



Discover Cube Land

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About this Document

Cube Land allows you to model the interaction between real estate markets and transportation systems. Using Cube Land, you can forecast the locations of households and businesses within a study area, and see how these locations might change with various transportation and policy assumptions. Cube Land also models real estate development and rent values, and can be used to study the effects of land use regulations.

This document introduces you to Cube Land and demonstrates some basic exercises using Cube Land with the Cubetown demonstration model. Topics include:

- Allocating socio-economic totals
- Studying transportation projects

Allocating socio-economic totals

This exercise shows how you might use Cube Land to allocate revised socio-economic control totals for a study area to transportation analysis zones for further analysis.

- To open and examine the Cube Land model

1. Open the Discover Cube catalog

- a. Start Cube.

You can:

- Double-click the Cube icon on your desktop.



- Click the **Start** button, point to **All Programs**, point to **Citilabs**, and choose **Cube** (in Windows XP).

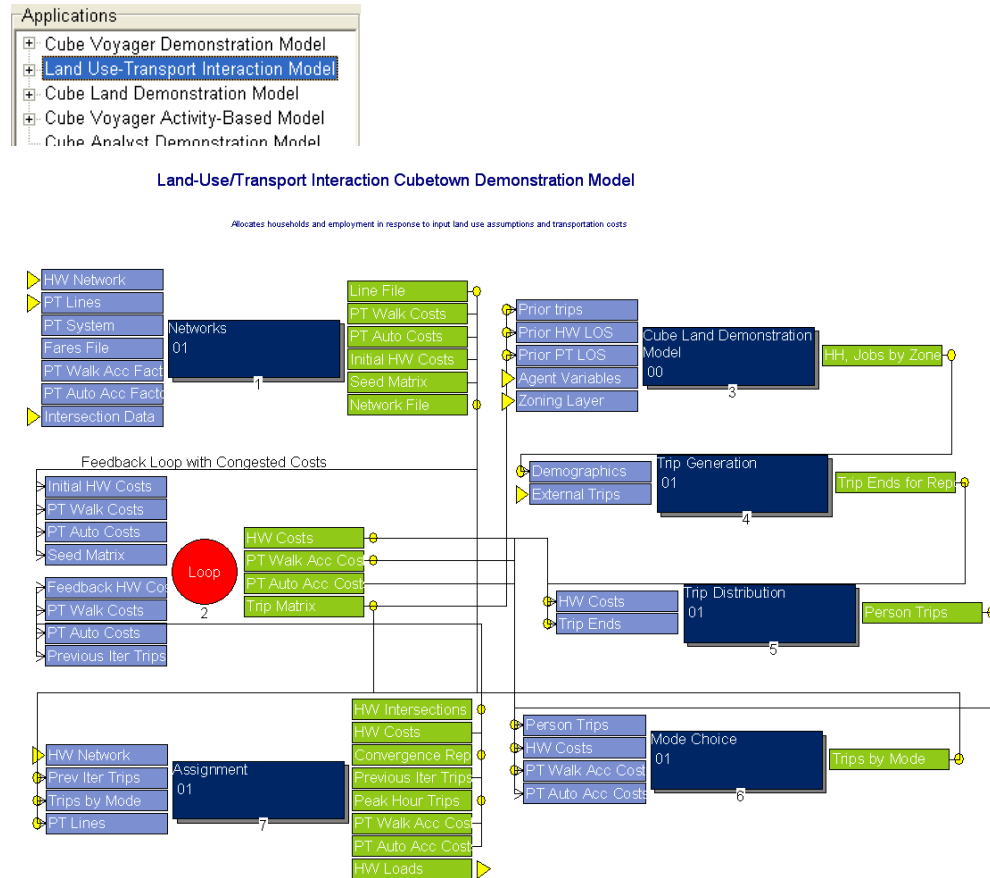
Cube displays the Welcome to Cube dialog box.



- b. Select **Open Discover Cube catalog** and click **OK**.

Cube opens the Discover Cube catalog in Scenario Manager. The catalog shows the scenarios, data, and applications used with the Cubetown demonstration models.

