Land Use Model Information

RPA Peer Review

5-23-11

Overview

Currently the Chattanooga and Hamilton County Regional Planning Agency (RPA) does not have a regional land use model. As part of this model update we are hoping to develop a land use model to assist with land use forecasting, scenario planning, development proposals evaluation and policy evaluation. This model will be used to forecast future growth for the Travel Demand Model's (TDM) horizon years. These forecasts will be summed up to the Traffic Analysis Zone (TAZ) level and fed into the TDM. As one primary goal of this model update is to integrate the land use and travel demand models, the model inputs from the TDM to should be fed back into the land use model in the form of accessibility measures.

To prepare for the development of a land use model several data collection efforts have been underway. These include the following: 1) regional land use survey, 2) building permit data collection, 3) subdivision data collection, 4) employment data collection and 5) data inventory and analysis to understand what data would be available and at what scale. The recent Central Hamilton County Scenario Planning Study funded by Tennessee Department of Transportation has helped to build capacity and familiarity with scenario planning as a tool and the scenario planning software, CommunityViz.

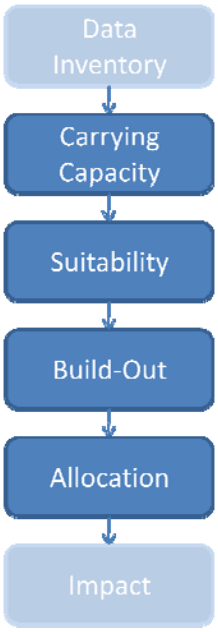
Depending on the final modeling approach and software chosen some of the data and model components from the Central Hamilton County Study may be useful for development of the land use model. Potential inputs from that process that could be used include the following: 1) suitability measures, 2) an extensive placetype pallet, 3) methodology for assessing impacts of various scenarios and potentially 4) model structure.

The RPA is also interested in microsimulation dynamic discrete choice models, such as UrbanSim. While the learning curve is much higher for this type of modeling approach and the data preparation more time consuming, the potential level of detail, sophistication, the ability to better model real-estate markets and individual agent's decisions make it a powerful tool for planning purposes. The RPA has augmented its data inventory process to assess the feasibility of creating such a model based on the data currently available. Staff has also begun educating themselves about the UrbanSim platform and has begun playing around with the program in an attempt to become more familiar with its strengths and weaknesses.

CommunityViz

As was stated before, the RPA does not currently have a regional land use forecasting model. That being said, staff has come up with the following basic model structure as one potential option. The base of this model structure includes four core modules which include: 1)a Carrying Capacity Module used to determine the amount of land available for development, 2) a Suitability Module used to determine the suitability of the land available for development, 3) a Build-Out Module which will determine the build-out potential of the land available for development based on its placetype and 4) an Allocation Module where households and employment by sectors are allocated (Figure 1).

Figure 1



At the book ends of the model structure are data inventor and impact analysis, both of which are key to the development of the overall model (Figure 1). From the Central Hamilton County Scenario Planning Study a placetype pallet, suitability criteria and constrained lands dataset were created. This study also created an impact analysis CommunityViz project to evaluate the various scenarios proposed in the study, which could also be leveraged for the development of a regional land use model.

Staff is currently reviewing the constrained lands, suitability criteria and weighting, placetype pallet, allocation and model structure of the Central Hamilton County Scenario Planning Study to determine what changes need to be made to expand the CommunityViz model created for this project to the region. The full draft report containing details about both the study and the model can be found on the peer review website.

In preparation of the development of a CommunityViz regional land use model staff has prepared a data inventory to determine the feasibility of such a model and to identify any additional data needed to develop the model. The following tables on the following pages show the current data inventory efforts, which are currently in process. The table is color coded to visually represent the data inventory. Please reference the key below when interpreting the inventory tables on the following pages.

