a program of Land of Sky

FRENCH BROAD RIVER

METROPOLITAN PLANNING ORGANIZATION

MTP 2045

APPENDIX B
Land Use Study

Friday, January 31, 2020

To: Tristan Winkler, French Broad River MPO

CC: Nick Kroncke, French Broad River MPO

From: Colby M Brown, Manhan Group LLC

RE: Socio-economic modeling of land use scenarios for the French Broad River MPO

This memorandum describes the work performed by Manhan Group to forecast potential future land uses in the French Broad River MPO region.

Topics to be covered include the following:

- Background
- Methodology
- Forecasts

Discussion regarding each of these topics is included in the sections that follow.

Background

The French Broad River MPO provides long-range transportation planning services to a five-county area (including Buncombe, Haywood, Henderson, Madison and Transylvania counties) surrounding Greater Asheville, in Western North Carolina. Nestled between forested mountains and home to the Biltmore mansion, with a walkable and vibrant downtown, the region is a significant tourist destination as well as an increasingly attractive relocation target for retirees and home-based workers seeking a high quality of life at lower cost than larger metropolitan regions can offer. A thriving music and arts scene contributes to this overall quality of life and broadens the region's cosmopolitan appeal.

Five years ago, FBRMPO conducted a scenario planning study, GroWNC, which created two fine-grained land use forecast scenarios for a 2040 long-range planning horizon year: a "business as usual" case and a proposed alternative vision of "efficient growth". The current forecasting project described in this memorandum was originally scoped as an incremental update of previously created forecasts, given the relatively short duration of time elapsed since then. However, several factors encountered early on during the data-gathering stage for this study contributed to the decision to shift towards a more standalone approach, most notably a higher employment level for some jurisdictions observed in newly gathered data than previously estimated for the planning horizon. The new approach developed to adapt to these circumstances is detailed in the following section.

Methodology

This study adopted a data-driven process, grounding future land use forecasts in available data and current information on development patterns, demographics, and economic forces in the greater Asheville region. The process included a data collection phase, followed by data analysis to develop forecasting models and assumptions, and application of these models to alternative future scenarios. Each of these phases is discussed in the sub-sections that follow.

Data Collection

FBRMPO staff provided a rich repository of data to the study team for use in characterizing existing and recent historical development patterns in the five-county MPO region. These included:

- parcel-level existing land use layers (ELUSE) for 2010 and 2015,
- InfoUSA point-level business establishment data for 2010 and 2015, and
- base year zonal socio-economic layers used as input to the regional travel demand model.