2. Under **Applications** in Scenario Manager, double-click **Land Use – Transport Interaction Model** to open the combined Cubetown land use and transport model.



The dark blue boxes represent steps in the model, the light blue boxes show inputs to each step, and the green boxes show the outputs. Lines represent the links between outputs from one step and inputs to the next step.

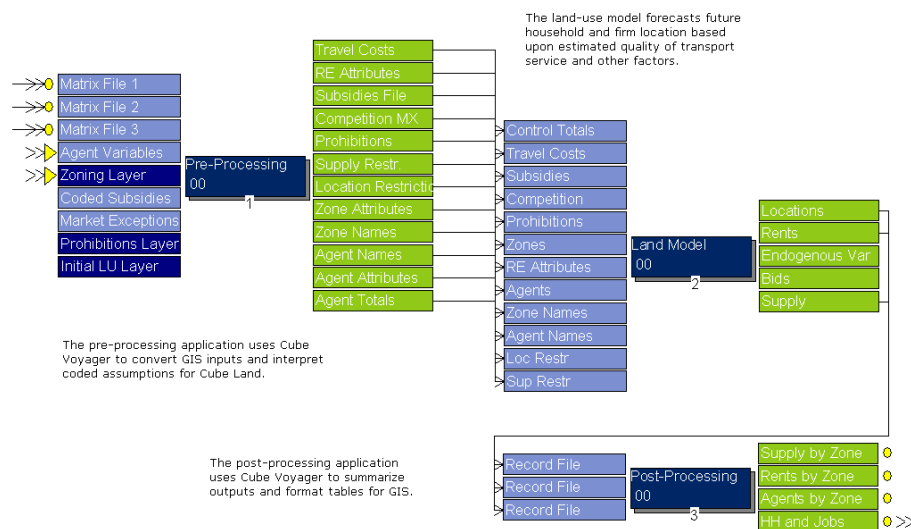
The model has seven steps:

- Network processing – prepares input networks and initial travel cost matrices
- Feedback loop – copies and replaces trip and travel cost matrices with their current values from the transportation model outputs
- Cube Land Demonstration Model – forecasts household and firm agent location based upon current transportation model outputs and zonal variables. Steps 3 through 7 are included in the feedback loop.
- Trip Generation – forecasts trip productions and attractions by zone based upon the household and firm locations output from Cube Land
- Trip Distribution – applies a gravity model to forecast person-trips by purpose
- Mode Choice – applies a logit choice model to forecast person-trips by mode

- Assignment – converts person-trips to peak hour vehicle-trips and performs highway as well as public transit network assignment with congested costs

In effect, the Cube Land Demonstration model shown here is integrated with a typical four-step Cube Voyager travel demand model. However, Cube Land can be integrated with any type of model system, including activity-based models and other software. In addition, if you have already developed all the necessary input files, you could run Cube Land by itself, without feedback to a travel demand model.

3. Double-click on the **Cube Land Demonstration Model** program group box to open the Cubetown Cube Land model.



This model has three steps:

- Pre-Processing – use Cube Voyager to convert and format Cube Land input data
- Land Model – run the Cube Land program
- Post-Processing – use Cube Voyager to convert and format Cube Land outputs

The Cube Land inputs include:

- Zone-to-zone transportation network time, distance and cost matrices, or “skims”
- Aggregate characteristics and total counts for each type of location decision-maker, or “agent”. Examples of agent types include medium-income three-person households and factories with 100 employees on average.

- Land use zoning and regulations, such as the total area available in each zone for designated land uses, and the typical characteristics of real estate options by type, as well as prohibited land uses and subsidies by zone.
- Initial characteristics of zones, such as the share of developable land used by type.

Some of the Cube Land inputs are generated by using Cube Voyager to interpret and re-format travel demand model and GIS files in the structures expected by Cube Land.