Color		Color Code Key
	No Color	Not inventoried
??	No Color	Unable to find but may exist
	Green	Existing and we have it
	Yellow	Exists and we don't have it
	Red	Does not exist

Data Type	Jurisdiction																		
	Hamilton County - TN											Dade County - GA	Walker County - GA				Catoosa County - GA		
	Chattanooga	Collegedale	East Ridge	Hamilton County	Lakesite	Lookout Mountain	Signal Mountain	Soddy-Daisy	Red Bank	Ridgeside	Walden	Dade County	Chickamauga	Lookout Mountain	Rossville	Walker County	Catoosa County	Fort Oglethorpe	Ringgold
GIS																			
Census Tract																			
Census Block Group																			
Census Block																			
Parcel																			
Parcel Level Land Use																			
Building Footprint																			
Parks												??	??	??	??	??	??	??	??
Public Schools												??	??	??	??	??	??	??	??
Private Schools												??	??	??	??	??	??	??	??
Colleges and Universities												No Colleges or Universities found in the GIS layer supplied by the State							
Employment Clusters	??	??	??	??	??	??	??	??	??	??	??	??	??	??	??	??	??	??	??
Commercial Clusters												??	??	??	??	??	??	??	??
Hotel and Motels												??	??	??	??	??	??	??	??
Employment Point File																			
Water Bodies																			
Streams																			
NWI Wetlands																			
Flood																			
Soils (Prime Farmland)																			
Soils (Septic Limitations)																			
Conservation Areas / Easements	??	??	??	??	??	??	??	??	??	??	??	??	??	??	??	??	??	??	??
Critical Habitat / Endangered Species												Have critical habitat data but no data on endangered species							
Slope												??	??	??	??	??	??	??	??
Water Lines	??	??	??	??	??	??	??	??	??	??	??	??	??	??	??	??	??	??	??
Sewer Lines												??	??	??	??	??	??	??	??
Water Shed																			
Sewer Shed												??	??	??	??	??	??	??	??
Fire Stations																			
Police Stations																			
Road																			
Interstate																			
Congested Corridors																			
Transit		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Bike Facilities																			
Greenways and Trails												??	??	??	??	??	??	??	??
Sidewalks																			
Walkability Index																			
Airports												??	??	??	??	??	??	??	??
Zoning												??	??	??	??	??	??	??	??
Future Land Use Plan	??	??	??	??	??	??	??	??	??	??	??	??	??	??	??	??	??	??	??
Aerial Photography	2010	2010	2010	2010	2010	2010	2010	2010	2010	2010	2010	2009	2009	2009	2009	2009	2009	2009	2009
Plans and Policies																			
Zoning Ordinance												??		??	??	municode	municode	municode	municode
Subdivision Regulation						??				??	??	??		??	??	??	??	??	??
Comprehensive Plan		??	??		??	??	??	??	??	??	??	??	??	??	??	??	??	??	??
Transportation Plan																			
Housing Plan																			
Parks Plan																			
Schools Plan																			
Infrastructure Plan																			
Capital Improvements Plan																			
Small Area Plans																			

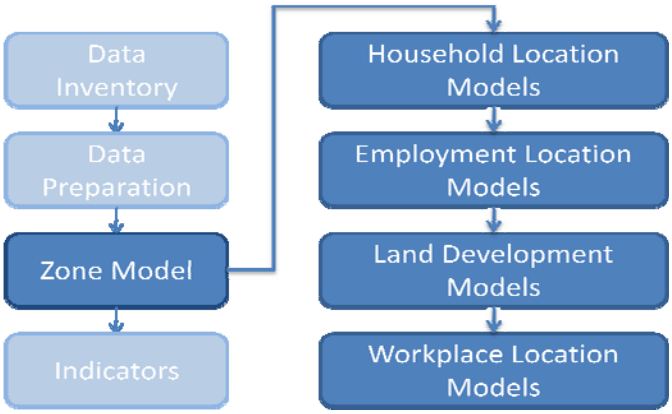
Data Type	Jurisdiction																		
	Hamilton County - TN											Dade County - GA	Walker County - GA				Catoosa County - GA		
	Chattanooga	Collegedale	East Ridge	Hamilton County	Lakesite	Lookout Mountain	Signal Mountain	Soddy-Daisy	Red Bank	Ridgeside	Walden	Dade County	Chickamauga	Lookout Mountain	Rossville	Walker County	Catoosa County	Fort Oglethorpe	Ringgold
Demographics																			
Census Tract 2010																			
Census Block Group 2010																			
Census Block 2010																			
Census Tract 2000																			
Census Block Group 2000																			
Census Block 2000																			
Census Tract 1990																			
Census Block Group 1990																			
Census Block 1990																			
Base Year Employment																			
Future Year Employment Forecasts																			
Base Year Population																			
Base Year Household																			
Future Year Population Forecasts																			
Future Year Household Forecasts																			
Local Factors*																			
Property Tax Rate																			
Sewage Treatment Capacity																			
Water Capacity?																			
School Capacity																			
Water Consuption by Place /Housing Type																			
Electricty Consuption by Place/ Housing Type																			
Gas Consuption by Place/Housing Type																			
Solid Waste Creation by Place/Housing Type																			
Impervious Surface by Place Type																			

