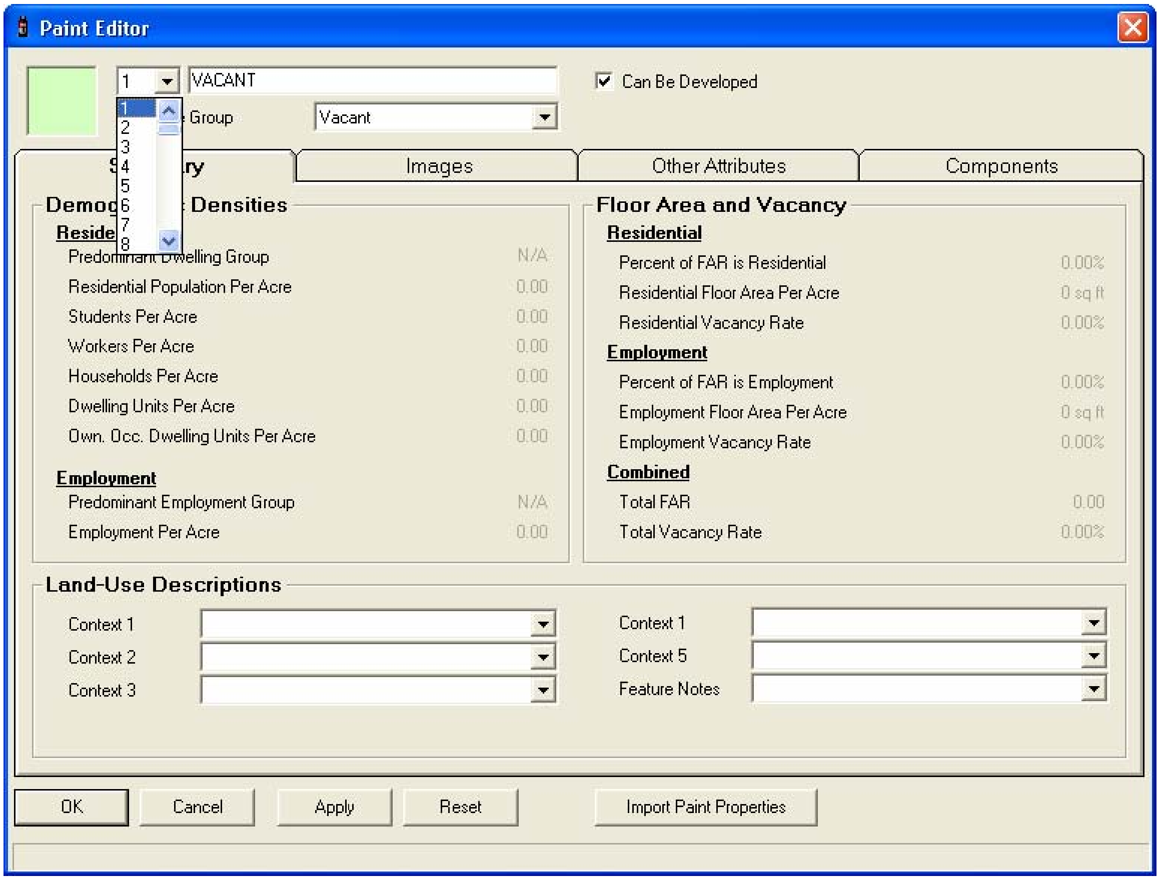
Paint Editor

The Paint Editor is used to create land-use “paints” for scenario building and digital charretting. Paints represent land-use types that possess dwelling, employment, and environmental attributes. The Paint Editor allows you to create three types of paints: existing land-use, planned land-use, and hypothetical or design paints. Existing land-use is used to describe current conditions that are present in an area. Planned land-use is used to describe current official plan designations that govern property development. Design paints are hypothetical land-use types that can be used to test new concepts when formulating scenarios and plans.

Existing land-use paints must be created for each local land-use type prior to loading land-use polygons (parcels, land-use cover, etc.) into INDEX. It may be preferable to condense local land-use types if the jurisdiction uses a large classification scheme (e.g. more than 20 land-use classes).



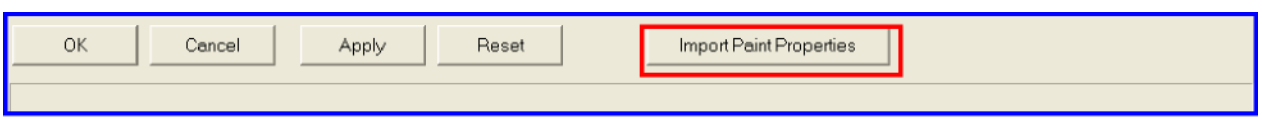
The Paint Editor can hold up to 250 land-use types or paints. Of these, 17 paints have already been created as samples with default values. Users may create an additional 233 paints of existing land-uses, planned land-uses, and/or design land-uses.



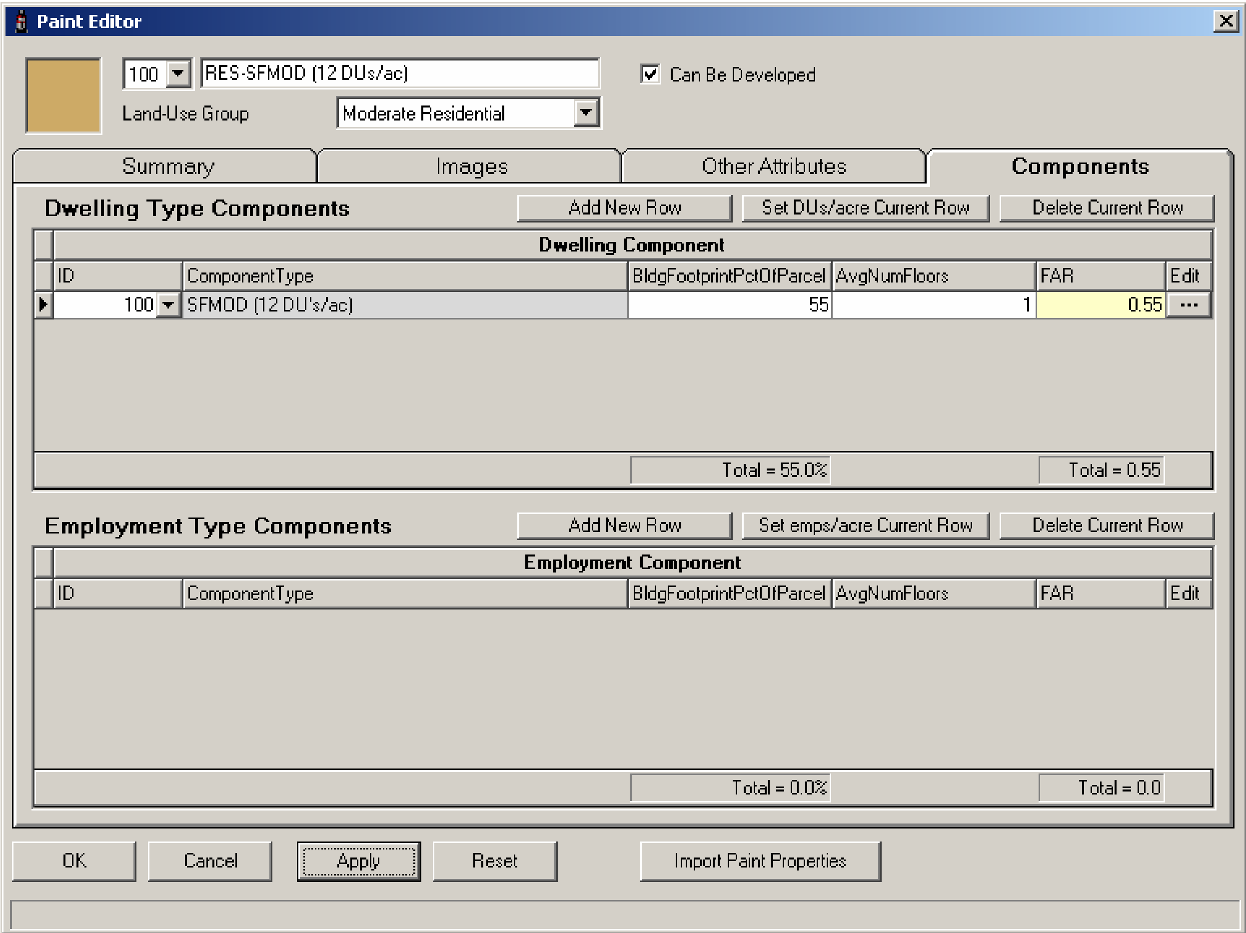
The first 17 paints are sample land-uses with default values. These paints should not be altered. You will use sample paints to define your own local existing land-uses in INDEX. The table below contains the primary properties associated with the sample paints.

	Paint ID	Default Name	Land-Use Group	Dwelling Groups	Employment Groups
	1	VACANT	Vacant	--	--
	2	Sample: RES SF LOW	Low density residential	Single-family	--
	3	Sample: RES SF MEDIUM	Medium density residential	Single-family	--
	4	Sample: RES MF HIGH	High density residential	Multi-family	--
	5	Sample: COM RETAIL/SERVICE	Retail/services	--	Retail
	6	Sample: COM OFFICE	Office	--	Service
	7	Sample: MIXED-USE COM/RES	Mixed-use	Multi-family	Retail
	8	Sample: INDUSTRIAL	Industrial	--	Manufacturing
	9	Sample: SCHOOL	School	--	Other
	10	Sample: INSTITUTIONAL	Institutional	--	Other
	11	Sample: AGRICULTURE--CROPS	Agricultural	--	--
	12	Sample: AGRICULTURE--PASTURE	Agricultural	--	--
	13	Sample: OPEN SPACE	Open space	--	--
	14	Sample: PARK	Park	--	--
	15	Sample: PARKING	Parking	--	--
	16	Sample: RIGHT OF WAY --STREET	Right-of-way	--	--
	17	Sample: RIGHT OF WAY --UTILITY	Right-of-way	--	--

Sample paint properties can be used to quickly create new paints with the Import Paint Properties function.



Dwelling and Employment Types are created independently of Land-Use Types and are given their own custom names, components (attributes), and ID numbers. Dwelling and Employment Types are linked to Land-Use Types from the Components Tab in the Paint Editor. As with land-uses, you can build up to 250 dwelling and employment types. To avoid inadvertently changing the attributes of a Dwelling or Employment Type Component that is already associated with Paint, use the same Dwelling or Employment Type Component ID as the Paint ID.



Dwelling and employment components provide density-based attributes which are derived from the size of the land-use polygons. These components are typically used to simulate build-out, not existing conditions. For Existing Land-Use Types, the dwelling and employment components should be set to one of the "NO DEMOGRAPHICS" settings with the correct component type (i.e. ELU SF-NO DEMOGRAPHICS vs. ELU MF-NO DEMOGRAPHICS).

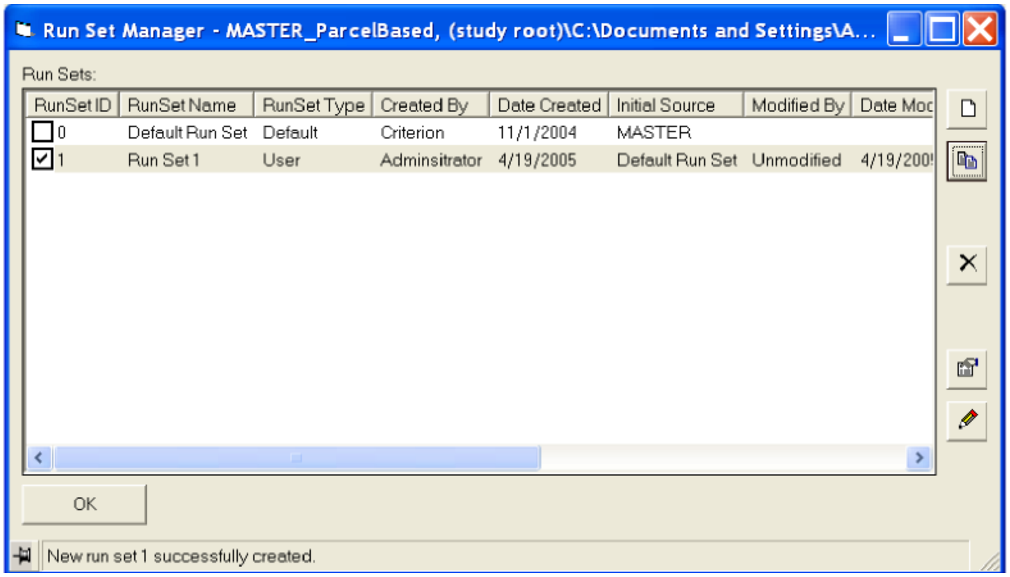
Run Set Manager

INDEX PlanBuilder evaluates cases with up to 77 indicators.

ArcView Users: The 57 indicators available for those with an ArcView license is a subset of the 77 available to users with ArcEditor or ArcInfo licenses. ArcView does not support network-based indicators.

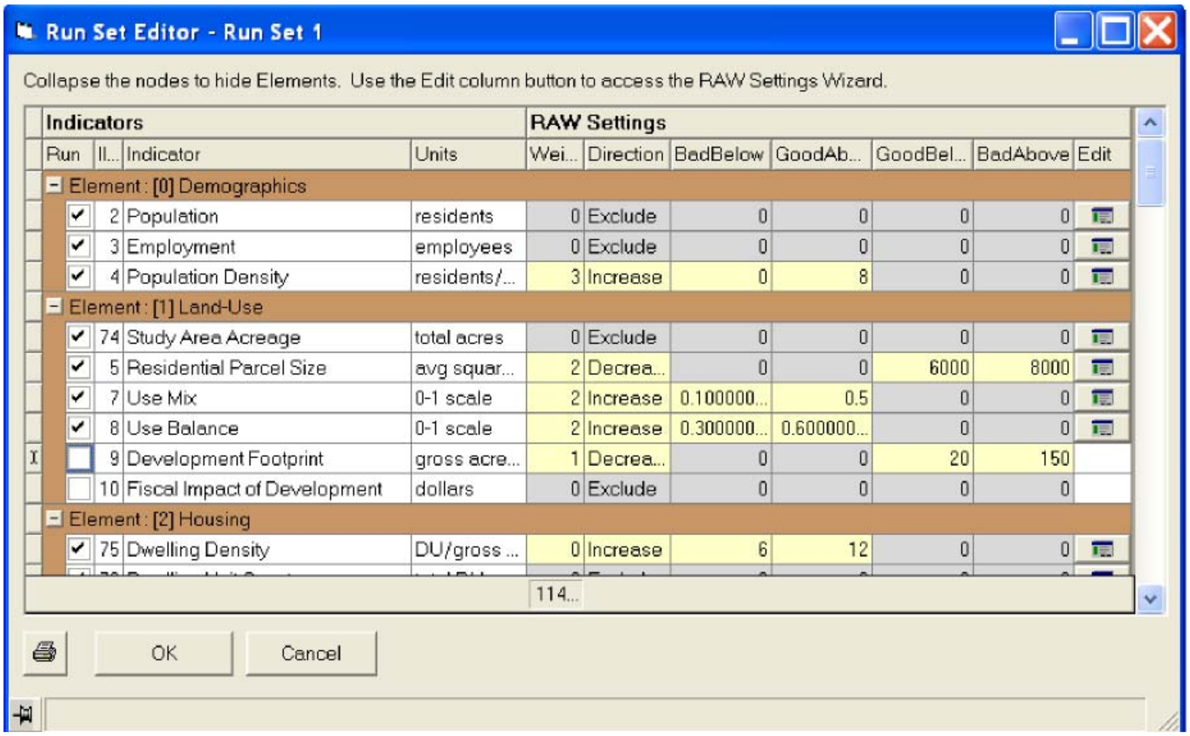
The run set manager allows users to pre-select subsets of indicators that are chosen according to relevance to study objectives, e.g. housing-related indicators for a housing study. The run set manager provides an interface for creating and storing many different run sets for various policy topics. It also provides the ability to set objectives for indicator scores, weight the importance of each indicator, and specify how indicator scores should be represented in map and chart output.

The default run set includes every indicator in the application. Running the full set of indicators can take a long time, and it is often only necessary to run a subset of indicators from the full menu. The solution is to create a run set with only the indicators you need. Much like the Case Manager, you can create, edit, and copy run sets using the run set manager.



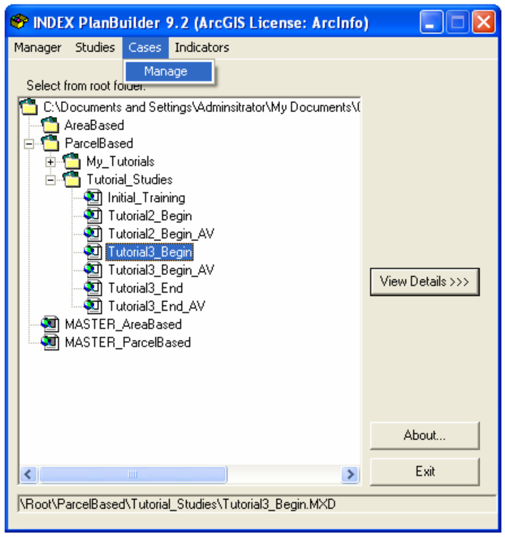
Run Set

The Run Set window allows you to select which indicators will be run when the Calculate command is selected.

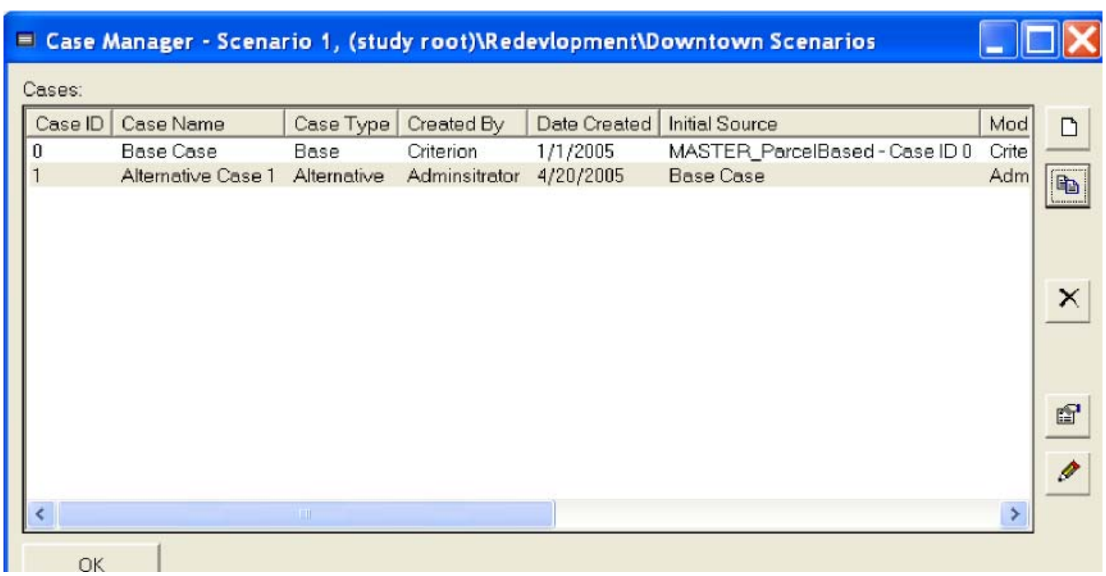


Case Manager

All studies are created with an empty Base Case, the starting point for all INDEX applications. Alternative cases can also be created for each study using the Case Manager. The Case Manager is accessed using the Cases > Manage menu option in Study Manager.



From this window, you can create new empty cases, copy existing cases, delete cases, and alter case properties.

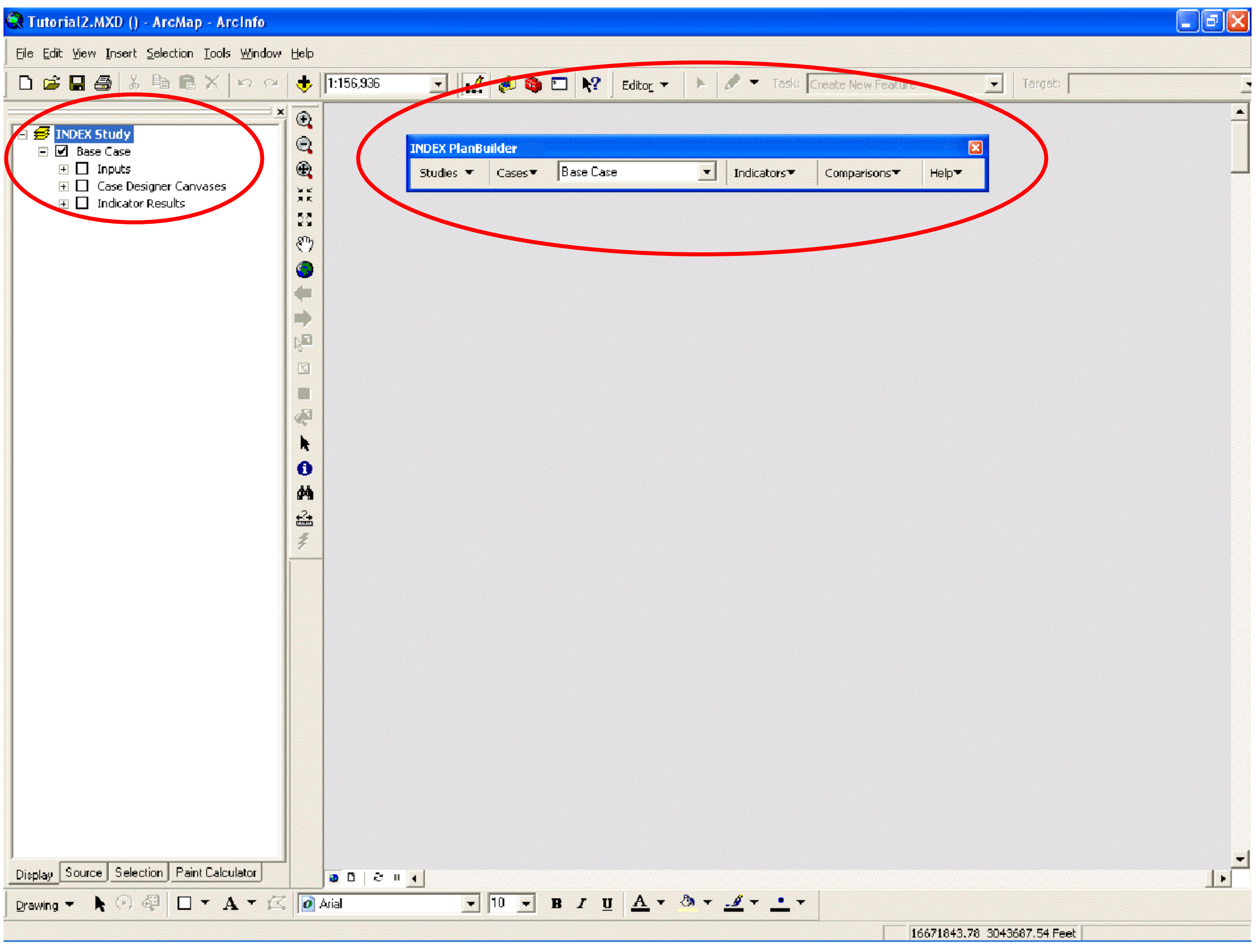


STUDY TOOLS

Having opened INDEX to a study, you are now ready to access the application's major tools for designing and evaluating cases.

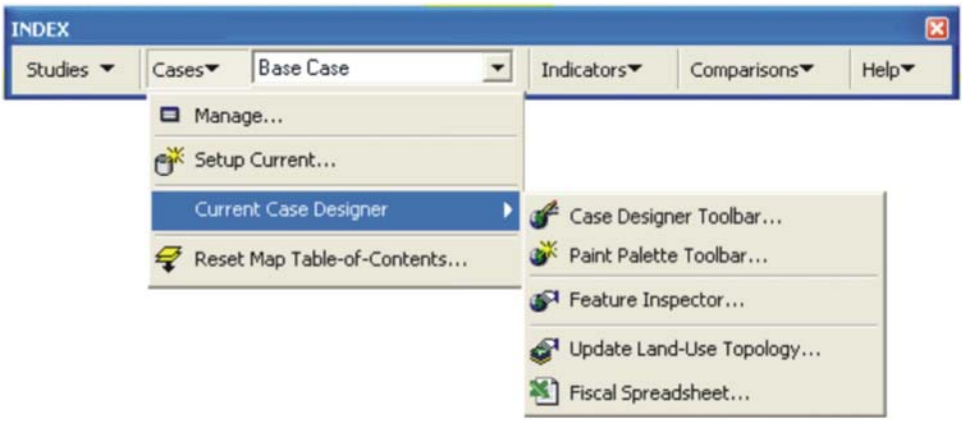
An INDEX study will always have an INDEX Data Frame in the table of contents. This is where maps are listed for the user to support various interactive INDEX functions. The Data Frame's contents are organized in a hierarchical way, using nested group layers and data layers. Each case presents the top-level set of group layers in the hierarchy.

A new study created from one of the study templates will open with only one case present. Under each case is an Inputs group layer, a Case Designer Canvases group layer, and an Indicator Results group layer. The structure of this hierarchy will not change, except when additional cases are created and deleted. The deepest contents of the various group layers in the case hierarchies are data layers. These layers are based on feature classes stored in the personal geodatabase associated with the study. The appearance of these layers will change as the user adds and edits the data associated with each case.



Case Menu & Case List

The Cases menu and Case List combo box on the INDEX toolbar contains all the functionality that allows you to work with cases and case data.

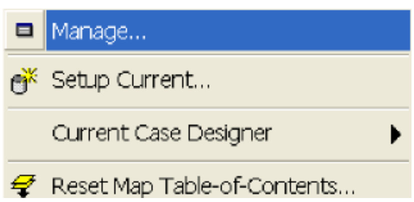


The Case List allows you to set the current case. This value is used by many of the INDEX functions and windows. Selecting a case changes the appearance of the INDEX Data Frame to focus on the part of the hierarchy of layers that reflect the data in that case. It also closes the edit session on the old case, if one is currently open.

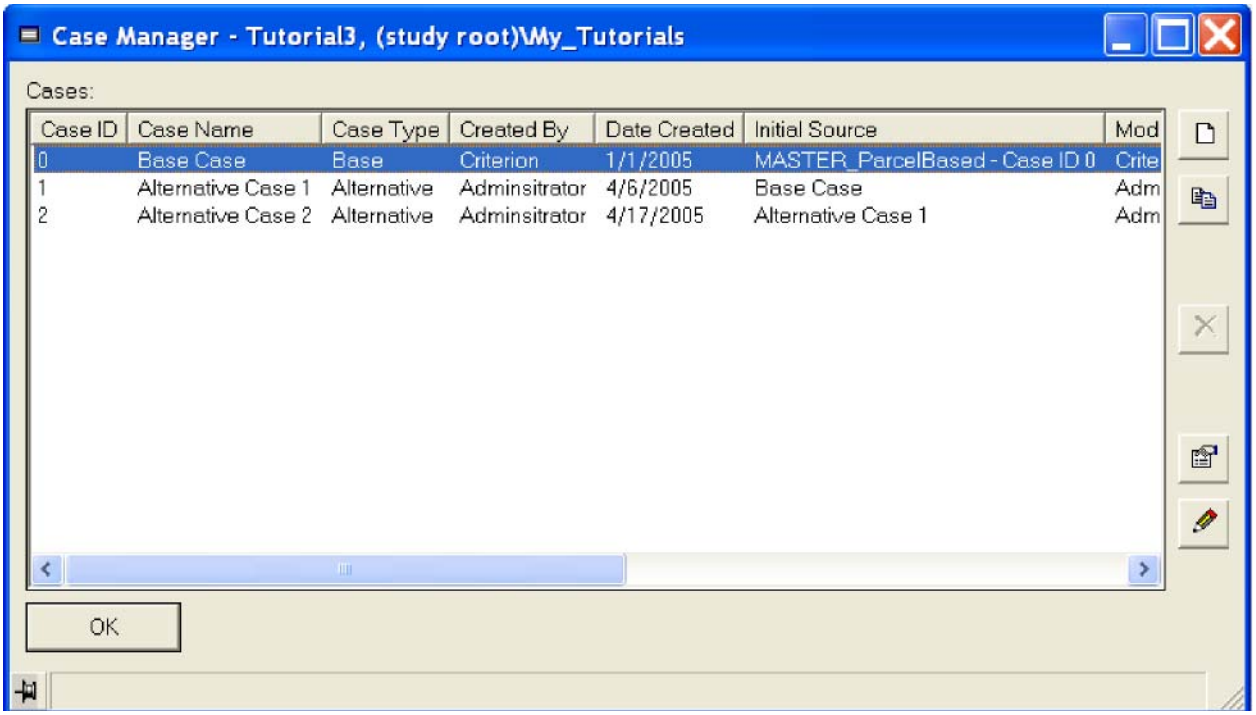
Do not open Study Manager at the same time that a Study is open. Always close a Study before returning to Study Manager.

<u>Case Manager</u>

Selecting the Manage option opens the Case Manager window, the same one accessible from study manager:

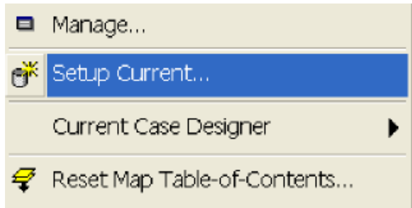


All cases in the study will be listed in the Case Manager dialog. Access this window to review and edit case notes in the properties window. You cannot create new, copy, or delete cases from inside a study. A shortcut button is also provided that allows you to access the Case Setup Editor for the selected case (see below).



<u>Case Setup Editor</u>

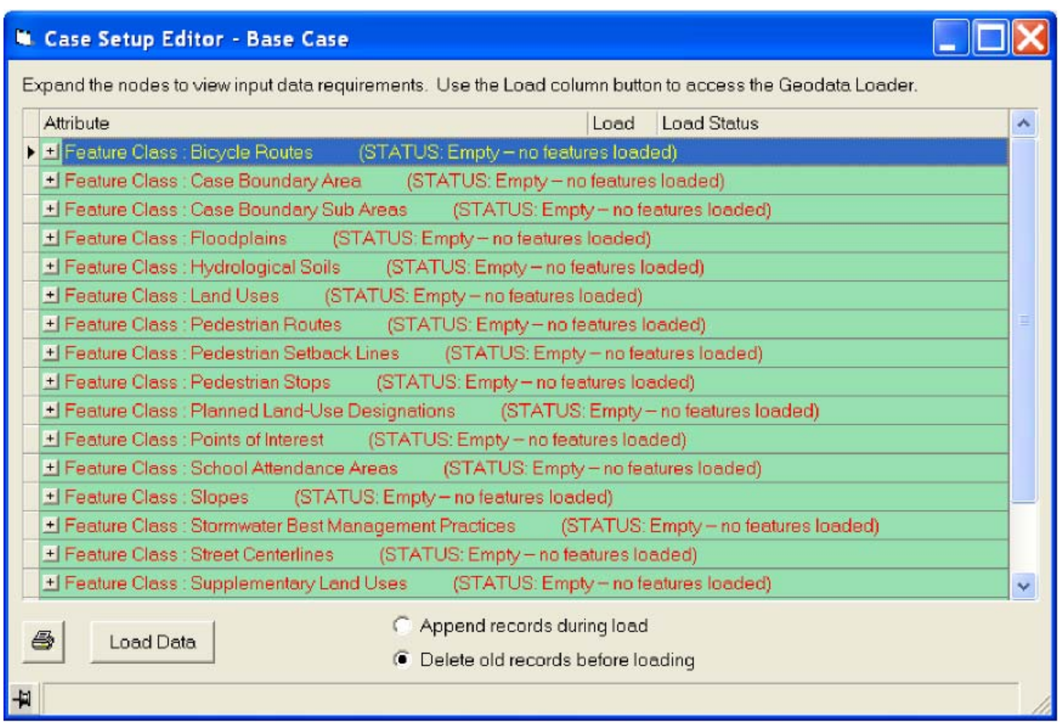
Selecting the Setup Current option from the Cases menu opens the Case Setup Editor for the current case. The current case is either the case selected in the Case List tool on the INDEX toolbar, or this same action can be accomplished using the Edit button on the Case Manager window.



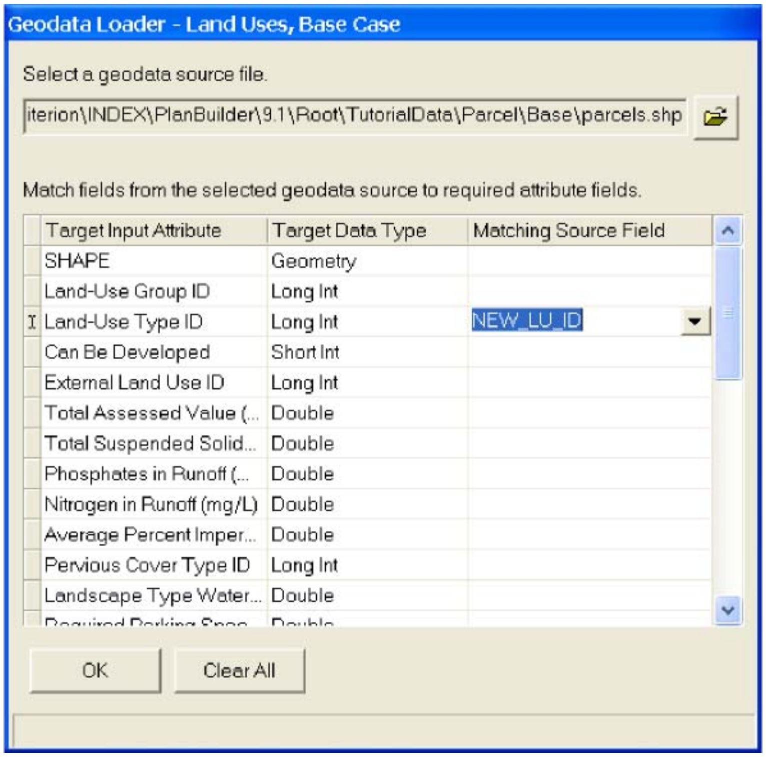
Case data must either be loaded or created within INDEX. Case data can only be loaded from shapefiles.

The spatial extent of required data is defined by a case boundary. This boundary is determined by a study's objectives and the amount of relevant geography, e.g. a one-half mile radius area surrounding a rail transit station that represents its catchment area walkshed. Data must be obtained or created for feature classes inside a case boundary, and for a reasonable distance surrounding the case boundary in order to account for nearby features relied upon by study area residents and workers, e.g. a nearby park that residents walk to.

Data within INDEX is stored in feature classes that reside in a personal geodatabase. To load data, expand the node for the feature class (for example, Land Uses). The listing that appears shows all the attributes of that feature class. Only attributes needed by INDEX to calculate indicators and present data are included in the feature classes. The status of previous data loading is displayed to the right of the feature class name and affects the color of the feature class node's text. Empty feature classes appear in red. Feature Classes that have a load pending appear in blue.



To load data, select the Load button from any line in the expanded feature class attribute listing. Selecting the Load button opens the Geodata Loader window.



This window allows you to select a geodata source file (shapefile) from your hard disk drive and associate its fields with the INDEX feature class attributes. Most attributes are required as input data for indicator calculations. The description attributes are provided for the user to add custom mapping and query fields to the attributes required by INDEX.

The user may also clear all mappings to the source data and its fields if a mistake has been made. Once data is loaded any fields not associated with a field in the source data will get default values.

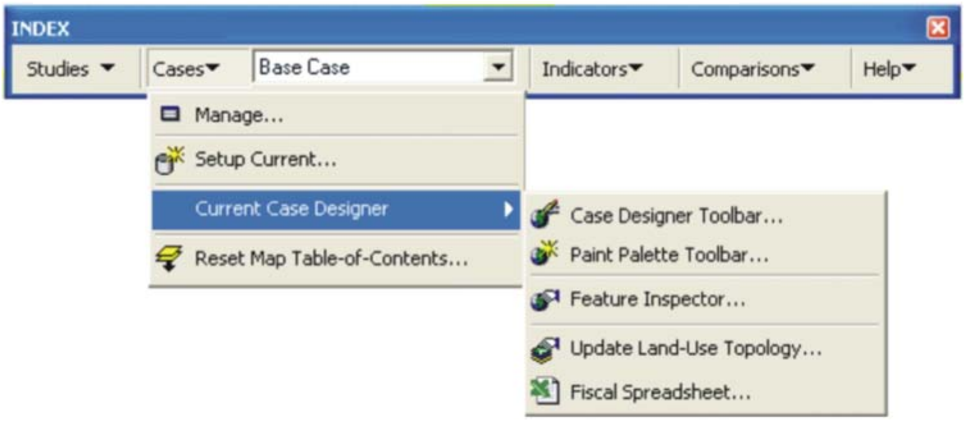
Once all desired fields have been assigned using the Geodata Loader, you select OK to commit the assignment and return to the Case Setup Editor. Once there the data can be loaded into the case by selecting the Load Data button.

Load Data has two options: “Append records during load” and “Delete old records before loading”. The Delete option is the default, but the Append option can be useful when inserting new features (e.g., new land-use parcels for an annexation area or a new subdivision). The Append option will not delete existing features that intersect appended features, so these must be deleted or trimmed prior to using Append.

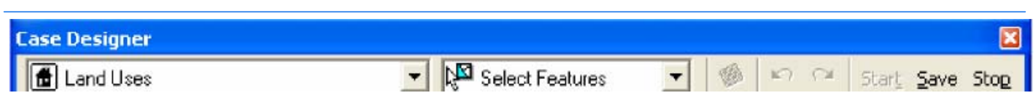
The data loading process can take several minutes, as INDEX processes the shapefile data for each feature class and creates new attributed features in the study geodatabase.

Case Designer Toolbar

The Case Designer toolbar is launched from the Cases Menu on the INDEX toolbar to support scenario building and digital charretting.



The Case Designer toolbar provides a custom editing environment similar to the ArcMap Editor toolbar. The purpose of this custom environment is to provide convenient access to scenario-related tools. Functions done with Case Designer could be done using other ArcMap tools, but it would be much more difficult and time-consuming for real time support of scenario building.

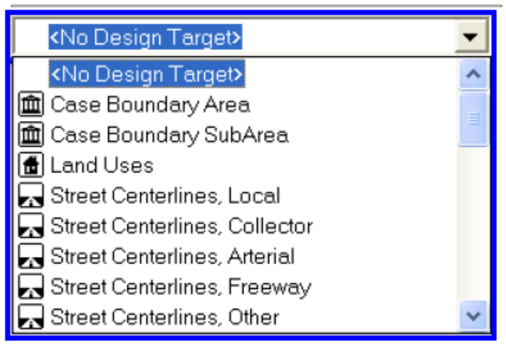


While you are using the Case Designer, it also executes other set-up steps. When it is launched from the Current Case Designer submenu, the Case Designer toolbar also triggers the start of an edit session. The workspace of this edit session is set to the workspace of the current case and its feature classes. When you use the Design Target tools (see below) many settings, such as the current selectable layers, the snapping environment, and the edit target and edit task, are set for you. Many of these actions will also cause other toolbars, such as the Editor and Effects toolbars, to appear.

The tools available on the Case Designer toolbar are: the Design Target combo box; the Design Mode list; the Toggle Sticky Notes button; the Undo and Redo buttons; and the Start, Save and Stop Editing buttons. The Toggle Sticky Notes button enables a tool for annotating maps with comments attached to spatial features.

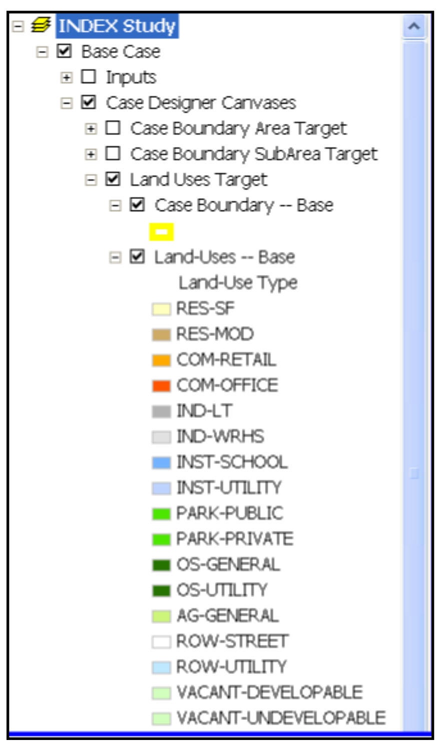
Design Targets

Design Targets are the elements of scenarios that can be designed or edited on-the-fly in digital charrettes. There are as many Design Targets as there are user-editable feature classes and feature class subtypes.



To edit data in a feature class, first select it from the Design Target combo box. Be sure to select the specific subtype of the feature you want to edit (for example, you would select “Transit Routes, Bus” if you want to edit Bus Routes).

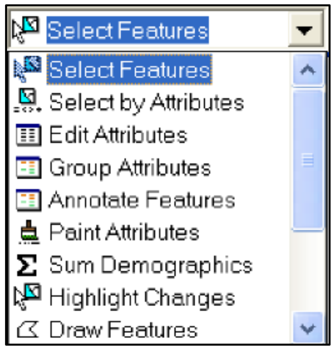
Selecting a Design Target changes the display state of case hierarchy group layers and data layers in the INDEX Data Frame in the Table-of-Contents. A special group layer called “Case Designer Canvases” is expanded under the current case. Under that group layer, another group layer (referred to as a “canvas” because it is where the creative process of case design “painting” takes place) is expanded that matches the name of the Design Target. For example, the Transit Routes Target canvas is expanded when Transit Routes, Bus is the Design Target.



Canvas group layers provide a collection of useful data layers to provide study context and guide you in editing the target data layer (for example, "Transit Routes – Base" in the image above).

<u>Design Modes (Data Editing)</u>

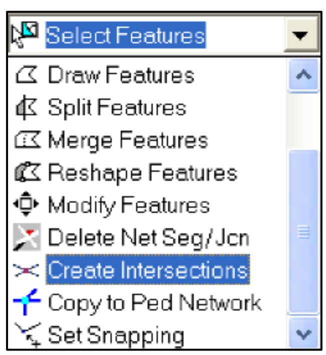
There are nine basic tools or "Modes" in the Design Mode combo box.



These tools provide many of the basic ArcMap editing functions in a consolidated format that works equally well for point, polyline and polygon feature classes. Each will automatically reference the right target layer. Each Mode will also warn you if the wrong number of features is selected, preventing that Mode from functioning.

It is important to note that extended feature class functionality for Land Uses, Case Boundary Area, Street Centerlines, and Transit Stops will cause many changes to occur beyond the simple changing of a shape. For example, right-of-way polygons may be created in Land Uses when Street Centerline segments are drawn.

Selecting some Design Targets, such as Street Centerlines or Pedestrian Routes, causes additional tools to appear in the Design Modes combo box.



Notice that Create Intersections has appeared in the combo box.

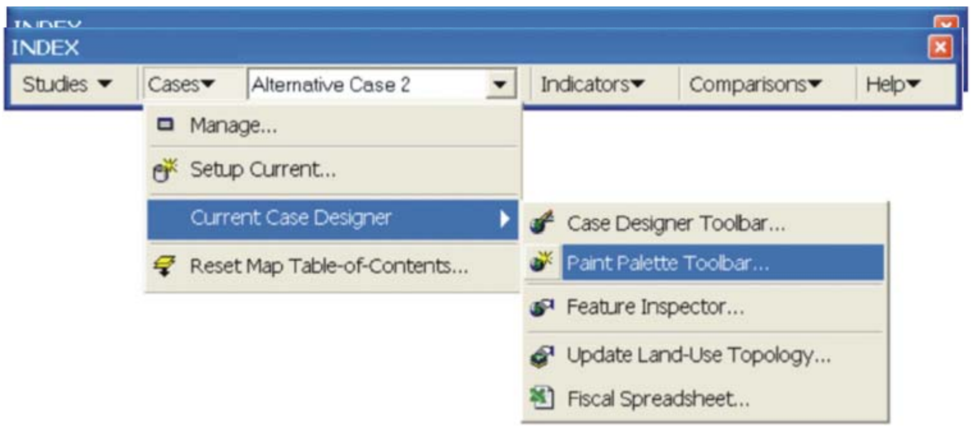
ArcView Users: Some design modes (such as "Delete Net Seg/Jcn") are not supported by ArcView.

Save Edit Buttons

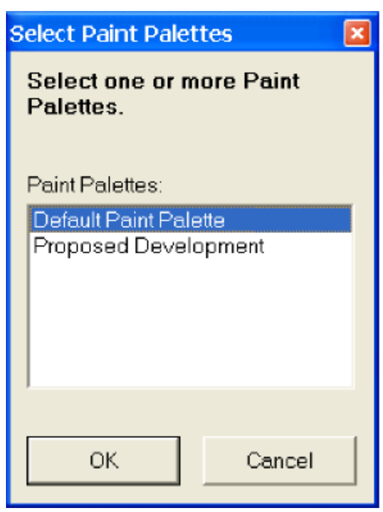
The Undo, Redo, Start, Stop and Save Editing commands are identical to those found on the standard ArcMap toolbars and in menus. They have been placed on the Case Designer toolbar for convenience. They may appear as words or icons as a function of ArcMap's operation independent of INDEX.

Paint Palette Toolbar

The Default Paint Palette, or any other user-created paint palettes, can be opened by selecting the Paint Palette Toolbar menu option from the Cases menu. This will call up the Select Paint Palettes window.



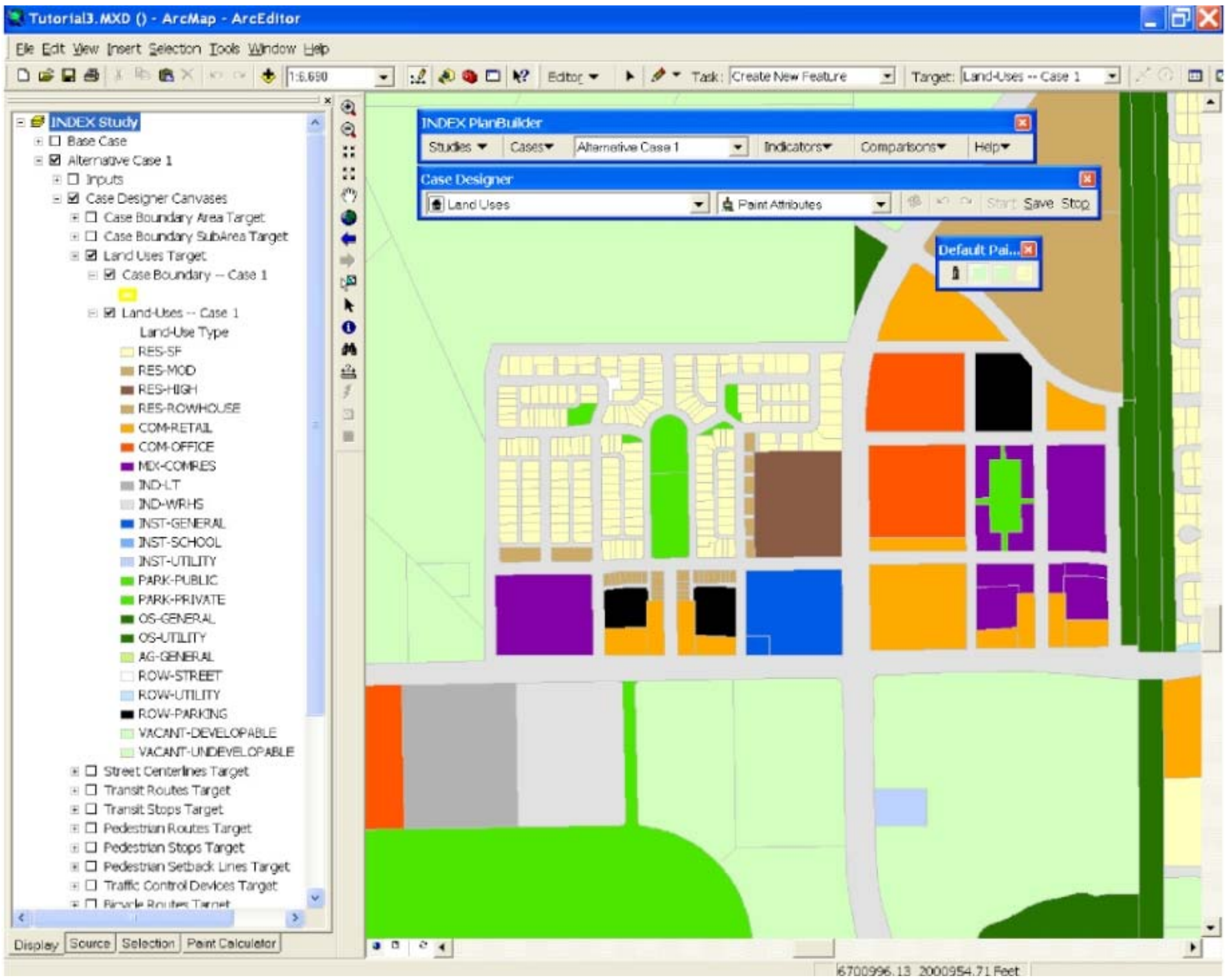
Paint Palettes are toolbars that hold sets of paint chips, the paints of which are sets of land-use types and attribute settings.



The Paint Palette toolbars are also accessed by way of the Paint Attributes Design Mode on the Case Designer toolbar. When first loaded, a paint palette may appear docked to the right edge of the Map area. You can move it around by simply undocking it like any other toolbar.

Using Paints to Change Land-Use Attributes

With Land Uses as the Design Target, Paint Attributes as the Design Mode, and the Paint Palette toolbar showing, you can begin scenario building by painting new Land-Use types.



If a paint palette toolbar is closed for any reason during a Case Designer edit session, the Paint Palette Toolbar option from the Current Case Designer submenu can be used to restore it.

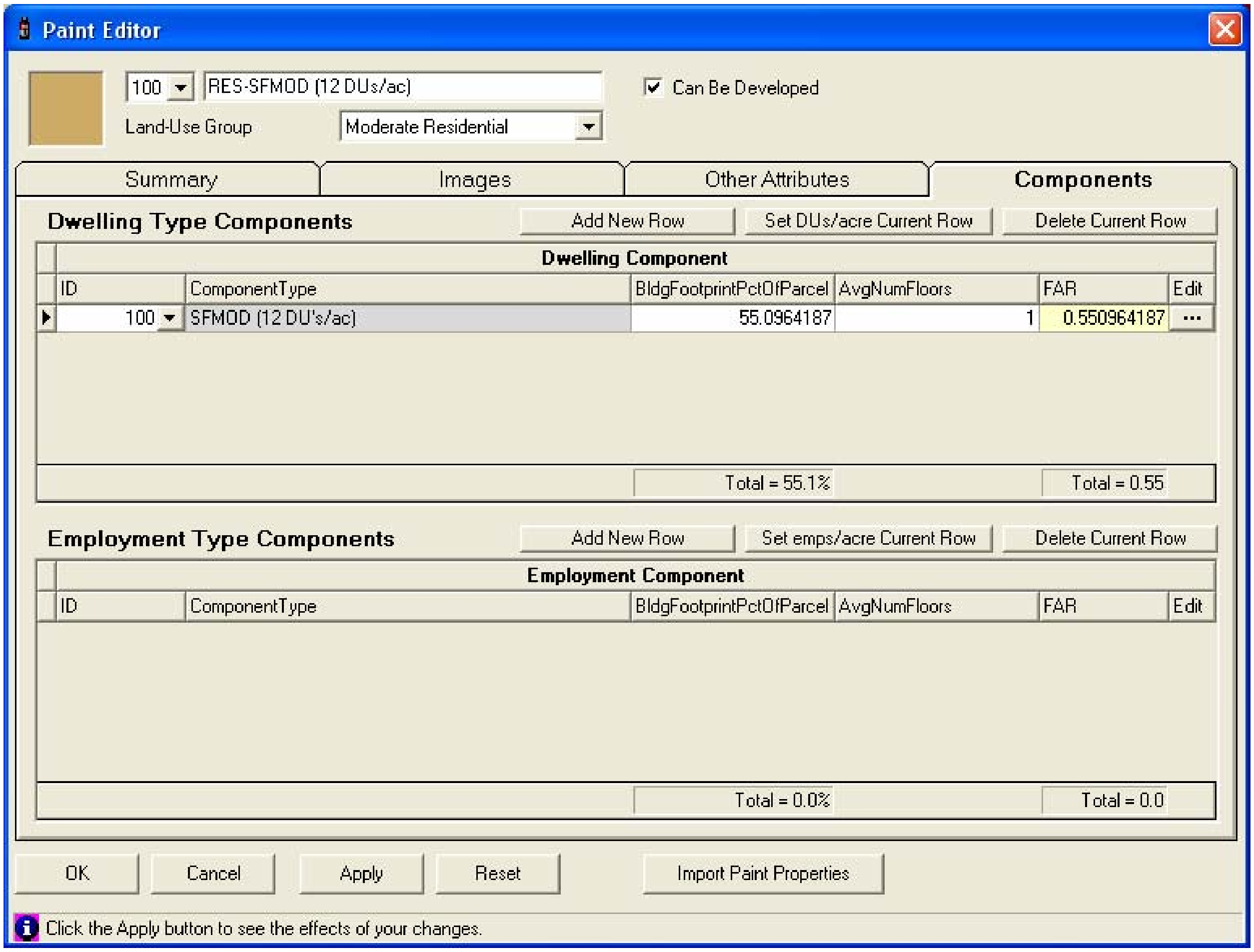
A "paint" is a land-use type and accompanying settings that are used to attach new attributes when the paint is applied to a Land Use feature.

Select a Paint chip from the Paint Palette toolbar to begin painting. The tool behaves much like the ArcMap selection tool, with the addition that upon selecting, the tool paints the attributes of the selected features with new attributes based on the settings of the selected paint.

When the paint is applied, the map will show the change in the Land Uses target data layer. You can use the Edit Attributes Design Mode to the see the new attributes of features after painting them.

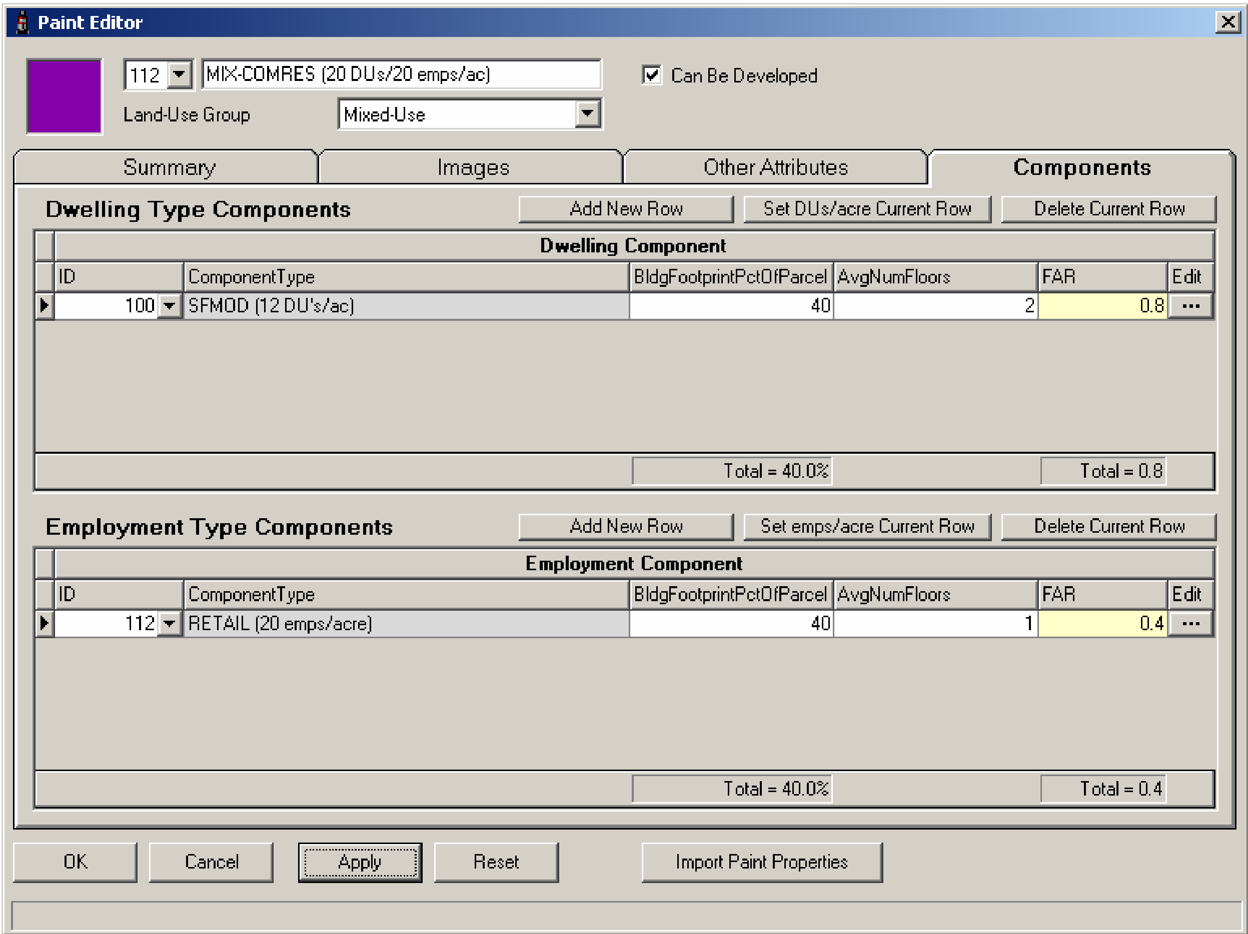
<u>Viewing Paint Details and Components in the Paint Editor</u>

Selecting the Paint Editor button on the Paint Palette toolbar will open the Paint Editor window. The Paint Editor comes up populated with the attributes of the selected Paint tool.



All attributes of the paint are calculated from this display or drawn from the paint data tables in the study geodatabase. The Paint Editor accessed from inside a Study is identical to the Paint Editor accessible from Study Manager.

Paints are also associated with Paint Components. These represent particular types of dwellings and employment characteristics that may be associated with a paint. A mixed-use paint, for example, will have both types associated with it.

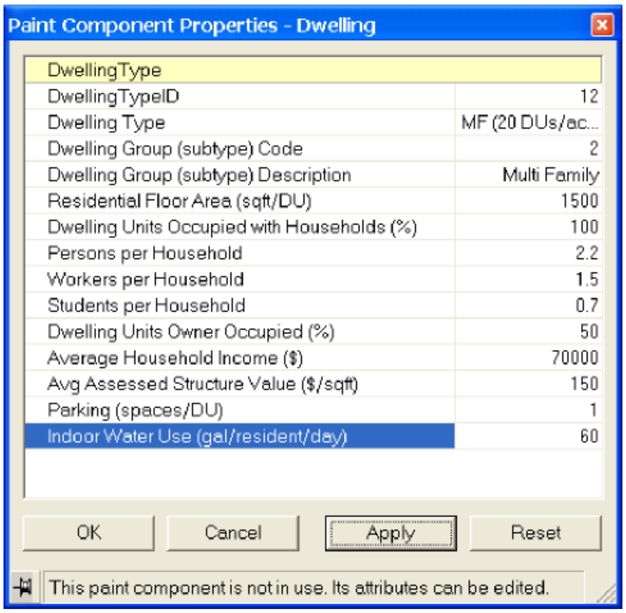


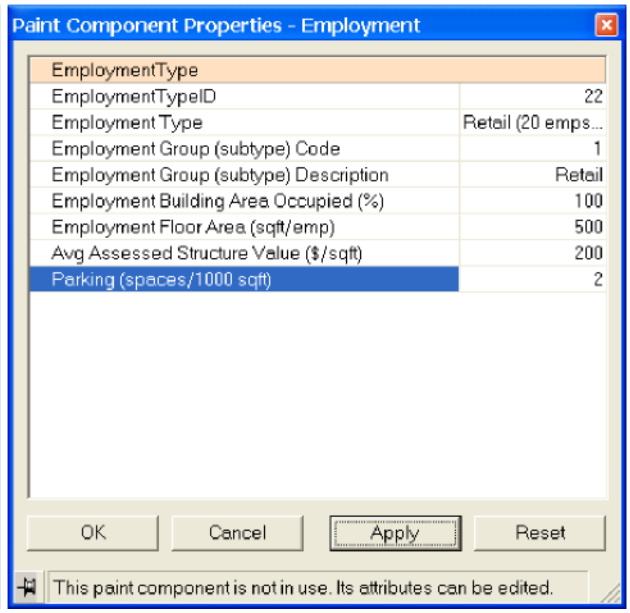
Paint components are assigned to a paint based on the area they would take up on a hypothetical parcel. In the above image a paint profile has 80% of the parcel area occupied by employment and residential building area; each of which accounts for 40% of the building footprint. In addition, the average number of floors and the resulting floor area ratio (FAR) is listed. The FAR is used to generate, among other items, the number of dwelling units, households, residents, and employees per acre for the paint.

Note: *If you paint a land-use polygon (parcel) and then change one of the paint values in Paint Editor and reapply the paint to the same land-use polygon, the attributes for the polygon will not be automatically updated. You must first remove the attributes of the land-use polygon by applying a different paint or the "turpentine" tool before applying the updated paint.*

Paint Component Properties

To see the attributes of a paint component, click the Edit button in the row that lists it. This will open the Paint Component Properties window.

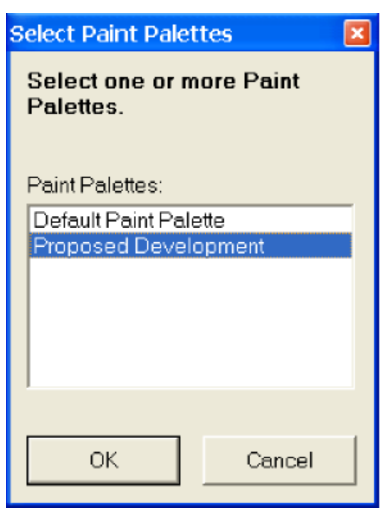




This window will list either Dwelling Group or Employment Group properties.

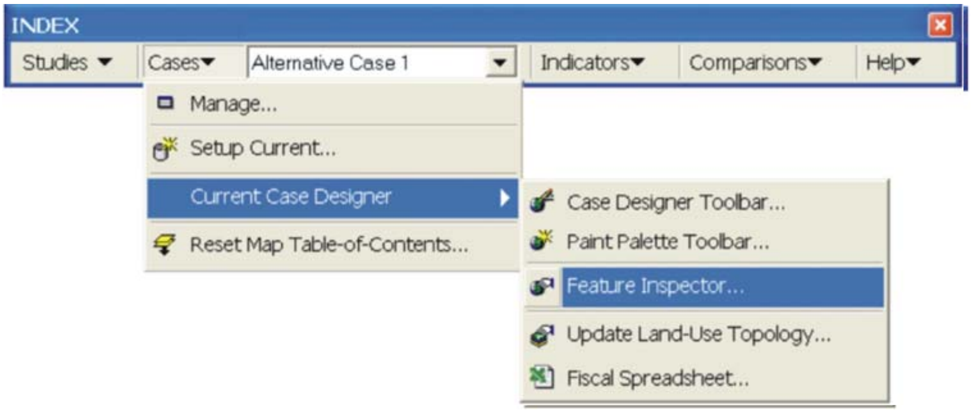
Custom Paints and Palettes

The alternative to using the default Paint Palette is to create a new palette. The advantage to creating a new palette is that its settings will remain with the project it is created in even if the project is moved to another computer, and it will also remain with any copies made of the project. Changes to the Default Paint Palette stay with the computer on which the changes are made.

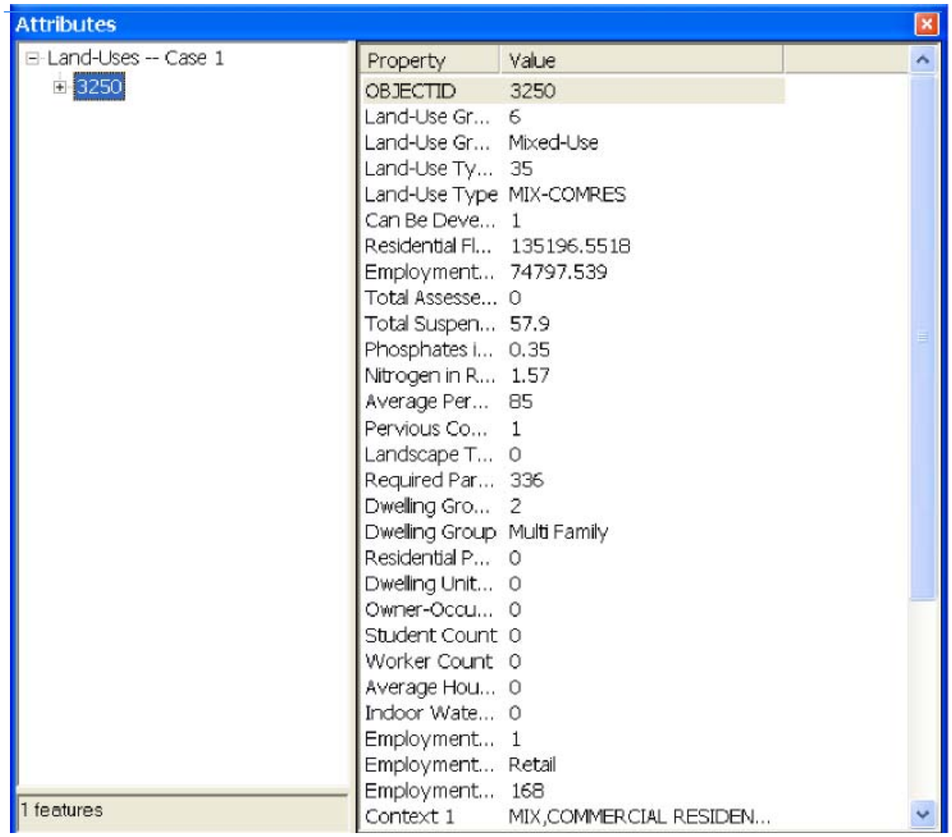


Feature Inspector

Select the Feature Inspector option from the Current Case Designer submenu to open this window.



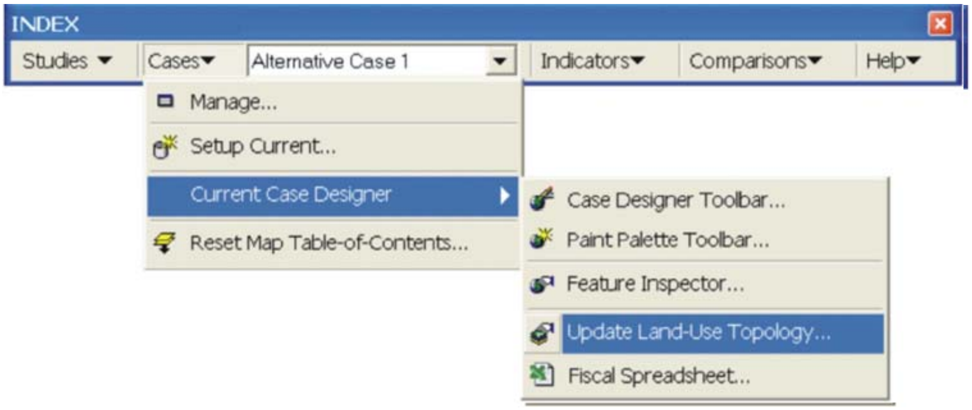
Even when not editing, you can investigate the attributes of features in INDEX feature classes using the Feature Inspector.



When the features being inspected are editable, the Feature Inspector becomes the attribute editor (the one also opened from the Edit Attributes Design Mode) and allows you to change the selected features' attribute data, individually or for all.

Land-Use Topology

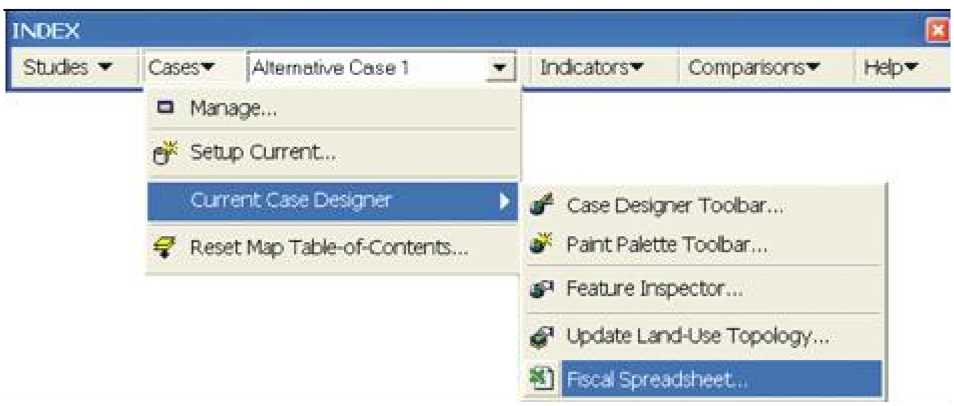
INDEX may make use of Land-Use Topology rules and geodatabase object behaviors to do some automatic editing of the input data to get it into a format consistent with INDEX requirements, depending on the study type and the feature classes.



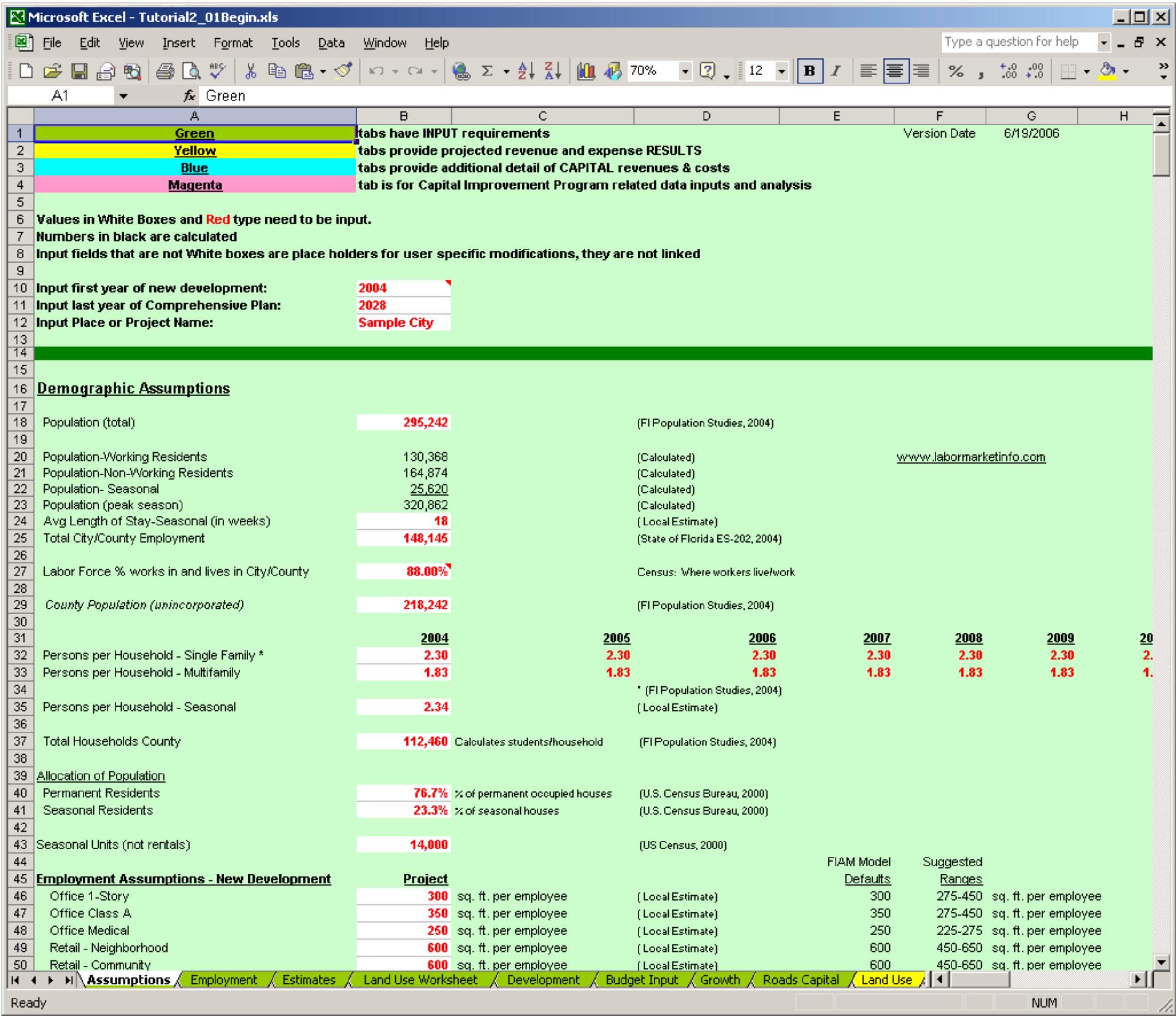
Land Use Topology also causes Dwelling and Business points to be created automatically from the attributes loaded into the Land Uses feature class.

Fiscal Spreadsheet

INDEX PlanBuilder includes the Florida Fiscal Impact Assessment Model (FIAM) that resides outside of ArcMap. Documentation of the fiscal impact methodology is available from the Florida Department of Community Affairs (www.dca.state.fl.us/fdcp/DCP/FIAM/index.cfm).



Selecting Fiscal Spreadsheet on the pull-down launches FIAM.



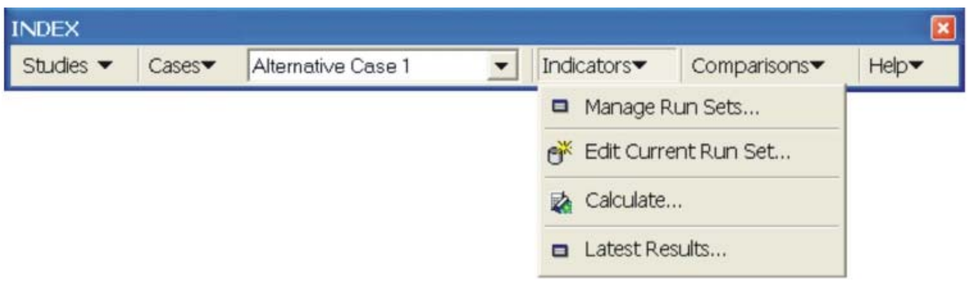
Indicators Menu

Indicators are "yardsticks" for identifying an area's strengths and weaknesses, testing alternative courses of action, and monitoring change over time. INDEX has a menu of 73 indicators available for evaluating cases and their impacts to study areas. From this menu, users may select those indicators that are most relevant to a given situation.

ArcView Users: The list of 57 indicators available for those with an ArcView license is a subset of the 77 available to users with ArcEditor or ArcInfo licenses (see Indicator Dictionary).

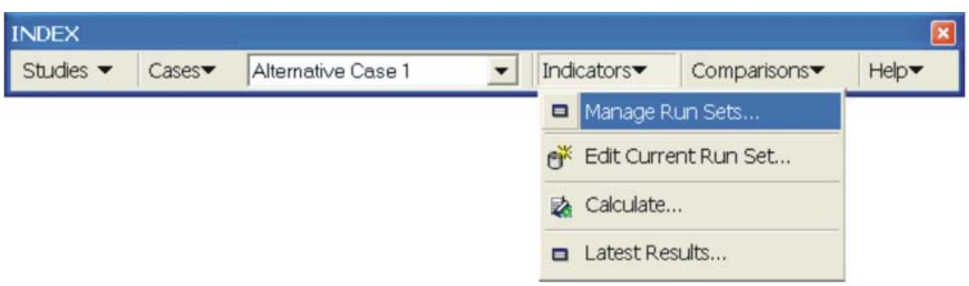
There are two kinds of indicator measurements made by INDEX: first, a numerical score for the study area; and second, mapping of the spatial pattern that produced the score. In this way users obtain both quantitative and geographic assessments of an area. The numeric scores are interpreted in relation to typical standards, common conditions in the local area, other alternative case scores, or adopted goals where they already exist. The geographic results are used to delineate areas where strengths can be protected and areas where weaknesses need to be corrected.

The Indicators menu allows users to set indicator objectives, manage run sets, run indicators, and view indicator scores.

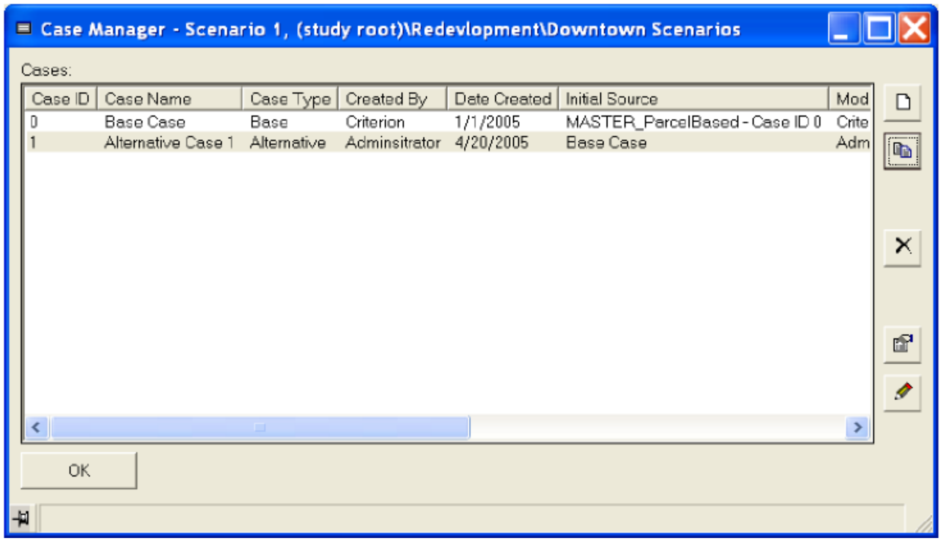


Manage Run Sets

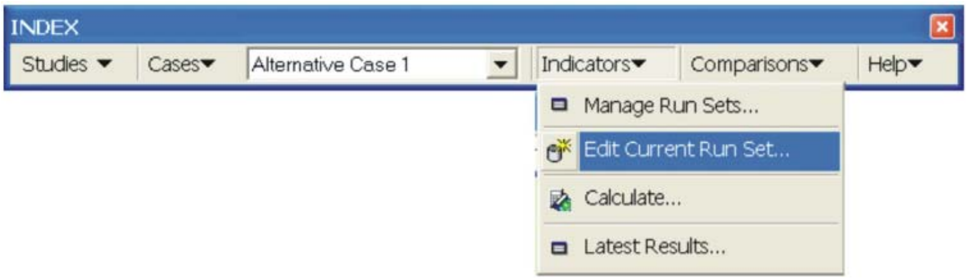
Much like the Case Manager, you can create, edit and copy run sets using the Run Set Manager.



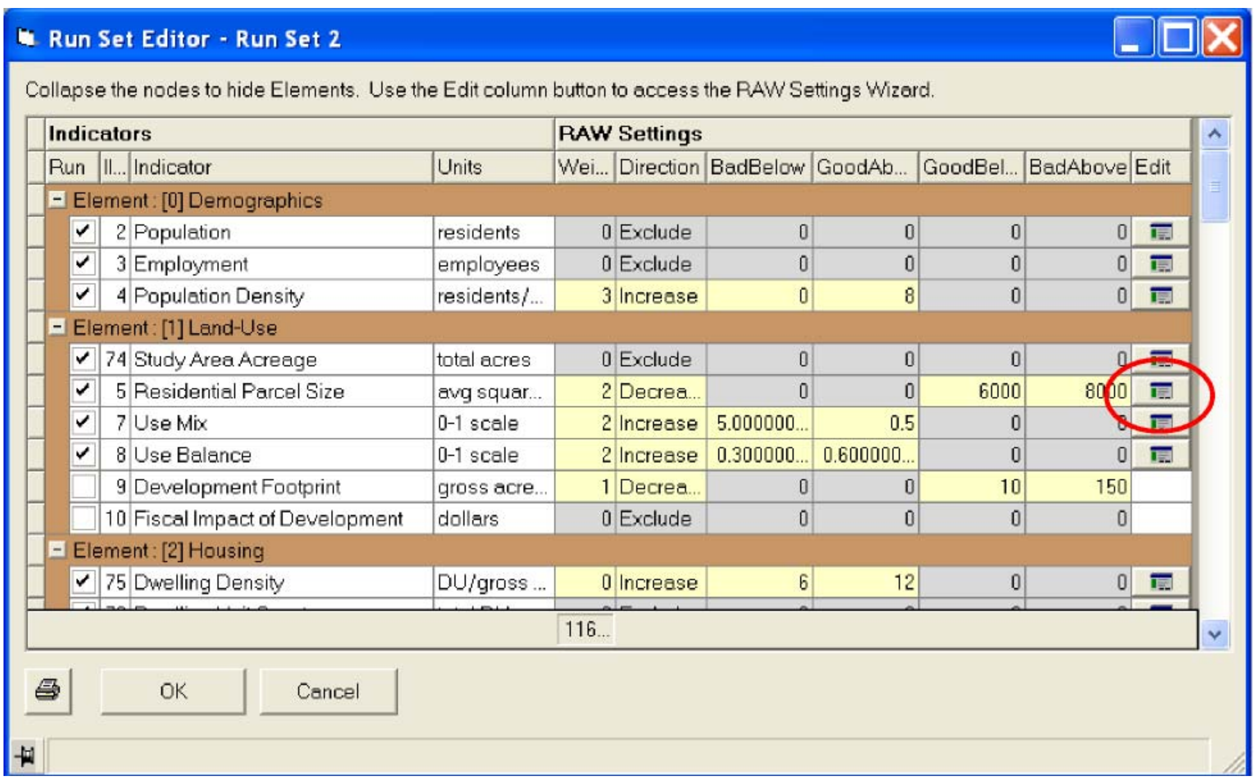
The default run set includes every indicator in the application. Running the full set of indicators can take a long time, and it is often only necessary to run a few indicators from the complete set. The run set manager is used to select whichever set of indicators is relevant to a given study.



Editing Current Run Set Including RAW Settings



The Run Set window allows you to select which indicators will be run when the Calculate command is selected. Note the Edit button at the far right of any selected indicator.



Clicking the Edit button opens the RAW Settings Editor.

RAW Settings

Rating and weighting (RAW) values are adjusted using the RAW settings wizard that is accessed through the Run Set Editor. The RAW tool allows INDEX users to define their goals and objectives according to desired indicator scores and relative weights of importance among indicators, as shown in Figure 4. This is an important means of comparing multiple cases with a common set of criteria in order to rank the cases according to their achievement of user goals.

For example, in a study that focuses on increasing transit use, stakeholders can use the RAW tool to specify that walk distances to transit stops should decrease generally; that preferred walk distances should be less than 1,000 ft.; and that indicators measuring transit orientation be weighted as more important than non-transit indicators.

ArcView Users: The following example indicator (Transit Proximity to Housing) is only available for ArcEditor and ArcInfo users, so you will not see it in your run set list.

The first step in entering RAW settings is assigning a score direction mode to selected indicators with one of four settings:

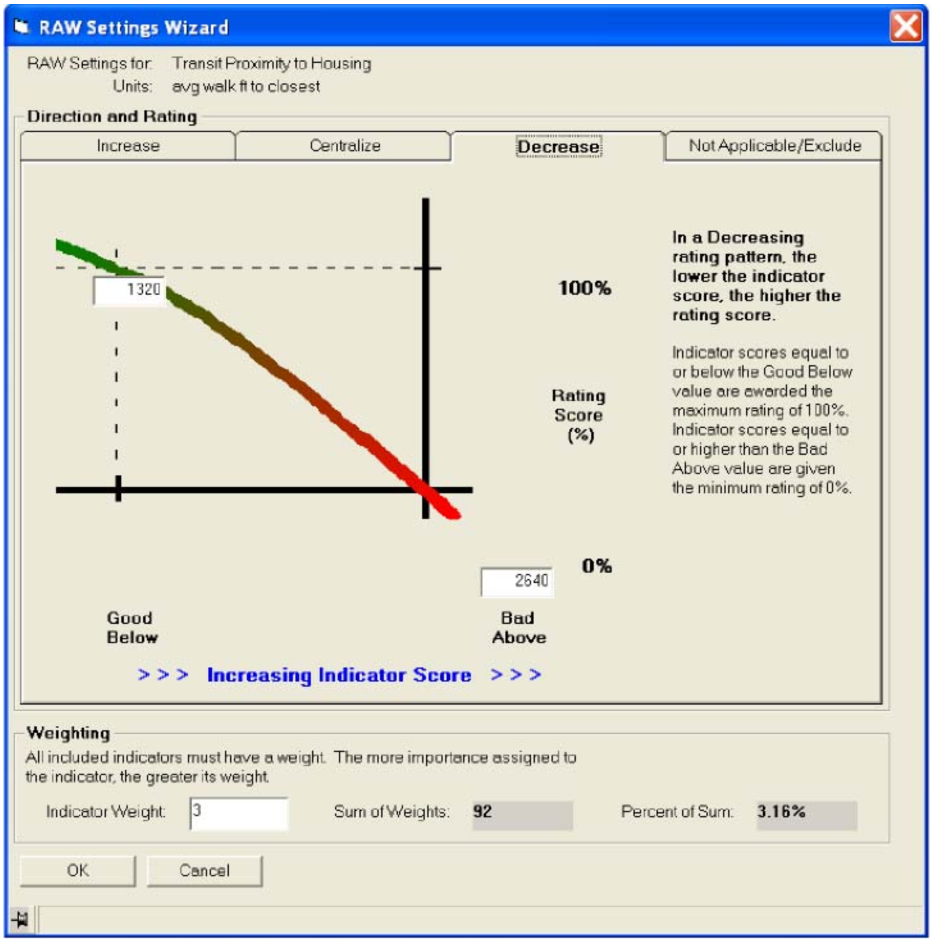
- **Increase Score –** The higher the score the better, until an ideal upper threshold has been reached.
- **Centralize Score –** Ideal scores fall in a range between two thresholds, with scores outside those thresholds getting less desirable.
- **Decrease Score –** The lower the score the better, until an ideal lower threshold has been reached.
- **Not Applicable/Exclude –** An indicator is not desired for inclusion in the RAW calculation.

Figure 4
HYPOTHETICAL RAW EXAMPLE

	SET UP					APPLICATION								
		Rating of Indicator Scores												
Indicator	*Weighting Allocation to Indicators*	*Positive Movement of Score*	*Worst Indicator Scores (Get 0)*	*Mediocre Indicator Scores (Get 0.5)*	*Best Indicator Scores (Get 1)*	*Indicator Score*	➔	*Equivalent Rating (0 to 1)*	x	*Indicator Weight*	=	*Indicator RAW Score*
Housing	- - -											
Dwelling Density	20	Up	10-	15	20+	16	➔	0.6	x	20	=	12
Distance to Transit	30	Down	2640+	1170	300-	1250	➔	0.4	x	30	=	12
Employment	- - -											
Employee Density	10	Up	20-	35	50+	37	➔	0.6	x	10	=	6
Distance to Transit	15	Down	2640+	1170	300-	863	➔	0.2	x	15	=	4
Parks	- - -											
Distance to Housing	25	Down	2640+	1170	300-	2300	➔	0.9	x	25	=	21
	100											

Overall Case Score (0-100 scale): 55

These setting modes are represented by the tabs on the RAW settings wizard.

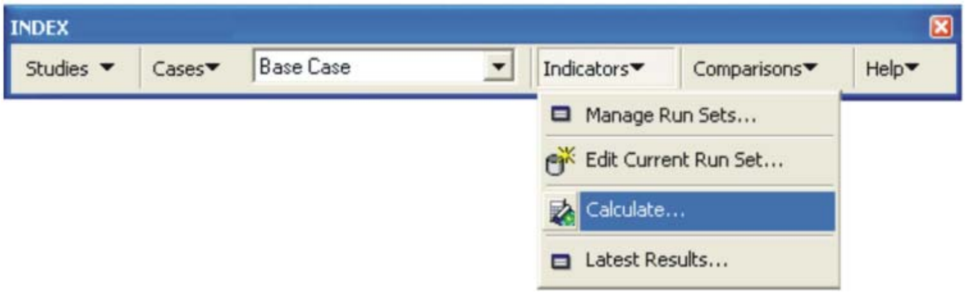


The second step in RAW setting is to specify desired indicator scores as expressions of scenario objectives. As shown above, this is done by specifying the thresholds or ranges of scores in their original units of measurement, e.g. any walk distance greater than 2,640 ft. is unacceptable.

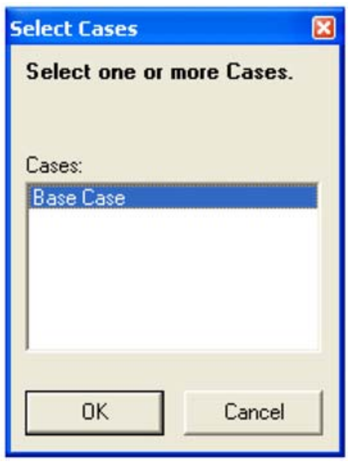
The third step in the RAW set-up is assigning weights of importance to indicators to denote their significance relative to one another. A weighting budget of 100 points should be used to allocate among weighted indicators (see Figure 4).

Calculate Indicators

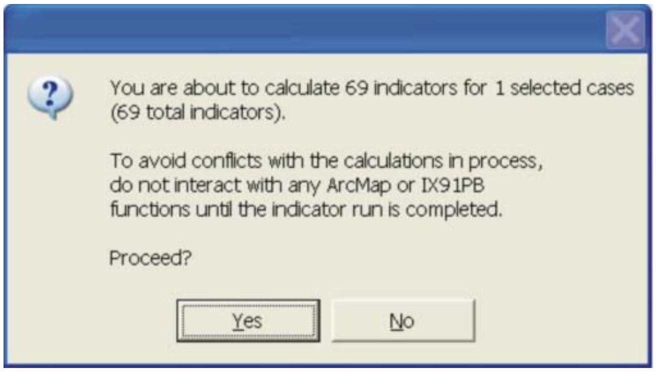
Having set-up the RAW tool, INDEX is now ready to calculate a set of indicators for a study case.



Selecting Calculate will start the indicator calculator for one or more user-selected cases.

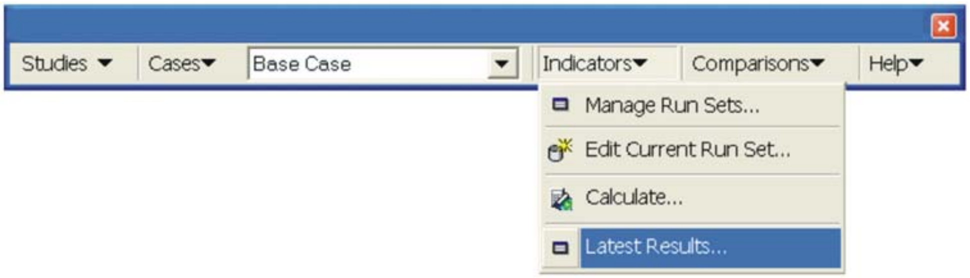


Before the calculation runs a warning message will appear alerting you to the number of indicators that will be run. You will be given an opportunity to exit the process if you wish.

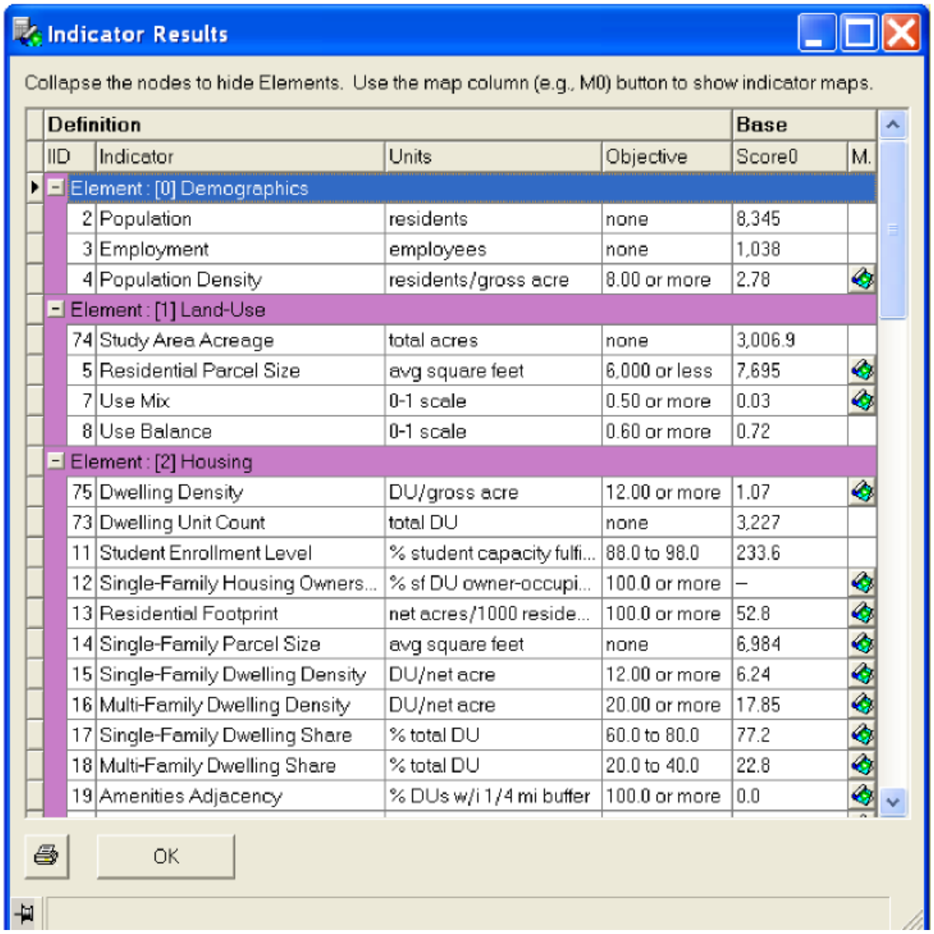


Viewing Latest Results

Select the Latest Results item on the Indicators pull-down to access the indicator results table (which also appears automatically at the end of each indicator run).

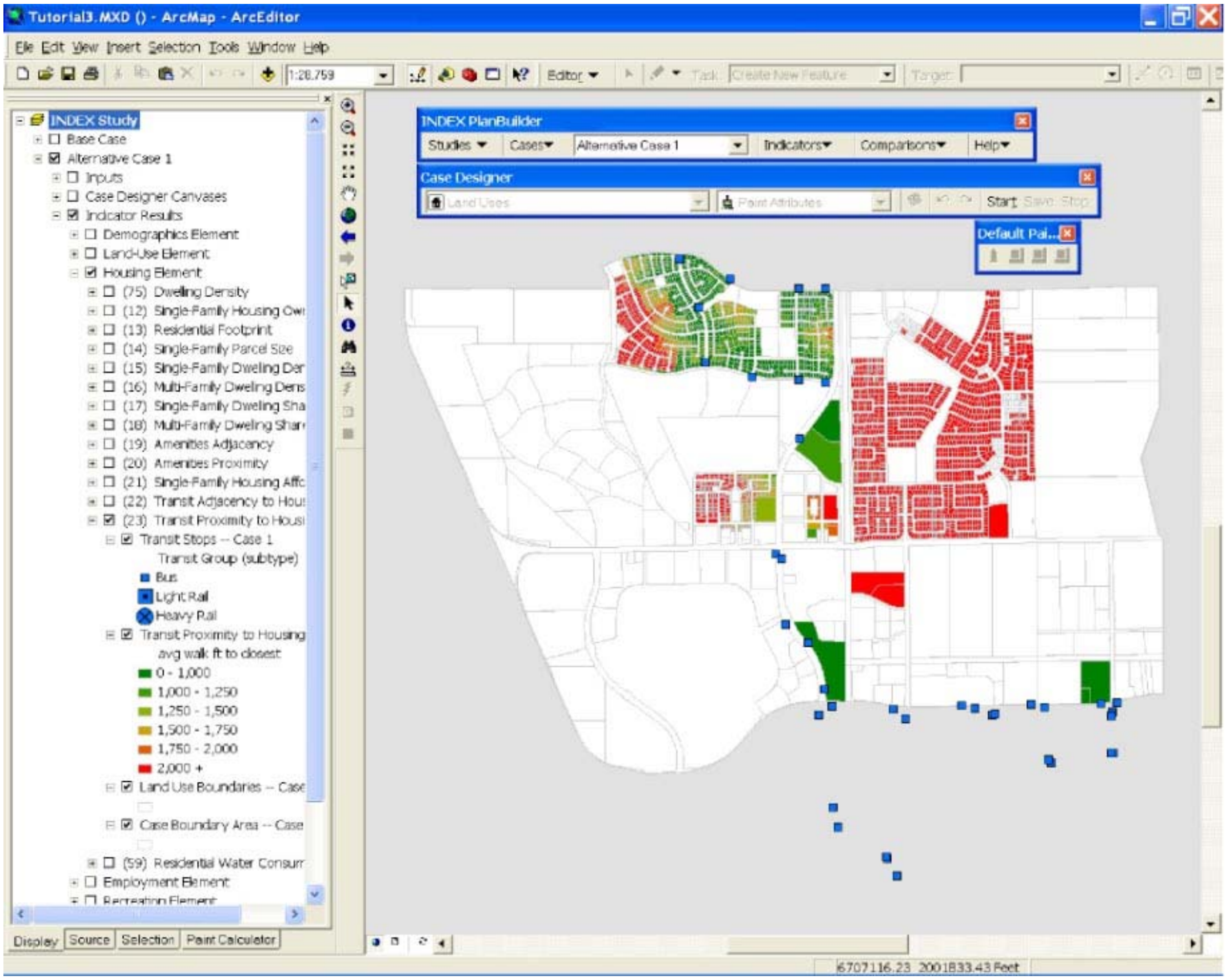


Results are viewed in the Indicator Results Table.



Definition				Base	
IID	Indicator	Units	Objective	Score0	M.
Element : [0] Demographics					
2	Population	residents	none	8,345	
3	Employment	employees	none	1,038	
4	Population Density	residents/gross acre	8.00 or more	2.78	
Element : [1] Land-Use					
74	Study Area Acreage	total acres	none	3,006.9	
5	Residential Parcel Size	avg square feet	6,000 or less	7,695	
7	Use Mix	0-1 scale	0.50 or more	0.03	
8	Use Balance	0-1 scale	0.60 or more	0.72	
Element : [2] Housing					
75	Dwelling Density	DU/gross acre	12.00 or more	1.07	
73	Dwelling Unit Count	total DU	none	3,227	
11	Student Enrollment Level	% student capacity fulfi...	88.0 to 98.0	233.6	
12	Single-Family Housing Owners...	% sf DU owner-occupi...	100.0 or more	–	
13	Residential Footprint	net acres/1000 reside...	100.0 or more	52.8	
14	Single-Family Parcel Size	avg square feet	none	6,984	
15	Single-Family Dwelling Density	DU/net acre	12.00 or more	6.24	
16	Multi-Family Dwelling Density	DU/net acre	20.00 or more	17.85	
17	Single-Family Dwelling Share	% total DU	60.0 to 80.0	77.2	
18	Multi-Family Dwelling Share	% total DU	20.0 to 40.0	22.8	
19	Amenities Adjacency	% DUs w/i 1/4 mi buffer	100.0 or more	0.0	

Indicator maps are also accessed through the Indicator Results table by clicking the map icon in the right-side column.



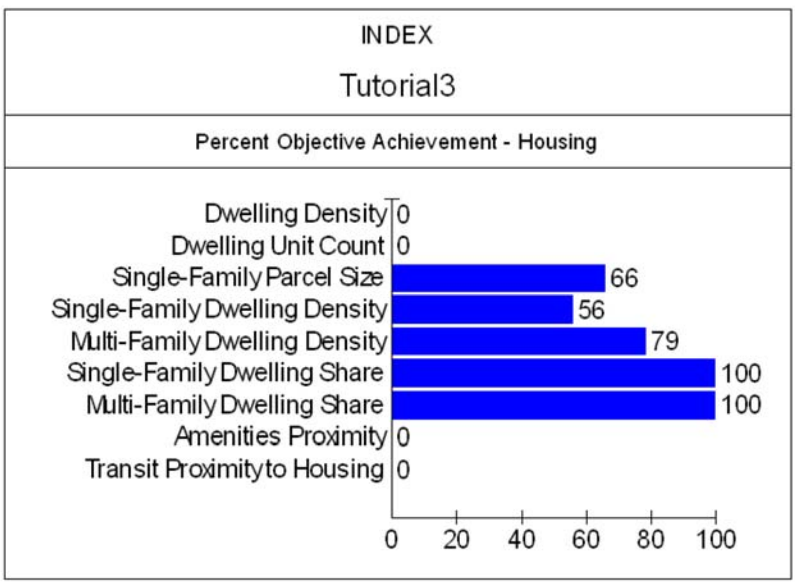
Comparisons Menu

The Comparisons menu provides access to bar charts that display how cases perform relative to user-defined objectives.

Objective Achievement

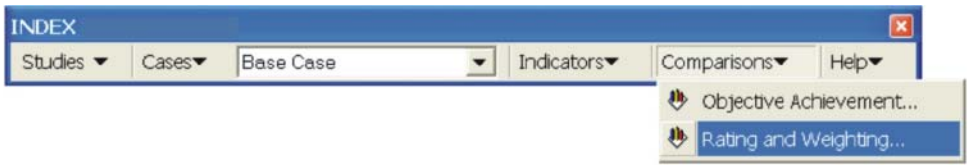
Select the Objective Achievement item on the Comparisons pull-down.

The objective achievement chart will open to describe indicator scores relative to upper and lower boundaries set in the RAW rating scale. Scores are displayed in a bar chart alongside other indicators within their element (i.e., Land-Use, Housing, etc.).

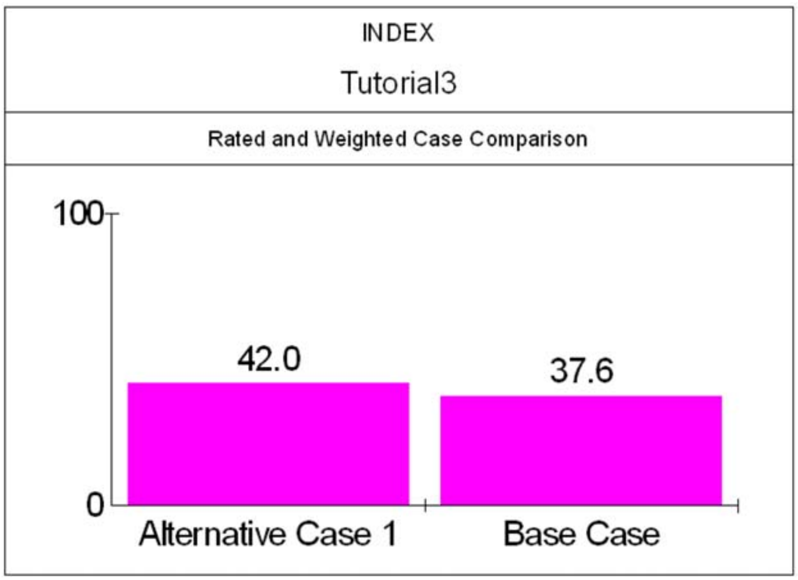


Rating and Weighting Comparison

Select the Rating and Weighting item from the Comparisons pull-down.



The rating and weighting comparison chart will open to provide a side-by-side bar chart of overall case scores using all RAW settings.



See Figure 4 for the calculation method of overall scores.

FREQUENTLY ASKED QUESTIONS

General

Q: Why does the Table of Contents reset every time I close and re-open a study?

A: The Table of Contents is dynamically generated based on data in the study geodatabase. This is done to ensure the correct target layers are available for Case Designer and other components of INDEX. Refreshing the TOC also accounts for situations when a user creates a copy of an INDEX study, ensuring INDEX points to the newly copied geodatabase.

Case Setup Editor

Q: Should I follow a feature class order when it comes to geoloading?

A: There is no absolute requirement to complete a geoload in a specific order. However, to have the Load Data process run as quickly as possible, you should load data in the following order:

1. Case Boundary
2. Land Uses
3. Street Centerlines
4. Transit Routes
5. Other Feature Classes

As well, if you wish to import a street centerline file, and that file has a valid Street Group ID or a valid Right-of-way Width field, then it is recommended that you first complete the import of Land Uses, so that the street right-of-way polygon creation process (via Land Use Topology) executes without overlaps.

Q: What are Land Use Groups, Dwelling Groups and Employment Groups?

A: The three sets of Groups (and their corresponding IDs) provide a way of mapping your organization's custom Land Use Types to the classifications required by several INDEX indicators. One of the key functions of the Land Use Type Paint Editor is to help you supply this information, which is inherited and applied for any land-use shapefile geoloaded into INDEX. They are:

Land-Use Group		**Dwelling Group**		**Employment Group**	
0	Vacant	0	N/A	0	N/A
1	Low residential	1	Single Family	1	Retail
2	Moderate residential	2	Multi Family	2	Service
3	High residential	3	Other (e.g. Group Quarters)	3	Other
4	Retail/services			4	Manufacturing
5	Office				
6	Mixed				
7	Industrial				
8	School				
9	Institutional				
10	Agriculture				
11	Open space				
12	Park				
13	Parking				
14	ROW				

Q: What are Supplementary Land Uses?

A: The “Supplementary Land Uses” feature class is an optional layer containing land-use features defined as “open space”, “park” or “parking” which are not already in the main Land-Uses feature class. All supplementary features are treated identically to regular land-use features for the calculation of the following indicators: Parking Lot Size (6), Park Space Supply (29), Park Adjacency (30), Park Proximity (31), Open Space Share (34).

If a residential, employment, mixed-use, or other parcel type polygon contains a sub-area that qualifies as open space, park, or parking lot, you can create a feature representing this sub-area and add it to Supplementary Land Uses.

Example: a school parcel is correctly designated as Land Use Group “School” for rendering purposes. However, the school’s schoolyard also qualifies as a “park” for the Park Proximity indicator because of its neighborhood recreational value. In this situation, add a feature to Supplementary Land Uses where the schoolyard is.

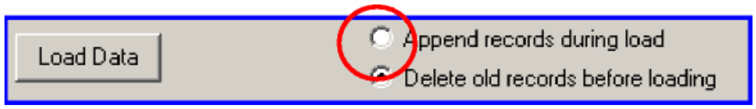
Q: I have an Amenities shapefile and a Central Nodes shapefile, both of which I want to import into the Points Of Interest feature class. However, Case Setup Editor only seems to allow a single source shapefile per Load Data run. Is this true, and if so how can I import multiple source shapefiles into a single feature class?

A: Feature classes like “Supplementary Land Uses” and “Points of Interest” are subtyped for efficient indicator calculations. These particular feature classes allow for multiple types of data to reside in one feature class:

Grouping Attribute	**Supplementary Land Uses (Land-Use Group subtype)**		**Points of Interest (Interest Group subtype)**	
Value/Designation	0	Vacant (default)	0	Undefined (default)
	4	Open Space	1	Amenity
	5	Park	2	Central Node
	6	Parking		

Users with multiple source shapefiles to be imported into the same destination feature classes can only do so by executing multiple Load Data runs.

WARNING: when executing Load Data into a destination feature class that already has data for other subtypes in it (as would be the case with Supplementary Land Uses and Points of Interest) be sure to select the “Append records during load” option before clicking Load Data:



Selecting this option will ensure that any existing subtyped data loaded in previous loads is preserved.

Q: My shapefile has several attributes that I don't see listed in the geoloader. I need the values in these shapefile attributes to help me "Select By Attributes" or for custom Annotation, and also as context attributes for layer display and reporting. How can I get them into INDEX?

A: The Case Setup Editor geoload process does NOT "link" a shapefile into INDEX for subsequent use. Rather, the geoload process reads in only the shapefile attributes identified in the attribute matcher, writing them to an already existing feature class inside the INDEX geodatabase.

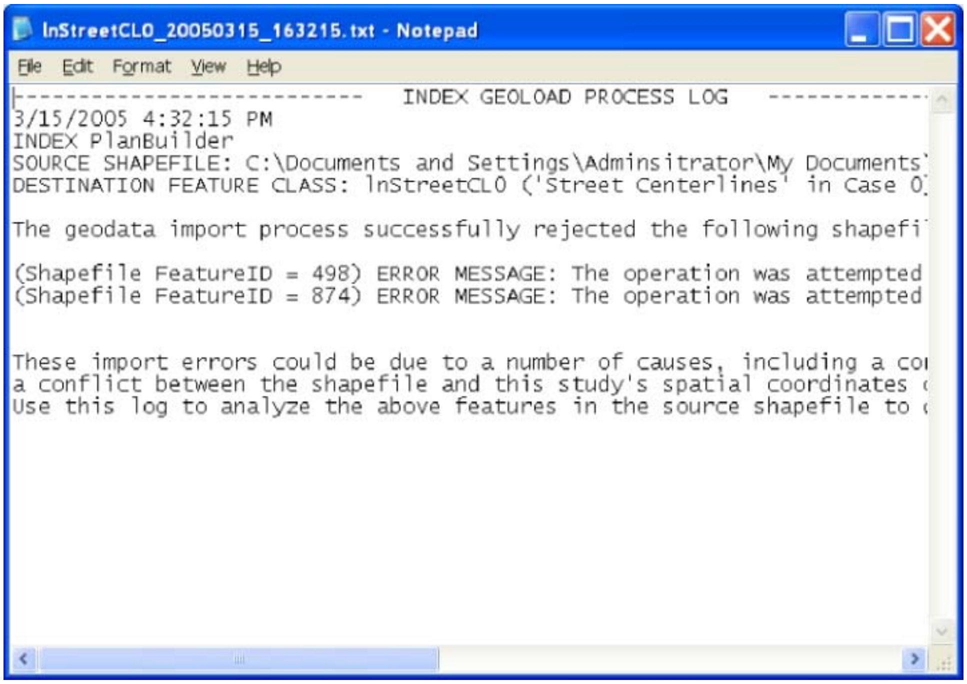
The majority of attributes in an INDEX feature class exist as inputs to indicator calculations. However, each feature class has one or more user-defined attributes available, i.e. "Context 1", "Context 2", etc. These attributes can be assigned the contents of whatever custom shapefile attributes the user chooses.

Context attributes have several uses. In making descriptive attribute assignments, keep in mind the following important functions a descriptive attribute can enable:

1. When editing features in Case Designer, you may want to make a change to all features that meet a certain selection criteria, a task made easier by ArcMap's "Select By Attribute" tool. Load from a source shapefile field to a "Context n" attribute that you intend to use in conjunction with "Select By Attribute".

2. In presenting data and interpreting indicator results, it is often useful to include descriptive attributes that are meaningful to the intended audience. These can come from the source shapefile by assigning a shapefile field to a "Context n" attribute.

Q: During a geoload run that is importing data from a shapefile into the Street Centerlines or Transit Routes feature class, I get the following message. What does this message mean?:



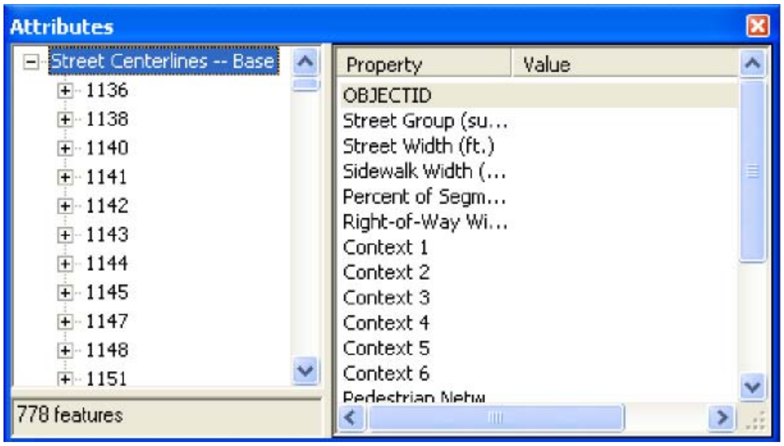
A: This message means that an internal GIS error occurred trying to import a feature from the source shapefile into the target feature class. Review the text that follows “ERROR MESSAGE:” to learn what the exact error was. Record the feature’s FID (the shapefile’s unique feature ID) so that after the geoload run, you can go back to the shapefile and inspect the feature to determine how to proceed.

When importing a Street Centerlines shapefile that has a valid Street Group ID, the above error may be reported as INDEX attempts to create right-of-way polygons in the Land Uses feature class. In this case, the street segment will have been created, but without a corresponding right-of-way polygon. Record the FID so that you can use Case Designer to create the right-of-way manually following the import.

Case Designer

Q: What is the easiest way to make an attribute change to many (or all) features in a feature class?

A: INDEX's Case Designer exposes several ArcMap efficiency tools for data entry and management. To make a "mass" change to many records, you must first select those records, either manually or by using the "Select By Attributes" tool. Once you have made your selection, use the Edit Attributes option in Case Designer to pull up the Attribute Editor:

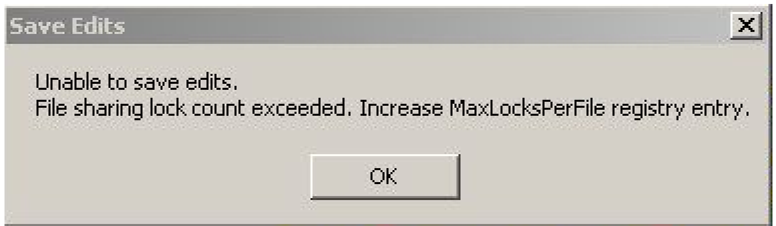


Then select the top of the tree on the left-hand pane (e.g. "Street Centerline - Base") which selects all records for the purposes of attribute editing. Finally enter the value you want to mass-change in the appropriate field in the right-hand pane. A progress bar at the bottom will track the progress of the change as it is implemented across all selected features.

Q: How do I draw or split a feature using freehand drawing?

A: When in draw or split mode, you can hit the F8 key (or right-click your mouse and choose Streaming) to activate the Streaming function. In streaming mode, a line sketch (with vertices) is created as you move your mouse, meaning you only have to click once to begin drawing, then double-click as usual to complete the drawing action.

Q: I get the following error when I try to make an attribute change to over 9500 selected features What does it mean and what is the workaround?



A: This is an ESRI-imposed default limitation and can be over-ridden. If you are calculating more than 9,500 records against an Access database (such as an INDEX geodatabase) when inside of an edit session, the operation will abort because of the Jet engine lock count limitation. If you increase this value, you can calculate more features. The key is:

HKEY_LOCAL_MACHINE\Software\Microsoft\Jet\4.0\Engines\Jet 4.0\MaxLocksPerFile

Note: Changing this registry key requires administrative privileges.

Change this key using the ArcMap Advanced Utilities exe. located in c:\arcgis\arcexe8x\Utilities. ESRI has reported that values up to 1,000,000 have not caused any problems in ArcMap.

Appendix A

Exporting Results to Florida State Models

For INDEX users in Florida, it is optionally possible to export INDEX land-use scenarios to three State of Florida models for additional analysis: 1) FDCA's Fiscal Impact Assessment Model (FIAM); 2) FDOT's CUBE/Voyager transportation model; and 3) FDEP's Watershed Assessment Model (WAM).

This Appendix describes the process for preparing INDEX land-use scenarios in anticipation of exporting results to these models and executing the exports. It is important that INDEX users be familiar with the Florida models and refer to their respective user manuals when operating INDEX in tandem with them.

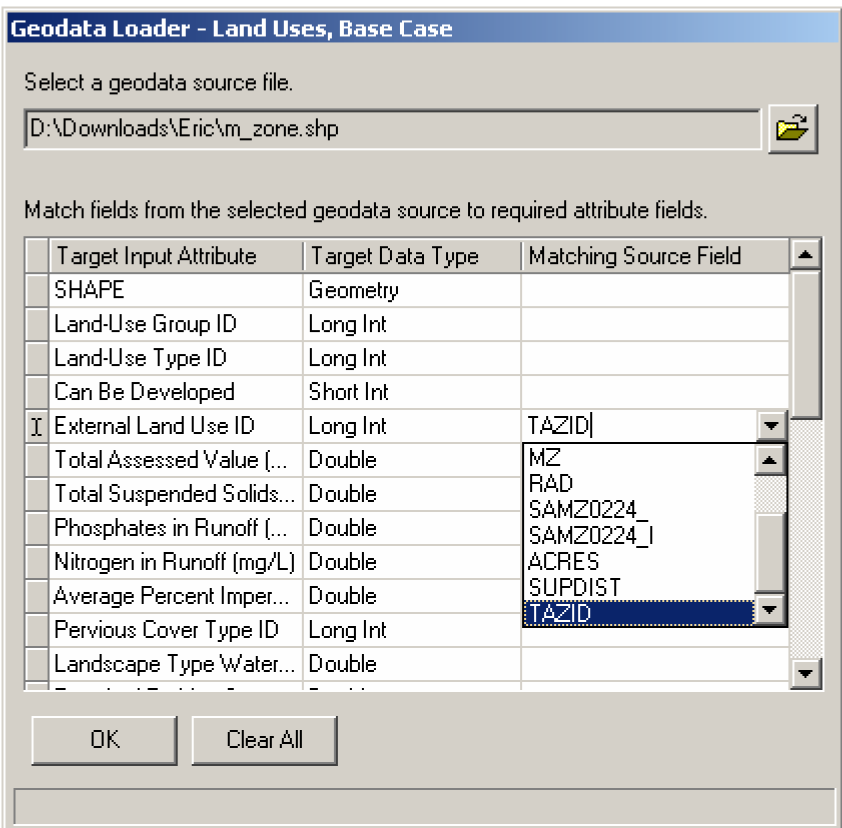
INDEX to CUBE/Voyager (FSUTMS)

CUBE requires all land-use data be rolled-up to the TAZ level by TAZ number or ZONE No. (referred to herein as TAZID). This roll-up should serve as the input file to the CUBE system referred to as ZONEDATA_yya.DBF in the "FSUTMS POWERED BY CUBE/VOYAGER DATA DICTIONARY" draft document of December 2005.

The TAZID is a unique numeric integer assigned to each polygon in a TAZ layer. Therefore, when setting up the land use feature class in INDEX, users must retain the relationship-- either numerically using the TAZID, or spatially using centroid intersection-- between each land use parcel polygon and the TAZ that the parcel belongs to. This can be accomplished in multiple ways.

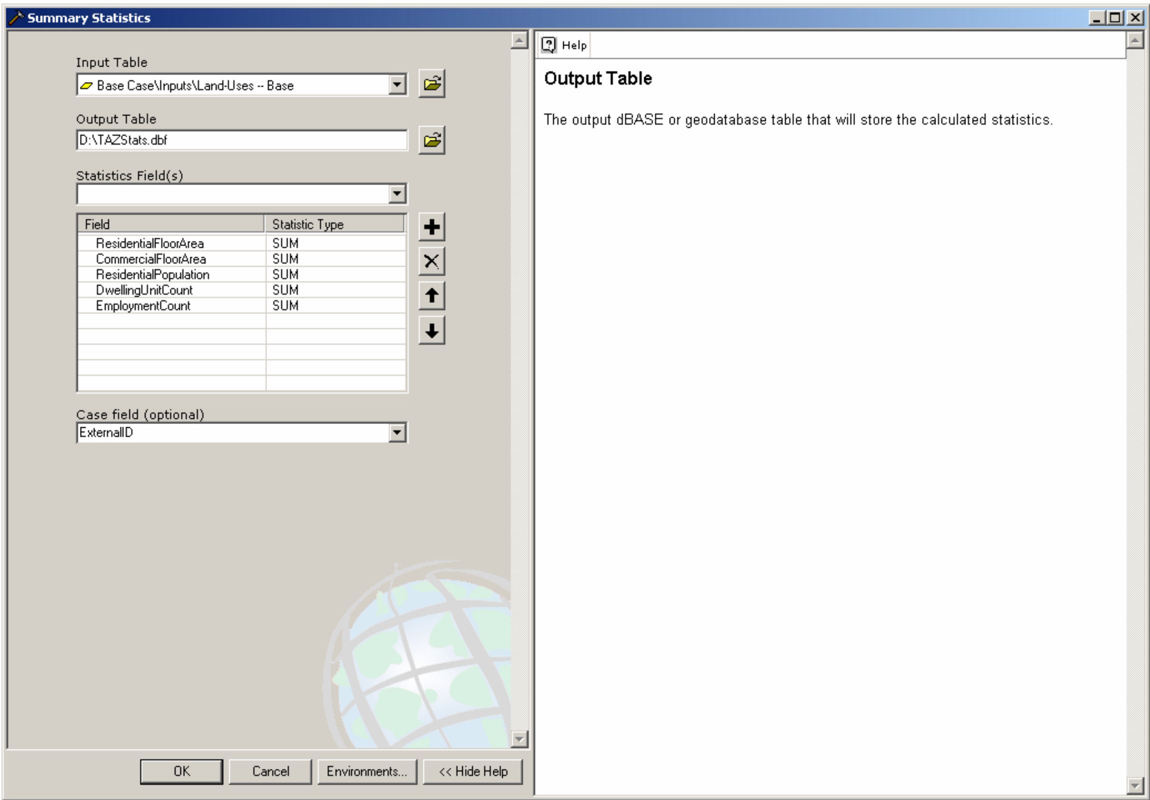
Geoloading the TAZ ID with the parcels layer

In some cases an INDEX user's source shapefile land-use parcel data will have already independently been attributed with the TAZID. In this case it is easy to retain this attribute during geoload in a parcel-based study by mapping the shapefile's TAZID field to the "External Land Use ID" field in the INDEX Land Uses geodatabase feature class:



Once this land-use data has been geoloaded and the painting of a scenario is completed, any land-use attribute such as total population, dwelling unit count and/or employment count, can be summarized by TAZID using ArcMap's Summarize tool.

The Summarize tool is accessed from the Analysis branch of the ArcGIS ArcToolbox's dockable window. The following example shows what the set of input parameters for this process might look like:

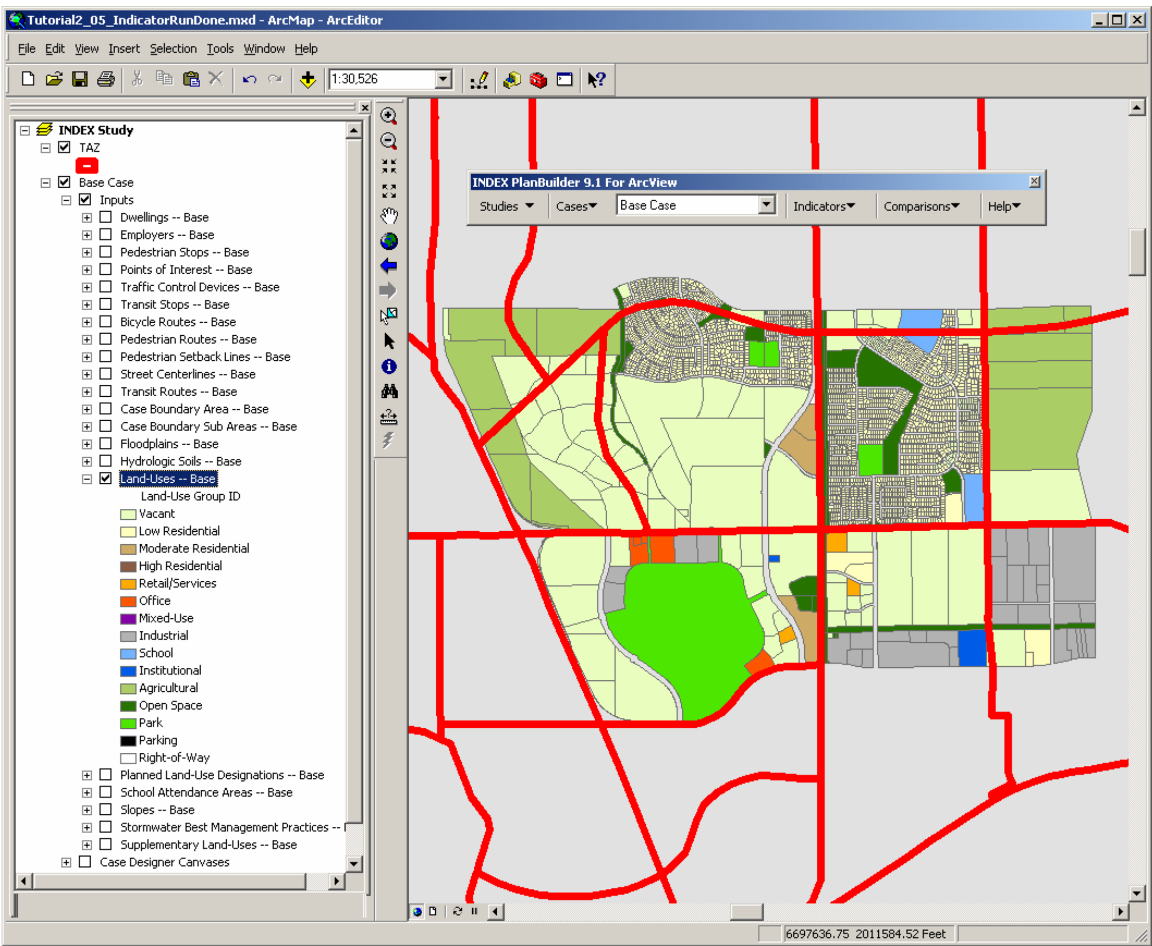


Note the Case parameter. This is what enables the output table to be broken down by the previously supplied TAZID. ExternalID is the INDEX field name for the "External Land Use ID" referred to above.

Spatially joining the TAZ layer with INDEX

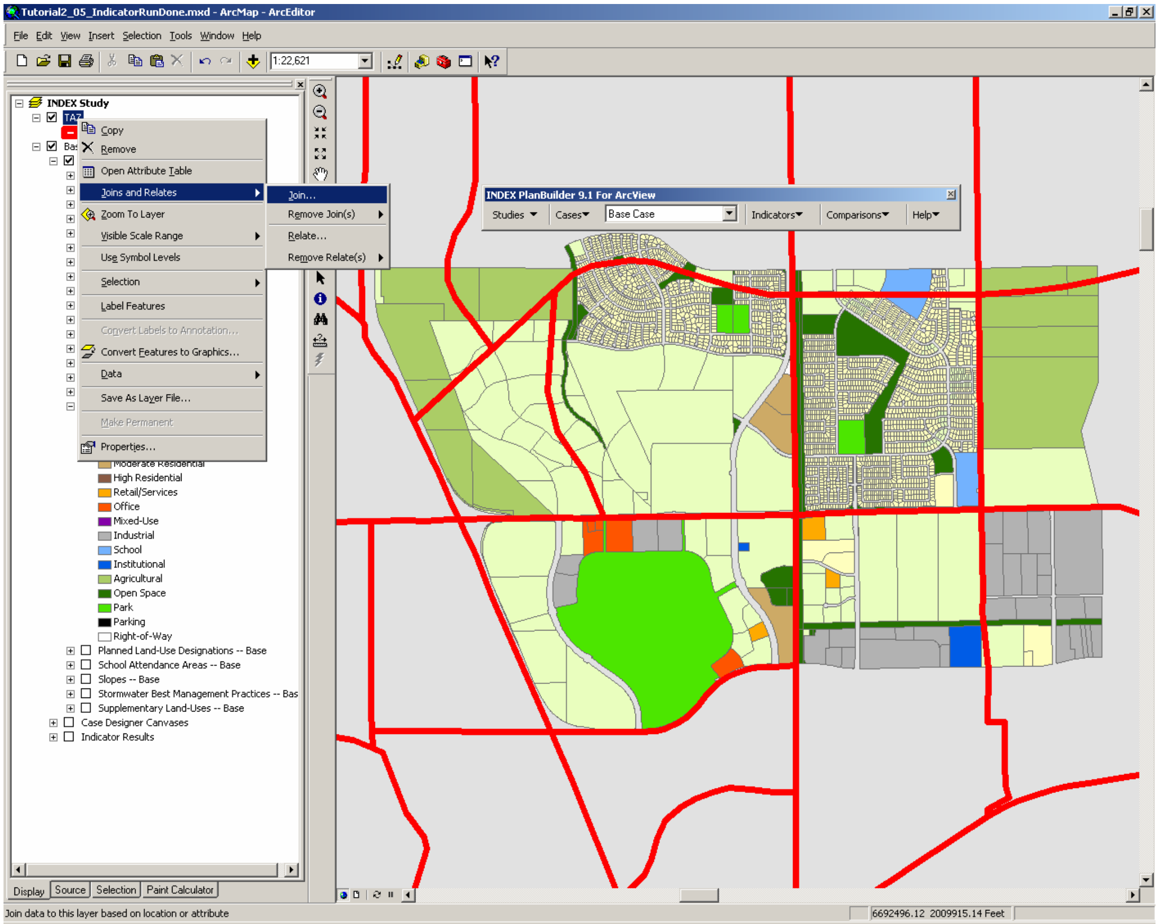
If the TAZID attribute does not already exist, it can be created by adding the TAZ layer to an INDEX study and performing a spatial join between it and the Land-Uses feature class. Spatial joins are most efficiently and accurately made between a polygon layer (TAZ) and a point layer. Though Land-Uses is clearly <u>not</u> a point layer, INDEX contains two supplementary point feature classes, Dwellings and Employers (one set for each case in a study, suffixed with the case number). Dwellings is attributed with population info, and employment contains employee counts.

First, add the TAZ layer to the completed INDEX case to ensure that the two layers do intersect:

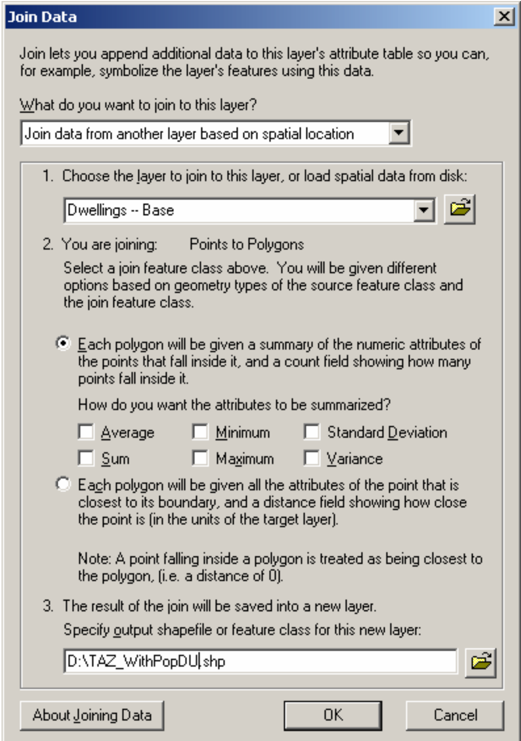


If they do not, reproject the TAZ layer to the Spatial Reference you used in creating the INDEX study.

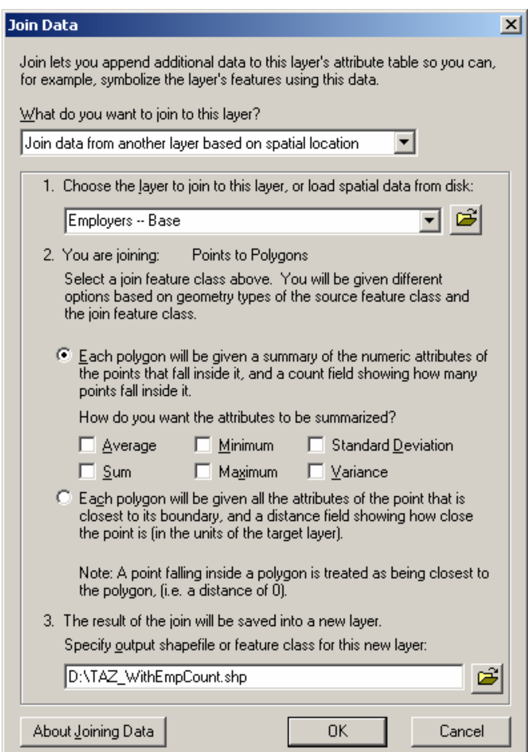
Next, right-click the TAZ layer and select the join option:



To summarize population data into each TAZ, set up the parameters of the join window as follows:



To summarize employment data into each TAZ, set up the parameters of the join window as follows:

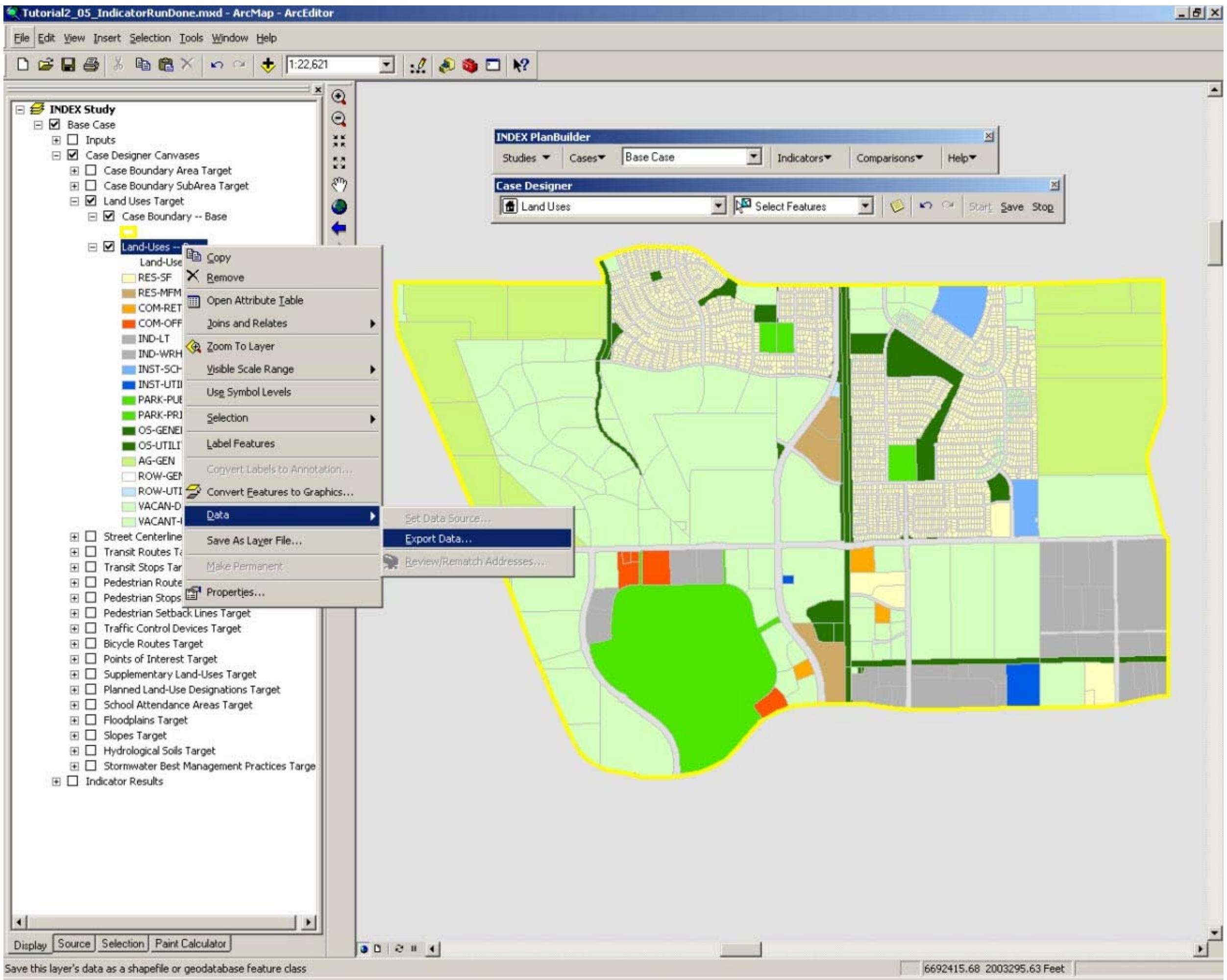


INDEX to WAM

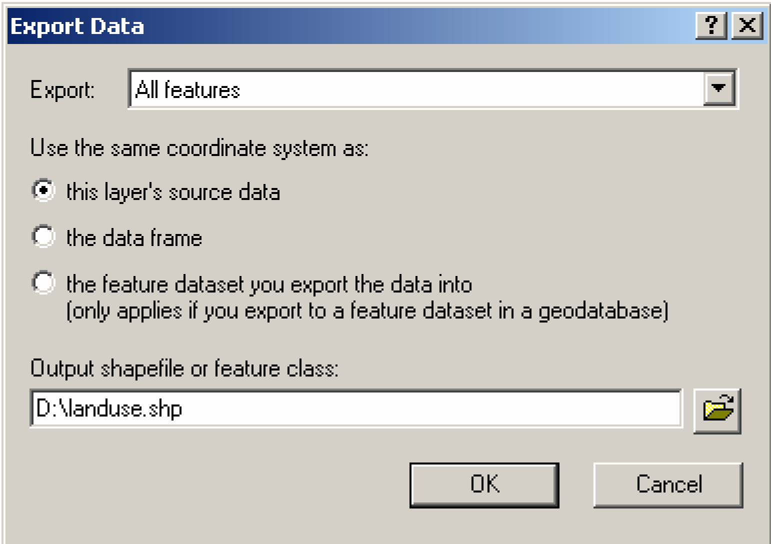
WAM requires a vector polygon shapefile with land-use code attribute (landuse.shp). INDEX data is stored in a personal geodatabase, but ArcMap natively provides the ability to export any geodatabase feature class to a shapefile. Each input land-use code attribute must exist in WAM's land-use table. Each land-use code in WAM's land-use table must be associated with a land-use group code. WAM's land-use model is pre-loaded with FLUCCS codes and their groupings, but custom editing of both WAM land-use and land-use group codes are supported and documented.

Exporting INDEX Land Uses as shapefile

To export any INDEX layer as a shapefile for subsequent import into WAM, open Case Designer to the target Land Uses layer, right-click the layer and choose Data > Export Data:



Set up the parameters of the export function as follows and click OK:



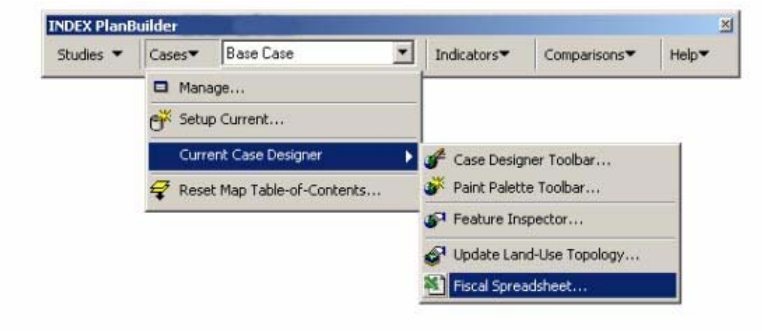
Configuring WAM for INDEX land use classifications

Whatever land-use codes are set up as paints in an INDEX study template must be set up in the land-use table in WAM, and mapped to one of WAM's existing land-use group codes. Assuming a static set of INDEX paints, this would be a one-time only task. If an INDEX land-use paint cannot be mapped into a WAM land-use group code, then a new WAM land-use group code can be created and customized, but only with an advanced knowledge of the WAM methodology and how it is affected by land-use group code parameters. Refer to page 38 of the document titled "WAM Model Documentation and User Manual" for instructions on configuring WAM to be consistent with the chosen INDEX land use paint classification system.

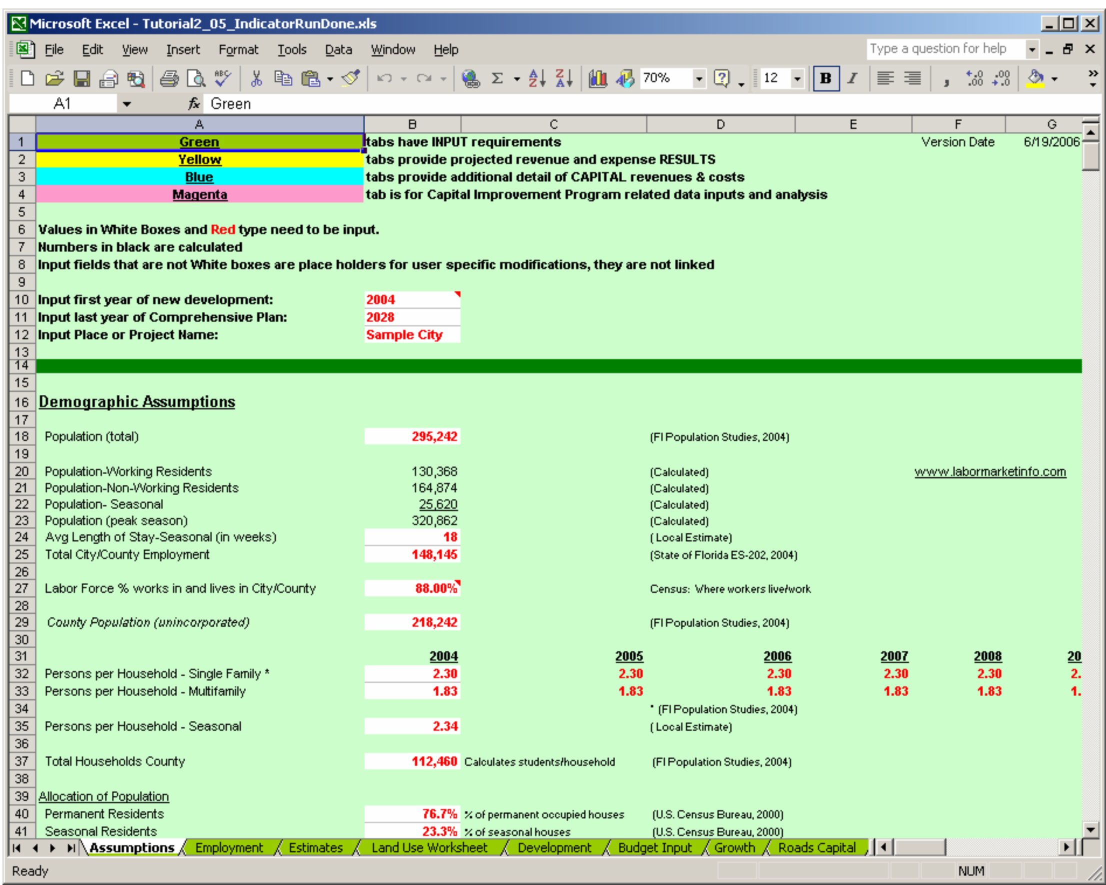
INDEX to FIAM

Accessing the FIAM application

To gain access to the FIAM application from within INDEX, select the Cases > Current Case > Fiscal Spreadsheet option from the INDEX toolbar:



The spreadsheet is opened into Microsoft Excel for completion:



Configuring INDEX for FIAM land use classifications

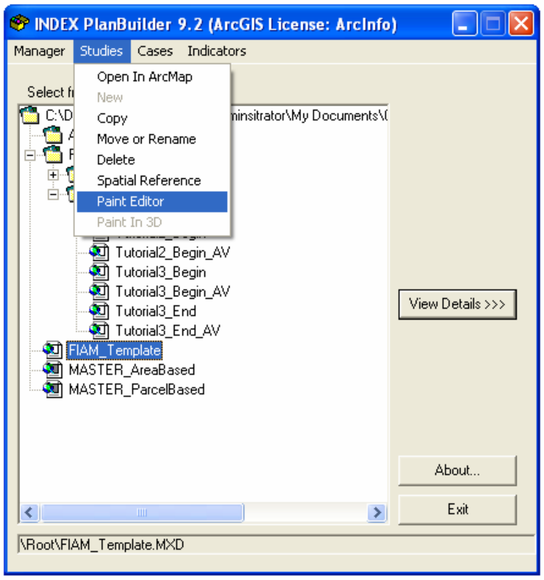
INDEX allows users flexibility when setting up land use classifications. To perform a FIAM-based analysis of an INDEX case, a user should-- during the "Defining Land Uses" stage of the Jurisdictional Setup process-- set up land-use paints that are consistent with the land use classification system required as inputs to FIAM's "Land Use Worksheet" tab. For further information on FIAM land uses, see pages 35-37 of the FIAM Training Manual (June 2005).

The table below maps each FIAM land use to its closest associated INDEX sample paint definition:

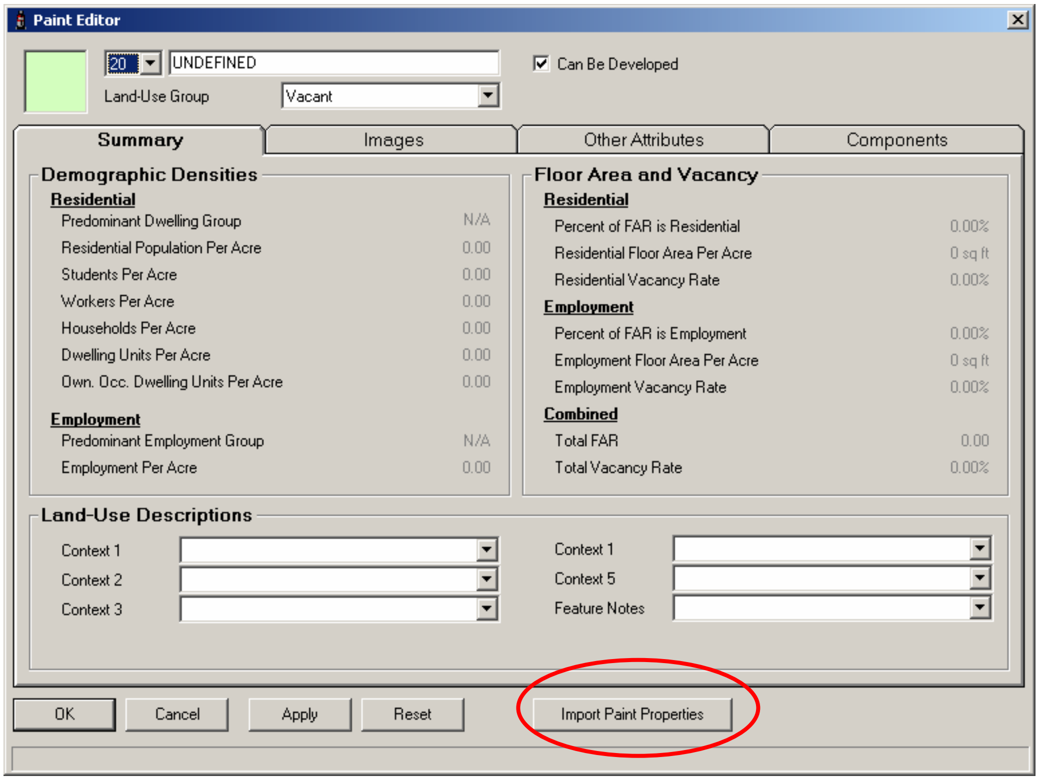
FIAM	**Closest INDEX Paint Equivalent**	
Land Use Classification	**Land-use Type ID**	**Paint Name**
Vacant Residential	1	VACANT
Single-Family	2	Sample: RES SF LOW
Mobile Homes	3	Sample: RES SF MEDIUM
Multifamily high density	4	Sample: RES MF HIGH
Condo/timeshare	3	Sample: RES SF MEDIUM
ACLF/Nursing Home	4	Sample: RES MF HIGH
MF Low density	4	Sample: RES MF HIGH
Vacant Commercial	1	VACANT
Retail-regional, tourist attractions	5	Sample: COM RETAIL
Retail - Community	5	Sample: COM RETAIL
Retail - Neighborhood	5	Sample: COM RETAIL
Restaurants - drive in	5	Sample: COM RETAIL
Restaurants - sit down	5	Sample: COM RETAIL
Offices 1-story non professional	6	Sample: COM OFFICE
Offices Class A	6	Sample: COM OFFICE
Offices medical & professional	6	Sample: COM OFFICE
Hotel/motel	5	Sample: COM RETAIL
Vacant Industrial	1	VACANT
Industrial	8	Sample: INDUSTRIAL
Warehouse	8	Sample: INDUSTRIAL
Golf Course Acres	14	Sample: PARK
Agriculture/Forestry	11	Sample: AGRICULTURE-- CROPS
Parks & Recreation	14	Sample: PARK
Institutional	10	Sample: INSTITUTIONAL
Government	10	Sample: INSTITUTIONAL
Roads, Sewage & Solid Waste	16	Sample: RIGHT OF WAY -- STREET
Mobile Home Parks, RV parks, Parking lots	15	Sample: PARKING

To set up a FIAM-compliant paint, follow these steps:

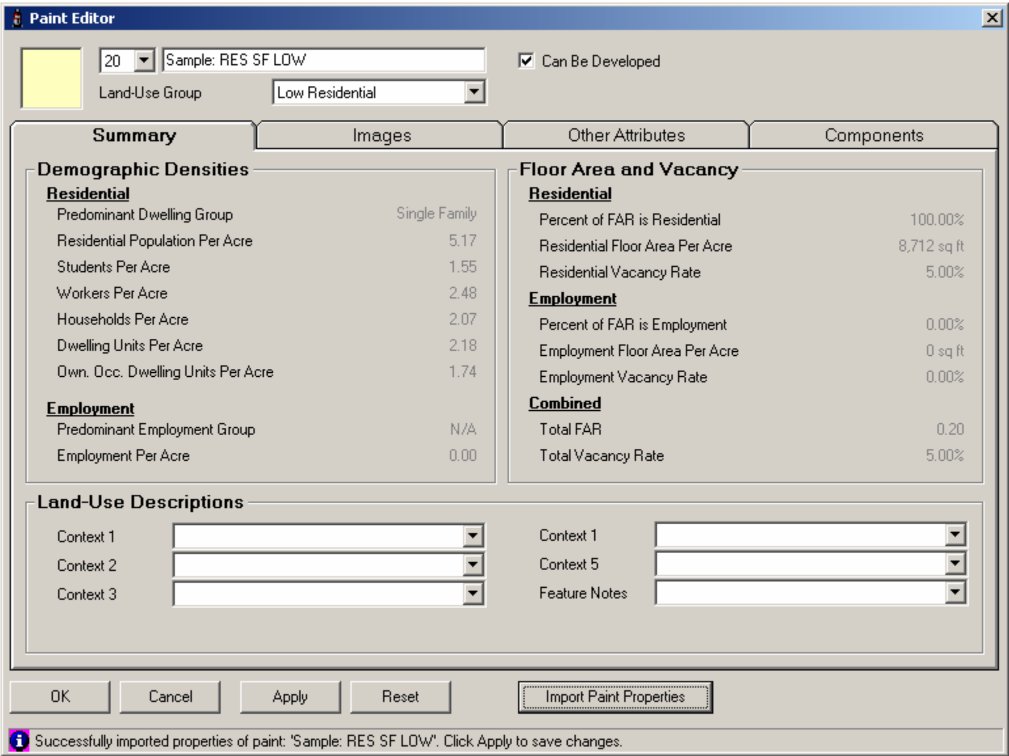
Using Study Manager, create a new empty study that is to be a source for FIAM analysis. Then select is and click the Paint Manager button:



Switch to the Paint Number where you want to create a FIAM paint and click the Import Paint Properties button:

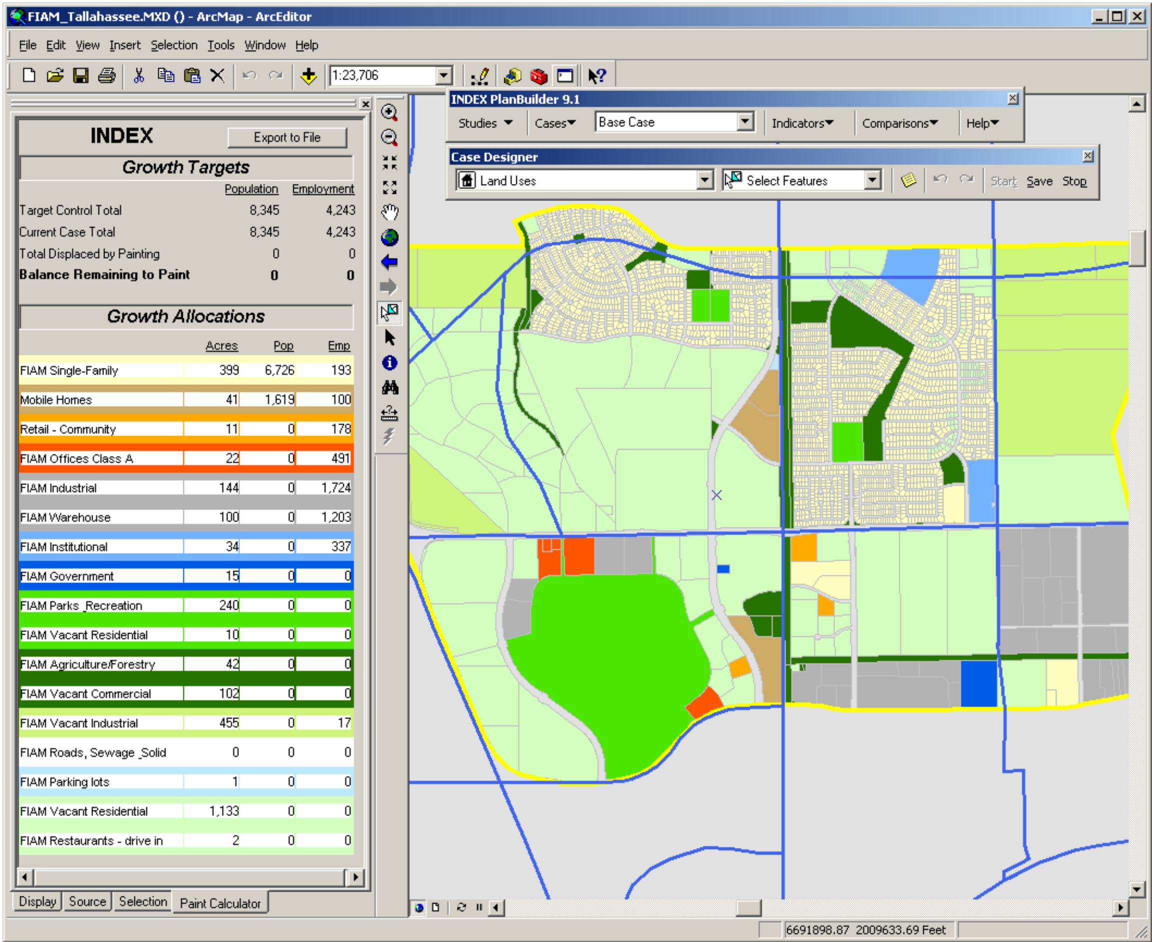


Using the above table as a guide, enter the ID of the closest INDEX paint and click OK. For example, to create a FIAM Single-Family paint, enter 2. The undefined paint's properties are now populated with initial default values applicable to the chosen INDEX land-use:

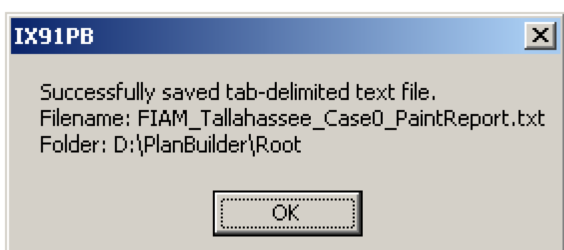


Customize the paint to the study area's specifications and click apply. Repeat the process until all the FIAM paints you need are created.