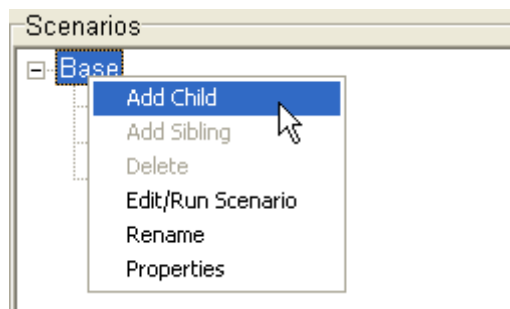
The Cube Land outputs include:

- The number of households and businesses of each type in each zone
- Rent associated with each type of real estate option in each zone
- Bids, the willingness of each agent to pay for each real estate option in each zone
- Real estate supply, such as dwelling units and commercial units by type and zone

Some of the Cube Land outputs are processed by Cube Voyager to summarize zonal values and write attribute tables to shapefiles that can be viewed in the GIS Window.

■ To run a Cube Land scenario

1. Create the Growth scenario.
 - a. Under **Scenarios** in Scenario Manager, right-click on **Base**, and select **Add Child**.



- b. Name the new scenario Growth and enter a description in the Scenario Properties dialog. Cube opens the Scenario Editing window for the Growth scenario.

Cubetown Metropolitan Transport Authority
cube 5

Application: Land Use-Transport Interaction Model

Highway network: C:\Cubetown\Inputs\cubetown.mdb\NoBuild Browse ... Edit ...

Intersections: C:\Cubetown\Inputs\base.ind Browse ... Edit ...

Public transit lines: C:\Cubetown\Inputs\cubetown.mdb\BasePT Browse ... Edit ...

Externally-based trip ends table: C:\Cubetown\Inputs\cubetown.mdb\EITrips Browse ... Edit ...

Truck trip table: C:\Cubetown\Base\FORCASTEDTRUCK.MAT Browse ... Edit ...

Growth Factor for EE Trips (i.e. 1.0 for Base, 1.5 for forecast, etc) 1.5

Set closure criteria: select the acceptable % change between iterations in public transit trips

0.5
 1
 2.5

Would you like to run a volume averaging assignment (faster)

Value of Time (Per Hour) 5.25

Socio-economic control totals C:\Cubetown\Inputs\SE_Totals.DBF Browse ... Edit ...

Zone-based land use regulations C:\Cubetown\Inputs\cubetown.mdb\Zoning Browse ... Edit ...

Save Close Run

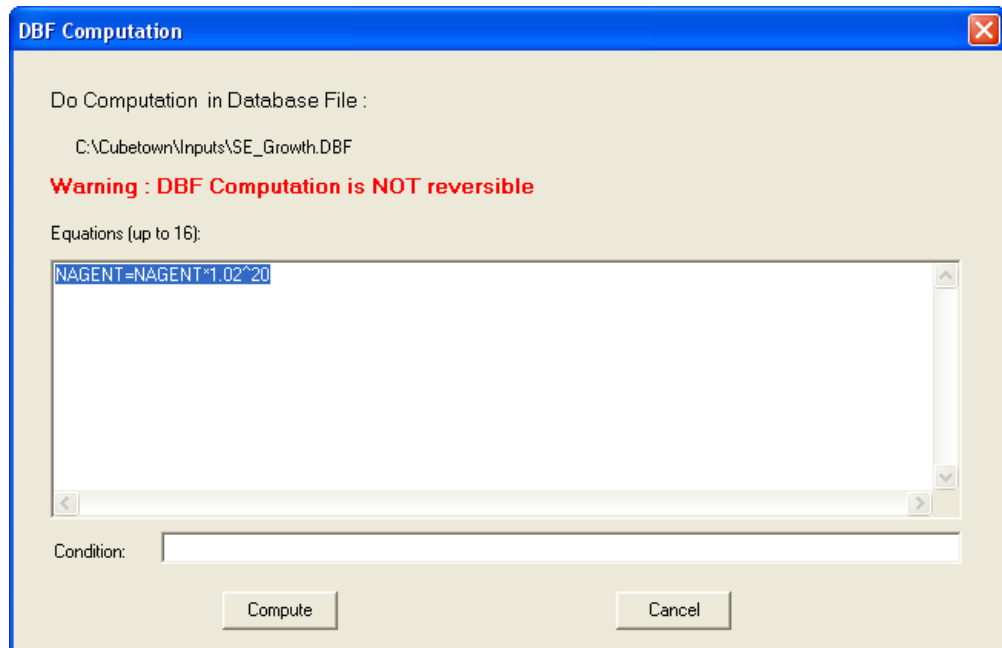
2. Change the **Growth Factor for EE Trips** field to 1.5.
3. Edit the control totals.
 - a. Click **Edit...** next to the line for **Agent attributes and control totals**.
 - b. Cube recognizes that the file is shared with the parent scenario and asks if you want to make a copy of the file for the current scenario. Click the **Yes** button.
 - c. Name the file **SE_GROWTH.dbf** and store it in the **C:\Cubetown\Inputs** folder. Cube opens the **SE_GROWTH.dbf** file.