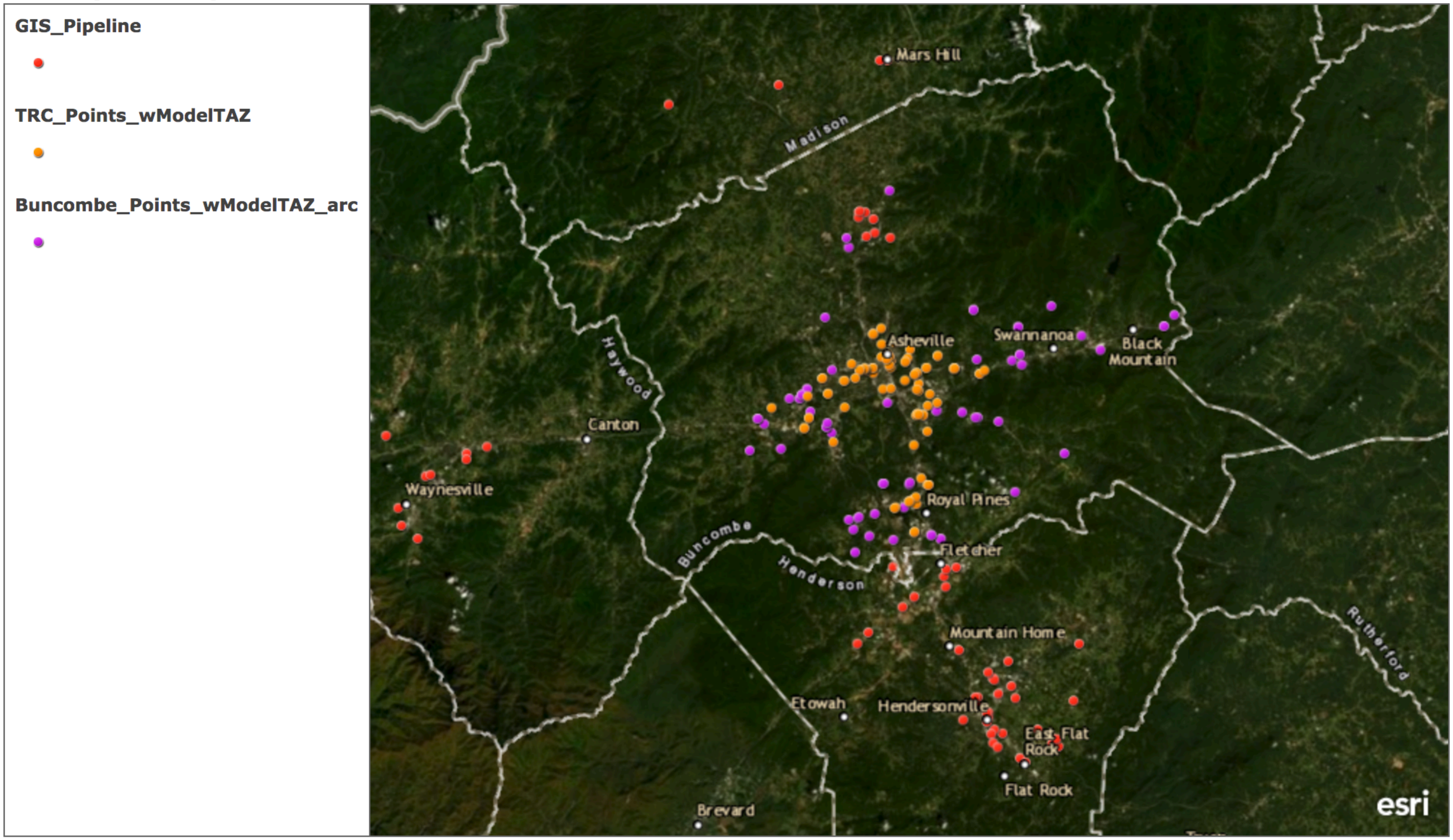
Complete zonal socio-economic data were provided for 2010, whereas a work-in-progress version of the zonal data was provided for 2015. Manhan Group worked with FBRMPO and NCDOT travel modeling staff to cross-check these data with available information from the US Census and other sources, arriving at a comprehensive updated base year. This process included the reconciliation of 2015 InfoUSA point-level establishment data with 2015 IMPLAN employment by county using block-level Census LEHD LODES data as an intermediary, described in a previously delivered memorandum (see "Proposed method for reconciling 2015 InfoUSA and IMPLAN/Moody's employment databases", dated May 10, 2019). As noted in that memorandum, IMPLAN data were collected in order to establish a base year understanding of employment that would be consistent with Moody's Analytics, the selected source for employment projections recommended by economics sub-consultants Metro Analytics.

Metro Analytics also gathered a detailed, point-level GIS layer cataloguing known real estate projects either completed between 2015 and the present, or pending completion with high certainty, including housing developments and commercial/office or industrial land uses, as well as hotels (see Figure 1). These data were used in conjunction with more detailed information on tourism activity in the region in order to populate certain 2015 zonal data fields that pertain specifically to visitor travel and lodging. Sources used in this effort included the "Destination Dashboard" reports provided by the Asheville Convention and Visitor Bureau (CVB) as well as the 2016 Asheville Visitor Profile report and AirDNA data collected by the CVB.