Once the land use paint palette is set up, geoload a land-uses coverage that is attributed with the INDEX-FIAM land-use IDs just created, create an alternative case, and paint a scenario using the INDEX-FIAM paints. Check the paint calculator to see that only FIAM land-use paints are employed:

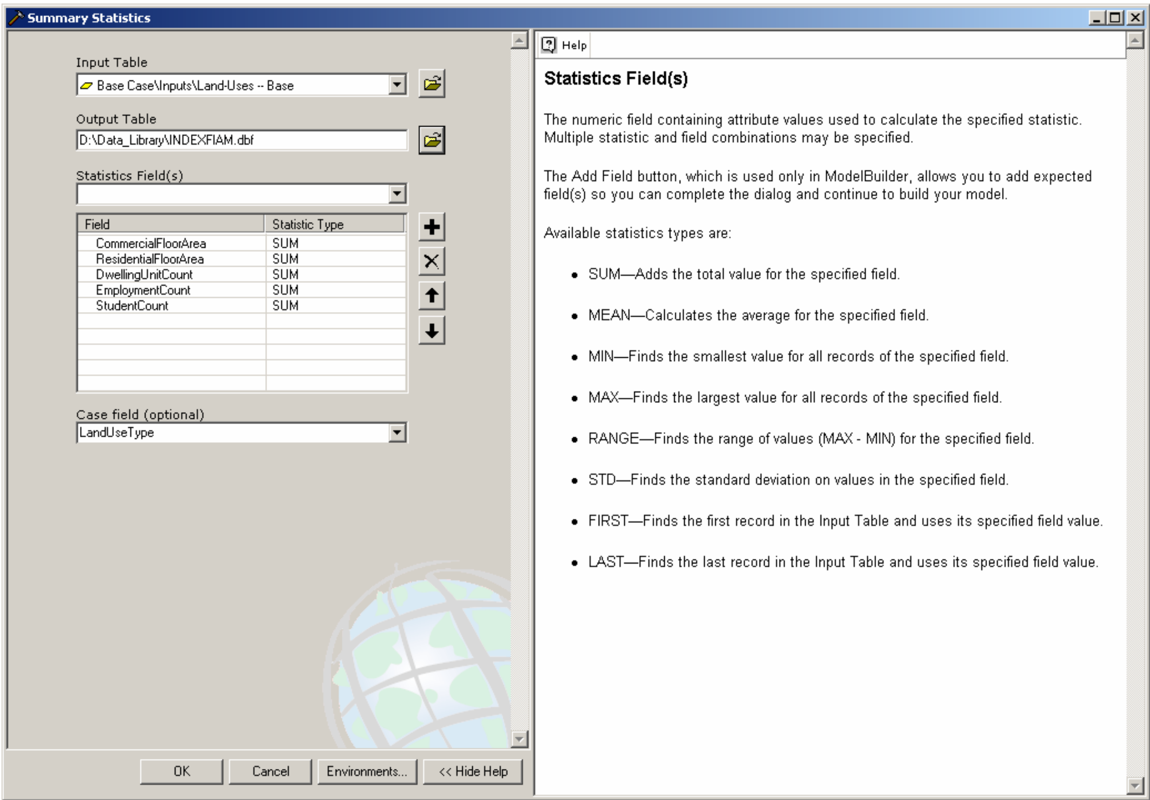


Information from the Paint Calculator can be used directly in FIAM, so click the Export to File button. An output file is created:



Once the painting of a scenario is completed, any land-use attribute such as total population, dwelling unit count and/or employment count, can be summarized by FIAM land-use type using ArcMap's Summarize tool.

The Summarize tool is accessed from the Analysis branch of the ArcGIS ArcToolbox's dockable window. The following example shows what the set of input parameters for this process might look like:



Note the Case field parameter. This is what enables the output table to be broken down by the FIAM land use types. Be sure to choose LandUseType from the drop-down list here.

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INTRODUCTION

This process guide describes ways in which INDEX PlanBuilder can support community planning as illustrated in Figures 1 and 2. To support such processes, INDEX is designed to be a tool for:

- Embodying stakeholder values and priorities.
- Creating plans collaboratively.
- Evaluating alternative courses of action and progress toward goals.

INDEX performs these functions with a scenario tool that allows digital charretting or on-the-fly drawing and editing of spatial features (see Figure 3); a set of indicators for measuring the performance of scenarios; and a set of user-defined objectives for ranking multiple scenarios according to goal achievement. Once a preferred plan has been adopted, INDEX can support plan implementation by evaluating the consistency of incremental development proposals against plan goals. Periodically, benchmarks can be updated to gauge cumulative progress toward goals.

The basic steps in applying INDEX are summarized in Figure 4. These begin with set-up of the tool for the jurisdiction in which it will be applied over time, e.g. an entire city or county, or a multi-jurisdiction region. The next set of steps are taken for individual studies of particular locations within the jurisdiction. These study-level steps constitute the major process to be followed in typical INDEX applications. Important process-related features of INDEX include:

- *Study areas.* The software can be applied to any area where data is available to support indicator calculations. Study areas may be created using existing official boundaries, such as parcels, local government jurisdictions, traffic analysis zones, or other administrative boundaries. Natural features such as watersheds may also be used, or users may create unique one-of-a-kind custom boundaries to fit special needs.

- *Parcel-based studies.* INDEX PlanBuilder is designed to execute studies at the parcel level for a fine grained, pedestrian scale analysis. INDEX is capable of executing studies at a coarser area-based level using land units larger than parcels, e.g. traffic analysis zones, but the complexities of area-based studies require consultation with Criterion staff before undertaking them. Assistance with area-based studies is outside the scope of standard INDEX technical support included with PlanBuilder purchases.

- *Cases.* Any number of scenarios or “cases” can be modeled in a study area. Cases can represent actual or proposed conditions. Usually a “base case” is used as a starting point in an application and “alternate cases” are created to represent different ideas and approaches to relevant issues.

- *Case designer.* This tool allows users to draw and edit spatial features on-the-fly in real time (digital charretting), including parcel boundaries, street and sidewalk networks, bike and transit routes, and land-use designations. Users are able to create and select from “palettes” of these features based on local standards and/or design objectives.

Figure 1. SUPPORT OF COMMUNITY PLANNING WITH INDEX PLANBUILDER

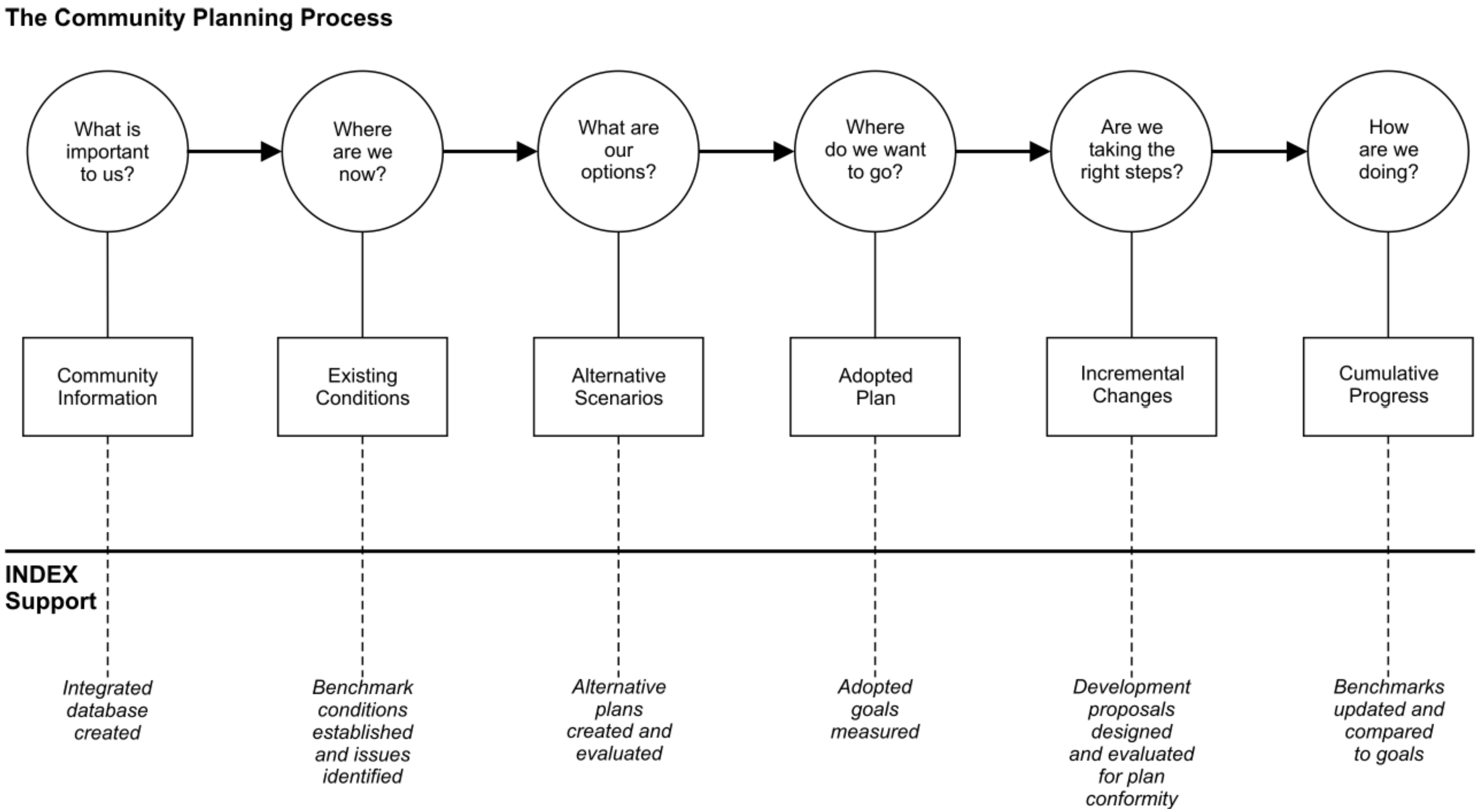
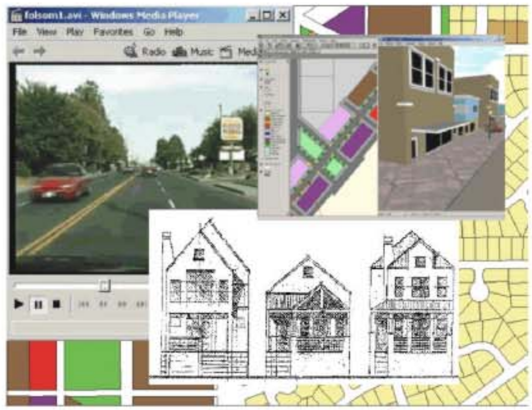
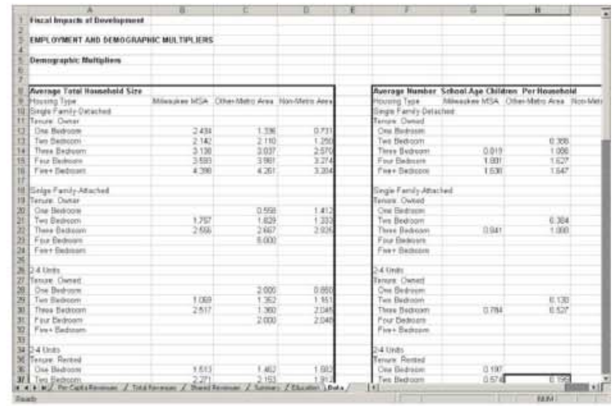


Figure 2. MAJOR PLANNING SUPPORT FUNCTIONS OF INDEX

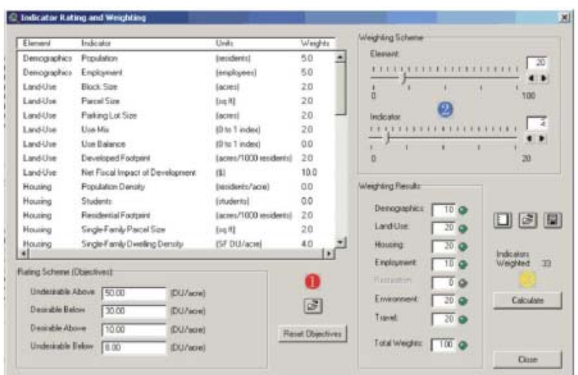
Design
Create scenarios interactively in real time.



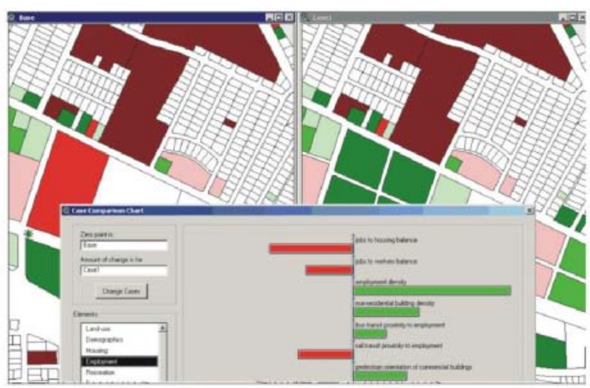
Visualize
View outcomes with optional 3D modeling video, and other media.



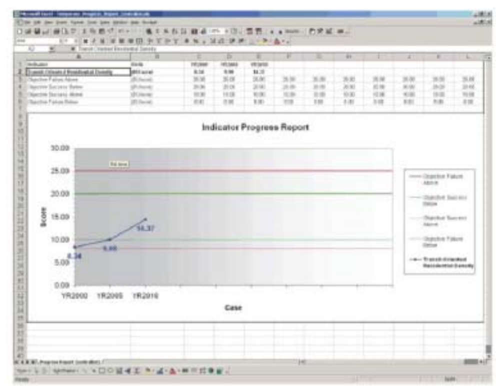
Analyze
Perform specialized technical analyses, e.g. air quality, stormwater, fiscal.



Score
Evaluate scenarios and development impacts with stakeholder-selected and weighted indicators.



Compare
Identify trade-offs between alternatives and gauge acceptability.



Monitor
Gauge cumulative progress toward plan goals.

Figure 3. DIGITAL CHARRETTING

INDEX PlanBuilder is uniquely capable of supporting real-time digital charretting that allows participants to create and evaluate scenarios on-the-fly in public meetings.

As with traditional charrettes, a digital session produces a complete work product in a compressed time period with the direct participation of stakeholders. What distinguishes a digital charrette is:

- *The ability to design scenarios of greater scope and complexity then can be supported with pen and paper.*
- *Immediate feedback on scenario impacts that are unavailable with pen and paper.*
- *Engagement of larger groups of participants than possible with pen and paper.*

Preparation and execution of a digital charrette should consider the following major items:

- ***Issues and goals.** Defining these in advance allows INDEX to be pre-set with stake holder-selected indicators and objectives for judging charrette output.*
- ***Data.** Based on selected indicators, data is assembled for the subject area and surrounding vicinity.*
- ***Computer hardware and software.** For rapid charrette processing, INDEX requires a one GB laptop with ArcEditor or ArcInfo for each table of 8-10 participants.*
- ***Other equipment.** Each table will need a projector and screen for their laptop, plus flip chart and other traditional charrette supplies.*
- ***Facilitation.** The most important ingredient in any charrette, digital or otherwise, is superior facilitation. With INDEX, it is important for facilitators to become familiar with the tool prior to the event.*
- ***Charrette design sequence.** Facilitators should use a pre-de fined design sequence for leading the group through a session. For example, in growth visioning, first set aside non-buildable lands; second, identify in fill and redevelopment sites; and third, delineate areas for staging greenfield growth.*

Communities may contact Criterion for digital charrette assistance in addition to standard INDEX use.

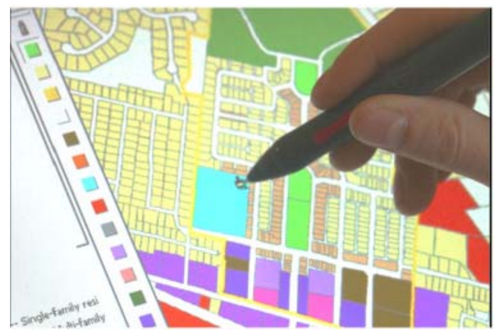
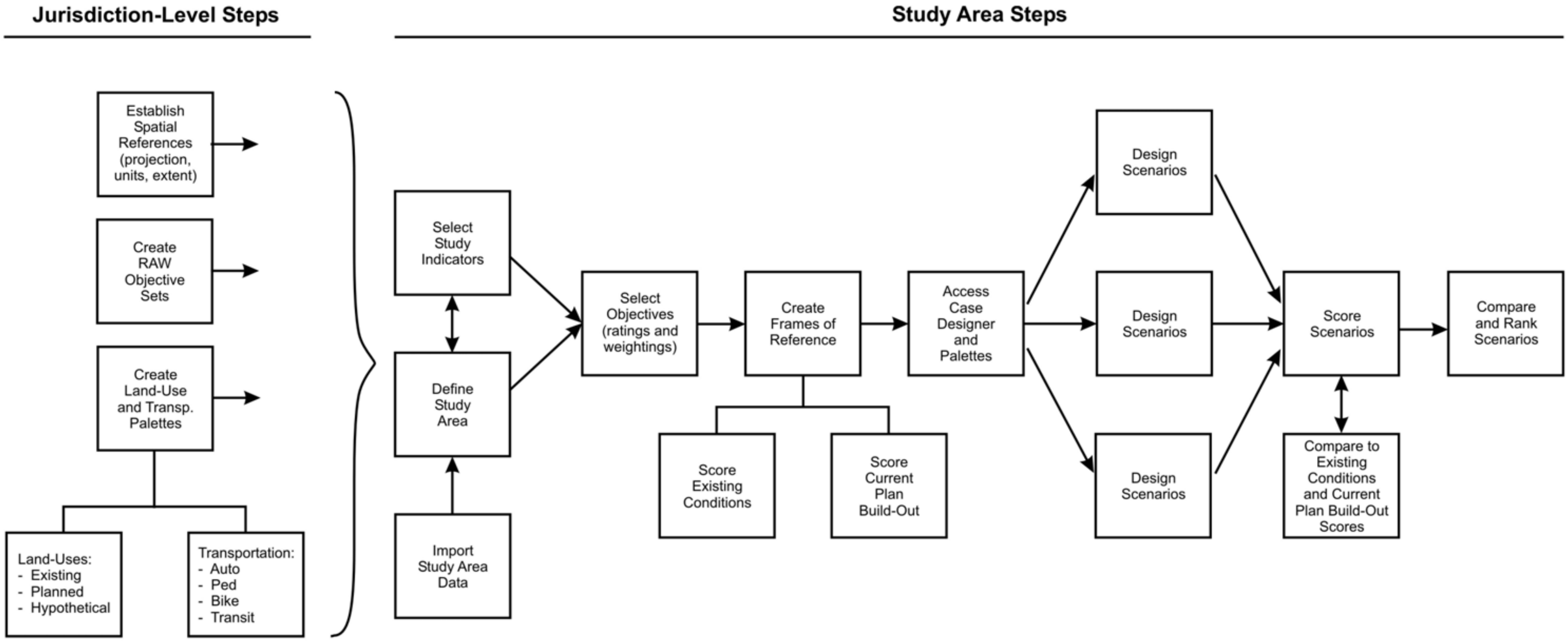


Figure 4. BASIC STEPS IN APPLYING INDEX

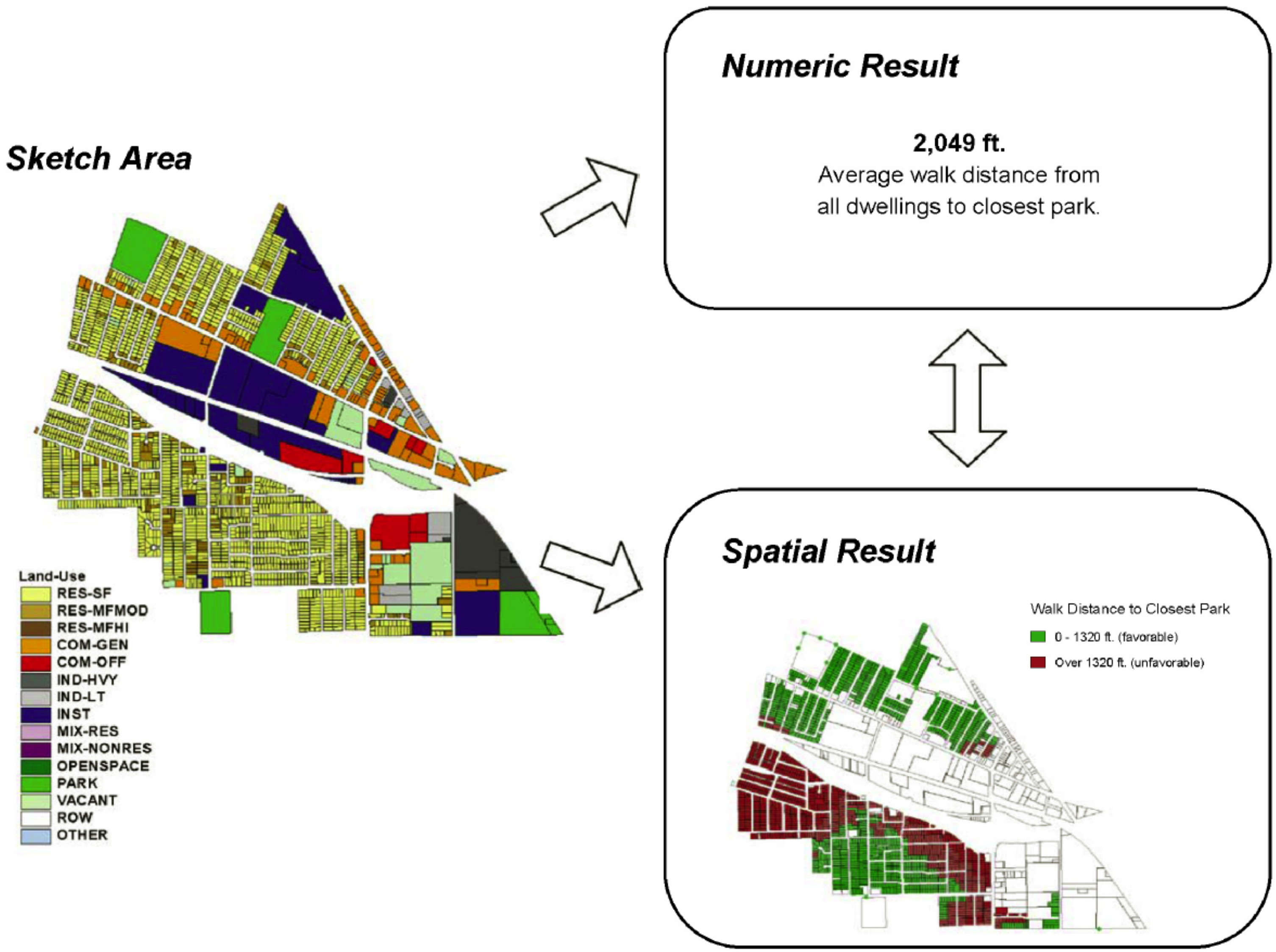


- *Indicators.* Indicators are “yardsticks” for identifying an area’s strengths and weaknesses, testing alternative courses of action, and monitoring change over time. INDEX has a menu of indicators (53 for ArcView license holders, 73 for ArcEditor or ArcInfo license holders) available for evaluating cases. From this menu, users may select those indicators that are most relevant to a given situation. Figure 5 illustrates the two kinds of indicator measurements made by INDEX: first, a numerical score for the study area; and second, mapping of the spatial pattern that produced the score. In this way users obtain both quantitative and geographic assessments of an area. The numeric scores are interpreted in relation to typical standards, common conditions in the local area, other alternative case scores, or adopted goals where they already exist. The geographic results are used to delineate areas where strengths can be protected and areas where weaknesses need to be corrected.

- *Interpreting indicator scores.* Indicator scores should be interpreted in the context of existing conditions and adopted goals or applicable policies. A key INDEX user document is the Indicator Dictionary that defines what is included in each indicator and how it is calculated. Users will need to gain experience in interpreting scores and changes in scores between cases. Users should examine the direction of change in scores (numerically increasing or decreasing) and the magnitude of change in scores (percent difference).

- *Indicator rating and weighting (RAW).* To determine if indicator scores are favorable or unfavorable according to local norms or goals, users may set objectives for each indicator according to the desired direction of indicator score movement, and thresholds of score desirability. For example, the objective for walk distance to parks would be a decrease in distance since shorter walks would be positive. The threshold for a desirable walk distance might therefore be set for anything less than 1,000 feet. To help stakeholders evaluate and rank multiple studies, weights of importance can also be assigned to indicators. These and the score ratings enable the calculation of a single overall weighted score for a given case, and in turn, the ranking of multiple cases according to their overall scores and achievement of goals.

Figure 5. INDICATOR EXAMPLE: HOUSING PROXIMITY TO PARKS



ORGANIZING STUDIES

Once INDEX PlanBuilder is installed, there are three major process-related tasks in organizing studies:

- *Select a study area boundary.* The study area boundary (called "case boundary" in the software) should be derived from the study's scope and objective, e.g. city limits if an entire municipality is being evaluated, or the neighborhood vicinity if a major development proposal is being examined. Sizing of the boundary in relation to the subject being studied is important because it affects the magnitude of change in results from study to study, e.g. a small development proposal inside a large study area will not significantly change baseline scores versus the same proposal measured in a smaller study boundary that would produce major baseline changes. In short, the boundary should be set to capture the logical spatial extent of a project's impact. For example, a one-half to one-mile buffer around a project site often constitutes a reasonable study area. In all Studies, care should be exercised along the study boundary edge to insure that important adjacent features that affect the study area are included, e.g. an elementary school just outside the boundary of a residential study area. Equally important, anomalous or irrelevant features should be excluded from study areas so they do not adversely influence scores, e.g. excluding a commercial area from a residential study.

- *Select indicators to calculate.* Users select those indicators that are most relevant to the subject at hand, e.g. employment-related indicators for an office park versus housing indicators for a residential subdivision. A user may select all of the indicators when a comprehensive set of measurements is desired, such as benchmarking existing conditions for a planning process. A prerequisite for selecting any indicator is availability of data to support the indicator calculation; data requirements are detailed in the Indicator Dictionary.

- *Set indicator ratings and weights.* If weighted results are desired, users may assign weights of importance and acceptable score ratings to each indicator. This function, known as rating and weighting (RAW), can be used to apply established community goals, or to test new or modified policies. The RAW evaluation is also useful when stakeholders are evaluating and ranking multiple cases in search of consensus on a preferred alternative. The RAW procedure includes the following steps:

    1. *Rating.* These values describe levels of acceptability in indicator scores. The model uses these to convert actual indicator scores from their original units of measurement into a common zero-to-one rating scale.

    2. *Weighting.* Stakeholders establish weights of importance for each indicator. The total weighting "budget" for all indicators is 100.

    3. *Calculation.* The weight is multiplied by the rating of each indicator score and these values are summed to obtain an overall score for each case of between zero and one hundred.

A hypothetical example of the RAW procedure is shown in Figure 6.

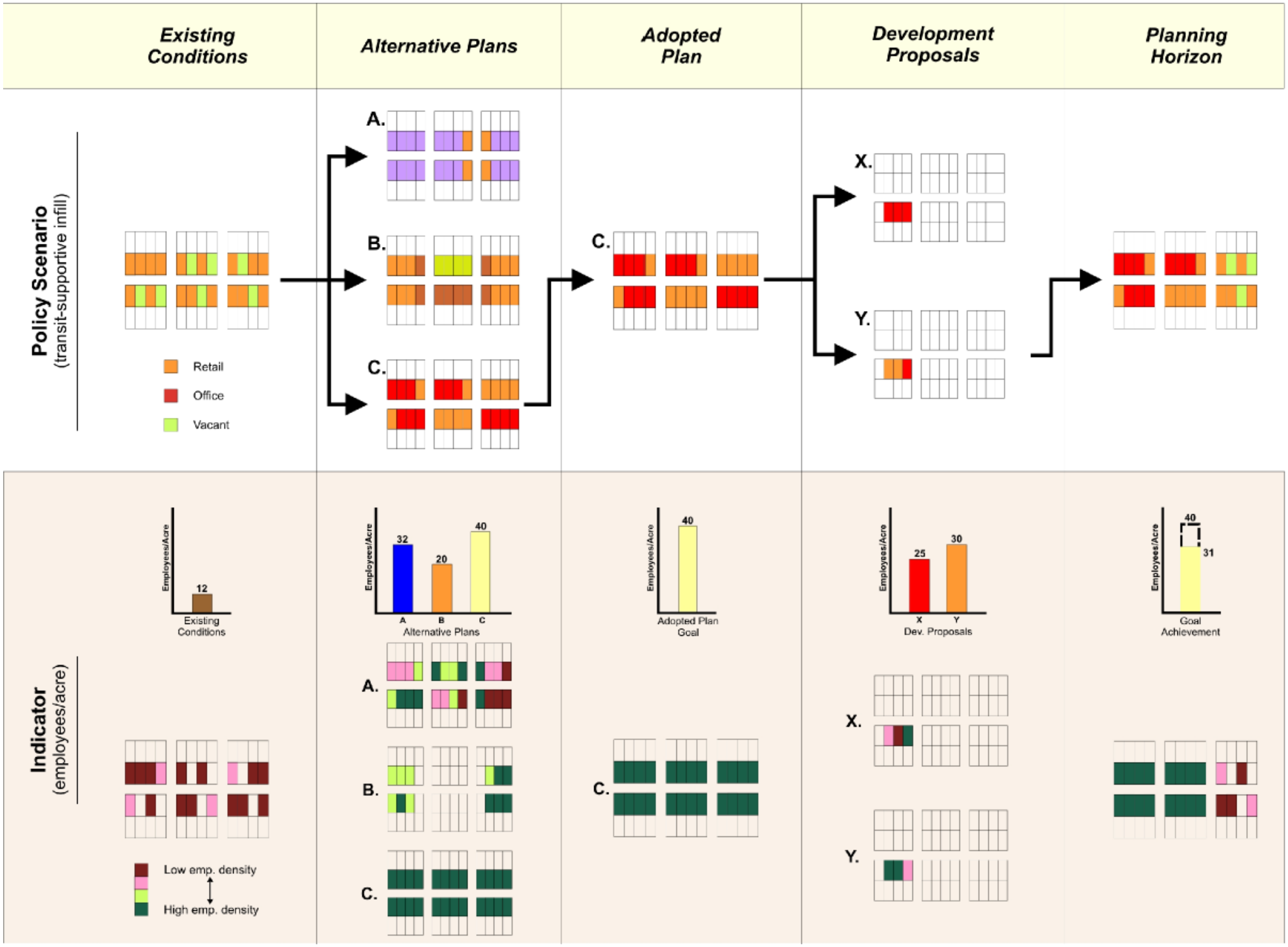
Figure 6. HYPOTHETICAL RAW EXAMPLE

	SET UP						*APPLICATION*						
	Weighting		*Rating*										
Indicator	*Overall Topic Importance*	*Allocation to Indicators*	*Positive Movement of Score*	*Worst Indicator Scores (Get 0)*	*Mediocre Indicator Scores (Get 0.5)*	*Best Indicator Scores (Get 1)*	*Indicator Score*	→	*Equivalent Rating (0 to 1)*	x	*Indicator Weight*	=	*Indicator RAW Score*
Housing	50	- - -											
Dwelling Density	- - -	20	Up	10-	15	20+	16	→	0.6	x	20	=	12
Distance to Transit	- - -	30	Down	2640+	1170	300-	1250	→	0.4	x	30	=	12
Employment	25	- - -											
Employee Density	- - -	10	Up	20-	35	50+	37	→	0.6	x	10	=	6
Distance to Transit	- - -	15	Down	2640+	1170	300-	863	→	0.2	x	15	=	4
Parks	25	- - -											
Distance to Housing	- - -	25	Down	2640+	1170	300-	2300	→	0.9	x	25	=	21
	100	100											

Overall Sketch Score (0-100 scale): 55

To illustrate a simplified INDEX application, a series of hypothetical cases for a neighborhood are shown in Figure 7. This example assumes a policy initiative to densify employment along an arterial corridor to encourage travel mode shifting to transit. The objective is to create a corridor of ridership that will support frequent transit service. “Employees per acre” is selected as a key indicator of transit service feasibility (higher employment density supports greater frequency in transit service). Each panel in Figure 7 is discussed sequentially in the following sections as the neighborhood planning process unfolds.

Figure 7. SIMPLIFIED APPLICATION OF INDEX



BENCHMARKING CURRENT CONDITIONS

Most applications of the software will begin with benchmark measurements of existing conditions in a study area. Benchmark indicator scores are used to:

- *Identify an area's strengths and weaknesses.* Scoring and mapping of existing conditions will reveal problems and opportunities that merit attention in plans.
- *Provide input into the formulation of goals and policies.* Benchmark scores are an important reference point when formulating goals and policies that will be applied to community development.
- *Provide a baseline for gauging change.* During plan implementation when development proposals are evaluated, each proposal's scores can be compared to benchmark measurements to gauge the amount of change that would be caused by the development.
- *Provide a baseline for gauging progress.* During periodic monitoring of plan accomplishments, updated benchmark measurements can be compared against previous benchmarks to gauge cumulative progress toward goals.

Benchmarking is shown in the left-hand panel of Figure 7 where the employment density indicator finds a relatively low 12 employees/acre, which is insufficient to support frequent transit service. This segment of the corridor therefore meets the threshold issue test of needing land-use changes to increase employment density.

CREATING SCENARIOS AND PLANS

Once existing conditions have been evaluated and planning issues identified, stakeholders can use INDEX to create and evaluate alternative scenarios that respond to the issues. Prepared optionally in digital charrettes, these can range from comprehensive community plans to any number of special-purpose or neighborhood plans. In any of these processes, alternative scenarios can be created and evaluated according to the following general sequence:

- *Preparation of alternative cases.* Using the Case Designer tool, stakeholders prepare alternatives that respond to the issues identified during benchmarking. Each of these is represented by an alternative case in the software with each case containing its own unique mix of features. If housing was identified as an issue, one alternative might emphasize a mix of single and multi-family dwellings while another alternative might contain only single-family units. Alternatives can be prepared before public meetings or during them using digital charrette techniques.

- *Review of alternative scores.* Stakeholders review indicator scores for each case in comparison to other alternatives and benchmark measurements to determine which alternatives respond most effectively to identified issues. For example, if excessive walking distance to parks was identified as a problem at the outset, stakeholders would review the alternatives' park proximity scores to determine which scenario offered the shortest walking distance to parks.

- *Iteration to preferred alternative and adopted plan.* Using the software to modify alternative designs and provide feedback of results, stakeholders can iterate among alternatives to a preferred, and ultimately adopted, plan.

- *Modeling of adopted goals.* Once a plan is formally adopted, its build-out or full implementation can be modeled and the resulting horizon year indicator scores used as quantitative expressions of its goals.

In the Figure 7 example, three alternative plans are suggested for the neighborhood corridor by stakeholders: a) vertical mixed-use with employment on lower floors and housing on upper floors; b) new commercial retail with separate multi-family housing and a small park; and c) a mix of offices and retail. The three alternative plans are scored with the employment density indicator producing results of 32, 20, and 40 employees/acre, respectively. Given the hypothetical policy objective of increased density for transit support, Plan C is adopted and its build-out measurement of 40 employees/acre becomes the corridor's goal.

IMPLEMENTING PLANS

Once plans are adopted, INDEX PlanBuilder can help implement them by evaluating the consistency of development proposals against plan goals. They can also gauge the magnitude of change that a development proposal would cause in an area. These implementation checks can be accomplished according to the following general sequence:

- *Acquire development proposal in GIS form.* In order to apply INDEX as a development evaluation tool, it will be necessary to obtain development proposals in GIS form. Given the widespread use of CAD in preparing development plans and the relatively easy conversion of CAD files to GIS format, it should be reasonable to request major development proposals in GIS format. To implement a requirement for digital development plans, jurisdictions would adopt the equivalent of the INDEX Indicator Dictionary as a data specification for digital submittals. Jurisdictions could decide the extent of these data requirements based on which indicators they intend to apply to proposals.

- *Score base study development proposal.* The development proposal is scored with indicators and the results are compared to: 1) existing conditions to gauge the amount of change represented by the development; and 2) adopted goals to determine how much goal achievement the development would accomplish.

- *Iterate to acceptable proposal.* Again using the software's capability for feedback, stakeholders and decision-markers can iterate to an acceptable development scheme during the permitting process.

In the Figure 7 example, this step is shown with two versions of a development proposal, X and Y. Proposal X contains offices and Proposal Y includes offices plus retail. The employment density indicator reveals that Proposal Y's employment density is 20% greater than Proposal X, and is therefore preferred because it is more supportive of the adopted corridor goal.

A simplified description of this procedure is given in Table 1 for the generic question of whether a proposed development project is acceptable or unfavorable for a community.

Table 1

IS A PROPOSED DEVELOPMENT PROJECT ACCEPTABLE OR UNFAVORABLE FOR MY COMMUNITY?

1. Determine which indicators are relevant to project issues.

2. Measure existing conditions in the proposed project vicinity without the project. Calculate indicator scores for a reasonable impact area around the proposed project site, or for an already-established local boundary that encompasses the project site.

3. Measure build-out scores for the existing official land-use plan for the area without the project. Build-out indicator scores are the equivalent of plan goals. If an official plan doesn't apply to the area, measure a set of tentative objectives and goals.

4. Measure the area with the project included (modify #2 to include project).

5. Gauge the type, direction, and magnitude of change in indicator scores between the baseline area (#2) and the area with the project (#4). Which indicator scores change, in what direction, and by how much?

6. Gauge the consistency of the project scores (#4) with the area's goals (#3). Does the project move indicator scores in the direction of the area's goals and if so, which indicators and by how much?

ACHIEVING PLANS

Periodically, INDEX PlanBuilder can be used to measure cumulative change and overall progress toward goals. This type of application includes the following steps:

- *Retrieve benchmark indicator scores.* Indicator scores from the previous benchmark year are used as the starting point, e.g. year 2000.
- *Incorporate built and natural environment changes.* The model's database is updated with constructed changes in the built environment, and resulting changes in the natural environment, that have occurred during the reporting period, e.g. 2000-2005.
- *Update indicator scores.* An updated "existing conditions" study is scored to establish measurements for the new benchmark year, e.g. 2005. The changes in indicator scores between 2000 and 2005 become the amount of goal achievement for the period.

In the Figure 7 example, cumulative changes over several years are measured, revealing a density increase from 12 to 31 employees/acre, which is substantial partial achievement of the goal of 40 employees/acre. However, despite this areawide progress, indicator mapping shows a continuing weakness in employment density in the eastern portion of the corridor where additional attention needs to be focused in order to fully achieve the plan.

SPECIAL PURPOSE APPLICATIONS

In addition to the generic planning steps described above, INDEX can be applied to any special purpose study where the tool's indicators are relevant to the study's subject matter. Examples include annexations, environmental impact reports, capital improvement planning, and facility siting. Any kind of comparative scenario evaluation or trade-off analysis that is land-based could conceivably be simulated in INDEX providing that its indicators are relevant to the issues at hand.

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Indicator Dictionary

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APPENDIX

INTRODUCTION

At the heart of INDEX is a set of indicators for measuring existing conditions, proposed plans, and progress toward goals. Indicators are “yardsticks” for identifying an area’s strengths and weaknesses, testing alternative courses of action, and monitoring change over time. INDEX PlanBuilder has a menu of many indicators available for performing these duties.

The exact list of indicators available to users depends on which ESRI ArcGIS license exists on the machine where INDEX is installed.

ArcEditor/ArcInfo Licensees Only have access to the complete set of 77 indicators.

ArcView Users can run 57 indicators (a subset of the full 77).

Indicators in this manual which are restricted to ArcEditor/ArcInfo users are marked appropriately.

Indicator measurements are reported in two ways: first, as numerical scores for the study area; and second, mapping of the spatial pattern that produced the scores. In this way users obtain both quantitative and geographic assessments of an area. Numeric scores should be interpreted in relation to typical standards, local conditions, other alternative case scores, or adopted goals where they already exist. Geographic results should be used to delineate areas where strengths can be protected and areas where weaknesses need to be corrected. Indicator selection is a key step in using INDEX, and users should consult the Community Process Guide for additional information on choosing indicators for studies.

The Indicator Dictionary provides the following information for each indicator:

- *Definition in units.* This is a narrative description of the indicator definition and the units in which scores are expressed.
- *Illustrative scores.* These are examples or ranges of typical indicator scores.
- *General formula.* This is an algebraic expression of the indicator calculation method.
- *Map type.* This describes the type of indicator mapping generated along with tabular scores.
- *Notes.* This provides any special comments about an indicator or its application.

In addition to these definition components, the Indicator Dictionary contains the following appendices:

- 5D method technical memorandum. ***ArcEditor/ArcInfo Licensees Only***
- Air pollutant and greenhouse gas emission factors. ***ArcEditor/ArcInfo Licensees Only***
- Indicator-data relationship matrices.
- Data summary.
- Methodology for estimating residential water use.

INDEX PlanBuilder is designed to execute studies at the parcel level for a fine grained, pedestrian scale analysis. INDEX is capable of executing studies at a coarser area-based level using land units larger than parcels, e.g. traffic analysis zones, but the indicator changes and other complexities of area-based studies require consultation with Criterion staff before undertaking them. Assistance with area-based studies is outside the scope of standard technical support included with a PlanBuilder purchase.

DEMOGRAPHICS

Indicator Name:	Population [2]
Definition and Units:	Total number of residents in user-defined study area.
Illustrative Scores:	Varies.
General formula:	$\sum R_p$ R_p = number of residents for residential polygon *p.*
Map Type:	None.
ESRI License Restrictions:	None.

Indicator Name:	Employment [3]
Definition and Units:	Total number of employees in user-defined study area.
Illustrative Scores:	Varies by study area.
General formula:	$\sum E_p$ E_p = number of employees for employment polygon *p.*
Map Type:	None.
ESRI License Restrictions:	None.

Indicator Name:	Population Density [4]
Definition and Units:	Total residents per gross study area acre.
Illustrative Scores:	Varies widely by type and composition of study area, e.g. 5 – 40 persons/acre.
General formula:	$\frac{\sum R_p}{\sum A_s}$ R_p = number of residents for polygon *p.* A_s = area in acres of study area polygon *s.*
Map Type:	Dynamic.
ESRI License Restrictions:	None.

LAND-USE

Indicator Name:	Study Area Acreage [74]
Definition and Units:	Total acreage of study area case boundary.
Illustrative Scores:	Varies by study area.
General formula:	$\sum B_p$ B_p = study area (case) boundary polygon *p.*
Map Type:	None.
ESRI License Restrictions:	None.

Indicator Name:	Average Parcel Size [5]
Definition and Units:	Average size of all parcels in square feet.
Illustrative Scores:	Varies depending on study area, e.g. 10,000-20,000 sq.ft.
General formula:	$$\frac{\sum A_p}{N}$$ A_p = area in sq.ft. of parcel *p*. N = number of parcels in the study area.
Map Type:	Dynamic.
ESRI License Restrictions:	None.

Indicator Name:	Use Mix [7]
Definition and Units:	Proportion of mixed or dissimilar developed land-uses among a grid of cells of user-defined size, expressed on a scale of 0 to 1. Includes vertical dissimilarity in mixed-use cells.
Illustrative Scores:	0.25 – 0.4 from moderately diverse areas; 0.65 – 0.8 for highly diverse areas.
General formula:	$$M_i = \frac{\sum_{i=1}^{n}\left(D_i + \sum_{a=1}^{8} D_a\right)}{\sum_{i=1}^{n}\left(U_i + \sum_{a=1}^{8} U_a\right)}$$ U_i = Uses at cell i. D_i = Uses at cell i dissimilar to another use at cell i (vertical mix). U_a = Uses at adjacent cell a. U_a = Uses at adjacent cell a. D_a = Uses at adjacent cell a dissimilar to any use at cell i (horizontal mix). M_i = Use Mix at cell i.
Map Type:	Dynamic.
ESRI License Restrictions:	None.
Note:	Vacant, ROW, Parking, Open Space, and Agriculture uses not included in the calculation. Cells are defined from primary land-uses only. Supplementary land-uses are not used. Cells size should be minimized for fine grained analysis of relatively small study areas, e.g. urban design evaluations of 1,000 acres or less. Cell size should be increased as study area size increases to maintain reasonable indicator run times.

Indicator Name:	Use Balance [8]
Definition and Units:	Proportional balance of developed land-uses, by (net or gross) land area, expressed on a scale of 0 (low) to 1 (high).
Illustrative Scores:	0.7 – 0.9 for well balanced areas; 0.3 – 0.5 for imbalanced areas.
General formula:	$$-\left(\frac{\sum\left[P_j * \ln\left(P_j\right)\right]}{\ln\left(N\right)}\right)$$ P_j = proportion of developed land in the j-th land-use type $(1 \leq j \leq N)$. N = number of unique developed land-uses in the study area.
Map Type:	None.
ESRI License Restrictions:	None.
Note:	Vacant, ROW, Open Space, and Agriculture uses not included in the calculation.

Indicator Name:	Development Footprint [9]
Definition and Units:	Developed acres per 1000 residents.
Illustrative Scores:	4 acres/capita in rural areas; 0.04 acres/capita in high-density urban areas.
General formula:	$\left(\frac{\sum A_{dp}}{\sum R_p}\right)*1000$ A_{dp} = area in acres of polygon p, if p is developed. R_p = number of residents for polygon p.
Map Type:	Static.
ESRI License Restrictions:	None.
Note:	Vacant, ROW, Park, Open Space, and Agriculture uses not included in the calculation.

Indicator Name:	Fiscal Impact of Development [10]
Definition and Units:	Fiscal impact of development, in dollars.
Illustrative Scores:	Varies widely according to project-specific conditions.
General formula:	$\sum F_a$ F_a = fiscal impact of development in dollars for study area polygon a.
Map Type:	None.
ESRI License Restrictions:	None.
Note:	University of Wisconsin fiscal impact model documentation is available for downloading from www.crit.com/documents/commdev.pdf.

HOUSING

Indicator Name:	Dwelling Density [75]
Definition and Units:	Dwelling units per gross acre.
Illustrative Scores:	Varies by study area.
General formula:	$$\frac{\sum D_{sp}}{\sum A_a}$$ D_{sp} = number of dwelling units for land-use polygon p. A_a = area of study area polygon a.
Map Type:	Dynamic.
ESRI License Restrictions:	None.

Indicator Name:	Dwelling Unit Count [73]
Definition and Units:	Total number of dwelling units in user-defined study area.
Illustrative Scores:	Varies by study area.
General formula:	$\sum D_p$ D_p = dwelling unit count of land use polygon p.
Map Type:	None.
ESRI License Restrictions:	None.

Indicator Name:	Student Enrollment Level [11]
Definition and Units:	Percent of total estimated enrollment capacity for student attendance areas met by estimated student enrollment from new and existing development.
Illustrative Scores:	Varies widely depending on student attendance area composition.
General formula:	$\frac{\sum_p S_p}{\sum_a \left(C_a * \frac{A_{as}}{A_a} \right)} * 100$ S_p = number of students for land-use polygon p. C_a = total enrollment capacity for attendance area a. A_a = area of attendance area a. A_{as} = area of attendance area a which intersects study area polygon s.
Map Type:	None.
ESRI License Restrictions:	None.

Indicator Name:	Residential Footprint [13]
Definition and Units:	Total residential acres per 1000 residents.
Illustrative Scores:	4 acres/capita in rural areas; 0.04 acres/capita in high-density urban areas.
General formula:	$\left(\frac{\sum A_{rp}}{\sum R_{rp}}\right) * 1000$ A_{rp} = area in acres of polygon p, if p is at least partially residential. R_{rp} = number of residents for polygon p
Map Type:	Static.
ESRI License Restrictions:	None.

Indicator Name:	Single-Family Parcel Size [14]
Definition and Units:	Average size of single-family residential parcels in square feet.
Illustrative Scores:	4,000 - 10,000 sq.ft.
General formula:	$\frac{\sum A_{sp}}{N_{sp}}$ A_{sp} = area in square feet of single-family parcel p. N_{sp} = number of single-family parcels in the study area.
Map Type:	Dynamic.
ESRI License Restrictions:	None.

Indicator Name:	Single-Family Dwelling Density [15]
Definition and Units:	Single-family dwelling units per net acre of land designated for single-family use.
Illustrative Scores:	4 - 12 DU/acre.
General formula:	$\frac{\sum D_{sp}}{\sum A_{sp}}$ D_{sp} = number of dwelling units for single-family polygon p. A_{sp} = area in acres of single-family polygon p.
Map Type:	Dynamic.
ESRI License Restrictions:	None.

Indicator Name:	Multi-Family Dwelling Density [16]
Definition and Units:	Multi-family dwelling units per net acre of land designated for multi-family use.
Illustrative Scores:	10 - 30 DU/acre.
General formula:	$\frac{\sum D_{mp}}{\sum A_{mp}}$ D_{mp} = number of dwelling units for multi-family or mixed-use polygon p. A_{mp} = area in acres for multi-family or mixed-use polygon p.
Map Type:	Dynamic.
ESRI License Restrictions:	None.

Indicator Name:	Single-Family Dwelling Share [17]
Definition and Units:	Percent of dwelling units that are single-family.
Illustrative Scores:	70 - 95%.
General formula:	$\frac{\sum D_{sp}}{\sum D_p} * 100$ D_{sp} = number of single-family dwelling units for polygon p. D_p = number of dwelling units for polygon p.
Map Type:	Static.
ESRI License Restrictions:	None.

Indicator Name:	Multi-Family Dwelling Share [18]
Definition and Units:	Percent of dwelling units that are multi-family.
Illustrative Scores:	10 - 30%.
General formula:	$\frac{\sum D_{mp}}{\sum D_p}$ D_{mp} = number of multi-family dwelling units for polygon p. D_p = number of dwelling units for polygon p.
Map Type:	Static.
ESRI License Restrictions:	None.

Indicator Name:	Amenities Adjacency [19]
Definition and Units:	Percent of residents within user-defined linear distance of user-designated amenities (e.g. school, community center, shopping, etc.).
Illustrative Scores:	Varies widely based on user-defined distance and study area character, e.g. 30% of dwellings within one mile of elementary schools.
General formula:	$$\frac{\sum R_{wa}}{\sum R_a} * 100$$ R_{wa} = number of residents for area a within walkable distance of an amenity. R_a = number of residents for area a.
Map Type:	Dynamic.
ESRI License Restrictions:	None.

Indicator Name:	Amenities Proximity [20]
Definition and Units:	Average travel distance from all residents to closest designated amenity.
Illustrative Scores:	1,000 - 2,000 ft. in urban areas; over 5,000 ft. in rural areas.
General formula:	$\frac{\sum (P_p * R_p)}{\sum R_p}$ P_p = shortest network path length in feet from polygon p to an amenity. R_p = number of residents for polygon p.
Map Type:	Dynamic.
ESRI License Restrictions:	***ArcEditor/ArcInfo Licensees Only***

Indicator Name:	Single-Family Housing Affordability [21]

Area-based
Parcel-based □

Definition and Units: Ratio of an affordable price (using an average household income, housing budget of 25% of income, and conventional financing terms) vs. 120% of average assessed value.

Illustrative Scores: Less than 1 is not affordable; greater than 1 is affordable.

General formula:

$$\frac{A * \sum D_p}{1.2 * \sum V_p}$$

A	=	Affordable single-family housing unit price.
V_p	=	total assessed value of polygon *p*.
D_p	=	number of dwelling units for polygon *p*.

Map Type: Dynamic.

Note: Affordable income threshold should be defined by the user, based on regional and national data.

Indicator Name:	Transit Adjacency to Housing [22]
Definition and Units:	Percent of residents dwelling within user-defined linear distance of transit routes (exclusive of heavy rail).
Illustrative Scores:	Varies widely based on user-defined distance and study area type.
General formula:	$\frac{\sum R_{wa}}{\sum R_a} * 100$ R_{wa} = number of residents for area a within walkable distance of a transit route (exclusive of heavy rail). R_a = number of residents for area a.
Map Type:	Dynamic.
ESRI License Restrictions:	None.

Indicator Name:	Transit Proximity to Housing [23]
Definition and Units:	Average walk distance from all residents to closest transit stop in ft.
Illustrative Scores:	Area-based scores will depend on user-defined distance and study area type; parcel-based scores will vary based on density and route directness, e.g. 500 - 2,000 ft.
General formula:	$\frac{\sum (P_p * R_p)}{\sum R_p}$ P_p = shortest network path length in feet from polygon p to a transit stop. R_p = number of residents for polygon p.
Map Type:	Dynamic.
ESRI License Restrictions:	***ArcEditor/ArcInfo Licensees Only***

Indicator Name:	Key Feature Adjacency to Housing [83]
Definition and Units:	Percent of residents within user-defined linear distances of up to 3 different layers of key features (point, polygon, line, each with their own buffer distance) NOTE: if one of the adjacency layers is left empty (no features) then the indicator excludes that layer as a pre-requisite determining adjacent population
Illustrative Scores:	Varies widely based on user-defined distance and study area character.
General formula:	$\frac{\sum R_{wa}}{\sum R_a} * 100$ R_{wa} = number of residents for area a within adjacent distance of up to three key feature layers. R_a = number of residents for area a.
Map Type:	Dynamic.
ESRI License Restrictions:	None.

Indicator Name:	Residential Infill [82]
Definition and Units:	Number of new residents allocated in an alternative case to land uses which in the base case were classified as developed. "Developed" land uses include: • Low Residential • Moderate Residential • High Residential • Retail/Services • Office • Mixed-Use • Industrial • School • Institutional • Parking • Rights-of-way NOTE: base case score for this indicator will always be zero. Only positive growth is counted in the indicator. Residential losses on a redeveloped piece of land are not subtracted from the total.
Illustrative Scores:	Varies widely based on study area character.
General formula:	$\sum R_p$ R_p = number of residents added to existing developed land use polygon *p* in an alternative case.
Map Type:	Dynamic.
ESRI License Restrictions:	None.

Indicator Name:	Wastewater Generation [76]
Definition and Units:	Total study area wastewater generation in gallons.
Illustrative Scores:	Varies by study area.
General formula:	$\sum R_p * WW$ R_p = number of residents for land uses polygon p. WW = waste water generation co-efficient in gal/capita.
Map Type:	None.
ESRI License Restrictions:	None.

Indicator Name:	Solid Waste Generation [77]
Definition and Units:	Total study area solid waste generation in pounds.
Illustrative Scores:	Varies by study area.
General formula:	$\sum R_p * SW$ R_p = number of residents for land uses polygon p. SW = solid waste generation co-efficient in lbs/capita.
Map Type:	None.
ESRI License Restrictions:	None.

Indicator Name:	Residential Structural Energy Use [78]

Definition and Units: Total annual MMBtu per capita for residential structural energy use.

Illustrative Scores: Varies by study area.

General formula:

$$\frac{T_{sf} + T_{mf}}{\sum R_p}$$

Where

$$T_{sf} = E_{sf} * \sum_p \left(\sum_d U_{sfdp} * C_p \right)$$

$$T_{mf} = E_{mf} * \sum_p \left(\sum_d U_{mfdp} * C_p \right)$$

$$C_p = 1 \quad \{\text{if } D_p \le 13\}$$

$$C_p = 1 - \left[\frac{2 * (D_p - 13)}{100} \right] \quad \{\text{if } 13 < D_p \le 20\}$$

$$C_p = 0.86 \quad \{\text{if } D_p > 20\}$$

$$D_p = \frac{\sum_d (U_{sfdp} + U_{mfdp})}{A_p}$$

T_{sf} = total single-family residential energy use.
T_{mf} = total multi-family residential energy use.
R_p = number of residents for land uses polygon *p.*
E_{sf} = residential energy use in MMBtu per single-family dwelling.
E_{mf} = residential energy use in MMBtu per multi-family dwelling.
U_{sfdp} = number of single-family dwellings on land uses polygon *p.*
U_{mfdp} = number of multi-family dwellings on land uses polygon *p.*
A_p = area in acres of land uses polygon *p.*
C_p = "common wall effect" adjustment for land uses polygon *p.*
D_p = dwelling density for land uses polygon *p.*

Map Type: None.

ESRI License Restrictions: None.

Indicator Name:	Residential Water Consumption [59]
Definition and Units:	Total residential indoor and outdoor water use in gallons per day per capita.
Illustrative Scores:	Varies by case boundary area composition and climate, e.g. 100 - 150 gal per day per capita.

General formula:

$$\frac{\sum_p I_p + O_p}{\sum_p R_p}$$

Where,

$$O_p = K * \frac{V}{365} * A_p * \left(\frac{100 - B_p}{100}\right) * M_{tp}$$

$$K = 0.6192 \frac{\text{gal}}{\text{sq.ft.-in.}}$$

I_p	=	indoor water use in gallons per day for all dwellings on land uses polygon *p.*
O_p	=	outdoor water use in gallons per day for land uses polygon *p.*
R_p	=	number of residents for land uses polygon *p.*
V	=	regional estimated applied water requirement for cool season grasses in inches per year for a normal rainfall year.
A_p	=	area in square feet of land uses polygon *p.*
B_p	=	percent impervious for land uses polygon *p.*
M_{tp}	=	landscape type factor for land uses polygon *p.*
K	=	water volume conversion constant.

Map Type:	Dynamic.
ESRI License Restrictions:	None.
Note:	The methodology used to estimate changes in water use for residences is derived from the AWWARF methodology described in Appendix E.

Indicator Name:	Household Energy Consumption [60]
Definition and Units:	Total annual MMBtu per capita for households, including structural energy and auto travel.
Illustrative Scores:	75 – 200 MMBtu per capita, depending on regional location.

General formula:

$$\frac{T_{rv} + T_{sf} + T_{mf}}{\sum R_p}$$

Where,

$$T_{rv} = E_{rv} * V * 365$$

$$T_{sf} = E_{sf} * \sum_p \left(\sum_d U_{sfdp} * C_p \right)$$

$$T_{mf} = E_{mf} * \sum_p \left(\sum_d U_{mfdp} * C_p \right)$$

$$C_p = 1 \quad \{\text{if } D_p \le 13\}$$

$$C_p = 1 - \left[\frac{2 * (D_p - 13)}{100} \right] \quad \{\text{if } 13 < D_p \le 20\}$$

$$C_p = 0.86 \quad \{\text{if } D_p > 20\}$$

$$D_p = \frac{\sum_d (U_{sfdp} + U_{mfdp})}{A_p}$$

V	=	total daily vehicle miles traveled per capita (HB + NHB).
E_{rv}	=	residential vehicle energy use in MMBtu per mile traveled.
T_{rv}	=	total residential vehicle energy use.
T_{sf}	=	total single-family residential energy use.
T_{mf}	=	total multi-family residential energy use.
R_p	=	number of residents for land uses polygon *p.*
E_{sf}	=	residential energy use in MMBtu per single-family dwelling.
E_{mf}	=	residential energy use in MMBtu per multi-family dwelling.
U_{sfdp}	=	number of single-family dwellings on land uses polygon *p.*
U_{mfdp}	=	number of multi-family dwellings on land uses polygon *p.*
A_p	=	area in acres of land uses polygon *p.*
C_p	=	“common wall effect” adjustment for land uses polygon *p.*
D_p	=	dwelling density for land uses polygon *p.*

Map Type: None.

ESRI License Restrictions: ***ArcEditor/ArcInfo Licensees Only***

EMPLOYMENT

Indicator Name:	Jobs to Housing Balance [24]
Definition and Units:	Total number of jobs divided by number of dwelling units.
Illustrative Scores:	Varies by study area type, e.g. 0.6 in residentially-oriented areas, 2.0 in employment-oriented areas.
General formula:	$\frac{\sum E_p}{\sum D_p}$ E_p = employees for polygon p. D_p = number of dwelling units for polygon p.
Map Type:	None.
ESRI License Restrictions:	None.

Indicator Name:	Employment Density [25]
Definition and Units:	Number of employees per net acre of land designated for employment uses.
Illustrative Scores:	10 – 30 employees/acre.
General formula:	$$\frac{\sum E_p}{\sum A_a}$$ E_p = number of employees for polygon p. A_a = area in acres of employment polygon a.
Map Type:	Dynamic.
ESRI License Restrictions:	None.

Indicator Name:	Commercial Building Density [26]
Definition and Units:	Average commercial building floor area ratio.
Illustrative Scores:	0.8 - 1.5 in urban areas; 0.3 - 0.5 in suburban areas.
General formula:	$$\frac{\sum C_p}{\sum A_p} * \frac{1}{43560}$$ C_p = commercial floor area for polygon p. A_p = area in square feet of polygon p.
Map Type:	Dynamic.
ESRI License Restrictions:	None.

Indicator Name:	Transit Adjacency to Employment [27]
Definition and Units:	Percent of employees within user-defined linear distance of transit routes (exclusive of heavy rail).
Illustrative Scores:	Varies based on user-defined distance and study area type.
General formula:	$\frac{\sum E_{wa}}{\sum E_a} * 100$ E_{wa} = number of employees for area a within walkable distance of a transit route (exclusive of heavy rail). E_a = number of employees for area a.
Map Type:	Dynamic.
ESRI License Restrictions:	None.

Indicator Name:	Transit Proximity to Employment [28]
Definition and Units:	Average walk distance from employees places of employment to closest transit stop in ft.
Illustrative Scores:	Area-based varies according to user-defined distance and study area type; parcel-based varies according to density and route directness, e.g. 500 - 1,000 ft. in urban areas.
General formula:	$$\frac{\sum(P_p * E_p)}{\sum E_p}$$ P_p = shortest network path length in feet from polygon p to a transit stop. E_p = number of employees for polygon p.
Map Type:	Dynamic.
ESRI License Restrictions:	***ArcEditor/ArcInfo Licensees Only***

Indicator Name:	Key Feature Adjacency to Employment [84]
Definition and Units:	Percent of employment within user-defined linear distances of up to 3 different layers of key features (point, polygon, line, each with their own buffer distance) NOTE: if one of the adjacency layers is left empty (no features) then the indicator excludes that layer as a pre-requisite determining adjacent employment
Illustrative Scores:	Varies widely based on user-defined distance and study area character.
General formula:	$\frac{\sum E_{wa}}{\sum E_{a}} * 100$ E_{wa} = number of employees for area a within adjacent distance of up to three key feature layers. E_{a} = number of employees for area a
Map Type:	Dynamic.
ESRI License Restrictions:	None.

Indicator Name:	Employment Infill [82]
Definition and Units:	Number of new employment counts allocated in an alternative case to land uses which in the base case were classified as developed. "Developed" land uses include: • Low Residential • Moderate Residential • High Residential • Retail/Services • Office • Mixed-Use • Industrial • School • Institutional • Parking • Right-Of-Way NOTE: base case score for this indicator will always be zero. Only positive growth is counted in the indicator. Employment losses on a redeveloped piece of land are not subtracted from the total.
Illustrative Scores:	Varies widely based on study area character.
General formula:	$\sum E_p$ E_p = number of employees added to existing developed land use polygon *p* in an alternative case.
Map Type:	Dynamic.
ESRI License Restrictions:	None.

RECREATION

Indicator Name:	Park/Schoolyard Space Supply [29]
Definition and Units:	Acres of park and school yards per 1,000 residents.
Illustrative Scores:	1 - 4 acres/1,000 residents.
General formula:	$\left(\frac{\sum A_y}{\sum R_p}\right) * 1000$ A_y = area in acres for park or school yard y. R_p = number of residents for polygon p.
Map Type:	Static.
ESRI License Restrictions:	None.
Note:	Park spaces are drawn from both primary and supplementary land-uses.

Indicator Name:	Park/Schoolyard Adjacency to Housing [30]
Definition and Units:	Percent of residents within user-defined linear distance of parks or school yards.
Illustrative Scores:	Varies according to user-defined distance and study area type.
General formula:	$\frac{\sum R_{wa}}{\sum R_a} * 100$ R_{wa} = number of residents for area a within walkable distance of a park or school yard. R_a = number of residents for area a.
Map Type:	Dynamic.
ESRI License Restrictions:	None.
Note:	Park spaces are drawn from both primary and supplementary land-uses.

Indicator Name:	Park/Schoolyard Proximity to Housing [31]
Definition and Units:	Average walk distance from all residents to closest park or school yard in ft.
Illustrative Scores:	Area-based varies according to user-defined distance and area composition; parcel-based varies by density and route directness, e.g. 1,000-3,000 ft.
General formula:	$\frac{\sum (P_p * R_p)}{\sum R_p}$ P_p = shortest network path length in feet from polygon p to a park or school yard. R_p = number of residents for polygon p.
Map Type:	Dynamic.
ESRI License Restrictions:	***ArcEditor/ArcInfo Licensees Only***
Note:	Park spaces are drawn from both primary and supplementary land-uses.

ENVIRONMENT

Indicator Name:	NOx Pollutant Emissions [32]
Definition and Units:	NO_x pollution emitted from light vehicles in lbs./capita/year.
Illustrative Scores:	25-40 lbs./year/capita.
General formula:	$\sum\left[\left(N_{vmt} * M\right)+\left(N_{vt} * 2T\right)\right]*365$
	N_{vmt} = NO_x per vehicle mile traveled coefficient.
	M = vehicle miles traveled per capita per day.
	N_{vt} = NO_x per vehicle trip end coefficient.
	T = vehicle trips per capita per day.
Map Type:	None.
ESRI License Restrictions:	***ArcEditor/ArcInfo Licensees Only***
Note:	See Appendix B for EPA coefficient source info.

Indicator Name:	HC Pollutant Emissions [57]
Definition and Units:	HC pollution emitted from light vehicles in lbs./capita/year.
Illustrative Scores:	50-80 lbs./year/capita.
General formula:	$\sum\left[\left(H_{vmt} * M\right) + \left(H_{vt} * 2T\right)\right] * 365$ H_{vmt} = HC per vehicle mile traveled coefficient. M = vehicle miles traveled per capita per day. H_{vt} = HC per vehicle trip end coefficient. T = vehicle trips per capita per day.
Map Type:	None.
ESRI License Restrictions:	***ArcEditor/ArcInfo Licensees Only***
Note:	See Appendix B for EPA coefficient source info.

Indicator Name:	CO Pollutant Emissions [58]
Definition and Units:	CO pollution emitted from light vehicles in lbs./capita/year.
Illustrative Scores:	400-600 lbs./year/capita.
General formula:	$\sum\left[\left(C_{vmt} * M\right)+\left(C_{vt} * 2T\right)\right] * 365$
	C_{vmt} = CO per vehicle mile traveled coefficient.
	M = vehicle miles traveled per capita per day.
	C_{vt} = CO per vehicle trip end coefficient.
	T = vehicle trips per capita per day.
Map Type:	None.
ESRI License Restrictions:	***ArcEditor/ArcInfo Licensees Only***
Note:	See Appendix B for EPA coefficient source info.

Indicator Name:	Greenhouse Gas Emissions [33]
Definition and Units:	CO_2 emitted from light vehicles in lbs/capita/year.
Illustrative Scores:	1,000-10,000 lbs/yr/capita.
General formula:	$\sum (C_{vmt} * M) * 365$ C_{vmt} = CO_2 per vehicle mile traveled coefficient. M = vehicle miles traveled per capita per day.
Map Type:	None.
ESRI License Restrictions:	***ArcEditor/ArcInfo Licensees Only***
Note:	See Appendix B for EPA coefficient source info.

Indicator Name:	Open Space Share [34]
Definition and Units:	Percent of total land area dedicated to open space.
Illustrative Scores:	5 - 20%.
General formula:	$\frac{\sum A_{op}}{\sum A_p} * 100$ A_{op} = area in acres of open space use type in polygon p. A_p = area in acres of polygon p.
Map Type:	None.
ESRI License Restrictions:	None.
Note:	Open spaces are drawn from both primary and supplementary land-uses.

Indicator Name:	Open Space Connectivity [35]
Definition and Units:	Open space connectivity among a grid of cells of user-defined size, expressed on a scale of 0 (low) to 1 (high).
Illustrative Scores:	0.2 - 0.4 for highly fragmented open space; 0.7 - 0.9 for highly connected open space.
General formula:	$\frac{\sum O_{ai}}{\sum C_{ai}}$ O_{ai} = number of open space cells adjacent to open space cell i $(0 \sim i \sim 8)$. C_{ai} = number of cells adjacent to cell i $(0 \sim i \sim 8)$.
Map Type:	Dynamic.
ESRI License Restrictions:	None.
Note:	Cells are defined from primary land-uses only. Supplementary land-uses are not used.

Indicator Name:	Stormwater Runoff [36]
Definition and Units:	Average annual runoff depth in cu.ft./acre/year.
Illustrative Scores:	3,000 cu.ft./acre/year in rural or low-density residential areas; 30,000 cu.ft./acre/year in high-density commercial areas.
General formula:	Uses the US EPA SGWATER methodology. EPA documentation of the methodology is available for downloading from www.crit.com/documents/sgwater.pdf.
Map Type:	Dynamic.
ESRI License Restrictions:	None.

Indicator Name:	Nonpoint Source Pollution [37]
Definition and Units:	Average annual combined NPS pollution in kg/acre/year for three pollutants (suspended solids, nitrogen compounds, and phosphorus compounds) based on imperviousness and stormwater runoff volume.
Illustrative Scores:	Total amount varies widely based on study area size.
General formula:	Uses the US EPA's SGWATER methodology. EPA documentation of the methodology is available for downloading from www.crit.com/documents/sgwater.pdf.
Map Type:	Dynamic.
ESRI License Restrictions:	None.
Note:	The scores in this indicator can be mitigated by the optional application of stormwater best management practices.

Indicator Name:	Imperviousness [38]
Definition and Units:	Amount of impervious surface as percent of total land area.
Illustrative Scores:	10-15% for low density development patterns; 30-40% for high density areas.
General formula:	$\frac{\sum (A_p * I_p)}{\sum A_p}$ A_p = area in square feet of parcel p. I_p = percent of parcel p which is impervious.
Map Type:	Dynamic.
ESRI License Restrictions:	None.

Indicator Name:	Floodplain Encroachment [39]
Definition and Units:	Percent of study area within designated floodplain.
Illustrative Scores:	Varies by study area.
General formula:	$\frac{\sum A_f}{\sum A_a} * 100$ A_f = area of floodplain polygon *f*. A_a = area of study area polygon *a*.
Map Type:	Static.
ESRI License Restrictions:	None.

Indicator Name:	Land Suitability [40]
Definition and Units:	Percent of vacant areas suitable for development due to suitable slopes, soils and location relative to designated floodplains.
Illustrative Scores:	Varies by study area.
General formula:	$\frac{\sum A_{sva}}{\sum A_{va}} * 100$ A_{sva} = area of study area polygon a that is suitable and vacant. A_{va} = area of study area polygon a that is vacant.
Map Type:	None.
ESRI License Restrictions:	None.
Note:	"Suitable" vacant parcels are defined in three respects: 1) presence of buildable soil; 2) absence of floodplain; and 3) a slope percentage at or below a user-defined maximum allowable percentage.

TRAVEL

Indicator Name:	Internal Street Connectivity [41]
Definition and Units:	Ratio of street intersections versus intersections and cul-de-sacs.
Illustrative Scores:	0.7 - 0.9 for highly connected street networks; 0.3 - 0.5 for poorly connected networks.
General formula:	$\frac{I}{C+I}$ C = number of cul-de-sacs in the study area. I = number of intersections in the study area.
Map Type:	Static.
ESRI License Restrictions:	***ArcEditor/ArcInfo Licensees Only***

Indicator Name:	External Street Connectivity [42]
Definition and Units:	Average distance between ingress/egress streets on study area cordon in ft. (excluding freeways).
Illustrative Scores:	Distances over 1,000 ft. are unfavorable; distances less than 500 ft. are very favorable.
General formula:	$\frac{\sum L_c}{N}$ L_c = length in feet of cordon segment c. N = number of segments comprising the cordon.
Map Type:	Dynamic.
ESRI License Restrictions:	None.

Indicator Name:	Street Segment Length [61]
Definition and Units:	Average street segment length in feet, exclusive of freeways.
Illustrative Scores:	Varies by case boundary area composition, e.g. 250 - 350 ft.
General formula:	$\frac{\sum L_s}{N}$ L_s = length in feet of street centerline segment s. N = number of street centerline segments.
Map Type:	Dynamic.
ESRI License Restrictions:	None.

Indicator Name:	Street Centerline Distance [62]
Definition and Units:	Total street centerline distance in feet.
Illustrative Scores:	Varies by case boundary area size and composition.
General formula:	$\sum L_s$ L_s = length in feet of street centerline segment s.
Map Type:	None.
ESRI License Restrictions:	None.

Indicator Name:	Street Network Density [43]
Definition and Units:	Density of streets (excluding freeways) in centerline miles per sq.mi.
Illustrative Scores:	15 - 40 mi/sq.mi. in urban areas; 3 - 5 mi/sq.mi. in rural areas.
General formula:	$$\frac{\sum L_s}{\sum A_a}$$ L_s = length in feet of street segment *s*. A_a = area in square miles of study area polygon *a*.
Map Type:	Static.
ESRI License Restrictions:	None.

Indicator Name:	Street Network Extent [44]
Definition and Units:	Total street centerline distance (excluding freeways) per 1000 residents.
Illustrative Scores:	Varies widely according to study area type.
General formula:	$\left(\frac{\sum L_s}{\sum R_p}\right) * 1000$ L_s = length in feet of street segment s. R_p = number of residents for polygon p.
Map Type:	None.
ESRI License Restrictions:	None.

Indicator Name:	Transit Service Coverage [45]
Definition and Units:	Transit stops per square mile.
Illustrative Scores:	6-12 in suburban/urban areas.
General formula:	$\frac{S}{\sum A_a}$ S = number of transit stops in the study area. A_a = area in square miles of study area polygon a.
Map Type:	Static.
ESRI License Restrictions:	None.

Indicator Name:	Transit Service Density [46]
Definition and Units:	Miles of transit routes multiplied by number of transit vehicles traveling those routes each day, divided by total acres.
Illustrative Scores:	1.0 - 2.0 in suburban/urban areas.
General formula:	$\frac{\sum(V_t * L_t)}{\sum A_a}$ V_t = number of vehicles for transit route t. L_t = length in feet of the part of the transit route t that is inside the study area. A_a = area in square miles of study area polygon a.
Map Type:	Static.
ESRI License Restrictions:	None.

Indicator Name:	Transit-Oriented Residential Density [65]
Definition and Units:	Average number of dwelling units per net residential acre within a user-defined walking distance in ft. of transit stops.
Illustrative Scores:	Varies by case boundary area composition, e.g. 8-12 DU per acre.
General formula:	$\frac{\sum D_{wp}}{\sum A_{wp}}$ D_{wp} = number of dwelling units for land uses polygon p within walkable network distance of a transit stop. A_{wp} = area in acres of walkable land uses polygon p.
Map Type:	Dynamic.
ESRI License Restrictions:	***ArcEditor/ArcInfo Licensees Only***

Indicator Name:	Transit-Oriented Employment Density [66]
Definition and Units:	Average number of employees per net non-residential acre within a user-defined walking distance in ft. of transit stops.
Illustrative Scores:	Varies by case boundary area composition, e.g. 15-25 employees per acre.
General formula:	$\frac{\sum E_{wp}}{\sum A_{wp}}$ E_{wp} = number of employees for land uses polygon *p* within walkable network distance of a transit stop. A_{wp} = area in acres of walkable land uses polygon *p*.
Map Type:	Dynamic.
ESRI License Restrictions:	***ArcEditor/ArcInfo Licensees Only***

Indicator Name:	Light Rail Transit Boardings [63]
Definition and Units:	Average daily number of persons boarding light rail transit (LRT).
Illustrative Scores:	Varies by case boundary area composition and size.
General formula:	$$\frac{\sum\left(e^{5.48} * e^{0.8T_s} * e^{-0.15P_s} * M_{ns}^{\ \ 0.65} * M_{cbds}^{\ \ 0.27} * D_{ps}^{\ \ 0.24} * D_{es}^{\ \ 0.49}\right)}{N}$$ T_s = is rail stop *s* a terminal (yes=1, no=0)? P_s = does LRT stop *s* have parking (yes=1, no=0)? M_{ns} = distance in miles from LRT stop *s* to nearest stop. M_{cbds} = distance in miles from LRT stop *s* to nearest CBD. D_{ps} = population density per acre within two miles of LRT stop *s*. D_{es} = employment density per acre within a half mile of LRT stop *s*. e = base of natural logarithms (2.71828). N = number of rail stops in the case boundary area.
Map Type:	Dynamic.
ESRI License Restrictions:	None.
Note:	This indicator requires a case boundary that extends in a 2-mile radius from the LRT station(s) in question.

Indicator Name:	Heavy Rail Mode Shift [68]
Definition and Units:	Average daily vehicle trips per capita shifted to heavy rail trips.
Illustrative Scores:	Varies by case boundary area composition and size.
General formula:	

$$\left[\left(\frac{U_{alt}}{U_{base}}\right)-1\right]*\left(V_{base}-V_{alt}\right)$$

Where,

$$U_{base} = K + 0.535*Ln(H_{base}) + 0.261*Ln(B_{base}) + 0.956*T_{base} + 0.203*Ln(P_{base})$$
$$U_{alt} = K + 0.535*Ln(H_{alt}) + 0.261*Ln(B_{alt}) + 0.956*T_{alt} + 0.203*Ln(P_{alt})$$
$$K = 3.289$$

V_{base} = number of vehicle trips per capita (Base case).
V_{alt} = number of vehicle trips per capita (Alt case).
H_{base} = number of peak hour trains serving the station (Base case).
H_{alt} = number of peak hour trains serving the station (Alt case).
B_{base} = number of peak hour feeder buses or other transit serving the station (Base case).
B_{alt} = number of peak hour feeder buses or other transit serving the station (Alt case).
T_{base} = 0 – Commuter Rail; 1 – Rail Rapid Transit (Base case).
T_{alt} = 0 – Commuter Rail; 1 – Rail Rapid Transit (Alt case).
P_{base} = total population and employment within one linear half mile of the station (Base case).
P_{alt} = total population and employment within one linear half mile of the station (Alt case).

Map Type:	None.
ESRI License Restrictions:	***ArcEditor/ArcInfo Licensees Only***
Note:	Uses the 5D methodology described in Appendix A.

Indicator Name:	Pedestrian Network Coverage [47]
Definition and Units:	Percent of total street frontage with improved sidewalks on both sides.
Illustrative Scores:	70 - 90% in urban areas.
General formula:	$$\frac{\sum\left(C_s * L_s\right)}{\sum L_s}$$ C_s = percent of sidewalk completeness for street segment s. L_s = length in feet of street segment s.
Map Type:	Dynamic.
ESRI License Restrictions:	None.

Indicator Name:	Pedestrian Crossing Distance [48]
Definition and Units:	Average street width curb-to-curb in feet.
Illustrative Scores:	25 - 35 ft.
General formula:	$\frac{\sum(W_s * L_s)}{\sum L_s}$ W_s = width in feet of street segment *s*. L_s = length in feet of street segment *s*.
Map Type:	Dynamic.
ESRI License Restrictions:	None.

Indicator Name:	Pedestrian Intersection Safety [49]
Definition and Units:	Percent of street intersections equipped with traffic control devices.
Illustrative Scores:	10 - 30%.
General formula:	$\left(\frac{T}{C}\right) * 100$ T = number of traffic controls at crossings in the study area. C = number of crossings in the study area.
Map Type:	Static.
ESRI License Restrictions:	***ArcEditor/ArcInfo Licensees Only***

Indicator Name:	Street Route Directness [56]
Definition and Units:	Weighted average ratio of shortest drivable route distance versus straight-line distance, from residents and employees of developed parcels to central node destination. NOTE: By default, a random selection of 10% of all possible residential/employment points are used to determine the indicator score. This % can be overridden by altering the Case Boundary's RandomSelectionPercent parameter. Also, different random selections for the same given set of origin residential/employment points can be created by altering the Case Boundary's RandomSelectionSeed parameter
Illustrative Scores:	1.2 - 1.5 for favorable direct areas; 1.6 - 1.8 for unfavorable Indirect areas.
General formula:	$$\frac{\sum_p \left[\frac{D_{np}}{D_{lp}} * \left(R_p + E_p\right) \right]}{\sum_p \left(R_p + E_p\right)}$$ D_{np} = network driving distance in feet from developed parcel p to the nearest central node point. D_{lp} = linear distance in feet from developed parcel p to the nearest central node point. R_p = number of residents for developed parcel p. E_p = number of employees for developed parcel p.
Map Type:	Dynamic.
ESRI License Restrictions:	***ArcEditor/ArcInfo Licensees Only***

Indicator Name:	Pedestrian Setback [51]
Definition and Units:	Average commercial building setback from major streets in feet.
Illustrative Scores:	0 - 100 ft.
General formula:	$$\frac{\sum (S_i * L_i)}{\sum L_i}$$ S_i = setback distance in feet for setback segment i. L_i = length in feet of building frontage i.
Map Type:	Static.
ESRI License Restrictions:	None.

Indicator Name:	Pedestrian Accessibilities [52]
Definition and Units:	Average percent of user-defined origins within 15-minute walk time to user-designated destination points, weighted by pedestrian trip generation and attraction capacity of origins and destinations.
Illustrative Scores:	Varies by study area and distribution of user-defined points.
General formula:	$$\frac{\sum_{d}\left(\frac{\sum_{aod} W_{aod}}{\sum_{iod} W_{iod}} * W_d\right)}{\sum_{d} W_d} * 100$$ T_{od} = shortest network travel time in feet from origin point o to nearest destination point d. W_{aod} = pedestrian accessibility weight for accessible origin point aod, where an origin point o is “accessible” if it has a $T_{od} \leq 15$. W_{iod} = pedestrian accessibility weight for origin point iod, if iod is within ¼ r linear distance in miles of destination point d, where r is the maximum walking speed in miles per hour. W_d = pedestrian accessibility weight for destination point d.
Map Type:	None.
ESRI License Restrictions:	***ArcEditor/ArcInfo Licensees Only***

Indicator Name:	Bicycle Network Coverage [53]
Definition and Units:	Percent of total street centerline distance with designated bike route.
Illustrative Scores:	10 - 25%.
General formula:	$\frac{\sum L_b}{\sum L_s} * 100$ L_b = length in feet of bicycle route segment *b*. L_s = length in feet of street segment *s*.
Map Type:	Static.
ESRI License Restrictions:	None.

Indicator Name:	Residential Multi-Modal Access [67]
Definition and Units:	Percent of dwellings within 1/8 mi. of three or more travel modes (bike, car, transit, or walk).
Illustrative Scores:	Varies by case boundary area composition, e.g. 20-30%.
General formula:	$\frac{\sum D_{3m}}{\sum D} * 100$ D_{3m} = number of dwellings, for land uses polygon p, within 1/8 mi. of three or more travel modes. D = number of dwelling units in the case boundary area.
Map Type:	Dynamic.
ESRI License Restrictions:	None.
Note:	Freeways are excluded, and street segments must have 50% or more sidewalk presence to be pedestrian-eligible.

Indicator Name:	Home Based Vehicle Miles Traveled [69]
Definition and Units:	Average daily home-based vehicle miles traveled per capita. Base case value entered by user; alternate case value calculated using formula below.
Illustrative Scores:	15 - 20 vehicle mi/day/capita in urban areas; 20 - 30 in suburban/rural areas.

General formula:

$$M_b * [1 + A_1 + A_2 + A_3 + A_4]$$

Where

$$A_1 = \left(\frac{D_{1c} - D_{1b}}{D_{1b}} * E_1 \right)$$

$$A_2 = \left(\frac{D_{2c} - D_{2b}}{D_{2b}} * E_2 \right)$$

$$A_3 = \left(\frac{D_{3c} - D_{3b}}{D_{3b}} * E_3 \right)$$

$$A_4 = \left(\frac{D_{4c} - D_{4b}}{D_{4b}} * E_4 \right)$$

M_b = HB vehicle miles traveled for the Base case.
D_{1b} = Density score for the Base case.
D_{1c} = Density score for the current case.
E_1 = Density elasticity for vehicle miles traveled.
D_{2b} = Diversity score for the Base case.
D_{2c} = Diversity score for the current case.
E_2 = Diversity elasticity for vehicle miles traveled.
D_{3b} = Design score for the Base case.
D_{3c} = Design score for the current case.
E_3 = Design elasticity for vehicle miles traveled.
D_{4b} = Destinations (accessibility) score for the Base case.
D_{4c} = Destinations (accessibility) score for the current case.
E_4 = Destinations elasticity for vehicle miles traveled.

Map Type:	None.
ESRI License Restrictions:	***ArcEditor/ArcInfo Licensees Only***
Note:	Uses the 5D methodology described in See Appendix A.

Indicator Name:	Non-Home Based Vehicle Miles Traveled [70]
Definition and Units:	Average daily non-home-based vehicle miles traveled per capita. Base case value entered by user; alternate case value calculated using formula below.
Illustrative Scores:	15 - 20 vehicle mi/day/capita in urban areas; 20 - 30 in suburban/rural areas.
General formula:	$M_b * [1 + A_1 + A_2 + A_3 + A_4]$

Where

$$A_1 = \left(\frac{D_{1c} - D_{1b}}{D_{1b}} * E_1 \right)$$

$$A_2 = \left(\frac{D_{2c} - D_{2b}}{D_{2b}} * E_2 \right)$$

$$A_3 = \left(\frac{D_{3c} - D_{3b}}{D_{3b}} * E_3 \right)$$

$$A_4 = \left(\frac{D_{4c} - D_{4b}}{D_{4b}} * E_4 \right)$$

M_b = HB vehicle miles traveled for the Base case.
D_{1b} = Density score for the Base case.
D_{1c} = Density score for the current case.
E_1 = Density elasticity for vehicle miles traveled.
D_{2b} = Diversity score for the Base case.
D_{2c} = Diversity score for the current case.
E_2 = Diversity elasticity for vehicle miles traveled.
D_{3b} = Design score for the Base case.
D_{3c} = Design score for the current case.
E_3 = Design elasticity for vehicle miles traveled.
D_{4b} = Destinations (accessibility) score for the Base case.
D_{4c} = Destinations (accessibility) score for the current case.
E_4 = Destinations elasticity for vehicle miles traveled.

Map Type:	None.
ESRI License Restrictions:	***ArcEditor/ArcInfo Licensees Only***
Note:	Uses the 5D methodology described in See Appendix A.

Indicator Name:	Indicator Name: Home Based Vehicle Trips [71]
Definition and Units:	Average daily home-based vehicle trips per capita. Base case value entered by user; alternate case value calculated using formula below.
Illustrative Scores:	4 - 5 vehicle trips/day/capita in urban areas; 6 - 7 in suburban/rural areas.

General formula:

$$T_b * [1 + A_1 + A_2 + A_3 + A_4]$$

Where

$$A_1 = \left(\frac{D_{1c} - D_{1b}}{D_{1b}} * E_1 \right)$$

$$A_2 = \left(\frac{D_{2c} - D_{2b}}{D_{2b}} * E_2 \right)$$

$$A_3 = \left(\frac{D_{3c} - D_{3b}}{D_{3b}} * E_3 \right)$$

$$A_4 = \left(\frac{D_{4c} - D_{4b}}{D_{4b}} * E_4 \right)$$

T_b = HB vehicle trips for the Base case.
D_{1b} = Density score for the Base case.
D_{1c} = Density score for the current case.
E_1 = Density elasticity for vehicle trips.
D_{2b} = Diversity score for the Base case.
D_{2c} = Diversity score for the current case.
E_2 = Diversity elasticity for vehicle trips.
D_{3b} = Design score for the Base case.
D_{3c} = Design score for the current case.
E_3 = Design elasticity for vehicle trips.
D_{3b} = Destinations (accessibility) score for the Base case.
D_{3c} = Destinations (accessibility) score for the current case.
E_3 = Destinations elasticity for vehicle trips.

Map Type:	None.
ESRI License Restrictions:	***ArcEditor/ArcInfo Licensees Only***
Note:	Uses the 5D methodology described in See Appendix A.

Indicator Name:	Non-Home Based Vehicle Trips [72]
Definition and Units:	Average daily non-home-based vehicle trips per capita. Base case value entered by user; alternate case value calculated using formula below.
Illustrative Scores:	4 - 5 vehicle trips/day/capita in urban areas; 6 - 7 in suburban/rural areas.

General formula:

$$T_b * [1 + A_1 + A_2 + A_3 + A_4]$$

Where

$$A_1 = \left(\frac{D_{1c} - D_{1b}}{D_{1b}} * E_1 \right)$$

$$A_2 = \left(\frac{D_{2c} - D_{2b}}{D_{2b}} * E_2 \right)$$

$$A_3 = \left(\frac{D_{3c} - D_{3b}}{D_{3b}} * E_3 \right)$$

$$A_4 = \left(\frac{D_{4c} - D_{4b}}{D_{4b}} * E_4 \right)$$

T_b	=	NHB vehicle trips for the Base case.
D_{1b}	=	Density score for the Base case.
D_{1c}	=	Density score for the current case.
E_1	=	Density elasticity for vehicle trips.
D_{2b}	=	Diversity score for the Base case.
D_{2c}	=	Diversity score for the current case.
E_2	=	Diversity elasticity for vehicle trips.
D_{3b}	=	Design score for the Base case.
D_{3c}	=	Design score for the current case.
E_3	=	Design elasticity for vehicle trips.
D_{3b}	=	Destinations (accessibility) score for the Base case.
D_{3c}	=	Destinations (accessibility) score for the current case.
E_3	=	Destinations elasticity for vehicle trips.

Map Type:	None.
ESRI License Restrictions:	***ArcEditor/ArcInfo Licensees Only***
Note:	Uses the 5D methodology described in See Appendix A.

Indicator Name:	Personal Vehicle Energy Use [79]
Definition and Units:	Total annual MMBtu per capita for personal vehicle energy use (HB + NHB).
Illustrative Scores:	Varies by study area.
General formula:	$T_{rv} = E_{rv} * V * 365$ Where, T_{rv} = total annual MMBtu per capita personal vehicle energy use (HB+NHB). V = total daily vehicle miles traveled per capita (HB + NHB). E_{rv} = residential vehicle energy use in MMBtu per mile traveled. R_p = number of residents for land uses polygon p.
Map Type:	None.
ESRI License Restrictions:	***ArcEditor/ArcInfo Licensees Only***

Indicator Name:	Parking Lot Size [6]
Definition and Units:	Average size of off-street surface parking lots in net acres.
Illustrative Scores:	0.5 - 8 net acres.
General formula:	$$\frac{\sum A_k}{N}$$ A_k = area in net acres of parking lot k. N = number of parking lots in the study area.
Map Type:	Static.
ESRI License Restrictions:	None.

Indicator Name:	Parking Requirements [64]
Definition and Units:	Total number of parking spaces required by all land uses.
Illustrative Scores:	Varies by case boundary area size and composition.
General formula:	$\sum S_p$ S_p = user-defined parking space rates for land uses polygon p.
Map Type:	None.
ESRI License Restrictions:	None.

Appendix A
5D METHOD TECHNICAL MEMORANDUM
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Introduction

This appendix summarizes the “5D” methodology for estimating travel demand impacts from land-use and urban design changes. The method’s name derives from five factors used to characterize the built environment and regional accessibility: density, diversity, design, destinations, and distance from a heavy rail transit station, collectively known as the 5Ds.

The travel impacts of the first four of these Ds (density, diversity, design, and destinations, hereafter referred to as the “4Ds”) are modeled using a set of elasticity factors that relate a neighborhood’s built environment characteristics and regional accessibility to the amount of vehicular travel generated in the neighborhood. These factors are used to compute the percentage change in vehicle trips (VT) and vehicle miles traveled (VMT) resulting from different land-use plans and urban designs. The fifth D, distance from a rail transit station, uses three independent variables (population and employment within one-half mile of a rail station, rail service frequency, and feeder bus service frequency) to estimate changes in rail transit use in planning areas served by a heavy rail (i.e., rapid transit or commuter rail) station. The estimated change in rail transit ridership is a subset of the total reduction in VT.

The 5D method is applied by defining baseline VT and VMT and, where applicable, heavy rail ridership in a base case, and then altering built environment characteristics under alternative scenarios. The impacts on travel of these alternative scenarios are computed in terms of VT and VMT change, as well as the change in rail ridership for study areas served by heavy rail transit.

The following method description focuses first on the 4Ds and secondly on the fifth D, and then concludes with a sample case worksheet.

Research Approach

The elasticity method for measuring the impact of the 4Ds is based on research into the relationship between land-use and travel behavior. Nationally, over forty studies are available on this subject by such noted authors as Robert Cervero of the University of California and the authors of Portland’s LUTRAQ study. Taken as a group, the studies indicate how changes in land-use characteristics, such as density, relate to changes in travel generation as measured by vehicle trips and vehicle miles of travel. A bibliography of the research appears at the conclusion of this memorandum.

Using this research data, the 4D method was developed as follows:

- Elasticities were derived between vehicular travel (VT and VMT) and primary descriptors of the built environment and accessibility for each study the bibliography whose research provided valid, comparable results. Elasticity is a measure of the percentage change that occurs in an dependent variable (VT or VMT) as a result of a percentage change in an influential variable (density, diversity, design or destinations). For example, if vehicle trips increase by 0.1% for each 1% increase in development density, then vehicle trips are said to have an elasticity of 0.1 with respect to density. If vehicle trips *decrease* by 0.05% for each 1% increase in density, then vehicle trips are said to have an elasticity of -0.05 with respect to density.

- Individual study results were synthesized into a unified matrix of partial elasticities. These express percentage changes in VT and VMT as a function of percentage changes in each of the 4Ds. The 4Ds are expressed in terms of: 1) density (population and employment per square mile); 2) diversity (the ratio of jobs to population); 3) design (pedestrian environment variables including street grid density, sidewalk completeness, and route directness); and 4) destinations (accessibility to other activity concentrations, expressed as the mean travel time to all other destinations within the region, e.g. a location within the regional core will ordinarily have a higher 'destinations' rating than a location on the fringe of the urban area, because the central location offers greater accessibility to a higher percentage of the region's employment).

- Creation of a table of elasticities as a quick-response tool for assessing the relative benefits of one land-use pattern compared with another.

Research Findings

Table A-1 presents the data synthesis for the 4D elasticities. These results reflect the state-of-the-art for quick response evaluations in the following respects:

- They include a larger number and wider range of research studies than previous syntheses, including recent studies in Portland (Sun, Lawton, PBQD), Seattle (Hess) and the San Francisco Bay Area (Cervero, Kockelman, Holtzclaw). These three were tightly controlled and statistically sophisticated.

- One of the research studies directly measures pedestrian travel through counts of pedestrian volumes entering commercial centers, whereas most studies rely on household or workplace questionnaires, which are known to under-report, walk travel.

Table A-1
4D ELASTICITIES

	Daily Vehicle Trips	Daily Vehicle Miles Traveled
Density	-0.04	-0.05
Diversity	-0.06	-0.05
Design	-0.02	-0.04
Destinations (Accessibility)	-0.03	-0.20

Density = Percent Change in [(Population + Employment) per Square Mile]

Diversity = Percent Change in {1 - [ABS(b * population - employment) / (b * population + employment)]}

where: *b* = regional employment / regional population

Design = Percent Change in Design Index

Design Index = 0.0195 * street network density + 1.18 * sidewalk completeness + 3.63 * route directness

where:

0.0195 = coefficient applied to street network density, expressing the relative weighting of this variable relative to the other variables in the Design Index formula,

street network density = length of street in miles/area of neighborhood in square miles

1.18 = coefficient applied to sidewalk completeness, expressing the relative weighting of this variable relative to the other variables in the Design Index formula,

sidewalk completeness = total sidewalk centerline distance/total street centerline distance

3.63 = coefficient applied to route directness, expressing the relative weighting of this variable relative to the other variables in the Design Index formula,

route directness = average airline distance to center/average road distance to center

Destinations (accessibility) = Percent Change in Gravity Model denominator for study TAZs "I": Sum[Attractions(j)*Travel Impedance(i,j)] for all regional TAZs "j"

- The fourth D or accessibility factor accounts for the fact that the other 3Ds (density, diversity, and design) will not produce the same effects on travel behavior in remote areas surrounded by typical suburban neighborhoods as they will at centrally-located infill locations. Several studies (including the research on which LUTRAQ is based) have demonstrated that the effects of the first three 4Ds on travel are weaker in outlying areas than infill areas, even if the areas are similar in other respects, such as transit service and average household income. When used in region-wide analysis, the accessibility factor also enables the analysis to recognize the benefits of placing development near transportation corridors, and at locations that are centrally located relative to compatible activities.

- The four D elasticities were reviewed and revised in late 2003. This review included examination of recent studies and applications of the 4Ds, as well as a Delphi panel survey of leading academic researchers in the field of transportation and land use studies.

Application of the 4D Elasticities

Ideally, the 4D method should only be applied in areas covered by a regional transportation demand model of the type normally operated by metropolitan planning organizations. A regional transportation model is needed to provide accurate baseline inputs for vehicle travel, as well as characterizing existing and future accessibility levels. If a transportation model is not available, the method should be applied with the assistance of a qualified transportation planner using professional judgment based on experience in the area.

The density, diversity, and design elasticities in Table A-1 may be used in cases where multiple land-use alternatives are being considered for the same site. The accessibility elasticities in Table A-1 do not need to be applied in this instance since a single site's relative regional accessibility would not vary from one land-use alternative to another. However, even when one site is under consideration and accessibility is not expected to change over time or as a function of different transportation concepts at the site, it is important to start the analysis with realistic baseline trip rates as influenced by the site's location within its region and its relative level of accessibility.

The accessibility elasticities in Table A-1 must be applied when accounting for changes in transportation systems or services to a single site. They require that a travel demand forecasting model be used to account for differences in accessibility that such transportation changes would create.

In summary, the method is applied to single sites as follows:

A. Define Study Area, Baseline Urban Form, Accessibility, and Trip Generation

1. Using the regional transportation model, identify which traffic analysis zone (TAZ) or TAZs encompass the study area. The boundaries of these host TAZs should match the study area boundary as closely as possible.

2. Compute the baseline density, diversity, design, and accessibility factors of the host TAZ as described in the variable definitions in Table A-1. If the area is greater than two miles in diameter or 2,000 acres, measure its density, diversity, and design by sampling those variables within 2-mile diameter subareas inside the larger area, and calculating average values.

3. Compute the baseline trip rates for the host TAZ. If the host TAZ is largely vacant or undeveloped, trip rates should be estimated at levels appropriate for the location using nearby developed TAZs for guidance. The baseline trip rates should be calculated as home-based (HB) VT and VMT per TAZ resident, and non home-based (NHB) VT and VMT per TAZ employee.

B. Calculate Change in 4D's for Each Land-Use Alternative

1. Compute the percentage change in density, diversity, and design under each land-use alternative relative to the base case.

2. Estimate any changes in regional accessibility envisioned for the study area using indicators such as projected change in highway travel speeds, transit frequency, or walk distance to transit. Data from the regional transportation model should be used in this step, such as percentages of transit trip time spent walking to, waiting for, and riding transit; or vehicle hours of delay or average highway travel speed.

C. Estimate Changes in Travel Indicators for Each Land-Use Alternative

1. For each land-use alternative, apply the elasticity value for density to the computed percentage change in area density from the baseline, to obtain the percentage change in HB VT and HB VMT per capita as a result of the density change. Similarly, compute the percentage changes in HB VT and HB VMT per capita resulting from changes in diversity and design. Sum the resulting percentage changes to obtain the total percentage change in trip generation resulting from the combined effects of density, diversity and design. Apply the resulting sum to the baseline HB

VT and HB VMT per capita to obtain the new HB VT and HB VMT per capita resulting from the land-use alternative.

2. Repeat the process to obtain the NHB VT and NHB VMT per employee resulting from the land-use alternative.

3. If regional accessibility is expected to change from one land-use alternative to another, apply the Table A-1 accessibility elasticity to the percentage change in accessibility from baseline to obtain the percent change expected in HB and NHB VT and VMT per capita and per employee, if any.

4. Compare the resulting VT and VMT changes between land-use alternatives to obtain relative differences in transportation performance.

This procedure assumes that study area household size and auto ownership does not change from one land-use alternative to another.

Size and Homogeneity of Study Areas

As noted above, the areas to which the 4D elasticities are directly applied should be less than two miles in diameter or 2,000 acres. If larger areas are under study, the 4D's should be sampled within two-mile subareas of the larger area, and the results averaged. This is because the effects of the 4Ds on auto travel and trip length are primarily due to the proximity of supportive and well-designed land-uses to one another, and the opportunity this provides for walk and bicycle travel between them. For example, a large area with employment clustered at one end and residential uses at the other should not be considered as diverse as an area with block-by-block mixing of land-uses. Therefore, this sampling and averaging technique is recommended to better capture the 4D effects in large study areas. Users should not allow undeveloped subareas within a study area to dilute the calculated density unless the undeveloped subarea lies well within active areas, thereby lengthening the travel distance for those traveling from one point to another within the active area. Open acreage on the edge of the study area should not be counted in the density calculation.

Regional or Multi-Site Analysis

The 4D method may also be used for comparison of growth scenarios for an entire region or for multiple development sites scattered throughout a region. Regional analysis includes comprehensive assessments of development patterns over a large, relatively homogeneous area, or a large area consisting of multiple communities. Growth scenarios can be comparisons of existing versus future conditions, or comparisons of "trends" versus "smart growth," or comparisons of several community plan or specific plan alternatives. Regional analysis methods will generally be used for areas of 25 square miles or greater, subject to the sampling technique described above. Multi-site analysis refers to analyses that attempt to compare the effects of allocating growth to one site within the region versus others. Sites would differ with respect to one or more of the following: 1) their degree of centralization; 2) their distance to jobs and housing; 3) their context within the urban fabric (infill within a dense area versus an edge or suburban setting); and/or 4) their proximity to transportation facilities. As with the individual site analysis, the regional and multi-site analyses use data from the regional transportation model for baseline VT and VMT generation rates for each individual geographic unit within the region. The VT and VMT rates should be for the forecast year under study, so that the relevant transportation network characteristics are reflected in the accessibility measure for each geographic unit. If the comparison is being made between two different forecast years, each year should be represented via regional transportation model data. In all cases, the VT and VMT should each be expressed as:

- HB VT per Resident: HB VT / TAZ Population
- NHB VT Trips per Employee: NHB VT / TAZ
- HB VMT per Resident: HB VMT / TAZ Population
- NHB VMT per Employee: NHB VMT / TAZ

These rates can be obtained by taking the appropriate ratios among the zonal population, employment, home-based vehicle trips produced, and non-home-based vehicle trips attracted for the TAZs that encompass the study area. The advantages of this approach include: a) multiple regional development patterns can be tested without running the four-step for each case; regional land-use form can be reflected (the effects of intensifying land-use in infill versus greenfield locations) and measured along with the effects of design, density and diversity within each development area; and b) the evaluation of land-use alternatives can be sensitive to the proximity of growth to regional transportation facilities, including fixed transit corridors.

Opportunities for Further Review and Enhancement

The 4D elasticities are based on a wide array of primary research studies. Some of the studies show results that disagree with one another. As a result of these disagreements, the resulting elasticities exhibit some apparent anomalies. For example, many experts may expect that the elasticity of VMT with respect to design should be lower than the elasticity of VT with respect to design. This is because many believe that the biggest impact of good urban design is to convert short-distance auto trips to walk or bike trips, while longer distance auto trips might not be affected by good design. However, the current elasticity results show a higher relationship for VMT than for VT. This is because, even though one of the reference studies indicated that the VMT elasticity should be lower than the VT elasticity, several other reputable studies disagreed. The LUTRAQ study, for example, found an elasticity of VMT to design significantly higher than the result of the 4D method synthesis. Two other studies found VMT/design elasticities very close to the 4D results and higher than the 4D VT/design elasticity. Therefore, the preponderance of empirical data available to the 4D synthesis suggests that good design reduces not only the amount of vehicle trip-making, but the average length of vehicle trips as well. While this may be counter-intuitive to some, the conventional wisdom on how the VMT and VT rates “should” compare with one another may not take into consideration the following phenomena:

- The effects of self-selection, where individuals who move to well-designed neighborhoods may have a pre-disposition to drive less for trips of any length.
- Developments that score high on the design index are often at infill locations nearer to a greater proportion of regional jobs and housing; therefore, average trip lengths may be shorter.
- Developments that score high on the design index are often at locations nearer to high-quality transit service than are locations with poorer design indices; therefore, residents of high-design neighborhoods may have better non-auto choices even for their longer trips than do residents of low-design neighborhoods.

Further research, using additional household survey datasets, could clarify these issues and otherwise improve the current 4D elasticities.

Limitations To Changes In The D-Variables (The Independent Variables)

The D-variable elasticity estimates are based on empirical studies of urban regions in the United States. As such, they reflect relationships between built form variables and travel behavior within typical U.S. ranges of the independent variables (i.e., the 4D variables) and the dependent travel behavior variables, (i.e., Vehicle Trips and Vehicle Miles Traveled per capita). In any statistical analysis, it is risky to assume that relationships between variables remain the same for extreme values, with extreme being defined as beyond the range of observed values of the variables. Extreme “out-of range” values commonly occur when a relatively undeveloped parcel is developed, resulting in very large percentage increases in the density, diversity and design indices.

For example if a parcel’s residential density increases from 0.1 units per acre (a typical exurban density) to 30 units per acre (a typical new urbanist density) the percentage increase is 3000 percent. Applying the INDEX 4D Vehicle Trip elasticity of -0.04 would result in a 120 percent reduction in trip making – clearly an impossible result.

Thus, INDEX limits the maximum allowable difference between the Base Case (the land use and transportation scenario that establishes the basic Vehicle Trip (VT) and Vehicle Miles Traveled (VMT) rates per capita for the study area) and any alternative scenario to a four-fold (i.e., a 400 percent) increase for the Density and Design variables. (The formula used to calculate change in land use Diversity is already constrained, and cannot yield out-of-range values).

Limitations To Changes In Per Capita Vehicle Trips And Vehicle Miles Traveled

Similarly, INDEX has floor values for change in dependent variables: Reductions in per capita Vehicle Trips and per capita Vehicle Miles Traveled are each limited to 60 percent. In other words, the per capita rates can be reduced to no less than 40 percent of the value observed in the Base Case. This is based on the VMT difference observed by the 1995 National Personal Transportation Survey between the densest quintile of U.S. census tracts and the least dense quintile (Ross and Dunning 1997).

Applying The 4D Elasticities To" Opportunity Sites" With Unique Land Use Mixes

In lieu of accepting the default floor and ceiling values described above, the INDEX user may elect to perform special trip generation analyses for travel analysis zones that feature unusual mixes of land uses. Such special studies are particularly appropriate for "opportunity sites" with unique land use mixes. In these cases, the 4D elasticities may be modified on the basis of the trip generation studies, or replaced with direct estimates of VT and VMT for the travel analysis zones (TAZs) affected.

If the study TAZ changes from vacant to non-vacant then the VT per capita or per employee and VMT/employee are initially taken to be the same as the average VT and VMT/employee of similar nearby zones. Changes in D-variable characteristics are then computed for the TAZ for the test scenario against the values for the neighboring zones. Adjustments to the rates are then made based on the percentage differences in the D-variable characteristics between the TAZ and the neighboring zone average. For example, if in the test scenario the TAZ has higher residential densities than the neighbor-zone average, then the VT per capita and VMT per capita will be adjusted downwards. A similar procedure should be used for calculating the Diversity (jobs/housing balance) and Design variables.

As the majority of the synthesis studies used to develop the D-variable elasticities focused on residentially generated trips, the synthesis results must be used with caution for land use scenarios that consist primarily of employment. Nonetheless two of the most credible studies of employment and urban form to date (Frank and Pivo, 1994, and Cervero, 2002) suggest that the D-variables work in a similar manner and with similar efficacy in employment centers as they do in predominantly residential areas.

Consequently, INDEX's elasticities may be used to adjust employment (non-home based travel). Future research studies may establish distinct elasticities for employment-based travel.

Application Of The Fifth D (Distance from Heavy Rail Transit Station)

The effects of distance from heavy rail transit (the 5th D) in INDEX are treated differently from the other 4Ds, since heavy rail transit use is a subset of the alternatives to private vehicle use, and the 5th D can only be applied in analysis zones directly served by heavy rail transit. "Heavy rail" is rail transit that does not mix with street traffic. Such heavy rail includes commuter rail (including diesel multiple unit trains), and rail rapid transit. It excludes light rail and street railways with a significant portion of right-of-way shared with other traffic.

A regression equation predicts the change in the likelihood of heavy rail transit use between a base-case and a scenario-case, based on differences in development density in proximity to rail transit stations, as well as changes in rail and feeder bus service levels.

The equation used in INDEX was selected from 66 equations comprised of different combinations of more than 20 land use and transit service variables used to estimate heavy rail patronage in the San Francisco Bay Area. The equation is intended for comparison of cases in which one or more of the transit service or land use characteristics are changed from one case to the next. When provided the base-case and scenario-case characteristics, the equation computes a unit-less probability of using heavy rail transit (a rail transit use index). The equation has the following form:

Rail Transit Usage Index = EXP [3.289 +
0.535 * LN (TRAIN) +
0.261 * LN (BUS) +
0.956 * TECH +
0.203 * LN (PE.50)]

Where:

BUS = the number of peak hour feeder buses serving the station (may include any other feeder transit service)

PE.50 = the sum of the population and employment within a half-mile buffer surrounding the station

TECH = 0 – Commuter Rail, 1 – Rail Rapid Transit

TRAIN = the number of peak hour trains serving the station

The base-case and scenario-case index values can be compared to predict a percentage increase in heavy rail transit use and a percentage increase in heavy rail transit use per capita for population and employment within the half-mile buffer around the station. This change in heavy rail transit use per capita can be used in conjunction with the results of 4D calculations for the same area to determine the percentage of person trips converted from automobile travel (the 4D reduction in vehicle trips per capita) that convert to rail transit (based on the 5th D calculation of added rail transit trips per capita), as opposed to walk or bike modes.

A Hypothetical Example

A hypothetical example of applying the 5D method is given in worksheet form in Table A-2. This example assumes that a 1.5 square mile study area served by a heavy rail station is undergoing redevelopment in a region of 50,000 persons and 35,000 jobs. The study area's proposed redevelopment includes an increase in population and employment, with a greater share of residential uses than before; construction of new streets and sidewalks to improve the area's pedestrian environment; and expanded rail transit service that will improve the area's accessibility by reducing transit travel time to and from the area.

The Table A-2 worksheet illustrates HB VMT calculations; the same procedure would be used for NHB VMT, HB VT, and NHB VT calculations.

The 5D Method And Four-Step Models

This section discusses typical shortcomings in four-step travel demand models that the 5D method is designed to address. Attention to the issues addressed below can assure that the 5D application does not double-count trip-reducing behavior already captured in the region's four-step model.

Four-step Travel Demand Models Typically Underestimate Short-Distance Travel

Changes in short-trip travel behavior represent one of the key differences between typical suburban and New Urbanist development. Short-distance trips often fall beneath the grain of regional models. Such models focus primarily on trip making on the freeway and arterial system and major transit spines, rather than on collectors and local streets. Four-step models were originally developed to predict travel demand on major limited-access regional transportation facilities. Such limited access facilities are intended for, and tend to attract, longer-distance trips for which facility speed can compensate for route circuitousness.

As a consequence of this original focus on long-distance travel, four-step models are usually least reliable when estimating either intra-zonal travel or travel to immediately adjacent traffic analysis zones. Specifically, local street network connectivity and network form (grid or cul-de-sac) are not accurately taken into account. The time and distance involved in traveling within a zone (within a neighborhood) or between a zone and its neighboring zones (within a community) are approximated on the basis of zone centroid placement, average straight-line travel distances to the collector and arterial network and an approximation of local travel speed. The travel time associated with remaining within a zone (neighborhood) is derived from approximated travel times to other zones, and set equal to 50% of the average travel times to the three nearest zones.

In view of the foregoing, it is not surprising that regional four-step models typically:

- Have estimated travel times and distances for intra-zonal and adjoining zones that vary significantly from their true values

- Use gravity model "friction factor" curves that are often inadequately calibrated for these short intra-zonal and nearby-zone trip lengths,

- Have limited or no representation of alternate modes for short trips

- Do not reflect influential factors such as local street connectivity and pedestrian design amenities.

Though the trips missed are by definition short trips, travel within zones or to neighboring zones often represents a relatively high percentage of overall travel within a community, and a short trip may sometimes substitute for a long trip. Furthermore, short trips have relatively high emissions impacts per VMT. Therefore, improving this estimate may be a critical element of evaluating the benefits of smart growth concepts.

<u>Model Recognition of Mode Choice Effects of Urban Form and Local Transit Accessibility is Usually Very Limited</u>

Most regional models are not sensitive to the extent to which neighborhood transit might influence local transit mode choice through improved transit service frequency or access mode frequency/directness. They do not attempt to estimate intra-zonal or neighbor-zone transit travel. Generally models do not consider transit modes that may be available for travel within a neighborhood or to nearby neighborhoods. All intra-zonal and neighbor-zone trips are considered automobile trips and add to regional VT and VMT estimates.

Most models estimate transit mode choice through an assessment of fairly macro-scale factors. The most dominant factors influencing commute mode choice in most model formulations are household auto-ownership, and whether the trip destination has paid parking. Typical mode choice models ascribe weak or no influence to urban form factors such as residential and employment density which are associated with greater probability to choose and alternative to driving. They are not responsive to other factors which could capture the effects of land use mix and form, regional placement, and urban design; beyond the factors identified above, any rely heavily on catch-all "constant" terms.

Moreover, the only walk and bike trips that most regional models address are the local access segments of transit trips, not door-to-door walk or bike trips. Most regional models do not include all short trips in their trip generation estimates, and those that are generated are relegated to "intra-zonal" activity where the numbers cannot be validated and the trip-length profiles cannot be determined.

To assess a model's ability to predict short trips, a knowledgeable transportation planner should review model's zonal and network structure and parameters related to the calculation of intra-zonal impedance, "terminal times" and zone centroid connectors. Particular attention should be paid to the model's estimates of trips shorter than five minutes, and whether the model's estimates are lower than exhibited in the travel survey data for the region. A knowledgeable transportation planner should also examine the model's mode choice estimation procedures to see if it adequately accounts for walk, bike and transit opportunities at the local level.

As noted above, most models do not adequately account for short trips and local mode choice factors. Consequently, application of the 5D factors to modify regional vehicle trip and vehicle miles traveled and heavy rail transit mode shares will be appropriate. Should the review determine that the model does account for local trip-making factors, the INDEX user may wish to modify or attenuate the effect of the 5Ds.

Four-Step Model Dynamic Validation Tests

A question that is logically prior to the ability of a four-step model's ability to account for the localized effects of the 5Ds is whether it can forecast *regional travel demand* in a coherent and consistent manner. Baseline forecasts of VT and VMT rates and heavy rail transit mode share must be as reasonable as possible. This section discusses methods for assuring that the four-step model applications reasonably recognize transportation system changes that are likely to occur in conjunction with smart-growth land use plans. It also discusses measures to mitigate "noise," or random instabilities, in four-step models that could distort the effects of smart growth plans with or without application of the 5Ds.

While most models are calibrated and validated to recreate observed conditions to some degree, such tests cannot assess how well the model will forecast expansion and modification of the region's transportation system and its land use arrangement. Yet these are important questions, and the ability to project future conditions in understandable and reasonable ways is an essential feature of a useful model.

Dynamic validation is a term for tests that can potentially be used to validate travel demand models' responsiveness to many types of changes in input; these changes in input reflect questions about transportation and land use system changed that planners and decision makers often rely upon models to help answer. Model input changes that may be checked or tested include the following:

Test 1: Home Based Trip Generation Project Size Threshold:

Change in Model Input: For a regional model, add 1, 10, 100, one thousand, five thousand, ten thousand, and twenty thousand households to a single suburban TAZ.

Expected Change in Model Output: Total VT change should be approximately the average VT per/dwelling unit in the area times the number of added units. Total VMT change should be approximately the average VMT per/dwelling unit in the area times the number of added units.

Test 2: Employment Trip Generation Project Size Threshold

Change in Model Input: For a regional model, add 1, 10, 100, one thousand, five thousand, ten thousand, and twenty thousand retail jobs to a single suburban TAZ.

Expected Change in Model Output: Total VT change should be approximately the average VT per/retail job in the area times the number of added jobs (assuming a reasonable balance between productions and attractions). The change in total VMT should reflect the difference in average trip lengths between trips attracted to this TAZ and the regional average (assuming that home-based trips are balanced to productions), and be proportional to the number of added jobs.

Test 3: Change in Assignment Iterations

Change in Model Input: Increase the number of iterations for peak hour assignment by 1.

Expected Change in Model Output: Any changes in traffic volumes should be very small.

Test 4: Change Speed/Flow Curve

Change in Model Input: change the speed/flow curve for minor arterials to be the same as that used for major arterials.

Expected Change in Model Output: Traffic assigned to minor arterials should increase 5%-10%.

Other Possible Tests

If the future scenarios entail significant expansion of transportation facilities (e.g., new roads and widening of existing roads, it may be test the models responsiveness to new links by *deleting* an arterial link. Traffic assigned to alternative link should increase, and traffic on links leading to the deleted link should decrease.

If the four-step model process includes an explicit mode choice model, this too can be tested dynamically. The modeled changes in ridership due to small changes in transit fares or frequencies should be in line with the transit system's recent experience. Changes should occur on routes affected by fare change. Auto trips should increase with transit fare increases and service cutbacks.

Dynamic Four-Step Model Validation: Summation

Traffic models are not developed as an end in themselves, but as a tool to predict the outcome of important decisions being made in planning our communities. The validity of a traffic model should therefore be based on its ability to accurately predict such outcomes. Traditional model validation provides a certain amount of useful information, but says little about how well a model will be able to predict changes in link volumes as a result of changes to model inputs. Dynamic validation provides a systematic method of evaluating a model's ability to perform this most important of its functions. The use of dynamic validation as a regular part of model development would be likely to improve the reliability of travel demand models.

Table A-2
HYPOTHETICAL EXAMPLE WORKSHEET

1. STUDY PARAMETERS

I. *Study Area:*

▸ Square miles:	1.5
▸ Heavy Rail Station present?:	Yes

1.2 Region Demographics:

▸ Population	50,000
▸ Employment	35,000

1.3 Study Area Base Case Conditions:

▸ Population:	1,000
▸ Employment:	2,000
▸ Population and jobs within ½ mile of rail station:	2,000
▸ Street network density:	17 mi./sq.mi.
▸ Sidewalk completeness:	75%
▸ Pedestrian route directness:	0.6
▸ Accessibility:	23 mean min.
▸ Peak hour trains at station	3
▸ Peak hour feeder buses at station	6
▸ HB VMT/capita/day:	20

1.4 Study Area Alternative Case Conditions:

▸ Population:	2,000
▸ Employment:	2,500
▸ Population and jobs within ½ mile of rail station:	3,000
▸ Street network density:	19 mi./sq.mi.
▸ Sidewalk completeness:	100%
▸ Pedestrian route directness:	0.8
▸ Accessibility:	20.75 mean min.
▸ Peak hour trains at station	4
▸ Peak hour feeder buses at station	6

Table A-2 *Continued*

2. DENSITY

2.1 Base Density:

1,000	population
+ 2,000	employees
3,000	persons ÷ 1.5 sq.mi. = 2,000

(1.5 sq.mi. = study area; 2,000 = persons/sq.mi.)

2.2 Alternative Density:

2,000	population
+ 2,500	employees
4,500	persons ÷ 1.5 sq.mi. = 3,000

(1.5 sq.mi. = study area; 3,000 = persons/sq.mi.)

2.3 Density Change:

3,000	persons
- 2,000	persons
1,000	persons ÷ 2,000 persons = 0.5 or 50%

(50% = density increase)

2.4 HB VMT Change From Density Change:

50% x -.05 = -2.5%

(50% = density increase; -.05 = elasticity; -2.5% = HB VMT decrease)

Table A-2 *Continued*

3. DIVERSITY

3.1 Base Diversity:

study area pop   *study area pop*

{ 1 - [ABS{ (0.7 x 1,000 - 2,000) / (0.7 x 1,000 + 2,000) }]= 0.52

region emp/pop   *study area emp*   *region emp/pop*   *study area emp*

3.2 Alternative Diversity:

study area pop   *persons/ sq.mi. pop*

[1 - [ABS {(0.7 x 2,000 - 2,500) ≡ (0.7 x 2,000 + 2,500) }] = 0.72

region emp/pop   *study area emp*   *region emp/pop*   *study area emp*

3.3 Diversity Change:

0.72
<u>- 0.52</u>
0.20   0.20 / 0.52 = 0.38 or 38%

diversity increase

3.4 HB VMT Change From Diversity Change:

38% x -0.05 = -1.9%

diversity increase   *elasticity*   *HB VMT decrease*

Table A-2 *Continued*

4. DESIGN

4.1 Base Design:

st.mi./sq.mi. *% walk complete* *route directness*

(0.0195 x 17) + (1.18 x 0.75) + (3.63 x 0.6) = 3.39

var. weight coefficient *var. weight coefficient* *var. weight coefficient* *design index*

4.2 Alternative Design:

st.mi./sq.mi. *% walk complete* *route directness*

(0.0195 x 19) + (1.18 x 1.00) + (3.63 x 0.8) = 4.45

var. weight coefficient *var. weight coefficient* *var. weight coefficient* *design index*

4.3 Design Change:

4.45
-3.39
1.06 ÷ 3.39 = 0.31 or 31%

design index increase

4.4 HB VMT Change From Design Change:

31% x -0.04 = -1.24%

design index increase *elasticity* *HB VMT decrease*

Table A-2 *Continued*

5. DESTINATIONS

5.1 Base Accessibility:

Mean travel time to all regional employment:

auto	20 min
transit	40 min
% transit	15%

Weighted average travel time:

$$\underline{\text{auto}}: 20 \text{ min} \times 85\% + \underline{\text{transit}}: 40 \text{ min} \times 15\% = 23 \text{ min}$$

5.2 Alternative Accessibility:

Mean travel time:

auto	20 min
transit	25 min

Weighted average travel time:

$$\underline{\text{auto}}: 20 \text{ min} \times 85\% + \underline{\text{transit}}: 25 \text{ min} \times 15\% = 20.75 \text{ min}$$

5.3 Accessibility Change:

$$1 - \frac{20.75 \text{ min}}{23.00 \text{ min}} = 1 - 0.902 = -9.8\%$$

5.4 HB VMT Change From Accessibility Change:

$$-9.8\% \times -0.20 = -0.02 = -2\%$$

-9.8%: *accessibility increase*; -0.20: *elasticity*

Table A-2 *Continued*

6. CUMULATIVE VMT CHANGE

6.1 HB VMT changes from:

Density change	- 2.50%
Diversity change	- 1.90%
Design change	- 1.24%
Accessibility change	- 2.00%
Total	- 7.64%

6.2 Alternative case HB VMT calculation:

20	x	0.0764	=	1.53
base case		*% reduction*		*VMT/capita/day reduction*

20	-	1.53	=	18.47
base case HB VMT /capita/day		*VMT reduction*		*alternate case HB VMT /capita/day*

Table A-2 *Continued*

7. Calculating Change in Heavy Rail Transit Ridership Using the 5th D (Distance to a Rail Transit Station)

Equation

Rail Transit Usage Index =EXP [3.289 + 0.535 * LN (TRAIN) + 0.261 * LN (BUS) + 0.956 * TECH + 0.203 * LN (PE.50)]

where:

BUS = the number of peak hour feeder buses serving the station (may include any other feeder transit service)

PE.50 = the sum of the population and employment within a half-mile buffer surrounding the station

TECH = 0 – Commuter Rail, 1 – Rail Rapid Transit

TRAIN = the number of peak hour trains serving the station

Example:

Station: Study Area:

Base-Case		Scenario-Case	
BUS:	6	BUS:	6
PE.50:	2,000	PE.50:	3,000
TECH:	0	TECH:	0
TRAIN:	3	TRAIN:	4

Study Area Base-Case Rail Transit Use Index: 360 Study Area Alternative Case Rail Transit Use Index: 457 Expected Change in Rail Transit Ridership at Station: + 27%

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Appendix B

AIR POLLUTANT & GREENHOUSE GAS EMISSION FACTORS

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INDEX PlanBuilder estimates air pollutant and greenhouse gas emissions for household travel as part of the indicator results for each study.

Table B-1 presents emission coefficients used for autos and light trucks in the transportation sector based on data published by U.S. EPA's Office of Mobile Sources. INDEX assumes a 50/50 mix of autos and light trucks when estimating transportation emissions.

It should be noted that estimates are based on current emission rates, and do not take into consideration potential changes in future emission rates when long-range forecast studies are prepared.

Table B-1
VEHICLE EMISSION FACTORS

A. Annual Emissions and Fuel Consumption for an "Average" Passenger Car[1]

Pollutant Problem	Amount [2]	Miles [3]	Pollution or Fuel Consumption [4]
Hydrocarbons	2.9 grams/mile	12,500	80 lbs of HC
Carbon Monoxide	22 grams/mile	12,500	606 lbs of CO
Nitrogen Oxides	1.5 grams/mile	12,500	41 lbs of NOx
Carbon Dioxide	0.8 pound/mile	12,500	10,000 lbs of CO2

B. Annual Emissions and Fuel Consumption for an "Average" Light Truck[1]

Pollutant Problem	Amount [2]	Miles [3]	Pollution or Fuel Consumption [4]
Hydrocarbons	3.7 gram/mile	14,000	114 lbs of HC
Carbon Monoxide	29 gram/mile	14,000	894 lbs of CO
Nitrogen Oxides	1.9 gram/mile	14,000	59 lbs of NOx
Carbon Dioxide	1.2 pound/mile	14,000	16,800 lbs of CO2

Notes:

[1] These values are averages. Individual vehicles may travel more or less miles and may emit more or less pollution per mile than indicated here. Emission factors and pollution/fuel consumption totals may differ slightly from original sources due to rounding.

[2] The emission factors used here come from standard EPA emission models. They assume an "average," properly maintained car or truck on the road in 1997, operating on typical gasoline on a summer day (72 to 96 degrees F). Emissions may be higher in very hot or very cold weather. Trip ends are embedded in the pollutant per mile amounts.

[3] Average annual mileage source: EPA emissions model MOBILE5.

[4] Fuel consumption is based on average in-use passenger car fuel economy of 22.5 miles per gallon and average in-use light truck fuel economy of 15.3 miles per gallon.

Source: U.S. Environmental Protection Agency
National Vehicle and Fuel Emissions Laboratory, April 1997

Appendix C
INDICATOR-DATA RELATIONSHIP MATRIX

Parcel-Based Studies

Element	Indicator (ID)	Feature Class	Field	Field Type	Filter	Required
Demographics	Population (2)	Case Boundary Area	SHAPE	Geometry		TRUE
		Land Uses	Residential Population	Double	>0	TRUE
			SHAPE	Geometry		TRUE
	Employment (3)	Case Boundary Area	SHAPE	Geometry		TRUE
		Land Uses	Employment Count	Double	>0	TRUE
			SHAPE	Geometry		TRUE
	Population Density (4)	Case Boundary Area	SHAPE	Geometry		TRUE
		Land Uses	Residential Population	Double	>0	TRUE
			SHAPE	Geometry		TRUE
Land-Use	Study Area Acreage (74)	Case Boundary Area	SHAPE	Geometry		TRUE
	Average Parcel Size (5)	Case Boundary Area	SHAPE	Geometry		TRUE
		Land Uses	Dwelling Group ID	Long Int	>0	TRUE
			SHAPE	Geometry		TRUE
	Use Mix (7)	Case Boundary Area	SHAPE	Geometry		TRUE
			Use Mix Cell Size (acres)	Double		TRUE
		Land Uses	Land-Use Group ID	Long Int	IN (1,2,3,4,5,6,7,8,9,12)	TRUE
			SHAPE	Geometry		TRUE
		Use Mix Grid	SHAPE	Geometry		TRUE
	Use Balance (8)	Case Boundary Area	SHAPE	Geometry		TRUE
		Land Uses	Land-Use Group ID	Long Int	IN (1,2,3,4,5,6,7,8,9,12,13)	TRUE
			SHAPE	Geometry		TRUE
	Development Footprint (9)	Case Boundary Area	SHAPE	Geometry		TRUE
		Land Uses	Land-Use Group ID	Long Int	IN (1,2,3,4,5,6,7,8,9,13)	TRUE
			Residential Population	Double		TRUE
			SHAPE	Geometry		TRUE
	Fiscal Impact of Development (10)	Case Boundary Area	Net Fiscal Impact Of Development ($)	Double		TRUE
			SHAPE	Geometry		TRUE
Housing	Dwelling Density (75)	Case Boundary Area	SHAPE	Geometry		TRUE
		Land Uses	Dwelling Unit Count	Double	>0	TRUE
			SHAPE	Geometry		TRUE
	Dwelling Unit Count (73)	Case Boundary Area	SHAPE	Geometry		TRUE
		Land Uses	Dwelling Unit Count	Double		TRUE
			SHAPE	Geometry		TRUE
	Student Enrollment Level (11)	Case Boundary Area	SHAPE	Geometry		TRUE
		Land Uses	SHAPE	Geometry		TRUE
			Student Count	Double		TRUE
		School Attendance Areas	Enrollment Capacity	Long Int		TRUE
			SHAPE	Geometry		TRUE

Element	Indicator (ID)	Feature Class	Field	Field Type	Filter	Required
Housing *Continued*	Residential Footprint (13)	Case Boundary Area	SHAPE	Geometry		TRUE
		Land Uses	Dwelling Group ID	Long Int	>0	TRUE
			Residential Population	Double	>0	TRUE
			SHAPE	Geometry		TRUE
	Single-Family Parcel Size (14)	Case Boundary Area	SHAPE	Geometry		TRUE
		Land Uses	Dwelling Group ID	Long Int	=1	TRUE
			SHAPE	Geometry		TRUE
	Single-Family Dwelling Density (15)	Case Boundary Area	SHAPE	Geometry		TRUE
		Land Uses	Dwelling Group ID	Long Int	=1	TRUE
			Dwelling Unit Count	Double	>0	TRUE
			SHAPE	Geometry		TRUE
	Multi-Family Dwelling Density (16)	Case Boundary Area	SHAPE	Geometry		TRUE
		Land Uses	Dwelling Group ID	Long Int	=2	TRUE
			Dwelling Unit Count	Double	>0	TRUE
			SHAPE	Geometry		TRUE
	Single-Family Dwelling Share (17)	Case Boundary Area	SHAPE	Geometry		TRUE
		Land Uses	Dwelling Group ID	Long Int	=1	TRUE
			Dwelling Unit Count	Double	>0	TRUE
			SHAPE	Geometry		TRUE
	Multi-Family Dwelling Share (18)	Case Boundary Area	SHAPE	Geometry		TRUE
		Land Uses	Dwelling Group ID	Long Int	=2	TRUE
			Dwelling Unit Count	Double	>0	TRUE
			SHAPE	Geometry		TRUE
	Amenities Adjacency (19)	Case Boundary Area	Maximum Theoretical Walkable Distance (ft.)	Double		TRUE
			SHAPE	Geometry		TRUE
		Land Uses	Residential Population	Double	>0	TRUE
			SHAPE	Geometry		TRUE
		Points of Interest	Interest Group (subtype)	Long Int	=1	TRUE
			SHAPE	Geometry		TRUE
	Amenities Proximity (20)	Case Boundary Area	SHAPE	Geometry		TRUE
		Dwellings	Residential Population	Long Int	>0	TRUE
			SHAPE	Geometry		TRUE
		Land Uses	SHAPE	Geometry		TRUE
		Pedestrian Routes	SHAPE	Geometry		TRUE
		Points of Interest	Interest Group (subtype)	Long Int	=1	TRUE
			SHAPE	Geometry		TRUE
	Transit Adjacency to Housing (22)	Case Boundary Area	Maximum Theoretical Walkable Distance (ft.)	Double		TRUE
			SHAPE	Geometry		TRUE
		Land Uses	Residential Population	Double	>0	TRUE
			SHAPE	Geometry		TRUE
		Transit Routes	SHAPE	Geometry		TRUE

Element	Indicator (ID)	Feature Class	Field	Field Type	Filter	Required
Housing *Continued*	Transit Proximity to Housing (23)	Case Boundary Area	SHAPE	Geometry		TRUE
		Dwellings	Residential Population	Long Int	>0	TRUE
			SHAPE	Geometry		TRUE
		Land Uses	SHAPE	Geometry		TRUE
		Pedestrian Routes	SHAPE	Geometry		TRUE
		Transit Stops	SHAPE	Geometry		TRUE
	Wastewater Generation (76)	Case Boundary Area	Waste Water Produced (gallons/capita/day)	Double		TRUE
		Land Uses	Residential Population	Double	>0	TRUE
	Solid Waste Generation (77)	Case Boundary Area	Municipal Solid Waste Disposed (pounds/capita/day)	Double		TRUE
		Land Uses	Residential Population	Double	>0	TRUE
	Residential Structural Energy Use (78)	Case Boundary Area	Annual Multi-Family Energy Use (MMBtu/DU)	Long Int		TRUE
			Annual Single-Family Energy Use (MMBtu/DU)	Long Int		TRUE
			SHAPE	Geometry		TRUE
		Dwellings	Dwelling Group (subtype)	Long Int	IN (1,2)	TRUE
			Dwelling Unit Count	Long Int	>0	TRUE
			Residential Population	Long Int	>0	TRUE
			SHAPE	Geometry		TRUE
	Residential Water Consumption (59)	Case Boundary Area	Applied Water Requirement (inches/year)	Double		TRUE
			SHAPE	Geometry		TRUE
		Dwellings	Dwelling Group (subtype)	Long Int	=1	TRUE
			Dwelling Unit Count	Long Int	>0	TRUE
		Land Uses	Average Percent Impervious	Double		TRUE
			Indoor Water Use (gal/day)	Double		TRUE
			Landscape Type Water Use Factor	Double		TRUE
			Residential Population	Double	>0	TRUE
			SHAPE	Geometry		TRUE
	Household Energy Consumption (60)	Case Boundary Area	Annual Multi-Family Energy Use (MMBtu/DU)	Long Int		TRUE
			Annual Single-Family Energy Use (MMBtu/DU)	Long Int		TRUE
			Base Case Home Based Vehicle Miles Traveled (miles/capita/day)	Double		TRUE
			Base Case Non-Home Based Vehicle Miles Traveled (miles/capita/day)	Double		TRUE
			Regional Accessibility	Double		TRUE
			Regional Employment	Long Int		TRUE
			Regional Population	Long Int		TRUE
			SHAPE	Geometry		TRUE
			Vehicle Energy Use (MMBtu/VMT)	Double		TRUE
		Dwellings	Dwelling Group (subtype)	Long Int	IN (1,2)	TRUE
			Dwelling Unit Count	Long Int	>0	TRUE
			Residential Population	Long Int	>0	TRUE
			SHAPE	Geometry		TRUE

Element	Indicator (ID)	Feature Class	Field	Field Type	Filter	Required
Employment	Jobs to Housing Balance (24)	Case Boundary Area	SHAPE	Geometry		TRUE
		Land Uses	Dwelling Unit Count	Double		TRUE
			Employment Count	Double		TRUE
			SHAPE	Geometry		TRUE
	Employment Density (25)	Case Boundary Area	SHAPE	Geometry		TRUE
		Land Uses	Employment Count	Double	>0	TRUE
			SHAPE	Geometry		TRUE
	Commercial Building Density (26)	Case Boundary Area	SHAPE	Geometry		TRUE
		Land Uses	Employment Floor Area (sqft)	Double	>0	TRUE
			SHAPE	Geometry		TRUE
	Transit Adjacency to Employment (27)	Case Boundary Area	Maximum Theoretical Walkable Distance (ft.)	Double		TRUE
			SHAPE	Geometry		TRUE
		Land Uses	Employment Count	Double	>0	TRUE
			SHAPE	Geometry		TRUE
		Transit Routes	SHAPE	Geometry		TRUE
	Transit Proximity to Employment (28)	Case Boundary Area	SHAPE	Geometry		TRUE
		Employers	Employment Count	Long Int	>0	TRUE
			SHAPE	Geometry		TRUE
		Land Uses	SHAPE	Geometry		TRUE
		Pedestrian Routes	SHAPE	Geometry		TRUE
		Transit Stops	SHAPE	Geometry		TRUE
Recreation	Park Space Supply (29)	Case Boundary Area	SHAPE	Geometry		TRUE
		Land Uses	Land-Use Group ID	Long Int	=12	TRUE
			Residential Population	Double	>0	TRUE
			SHAPE	Geometry		TRUE
		Supplementary Land Uses	Land-Use Group (subtype)	Long Int	=12	FALSE
			SHAPE	Geometry		FALSE
	Park Adjacency (30)	Case Boundary Area	Maximum Theoretical Walkable Distance (ft.)	Double		TRUE
			SHAPE	Geometry		TRUE
		Land Uses	Land-Use Group ID	Long Int	=12	TRUE
			Residential Population	Double	>0	TRUE
			SHAPE	Geometry		TRUE
		Supplementary Land Uses	Land-Use Group (subtype)	Long Int	=12	FALSE
			SHAPE	Geometry		FALSE
	Park Proximity (31)	Case Boundary Area	SHAPE	Geometry		TRUE
		Dwellings	Residential Population	Long Int	>0	TRUE
			SHAPE	Geometry		TRUE
		Land Uses	Land-Use Group ID	Long Int	=12	TRUE
			SHAPE	Geometry		TRUE
		Pedestrian Routes	SHAPE	Geometry		TRUE
		Supplementary Land Uses	Land-Use Group (subtype)	Long Int	=12	FALSE
			SHAPE	Geometry		FALSE

Element	Indicator (ID)	Feature Class	Field	Field Type	Filter	Required
Environment	NOx Pollutant Emissions (32)	Case Boundary Area	Base Case Home Based Vehicle Miles Traveled (miles/capita/day)	Double		TRUE
			Base Case Home Based Vehicle Trips (trips/capita/day)	Double		TRUE
			Base Case Non-Home Based Vehicle Miles Traveled (miles/capita/day)	Double		TRUE
			Base Case Non-Home Based Vehicle Trips (trips/capita/day)	Double		TRUE
			NOX Emissions (g/mile)	Double		TRUE
			NOX Emissions (g/trip end)	Double		TRUE
			Regional Accessibility	Double		TRUE
			Regional Employment	Long Int		TRUE
			Regional Population	Long Int		TRUE
			SHAPE	Geometry		TRUE
	HC Pollutant Emissions (57)	Case Boundary Area	Base Case Home Based Vehicle Miles Traveled (miles/capita/day)	Double		TRUE
			Base Case Home Based Vehicle Trips (trips/capita/day)	Double		TRUE
			Base Case Non-Home Based Vehicle Miles Traveled (miles/capita/day)	Double		TRUE
			Base Case Non-Home Based Vehicle Trips (trips/capita/day)	Double		TRUE
			HC Emissions (g/mile)	Double		TRUE
			HC Emissions (g/trip end)	Double		TRUE
			Regional Accessibility	Double		TRUE
			Regional Employment	Long Int		TRUE
			Regional Population	Long Int		TRUE
			SHAPE	Geometry		TRUE
	CO Pollutant Emissions (58)	Case Boundary Area	Base Case Home Based Vehicle Miles Traveled (miles/capita/day)	Double		TRUE
			Base Case Home Based Vehicle Trips (trips/capita/day)	Double		TRUE
			Base Case Non-Home Based Vehicle Miles Traveled (miles/capita/day)	Double		TRUE
			Base Case Non-Home Based Vehicle Trips (trips/capita/day)	Double		TRUE
			CO Emissions (g/mile)	Double		TRUE
			CO Emissions (g/trip end)	Double		TRUE
			Regional Accessibility	Double		TRUE
			Regional Employment	Long Int		TRUE
			Regional Population	Long Int		TRUE
			SHAPE	Geometry		TRUE

Element	Indicator (ID)	Feature Class	Field	Field Type	Filter	Required
Environment *Continued*	Greenhouse Gas Emissions (33)	Case Boundary Area	Base Case Home Based Vehicle Miles Traveled (miles/capita/day)	Double		TRUE
			Base Case Home Based Vehicle Trips (trips/capita/day)	Double		TRUE
			Base Case Non-Home Based Vehicle Miles Traveled (miles/capita/day)	Double		TRUE
			Base Case Non-Home Based Vehicle Trips (trips/capita/day)	Double		TRUE
			CO2 Emissions (g/mile)	Double		TRUE
			Regional Accessibility	Double		TRUE
			Regional Employment	Long Int		TRUE
			Regional Population	Long Int		TRUE
			SHAPE	Geometry		TRUE
	Open Space Share (34)	Case Boundary Area	SHAPE	Geometry		TRUE
		Land Uses	Land-Use Group ID	Long Int	=11	TRUE
			SHAPE	Geometry		TRUE
		Supplementary Land Uses	Land-Use Group (subtype)	Long Int	=11	FALSE
			SHAPE	Geometry		FALSE
	Open Space Connectivity (35)	Case Boundary Area	Open Space Connectivity Cell Size (acres)	Double		TRUE
			SHAPE	Geometry		TRUE
		Land Uses	Land-Use Group ID	Long Int	=11	TRUE
			SHAPE	Geometry		TRUE
		Open Space Grid	SHAPE	Geometry		TRUE
		Supplementary Land Uses	Land-Use Group (subtype)	Long Int	=11	FALSE
			SHAPE	Geometry		FALSE
	Stormwater Runoff (36)	Case Boundary Area	SHAPE	Geometry		TRUE
		Hydrological Soils	Hydrological Group	Text	IN ("A","B","C","D")	TRUE
			SHAPE	Geometry		TRUE
		Land Uses	Average Percent Impervious	Double		TRUE
			SHAPE	Geometry		TRUE
	Nonpoint Pollution (37)	Case Boundary Area	SHAPE	Geometry		TRUE
		Hydrological Soils	Hydrological Group	Text	IN ("A","B","C","D")	TRUE
			SHAPE	Geometry		TRUE
		Land Uses	Average Percent Impervious	Double		TRUE
			Nitrogen in Runoff (mg/L)	Double		TRUE
			Phosphates in Runoff (mg/L)	Double		TRUE
			SHAPE	Geometry		TRUE
			Total Suspended Solids in Runoff (g/L)	Double		TRUE
		Stormwater Best Management Practices	Nitrogen Removal (%)	Double		FALSE
			Phosphate Removal (%)	Double		FALSE
			SHAPE	Geometry		FALSE
			TSS Removal (%)	Double		FALSE

Element	Indicator (ID)	Feature Class	Field	Field Type	Filter	Required
Environment *Continued*	Imperviousness (38)	Case Boundary Area	SHAPE	Geometry		TRUE
		Land Uses	Average Percent Impervious	Double		TRUE
			Residential Population	Double		TRUE
			SHAPE	Geometry		TRUE
	Floodplain Encroachment (39)	Case Boundary Area	SHAPE	Geometry		TRUE
		Floodplains	SHAPE	Geometry		TRUE
	Land Suitability (40)	Case Boundary Area	SHAPE	Geometry		TRUE
			Suitable Slope Percent	Double		TRUE
		Floodplains	SHAPE	Geometry		TRUE
		Hydrological Soils	SHAPE	Geometry		TRUE
			Treat As Non-Buildable	Short Int	=False	TRUE
		Land Uses	Land-Use Group ID	Long Int	=0	TRUE
			SHAPE	Geometry		TRUE
		Slopes	SHAPE	Geometry		TRUE
			Slope Percent	Double	<=CaseBd.SuitableSlopePercent	TRUE
Travel	Internal Street Connectivity (41)	Case Boundary Area	SHAPE	Geometry		TRUE
		Street Centerlines	SHAPE	Geometry	Custom: StreetNetwork_Junctions feature class created FROM InStreetCL during network creation (network build creates attrib IND_41; write detail result of this indicator to it)	TRUE
	External Street Connectivity (42)	Case Boundary Area	SHAPE	Geometry		TRUE
		Case Boundary Cordon	SHAPE	Geometry		TRUE
		Street Centerlines	SHAPE	Geometry		TRUE
	Street Segment Length (61)	Case Boundary Area	SHAPE	Geometry		TRUE
		Street Centerlines	SHAPE	Geometry		TRUE
	Street Centerline Distance (62)	Case Boundary Area	SHAPE	Geometry		TRUE
		Street Centerlines	SHAPE	Geometry		TRUE
	Street Network Density (43)	Case Boundary Area	SHAPE	Geometry		TRUE
		Street Centerlines	SHAPE	Geometry		TRUE
			Street Width (ft.)	Double	>0	TRUE
	Street Network Extent (44)	Case Boundary Area	SHAPE	Geometry		TRUE
		Land Uses	Residential Population	Double		TRUE
			SHAPE	Geometry		TRUE
		Street Centerlines	SHAPE	Geometry		TRUE
	Transit Service Coverage (45)	Case Boundary Area	SHAPE	Geometry		TRUE
		Transit Stops	SHAPE	Geometry		TRUE
			Transit Group (subtype)	Long Int		TRUE
	Transit Service Density (46)	Case Boundary Area	SHAPE	Geometry		TRUE
		Transit Routes	Route Segment Traffic (vehicles/day)	Long Int		TRUE
			SHAPE	Geometry		TRUE
			Transit Group (subtype)	Long Int		TRUE

Element	Indicator (ID)	Feature Class	Field	Field Type	Filter	Required
Travel *Continued*	Transit-Oriented Residential Density (65)	Case Boundary Area	Maximum Theoretical Walkable Distance (ft.)	Double		TRUE
			SHAPE	Geometry		TRUE
		Dwellings	Dwelling Unit Count	Long Int		TRUE
			SHAPE	Geometry		TRUE
		Land Uses	SHAPE	Geometry		TRUE
		Pedestrian Routes	SHAPE	Geometry		TRUE
		Transit Stops	SHAPE	Geometry		TRUE
	Transit-Oriented Employment Density (66)	Case Boundary Area	Maximum Theoretical Walkable Distance (ft.)	Double		TRUE
			SHAPE	Geometry		TRUE
		Employers	Employment Count	Long Int		TRUE
			SHAPE	Geometry		TRUE
		Land Uses	SHAPE	Geometry		TRUE
		Pedestrian Routes	SHAPE	Geometry		TRUE
		Transit Stops	SHAPE	Geometry		TRUE
	Light Rail Transit Boardings (63)	Case Boundary Area	SHAPE	Geometry		TRUE
		Dwellings	Residential Population	Long Int		TRUE
		Employers	Employment Count	Long Int		TRUE
		Transit Stops	Distance to Nearest Central Business District (miles)	Double		TRUE
			Distance to Nearest Stop of Same Type (miles)	Double		TRUE
			Does the Stop Offer Parking	Short Int		TRUE
			Is the Stop a Terminus	Short Int		TRUE
			Transit Group (subtype)	Long Int	=1	TRUE
	Heavy Rail Mode Shift (68)	Case Boundary Area	SHAPE	Geometry		TRUE
		Dwellings	Residential Population	Long Int		TRUE
			SHAPE	Geometry		TRUE
		Employers	Employment Count	Long Int		TRUE
			SHAPE	Geometry		TRUE
		Transit Stops	Commuter Stop (Peak Hour Service Only)	Short Int		TRUE
			SHAPE	Geometry		TRUE
			Transit Group (subtype)	Long Int	=2	TRUE
	Pedestrian Network Coverage (47)	Case Boundary Area	SHAPE	Geometry		TRUE
		Street Centerlines	Percent of Segment with Sidewalks	Double		TRUE
			SHAPE	Geometry		TRUE
	Pedestrian Crossing Distance (48)	Case Boundary Area	SHAPE	Geometry		TRUE
		Street Centerlines	SHAPE	Geometry		TRUE
			Street Width (ft.)	Double	>0	TRUE
	Pedestrian Intersection Safety (49)	Case Boundary Area	SHAPE	Geometry		TRUE
		Street Centerlines	SHAPE	Geometry	Custom: StreetNetwork_Junctions feature class created FROM InStreetCL during network creation (network build creates attrib IND_49; write detail result of this indicator to it)	TRUE
		Traffic Control Devices	SHAPE	Geometry		TRUE

Element	Indicator (ID)	Feature Class	Field	Field Type	Filter	Required
Travel *Continued*	Street Route Directness (56)	Case Boundary Area	SHAPE	Geometry		TRUE
		Dwellings	Residential Population	Long Int	>0	TRUE
			SHAPE	Geometry		TRUE
		Employers	Employment Count	Long Int	>0	TRUE
			SHAPE	Geometry		TRUE
		Land Uses	SHAPE	Geometry		TRUE
		Points of Interest	Interest Group (subtype)	Long Int	=2	TRUE
			SHAPE	Geometry		TRUE
		Street Centerlines	SHAPE	Geometry		TRUE
	Pedestrian Setback (51)	Case Boundary Area	SHAPE	Geometry		TRUE
		Pedestrian Setback Lines	Setback Distance (ft.)	Double	>0	TRUE
			SHAPE	Geometry		TRUE
	Pedestrian Accessibilities (52)	Case Boundary Area	Maximum Theoretical Walkable Distance (ft.)	Double		TRUE
			Maximum Walking Speed (mph)	Double		TRUE
			SHAPE	Geometry		TRUE
		Pedestrian Routes	SHAPE	Geometry		TRUE
		Pedestrian Stops	Pedestrian Accessibility Weight	Double	>0	TRUE
			Pedestrian Stop Group (subtype)	Long Int	0 (origins), 1 (destinations)	TRUE
			SHAPE	Geometry		TRUE
	Bicycle Network Coverage (53)	Bicycle Routes	SHAPE	Geometry		TRUE
		Case Boundary Area	SHAPE	Geometry		TRUE
		Street Centerlines	SHAPE	Geometry		TRUE
	Residential Multi-Modal Access (67)	Bicycle Routes	SHAPE	Geometry		TRUE
		Case Boundary Area	SHAPE	Geometry		TRUE
		Land Uses	Dwelling Unit Count	Double	>0	TRUE
			SHAPE	Geometry		TRUE
		Pedestrian Routes	SHAPE	Geometry		TRUE
		Street Centerlines	SHAPE	Geometry		TRUE
		Transit Routes	SHAPE	Geometry		TRUE
	Home Based Vehicle Miles Traveled (69)	Case Boundary Area	Base Case Home Based Vehicle Miles Traveled (miles/capita/day)	Double		TRUE
			Regional Accessibility	Double		TRUE
			Regional Employment	Long Int		TRUE
			Regional Population	Long Int		TRUE
			SHAPE	Geometry		TRUE
		Dwellings	Residential Population	Long Int	>0	TRUE
			SHAPE	Geometry		TRUE
		Employers	Employment Count	Long Int	>0	TRUE
			SHAPE	Geometry		TRUE
		Land Uses	SHAPE	Geometry		TRUE
		Points of Interest	Interest Group (subtype)	Long Int	=2	TRUE
			SHAPE	Geometry		TRUE
		Street Centerlines	Percent of Segment with Sidewalks	Double		TRUE
			SHAPE	Geometry		TRUE

Element	Indicator (ID)	Feature Class	Field	Field Type	Filter	Required
Travel *Continued*	Non-Home Based Vehicle Miles Traveled (70)	Case Boundary Area	Base Case Non-Home Based Vehicle Miles Traveled (miles/capita/day)	Double		TRUE
			Regional Accessibility	Double		TRUE
			Regional Employment	Long Int		TRUE
			Regional Population	Long Int		TRUE
			SHAPE	Geometry		TRUE
		Dwellings	Residential Population	Long Int	>0	TRUE
			SHAPE	Geometry		TRUE
		Employers	Employment Count	Long Int	>0	TRUE
			SHAPE	Geometry		TRUE
		Land Uses	SHAPE	Geometry		TRUE
		Points of Interest	Interest Group (subtype)	Long Int	=2	TRUE
			SHAPE	Geometry		TRUE
		Street Centerlines	Percent of Segment with Sidewalks	Double		TRUE
			SHAPE	Geometry		TRUE
	Home Based Vehicle Trips (71)	Case Boundary Area	Base Case Home Based Vehicle Trips	Double		TRUE
			Regional Accessibility	Double		TRUE
			Regional Employment	Long Int		TRUE
			Regional Population	Long Int		TRUE
			SHAPE	Geometry		TRUE
		Dwellings	Residential Population	Long Int	>0	TRUE
			SHAPE	Geometry		TRUE
		Employers	Employment Count	Long Int	>0	TRUE
			SHAPE	Geometry		TRUE
		Land Uses	SHAPE	Geometry		TRUE
		Points of Interest	Interest Group (subtype)	Long Int	=2	TRUE
			SHAPE	Geometry		TRUE
		Street Centerlines	Percent of Segment with Sidewalks	Double		TRUE
			SHAPE	Geometry		TRUE
	Non-Home Based Vehicle Trips (72)	Case Boundary Area	Base Case Non-Home Based Vehicle Trips (trips/capita/day)	Double		TRUE
			Regional Accessibility	Double		TRUE
			Regional Employment	Long Int		TRUE
			Regional Population	Long Int		TRUE
			SHAPE	Geometry		TRUE
		Dwellings	Residential Population	Long Int	>0	TRUE
			SHAPE	Geometry		TRUE
		Employers	Employment Count	Long Int	>0	TRUE
			SHAPE	Geometry		TRUE
		Land Uses	SHAPE	Geometry		TRUE
		Points of Interest	Interest Group (subtype)	Long Int	=2	TRUE
			SHAPE	Geometry		TRUE
		Street Centerlines	Percent of Segment with Sidewalks	Double		TRUE
			SHAPE	Geometry		TRUE

Element	Indicator (ID)	Feature Class	Field	Field Type	Filter	Required
Travel *Continued*	Personal Vehicle Energy Use (79)	Case Boundary Area	Base Case Home Based Vehicle Miles Traveled (miles/capita/day)	Double		TRUE
			Base Case Non-Home Based Vehicle Miles Traveled (miles/capita/day)	Double		TRUE
			Vehicle Energy Use (MMBtu/VMT)	Double		TRUE
	Parking Lot Size (6)	Case Boundary Area	SHAPE	Geometry		TRUE
		Land Uses	Land-Use Group ID	Long Int	=13	TRUE
			SHAPE	Geometry		TRUE
		Supplementary Land Uses	Land-Use Group (subtype)	Long Int	=13	FALSE
			SHAPE	Geometry		FALSE
	Parking Requirements (64)	Case Boundary Area	SHAPE	Geometry		TRUE
		Land Uses	Required Parking Spaces	Double		TRUE
			SHAPE	Geometry		TRUE

Appendix D
DATA SUMMARY

Input Shapefile	Target Data Type	Target Input Attribute	Default Value	Subtype Value	Subtype Definition
Bicycle Routes	line	--	--	--	--
Case Boundary	polygon	Regional Population	0	--	--
		Regional Employment	0	--	--
		Fiscal Impact Of Development ($)	0	--	--
		Affordable Single-Family Housing Unit Price *(not currently enabled)*	0	--	--
		Use Mix Cell Size (acres)	0.5	--	--
		Open Space Connectivity Cell Size (acres)	0.5	--	--
		Maximum Suitable Slope Percent	12	--	--
		Maximum Walking Distance (ft.)	1320	--	--
		Maximum Walking Speed (mph)	3.5	--	--
		Base Case Home Based Vehicle Miles Traveled (miles/capita/day)	25	--	--
		Base Case Non-Home Based Vehicle Miles Traveled (miles/capita/day)	5	--	--
		Base Case Home Based Vehicle Trips (trips/capita/day)	5	--	--
		Base Case Non-Home Based Vehicle Trips (trips/capita/day)	1	--	--
		Wastewater Produced (gallons/capita/day)	60	--	--
		Municipal Solid Waste Disposed (pounds/capita/day)	2.49	--	--
		Regional Accessibility (% change in travel time)	0	--	--
		NOX Emissions (g/mile)	1.7	--	--
		HC Emissions (g/mile)	3.3	--	--
		CO Emissions (g/mile)	25.5	--	--
		CO2 Emissions (g/mile)	453.6	--	--
		NOX Emissions (g/trip end)	0	--	--
		HC Emissions (g/trip end)	0	--	--
		CO Emissions (g/trip end)	0	--	--
		Applied Water Requirement (inches/year)	22.1	--	--
		Vehicle Energy Use (MMBtu/VMT)	0.00625	--	--
		Annual Single-Family Energy Use (MMBtu/DU)	120	--	--
		Annual Multi-Family Energy Use (MMBtu/DU)	80	--	--
		Control Target Total Population	0	--	--
		Control Target Total Employment	0	--	--

Input Shapefile	Target Data Type	Target Input Attribute	Default Value	Subtype Value	Subtype Definition
Floodplains	polygon	--	--	--	--
Hydrological Soils	polygon	Hydrological Group	--	A	Deep sand, deep loess
			--	B	Sandy loam
			--	C	Clay loams
			--	D	Heavy plastic clays
		Treat As Non-Buildable	--	--	--
Land Uses	polygon	Land-Use Group ID	0	--	--
Some land-use values are set using the Paint Editor tool.		Land-Use Type ID	0	--	--
		Can Be Developed	0	--	--
		External Land Use ID	0	--	--
		Total Assessed Value (Land+Structure) *(not currently enabled)*	0	--	--
		Total Suspended Solids in Runoff (g/L)	0	--	--
		Phosphates in Runoff (mg/L)	0	--	--
		Nitrogen in Runoff (mg/L)	0	--	--
		Average Percent Impervious	0	--	--
		Pervious Cover Type ID	0	--	--
		Landscape Type Water Use Factor	0	--	--
		Required Parking Spaces	0	--	--
		Dwelling Group ID	0	--	--
		Dwelling Unit Count	0	--	--
		Owner-Occupied Dwelling Unit Count	0	--	--
		Residential Population	0	--	--
		Student Count	0	--	--
		Worker Count	0	--	--
		Residential Floor Area (sqft)	0	--	--
		Average Household Income ($/yr) *(not currently enabled)*	0	--	--
		Indoor Water Use (gal/day)	0	--	--
		Employment Group ID	0	--	--
		Employment Count	0	--	--
		Employment Floor Area (sqft)	0	--	--
Pedestrian Routes	line	--	--	--	--
Pedestrian Setback	line	Setback Distance (ft)	--	--	--
Planned Land-Use Designations	polygon	Employment Conformance *(not currently enabled)*	1	1	Conforming
				0	Non-conforming
		Residential Conformance *(not currently enabled)*	1	1	Conforming
				0	Non-conforming

Input Shapefile	Target Data Type	Target Input Attribute	Default Value	Subtype Value	Subtype Definition
Points of Interest	point	Interest Group (subtype)	0	0	None
				1	Amenities
				2	Central nodes
School Attendance Areas	polygon	Enrollment Capacity	0	--	--
Slopes	polygon	Slope Percent	0	--	--
Stormwater Best Management Practice	polygon	TSS Removal (%)	0	--	--
		Phosphate Removal (%)	0	--	--
		Nitrogen Removal (%)	0	--	--
Street Centerlines	line	Street Group (subtype)	0	0	No right-of-way
				1	Local
				2	Collector
				3	Arterial
				4	Freeway
		Street Width (ft.)	0	--	--
		Sidewalk Width (ft.)	0	--	--
		Right-of-Way Width (ft.)	0	--	--
		Percent of Segment with Sidewalks	0	--	--
Supplementary Land Uses	polygon	Land-Use Group (subtype)	0	0	Vacant
				11	Open Space
				12	Park
				13	Parking
Traffic Control Devices	point	--	--	--	--
Transit Routes	line	Transit Group (subtype)	0	0	Bus
				1	Light Rail
				2	Heavy Rail
		Route Name	--	--	--
		Route Number	--	--	--
		Right-of-Way Width	--	--	--
		Route Segment Traffic (vehicles/day)	--	--	--

Input Shapefile	Target Data Type	Target Input Attribute		Default Value	Subtype Value	Subtype Definition
Transit Stops	point	Transit Group (subtype)		0	0	Bus
					1	Light Rail
					2	Heavy Rail
		Stop Name		--	--	--
		Stop Number		0	--	--
		Is the Stop a Terminus	Heavy Commuter Rail Stops Only	0	0	No
					1	Yes
		Does the Stop Offer Parking		0	0	No
					1	Yes
		Commuter Stop (Peak Hour Service Only)		0	0	No
					1	Yes
		Number of Passenger Pick-ups During Peak Hour		6	--	--
		Distance to Nearest Central Business District (miles)		5	--	--
		Distance to Nearest Stop of Same Type (miles)		0.2	--	--

Appendix E

Methodology for Estimating Single-Family Residential Water Use

The methodology used in INDEX to estimate changes in water use for residences is derived from AWWARF, 1999 (see References). The method requires calculation of indoor water use based on usage patterns and outdoor water use based on typical imperviousness, precipitation, and landscaping.