* Depends on the values and proposed uses of the model

UrbanSim

The RPA is also interested in microsimulation dynamic discrete choice models as a potential land use model. While the added complexity needed to simulate the land use decisions of the various land use players makes it more difficult to develop it also provides as level of realism and detail not possible with rule based scenario planning models, such as CommunityViz.

Figure 2



Staff has decided that it would be best to first develop a zone based model and slowly transition to a parcel based UrbanSim model (Figure 2). This would allow for more rapid development of the model and provide a path towards developing the parcel model.

Another benefit of this methodology is that the zone based model could be slowly updated, with different submodel being added to add complexity to the model as the data is developed and staff becomes more familiar with the OPUS environment and UrbanSim model . Using this method, the household and employment models could be developed first and the land development and workplace models added later (Figure 2).

To assist with the assessment of the potential to developing an UrbanSim model staff preformed a data inventory. The inventory was based on the data needs for the zone based model and was not performed for the parcel based model. The study area comprises of four counties in two different states. The assessor's databases were review for each county to determine the availability (not quality) of the data needed for the zonal model. In order to assist with the interpretation of the tables the section below was created to describe coding used for tables. The tables following this section summarize the findings of the data inventory.

While much of the underlying data needed to create an UrbanSim model exists, it will be a major effort to convert the data into the format needed for the model. Towards that end staff has begun investigation of various database packages to organize and format the data needed for the model. One major consideration is the creation of the synthetic households for the household location models since these tools are not currently incorporated into UrbanSim.

How to read the UrbanSim Zonal Model Data Needs tables:

Each table on the following pages corresponds with a table needed for the zone base model in UrbanSim. Green colored table names are those required by UrbanSim. Light brown colored table names are the optional tables. After each table name is either a checkmark or a X for the table status. A checkmark means that we are able to create this table. The X indicates that we are unable to create this table at this time. Our ability to create this table is based on the data status for the required data fields. (See example table below)

Annual Employment Control Totals ✓

Column Name	Data Type	Required	Data Status	Description
year	Integer	Y	Y	simulation year
sector_id	Integer	Y	Y	unique id for the employment sector
home_based_status	Integer	Y	Y & N	flag for home-based employment
number_of_jobs	Integer	Y	Y	control total

Data Status Key

Data Status	Data Status
Y	Yes - we have the data in the needed format
Y & N	Yes - we have the data, no - it is not in the needed format
N &Y	No - we do not have the data, Yes - we have the knowledge, tools and or data to create it
N	No - we do not have access to the data
?	Don't know if we have access to the data or if we can create it

Annual Employment Control Totals ✓

Column Name	Data Type	Required	Data Status	Description
year	Integer	Y	Y	simulation year
sector_id	Integer	Y	Y	unique id for the employment sector
home_based_status	Integer	Y	Y & N	flag for home-based employment
number_of_jobs	Integer	Y	Y	control total

Annual Household Control Totals ✓

Column Name	Data Type	Required	Data Status	Description
year	Integer	Y	Y	simulation year
race_id	Integer	N	Y	race_id category
age_of_head_min	Integer	N	?	lower bound age_of_head category; put -1 for any value
age_of_head_max	Integer	N	?	upper bound age_of_head category; put -1 for any value
total_number_of_hoseholds	Integer	Y	Y	total number of households for the specified category