Data Analysis

As noted above, Metro Analytics was hired to provide regional employment growth forecasts for the five-county region. Metro in turn selected Moody's Analytics as its recommended source of growth rates by industry classification and county, for a variety of reasons detailed in a memorandum delivered to Manhan Group, LLC on April 29, 2019. These are illustrated in Figure 2. Metro Analytics also used TREDIS software to test the impact of committed future transportation infrastructure projects on these economic forecasts, and found little sign that employment would be under-projected by adopting the Moody's growth rates (which do not, on their own, reflect the completion of such projects).

Development Pipeline Data



Near-term future development for review

Figure 1. *Locations of projects included in the development pipeline inventory gathered by the Manhan Group team.*

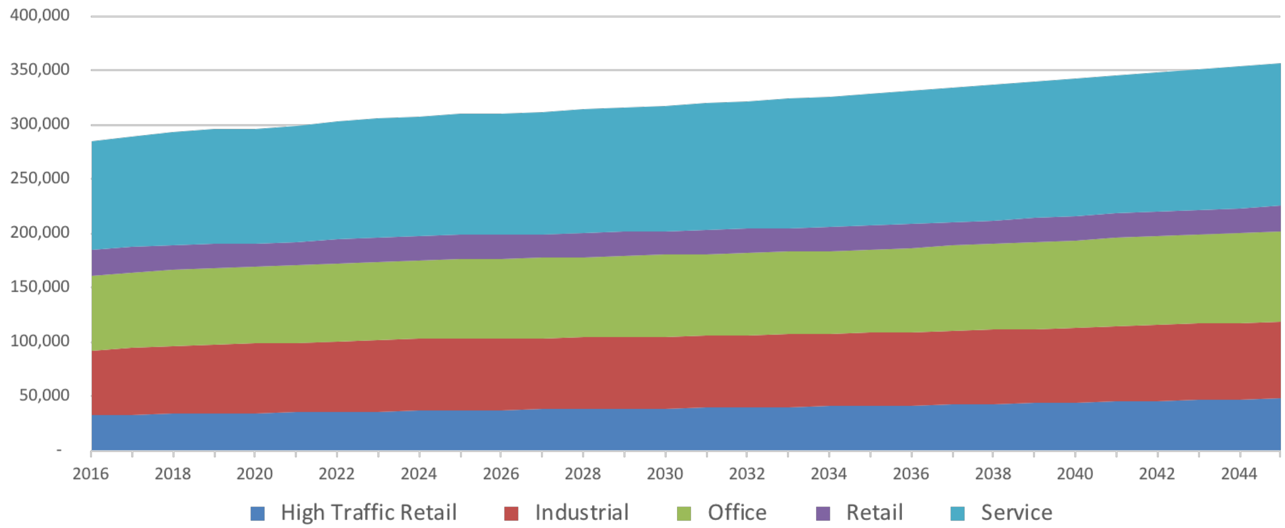


Figure 2. *Regional Employment Forecast by Sector, 2016-2045*

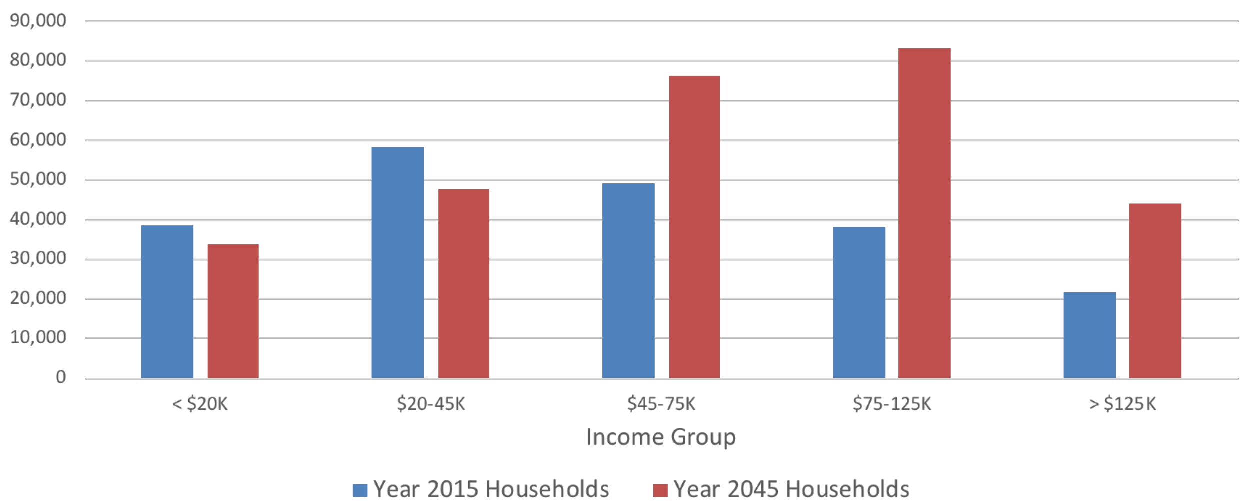


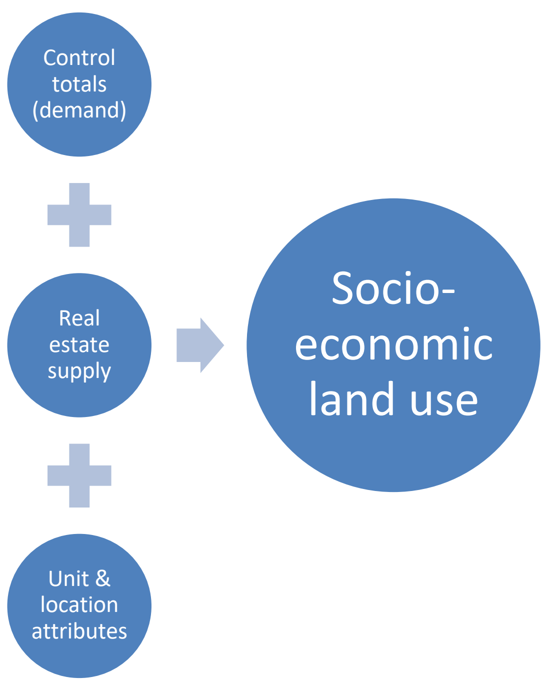
Figure 3. *Households by Income Group in 2015 and 2045*

To develop population projections, Metro Analytics used forecasts through 2038 available from the North Carolina Office of State Budget & Management as a starting point. These were then adjusted to reflect labor market growth commensurate with the Moody's employment forecast, and extrapolated forward to the FBRMPO horizon year, 2045. Household estimates were initially derived from these population projections by Metro Analytics using assumptions regarding average household size trends.

Bid-Auction, Accessibility, and Real Estate Supply Sub-Models

To allocate future control totals of household and employment to zones, Manhan Group developed a bid-auction model based upon well-established urban economic theory. While bid-rent analysis was first established as a classical methodology in urban economics by William Alonso in 1964, the bid-auction framework used by Manhan Group is based upon the more recent work of Francisco Martinez and colleagues at the University of Santiago in Chile. Their MUSSA land-use model simulates the auction of property to a highest bidder from among various competing "agents", such as different industry sectors or household types, resulting in predictions of expected maximum bid for the property. The mathematical formulation of the simulated auction is a constrained multinomial logit equation representing a landlord's choice of tenant (or seller's choice of buyer); thus the model also provides predictions of the probability that a given household or business type will occupy a unit of real estate.