Indoor Water Use

Table E-1 shows estimates based on the average inside uses measured in 1,188 homes in 14 North American cities including an additional 5% to account for estimated "in place" savings due to existing conservation.

Outdoor Water Use

Outdoor water use is calculated using the following equation:

$$AWR = SUM_t(A_t * S_t * V * 0.623)$$

where

AWR	is the Annual applied water requirement, in gallons
A_t	is the Area of the parcel under this landscaping, in square feet
S_t	is the Landscape type multiplier
V	is the estimated applied water requirement for cool season grasses in a residential setting, in inches per year for a normal rainfall year

In the equation above, "V" is the estimated applied water requirement for cool season grasses in a residential setting in inches per year for a normal rainfall year. Values are based on a special 1976 study by the U.S. Department of Agriculture's Soil Conservation Service (now the Natural Resources Conservation Service) of the irrigation requirements for alfalfa. These were adjusted to reflect differences in irrigation efficiency and evapo-transpiration requirements. V-values by region are shown in Table E-2.

Table E-1

Household End Use of Water (gallons per capita per day)
Without and With Conservation, Potential Savings

	Without Conservation		With Conservation	
End Use	**Share**	**gcd**	**Share**	**gcd**
Toilets	27.70%	20.1	19.30%	9.6
Clothes Washers	20.90%	15.1	21.40%	10.6
Showers	17.30%	12.6	20.10%	10
Faucets	15.30%	11.1	21.90%	10.8
Leaks	13.80%	10	10.10%	5
Other Domestic	2.10%	1.5	3.10%	1.5
Baths	1.60%	1.2	2.40%	1.2
Dish Washers	1.30%	1	2.00%	1
Inside Total	**100%**	**72.5**	**100%**	**49.6**

Table E-2
Estimated Applied Water Requirement by Region

State	Sector or Drainage (major city)	V	State	Sector or Drainage (major city)	V
Alabama	Prairie (Montgomery)	15.6	Mississippi	Coastal (Biloxi)	20.8
	Gulf (Mobile)	10.4		Southwest (Vicksburg)	24.7
Arizona	Northeast (Flagstaff)	31.2	Missouri	Northeast Prairie (St. Louis)	23.4
	South Central (Phoenix)	76.7		Northwest Prairie (Kansas City)	19.5
	Southeast (Tucson)	71.5	Montana	Western (Missoula)	20.8
Arkansas	Central (Little Rock)	19.5	Nebraska	East Central (Omaha)	26.0
California	North Coast Drainage (Eureka)	27.3	Nevada	Northwestern (Reno)	36.4
	Sacramento Drainage (Sacramento)	39.0		Extreme Southern (Las Vegas)	55.9
	Central Coast Drainage (San Francisco)	27.3	New Hampshire	Southern (Concord)	14.3
	South Coast Drainage (Los Angeles)	62.4	New Jersey	Northern (Newark)	13.0
Colorado	Platte Drainage Basin (Denver)	28.6	New Mexico	Northern Mountains (Santa Fe)	31.2
Connecticut	Central Coastal (Hartford)	14.3		Central Valley (Albuquerque)	39.0
Delaware	Northern (Wilmington)	20.8	New York	Coastal (New York)	14.3
Florida	North (Jacksonville)	36.4		Great Lakes (Buffalo)	13.0
	South Central (Tampa)	36.4	North Carolina	Southern Mountains (Asheville)	14.3
	Lower East Coast (Ft. Lauderdale)	33.8		Central Piedmont (Raleigh)	24.7
Georgia	(Entire State)	29.9	North Dakota	South Central (Bismark)	19.5
Idaho	Southwestern Valleys (Boise)	35.1	Ohio	Northeast (Cleveland)	18.2
Illinois	Northeast (Chicago)	19.5		Southwest (Dayton)	20.8
	West Southwest (Springfield)	22.1	Oklahoma	Central (Oklahoma City)	26.0
Indiana	Central (Indianapolis)	20.8	Oregon	Willamette Valley (Portland)	24.7
Iowa	Central (Des Moines)	20.8	Pennsylvania	Southeastern Piedmont (Philadelphia)	13.0
Kansas	Northeast (Kansas City)	23.4	Rhode Island	(Entire State)	14.3
	South Central (Wichita)	18.2	South Carolina	Southern (Charleston)	24.7
Kentucky	Central (Louisville)	23.4	South Dakota	Southeast (Sioux Falls)	24.7
Louisiana	Southeast (New Orleans)	20.8	Tennessee	Western (Memphis)	22.1
Maine	Coastal (Portland)	11.7	Texas	North Central (Dallas)	37.7
Maryland	Northern Central (Baltimore)	20.8		South Central (San Antonio)	49.4
Massachusetts	Coastal (Boston)	16.9		Upper Coast (Houston)	28.6
Michigan	Southeast Lower (Detroit)	14.3	Utah	North Central (Salt Lake City)	31.2
Minnesota	East Central (Minneapolis)	10.4	Vermont	Northeast (Montpelier)	14.3

Table E-2 *Continued*

State	Sector or Drainage (major city)	V	State	Sector or Drainage (major city)	V
Virginia	Eastern Piedmont (Richmond)	13.0	West Virginia	Southwestern (Charleston)	13.0
Washington	Puget Sound Lowland (Seattle)	19.5	Wisconsin	Southeast (Milwaukee)	11.7
			Wyoming	Platte Drainage (Cheyenne)	23.4

Note: *"V" is the estimated applied water requirement for cool season grasses in a residential setting in inches per year for a normal rainfall year. Values are based on a special 1976 study by the U.S. Department of Agriculture's Soil Conservation Service (now the Natural Resources Conservation Service) on the irrigation requirements for alfalfa. These were adjusted to reflect differences in irrigation efficiency and evapotranspiration requirements.*

In the equation above, "S" is the ratio of the applied water requirement (AWR) of the landscape type noted to the AWR for cool season grasses. It is assumed water is applied by sprinkler, except for shrubs and trees which are assumed to be irrigated by drip or by hand. Table E-3 shows these values.

The annual applied water requirement for each landscaped area by type is added up to find the total AWR for the parcel.

Total Water Use

Total water use is calculated using the following equation:

Total Household Water Use:

HWU = GCD + (AWR / (365 * R))

where

HWU	is the Household water use, in gal/capita/day is
GCD	the Indoor water use, in gal/capita/day is the
AWR	Annual applied water requirement is the
R	Residents of the parcel

References

American Water Works Association Research Foundation, 1999. *Residential End Uses of Water.*

United States Department of Agriculture, 1986. Soil Conservation Service, *Urban Hydrology for Small Watersheds,* Technical Release 55.

Table E-3
Basic Landscape Types and Corresponding "S" Factor

Basic Landscape Type	S Factor
Cool season grasses *(a)*	1.00
Warm season grasses *(b)*	0.70
Average of grasses	*0.85*
Ground covers	0.50
Shrubs and trees	0.20

(a) *Kentucky bluegrass, rye, tall fescue, red fescue, etc.*
(b) *Bermuda, Zoysia.*

Appendix F
GEODATABASE OBJECT CLASS SUMMARY

ObjectClass Summary

ObjectClass Name (Base Case)	Type	Geometry	Subtype
lnBicycleRoutes0	FeatureClass	Polyline	-
lnCaseBdCordon0	FeatureClass	Polyline	-
lnPedRoutes0	FeatureClass	Polyline	-
lnPedSetbacks0	FeatureClass	Polyline	-
lnStreetCL0	FeatureClass	Polyline	Arterial Collector Freeway Local NoRightOfWay
lnTransitRoutes0	FeatureClass	Polyline	Bus Heavy Rail Light Rail
ptBusinesses0	FeatureClass	Point	N/A Other Retail Service
ptDwellings0	FeatureClass	Point	Multi Family N/A Single Family
ptPedStops0	FeatureClass	Point	(undefined) Destination Origin
ptPointsOfInterest0	FeatureClass	Point	(Undefined) Amenity Central Node Key Feature
ptTrafficDevices0	FeatureClass	Point	-
ptTransitStops0	FeatureClass	Point	Bus Heavy Rail Light Rail
pyCaseBd0	FeatureClass	Polygon	-
pyCaseBdSubArea0	FeatureClass	Polygon	-
pyDemographics0	FeatureClass	Polygon	-
pyFloodplains0	FeatureClass	Polygon	-
pyLandUses0	FeatureClass	Polygon	-
pyLandUsesSupplementary0	FeatureClass	Polygon	Open Space Park Parking Vacant

pyOpenSpaceGrid0	FeatureClass	Polygon	-
pyPlannedDesignations0	FeatureClass	Polygon	-
pySchoolAreas0	FeatureClass	Polygon	-
pySlopes0	FeatureClass	Polygon	-
pySoils0	FeatureClass	Polygon	-
pyStormwaterBMPs0	FeatureClass	Polygon	-
pyUseMixGrid0	FeatureClass	Polygon	-

InBicycleRoutes0

Alias	Bicycle Routes	**Geometry:**Polyline **Average Number of Points:**0 **Has M:**No **Has Z:**No **Grid Size:**1000
Dataset Type	FeatureClass	
FeatureType	Simple	

Field Name	Alias	Type	Precn.	Scale	Length	Edit	Null	Req.	Domain Fixed
OBJECTID	OBJECTID	OID	0	0	4	No	No	Yes	No
SHAPE	SHAPE	Geometry	0	0	0	Yes	No	Yes	No
Context1	Context 1	String	0	0	255	Yes	Yes	No	No
Context2	Context 2	String	0	0	255	Yes	Yes	No	No
Context3	Context 3	String	0	0	255	Yes	Yes	No	No

Subtype Name	Default Value	Domain
(=0) [Default]		

Index Name	Ascending	Unique	Fields
FDO_OBJECTID	Yes	Yes	OBJECTID
SHAPE_INDEX	Yes	Yes	SHAPE

InCaseBdCordon0

Alias	Case Boundary Cordon	**Geometry:**Polyline **Average Number of Points:**0 **Has M:**No **Has Z:**No **Grid Size:**1000
Dataset Type	FeatureClass	
FeatureType	Simple	

Field Name	Alias	Type	Precn.	Scale	Length	Edit	Null	Req.	Domain Fixed
OBJECTID	OBJECTID	OID	0	0	4	No	No	Yes	No
SHAPE	SHAPE	Geometry	0	0	0	Yes	No	Yes	No
IND_42	External Street Connectivity	Double	0	0	8	Yes	No	No	No
IND_APPLICABLE	Indicator Score Applicable	Small Integer	0	0	2	Yes	No	No	No

Subtype Name	Default Value	Domain
(=0) [Default]		
IND_42	-999	IndScore_Dflt_Dflt
IND_APPLICABLE	-1	Bool_Dup_Dflt

Index Name	Ascending	Unique	Fields
FDO_OBJECTID	Yes	Yes	OBJECTID
SHAPE_INDEX	Yes	Yes	SHAPE

InPedRoutes0

Alias	Pedestrian Routes	**Geometry:**Polyline **Average Number of Points:**0 **Has M:**No **Has Z:**No **Grid Size:**1000
Dataset Type	FeatureClass	
FeatureType	Simple	

Field Name	Alias	Type	Precn.	Scale	Length	Edit	Null	Req.	Domain Fixed
OBJECTID	OBJECTID	OID	0	0	4	No	No	Yes	No
SHAPE	SHAPE	Geometry	0	0	0	Yes	No	Yes	No
Context1	Context 1	String	0	0	255	Yes	Yes	No	No
Context2	Context 2	String	0	0	255	Yes	Yes	No	No
Context3	Context 3	String	0	0	255	Yes	Yes	No	No
Enabled	Enabled	Small Integer	0	0	2	Yes	Yes	Yes	Yes

Subtype Name	Default Value	Domain
(=0) [Default]		
Enabled	1	EnabledDomain

Index Name	Ascending	Unique	Fields
FDO_OBJECTID	Yes	Yes	OBJECTID
SHAPE_INDEX	Yes	Yes	SHAPE

InPedSetbacks0

Alias	Pedestrian Setback Lines	**Geometry:**Polyline **Average Number of Points:**0 **Has M:**No **Has Z:**No **Grid Size:**1000
Dataset Type	FeatureClass	
FeatureType	Simple	

Field Name	Alias	Type	Precn.	Scale	Length	Edit	Null	Req.	Domain Fixed
OBJECTID	OBJECTID	OID	0	0	4	No	No	Yes	No
SHAPE	SHAPE	Geometry	0	0	0	Yes	No	Yes	No
SetbackDistance	Setback Distance (ft.)	Double	0	0	8	Yes	No	No	No
Context1	Context 1	String	0	0	255	Yes	Yes	No	No
Context2	Context 2	String	0	0	255	Yes	Yes	No	No
Context3	Context 3	String	0	0	255	Yes	Yes	No	No
IND_51	Pedestrian Setback	Double	0	0	8	Yes	No	No	No
IND_APPLICABLE	Indicator Score Applicable	Small Integer	0	0	2	Yes	No	No	No

Subtype Name	Default Value	Domain
(=0) [Default]		
SetbackDistance	0	AvgPer_Dup_WAvg
IND_51	-999	IndScore_Dflt_Dflt
IND_APPLICABLE	0	Bool_Dup_Dflt

Index Name	Ascending	Unique	Fields
FDO_OBJECTID	Yes	Yes	OBJECTID
SHAPE_INDEX	Yes	Yes	SHAPE

InStreetCL0

Alias	Street Centerlines	**Geometry:** Polyline **Average Number of Points:** 0 **Has M:** No **Has Z:** No **Grid Size:** 1000
Dataset Type	FeatureClass	
FeatureType	Simple	

Field Name	Alias	Type	Precn.	Scale	Length	Edit	Null	Req.	Domain Fixed
OBJECTID	OBJECTID	OID	0	0	4	No	No	Yes	No
SHAPE	SHAPE	Geometry	0	0	0	Yes	No	Yes	No
StreetGroupID	Street Group (subtype)	Integer	0	0	4	Yes	No	No	No
StreetWidth	Street Width (ft.)	Double	0	0	8	Yes	No	No	No
SidewalkWidth	Sidewalk Width (ft.)	Double	0	0	8	Yes	No	No	No
SidewalkPercent	Percent of Segment with Sidewalks	Double	0	0	8	Yes	No	No	No
RightOfWayWidth	Right-of-Way Width (ft.)	Double	0	0	8	Yes	No	No	No
Context1	Context 1	String	0	0	255	Yes	Yes	No	No
Context2	Context 2	String	0	0	255	Yes	Yes	No	No
Context3	Context 3	String	0	0	255	Yes	Yes	No	No
Context4	Context 4	String	0	0	255	Yes	Yes	No	No
Context5	Context 5	String	0	0	255	Yes	Yes	No	No
Context6	Context 6	String	0	0	255	Yes	Yes	No	No
IND_47	Pedestrian Network Coverage	Double	0	0	8	Yes	No	No	No
IND_48	Pedestrian Crossing Distance	Double	0	0	8	Yes	No	No	No
IND_61	Street Segment Length	Double	0	0	8	Yes	No	No	No
IND_APPLICABLE	Indicator Score Applicable	Small Integer	0	0	2	Yes	No	No	No
IND_DirtyLUT	Land-Use Topology Dirty	Small Integer	0	0	2	Yes	No	No	No
Enabled	Enabled	Small Integer	0	0	2	Yes	Yes	Yes	Yes

Subtype Name	Default Value	Domain
NoRightOfWay (StreetGroupID=0) [Default]		
StreetWidth	20	AvgPer_Dup_WAvg
SidewalkWidth	0	AvgPer_Dup_WAvg
SidewalkPercent	0	AvgPer_Dup_WAvg
RightOfWayWidth	0	AvgPer_Dup_WAvg
IND_47	-999	IndScore_Dflt_Dflt
IND_48	-999	IndScore_Dflt_Dflt
IND_61	-999	IndScore_Dflt_Dflt
IND_APPLICABLE	0	Bool_Dup_Dflt
IND_DirtyLUT	-1	Bool_Dup_Dflt
Enabled	1	EnabledDomain
Local (StreetGroupID=1)		
StreetWidth	36	AvgPer_Dup_WAvg
SidewalkWidth	4	AvgPer_Dup_WAvg
SidewalkPercent	100	AvgPer_Dup_WAvg
RightOfWayWidth	44	AvgPer_Dup_WAvg
IND_47	-999	IndScore_Dflt_Dflt
IND_48	-999	IndScore_Dflt_Dflt
IND_61	-999	IndScore_Dflt_Dflt
IND_APPLICABLE	0	Bool_Dup_Dflt
IND_DirtyLUT	-1	Bool_Dup_Dflt
Enabled	1	EnabledDomain
Collector (StreetGroupID=2)		
StreetWidth	44	AvgPer_Dup_WAvg
SidewalkWidth	5	AvgPer_Dup_WAvg
SidewalkPercent	100	AvgPer_Dup_WAvg
RightOfWayWidth	54	AvgPer_Dup_WAvg
IND_47	-999	IndScore_Dflt_Dflt
IND_48	-999	IndScore_Dflt_Dflt

IND_61	-999	IndScore_Dflt_Dflt
IND_APPLICABLE	0	Bool_Dup_Dflt
IND_DirtyLUT	-1	Bool_Dup_Dflt
Enabled	1	EnabledDomain
Arterial (StreetGroupID=3)		
StreetWidth	68	AvgPer_Dup_WAvg
SidewalkWidth	6	AvgPer_Dup_WAvg
SidewalkPercent	100	AvgPer_Dup_WAvg
RightOfWayWidth	80	AvgPer_Dup_WAvg
IND_47	-999	IndScore_Dflt_Dflt
IND_48	-999	IndScore_Dflt_Dflt
IND_61	-999	IndScore_Dflt_Dflt
IND_APPLICABLE	0	Bool_Dup_Dflt
IND_DirtyLUT	-1	Bool_Dup_Dflt
Enabled	1	EnabledDomain
Freeway (StreetGroupID=4)		
StreetWidth	110	AvgPer_Dup_WAvg
SidewalkWidth	0	AvgPer_Dup_WAvg
SidewalkPercent	0	AvgPer_Dup_WAvg
RightOfWayWidth	210	AvgPer_Dup_WAvg
IND_47	-999	IndScore_Dflt_Dflt
IND_48	-999	IndScore_Dflt_Dflt
IND_61	-999	IndScore_Dflt_Dflt
IND_APPLICABLE	0	Bool_Dup_Dflt
IND_DirtyLUT	-1	Bool_Dup_Dflt
Enabled	1	EnabledDomain

Index Name	Ascending	Unique	Fields
FDO_OBJECTID	Yes	Yes	OBJECTID
SHAPE_INDEX	Yes	Yes	SHAPE

InTransitRoutes0

Alias	Transit Routes	**Geometry:**Polyline
Dataset Type	FeatureClass	**Average Number of Points:**0
FeatureType	Simple	**Has M:**No
		Has Z: No
		Grid Size:1000

Field Name	Alias	Type	Precn.	Scale	Length	Edit	Null	Req.	Domain Fixed
OBJECTID	OBJECTID	OID	0	0	4	No	No	Yes	No
SHAPE	SHAPE	Geometry	0	0	0	Yes	No	Yes	No
TransitGroupID	Transit Group (subtype)	Integer	0	0	4	Yes	No	No	No
RouteNumber	Route Number	String	0	0	255	Yes	No	No	No
RouteName	Route Name	String	0	0	255	Yes	No	No	No
RightOfWayWidth	Right-of-Way Width	Double	0	0	8	Yes	No	No	No
VehicleCount	Route Segment Traffic (vehicles/day)	Integer	0	0	4	Yes	No	No	No
Context1	Context 1	String	0	0	255	Yes	Yes	No	No
Context2	Context 2	String	0	0	255	Yes	Yes	No	No
Context3	Context 3	String	0	0	255	Yes	Yes	No	No
IND_46	Transit Service Density	Double	0	0	8	Yes	No	No	No
IND_APPLICABLE	Indicator Score Applicable	Small Integer	0	0	2	Yes	No	No	No
IND_DirtyLUT	Land-Use Topology Dirty	Small Integer	0	0	2	Yes	No	No	No

Subtype Name	Default Value	Domain
Bus (TransitGroupID=0) [Default]		
RightOfWayWidth	0	AvgPer_Dup_WAvg
VehicleCount	72	LngInt_Dup_WAvg
IND_46	-999	IndScore_Dflt_Dflt
IND_APPLICABLE	0	Bool_Dup_Dflt
IND_DirtyLUT	0	Bool_Dup_Dflt
Light Rail (TransitGroupID=1)		
RightOfWayWidth	0	AvgPer_Dup_WAvg
VehicleCount	140	LngInt_Dup_WAvg
IND_46	-999	IndScore_Dflt_Dflt
IND_APPLICABLE	0	Bool_Dup_Dflt
IND_DirtyLUT	-1	Bool_Dup_Dflt
Heavy Rail (TransitGroupID=2)		
RightOfWayWidth	0	AvgPer_Dup_WAvg
VehicleCount	18	LngInt_Dup_WAvg
IND_46	-999	IndScore_Dflt_Dflt
IND_APPLICABLE	0	Bool_Dup_Dflt
IND_DirtyLUT	-1	Bool_Dup_Dflt

Index Name	Ascending	Unique	Fields
FDO_OBJECTID	Yes	Yes	OBJECTID
SHAPE_INDEX	Yes	Yes	SHAPE

ptBusinesses0

Alias	Employers	**Geometry:**Point **Average Number of Points:**0 **Has M:**No **Has Z:**No **Grid Size:**1000
Dataset Type	FeatureClass	
FeatureType	Simple	

Field Name	Alias	Type	Precn.	Scale	Length	Edit	Null	Req.	Domain Fixed
OBJECTID	OBJECTID	OID	0	0	4	No	No	Yes	No
SHAPE	SHAPE	Geometry	0	0	0	Yes	No	Yes	No
BusinessGroupID	Employment Group (subtype)	Integer	0	0	4	Yes	No	No	No
BusinessName	Employer Name	String	0	0	255	Yes	No	No	No
BusinessAddress	Address of Employer Location	String	0	0	255	Yes	No	No	No
EmploymentCount	Employment Count	Double	0	0	8	Yes	No	No	No
Context1	Context 1	String	0	0	255	Yes	Yes	No	No
Context2	Context 2	String	0	0	255	Yes	Yes	No	No
Context3	Context 3	String	0	0	255	Yes	Yes	No	No
IND_28	Transit Proximity to Employment	Double	0	0	8	Yes	No	No	No
IND_56	Street Route Directness	Double	0	0	8	Yes	No	No	No
IND_66	Transit-Oriented Employment Density	Double	0	0	8	Yes	No	No	No
IND_APPLICABLE	Indicator Score Applicable	Small Integer	0	0	2	Yes	No	No	No

Subtype Name	Default Value	Domain
N/A (BusinessGroupID=0)		
BusinessName		-
BusinessAddress		-
EmploymentCount	0	CountD_GeomRatio_Sum
IND_56	-999	IndScore_Dflt_Dflt
IND_28	-999	IndScore_Dflt_Dflt
IND_66	-999	IndScore_Dflt_Dflt
IND_APPLICABLE	0	Bool_Dup_Dflt
Retail (BusinessGroupID=1) [Default]		
BusinessName	Unknown	-
BusinessAddress	Unavailable	-
EmploymentCount	0	CountD_GeomRatio_Sum
IND_56	-999	IndScore_Dflt_Dflt
IND_28	-999	IndScore_Dflt_Dflt
IND_66	-999	IndScore_Dflt_Dflt
IND_APPLICABLE	0	Bool_Dup_Dflt
Service (BusinessGroupID=2)		
BusinessName	Unknown	-
BusinessAddress	Unavailable	-
EmploymentCount	0	CountD_GeomRatio_Sum
IND_56	-999	IndScore_Dflt_Dflt
IND_28	-999	IndScore_Dflt_Dflt
IND_66	-999	IndScore_Dflt_Dflt
IND_APPLICABLE	0	Bool_Dup_Dflt
Other (BusinessGroupID=3)		
BusinessName	Unknown	-
BusinessAddress	Unavailable	-
EmploymentCount	0	CountD_GeomRatio_Sum
IND_56	-999	IndScore_Dflt_Dflt
IND_28	-999	IndScore_Dflt_Dflt
IND_66	-999	IndScore_Dflt_Dflt
IND_APPLICABLE	0	Bool_Dup_Dflt

Index Name	Ascending	Unique	Fields
FDO_OBJECTID	Yes	Yes	OBJECTID
SHAPE_INDEX	Yes	Yes	SHAPE

ptDwellings0

Alias	Dwellings	**Geometry:**Point **Average Number of Points:**0 **Has M:**No **Has Z:**No **Grid Size:**1000
Dataset Type	FeatureClass	
FeatureType	Simple	

Field Name	Alias	Type	Precn.	Scale	Length	Edit	Null	Req.	Domain Fixed
OBJECTID	OBJECTID	OID	0	0	4	No	No	Yes	No
SHAPE	SHAPE	Geometry	0	0	0	Yes	No	Yes	No
DwellingGroupID	Dwelling Group (subtype)	Integer	0	0	4	Yes	No	No	No
DwellingAddress	Address of Dwelling Building	String	0	0	255	Yes	No	No	No
ResidentialPopulation	Residential Population	Double	0	0	8	Yes	No	No	No
DwellingUnitCount	Dwelling Unit Count	Double	0	0	8	Yes	No	No	No
DwellingUnitCountOO	Owner-Occupied DwellingUnitCount	Double	0	0	8	Yes	No	No	No
StudentCount	Student Count	Double	0	0	8	Yes	No	No	No
WorkerCount	Worker Count	Double	0	0	8	Yes	No	No	No
Context1	Context 1	String	0	0	255	Yes	Yes	No	No
Context2	Context 2	String	0	0	255	Yes	Yes	No	No
Context3	Context 3	String	0	0	255	Yes	Yes	No	No
IND_20	Amenities Proximity	Double	0	0	8	Yes	No	No	No
IND_23	Transit Proximity to Housing	Double	0	0	8	Yes	No	No	No
IND_31	Park Proximity	Double	0	0	8	Yes	No	No	No
IND_56	Street Route Directness	Double	0	0	8	Yes	No	No	No
IND_65	Transit-Oriented Residential Density	Double	0	0	8	Yes	No	No	No
IND_APPLICABLE	Indicator Score Applicable	Small Integer	0	0	2	Yes	No	No	No

Subtype Name	Default Value	Domain
N/A (DwellingGroupID=0)		
DwellingAddress		-
ResidentialPopulation	0	CountD_GeomRatio_Sum
DwellingUnitCount	0	CountD_GeomRatio_Sum
DwellingUnitCountOO	0	CountD_GeomRatio_Sum
StudentCount	0	CountD_GeomRatio_Sum
WorkerCount	0	CountD_GeomRatio_Sum
IND_20	-999	IndScore_Dflt_Dflt
IND_23	-999	IndScore_Dflt_Dflt
IND_31	-999	IndScore_Dflt_Dflt
IND_56	-999	IndScore_Dflt_Dflt
IND_65	-999	IndScore_Dflt_Dflt
IND_APPLICABLE	0	Bool_Dup_Dflt
Single Family (DwellingGroupID=1) [Default]		
DwellingAddress	Unknown	-
ResidentialPopulation	0	CountD_GeomRatio_Sum
DwellingUnitCount	1	CountD_GeomRatio_Sum
DwellingUnitCountOO	0	CountD_GeomRatio_Sum
StudentCount	0	CountD_GeomRatio_Sum
WorkerCount	0	CountD_GeomRatio_Sum
IND_20	-999	IndScore_Dflt_Dflt
IND_23	-999	IndScore_Dflt_Dflt
IND_31	-999	IndScore_Dflt_Dflt
IND_56	-999	IndScore_Dflt_Dflt
IND_65	-999	IndScore_Dflt_Dflt
IND_APPLICABLE	0	Bool_Dup_Dflt
Multi Family (DwellingGroupID=2)		
DwellingAddress	Unknown	-
ResidentialPopulation	0	CountD_GeomRatio_Sum
DwellingUnitCount	2	CountD_GeomRatio_Sum
DwellingUnitCountOO	0	CountD_GeomRatio_Sum

StudentCount	0	CountD_GeomRatio_Sum
WorkerCount	0	CountD_GeomRatio_Sum
IND_20	-999	IndScore_Dflt_Dflt
IND_23	-999	IndScore_Dflt_Dflt
IND_31	-999	IndScore_Dflt_Dflt
IND_56	-999	IndScore_Dflt_Dflt
IND_65	-999	IndScore_Dflt_Dflt
IND_APPLICABLE	0	Bool_Dup_Dflt

Index Name	Ascending	Unique	Fields
FDO_OBJECTID	Yes	Yes	OBJECTID
SHAPE_INDEX	Yes	Yes	SHAPE

ptPedStops0

Alias	Pedestrian Stops	**Geometry:**Point **Average Number of Points:**0 **Has M:**No **Has Z:**No **Grid Size:**1000
Dataset Type	FeatureClass	
FeatureType	Simple	

Field Name	Alias	Type	Precn.	Scale	Length	Edit	Null	Req.	Domain Fixed
OBJECTID	OBJECTID	OID	0	0	4	No	No	Yes	No
SHAPE	SHAPE	Geometry	0	0	0	Yes	No	Yes	No
PedStopGroupID	Pedestrian Stop Group (subtype)	Integer	0	0	4	Yes	No	No	No
PedAccessibilityWeight	Pedestrian Accessibility Weight	Double	0	0	8	Yes	No	No	No
Context1	Context 1	String	0	0	255	Yes	Yes	No	No
Context2	Context 2	String	0	0	255	Yes	Yes	No	No
Context3	Context 3	String	0	0	255	Yes	Yes	No	No
IND_52	Pedestrian Accessibilities	Double	0	0	8	Yes	No	No	No
IND_APPLICABLE	Indicator Score Applicable	Small Integer	0	0	2	Yes	No	No	No

Subtype Name	Default Value	Domain
Origin (PedStopGroupID=0)		
PedAccessibilityWeight	1	AvgPer_Dup_WAvg
IND_52	-999	IndScore_Dflt_Dflt
IND_APPLICABLE	0	Bool_Dup_Dflt
Destination (PedStopGroupID=1)		
PedAccessibilityWeight	1	AvgPer_Dup_WAvg
IND_52	-999	IndScore_Dflt_Dflt
IND_APPLICABLE	0	Bool_Dup_Dflt
(undefined) (PedStopGroupID=2) [Default]		
PedAccessibilityWeight	1	AvgPer_Dup_WAvg
IND_52	-999	IndScore_Dflt_Dflt
IND_APPLICABLE	0	Bool_Dup_Dflt

Index Name	Ascending	Unique	Fields
FDO_OBJECTID	Yes	Yes	OBJECTID
SHAPE_INDEX	Yes	Yes	SHAPE

ptPointsOfInterest0

Alias	Points of Interest	**Geometry:**Point **Average Number of Points:**0
Dataset Type	FeatureClass	**Has M:**No **Has Z:**No
FeatureType	Simple	**Grid Size:**1000

Field Name	Alias	Type	Precn.	Scale	Length	Edit	Null	Req.	Domain Fixed
OBJECTID	OBJECTID	OID	0	0	4	No	No	Yes	No
SHAPE	SHAPE	Geometry	0	0	0	Yes	No	Yes	No
InterestGroupID	Interest Group (subtype)	Integer	0	0	4	Yes	No	No	No
Context1	Context 1	String	0	0	255	Yes	Yes	No	No
Context2	Context 2	String	0	0	255	Yes	Yes	No	No
Context3	Context 3	String	0	0	255	Yes	Yes	No	No

Subtype Name	Default Value	Domain
(Undefined) (InterestGroupID=0) [Default]		
Amenity (InterestGroupID=1)		
Central Node (InterestGroupID=2)		
Key Feature (InterestGroupID=3)		

Index Name	Ascending	Unique	Fields
FDO_OBJECTID	Yes	Yes	OBJECTID
SHAPE_INDEX	Yes	Yes	SHAPE

ptTrafficDevices0

Alias	Traffic Control Devices	**Geometry:**Point **Average Number of Points:**0
Dataset Type	FeatureClass	**Has M:**No **Has Z:**No
FeatureType	Simple	**Grid Size:**1000

Field Name	Alias	Type	Precn.	Scale	Length	Edit	Null	Req.	Domain Fixed
OBJECTID	OBJECTID	OID	0	0	4	No	No	Yes	No
SHAPE	SHAPE	Geometry	0	0	0	Yes	No	Yes	No
Context1	Context 1	String	0	0	255	Yes	Yes	No	No
Context2	Context 2	String	0	0	255	Yes	Yes	No	No
Context3	Context 3	String	0	0	255	Yes	Yes	No	No

Subtype Name	Default Value	Domain
(=0) [Default]		

Index Name	Ascending	Unique	Fields
FDO_OBJECTID	Yes	Yes	OBJECTID
SHAPE_INDEX	Yes	Yes	SHAPE

ptTransitStops0

Alias	Transit Stops	**Geometry:**Point **Average Number of Points:**0 **Has M:**No **Has Z:**No **Grid Size:**1000
Dataset Type	FeatureClass	
FeatureType	Simple	

Field Name	Alias	Type	Precn.	Scale	Length	Edit	Null	Req.	Domain Fixed
OBJECTID	OBJECTID	OID	0	0	4	No	No	Yes	No
SHAPE	SHAPE	Geometry	0	0	0	Yes	No	Yes	No
TransitGroupID	Transit Group (subtype)	Integer	0	0	4	Yes	No	No	No
StopName	Stop Name	String	0	0	255	Yes	No	No	No
StopNumber	Stop Number	String	0	0	255	Yes	No	No	No
IsTerminus	Is the Stop a Terminus	Small Integer	0	0	2	Yes	No	No	No
HasParking	Does the Stop Offer Parking	Small Integer	0	0	2	Yes	No	No	No
PeakHourServiceOnly	Commuter Stop (Peak Hour Service Only)	Small Integer	0	0	2	Yes	No	No	No
PeakHourServiceCount	Number of Passenger Pick-ups During Peak Hour	Double	0	0	8	Yes	No	No	No
DistanceToNearestCBD	Distance to Nearest Central Business District (miles)	Double	0	0	8	Yes	No	No	No
DistanceToNearestStop	Distance to Nearest Stop of Same Type (miles)	Double	0	0	8	Yes	No	No	No
Context1	Context 1	String	0	0	255	Yes	Yes	No	No
Context2	Context 2	String	0	0	255	Yes	Yes	No	No
Context3	Context 3	String	0	0	255	Yes	Yes	No	No
IND_63	Light Rail Transit Boardings	Double	0	0	8	Yes	No	No	No

Subtype Name	Default Value	Domain
Bus (TransitGroupID=0) [Default]		
IsTerminus	0	Bool_Dup_Dflt
HasParking	0	Bool_Dup_Dflt
DistanceToNearestCBD	5	AvgPer_Dup_WAvg
DistanceToNearestStop	0.2	AvgPer_Dup_WAvg
PeakHourServiceOnly	0	Bool_Dup_Dflt
PeakHourServiceCount	6	AvgPer_Dup_WAvg
IND_63	-999	IndScore_Dflt_Dflt
Light Rail (TransitGroupID=1)		
IsTerminus	0	Bool_Dup_Dflt
HasParking	0	Bool_Dup_Dflt
DistanceToNearestCBD	5	AvgPer_Dup_WAvg
DistanceToNearestStop	2	AvgPer_Dup_WAvg
PeakHourServiceOnly	0	Bool_Dup_Dflt
PeakHourServiceCount	3	AvgPer_Dup_WAvg
IND_63	-999	IndScore_Dflt_Dflt
Heavy Rail (TransitGroupID=2)		
IsTerminus	0	Bool_Dup_Dflt
HasParking	0	Bool_Dup_Dflt
DistanceToNearestCBD	5	AvgPer_Dup_WAvg
DistanceToNearestStop	5	AvgPer_Dup_WAvg
PeakHourServiceOnly	0	Bool_Dup_Dflt
PeakHourServiceCount	1	AvgPer_Dup_WAvg
IND_63	-999	IndScore_Dflt_Dflt

Index Name	Ascending	Unique	Fields
FDO_OBJECTID	Yes	Yes	OBJECTID
SHAPE_INDEX	Yes	Yes	SHAPE

pyCaseBd0

Alias	Case Boundary Area	**Geometry:**Polygon
Dataset Type	FeatureClass	**Average Number of Points:**0
FeatureType	Simple	**Has M:**No **Has Z:**No **Grid Size:**1000

Field Name	Alias	Type	Precn.	Scale	Length	Edit	Null	Req.	Domain Fixed
OBJECTID	OBJECTID	OID	0	0	4	No	No	Yes	No
SHAPE	SHAPE	Geometry	0	0	0	Yes	No	Yes	No
Context1	Context 1	String	0	0	255	Yes	Yes	No	No
Context2	Context 2	String	0	0	255	Yes	Yes	No	No
Context3	Context 3	String	0	0	255	Yes	Yes	No	No
RegionalPopulation	Regional Population	Integer	0	0	4	Yes	No	No	No
RegionalEmployment	Regional Employment	Integer	0	0	4	Yes	No	No	No
NetFiscalImpactOfDevelopment	Net Fiscal Impact Of Development ($)	Double	0	0	8	Yes	No	No	No
AffordableSFUnitPrice	Affordable Single-Family Housing Unit Price	Double	0	0	8	Yes	No	No	No
UseMixCellSize	Use Mix Cell Size (acres)	Double	0	0	8	Yes	No	No	No
OpenSpaceConnectivityCellSize	Open Space Connectivity Cell Size (acres)	Double	0	0	8	Yes	No	No	No
SuitableSlopePercent	Suitable Slope Percent (Maximum)	Double	0	0	8	Yes	No	No	No
MaximumTheoreticalWalkableDistance	Maximum Theoretical Walkable Distance (ft.)	Double	0	0	8	Yes	No	No	No
MaximumWalkingSpeed	Maximum Walking Speed (mph)	Double	0	0	8	Yes	No	No	No
VMTHB	Base Case Home Based Vehicle Miles Travelled (miles/capita/day)	Double	0	0	8	Yes	No	No	No
VMTNHB	Base Case Non-Home Based Vehicle Miles Travelled (miles/capita/day)	Double	0	0	8	Yes	No	No	No
VTHB	Base Case Home Based Vehicle Trips (trips/capita/day)	Double	0	0	8	Yes	No	No	No
VTNHB	Base Case Non-Home Based Vehicle Trips (trips/capita/day)	Double	0	0	8	Yes	No	No	No
SolidWaste	Municipal Solid Waste Disposed (pounds/capita/day)	Double	0	0	8	Yes	No	No	No
WasteWater	Waste Water Produced (gallons/capita/day)	Double	0	0	8	Yes	No	No	No
RegionalAccessibility	Regional Accessibility	Double	0	0	8	Yes	No	No	No
NOXPerMile	NOX Emissions (g/mile)	Double	0	0	8	Yes	No	No	No
HCPerMile	HC Emissions (g/mile)	Double	0	0	8	Yes	No	No	No
COPerMile	CO Emissions (g/mile)	Double	0	0	8	Yes	No	No	No
CO2PerMile	CO2 Emissions (g/mile)	Double	0	0	8	Yes	No	No	No
NOXPerTripEnd	NOX Emissions (g/trip end)	Double	0	0	8	Yes	No	No	No
HCPerTripEnd	HC Emissions (g/trip end)	Double	0	0	8	Yes	No	No	No
COPerTripEnd	CO Emissions (g/trip end)	Double	0	0	8	Yes	No	No	No
AppliedWaterRequirement	Applied Water Requirement (inches/year)	Double	0	0	8	Yes	No	No	No
VehicleEnergyUse	Vehicle Energy Use (MMBtu/VMT)	Double	0	0	8	Yes	No	No	No
AnnualSingleFamilyEnergyUse	Annual Single-Family Energy Use (MMBtu/DU)	Integer	0	0	4	Yes	No	No	No
AnnualMultiFamilyEnergyUse	Annual Multi-Family Energy Use (MMBtu/DU)	Integer	0	0	4	Yes	No	No	No
TargetPopulation	Target Control Total Population	Integer	0	0	4	Yes	No	No	No
TargetEmployment	Target Control Total Employment	Integer	0	0	4	Yes	No	No	No
TotalLostPopulation	Total Lost Population	Integer	0	0	4	Yes	No	No	No
TotalLostEmployment	Total Lost Employment	Integer	0	0	4	Yes	No	No	No
BaseStudyGeoDB	FilePath to Base Case Study GeoDB	String	0	0	255	Yes	Yes	No	No

Subtype Name	Default Value	Domain
(=0) [Default]		
RegionalPopulation	0	Count, GeomRatio, Sum

RegionalEmployment	0	Count_GeomRatio_Sum
NetFiscalImpactOfDevelopment	0	AvgPer_Dup_WAvg
UseMixCellSize	0.5	AvgPer_Dup_WAvg
OpenSpaceConnectivityCellSize	0.5	AvgPer_Dup_WAvg
SuitableSlopePercent	12	Pct_Dup_WAvg
MaximumTheoreticalWalkableDistance	1320	AvgPer_Dup_WAvg
MaximumWalkingSpeed	3.5	AvgPer_Dup_WAvg
VMTHB	25	AvgPer_Dup_WAvg
VMTNHB	5	AvgPer_Dup_WAvg
VTHB	5	AvgPer_Dup_WAvg
VTNHB	1	AvgPer_Dup_WAvg
SolidWaste	2.49	AvgPer_Dup_WAvg
WasteWater	60	AvgPer_Dup_WAvg
RegionalAccessibility	30	AvgPer_Dup_WAvg
NOXPerMile	1.7	AvgPer_Dup_WAvg
HCPerMile	3.3	AvgPer_Dup_WAvg
COPerMile	25.5	AvgPer_Dup_WAvg
CO2PerMile	453.6	AvgPer_Dup_WAvg
NOXPerTripEnd	0	AvgPer_Dup_WAvg
HCPerTripEnd	0	AvgPer_Dup_WAvg
COPerTripEnd	0	AvgPer_Dup_WAvg
AffordableSFUnitPrice	0	AvgPer_Dup_WAvg
AppliedWaterRequirement	22.1	AvgPer_Dup_WAvg
VehicleEnergyUse	50	AvgPer_Dup_WAvg
AnnualSingleFamilyEnergyUse	30	Count_GeomRatio_Sum
AnnualMultiFamilyEnergyUse	20	Count_GeomRatio_Sum
TargetPopulation	0	Count_GeomRatio_Sum
TargetEmployment	0	Count_GeomRatio_Sum
TotalLostPopulation	0	Count_GeomRatio_Sum
TotalLostEmployment	0	Count_GeomRatio_Sum

Index Name	Ascending	Unique	Fields
FDO_OBJECTID	Yes	Yes	OBJECTID
SHAPE_INDEX	Yes	Yes	SHAPE

pyCaseBdSubArea0

Alias	Case Boundary Sub Areas	**Geometry:**Polygon **Average Number of Points:**0 **Has M:**No **Has Z:**No **Grid Size:**1000
Dataset Type	FeatureClass	
FeatureType	Simple	

Field Name	Alias	Type	Precn.	Scale	Length	Edit	Null	Req.	Domain Fixed
OBJECTID	OBJECTID	OID	0	0	4	No	No	Yes	No
SHAPE	SHAPE	Geometry	0	0	0	Yes	No	Yes	No
Context1	Context 1	String	0	0	255	Yes	Yes	No	No
Context2	Context 2	String	0	0	255	Yes	Yes	No	No
Context3	Context 3	String	0	0	255	Yes	Yes	No	No
RegionalPopulation	Regional Population	Integer	0	0	4	Yes	No	No	No
RegionalEmployment	Regional Employment	Integer	0	0	4	Yes	No	No	No
NetFiscalImpactOfDevelopment	Net Fiscal Impact Of Development ($)	Double	0	0	8	Yes	No	No	No
AffordableSFUnitPrice	Affordable Single-Family Housing Unit Price	Double	0	0	8	Yes	No	No	No
UseMixCellSize	Use Mix Cell Size (acres)	Double	0	0	8	Yes	No	No	No
OpenSpaceConnectivityCellSize	Open Space Connectivity Cell Size (acres)	Double	0	0	8	Yes	No	No	No
SuitableSlopePercent	Suitable Slope Percent (Maximum)	Double	0	0	8	Yes	No	No	No
MaximumTheoreticalWalkableDistance	Maximum Theoretical Walkable Distance (ft.)	Double	0	0	8	Yes	No	No	No
MaximumWalkingSpeed	Maximum Walking Speed (mph)	Double	0	0	8	Yes	No	No	No
VMTHB	Base Case Home Based Vehicle Miles Travelled (miles/capita/day)	Double	0	0	8	Yes	No	No	No
VMTNHB	Base Case Non-Home Based Vehicle Miles Travelled (miles/capita/day)	Double	0	0	8	Yes	No	No	No
VTHB	Base Case Home Based Vehicle Trips (trips/capita/day)	Double	0	0	8	Yes	No	No	No
VTNHB	Base Case Non-Home Based Vehicle Trips (trips/capita/day)	Double	0	0	8	Yes	No	No	No
SolidWaste	Municipal Solid Waste Disposed (pounds/capita/day)	Double	0	0	8	Yes	No	No	No
WasteWater	Waste Water Produced (gallons/capita/day)	Double	0	0	8	Yes	No	No	No
RegionalAccessibility	Regional Accessibility	Double	0	0	8	Yes	No	No	No
NOXPerMile	NOX Emissions (g/mile)	Double	0	0	8	Yes	No	No	No
HCPerMile	HC Emissions (g/mile)	Double	0	0	8	Yes	No	No	No
COPerMile	CO Emissions (g/mile)	Double	0	0	8	Yes	No	No	No
CO2PerMile	CO2 Emissions (g/mile)	Double	0	0	8	Yes	No	No	No
NOXPerTripEnd	NOX Emissions (g/trip end)	Double	0	0	8	Yes	No	No	No
HCPerTripEnd	HC Emissions (g/trip end)	Double	0	0	8	Yes	No	No	No
COPerTripEnd	CO Emissions (g/trip end)	Double	0	0	8	Yes	No	No	No
AppliedWaterRequirement	Applied Water Requirement (inches/year)	Double	0	0	8	Yes	No	No	No
VehicleEnergyUse	Vehicle Energy Use (MMBtu/VMT)	Double	0	0	8	Yes	No	No	No
AnnualSingleFamilyEnergyUse	Annual Single-Family Energy Use (MMBtu/DU)	Integer	0	0	4	Yes	No	No	No
AnnualMultiFamilyEnergyUse	Annual Multi-Family Energy Use (MMBtu/DU)	Integer	0	0	4	Yes	No	No	No
TargetPopulation	Target Control Total Population	Integer	0	0	4	Yes	No	No	No
TargetEmployment	Target Control Total Employment	Integer	0	0	4	Yes	No	No	No
TotalLostPopulation	Total Lost Population	Integer	0	0	4	Yes	No	No	No
TotalLostEmployment	Total Lost Employment	Integer	0	0	4	Yes	No	No	No
IsDirty	Requires Indicator Refresh	Small Integer	0	0	2	Yes	No	No	No
LandUsePopulation	Total Land Use Population	Integer	0	0	4	Yes	No	No	No
LandUseDwellingUnits	Total Land Use Dwelling Units (SF+MF)	Integer	0	0	4	Yes	No	No	No

LandUseDwellingUnitsSF	Total Land Use SF Dwelling Units	Integer	0	0	4	Yes	No	No	No
LandUseDwellingUnitsMF	Total Land Use MF Dwelling Units	Integer	0	0	4	Yes	No	No	No
LandUseEmployment	Total Land Use Employment	Integer	0	0	4	Yes	No	No	No
LandUseAcres	Total Land Use Acres	Integer	0	0	4	Yes	No	No	No

Subtype Name	Default Value	Domain
(=0) [Default]		
RegionalPopulation	0	Count_GeomRatio_Sum
RegionalEmployment	0	Count_GeomRatio_Sum
NetFiscalImpactOfDevelopment	0	AvgPer_Dup_WAvg
UseMixCellSize	0.5	AvgPer_Dup_WAvg
OpenSpaceConnectivityCellSize	0.5	AvgPer_Dup_WAvg
SuitableSlopePercent	12	Pct_Dup_WAvg
MaximumTheoreticalWalkableDistance	1320	AvgPer_Dup_WAvg
MaximumWalkingSpeed	3.5	AvgPer_Dup_WAvg
VMTHB	25	AvgPer_Dup_WAvg
VMTNHB	5	AvgPer_Dup_WAvg
VTHB	5	AvgPer_Dup_WAvg
VTNHB	1	AvgPer_Dup_WAvg
SolidWaste	2.49	AvgPer_Dup_WAvg
WasteWater	60	AvgPer_Dup_WAvg
RegionalAccessibility	30	AvgPer_Dup_WAvg
NOXPerMile	1.7	AvgPer_Dup_WAvg
HCPerMile	3.3	AvgPer_Dup_WAvg
COPerMile	25.5	AvgPer_Dup_WAvg
CO2PerMile	453.6	AvgPer_Dup_WAvg
NOXPerTripEnd	0	AvgPer_Dup_WAvg
HCPerTripEnd	0	AvgPer_Dup_WAvg
COPerTripEnd	0	AvgPer_Dup_WAvg
AffordableSFUnitPrice	0	AvgPer_Dup_WAvg
AppliedWaterRequirement	22.1	AvgPer_Dup_WAvg
VehicleEnergyUse	50	AvgPer_Dup_WAvg
AnnualSingleFamilyEnergyUse	30	Count_GeomRatio_Sum
AnnualMultiFamilyEnergyUse	20	Count_GeomRatio_Sum
TargetPopulation	0	Count_GeomRatio_Sum
TargetEmployment	0	Count_GeomRatio_Sum
TotalLostPopulation	0	Count_GeomRatio_Sum
TotalLostEmployment	0	Count_GeomRatio_Sum
IsDirty	1	Bool_Dup_Dflt
LandUsePopulation	1	Count_GeomRatio_Sum
LandUseDwellingUnits	1	Count_GeomRatio_Sum
LandUseDwellingUnitsSF	1	Count_GeomRatio_Sum
LandUseDwellingUnitsMF	1	Count_GeomRatio_Sum
LandUseEmployment	1	Count_GeomRatio_Sum
LandUseAcres	1	Count_GeomRatio_Sum

Index Name	Ascending	Unique	Fields
FDO_OBJECTID	Yes	Yes	OBJECTID
SHAPE_INDEX	Yes	Yes	SHAPE

pyDemographics0

Alias	Area Demographic Data	**Geometry:**Polygon **Average Number of Points:**0 **Has M:**No **Has Z:**No **Grid Size:**1000
Dataset Type	FeatureClass	
FeatureType	Simple	

Field Name	Alias	Type	Precn.	Scale	Length	Edit	Null	Req.	Domain Fixed
OBJECTID	OBJECTID	OID	0	0	4	No	No	Yes	No
SHAPE	SHAPE	Geometry	0	0	0	Yes	No	Yes	No
ResidentialPopulation	Residential Population	Double	0	0	8	Yes	Yes	No	No
DwellingUnitCount	Dwelling Unit Count	Double	0	0	8	Yes	No	No	No
DwellingUnitCountOO	Owner-Occupied Dwelling Unit Count	Double	0	0	8	Yes	No	No	No
StudentCount	Student Count	Double	0	0	8	Yes	No	No	No
WorkerCount	Worker Count	Double	0	0	8	Yes	No	No	No
AverageHouseholdIncome	Average Household Income ($/yr)	Double	0	0	8	Yes	No	No	No
EmploymentCount	Employment Count	Double	0	0	8	Yes	No	No	No
GroupQuartersPop	Population in Group Quarters	Double	0	0	8	Yes	No	No	No
Context1	Context 1	String	0	0	255	Yes	Yes	No	No
Context2	Context 2	String	0	0	255	Yes	Yes	No	No
Context3	Context 3	String	0	0	255	Yes	Yes	No	No

Subtype Name	Default Value	Domain
(=0) [Default]		
ResidentialPopulation	0	CountD_GeomRatio_Sum
DwellingUnitCount	0	CountD_GeomRatio_Sum
DwellingUnitCountOO	0	CountD_GeomRatio_Sum
StudentCount	0	CountD_GeomRatio_Sum
WorkerCount	0	CountD_GeomRatio_Sum
AverageHouseholdIncome	0	AvgPer_Dup_WAvg
EmploymentCount	0	CountD_GeomRatio_Sum
GroupQuartersPop	0	CountD_GeomRatio_Sum

Index Name	Ascending	Unique	Fields
FDO_OBJECTID	Yes	Yes	OBJECTID
SHAPE_INDEX	Yes	Yes	SHAPE

pyFloodplains0

Alias	Floodplains	**Geometry:**Polygon **Average Number of Points:**0 **Has M:**No **Has Z:**No **Grid Size:**1000
Dataset Type	FeatureClass	
FeatureType	Simple	

Field Name	Alias	Type	Precn.	Scale	Length	Edit	Null	Req.	Domain Fixed
OBJECTID	OBJECTID	OID	0	0	4	No	No	Yes	No
SHAPE	SHAPE	Geometry	0	0	0	Yes	No	Yes	No
Context1	Context 1	String	0	0	255	Yes	Yes	No	No
Context2	Context 2	String	0	0	255	Yes	Yes	No	No
Context3	Context 3	String	0	0	255	Yes	Yes	No	No

Subtype Name	Default Value	Domain
(=0) [Default]		

Index Name	Ascending	Unique	Fields
FDO_OBJECTID	Yes	Yes	OBJECTID
SHAPE_INDEX	Yes	Yes	SHAPE

pyLandUses0

Alias	Land Uses	**Geometry:**Polygon **Average Number of Points:**0 **Has M:**No **Has Z:**No **Grid Size:**1000
Dataset Type	FeatureClass	
FeatureType	Simple	

Field Name	Alias	Type	Precn.	Scale	Length	Edit	Null	Req.	Domain Fixed
OBJECTID	OBJECTID	OID	0	0	4	No	No	Yes	No
SHAPE	SHAPE	Geometry	0	0	0	Yes	No	Yes	No
LandUseGroupID	Land-Use Group ID	Integer	0	0	4	Yes	No	No	No
LandUseGroup	Land-Use Group	String	0	0	255	Yes	Yes	No	No
LandUseTypeID	Land-Use Type ID	Integer	0	0	4	Yes	No	No	No
LandUseType	Land-Use Type	String	0	0	255	Yes	No	No	No
IsDevelopable	Can Be Developed	Small Integer	0	0	2	Yes	Yes	No	No
ResidentialFloorArea	Residential Floor Area (sqft)	Double	0	0	4	Yes	No	No	No
CommercialFloorArea	Employment Floor Area (sqft)	Double	0	0	4	Yes	No	No	No
TotalAssessedValue	Total Assessed Value ($)	Double	0	0	4	Yes	No	No	No
TSS	Total Suspended Solids in Runoff (g/L)	Double	0	0	8	Yes	No	No	No
Phosphates	Phosphates in Runoff (mg/L)	Double	0	0	8	Yes	No	No	No
Nitrogen	Nitrogen in Runoff (mg/L)	Double	0	0	8	Yes	No	No	No
AvgImpPercent	Average Percent Impervious	Double	0	0	8	Yes	No	No	No
PerviousCoverTypeID	Pervious Cover Type ID	Integer	0	0	4	Yes	No	No	No
LandscapeTypeWaterUseFactor	Landscape Type Water Use Factor	Double	0	0	8	Yes	No	No	No
RequiredParkingSpaces	Required Parking Spaces	Double	0	0	8	Yes	No	No	No
DwellingGroupID	Dwelling Group ID	Integer	0	0	4	Yes	No	No	No
DwellingGroup	Dwelling Group	String	0	0	255	Yes	No	No	No
ResidentialPopulation	Residential Population	Double	0	0	8	Yes	No	No	No
DwellingUnitCount	Dwelling Unit Count	Double	0	0	8	Yes	No	No	No
DwellingUnitCountOO	Owner-Occupied Dwelling Unit Count	Double	0	0	8	Yes	No	No	No
StudentCount	Student Count	Double	0	0	8	Yes	No	No	No
WorkerCount	Worker Count	Double	0	0	8	Yes	No	No	No
AverageHouseholdIncome	Average Household Income ($/yr)	Double	0	0	8	Yes	No	No	No
IndoorWaterUse	Indoor Water Use (gal/day)	Double	0	0	8	Yes	No	No	No
BusinessGroupID	Employment Group ID	Integer	0	0	4	Yes	No	No	No
BusinessGroup	Employment Group	String	0	0	255	Yes	No	No	No
EmploymentCount	Employment Count	Double	0	0	8	Yes	No	No	No
Context1	Context 1	String	0	0	255	Yes	Yes	No	No
Context2	Context 2	String	0	0	255	Yes	Yes	No	No
Context3	Context 3	String	0	0	255	Yes	Yes	No	No
Context4	Context 4	String	0	0	255	Yes	Yes	No	No
Context5	Context 5	String	0	0	255	Yes	Yes	No	No
Context6	Feature Notes	String	0	0	255	Yes	Yes	No	No
IND_APPLICABLE	Indicator Score Applicable	Small Integer	0	0	2	Yes	No	No	No
IND_DirtyLUT	Land-Use Topology Dirty	Small Integer	0	0	2	Yes	No	No	No
CaseBdSubAreaID	CaseBd SubArea OBJECTID	Integer	0	0	4	Yes	No	No	No
ExternalID	External Land Use ID	Integer	0	0	4	Yes	No	No	No

Subtype Name	Default Value	Domain
(=0) [Default]		
LandUseGroupID	0	LandUseGroupID_Dup_Custom
LandUseGroup	Vacant	-
LandUseTypeID	1	IDs_Dup_Dflt
LandUseType	Custom	-
IsDevelopable	1	Bool_Dup_Dflt
ResidentialFloorArea	0	CountD_GeomRatio_Sum

CommercialFloorArea	0	CountD_GeomRatio_Sum
TotalAssessedValue	0	CountD_GeomRatio_Sum
TSS	0	AvgPer_Dup_WAvg
Phosphates	0	AvgPer_Dup_WAvg
Nitrogen	0	AvgPer_Dup_WAvg
AvgImpPercent	0	Pct_Dup_WAvg
PerviousCoverTypeID	2	IDs_Dup_Dflt
LandscapeTypeWaterUseFactor	1	AvgPer_Dup_WAvg
RequiredParkingSpaces	0	AvgPer_Dup_WAvg
DwellingGroupID	0	IDs_Dup_Dflt
DwellingGroup	N/A	-
ResidentialPopulation	0	CountD_GeomRatio_Sum
DwellingUnitCount	0	CountD_GeomRatio_Sum
DwellingUnitCountOO	0	CountD_GeomRatio_Sum
StudentCount	0	CountD_GeomRatio_Sum
WorkerCount	0	CountD_GeomRatio_Sum
AverageHouseholdIncome	0	AvgPer_Dup_WAvg
IndoorWaterUse	0	AvgPer_Dup_WAvg
BusinessGroupID	0	IDs_Dup_Dflt
BusinessGroup	N/A	-
EmploymentCount	0	CountD_GeomRatio_Sum
IND_APPLICABLE	0	Bool_Dup_Dflt
IND_DirtyLUT	-1	Bool_Dup_Dflt
CaseBdSubAreaID	0	IDs_Dup_Dflt
ExternalID	0	IDs_Dup_Dflt

Index Name	Ascending	Unique	Fields
FDO_OBJECTID	Yes	Yes	OBJECTID
SHAPE_INDEX	Yes	Yes	SHAPE

pyLandUsesSupplementary0

Alias	Supplementary Land Uses	**Geometry:**Polygon **Average Number of Points:**0 **Has M:**No **Has Z:**No **Grid Size:**1000
Dataset Type	FeatureClass	
FeatureType	Simple	

Field Name	Alias	Type	Precn.	Scale	Length	Edit	Null	Req.	Domain Fixed
OBJECTID	OBJECTID	OID	0	0	4	No	No	Yes	No
SHAPE	SHAPE	Geometry	0	0	0	Yes	No	Yes	No
LandUseGroupID	Land-Use Group (subtype)	Integer	0	0	4	Yes	No	No	No
Context1	Context 1	String	0	0	255	Yes	Yes	No	No
Context2	Context 2	String	0	0	255	Yes	Yes	No	No
Context3	Context 3	String	0	0	255	Yes	Yes	No	No
IND_6	Parking Lot Size	Double	0	0	8	Yes	No	No	No
IND_APPLICABLE	Indicator Score Applicable	Small Integer	0	0	2	Yes	No	No	No

Subtype Name	Default Value	Domain
Vacant (LandUseGroupID=0) [Default]		
IND_6	-999	IndScore_Dflt_Dflt
IND_APPLICABLE	0	Bool_Dup_Dflt
Open Space (LandUseGroupID=11)		
IND_6	-999	IndScore_Dflt_Dflt
IND_APPLICABLE	0	Bool_Dup_Dflt
Park (LandUseGroupID=12)		
IND_6	-999	IndScore_Dflt_Dflt
IND_APPLICABLE	0	Bool_Dup_Dflt
Parking (LandUseGroupID=13)		
IND_6	-999	IndScore_Dflt_Dflt
IND_APPLICABLE	0	Bool_Dup_Dflt

Index Name	Ascending	Unique	Fields
FDO_OBJECTID	Yes	Yes	OBJECTID
SHAPE_INDEX	Yes	Yes	SHAPE

pyOpenSpaceGrid0

Alias	Open Space Grid	**Geometry:**Polygon **Average Number of Points:**0 **Has M:**No **Has Z:**No **Grid Size:**1000
Dataset Type	FeatureClass	
FeatureType	Simple	

Field Name	Alias	Type	Precn.	Scale	Length	Edit	Null	Req.	Domain Fixed
OBJECTID	OBJECTID	OID	0	0	4	No	No	Yes	No
SHAPE	SHAPE	Geometry	0	0	0	Yes	No	Yes	No
GRID_ID	GRID_ID	String	0	0	50	Yes	Yes	No	No
COL_NUM	COL_NUM	Integer	0	0	4	Yes	Yes	No	No
ROW_NUM	ROW_NUM	Integer	0	0	4	Yes	Yes	No	No
LandUseGroupID	LandUseGroupID	Integer	0	0	4	Yes	Yes	No	No
IND_35	Open Space Connectivity	Double	0	0	8	Yes	No	No	No
IND_APPLICABLE	Indicator Score Applicable	Small Integer	0	0	2	Yes	No	No	No
CaseBdSubAreaID	CaseBd SubArea OBJECTID	Integer	0	0	4	Yes	No	No	No

Subtype Name	Default Value	Domain
(=0) [Default]		
IND_35	-999	IndScore_Dflt_Dflt
IND_APPLICABLE	-1	Bool_Dup_Dflt
CaseBdSubAreaID	0	IDs_Dup_Dflt

Index Name	Ascending	Unique	Fields
FDO_OBJECTID	Yes	Yes	OBJECTID
SHAPE_INDEX	Yes	Yes	SHAPE

pyPlannedDesignations0

Alias	Planned Land-Use Designations	**Geometry:**Polygon **Average Number of Points:**0 **Has M:**No **Has Z:**No **Grid Size:**1000
Dataset Type	FeatureClass	
FeatureType	Simple	

Field Name	Alias	Type	Precn.	Scale	Length	Edit	Null	Req.	Domain Fixed
OBJECTID	OBJECTID	OID	0	0	4	No	No	Yes	No
SHAPE	SHAPE	Geometry	0	0	0	Yes	No	Yes	No
EmploymentConformance	Employment Conformance	Small Integer	0	0	2	Yes	No	No	No
ResidentialConformance	Residential Conformance	Small Integer	0	0	2	Yes	No	No	No
LandUseTypeID	Land-Use Type ID	Integer	0	0	4	Yes	No	No	No
LandUseType	Land-Use Type	String	0	0	255	Yes	No	No	No
Context1	Context 1	String	0	0	255	Yes	Yes	No	No
Context2	Context 2	String	0	0	255	Yes	Yes	No	No
Context3	Context 3	String	0	0	255	Yes	Yes	No	No

Subtype Name	Default Value	Domain
(=0) [Default]		
EmploymentConformance	1	Bool_Dup_Dflt
ResidentialConformance	1	Bool_Dup_Dflt
LandUseTypeID	1	IDs_Dup_Dflt

Index Name	Ascending	Unique	Fields
FDO_OBJECTID	Yes	Yes	OBJECTID
SHAPE_INDEX	Yes	Yes	SHAPE

pySchoolAreas0

Alias	School Attendance Areas	**Geometry:**Polygon **Average Number of Points:**0 **Has M:**No **Has Z:**No **Grid Size:**1000
Dataset Type	FeatureClass	
FeatureType	Simple	

Field Name	Alias	Type	Precn.	Scale	Length	Edit	Null	Req.	Domain Fixed
OBJECTID	OBJECTID	OID	0	0	4	No	No	Yes	No
SHAPE	SHAPE	Geometry	0	0	0	Yes	No	Yes	No
EnrollmentCapacity	Enrollment Capacity	Integer	0	0	4	Yes	No	No	No
Context1	Context 1	String	0	0	255	Yes	Yes	No	No
Context2	Context 2	String	0	0	255	Yes	Yes	No	No
Context3	Context 3	String	0	0	255	Yes	Yes	No	No
IND_APPLICABLE	Indicator Score Applicable	Small Integer	0	0	2	Yes	No	No	No

Subtype Name	Default Value	Domain
(=0) [Default]		
EnrollmentCapacity	0	Count_GeomRatio_Sum
IND_APPLICABLE	0	Bool_Dup_Dflt

Index Name	Ascending	Unique	Fields
FDO_OBJECTID	Yes	Yes	OBJECTID
SHAPE_INDEX	Yes	Yes	SHAPE

pySlopes0

Alias	Slopes	**Geometry:**Polygon **Average Number of Points:**0 **Has M:**No **Has Z:**No **Grid Size:**1000
Dataset Type	FeatureClass	
FeatureType	Simple	

Field Name	Alias	Type	Precn.	Scale	Length	Edit	Null	Req.	Domain Fixed
OBJECTID	OBJECTID	OID	0	0	4	No	No	Yes	No
SHAPE	SHAPE	Geometry	0	0	0	Yes	No	Yes	No
SlopePercent	Slope Percent	Double	0	0	8	Yes	No	No	No
Context1	Context 1	String	0	0	255	Yes	Yes	No	No
Context2	Context 2	String	0	0	255	Yes	Yes	No	No
Context3	Context 3	String	0	0	255	Yes	Yes	No	No

Subtype Name	Default Value	Domain
(=0) [Default]		
SlopePercent	0	Pct_Dup_WAvg

Index Name	Ascending	Unique	Fields
FDO_OBJECTID	Yes	Yes	OBJECTID
SHAPE_INDEX	Yes	Yes	SHAPE

pySoils0

Alias	Hydrological Soils	**Geometry:**Polygon **Average Number of Points:**0 **Has M:**No **Has Z:**No **Grid Size:**1000
Dataset Type	FeatureClass	
FeatureType	Simple	

Field Name	Alias	Type	Precn.	Scale	Length	Edit	Null	Req.	Domain Fixed
OBJECTID	OBJECTID	OID	0	0	4	No	No	Yes	No
SHAPE	SHAPE	Geometry	0	0	0	Yes	No	Yes	No
HydrologicalGroup	Hydrological Group	String	0	0	255	Yes	No	No	No
TreatAsNonBuildable	Treat As Non-Buildable	Small Integer	0	0	2	Yes	No	No	No
Context1	Context 1	String	0	0	255	Yes	Yes	No	No
Context2	Context 2	String	0	0	255	Yes	Yes	No	No
Context3	Context 3	String	0	0	255	Yes	Yes	No	No

Subtype Name	Default Value	Domain
(=0) [Default]		
HydrologicalGroup	D	HydroGroup
TreatAsNonBuildable	0	Bool_Dup_Dflt

Index Name	Ascending	Unique	Fields
FDO_OBJECTID	Yes	Yes	OBJECTID
SHAPE_INDEX	Yes	Yes	SHAPE

pyStormwaterBMPs0

Alias	Stormwater Best Management Practices	**Geometry:**Polygon **Average Number of Points:**0 **Has M:**No **Has Z:**No **Grid Size:**1000
Dataset Type	FeatureClass	
FeatureType	Simple	

Field Name	Alias	Type	Precn.	Scale	Length	Edit	Null	Req.	Domain Fixed
OBJECTID	OBJECTID	OID	0	0	4	No	No	Yes	No
SHAPE	SHAPE	Geometry	0	0	0	Yes	No	Yes	No
TSSRemovalPct	TSS Removal (%)	Double	0	0	8	Yes	No	No	No
PhosphateRemovalPct	Phosphate Removal (%)	Double	0	0	8	Yes	No	No	No
NitrogenRemovalPct	Nitrogen Removal (%)	Double	0	0	8	Yes	No	No	No
Context1	Context 1	String	0	0	255	Yes	Yes	No	No
Context2	Context 2	String	0	0	255	Yes	Yes	No	No
Context3	Context 3	String	0	0	255	Yes	Yes	No	No

Subtype Name	Default Value	Domain
(=0) [Default]		
TSSRemovalPct	0	Pct_Dup_WAvg
PhosphateRemovalPct	0	Pct_Dup_WAvg
NitrogenRemovalPct	0	Pct_Dup_WAvg

Index Name	Ascending	Unique	Fields
FDO_OBJECTID	Yes	Yes	OBJECTID
SHAPE_INDEX	Yes	Yes	SHAPE

pyUseMixGrid0

Alias	Use Mix Grid	**Geometry:**Polygon **Average Number of Points:**0 **Has M:**No **Has Z:**No **Grid Size:**1000
Dataset Type	FeatureClass	
FeatureType	Simple	

Field Name	Alias	Type	Precn.	Scale	Length	Edit	Null	Req.	Domain Fixed
OBJECTID	OBJECTID	OID	0	0	4	No	No	Yes	No
SHAPE	SHAPE	Geometry	0	0	0	Yes	No	Yes	No
GRID_ID	GRID_ID	String	0	0	50	Yes	Yes	No	No
COL_NUM	COL_NUM	Integer	0	0	4	Yes	Yes	No	No
ROW_NUM	ROW_NUM	Integer	0	0	4	Yes	Yes	No	No
LandUseGroupID	LandUseGroupID	Integer	0	0	4	Yes	Yes	No	No
IND_7	Use Mix	Double	0	0	8	Yes	No	No	No
IND_APPLICABLE	Indicator Score Applicable	Small Integer	0	0	2	Yes	No	No	No
CaseBdSubAreaID	CaseBd SubArea OBJECTID	Integer	0	0	4	Yes	No	No	No

Subtype Name	Default Value	Domain
(=0) [Default]		
IND_7	-999	IndScore_Dflt_Dflt
IND_APPLICABLE	-1	Bool_Dup_Dflt
CaseBdSubAreaID	0	IDs_Dup_Dflt

Index Name	Ascending	Unique	Fields
FDO_OBJECTID	Yes	Yes	OBJECTID
SHAPE_INDEX	Yes	Yes	SHAPE

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Planning Support System
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Initial Training Exercise: Evaluate a Development Proposal

April 2007

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INTRODUCTION

Evaluating a Development Proposal with PlanBuilder

This is an initial training exercise for new users of INDEX PlanBuilder to familiarize them with the tool by applying it to a typical development proposal review.

The exercise simulates the following sequence of events:

- When a development proposal is submitted to a community planning agency, the surrounding vicinity is characterized with benchmark or base case indicator scores that describe existing conditions without the proposal.

- The vicinity geography is modified to incorporate the proposed development, and the area is rescored with the same indicators to get scores that reflect the addition of the proposed development.

- Assuming the development review process allows opportunity for modifying proposals, the original development concept is modified in an attempt to improve its scores. The vicinity is rescored with the modified proposal, and results are compared to determine if outcomes have been improved.

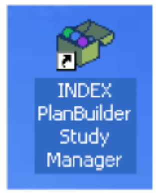
This is an initial exercise only, and new INDEX users must also complete Tutorials 1 through 3 in their entirety in order to gain a full understanding of INDEX operations and applications.

INDEX PlanBuilder supports all ArcGIS license types (ArcView, ArcEditor, ArcInfo). However ArcView users are limited in the kinds of indicators they can run, and therefore have reduced data requirements. This initial training exercise uses a run set that is supported by all ArcGIS license levels.

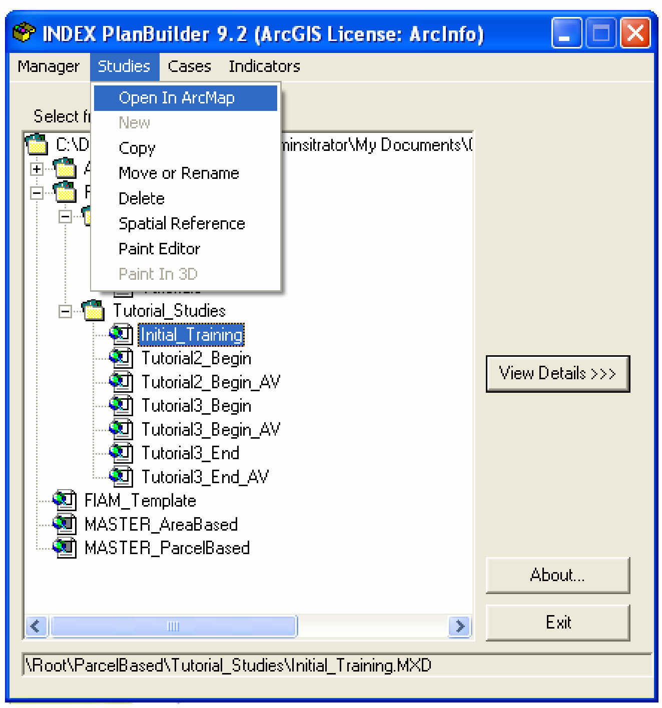
RETRIEVE VICNITY BENCHMARK SCORES

Open the Study

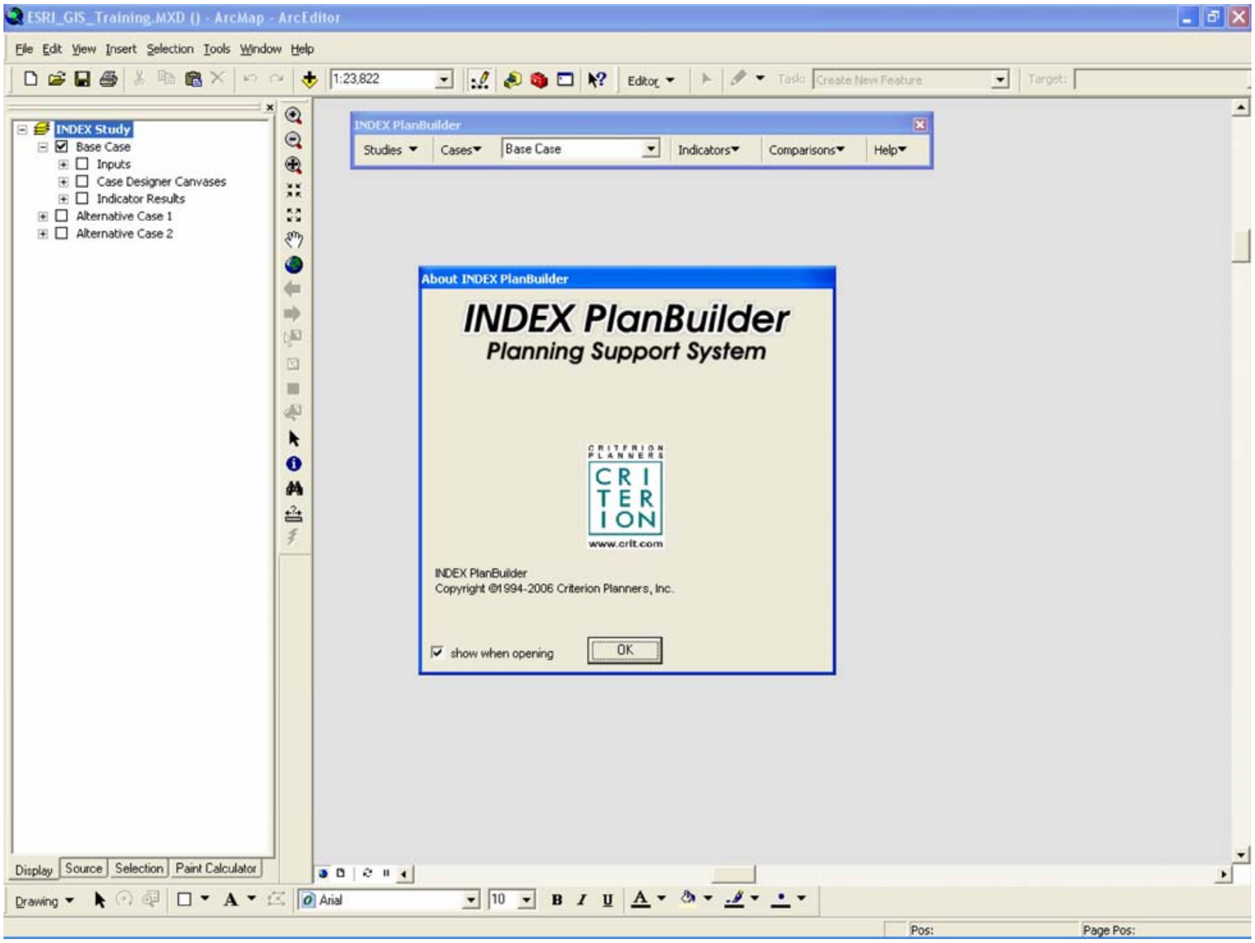
To access the INDEX Study, launch the Study Manager by double-clicking the Study Manager icon located on the desktop.



Expand the ParcelBased folder structure in the Study Manager window. Select the “Initial_Training” study and select the Open in ArcMap menu option:

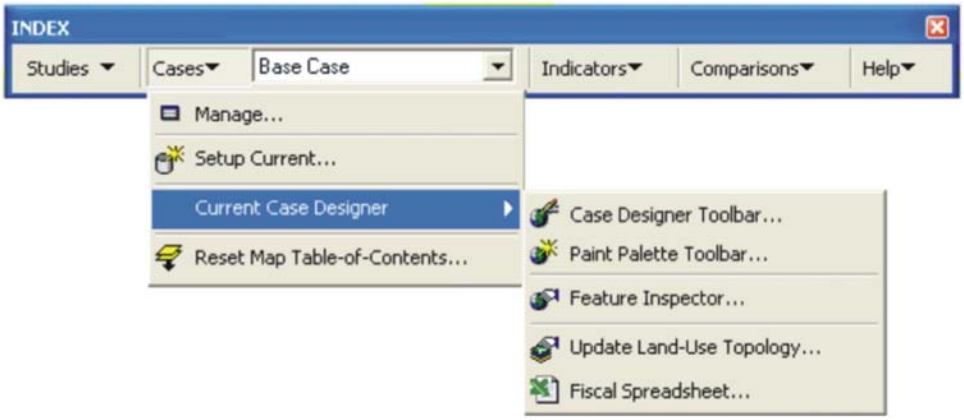


Opening the study launches an ArcMap session with the INDEX extension loaded:

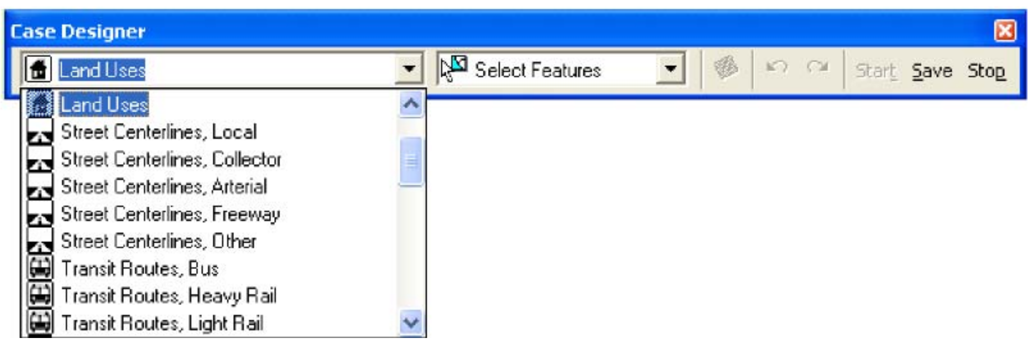


Explore the INDEX Design Targets (Vicinity Geography)

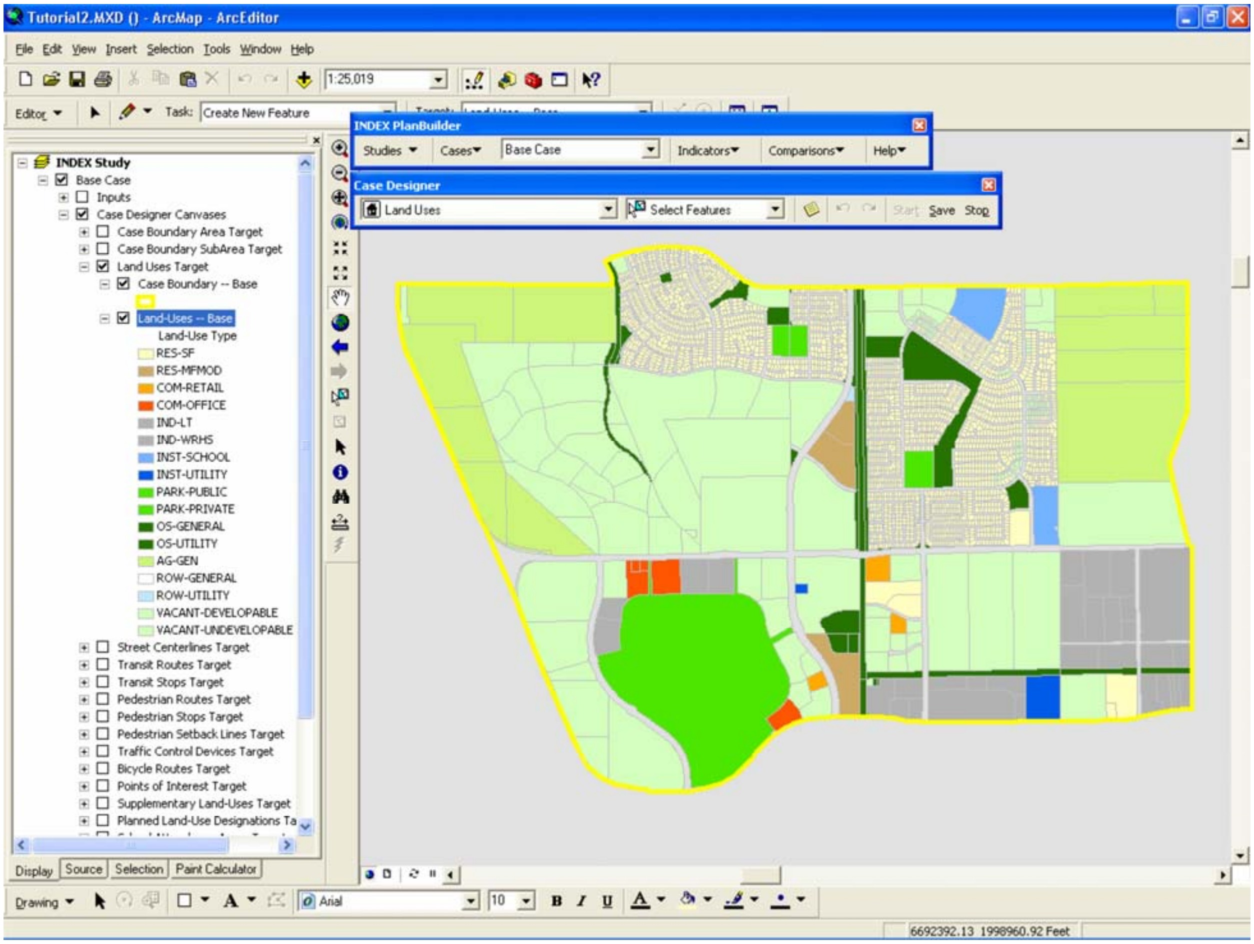
The INDEX Design Targets represent the vicinity geography used in each study. To view the design targets launch the Case Designer toolbar. Select the Cases menu on the INDEX toolbar and Current Case Designer option, and then select the Case Designer Toolbar option:



You will use the Case Designer toolbar to navigate to design targets (land-use, streets, bus routes, etc…) to perform editing tasks. Take a moment to explore the Design targets, beginning with Land Uses:



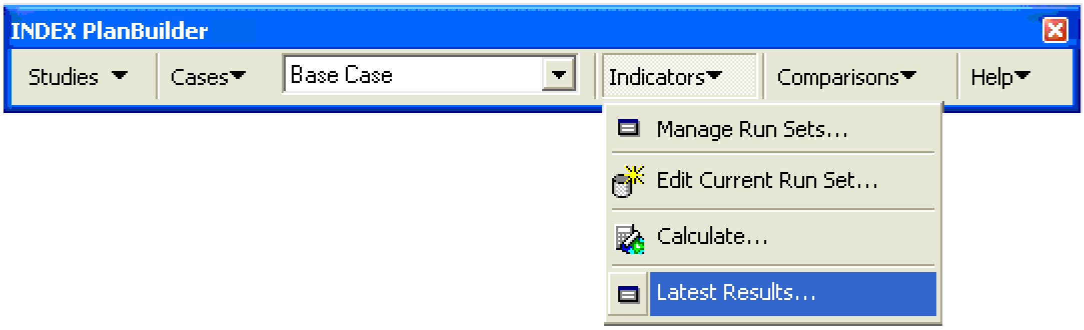
Selecting a design target will trigger a rearrangement of the INDEX table of contents (TOC) and the Land-Use Target Layer or “Canvas” will expand. Notice that existing land-uses are represented in the TOC:



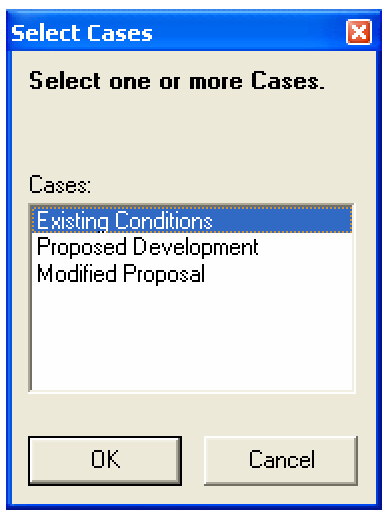
After exploring the Design Targets, end the edit session by selecting the Stop button on the Case Designer toolbar:

Launch the Indicator Results Table

Select the Latest Results option on the Indicators menu:



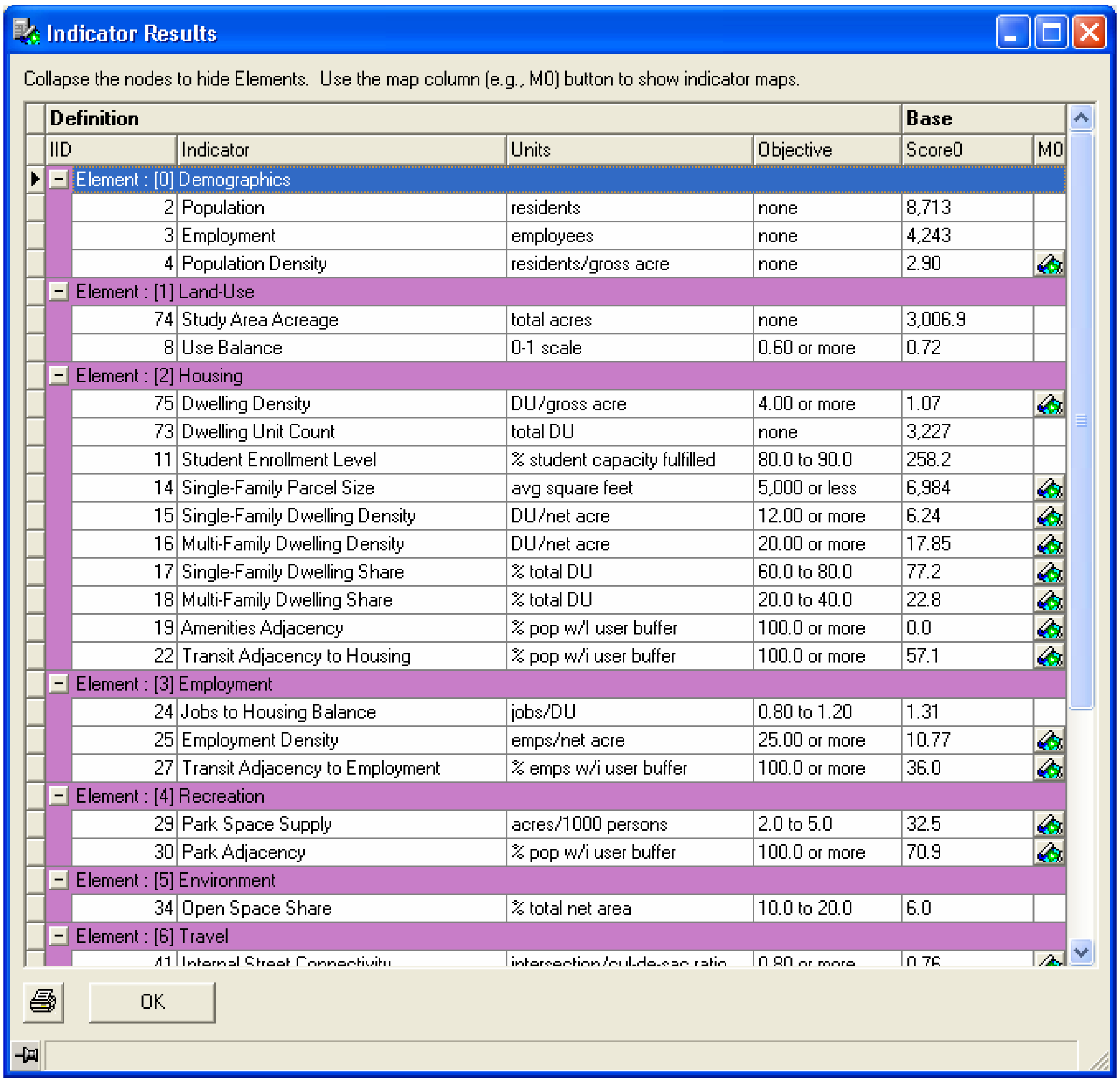
Select Existing Conditions from the Select Cases dialog:



Indicator Results

Indicator scores should be interpreted in the context of existing conditions and adopted goals or applicable policies. A key INDEX user document is the Indicator Dictionary that defines what is included in each indicator and how it is calculated. Users will need to gain experience in interpreting scores and changes in scores between studies and cases, in particular the direction of change in scores (numerically increasing or decreasing) and the magnitude of change in scores (percent difference).

Scroll through the indicator results:

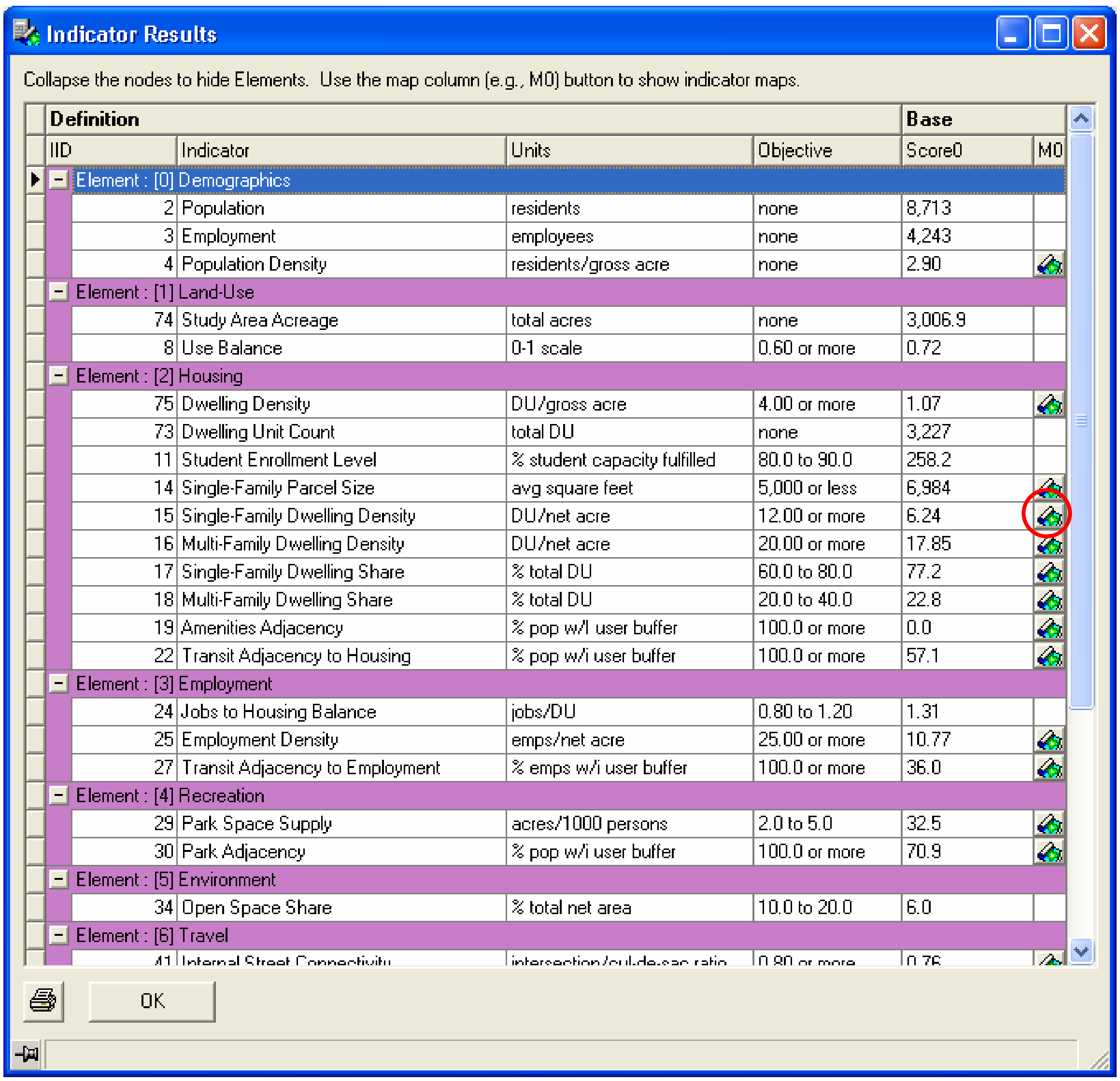


Definition				Base	
IID	Indicator	Units	Objective	Score0	M0
Element : [0] Demographics					
2	Population	residents	none	8,713	
3	Employment	employees	none	4,243	
4	Population Density	residents/gross acre	none	2.90	
Element : [1] Land-Use					
74	Study Area Acreage	total acres	none	3,006.9	
8	Use Balance	0-1 scale	0.60 or more	0.72	
Element : [2] Housing					
75	Dwelling Density	DU/gross acre	4.00 or more	1.07	
73	Dwelling Unit Count	total DU	none	3,227	
11	Student Enrollment Level	% student capacity fulfilled	80.0 to 90.0	258.2	
14	Single-Family Parcel Size	avg square feet	5,000 or less	6,984	
15	Single-Family Dwelling Density	DU/net acre	12.00 or more	6.24	
16	Multi-Family Dwelling Density	DU/net acre	20.00 or more	17.85	
17	Single-Family Dwelling Share	% total DU	60.0 to 80.0	77.2	
18	Multi-Family Dwelling Share	% total DU	20.0 to 40.0	22.8	
19	Amenities Adjacency	% pop w/I user buffer	100.0 or more	0.0	
22	Transit Adjacency to Housing	% pop w/i user buffer	100.0 or more	57.1	
Element : [3] Employment					
24	Jobs to Housing Balance	jobs/DU	0.80 to 1.20	1.31	
25	Employment Density	emps/net acre	25.00 or more	10.77	
27	Transit Adjacency to Employment	% emps w/i user buffer	100.0 or more	36.0	
Element : [4] Recreation					
29	Park Space Supply	acres/1000 persons	2.0 to 5.0	32.5	
30	Park Adjacency	% pop w/i user buffer	100.0 or more	70.9	
Element : [5] Environment					
34	Open Space Share	% total net area	10.0 to 20.0	6.0	
Element : [6] Travel					
41	Internal Street Connectivity	intersection/cul-de-sac ratio	0.80 or more	0.76	

Indicator Maps

Maps are automatically created for indicators with the map icon displayed in the column next to the indicator scores. Indicator maps are spatial expressions of conditions that produced scores and can be used as spatial diagnostic tools that reveal the locations of an area's strengths and weaknesses, and can be helpful in optimizing new land development design or correcting problems during redevelopment.

To view an indicator map, single-click the Map Output icon in the M0 field (M1 for case 1, etc.):

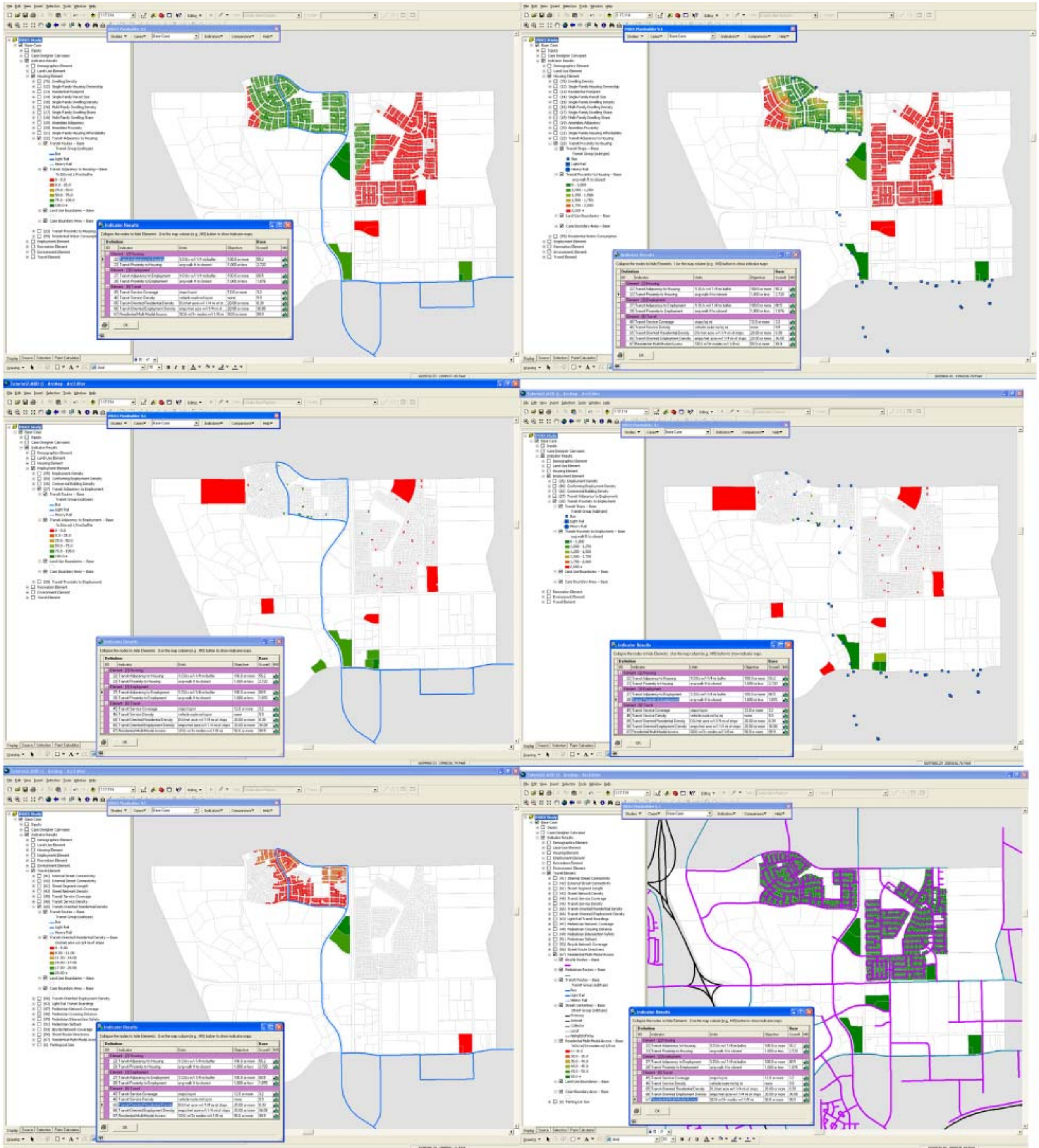

Indicator Results

Collapse the nodes to hide Elements. Use the map column (e.g., M0) button to show indicator maps.

Definition				Base	
IID	Indicator	Units	Objective	Score0	M0
Element : [0] Demographics					
2	Population	residents	none	8,713	
3	Employment	employees	none	4,243	
4	Population Density	residents/gross acre	none	2.90	
Element : [1] Land-Use					
74	Study Area Acreage	total acres	none	3,006.9	
8	Use Balance	0-1 scale	0.60 or more	0.72	
Element : [2] Housing					
75	Dwelling Density	DU/gross acre	4.00 or more	1.07	
73	Dwelling Unit Count	total DU	none	3,227	
11	Student Enrollment Level	% student capacity fulfilled	80.0 to 90.0	258.2	
14	Single-Family Parcel Size	avg square feet	5,000 or less	6,984	
15	Single-Family Dwelling Density	DU/net acre	12.00 or more	6.24	
16	Multi-Family Dwelling Density	DU/net acre	20.00 or more	17.85	
17	Single-Family Dwelling Share	% total DU	60.0 to 80.0	77.2	
18	Multi-Family Dwelling Share	% total DU	20.0 to 40.0	22.8	
19	Amenities Adjacency	% pop w/I user buffer	100.0 or more	0.0	
22	Transit Adjacency to Housing	% pop w/i user buffer	100.0 or more	57.1	
Element : [3] Employment					
24	Jobs to Housing Balance	jobs/DU	0.80 to 1.20	1.31	
25	Employment Density	emps/net acre	25.00 or more	10.77	
27	Transit Adjacency to Employment	% emps w/i user buffer	100.0 or more	36.0	
Element : [4] Recreation					
29	Park Space Supply	acres/1000 persons	2.0 to 5.0	32.5	
30	Park Adjacency	% pop w/i user buffer	100.0 or more	70.9	
Element : [5] Environment					
34	Open Space Share	% total net area	10.0 to 20.0	6.0	
Element : [6] Travel					
41	Internal Street Connectivity	intersection/cul-de-sac ratio	0.80 or more	0.76	

OK

Scroll through the Indicator Results table and become familiar with the indicator map output:



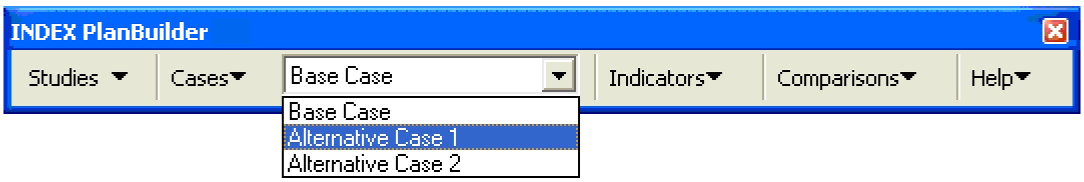
SELECT OBJECTIVES AND RUN INDICATORS

An important step in applying INDEX is selecting the most relevant indicators to measure proposed development, and setting objectives for those indicator measurements so that proposal outcomes can be judged by their degree of objective achievement.

Activate the Development Proposal Scenario

An alternative scenario containing a proposed development was created by making a copy of the existing conditions (Base Case) and integrating the proposed development's physical design into the vicinity geography.

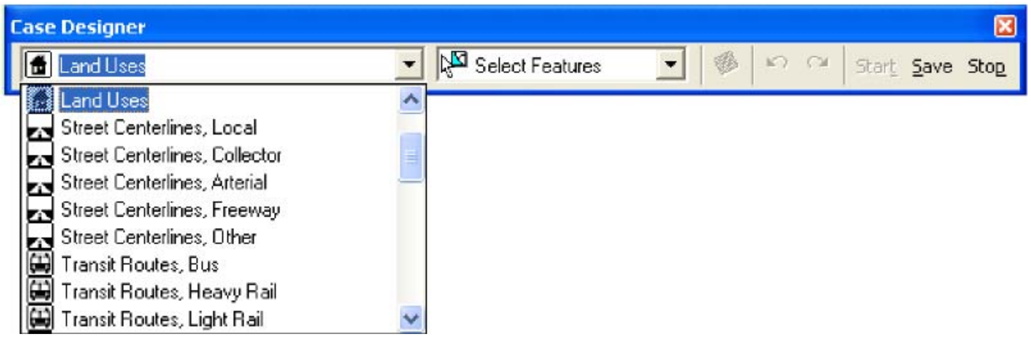
Activate the development proposal scenario by selecting Alternative Case 1 from the INDEX toolbar:



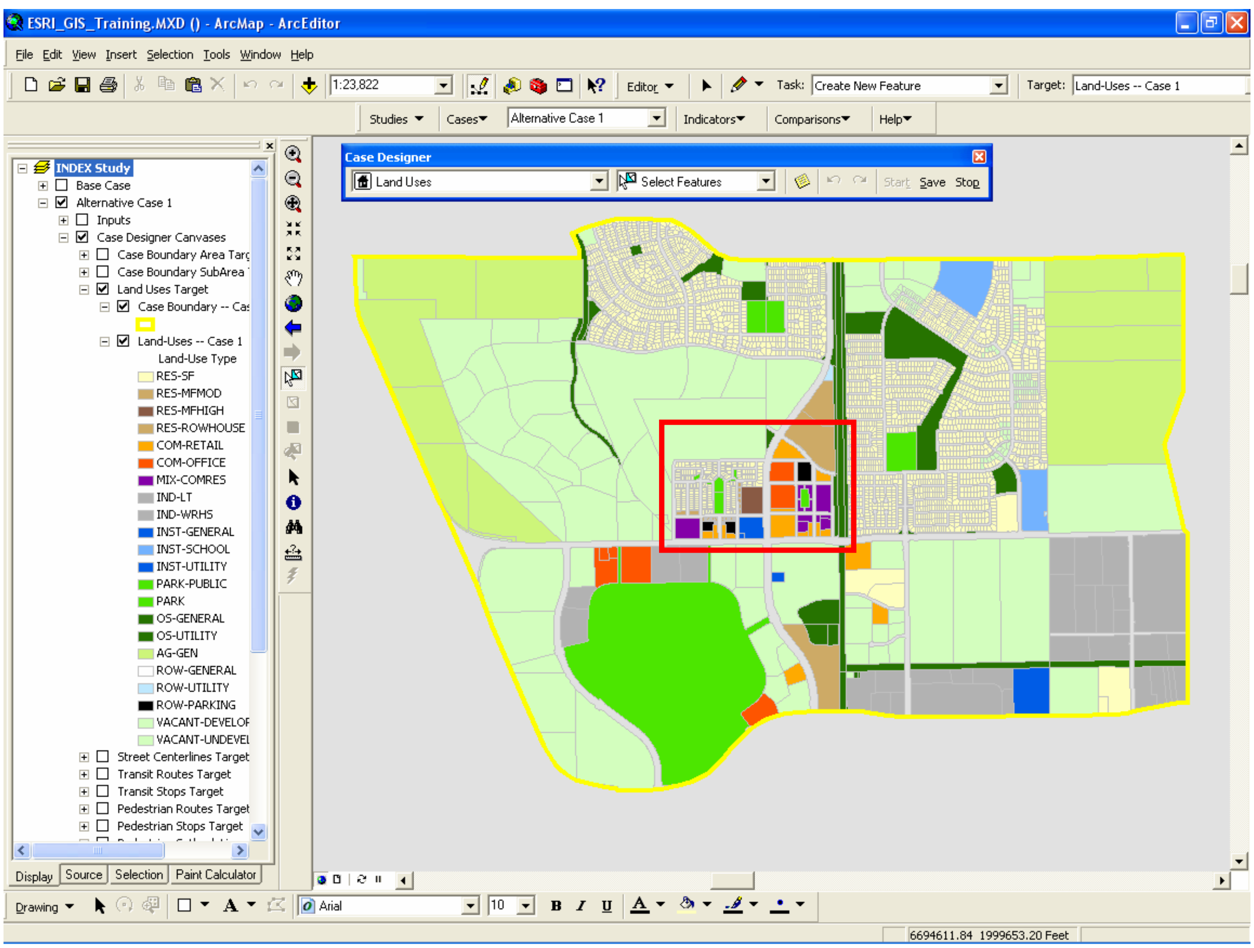
Explore the Development Proposal Features

Re-launch the Case Designer toolbar if it is closed or reactivate the Case Designer toolbar by selecting the Start button:

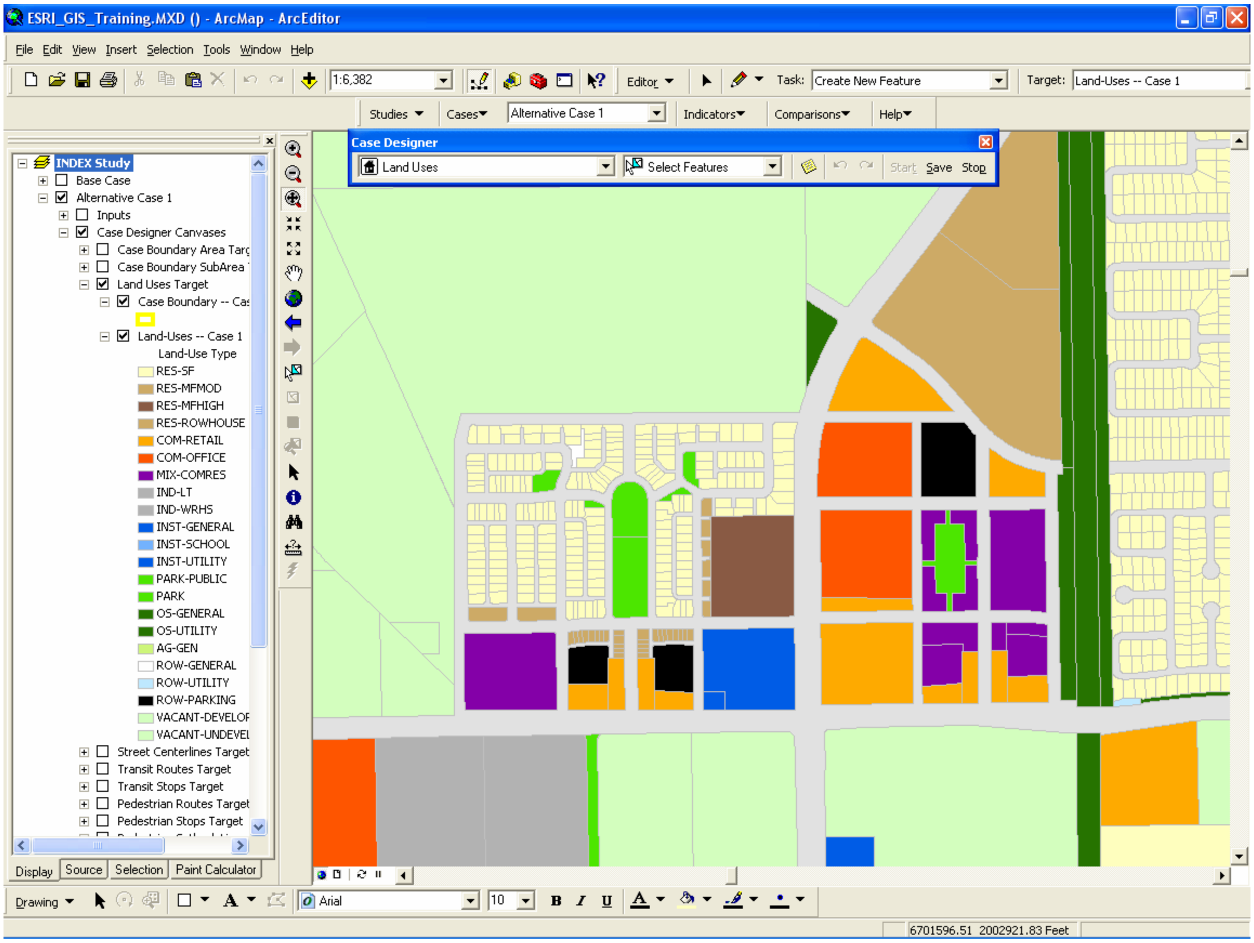
Select Land-Uses from Design Target pull down list:



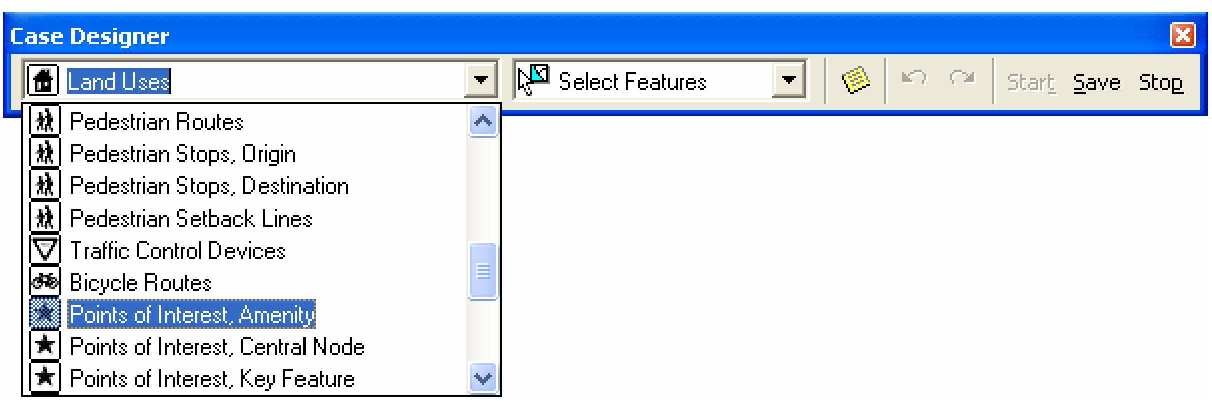
The proposed development is located near the center of the study area:



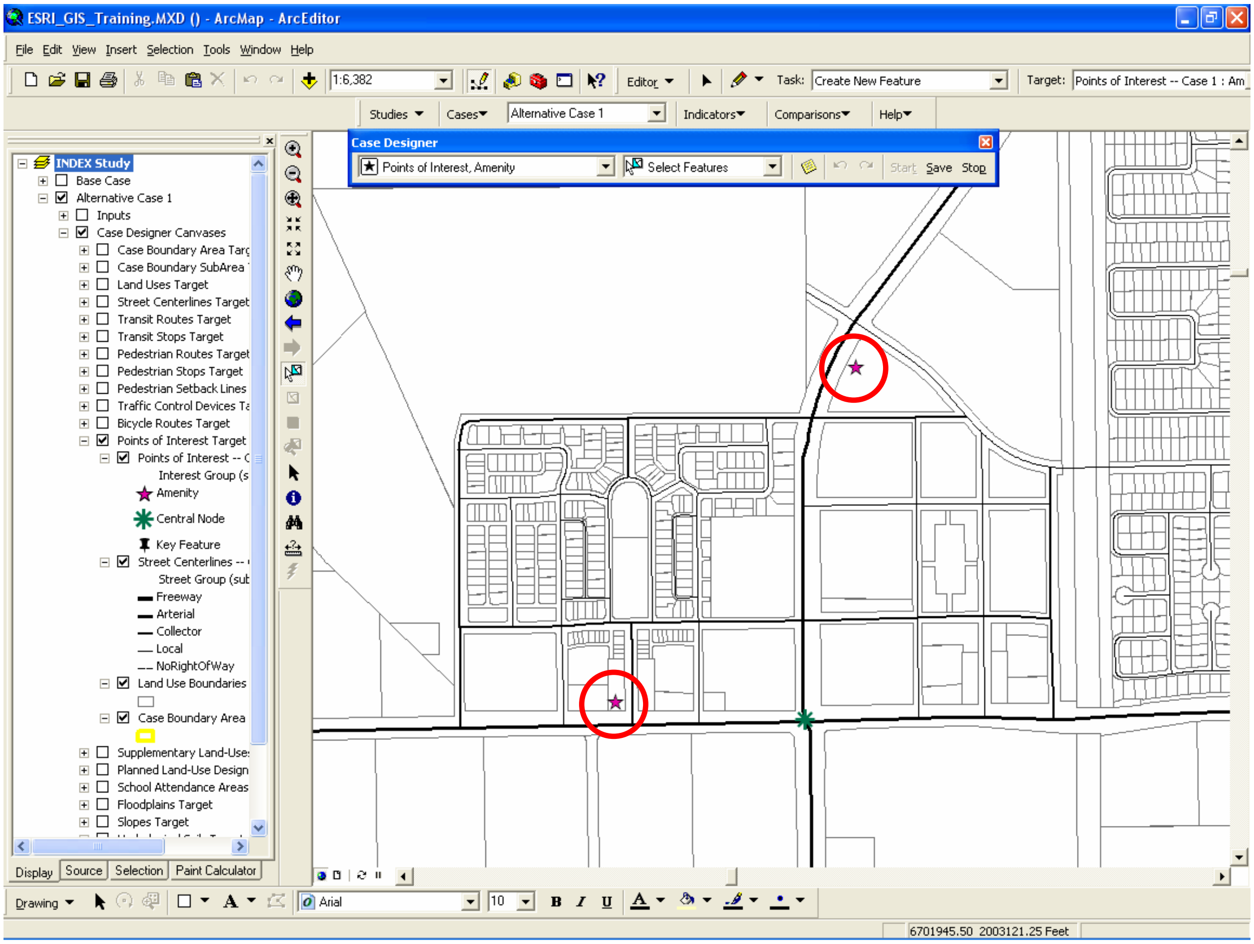
Zoom into the proposed development. The proposed land-use types have been added to the table of contents:



Plans for a grocery and convenient store were included in the proposal. Select Points of Interest, Amenity from the Case Designer pull down list to view their locations:



The amenity locations are shown below:



End the edit session by selecting the Stop button on the Case Designer toolbar:

Setting Indicator Objectives

To determine if indicator scores are favorable or unfavorable according to local norms and whether cases achieve local goals, users may set objectives for each indicator according to the desired direction of indicator score movement, and thresholds of score acceptability. For example, the objective for walk distance to parks would be a decrease in distance since shorter walks would be positive. The threshold for a desirable walk distance might therefore be set for anything less than 1,000 feet. To further help stakeholders evaluate and rank multiple cases, weights of importance can also be assigned to indicators. These and the score ratings enable the calculation of a single overall weighted score for a given case (see Figure 4 in the Getting Started Guide).

This rating and weighting (RAW) procedure includes the following general steps:

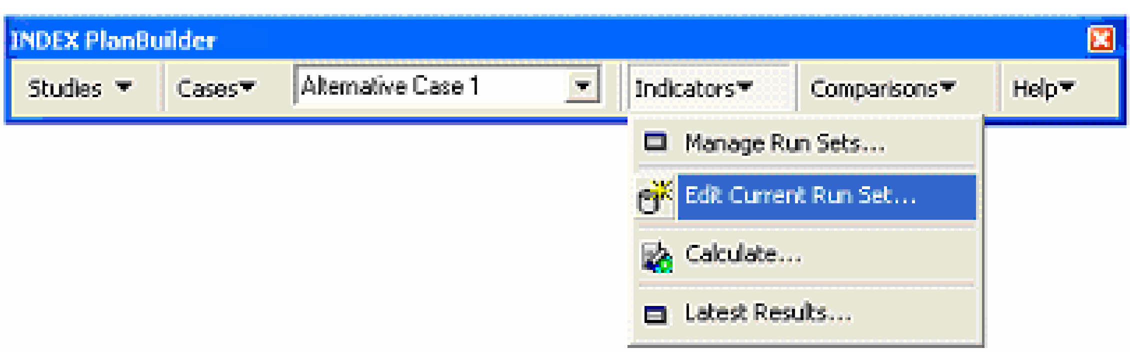
1. *Rating.* These values describe levels of acceptability in indicator scores. The model uses these to convert actual indicator scores from their original units of measurement into a common zero-to-one rating scale.

2. *Weighting.* Stakeholders establish weights of importance for each indicator. The total weighting "budget" for all indicators is 100.

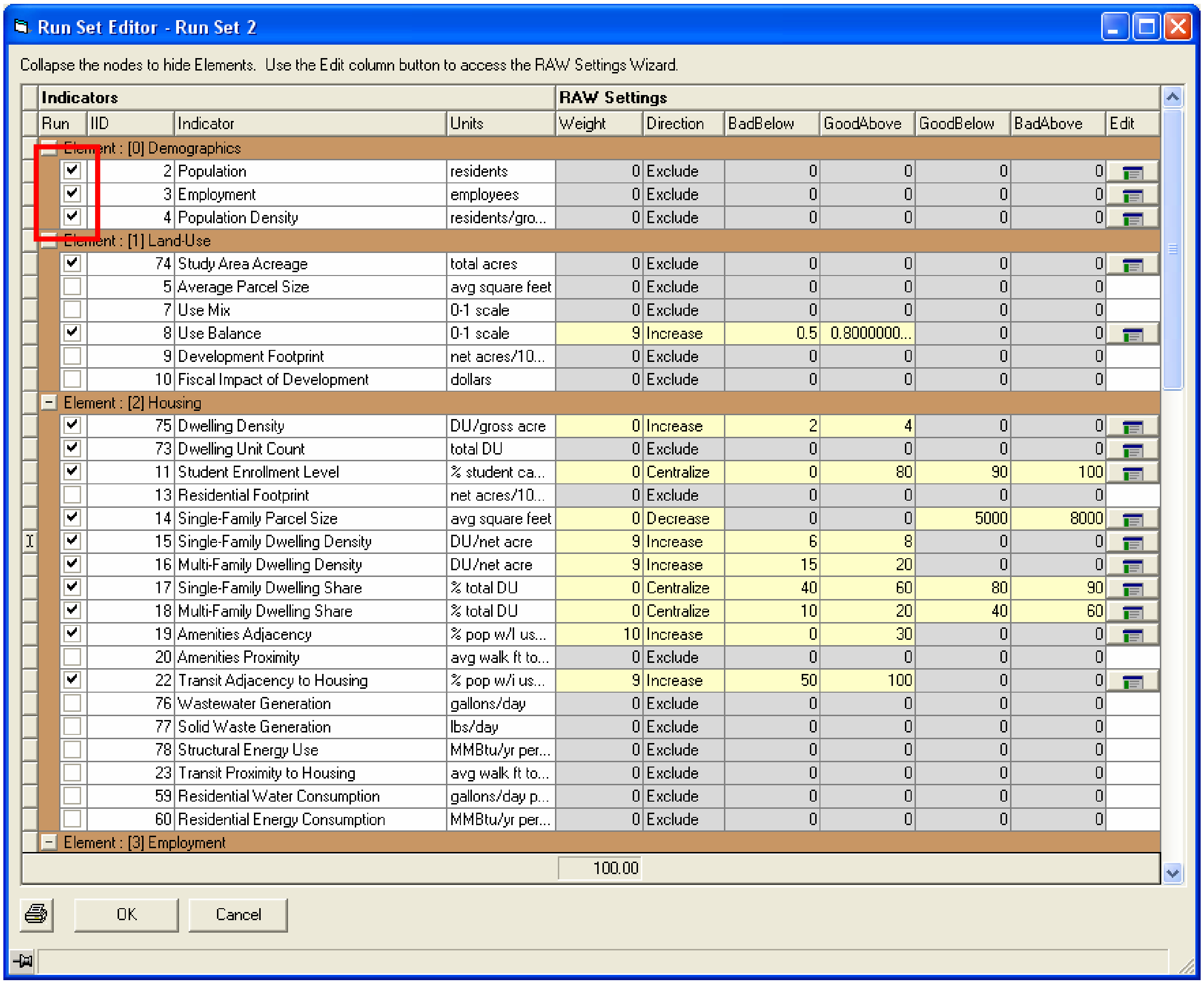
3. *Calculation.* To calculate RAW values, the weight is multiplied by the rating for each indicator score and these values are summed to obtain an overall score for each study of between zero and one hundred, i.e. percent of overall goal achievement.

Edit the Current Run Set

Open the Indicator Run Set by selecting the Edit Current Run Set option from the Indicators pull down menu on the INDEX toolbar:

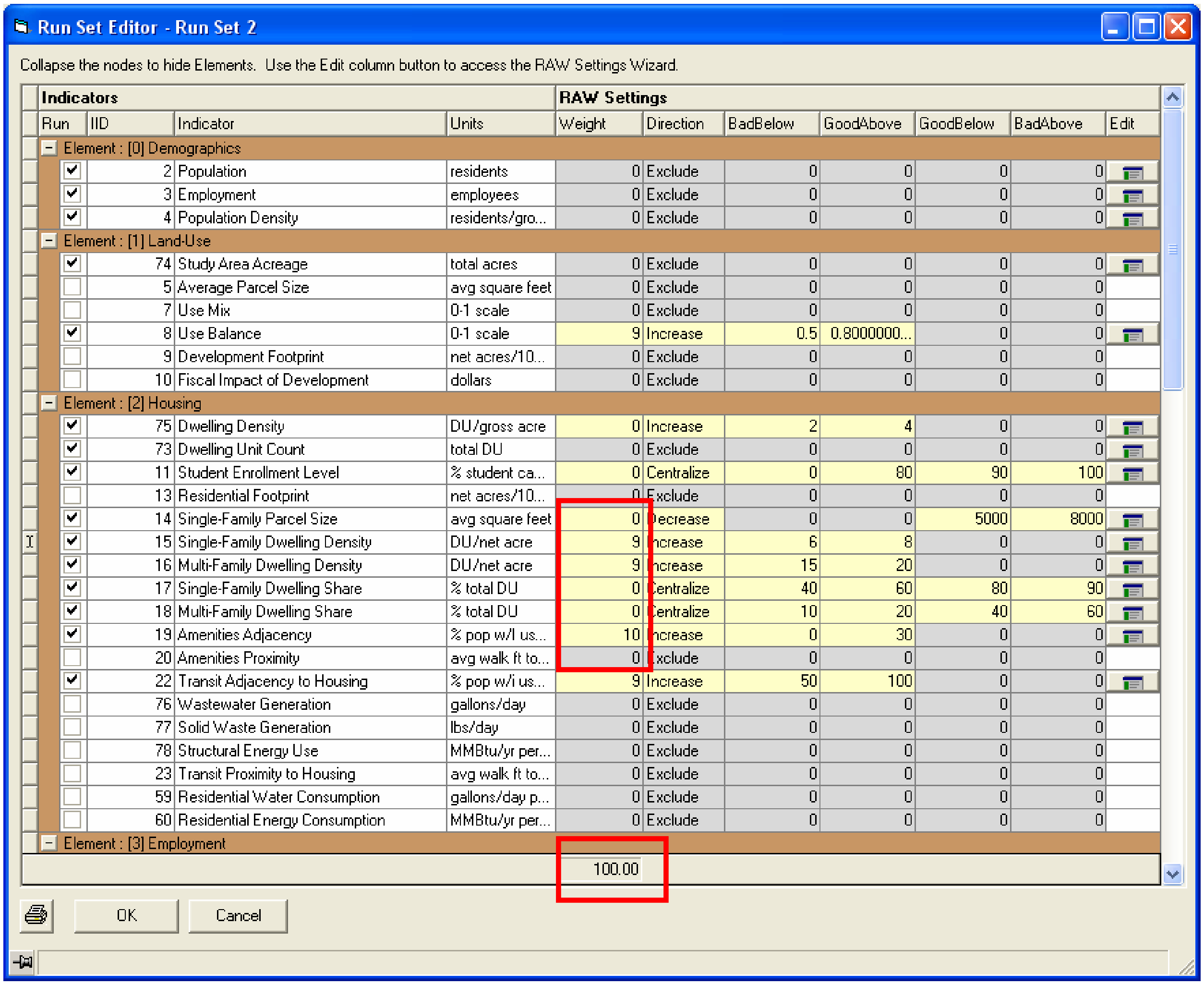


Scroll down the list of indicators in the Indicator Run Set table. Indicators can be turned on or off by clicking on the check box to the left of the indicator:



Indicators				RAW Settings						
Run	IID	Indicator	Units	Weight	Direction	BadBelow	GoodAbove	GoodBelow	BadAbove	Edit
Element : [0] Demographics										
☑	2	Population	residents	0	Exclude	0	0	0	0	
☑	3	Employment	employees	0	Exclude	0	0	0	0	
☑	4	Population Density	residents/gro...	0	Exclude	0	0	0	0	
Element : [1] Land-Use										
☑	74	Study Area Acreage	total acres	0	Exclude	0	0	0	0	
☐	5	Average Parcel Size	avg square feet	0	Exclude	0	0	0	0	
☐	7	Use Mix	0-1 scale	0	Exclude	0	0	0	0	
☑	8	Use Balance	0-1 scale	9	Increase	0.5	0.8000000...	0	0	
☐	9	Development Footprint	net acres/10...	0	Exclude	0	0	0	0	
☐	10	Fiscal Impact of Development	dollars	0	Exclude	0	0	0	0	
Element : [2] Housing										
☑	75	Dwelling Density	DU/gross acre	0	Increase	2	4	0	0	
☑	73	Dwelling Unit Count	total DU	0	Exclude	0	0	0	0	
☑	11	Student Enrollment Level	% student ca...	0	Centralize	0	80	90	100	
☐	13	Residential Footprint	net acres/10...	0	Exclude	0	0	0	0	
☑	14	Single-Family Parcel Size	avg square feet	0	Decrease	0	0	5000	8000	
☑	15	Single-Family Dwelling Density	DU/net acre	9	Increase	6	8	0	0	
☑	16	Multi-Family Dwelling Density	DU/net acre	9	Increase	15	20	0	0	
☑	17	Single-Family Dwelling Share	% total DU	0	Centralize	40	60	80	90	
☑	18	Multi-Family Dwelling Share	% total DU	0	Centralize	10	20	40	60	
☑	19	Amenities Adjacency	% pop w/I us...	10	Increase	0	30	0	0	
☐	20	Amenities Proximity	avg walk ft to...	0	Exclude	0	0	0	0	
☑	22	Transit Adjacency to Housing	% pop w/i us...	9	Increase	50	100	0	0	
☐	76	Wastewater Generation	gallons/day	0	Exclude	0	0	0	0	
☐	77	Solid Waste Generation	lbs/day	0	Exclude	0	0	0	0	
☐	78	Structural Energy Use	MMBtu/yr per...	0	Exclude	0	0	0	0	
☐	23	Transit Proximity to Housing	avg walk ft to...	0	Exclude	0	0	0	0	
☐	59	Residential Water Consumption	gallons/day p...	0	Exclude	0	0	0	0	
☐	60	Residential Energy Consumption	MMBtu/yr per...	0	Exclude	0	0	0	0	
Element : [3] Employment										
				100.00						

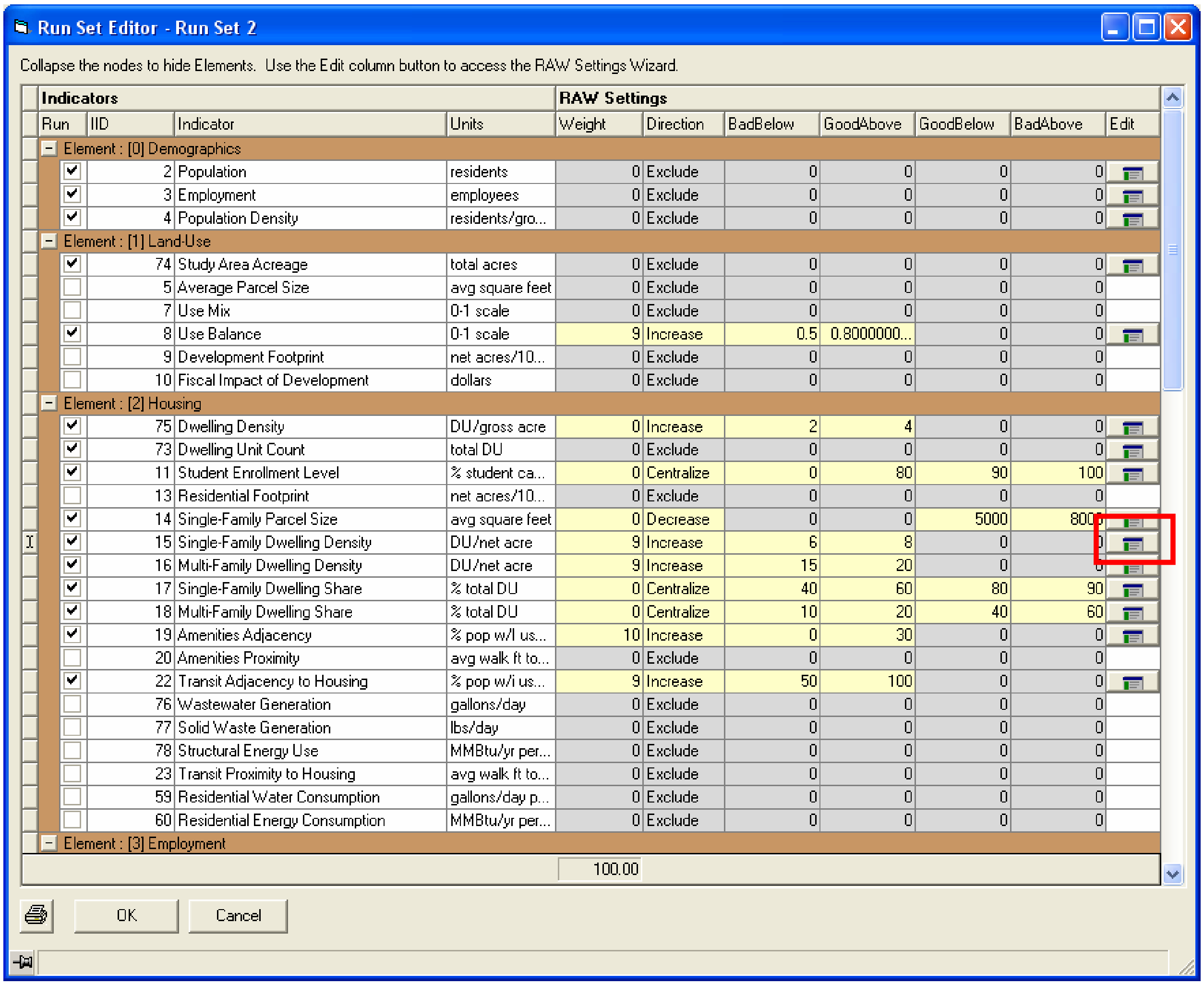
The weight of each indicator is shown in the Weight column. Not all of the activated indicators are given weight in the weighting budget. Those indicators without weights will still be calculated, but they will not be included in the Rating and Weighting case comparison.



Run	IID	Indicator	Units	Weight	Direction	BadBelow	GoodAbove	GoodBelow	BadAbove	Edit
Element : [0] Demographics										
✓	2	Population	residents	0	Exclude	0	0	0	0	
✓	3	Employment	employees	0	Exclude	0	0	0	0	
✓	4	Population Density	residents/gro...	0	Exclude	0	0	0	0	
Element : [1] Land-Use										
✓	74	Study Area Acreage	total acres	0	Exclude	0	0	0	0	
	5	Average Parcel Size	avg square feet	0	Exclude	0	0	0	0	
	7	Use Mix	0-1 scale	0	Exclude	0	0	0	0	
✓	8	Use Balance	0-1 scale	9	Increase	0.5	0.8000000...	0	0	
	9	Development Footprint	net acres/10...	0	Exclude	0	0	0	0	
	10	Fiscal Impact of Development	dollars	0	Exclude	0	0	0	0	
Element : [2] Housing										
✓	75	Dwelling Density	DU/gross acre	0	Increase	2	4	0	0	
✓	73	Dwelling Unit Count	total DU	0	Exclude	0	0	0	0	
✓	11	Student Enrollment Level	% student ca...	0	Centralize	0	80	90	100	
	13	Residential Footprint	net acres/10...	0	Exclude	0	0	0	0	
✓	14	Single-Family Parcel Size	avg square feet	0	ecrease	0	0	5000	8000	
✓	15	Single-Family Dwelling Density	DU/net acre	9	ncrease	6	8	0	0	
✓	16	Multi-Family Dwelling Density	DU/net acre	9	ncrease	15	20	0	0	
✓	17	Single-Family Dwelling Share	% total DU	0	entralize	40	60	80	90	
✓	18	Multi-Family Dwelling Share	% total DU	0	entralize	10	20	40	60	
✓	19	Amenities Adjacency	% pop w/I us...	10	ncrease	0	30	0	0	
	20	Amenities Proximity	avg walk ft to...	0	xclude	0	0	0	0	
✓	22	Transit Adjacency to Housing	% pop w/i us...	9	Increase	50	100	0	0	
	76	Wastewater Generation	gallons/day	0	Exclude	0	0	0	0	
	77	Solid Waste Generation	lbs/day	0	Exclude	0	0	0	0	
	78	Structural Energy Use	MMBtu/yr per...	0	Exclude	0	0	0	0	
	23	Transit Proximity to Housing	avg walk ft to...	0	Exclude	0	0	0	0	
	59	Residential Water Consumption	gallons/day p...	0	Exclude	0	0	0	0	
	60	Residential Energy Consumption	MMBtu/yr per...	0	Exclude	0	0	0	0	
Element : [3] Employment										
				100.00						

The indicator objectives appear in the columns to the left of the indicator weights.

To access the Rating and Weighting Settings wizard, select the button in the Edit field next to indicator settings. For this exercise, edit the settings for Single-Family Dwelling Density:


Run Set Editor - Run Set 2

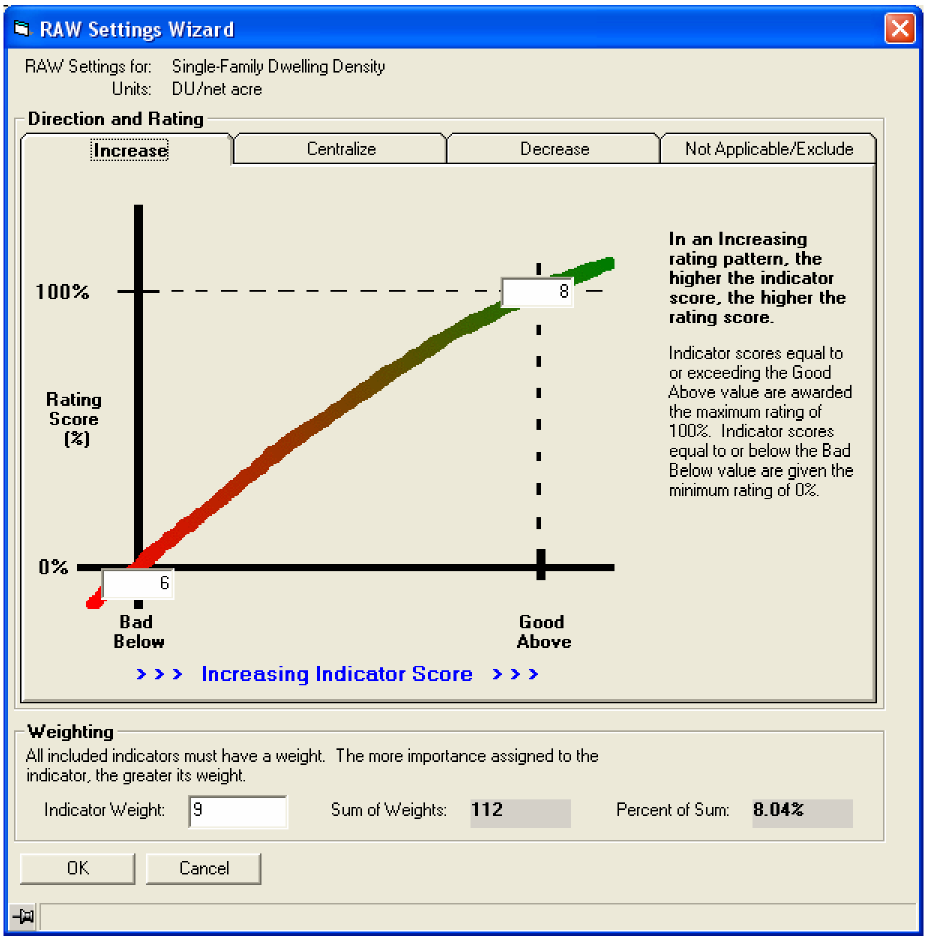
Collapse the nodes to hide Elements. Use the Edit column button to access the RAW Settings Wizard.

Indicators				RAW Settings						
Run	IID	Indicator	Units	Weight	Direction	BadBelow	GoodAbove	GoodBelow	BadAbove	Edit
Element : [0] Demographics										
☑	2	Population	residents	0	Exclude	0	0	0	0	
☑	3	Employment	employees	0	Exclude	0	0	0	0	
☑	4	Population Density	residents/gro...	0	Exclude	0	0	0	0	
Element : [1] Land-Use										
☑	74	Study Area Acreage	total acres	0	Exclude	0	0	0	0	
☐	5	Average Parcel Size	avg square feet	0	Exclude	0	0	0	0	
☐	7	Use Mix	0-1 scale	0	Exclude	0	0	0	0	
☑	8	Use Balance	0-1 scale	9	Increase	0.5	0.8000000...	0	0	
☐	9	Development Footprint	net acres/10...	0	Exclude	0	0	0	0	
☐	10	Fiscal Impact of Development	dollars	0	Exclude	0	0	0	0	
Element : [2] Housing										
☑	75	Dwelling Density	DU/gross acre	0	Increase	2	4	0	0	
☑	73	Dwelling Unit Count	total DU	0	Exclude	0	0	0	0	
☑	11	Student Enrollment Level	% student ca...	0	Centralize	0	80	90	100	
☐	13	Residential Footprint	net acres/10...	0	Exclude	0	0	0	0	
☑	14	Single-Family Parcel Size	avg square feet	0	Decrease	0	0	5000	800[illegible]	
☑	15	Single-Family Dwelling Density	DU/net acre	9	Increase	6	8	0	[illegible]	
☑	16	Multi-Family Dwelling Density	DU/net acre	9	Increase	15	20	0	0	
☑	17	Single-Family Dwelling Share	% total DU	0	Centralize	40	60	80	90	
☑	18	Multi-Family Dwelling Share	% total DU	0	Centralize	10	20	40	60	
☑	19	Amenities Adjacency	% pop w/I us...	10	Increase	0	30	0	0	
☐	20	Amenities Proximity	avg walk ft to...	0	Exclude	0	0	0	0	
☑	22	Transit Adjacency to Housing	% pop w/i us...	9	Increase	50	100	0	0	
☐	76	Wastewater Generation	gallons/day	0	Exclude	0	0	0	0	
☐	77	Solid Waste Generation	lbs/day	0	Exclude	0	0	0	0	
☐	78	Structural Energy Use	MMBtu/yr per...	0	Exclude	0	0	0	0	
☐	23	Transit Proximity to Housing	avg walk ft to...	0	Exclude	0	0	0	0	
☐	59	Residential Water Consumption	gallons/day p...	0	Exclude	0	0	0	0	
☐	60	Residential Energy Consumption	MMBtu/yr per...	0	Exclude	0	0	0	0	
Element : [3] Employment										
				100.00						

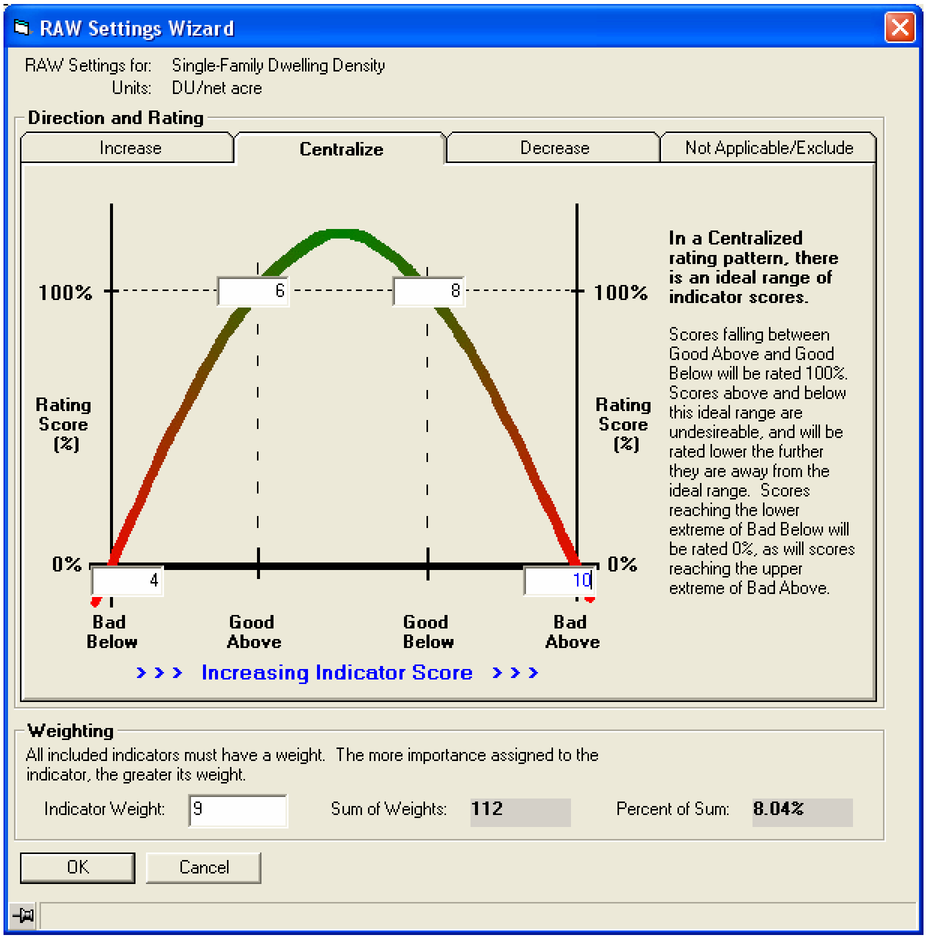
OK Cancel

The indicator objective is currently set to show that the objective of local stakeholders is to achieve a single-family dwelling density of 8 dwellings per acre or greater. A density below 6 dwellings per acre would signify the score did not achieve the minimum acceptable density and the indicator will receive 0% of its budgeted weight.