DESAGENT	DSCAGGRA	IDAGENT	IDMARKET	IDAGGRA	UPPERBB	INCOME	PERSONS	NAGENT
Income 1 Size 1	Size 1	1	1	1	88	750	1	3838
Income 1 Size 2	Size 2	2	1	1	88	750	2	1908
Income 1 Size 3	Size 3	3	1	1	88	750	3	1004
Income 1 Size 4	Size 4	4	1	1	88	750	4	377
Income 1 Size 5	Size 5	5	1	1	88	750	5.9	684
Income 2 Size 1	Size 1	6	1	2	88	2167	1	1706

This table contains a row for each household or firm type in the model, and

columns corresponding to the attributes of the household or firm type. In particular, the required column NAGENT contains the number of members of each household or firm category, i.e. the total number of decision-making “agents” to be located within the model.

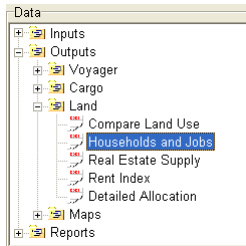
- d. Go to the **Database** menu and select **Compute...** to apply a simple recursive growth rate calculation to the columns of the table. Type “NAGENT=NAGENT*1.02^20” in the **Equations** field, then click **Compute**.



You can also modify the table cells directly in the Cube table editor window. In real-world models, this table might be generated by regional macroeconomic and demographic forecasting models, such as a spatial input-output analysis package.

- e. Close the table.
4. Run the model.
 - a. Click **Save**, then **Run** in the Scenario Editing window. The Task Monitor window opens, showing the progress of the run. When complete, a Task Run Result dialog box opens.
 - b. Click **OK**.
 5. View the model outputs.


- a. Under **Data** in Scenario Manager, expand the folder named **Outputs**, and the sub-folder named **Land**.



- b. Double-click on **Households and Jobs**.
Cube opens the ZO_HHJOBS.SHP file, which is based upon the output of the land-use model.
- c. From the Cube menu, select **Post**, then point to **Node/Point Chart...**
- d. Apply the Boundary Layer Node Chart settings shown below, and click **OK**.