The diagram below gives a very broad picture of the process: the major inputs include control totals of households and jobs by type for the entire region, as well as the real estate supply stock (by zone) for the scenario being considered, and the attributes of the real estate units and zones being analyzed. The output consists of zonal households by income and size (number of persons), as well as employment segmented into the five major categories used in the FBRMPO travel demand (retail, high-traffic retail, industrial, office, and service).



A simple real estate typology has been defined for the French Broad River MPO, classifying housing units as either single-family or multi-family, as well as non-residential real estate types based upon the land use classification scheme adopted in FBRMPO's existing land use (ELUSE) layers.

Prior to this study, Manhan Group, LLC had developed a suite of bid-rent models for the entire USA based upon publicly available Census American Community Survey (ACS) Public Use Microdata (PUMS). These models simulate the auction of housing units to the highest bidder, selected from a set of competing households that can be weighted to reflect either specific sub-markets representing current demand, or a potential future year demand profile. The bid-rent model for the South Atlantic Census Division region in which western North Carolina falls was transferred from that prior effort and adapted for use in this study, using available Census ACS tract-level tabulations to calibrate a 2015 base year.

The following variables are considered in the standard residential bid model transferred and adapted for use in this study:

- Building characteristics
    - New construction (within last decade)
    - Historic status (built before 1960)
    - Single-family / multi-family status
- Housing unit characteristics
    - Number of bedrooms
    - Total number of rooms
- Household characteristics
    - Household size
    - Household income
    - Number of college graduates
    - Number of workers in household
    - Number of students in household
    - Householder college graduate status
    - Householder enrollment
    - Age of head of household

Income is an important factor used by the Manhan Group bid-auction model to calculate household willingness to pay for housing. However, the Metro/Moody's methodology did not produce a forecast of households classified by income group. Therefore, Manhan Group consulted forecasts of households by income produced by Woods and Poole Economics to disaggregate the Metro/Moody's forecast households to each of five annual income groups (less than $20,000, $20,000 - $45,000, $45,000 - $75,000, $75,000 - $125,000, and $125,000 or over). Figure 3 illustrates the resulting changes in households by income group between 2015 and 2045. The base year (2015) distribution of households by income group was derived from Census American Community Survey data (five-year, 2013-2017), at both the region/county and Census Tract level. The output of the residential bid model was initially calibrated to match the joint distribution of households by size and income group at the Census Tract level, and later re-calibrated to match the TAZ-level distribution of households by size assumed within the region's travel model.

An additional bid function was estimated for non-residential land uses, to predict job type (industry) based primarily upon transportation accessibility factors, as well as household and job density, and land use type (i.e. Retail, Lodging, Office, Mixed, Institutional, Special). Transportation accessibility is defined for the non-residential market as a labor market access measure, considering how many households can reach a place of business by car during the peak period within a given travel time, using a decay function to give more weight to closer households than those with very long trips. Due to uncertainty regarding the status of a 2015 travel model run for the FBRMPO region during the estimation of bid function parameters, the base year labor market access measure was initially calculated using free-flow origin-destination travel times extracted from OpenStreetMap (OSM) data, adjusted to reflect reported travel times to work from each origin Census tract in the ACS Journey to Work tabulations. This calculation method was subsequently replicated using travel model data once an updated base year 2015 run became available, using the flow-weighted average ratio between free-flow and congested peak highway travel times for all home-based-work trips for each origin TAZ in place of the Census-based adjustment factor. The non-residential bid function was calibrated using these accessibility measures to match the distribution of employees by type at the TAZ level for the 2015 base year (adjusted and reconciled using multiple sources, as noted previously).

An accessibility measure representing access to jobs was calculated in a similar manner, initially using OSM network skims, and later replicated using travel model data once available (see Figure 4). This measure was used to inform the residential real estate supply sub-model, which predicts how the distribution of housing units by location and type will shift in the future. Other variables considered in this sub-model include housing density (which tends to increase the production of multi-family housing and reduce the share of single-family housing dwelling units) as well as a "market pressure index" generated by the bid function that represents the intensity of competition for different types of housing distributed across the region, based upon the relationship between the regional demand profile, willingness-to-pay functions, and the available real estate supply stock. This market pressure index can be thought of as a price signal which tells the residential real estate supply sub-model to produce more (or less) of a given housing type in a given location, depending on demand.