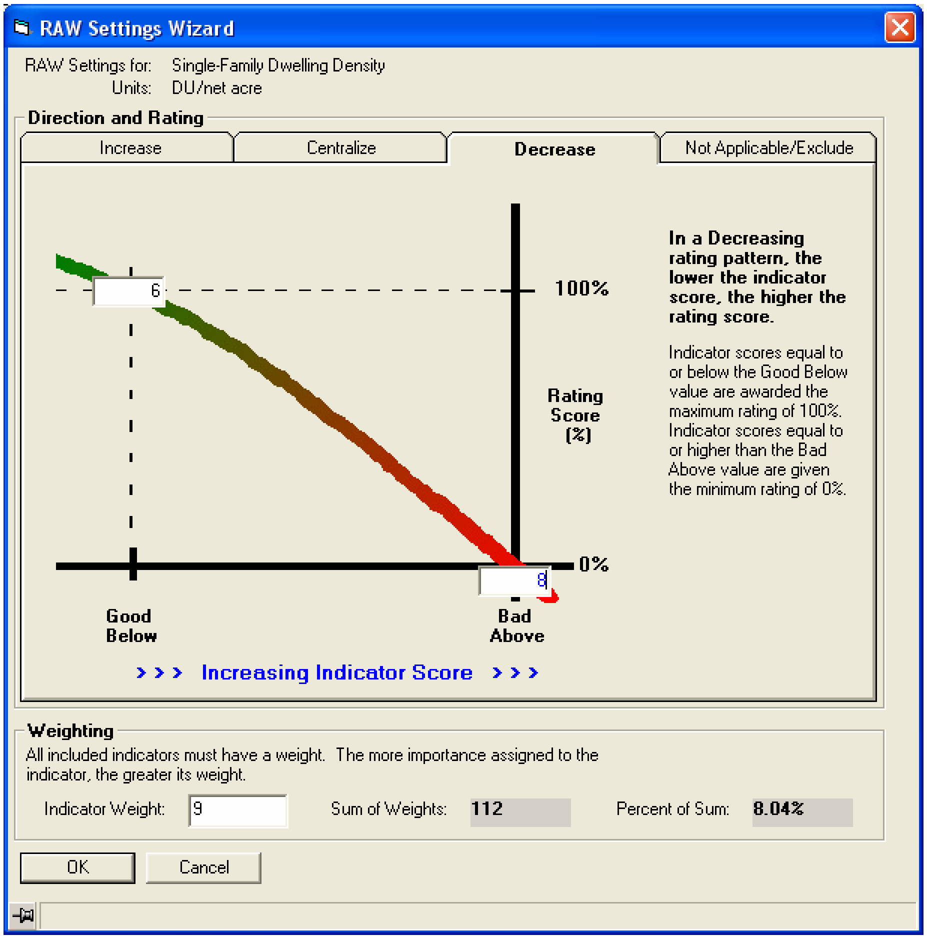
You can also adjust the weight of the indicator in the box near the bottom of the dialog:



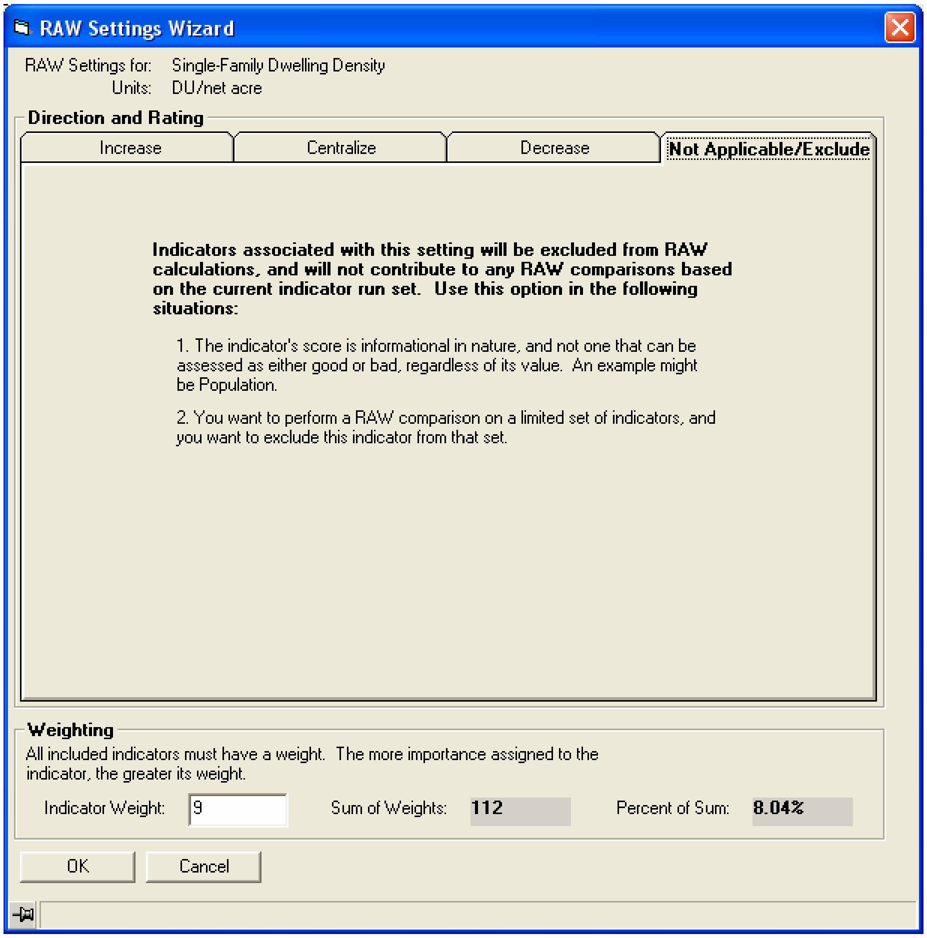
The Centralize tab allows you to set both minimum and maximum objectives for each indicator:



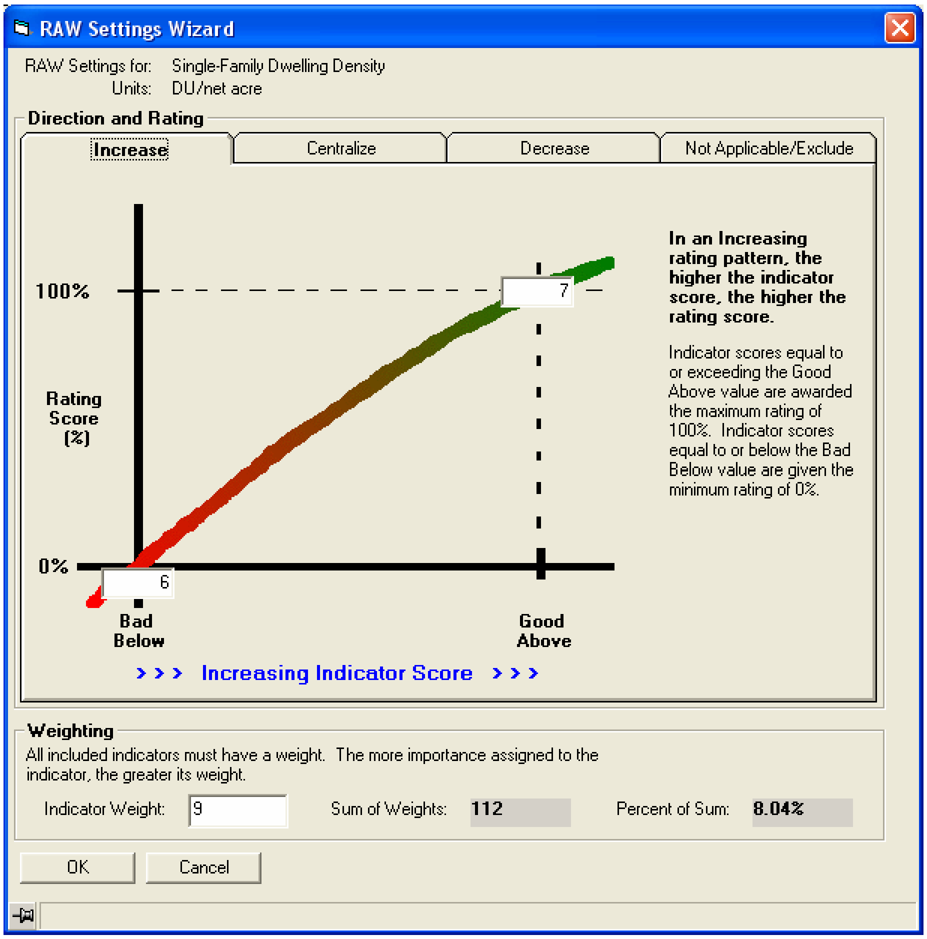
The Decrease tab allows you to define the indicator objective as a decreasing score:



The Not Applicable/Exclude tab allows you to exclude the indicator from the Rating and Weighting comparison analysis. The indicator will still calculate, but it is the same as setting the indicator weight to 0:

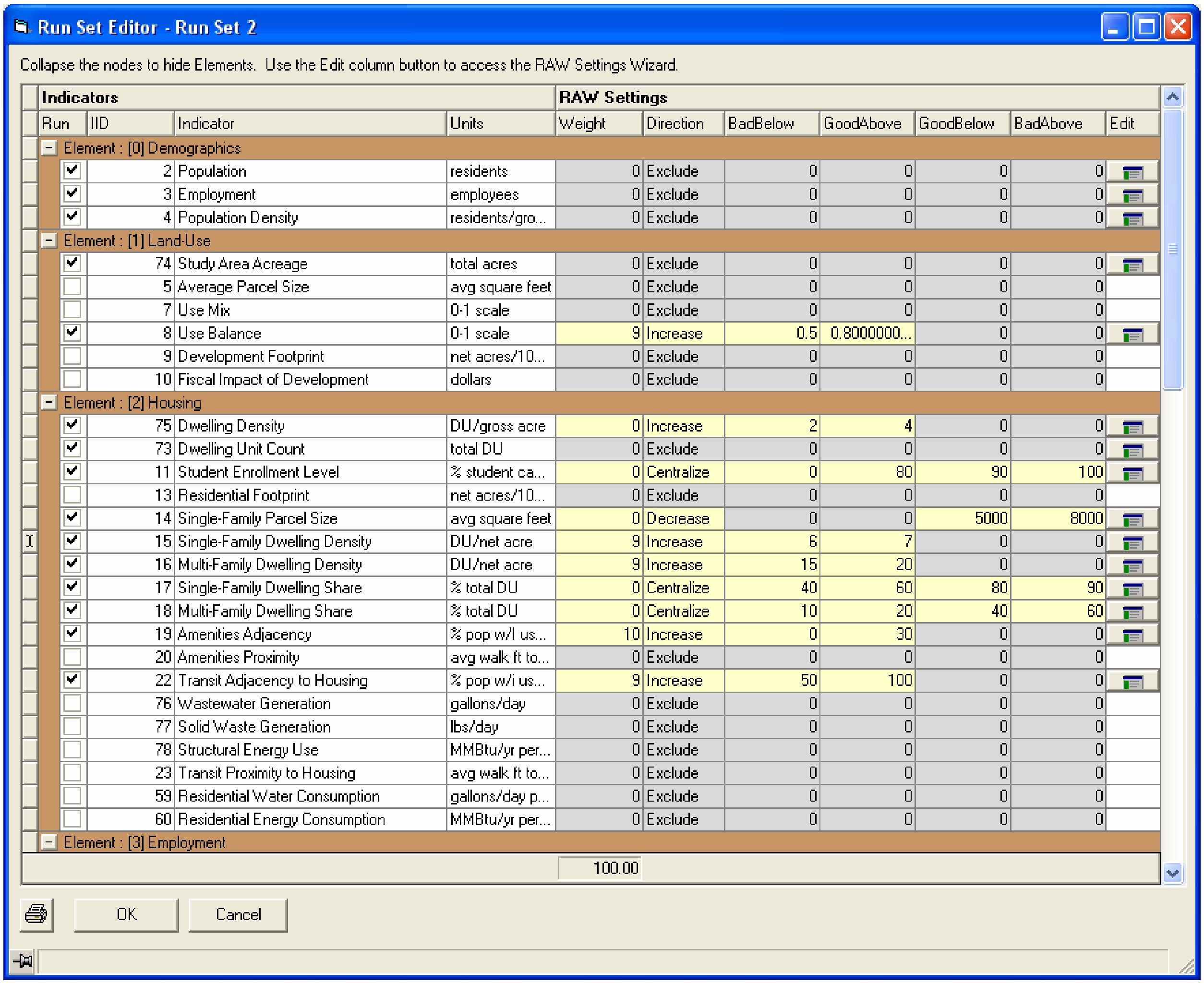


For this exercise, increase the sensitivity of the indicator score by setting the upper objective to 7 dwellings per acre.



Apply your settings by selecting the OK button.

Apply changes to the Run Set by selecting the OK bottom at the bottom of the dialog.



Run Set Editor - Run Set 2

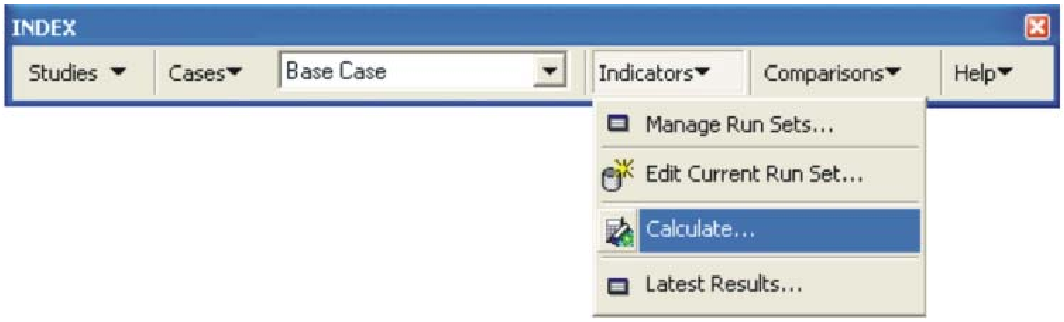
Collapse the nodes to hide Elements. Use the Edit column button to access the RAW Settings Wizard.

Indicators				RAW Settings						
Run	IID	Indicator	Units	Weight	Direction	BadBelow	GoodAbove	GoodBelow	BadAbove	Edit
Element : [0] Demographics										
✔	2	Population	residents	0	Exclude	0	0	0	0	
✔	3	Employment	employees	0	Exclude	0	0	0	0	
✔	4	Population Density	residents/gro...	0	Exclude	0	0	0	0	
Element : [1] Land-Use										
✔	74	Study Area Acreage	total acres	0	Exclude	0	0	0	0	
	5	Average Parcel Size	avg square feet	0	Exclude	0	0	0	0	
	7	Use Mix	0-1 scale	0	Exclude	0	0	0	0	
✔	8	Use Balance	0-1 scale	9	Increase	0.5	0.8000000...	0	0	
	9	Development Footprint	net acres/10...	0	Exclude	0	0	0	0	
	10	Fiscal Impact of Development	dollars	0	Exclude	0	0	0	0	
Element : [2] Housing										
✔	75	Dwelling Density	DU/gross acre	0	Increase	2	4	0	0	
✔	73	Dwelling Unit Count	total DU	0	Exclude	0	0	0	0	
✔	11	Student Enrollment Level	% student ca...	0	Centralize	0	80	90	100	
	13	Residential Footprint	net acres/10...	0	Exclude	0	0	0	0	
✔	14	Single-Family Parcel Size	avg square feet	0	Decrease	0	0	5000	8000	
✔	15	Single-Family Dwelling Density	DU/net acre	9	Increase	6	7	0	0	
✔	16	Multi-Family Dwelling Density	DU/net acre	9	Increase	15	20	0	0	
✔	17	Single-Family Dwelling Share	% total DU	0	Centralize	40	60	80	90	
✔	18	Multi-Family Dwelling Share	% total DU	0	Centralize	10	20	40	60	
✔	19	Amenities Adjacency	% pop w/I us...	10	Increase	0	30	0	0	
	20	Amenities Proximity	avg walk ft to...	0	Exclude	0	0	0	0	
✔	22	Transit Adjacency to Housing	% pop w/i us...	9	Increase	50	100	0	0	
	76	Wastewater Generation	gallons/day	0	Exclude	0	0	0	0	
	77	Solid Waste Generation	lbs/day	0	Exclude	0	0	0	0	
	78	Structural Energy Use	MMBtu/yr per...	0	Exclude	0	0	0	0	
	23	Transit Proximity to Housing	avg walk ft to...	0	Exclude	0	0	0	0	
	59	Residential Water Consumption	gallons/day p...	0	Exclude	0	0	0	0	
	60	Residential Energy Consumption	MMBtu/yr per...	0	Exclude	0	0	0	0	
Element : [3] Employment										
				100.00						

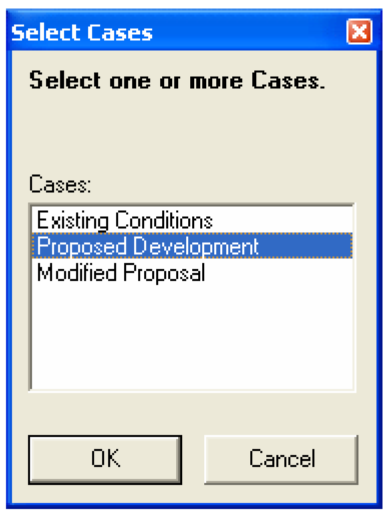
OK Cancel

Run Indicators for the Proposed Development

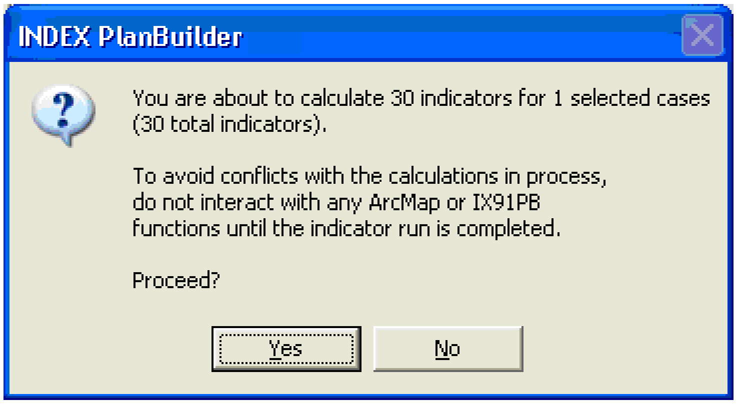
Select the Calculate option from the Indicators menu on the INDEX toolbar:



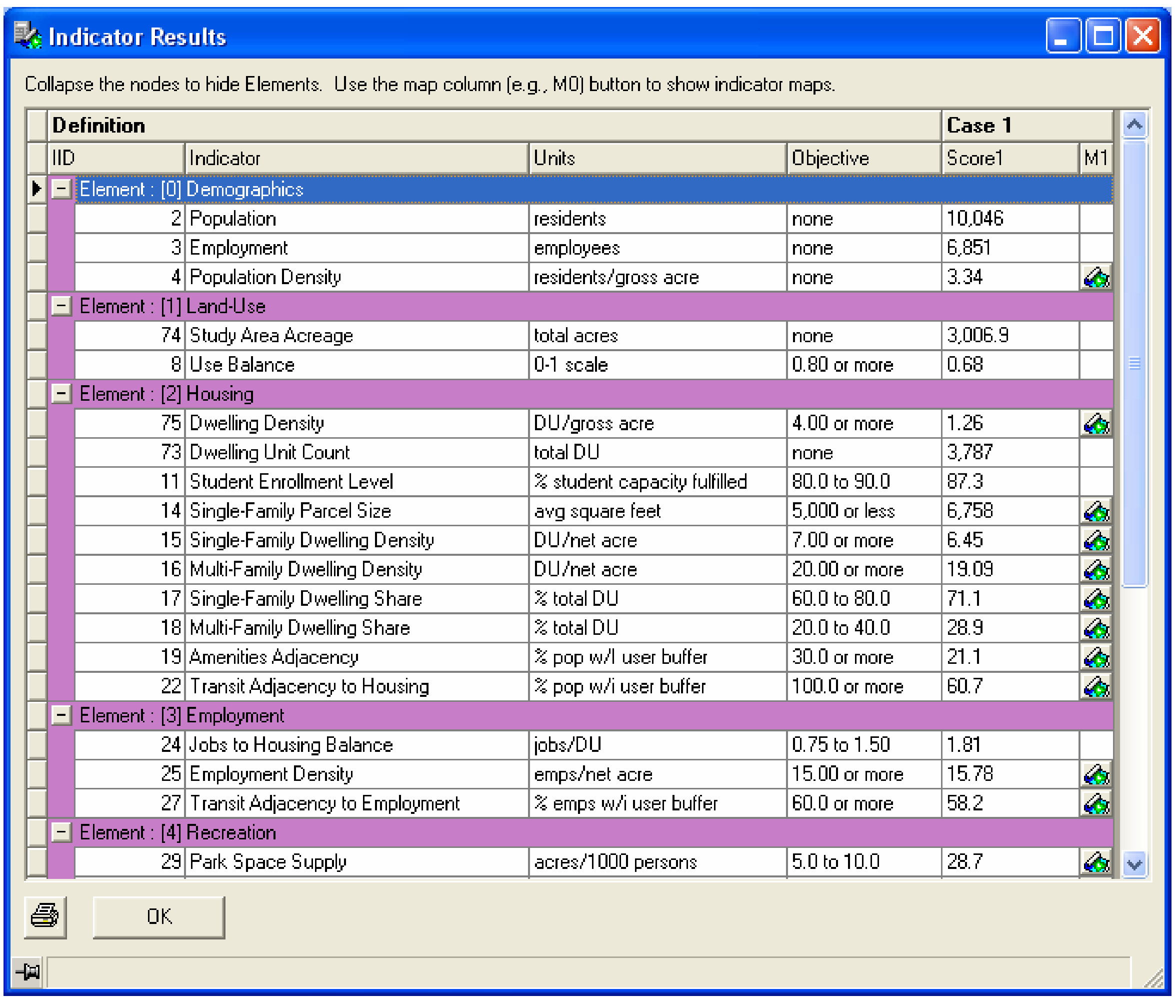
Select 'Proposed Development' from the Cases list and click 'OK':



Verify that the dialog information is correct and select 'Yes' to proceed:



The Indicator Results table will open automatically when the indicators finish calculating.



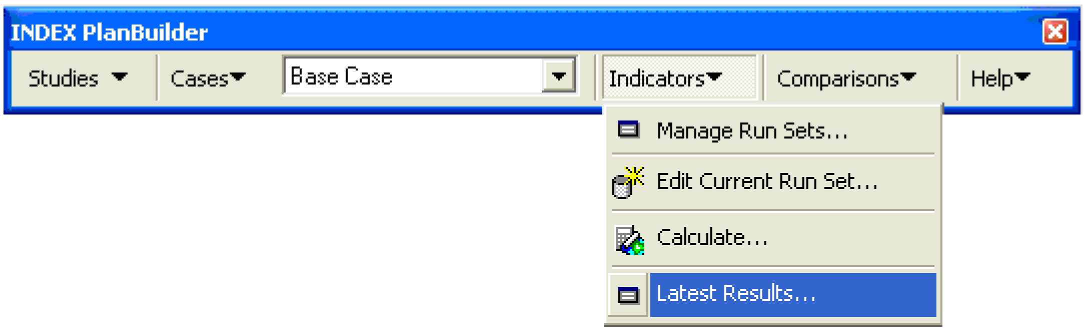
Definition				Case 1	
IID	Indicator	Units	Objective	Score1	M1
Element : [0] Demographics					
2	Population	residents	none	10,046	
3	Employment	employees	none	6,851	
4	Population Density	residents/gross acre	none	3.34	
Element : [1] Land-Use					
74	Study Area Acreage	total acres	none	3,006.9	
8	Use Balance	0-1 scale	0.80 or more	0.68	
Element : [2] Housing					
75	Dwelling Density	DU/gross acre	4.00 or more	1.26	
73	Dwelling Unit Count	total DU	none	3,787	
11	Student Enrollment Level	% student capacity fulfilled	80.0 to 90.0	87.3	
14	Single-Family Parcel Size	avg square feet	5,000 or less	6,758	
15	Single-Family Dwelling Density	DU/net acre	7.00 or more	6.45	
16	Multi-Family Dwelling Density	DU/net acre	20.00 or more	19.09	
17	Single-Family Dwelling Share	% total DU	60.0 to 80.0	71.1	
18	Multi-Family Dwelling Share	% total DU	20.0 to 40.0	28.9	
19	Amenities Adjacency	% pop w/i user buffer	30.0 or more	21.1	
22	Transit Adjacency to Housing	% pop w/i user buffer	100.0 or more	60.7	
Element : [3] Employment					
24	Jobs to Housing Balance	jobs/DU	0.75 to 1.50	1.81	
25	Employment Density	emps/net acre	15.00 or more	15.78	
27	Transit Adjacency to Employment	% emps w/i user buffer	60.0 or more	58.2	
Element : [4] Recreation					
29	Park Space Supply	acres/1000 persons	5.0 to 10.0	28.7	

COMPARE CASES

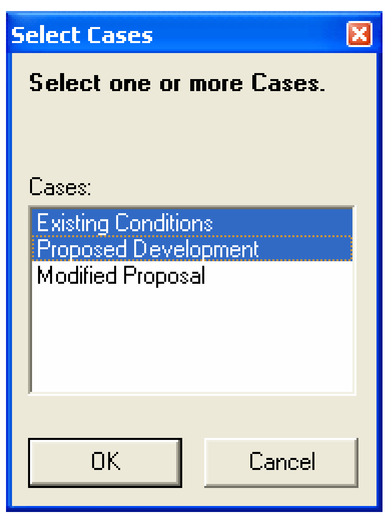
At this point the user will be able to gauge the type and magnitude of change caused to the study area's existing condition scores by the development proposal represented in Case 1.

Side-by-Side Indicator Results

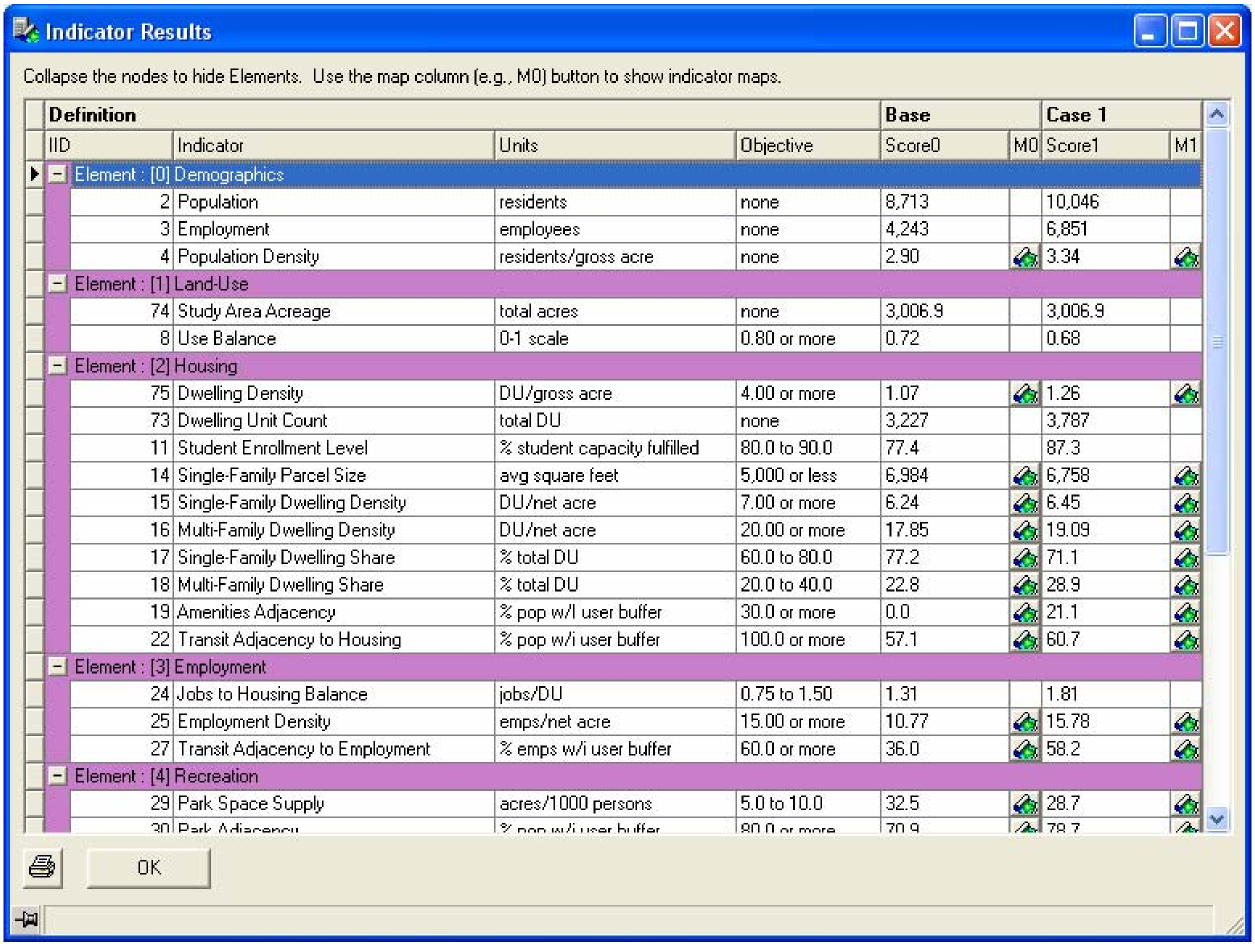
Select the Latest Results option on the Indicators menu:



Select both 'Existing Conditions' and 'Proposed Development' from the Select Cases dialog, then select the OK button:

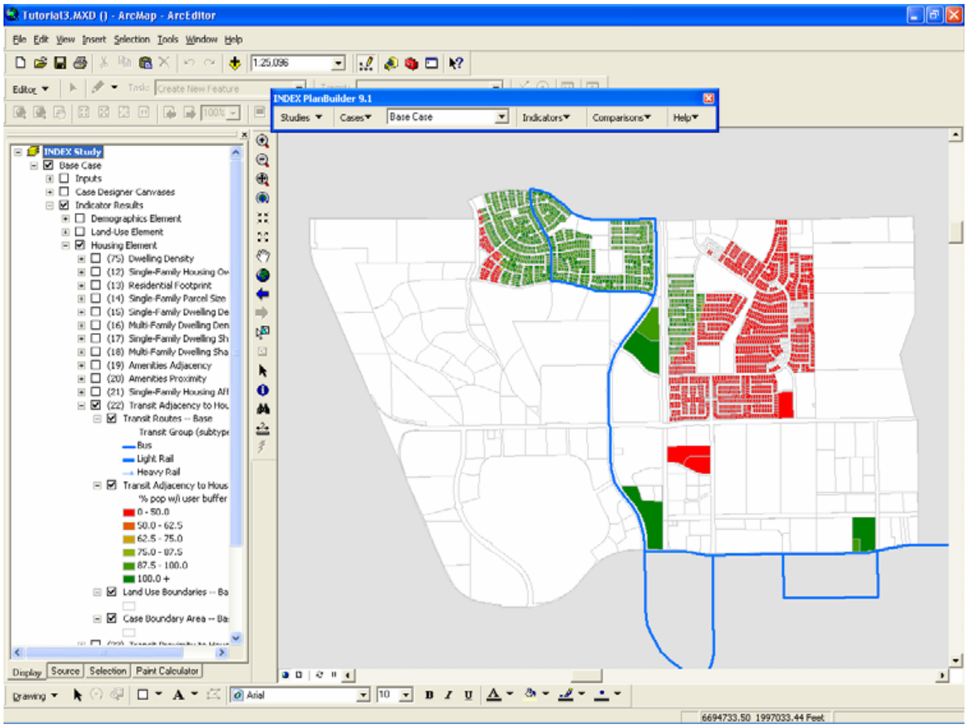


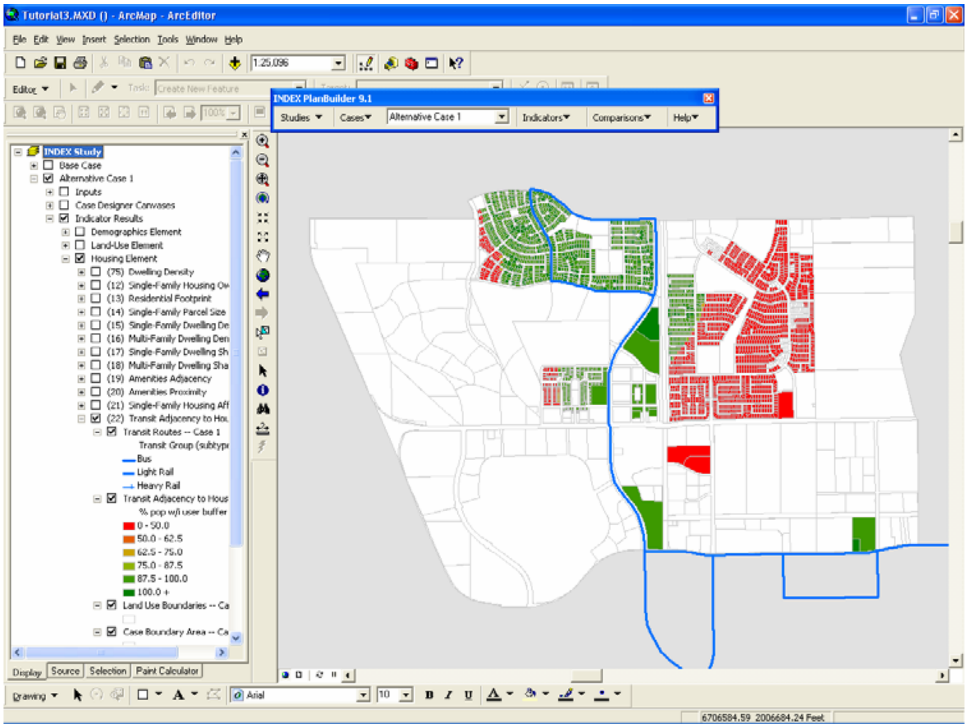
Scroll through the Indicator Results table and identify the changes in scores between the cases:



Definition				Base		Case 1	
IID	Indicator	Units	Objective	Score0	M0	Score1	M1
Element : [0] Demographics							
2	Population	residents	none	8,713		10,046	
3	Employment	employees	none	4,243		6,851	
4	Population Density	residents/gross acre	none	2.90		3.34	
Element : [1] Land-Use							
74	Study Area Acreage	total acres	none	3,006.9		3,006.9	
8	Use Balance	0-1 scale	0.80 or more	0.72		0.68	
Element : [2] Housing							
75	Dwelling Density	DU/gross acre	4.00 or more	1.07		1.26	
73	Dwelling Unit Count	total DU	none	3,227		3,787	
11	Student Enrollment Level	% student capacity fulfilled	80.0 to 90.0	77.4		87.3	
14	Single-Family Parcel Size	avg square feet	5,000 or less	6,984		6,758	
15	Single-Family Dwelling Density	DU/net acre	7.00 or more	6.24		6.45	
16	Multi-Family Dwelling Density	DU/net acre	20.00 or more	17.85		19.09	
17	Single-Family Dwelling Share	% total DU	60.0 to 80.0	77.2		71.1	
18	Multi-Family Dwelling Share	% total DU	20.0 to 40.0	22.8		28.9	
19	Amenities Adjacency	% pop w/I user buffer	30.0 or more	0.0		21.1	
22	Transit Adjacency to Housing	% pop w/i user buffer	100.0 or more	57.1		60.7	
Element : [3] Employment							
24	Jobs to Housing Balance	jobs/DU	0.75 to 1.50	1.31		1.81	
25	Employment Density	emps/net acre	15.00 or more	10.77		15.78	
27	Transit Adjacency to Employment	% emps w/i user buffer	60.0 or more	36.0		58.2	
Element : [4] Recreation							
29	Park Space Supply	acres/1000 persons	5.0 to 10.0	32.5		28.7	
30	Park Adjacency	% pop w/i user buffer	80.0 or more	70.9		78.7	

Select the Map icon on the Indicator Results table and view the differences in the indicator maps between the Base Case and Alternative Case 1:

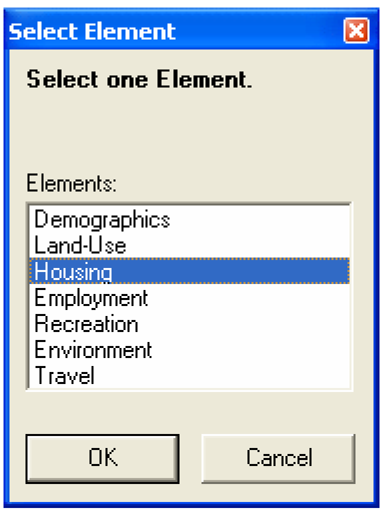




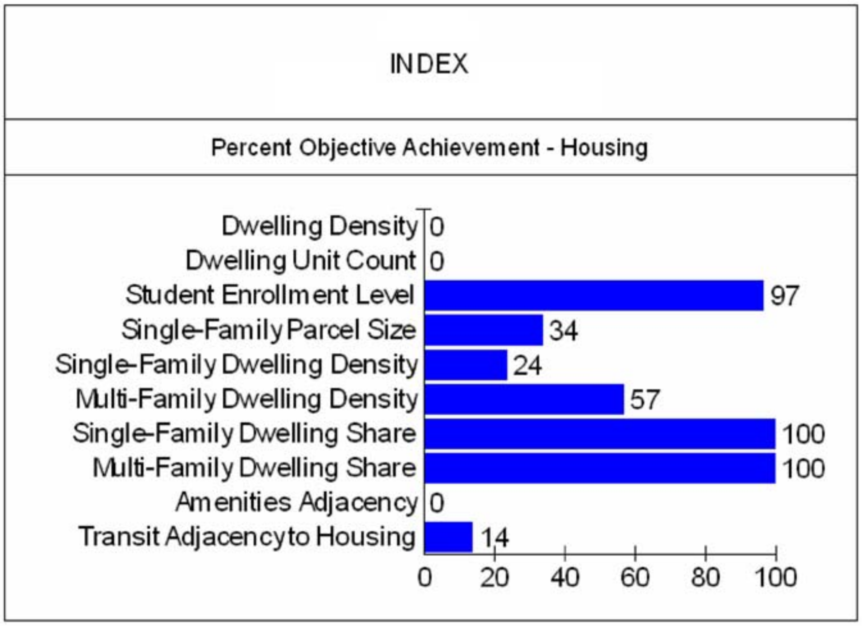
Objective Achievement

To review how each indicator scored relative to their rating objectives using the Objective Achievement bar chart, make Base Case the active case on the INDEX toolbar, and select Objective Achievement from the Comparisons menu:

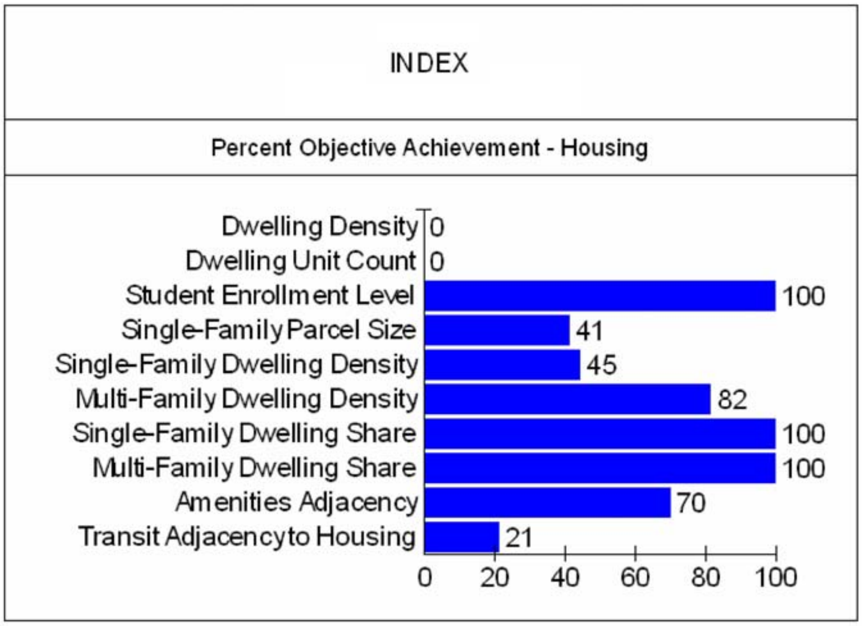
Select the Housing Element and click the OK button:



Examine the results to determine where the deficiencies are:



Make Case 1 the active case and activate the Objective Achievement bar chart. Notice that there were several improvements with respect to the objectives, but still some major deficiencies, e.g. Transit Adjacencies to Housing:

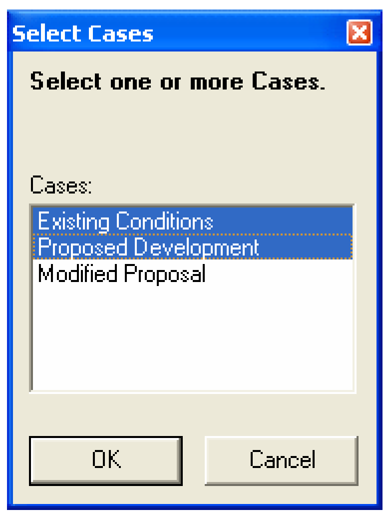


Rating and Weighting Comparison

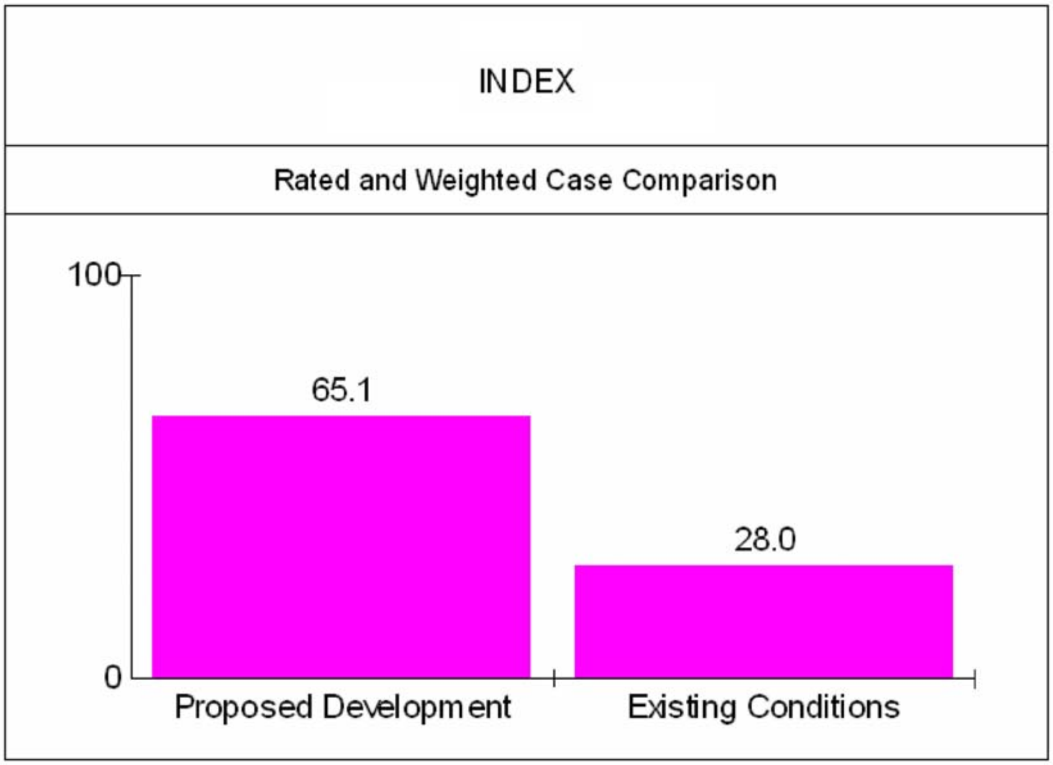
Compare the impact of the development proposal to the study area's existing conditions using the settings established previously in RAW.

Activate the Rating and Weighting bar chart by selecting Rating and Weighting from the Comparisons menu on the INDEX toolbar:

Select the 'Existing Conditions' and 'Proposed Development':



According to the user-defined RAW criteria, the developer's proposal would help the community towards its goals but there is still room for improvement:



Note: actual scores may vary as they depend on individual edits

MODIFY DEVELOPMENT PROPOSAL

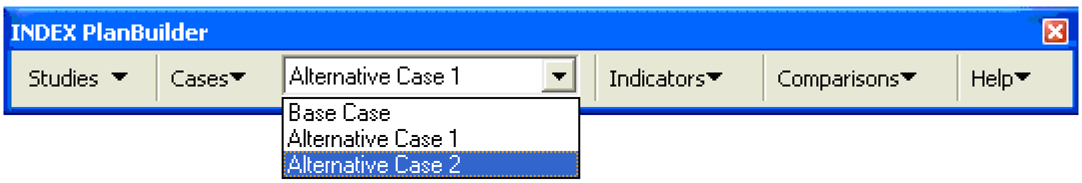
By using INDEX to modify and improve community proposals, stakeholders can iterate among alternatives to a preferred, and ultimately adopted, plan or development proposal.

In this section you will modify the original development proposal to specify changes that help the community achieve more of its goals.

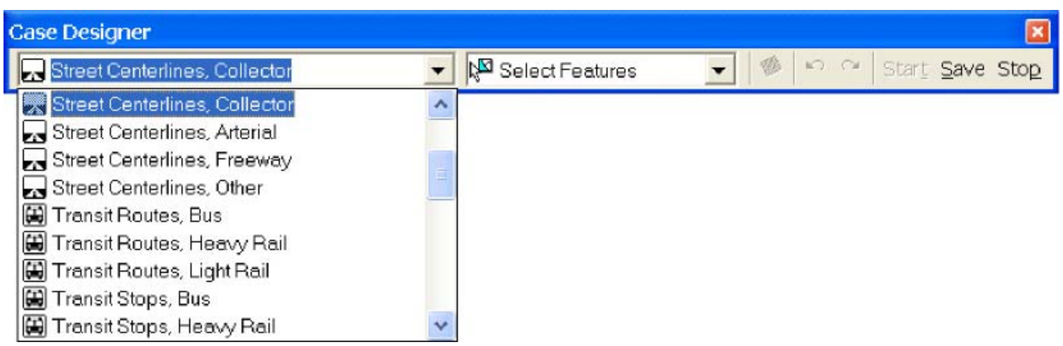
Improve Street Access

In this section you will modify the proposed development by improving street access from the development site to the surrounding neighborhood.

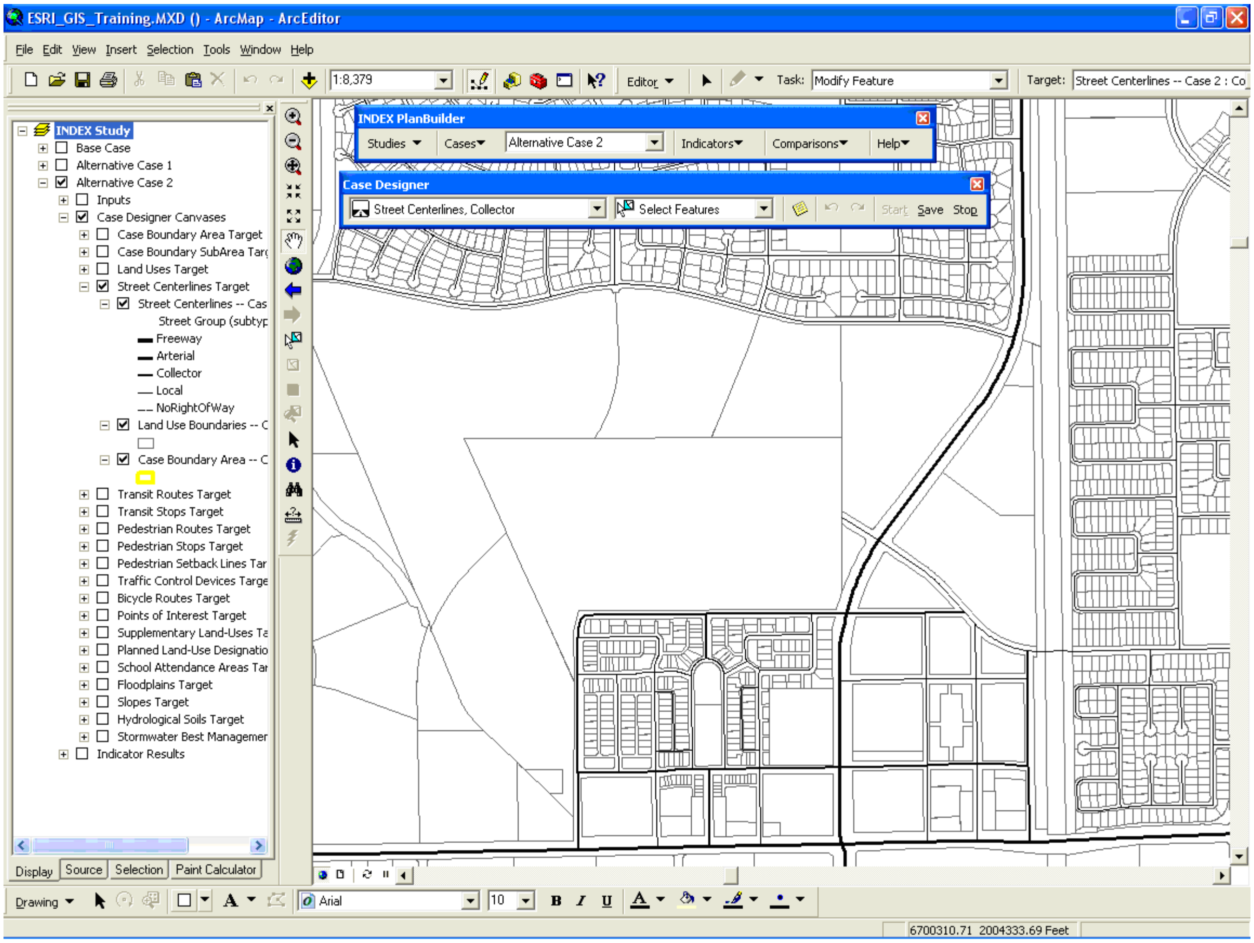
Make Alternative Case 2 the active case:



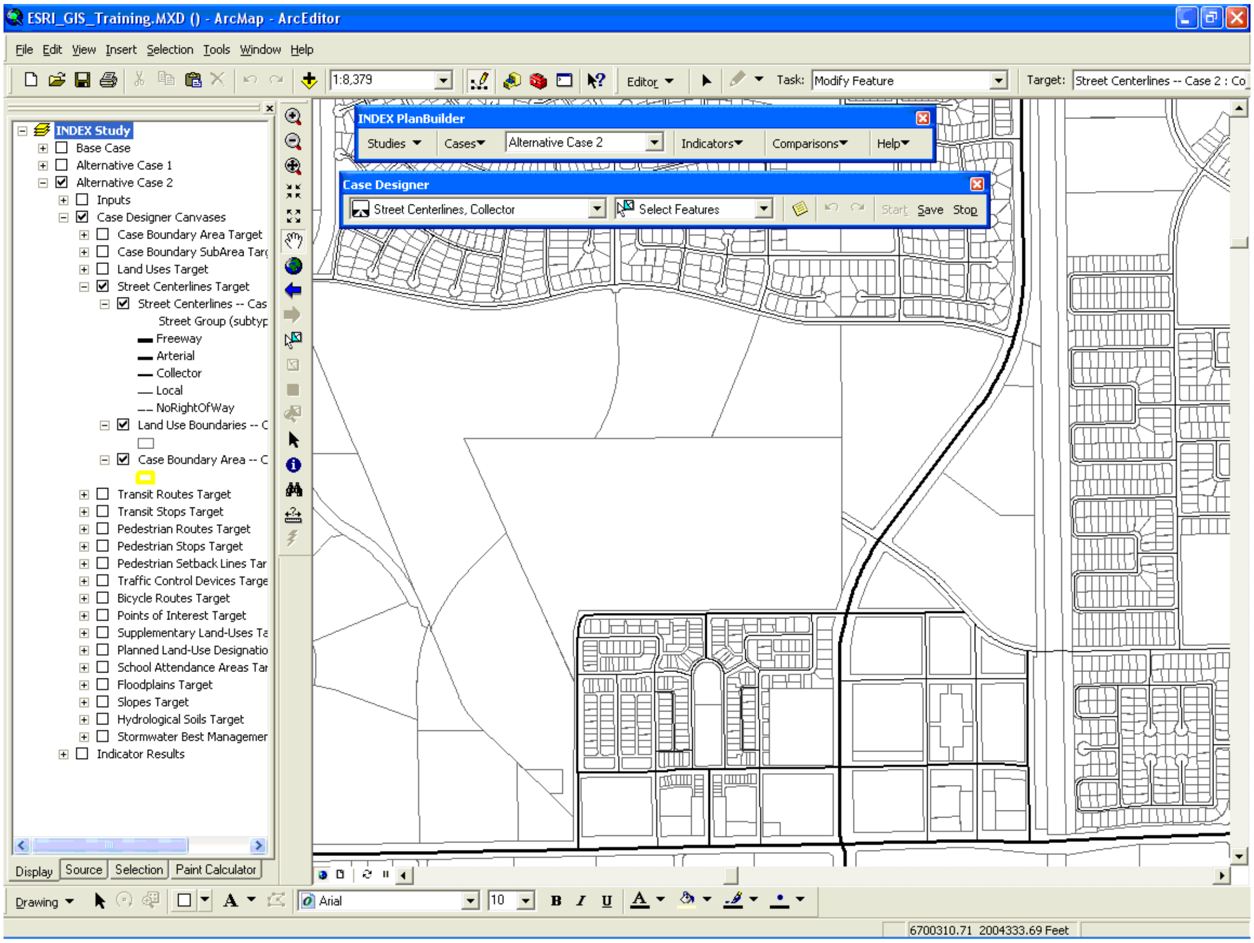
Open the Case Designer toolbar and make Collector Streets the editable design target:



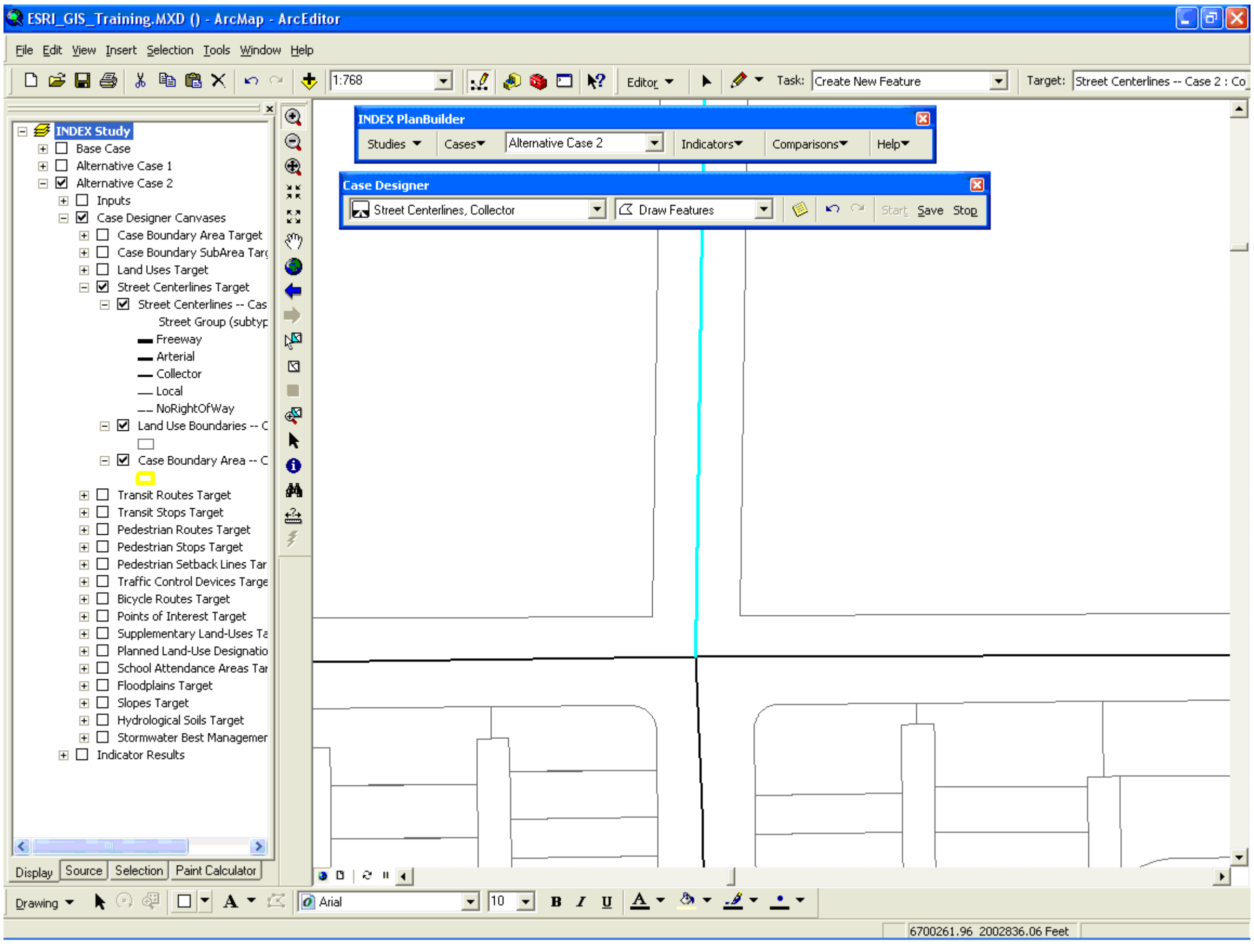
Zoom into the development proposal and include the lower portion of the neighborhood to the north:



Select the draw tool and draw two collector streets to connect the developments, as shown below:

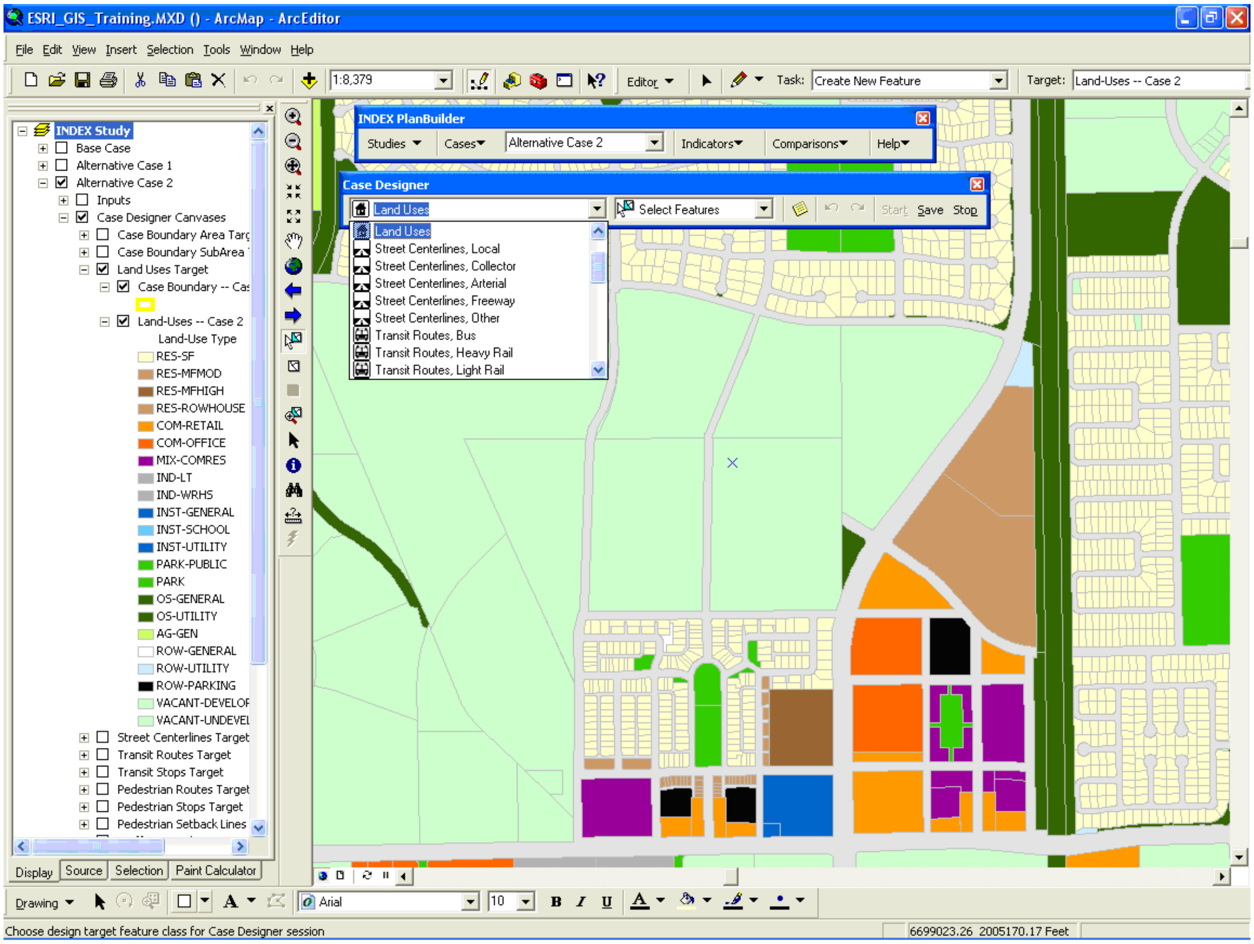


If you zoom in, you will see that right-of-ways are automatically created in the land-use layer:

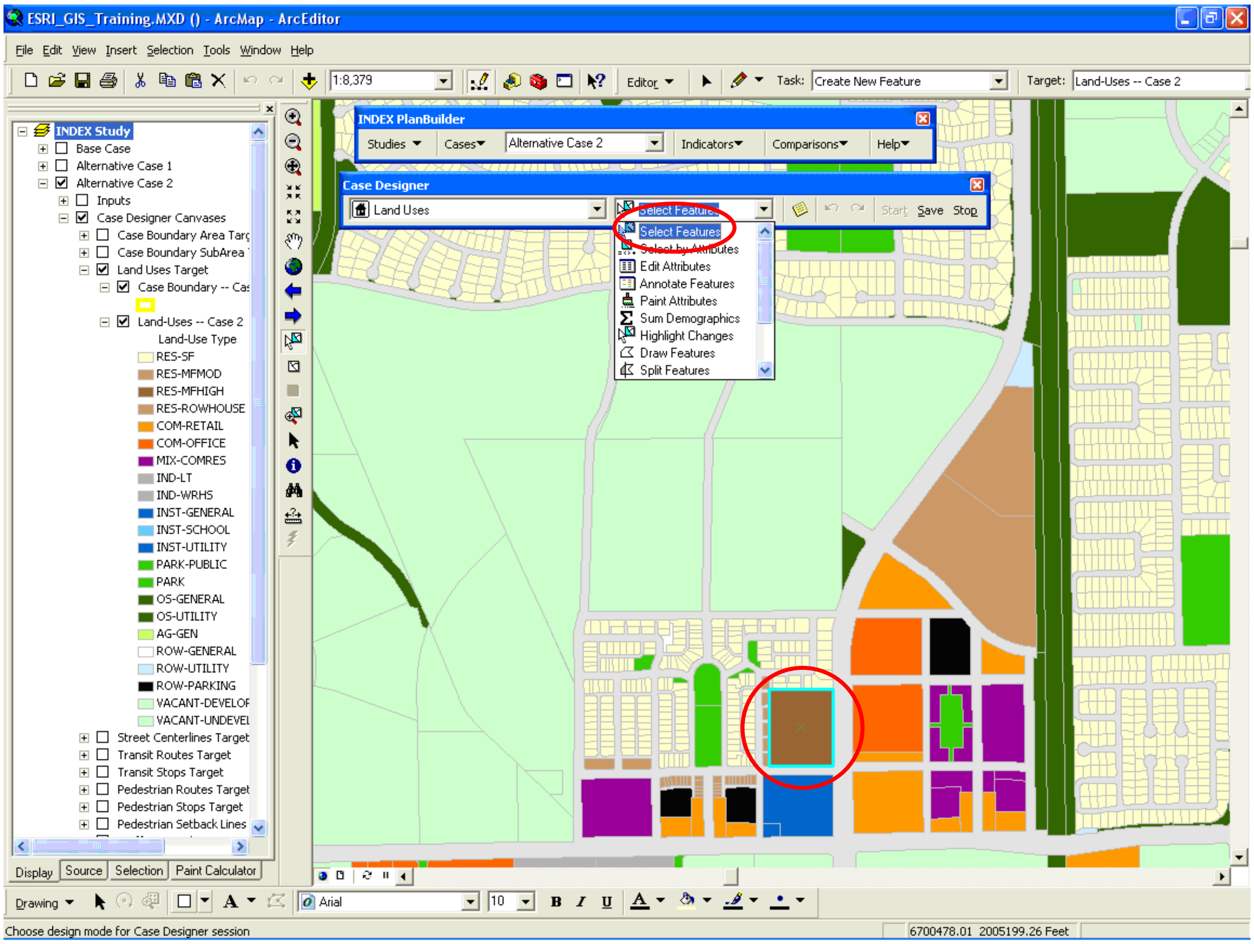


Modify the Proposed Development Parcels

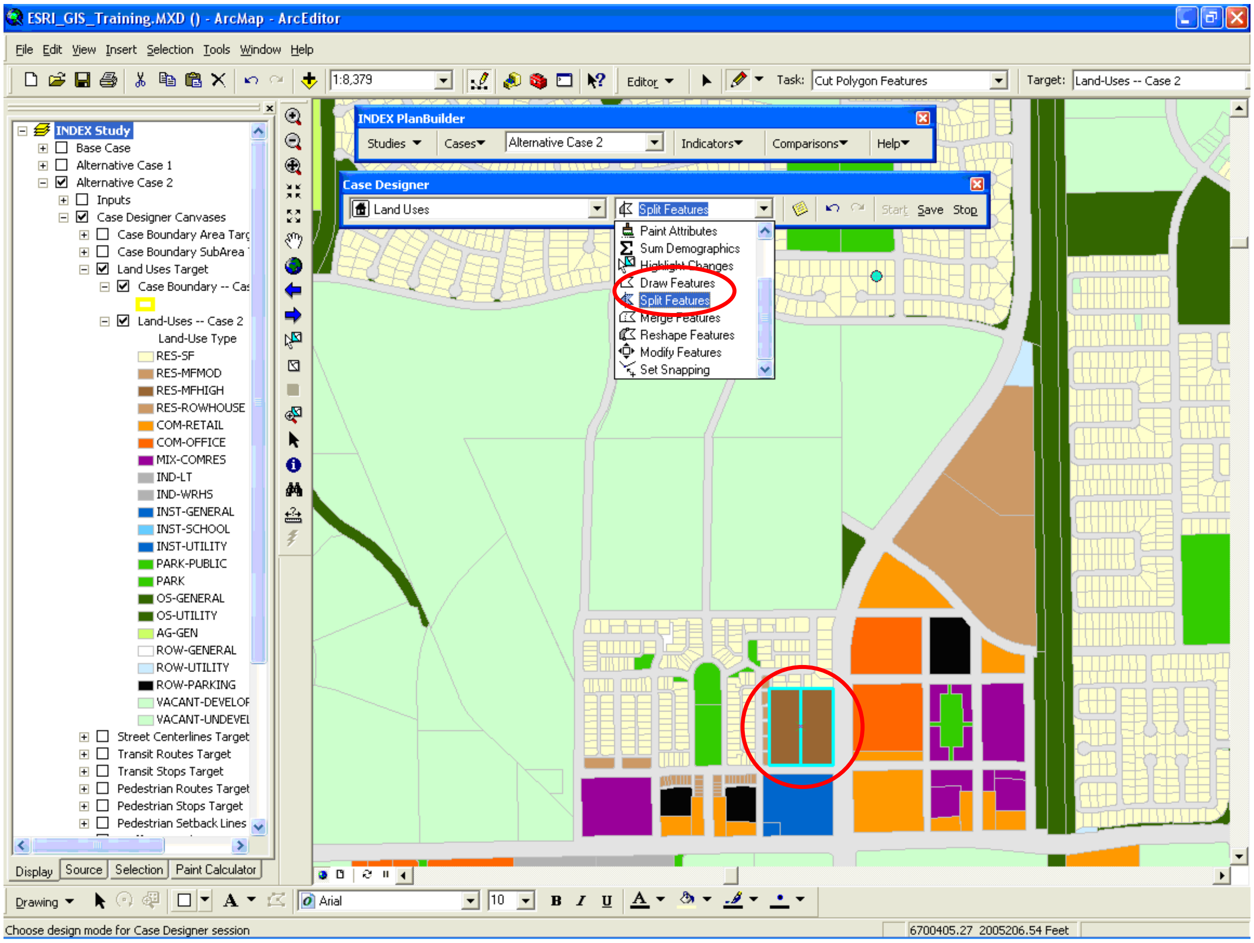
Change the design target to Land-Uses and zoom to the development proposal again.



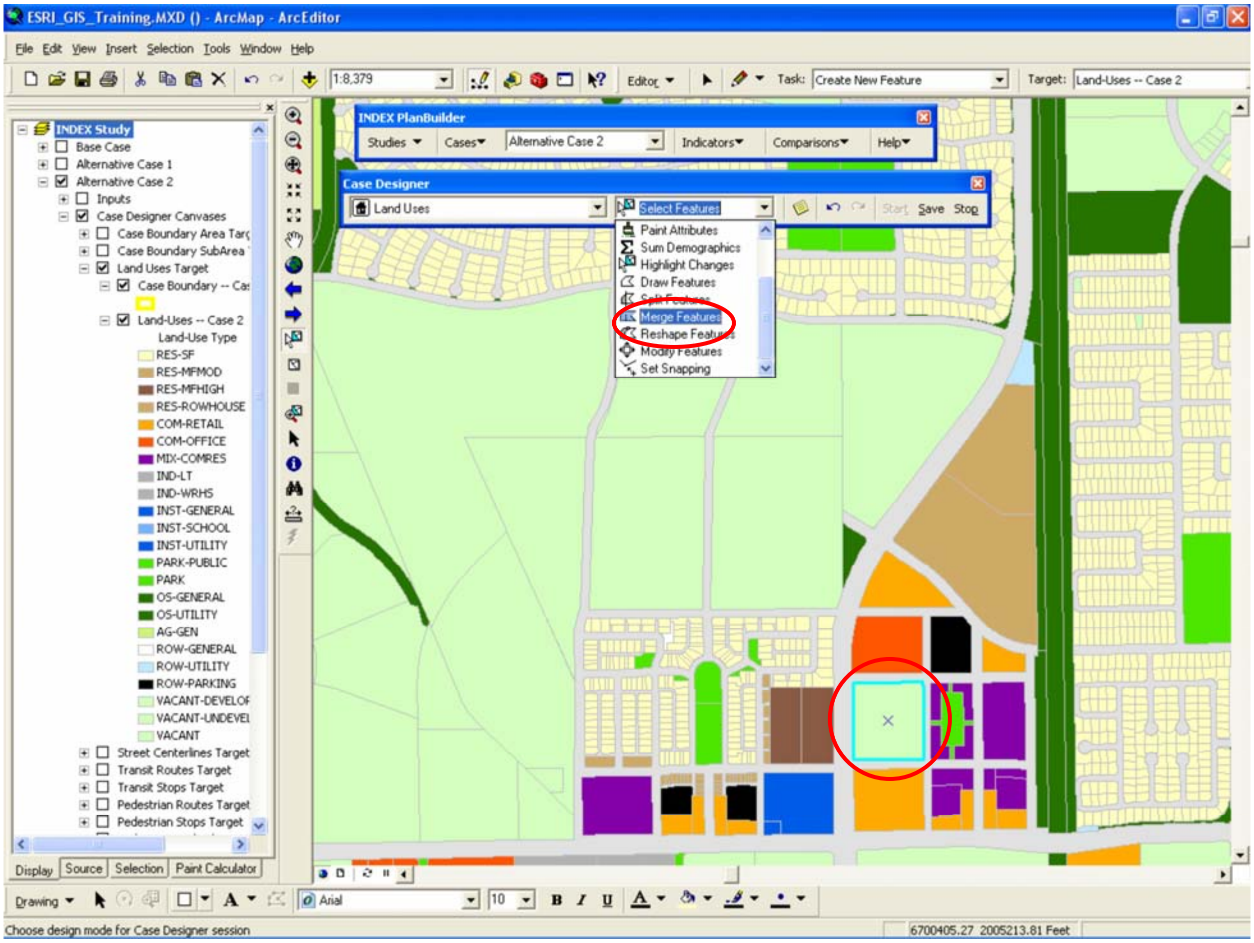
Select the high-density residential parcel near the center of the development with the Select Features tool:



Select the Split tool from the Case Designer tool bar and split the parcel vertically by clicking on one side of the parcel and dragging the mouse to the other side:



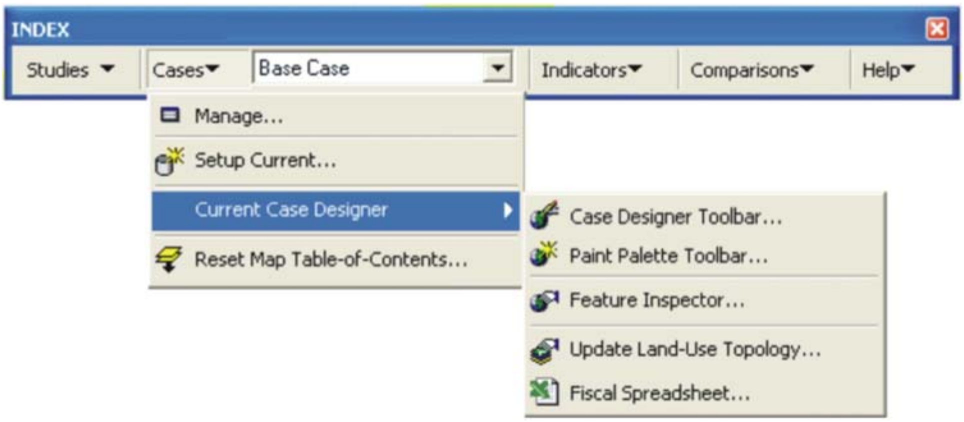
To merge two parcels together, select the two parcels shown below with the Select Features tool the Merge tool from the Design tools:



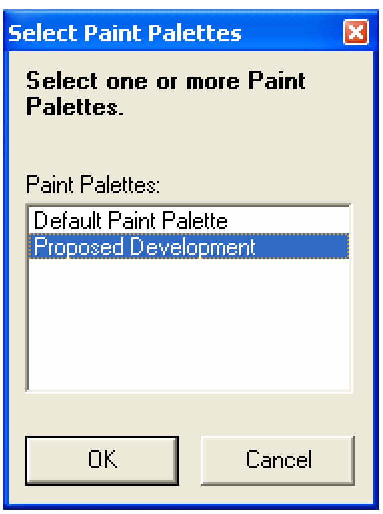
INDEX will automatically remove all of the attributes from the parcel.

Access the Paint Palette Set

INDEX allows you to create multiple Paint Palettes. To select a palette, select the Current Case Designer option from the Cases pull-down menu and select the Paint Palette Toolbar option:



Select the Proposed Development palette:

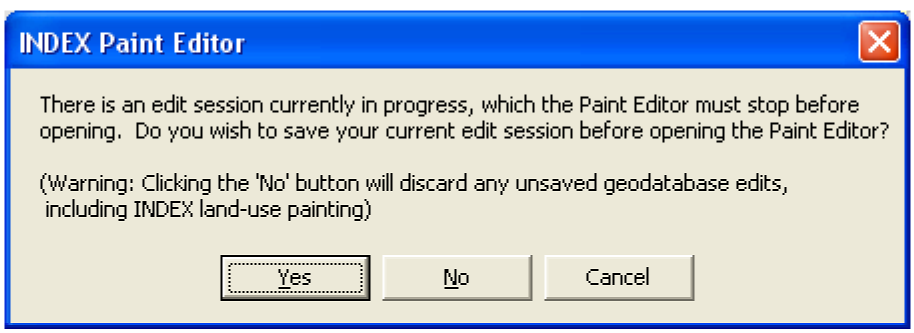


The selected Paint Palette will open automatically:

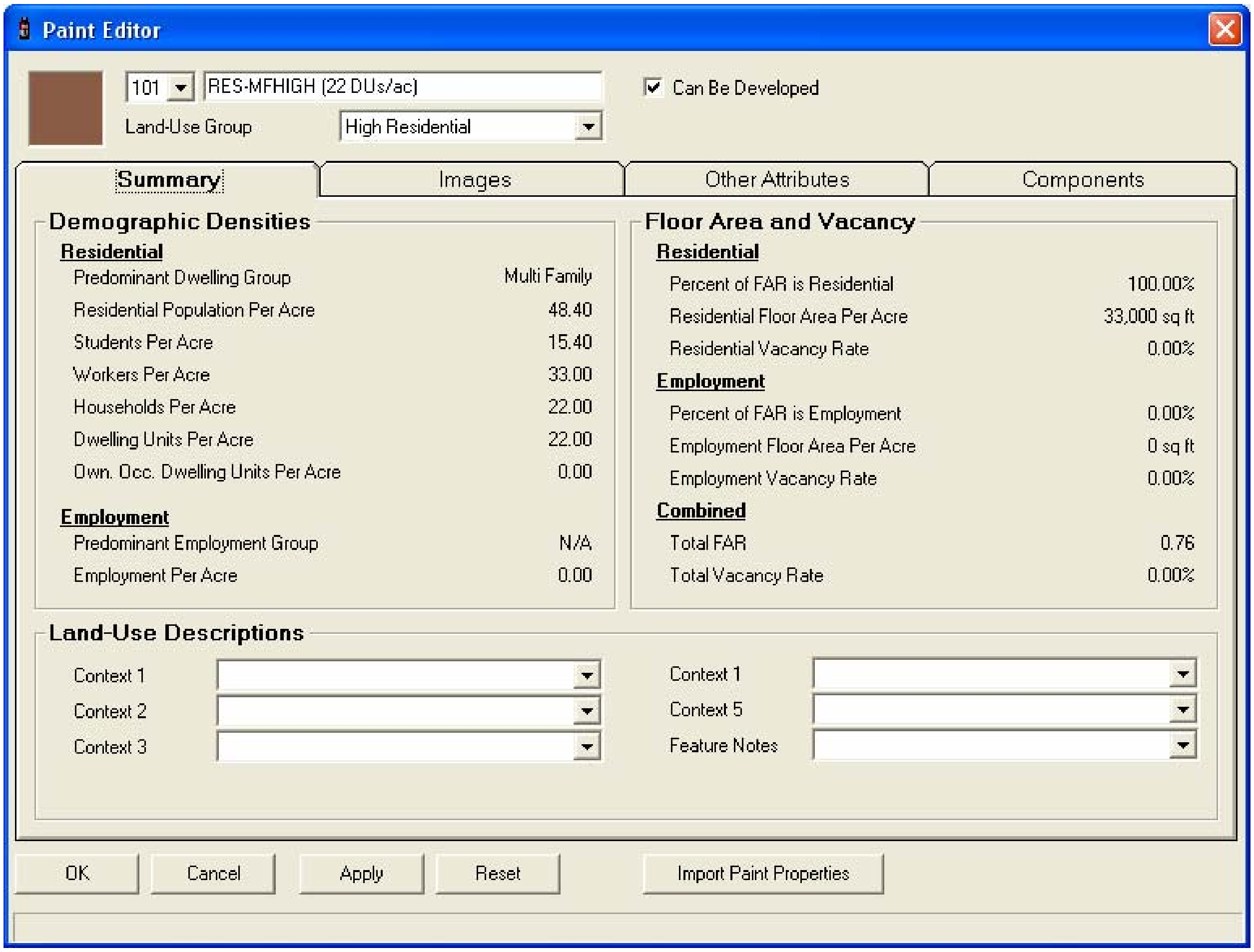
To view the attributes of the paint, first select a paint chip:

Next, select the Paint Editor Button while the paint chip is still depressed:

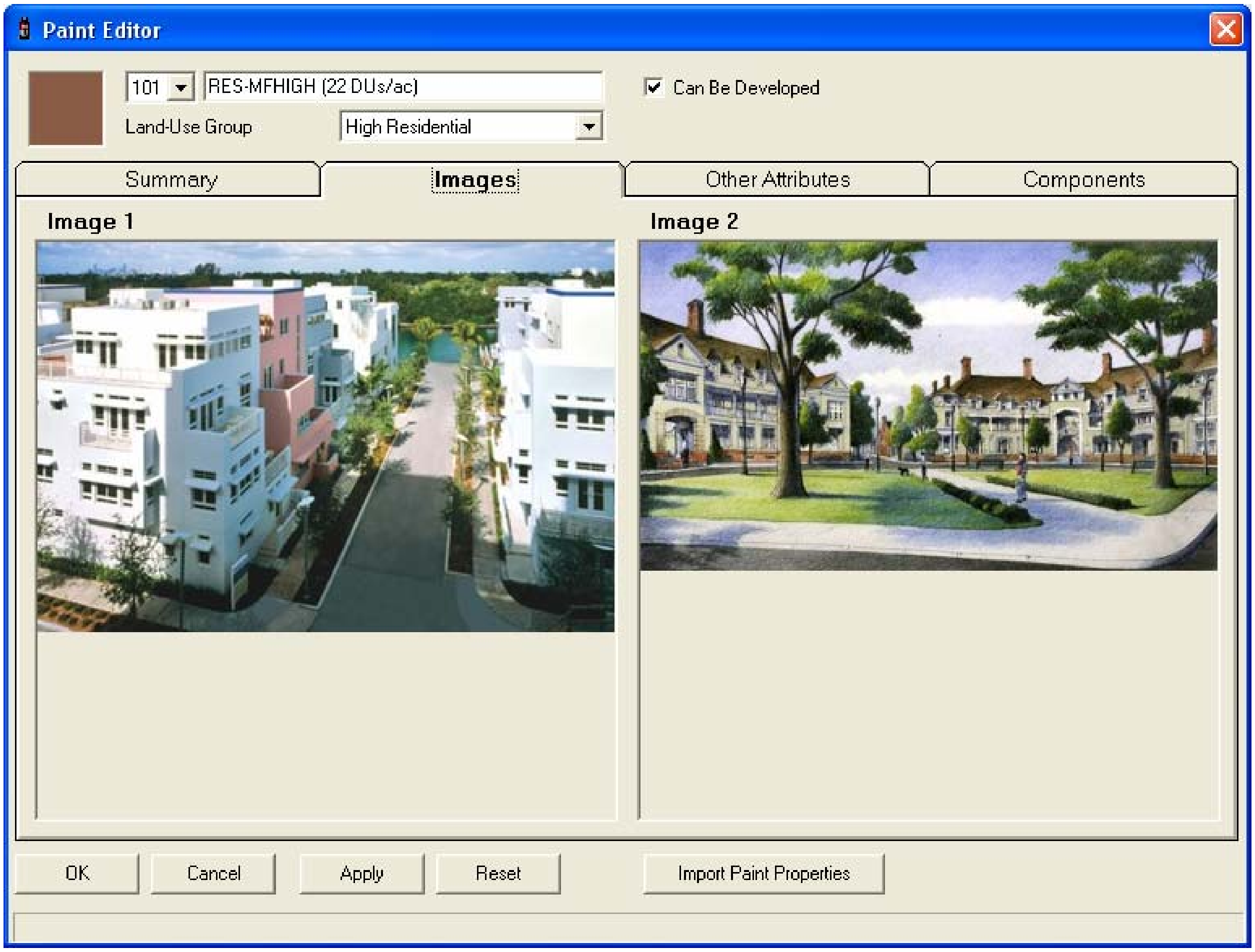
A warning message will automatically open asking if you want to save your previous edits. Select 'Yes':



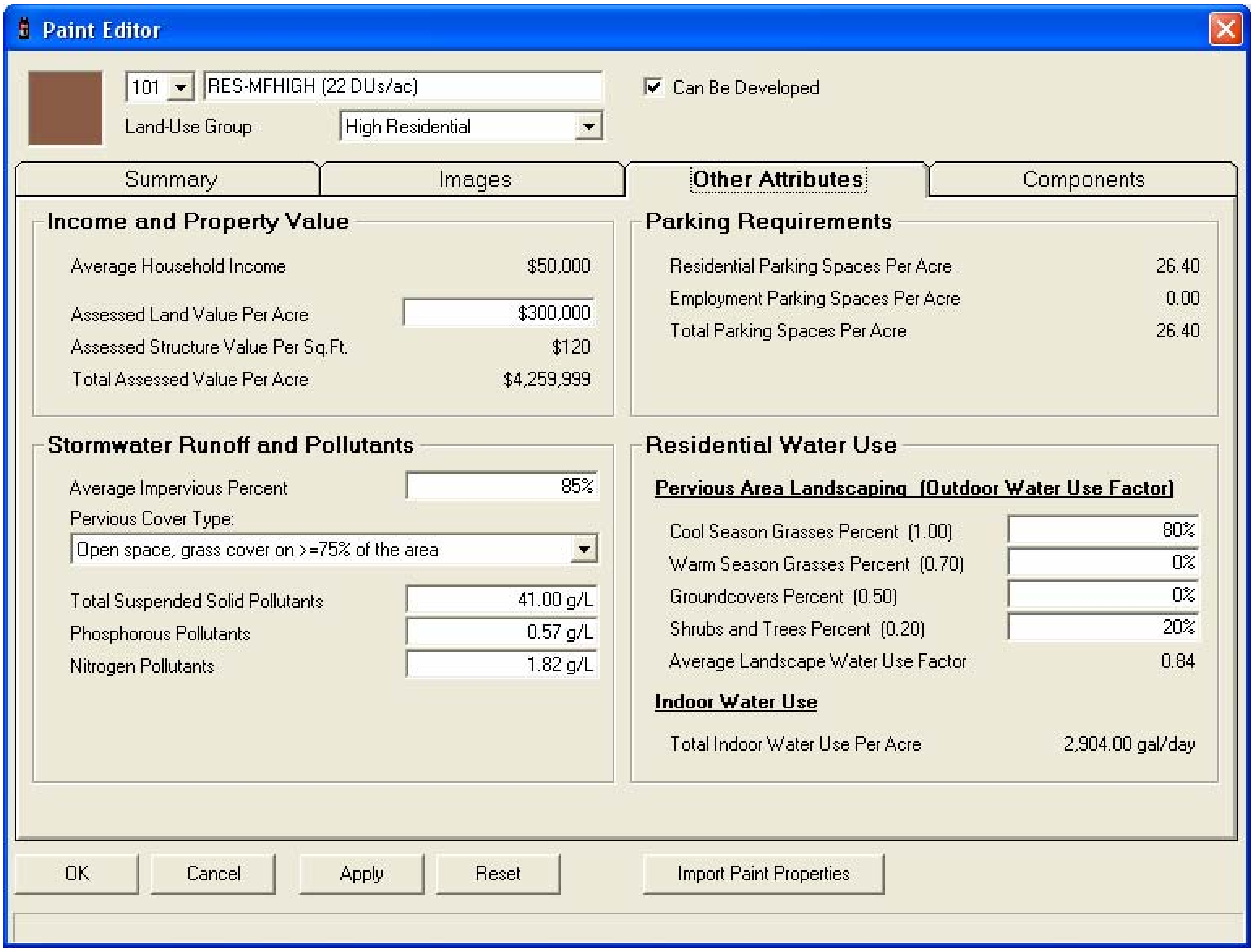
The Summary tab contains density and floor area information that will be applied by the paint:



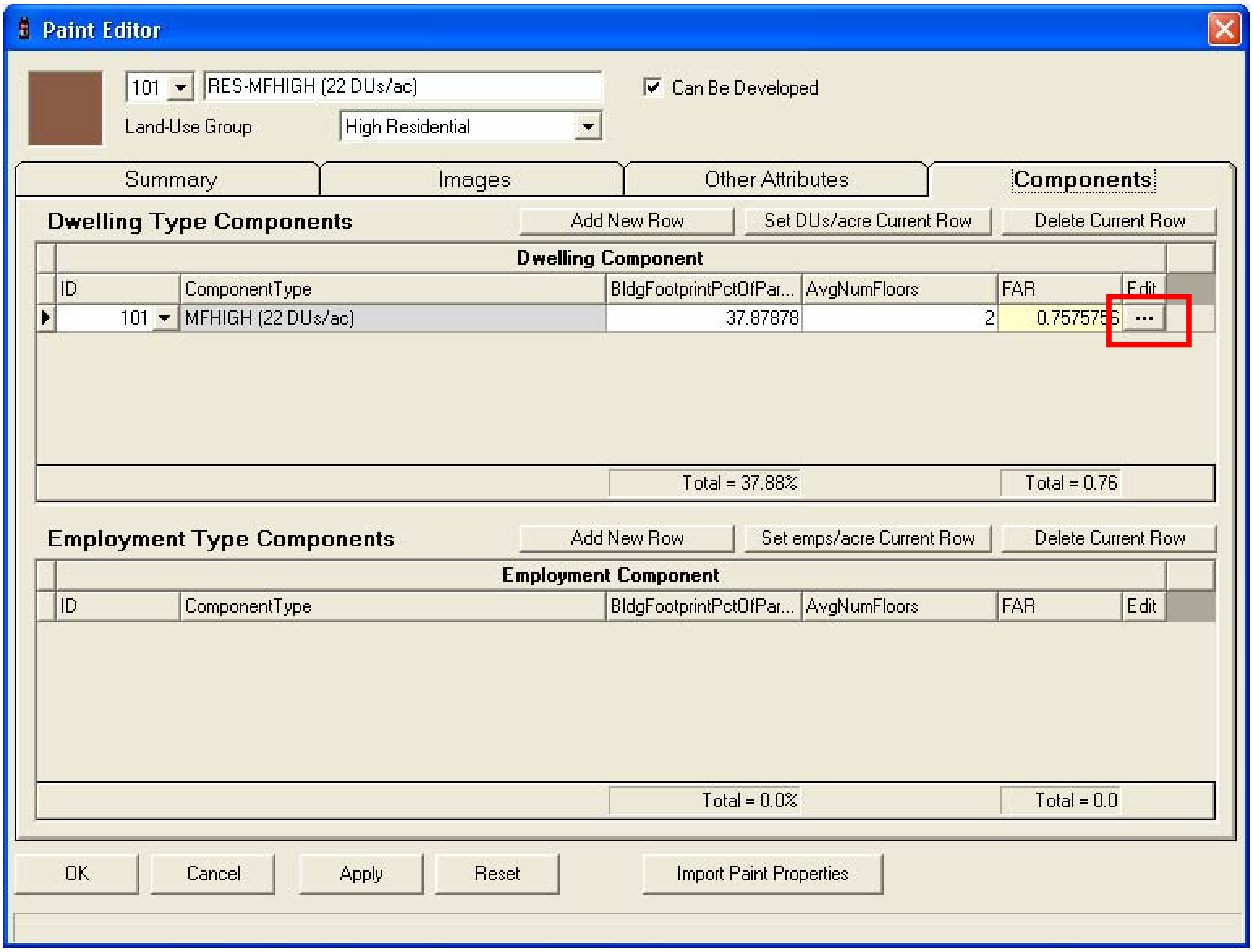
The Images tab provides a location for loading photos or drawings of the land-use type. If you double click in the image frame you can browse to a new photo and load it into the image frame:



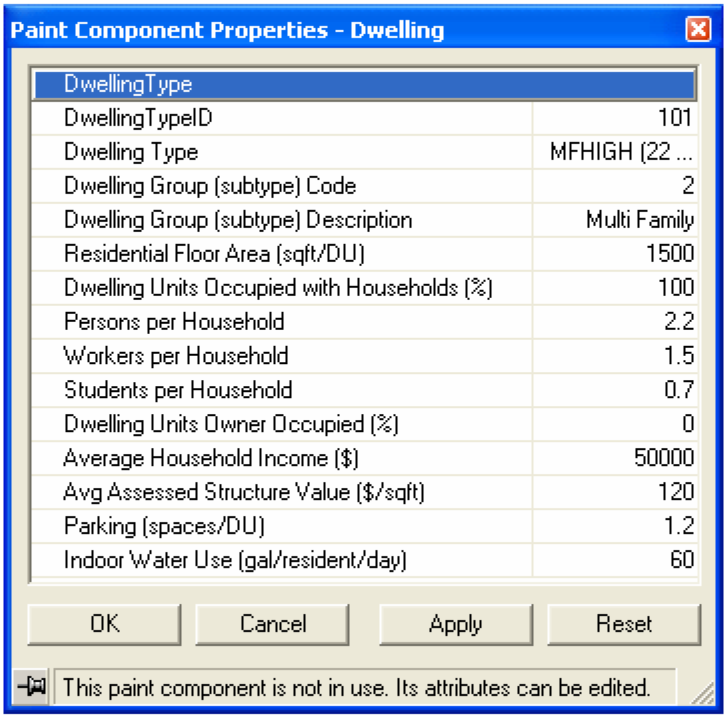
The Other Attributes tab contains input boxes for land value, SGWATER information, and landscaping percentages; along with additional summary information:



The Components tab allows you to associate one or more dwelling and/or employment types with the paint and set their densities. Select the Edit button next to the component type to edit the component attributes:



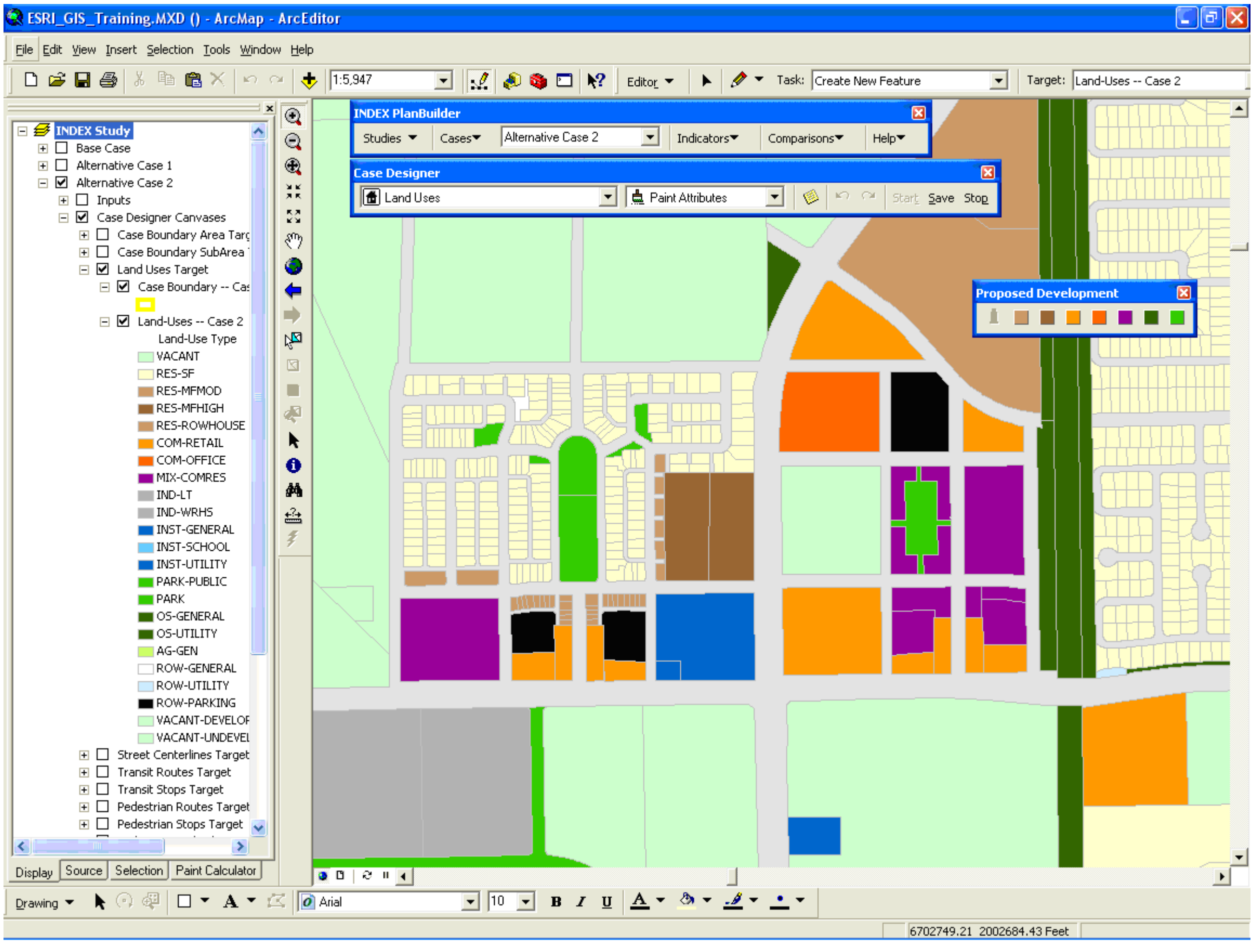
The Paint Component Properties dialog below shows attributes that can be associated with each component type:



Close both the Paint Component Properties dialog and the Paint Editor.

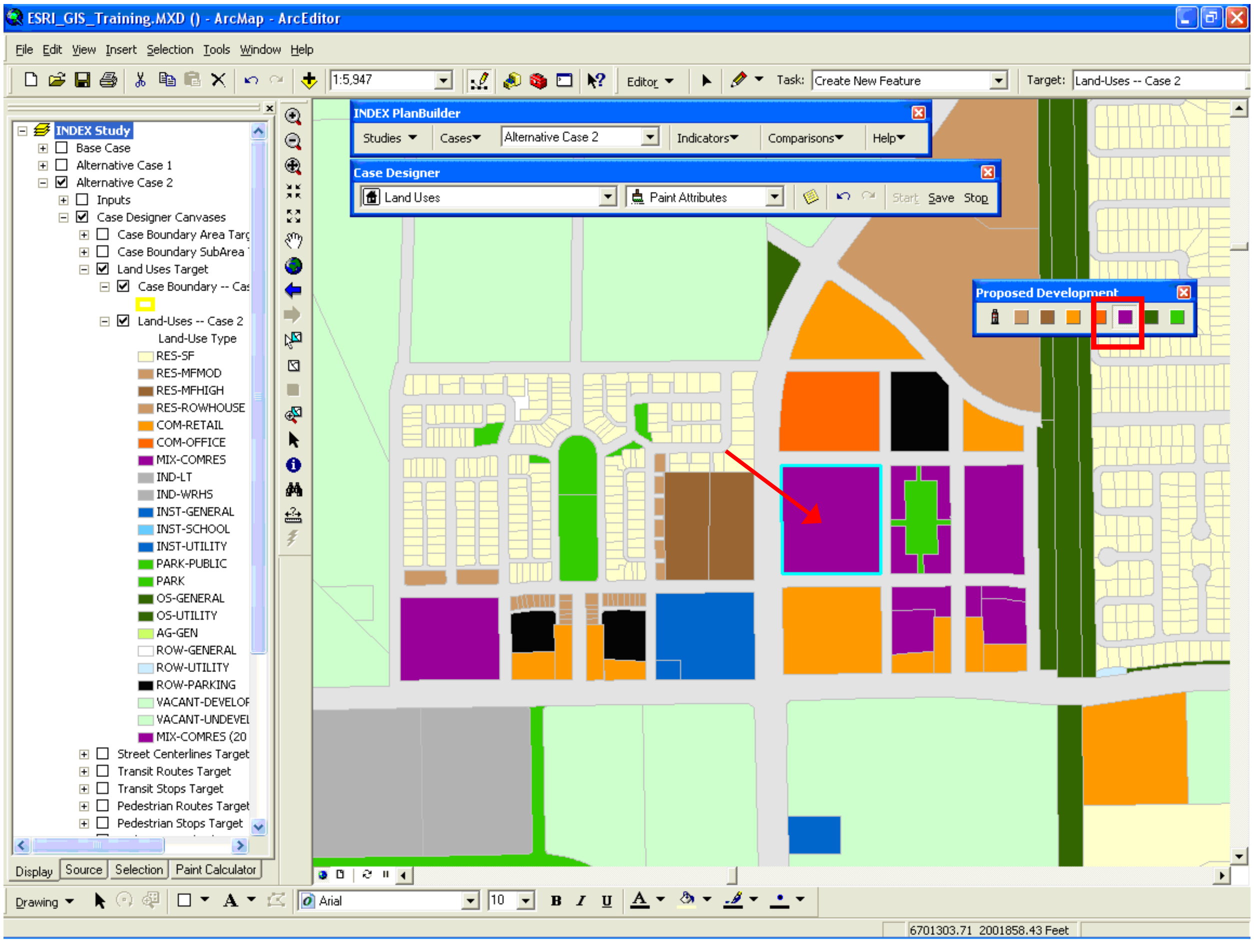
Apply Paints to Land-Uses

Zoom to the development proposal:

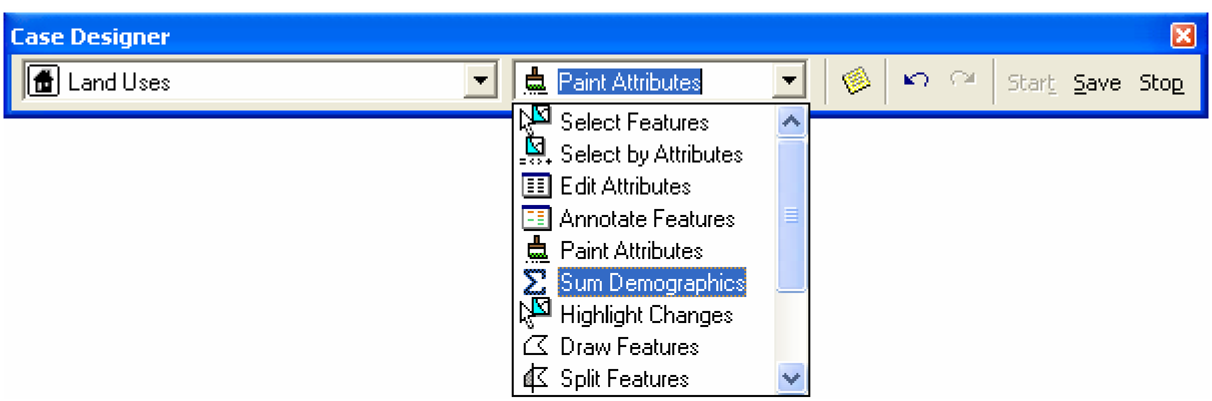


When you select one of the paints, the mouse icon will change to a paint brush.

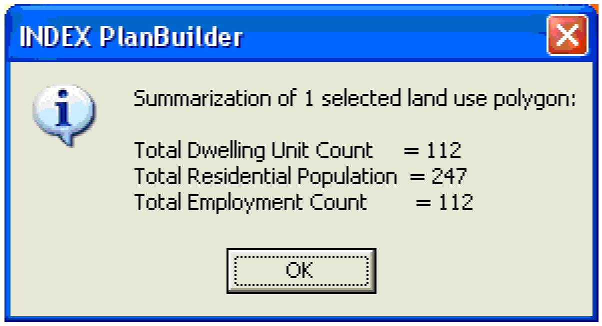
Select the Mixed-Use paint chip and paint the vacant parcel near the center of the development site by clicking on it, as shown below:



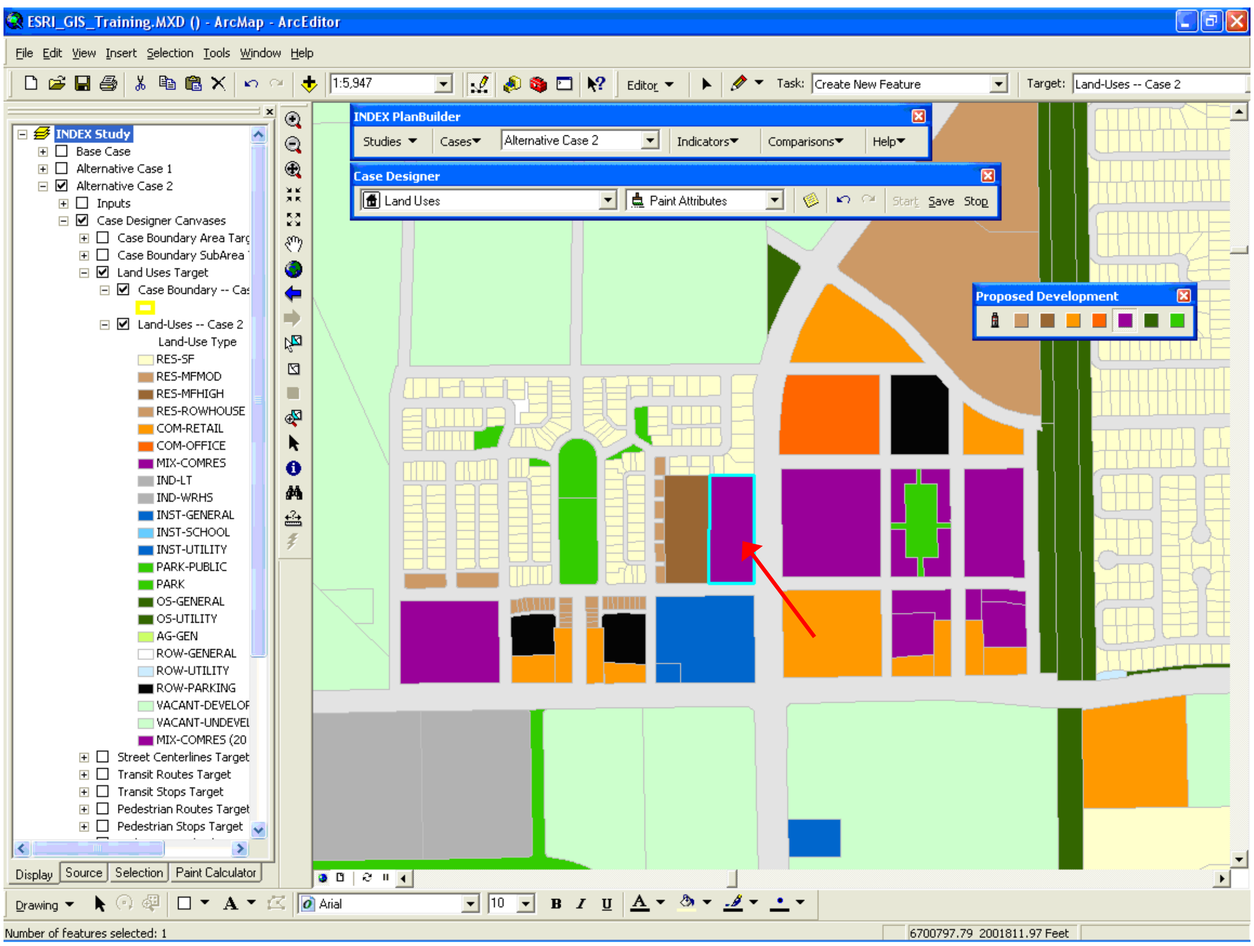
While the parcel is still selected, select the Sum Demographics tool from the Case Designer tools:



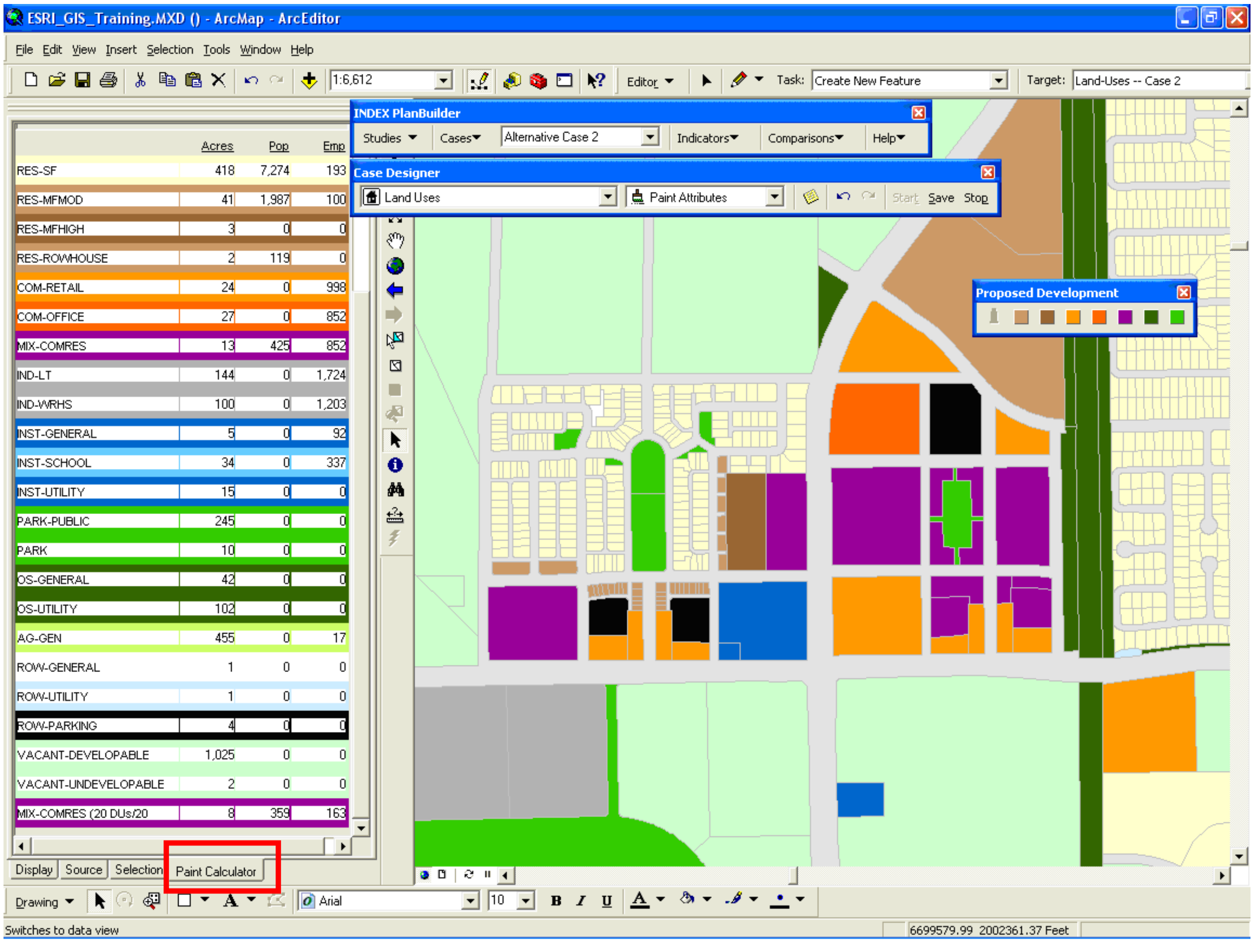
The Sum Demographics tool displays a dialog showing how many dwellings, residents, and employees were added to the parcel:



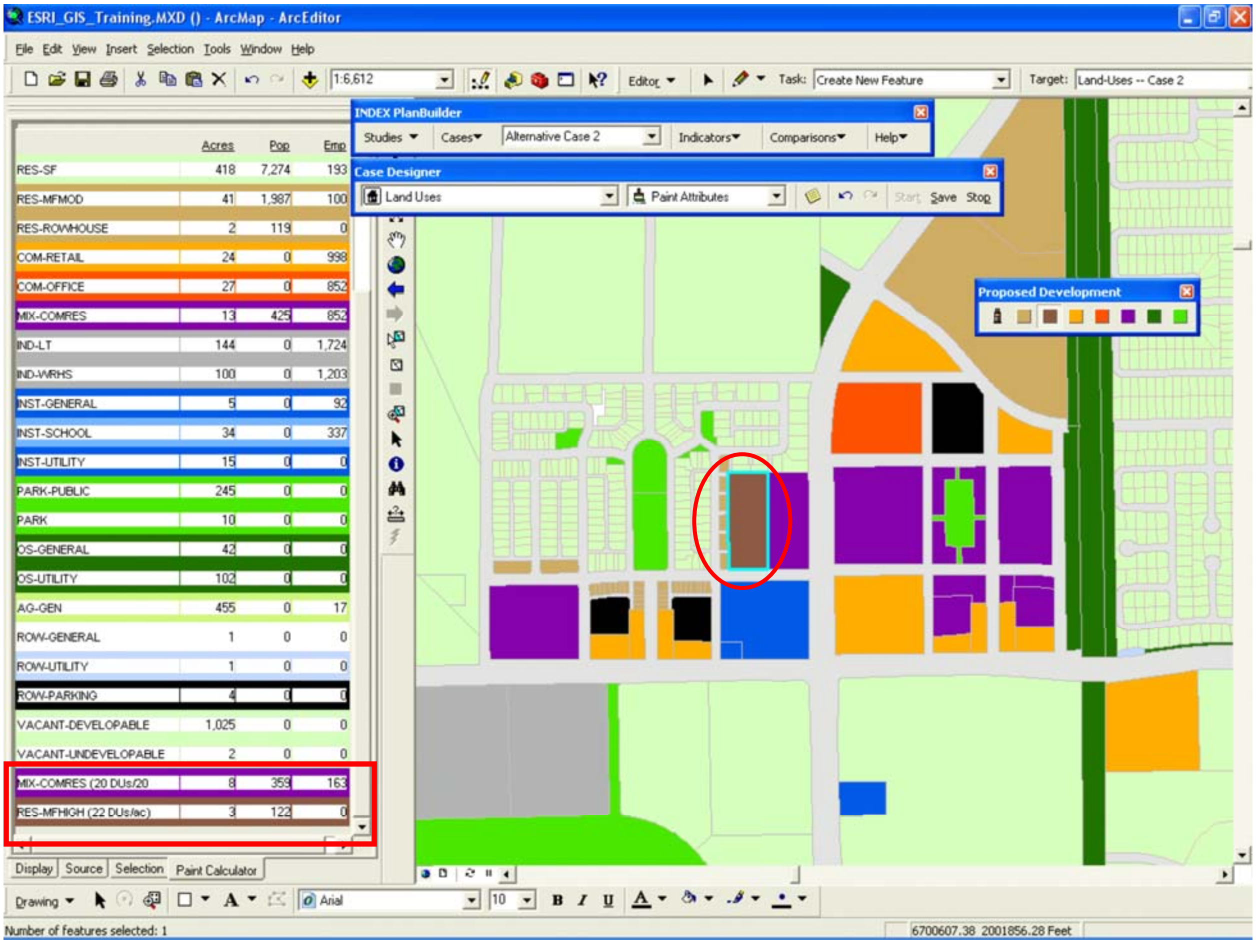
Painting land-use areas will remove all existing attributes and replace them with the paint values. Paint the parcel across from the previous one you painted with the mixed-use paint, as shown below:



To dynamically display the cumulative land area, population and employment for each land-use, select the Paint Calculator tab at the bottom of the Table of Contents and scroll down:



Try to increase multi-family dwelling density by selecting the RES-HIGH (22 DUs/ac) paint and paint the parcel shown below. Notice that the new land-use is dynamically added to the Paint Calculator:

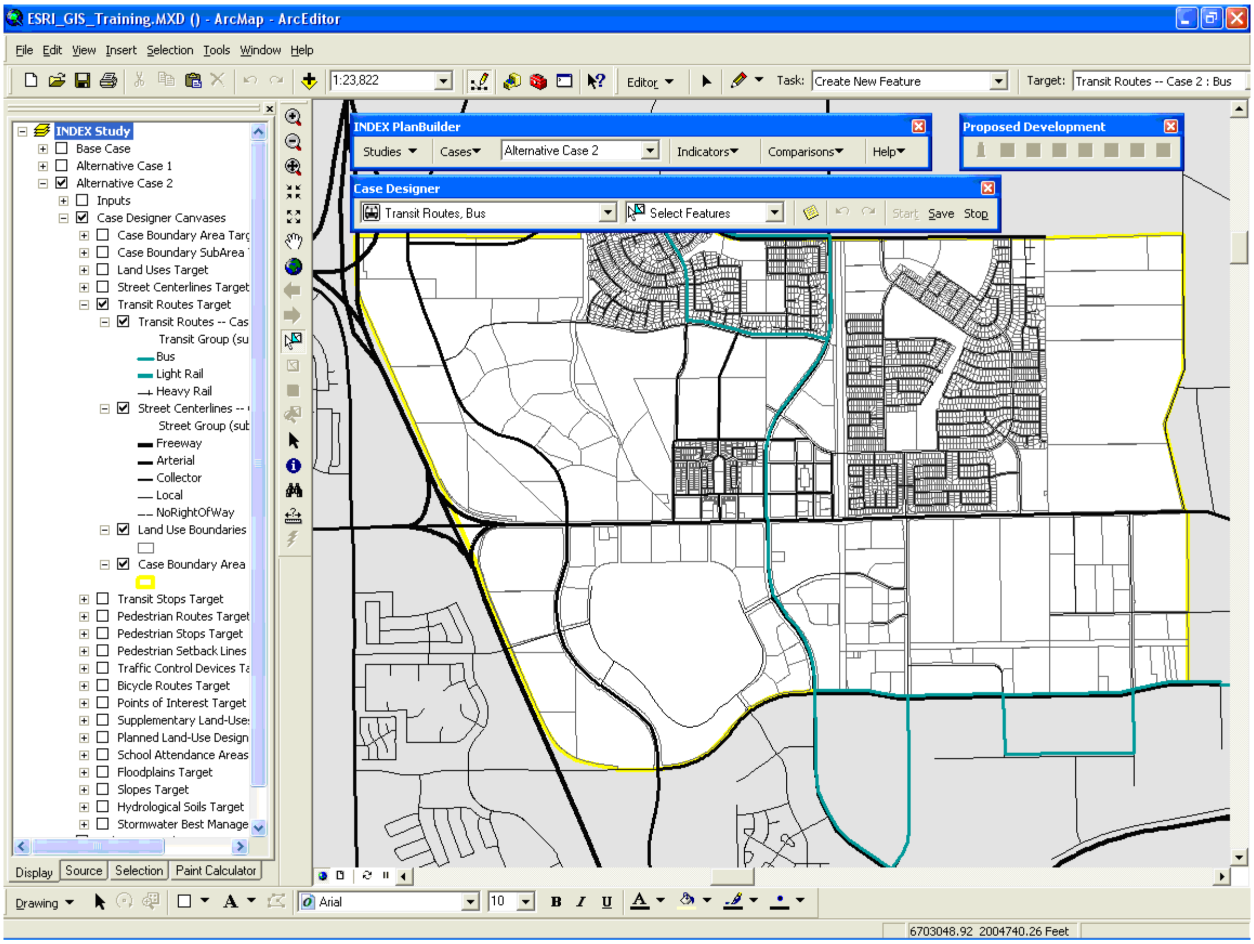


Save your edits and stop editing.

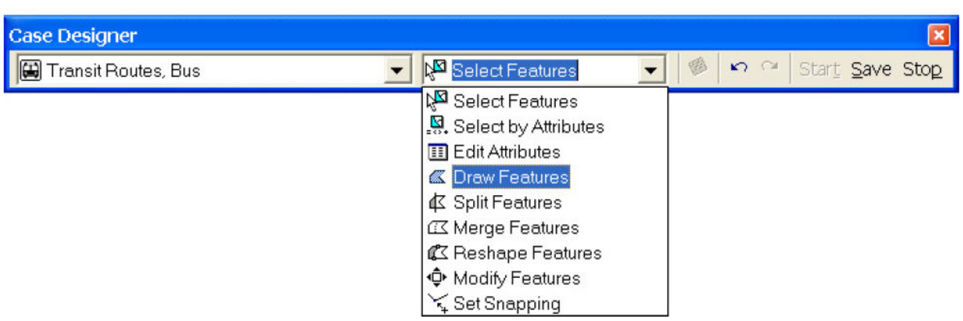
Improve Transit Coverage

The vicinity is deficient is transit service coverage according to case scores. In this section you will improve the transit coverage by creating a new bus route with bus stops through the center of the study area.

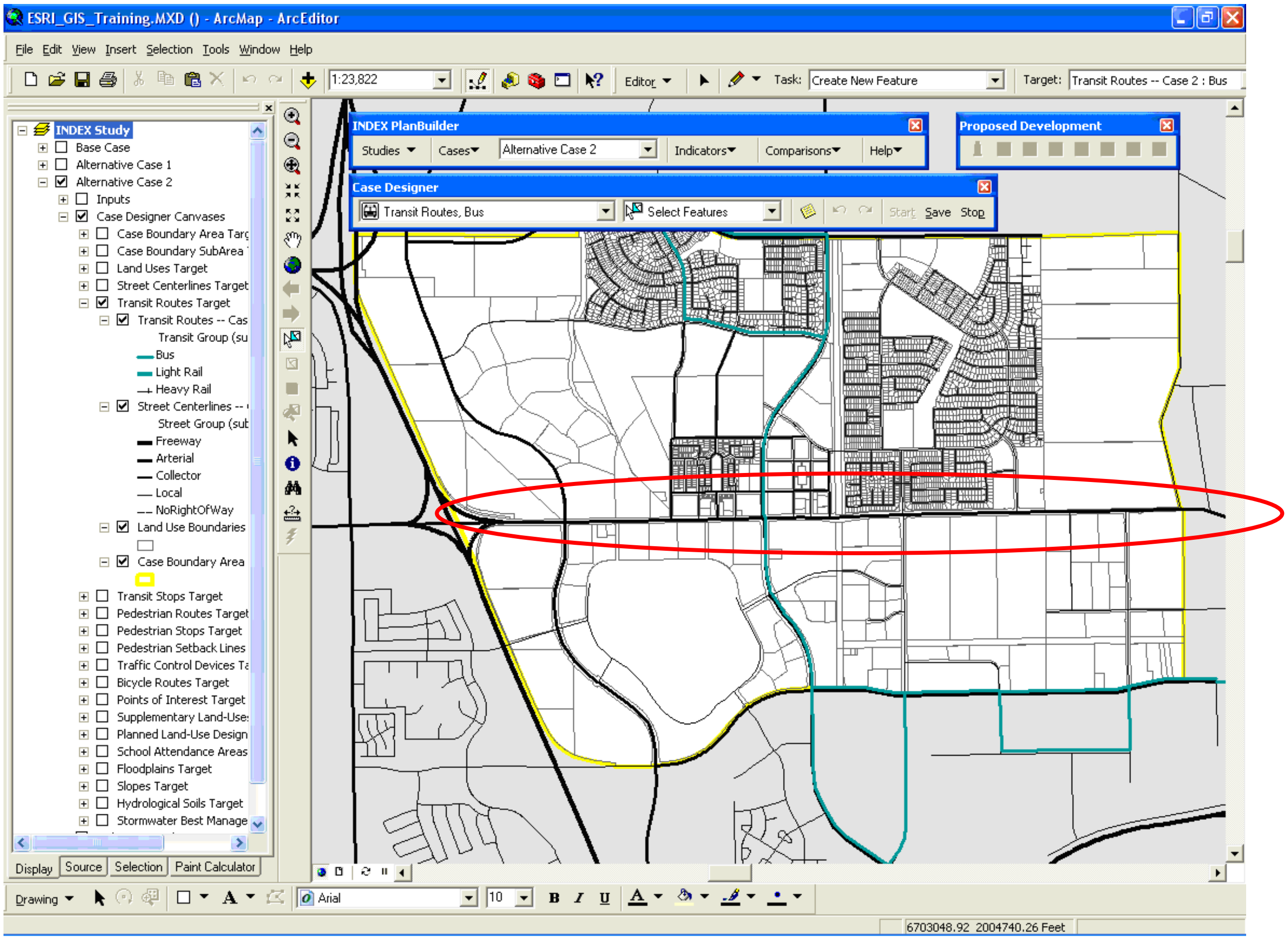
Activate Case Designer and make Bus Routes the active design target:



Select the Draw Features tool from the Case Designer toolbar:



Draw a bus route from the east to the west side of the study area:



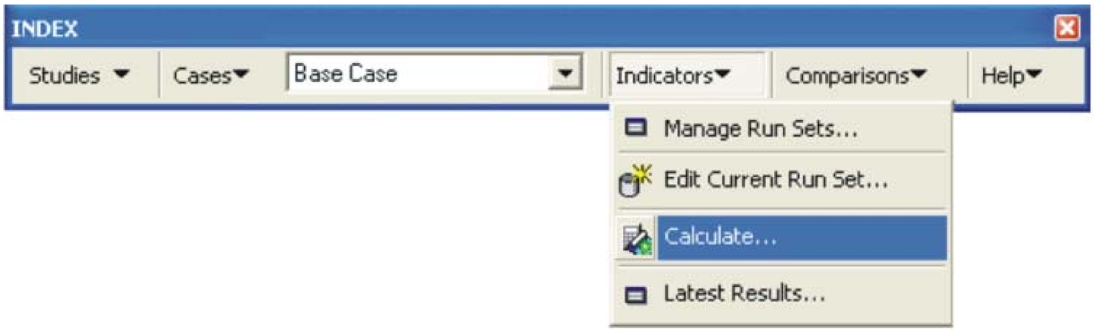
Save your edits.

RERUN INDICATORS AND COMPARE CASES

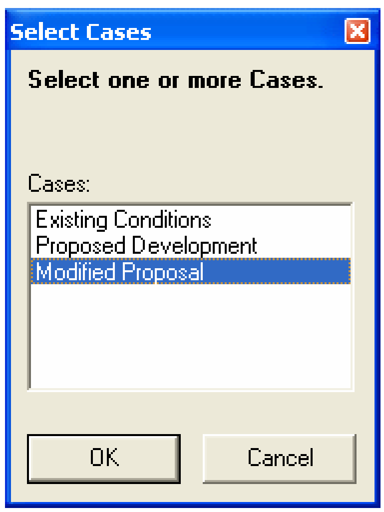
In this section you will evaluate the changes made to the development proposal by rerunning the indicators and comparing goal achievement.

Rerun Indicators

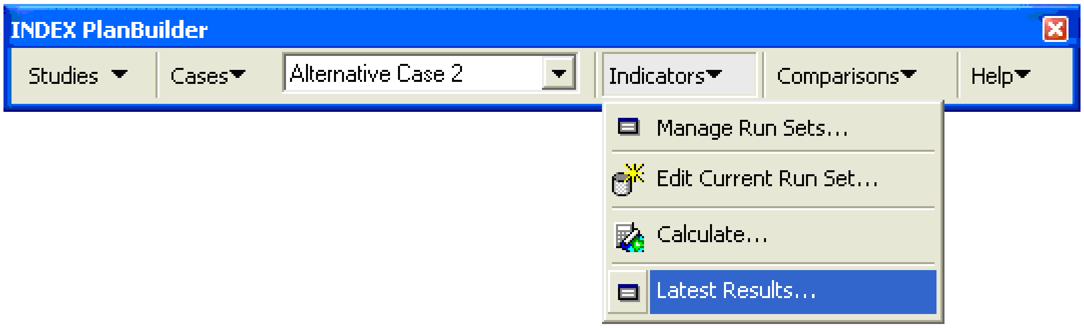
Select the Calculate option from the Indicators menu on the INDEX toolbar:



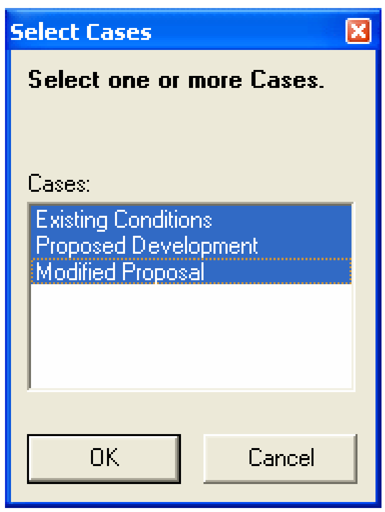
Select Alternative Case 2 and click the OK button:



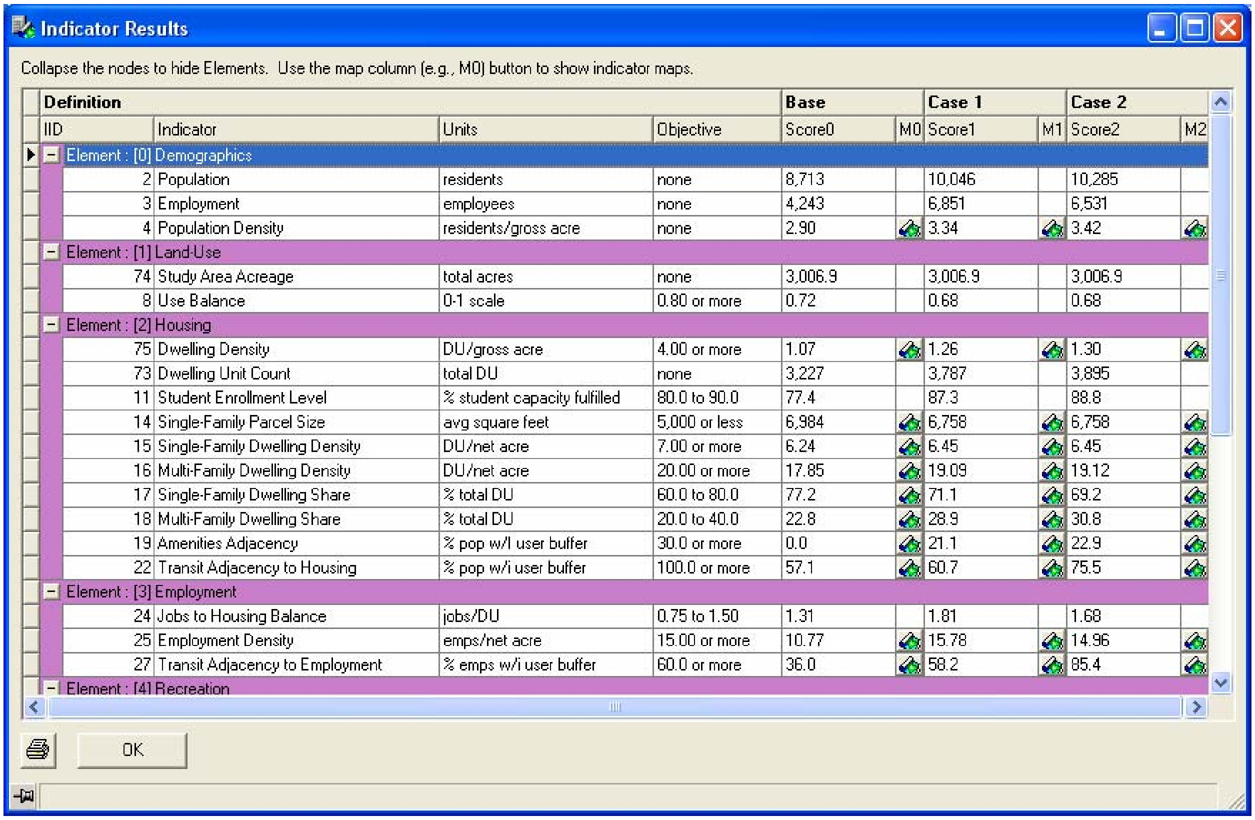
When the indicator run finishes, close the Indicator Results table and select the Latest Results option:



Select all three cases and click the OK button:



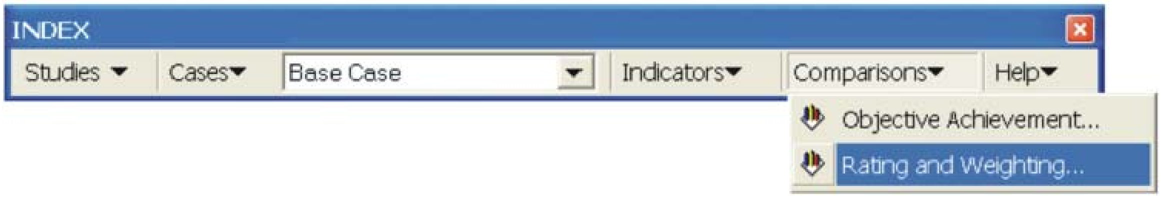
Expand the Indicator Results table so all three cases are showing and scroll through the results. Compare the changes in indicator scores between cases:



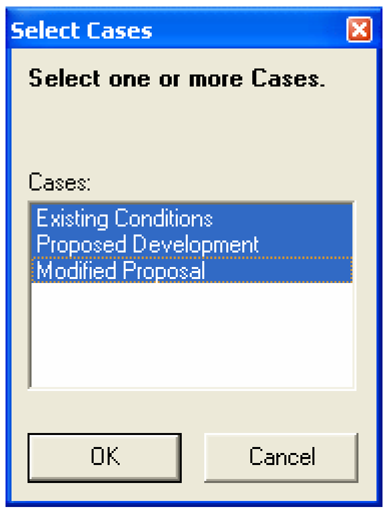
Definition				Base		Case 1		Case 2	
IID	Indicator	Units	Objective	Score0	M0	Score1	M1	Score2	M2
Element : [0] Demographics									
2	Population	residents	none	8,713		10,046		10,285	
3	Employment	employees	none	4,243		6,851		6,531	
4	Population Density	residents/gross acre	none	2.90		3.34		3.42	
Element : [1] Land-Use									
74	Study Area Acreage	total acres	none	3,006.9		3,006.9		3,006.9	
8	Use Balance	0-1 scale	0.80 or more	0.72		0.68		0.68	
Element : [2] Housing									
75	Dwelling Density	DU/gross acre	4.00 or more	1.07		1.26		1.30	
73	Dwelling Unit Count	total DU	none	3,227		3,787		3,895	
11	Student Enrollment Level	% student capacity fulfilled	80.0 to 90.0	77.4		87.3		88.8	
14	Single-Family Parcel Size	avg square feet	5,000 or less	6,984		6,758		6,758	
15	Single-Family Dwelling Density	DU/net acre	7.00 or more	6.24		6.45		6.45	
16	Multi-Family Dwelling Density	DU/net acre	20.00 or more	17.85		19.09		19.12	
17	Single-Family Dwelling Share	% total DU	60.0 to 80.0	77.2		71.1		69.2	
18	Multi-Family Dwelling Share	% total DU	20.0 to 40.0	22.8		28.9		30.8	
19	Amenities Adjacency	% pop w/I user buffer	30.0 or more	0.0		21.1		22.9	
22	Transit Adjacency to Housing	% pop w/i user buffer	100.0 or more	57.1		60.7		75.5	
Element : [3] Employment									
24	Jobs to Housing Balance	jobs/DU	0.75 to 1.50	1.31		1.81		1.68	
25	Employment Density	emps/net acre	15.00 or more	10.77		15.78		14.96	
27	Transit Adjacency to Employment	% emps w/i user buffer	60.0 or more	36.0		58.2		85.4	
Element : [4] Recreation									

Close the Indicator Results table.

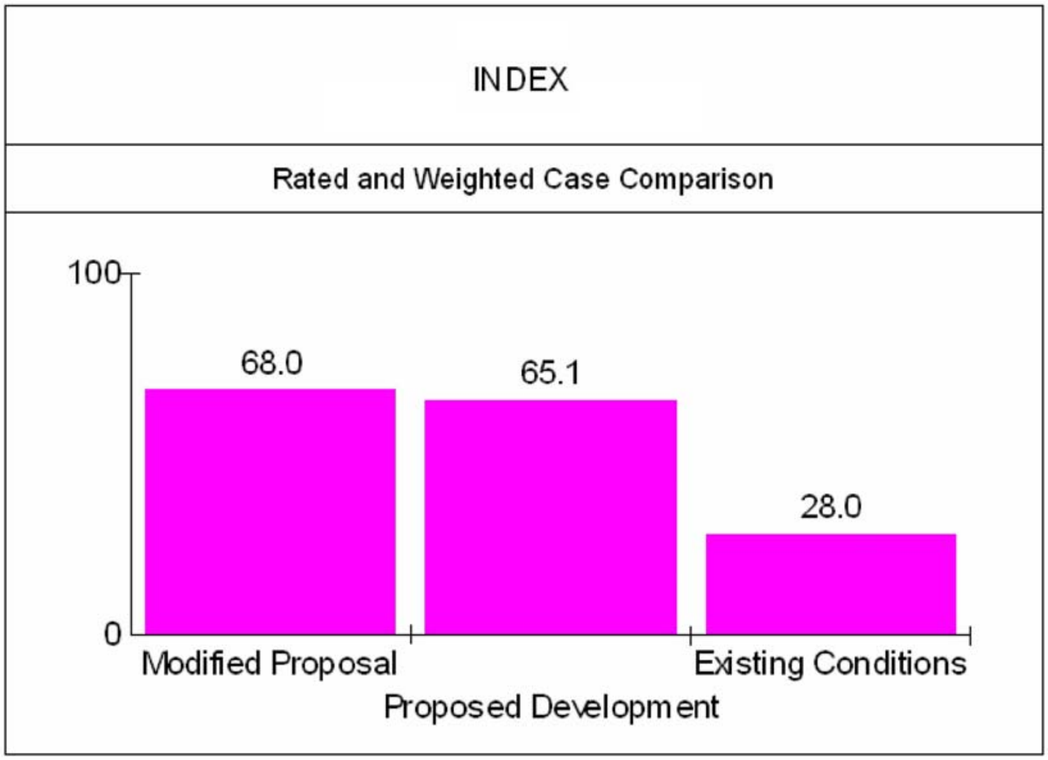
Compare the goal achievement of the two cases side-by-side with the RAW bar chart. Open the Rating and Weighting bar from the Comparisons menu on the INDEX toolbar:



Select all three cases from the Select Cases dialog:



The RAW bar chart reveals a positive impact from the changes made to the original development proposal:



Note: actual scores may vary as they depend on individual edits

INDEX PlanBuilder

Planning Support System
Release 9.2

Tutorial 1:
Jurisdiction Set-Up

April 2007

CRITERION PLANNERS

CRITERION

www.crit.com

CONTENTS

INTRODUCTION

This tutorial covers the initial set-up of INDEX for a jurisdiction, such as a city or county, or multi-jurisdiction region. As shown in Figure 1, this stage prepares INDEX for subsequent use at any location in the jurisdiction where individual studies can be created and evaluated.

Jurisdictional set-up of INDEX addresses the following primary tasks:

- Pre-process jurisdiction data.
- Establish spatial references.
- Create sets of indicators and objectives.
- Create palettes of land-use paints and transportation features for use in scenario-building.

As shown in Figure 2, once the jurisdictional set-up is completed, users are able to create studies anywhere in the jurisdiction. It is possible to set-up INDEX for only a subarea or portion of a jurisdiction, but the disadvantage of that approach is having to set-up the tool again when another study at a different location is started. Having the entire jurisdiction set-up at the outset will save time and enable quicker study responses.

INDEX PlanBuilder supports all ArcGIS license types (ArcView, ArcEditor, ArcInfo). However ArcView users are limited in the kinds of indicators they can run, and therefore have reduced data requirements. Throughout the INDEX PlanBuilder documentation, where applicable the following highlights denote license-specific features or instructions:

ArcEditor/ArcInfo Users, or

ArcView Users

Figure 1. BASIC STEPS IN APPLYING INDEX

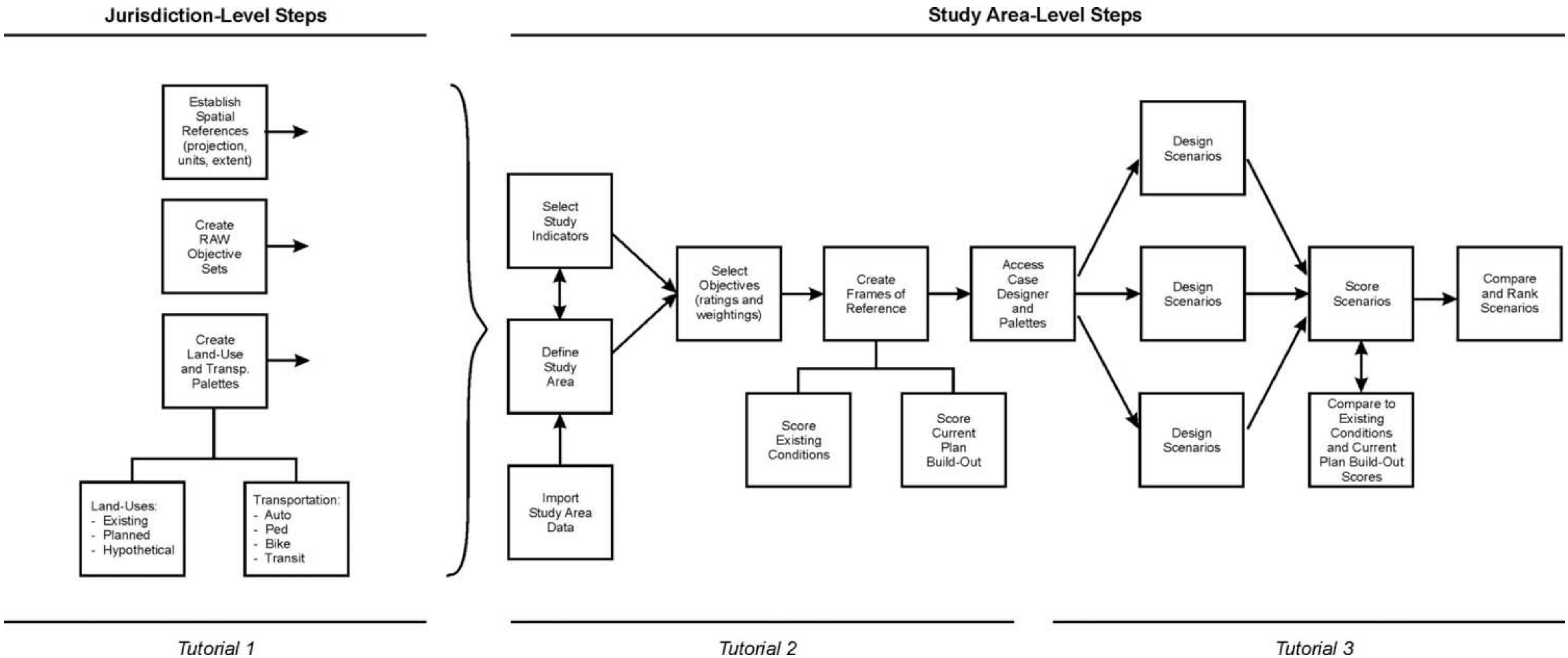
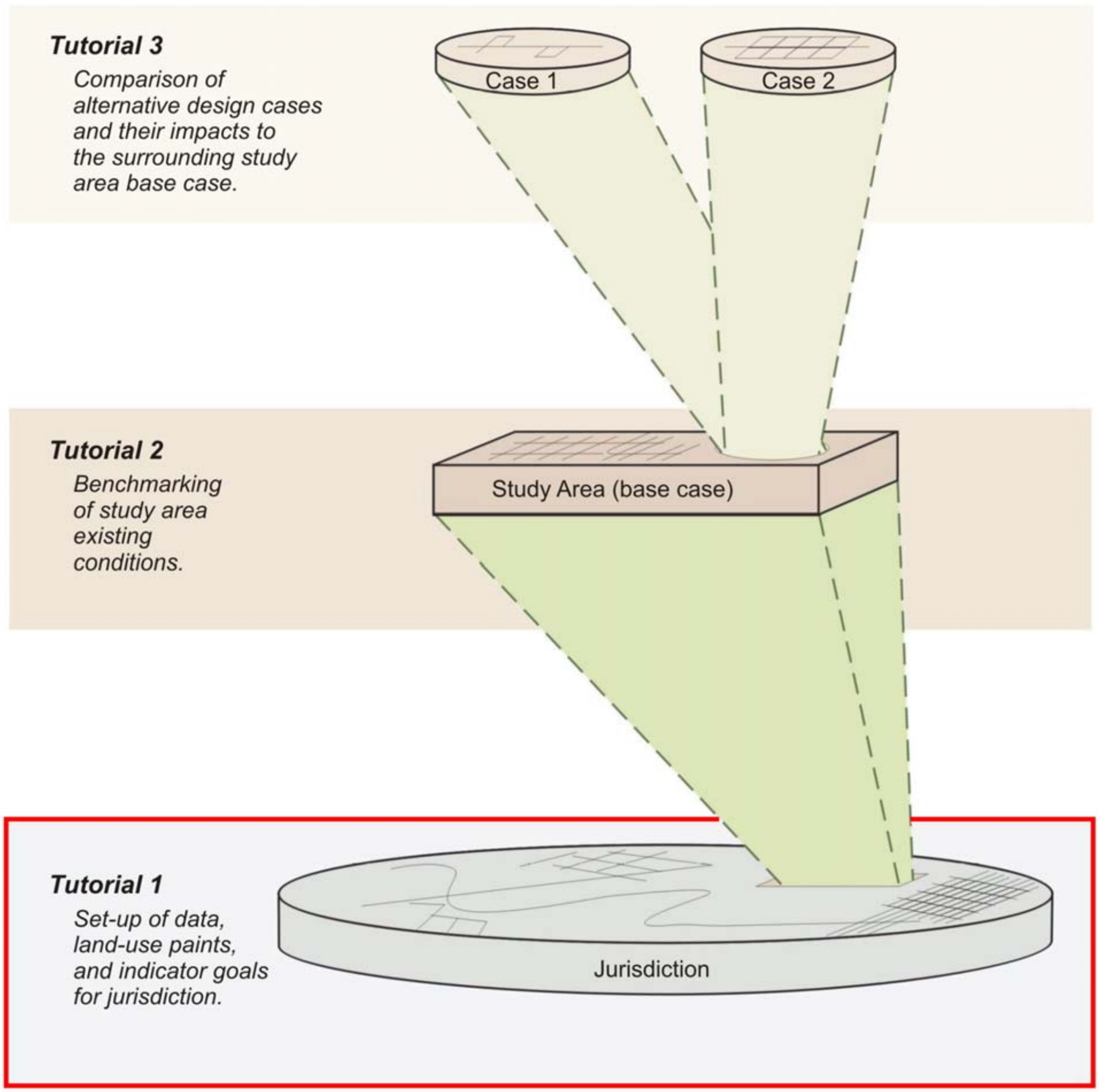


Figure 2

TUTORIAL SEQUENCE AND GEOGRAPHIC RELATIONSHIPS



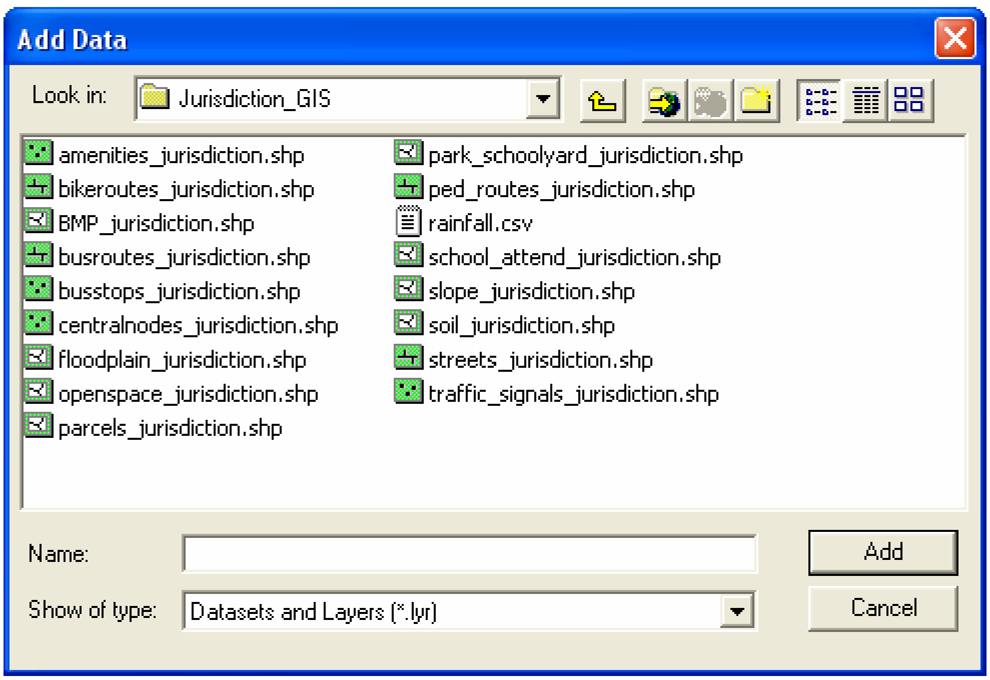
PRE-PROCESSING OF JURISDICTION DATA

INDEX has specific data requirements that vary depending on the indicators you choose to run (refer to Appendix D in the Indicator Dictionary for a detailed description of indicator data requirements). Much of the data will exist in the jurisdiction's GIS database; however, some may need to be created or acquired from other sources. The optimal approach is to set up data for the entire jurisdiction and clip out or extract portions for study areas as the need arises.

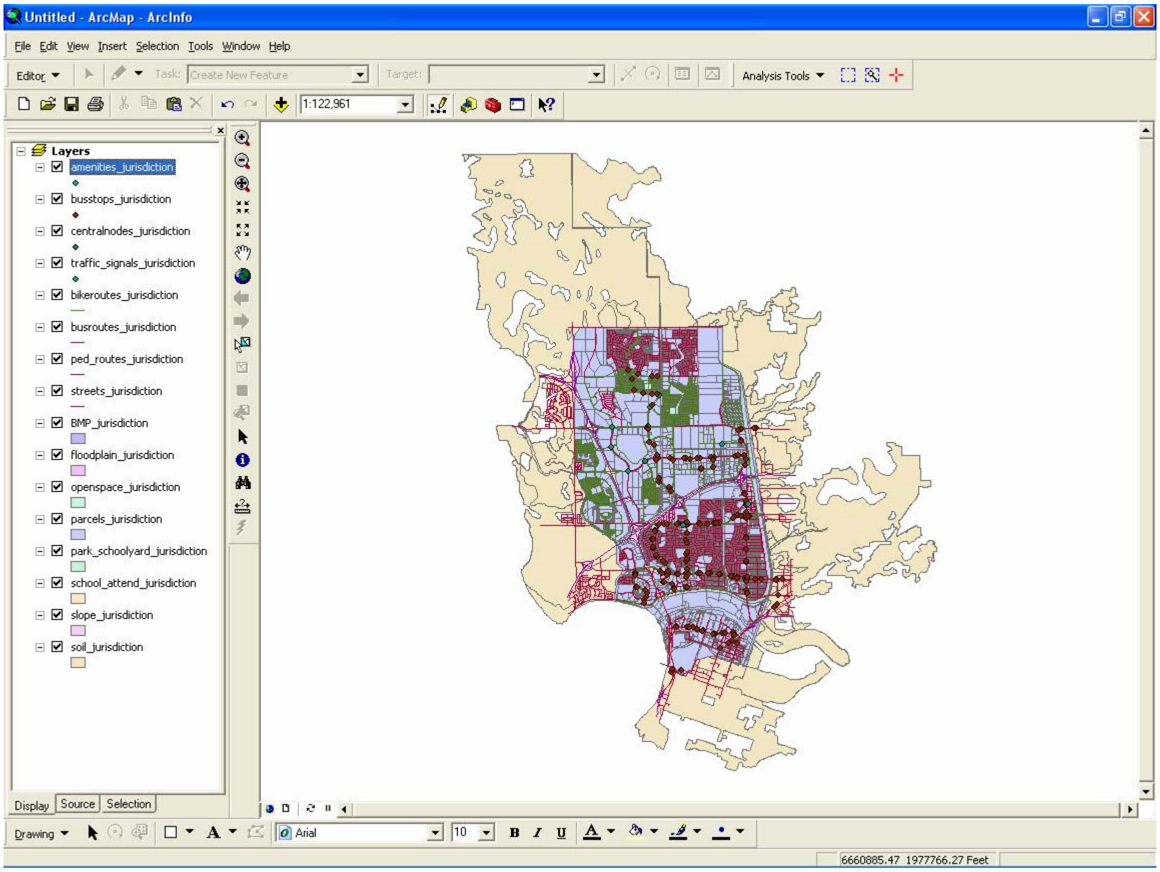
In this section you will explore some of the primary data used by INDEX, with particular attention to data type, geographic extent, and tabular attributes. You will also modify the existing land-use shapefile (parcels) by providing a numeric value for each of the jurisdiction's land-use types. The data used in this tutorial is intended to be representative of a small municipal jurisdiction.

Open a standard ArcMap project and load all of the shapefiles located in the folder:

[My Documents]\Criterion\INDEX\PlanBuilder\9.2\TutorialData\Jurisdiction_GIS



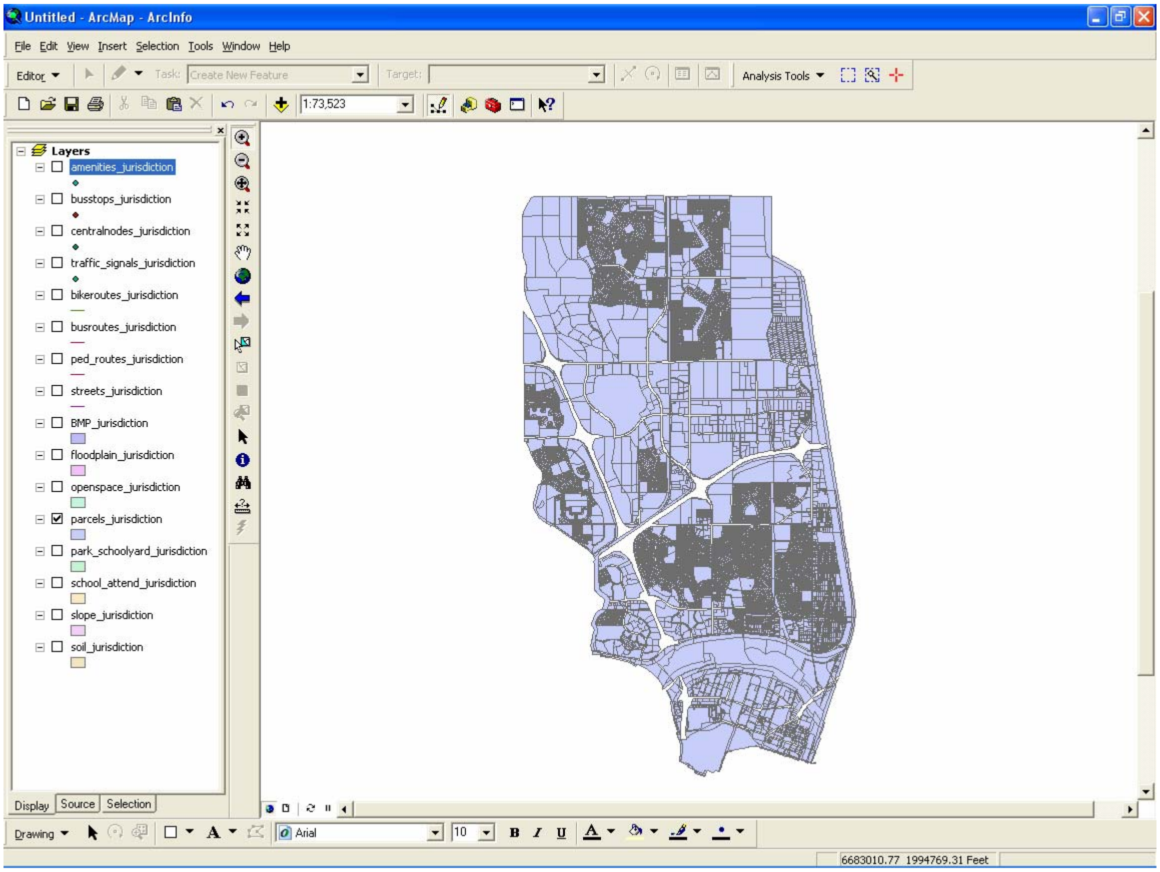
The data available for the jurisdiction is fairly extensive, and more will be provided for the study area. Explore the shapefiles in ArcMap, paying close attention to the table attributes:

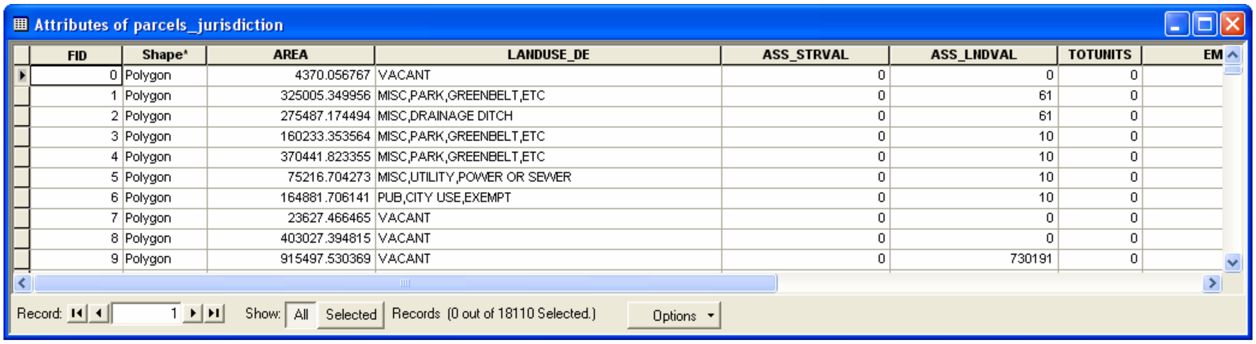


Existing Land-Use

Existing land-use is one of the most heavily attributed feature classes in INDEX and is used in many of the indicator calculations.

Right-click on the Parcels layer in the TOC and open the attributes table and look at the data in the attribute fields:



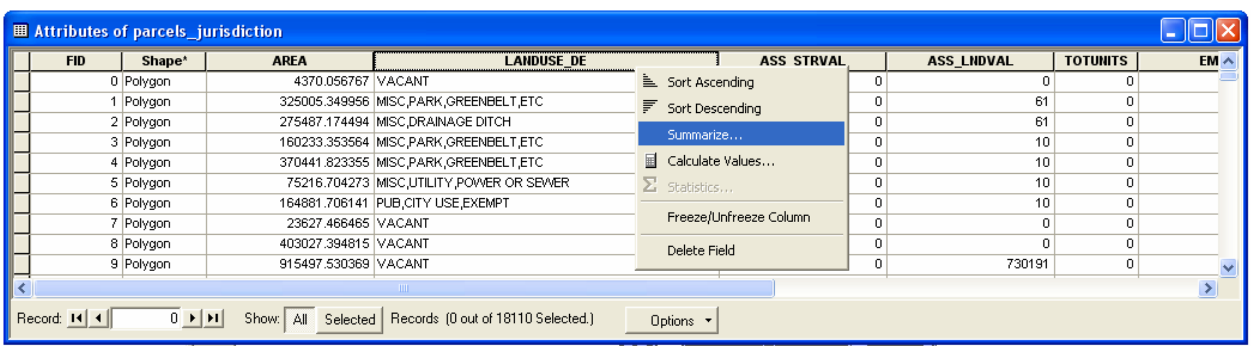


Use the table in Appendix D of the Indicator Dictionary to identify attributes from the Parcel attribute table that can be used to populate the INDEX Land-Use data fields.

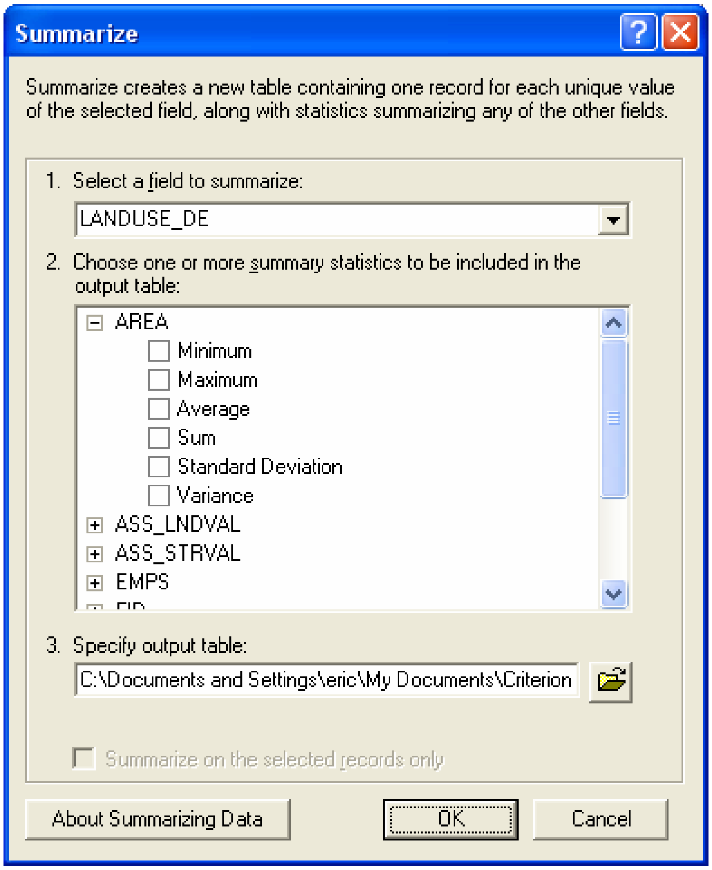
There are two fields in the attribute table that can be loaded directly into INDEX: TOTUNITS (total number of housing units) and EMPS (number of employees). The ASS_STRVL (assessed structure value) and the ASS_LNDVAL (assessed land value) values can be summed in a new field to calculate the Total Assessed Value, which can be loaded directly into INDEX.