Boundary Layer Node Chart Settings

Set: 1:Jobs by type Name: Jobs by type

Chart Type:  Min. Size: 6 Size By: Sum of values

Orientation: Geographic Arithmetic

3D Chart Show Polygon

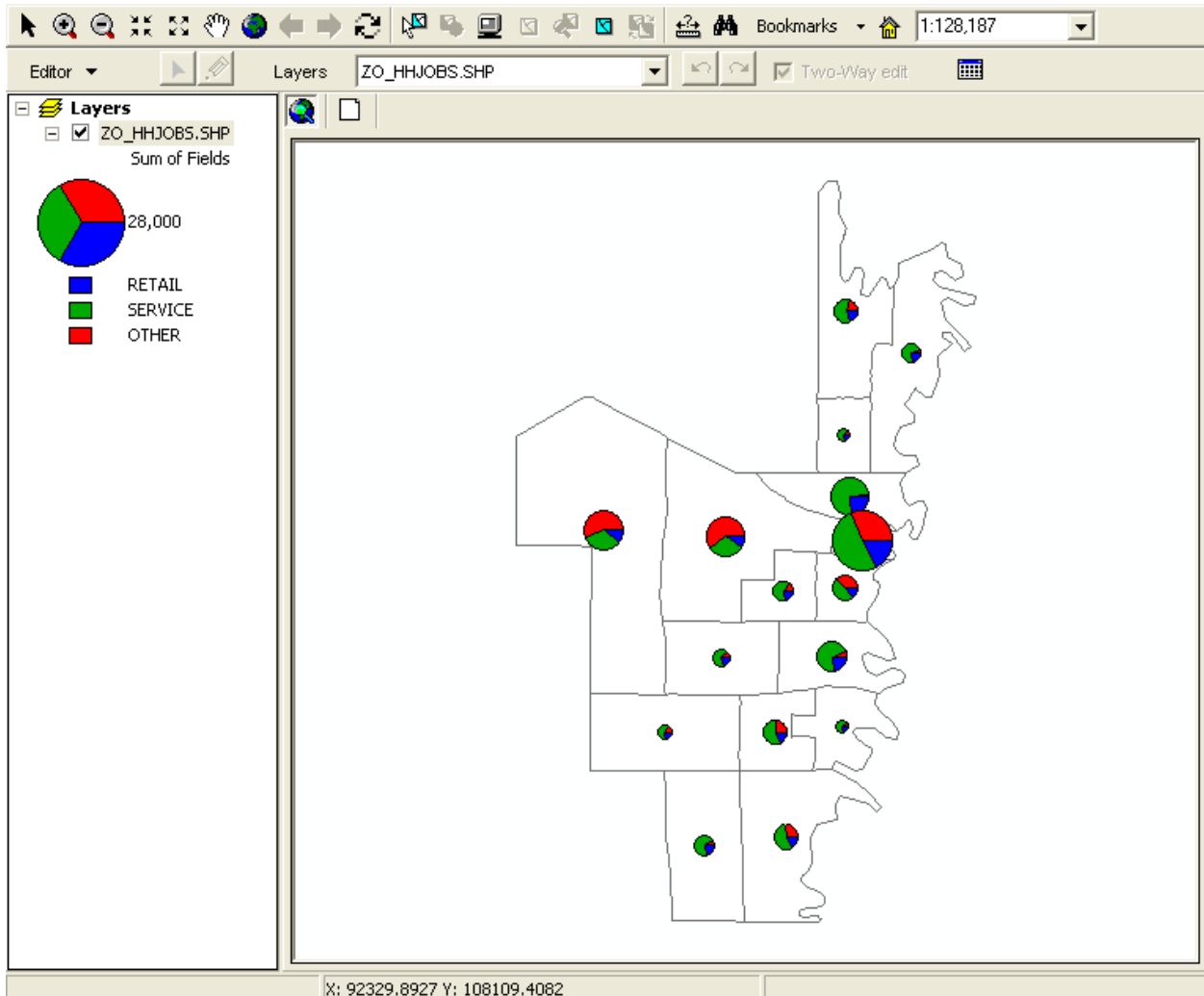
Attributes	Color Settings	Value Range
RETAIL	<input type="radio"/> Node Color <input checked="" type="radio"/> Fix Color <input type="radio"/> Dynamic Color Color	208.18-2464.73
SERVICE	<input type="radio"/> Node Color <input checked="" type="radio"/> Fix Color <input type="radio"/> Dynamic Color Color	651.75-7716.3
OTHER	<input type="radio"/> Node Color <input checked="" type="radio"/> Fix Color <input type="radio"/> Dynamic Color Color	72.15-4627.28
	<input type="radio"/> Node Color <input checked="" type="radio"/> Fix Color <input type="radio"/> Dynamic Color Color	
	<input type="radio"/> Node Color <input checked="" type="radio"/> Fix Color <input type="radio"/> Dynamic Color	
	<input type="radio"/> Node Color <input checked="" type="radio"/> Fix Color <input type="radio"/> Dynamic Color	
	<input type="radio"/> Node Color <input checked="" type="radio"/> Fix Color <input type="radio"/> Dynamic Color	
	<input type="radio"/> Node Color <input checked="" type="radio"/> Fix Color <input type="radio"/> Dynamic Color	

Scale Range to Show Posting: 0 to 0

Key Value: Key1: 0 Key2: 0 Key3: 0 Key4: 0 Key +

Key Min. Width: Key1: 1 Key2: 1 Key3: 1 Key4: 1 Key -

Cube displays a pie chart map showing the location and type of jobs in the study area as forecast by the Cube Land model. Larger circles correspond to zones with more employment, and the size of the slices in each circle represents the relative share of the corresponding type of employment.