A non-residential real estate supply model was also estimated, using the market pressure index from the bid function described above along with the labor market access measure and housing density, as well as an industrial suitability measure borrowed from the prior scenario planning exercise conducted using CommunityViz software (using the GroWNC model). However, both the residential and non-residential real estate supply functions were implemented as incremental logit, or "pivot-point", models. What this means in practice is that only variables which change from the values collected for the 2015 base year affect changes in the shares of housing or non-residential land use by type and location in any future scenario. In none of the scenarios considered was industrial suitability modified; thus it does not affect the forecast results materially.

After demand is fully allocated to transportation analysis zones based upon the calculated shifts in supply, input zonal variables such as housing and job density may be updated, in addition to the jobs and labor market access measures. Iteratively re-evaluating the bid (demand) and supply sub-models and re-calculating zonal variables should help produce a forecast representing market equilibrium, although it is better practice to also re-run a travel model and re-evaluate congested travel times.

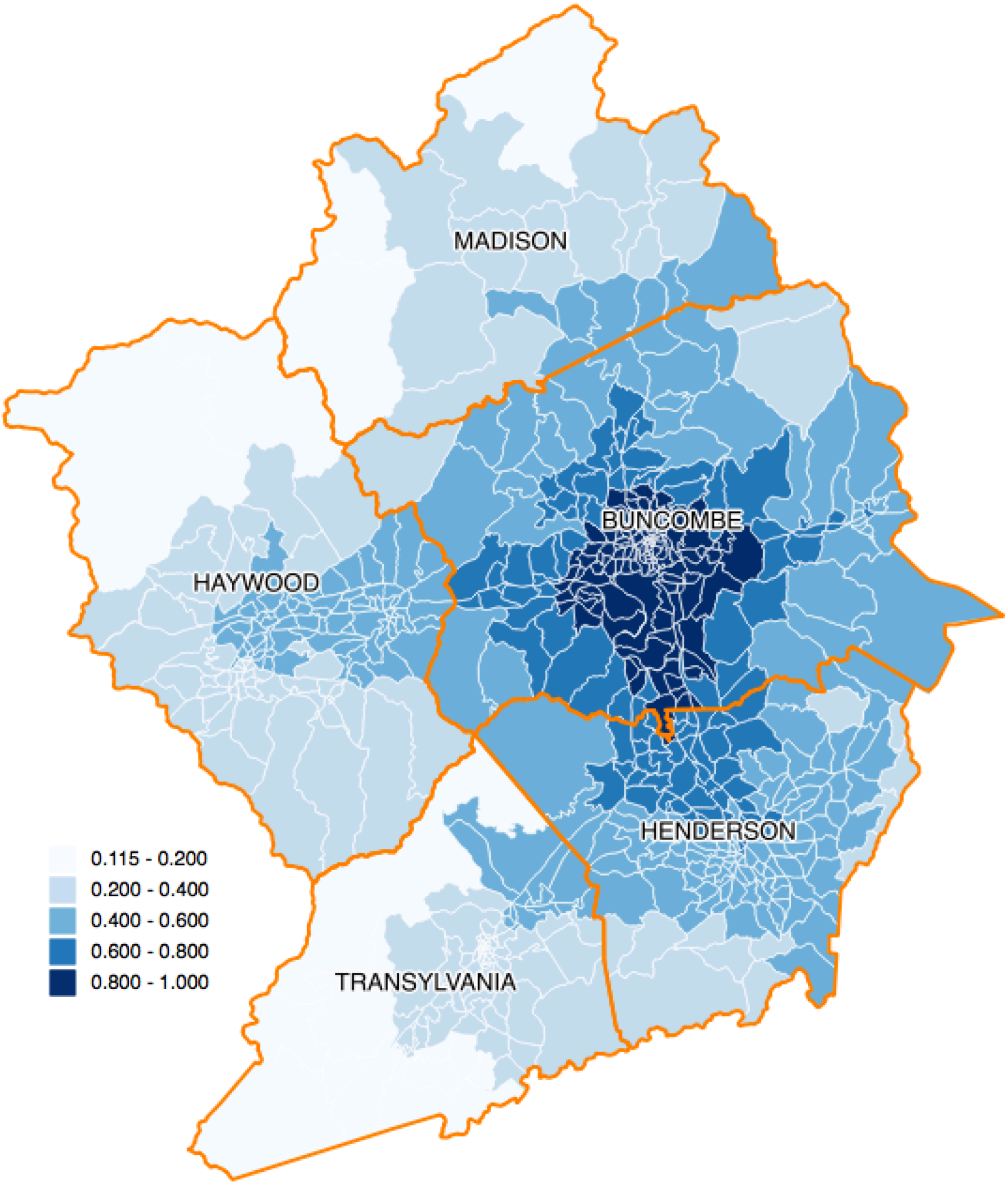


Figure 4. *Relative Index of Access to Jobs (1.000 = regional maximum), 2015*

Forecasts

Manhan Group's initial scope of work included two 2045 forecast scenarios: a "business as usual" case and an "alternative" vision. There are no differences between the two scenarios in terms of regional growth or transportation network assumptions: the same employment forecast and control total for future households were used in both cases. The coded transportation network, developed by NCDOT, includes no major transit system investments and only those highway projects with existing funding commitments (i.e. those listed in the Transportation Improvement Program, or TIP, for the region, as provided to NCDOT by FBRMPO staff).