Other values may be derived from the existing fields. For example, Residential Population can be obtained from the TOTUNITS field by multiplying the Total Units by the average number of residents per household for each dwelling type.

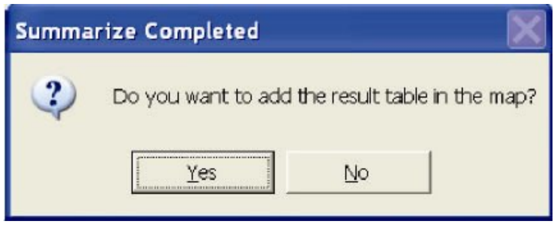
Before land-uses can be loaded into INDEX, a numeric value must be provided for each of the jurisdiction's land-use types. The LANDUSE_DE field contains definitions of all of the jurisdiction's existing land-uses. Right click on the LANDUSE_DE field title and select Summary to obtain a list of all of the land-use types:



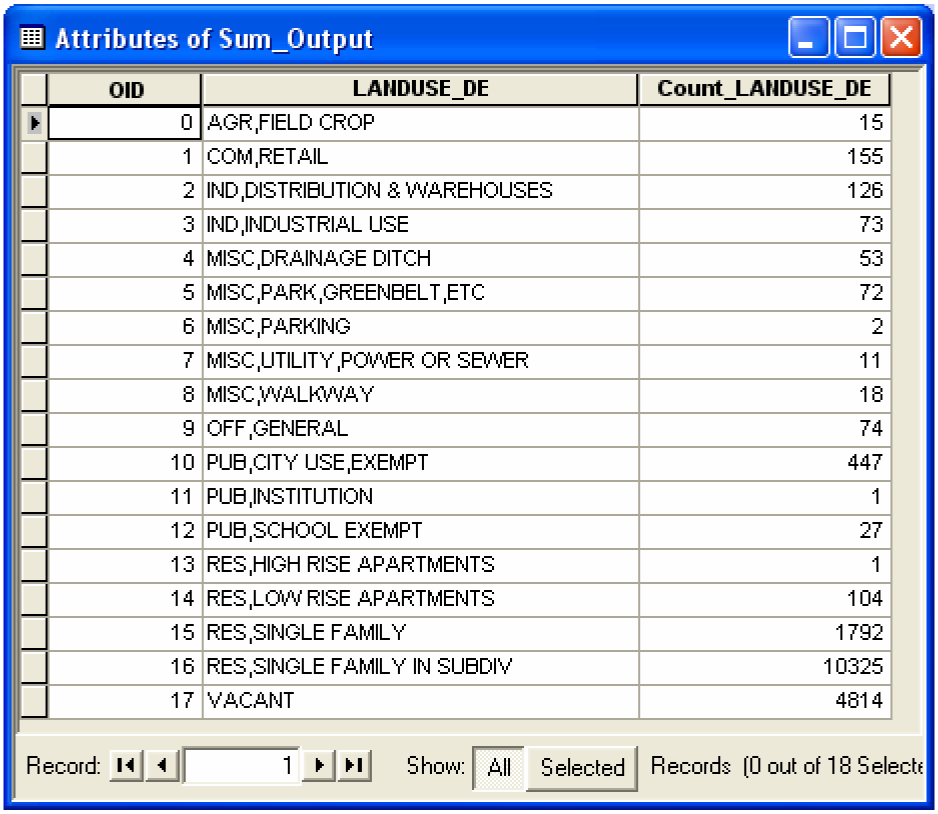
There is no need to summarize additional information from the other fields, so select OK on the Summarize dialog:



Select "Yes" to add the Summary Result table:



Open the Summary Result table from the ArcMap TOC:



Attributes of Sum_Output

OID	LANDUSE_DE	Count_LANDUSE_DE
0	AGR,FIELD CROP	15
1	COM,RETAIL	155
2	IND,DISTRIBUTION & WAREHOUSES	126
3	IND,INDUSTRIAL USE	73
4	MISC,DRAINAGE DITCH	53
5	MISC,PARK,GREENBELT,ETC	72
6	MISC,PARKING	2
7	MISC,UTILITY,POWER OR SEWER	11
8	MISC,WALKWAY	18
9	OFF,GENERAL	74
10	PUB,CITY USE,EXEMPT	447
11	PUB,INSTITUTION	1
12	PUB,SCHOOL EXEMPT	27
13	RES,HIGH RISE APARTMENTS	1
14	RES,LOW RISE APARTMENTS	104
15	RES,SINGLE FAMILY	1792
16	RES,SINGLE FAMILY IN SUBDIV	10325
17	VACANT	4814

Record: 1 Show: All Selected Records (0 out of 18 Selecte

The Summary Result table provides a list of all of the existing land-use types in the jurisdiction.

INDEX requires that land-use types must be represented by a numeric value between 18 and 250 (values 1-17 are reserved for sample land-use definitions). The numeric values will be matched up with land-use definitions that you will create in INDEX.
Land-use types should be categorized using a logical classification scheme based on jurisdiction standards. Land-use ID#'s 18 and 19 are available, but for purposes of the tutorial you will start with ID# 20 to better organize the jurisdiction's existing land-use categories. The table below provides an example of how existing land-use types might be grouped:

LAND-USE CATEGORIES	NUMERIC CATEGORIES
RESIDENTIAL TYPES	20 – 29
COMMERCIAL/OFFICE TYPES	30 – 34
MIXED-USE TYPES	35 – 39
INDUSTRIAL TYPES	40 – 44
INSTITUTIONAL TYPES	45 – 49
PARK/RECREATION TYPES	50 – 54
OPEN SPACE TYPES	55 – 59
AGRICULTURE TYPES	60 – 64
RIGHT-OF-WAY TYPES	65 – 69
MISCELLANEOUS TYPES	70 – 74
VACANT TYPES	75 - 79

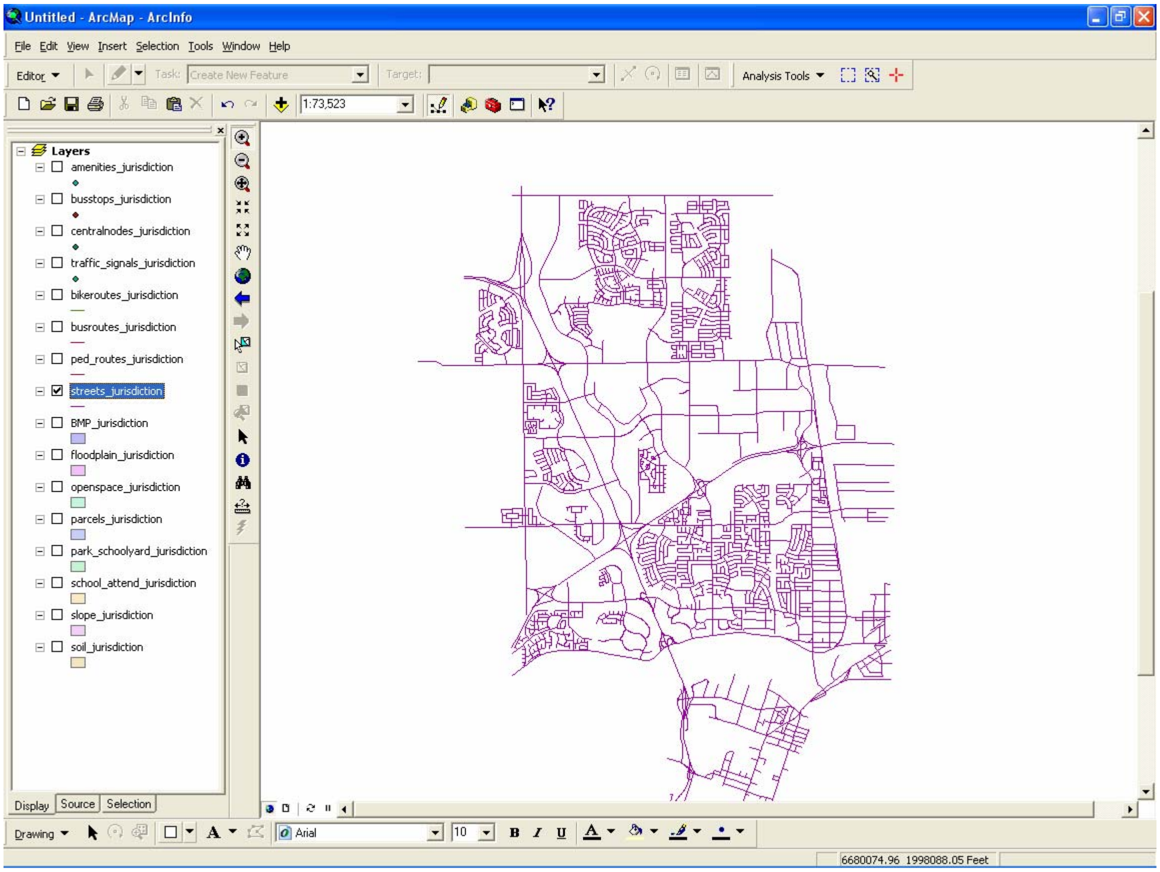
Note: the available 233 paints will also be used to define planned land-uses and design paints.

Next, create a field in the Parcel attribute table and add numeric values for the existing land-use types. This field has already been created in the tutorial attribute table for you. New INDEX land-use values are provided in the INDEX Type ID table below:

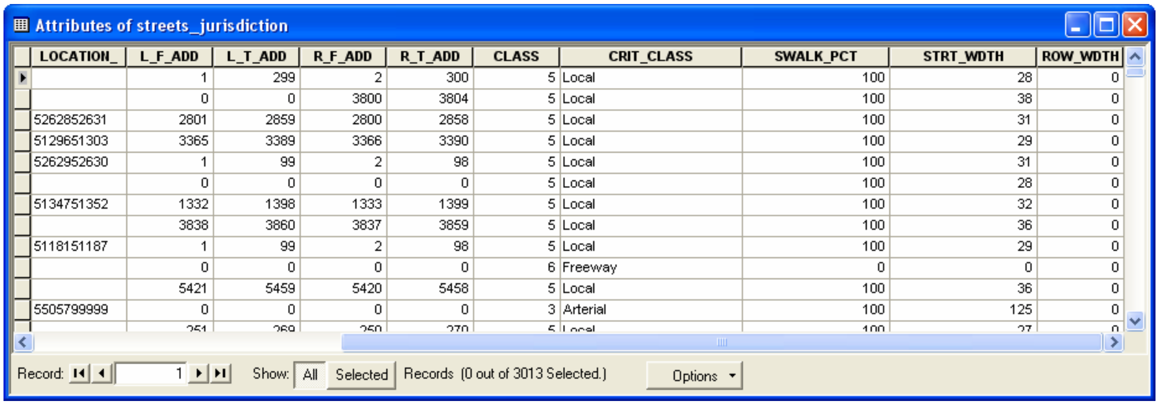
LANDUSE_DE (existing land-uses)	**INDEX TYPE ID**
RES,SINGLE FAMILY	20
RES,SINGLE FAMILY IN SUBDIV	20
RES,LOW RISE APARTMENTS	21
RES,HIGH RISE APARTMENTS	22
COM,RETAIL	30
OFF,GENERAL	31
IND,INDUSTRIAL USE	40
IND,DISTRIBUTION & WAREHOUSES	41
PUB,INSTITUTIONAL	45
PUB,SCHOOL EXEMPT	46
PUB,CITY USE,EXEMPT	47
MISC,PARK,GREENBELT,ETC	50
MISC,DRAINAGE,OPENSPACE	55
AGR,FIELD CROP	60
MISC,WALKWAY	66
MISC,UTILITY,POWER OR SEWER	67
MISC,PARKING	68
VACANT	75

Street Centerlines

Street Centerlines are another important data requirement for INDEX. Notice that the centerline segments extend beyond the study area in order to capture nearby surroundings that might impact the study area:



Open the Street attribute table and look at the data in the attribute fields. These characteristics of the street network are associated with each line segment, including sidewalk information:


Attributes of streets_jurisdiction

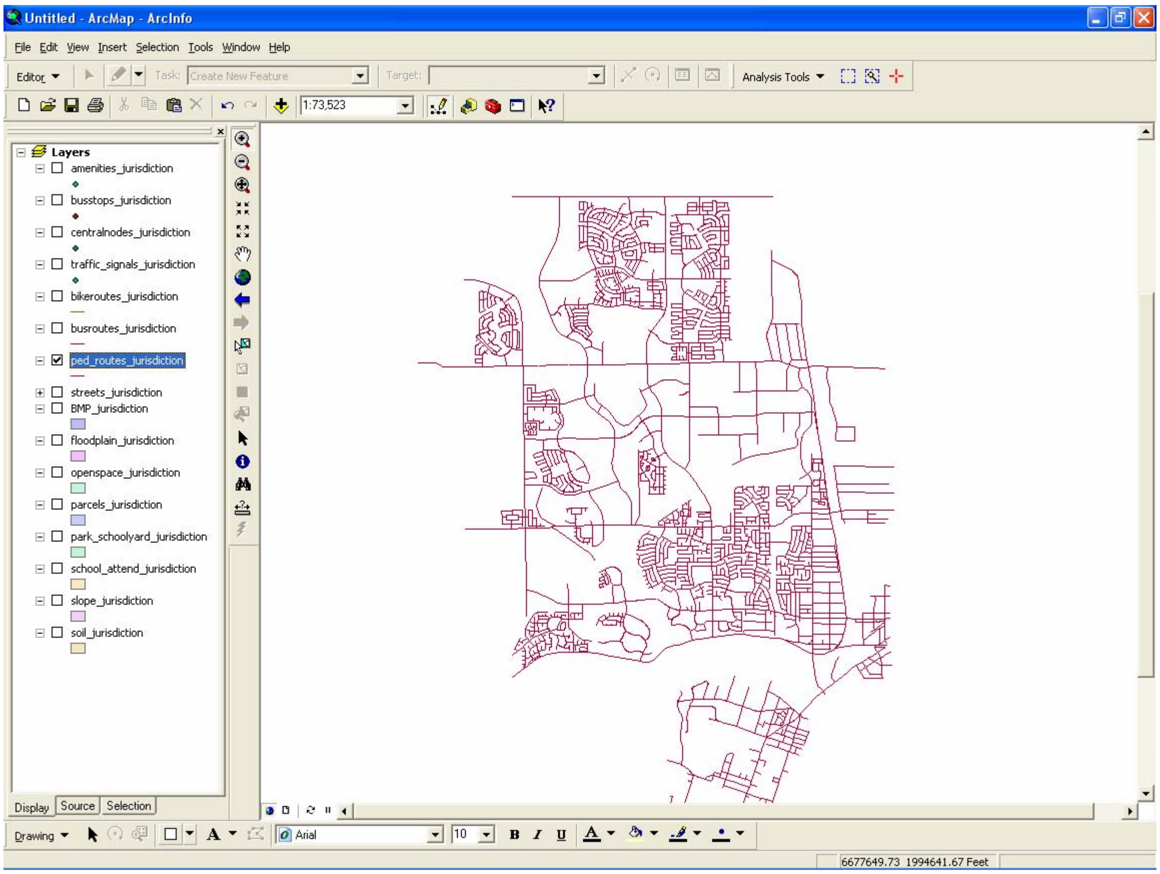
LOCATION_	L_F_ADD	L_T_ADD	R_F_ADD	R_T_ADD	CLASS	CRIT_CLASS	SWALK_PCT	STRT_WDTH	ROW_WDTH
	1	299	2	300	5	Local	100	28	0
	0	0	3800	3804	5	Local	100	38	0
5262852631	2801	2859	2800	2858	5	Local	100	31	0
5129651303	3365	3389	3366	3390	5	Local	100	29	0
5262952630	1	99	2	98	5	Local	100	31	0
	0	0	0	0	5	Local	100	28	0
5134751352	1332	1398	1333	1399	5	Local	100	32	0
	3838	3860	3837	3859	5	Local	100	36	0
5118151187	1	99	2	98	5	Local	100	29	0
	0	0	0	0	6	Freeway	0	0	0
	5421	5459	5420	5458	5	Local	100	36	0
5505799999	0	0	0	0	3	Arterial	100	125	0

Record: 1 Show: All Selected Records (0 out of 3013 Selected.) Options

ArcEditor/ArcInfo Users: Street Centerlines are used for network-based indicator calculations such as Street Route Directness. Complete network connectivity is required in order to load shapefiles into the application. Line segments that are not directly connected to the main network will be rejected during the geo-loading process, potentially creating a misrepresentation of the built environment. The geo-loader will create a log of Feature ID's of segments rejected during the geo-loading process.

ArcEditor/ArcInfo Users: **Pedestrian Network**

Like Street Centerlines, the Pedestrian Network is also used for network-based calculations and requires complete network connectivity. The feature class is used solely for proximity calculations and requires no additional attributes. It should represent paths where people walk including: streets (excluding freeways), off-road sidewalks, and trails. In cases where it is not feasible to collect sidewalk centerlines, the Street Centerline is used as a substitute:



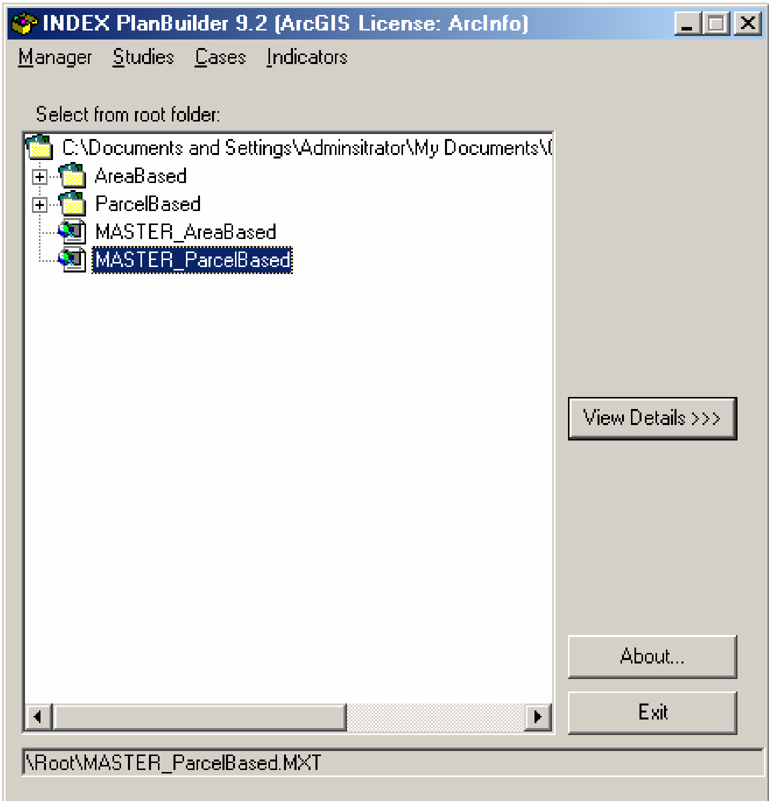
Continue exploring the tutorial shapefiles and corresponding tables while referencing data requirements in the indicator Dictionary.

SETTING SPATIAL REFERENCES

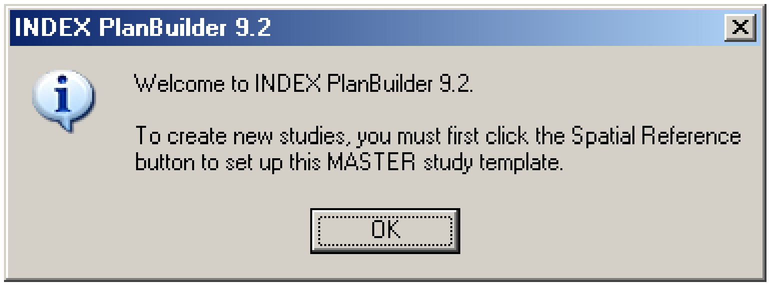
The spatial reference is based on projection information from a shapefile's .prj file, and is used as the greatest geographic extent of data to be loaded into INDEX. The spatial reference must be set first for the INDEX Master Templates before any data can be loaded into the application. If the geographic extent of a shapefile is larger than the extent set for the INDEX Master Template at the time the project is created, the shapefile will be rejected during the data loading process.

To begin setting the spatial reference for the INDEX Master Template open the Study Manager by double clicking the Study Manager desktop icon or selecting study manager from the INDEX menu.

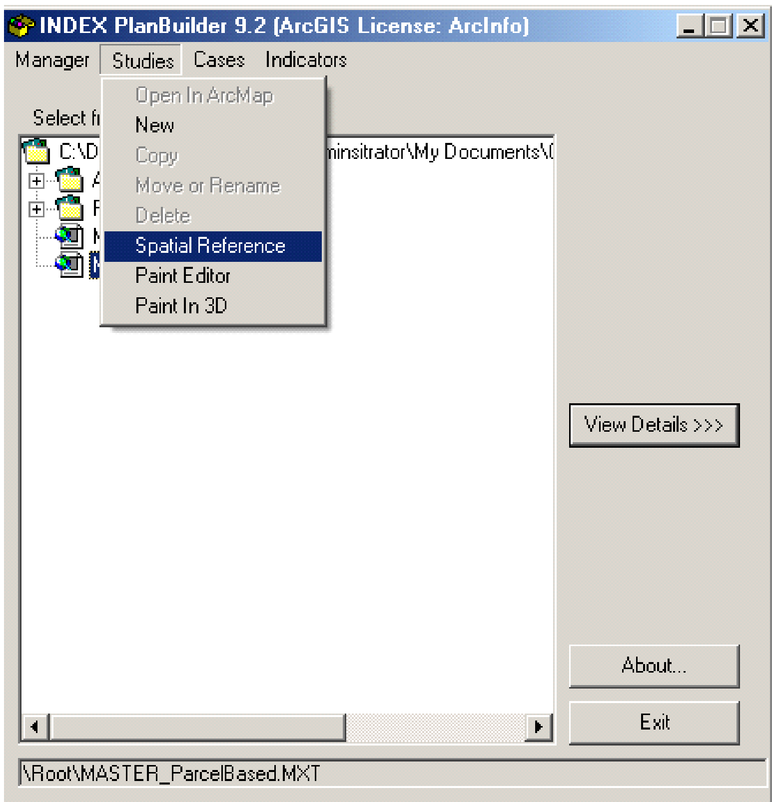
Open the Study Manager from the Start Menu or the desktop. Study Manager appears:



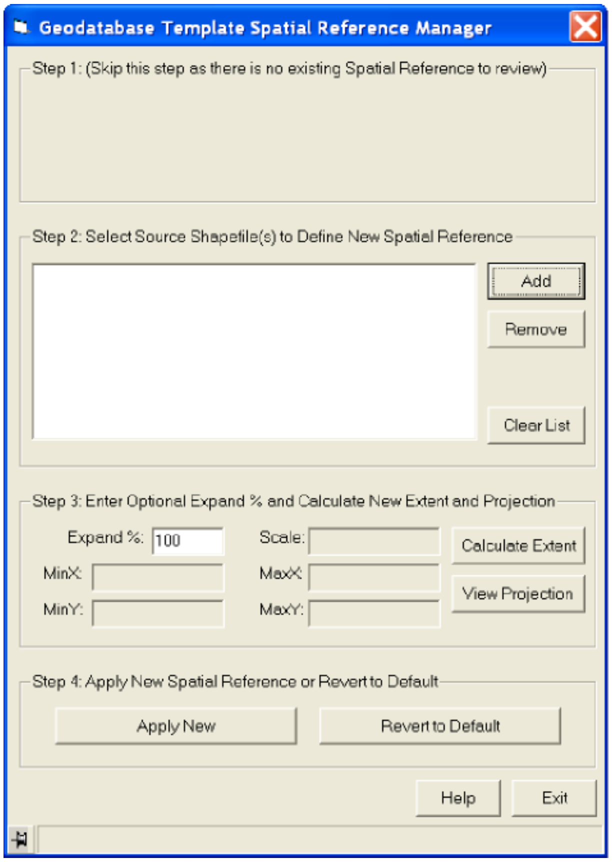
If this is the first time you are using INDEX, the following dialog may appear:



You must perform the one-time step of setting a spatial reference for INDEX. See the *Getting Started Guide* for advanced instructions on defining a spatial reference based on your data requirements and geographic location. Select the Studies > Spatial Reference menu option:



The Geodatabase Template Spatial Reference Manager is displayed:

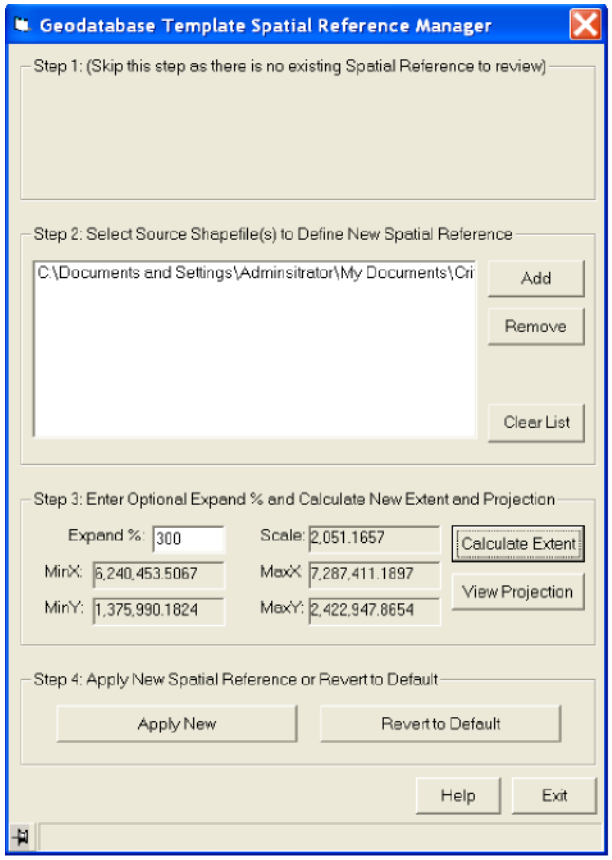


The soils file has the greatest extent of all input data so it will be used to capture the entire extent of the jurisdiction (soils are needed if you run stormwater-related indicators). Select the Add button and browse to the soils shapefile located at the following location:

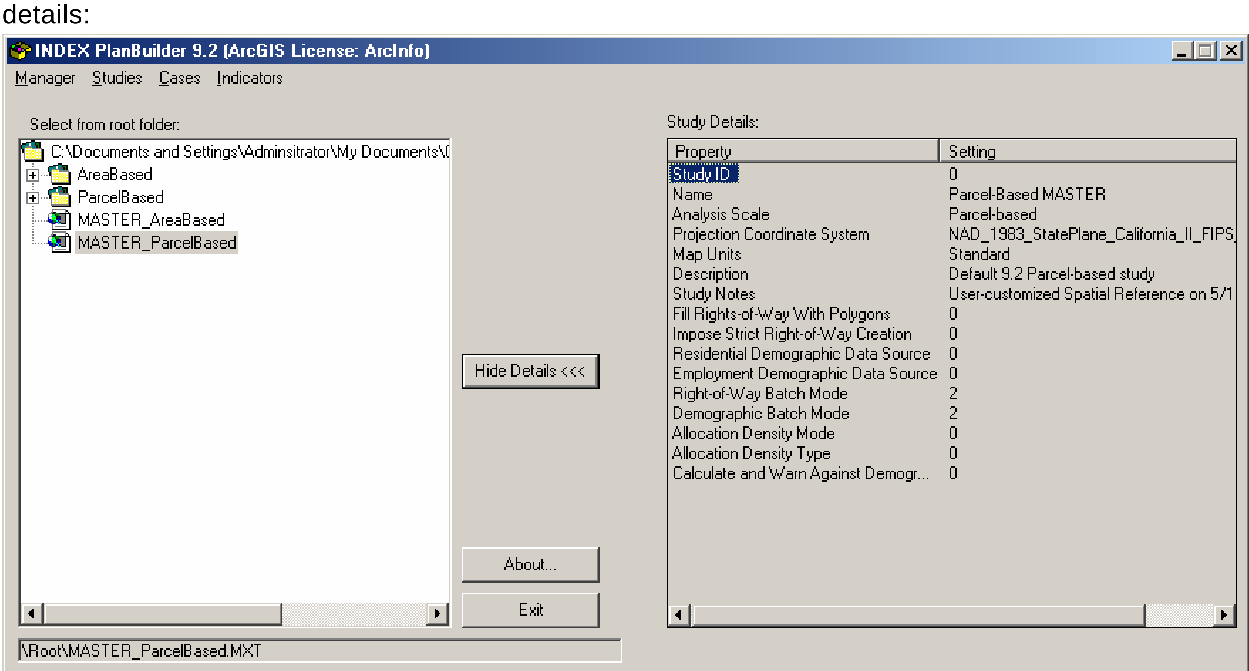
[My Documents]\Criterion\INDEX\PlanBuilder\9.2\TutorialData\Jurisdiction_GIS\soil_jurisdiction.shp

The soils file may represent the largest extent currently anticipated, but it is possible that some as-yet undetermined shapefile layer with an even greater extent will be required. To account for this possibility, triple the extent of the county boundary by typing “300” in the Expand% box.

Select the Calculate Extent button and select the “Apply New” Extent/Projection button:

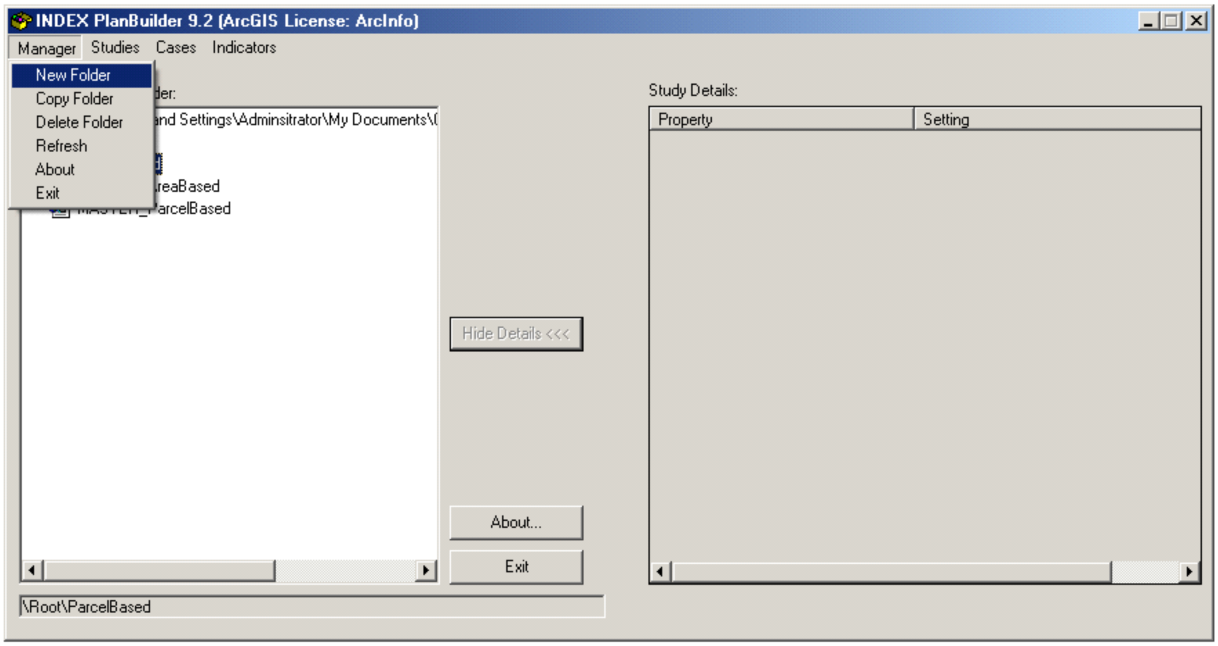


The spatial reference should be reset before a new study is created if a file for that new study will be loaded with a greater extent than the one originally set for the Master Templates, or if files with a different projection than the Master Templates are to be used. Click the Exit button to return to Study Manager. Now click the Show Details button on Study Manager to expand the Parcel template details:

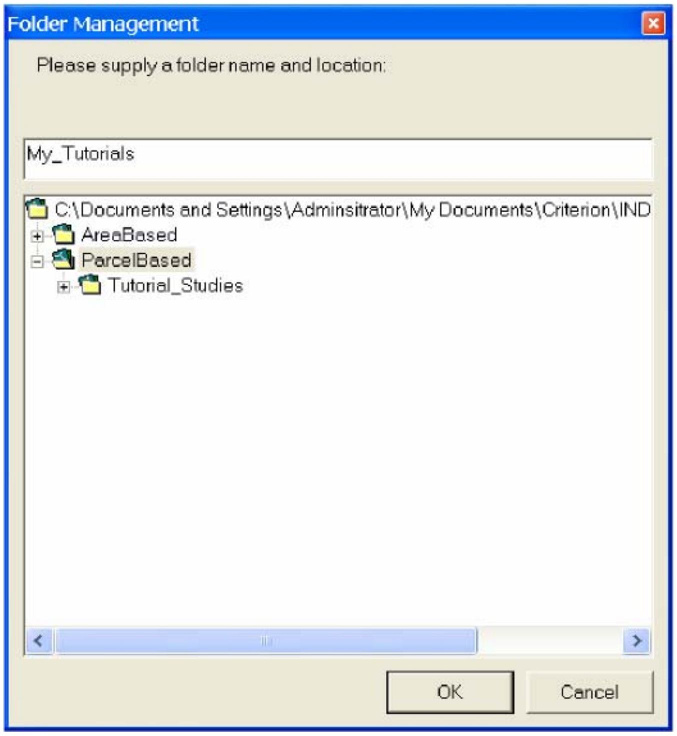


Create a New Study Location (Folder)

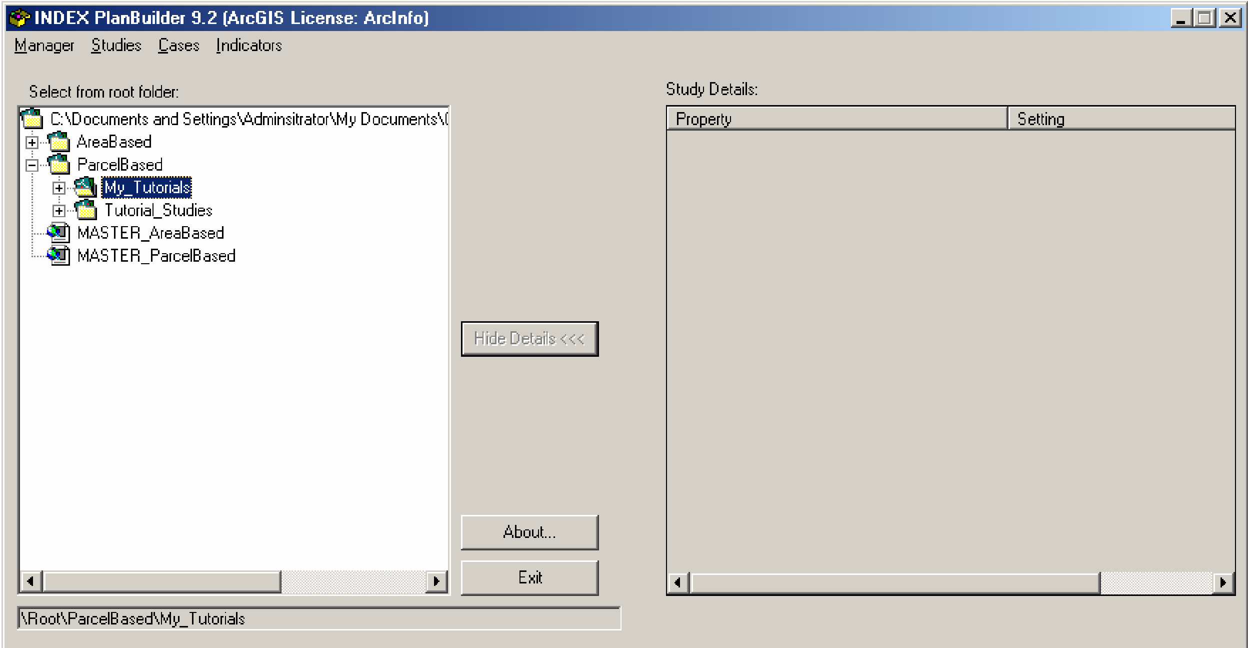
To create a new folder to hold your tutorial studies, select a parent folder like ParcelBased, then select the Manager > New Folder menu option:



The Folder Management dialog appears. Enter the folder name "My_Tutorials", the click OK:



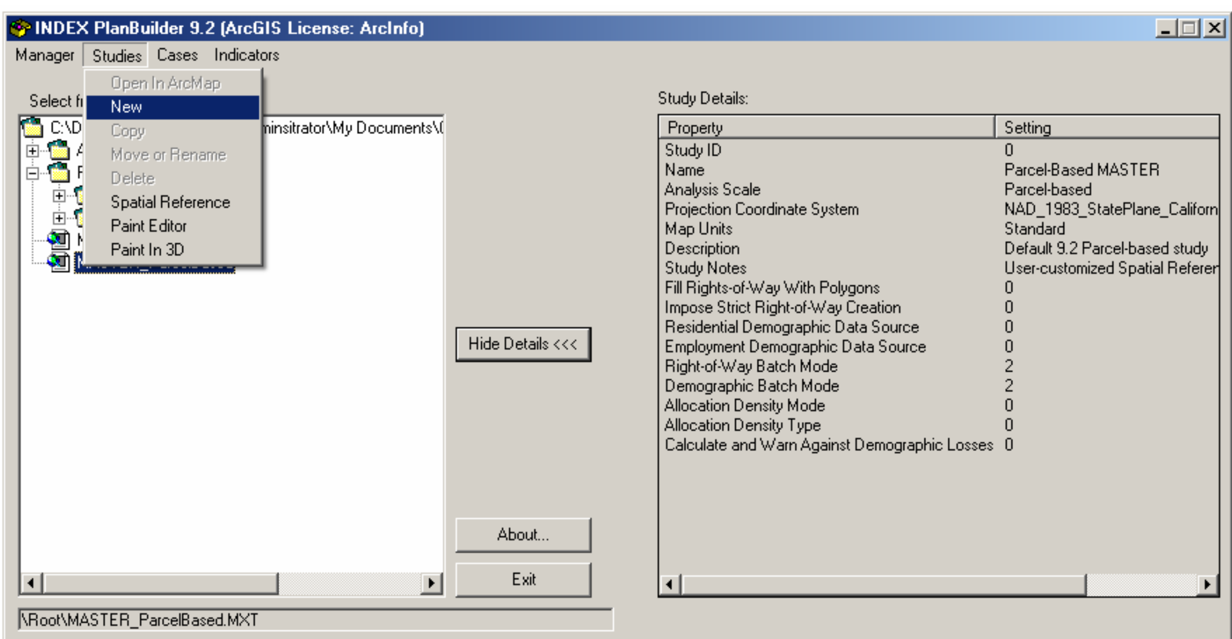
Open the ParcelBased folder to access the folder you just created:



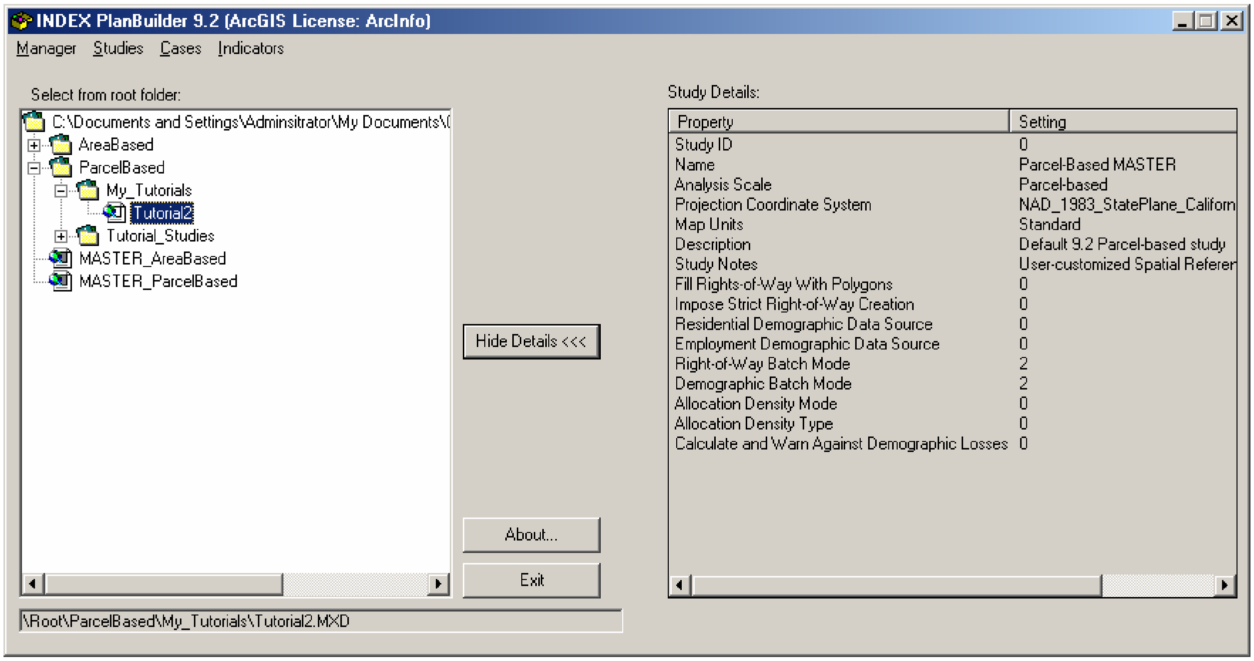
Create a New Study

You can create a new study based on a Master Template or copy an existing project. New studies are empty projects in terms of data; copied projects inherit data and settings from the parent project. You will create a new study in this tutorial.

Select "Master_ParcelBased" study and select Studies > New menu option:



Name the Study "Tutorial2", select the "My_Tutorials" folder as its destination, and click OK. The study has now been added to the tree view in the main Study Manager window. You will need to expand the tree structure to reveal it:

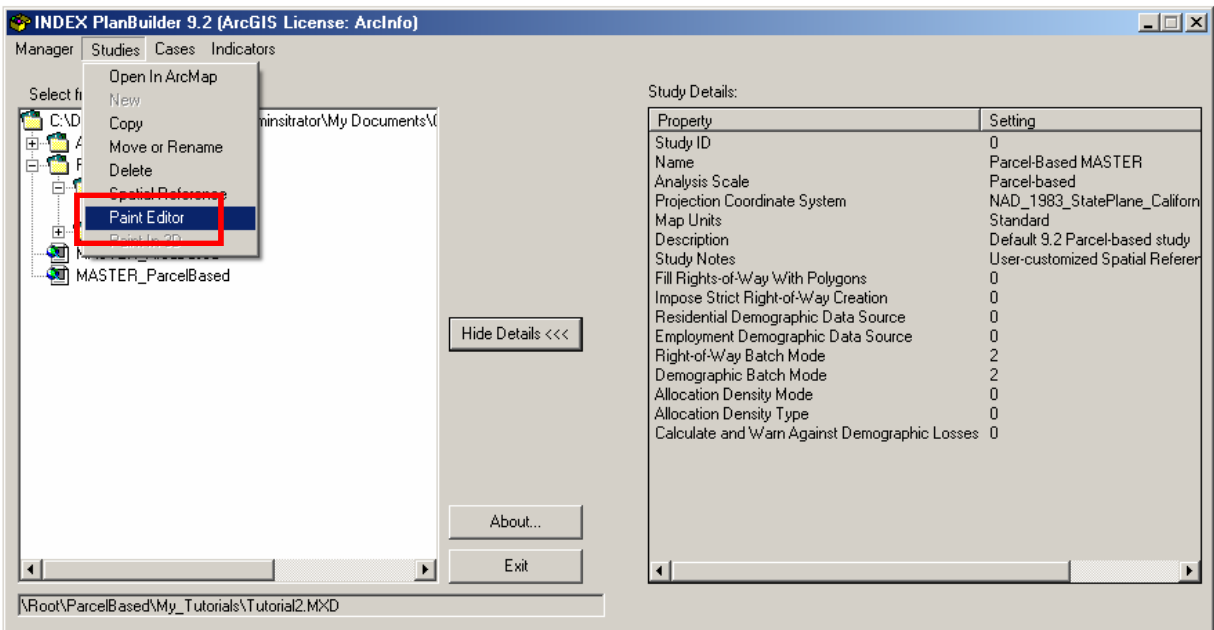


DEFINING EXISTING LAND-USES

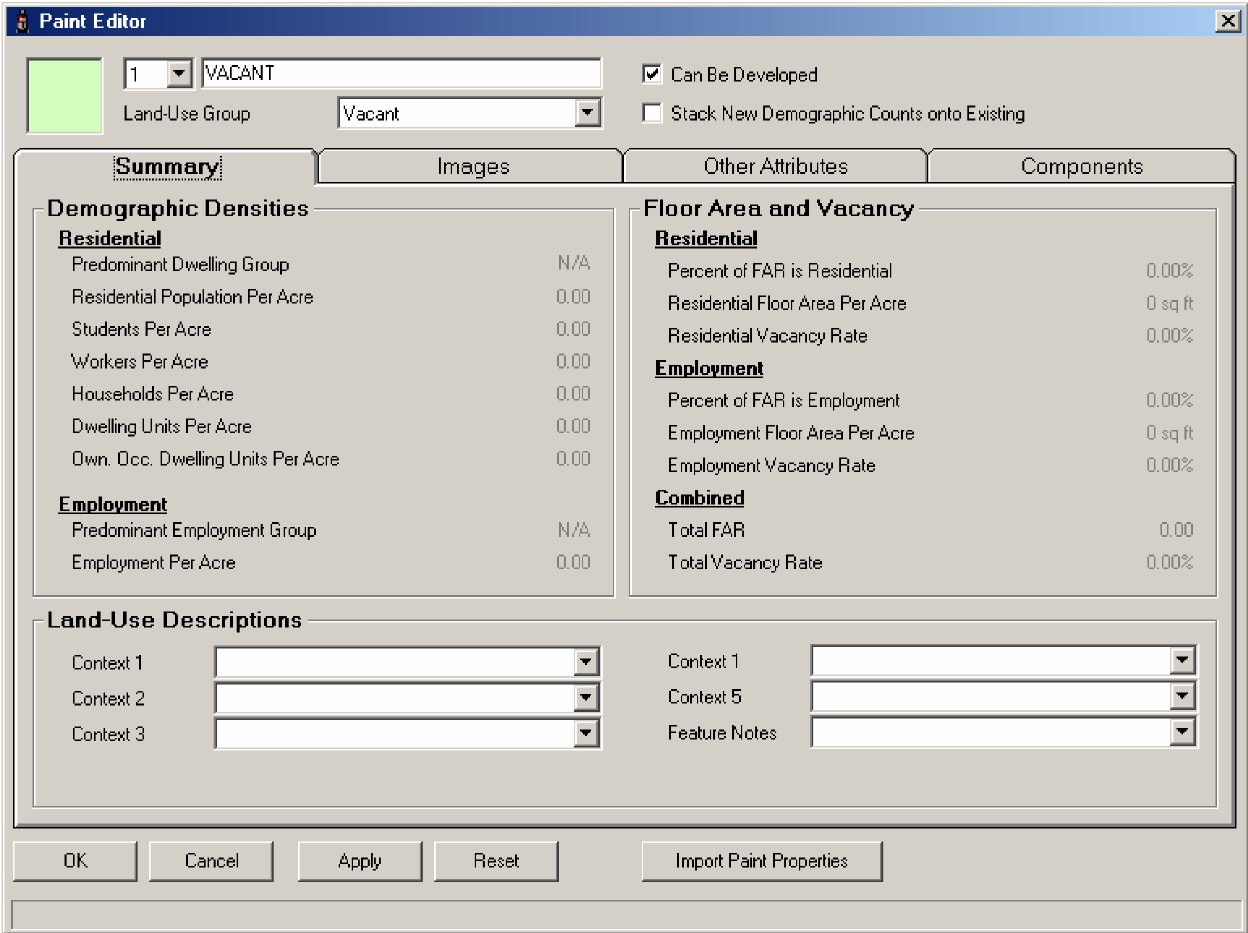
In pre-processing the jurisdiction data, numeric values were provided for existing land-uses. In this section you will use the Paint Editor tool to further define each of the existing land-use types.

Land-uses can be defined in the Master Templates or in an individual study. Land-uses defined in the Master Templates are inherited by all subsequent studies created from the Master Templates, while land-uses defined in an individual study are specific to that study. In the tutorial, you will define existing land-uses in the tutorial study you just created.

Select the Tutorial2 study in Study Manager and select the Studies > Paint Editor menu option:



The Paint Editor will automatically open in the Summary tab:



Existing land-uses are defined by several properties: INDEX ID #, INDEX name, land-use color, and land-use group.

- INDEX ID # – the numeric values provided for land-use types in the existing land-uses shapefile.
- INEX name – a unique name for land-use types that can come directly from the jurisdiction's land-use classification scheme.
- Land-use color – the color used to represent land-uses on maps in INDEX.
- Land-use groups – categories that all land-use types must be associated with, including:
  - Vacant
  - Low residential
  - Moderate residential
  - High residential
  - Retail/services
  - Office
  - Mixed
  - Industrial
  - School

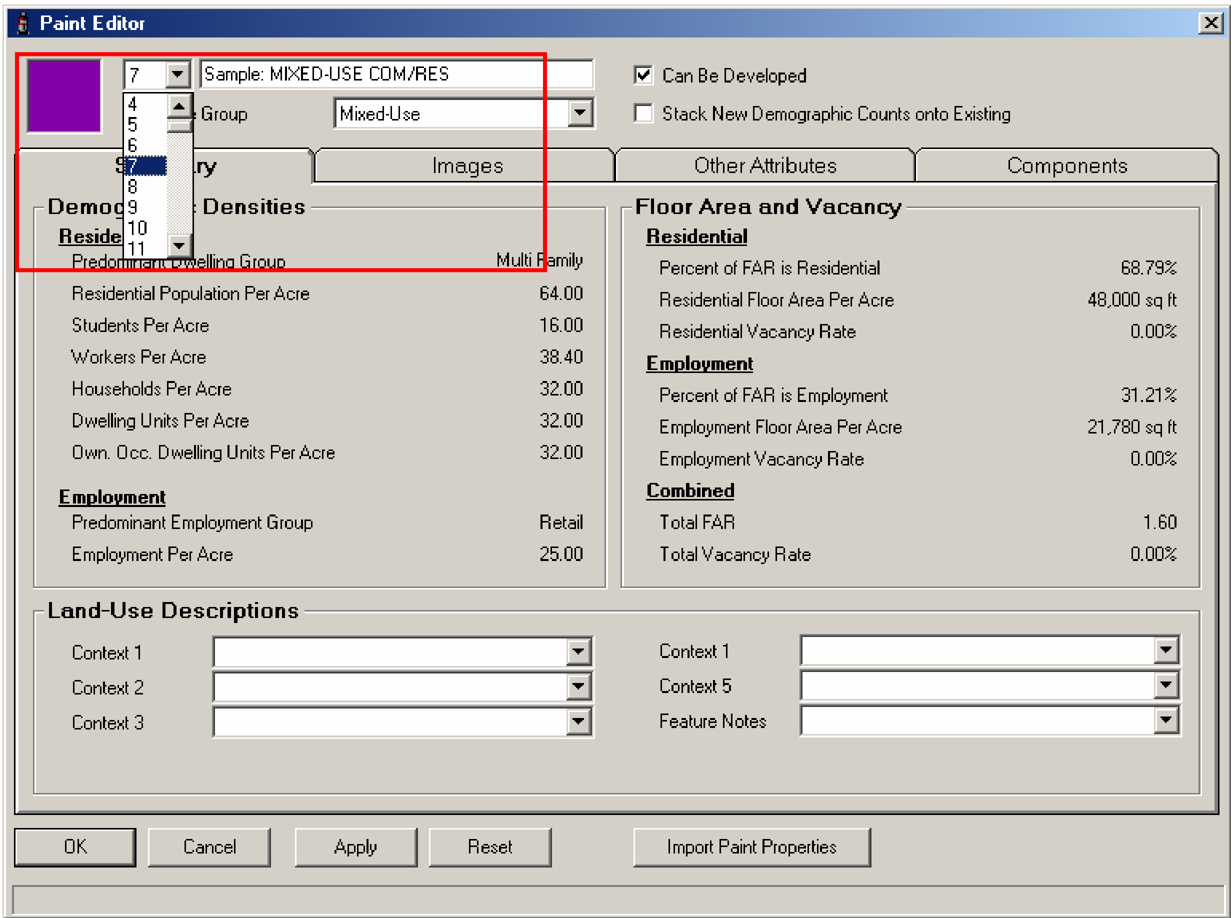
Institutional
Agriculture
Open space
Park
Parking
ROW

The first 17 paints are sample land-uses with default values. These paints should not be altered. You will use sample paints to define existing land-uses in INDEX. The table below contains the primary properties associated with the sample paints.

	Paint ID	Default Name	Land-Use Group	Dwelling Groups	Employment Groups
	1	VACANT	Vacant	--	--
	2	Sample: RES SF LOW	Low density residential	Single-family	--
	3	Sample: RES SF MEDIUM	Medium density residential	Single-family	--
	4	Sample: RES MF HIGH	High density residential	Multi-family	--
	5	Sample: COM RETAIL/SERVICE	Retail/services	--	Retail
	6	Sample: COM OFFICE	Office	--	Service
	7	Sample: MIXED-USE COM/RES	Mixed-use	Multi-family	Retail
	8	Sample: INDUSTRIAL	Industrial	--	Manufacturing
	9	Sample: SCHOOL	School	--	Other
	10	Sample: INSTITUTIONAL	Institutional	--	Other
	11	Sample: AGRICULTURE—CROPS	Agricultural	--	--
	12	Sample: AGRICULTURE—PASTURE	Agricultural	--	--
	13	Sample: OPEN SPACE	Open space	--	--
	14	Sample: PARK	Park	--	--
	15	Sample: PARKING	Parking	--	--
	16	Sample: RIGHT OF WAY -- STREET	Right-of-way	--	--
	17	Sample: RIGHT OF WAY -- UTILITY	Right-of-way	--	--

You can use this table for guidance in selecting sample paints that can be modified to create other paints that are more specific to your jurisdiction.

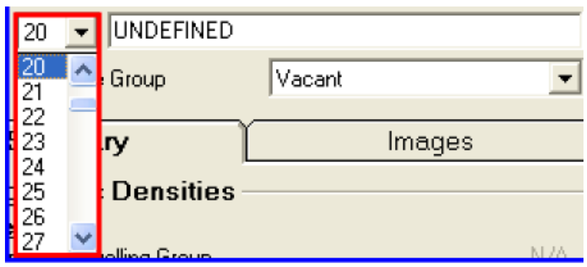
Scroll through the sample paints, 1 thru 17, and identify which paints best match up with the tutorial land-use data:



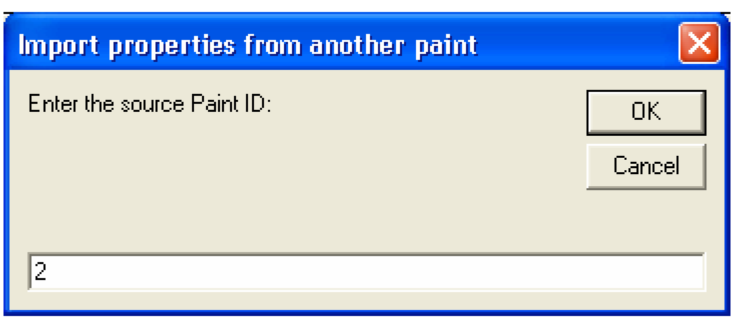
You will use the following values to set up your tutorial's existing land-uses in INDEX:

INDEX TYPE ID	Based-on Sample Paint ID	INDEX Name	Dwelling Group (ID)	Employment Group (ID)
20	2	RES,SINGLE FAMILY	Single-Family (1)	--
21	3	RES,LOW RISE APARTMENTS	Multi-Family (2)	--
22	4	RES,HIGH RISE APARTMENTS	Multi-Family (2)	--
30	5	COM,RETAIL	--	Retail (1)
31	6	OFF,GENERAL	--	Service (2)
40	8	IND,INDUSTRIAL USE	--	Manufacturing (10)
41	8	IND,DISTRIBUTION & WAREHOUSES	--	Manufacturing (10)
45	10	PUB,INSTITUTIONAL	--	Other (3)
46	9	PUB,SCHOOL EXEMPT	--	Other (3)
47	10	PUB,CITY USE,EXEMPT	--	--
50	14	MISC,PARK,GREENBELT,ETC	--	--
55	13	MISC,DRAINAGE,OPENSPACE	--	--
60	11	AGR,FIELD CROP	--	--
66	16	MISC,WALKWAY	--	--
67	17	MISC,UTILITY,POWER OR SEWER	--	--
68	15	MISC,PARKING	--	--
75	1	VACANT	--	--

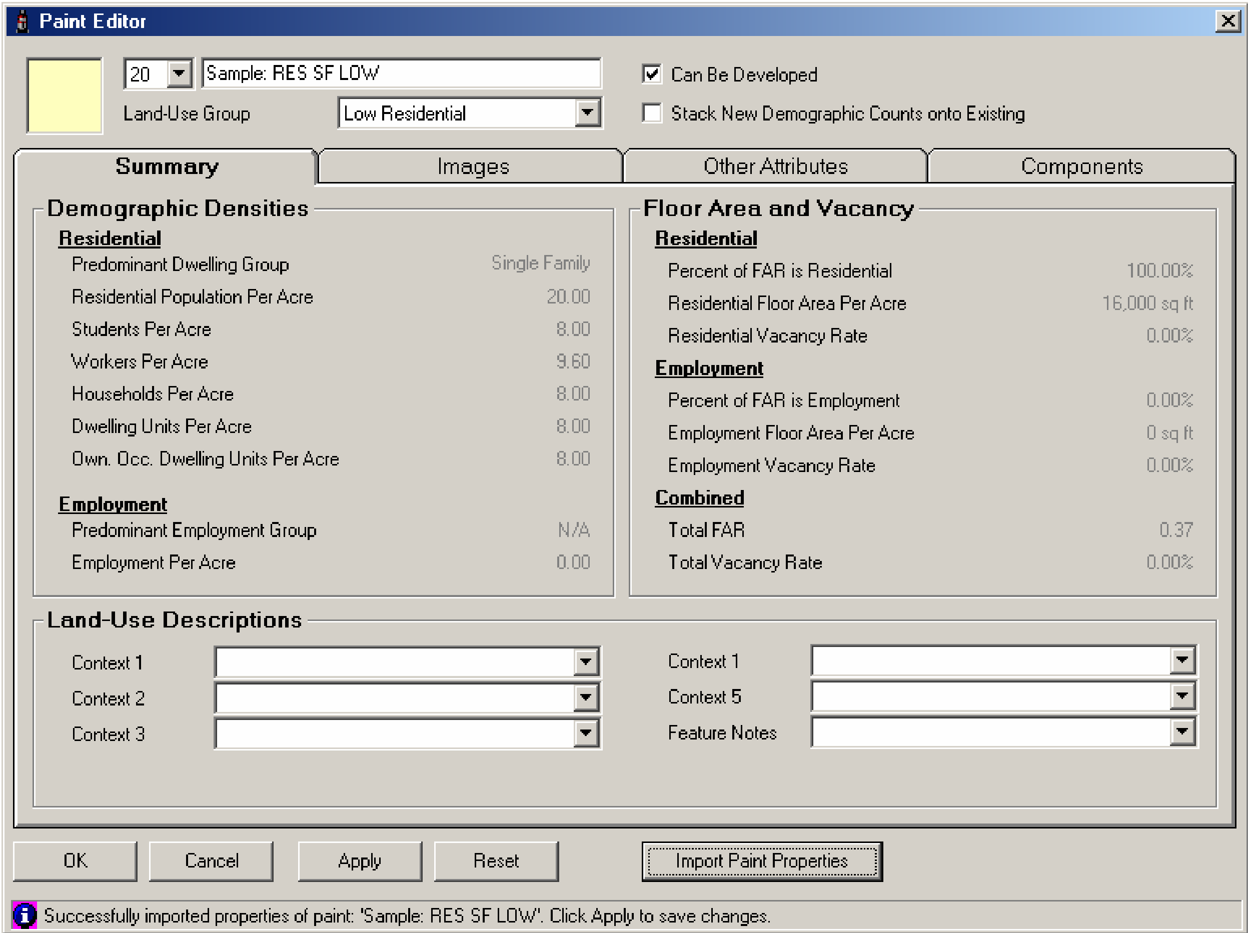
Scroll to the number 20 to create the first paint and import numeric value:



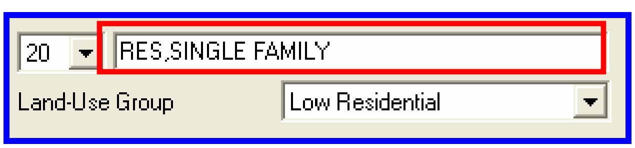
Scrolling through the sample paints, it should be easy to determine that Paint ID 2 provides the best description for the "RES,SINGLE FAMILY" and "RES,SINGLE FAMILY IN SUBDIV" land-use types. Begin importing this sample paint by clicking on the Import Paint Properties at the bottom of the dialog. The Import properties dialog appears:



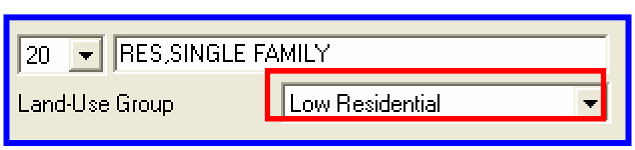
Type 2 in the Import Properties dialog and click OK. The paint id 20 has inherited the values from 2:



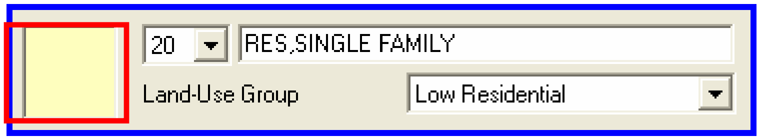
Provide a name for the paint:



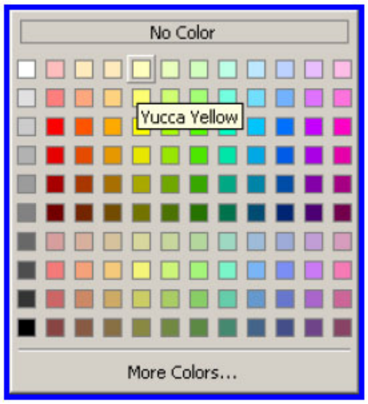
Notice that the Land-Use Group was provided for you as one of the default values:



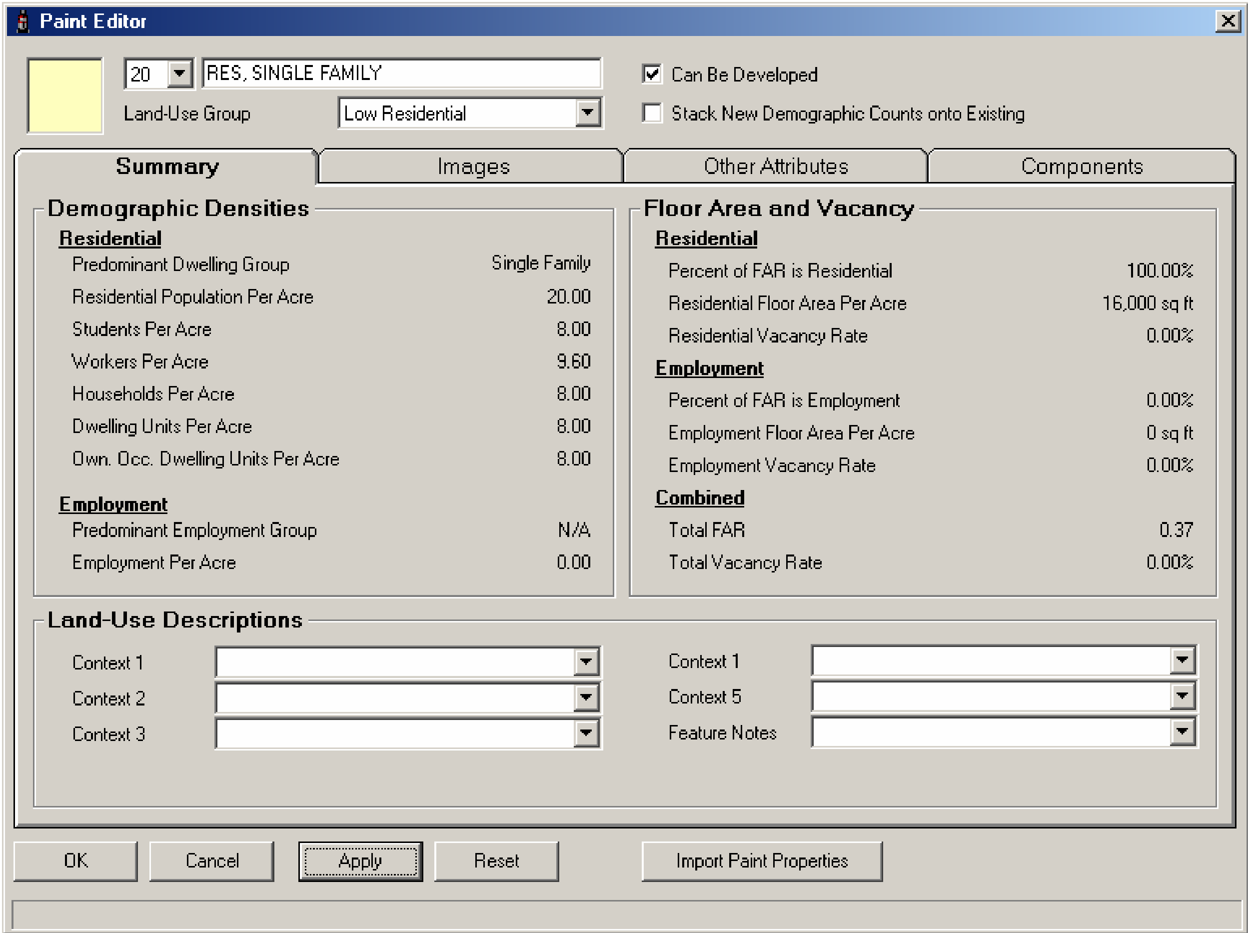
A color was also provided as a default value, but you can change the color if you choose by clicking on the color box:



Either select a color from the palette or create a new color using RGB values:



Select the Apply button to commit the paint to the database:

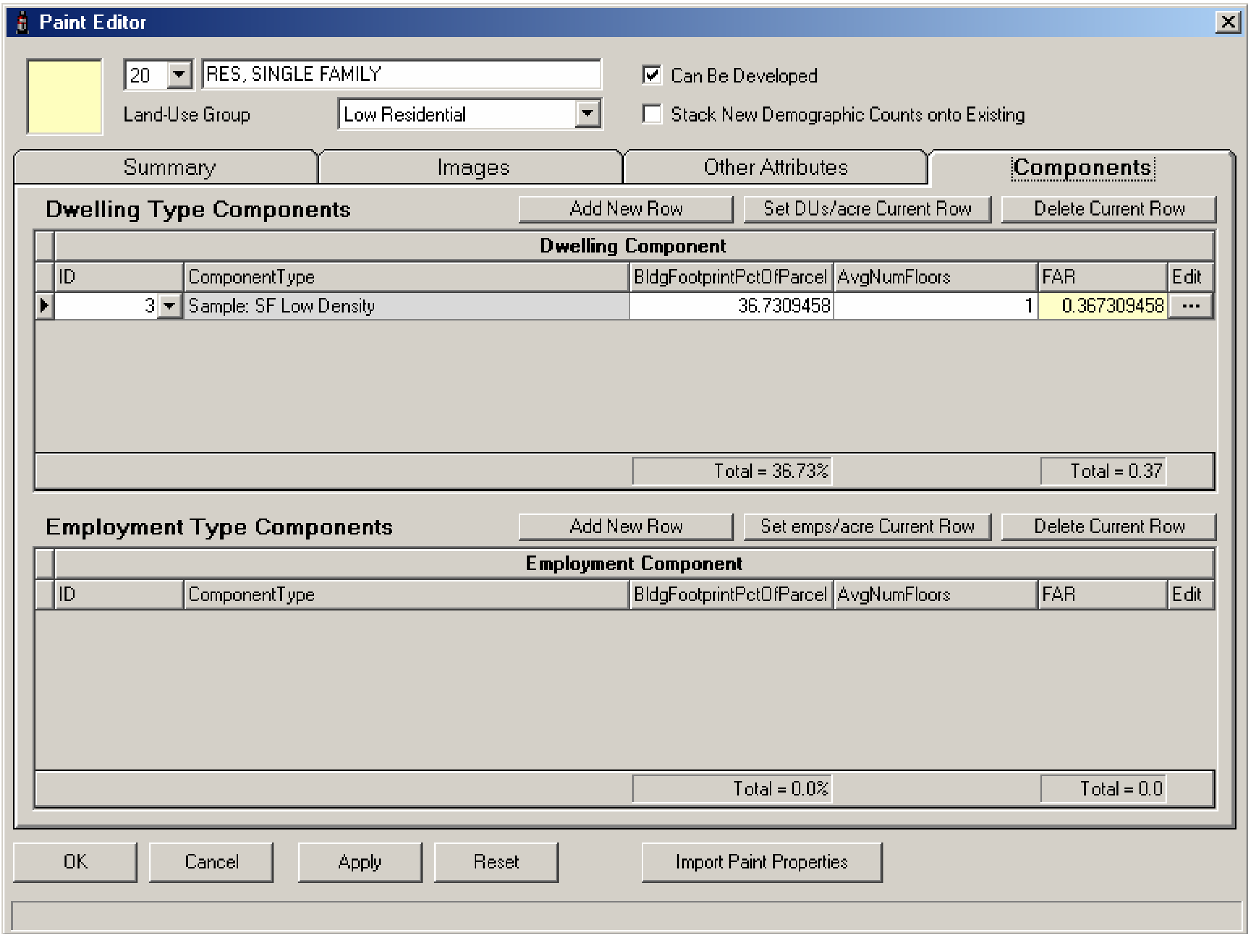


Notice that Summary Demographics are populated with values. The Dwelling and Employment Group Components control residential and employment attributes associated with paints, and are primarily used by Design Paints to simulate hypothetical scenarios. The components automatically default to design mode with demographic attributes.

Dwelling and Employment Types are created independently of Land-Use Types and are given their own custom names, components (attributes), and ID numbers. Dwelling and Employment Types are linked to Land-Use Types from the Components Tab in the Paint Editor. As with land-uses, you can build up to 250 dwelling types and 250 employment types. To avoid inadvertently changing the attributes of a Dwelling or Employment Type Component that is already associated with Paint, use the same Dwelling or Employment Type Component ID as the Paint ID.

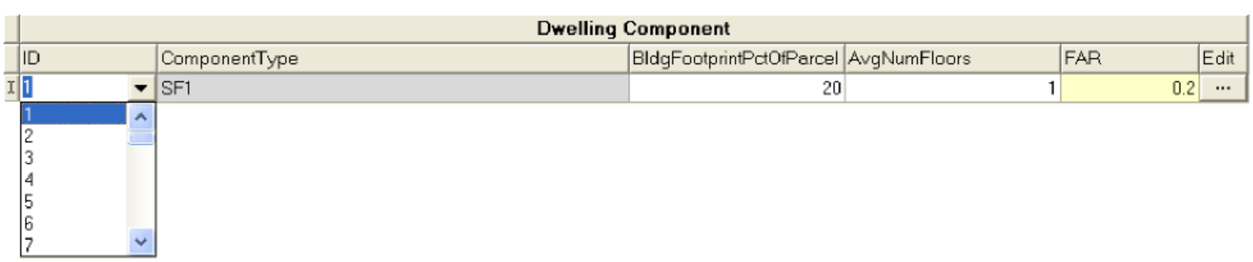
Dwelling and employment components provide density-based attributes which are derived from the size of the land-use polygons. These components are typically used to simulate build-out, not existing conditions. For Existing Land-Use Types, the dwelling and employment components should be set to one of the “NO DEMOGRAPHICS” settings with the correct component type (i.e. ELU SF-NO DEMOGRAPHICS vs. ELU MF-NO DEMOGRAPHICS).

Select the Components tab on the Paint Editor window:



If you did not previously click the Apply button, do so before attempting to change the paint components.

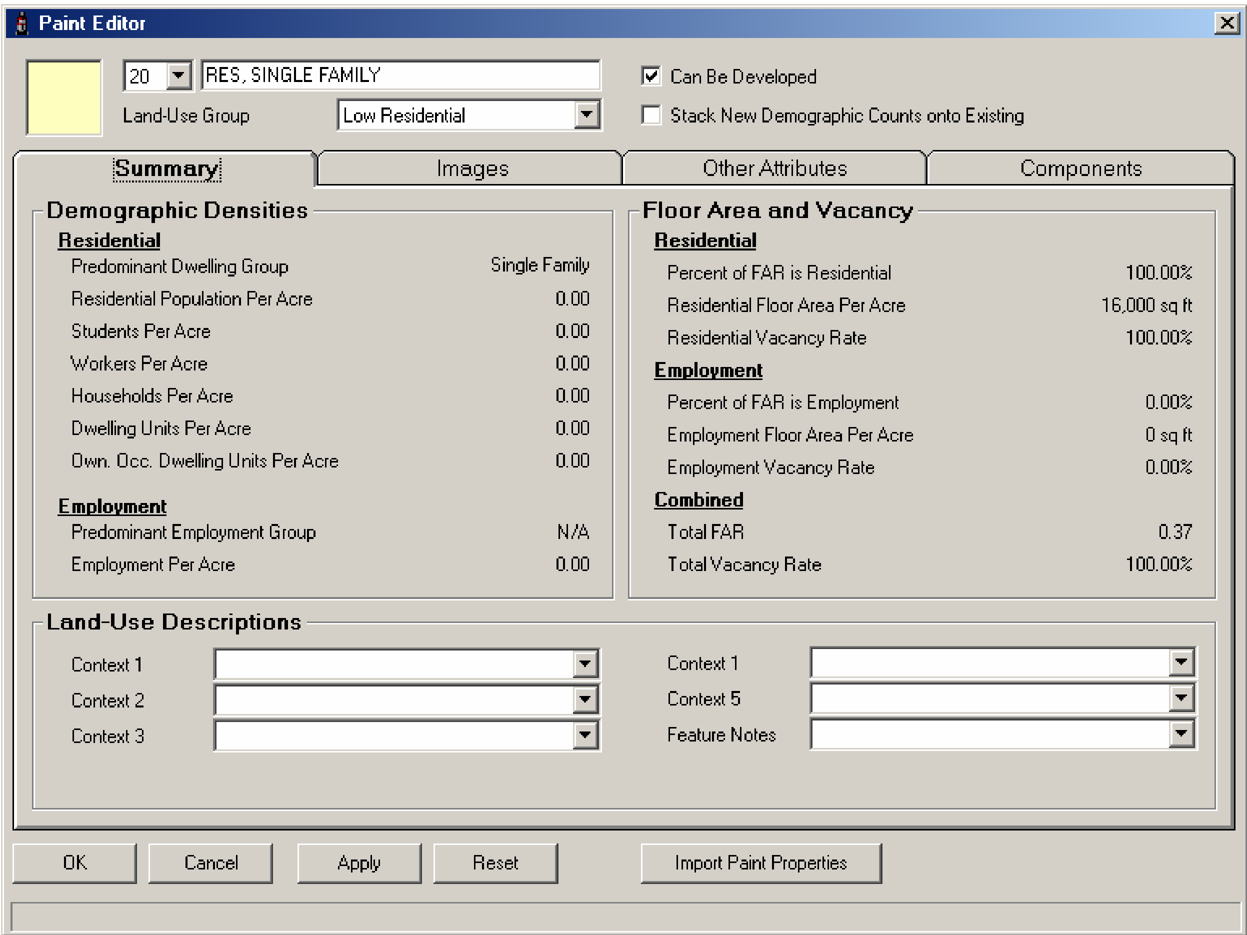
Select the Dwelling Type Component ID and select 1 in the pull-down list:



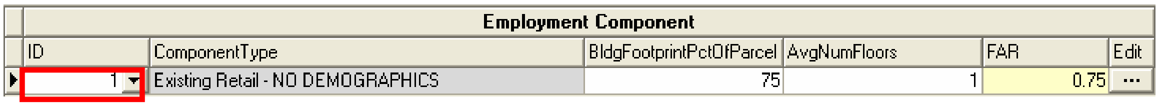
ID 1 represents single-family default values, including dwelling type, with no demographics and ID 2 represents multi-family default values with no demographics. Click in the Component Type window to view its status:

Dwelling Component					
ID	ComponentType	BldgFootprintPctOfParcel	AvgNumFloors	FAR	Edit
1	ELU SF - NO DEMOGRAPHICS	20	1	0.2	...

Click the Apply button to commit the change and return to the Summary tab:



Repeat these steps for one of the employment land-use classifications by changing the Employment Component to: ID 1 – retail with no demographics; ID 2 – service with no demographics; or ID 3 other with no demographics, etc.



Continue building the rest of the existing land-use definitions using the values shown in the table below:

INDEX TYPE ID	Sample Paint ID	INDEX Name	Dwelling Group (ID)	Employment Group (ID)
20	2	RES,SINGLE FAMILY	Single-Family (1)	--
21	3	RES,LOW RISE APARTMENTS	Multi-Family (2)	--
22	4	RES,HIGH RISE APARTMENTS	Multi-Family (2)	--
30	5	COM,RETAIL	--	Retail (1)
31	6	OFF,GENERAL	--	Service (2)
40	8	IND,INDUSTRIAL USE	--	Manufacturing (10)
41	40	IND,DISTRIBUTION & WAREHOUSES	--	Manufacturing (10)
45	10	PUB,INSTITUTIONAL	--	Other (3)
46	9	PUB,SCHOOL EXEMPT	--	Other (3)
47	45	PUB,CITY USE,EXEMPT	--	Other (3)
50	14	MISC,PARK,GREENBELT,ETC	--	--
55	13	MISC,DRAINAGE, OPENSPACE	--	--
60	11	AGR,FIELD CROP	--	--
66	16	MISC,WALKWAY	--	--
67	17	MISC,UTILITY,POWER OR SEWER	--	--
68	15	MISC,PARKING	--	--
75	1	VACANT	--	--

CREATING INDICATOR AND OBJECTIVE SETS

Indicators are “yardsticks” for identifying an area’s strengths and weaknesses, testing alternative courses of action, and monitoring change over time. INDEX PlanBuilder has a menu of indicators based on which ESRI ArcGIS license is employed:

ArcEditor/ArcInfo Users: 77 indicators

ArcView Users: 57 indicators

From this menu, users may select those indicators that are most relevant to the subject of a study.

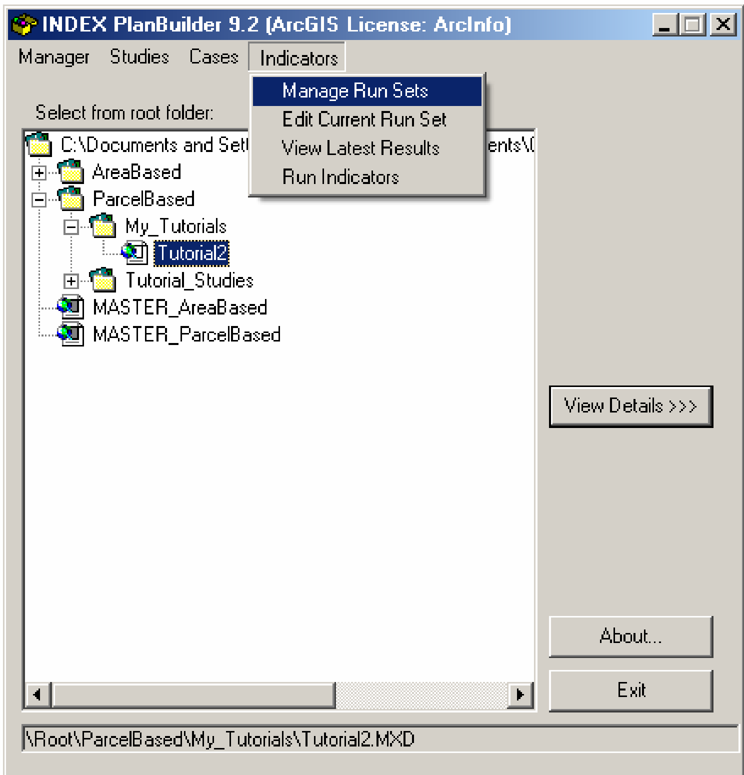
There are two kinds of indicator measurements made by INDEX: first, a numerical score for the study area; and second, mapping of the spatial pattern that produced the score. In this way users obtain both quantitative and geographic assessments of an area. The numeric scores are interpreted in relation to typical standards, common conditions in the local area, other alternative case scores, or adopted goals where they already exist. The geographic results are used to delineate areas where strengths can be protected and areas where weaknesses need to be corrected.

Therefore, an important part of jurisdictional set-up is becoming familiar with the menu of INDEX indicators, and how they can be organized to provide the most insight into community conditions and proposed changes. Users make two major decisions in organizing indicator and objective sets: 1) the selection of an indicator as being relevant to a study’s objectives, and therefore worth assembling data to support; and 2) setting the RAW tool to rank cases using stakeholder-defined values of what constitutes acceptable indicator scores, and how important the indicators are relative to one another.

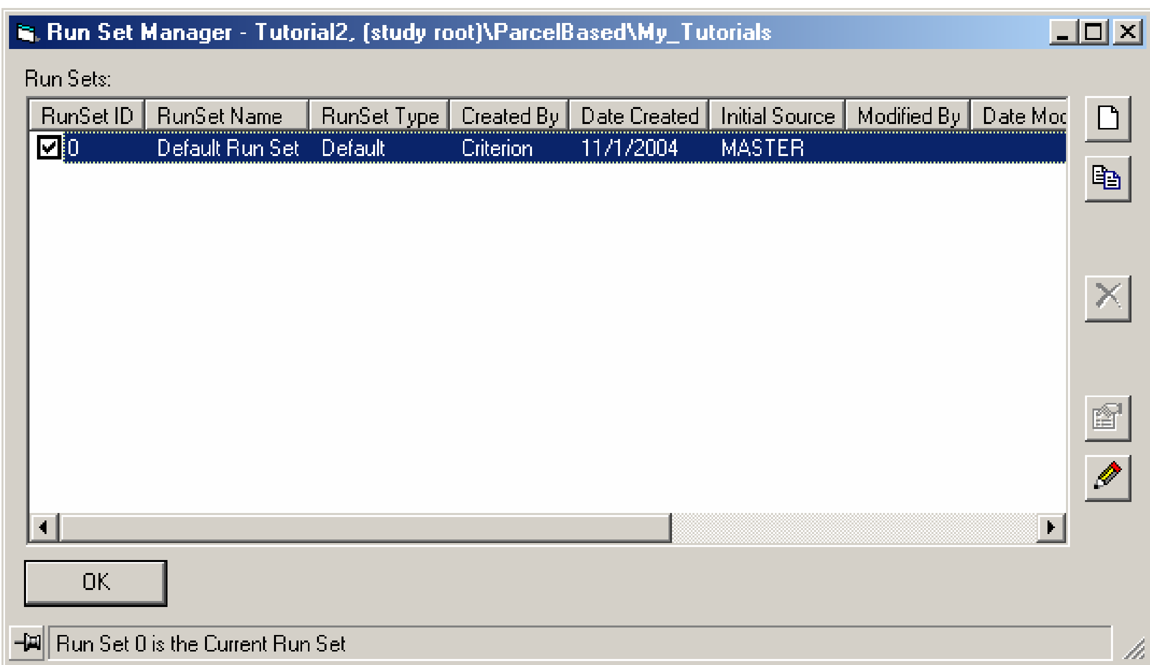
As with the Land-Use Palette, you will set up an indicator run set in your Tutorial study for this exercise. Use the Parcel-based MASTER template to set values specific to your jurisdiction.

Setting up a Run Set

Select the Tutorial2 study in the Study Manager and select the Indicators > Manage Run Sets menu option:

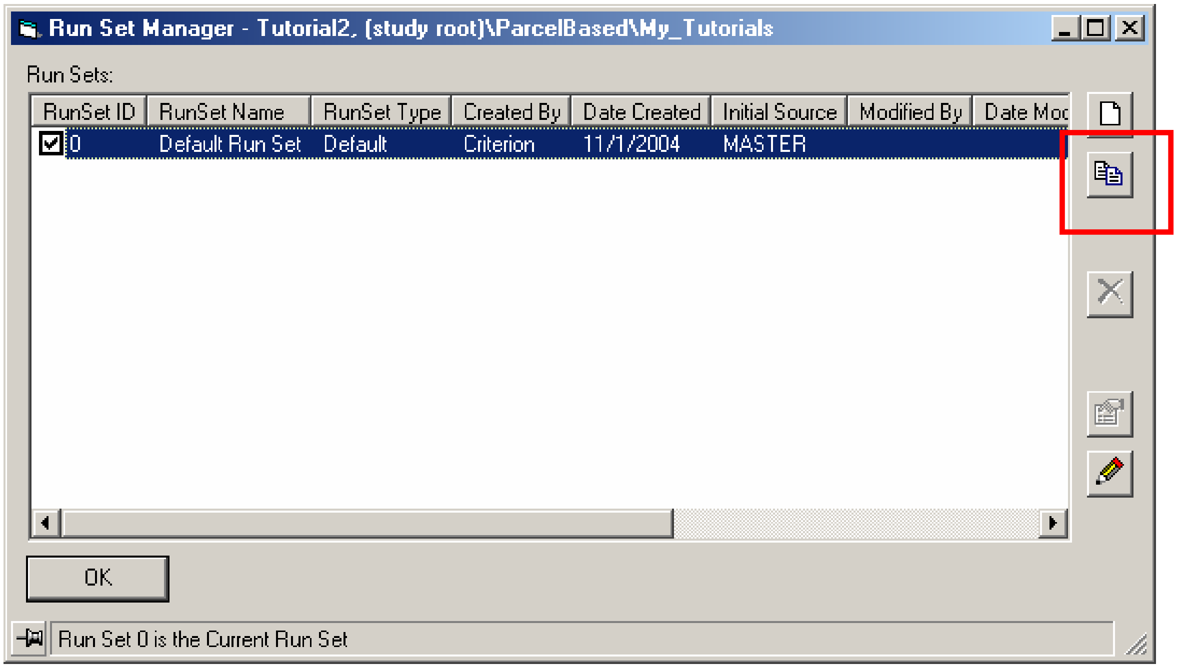


The Run Set Manager is displayed:

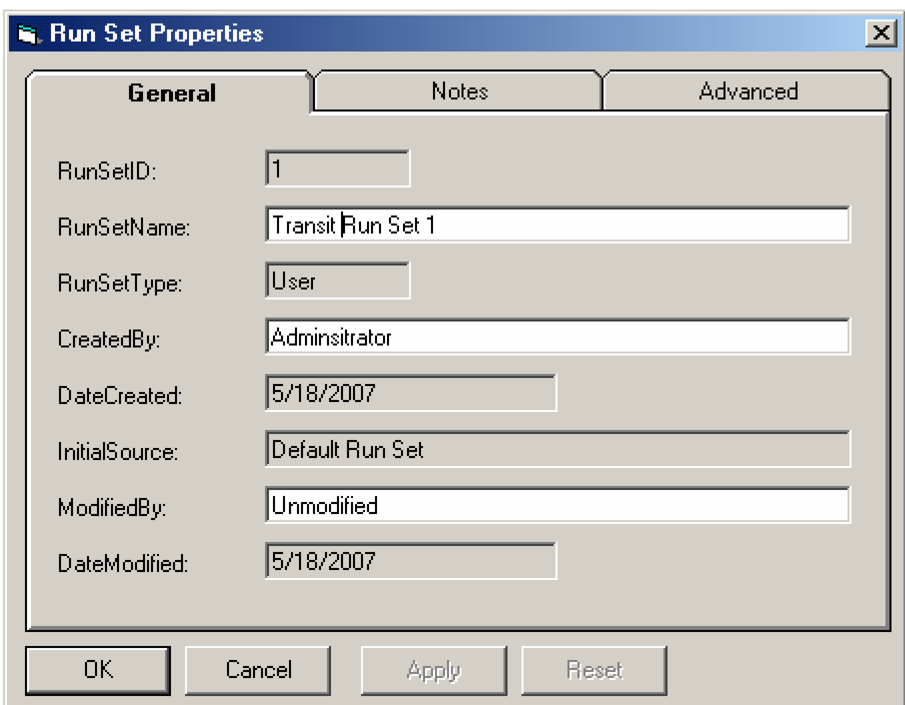


You can create a new empty run set with no indicators selected by selecting the New button on the right side of the Run Set Manager. New run sets have no indicators selected or RAW values set. RAW values must be set in order to view indicator maps or compare indicator scores between cases.

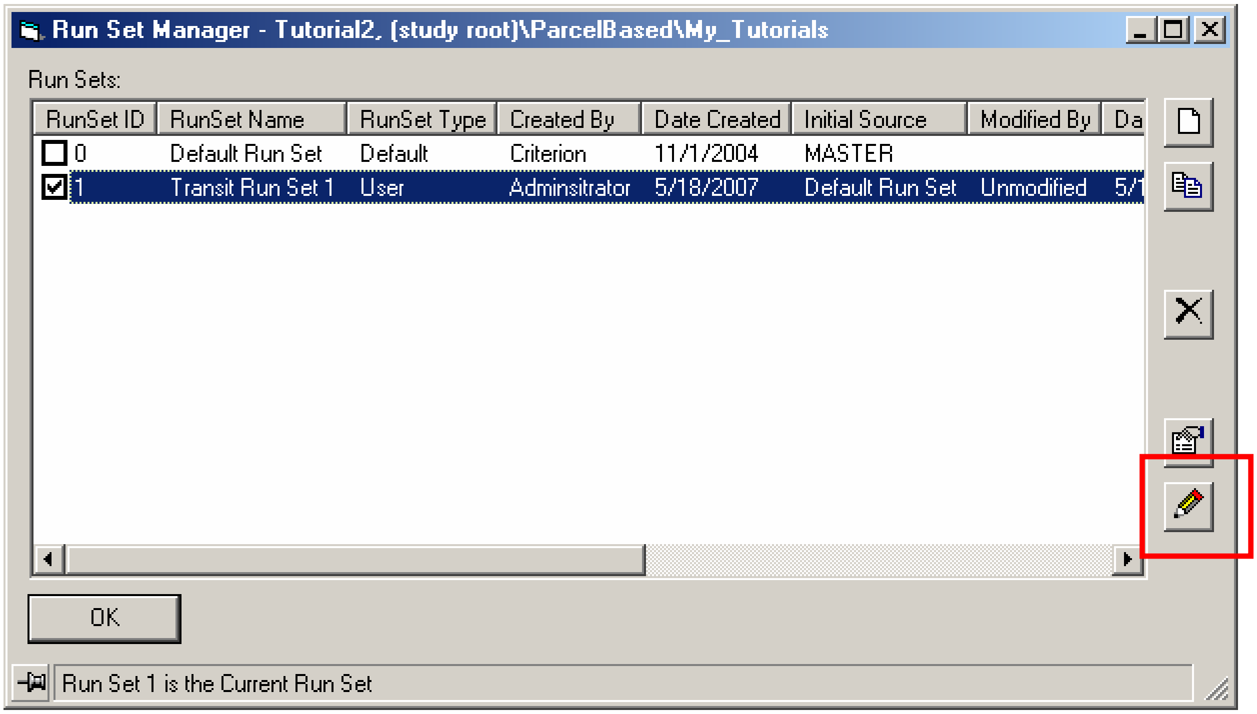
The Copy button creates a duplicate of a selected run set with indicators selected, including RAW settings. Select the copy button on the dialog and create a copy of the Default Run Set:



The run set copy is created and the Run Set Properties opens. Provide a name, like "Transit Run Set 1," in the Run Set Properties window and select the OK button. Provide the requested information in the Run Set Properties window and select the OK button.



Select the run set you just created in the Run Set Manager window and click the Edit button on the Run Set Manager:

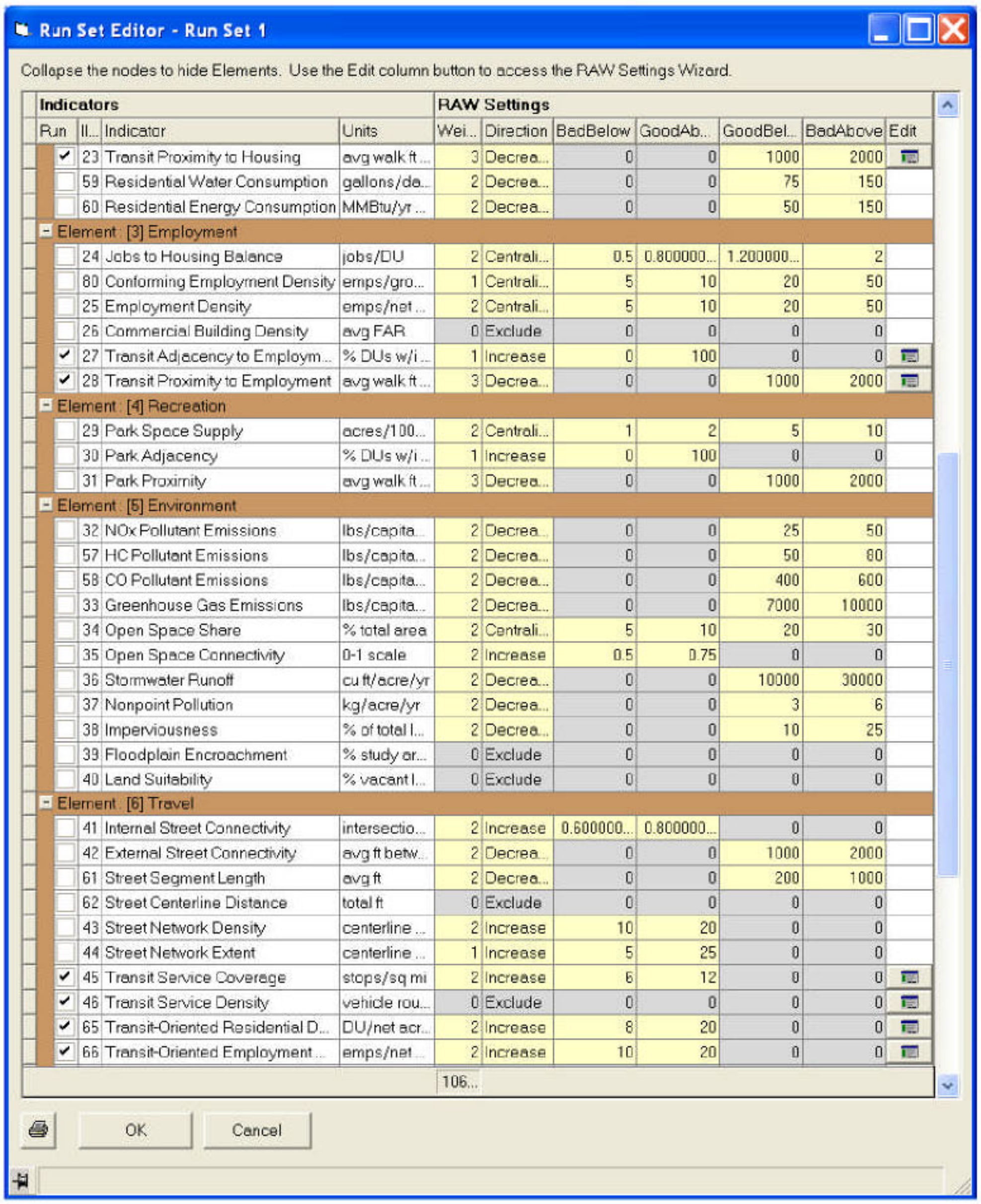


For purposes of the tutorial, uncheck all indicators that are not relevant to transit issues, leaving you with the following selected run set:

Element: Housing
- Transit Adjacency to Housing
- ***ArcEditor/ArcInfo Users:*** Transit Proximity to Housing

Element: Employment
- Transit Adjacency to Employment
- ***ArcEditor/ArcInfo Users:*** Transit Proximity to Employment

Element: Travel
- Transit Service Coverage
- Transit Service Density
- ***ArcEditor/ArcInfo Users:*** Transit-Oriented Residential Density
- ***ArcEditor/ArcInfo Users:*** Transit-Oriented Employment Density
- Residential Multi-Modal Access



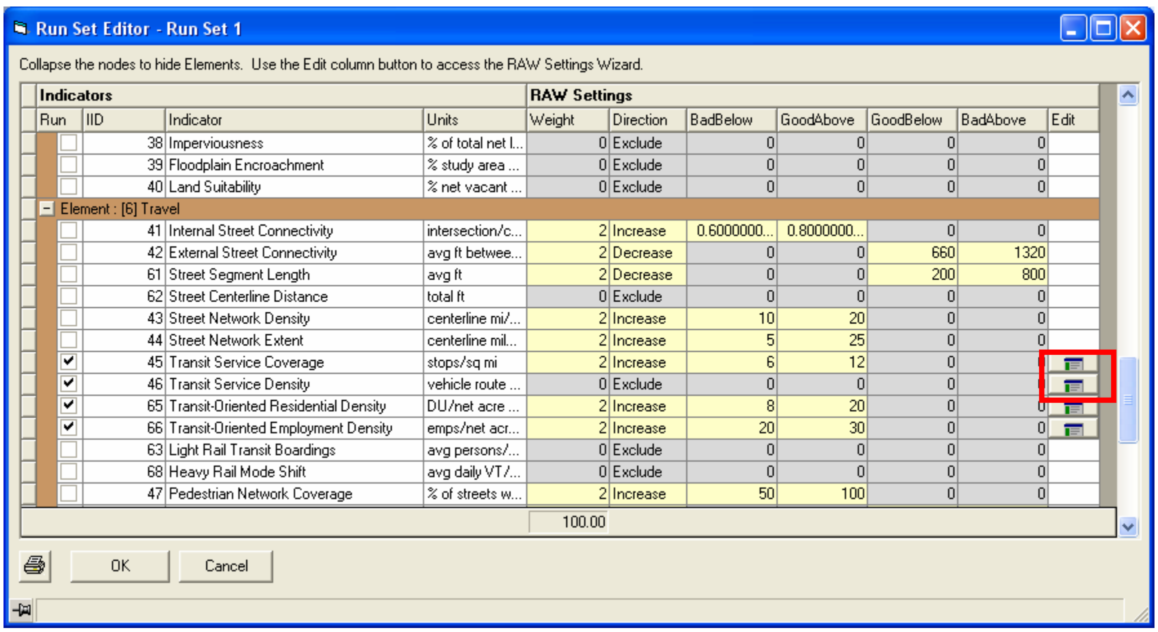
Run	Il...	Indicator	Units	Wei...	Direction	BadBelow	GoodAb...	GoodBel...	BadAbove	Edit
✔	23	Transit Proximity to Housing	avg walk ft ...	3	Decrea...	0	0	1000	2000	▤
	59	Residential Water Consumption	gallons/da...	2	Decrea...	0	0	75	150	
	60	Residential Energy Consumption	MMBtu/yr ...	2	Decrea...	0	0	50	150	
Element: [3] Employment										
	24	Jobs to Housing Balance	jobs/DU	2	Centrali...	0.5	0.800000...	1.200000...	2	
	80	Conforming Employment Density	emps/gro...	1	Centrali...	5	10	20	50	
	25	Employment Density	emps/net ...	2	Centrali...	5	10	20	50	
	26	Commercial Building Density	avg FAR	0	Exclude	0	0	0	0	
✔	27	Transit Adjacency to Employm...	% DUs w/i ...	1	Increase	0	100	0	0	▤
✔	28	Transit Proximity to Employment	avg walk ft ...	3	Decrea...	0	0	1000	2000	▤
Element: [4] Recreation										
	29	Park Space Supply	acres/100...	2	Centrali...	1	2	5	10	
	30	Park Adjacency	% DUs w/i ...	1	Increase	0	100	0	0	
	31	Park Proximity	avg walk ft ...	3	Decrea...	0	0	1000	2000	
Element: [5] Environment										
	32	NOx Pollutant Emissions	lbs/capita...	2	Decrea...	0	0	25	50	
	57	HC Pollutant Emissions	lbs/capita...	2	Decrea...	0	0	50	80	
	58	CO Pollutant Emissions	lbs/capita...	2	Decrea...	0	0	400	600	
	33	Greenhouse Gas Emissions	lbs/capita...	2	Decrea...	0	0	7000	10000	
	34	Open Space Share	% total area	2	Centrali...	5	10	20	30	
	35	Open Space Connectivity	0-1 scale	2	Increase	0.5	0.75	0	0	
	36	Stormwater Runoff	cu ft/acre/yr	2	Decrea...	0	0	10000	30000	
	37	Nonpoint Pollution	kg/acre/yr	2	Decrea...	0	0	3	6	
	38	Imperviousness	% of total l...	2	Decrea...	0	0	10	25	
	39	Floodplain Encroachment	% study ar...	0	Exclude	0	0	0	0	
	40	Land Suitability	% vacant l...	0	Exclude	0	0	0	0	
Element: [6] Travel										
	41	Internal Street Connectivity	intersectio...	2	Increase	0.600000...	0.800000...	0	0	
	42	External Street Connectivity	avg ft betw...	2	Decrea...	0	0	1000	2000	
	61	Street Segment Length	avg ft	2	Decrea...	0	0	200	1000	
	62	Street Centerline Distance	total ft	0	Exclude	0	0	0	0	
	43	Street Network Density	centerline ...	2	Increase	10	20	0	0	
	44	Street Network Extent	centerline ...	1	Increase	5	25	0	0	
✔	45	Transit Service Coverage	stops/sq mi	2	Increase	6	12	0	0	▤
✔	46	Transit Service Density	vehicle rou...	0	Exclude	0	0	0	0	▤
✔	65	Transit-Oriented Residential D...	DU/net acr...	2	Increase	8	20	0	0	▤
✔	66	Transit-Oriented Employment ...	emps/net ...	2	Increase	10	20	0	0	▤

Editing RAW Values

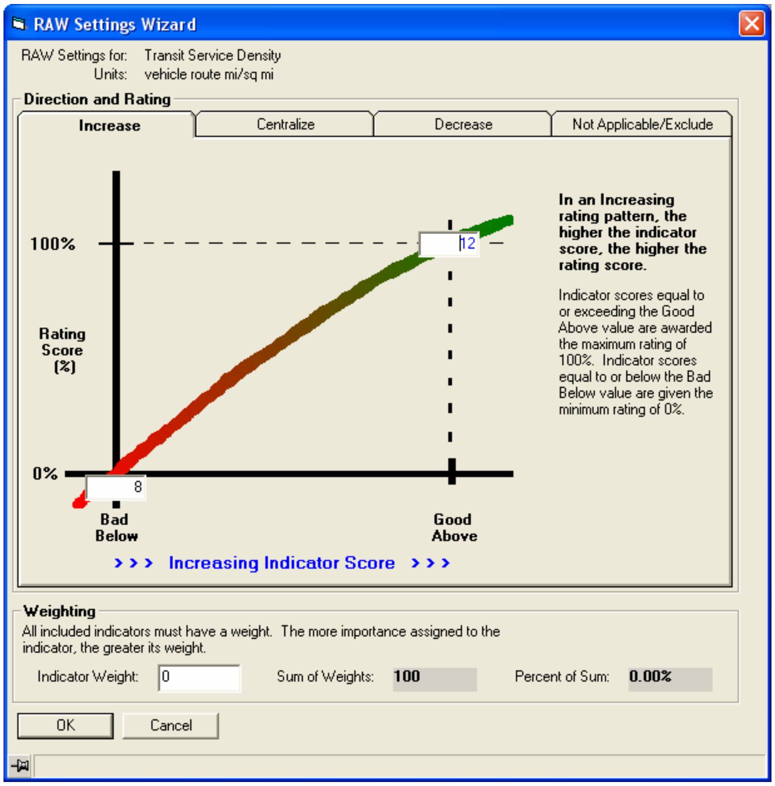
To determine if indicator scores are favorable or unfavorable according to local norms or degree of goal achievement, users may set objectives for each indicator according to the desired direction of indicator score movement, and thresholds of score acceptability.

For this example we will modify the Transit Service Density indicator RAW settings. Assume the jurisdiction's is to increase transit service density in the study area with an objective of no less than 8 vehicle miles/square mile and ideally 12 vehicle miles/square mile of transit vehicle trips per day.

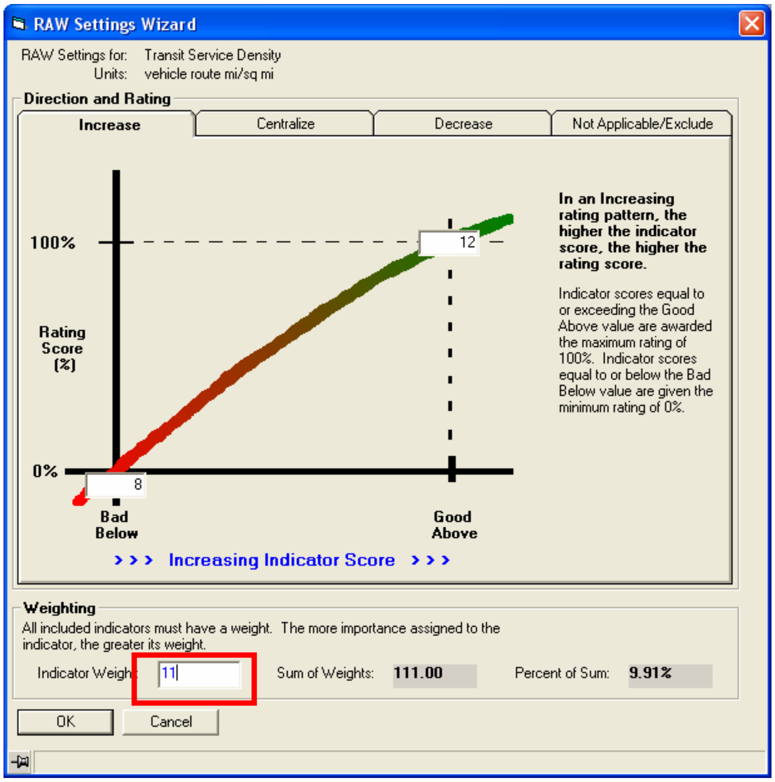
Select the Edit button on the same row as the Transit Service Density indicator:



Select the Increase Tab, and set the lower "Bad Below" target to 8. Then enter 12 in the "Good Above" target. Also increase the indicator weight and click the OK button:



Set the Indicator Weights for the selected indicators so the total weight equals 100.



Indicator	**ArcEditor/ArcInfo Weight**	**ArcView Weight**
Transit Adjacency to Housing	11	20
Transit Proximity to Housing	12	--
Transit Adjacency to Employment	11	20
Transit Proximity to Employment	11	--
Transit Service Coverage	11	20
Transit Service Density	11	20
Transit-Oriented Residential Density	11	--
Transit-Oriented Employment Density	11	--
Residential Multi-Modal Access	11	20

To save values, click OK on the Run Set Editor. Close the Run Set Manager.

APPENDIX A
TRANSPORTATION FEATURES

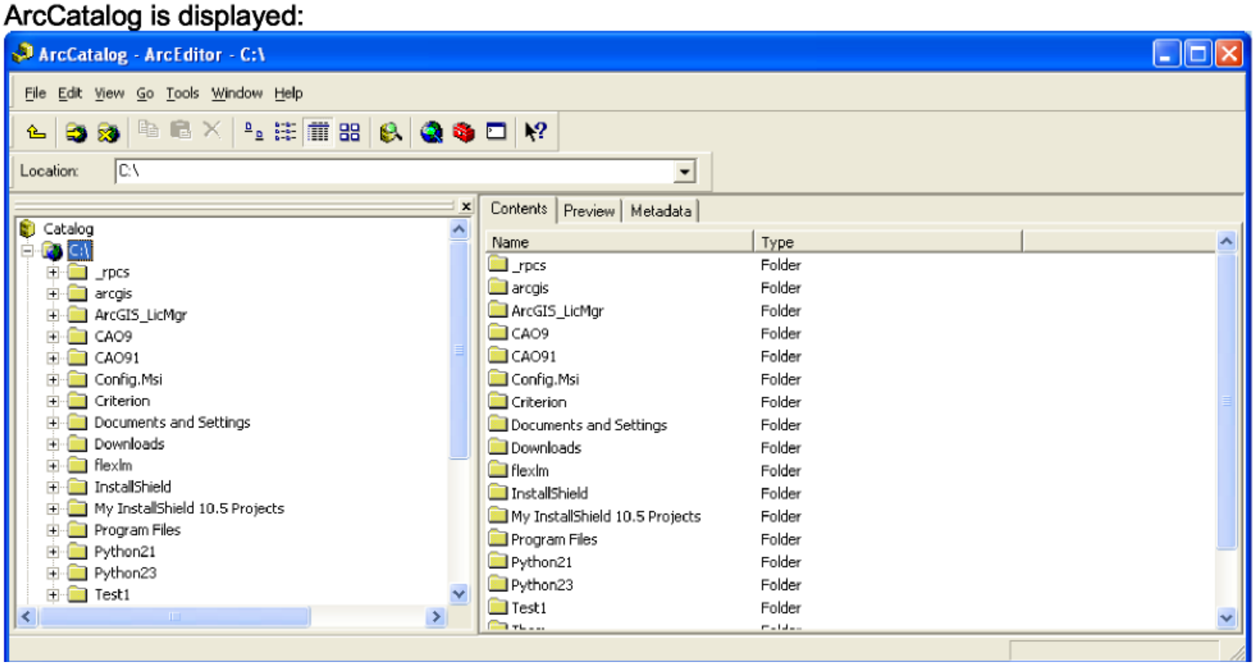
In addition to “painting” land-uses via the Paint Editor, INDEX allows users to define a comparable palette of transportation facilities, so that scenarios can be created with integrated land-use and transportation considerations.

Default transportation feature properties for INDEX pedestrian, street, and transit networks are stored as feature class subtypes. Though not necessary for the functioning of INDEX, you can customize your defaults the same way you customize the defaults of any ESRI personal geodatabase feature class.

Note that the following steps are for advanced data stewards only:

To override the transportation defaults for a given study's case, first create the case using Case Manager. Then launch ESRI's data management application, ArcCatalog:

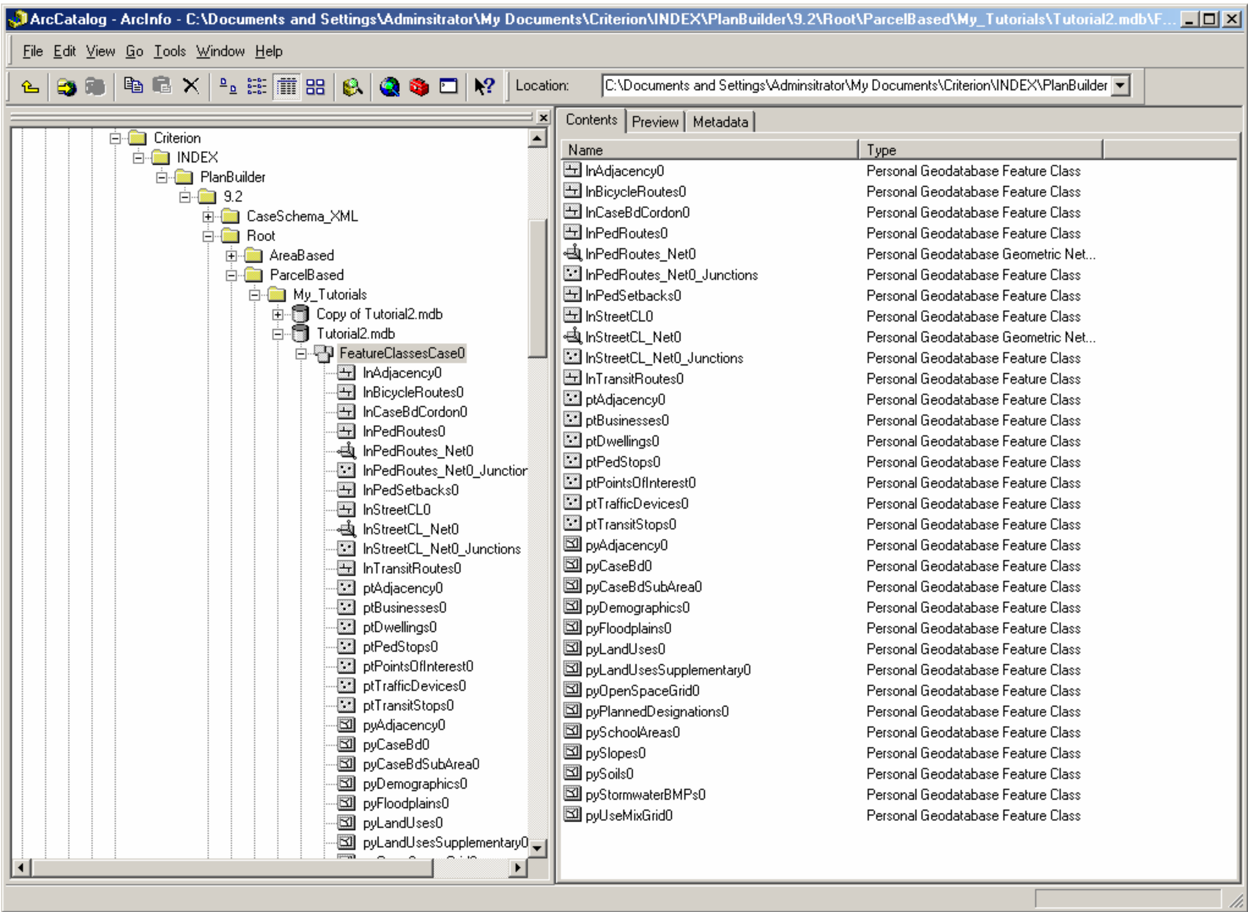
ArcCatalog is displayed:



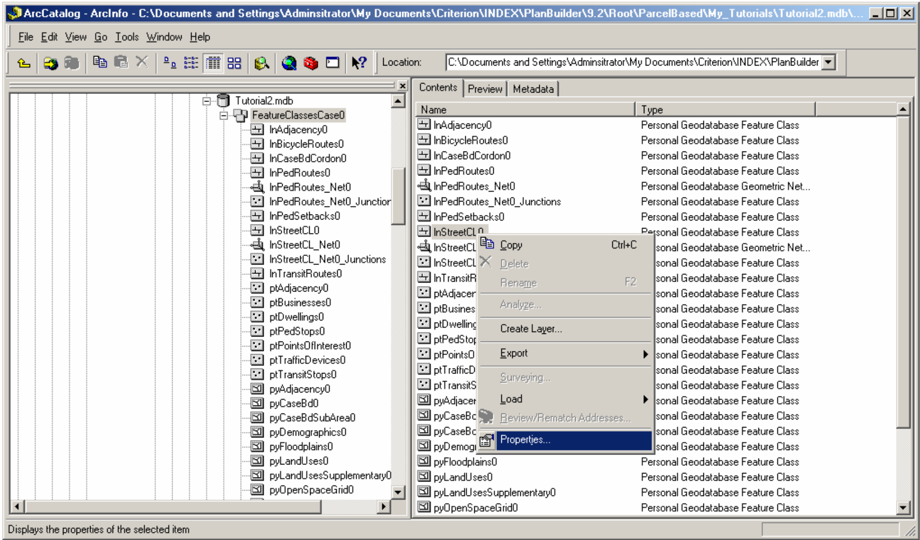
Navigate to the INDEX Root folder location and find the study you want to change. By default in Windows XP this would be:

C:\Documents and Settings\<username>\My Documents\Criterion\IN DEX\PlanBuilder\9.2\Root

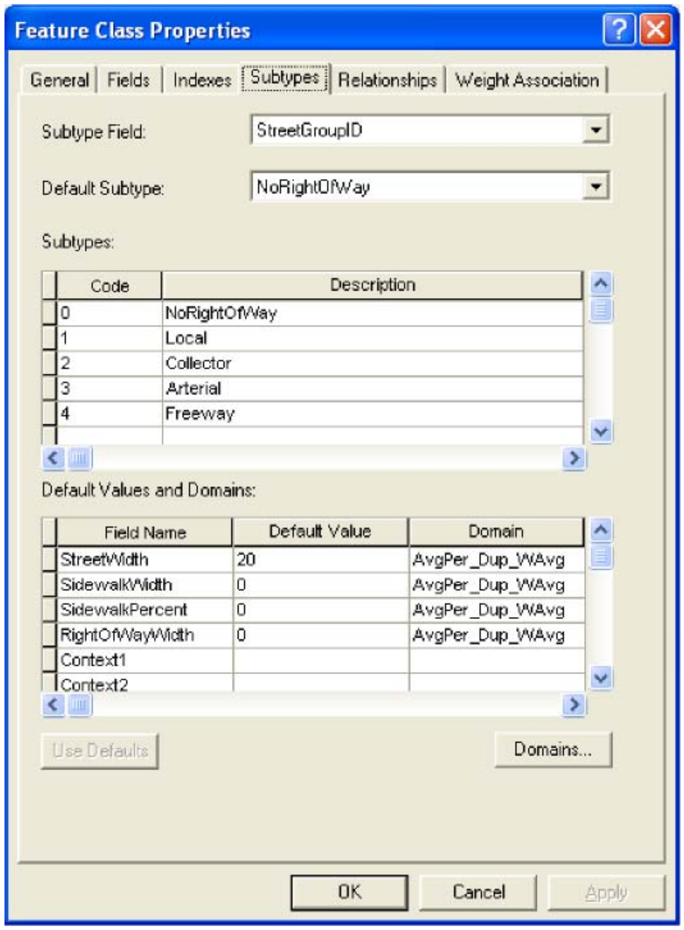
Once you locate the study geodatabase, expand the node next to it and then expand the feature dataset corresponding to the numeric ID of the case you just created ("Base Case" is FeatureClassesCase0, etc.)



Right-click the feature class whose defaults you wish to change and select Properties:



The feature class properties window appears. Select the Subtypes tab:



Once in this window, select the appropriate Subtype in the upper window, then edit the appropriate default in the lower window. Then click OK or Apply to commit the change.

INDEX PlanBuilder

Planning Support System
Release 9.2

Tutorial 2: Benchmarking Existing Conditions

April 2007

CRITERION PLANNERS

CRITERION

www.crit.com

CONTENTS

INTRODUCTION

This tutorial covers one of the most basic applications of INDEX: benchmarking existing conditions in an area to create a frame of reference for subsequent planning. As shown in Figure 1, benchmarking is an important step in identifying issues and circumstances that warrant attention in alternative plans. Benchmarking is also necessary as a point of reference for gauging periodic progress towards goal achievement.

The tutorial addresses benchmarking according to the following major tasks:

- Create a study.
- Create a base case.
- Load study data.
- Select indicators and objectives.
- Benchmark existing conditions.
- Review results.

As shown in Figure 2, this tutorial represents the first step in applying INDEX to a study-level analysis of a location within a jurisdiction. The tutorial describes benchmarking of a small study area, but an entire jurisdiction can and should be benchmarked in certain situations, e.g. measuring current conditions and cumulative progress toward comprehensive plan goal achievement.

INDEX PlanBuilder supports all ArcGIS license types (ArcView, ArcEditor, ArcInfo). However ArcView users are limited in the kinds of indicators they can run, and therefore have reduced data requirements. Throughout the INDEX PlanBuilder documentation, where applicable the following highlights denote license-specific features or instructions:

ArcEditor/ArcInfo Users, or

ArcView Users

Figure 1. BASIC STEPS IN APPLYING INDEX

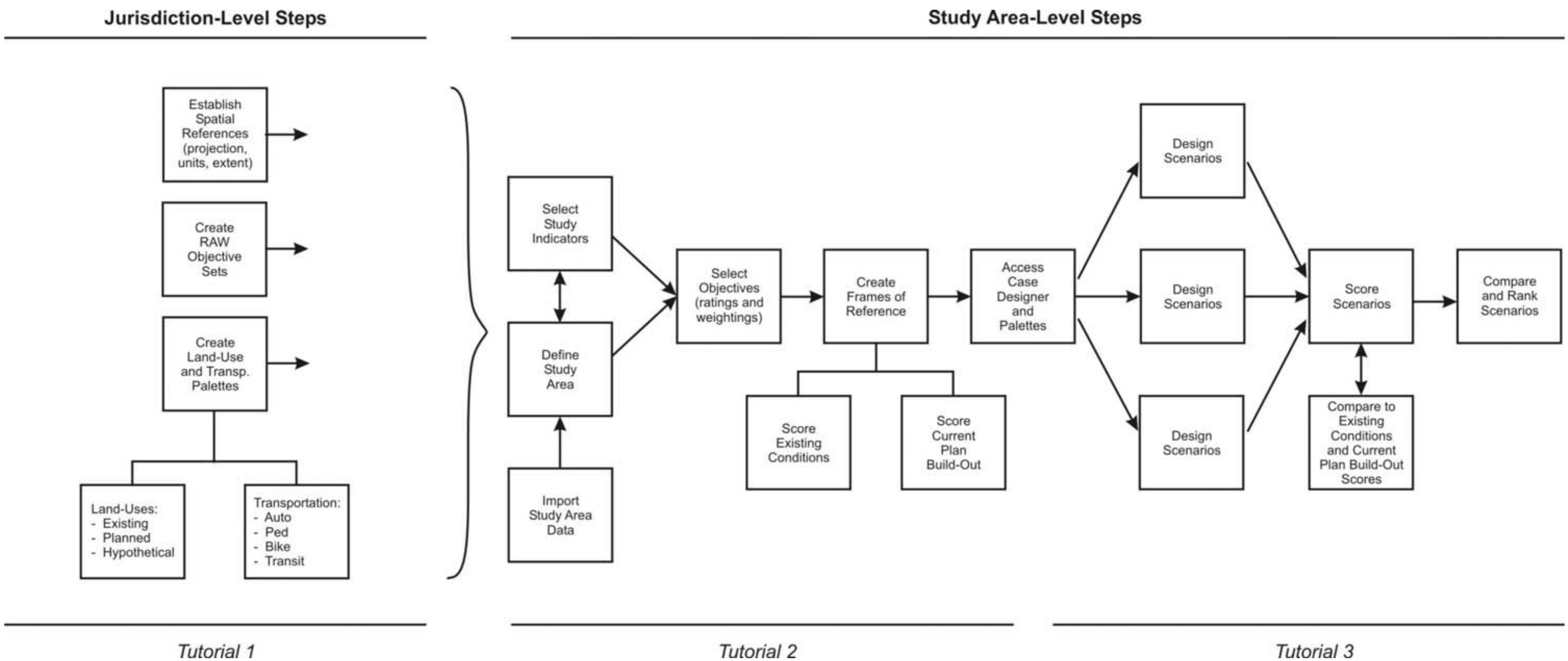
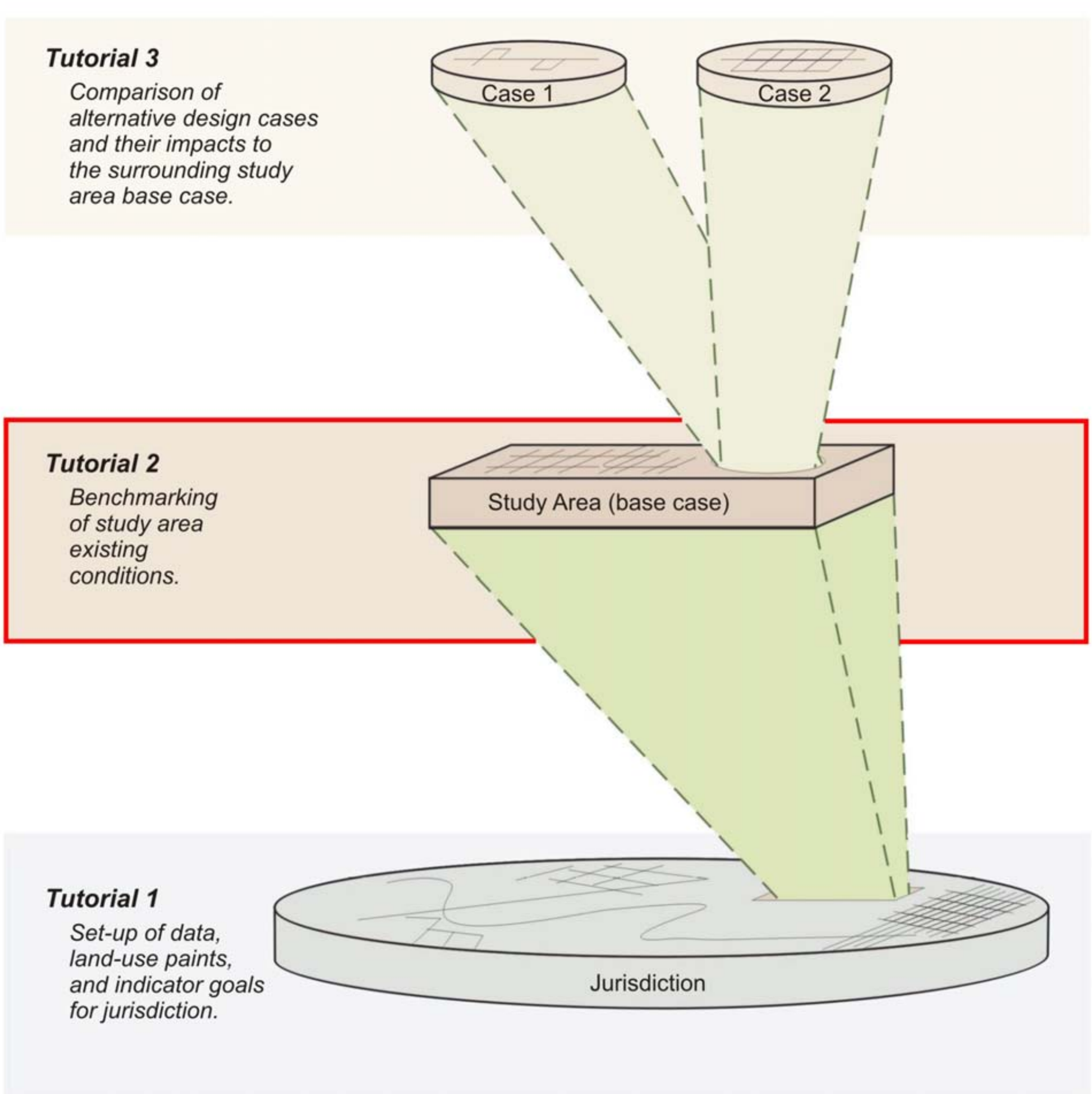


Figure 2
TUTORIAL SEQUENCE AND GEOGRAPHIC RELATIONSHIPS



CREATE A STUDY

During the initial set-up process you worked with jurisdiction-level data and provided local values in the Master Template. In this tutorial, the focus will shift to a designated study area within the jurisdiction where existing conditions will be benchmarked to create a base case.

Case Boundary Area

A key task in creating a study is the definition of its boundary. This defines the area for which indicators are calculated and mapped (see Figure 3). The study area boundary (called "case boundary" in the software) should be derived from the study's scope and objective, e.g. city limits if an entire municipality is being evaluated, or the neighborhood vicinity if a major development proposal is being examined.

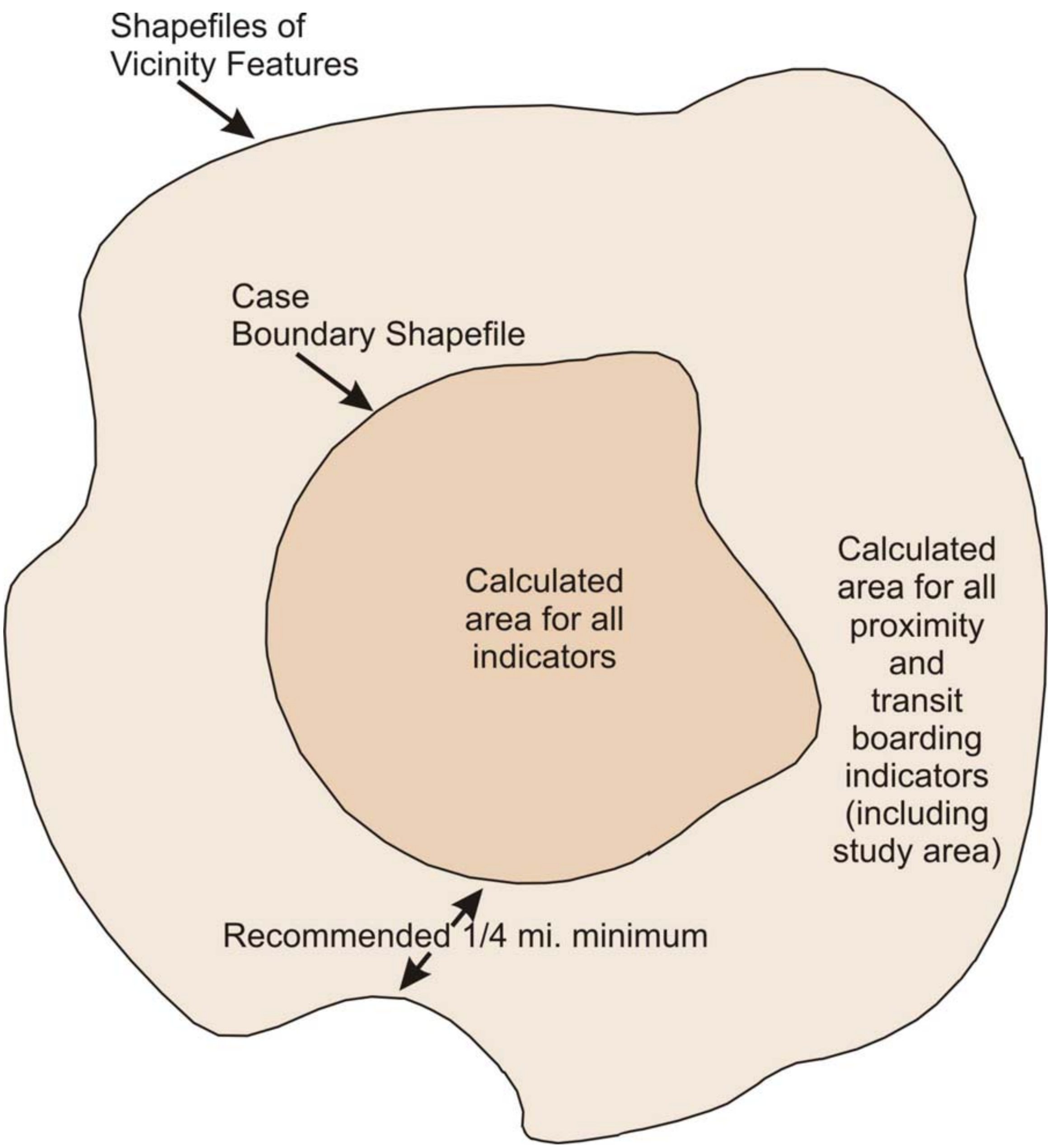
Sizing of the boundary in relation to the subject being studied is important because it affects the magnitude of change that will be seen in results from study to study, e.g. a small development proposal inside a large study area will not significantly change baseline scores versus the same proposal measured in a smaller study boundary that would produce major baseline changes. In short, the boundary should be set to capture the logical spatial extent of a project's impact.

For example, a one-half to one-mile buffer around a project site often constitutes a reasonable study area. In all studies, care should be exercised along the study boundary edge to insure that important adjacent features that affect the study area are included, e.g. an elementary school just outside the boundary of a residential study area. Equally important, anomalous or irrelevant features should be excluded from study areas so they do not adversely influence scores, e.g. excluding a commercial area from a residential housing study area.

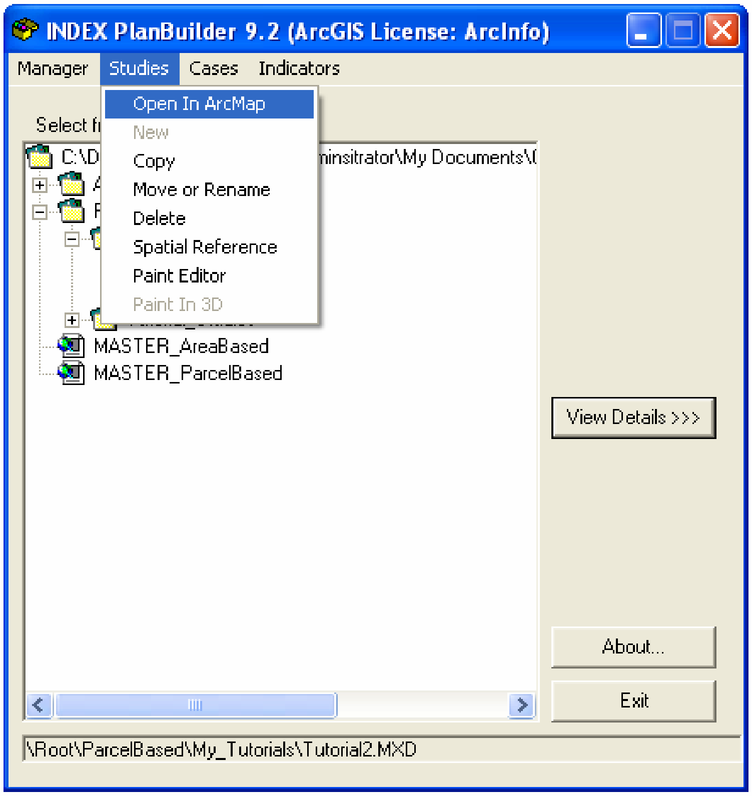
The Case Boundary not only defines the study area geographically, but it is also used to store case-specific parameters required for indicator calculations. Do not match any of the source shapefile fields with target input attributes. Several of the target attributes will automatically be populated with default values. The study data for the tutorial is located in the following folder:

[My Documents]\Criterion\INDEX\PlanBuilder\9.2\TutorialData\ParcelBased\StudyArea_GIS

Figure 3
CASE BOUNDARY AND VICINITY FEATURES



Select the “Tutorial2” study and click the Studies > Open in ArcMap menu option:

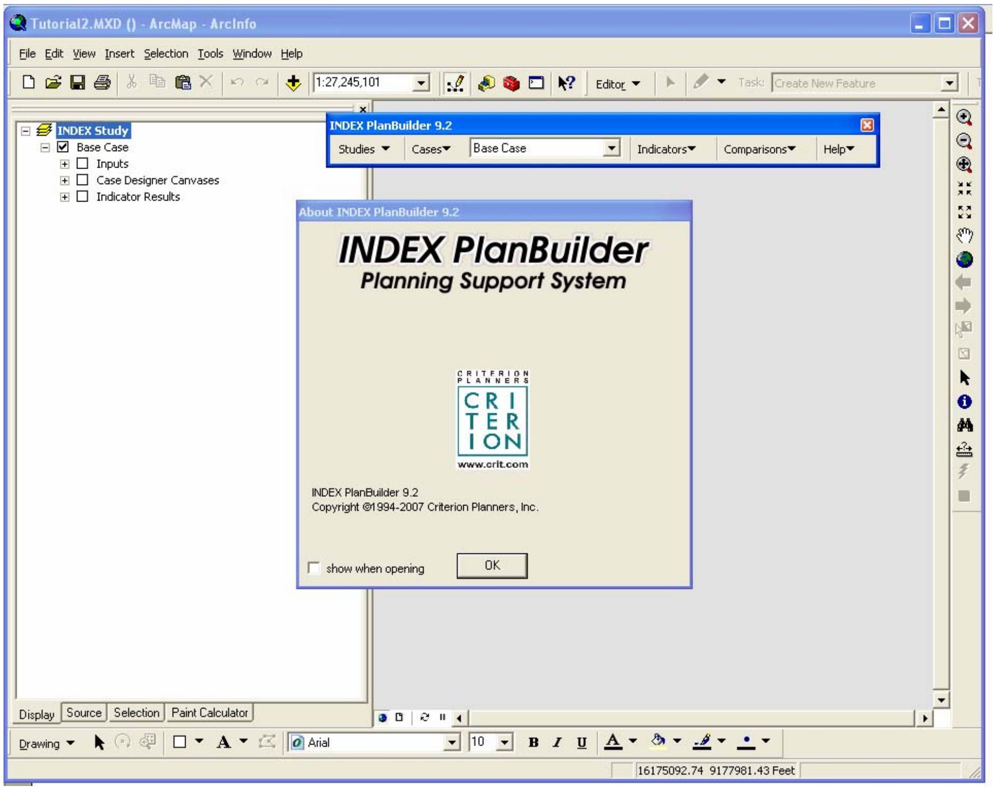


Studies are provided in increments in the Tutorial_Studies folder for your convenience.

ArcEditor/ArcInfo Users: *the beginning study is saved at this point as Tutorial2_Begin*

ArcView Users: *the beginning study is saved at this point as Tutorial2_Begin_AV*

Opening the study launches an ArcMap session with the INDEX extension loaded.



Performance Note

To improve INDEX performance, when opening any Study for the first time on a particular computer, or copying any Study or Case to create a new Study or Case, always click Save before proceeding with the application. Once this has been done on a particular computer, it isn't necessary to repeat the Save procedure during subsequent work on the Study or Case.

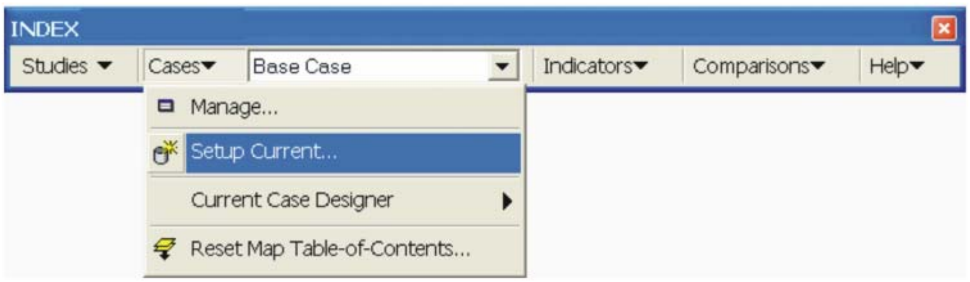
LOAD BASE CASE DATA

Shapefiles are loaded into INDEX through the Case Setup Editor and Geodata Loader windows. During the geoloading process shapefiles are converted to feature classes, automatically inspected for topology errors, and saved in the INDEX geodatabase.

Do not open Study Manager at the same time that a study is open. Always close a Study before returning to Study Manager.

Open the Case Setup Editor

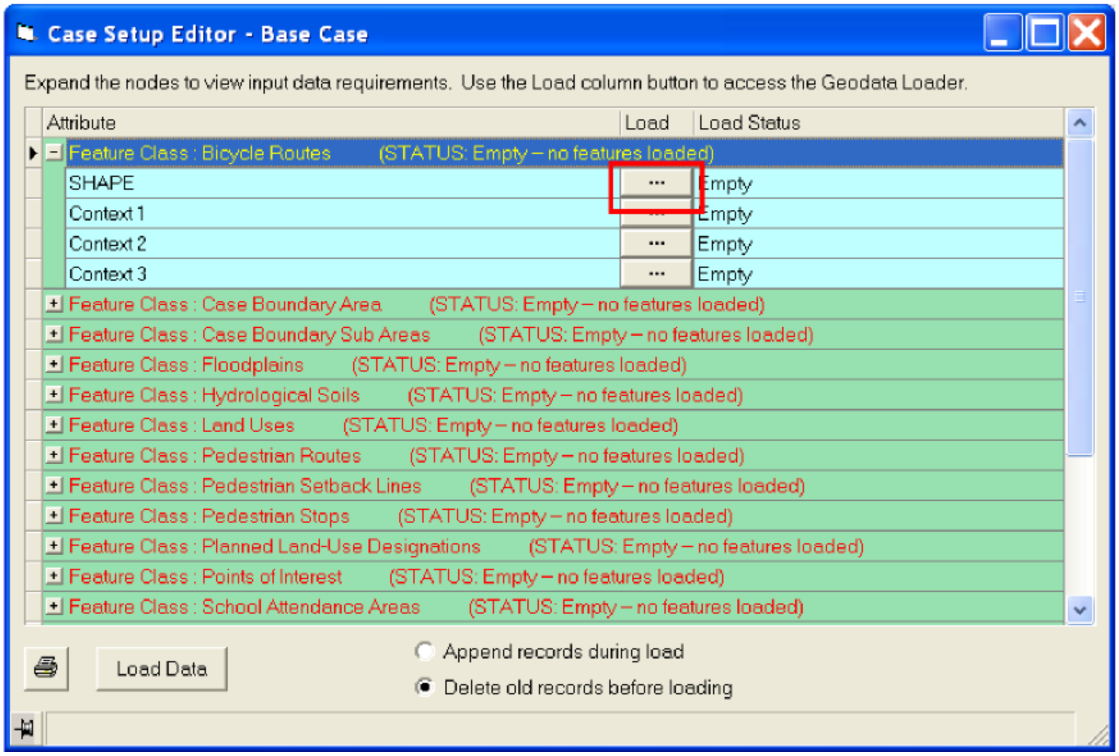
Select the Cases menu on INDEX toolbar and select the Setup Current option:



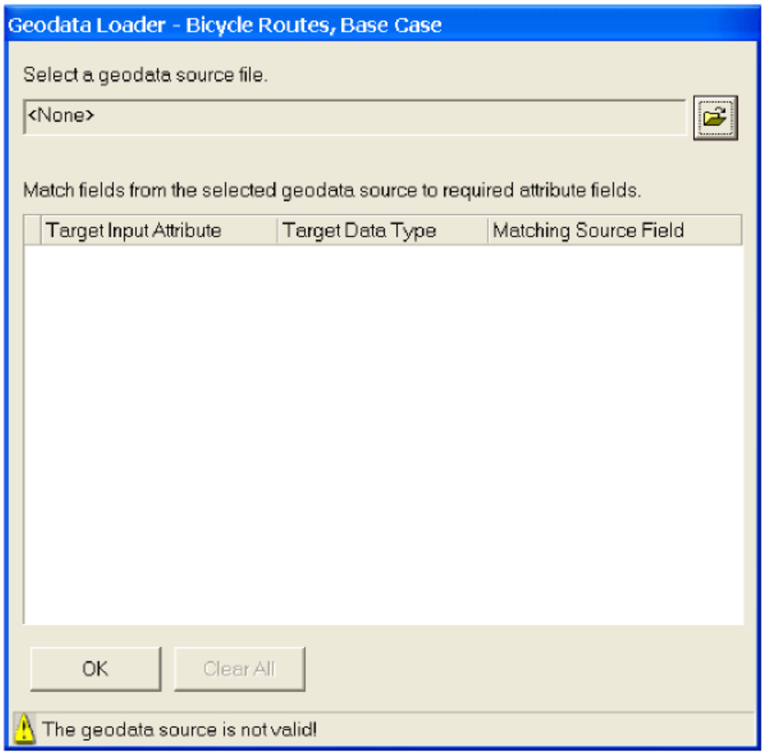
Case Setup Editor window shows the load status of the feature classes in the current case. Since the Base Case has no data loaded all feature classes are displayed in red.

Geodata Load Definition Steps

Expand the node of the feature and click one of the Load (…) buttons to open the Geodata Loader window:

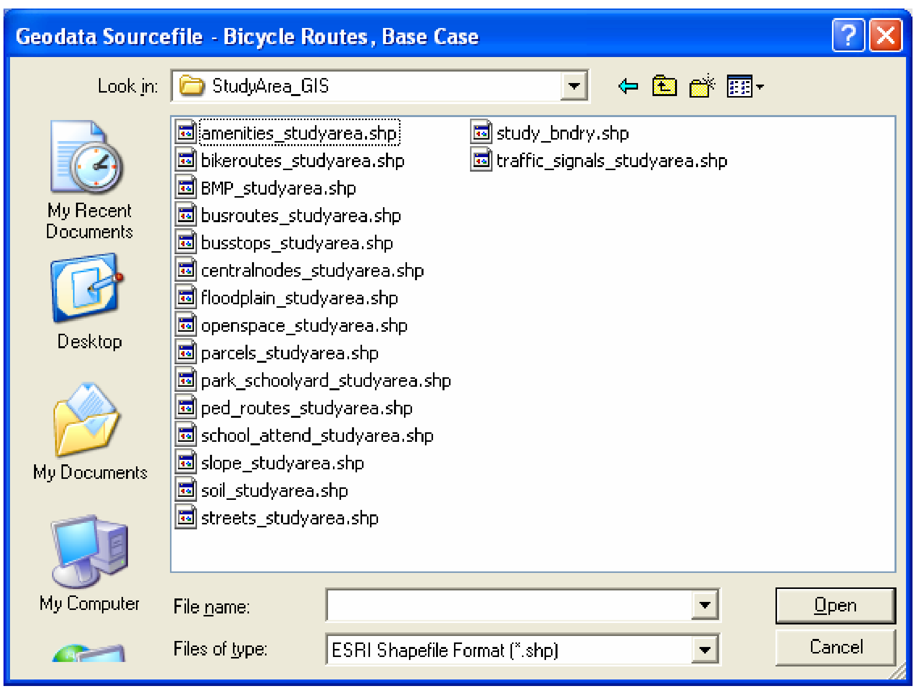


Click the Browse button:

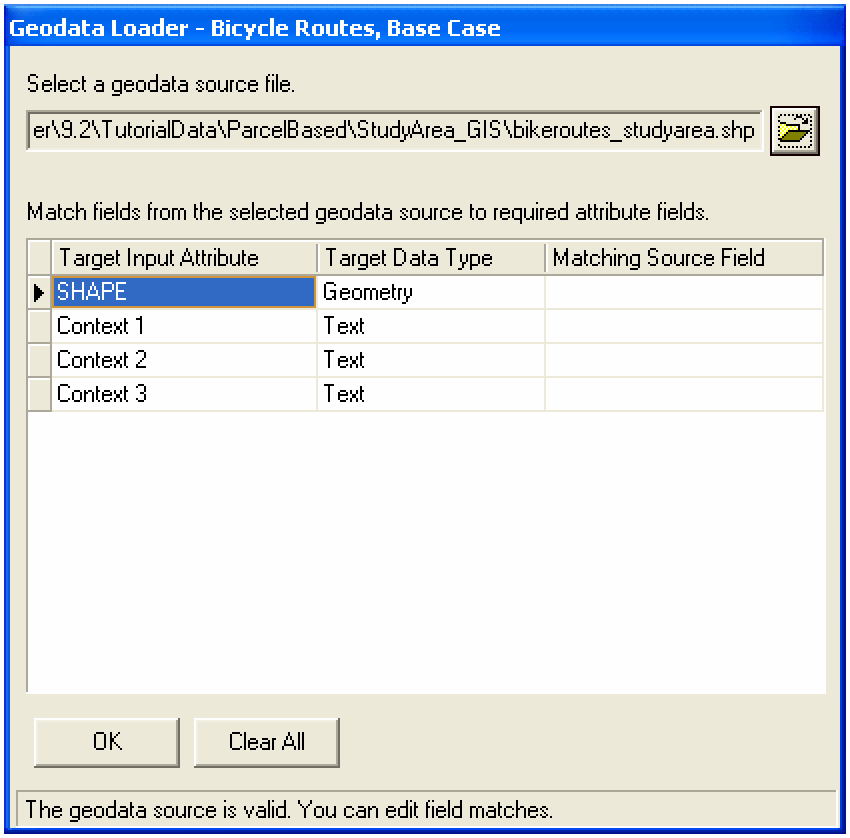


Navigate to the Tutorial Data folder:

[My Documents]\Criterion\INDEX\PlanBuilder\9.2\TutorialData\ParcelBased\StudyArea_GIS

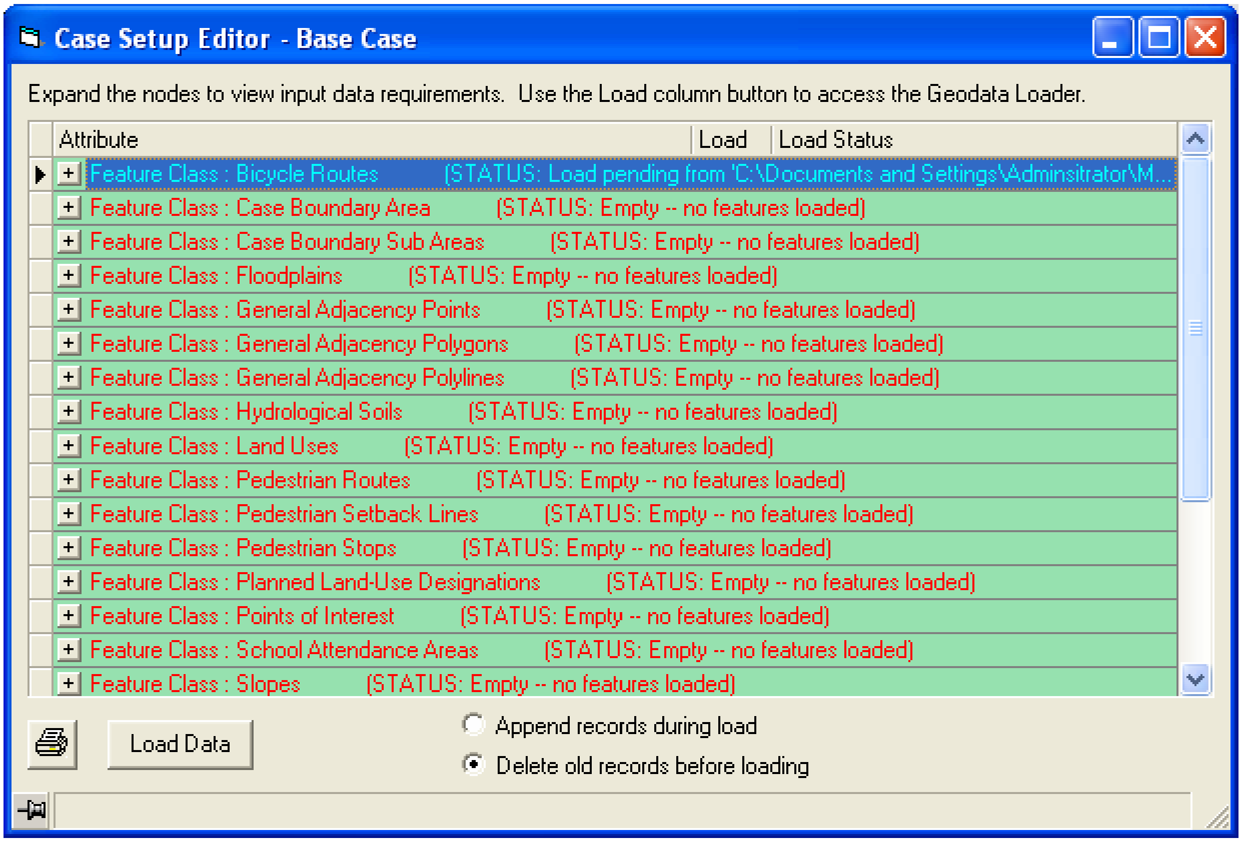


Select the source shapefile – “bikeroutes_studyarea.shp” and click the Open button:



For each target attribute, click one of the spaces in the Matching Source Field column to enable the drop-down list from which you can select a field. Match the fields you want to import from the source shapefile into the geodatabase. Context fields are available so users can import descriptive attributes along with INDEX-specific data. Take note of which data are being loaded into the context fields because original field names will not be loaded into INDEX.

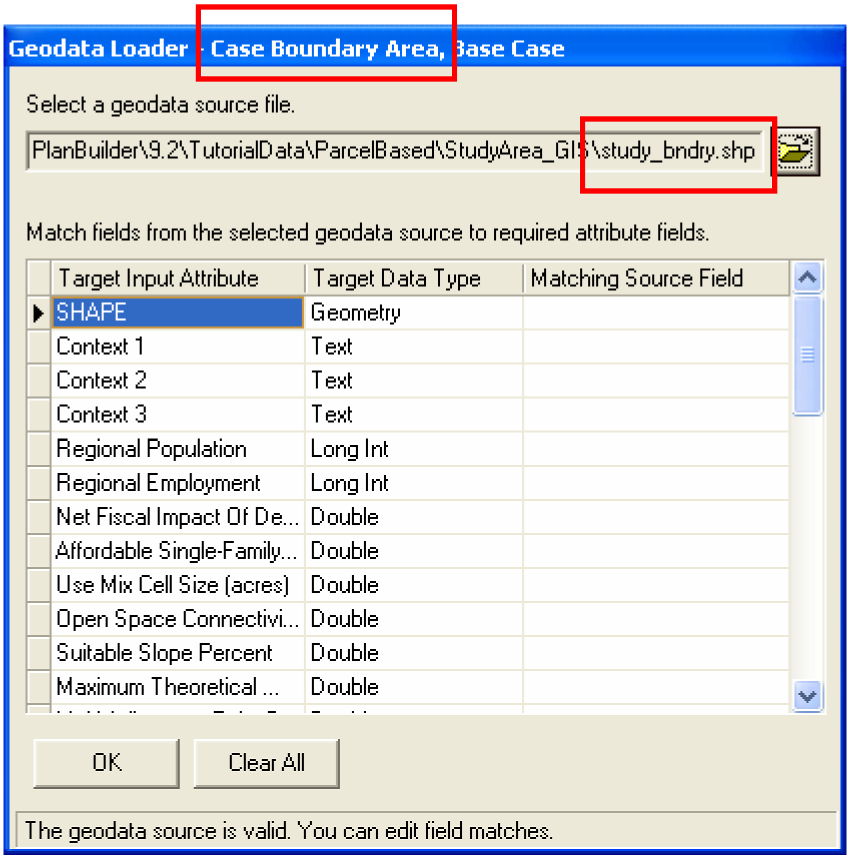
After all of the desired fields are selected, click OK to return to Case Setup Editor. Note that the Feature Classes with pending geoloads are noted:



Geodata Loader Attribute Matching

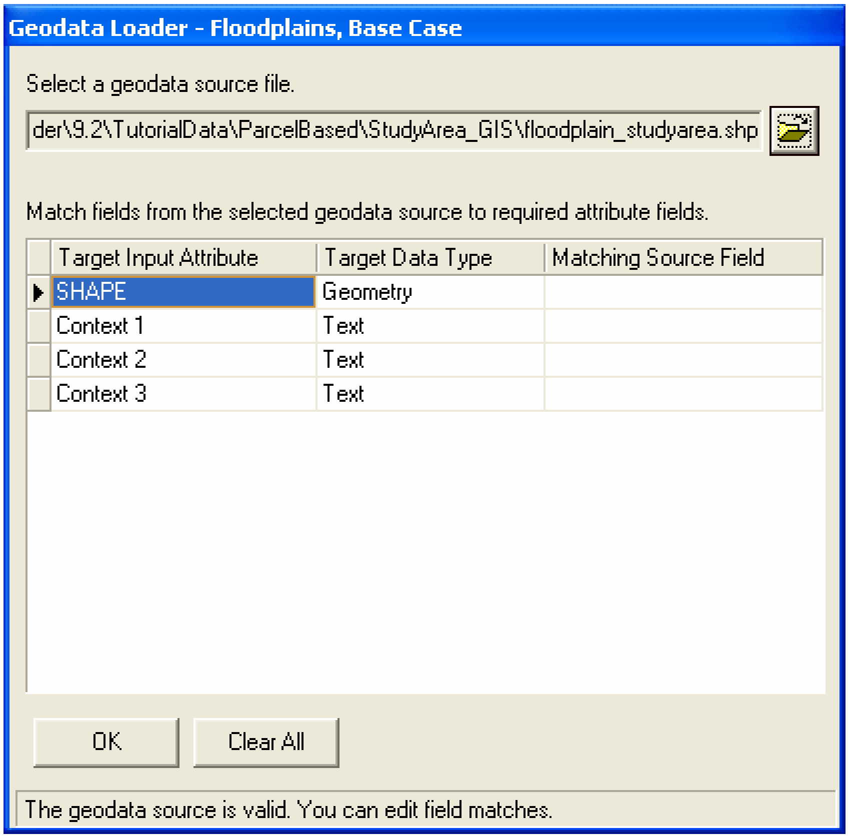
Load the following shapefiles, matching source fields with target attributes as demonstrated in the screen captures. Default values will automatically populate some target attributes when original source data is not supplied. Refer to Appendix D of the Indicator Dictionary for detailed descriptions of required attributes and default values.