You could also create a bar chart showing the distribution of households by size category (HH1 through HH4), or overlay other data, such as transportation networks, and save an ArcGIS map document to share with others. Close the map when finished.

Studying transportation projects

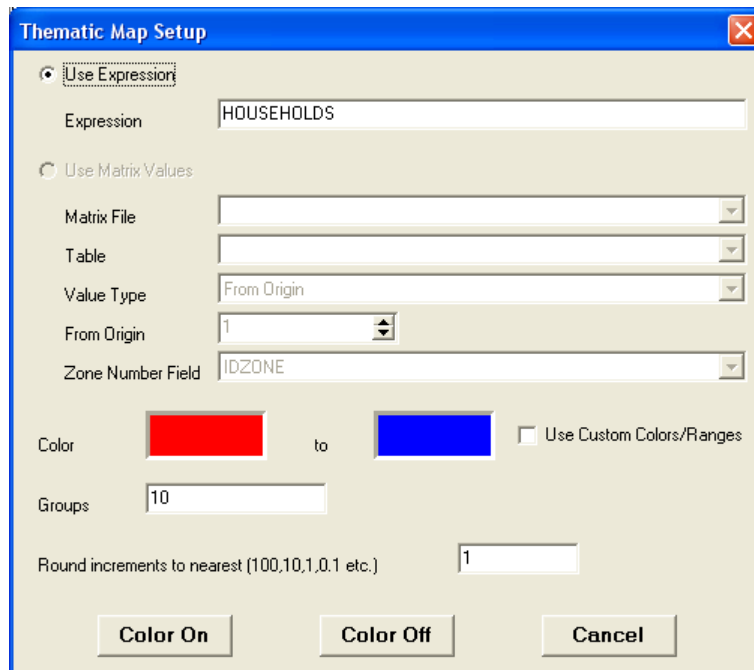
When Cube Land is integrated with a travel demand model, you can use the integrated model to study the possible land-use effects of transportation projects. This exercise shows how you might use Cube Land to study the effects of a roadway project.

- To analyze the land-use effects of a roadway project

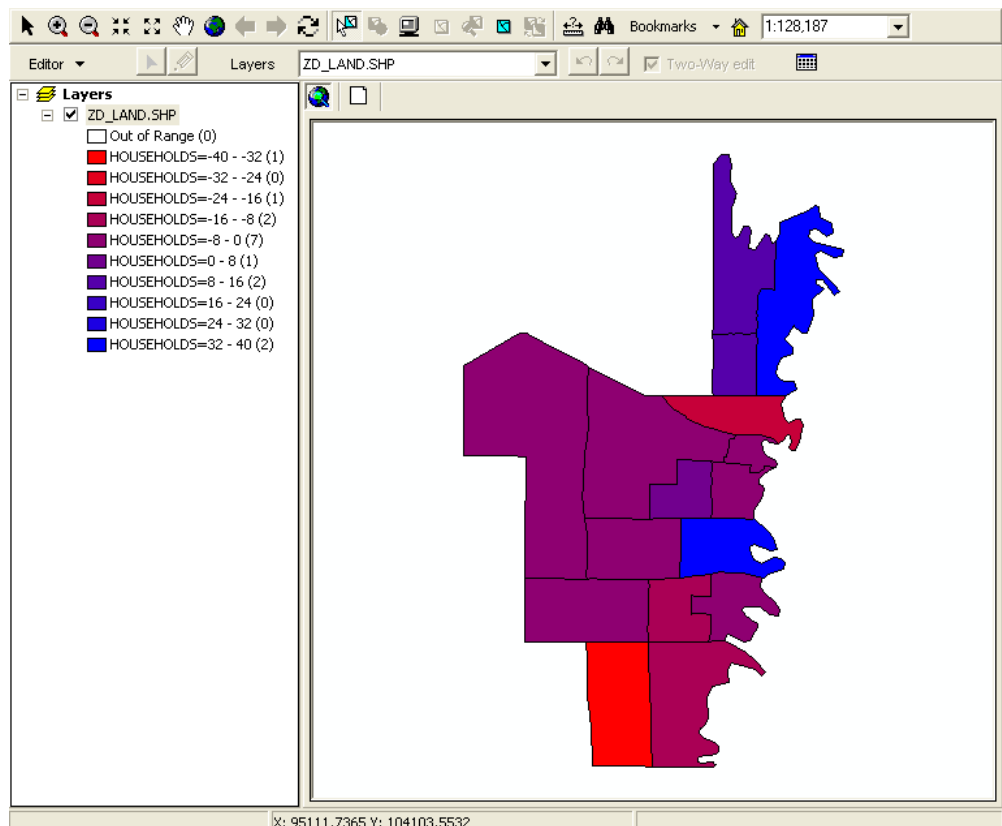
1. Create the new scenario.
 - a. Right-click on the **Growth** scenario and select **Add Child**.
 - b. Name the new scenario **Roadways** and enter a description in the **Scenario Properties** dialog.
2. Change the **Highway network** input path to the Build Road network, stored at "C:\Cubetown\Inputs\cubetown.mdb\Build".