Annual Household Relocation Rates ✗

Column Name	Data Type	Required	Data Status	Description
age_min	Integer	Y	?	Start of age range
age_max	Integer	Y	?	End of age range
income_min	Integer	Y	?	Start of income range
income_max	Integer	Y	?	End of income range
probability_of_relocating	Float	Y	?	annual relocation probability (between 0 and 1)

Annual Job Relocation Rates ✗

Column Name	Data Type	Required	Data Status	Description
sector_id	Integer	Y	Y	Unique id of employment sector
job_relocation_probability	Float	Y	?	Probability of a job relocating within a year (between 0 and 1)

Buildings ✓

Column Name	Data Type	Required	Data Status	Description
building_id	Integer	Y	N & Y	Unique id of building (one per zone and building type)
land_area	Integer	N	Y & N	Land area in sqft used by the aggregate building
non_residential_sqft	Integer	Y	Y & N	Total non-residential sqft in building
non_residential_sqft_capacity	Integer	Y	N & Y	Developable capacity for non-residential sqft in the zone for this building type
residential_units	Integer	Y	Y	Total residential units in building
residential_units_capacity	Integer	Y	N & Y	Developable capacity for residential units in the zone of this building type
sqft_per_unit	Integer	N	N & Y	Average square feet per residential unit in building
year_built	Integer	N	N & Y	Average year built of this aggregated building
average_value_per_unit	Integer	Y	N & Y	Average property value (land + building) per unit (either residential units or non-residential sqft)
zone_id	Integer	Y	N & Y	Unique id of the zone in which this building is located
building_type_id	Integer	Y	N & Y	Unique id of the building type of this building

Building Sqft Per Job ✓

Column Name	Data Type	Required	Data Status	Description
zone_id	Integer	Y	Y & N	The zone id of the record
building_type_id	Integer	Y	N & Y	The building type id of the record
building_sqft_per_job	Integer	Y	N & Y	The number of sqft per job for jobs with the corresponding zone_id and building_type_id

Building Types ✓

Column Name	Data Type	Required	Data Status	Description
building_type_id	Integer	Y	N & Y	Unique id for building types
is_residential	Integer	Y	Y & N	1 if residential, 0 otherwise
building_type_name	String(50)	Y	N & Y	Description of the building type

Cities ✓

Column Name	Data Type	Required	Data Status	Description
city_id	Integer	Y	Y	Unique id for each city
city_name	String(50)	Y	Y	Name of the city

Counties ✓

Column Name	Data Type	Required	Data Status	Description
county_id	Integer	Y	Y	Unique id for each city
county_name	String(50)	Y	Y	Name of the city

Development Event History ✓

Column Name	Data Type	Required	Data Status	Description
zone_id	Integer	Y	Y	Unique id for the zone
building_type_id	Integer	Y	N & Y	Unique id for the building type
scheduled_year	Integer	N	Y	Year in which the development event occurs
residential_units	Integer	Y	Y	The number of residential units in this development event
non_residential_sqft	Integer	Y	N & Y	The number of non-residential sqft in this development event
change_type	String(1)	N	Y	Values are A (add), D (demolish), or R (replace)

Employment Ad-Hoc Sector Groups ✓

Column Name	Data Type	Required	Data Status	Description
group_id	Integer	Y	N & Y	unique id for each ad-hoc sector group
name	String	Y	N & Y	descriptive name for each ad-hoc sector group

Employment Ad-Hoc Sector Groups Definitions ✓

Column Name	Data Type	Required	Data Status	Description
sector_id	Integer	Y	N & Y	unique id for each employment sector
group_id	Integer	Y	N & Y	unique id for each ad-hoc sector group

Employment Sectors ✓

Column Name	Data Type	Required	Data Status	Description
sector_id	Integer	Y	N & Y	Unique id for the employment sector
name	String(20)	Y	N & Y	Descriptive name for the employment sector

FAZes ✓

Column Name	Data Type	Required	Data Status	Description
faz_id	Integer	Y	Y	Unique id for the FAZ
large_area_id	Integer	N	Y	Unique id for a user-specified aggregation of FAZ geographies into larger districts