Click the OK button when you are ready to proceed:



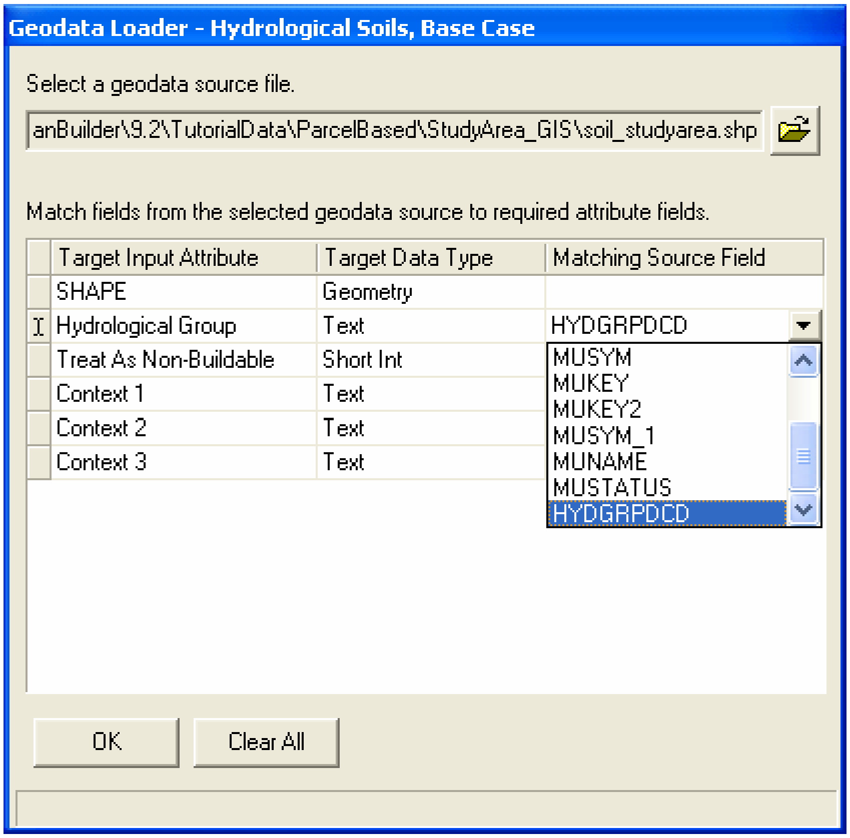
Floodplains

No attributes are required for Floodplains, but the user may choose to load data into a context target for reporting or mapping purposes:



Hydrologic Soils

Match the HYDGRPCD field from the soil.shp file to the Hydrologic Group target field. For a description of Hydrologic Soils and required attributes, see Appendix D of the Indicator Dictionary:



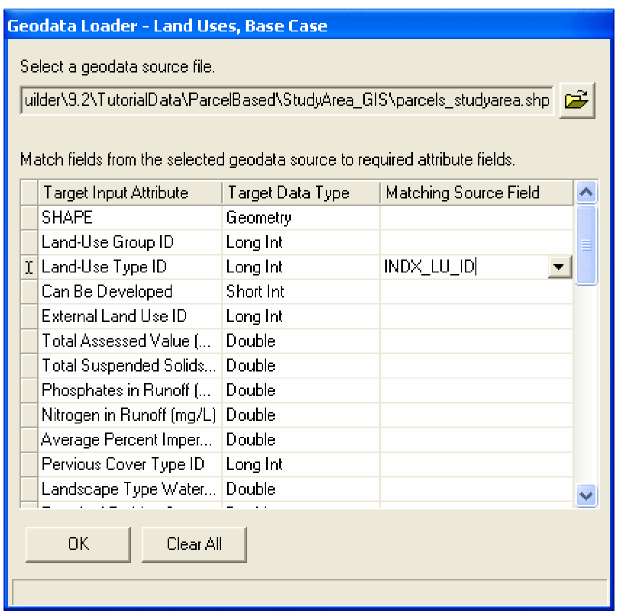
Land-Uses

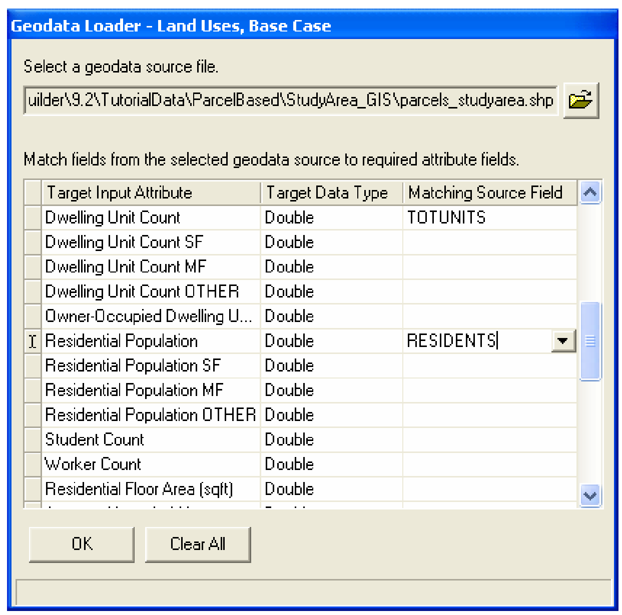
When selecting a Land Use source shapefile, a unique message appears:

INDEX supports detail breakdown fields which further describe the kind of demographic data that is being loaded. Instead of loading directly to these detail fields, we will rely on our existing land-use paint definitions to supply the type of demographic classification.

In Tutorial 1, you created a field in the source shapefile defining land-use types (paint editor). Match the INDX_LU_ID to the Land-Use Type ID target attribute.

Four other attributes used by INDEX are available in the source shapefile: number of dwelling units, number of residents, parking spaces, and number of employees. Match the PARKING_SP target attribute to the Required Parking Spaces field, TOTUNITS field to Dwelling Unit Count, RESIDENTS field to Residential Population, and EMPS to Employment Count.





The selected source shapefile does not contain attributes that match up exactly with all of the data fields in INDEX; however, some of the attribute data can be created from existing attributes. Total assessed value can be obtained by adding assessed structure values and assessed land values together. Load ASS_STRVAL attributes into the Context 1 target attribute, ASS_LNDVAL attributes into the Context 2 target attribute, and LANDUSE_DE in the Context 3 target attribute. Remember to keep track of which source fields are loaded into the description fields because the original source field names are not loaded with the data.

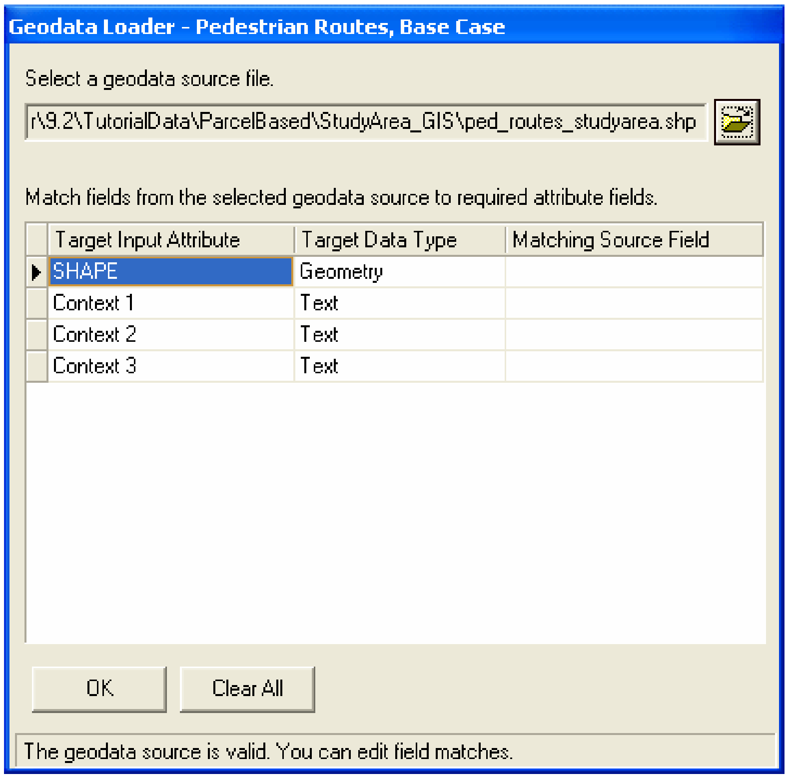
The remaining fields will either be populated with default values based on the land-use group or calculated using existing data and external sources.

Click the OK button when you are ready to proceed.

ArcEditor/ArcInfo Users: Pedestrian Routes

INDEX evaluates the pedestrian environment with several "proximity" indicators. As described below, it is possible to use a simple network shapefile, or if a more rigorous analysis is desired, the methodology described in Appendix A should be used. No attributes are required for pedestrian routes, but network connectivity is very important.

Load the Ped_routes_studyarea.shp shapefile and select OK:



Pedestrian Setback Lines

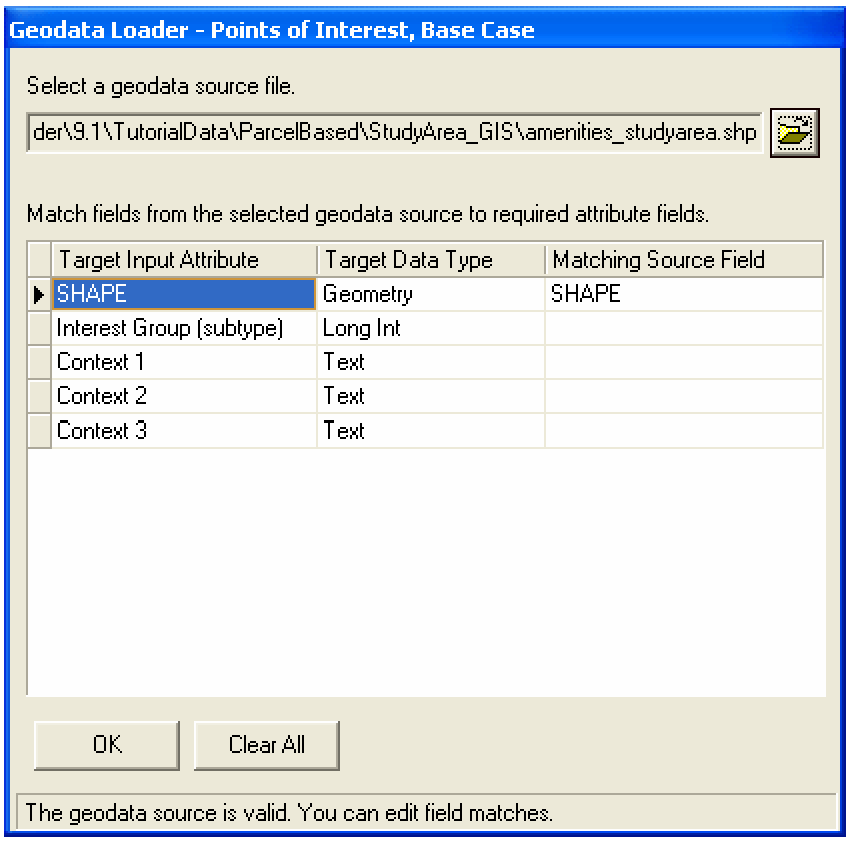
Pedestrian Setback Lines are digitized lines that run parallel with parcel frontages and are attributed with the distance from street to the building entrance. Skip this and other feature classes because you won't be using them in this tutorial. For a description of pedestrian setback lines and required attribute, see Appendix D of the Indicator Dictionary.

Points of Interest

The Points of Interest feature class contains three types of points: amenities, central nodes, and key features. Amenities are local destinations people frequent, like grocery stores, and central nodes are heavily trafficked points in the neighborhood, like a main intersection.

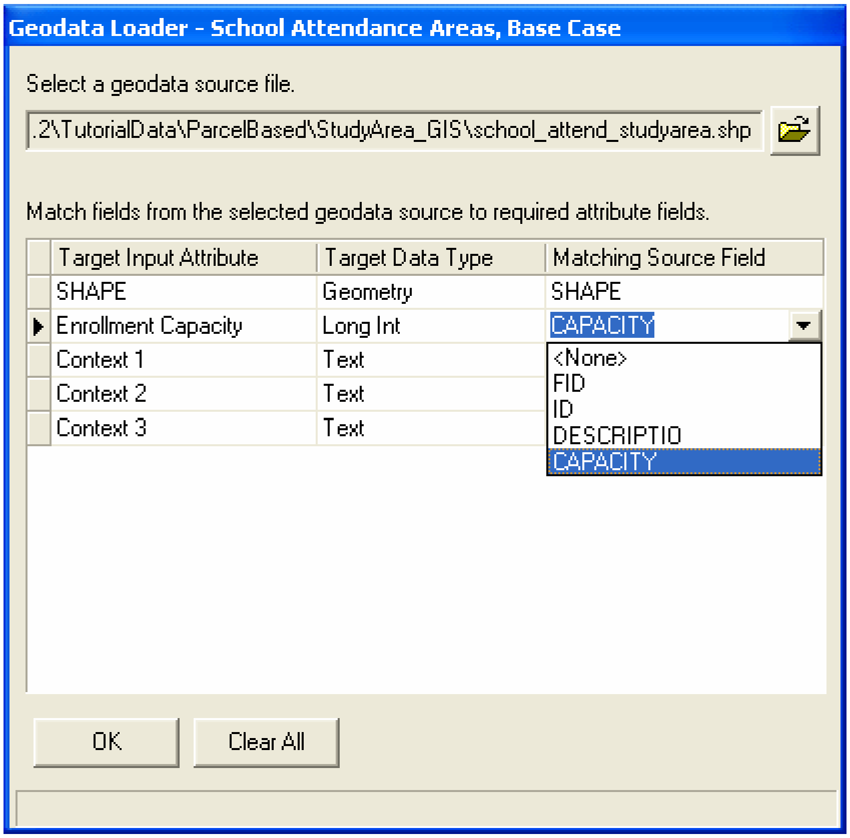
Only one "Points of Interest" subtype can be added at a time, so Amenities will be the first source shapefile added. Central Nodes will be appended to this feature class later in the tutorial. Do not load an interest group subtype. By default, undesignated points added to this feature class are assigned the Interest Group value of 1 (Amenity).

Load amenities_studyarea.shp source file:



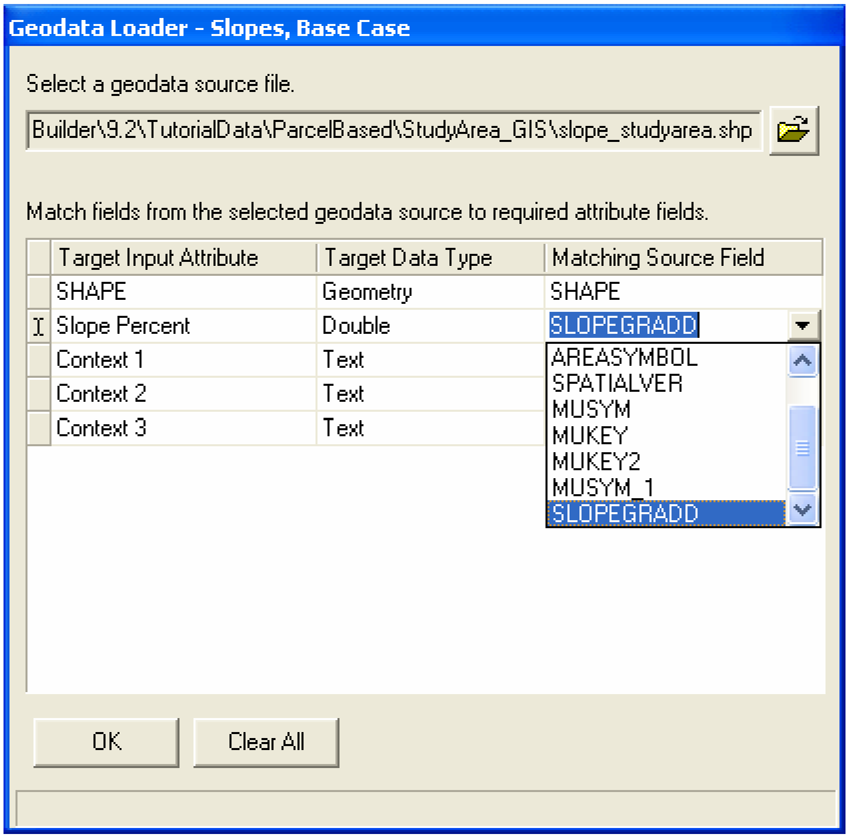
School Attendance Areas

Load the school_attend_studyarea.shp source file and match the CAPACITY field to the Enrollment Capacity target attribute:



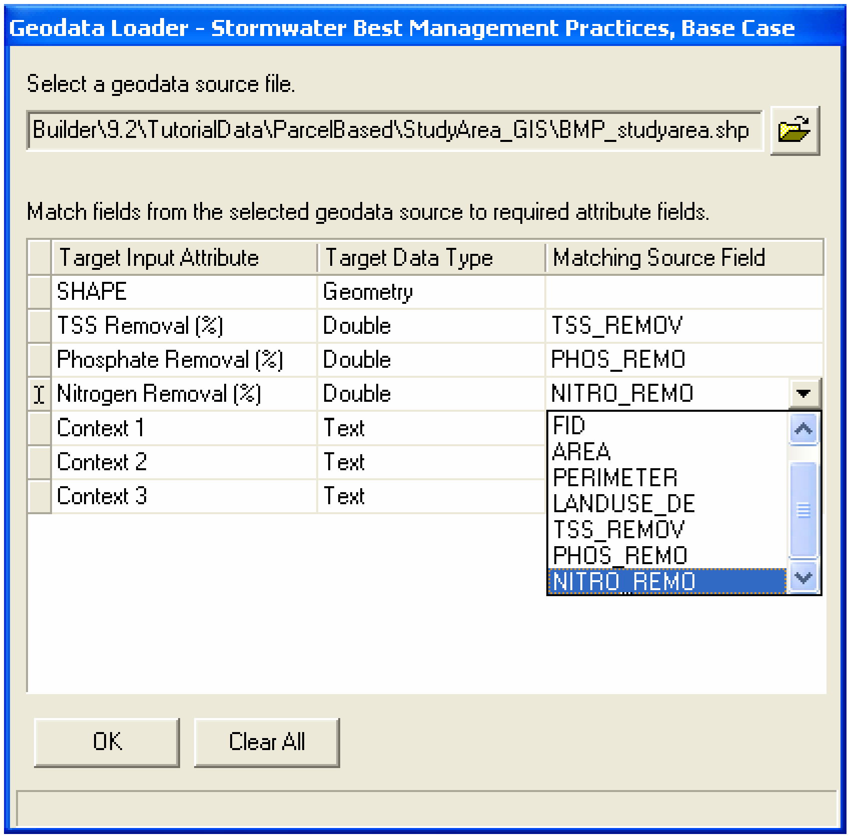
Slopes

Load the Slopes_studyarea.shp source file and match the SLOPE field to the Slope Percent target attribute:



Stormwater Best Management Practices

Load the BMP_studyarea.shp source file and match the TSS field to the TSS Removal target attribute, the Phosphate field to the Phosphate Removal target attribute, and the Nitrogen field to the Nitrogen Removal target attribute:

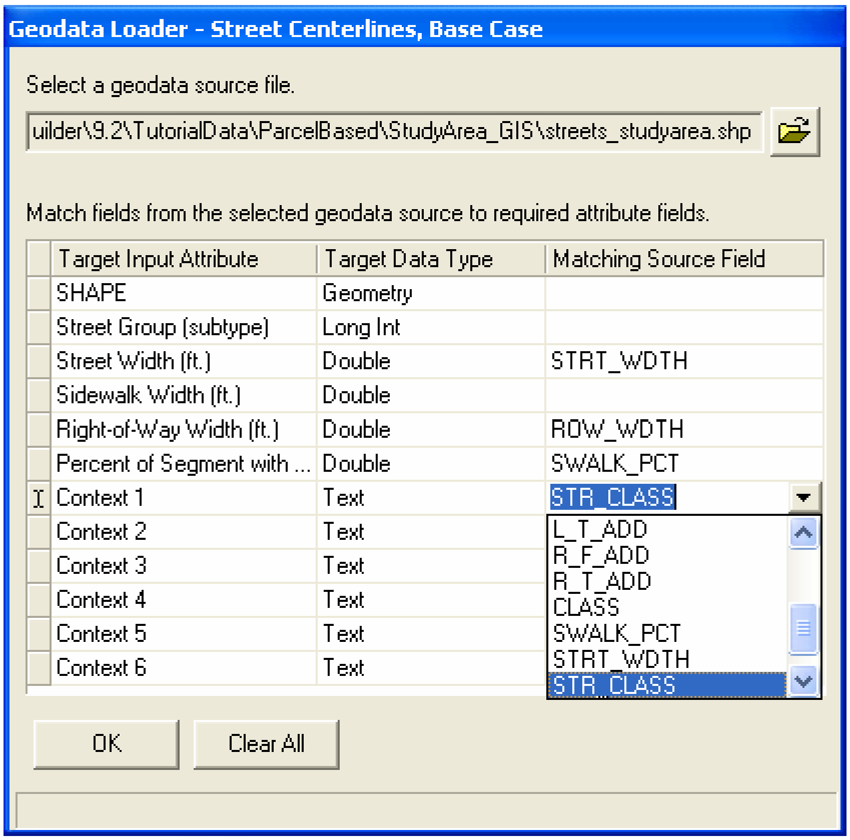


Stormwater BMPs are part of the SGWATER tool inside of INDEX. SGWATER is a U.S. EPA methodology that estimates nonpoint source pollution from stormwater runoff. Because of its complexity, users are strongly encouraged to review the Indicator Dictionary's discussion of stormwater indicators, and U.S. EPA's SGWATER documentation that can be downloaded from www.crit.com/documents/sgwater.pdf.

Street Centerlines

Two of the target attributes already exist in the source data: Street Width and Percent of Segments with Sidewalks. A third target attribute, Street Group subtype, can be created later from the CLASS field attributes.

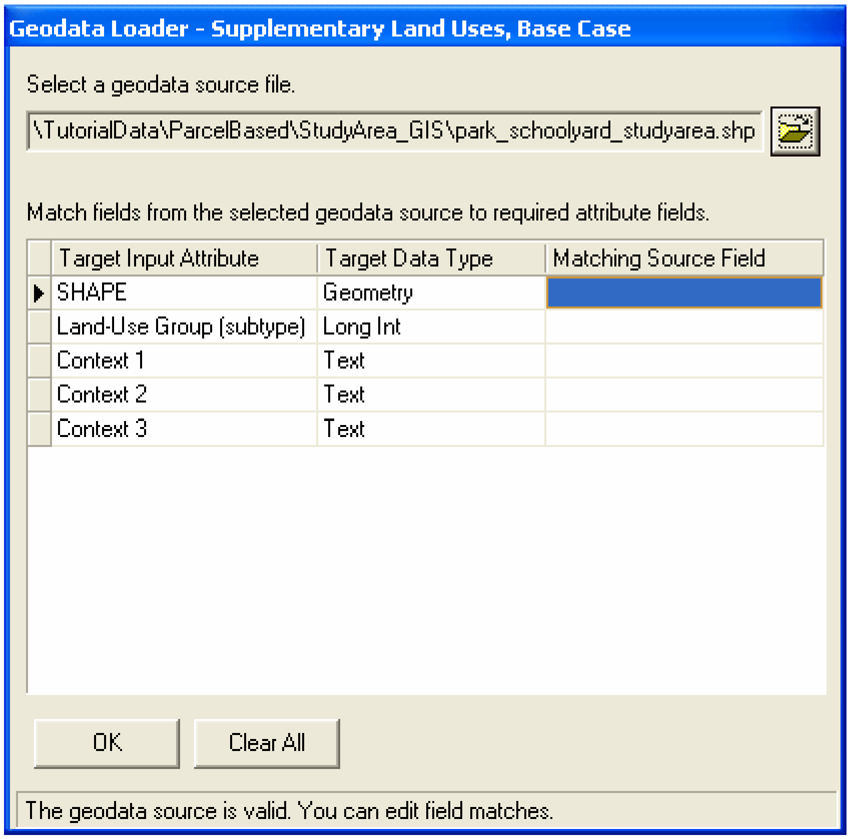
Load the streets_studyarea.shp source file and match the STRT_WDTH field to the Street Width target, ROW_WDTH field to the Right-of-Way Width target, SWALK_PCT field to the Percent of Segment with Sidewalks, and the STR_CLASS field the Context 1 target:



Supplementary Land-Uses

In cases where parcels have multiple uses, such as a school where a portion of the parcel is used as park space, the user may add supplementary land-uses (refer to the Indicator Dictionary for a detailed description of supplementary land-uses).

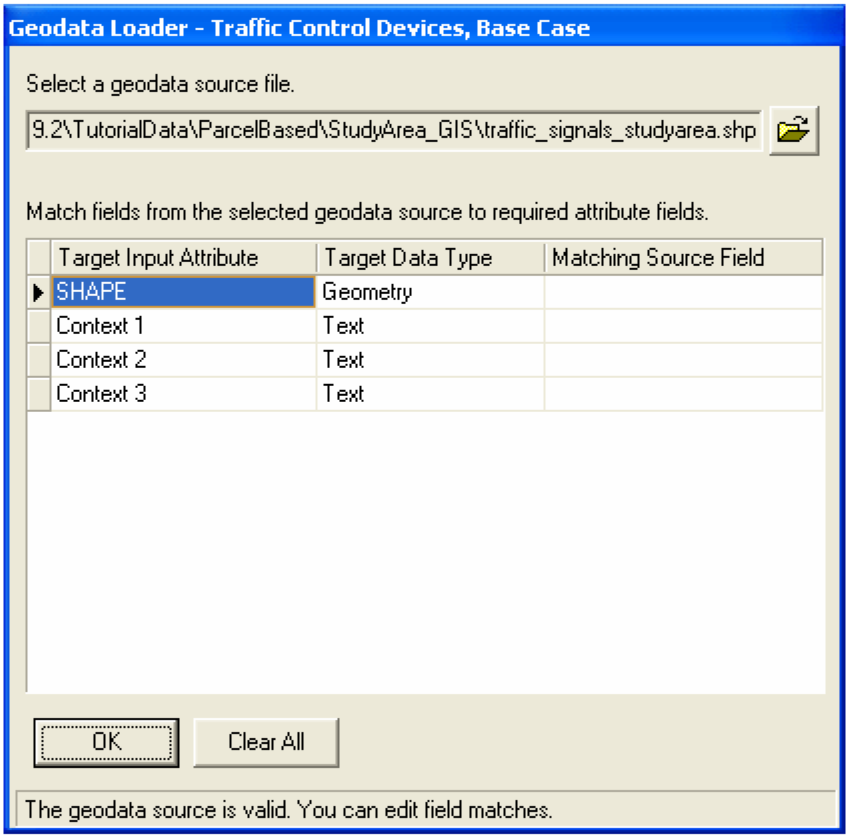
Load the park_schoolyard_studyarea.shp source file, but do not set a field for the Land-Use Group subtype:



The Land-Use Group will be added to the feature attributes later in the tutorial.

Traffic Control Devices

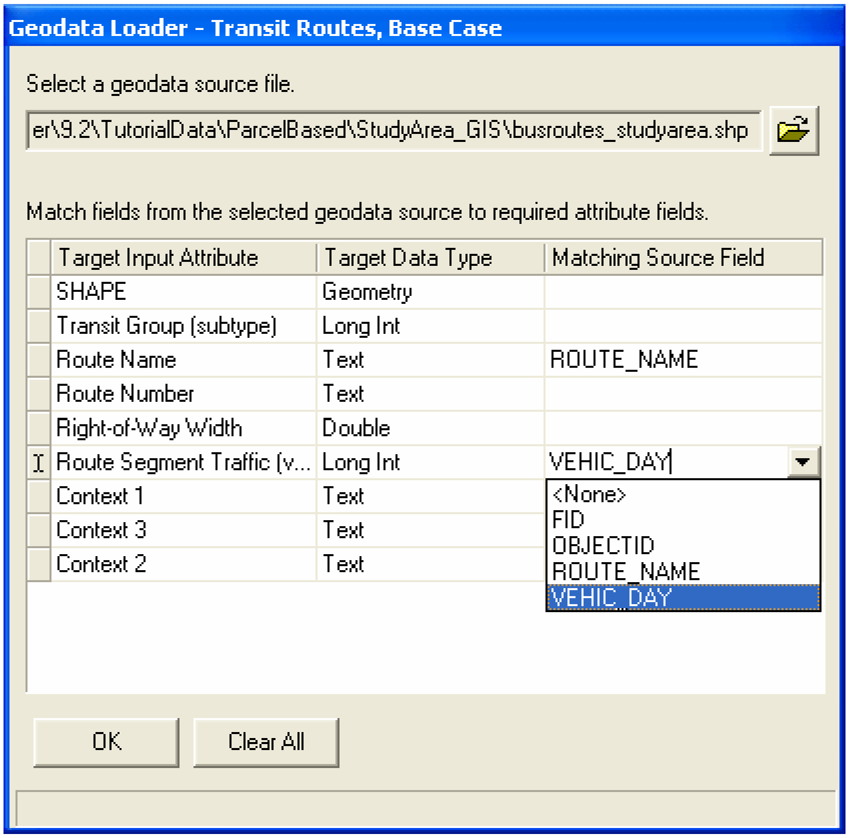
Load the traffic_signals_studyarea.shp source file. No attributes are required for Traffic Control Devices:



Transit Routes

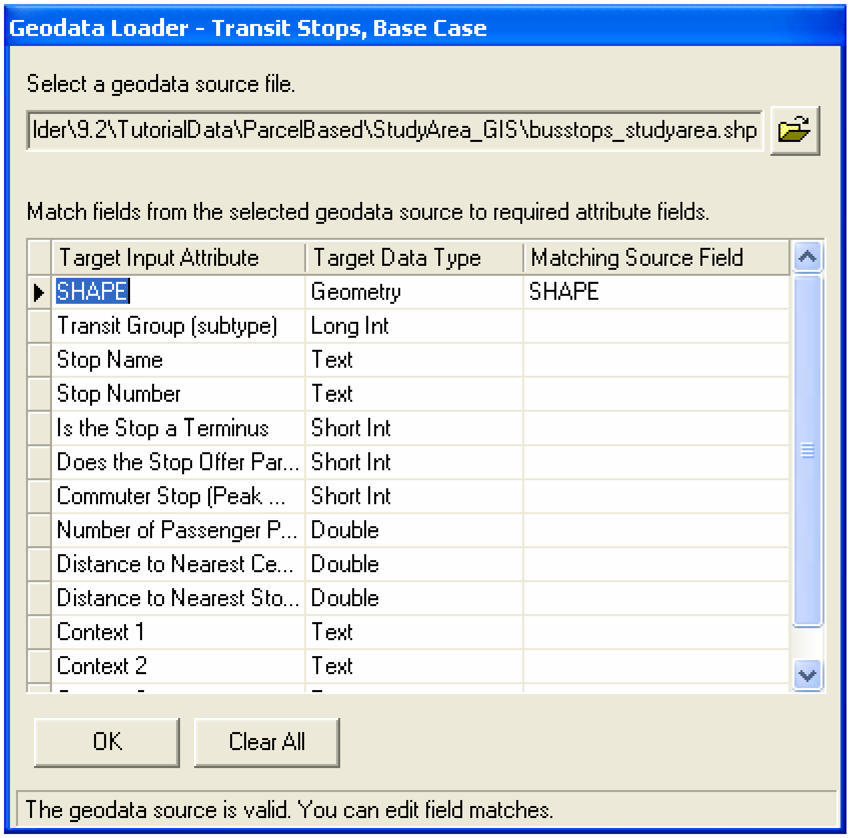
INDEX allows for three types of transit-routes: bus, light rail, and heavy rail. All three types may reside either in the same shapefile or in separate shapefiles. Bus routes will be the only type of transit route measured in this tutorial.

Load the busroutes_studyarea.shp source file and match the ROUTE_NAME field to the Route Name target attribute and the VEHIC_DAY field to the Route Segment Traffic target attribute:



Transit Stops

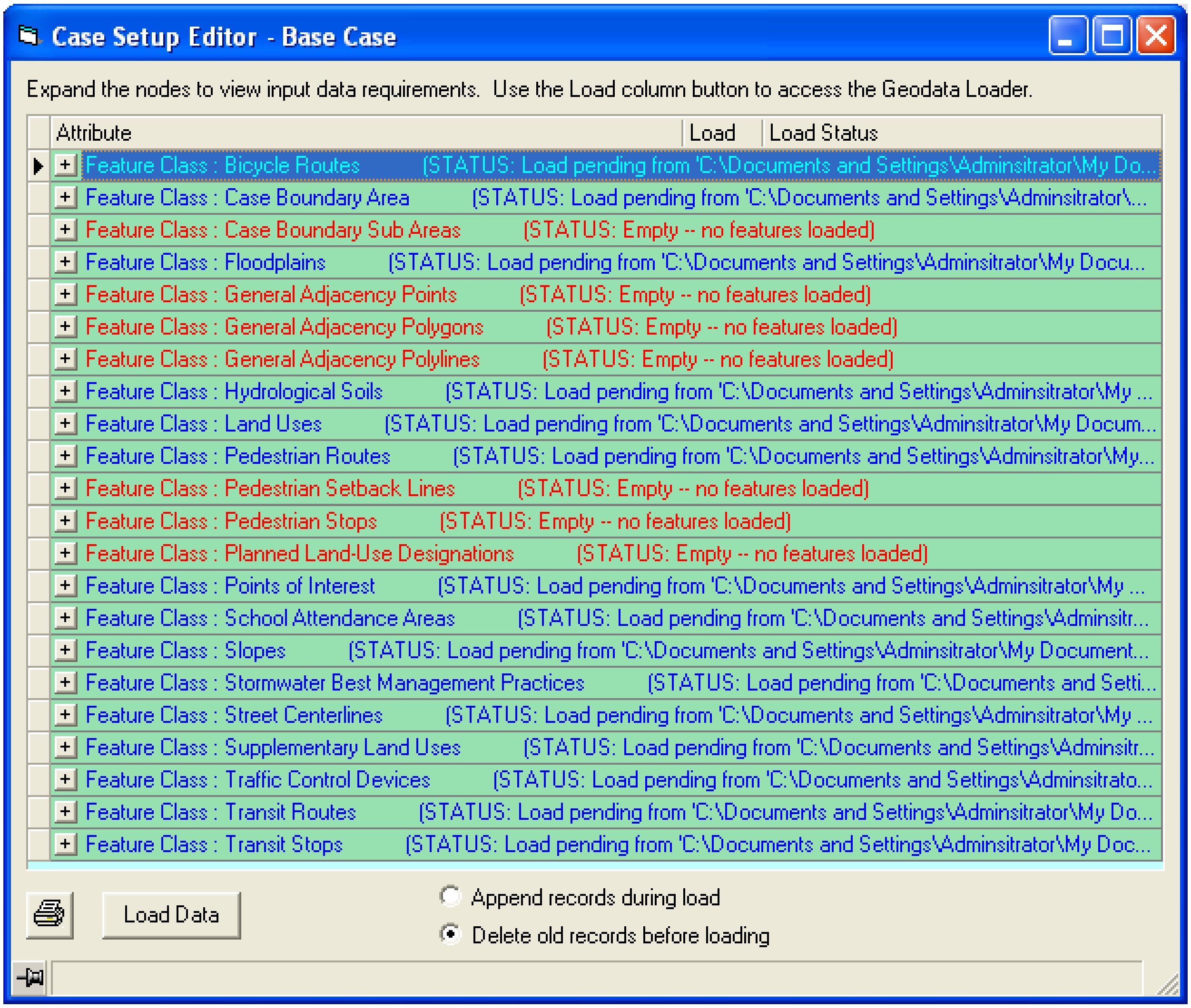
Like transit routes, there are three types of transit stops: bus, light rail, and heavy rail. Load the busstops_studyarea.shp source file, but do not match any of the source fields with the target attribute:



The Geo-Data Load Process

Once the data has been set up, the Load process is ready to begin. The text now shows blue for all feature classes that have loads pending.

For the current load, make sure the "Delete old records before loading" option is selected. Next, click the Load Data button:



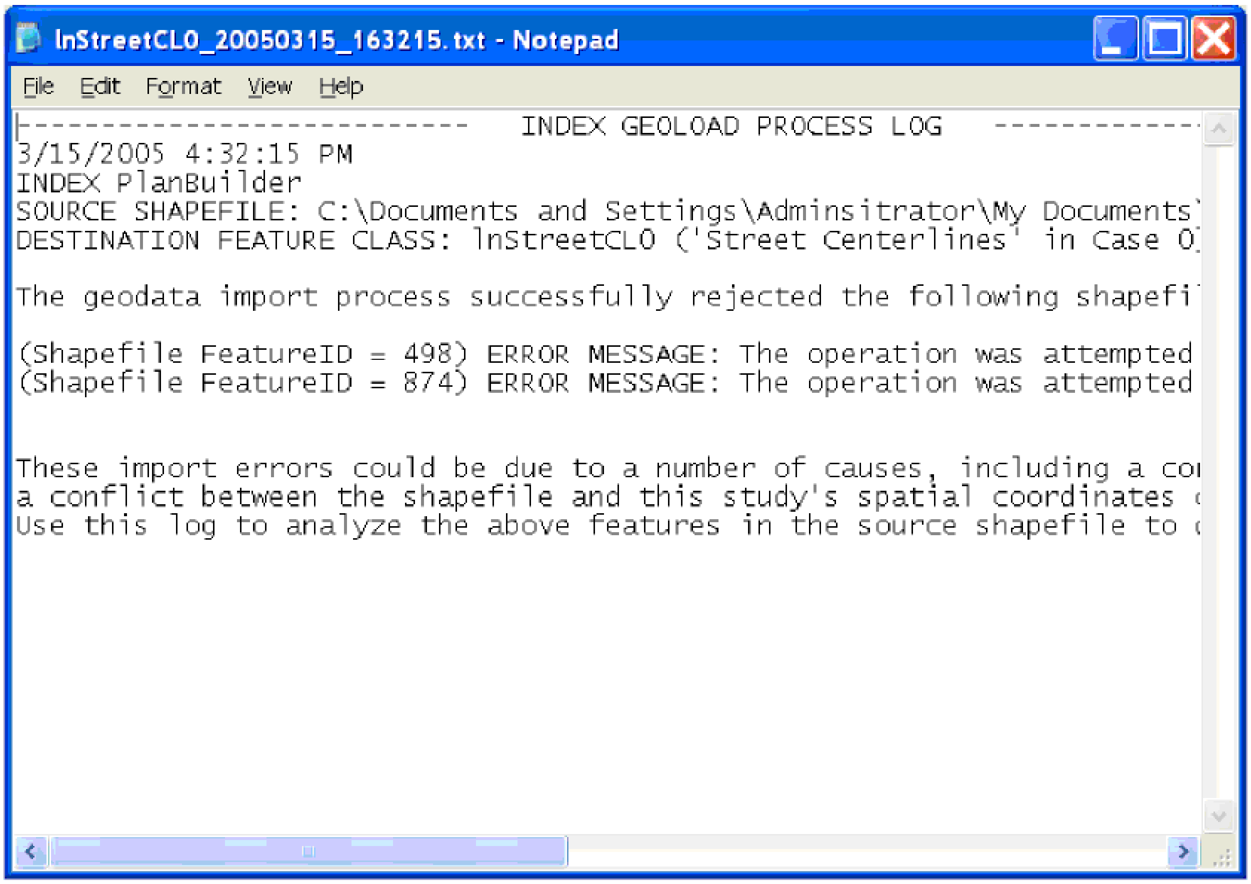
When the load process is finished (this may take a while, depending on the speed of your computer) the Case Setup Editor will close automatically.

For a number of reasons INDEX might reject features from the source shapefile during geo-load. When geoload errors occur, a text file is created that reports the source shapefile FeatureID number of the feature containing the error.

ArcEditor/ArcInfo Users: The pedestrian route and street centerline source shapefiles used in the tutorial may have empty geometries and/or network disconnects.

To explain why features were rejected, manually add the source shapefile to the INDEX study using the standard ArcMap Add Data button and compare its features to those of the INDEX geodatabase feature class. Use the FeatureID values listed in the error log to find the bad features.

Below is a sample GEOLOAD PROCESS LOG:



InStreetCLO_20050315_163215.txt - Notepad

File Edit Format View Help

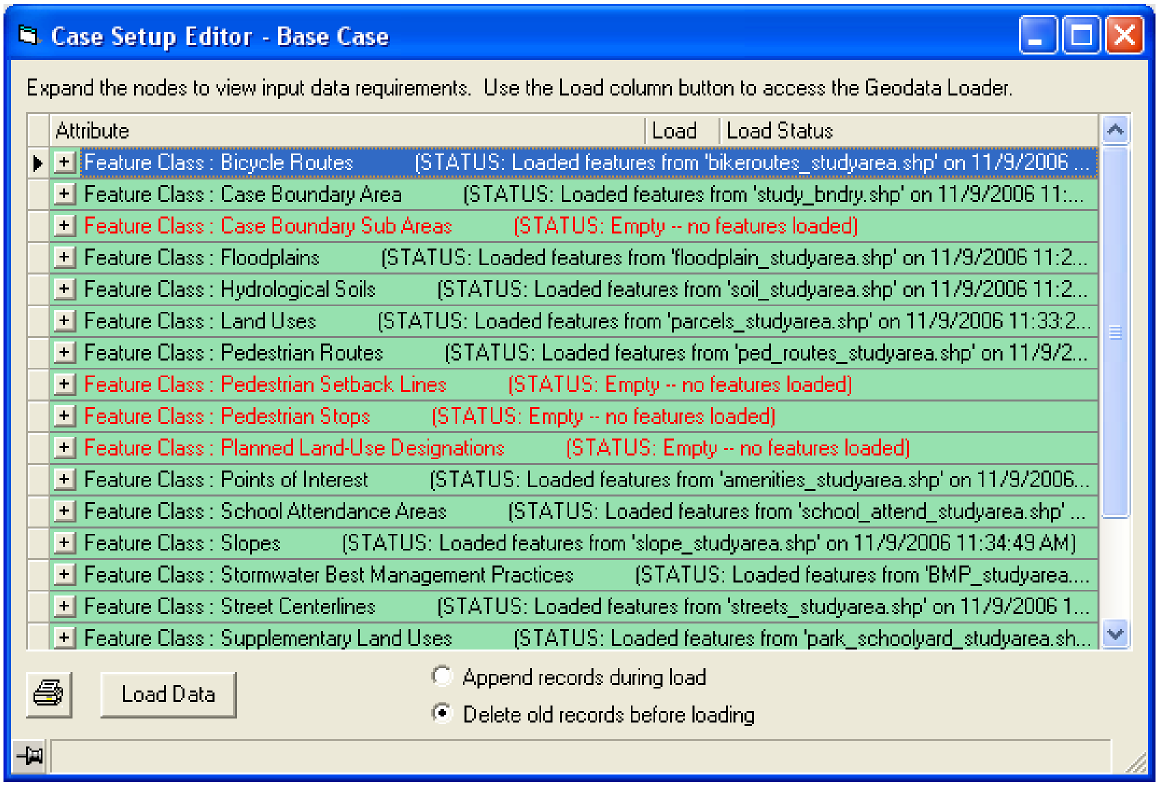
```
---------------------------   INDEX GEOLOAD PROCESS LOG   -------------
3/15/2005 4:32:15 PM
INDEX PlanBuilder
SOURCE SHAPEFILE: C:\Documents and Settings\Adminsitrator\My Documents
DESTINATION FEATURE CLASS: lnStreetCLO ('Street Centerlines' in Case O

The geodata import process successfully rejected the following shapefi

(Shapefile FeatureID = 498) ERROR MESSAGE: The operation was attempted
(Shapefile FeatureID = 874) ERROR MESSAGE: The operation was attempted


These import errors could be due to a number of causes, including a co
a conflict between the shapefile and this study's spatial coordinates
Use this log to analyze the above features in the source shapefile to
```

Open the Case Setup Editor again to see the changed load status to the right of each Feature Class name.

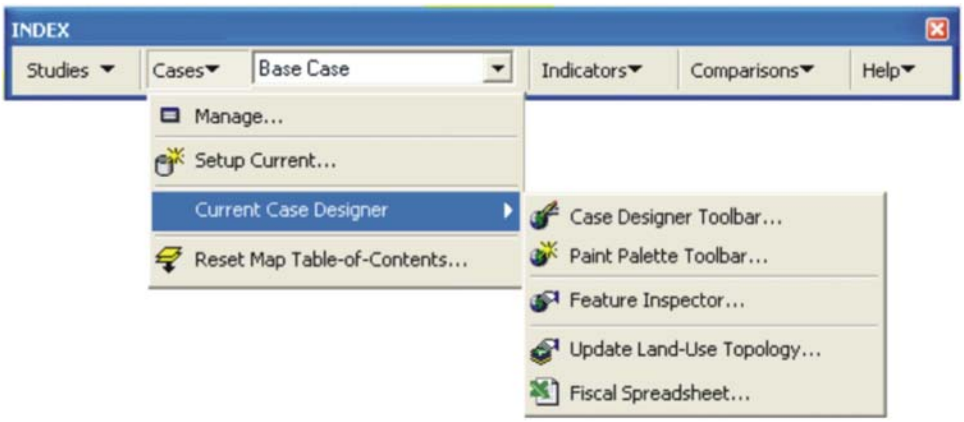


Supplement Loaded Data Using Case Designer

Data that has already been loaded can be expanded upon using Case Designer tools.

Show Case Designer Toolbar

Launch the Case Designer Toolbar from the Cases menu on the INDEX toolbar:

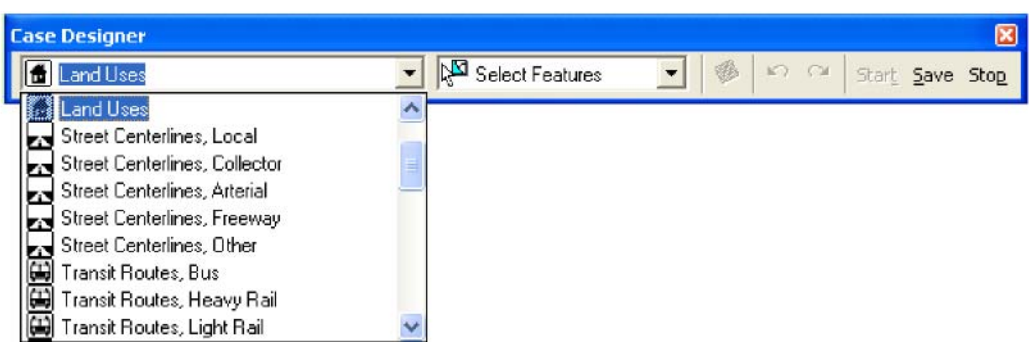


You will use Case Designer toolbar to navigate to design targets (land-use, streets, bus routes, etc…) to perform editing tasks:

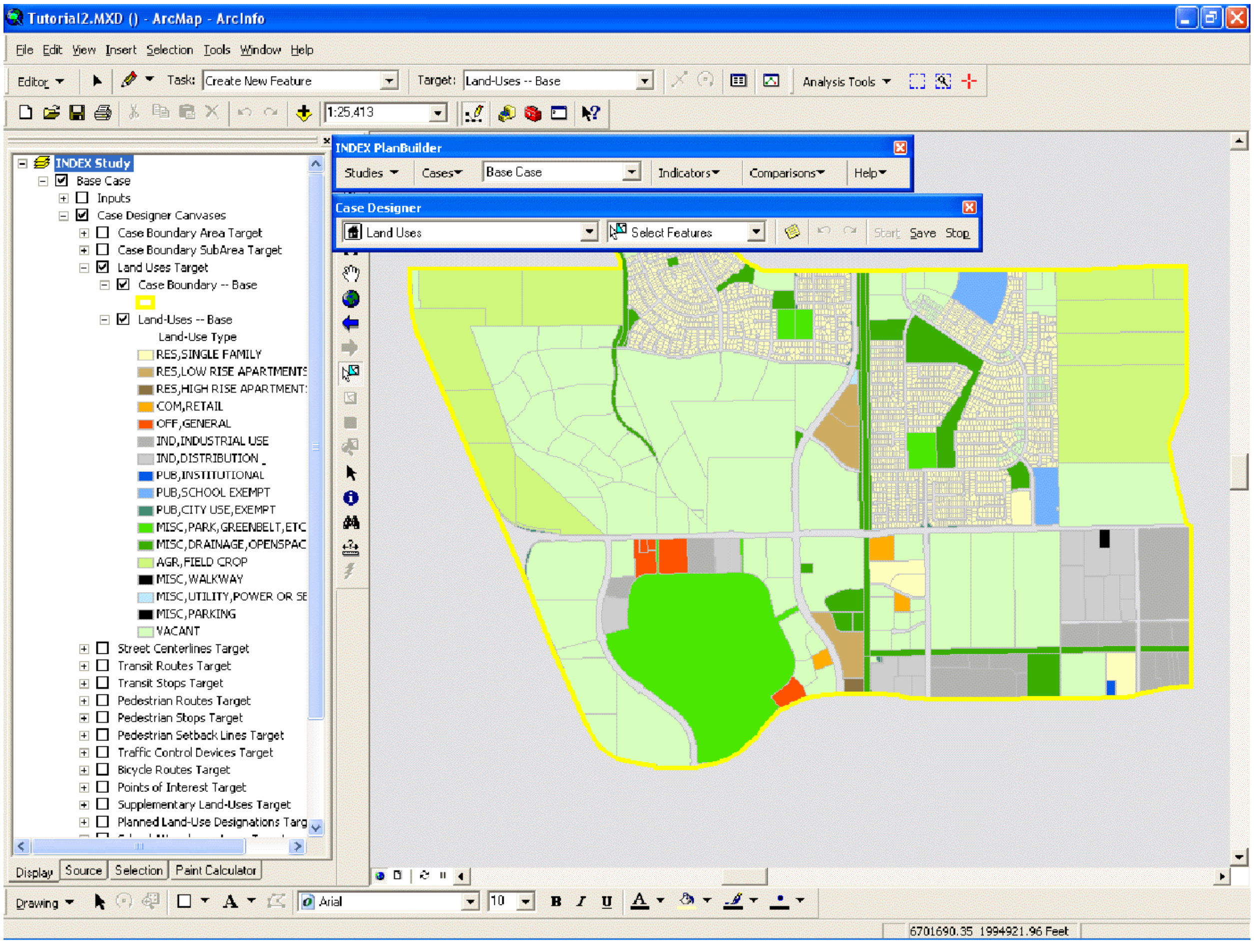
Note: the toolbar includes Undo and Redo buttons (arrows curving left and right). They can be very handy when you are experimenting with the editing tools. When you are done editing the shapes or attributes of features, do not forget to use either the Save or Stop buttons to save your edits.

Update Land Uses Grouping Attributes

Activate land-uses by selecting the Land-Uses design target from the Design Targets combo box:



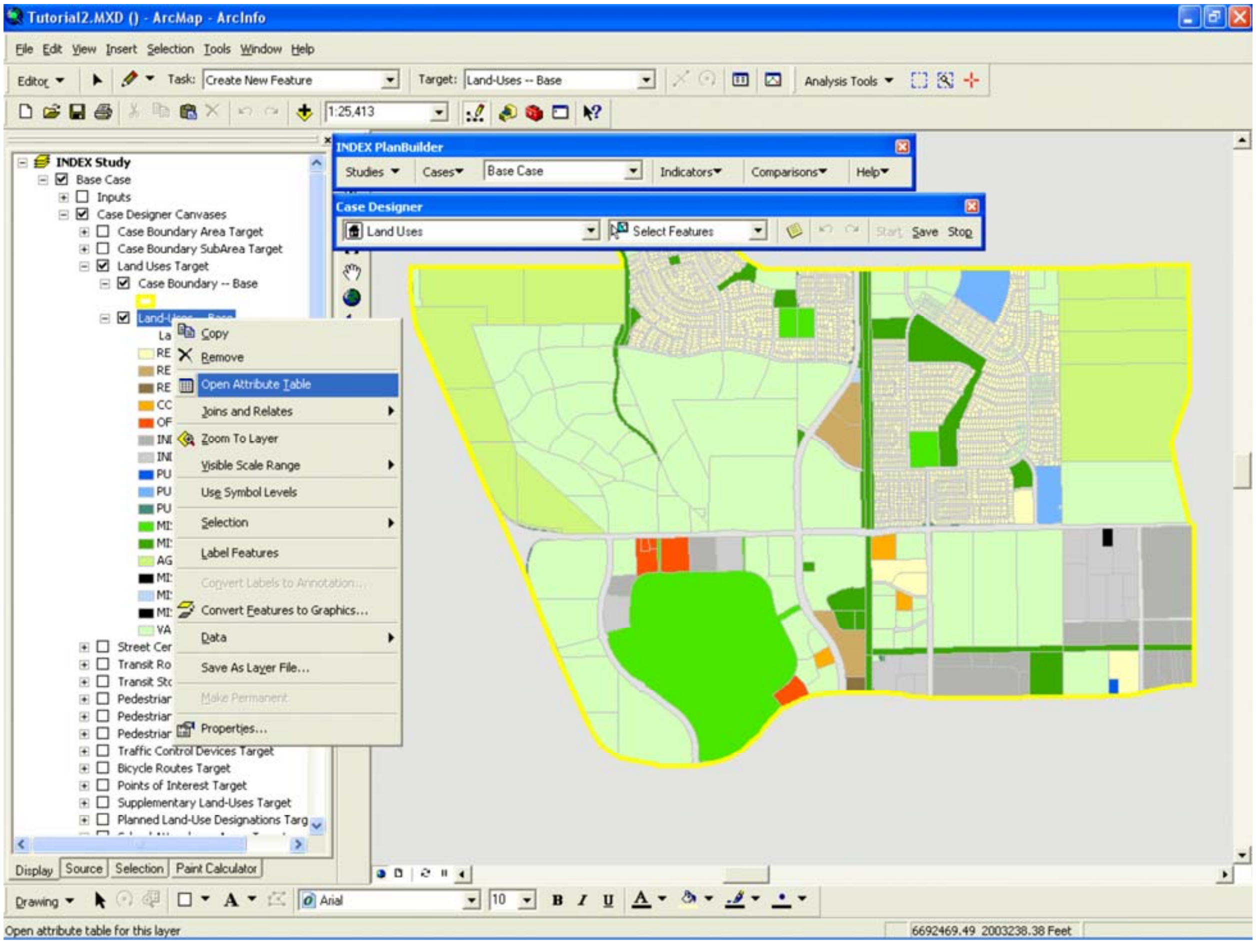
Selecting a design target will trigger a rearrangement of the INDEX table of contents (TOC) and the Land-Use Target Layer or "Canvas" will expand. The map window will also zoom to the extent of the study area. Notice the colors you chose to represent existing land-uses appear in the TOC:



Note: If the parcels layer does not appear as above, right-click the "Land-Use—Base" layer in the TOC and choose the "Zoom to Layer" option.

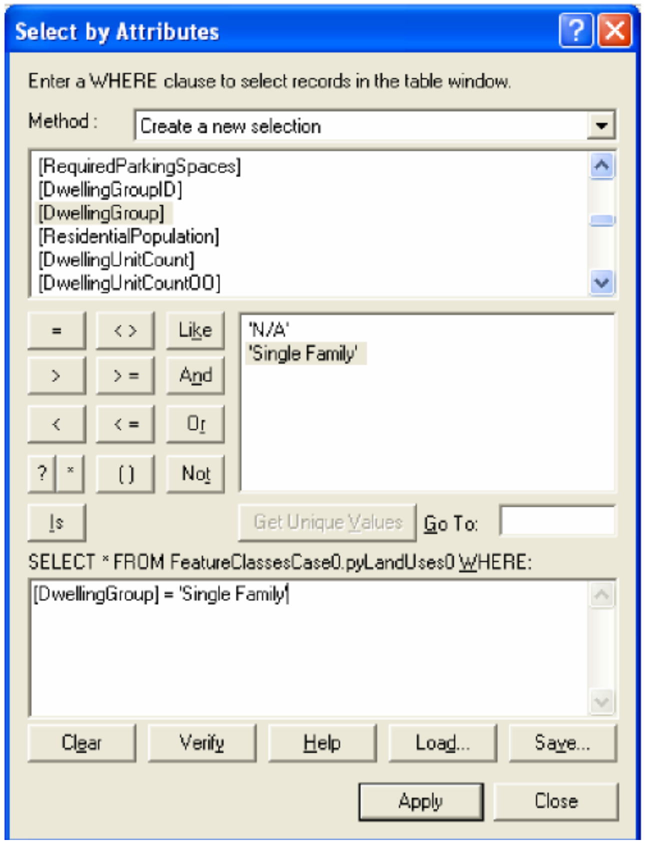
Land-Use Attribute Settings

Some of the Design Target attributes still need to be updated. Open the attributes for the Land-Uses design target by right-clicking feature class and selecting Open Attributes Table in the floating menu:

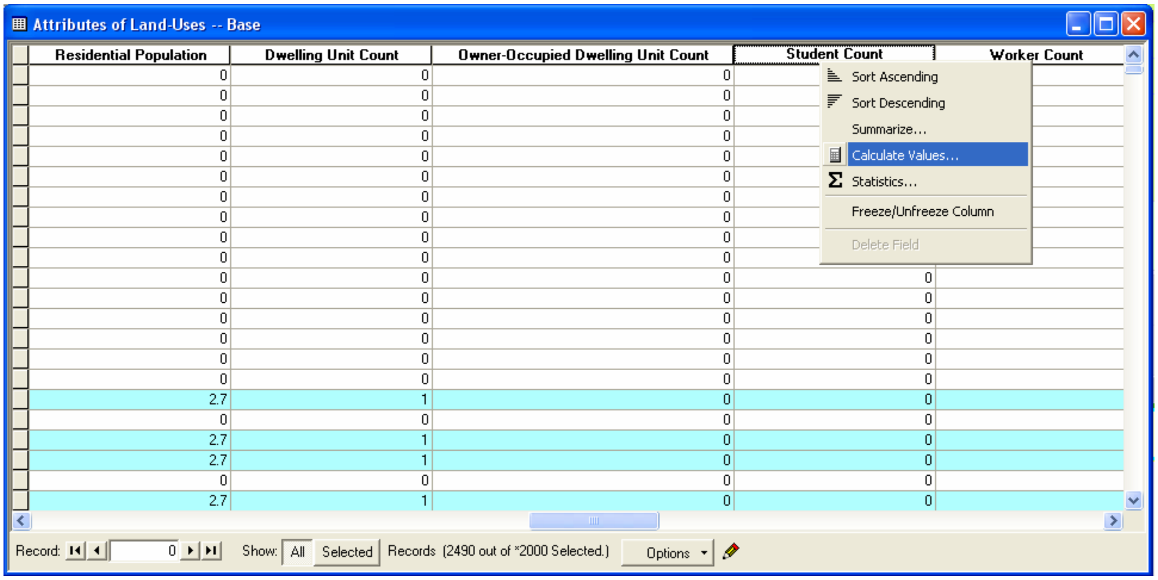


Data from the Dwelling Count field, which was inherited from the source data, can be used to populate several of the household demographic fields including: Residential Population, Student Count, and parking requirements. Household demographics often vary by single-family or multi-family dwelling type.

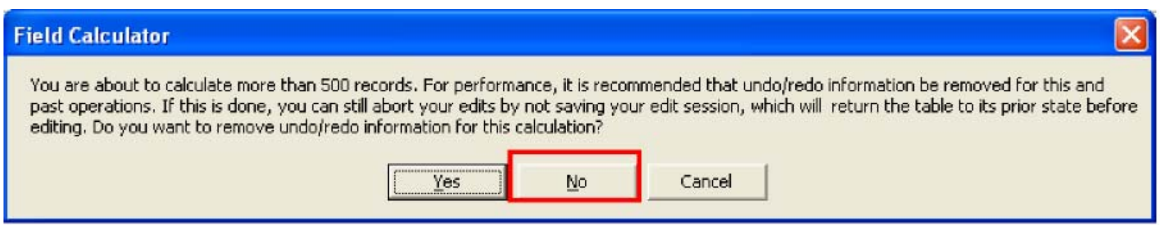
Select (query) the "Single Family" dwellings in the <u>Dwelling Group</u> field using the Select by Attributes tool in the Options menu:



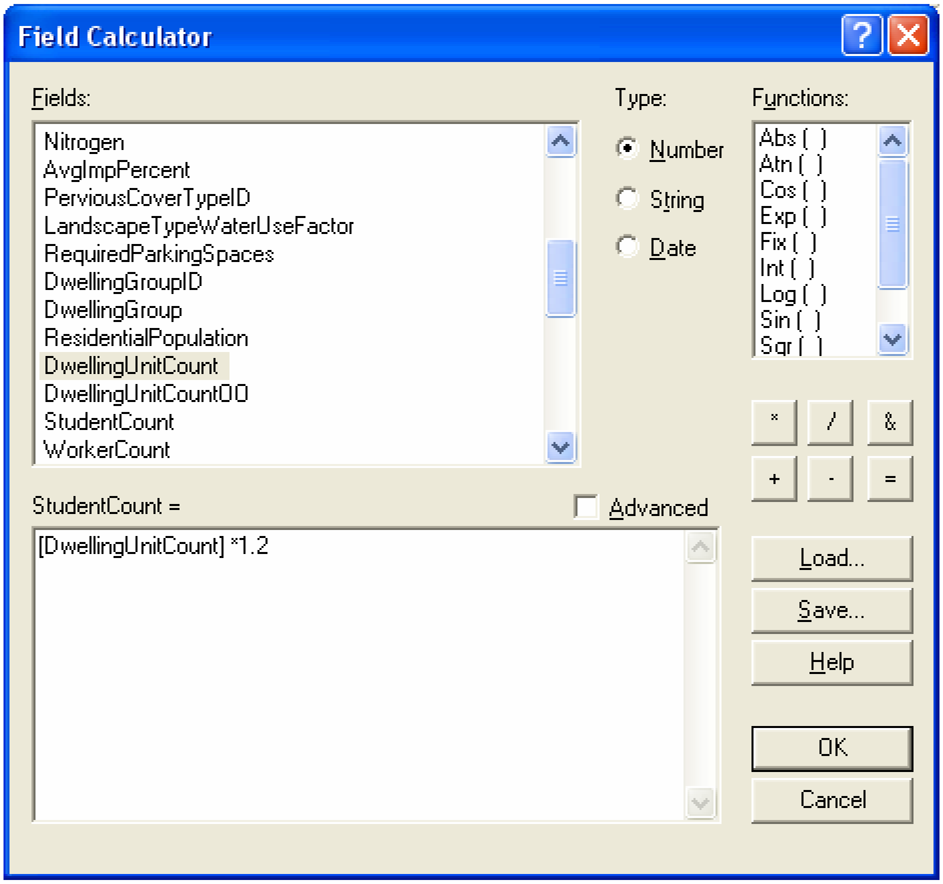
Right-click the student count column and select the Calculate Values option:



If the current selection exceeds 500 rows, the following dialog will appear. Select 'No' to maintain the ability to undo:



Multiply the selected records from the DwellingUnitCount field by 1.2 (this is a sample value for students per dwelling unit):



Continue populating the Student Count field by selecting [DwellingGroup] = 'Multi Family' and calculating [DwellingUnitCount] * 0.7.

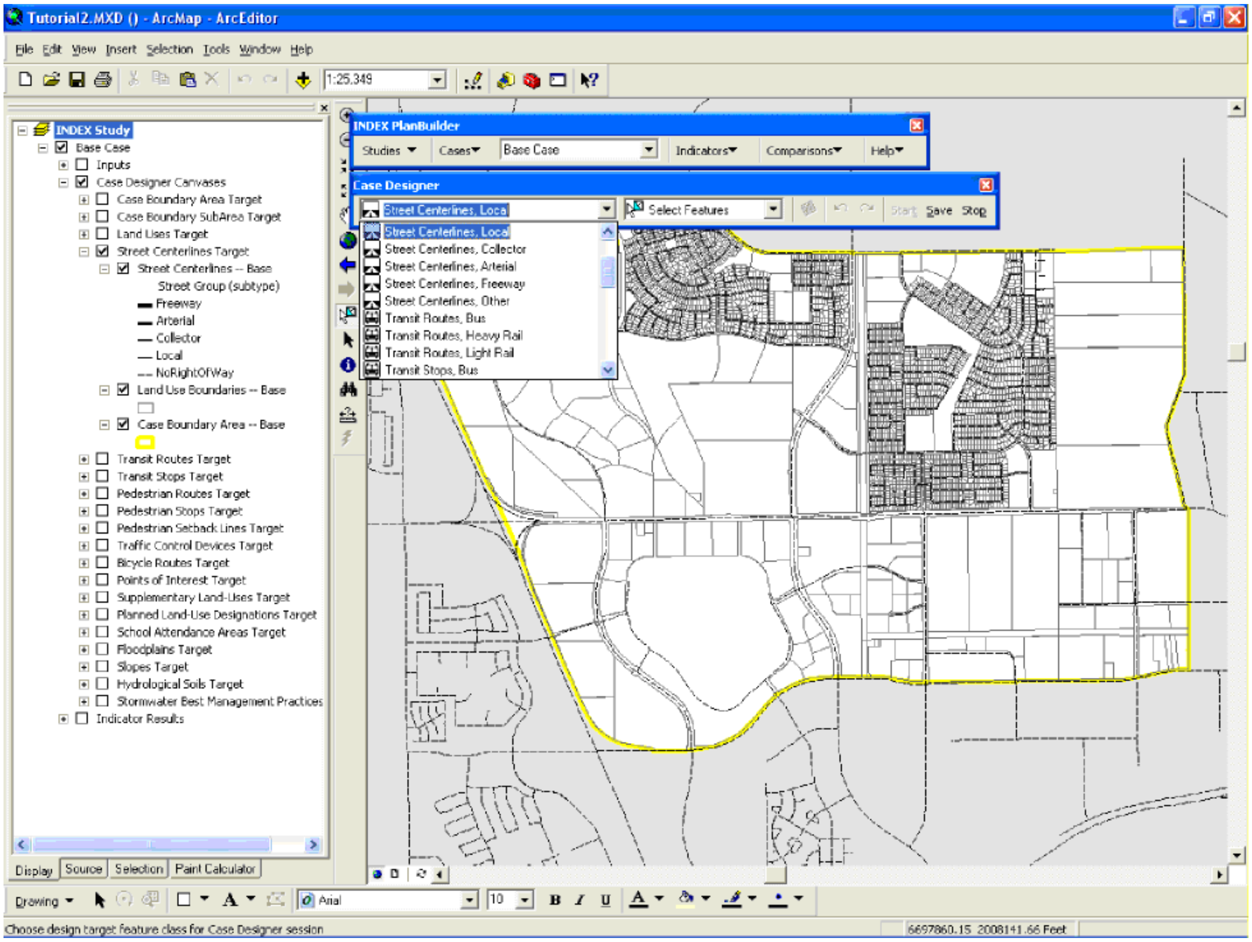
The following land-use attributes were provided in the tutorial source data: Required Parking Spaces, Dwelling Unit Count, Residential Population, and Employment Count.

Some attributes such as Residential Floor Area have not been included here due to the difficulty of finding realistic approximation methods. This data typically comes directly from a source shapefile from sources such as tax assessor records.

Update Street Centerline Grouping Attribute

Select Street Centerlines Design Target

Select any one of the Street Centerlines targets from the Design Target combo box. This will trigger a rearrangement of the INDEX TOC.

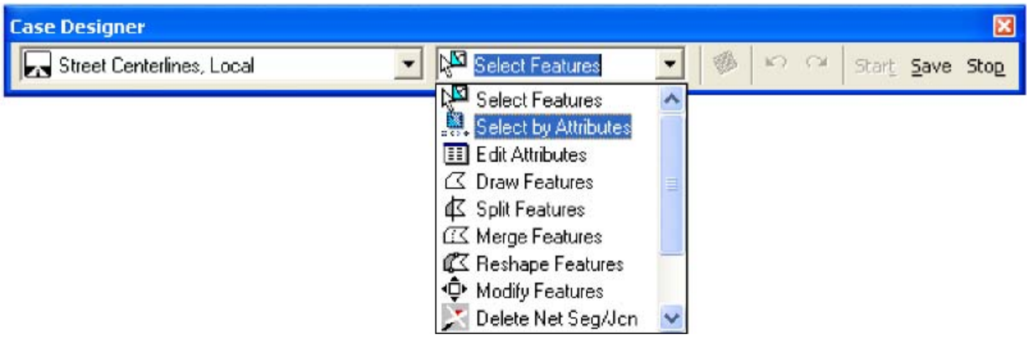


Group Attributes Using Design Modes

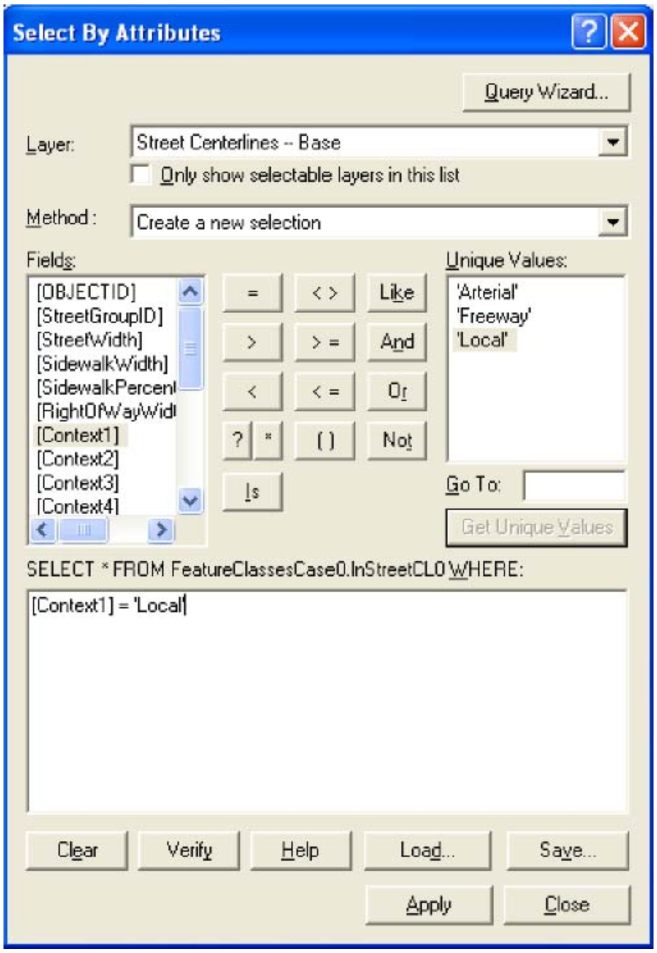
In this section you will finish setting up attributes for street centerlines using the Case Designer tools.

During the geoload process, you loaded the source data street type into the Context1 field. You will use that information to define the Street Group and Street Width in the Street Centerline feature class.

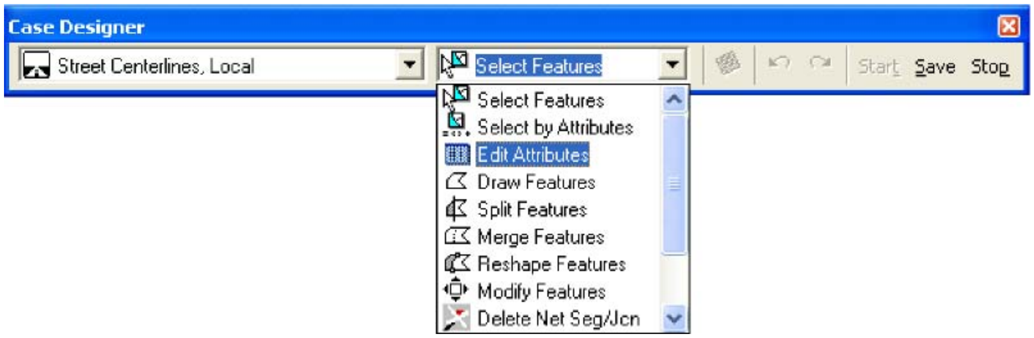
Activate the Select by Attributes tool in the Case Designer menu:



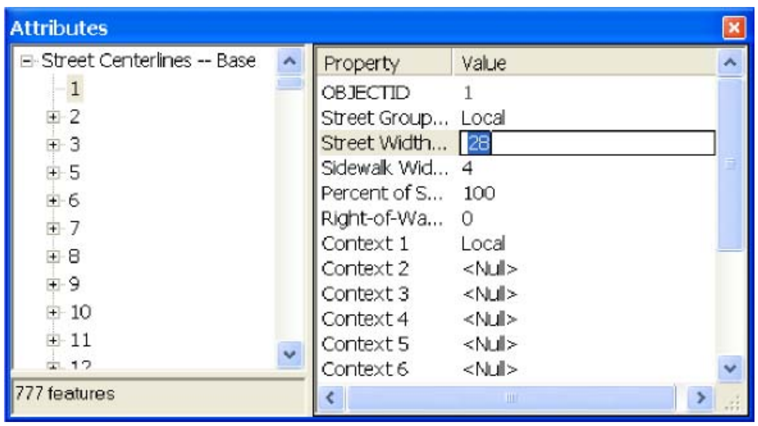
Select the "Local" street class in the Context1 field ([Context1] = 'Local'):



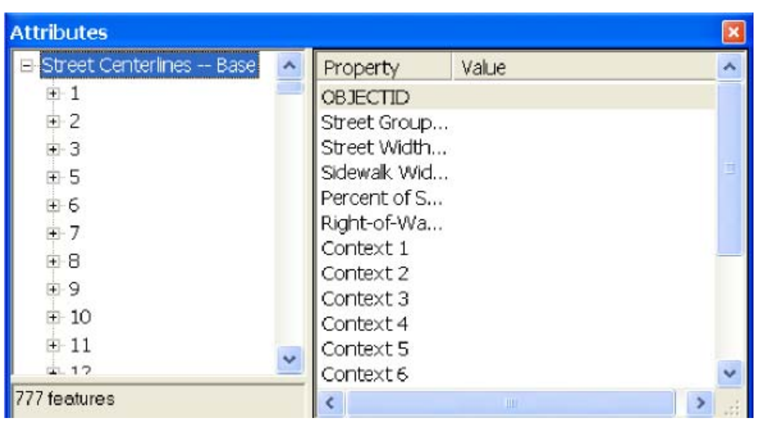
Open the Edit Attributes dialog in the Case Designer menu:



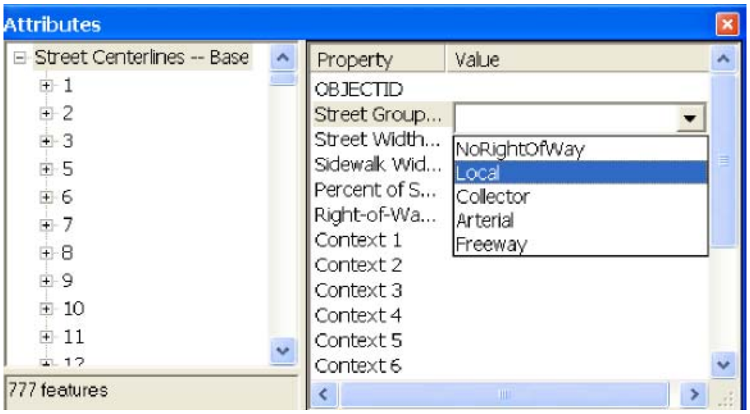
The Edit Attributes dialog displays the IDs of all the selected features in the left window and their attributes in the right window. Click on one of the values in right window. Notice you are able to edit the attribute values in this window:



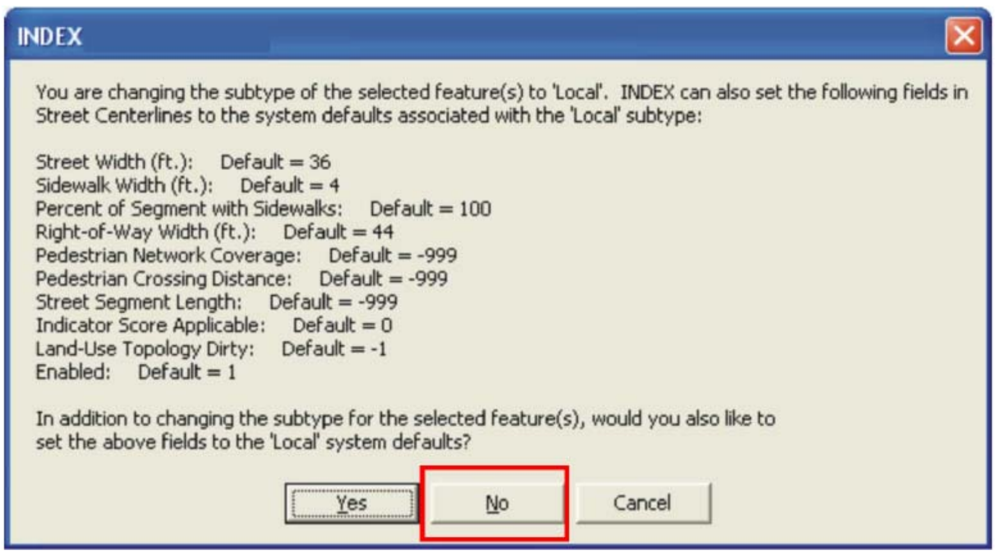
To edit all of the selected features at once, select the top node, "Street Centerlines – Base," in the tree view at the left of the Attributes window. Notice that the Value field in the right pane is now blank for all entries. This signifies that the editor is in multi-feature edit mode. Editing the rows in this field will change all selected features to the new value:



The current query is for Local, so select this from the list that drops down when you click in the Value cell next to the "Street Group (subtype)" entry on the right side of the Attribute window.

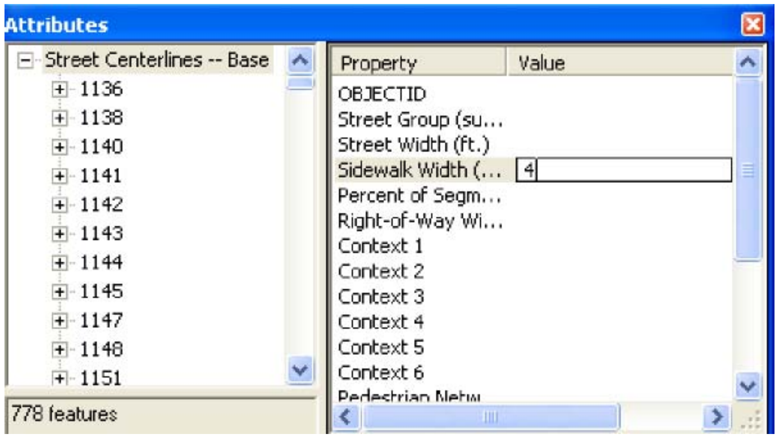


After selecting a Street Group you will be asked if you would like to accept the default values. Select **No.** Selecting 'Yes' would cause the attribute fields to be populated with the default values shown in the dialog, overwriting values inherited from the source data.



You already provided Street Width and Percent of Segment with Sidewalks from the existing data.

Change Sidewalk Width for local streets to 4 feet:



Repeat these Steps for All Street Group Classes:

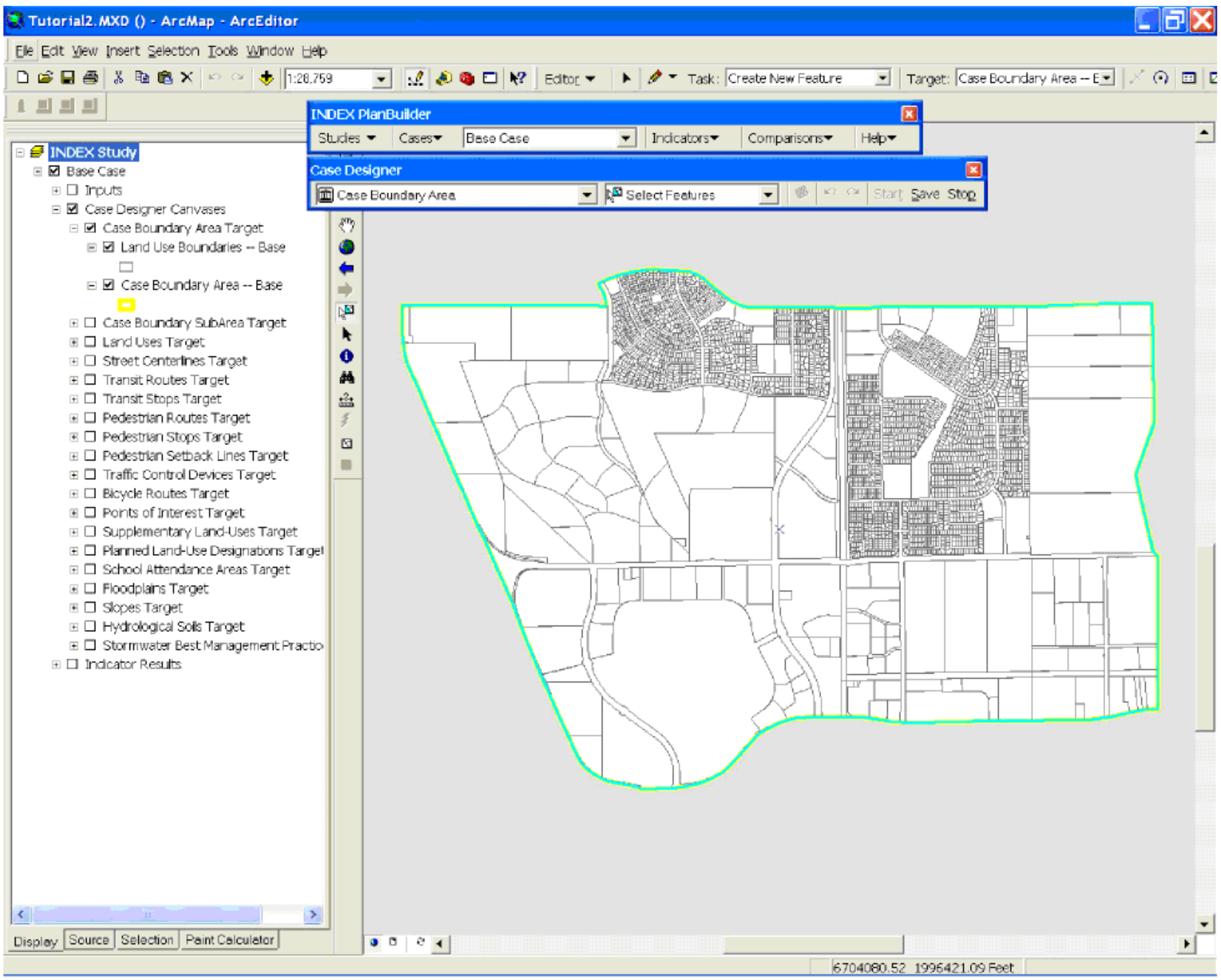
Fields	Queries - Select by Attributes	Input Values
Street Group	[Context1] = 'Locals' [Context1] = 'Collector' [Context1] = 'Arterial' [Context1] = 'Freeway'	= 'Local' = 'Collector' (no collectors in base tutorial data) = 'Arterial' = 'Freeway'
Sidewalk Width	[Context1] = 'Locals' [Context1] = 'Collector' [Context1] = 'Arterial' [Context1] = 'Freeway'	= 4 = 5 (no collectors in base tutorial data) = 6 = 0

Other Feature Class Updates

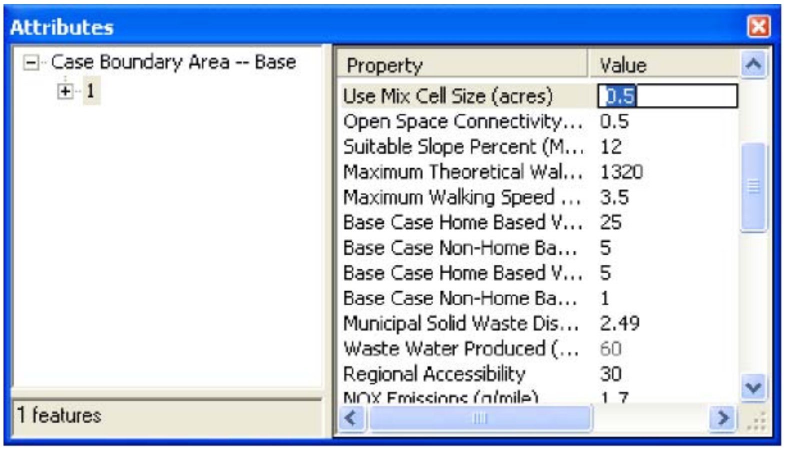
Case Boundary Area

The Case Area Boundary defines the spatial extent of the study. It also acts as a repository inside the application for several external parameters used in indicator calculations. External parameters can be obtained from a variety of sources including U.S. Census information and traffic analysis zone data. Open the Case Area Boundary shapefile attribute table.

Select the Case Boundary design target and select the Case Boundary using the Select Features tool:



Populate the Case Boundary fields with the information in the table below inside the Edit Attributes dialog:

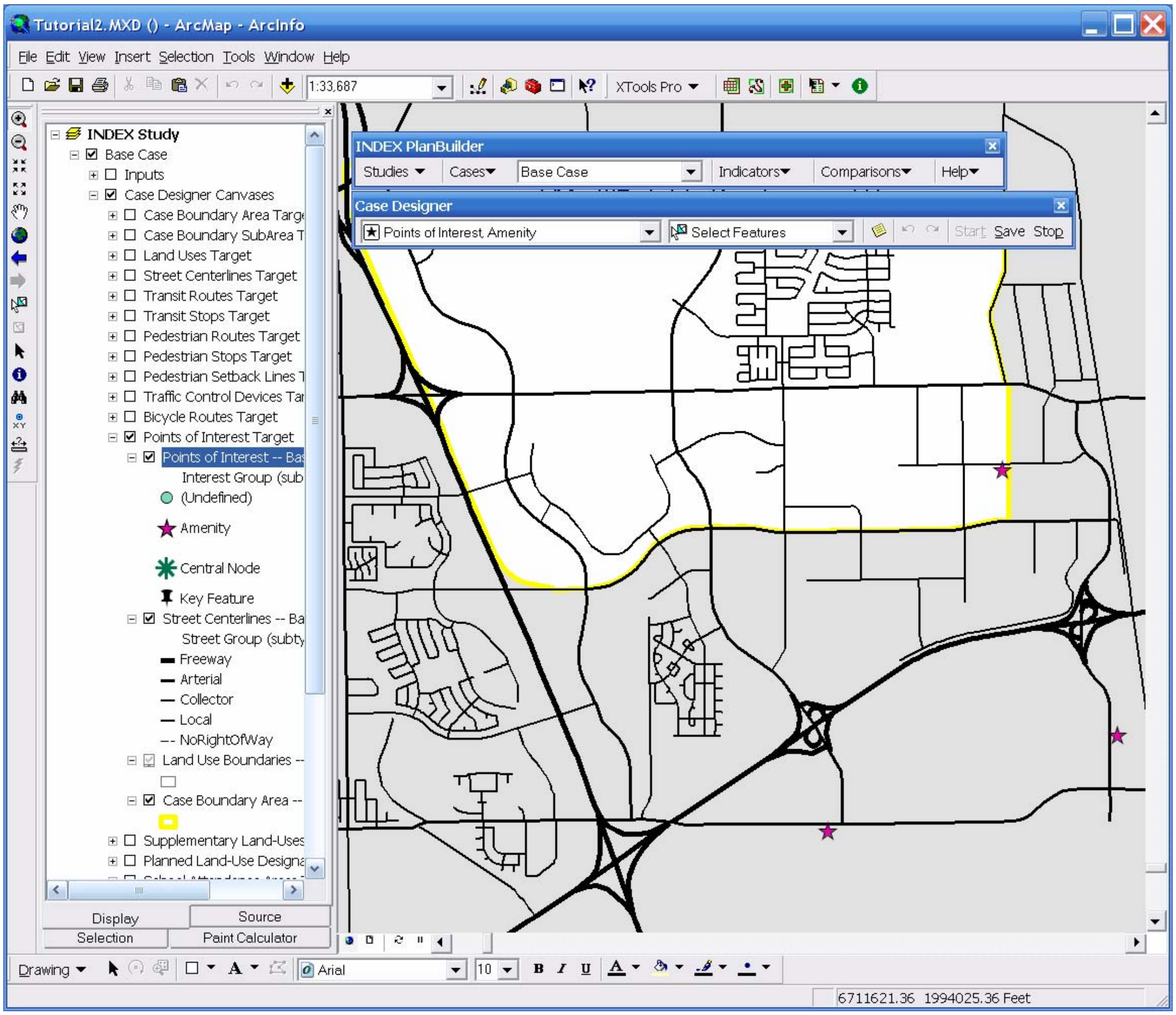


Field	Data Source	Input Values
Regional Population	External source (e.g., Census)	= 565,352
Regional Employment	External source (e.g., ES-202, Claritas)	= 398,547
Affordable Single-Family Housing Unit Price	External source (County Assessor, Multiple Listing Service)	= ($)140,000
Home Based VMT	External source (e.g., Local MPO, 4-Step Model)	= 22 (miles)
Non-Home Based VMT	External source (e.g., Local MPO, 4-Step Model)	= 5 (miles)
Home Based VT	External source (e.g., Local MPO, 4-Step Model)	= 4 (trips)
Non-Home Based VT	External source (e.g., Local MPO, 4-Step Model)	= 1 (trips)
Regional Accessibility	External source (e.g., Local MPO, 4-Step Model)	= 32 (minutes)

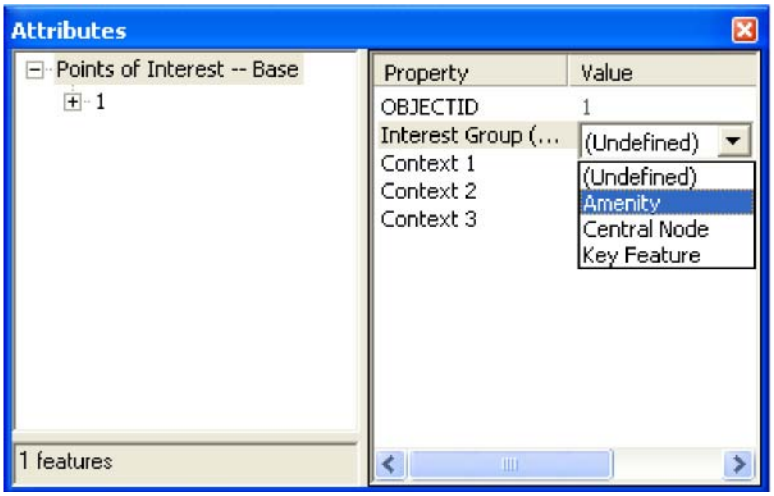
Note: Other attributes that you might also edit would include: Use Mix and Open Space Connectivity Cell Sizes, Maximum Theoretical Walkable Distance, Maximum Walking Speed, Emissions (NOx, CO_2, etc.), Applied Water Requirement, Vehicle Energy Use, Single-Family and Multi-Family Energy Use. For the purposes of the tutorial we will use the defaults.

Points of Interest

During the geoload process, you loaded Amenities as the Points of Interest feature. Note that these points were classified by default as Amenities (InterestGroupID=1):



Review the field attributes using the Input Values in the field below:



Field	Queries - Select by Attributes	Input Values
Interest Group	Select all features currently loaded	= 'Amenity'

Supplementary Land-Uses

During the geoload process, you loaded Parks as the Supplementary Land-Use feature. Select the Supplementary Land-Uses/Park design target and select all of the Park polygons by drawing a box around the full extent of the view using the Select Features tool. Update the field attributes using the Input Values in the field below:

Field	Queries - Select by Attributes	Input Values
Land-Use Group	Select all features currently loaded	= 'Park'

Remember to save your edits when you are finished with this step!

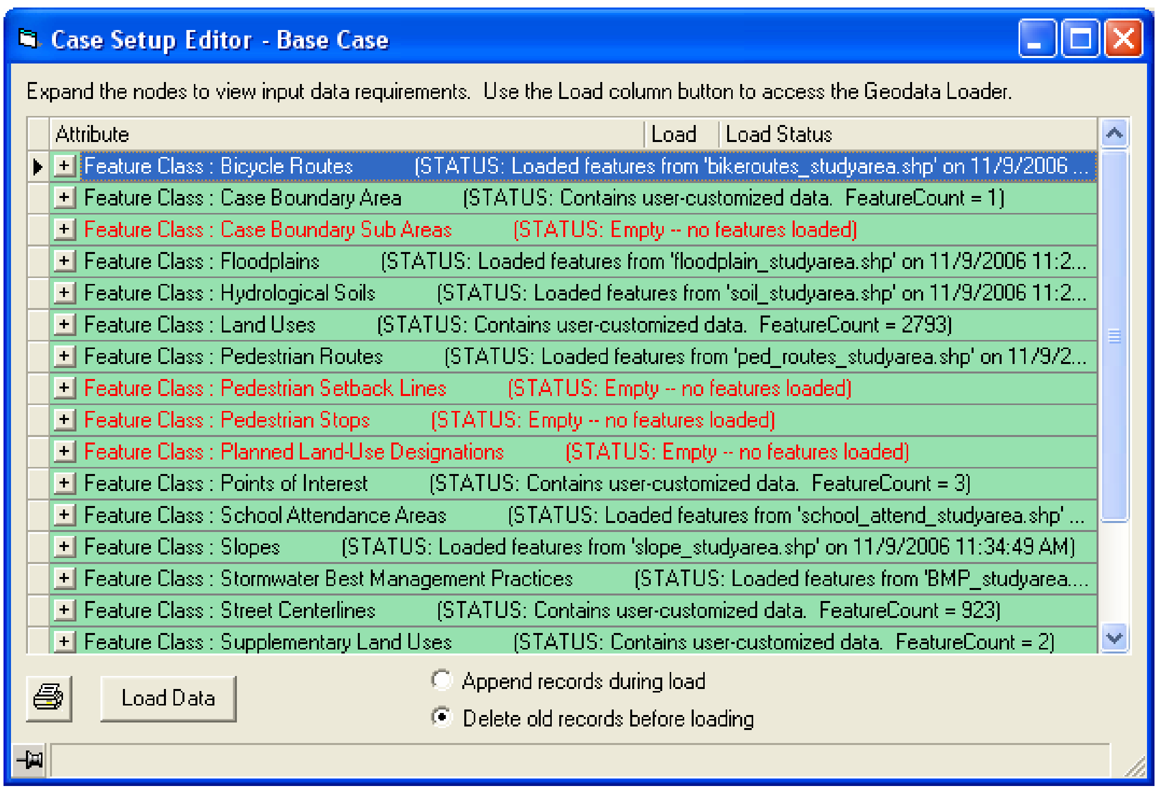
CASE SET-UP SECOND PASS

Recall that you did not load Central Nodes or Supplemental Open Space. You will load these features in another pass using Case Setup Editor. This time you will select the “Append Records During Load” option so you do not overwrite data loaded during the first pass.

Between each pass you will use Case Designer tools to update the attributes of the new features added.

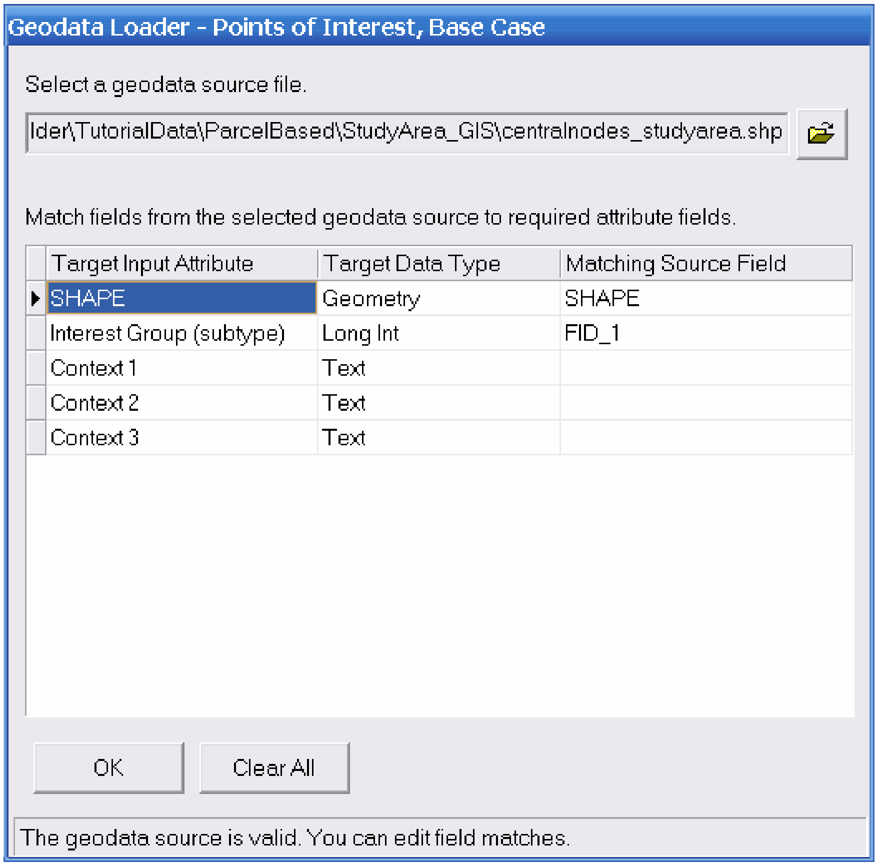
Load Additional Shapefiles

Reopen the Case Setup Editor:



Points of Interest (Central Nodes)

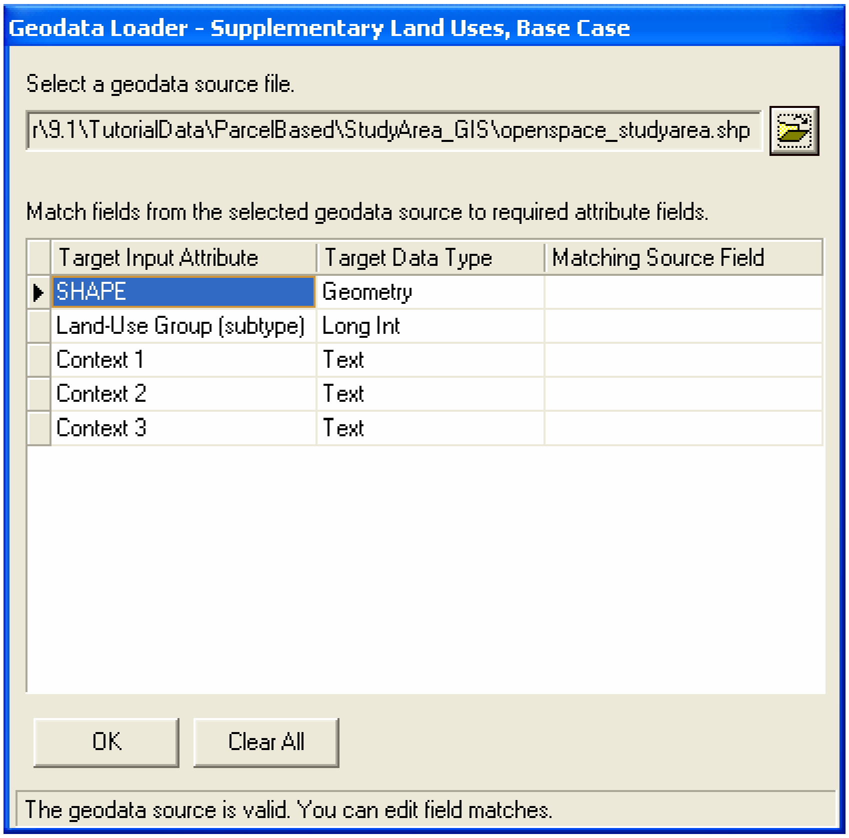
Expand the Points of Interest tree and browse the tutorial data folder and select Central Nodes. Map FID_1 to the interest group:



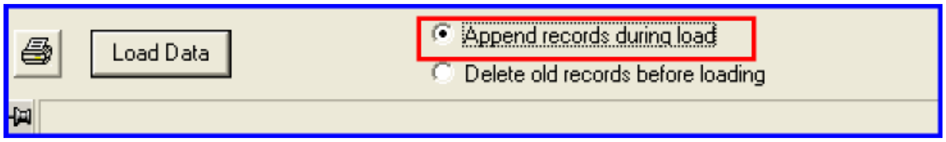
Supplementary Land-Uses (Open Space)

In some cases, particularly around the urban fringe, jurisdictions will give open space credit to parks and vice-versa.

Load the open space shapefile as a supplementary land-use:



Parking lot polygons could also be loaded as a supplementary land-use if the data is available. Select the "Append records during load" option at the bottom of the Case Setup Editor dialog and click the Load Data button:



WARNING: IF YOU DO NOT SET THE LOAD METHOD TO "APPEND," THE PREVIOUSLY LOADED DATA WILL BE OVERWRITTEN.

Update the Appended Attributes

Next you will provide attributes of the newly-loaded features. Launch the Case Designer toolbar again. Select the target for each from the Design Targets combo box on the Case Designer toolbar and then perform the following updates.

Points of Interest (Central Nodes)

Use the Select Features by Attributes tool to query features equal to zero, as shown in the table below ([InterestGroupID] = 0). Next, use the Edit Attributes dialog to edit the attributes for the selected features.

Field	Queries - Select by Attributes	Input Values
Interest Group	[InterestGroupID] = 0	= 'Central Node'

Supplementary Land-Uses (Open Space)

Use the Select Features by Attributes to query features equal to zero, as shown in the table below ([LandUseGroupID] = 0). Once again, use the Edit Attributes dialog to edit the attributes for the selected features.

Field	Queries - Select by Attributes	Input Values
Land-Use Group	[LandUseGroupID] = 0	= 'Open Space'

Remember to save your edits when you are finished with this step.

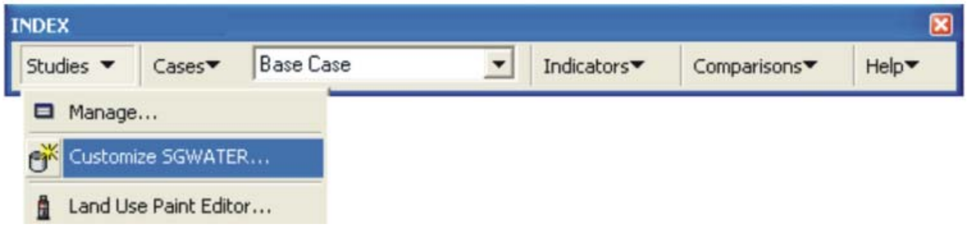
SGWATER CUSTOMIZATION

INDEX indicators that measure stormwater runoff and nonpoint source pollution utilize a U.S. EPA methodology called SGWATER. In order for these indicators to produce results, SGWATER's rainfall table must be populated with regional rainfall data. This section describes how to load rainfall data file into the SGWATER database. It is recommended that SGWATER documentation be reviewed by downloading it from www.crit.com/documents/sgwater.pdf.

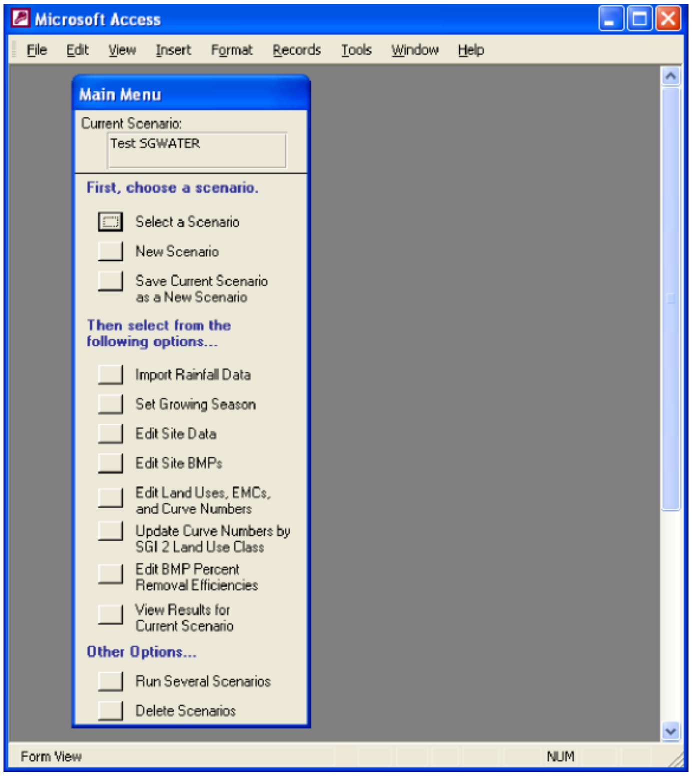
Note: SGWATER is a Microsoft Access application. Therefore you must have MS-Access 2000 or higher installed on your machine to load custom rainfall data. This copy of Access must reside within Microsoft Office 2000 Professional or higher due to other INDEX requirements.

Launching SGWATER

Select the "Customize SGWATER" menu option from the INDEX menu:



The Customize SGWATER option launches the SGWATER application inside MS-Access:

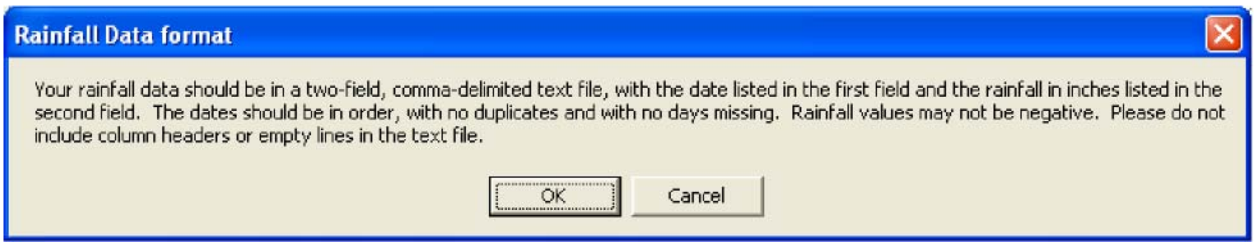


SGWATER is fully customizable for those advanced INDEX users who require additional flexibility and power over the way SGWATER performs its calculations.

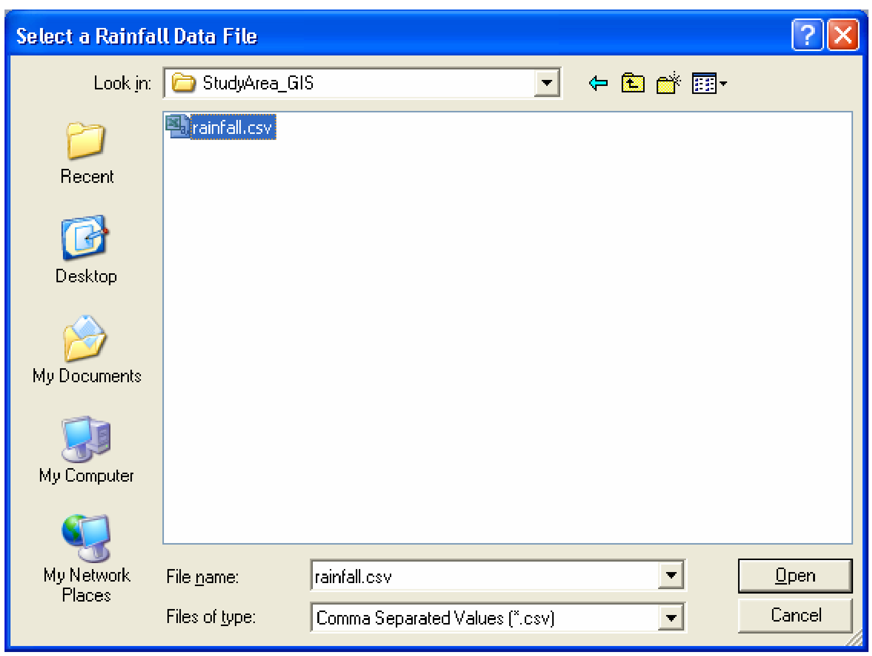
Populating the Rainfall Table

Click the “Import Rainfall Data” option button on the SGWATER main menu:

Read the following dialog carefully for instructions on rainfall data formatting and click OK:

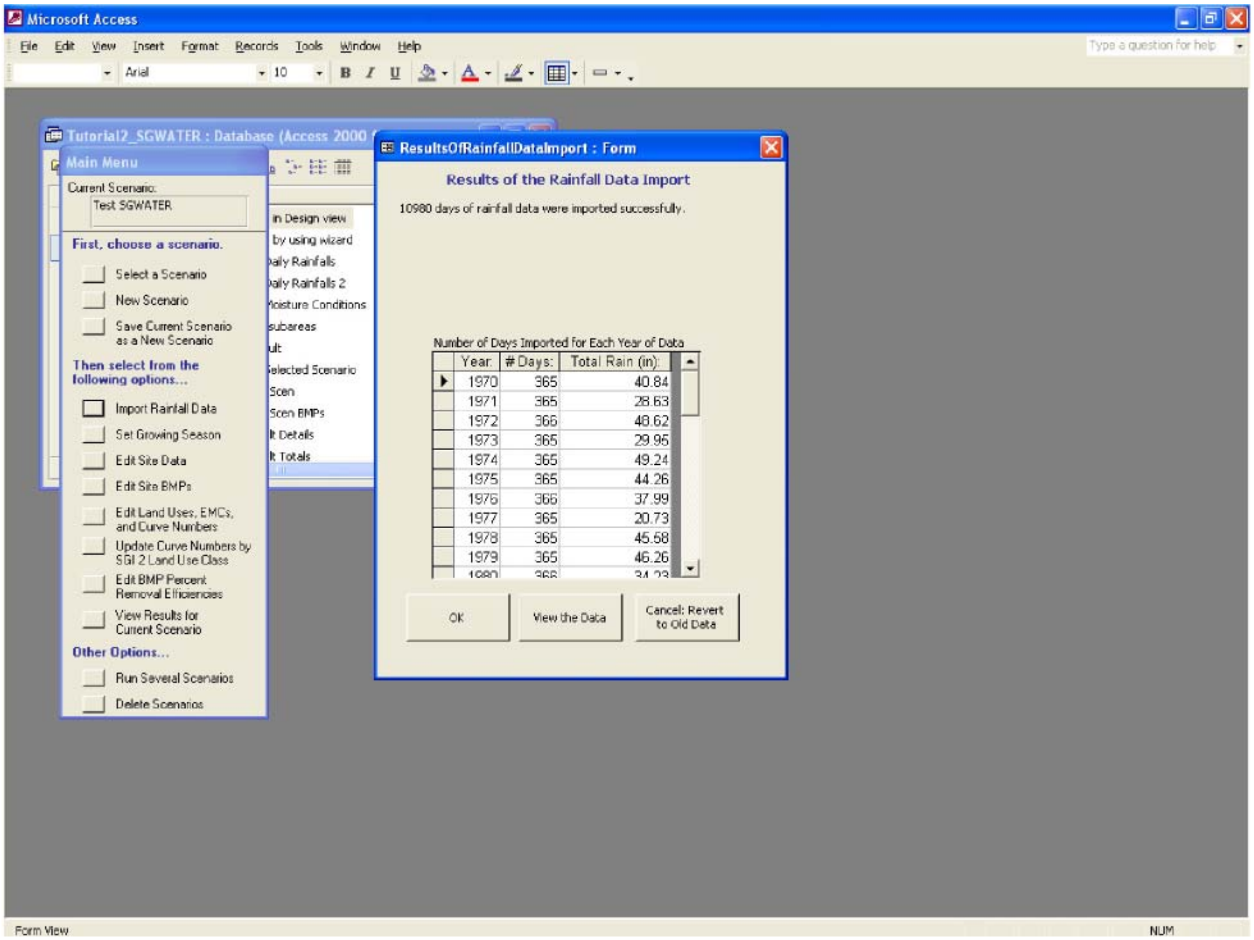


Navigate to the [My Documents]\Criterion\IN DEX\ PlanBuilder\9. 1\TutorialData\Parcel\Base folder and select **Rainfall.csv:**



Click the Open button to begin the process.

When the import process is finished, the following dialog appears.



Click OK and close MS-Access database when finished.

SELECT INDICATORS AND OBJECTIVES

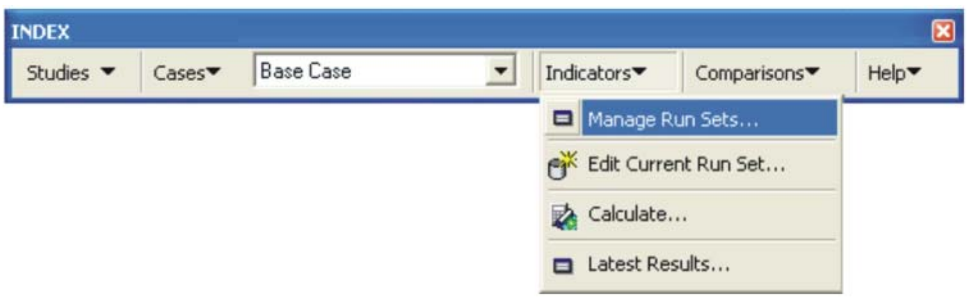
Users select those indicators that are most relevant to the subject at hand, e.g. employment-related indicators for an office park study versus housing indicators for a residential subdivision study. A user may select all of the indicators when a comprehensive set of measurements is desired, such as benchmarking existing conditions for a comprehensive planning process. A prerequisite for selecting any indicator is availability of data to support the indicator calculation; data requirements are detailed in the Indicator Dictionary.

In this section, you will create a custom indicator run set and calculate indicators.

Manage Run Sets

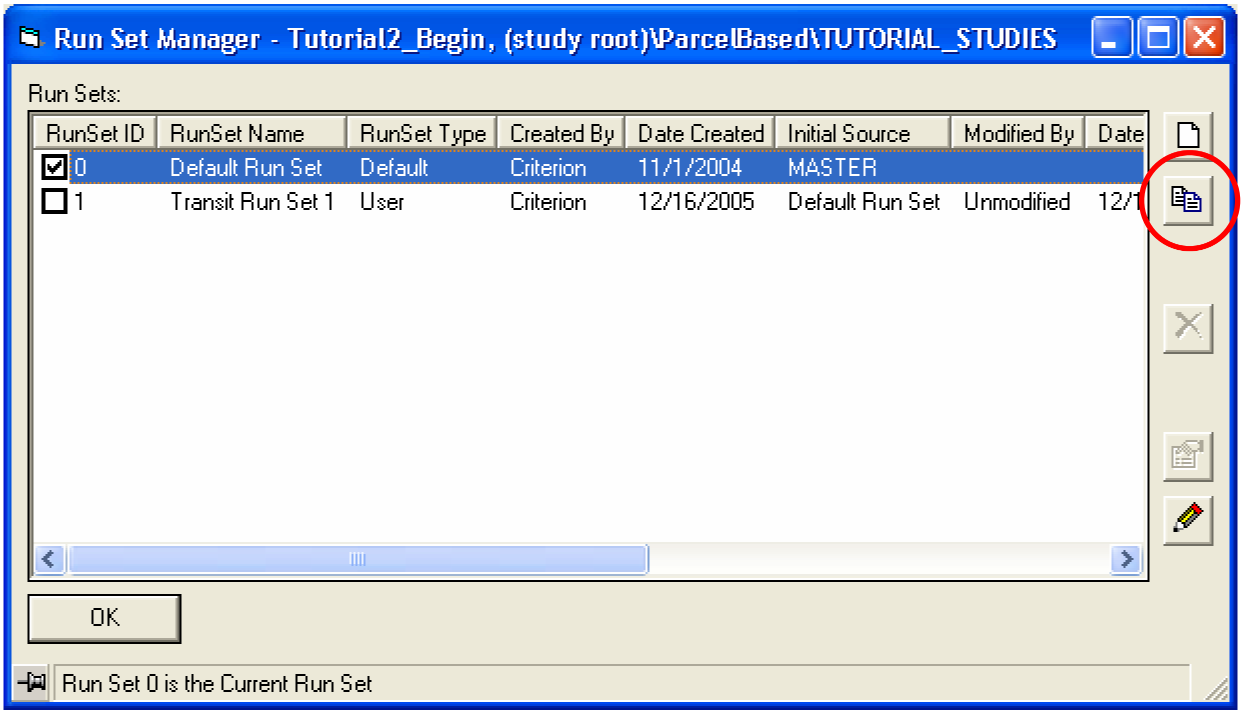
In the previous tutorial, you selected indicators and set indicator objectives in RAW; the same functionality can also be accessed within a study.

Select the Manage Run Sets option from the Indicators menu on the INDEX toolbar:

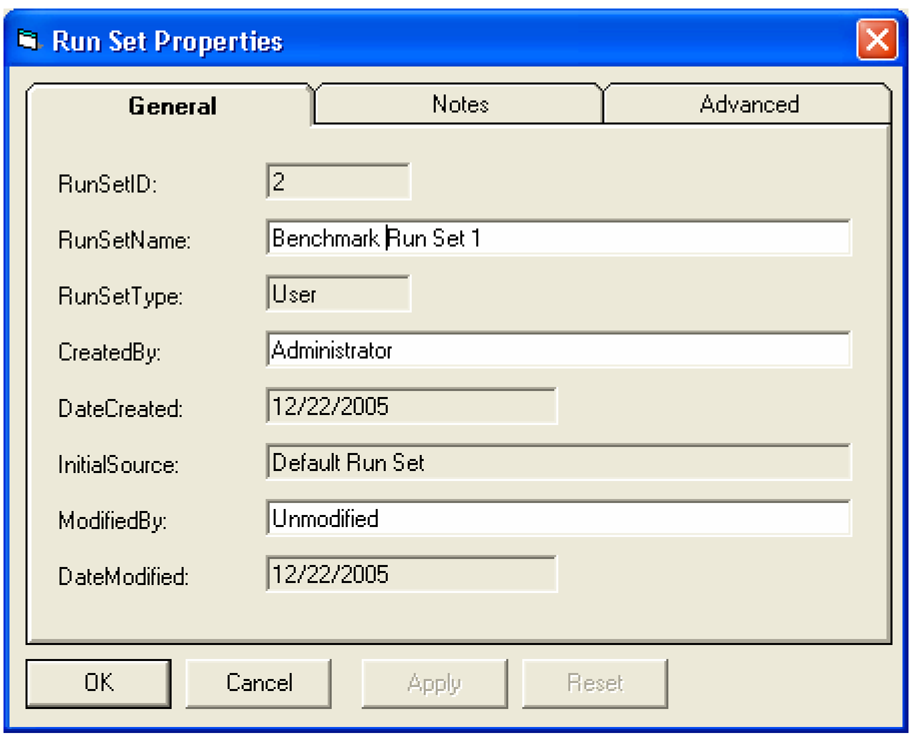


As discussed in Tutorial 1, you can create a new run set using either the New or the Copy button on the right side of the Run Set Manager. The New button creates a new empty run set with no indicators selected or other settings set. The Copy button creates an exact duplicate of the selected run set, including all its settings.

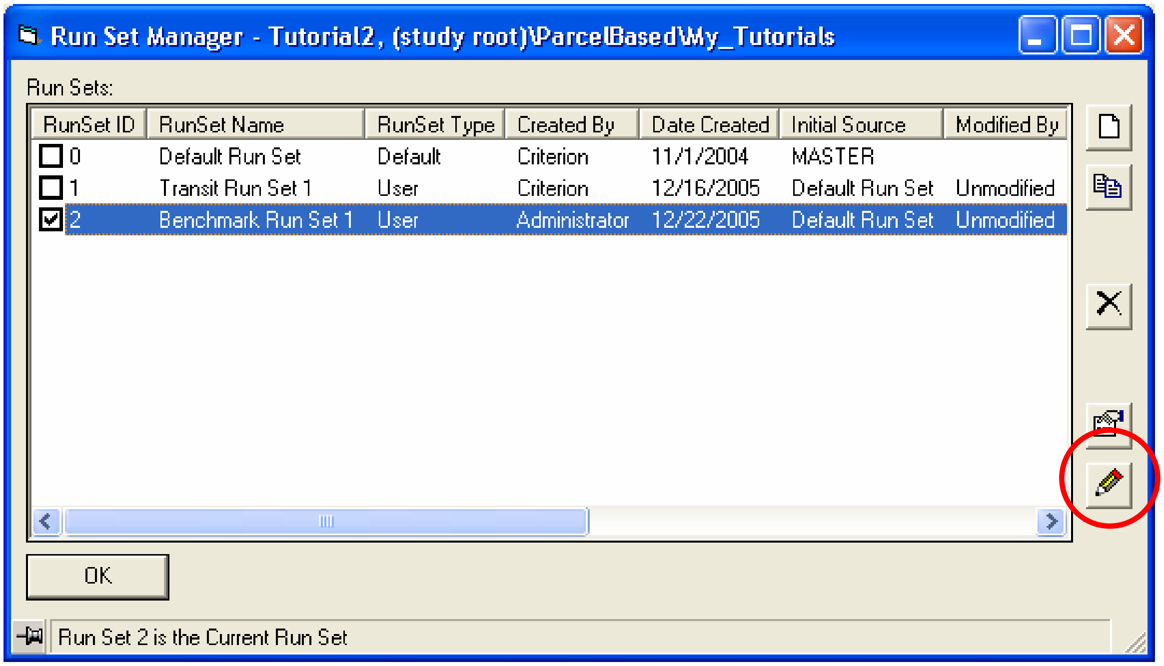
Create an editable copy of a run set by selecting the Default Run Set and clicking the 'Copy' button:



Provide a name, like "Benchmark Run Set 1," in the Run Set Properties window and select the OK button.



Select the new run set in the window and click the Edit button on the Run Set Manager.



It is often not necessary or desirable to run all possible indicators for each study. For purposes of the tutorial, select (check) only the indicators listed below:

Element: [0] Demographics
- Population
- Employment
- Population Density

Element: [1] Land-Use
- Study Area Acreage
- Use Balance

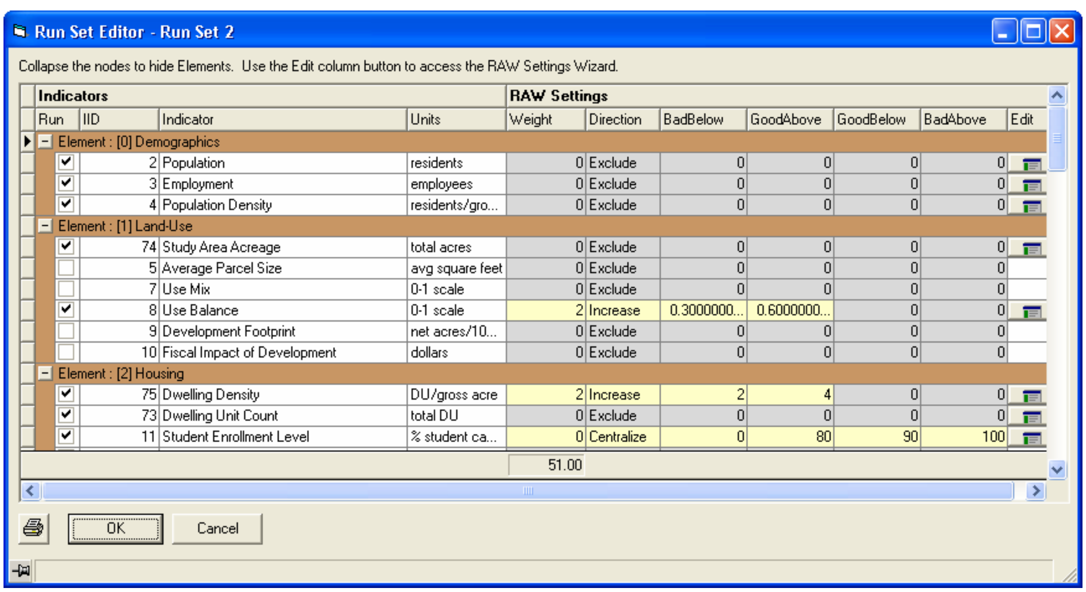
Element: [2] Housing
- Dwelling Density
- Dwelling Unit Count
- Student Enrollment Level
- Single-Family Parcel Size
- Single-Family Dwelling Density
- Single-Family Dwelling Share
- Multi-Family Dwelling Density
- Multi-Family Dwelling Share
- Amenities Adjacency
- Transit Adjacency to Housing

Element: [3] Employment
- Jobs to Housing Balance
- Employment Density
- Transit Adjacency to Employment

Element: [4] Recreation
- Park/Schoolyard Supply
- Park/Schoolyard Adjacency to Housing

Element: [5] Environment
- Open Space Share

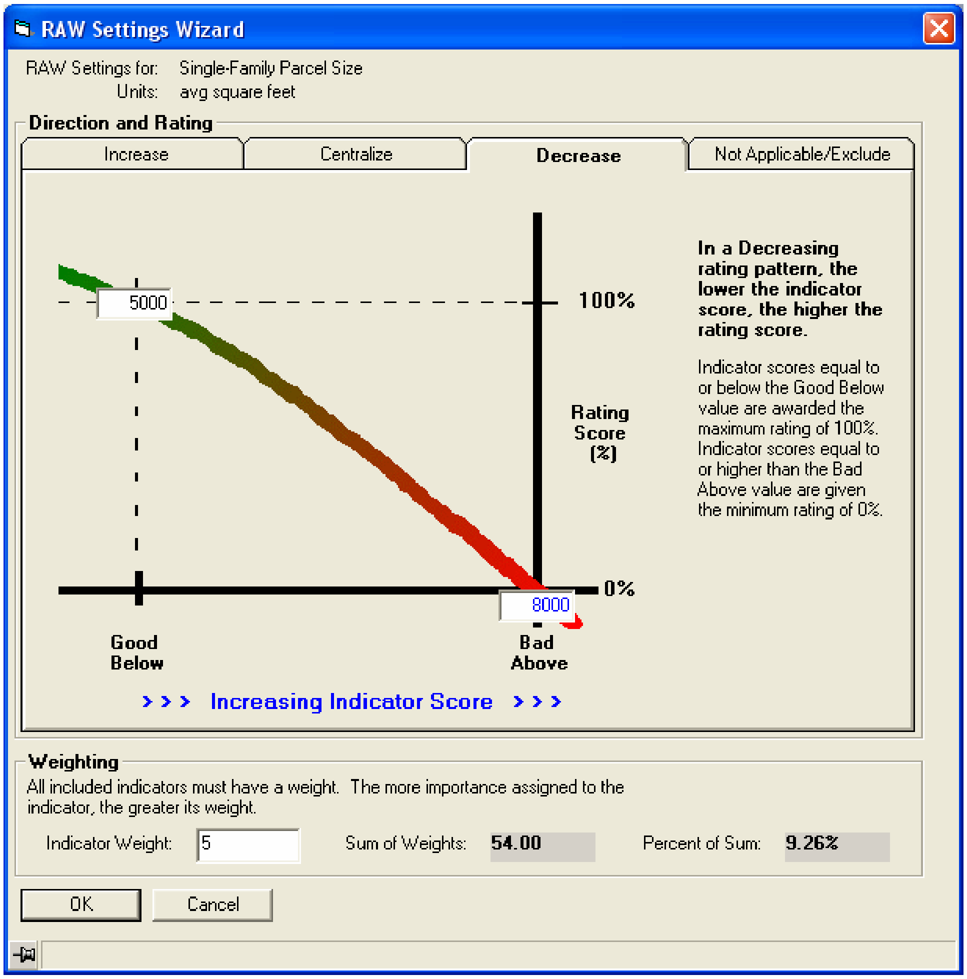
Element: [6] Travel
- Internal Street Connectivity ***ArcEditor/ArcInfo Users***
- External Street Connectivity
- Street Network Density
- Transit Service Coverage
- Transit Service Density
- Pedestrian Network Coverage
- Pedestrian Crossing Distance
- Pedestrian Intersection Safety ***ArcEditor/ArcInfo Users***
- Bicycle Network Coverage
- Residential Multi-Modal Access
- Parking Requirements



Indicators				RAW Settings						
Run	IID	Indicator	Units	Weight	Direction	BadBelow	GoodAbove	GoodBelow	BadAbove	Edit
Element : [0] Demographics										
✔	2	Population	residents	0	Exclude	0	0	0	0	
✔	3	Employment	employees	0	Exclude	0	0	0	0	
✔	4	Population Density	residents/gro...	0	Exclude	0	0	0	0	
Element : [1] Land-Use										
✔	74	Study Area Acreage	total acres	0	Exclude	0	0	0	0	
	5	Average Parcel Size	avg square feet	0	Exclude	0	0	0	0	
	7	Use Mix	0-1 scale	0	Exclude	0	0	0	0	
✔	8	Use Balance	0-1 scale	2	Increase	0.3000000...	0.6000000...	0	0	
	9	Development Footprint	net acres/10...	0	Exclude	0	0	0	0	
	10	Fiscal Impact of Development	dollars	0	Exclude	0	0	0	0	
Element : [2] Housing										
✔	75	Dwelling Density	DU/gross acre	2	Increase	2	4	0	0	
✔	73	Dwelling Unit Count	total DU	0	Exclude	0	0	0	0	
✔	11	Student Enrollment Level	% student ca...	0	Centralize	0	80	90	100	
				51.00						

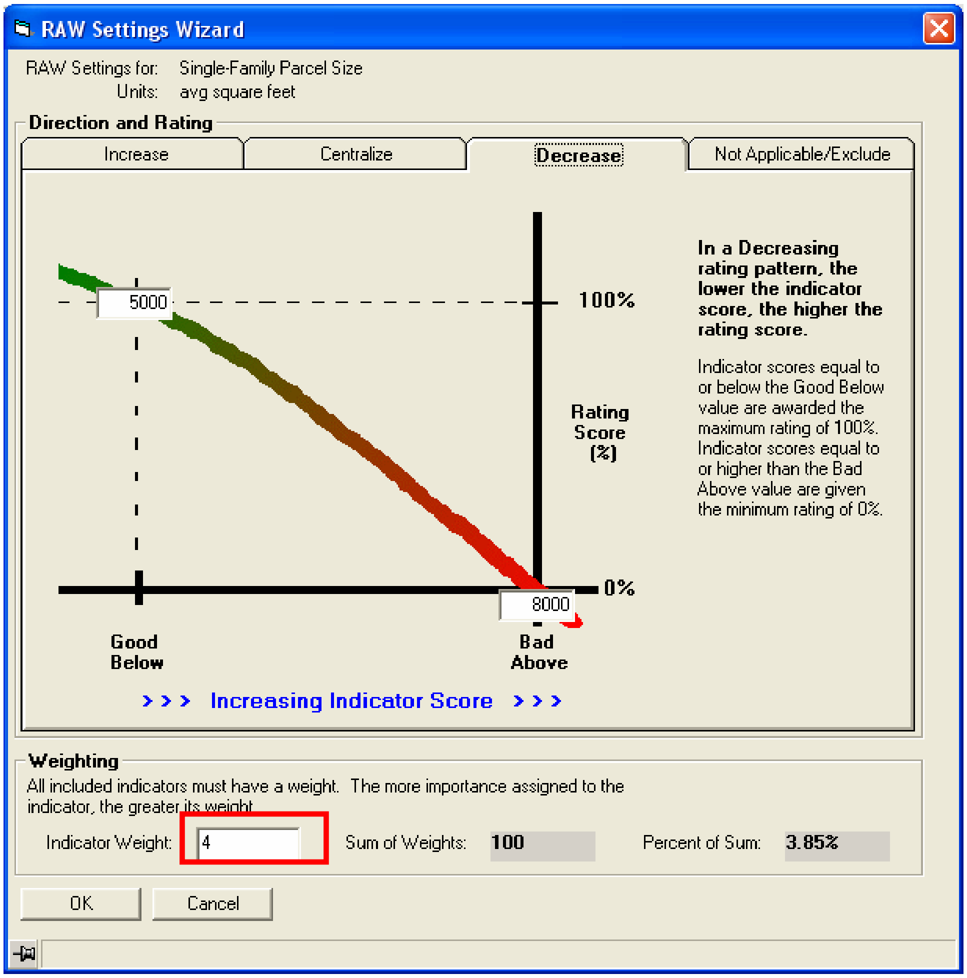
During pre-processing, RAW settings were defined in the Master template for the entire jurisdiction. Since objectives may vary from study to study you would typically adjust RAW values at this time.

Use the default settings for this study:



Edit the weights of the indicators with rating values (indicators not set to Exclude), so that the sum of the total indicator weight equals 100.

Change the Indicator Weight of all selected indicators to ‘4’ whose RAW settings are not set to ‘Exclude’.



BENCHMARK EXISTING CONDITIONS

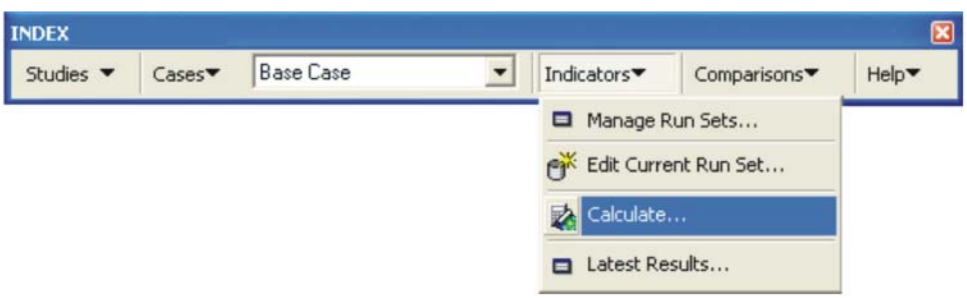
At this point, you are ready to calculate indicators to score benchmark or existing conditions in your study area. Benchmark indicator scores are used to:

- *Identify an area's strengths and weaknesses.* Scoring and mapping of existing conditions will reveal problems and opportunities that merit attention in plans.
- *Provide input into the formulation of community goals.* Benchmark scores are an important reference point when formulating goals that will be applied to community development.
- *Provide a baseline for gauging change.* During plan implementation when development proposals are evaluated, each proposal's scores can be compared to benchmark measurements to gauge the amount of change that would be caused by the development.
- *Provide a baseline for gauging progress.* During periodic monitoring of plan accomplishments, updated benchmark measurements can be compared against previous benchmarks to gauge progress toward goals.

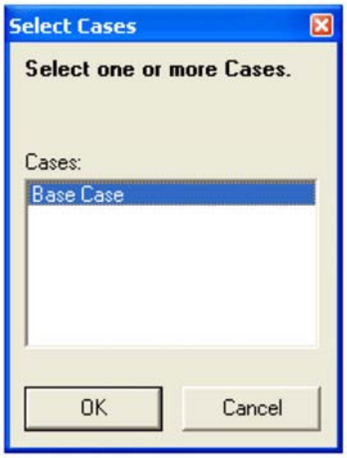
In this section you will benchmark existing conditions using the "Walkability Run Set 2" indicators.

Calculate Indicators

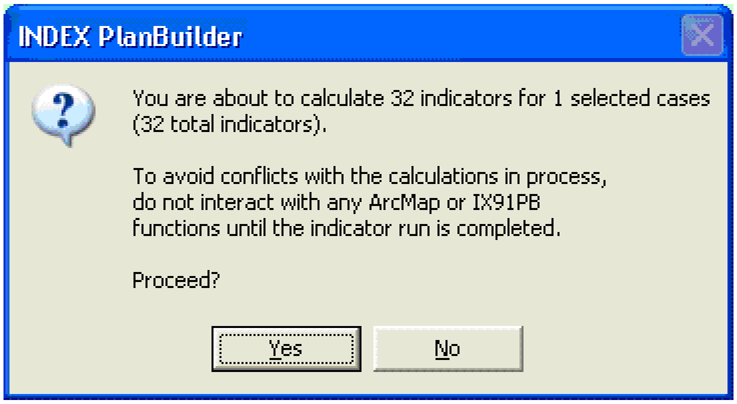
Select the Calculate option from the Indicators menu on the INDEX toolbar:



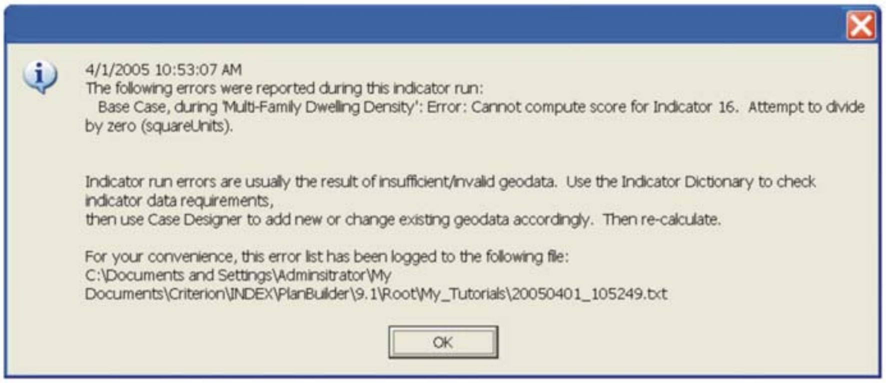
Select the Case from the list that you would like to run indicators for (the only case created so far is the Base Case) and click OK:



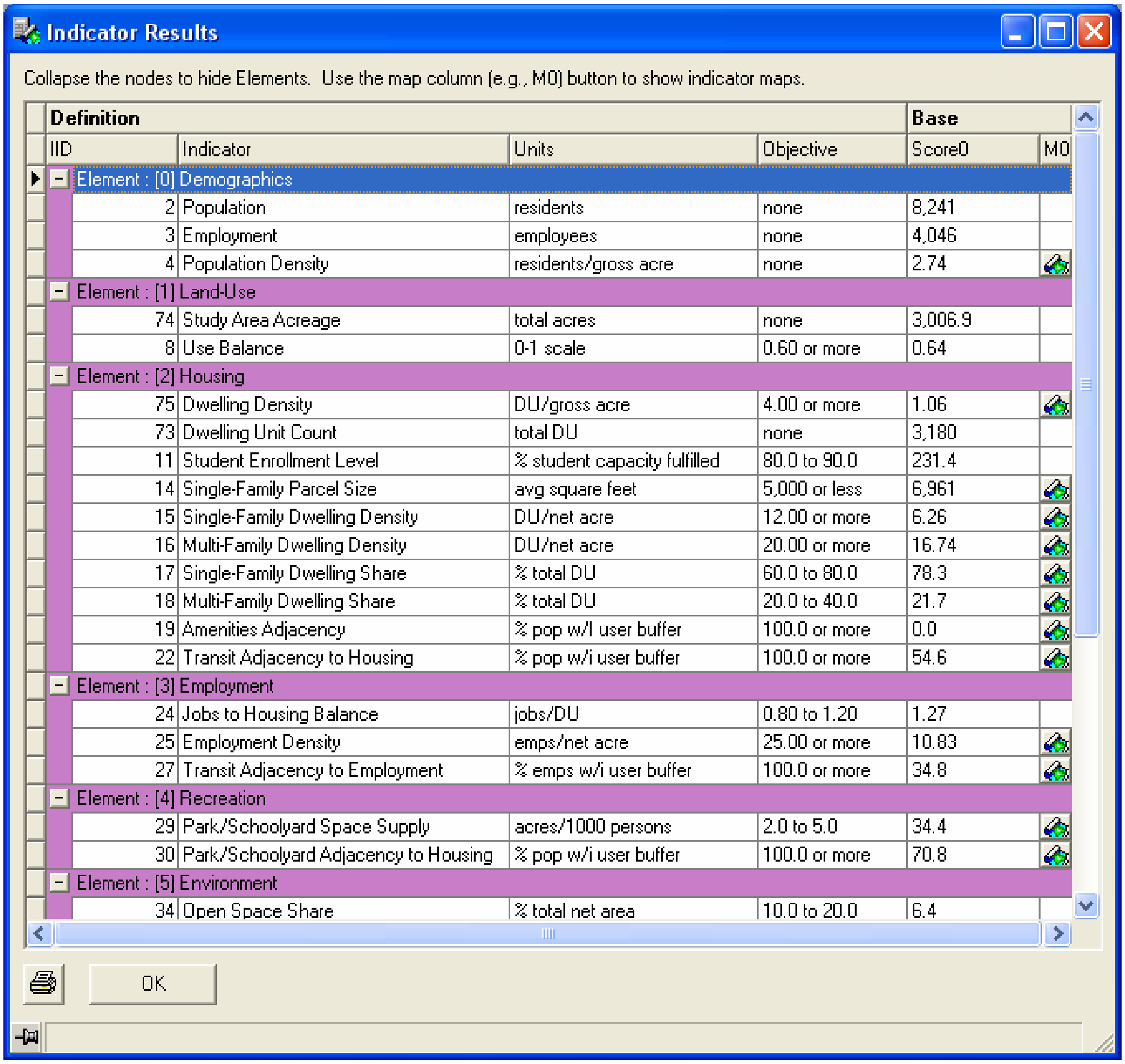
The Indicator Calculator is set to run the 30 or so indicators that were selected in "Benchmark Runs Set 1." If you would like to run fewer indicators return to the Run Set Manager and select Transit Run Set 1; otherwise, select the Yes button to proceed:



Error messages may occur during indicator runs. Errors typically occur when data is not provided to run one of the selected indicators. If you receive an error message during an indicator run, read the message to determine which indicator did not calculate and refer to the Indicator Dictionary to identify missing data.



The Indicator Results table will open automatically after the indicators are finished calculating:



Definition				Base	
IID	Indicator	Units	Objective	Score0	M0
Element : [0] Demographics					
2	Population	residents	none	8,241	
3	Employment	employees	none	4,046	
4	Population Density	residents/gross acre	none	2.74	
Element : [1] Land-Use					
74	Study Area Acreage	total acres	none	3,006.9	
8	Use Balance	0-1 scale	0.60 or more	0.64	
Element : [2] Housing					
75	Dwelling Density	DU/gross acre	4.00 or more	1.06	
73	Dwelling Unit Count	total DU	none	3,180	
11	Student Enrollment Level	% student capacity fulfilled	80.0 to 90.0	231.4	
14	Single-Family Parcel Size	avg square feet	5,000 or less	6,961	
15	Single-Family Dwelling Density	DU/net acre	12.00 or more	6.26	
16	Multi-Family Dwelling Density	DU/net acre	20.00 or more	16.74	
17	Single-Family Dwelling Share	% total DU	60.0 to 80.0	78.3	
18	Multi-Family Dwelling Share	% total DU	20.0 to 40.0	21.7	
19	Amenities Adjacency	% pop w/I user buffer	100.0 or more	0.0	
22	Transit Adjacency to Housing	% pop w/i user buffer	100.0 or more	54.6	
Element : [3] Employment					
24	Jobs to Housing Balance	jobs/DU	0.80 to 1.20	1.27	
25	Employment Density	emps/net acre	25.00 or more	10.83	
27	Transit Adjacency to Employment	% emps w/i user buffer	100.0 or more	34.8	
Element : [4] Recreation					
29	Park/Schoolyard Space Supply	acres/1000 persons	2.0 to 5.0	34.4	
30	Park/Schoolyard Adjacency to Housing	% pop w/i user buffer	100.0 or more	70.8	
Element : [5] Environment					
34	Open Space Share	% total net area	10.0 to 20.0	6.4	

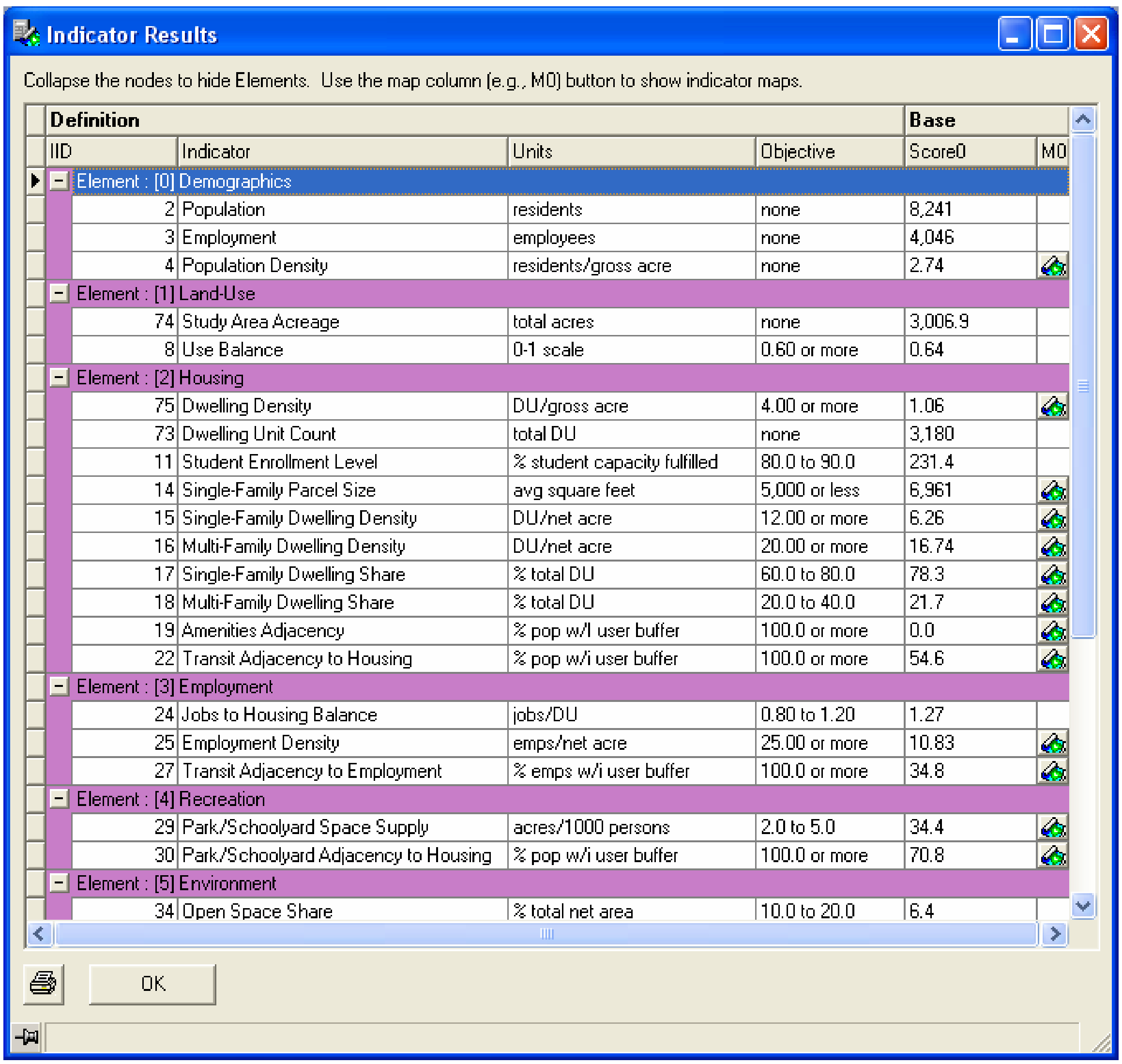
Only the results of the selected case are shown.

REVIEW RESULTS

Indicator Results

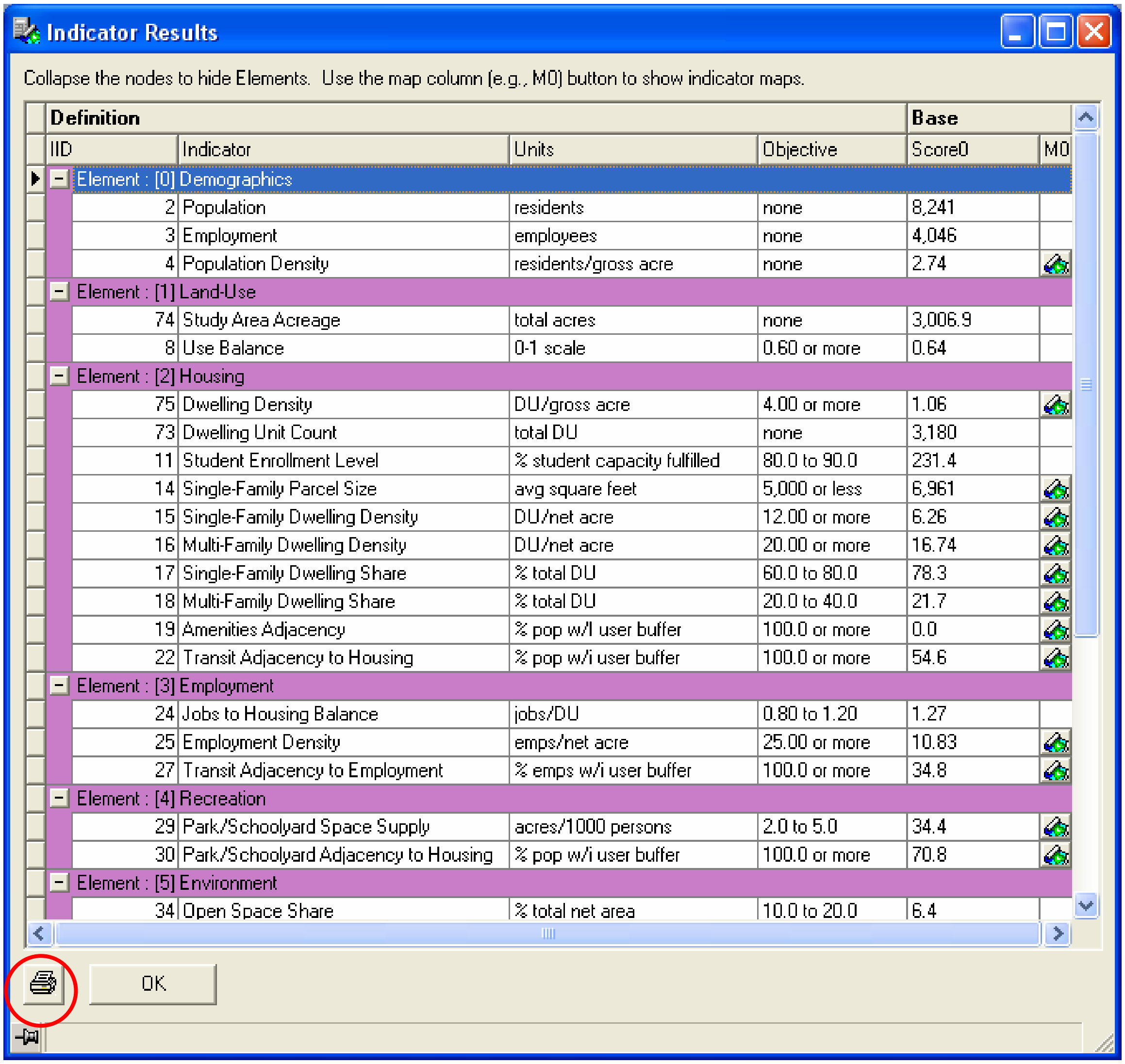
Indicator scores should be interpreted in the context of existing conditions and applicable goals or policies. A key INDEX user document is the Indicator Dictionary that defines what is included in each indicator and how it is calculated. Users will need to gain experience in interpreting scores and changes in scores between studies and cases, in particular the direction of change in scores (numerically increasing or decreasing) and the magnitude of change in scores (percent difference).