Note: This exercise assumes that you have already edited the Build network to show the new roadway project. For more information, see the Exploring Cube Base and Cube Voyager section of the Discover Cube tutorials.

3. Run the model.
 - a. Click **Save**, then **Run** in the Scenario Editing window.
The Task Monitor window opens, showing the progress of the run. When complete, a Task Run Result dialog box opens.
 - b. Click **OK**.
 - c. Click **Close** to hide the Scenario Editing window.
4. View the outputs.
 - a. Under **Data** in Scenario Manager, expand **Outputs**, then **Land**. Double-click on **Compare Land Use** to open the ZD_LAND.SHP file, which is a shapefile containing differences between this scenario (Roadways) and its parent (Growth) scenario.
 - b. Go to the **Post** menu and select **Thematic Map...**
 - c. In the **Expression** field, type HOUSEHOLDS. Click on the leftmost **Color** rectangle and choose a red color, then click on the rightmost **Color** rectangle and choose a blue color. Click **Color On** to apply the thematic map settings as shown below.



Cube displays a thematic map showing the effects of roadway construction on household location. Zones that gain households are shown in blue, while zones that lose households are shown in red. Purple zones experience no change.



- To analyze the land-use effects of a transit project
 1. Create the new scenario.
 - a. Right-click on the **Growth** scenario and select **Add Child**.
 - b. Name the new scenario **Transit** and enter a description in the **Scenario Properties** dialog.
 2. Change the **Public transit lines** input path to the Headway PT network, stored at “C:\Cubetown\Inputs\cubetown.mdb\Headway”.

Note: This exercise assumes that you have already edited the Headway PT network to show increased transit service. For more information, see the Exploring Cube Base and Cube Voyager section of the Discover Cube tutorials.

3. Run the model.
 - a. Click **Save**, then **Run** in the Scenario Editing window.
The Task Monitor window opens, showing the progress of the run. When complete, a Task Run Result dialog box opens.
 - b. Click **OK**.
 - c. Click **Close** to hide the Scenario Editing window.
4. View the outputs by repeating step 4 of the previous exercise to set up a thematic comparison map showing changes in household location.

Any type of project that can be represented in a travel model can be analyzed using an integrated land use / transportation model. The sensitivity of household and firm location to transportation projects in Cube Land will depend upon the form of the accessibility and attractiveness measures used to represent the level of transportation service in each zone by agent and mode, as well as the estimated location bid functions coefficients for these variables.

You can also represent a wide variety of land use regulations using Cube Land, including:

- Zoning restrictions on the amount of land available for certain uses
- Development constraints and prohibitions on land uses in selected zones
- Fixed (policy-driven) development and institutional uses
- Taxes and subsidies for specific types of land use and real estate development

For more information on these topics, please see the Cube Land Reference Guide.



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