Home Based Status ✓

Column Name	Data Type	Required	Data Status	Description
home_based_status	Integer	Y	Y	Unique id for home based status (1 = home-based, 0 otherwise)
name	String(20)	Y	Y	Description of the home based status

Household Characteristics for HT ✘

Column Name	Data Type	Required	Data Status	Description
characteristic	String(11)	Y	?	Name of the attribute on the household table (must match exactly)
min	Integer	Y	?	Start of user-defined class range
max	Integer	Y	?	End of user-defined class range

Households ✘

Column Name	Data Type	Required	Data Status	Description
household_id	Integer	Y	?	Unique household id
building_id	Integer	Y	?	Unique id of the building in which the household is located
persons	Integer	Y	?	Number of persons in the household
income	Integer	Y	?	Total annual income of the household
age_of_head	Integer	Y	?	Age of the head of the household (according to the census)
race_id	Integer	Y	?	Unique id of the race of the head of the household
workers	Integer	Y	?	Number of workers in the household
children	Integer	Y	?	1 if children are present, 0 otherwise
cars	Integer	Y	?	Number of cars owned by the household

Households For Estimation ✘

Column Name	Data Type	Required	Data Status	Description
household_id	Integer	Y	?	Unique household id
building_id	Integer	Y	?	Unique id of the building in which the household is located
persons	Integer	Y	?	Number of persons in the household
income	Integer	Y	?	Total annual income of the household
age_of_head	Integer	Y	?	Age of the head of the household (according to the census)
race_id	Integer	Y	?	Unique id of the race of the head of the household
workers	Integer	Y	?	Number of workers in the household
children	Integer	Y	?	1 if children are present, 0 otherwise
cars	Integer	Y	?	Number of cars owned by the household

Jobs ✓

Column Name	Data Type	Required	Data Status	Description
job_id	Integer	Y	Y & N	Unique id for each job
building_id	Integer	Y	N & Y	Unique id for the building in which the job is located
home_based_status	Integer	Y	N & Y	1 if the job is home-based, 0 otherwise
sector_id	Integer	Y	Y & N	Unique id of the employment sector of the job

Jobs For Estimation ✓

Column Name	Data Type	Required	Data Status	Description
job_id	Integer	Y	Y & N	Unique id for each job
building_id	Integer	Y	N & Y	Unique id for the building in which the job is located
home_based_status	Integer	Y	N & Y	1 if the job is home-based, 0 otherwise
sector_id	Integer	Y	Y & N	Unique id of the employment sector of the job

Large Areas ✓

Column Name	Data Type	Required	Data Status	Description
large_area_id	Integer	Y	Y	Unique id for each large area
large_area_name	String(50)	Y	Y	Name for each large area
county_id	Integer	Y	Y	Unique id for each county

Race Names ✓

Column Name	Data Type	Required	Data Status	Description
race_id	Integer	Y	Y	Unique id of the race category from the census
minority	Integer	Y	Y	1 if race is considered a minority, 0 otherwise
name	String(20)	Y	Y	Descriptive name for the race categ

Target Vacancies ✘

Column Name	Data Type	Required	Data Status	Description
building_type_id	Integer	N	N & Y	Unique id of the building type
is_residential	Integer	N	Y & N	0 for non-residential, 1 for residential building types
target_vacancy_rate	Float	Y	?	The ratio of unused space to total building space
year	Integer	Y	Y	The simulation year

Travel Data ✓

Column Name	Data Type	Required	Data Status	Description
from_zone_id	Integer	Y	Y	origin zone
to_zone_id	Integer	Y	Y	destination zone
am_single_vehicle_to_work_travel_time	Integer	Y	Y	zone-to-zone morning peak period travel time for vehicles traveling in mixed flow lanes

Zone Table ✓

Column Name	Data Type	Required	Data Status	Description
zone_id	Integer	Y	N & Y	unique id for each zone
city_id	Integer	Y	N & Y	unique id for each city
county_id	Integer	Y	N & Y	unique id for each county
faz_id	Integer	Y	N & Y	unique id for each forecast analysis zone or any user-specified aggregation of zones