Scroll through the indicator results:



Definition				Base	
IID	Indicator	Units	Objective	Score0	M0
Element : [0] Demographics					
2	Population	residents	none	8,241	
3	Employment	employees	none	4,046	
4	Population Density	residents/gross acre	none	2.74	
Element : [1] Land-Use					
74	Study Area Acreage	total acres	none	3,006.9	
8	Use Balance	0-1 scale	0.60 or more	0.64	
Element : [2] Housing					
75	Dwelling Density	DU/gross acre	4.00 or more	1.06	
73	Dwelling Unit Count	total DU	none	3,180	
11	Student Enrollment Level	% student capacity fulfilled	80.0 to 90.0	231.4	
14	Single-Family Parcel Size	avg square feet	5,000 or less	6,961	
15	Single-Family Dwelling Density	DU/net acre	12.00 or more	6.26	
16	Multi-Family Dwelling Density	DU/net acre	20.00 or more	16.74	
17	Single-Family Dwelling Share	% total DU	60.0 to 80.0	78.3	
18	Multi-Family Dwelling Share	% total DU	20.0 to 40.0	21.7	
19	Amenities Adjacency	% pop w/I user buffer	100.0 or more	0.0	
22	Transit Adjacency to Housing	% pop w/i user buffer	100.0 or more	54.6	
Element : [3] Employment					
24	Jobs to Housing Balance	jobs/DU	0.80 to 1.20	1.27	
25	Employment Density	emps/net acre	25.00 or more	10.83	
27	Transit Adjacency to Employment	% emps w/i user buffer	100.0 or more	34.8	
Element : [4] Recreation					
29	Park/Schoolyard Space Supply	acres/1000 persons	2.0 to 5.0	34.4	
30	Park/Schoolyard Adjacency to Housing	% pop w/i user buffer	100.0 or more	70.8	
Element : [5] Environment					
34	Open Space Share	% total net area	10.0 to 20.0	6.4	

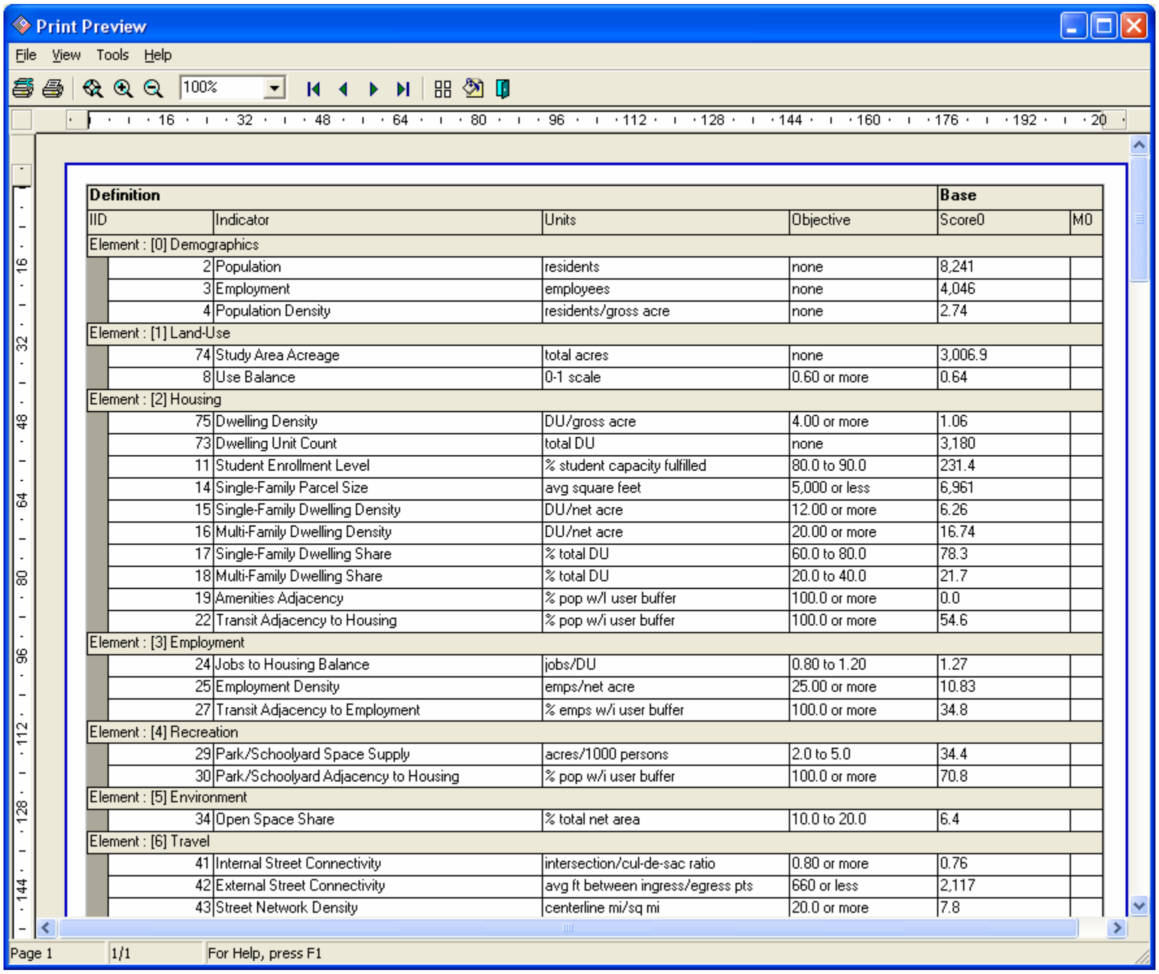
Indicator results can be exported into a print-ready format by clicking the print button in the lower-right corner of the Indicator Results window. Click the Print button to view the printable indicator results table:



Definition				Base	
IID	Indicator	Units	Objective	Score0	M0
Element : [0] Demographics					
2	Population	residents	none	8,241	
3	Employment	employees	none	4,046	
4	Population Density	residents/gross acre	none	2.74	
Element : [1] Land-Use					
74	Study Area Acreage	total acres	none	3,006.9	
8	Use Balance	0-1 scale	0.60 or more	0.64	
Element : [2] Housing					
75	Dwelling Density	DU/gross acre	4.00 or more	1.06	
73	Dwelling Unit Count	total DU	none	3,180	
11	Student Enrollment Level	% student capacity fulfilled	80.0 to 90.0	231.4	
14	Single-Family Parcel Size	avg square feet	5,000 or less	6,961	
15	Single-Family Dwelling Density	DU/net acre	12.00 or more	6.26	
16	Multi-Family Dwelling Density	DU/net acre	20.00 or more	16.74	
17	Single-Family Dwelling Share	% total DU	60.0 to 80.0	78.3	
18	Multi-Family Dwelling Share	% total DU	20.0 to 40.0	21.7	
19	Amenities Adjacency	% pop w/I user buffer	100.0 or more	0.0	
22	Transit Adjacency to Housing	% pop w/i user buffer	100.0 or more	54.6	
Element : [3] Employment					
24	Jobs to Housing Balance	jobs/DU	0.80 to 1.20	1.27	
25	Employment Density	emps/net acre	25.00 or more	10.83	
27	Transit Adjacency to Employment	% emps w/i user buffer	100.0 or more	34.8	
Element : [4] Recreation					
29	Park/Schoolyard Space Supply	acres/1000 persons	2.0 to 5.0	34.4	
30	Park/Schoolyard Adjacency to Housing	% pop w/i user buffer	100.0 or more	70.8	
Element : [5] Environment					
34	Open Space Share	% total net area	10.0 to 20.0	6.4	

When you click the Print button on the Indicator Results window an Excel file containing the indicator results is automatically created in the directory where the working study is stored. The Excel file name inherits the name of the study (Tutorial2_IndicatorResultReport.xls). The file is overwritten each time the Print button on the Indicator Results window is selected.

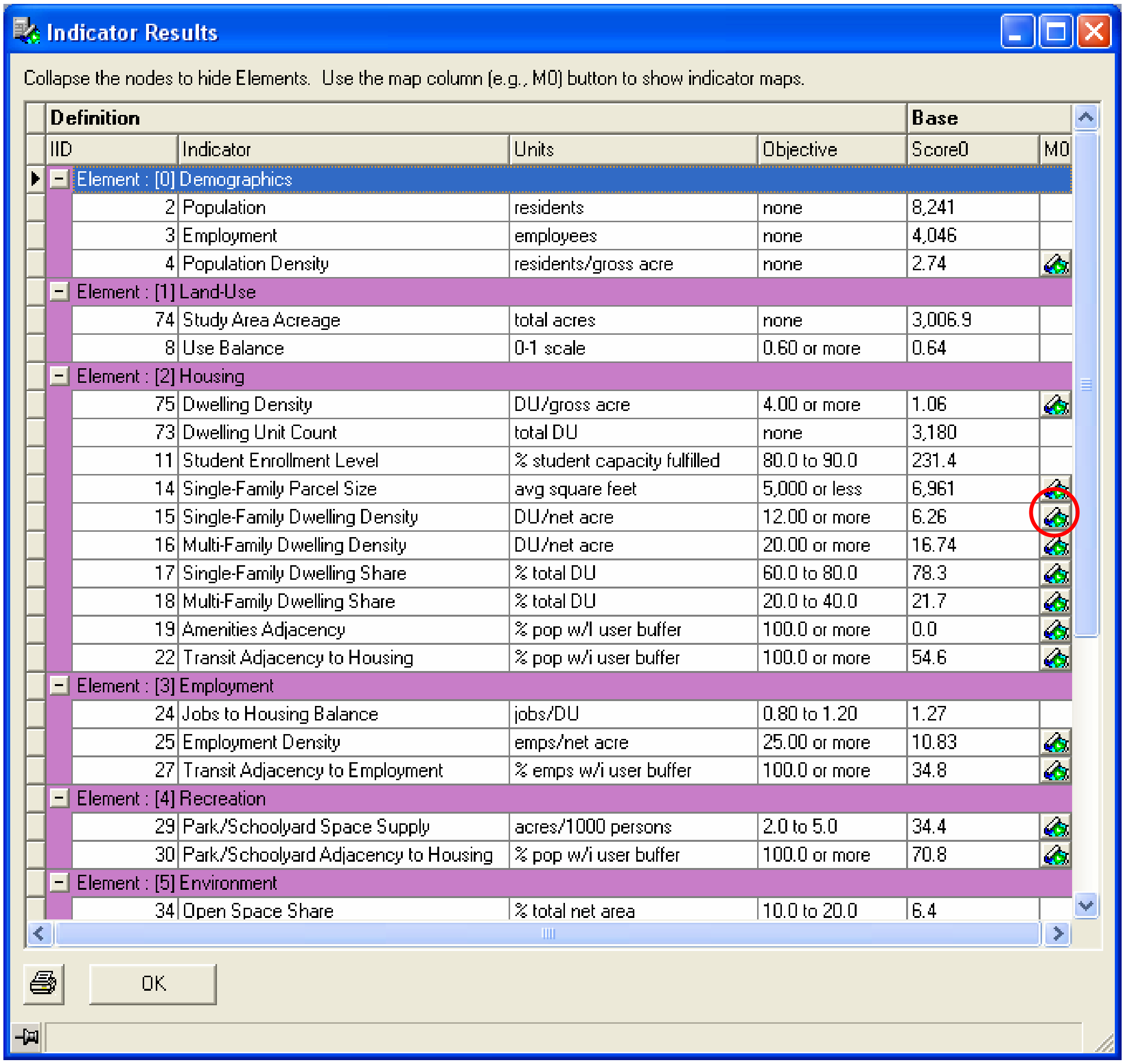
Copy the Indicator Results Excel table from the working directory to a temporary location and open it:



Definition				Base	
IID	Indicator	Units	Objective	Score0	M0
Element : [0] Demographics					
2	Population	residents	none	8,241	
3	Employment	employees	none	4,046	
4	Population Density	residents/gross acre	none	2.74	
Element : [1] Land-Use					
74	Study Area Acreage	total acres	none	3,006.9	
8	Use Balance	0-1 scale	0.60 or more	0.64	
Element : [2] Housing					
75	Dwelling Density	DU/gross acre	4.00 or more	1.06	
73	Dwelling Unit Count	total DU	none	3,180	
11	Student Enrollment Level	% student capacity fulfilled	80.0 to 90.0	231.4	
14	Single-Family Parcel Size	avg square feet	5,000 or less	6,961	
15	Single-Family Dwelling Density	DU/net acre	12.00 or more	6.26	
16	Multi-Family Dwelling Density	DU/net acre	20.00 or more	16.74	
17	Single-Family Dwelling Share	% total DU	60.0 to 80.0	78.3	
18	Multi-Family Dwelling Share	% total DU	20.0 to 40.0	21.7	
19	Amenities Adjacency	% pop w/l user buffer	100.0 or more	0.0	
22	Transit Adjacency to Housing	% pop w/i user buffer	100.0 or more	54.6	
Element : [3] Employment					
24	Jobs to Housing Balance	jobs/DU	0.80 to 1.20	1.27	
25	Employment Density	emps/net acre	25.00 or more	10.83	
27	Transit Adjacency to Employment	% emps w/i user buffer	100.0 or more	34.8	
Element : [4] Recreation					
29	Park/Schoolyard Space Supply	acres/1000 persons	2.0 to 5.0	34.4	
30	Park/Schoolyard Adjacency to Housing	% pop w/i user buffer	100.0 or more	70.8	
Element : [5] Environment					
34	Open Space Share	% total net area	10.0 to 20.0	6.4	
Element : [6] Travel					
41	Internal Street Connectivity	intersection/cul-de-sac ratio	0.80 or more	0.76	
42	External Street Connectivity	avg ft between ingress/egress pts	660 or less	2,117	
43	Street Network Density	centerline mi/sq mi	20.0 or more	7.8	

Indicator Maps

Maps are automatically created for indicators with the map icon displayed in the column next to the indicator scores. Indicator maps are spatial expressions of conditions that produced the scores and are spatial diagnostic tools that reveal the locations of an area's strengths and weaknesses. They can be helpful in optimizing new land development design or correcting problems during redevelopment.



Indicator Results

Collapse the nodes to hide Elements. Use the map column (e.g., M0) button to show indicator maps.

Definition				Base	
IID	Indicator	Units	Objective	Score0	M0
Element : [0] Demographics					
2	Population	residents	none	8,241	
3	Employment	employees	none	4,046	
4	Population Density	residents/gross acre	none	2.74	
Element : [1] Land-Use					
74	Study Area Acreage	total acres	none	3,006.9	
8	Use Balance	0-1 scale	0.60 or more	0.64	
Element : [2] Housing					
75	Dwelling Density	DU/gross acre	4.00 or more	1.06	
73	Dwelling Unit Count	total DU	none	3,180	
11	Student Enrollment Level	% student capacity fulfilled	80.0 to 90.0	231.4	
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16	Multi-Family Dwelling Density	DU/net acre	20.00 or more	16.74	
17	Single-Family Dwelling Share	% total DU	60.0 to 80.0	78.3	
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19	Amenities Adjacency	% pop w/I user buffer	100.0 or more	0.0	
22	Transit Adjacency to Housing	% pop w/i user buffer	100.0 or more	54.6	
Element : [3] Employment					
24	Jobs to Housing Balance	jobs/DU	0.80 to 1.20	1.27	
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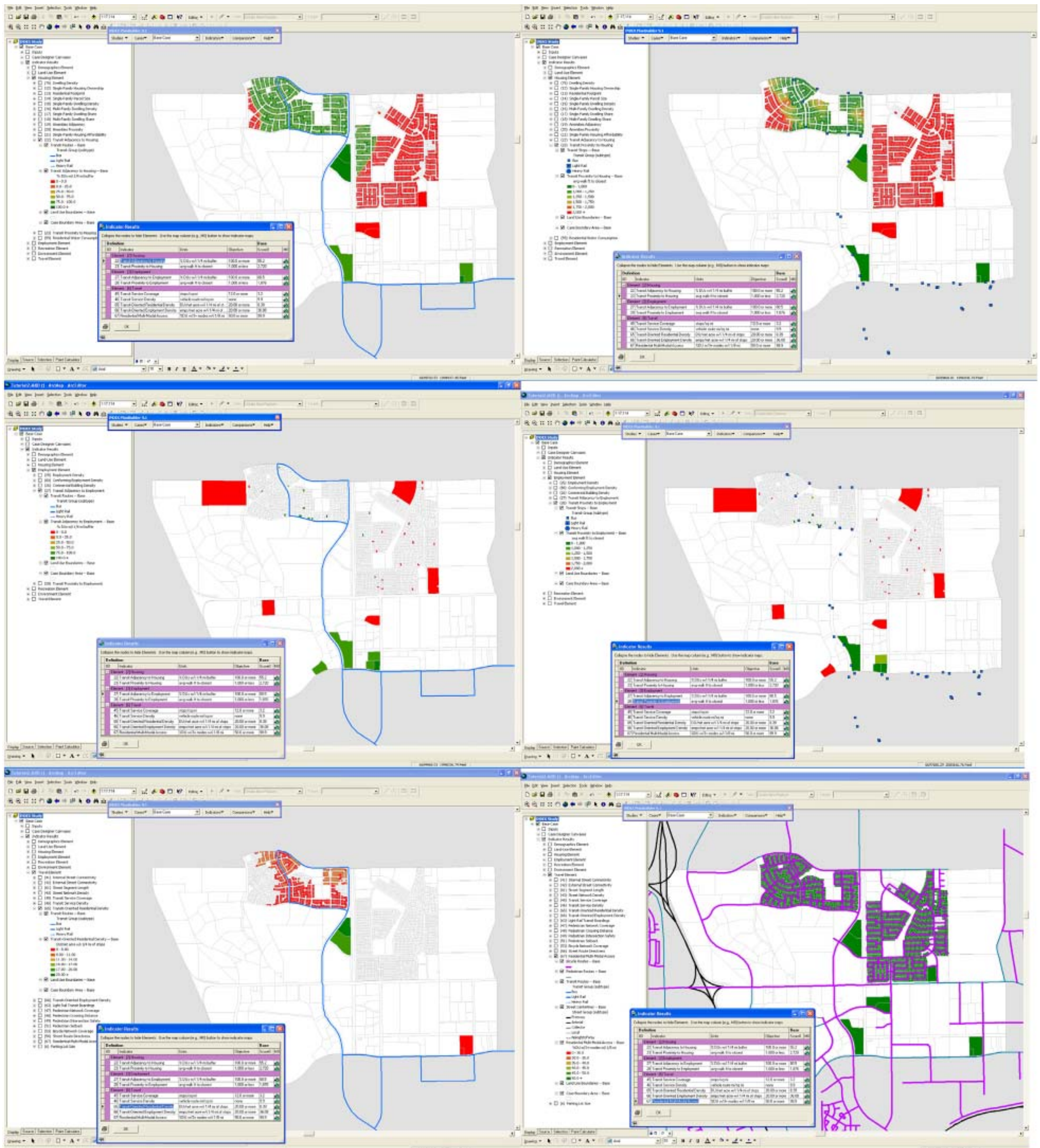
Element : [4] Recreation					
29	Park/Schoolyard Space Supply	acres/1000 persons	2.0 to 5.0	34.4	
30	Park/Schoolyard Adjacency to Housing	% pop w/i user buffer	100.0 or more	70.8	
Element : [5] Environment					
34	Open Space Share	% total net area	10.0 to 20.0	6.4	

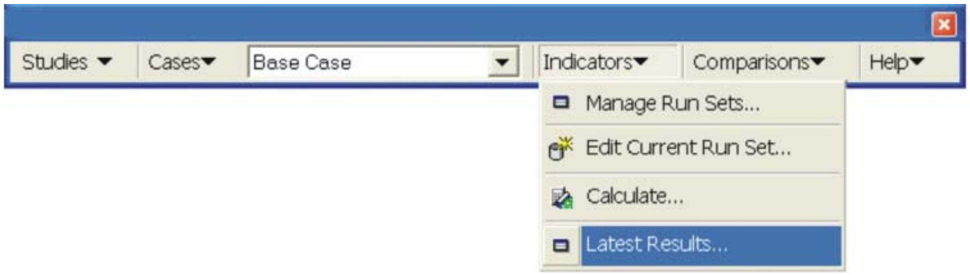
To view an indicator map, single-click the Map Output icon in the M0 field (M1 for case 1, etc.):

Scroll through the Indicator Results table and become familiar with the indicator map output:



Latest Results

The Indicator Results Table can also be accessed through the Latest Results option from the Indicators menu. Select the Latest Results option on the Indicators menu:



RAW Evaluation

It is possible to run the base case results through the RAW tool, which is accomplished by navigating to the Comparisons pull-down. However, since the primary function of the RAW tool is to compare multiple cases, this feature is addressed in the following tutorial where a comparison of multiple cases is possible.

Appendix A

BUILDING ACCURATE PEDESTRIAN NETWORKS

ArcEditor/ArcInfo Users Only

Several indicators in INDEX use the street network to perform network-based travel distance calculations. These indicators have been designed to take advantage of detailed pedestrian network representations to accurately model pedestrian travel. Therefore, a pedestrian network theme distinct from the street network is recommended. This shapefile can take one of several forms depending on the accuracy desired and the resources available to create a detailed representation of sidewalks and walking paths. In order to understand how inaccuracies arise when using less detailed representations of the pedestrian network, it is necessary to understand what INDEX is doing in a typical network distance calculation.

When proximity via the street network is being calculated, the inputs are the origin theme, the destination theme, and the network theme. The origin theme is typically a polygon theme (usually parcels). The destination theme may be a polygon theme (parks and school yards) or a point theme (transit stops). INDEX only calculates distances between points located on the network, so any origins or destinations not on the network must be placed at the best location on it. Origins and destinations that are not points must also be converted to one or more representative points before they can be located on the network. Inaccuracies arise at one or more of the three phases in this calculation, which are:

a) Generate a set of representative points for each origin and destination;

b) Locate these points on the network; and

c) Use the network to calculate the average distance from each origin to the closest destination.

Locating Origin and Destination Points on the Network

There are many ways that points can be generated from polygons and then located on the network. The least accurate way is to use the centroid of the polygon and then locate the nearest point on the network to the centroid point. The straight-line distance to the network can be added to the total distance on the network for each proximity calculation. The problem with this method is that it fails to account for pedestrian routes and barriers to pedestrian movement inside and immediately surrounding the origin or destination polygon. Large polygons can also cause inaccurate results using this method. For example, a large park might have its center close to the network but at a point very distant from the nearest residential parcel. Even if the residential parcel is right across the street from part of the same large polygon, the proximity to the park will be based on the network location nearest the centroid. See Figure A-1.

A more accurate method of location is to place the origin and destination points wherever there are logical entrances to the pedestrian network. Thus, large polygons will have multiple entrances, each accessible to travel coming from a different direction. The closer these points are to networks segments, the more accurate the calculations will be. The current methodology for proximity-based indicators is to place a pedestrian entrance node at the terminated end (dead-end) of any network segment which intersects an origin or destination polygon. If a polygon is intersected by more than one terminating segment, the calculations for each entrance are averaged (or sometimes the minimum is taken). If no segments intersect the polygon, the centroid will be used by default. See Figure A-2.

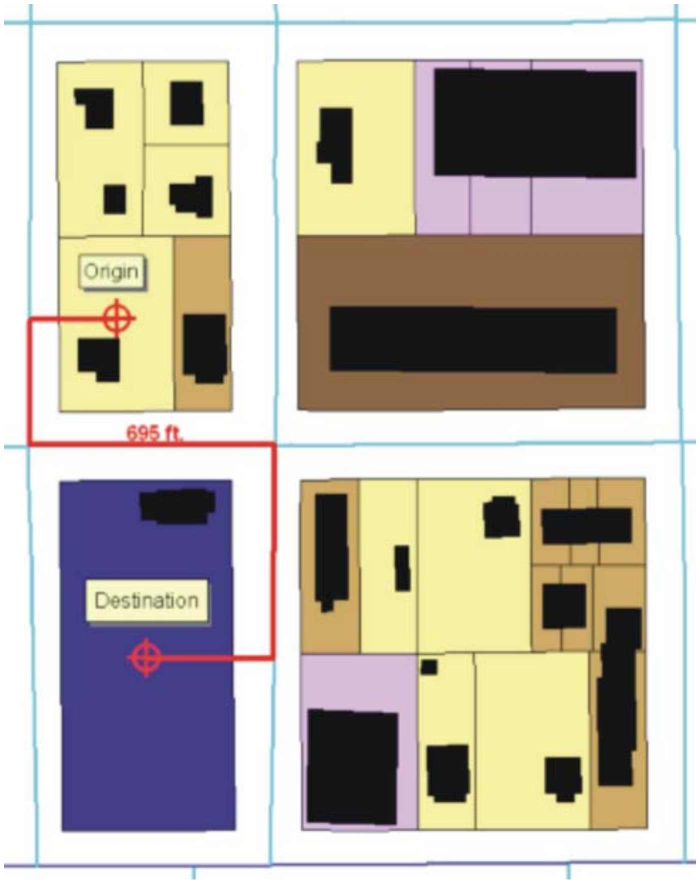


Figure A-1
Using the polygon centroid results in a “shortest” network path which is too long.

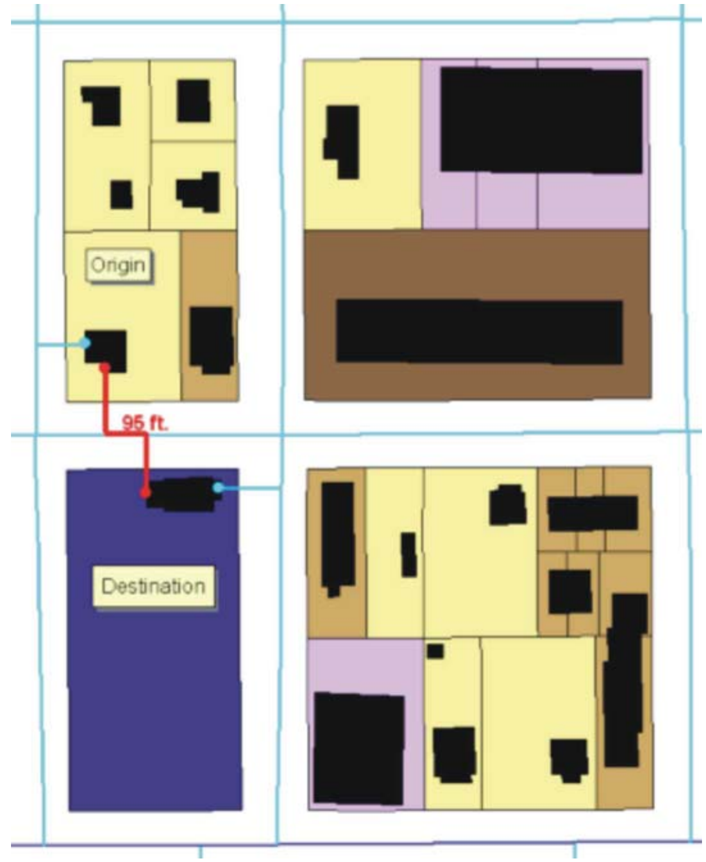


Figure A-2
Using pedestrian entrances automatically placed at the end of network “spurs,” the resulting “shortest” network path is very accurate.

Level of Detail in Network Representation

Once points have been generated and located on the network, the level of detail reflected in the network determines the accuracy of the proximity calculations. One way the network can be improved is to include “internal” network segments inside parcels. In areas with large parcels, for example, network segments internal to or intersecting origin and destination polygons will improve results. Internal networks give a clear path for pedestrians to follow in order to avoid barriers. The combination of internal and external network segments allow pedestrians to take the best route from their true origin (the doorway of a building) to their true destination (the closest entrance to a park facility). Sidewalks, street crossings, pedestrian overpasses, paths and other unmarked or unimproved paths, and routes that pedestrians tend to follow can also represented by network segments. Adding these features will increase the “reality” of the network model and the accuracy of the calculations. Figure A-3 depicts a range of network detail in three diagrams, each depicting a pedestrian network more detailed than the last.

In the simplest form (Figure A-3), the street centerline theme is used to represent the general pattern of pedestrian movement. While this theme is often the easiest to acquire, it generates an inaccurate model of pedestrian movement for several reasons:

- The presence or absence of sidewalks, crossings, or other good conditions for pedestrian travel is not accounted for.
- Since terminated segments do not intersect the origin and destination parcels, internal networks and barriers to pedestrian travel are not accounted for.
- Other kinds of pedestrian routes such as pedestrian malls or boardwalks are not accounted for.
- Wrong direction “jumps” onto the network are not prevented.

In an intermediate form (Figure A-3b), the street centerline is still used as the basis, but additional intersecting segments have been added, breaking the street segment into two where they intersect. These “spurs” also intersect the origin or destination parcels and essentially channel the modeled flow of pedestrian movement along the spur. This is particularly important to avoid crossing barriers or jumping onto the network in the wrong direction. These spurs are added only where needed to force correct calculations. A good example of where spurs may be required is in the case of parcels on cul-de-sacs that also have a street adjacent to the back property line. Such parcels typically have barriers to movement in that direction (fences, sound walls) in the real world. In the model in these situations, if spurs are not used there is a chance that the centroid will found to be closer to the street at the rear than to the street at the front, and will erroneously start calculations from that location on the network.

In the most advanced form (Figure A-3c), several pedestrian routes have been included in a topologically complete pedestrian network. The investment required to generate this sort of theme can be significant. Air photos, CAD drawings, and other resources may be needed to create a thoroughly complete sidewalk and pedestrian path centerline theme. Intermediate solutions can incorporate varying degrees of local detail, particularly in spots where a simpler map would be ambiguous. Note that, in this advanced form, the street centerline is no longer used, and a pair of sidewalk centerlines, closer to the adjacent parcels, but still in the street right-of-way, replaces it.

Other Street Network Issues

Any street network, regardless of its complexity, must be topologically complete. This means that all segments that intersect must end at their intersection. Segments which do not break when intersected will not allow travel to pass to the intersecting segment. It is also important to note that a more complex network, with many entrances and segments, will cause longer calculation times, particularly in larger study areas.

Figure A-3

Figure A-3a
408 ft. is much too low, and the barrier is crossed.

Figure A-3b
1,238 ft. is a little too high, but the barrier is not crossed.

Figure A-3c
1,047 ft. is very accurate, and the barrier is not crossed.

INDEX PlanBuilder

Planning Support System
Release 9.2

Tutorial 3:
Create & Evaluate Development Proposals

April 2007

CRITERION PLANNERS

CRITERION

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CONTENTS

INTRODUCTION

This tutorial addresses the creation and evaluation of alternate cases and their impacts to study areas. For purposes of the tutorial, a development proposal is assumed to be the alternate case. As shown in Figure 1, a major application of the tool is development reviews that: 1) gauge the amount of change from existing conditions that would result from a development; and 2) measure the degree of adopted plan conformity or goal achievement produced by development.

The tutorial organizes this stage of INDEX use into the following major tasks:

- Create a development proposal.
- Select and run indicators.
- Compare cases.
- Modify development proposal.
- Rerun indicators and compare cases.

As shown in Figure 2, any portion of a study area can be modified in INDEX to simulate a proposed development, and the study area can then be rescored to determine the magnitude of change and/or the degree of goal achievement caused by the modification.

INDEX PlanBuilder supports all ArcGIS license types (ArcView, ArcEditor, ArcInfo). However ArcView users are limited in the kinds of indicators they can run, and therefore have reduced data requirements. Throughout the INDEX PlanBuilder documentation, where applicable the following highlights denote license-specific features or instructions:

ArcEditor/ArcInfo Users, or

ArcView Users

Figure 1. BASIC STEPS IN APPLYING INDEX

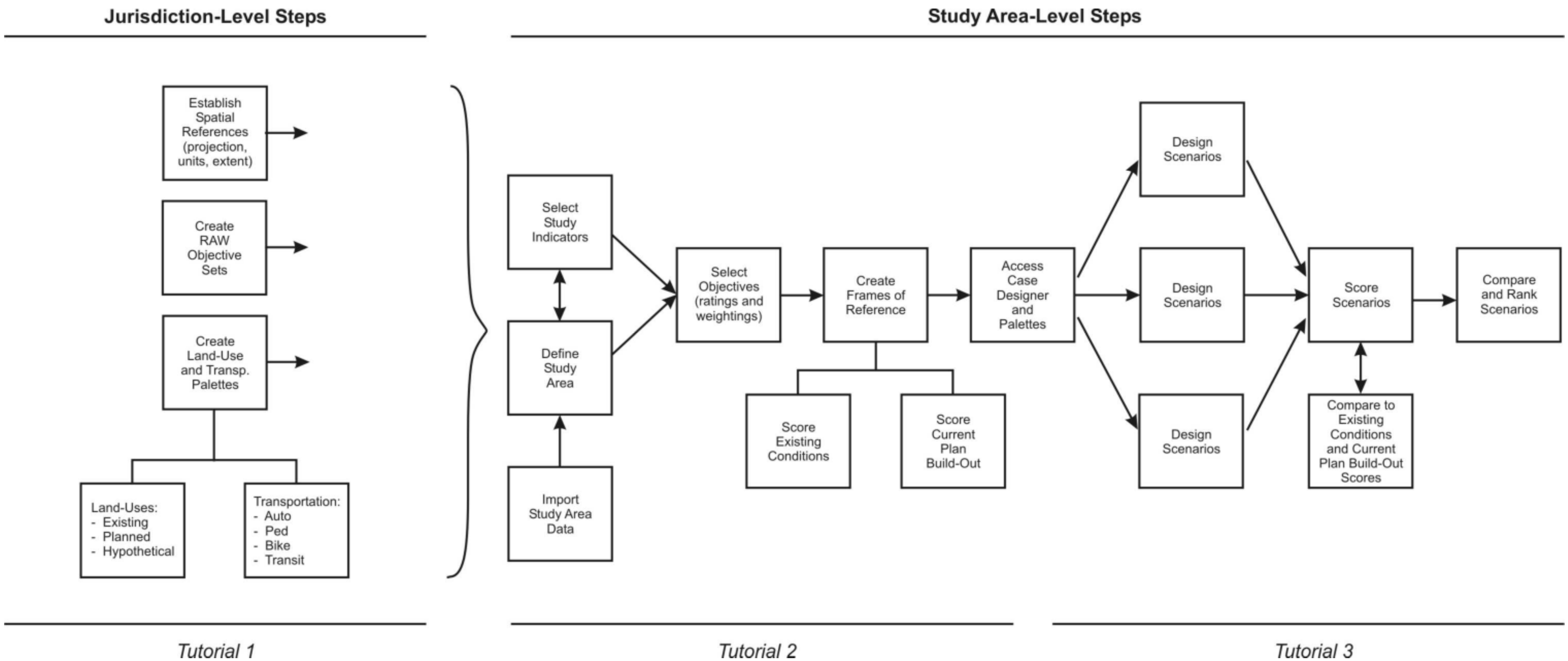
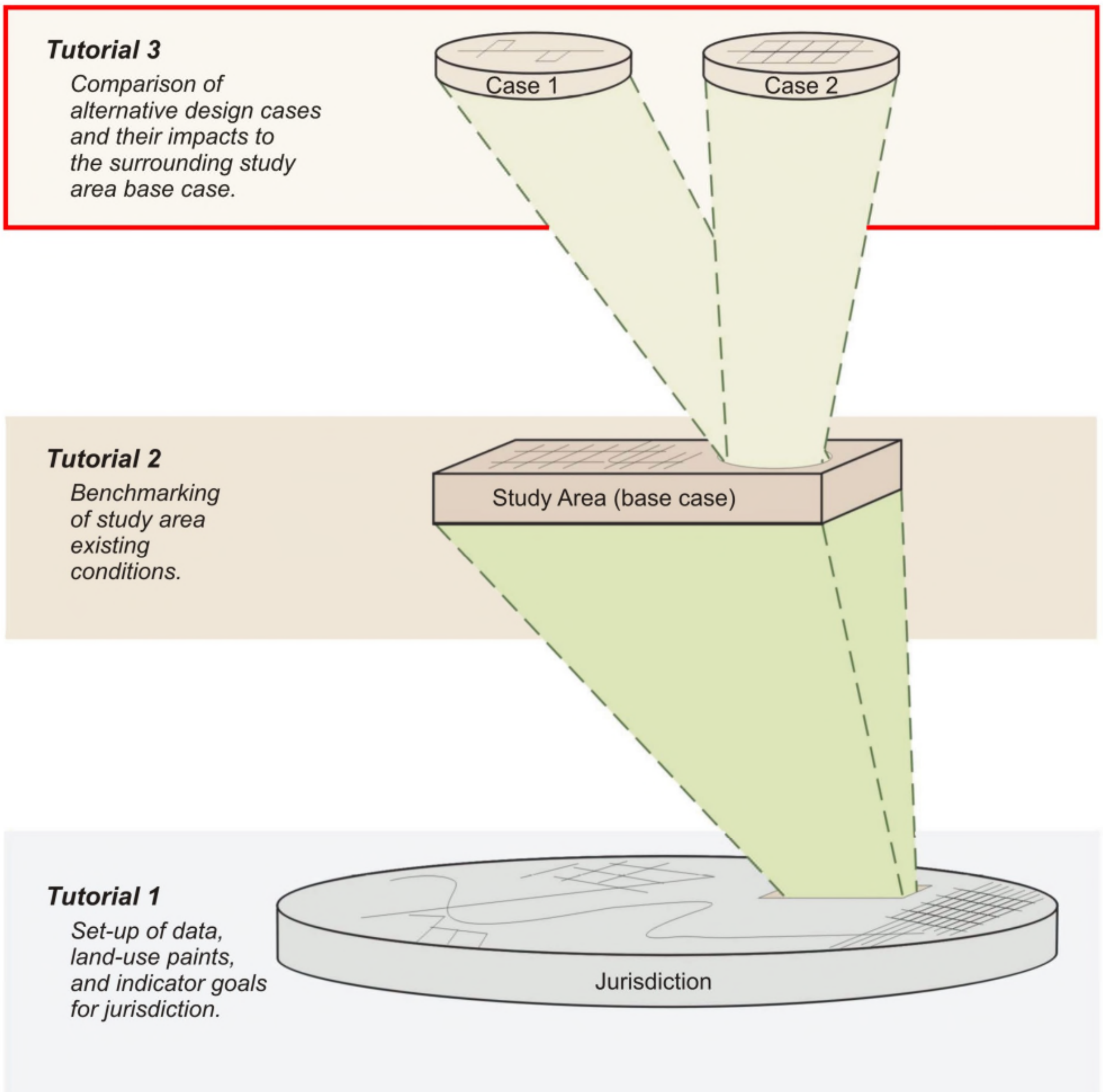


Figure 2
TUTORIAL SEQUENCE AND GEOGRAPHIC RELATIONSHIPS



CREATE A DEVELOPMENT PROPOSAL

Once existing conditions have been evaluated and planning issues identified, stakeholders can use INDEX to create and evaluate alternative scenarios (or cases) that respond to the issues. These can range from community plans to developer proposals. In any of these processes, alternatives can be evaluated according to the following general sequence:

- *Preparation of alternatives.* Using the Case Designer tool, stakeholders prepare alternatives that respond to the issues identified during benchmarking. Each of these is represented by an alternative case in the software with each case containing its own unique mix of features. If housing choice was identified as an issue, one alternative might emphasize a mix of single and multi-family dwellings while another alternative might contain only single-family units.

- *Review of alternative scores.* Stakeholders review indicator scores for each case in comparison to other alternatives and the base case in order to determine which alternatives respond most effectively to identified issues. For example, if excessive walking distance to parks was identified as a problem in the base case, stakeholders would review the alternatives' park proximity scores to determine which alternative offered the shortest walking distance to parks.

- *Iteration to preferred alternative and adopted plan.* Using the software to modify alternative designs and provide indicator score feedback, stakeholders can iterate among alternatives to a preferred, and ultimately adopted, plan or development proposal.

- *Modeling of adopted goals.* Once a plan or development proposal is formally adopted, its build-out or full implementation can be modeled and the resulting indicator scores used as quantitative expressions of its goals.

In this tutorial, you will import a development proposal using the geoloader and modify the design using the Case Designer tools, and evaluate the impacts to study area indicator scores.

Pre-Process the Development Proposal Data

In order to apply INDEX as a development evaluation tool, it will be necessary to obtain development proposals in GIS form. Given the widespread use of CAD in preparing development plans and the relatively easy conversion of CAD files to GIS files, it should be reasonable for jurisdictions to request major development proposals in GIS format. To implement a requirement for digital development plans, jurisdictions would adopt the equivalent of the INDEX Indicator Dictionary as a data specification for digital submittals. Jurisdictions could decide the extent of these data requirements based on which indicators they intend to apply to proposals.

Parcels and streets representing the development proposal are provided for you in shapefile format.

Open a standard ArcMap project and load the proposed_landuse.shp file located in the following folder:

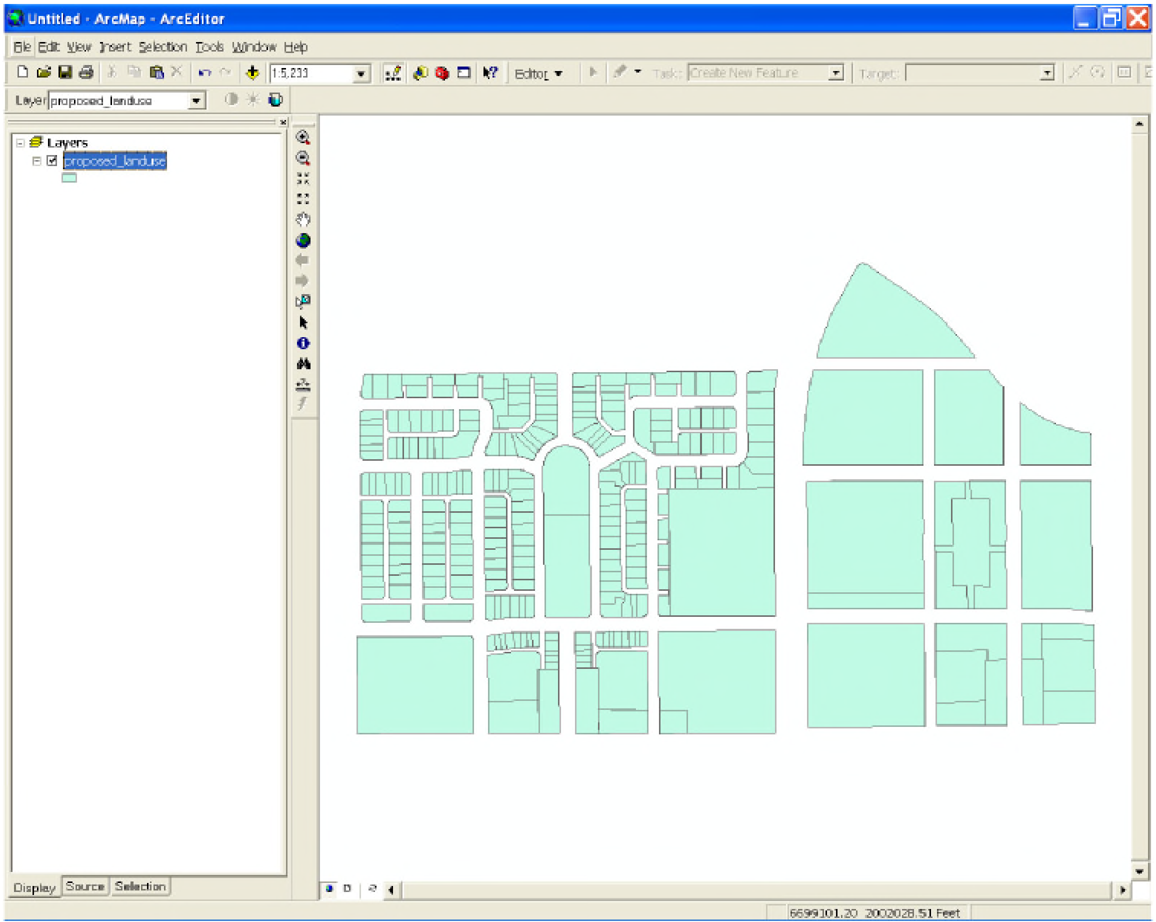
[My Documents]\Criterion\INDEX\PlanBuilder\9.2\TutorialData\ParcelBased\ProposedDevelopment_GIS

Attributes of proposed_landuse

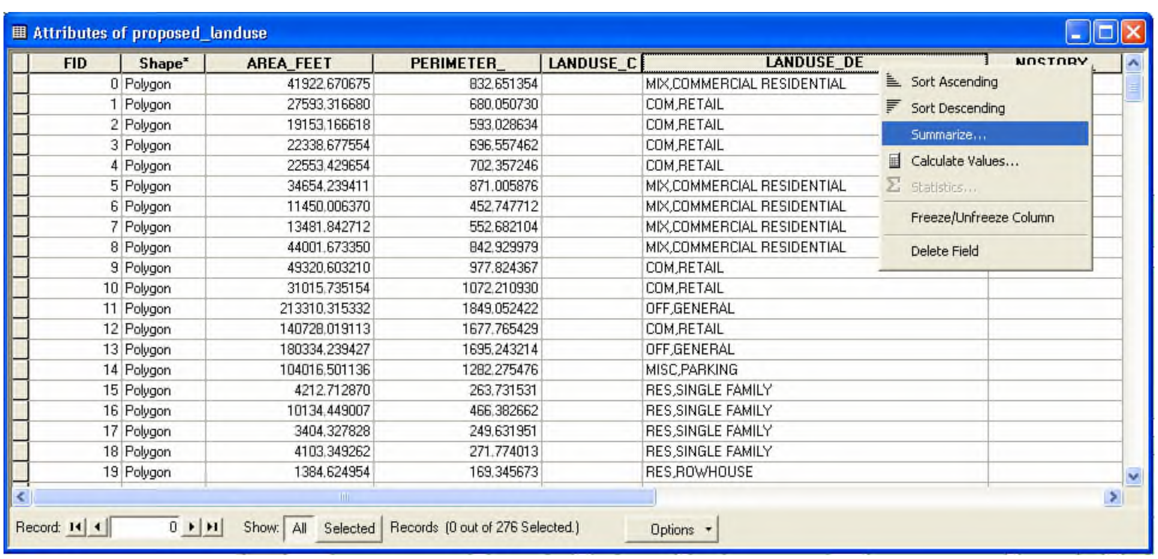
LANDUSE_DE	TOTUNITS	EMPS	NEW_LU_ID	RESIDENTS	STUDENTS	PARKING
COM,RETAIL	0	75	30	0	0	150
COM,RETAIL	0	50	30	0	0	100
COM,RETAIL	0	34	30	0	0	68
COM,RETAIL	0	40	30	0	0	80
COM,RETAIL	0	41	30	0	0	82
COM,RETAIL	0	62	30	0	0	124
COM,RETAIL	0	20	30	0	0	40
COM,RETAIL	0	24	30	0	0	48
COM,RETAIL	0	79	30	0	0	158
COM,RETAIL	0	49	30	0	0	98
COM,RETAIL	0	56	30	0	0	112
OFF,GENERAL	0	427	31	0	0	640.5
COM,RETAIL	0	141	30	0	0	282
OFF,GENERAL	0	361	31	0	0	541.5
MISC,PARKING	0	0	68	0	0	0
RES,SINGLE FAMILY	1	0	20	2.7	1.2	2
RES,SINGLE FAMILY	1	0	20	2.7	1.2	2
RES,SINGLE FAMILY	1	0	20	2.7	1.2	2
RES,SINGLE FAMILY	1	0	20	2.7	1.2	2
RES,LOW RISE APARTMENTS	1	0	21	2.2	0.7	1.5
RES,LOW RISE APARTMENTS	2	0	21	4.4	1.4	3
RES,LOW RISE APARTMENTS	1	0	21	2.2	0.7	1.5

Record: 0 Show: All Selected Records (0 out of 276 Selected.) Options

Open the proposed land-use attribute table:



During pre-processing in Tutorial 1, numeric values were provided for the jurisdiction's existing land-uses that were used to define the land-use types in INDEX; in this section numeric values are also provide for land-use parcels submitted in a development proposal.



FID	Shape*	AREA_FEET	PERIMETER_	LANDUSE_C	LANDUSE_DE	NOSTORY
0	Polygon	41922.670675	832.651354		MIX,COMMERCIAL RESIDENTIAL	
1	Polygon	27593.316680	680.050730		COM,RETAIL	
2	Polygon	19153.166618	593.028634		COM,RETAIL	
3	Polygon	22338.677554	696.557462		COM,RETAIL	
4	Polygon	22553.429654	702.357246		COM,RETAIL	
5	Polygon	34654.239411	871.005876		MIX,COMMERCIAL RESIDENTIAL	
6	Polygon	11450.006370	452.747712		MIX,COMMERCIAL RESIDENTIAL	
7	Polygon	13481.842712	552.682104		MIX,COMMERCIAL RESIDENTIAL	
8	Polygon	44001.673350	842.929979		MIX,COMMERCIAL RESIDENTIAL	
9	Polygon	49320.603210	977.824367		COM,RETAIL	
10	Polygon	31015.735154	1072.210930		COM,RETAIL	
11	Polygon	213310.315332	1849.052422		OFF,GENERAL	
12	Polygon	140728.019113	1677.765429		COM,RETAIL	
13	Polygon	180334.239427	1695.243214		OFF,GENERAL	
14	Polygon	104016.501136	1282.275476		MISC,PARKING	
15	Polygon	4212.712870	263.731531		RES,SINGLE FAMILY	
16	Polygon	10134.449007	466.382662		RES,SINGLE FAMILY	
17	Polygon	3404.327828	249.631951		RES,SINGLE FAMILY	
18	Polygon	4103.349262	271.774013		RES,SINGLE FAMILY	
19	Polygon	1384.624954	169.345673		RES,ROWHOUSE	

Create a Copy of the Current Study

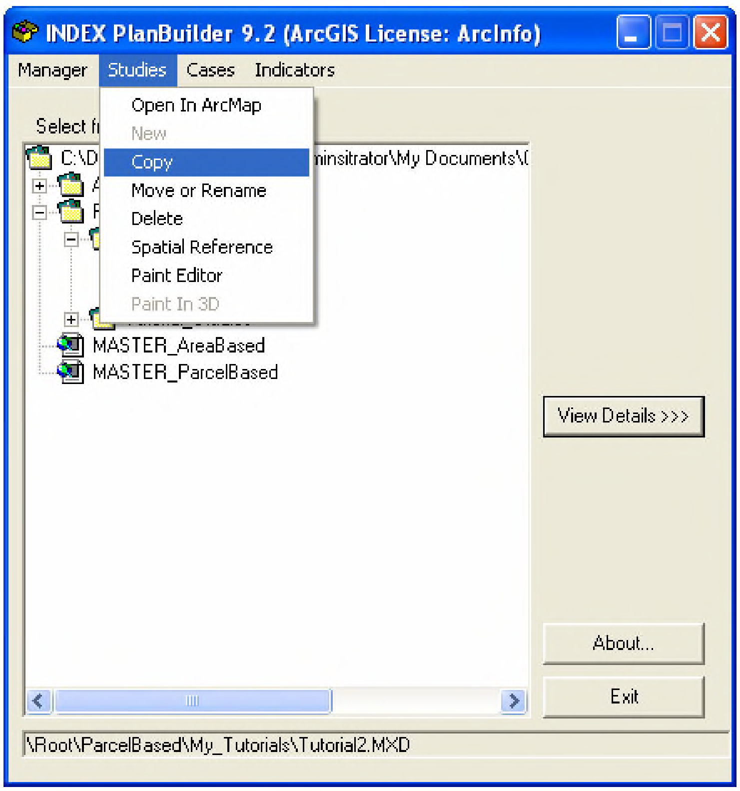
You can preserve the work accomplished in a study by creating a copy of the study. In this section, you will preserve the progress made in Tutorial 2 by creating a copy of the “Tutorial2” study. The copy of the study will become the working study.

If you do not have a completed “Tutorial2” study, copy the appropriate study from the “Tutorial_Studies” folder into the “My_Tutorials” folder and name it “Tutorial3”.

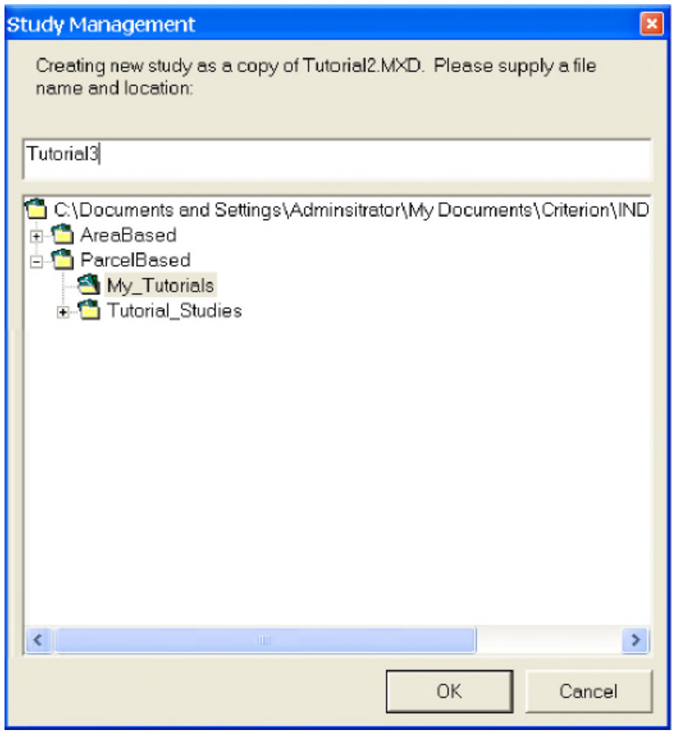
ArcEditor/ArcInfo Users*: the study to copy is Tutorial3_Begin*

ArcView Users*: the study to copy is Tutorial3_Begin_AV*

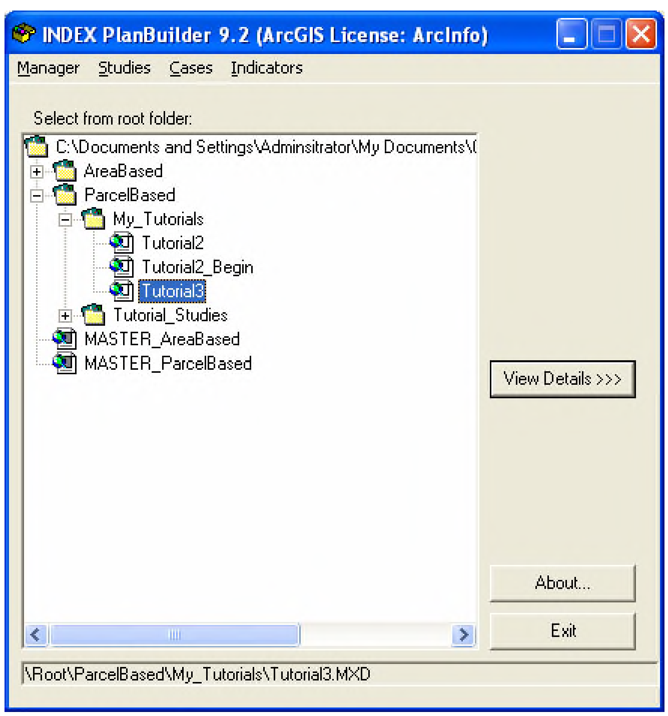
Open INDEX Study Manager. Expand the “My_Tutorials” folder tree and select the “Tutorial2” study. The Copy button will automatically become active. Click the Studies > Copy menu option:



Rename the study “Tutorial3,” and save it in the “My_Tutorials” folder:



Verify that “Tutorial3” is visible in the “My_Tutorials” folder:

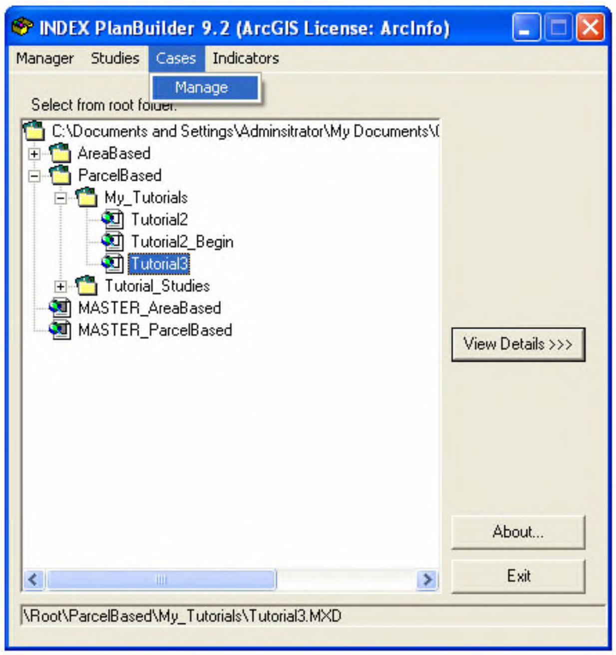


The study is saved at this point as Tutorial3.

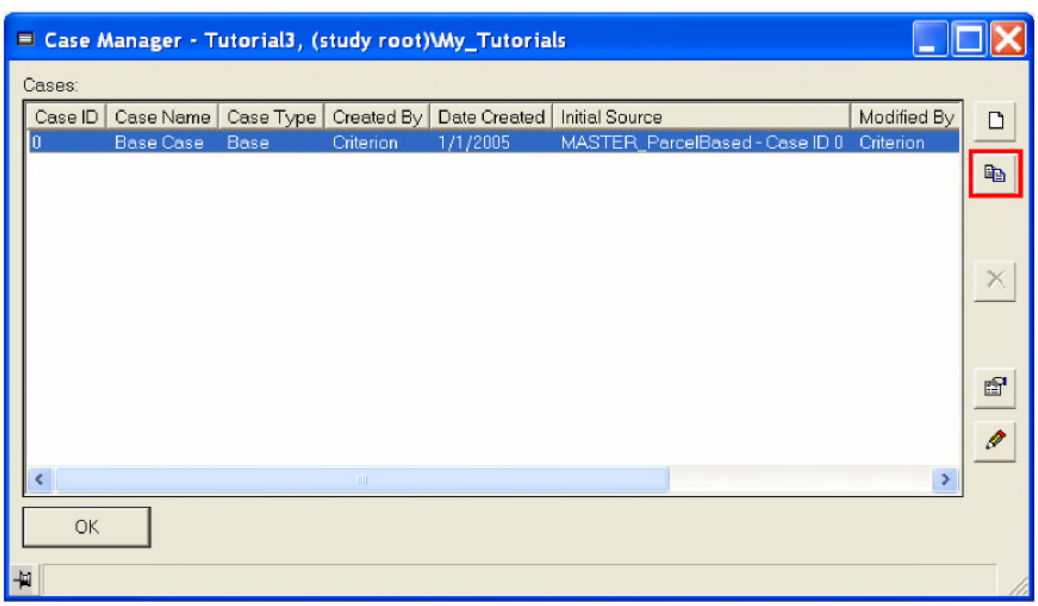
Create an Alternative Case

Alternative cases are created to represent different ideas and approaches to the issues at hand in a study area. In this tutorial, a proposed development project will be evaluated and compared to existing study area conditions to see what effect the development would have on its surrounding vicinity, i.e. does it improve or degrade existing neighborhood conditions? Since Case 1 is an alternative to the Base Case, it will be created from a copy of the Base Case.

Select the "Tutorial3" study and select the Cases > Manage menu option:

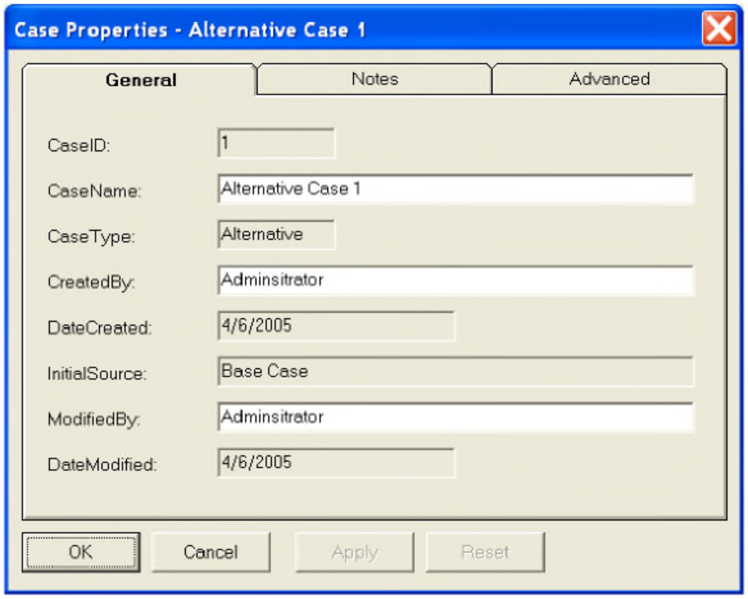


Select the Base Case in Case Manager and select the Copy button:



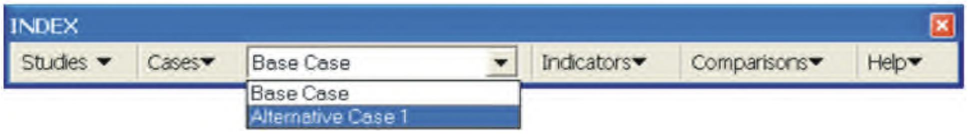
The Case Properties dialog allows you to provide information about the case.

Select the OK button to close the dialog:



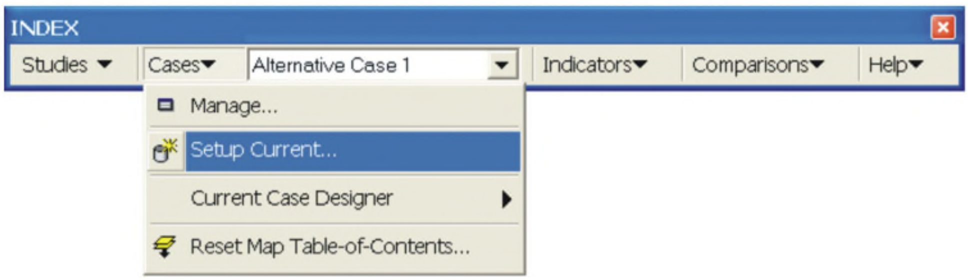
Select the “Tutorial3” study and select the Studies > Open in ArcMap menu option to open this study into ArcMap

Change the case to Case 1 using the INDEX toolbar pull-down menu:

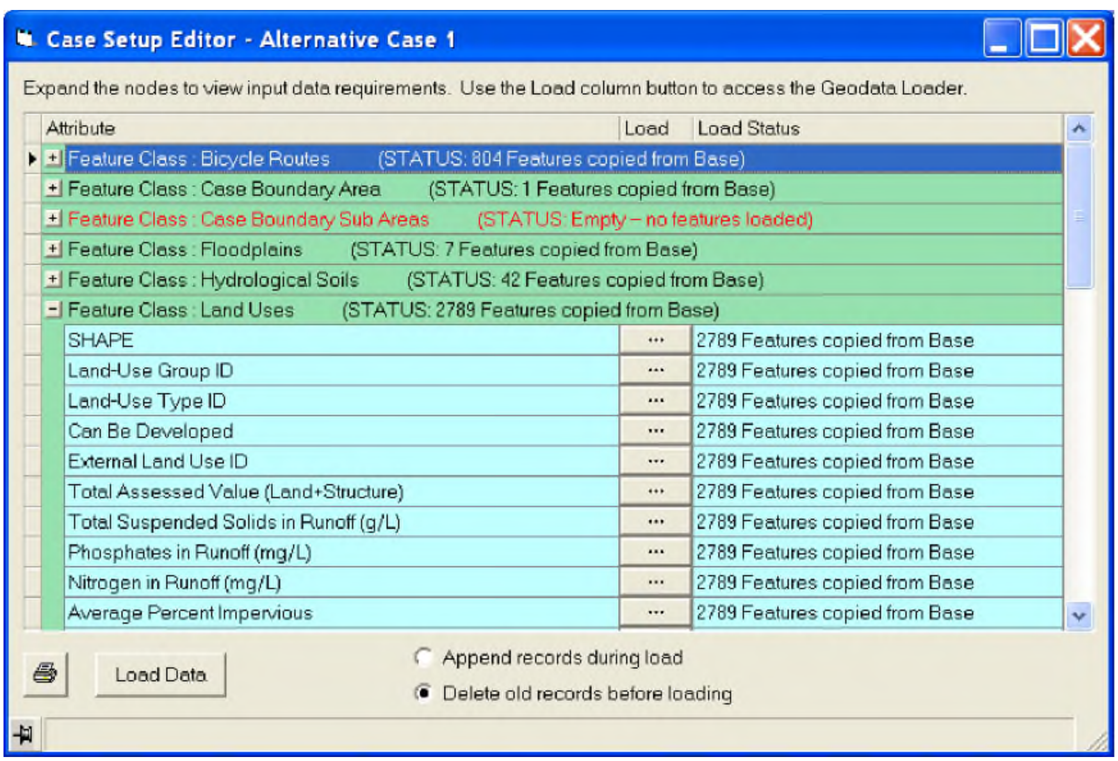


Import Development Proposal Shapefiles

Select Setup Current from the Cases menu on the INDEX toolbar;

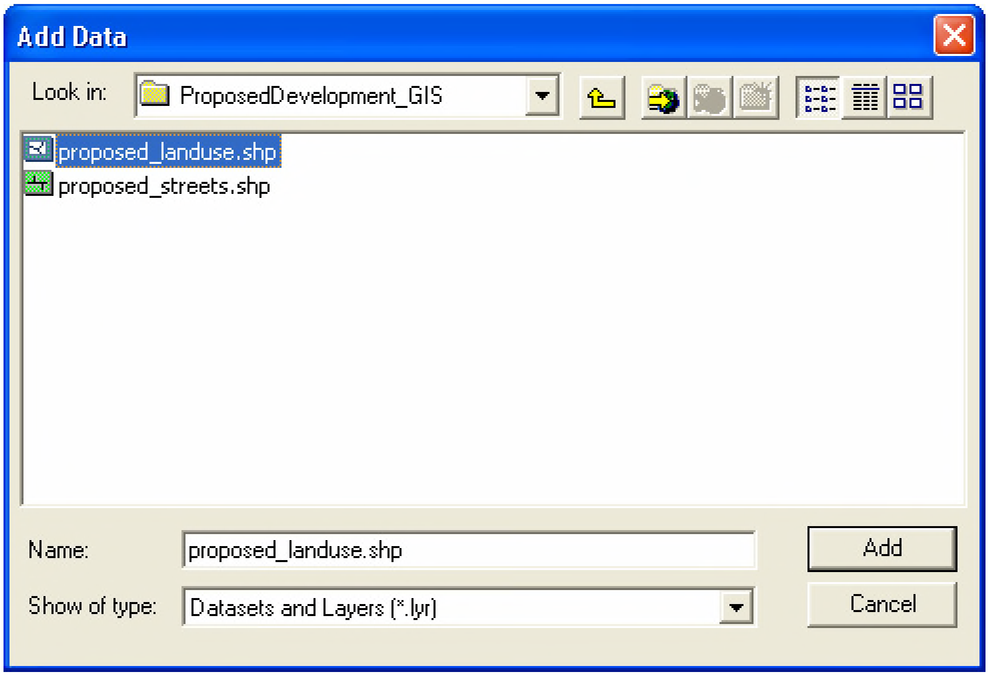


Select the Land-Uses feature class in the Case Setup Editor and select one of the "..." buttons:

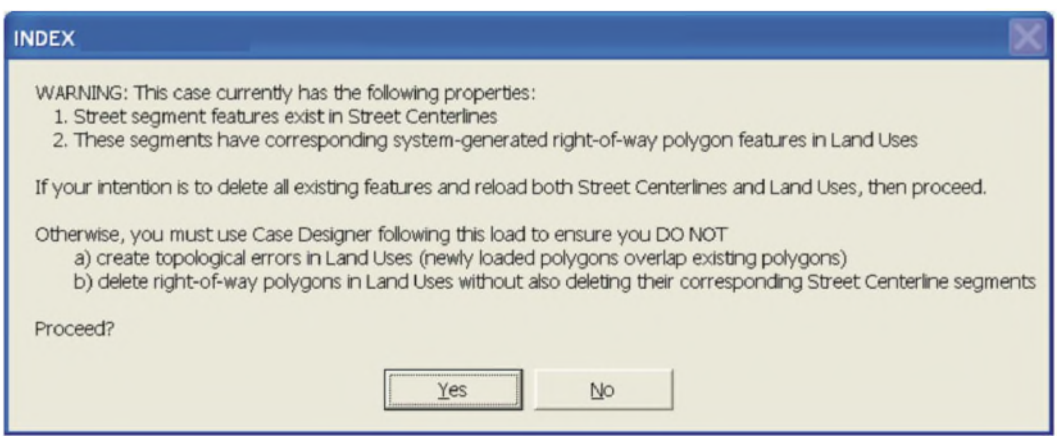


Click the Browse button to browse to the following directory and select the proposed_landuse.shp file:

[My Documents]\Criterion\INDEX\PlanBuilder\9.2\TutorialData\ParcelBased\ProposedDevelopment_GIS



The following message will appear whenever you update the Land-Uses feature class:



Select “Yes”.

Match the source fields to the following target attributes:

Land-Use Type ID target = New_LU_ID field

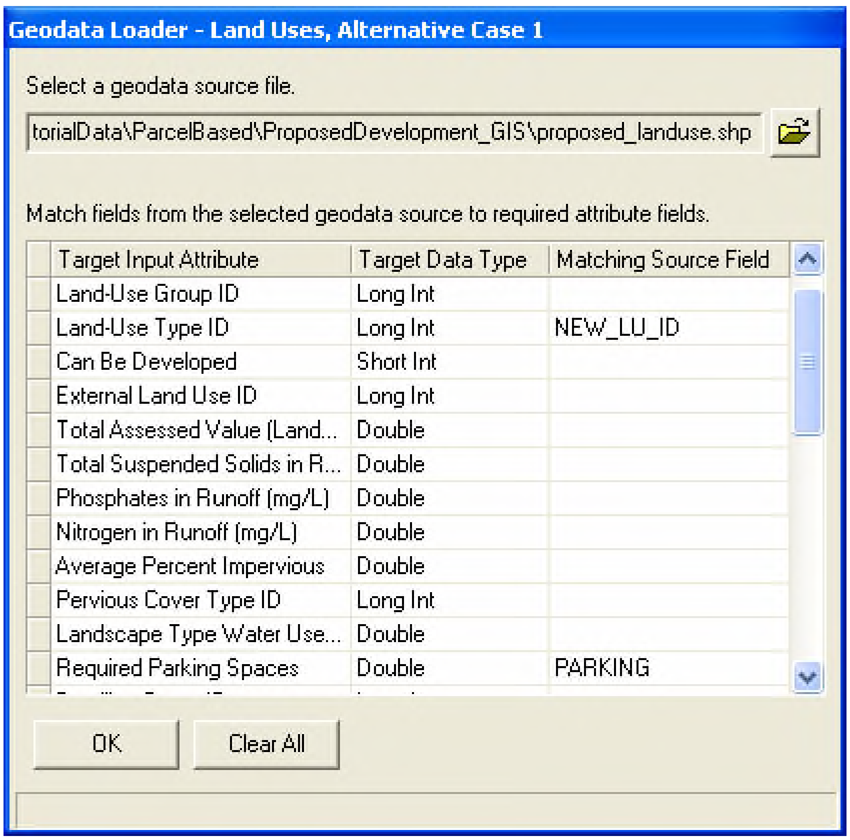
Required Parking Spaces = PARKING

Dwelling Unit Count target = TOTUNITS field

Residential Population = RESIDENTS

Student Count = STUDENTS

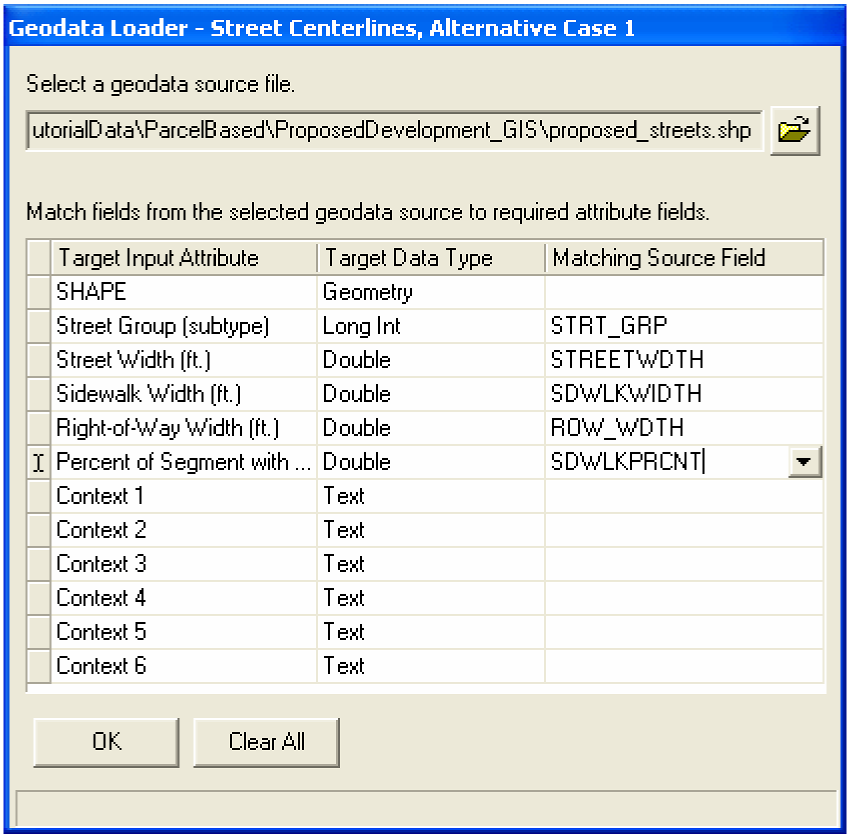
Employment Count target = EMPS field



Select OK to continue.

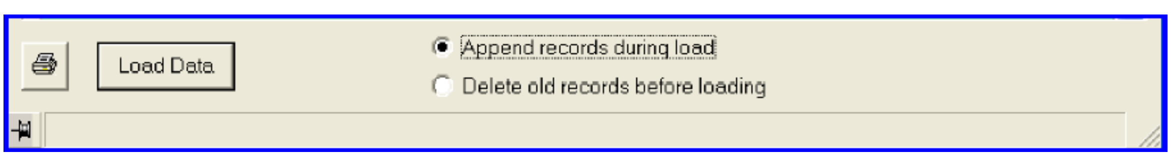
Repeat the previous steps for the Proposed_streets.shp: Match the source fields to the following target attributes:

Street Group → STR_GRP field
Street Width target → STREETWDTH field
Sidewalk Width target → SDWLKWIDTH field
Percent of Segment with Sidewalks target → SDWLKPRCNT field
Right-of-way width → ROW_WDTH field



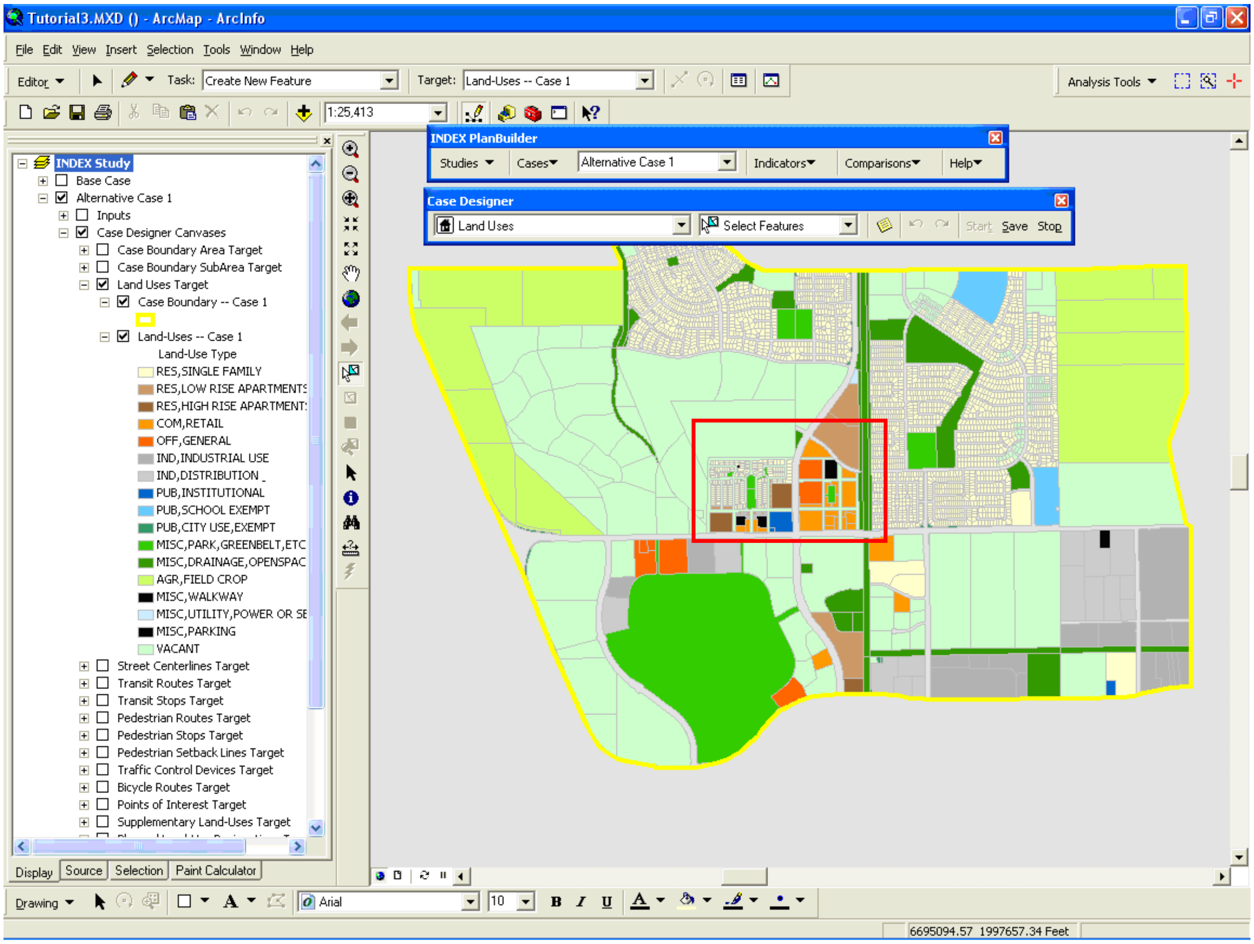
Select OK to continue:

Change the selection at the bottom of the Case Editor window to “Append records during load” and select the Load Data button:

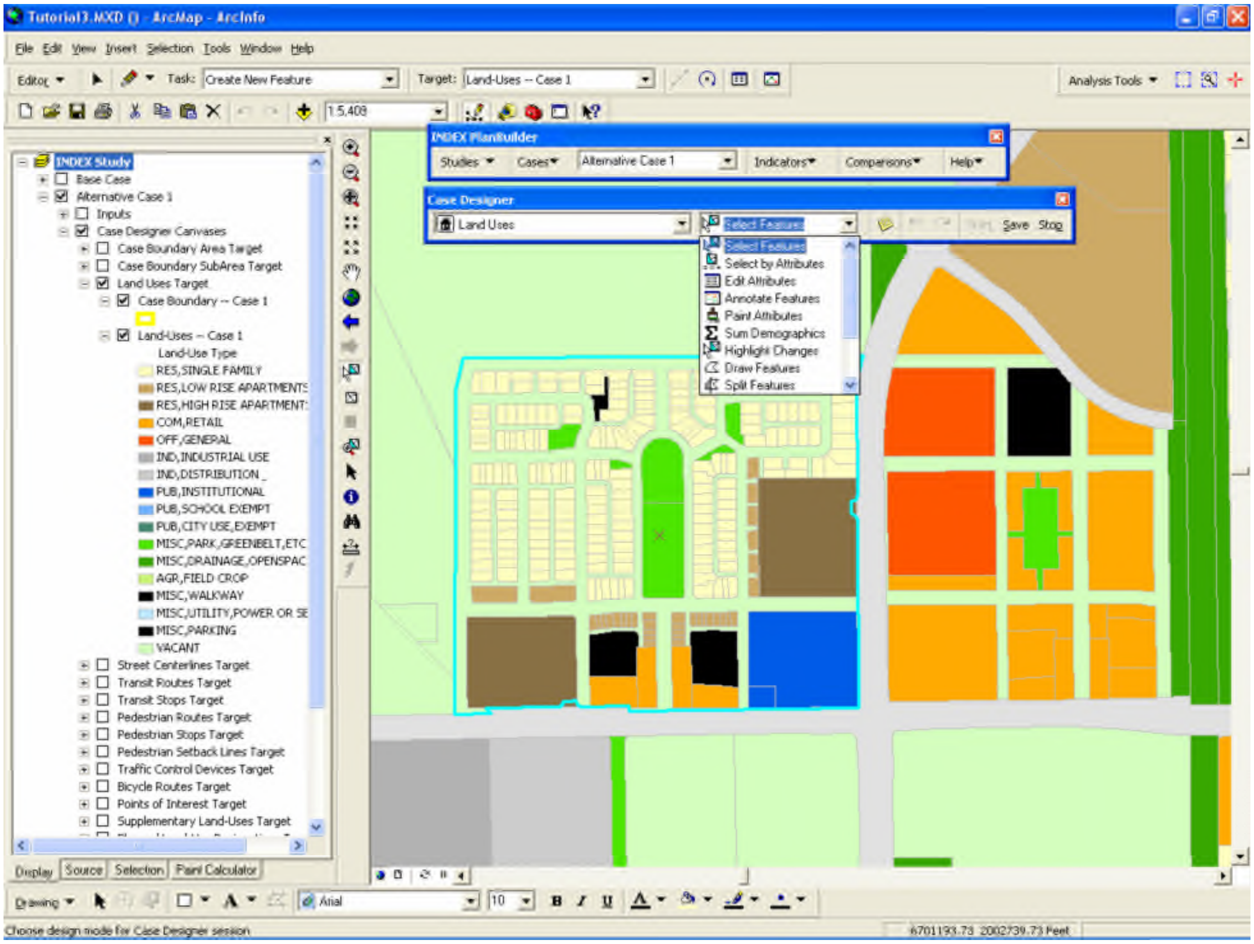


Edit Development Proposal Features

After importing the shapefiles, activate the Case Designer toolbar and set the Design Target to Land Uses:



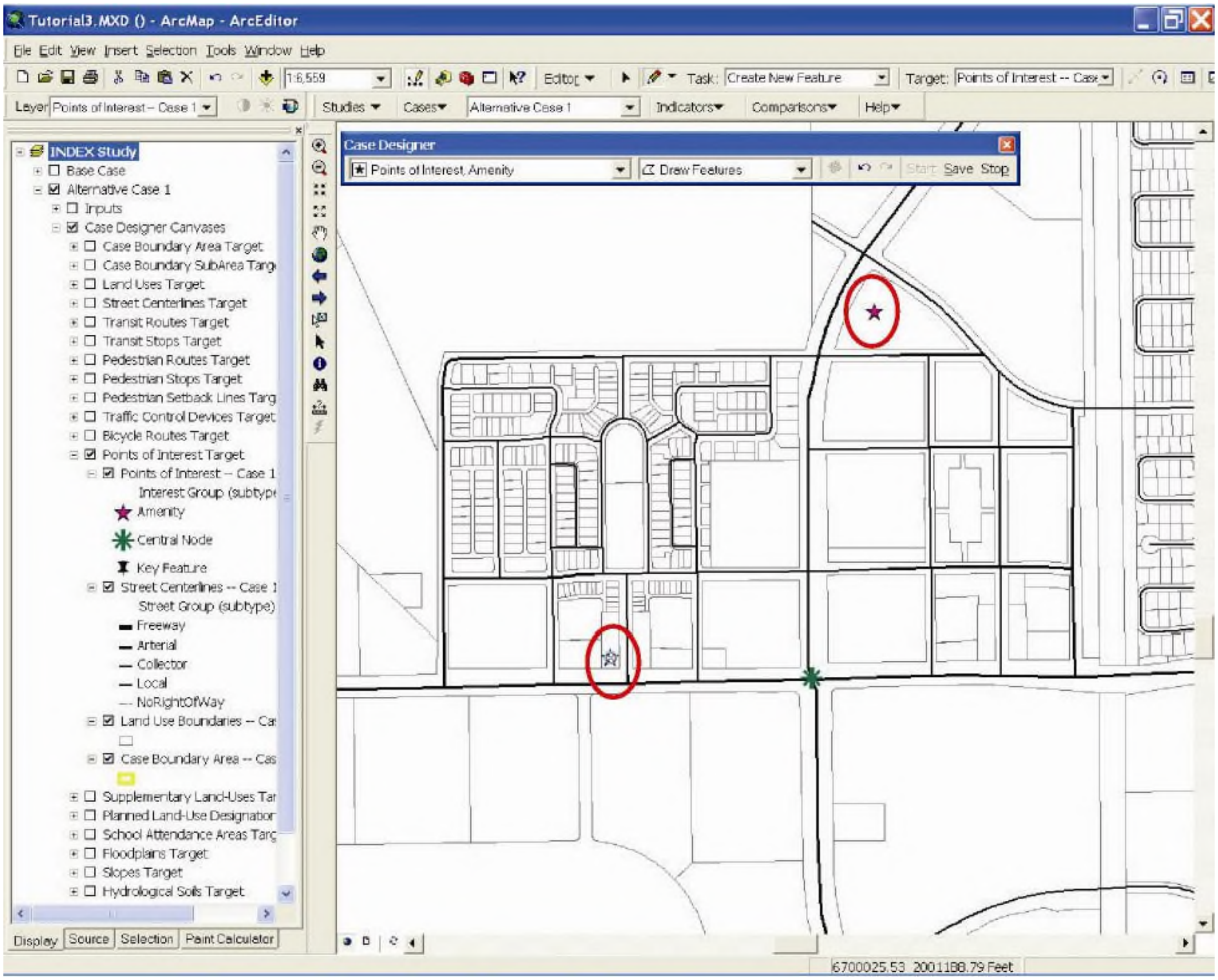
Zoom to the proposed development site near the center of the study area. The existing condition parcels are still present in the alternative case below the proposed development site. Select the underlying parcels and delete them (making sure not to select any of the proposed development parcels).



Draw Amenities

The development proposal contains plans for a grocery store and convenience store. There are estimated employee counts associated with the parcels, but the location of the stores were not provided in digital format. You can add these amenities to the development proposal using the Case Designer tools.

Select the Amenities design target and use the Draw tool from the Case Designer toolbar to create the amenity points on the parcels shown below:

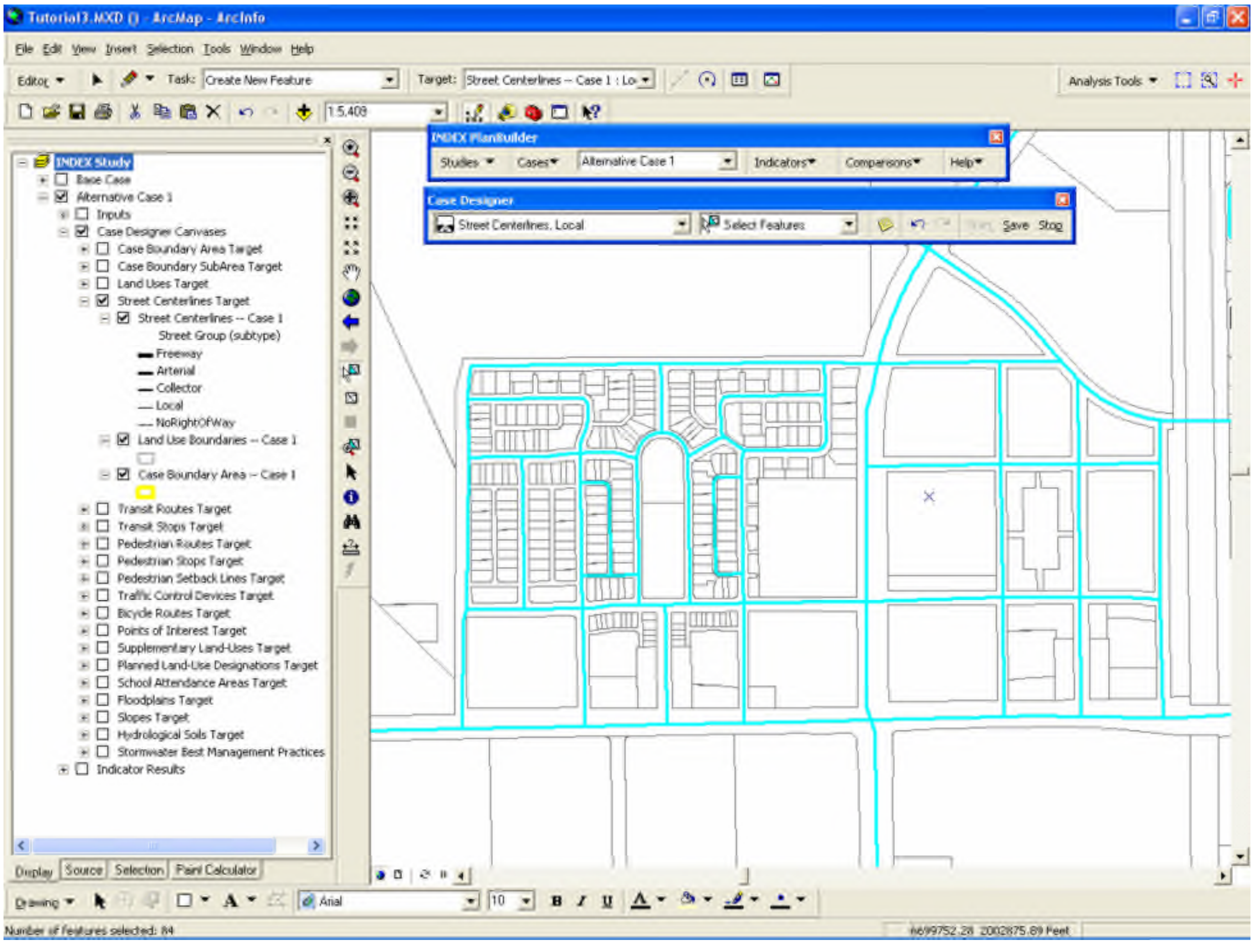


Save your edits and stop editing.

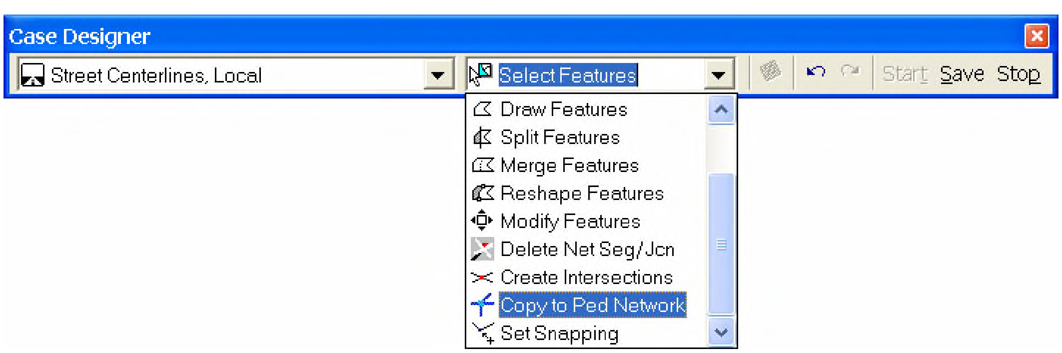
ArcEditor/ArcInfo Users: Integrate New Streets Into Network

The proposed additions to the street network were loaded into the INDEX with each of the target attributes populated outside of INDEX, but the proposed centerlines still need to be integrated with the existing street network by creating intersections.

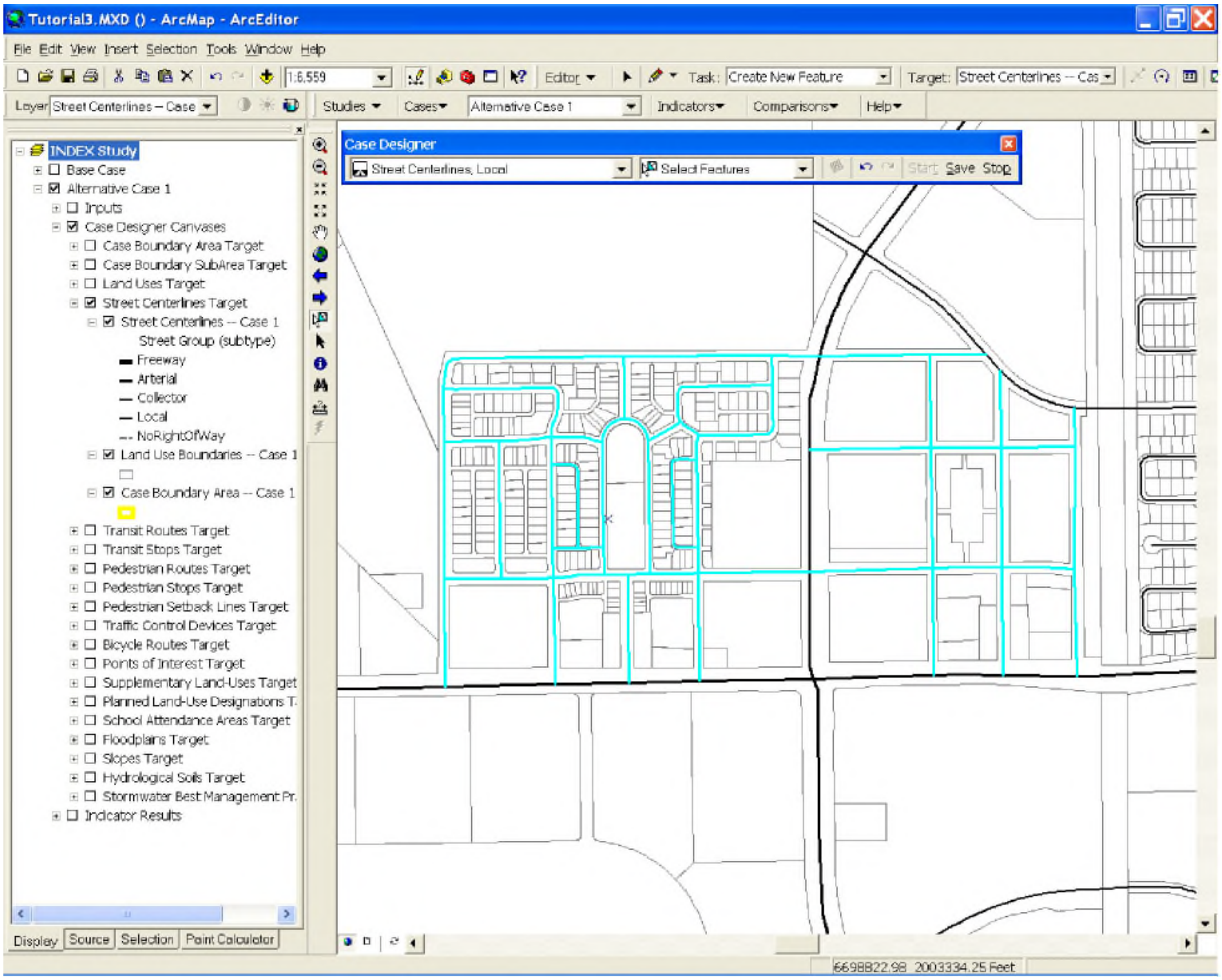
Select the proposed centerlines along with all of the surrounding centerlines:



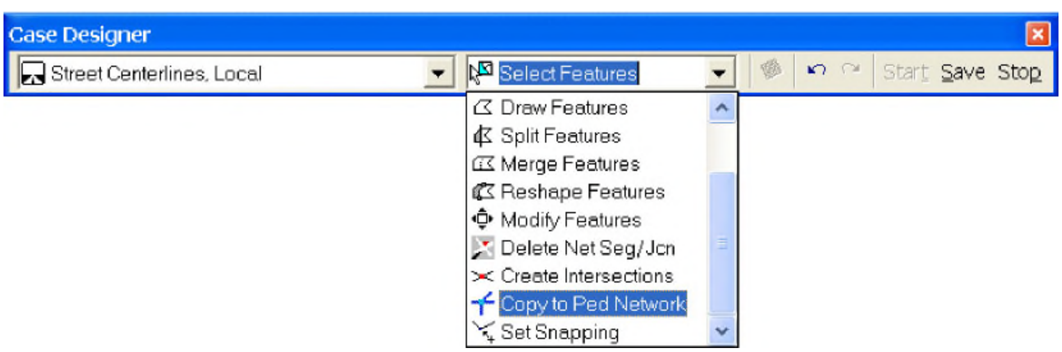
Select the Create Intersections tool from the Street Centerlines Design Tools:



The new street segments must also be copied to the Pedestrian Route network. This time select only the new street segments:

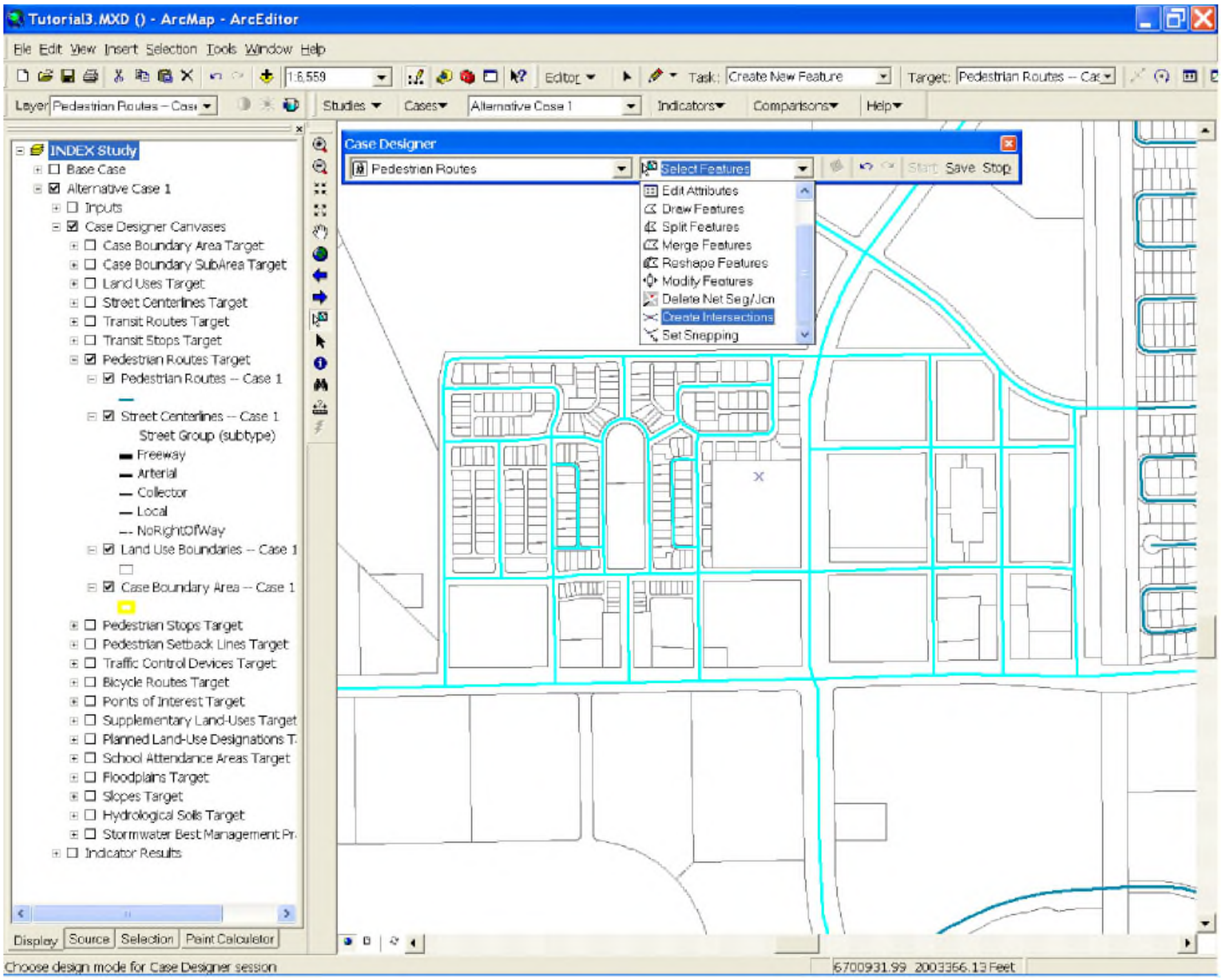


Select the Copy to Ped Network tool from the Case Designer toolbar:



Select Pedestrian Routes from the Case Designer targets and confirm that streets segments were copied to the pedestrian network.

Select Pedestrian Routes in and around the development proposal and select the Create Intersections tool from the Case Designer toolbar:



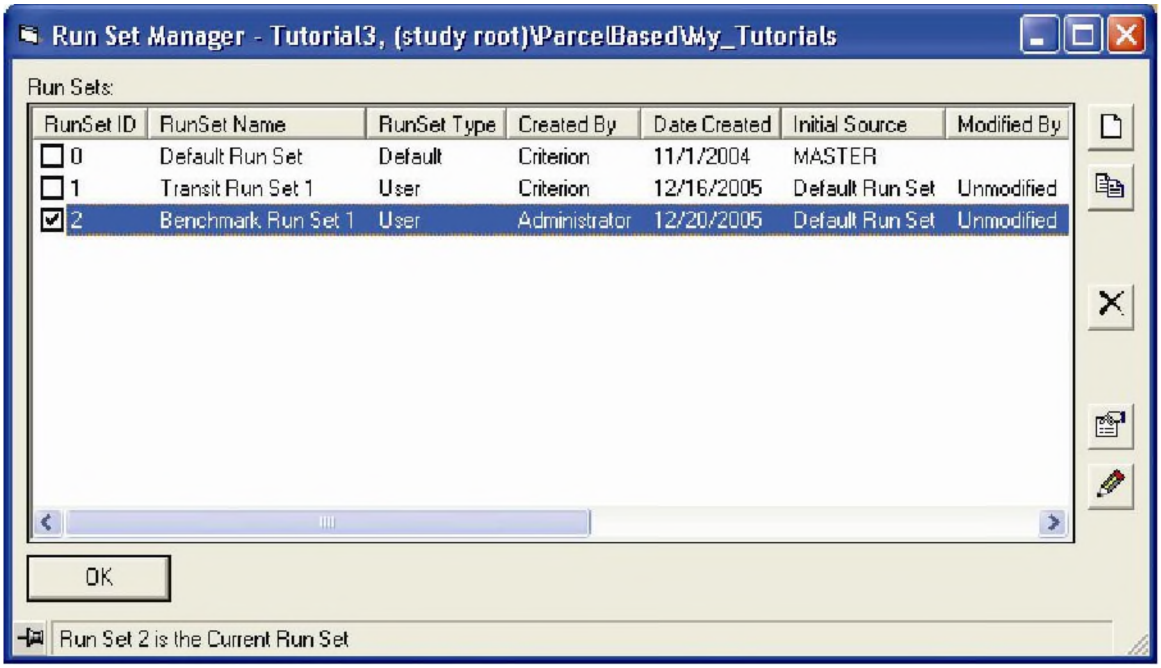
Save you edits before proceeding.

SELECT AND RUN INDICATORS

The indicator run set used for the base case in the previous tutorial should be used again to evaluate the alternative case in order to maintain an “apples-to-apples” comparison.

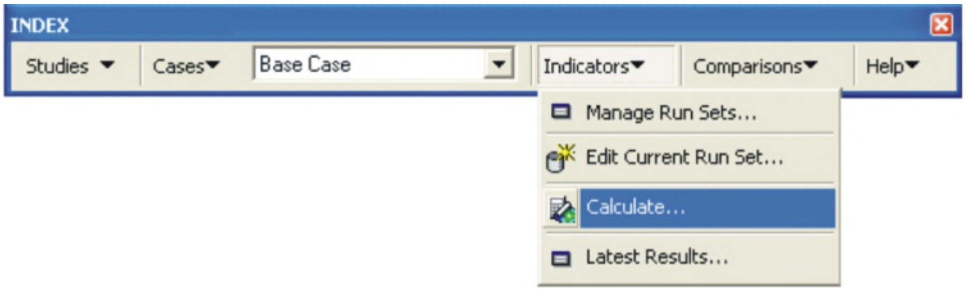
Select a Run Set

Open the Run Set Manager. Verify that Benchmark Run Set 1 is selected:

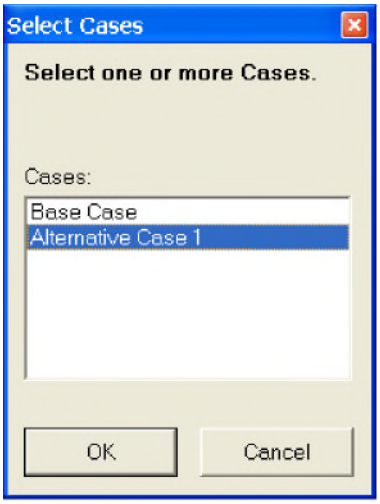


Run Indicators

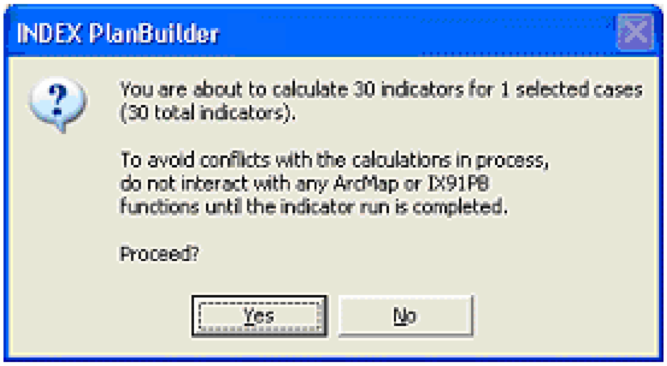
Select the Calculate option from the Indicators menu:



Select Alternative Case 1 from the Cases list and click OK:



Given the tutorial's set-ups, the run time will be 5-10 minutes, depending on computer speed, for the selected indicators. Select 'Yes' to proceed:

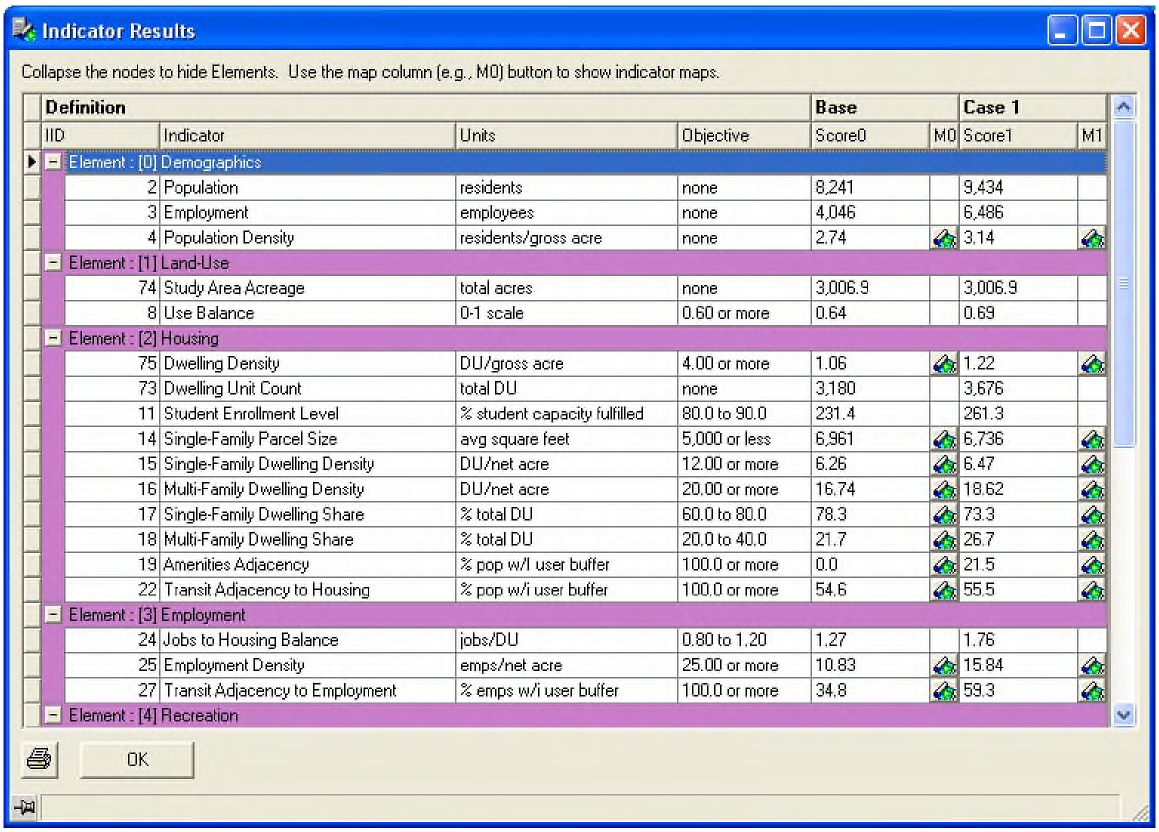


ArcView Users: only 30 indicators will be run.

COMPARE CASES

Indicator Results

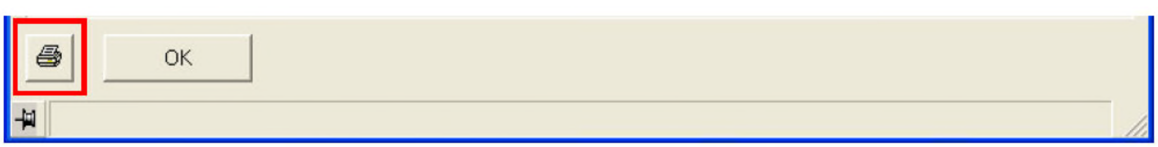
The Indicator Results window will open automatically after the indicators finish calculating. At this point the user will be able to gauge the type and magnitude of change caused to the study area's existing condition scores by the development proposal represented in Case 1. Scroll through the Indicator Results table and identify the changes in scores between the cases:



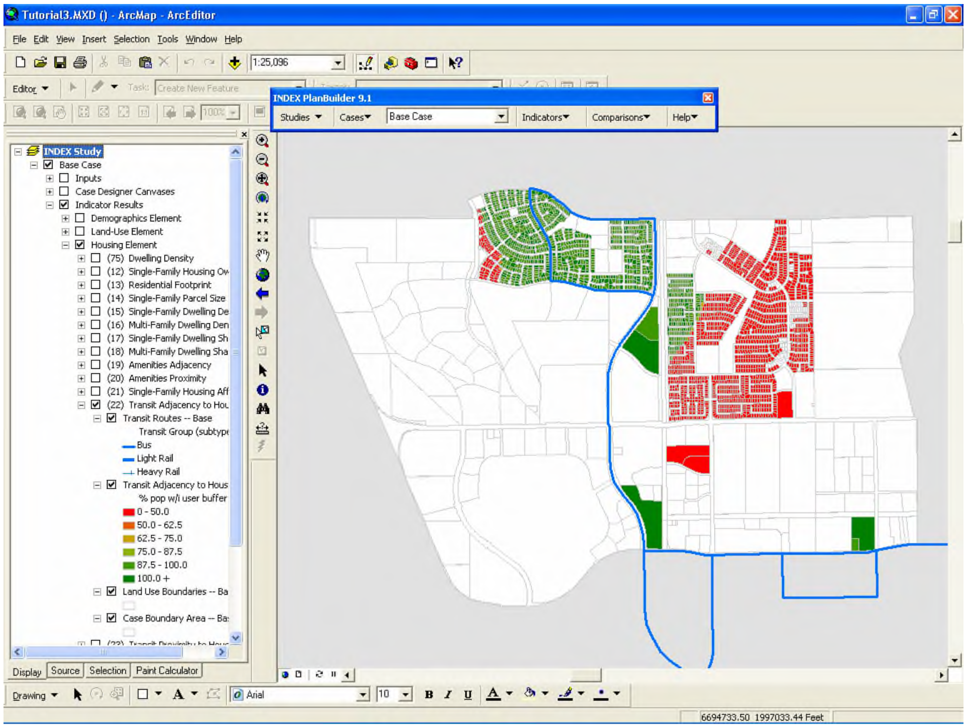
Definition				Base		Case 1	
IID	Indicator	Units	Objective	Score0	M0	Score1	M1
Element : [0] Demographics							
2	Population	residents	none	8,241		9,434	
3	Employment	employees	none	4,046		6,486	
4	Population Density	residents/gross acre	none	2.74		3.14	
Element : [1] Land-Use							
74	Study Area Acreage	total acres	none	3,006.9		3,006.9	
8	Use Balance	0-1 scale	0.60 or more	0.64		0.69	
Element : [2] Housing							
75	Dwelling Density	DU/gross acre	4.00 or more	1.06		1.22	
73	Dwelling Unit Count	total DU	none	3,180		3,676	
11	Student Enrollment Level	% student capacity fulfilled	80.0 to 90.0	231.4		261.3	
14	Single-Family Parcel Size	avg square feet	5,000 or less	6,961		6,736	
15	Single-Family Dwelling Density	DU/net acre	12.00 or more	6.26		6.47	
16	Multi-Family Dwelling Density	DU/net acre	20.00 or more	16.74		18.62	
17	Single-Family Dwelling Share	% total DU	60.0 to 80.0	78.3		73.3	
18	Multi-Family Dwelling Share	% total DU	20.0 to 40.0	21.7		26.7	
19	Amenities Adjacency	% pop w/I user buffer	100.0 or more	0.0		21.5	
22	Transit Adjacency to Housing	% pop w/i user buffer	100.0 or more	54.6		55.5	
Element : [3] Employment							
24	Jobs to Housing Balance	jobs/DU	0.80 to 1.20	1.27		1.76	
25	Employment Density	emps/net acre	25.00 or more	10.83		15.84	
27	Transit Adjacency to Employment	% emps w/i user buffer	100.0 or more	34.8		59.3	
Element : [4] Recreation							

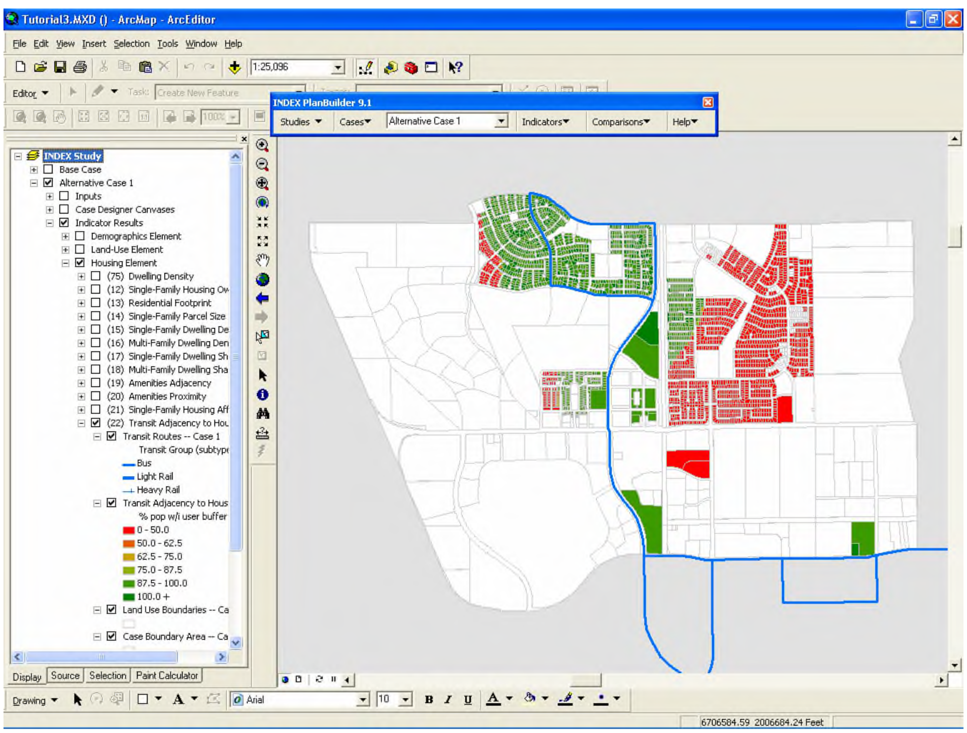
Selecting the print button will create a printable report of the indicator results. It also creates an editable file in the project folder (i.e. Tutorial3_IndicatorResultReport.xls), as discussed in Tutorial 2.

Click the Print button in the lower left corner of the Indicator Results dialog:



Select the Map icon on the Indicator Results table and view the differences in the indicator maps between the Base Case and Alternative Case:



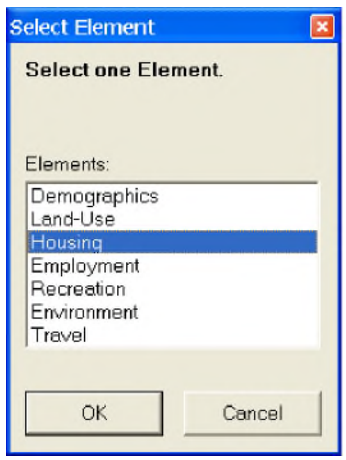


Objective Achievement

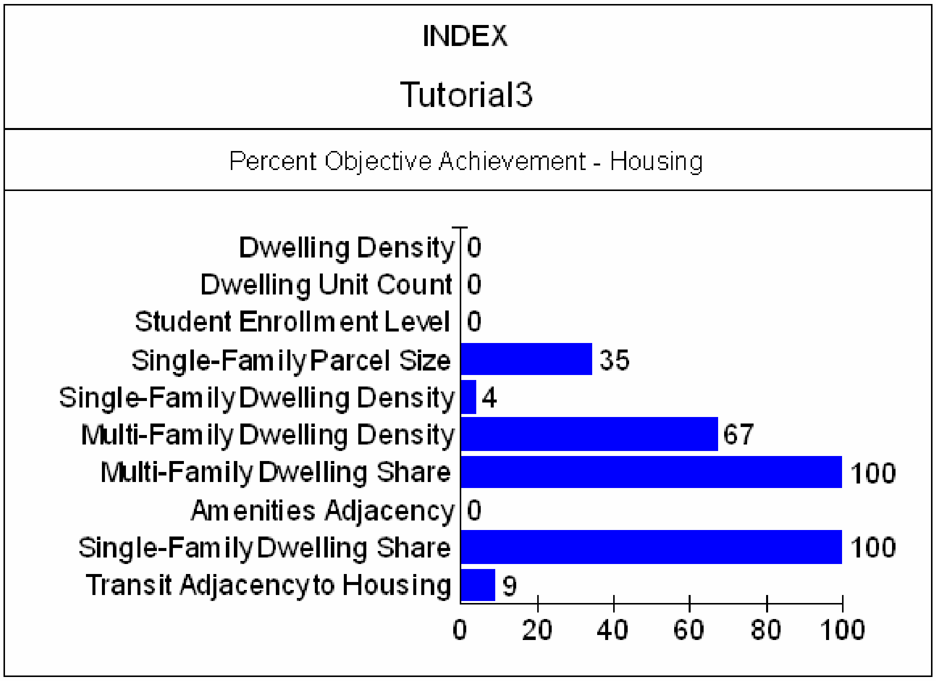
In order to review how each indicator scored with respect to their objectives, make Base Case the active case on the INDEX toolbar:

Activate the Objective Achievement bar chart by selecting Objective Achievement from the Comparisons menu:

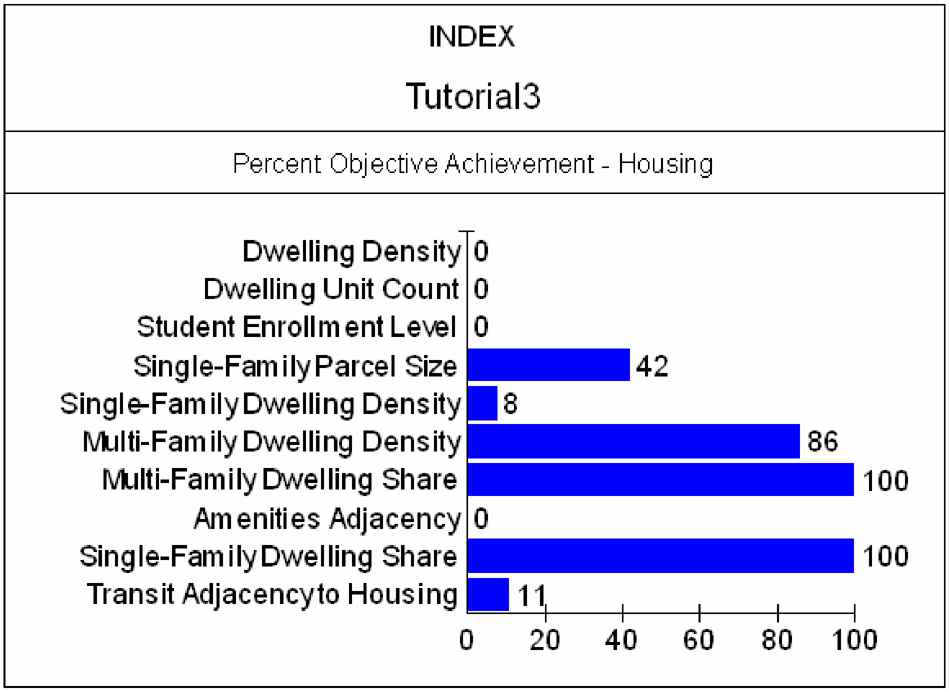
Select the Housing Element and click the OK button:



Examine the results to determine where the deficiencies are:

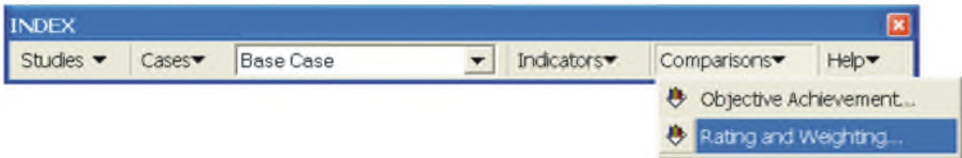


Make Case 1 the active case and activate the Objective Achievement bar chart. Notice that there were several improvements with respect to the objectives and still some major deficiencies, e.g. Amenities Adjacencies and Transit Adjacencies to Housing:

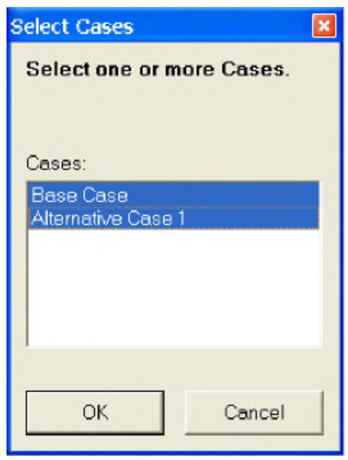


Rating and Weighting Comparison

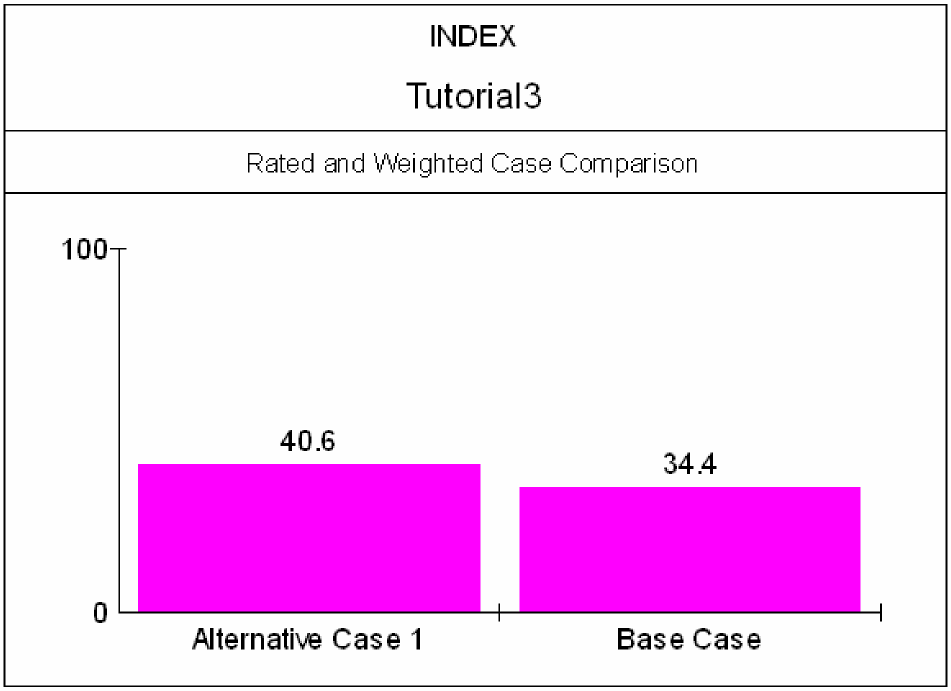
Compare the goal achievement of the two cases side-by-side with the Rating and Weighting bar chart. Activate the RAW bar chart by selecting Rating and Weighting from the Comparisons menu on the INDEX toolbar:



Select the Base Case and Alternative Case 1:



According to the user-defined RAW criteria, the developer's proposal would help the community towards its goals, but perhaps not as much as local stakeholders are hoping for:



Note: actual numbers will vary due to difference in individual user edits.

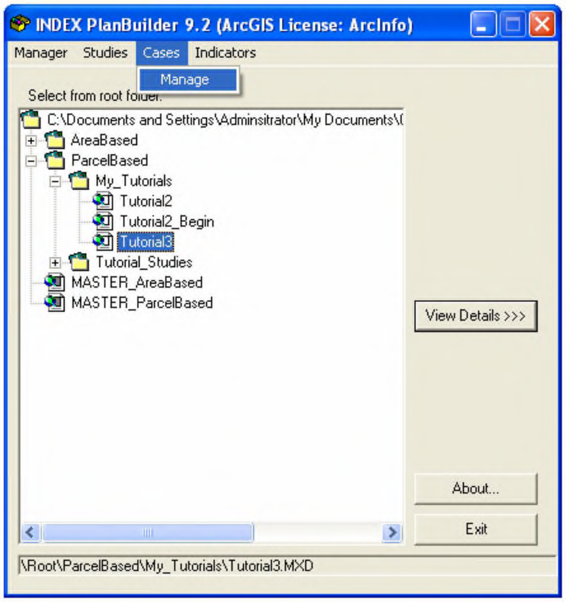
MODIFY DEVELOPMENT PROPOSAL

By using INDEX to modify and improve planning proposals, stakeholders can iterate among alternatives to a preferred, and ultimately adopted, plan or development proposal.

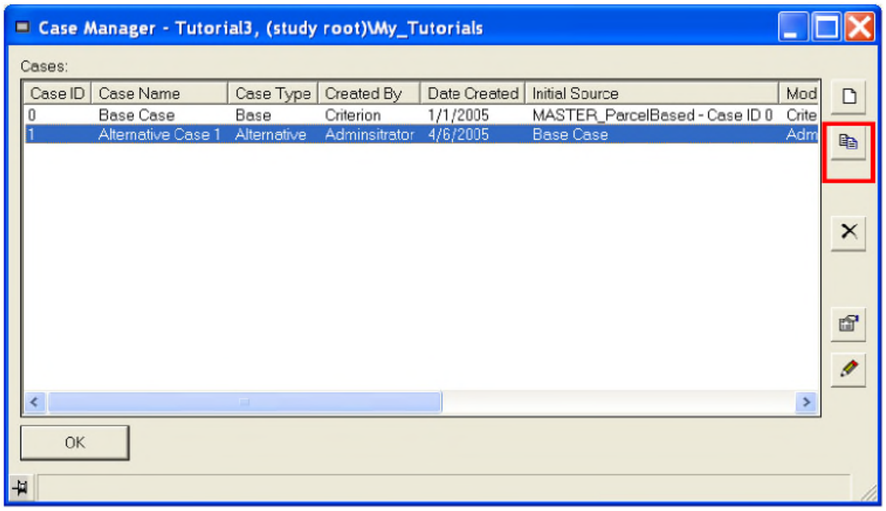
In this section you will modify the original development proposal to help the community better achieve its goals.

Create a Copy of the Alternative Case

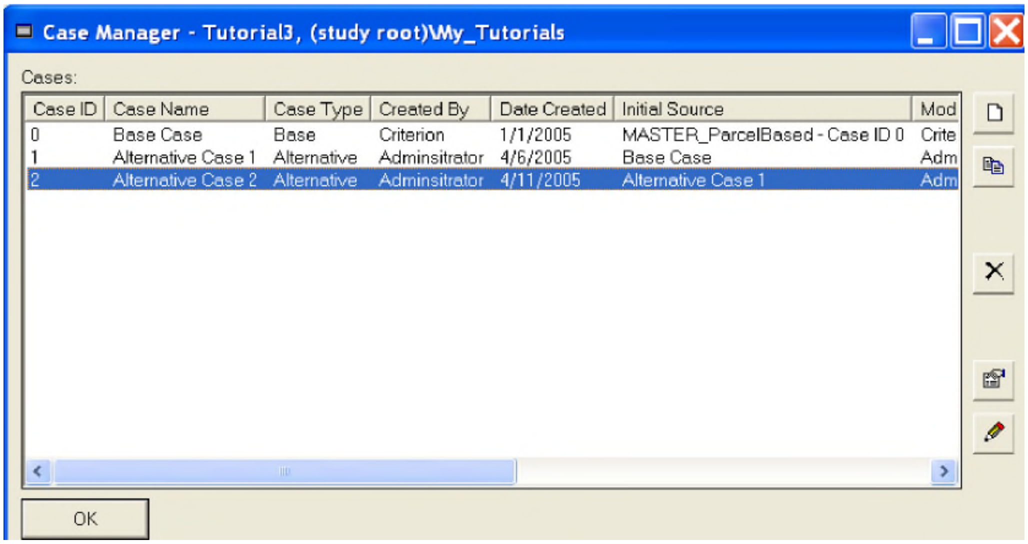
Close the project and open Study Manager. Select the Tutorial3 project and open the Case Manager:



Create a copy of Alternative Case 1:



A new case is created:

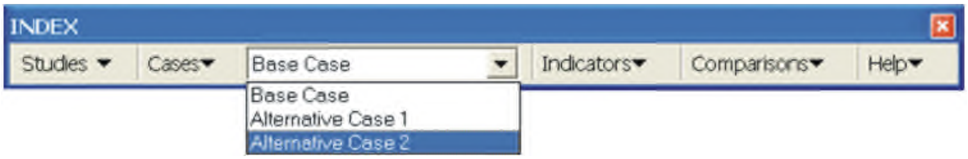


Close the Case Manager dialog and reopen the project:

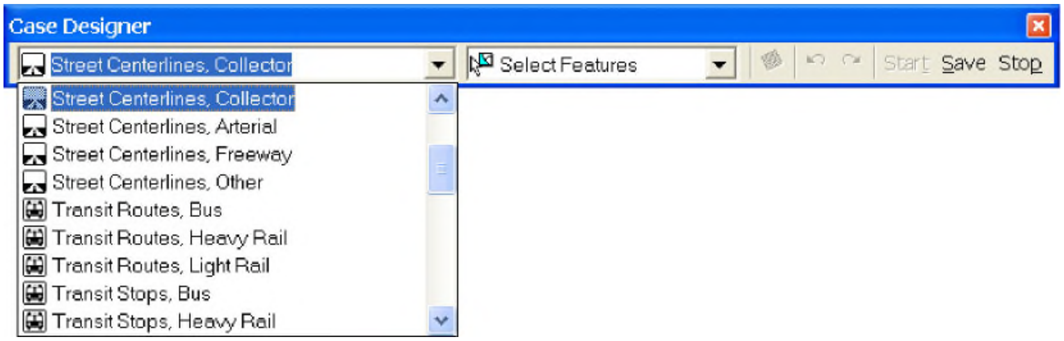
Improve Street Access

In this section you will modify the proposed development by improving street access from the proposed development site to the surrounding neighborhood.

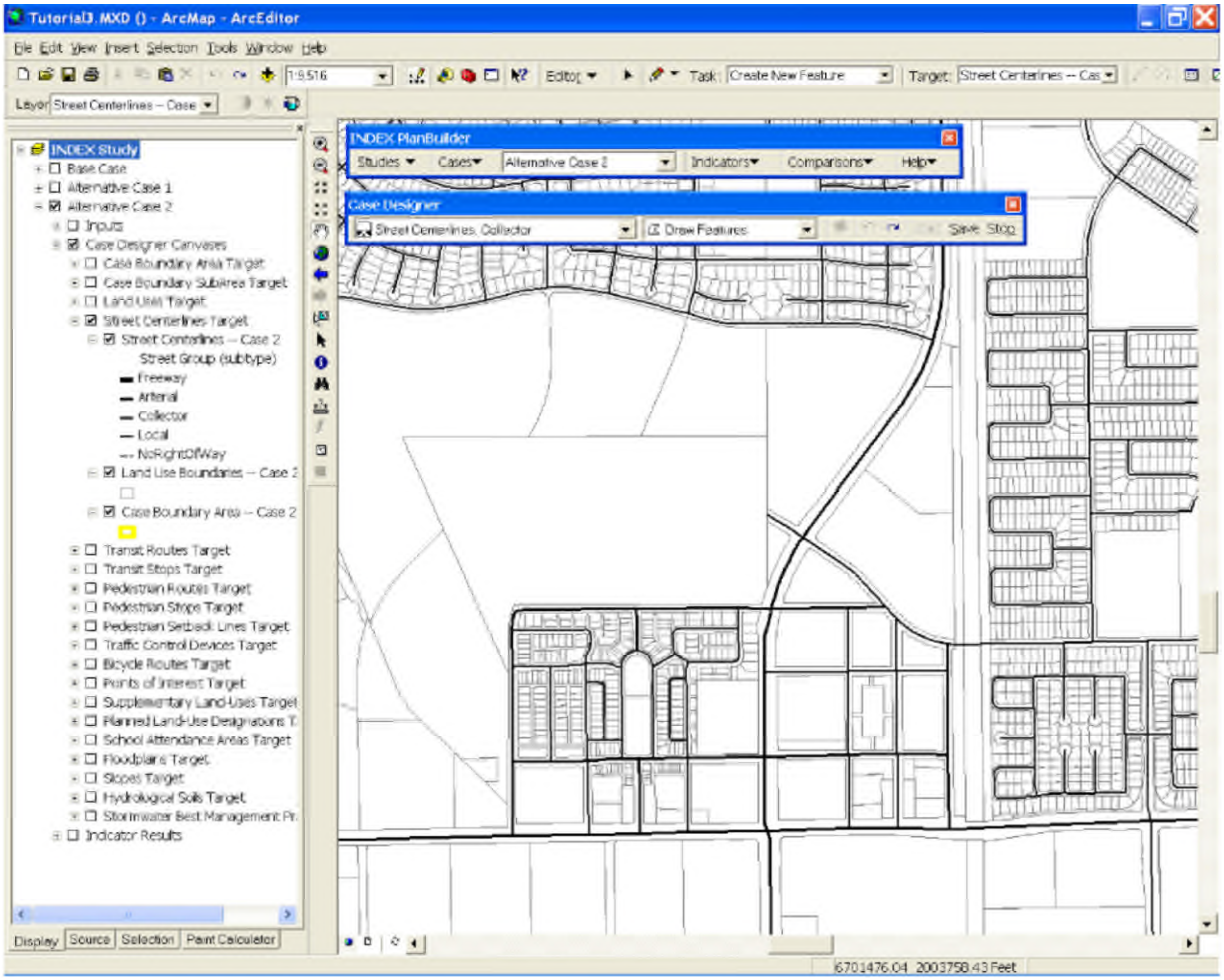
Make Alternative Case 2 the active case:



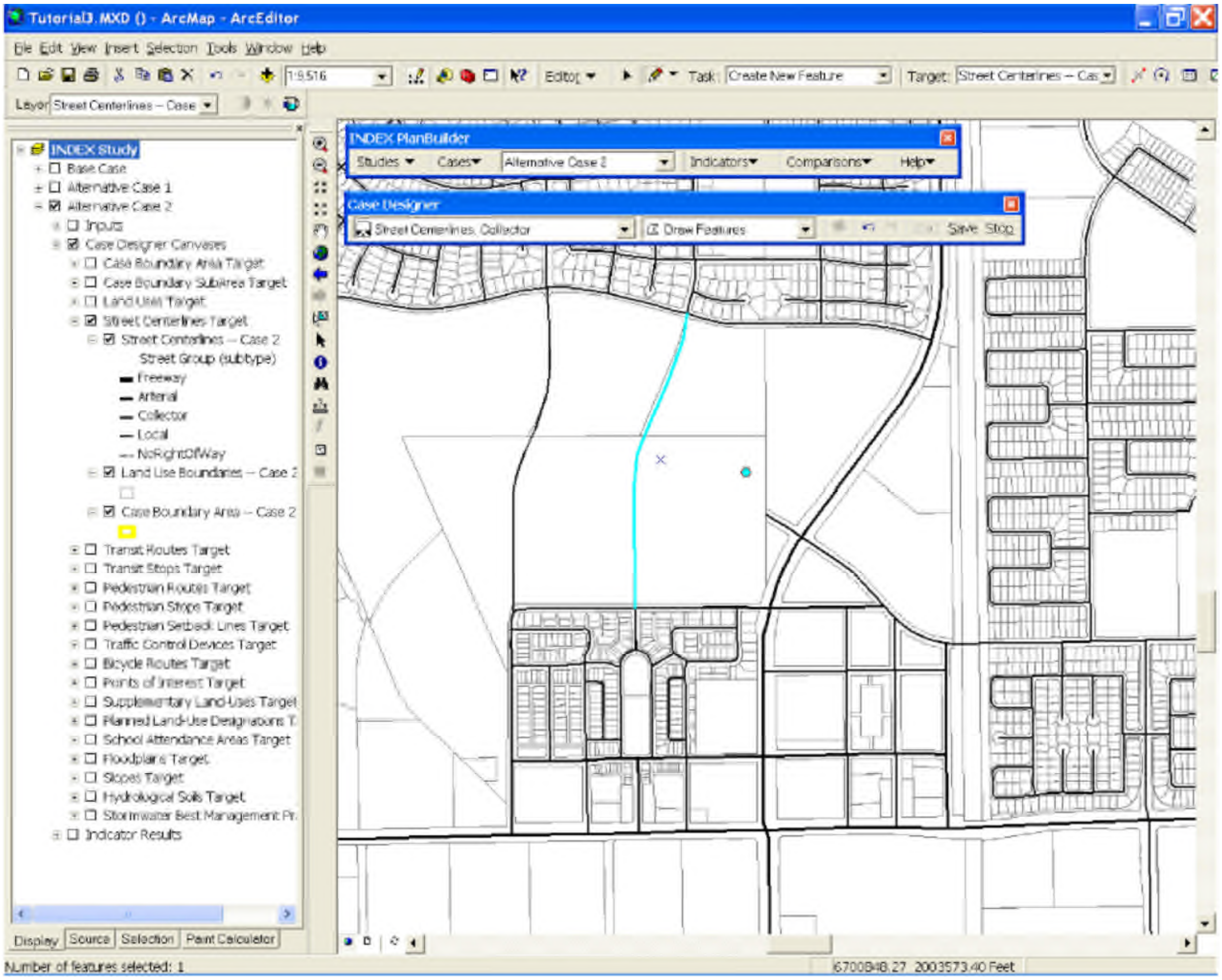
Open the Case Designer toolbar and make Collector Streets the editable design target:



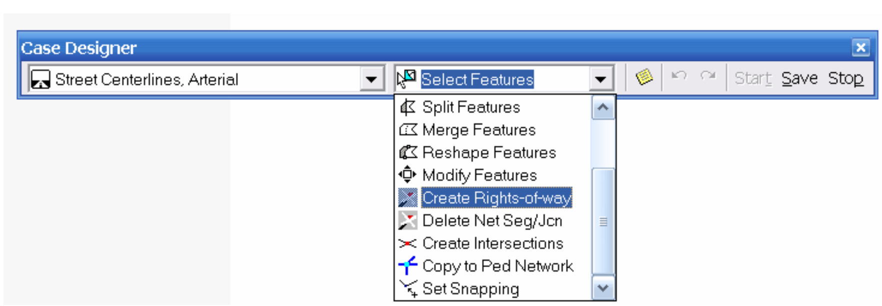
Zoom into the development proposal and include the lower portion of the neighborhood to the north:



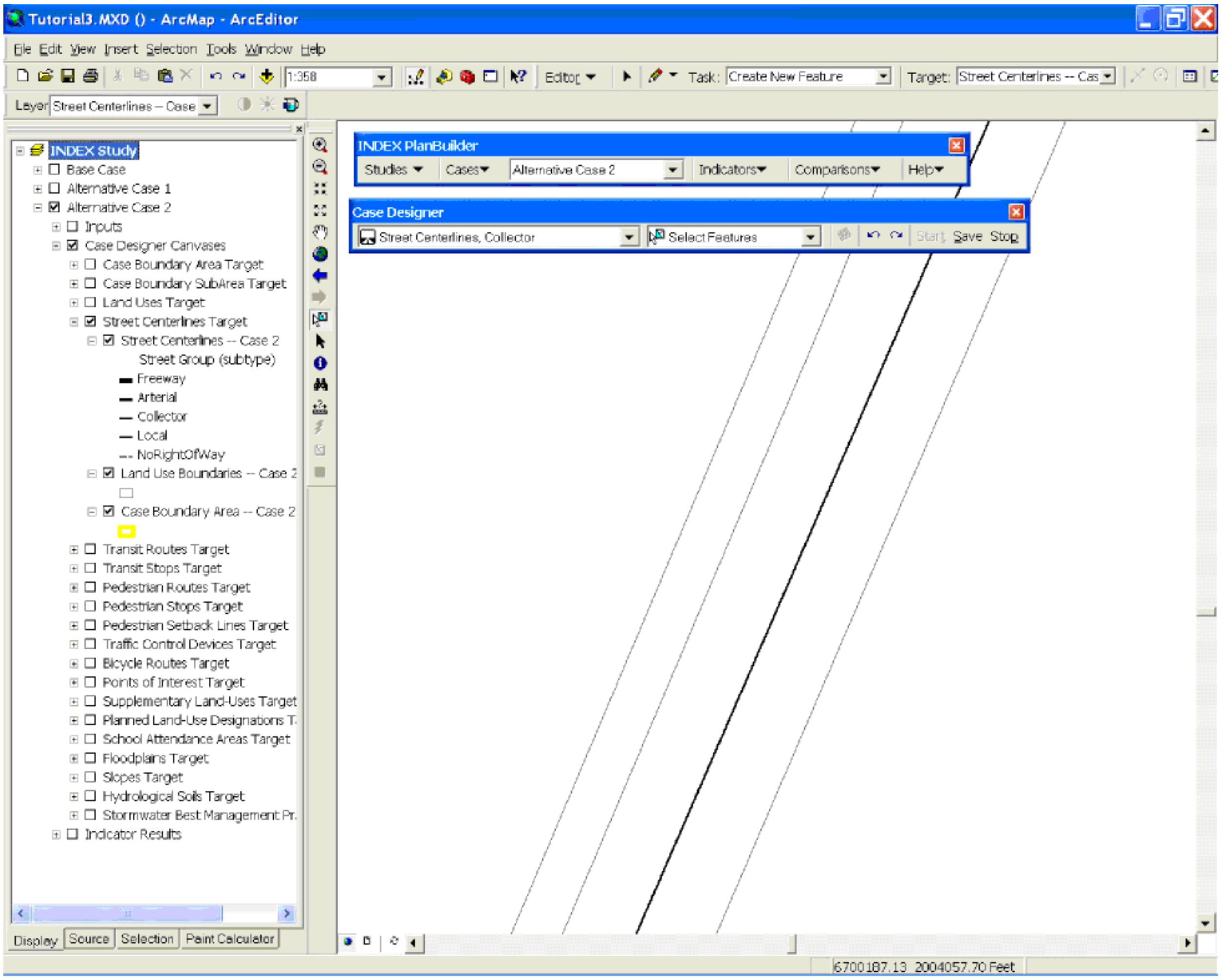
Select the draw tool and draw two collector streets to connect the developments, as shown below:



To create Rights of ways in the land uses layer, select the streets you just created and choose the Create Right of Ways menu option:



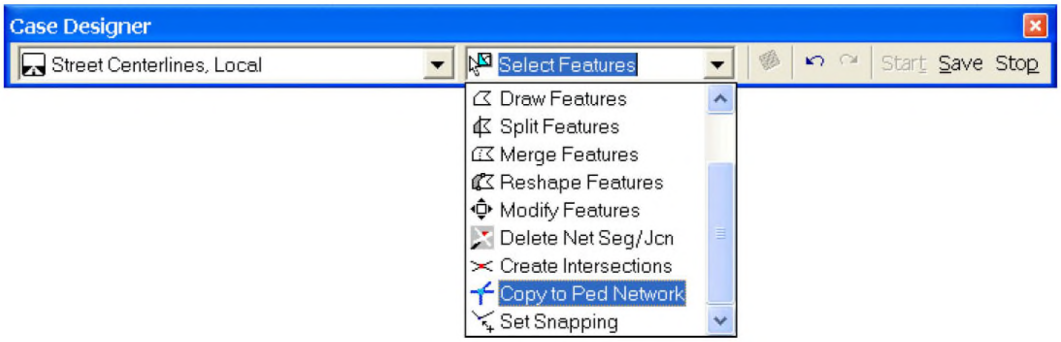
Zoom in and you will see that right-of-ways are automatically created in the land-use layer:



Save your edits.

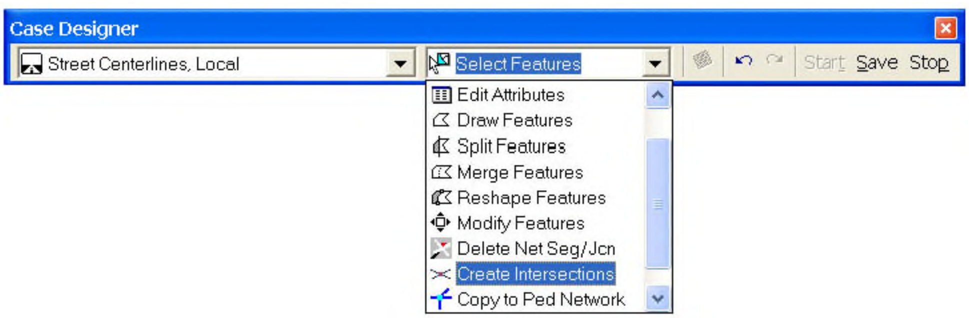
ArcEditor/ArcInfo Users: Update the Ped Routes Layer

Once again, the new street segments must be copied to the Pedestrian Route network. Select only the new street segments, and then choose the Copy to Ped Network tool from the Case Designer toolbar:



Select Pedestrian Routes from the Case Designer targets and confirm that streets segments were copied to the pedestrian network.

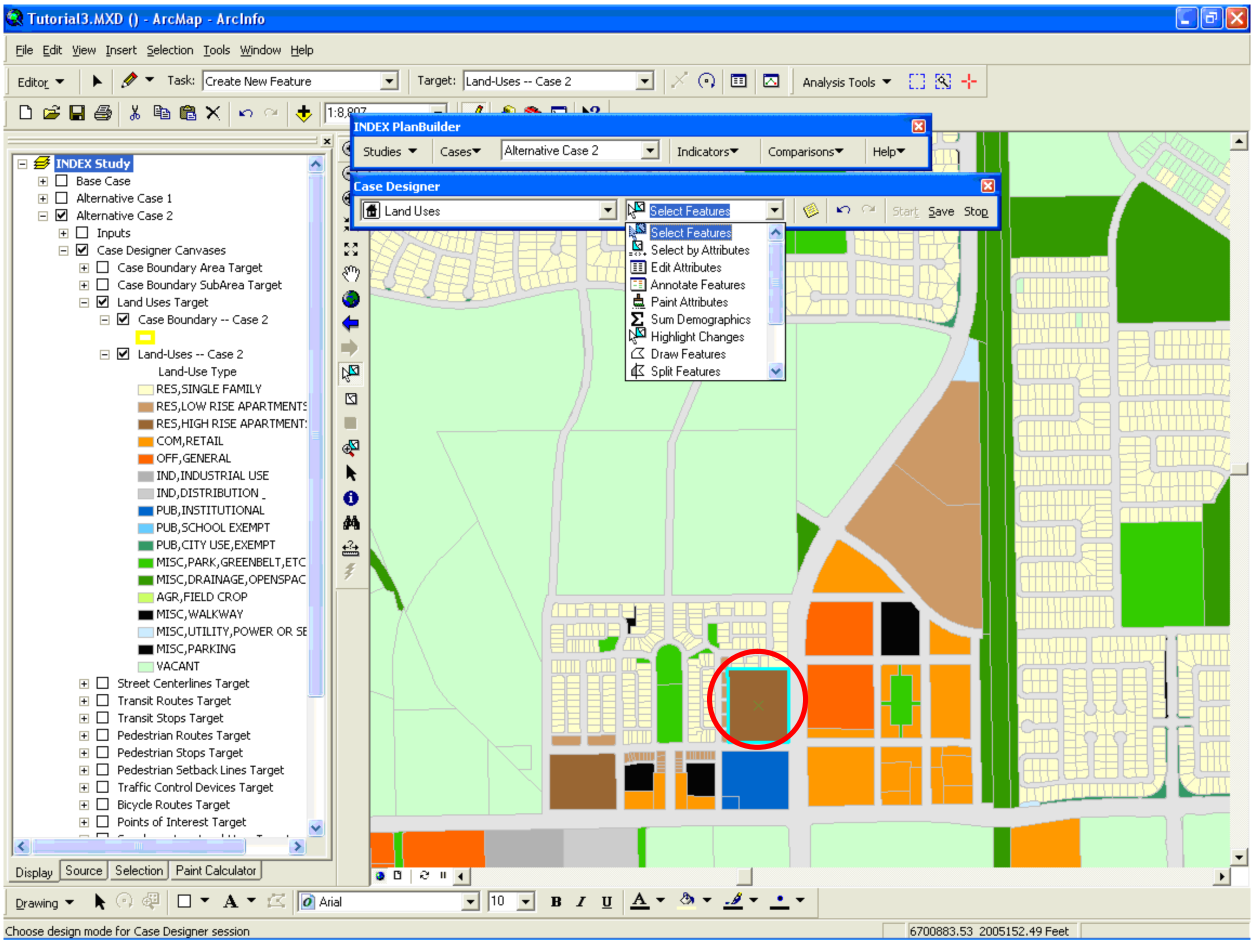
Select Pedestrian Routes in and around the development proposal and select the Create Intersections tool from the Case Designer toolbar:



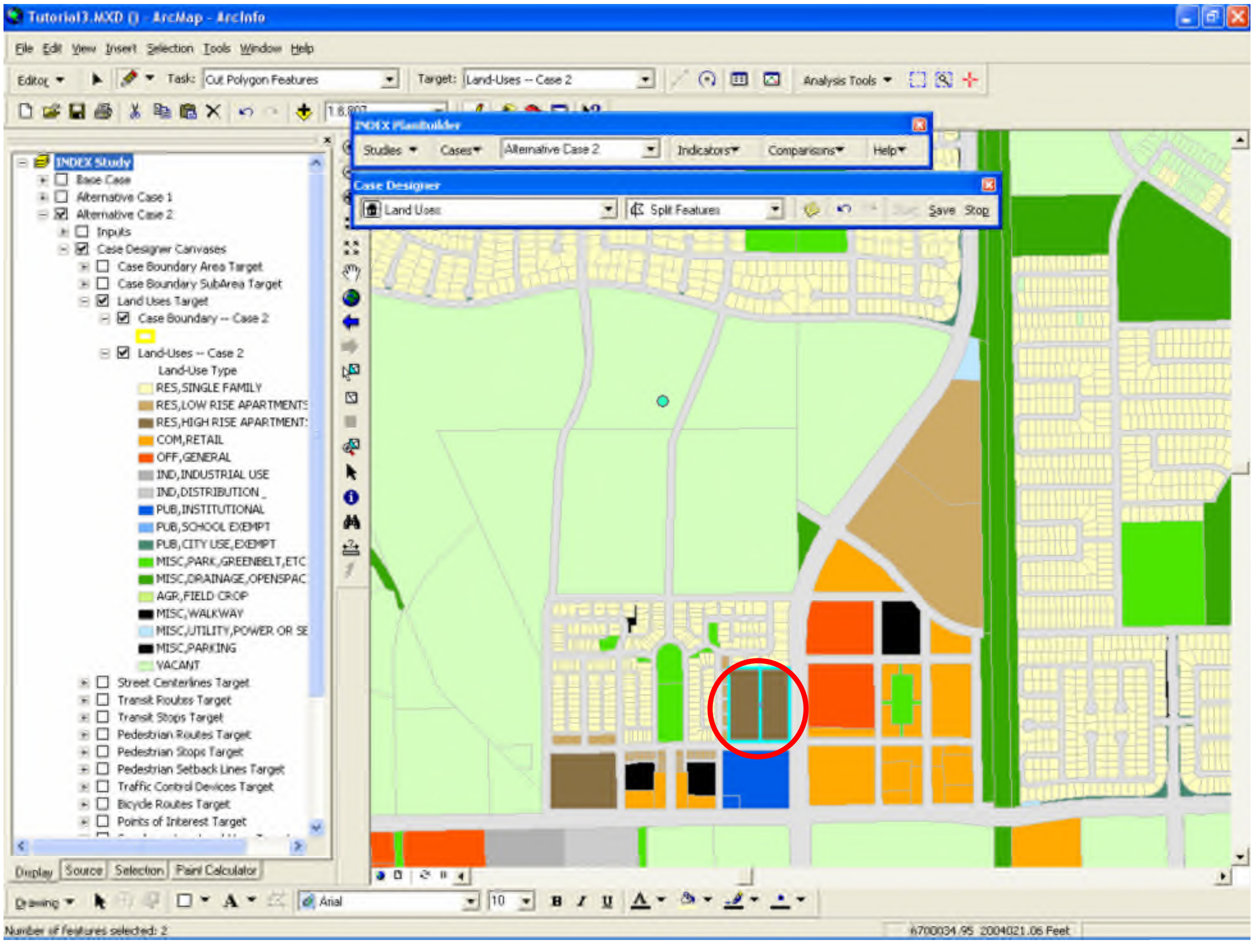
Modify the Proposed Development Parcels

Change the design target to Land-Uses again and zoom to the development proposal.

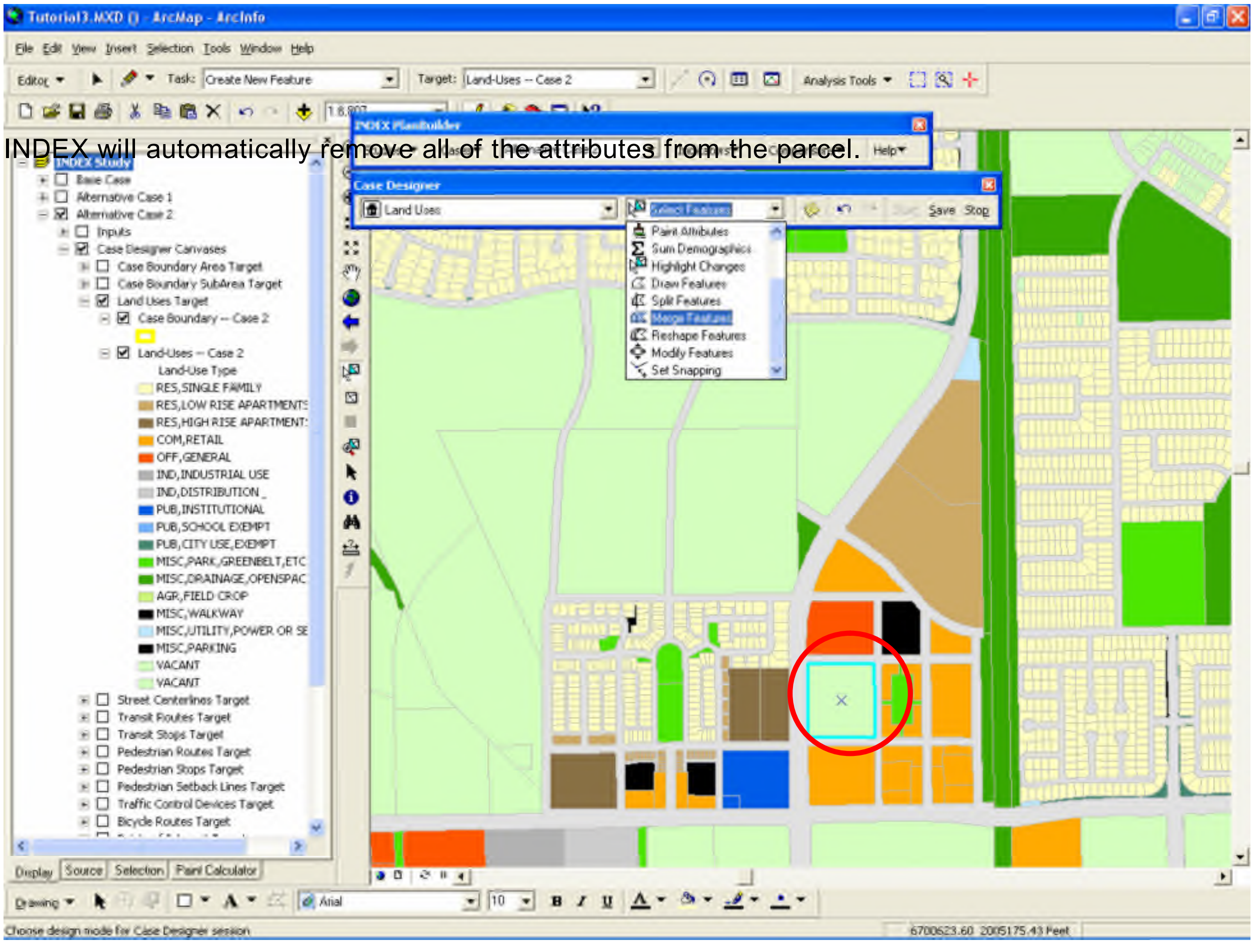
Select the high-density residential parcel near the center of the development with the Select Features tool:



Select the Split tool from the Case Designer tool bar and split the parcel vertically:



Select the two parcels shown below and merge them together using the merge tool from the Case Designer toolbar:



INDEX will automatically remove all of the attributes from the parcel.

Create Land-Use Paints

Case Designer is a major component of INDEX offering the ability to make changes to land-uses on-the-fly. Paints represent land-use types and possess attributes including dwelling, employment, and environmental information. The paint tool is often applied in charrettes or public participation meetings where there is a need to quickly create and evaluate scenarios.

In this section you will create a new set of fully attributed paints and apply them to parcels in the development proposal.

Define The Numeric Categories For Design Paints

In Tutorial 1, you reserved paints 20 – 79 for existing land-use types; here you will use paints 100 – 199 to define the new land-use scheme.

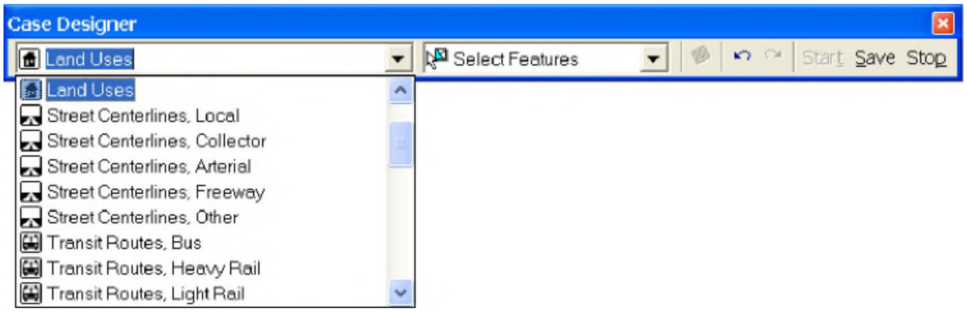
Land-use Categories	Numeric Categories
Residential types	100-109
Commercial/office types	110-119
Mixed-Use types	120-129
Industrial types	130-139
Institutional types	140-149
Miscellaneous types	150-159

The following table lists the new future or hypothetical land-use paints that are required for this scenario, as well as their proposed Paint ID:

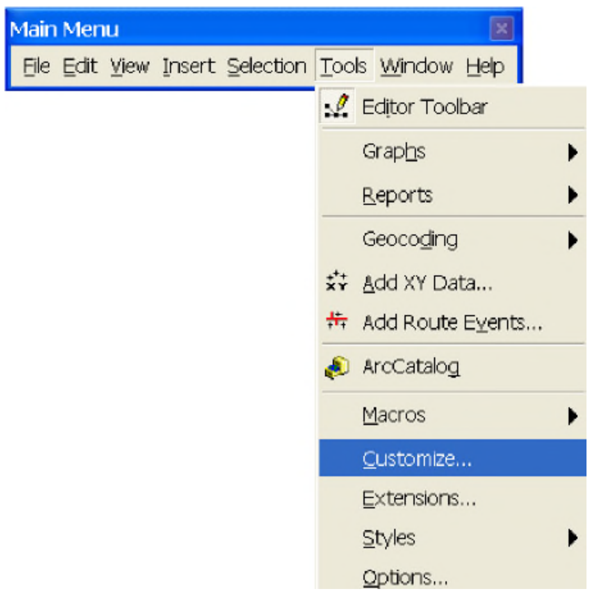
New Paint Name	New Paint ID
RES-SFMOD (12 DUs/ac)	100
RES-HIGH (22 DUs/ac)	101
COM-RETAIL (30 emps/ac)	110
COM-OFFICE (40 emps/ac)	111
MIX-COMRES (20 DUs/20 emps/ac)	120

Create a New Paint Palette

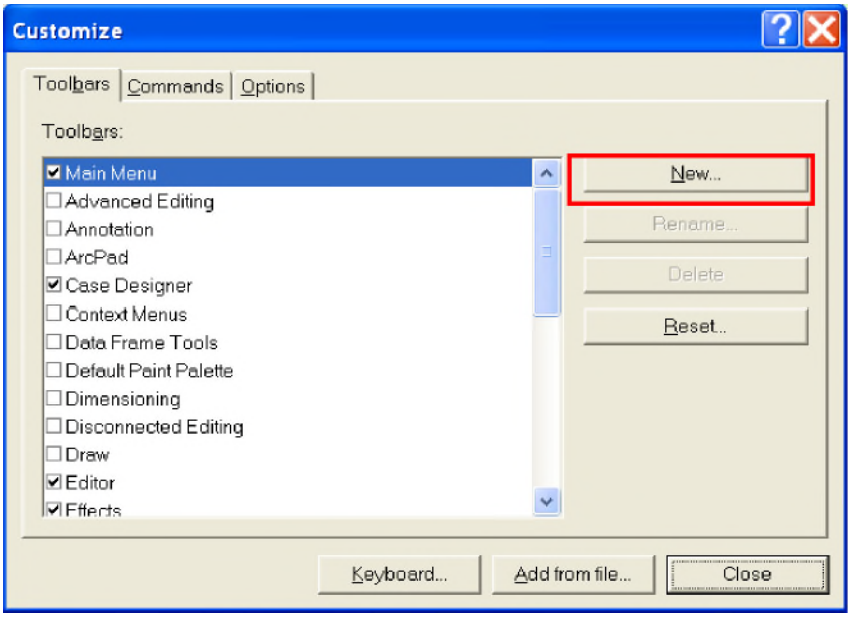
INDEX allows you to create paint palettes containing combinations of paints. Activate the Land-Uses design target:



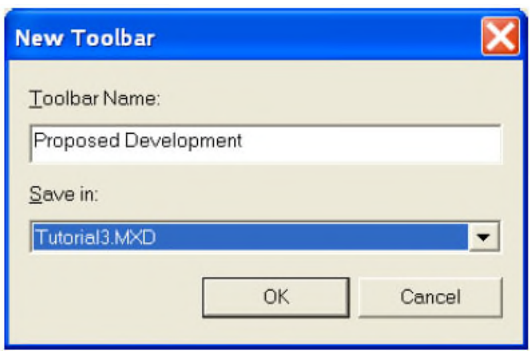
Select Customize from the Tools menu on the ArcMap menu bar:



Select the Toolbars tab and click the ‘New’ button on the Customize dialog:

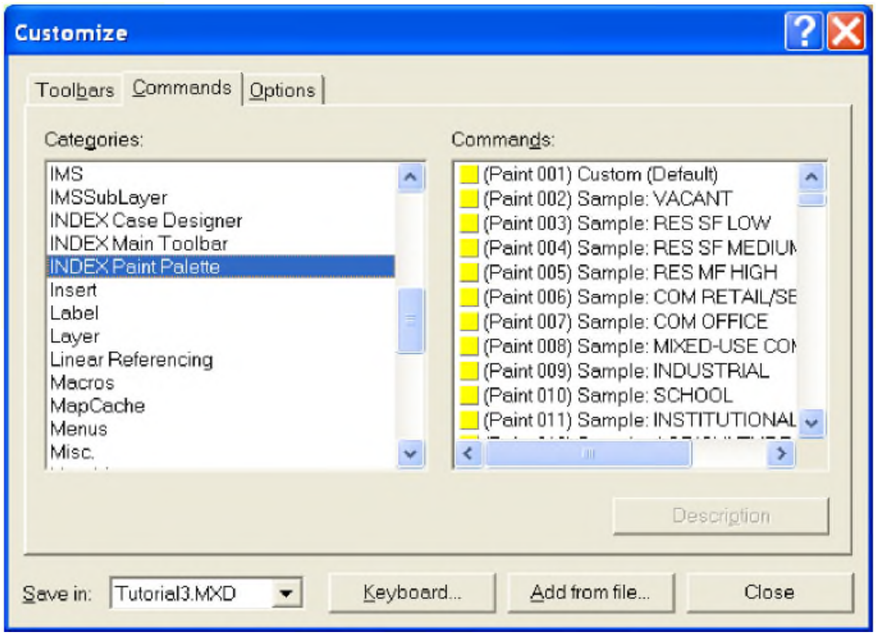


Name the toolbar “Proposed Development” and save it in the “Tutorial3.MXD” file:



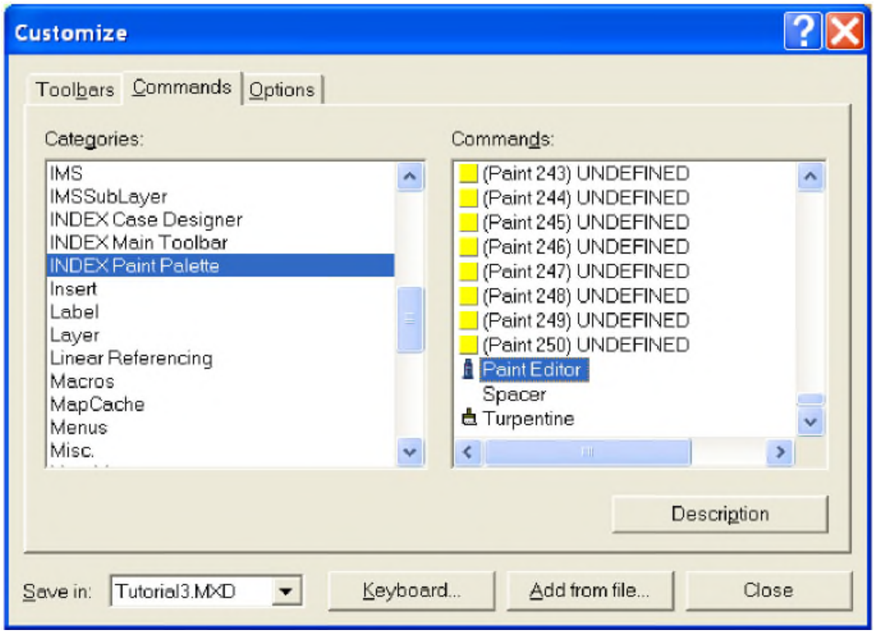
You will find the empty toolbar floating in ArcMap:

Select the Commands tab and scroll down to the INDEX Paint Palette category in the Categories window:



If you scroll through paints, you will see the sample paints along with the set of paints you created for existing land-uses:

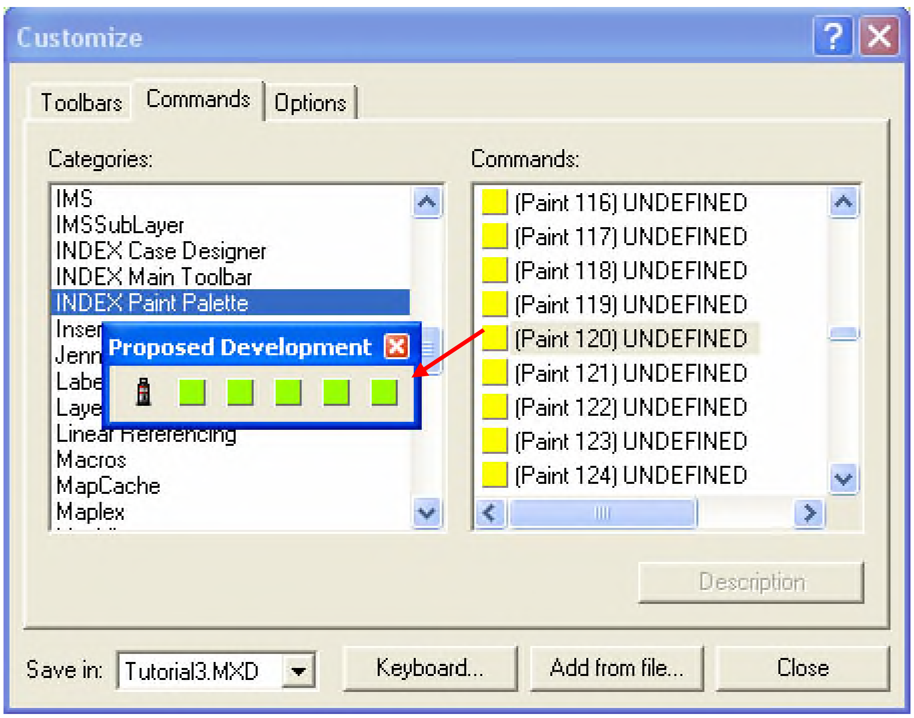
Scroll to the bottom of the Commands window and select the Paint Editor tool:



Select the Paint Editor tool from the window and drag it onto the Proposed Development toolbar:

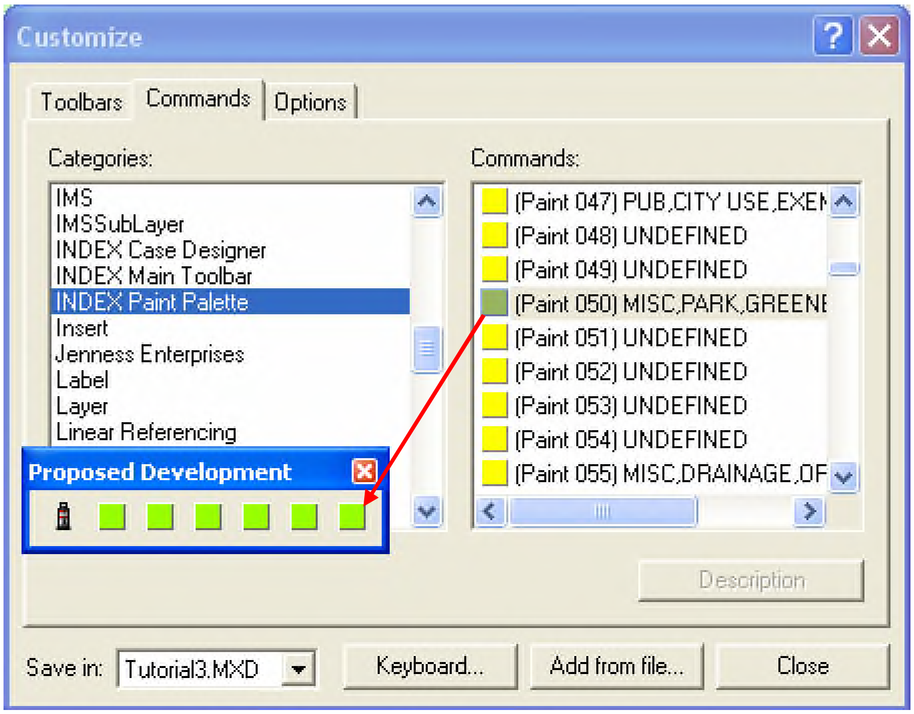
The Paint Editor tool is used to access the Paint Attributes.

Select Undefined Paints: 100, 101, 110, 111, and 120; and drag them onto Paint Palette:



Existing land-use paints that do not possess demographic attributes can be reused, e.g. park and open space.

Select Paint 50, MISC, PARK, GREENBELT, ETC, and move it onto the Paint Palette:



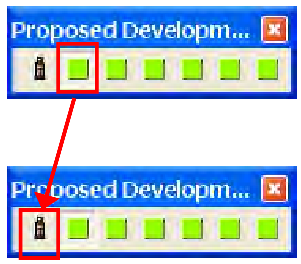
Close the Customize dialog.

Populate the Paints

Attributes are added to paints using the Paint Editor dialog.

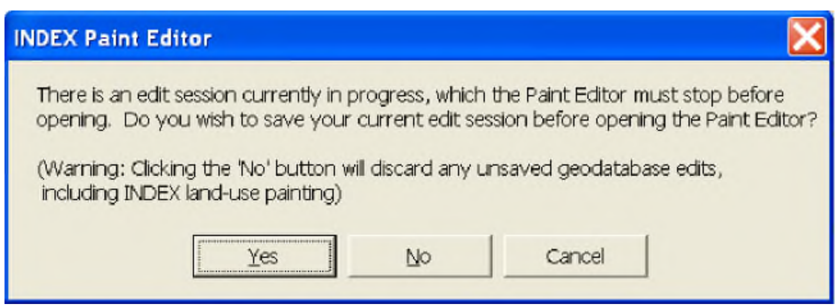
Paint ID# 100

Activate first Paint on the Paint Palette by selecting it and then select the Paint Editor tool. This will launch the Paint Editor dialog:



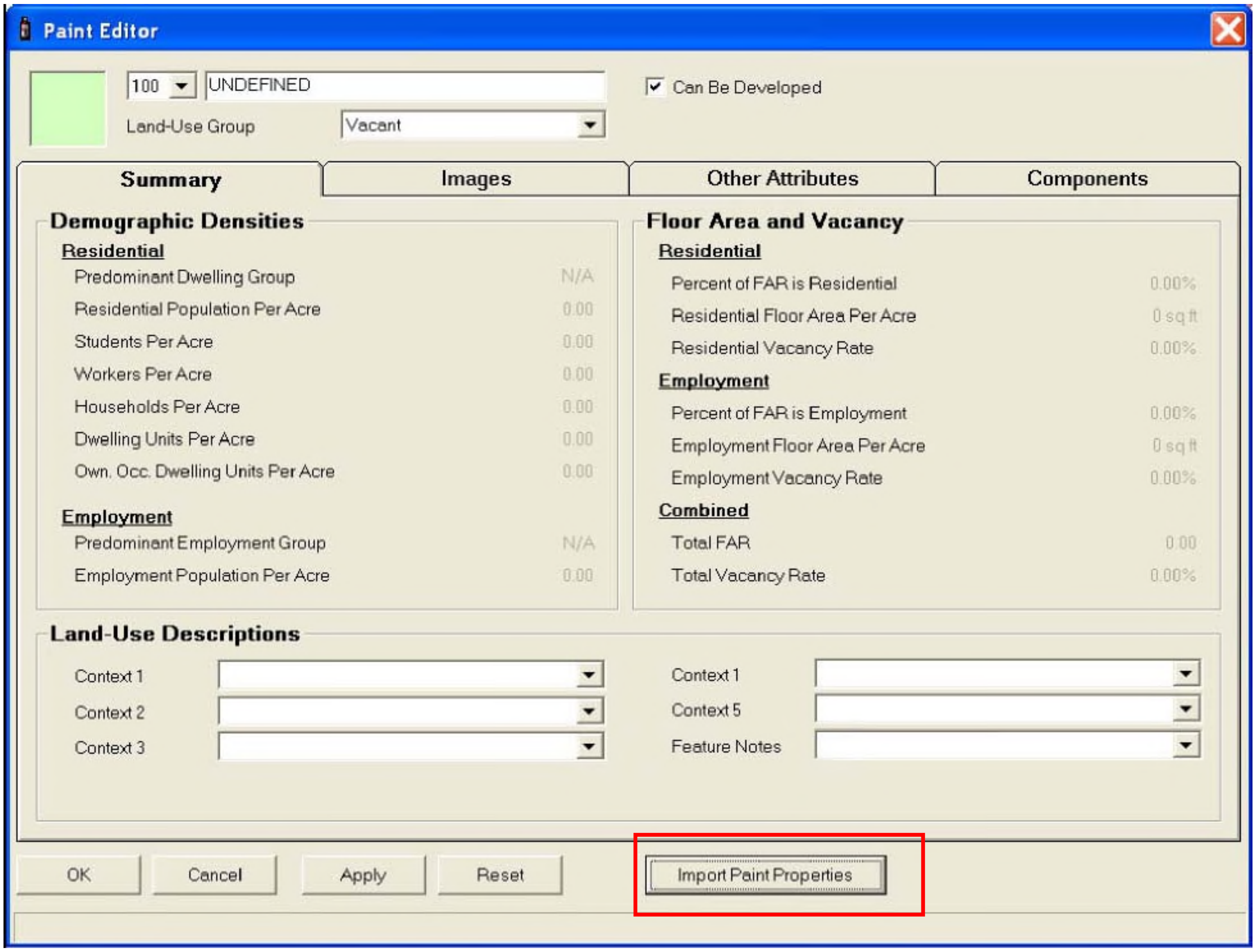
A message will open when the Paint Editor dialog is launched warning you to save your edits before changing paint attributes.

Select 'Yes':



As with existing land-uses, you will use sample paints to populate the design land-uses.

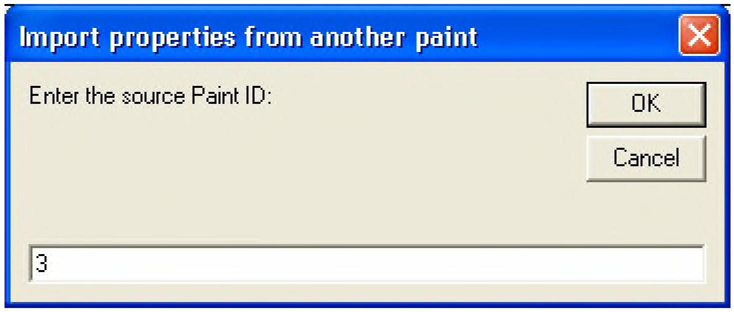
Select the Import Paint Properties button:



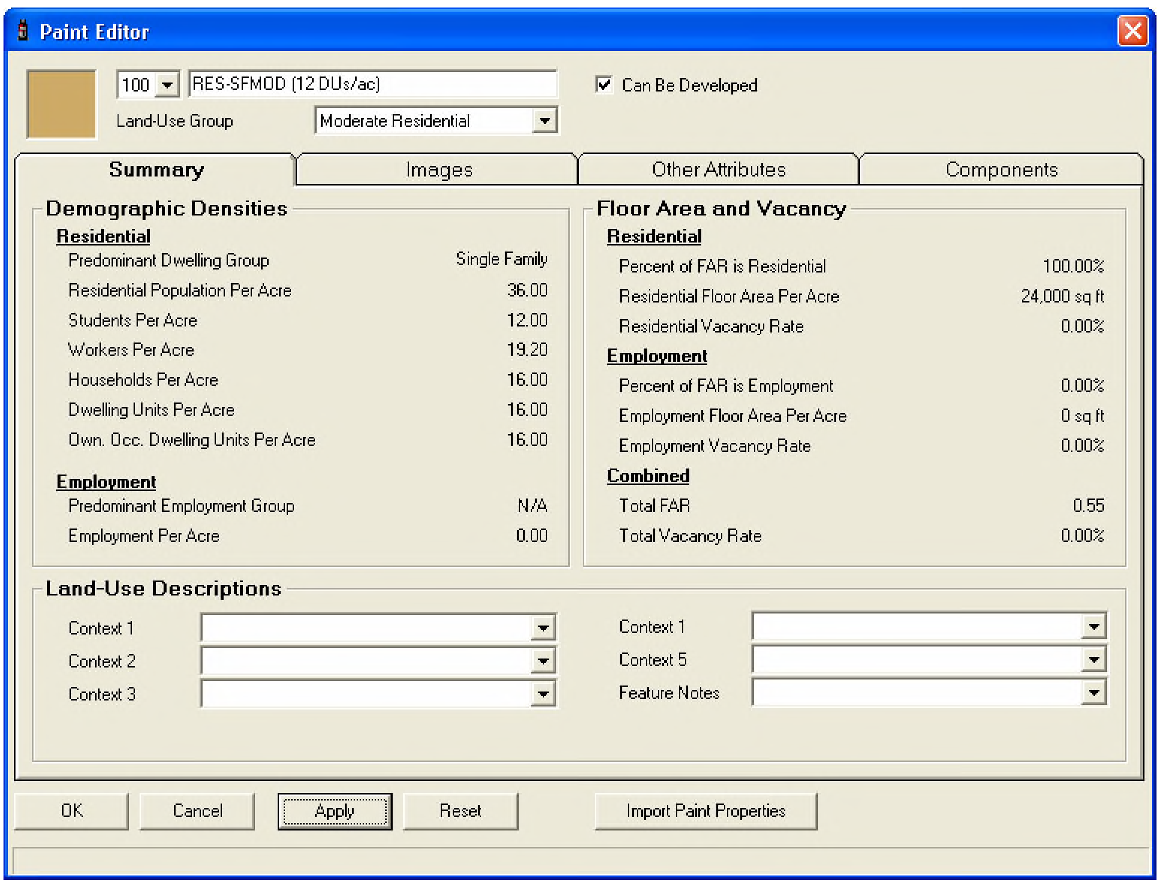
Use the predefined attributes from the table shown below to populate the paint chips:

New Paint Name	Paint ID	Sample Paint ID	DU Type	DU ID	DU/acre	Emp Type	Emp ID	Emp/acre	Paint Color
RES-SFMOD (12 DUs/ac)	100	3	SF	100	12	--		--	Lt. brown
RES-HIGH (22 DUs/ac)	101	4	MF	101	22	--		--	Dk. Brown
COM-RETAIL (30 emps/ac)	110	5	--	--	--	Retail	110	30	Orange
COM-OFFICE (40 emps/ac)	111	6	--	--	--	Service	111	40	Red
MIX-COMRES (20 DUs/20 emps/ac)	120	7	MF	101	20	Retail	110	20	Purple

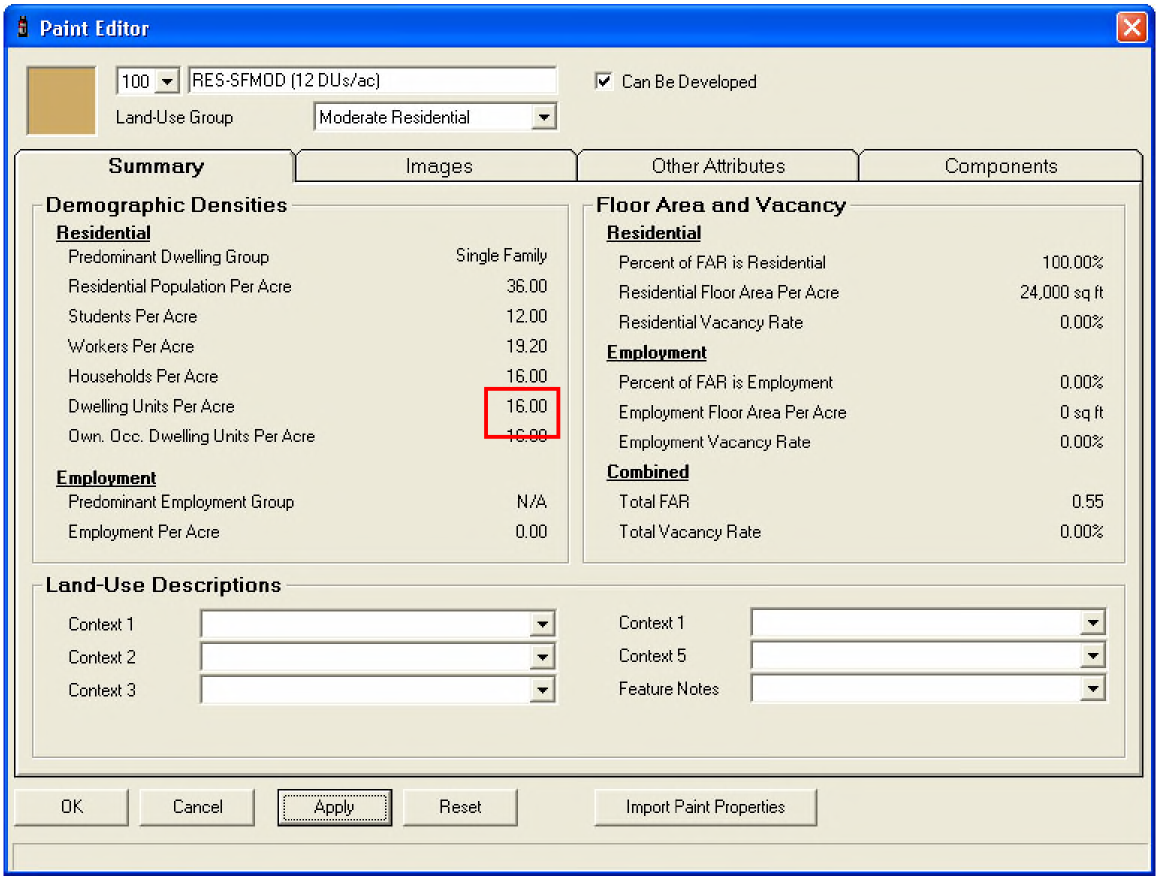
Load attributes from Sample Paint #3:



Change the Paint name to RES-MOD (12 DUs/ac) and click the Apply button:



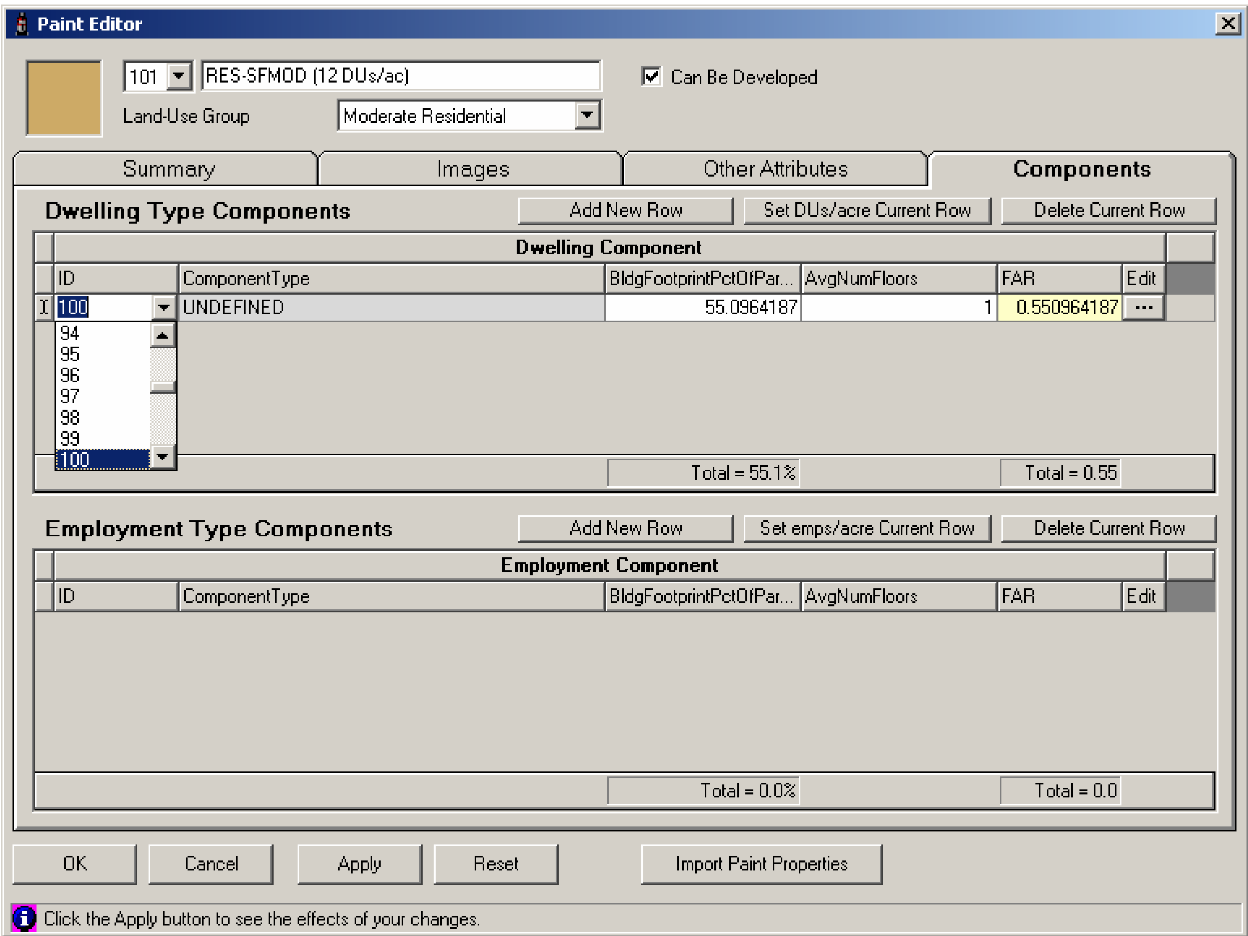
Explore the data displayed on the Summary tab and determine which changes need to made to the demographic components. The dwelling unit density for this paint should be 12 dwelling units per acre. This value will have to be adjusted:



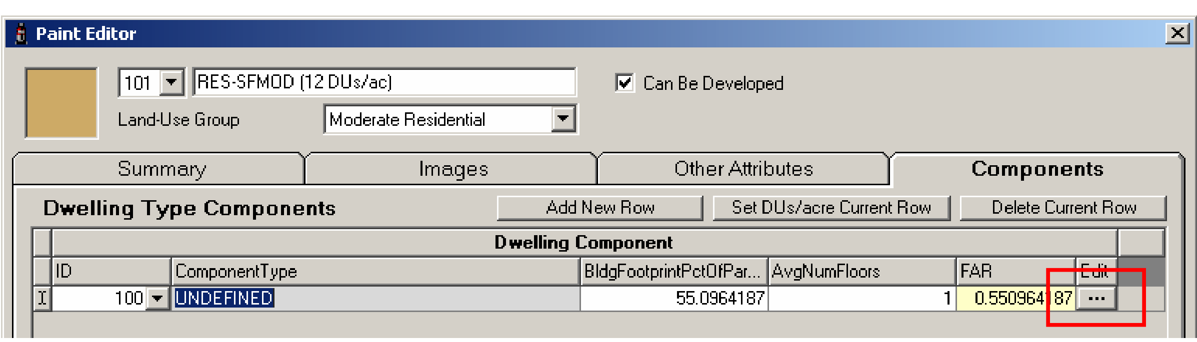
Select the Components tab and explore the Dwelling Components. The Dwelling ID field provides the opportunity to create new dwelling types with unique attributes. As with land-uses, you can build up to 250 dwelling types and 250 employment types. To avoid inadvertently changing the attributes of a Dwelling or Employment Type Component that is already used by another Paint use the same Dwelling or Employment Type Component ID# as the Paint ID#. In the example below, both the Paint and Dwelling Type Component use ID# 100.

Do not make changes to any of the default dwelling types.

Create a new dwelling type starting at Dwelling ID# 100:

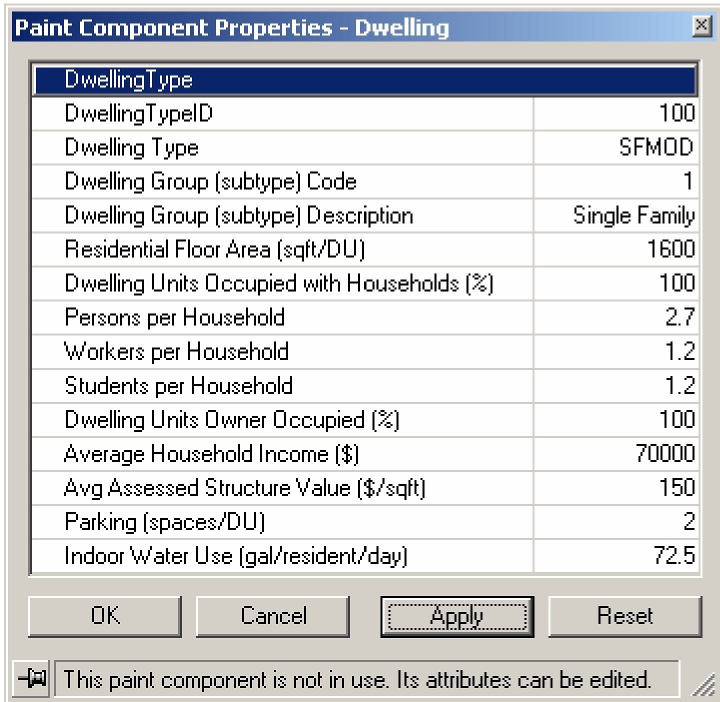


Click the Edit button to launch the Dwelling Component dialog:



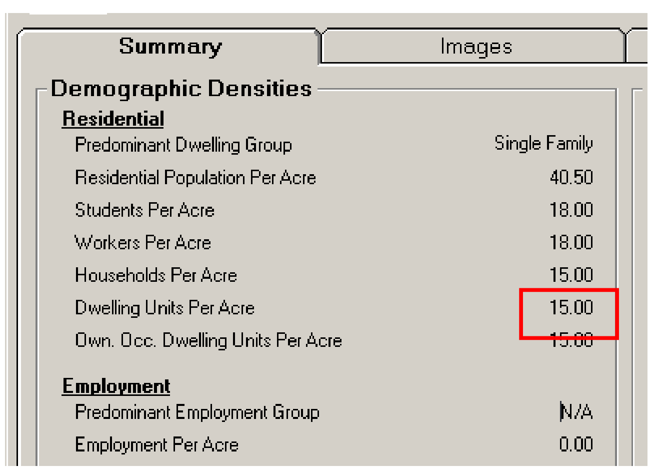
The components are based on values used to populate existing land-use attributes.

Provide the changes shown below to the Dwelling Components:



Once back in the Paint Editor, click the Apply button to save the changes:

Select the Summary tab to see how the changes affected the paint attributes. The number of dwelling units is changed to 15 dwelling per acre. This density can be adjusted by changing the Building Footprint Percent of Parcel of the Dwelling Component Type:



The following formula describes how Dwelling Density (DUs/acre) is calculated for a given Paint Component:

$$\text{Density}_{DU} = \left(\frac{43560(\textit{sqft/acre}) * \text{BldgFtPrnt\%} * \text{AvgNumFloors}}{\text{ResFloorArea}\,(\textit{sqft/DU})} \right) * \text{HouseholdOccupancy\%}$$

Further:

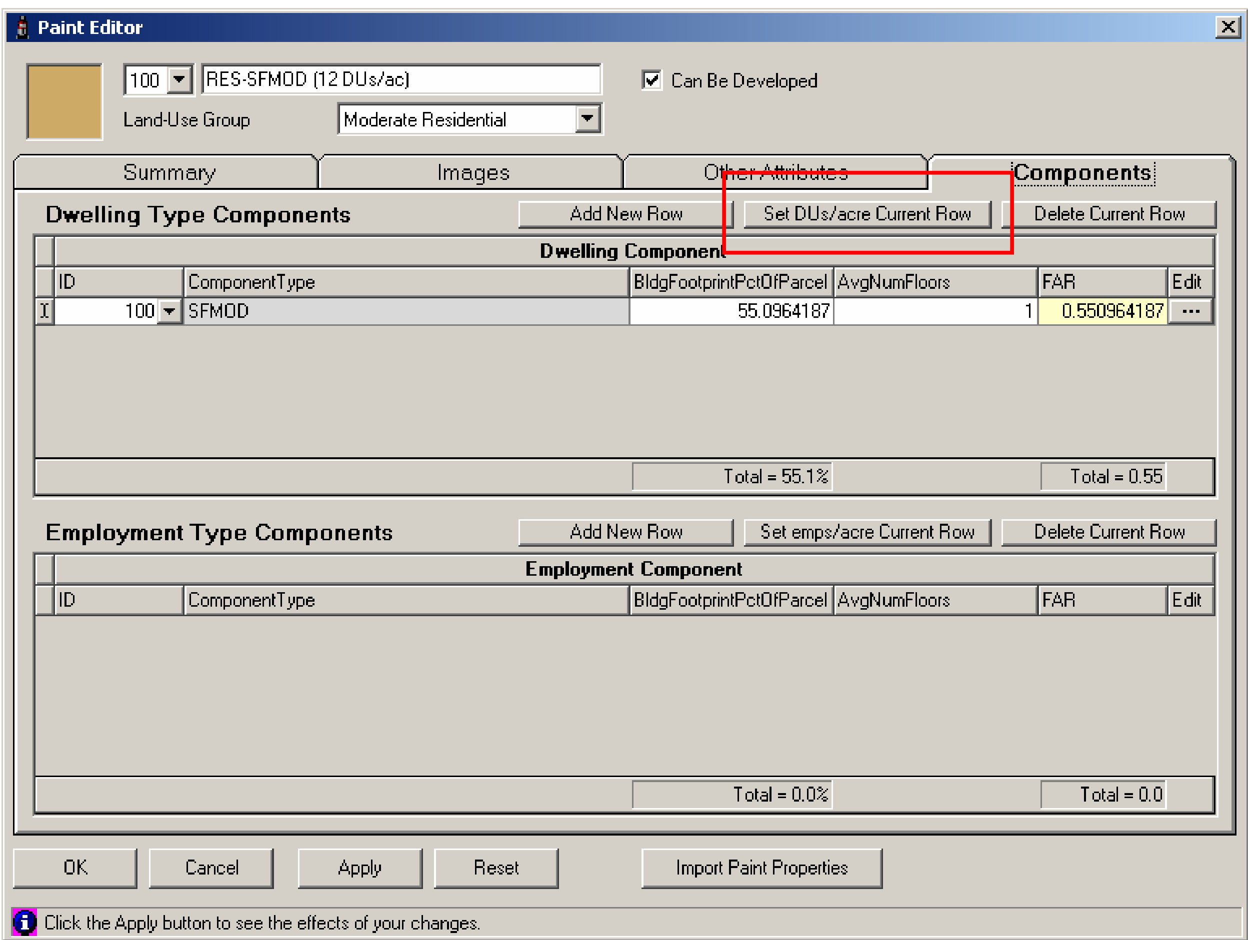
$$\text{ResidentialPopulation}\,(\textit{persons/acre}) = \text{Density}_{DU} * \text{PersonsPerHousehold}$$

$$\text{WorkerCount}\,(\textit{workers/acre}) = \text{Density}_{DU} * \text{WorkersPerHousehold}$$

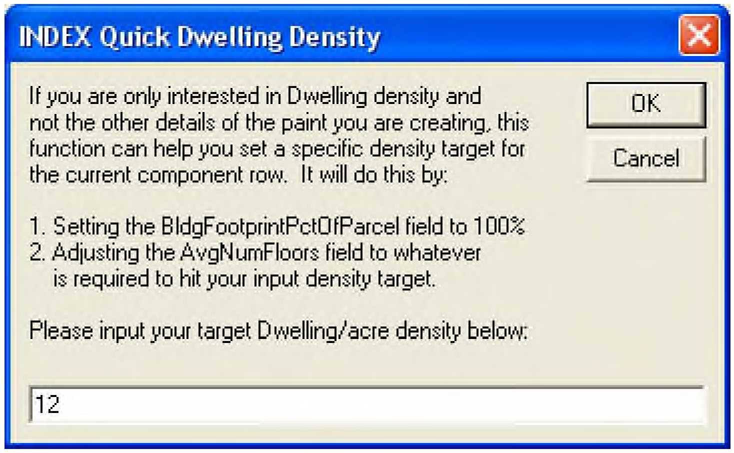
$$\text{StudentCount}\,(\textit{students/acre}) = \text{Density}_{DU} * \text{StudentsPerHousehold}$$

If you are only interested in Dwelling Density, INDEX provides a "quick density" tool that will calculate the paint component details to achieve the desired density.

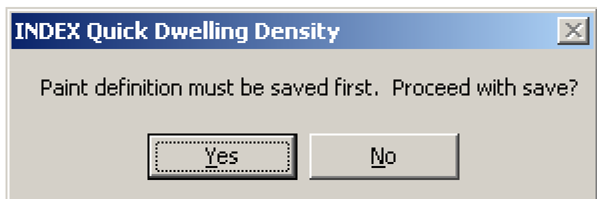
Switch to the Components tab and click the "Set DUs/acre Current Row" button:



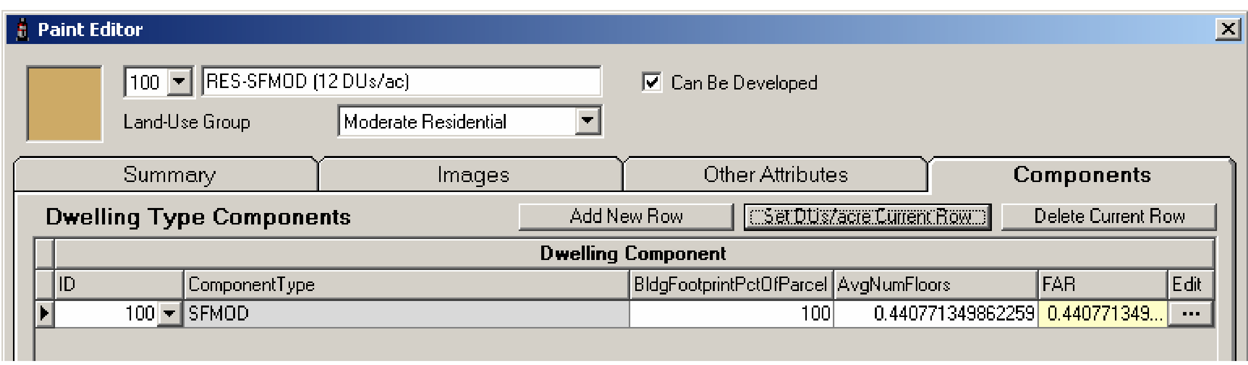
The following input box appears:



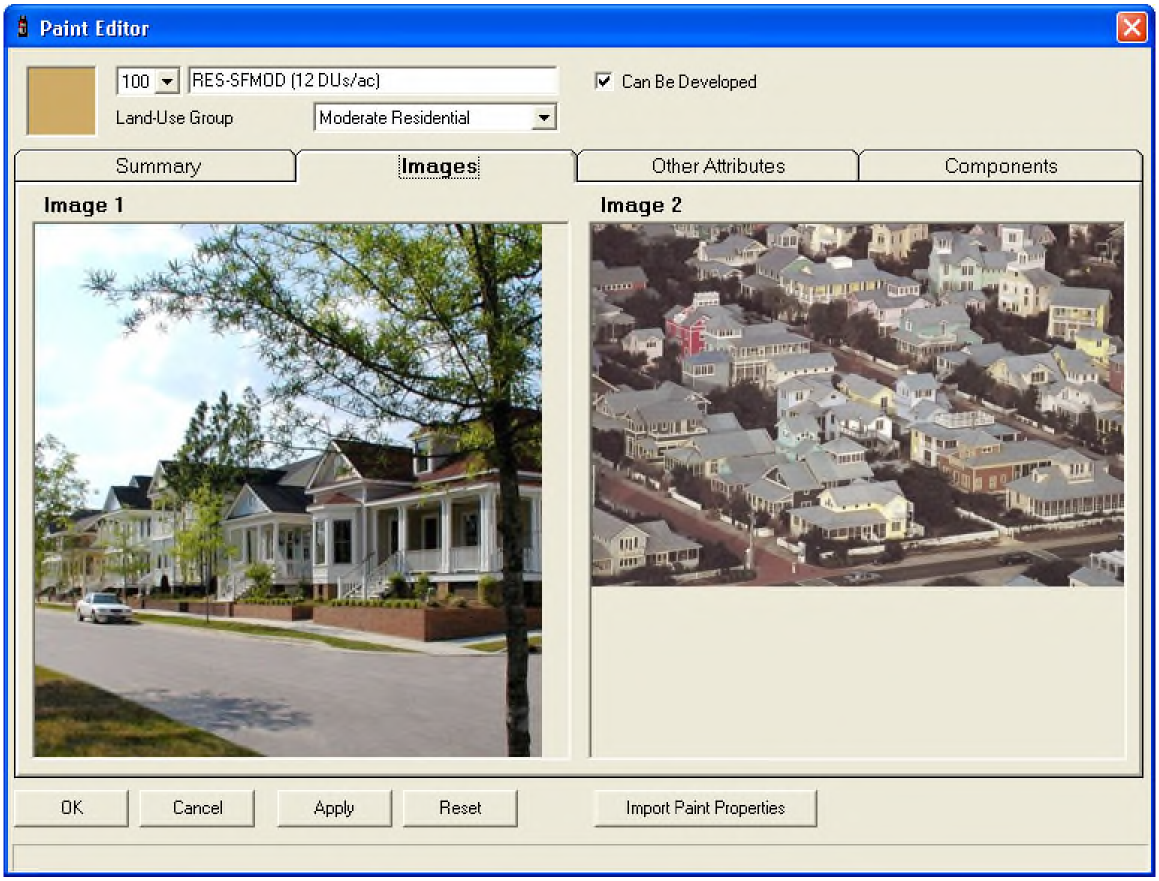
Enter the desired target density of 12 DUs/acre and click OK. The following dialog may appear:



If it does, click OK. The BldgFootprintPctOfParcel and AvgNumFloors values have been changed, and the DU Density is now 12 DUs/acre:



Select the Images tab to see the images that are associated with the default paint attributes and attribute density:



You can associate your own images with the new land-use by double clicking inside the image frame and navigating to the local directory where your image is stored. The height and width of images must be no greater than 356 pixels.

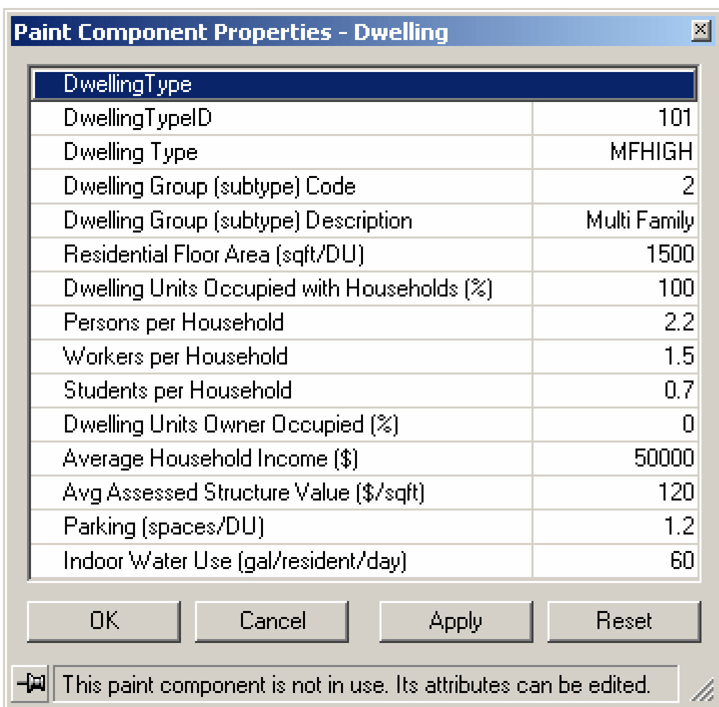
Select the OK button to apply the changes to the Paint Palette and close the Paint Editor dialog:

The color you provided for the new residential paint shows up now on the Paint Palette. The color also shows up for the last paint added because it is a pre-existing paint:

Paint ID# 101

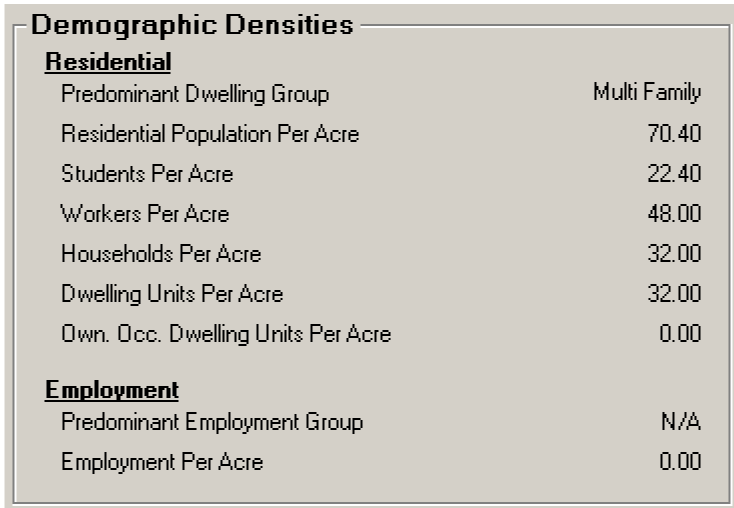
The second paint represents another exclusively residential land-use. Switch to Paint ID 101, use the Import Paint Properties button to inherit the properties of Paint ID 4, and then rename the paint to "RES-MFHIGH (22 DUs/ac)". Click Apply to commit the changes thus far.

Change the paint's dwelling component to the currently undefined component ID 101, and populate it with the following properties:

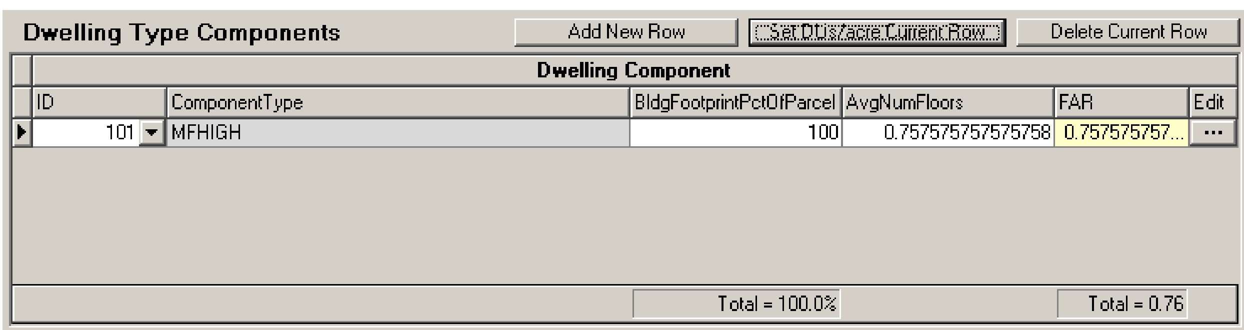


DwellingType	
DwellingTypeID	101
Dwelling Type	MFHIGH
Dwelling Group (subtype) Code	2
Dwelling Group (subtype) Description	Multi Family
Residential Floor Area (sqft/DU)	1500
Dwelling Units Occupied with Households (%)	100
Persons per Household	2.2
Workers per Household	1.5
Students per Household	0.7
Dwelling Units Owner Occupied (%)	0
Average Household Income ($)	50000
Avg Assessed Structure Value ($/sqft)	120
Parking (spaces/DU)	1.2
Indoor Water Use (gal/resident/day)	60

Using this component with the existing FAR yields a density of 32 DUs/acre:



Since 22 DUs/acre is the target, click the "Set DUs/acre Current Row" button and enter 22. The new FAR should look like this:



Paint ID# 110

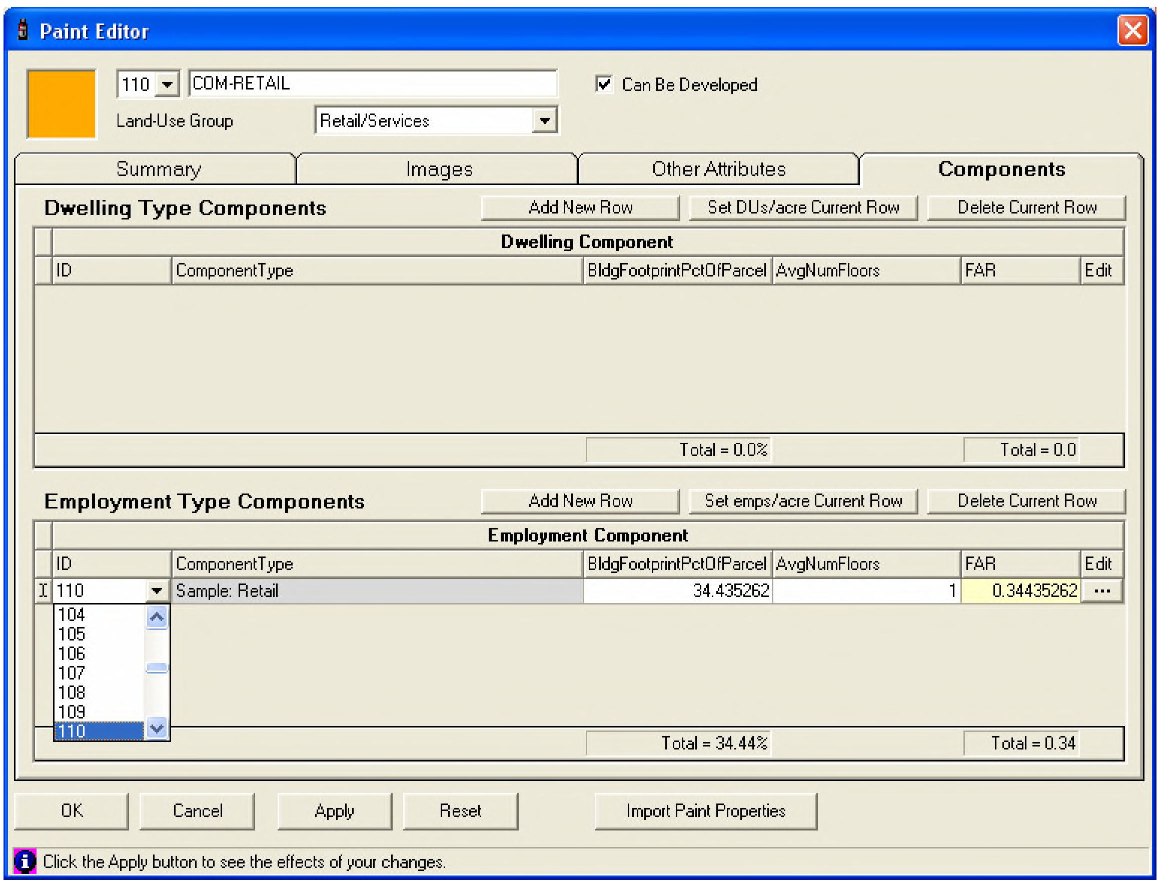
Select the third paint on the Paint Palette and click the Paint Editor button. Import the Paint Properties from Paint ID #5, rename the paint "COM-RETAIL (30 emps/ac)", and apply the changes.

Click the Components tab. This time you will edit the Employment Components. You can build also build up to 250 employment types. Once again, do not make changes to any of the default types.

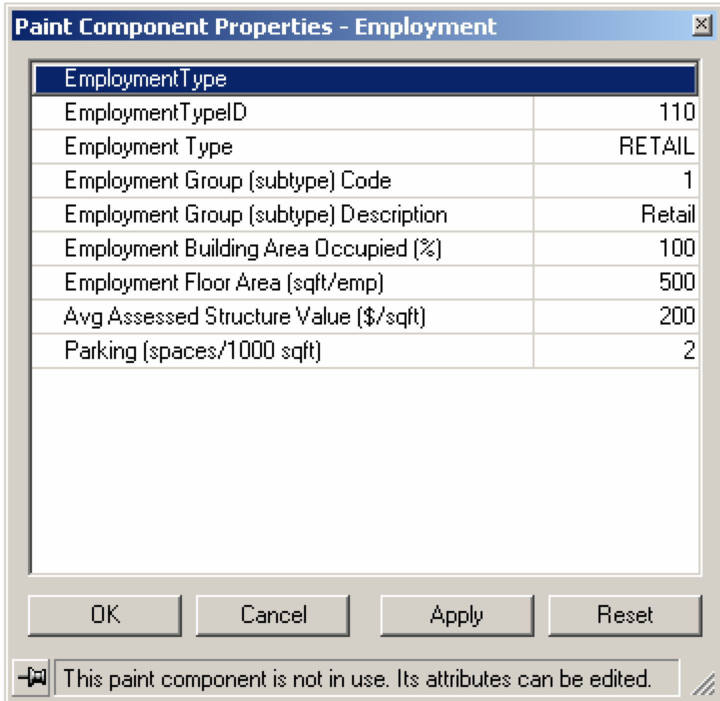
The following formula describes how Employment Density (emps/acre) is calculated for a given Paint Component:

$$Density_{Emp} = \left(\frac{43560(\textit{sqft/acre}) * BldgFtPrnt\% * AvgNumFloors}{EmpFloorArea\,(\textit{sqft/emp})} \right) * EmpBldgAreaOccupied\%$$

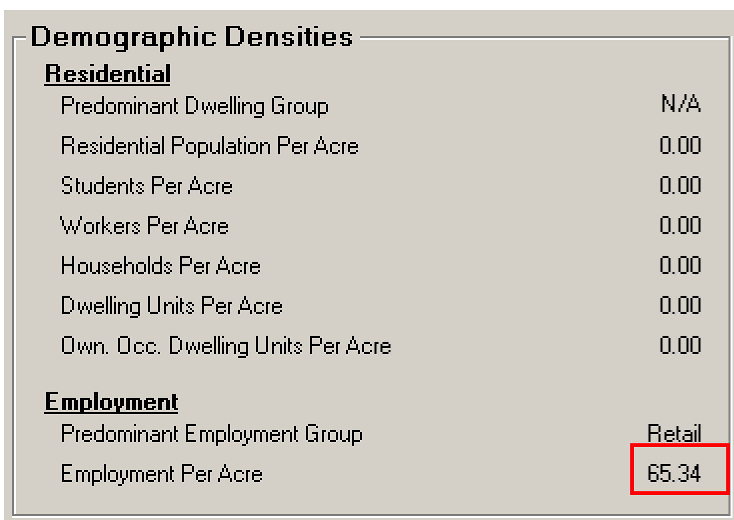
Select a new employment type aligned with the Paint ID#, in this case Employment ID# 110.



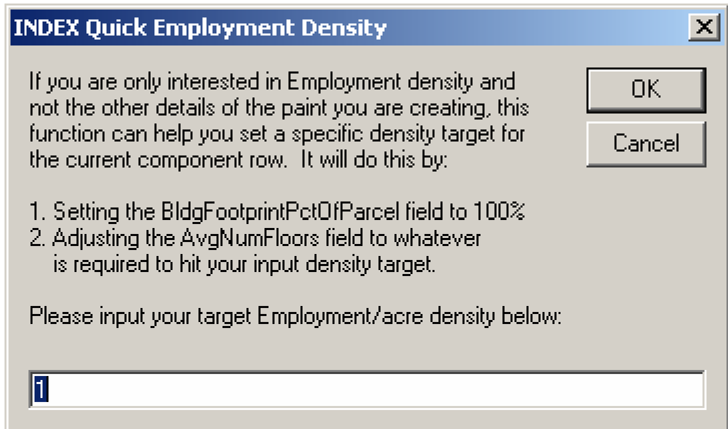
Select the Employment Component Edit button and the values below to the Paint Component Properties dialog and click the Apply button:



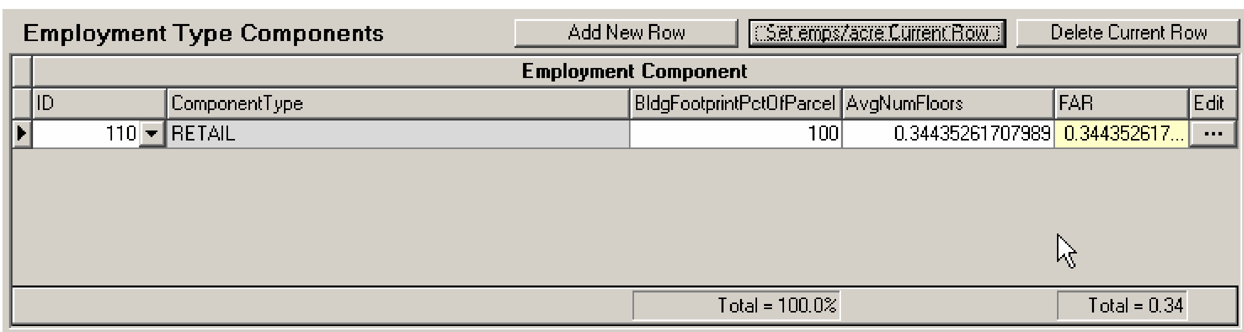
The target density is 30 employees per acre. Apply the changes and select the Summary tab to see how close the current FAR is to providing that value:



Since this is too high, return to the Components tab and click the "Set emps/acre Current Row" button. The following dialog appears:



Enter the target employment density of 30 and click ok. The employment FAR has changed:



The summary now shows a density of 30 emps/acre:

Select the OK button to apply the changes to the Paint Palette and close the Paint Editor dialog.

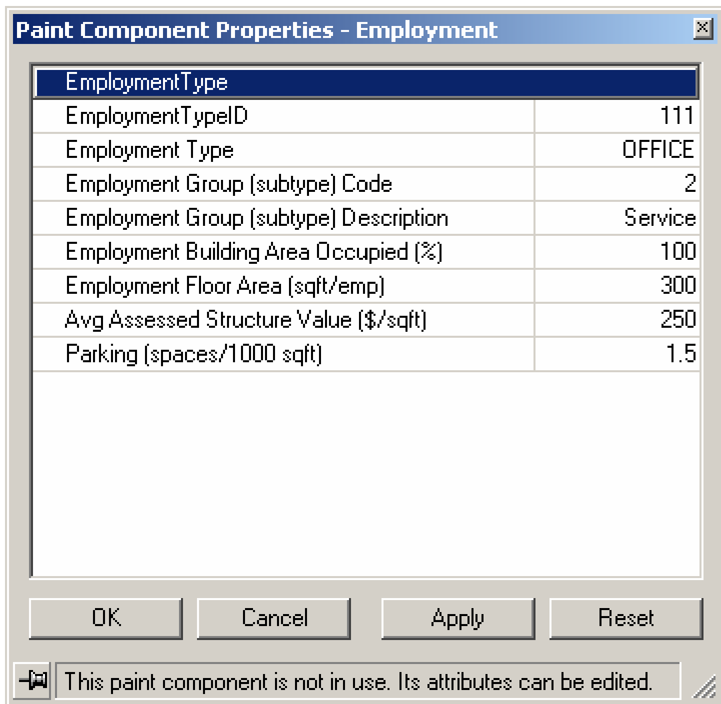
Paint ID# 111

Select the fourth paint on the Paint Palette and click the Paint Editor button.

Import the Paint Properties from Paint ID #6, rename the paint “COM-OFFICE (40 emps/ac)”, and apply the changes.

Click the Components tab. Create a new employment type starting at Employment ID# 111.

Use the predefined attributes to populate the values for the COM-OFFICE (40 emps/ac) paint. Enter the following properties for the Paint Component:



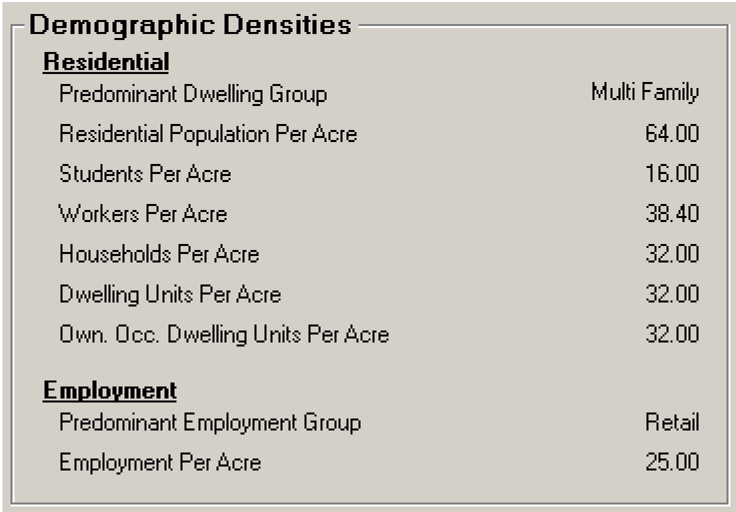
Click OK and then Apply in the Paint Editor. With the current FAR the density is too high:

Use the "Set emps/acre Current Row" button to achieve the desired 30 emps/acre density.

Paint ID# 120

The fifth paint, MIX-COMRES (20 DUs/20 emps/ac), is unique because it includes residential and employment attributes. Select the fifth paint on the Paint Palette and click the Paint Editor button:

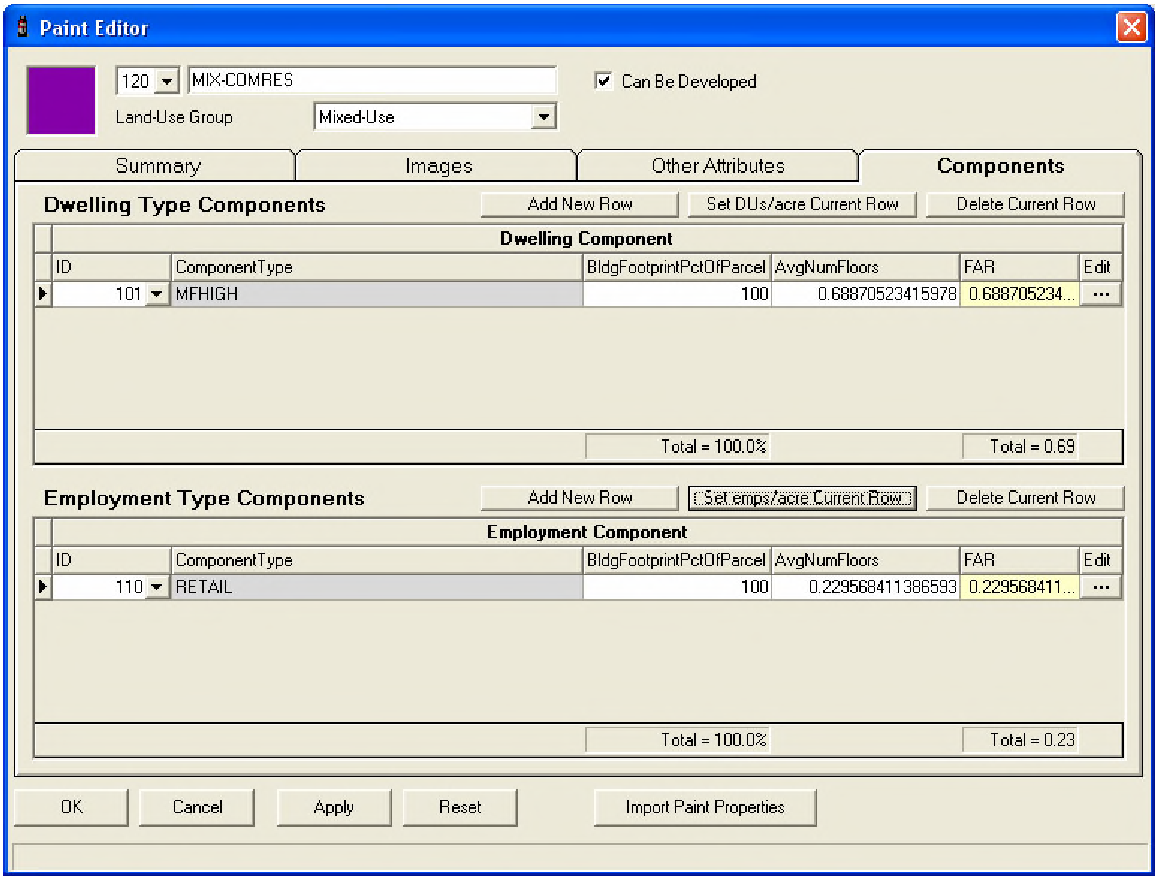
Import Paint Properties from Sample Paint #7 and rename the paint "MIX-COMRES (20 DUs / 20 emps / ac) ". Review its densities:



Demographic Densities

Residential	
Predominant Dwelling Group	Multi Family
Residential Population Per Acre	64.00
Students Per Acre	16.00
Workers Per Acre	38.40
Households Per Acre	32.00
Dwelling Units Per Acre	32.00
Own. Occ. Dwelling Units Per Acre	32.00
Employment	
Predominant Employment Group	Retail
Employment Per Acre	25.00

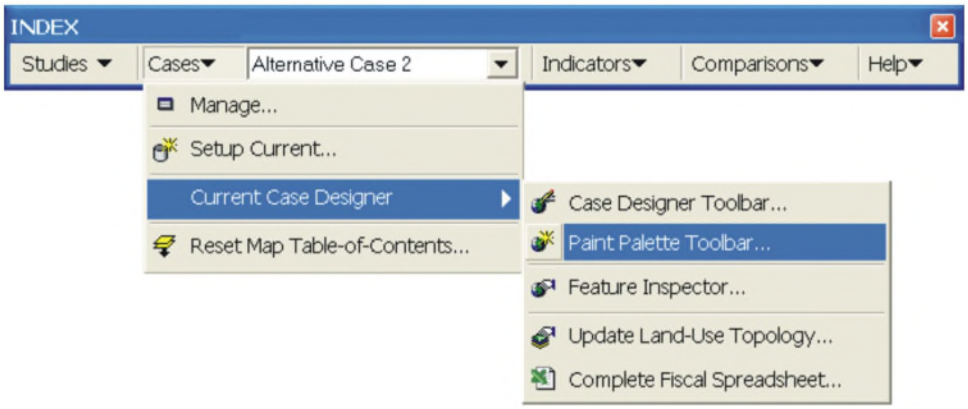
On the Components tab, switch the Dwelling Component to the previously-created MFHIGH (ID 101) and the Employment Component to the previously created RETAIL (ID 110):



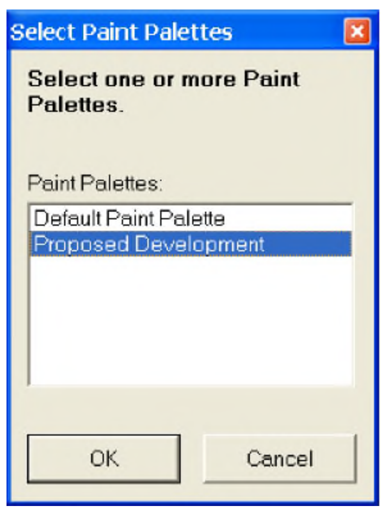
As you did previously, use the "Set DUs/acre Current Row" button to set the Dwelling Density to 20, and then use the "Set emps/acre Current Row" button to set the Employment Density to 20 as well.

Access the Paint Palette Set

INDEX allows you to create multiple Paint Palettes. To select a palette, select the Current Case Designer option from the Cases pull-down menu and select the Paint Palette Toolbar option:



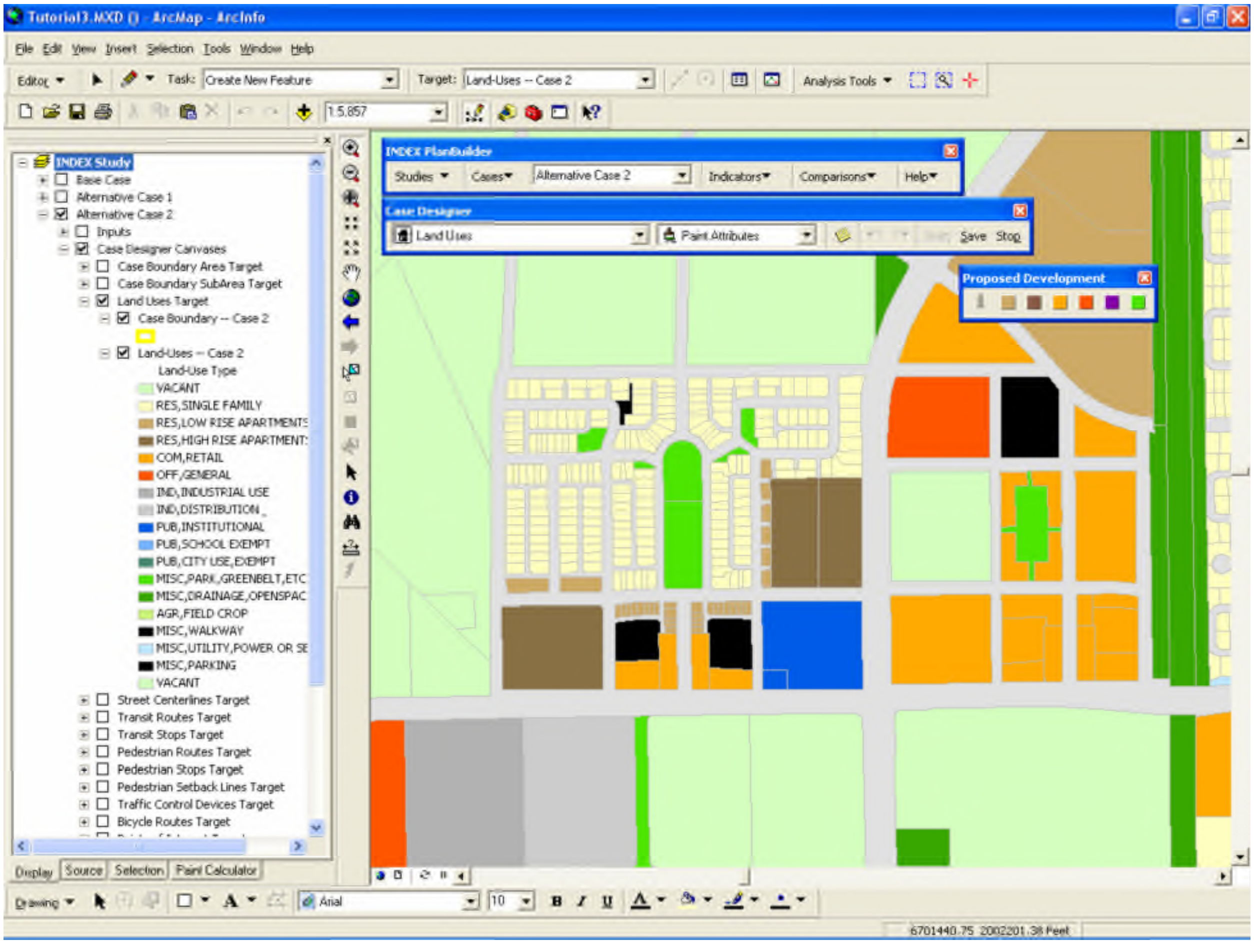
Select the Paint Palette you would like use:



The selected Paint Palette will open automatically:

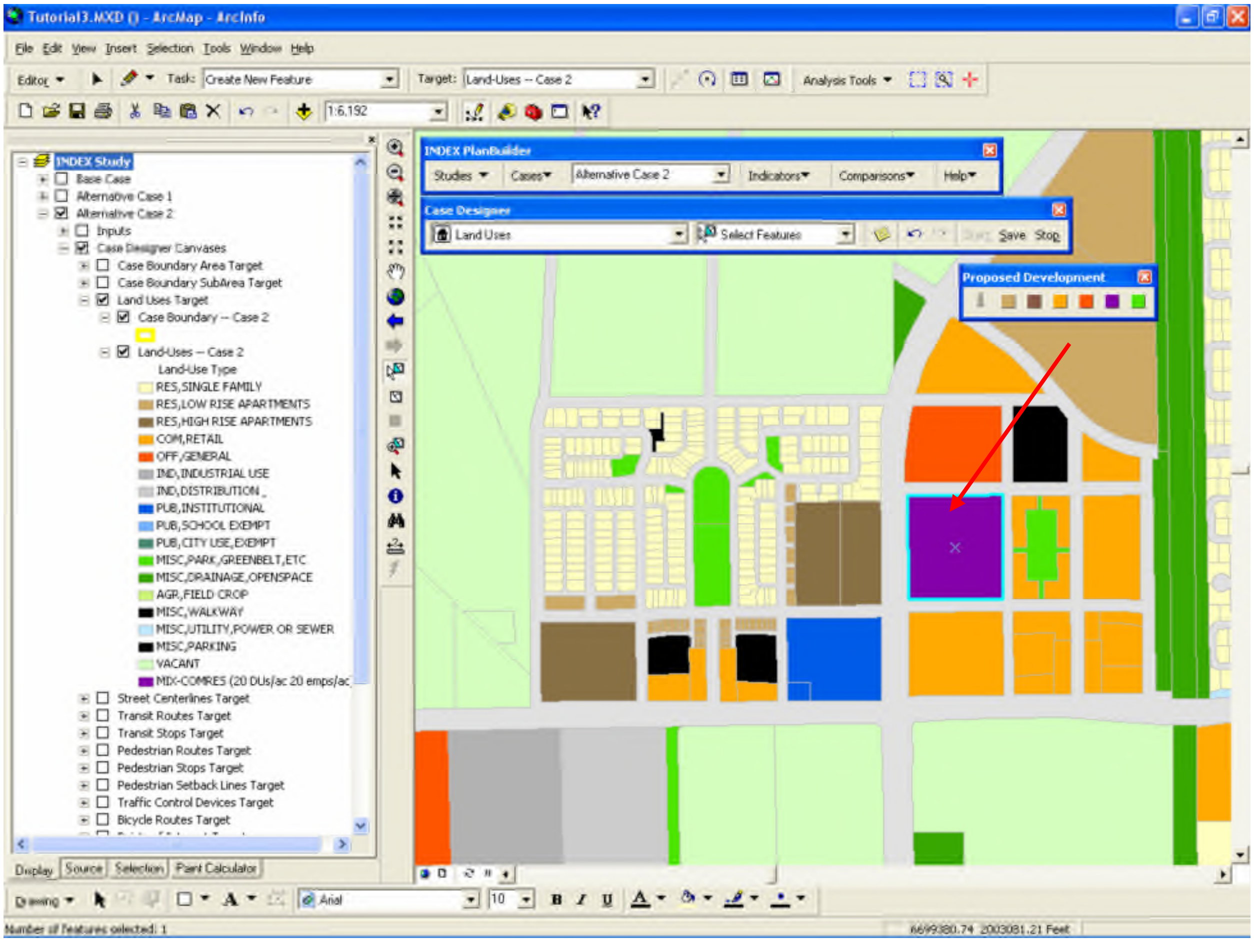
Apply Paints to Land-Uses

Zoom to the development proposal:

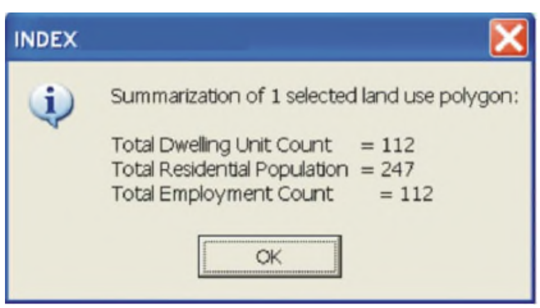


When you select one of the paints, the mouse icon will change to a paint brush.

Select the Mixed-Use paint chip and paint the vacant parcel near the center of the development site by clicking on it, as shown below:

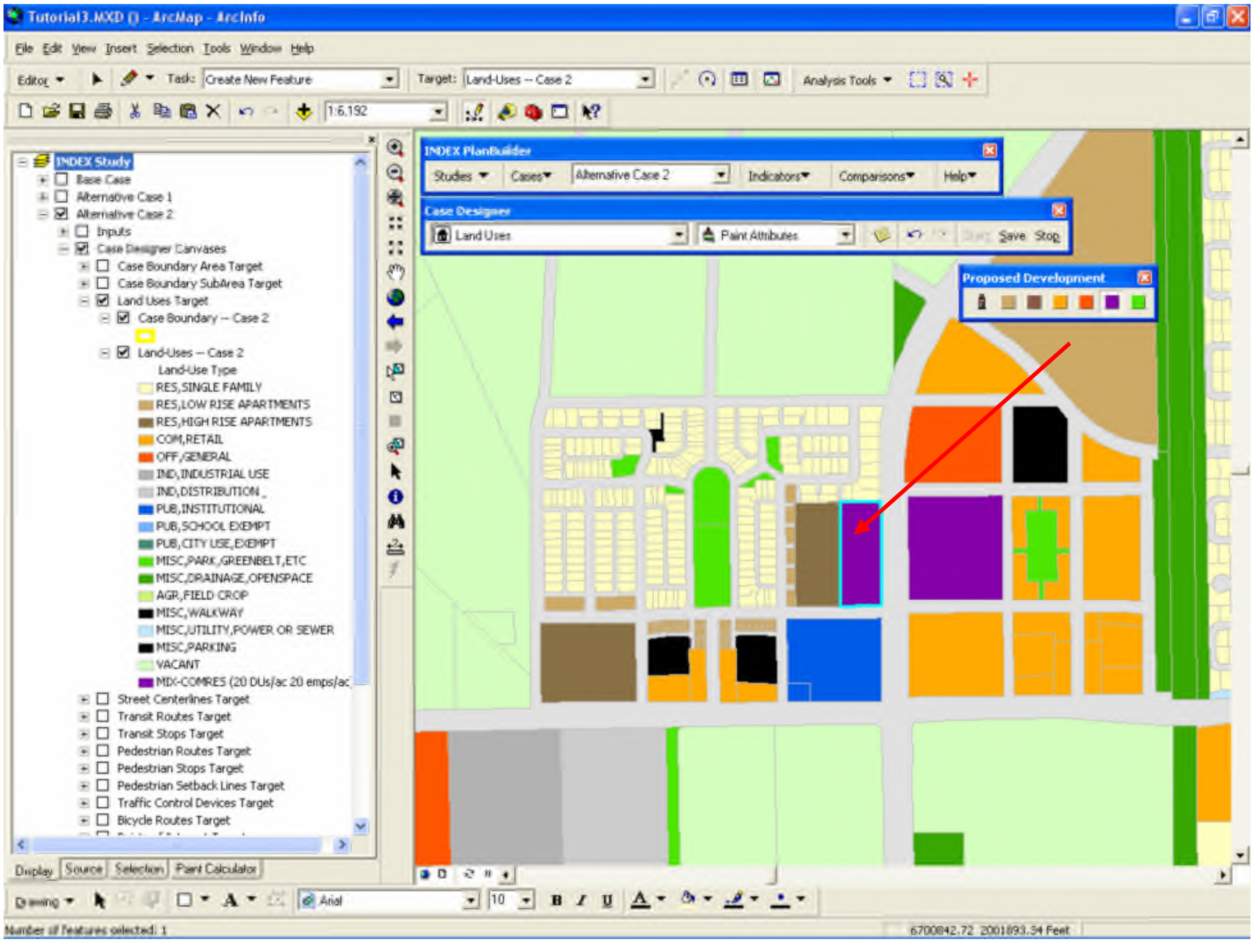


While the parcel is still selected, select the Sum Demographics tool from the Case Designer tool menu to see how many dwellings, residents, and employees were added to the parcel:



Painting land-use areas will remove all existing attributes and replace them with the paint values.

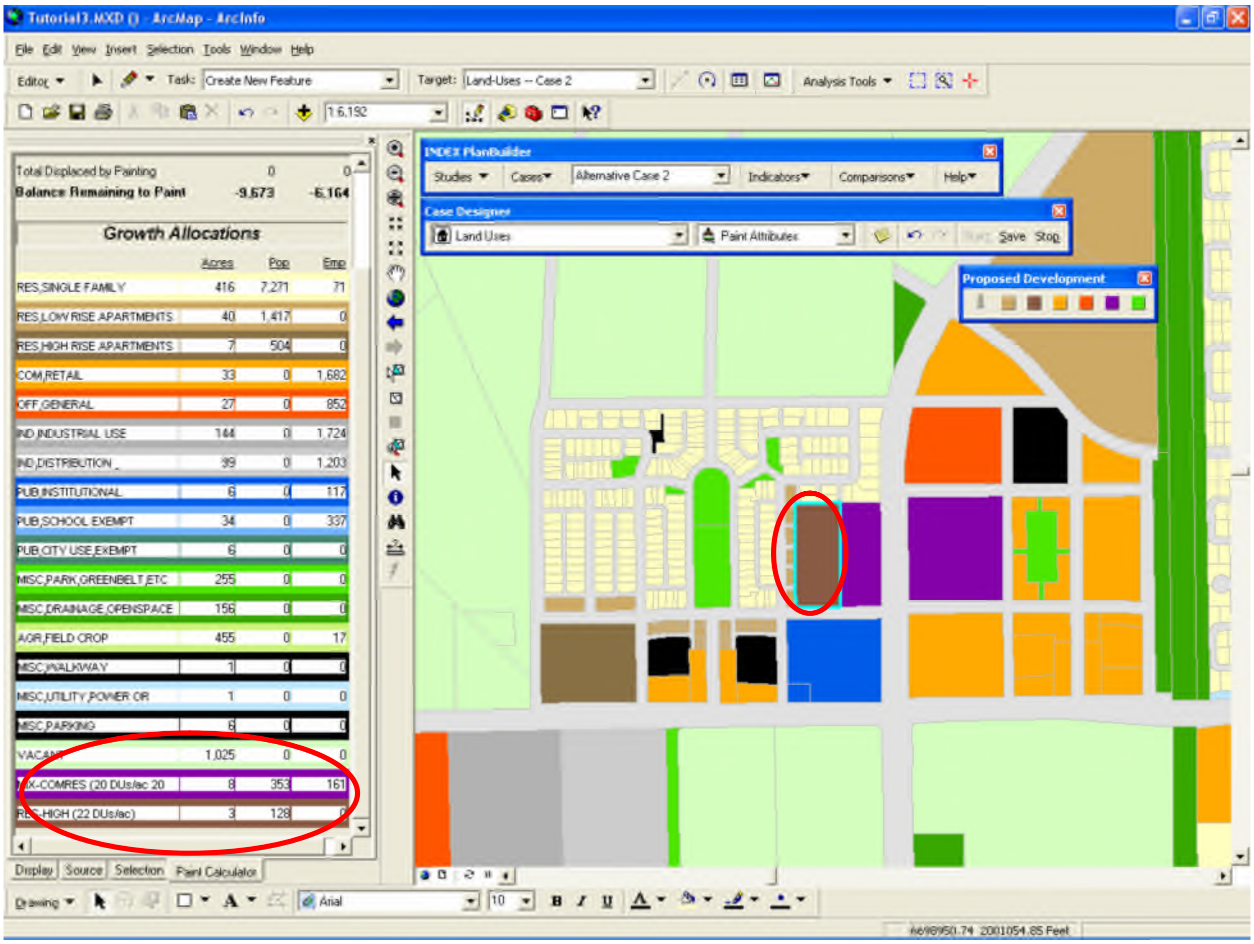
Paint the parcels across from the previous one you painted, as shown below:



***Note:** If you paint a land-use polygon (parcel) and then change one of the paint values in Paint Editor and reapply the paint to the same land-use polygon, the attributes for the polygon will not be automatically updated. You must first remove the attributes of the land-use polygon by applying a different paint or the "turpentine" tool before applying the updated paint. A better method is to use the Import Paint Properties button to create a new paint at another ID, leaving the original paint unchanged. Then simply apply to the new paint to the target polygons.*

You can view how much population, employment, and land area is dedicated to each land-use type by selecting the Paint Calculator tab at the bottom of the Table of Contents window. Land-use information is dynamically updated when changes to the attributes occur. The Paint Calculator will be discussed in greater detail later in the tutorial.

Increase multi-family dwelling density by selecting the RES-HIGH (22 DUs/ac) paint and paint parcel shown below:

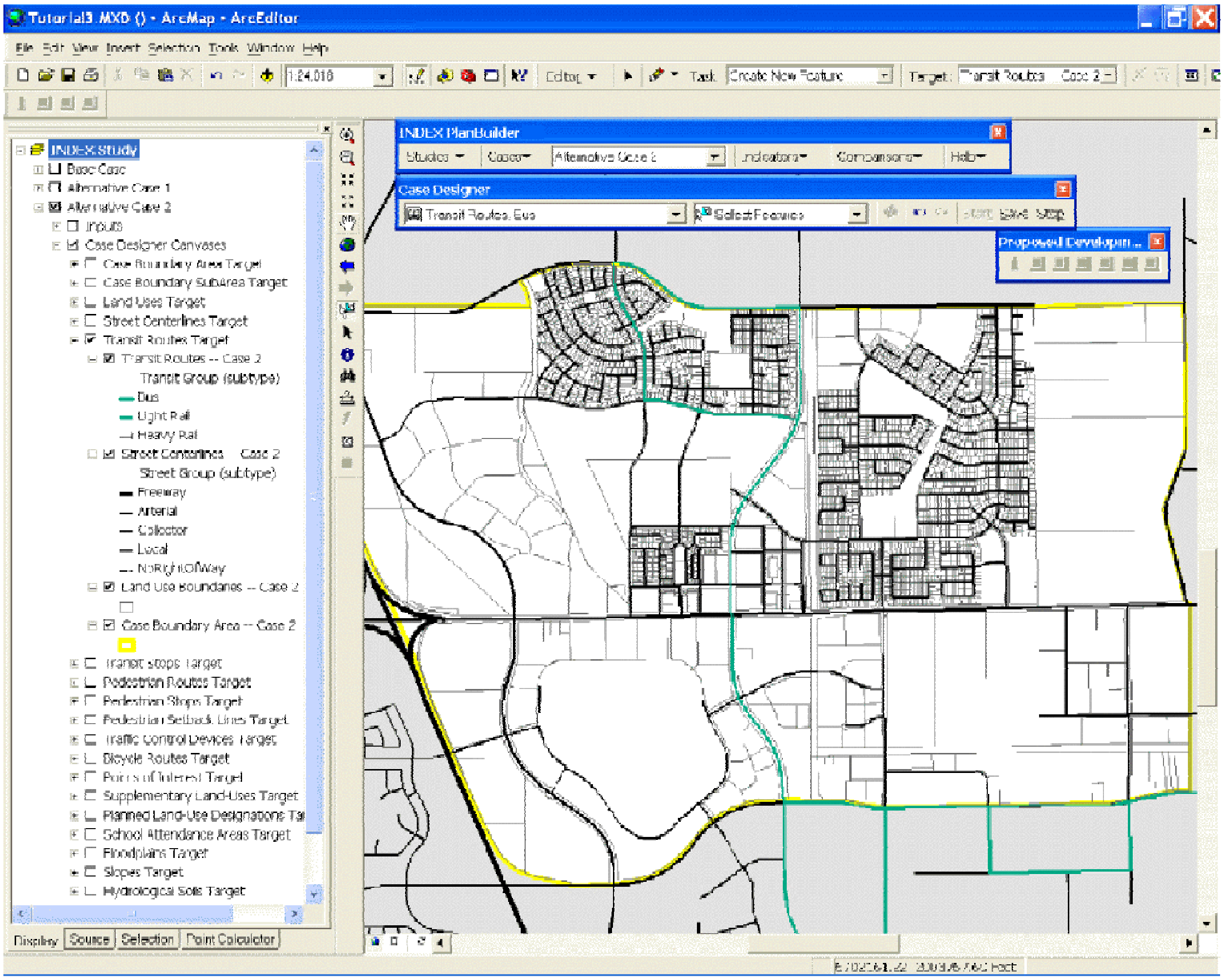


Save your edits.

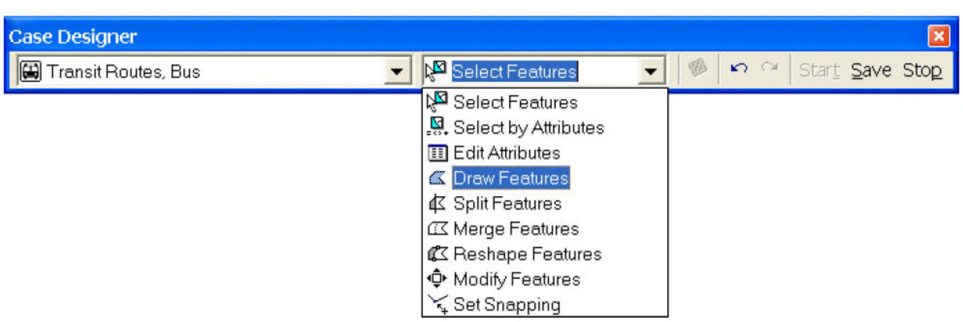
Improve Transit Coverage

One feature where the study area is deficient is transit service coverage. In this section you will improve the transit coverage by creating a new bus route with bus stops through the center of the study area.

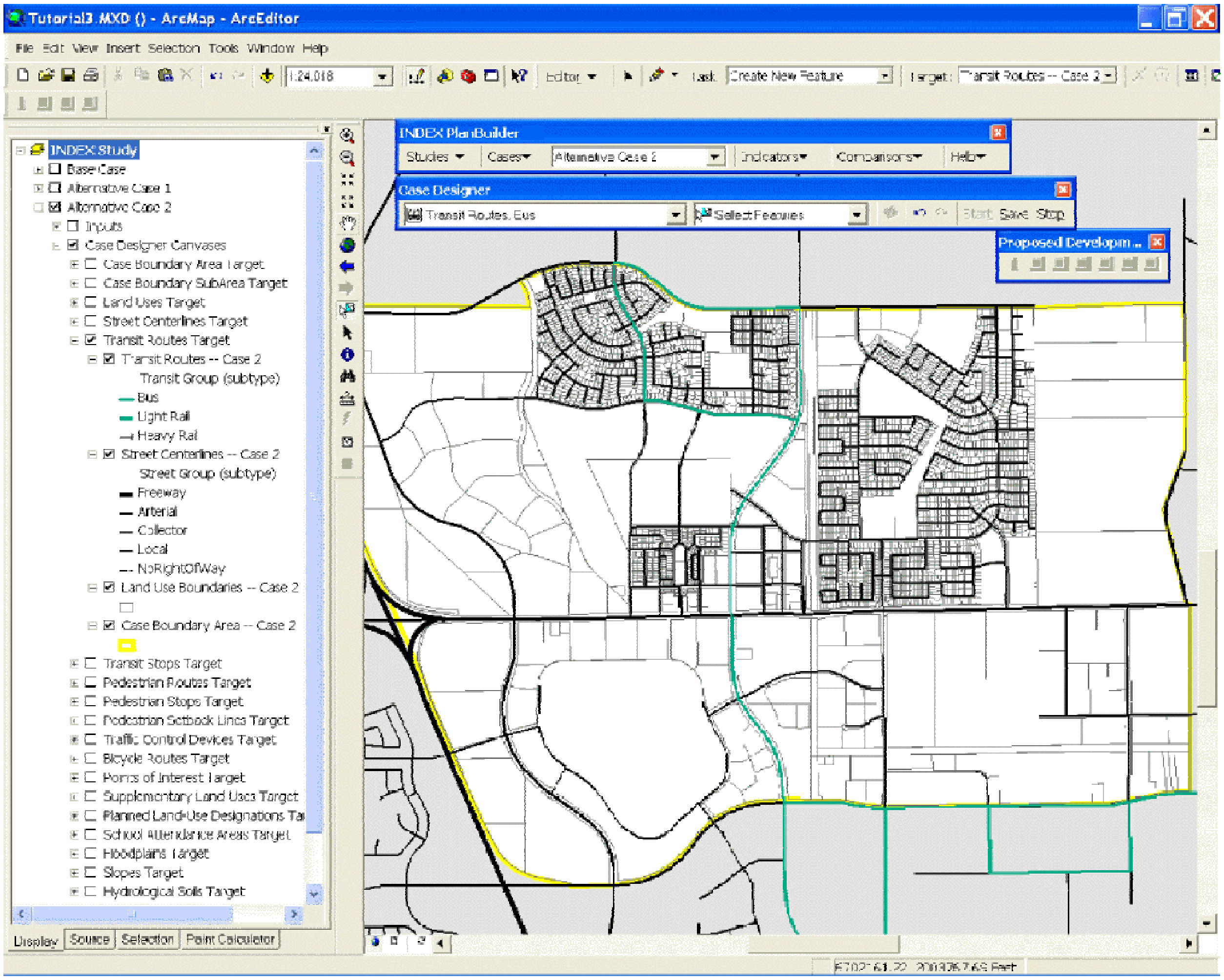
Activate Case Designer and make Bus Routes the active design target:



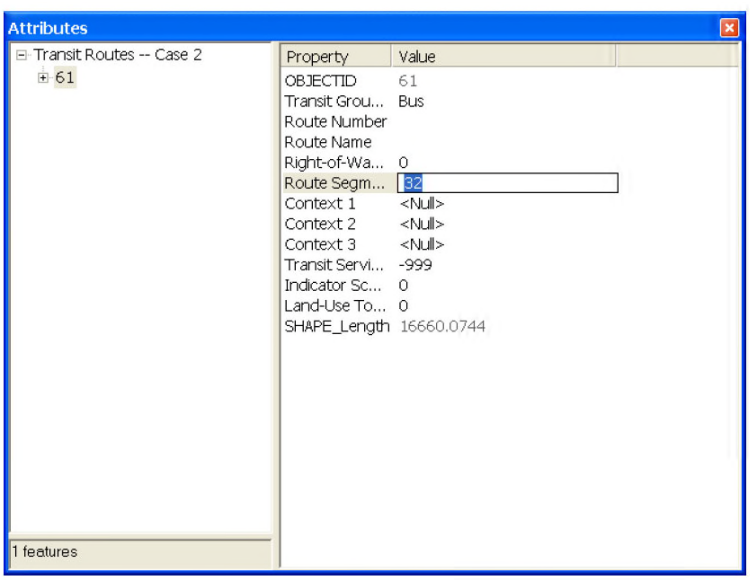
Select the Draw Features tool from the Case Designer toolbar:



Draw a bus route from the east to the west side of the study area:

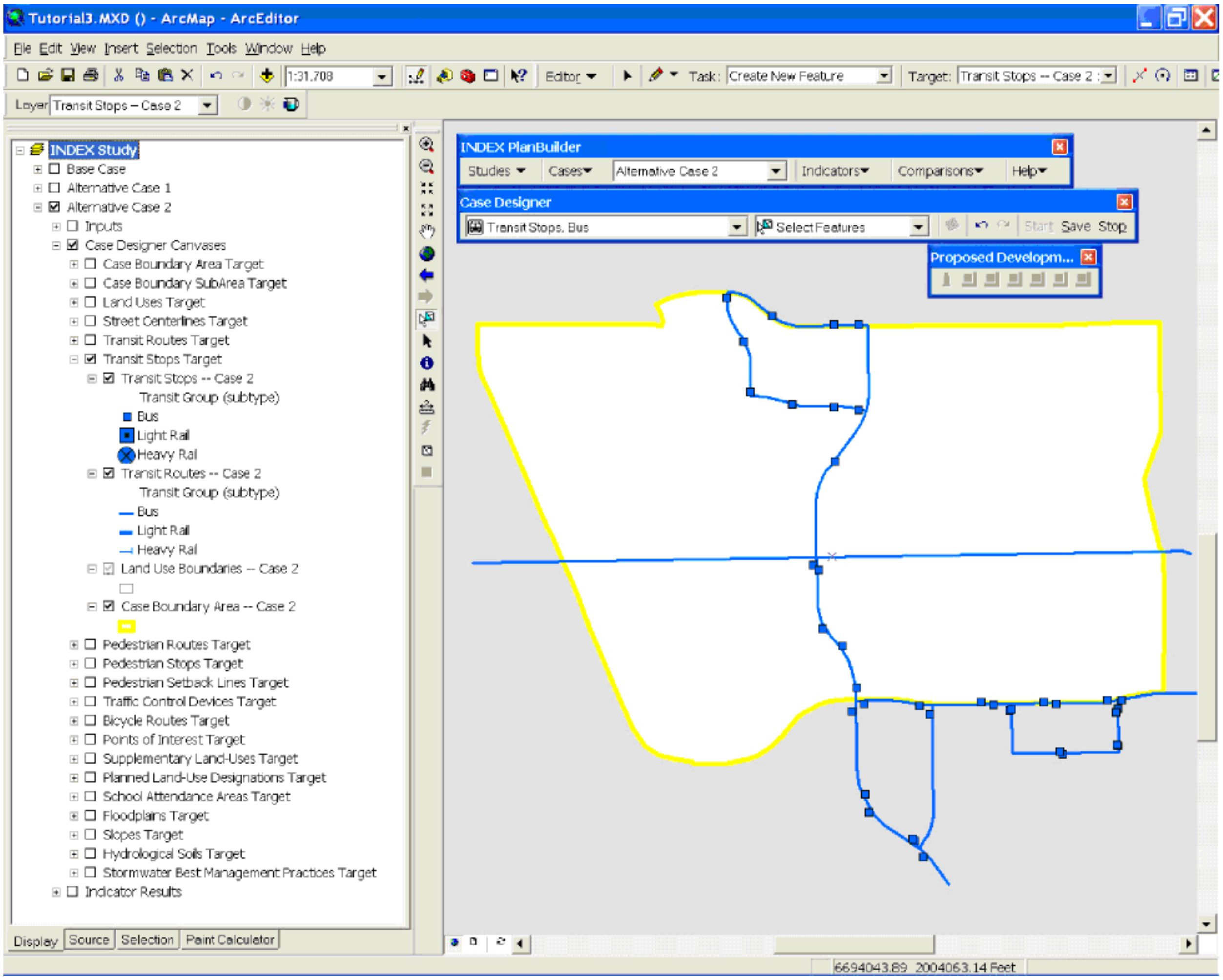


Launch the Edit Attributes tool from the Case Designer toolbar while the new transit line is still selected and change the headway to 32 vehicles per day:

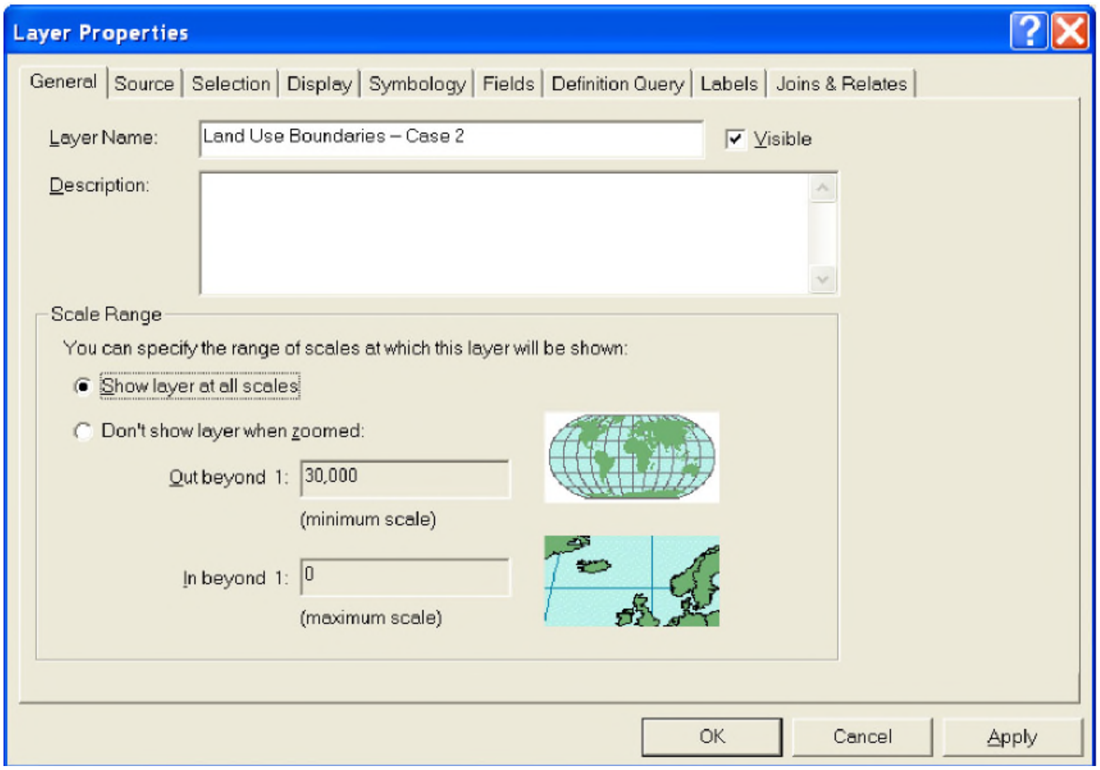


Save your edits.

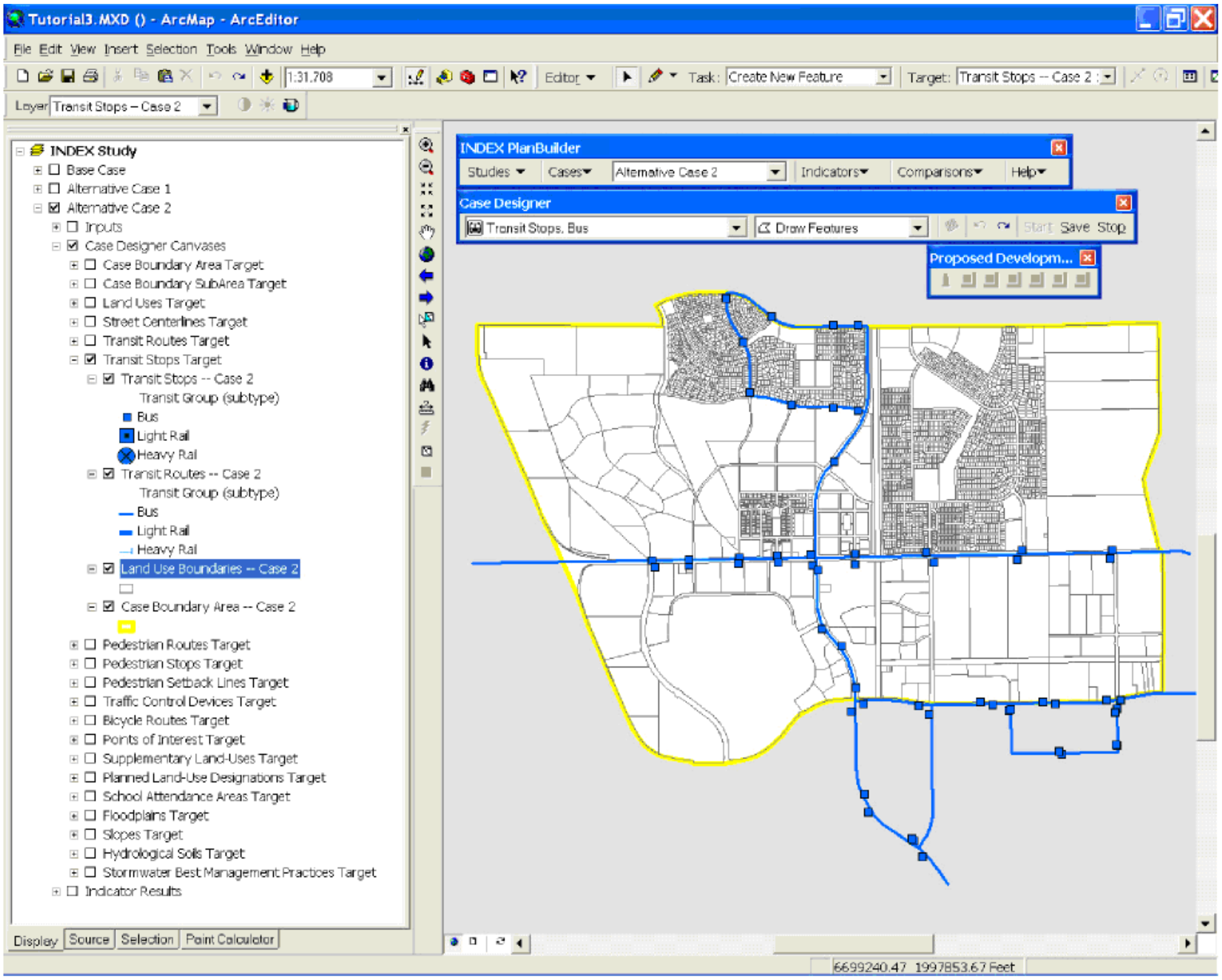
Next, add bus stops along the new transit line. Change the design target to Bus Stops:



The Land-Use Boundaries scale range is set to be viewable within 30,000 feet. Because parcels are not viewable at this scale, but would be helpful to see while siting new bus stops, you should zoom in to make them viewable. To view the Land-Use Boundaries either zoom into the study until the boundary lines are visible or right click on the Land-Use Boundaries in the TOC and set the scale range to show the layer at all scales:



Select the Draw Features tool from the Case Designer toolbar and place bus stops along the new bus route:



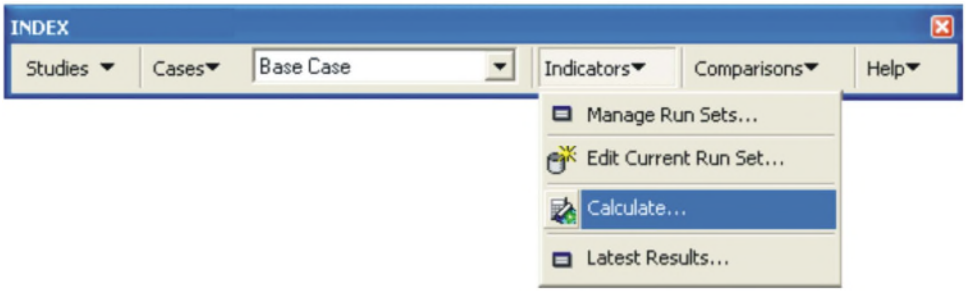
Stop editing and save your edits.

RERUN INDICATORS AND COMPARE CASES

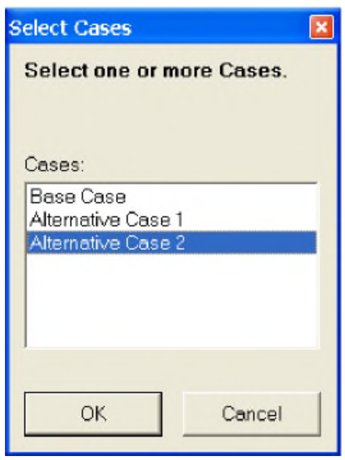
In this section you will evaluate the changes made to the development proposal by rerunning the indicators and comparing goal achievement.

Rerun Indicators

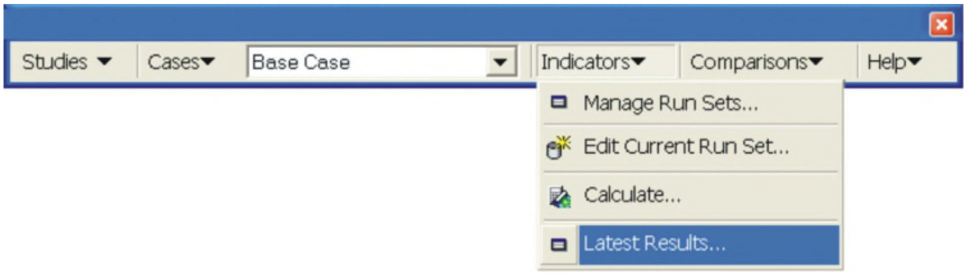
Select the Calculate option from the Indicators menu on the INDEX toolbar:



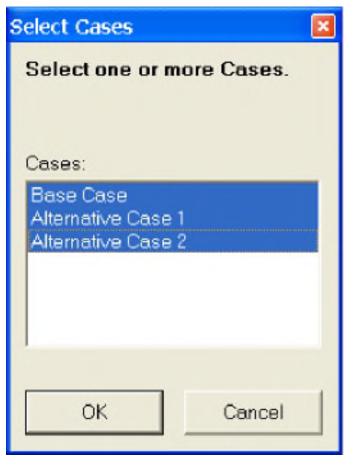
Select Alternative Case 2 and click the OK button:



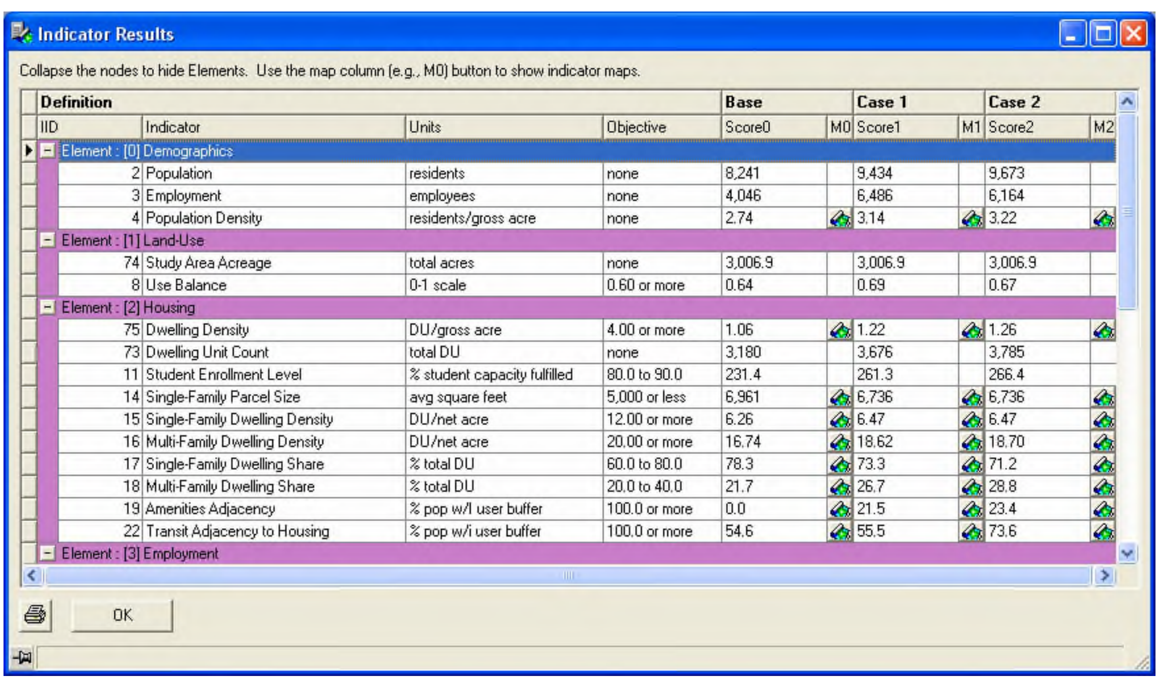
When the indicator run finishes, close the Indicator Results table and select the Latest Results option:



Select all three cases and click the OK button:



Expand the Indicator Results table so all three cases are showing and scroll through the results:



Indicator Results

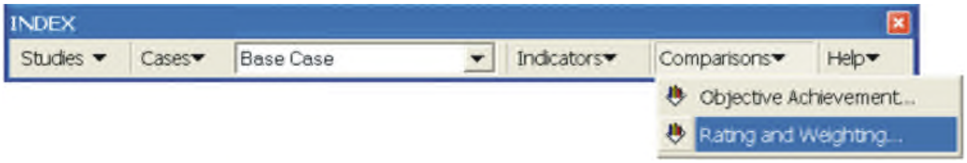
Collapse the nodes to hide Elements. Use the map column (e.g., M0) button to show indicator maps.

Definition				Base		Case 1		Case 2	
IID	Indicator	Units	Objective	Score0	M0	Score1	M1	Score2	M2
Element : [0] Demographics									
2	Population	residents	none	8,241		9,434		9,673	
3	Employment	employees	none	4,046		6,486		6,164	
4	Population Density	residents/gross acre	none	2.74		3.14		3.22	
Element : [1] Land-Use									
74	Study Area Acreage	total acres	none	3,006.9		3,006.9		3,006.9	
8	Use Balance	0-1 scale	0.60 or more	0.64		0.69		0.67	
Element : [2] Housing									
75	Dwelling Density	DU/gross acre	4.00 or more	1.06		1.22		1.26	
73	Dwelling Unit Count	total DU	none	3,180		3,676		3,785	
11	Student Enrollment Level	% student capacity fulfilled	80.0 to 90.0	231.4		261.3		266.4	
14	Single-Family Parcel Size	avg square feet	5,000 or less	6,961		6,736		6,736	
15	Single-Family Dwelling Density	DU/net acre	12.00 or more	6.26		6.47		6.47	
16	Multi-Family Dwelling Density	DU/net acre	20.00 or more	16.74		18.62		18.70	
17	Single-Family Dwelling Share	% total DU	60.0 to 80.0	78.3		73.3		71.2	
18	Multi-Family Dwelling Share	% total DU	20.0 to 40.0	21.7		26.7		28.8	
19	Amenities Adjacency	% pop w/i user buffer	100.0 or more	0.0		21.5		23.4	
22	Transit Adjacency to Housing	% pop w/i user buffer	100.0 or more	54.6		55.5		73.6	
Element : [3] Employment									

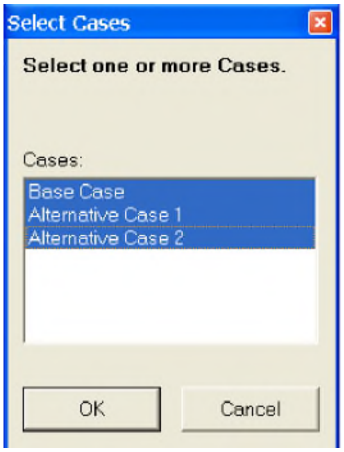
OK

Close the Indicator Results table.

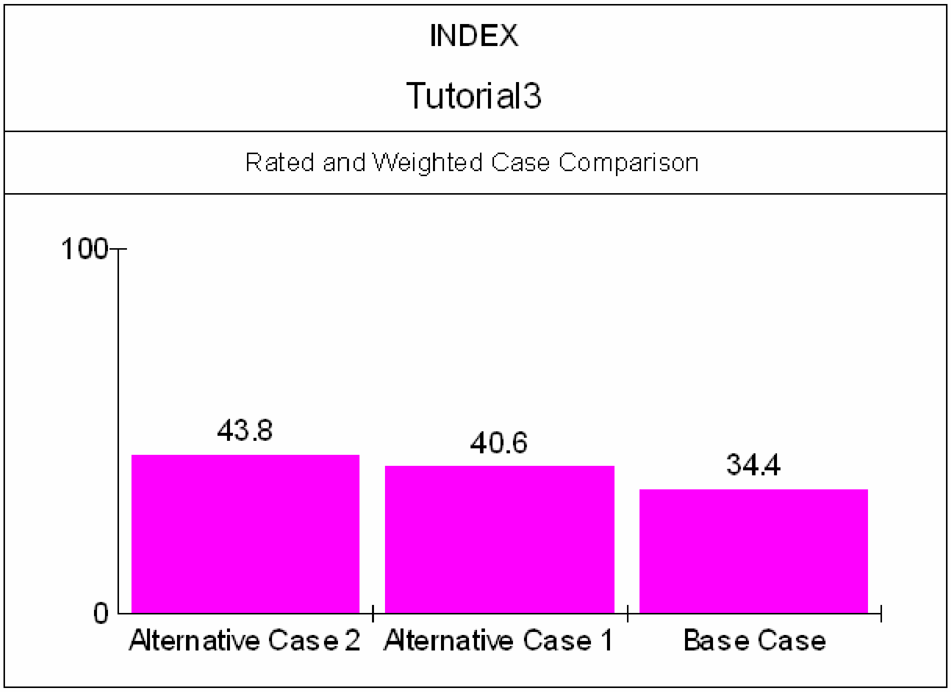
Compare the goal achievement of the two cases side-by-side with the RAW bar chart. Open the Rating and Weighting bar from the Comparisons menu on the INDEX toolbar:



Select all three cases:



The RAW bar chart reveals the positive impact of the changes made to the original development proposal:



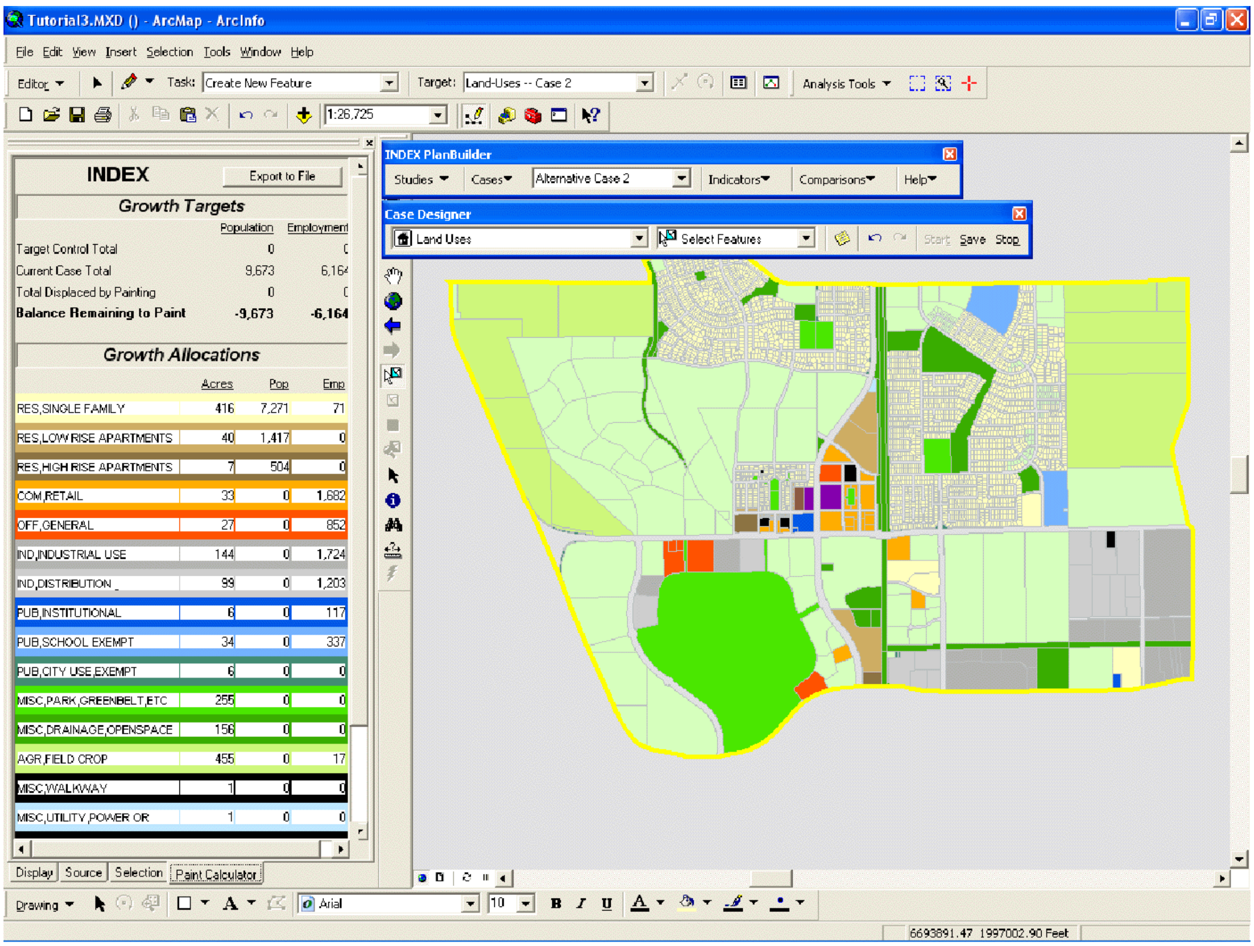
Note: actual scores may vary as they depend on individual edits

Appendix A
PAINT TARGETED GROWTH ALLOCATION

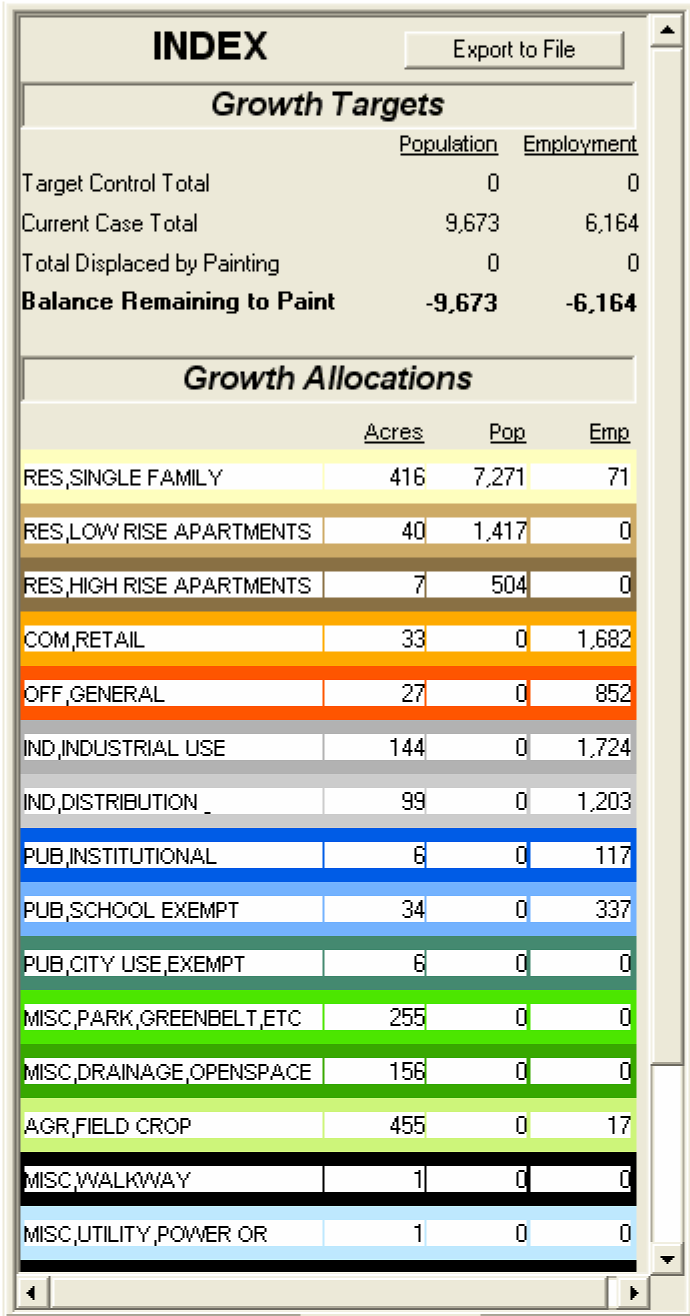
In this Appendix you will set growth allocation targets for Population and Employment, use Case Designer to achieve these targets, and then run indicators to ensure your allocation improves the scenario's RAW score.

The Paint Calculator

Select Alternative Case 2 from the INDEX toolbar Case List. In the ArcMap TOC, choose the Paint Calculator tab. The Paint Calculator is displayed for the current case:



Note there are currently no growth targets defined:



INDEX Export to File

Growth Targets

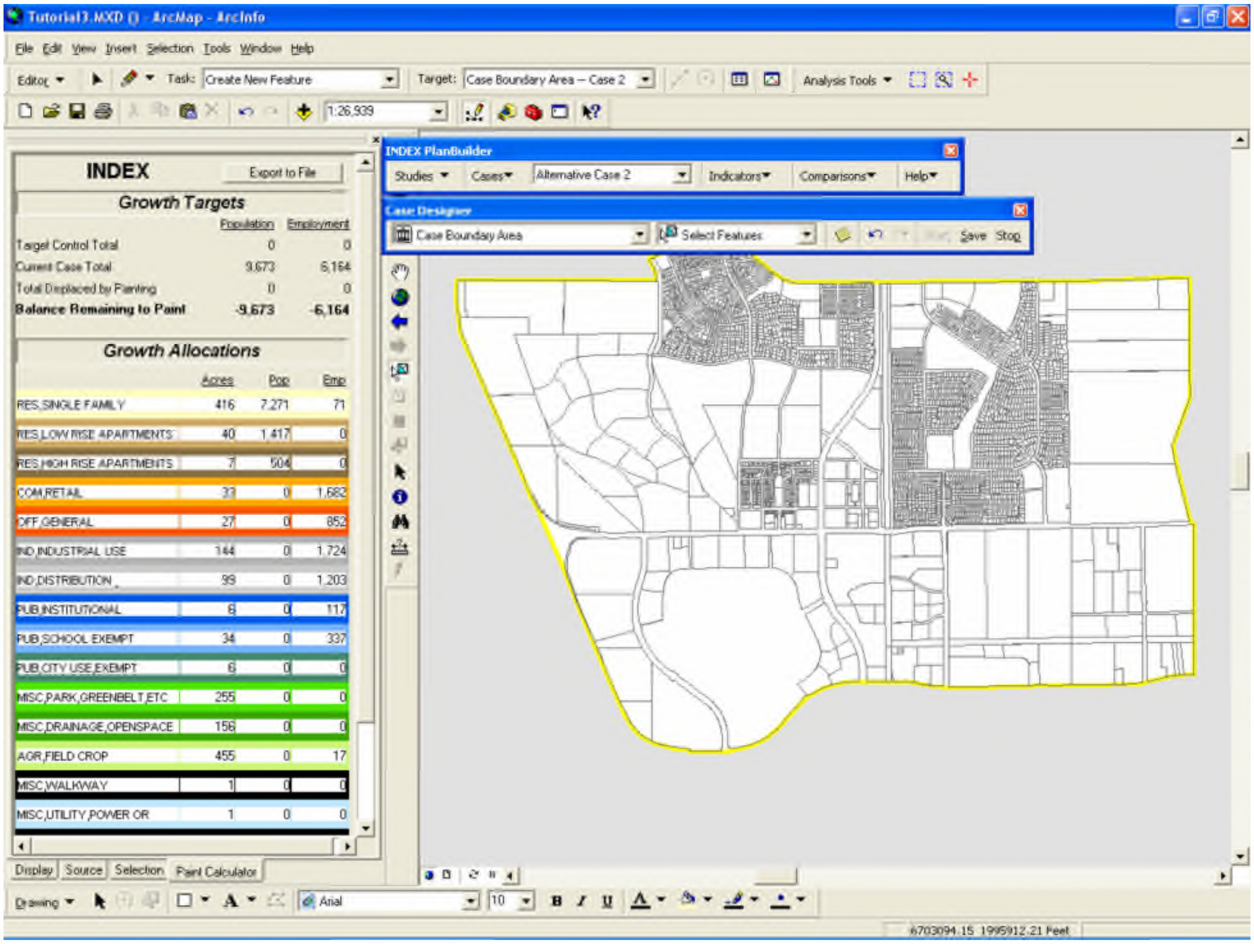
	Population	Employment
Target Control Total	0	0
Current Case Total	9,673	6,164
Total Displaced by Painting	0	0
Balance Remaining to Paint	**-9,673**	**-6,164**

Growth Allocations

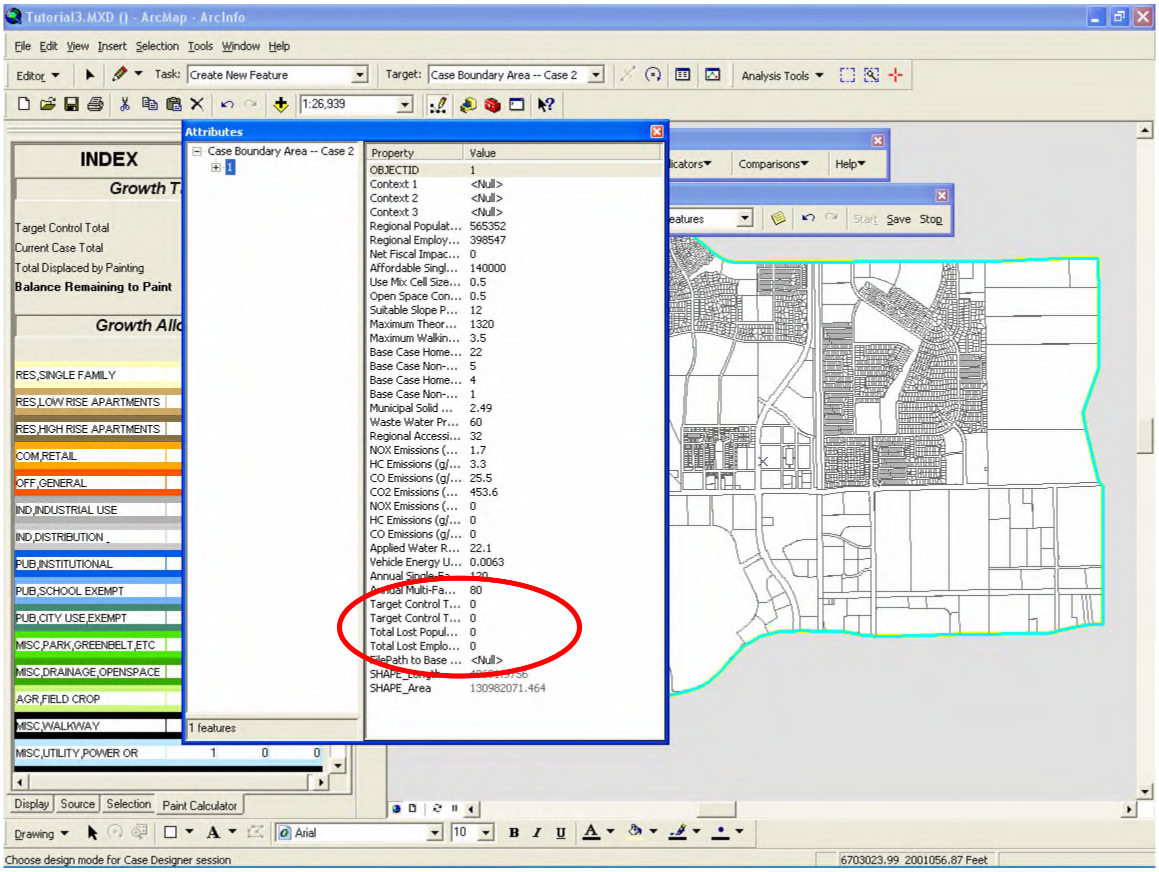
	Acres	Pop	Emp
RES,SINGLE FAMILY	416	7,271	71
RES,LOW RISE APARTMENTS	40	1,417	0
RES,HIGH RISE APARTMENTS	7	504	0
COM,RETAIL	33	0	1,682
OFF,GENERAL	27	0	852
IND,INDUSTRIAL USE	144	0	1,724
IND,DISTRIBUTION _	99	0	1,203
PUB,INSTITUTIONAL	6	0	117
PUB,SCHOOL EXEMPT	34	0	337
PUB,CITY USE,EXEMPT	6	0	0
MISC,PARK,GREENBELT,ETC	255	0	0
MISC,DRAINAGE,OPENSPACE	156	0	0
AGR,FIELD CROP	455	0	17
MISC,WALKWAY	1	0	0
MISC,UTILITY,POWER OR	1	0	0

Setting Growth

Growth Targets for Population and Employment are saved as attributes of the Case Boundary Area feature class, so to change them you need to edit that target. Select the Cases > Current Case Designer > Case Designer Toolbar menu option and select the Case Boundary Area target from the list:



Click anywhere on the polygon to select it and then choose the Edit Attributes design mode from the list. The two target attributes are near the end of the list:



Enter the following growth targets:

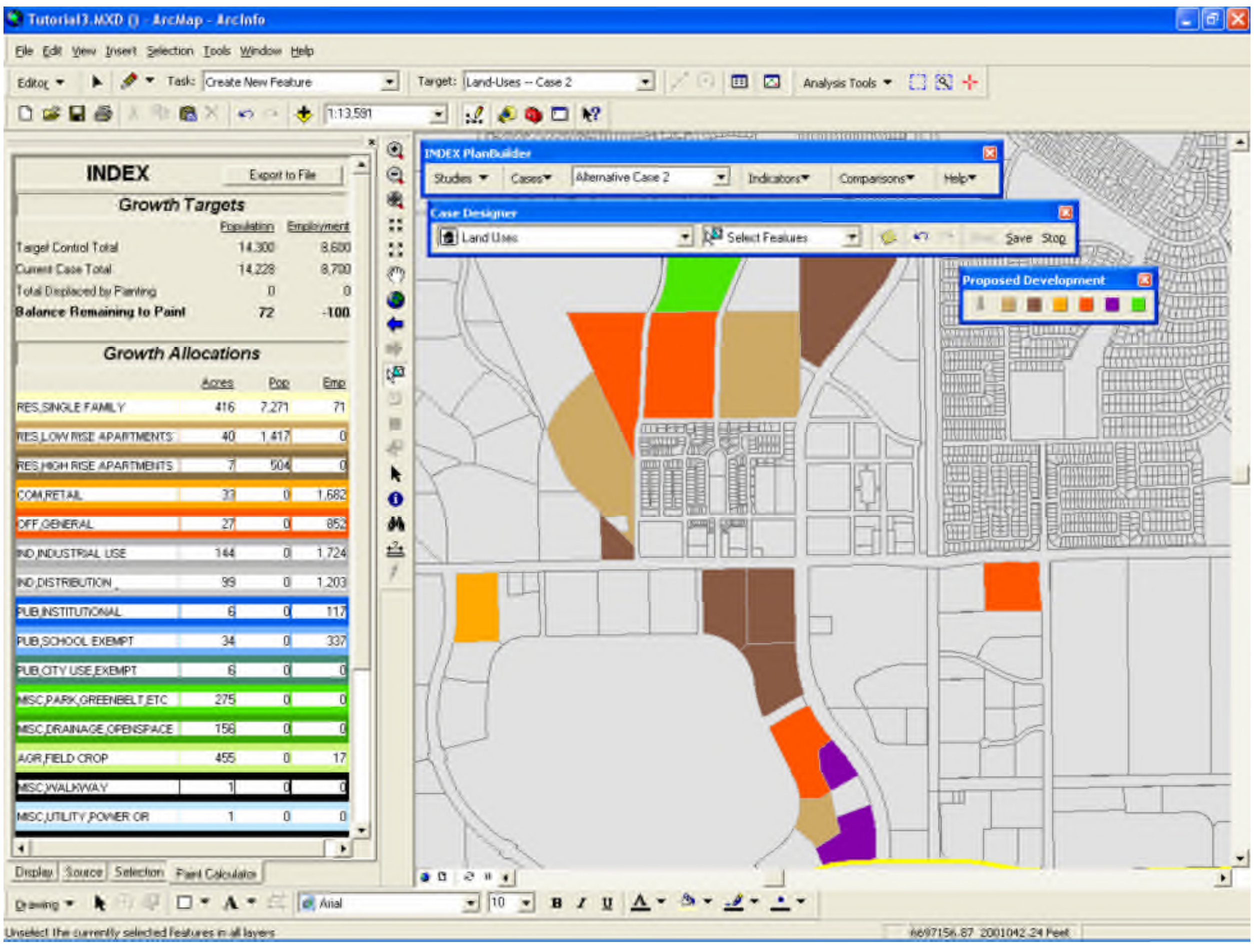
Target Control Total Population = 14,300

Target Control Total Employment = 8,600

Painting Growth

We want to focus growth around transit, amenities, and parks in order to maximize related indicator scores.

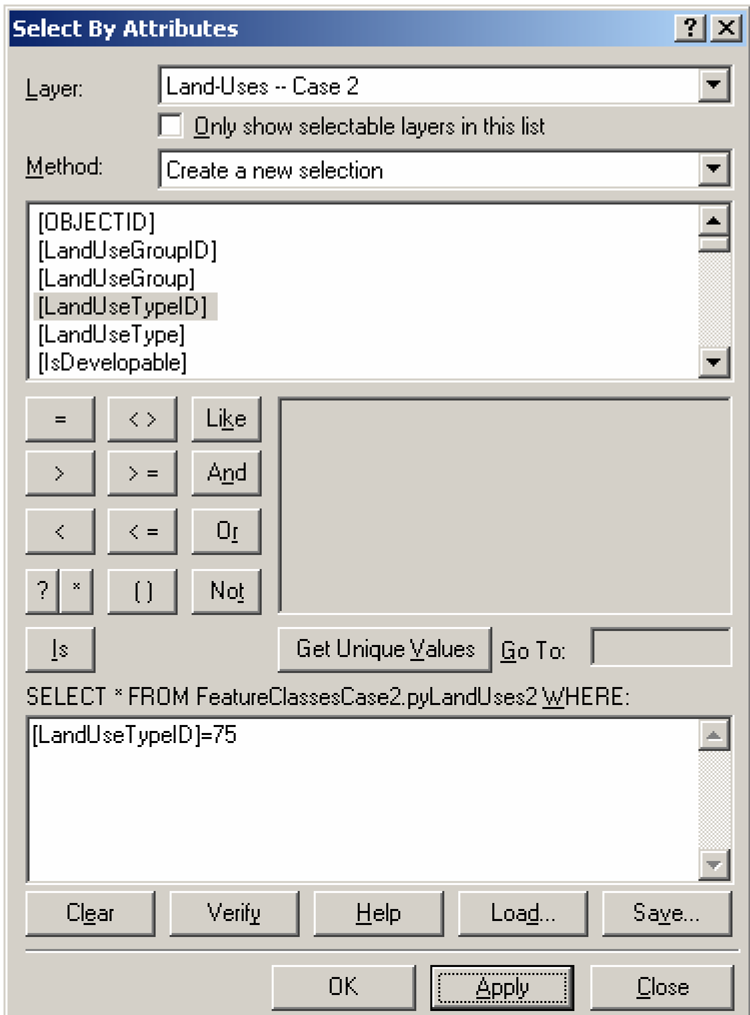
To begin painting, select the Cases > Current Case Designer > Paint Palette Toolbar menu option and choose the "Proposed Development" toolbar. Then, paint the following vacant polygons with the indicated paints (NOTE: for clarity, the Land-Uses rendering below has been filtered to show only newly painted vacant polygons)



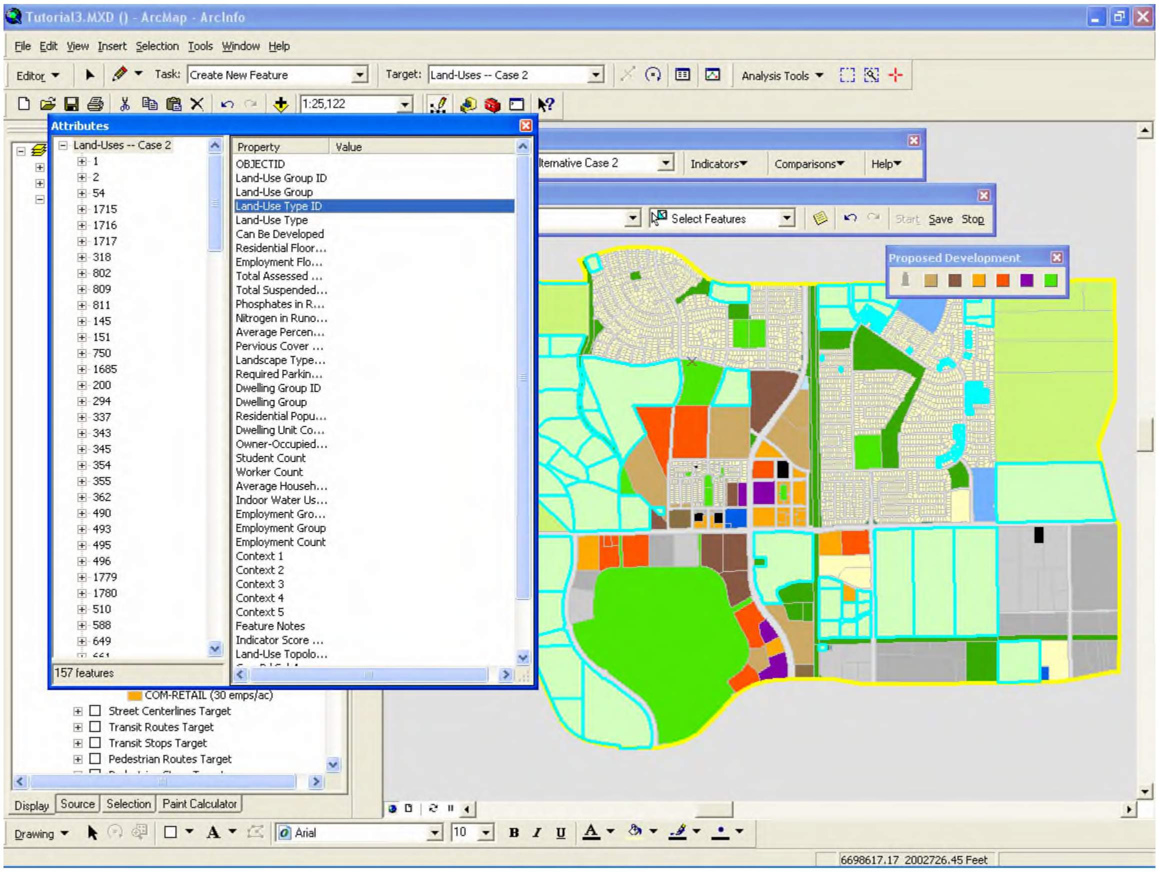
"Mass" Painting Land-Uses

Now that we have achieved our targeted growth, we will convert the remaining vacant polygons into Open Space. Manually finding and clicking every single vacant polygon would be time consuming, so instead we will perform a mass change by selecting all VACANT polys (with LandUseTypeID=75). Then, by simply changing their LandUseTypeID value (in this study, Open Space is defined as LandUseTypeID 55) all properties appropriate to Open Space will be transferred onto the poly as if we painted it manually.

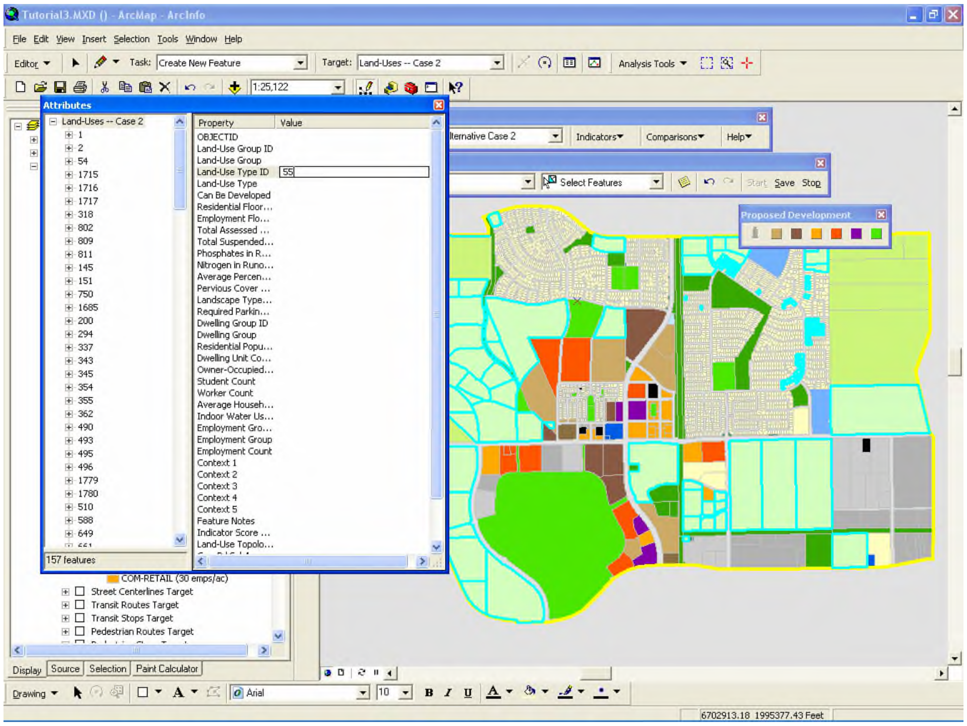
First, Choose the Select by Attributes design mode. Select where LandUseTypeID=75:



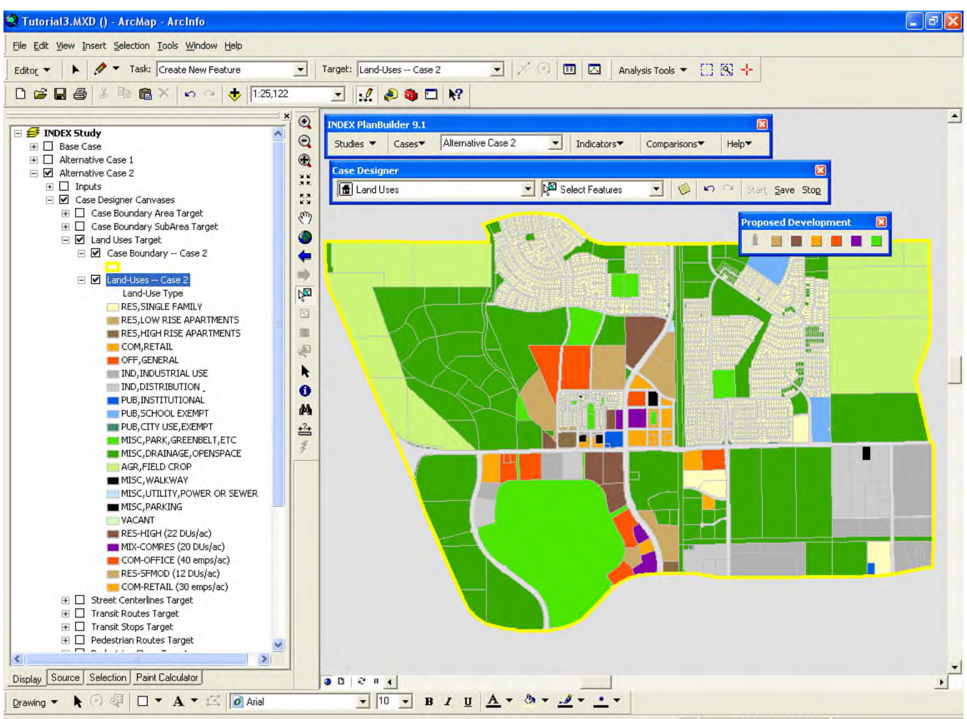
153 polygons are selected. To edit them all, choose the Edit Attributes design mode and click at the top of the selected list in the left pane to choose to edit all selected polygons:


Tutorial3.MXD () - ArcMap - ArcInfo
File Edit View Insert Selection Tools Window Help
Editor
Task: Create New Feature
Target: Land-Uses -- Case 2
Analysis Tools
1:25,122
Attributes
Land-Uses -- Case 2
157 features
Property
Value
OBJECTID
Land-Use Group ID
Land-Use Group
Land-Use Type ID
Land-Use Type
Can Be Developed
Residential Floor...
Employment Flo...
Total Assessed ...
Total Suspended...
Phosphates in R...
Nitrogen in Runo...
Average Percen...
Pervious Cover ...
Landscape Type...
Required Parkin...
Dwelling Group ID
Dwelling Group
Residential Popu...
Dwelling Unit Co...
Owner-Occupied...
Student Count
Worker Count
Average Househ...
Indoor Water Us...
Employment Gro...
Employment Group
Employment Count
Context 1
Context 2
Context 3
Context 4
Context 5
Feature Notes
Indicator Score ...
Land-Use Topolo...
lternative Case 2
Indicators
Comparisons
Help
Select Features
Start Save Stop
Proposed Development
COM-RETAIL (30 emps/ac)
Street Centerlines Target
Transit Routes Target
Transit Stops Target
Pedestrian Routes Target
Display Source Selection Paint Calculator
Drawing
Arial
10
6698617.17 2002726.45 Feet

Finally, enter 55 into the LandUseTypeID field and hit Enter. You will see the painting progress on the ArcMap status bar:

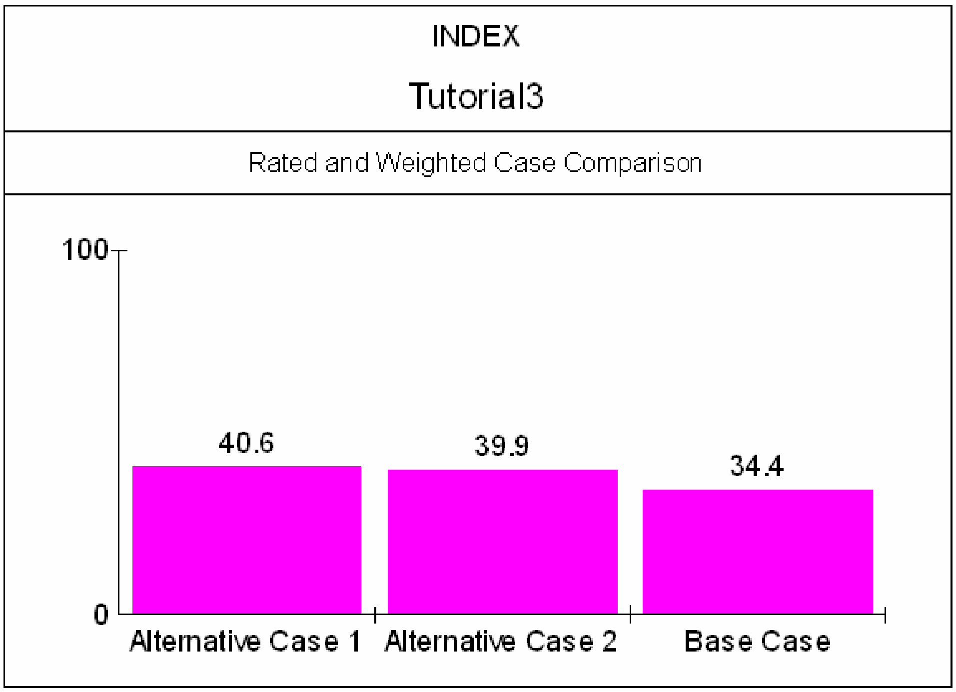


And now all Vacant polygons are Open Space:



Re-Run Indicators and Compare Scores

Select the Calculate option from the Indicators menu on the INDEX toolbar. Only choose to re-run Alternative Case 2. When the indicator run is complete, Choose the Comparisons > Rating and Weighting menu option and select all three cases. The following chart is displayed:



Note: actual scores may vary as they depend on individual edits