Instead the differences between the two scenarios reflect, to some extent, different planning processes. The business as usual (or "baseline") scenario represents a normative outcome based upon what is likely to occur, given what has happened in the past, using conservative assumptions. The "alternative" vision attempts to posit a preferred outcome that shifts growth in a different direction from business as usual based upon generally agreed-upon planning principles. Since land use policy is not directly controlled by the French Broad River MPO, but rather by the local government bodies (i.e. cities and counties) belonging to the Land of Sky Regional Council, inter-agency coordination would likely be required to make any alternative scenario a reality, although future scenario analyses could look at transportation projects or economic development incentives which might substitute for direct regulation as a means of realizing the alternative scenario vision.

Accordingly, although the same underlying data analysis (described in the previous section) was used to evaluate both the baseline and alternative scenarios, the land use models were run in slightly different "modes" and with differing starting assumptions regarding land use supply and capacity. In the baseline scenario, the supply of available developable land was calculated for each zone based upon parcel data developed for the prior GroWNC scenario planning exercise. In other words, no zoning or other land use regulations were assumed to have a controlling impact on growth. As housing and non-residential land uses were allocated to transportation analysis zones in the region, the land use model re-calculates land consumed based upon 2015 base year prevailing densities (i.e. acres per housing unit or job, derived from FBRMPO's parcel-level ELUSE data). As any zone approaches build-out (where the land consumed meets or exceeds the supply), the profit associated with further development is attenuated, in order to enforce land supply constraints. This capacity checking process is integrated into the baseline forecast along with re-evaluation of densities and accessibility measures (including re-calculated congested travel times from the regional travel demand model), yielding an equilibrium land use forecast driven by market preferences, but constrained by developable land supply as well as roadway capacity.

By contrast, the "alternative" scenario was never intended to represent a market equilibrium outcome. As such, the supply and travel demand models have much less input to this alternative scenario, with minimal feedback loops to update inputs. Instead, the starting point for this analysis was taken from the spatial distribution of land uses given by the "efficient growth" scenario previously developed using the GroWNC CommunityViz model. Part of the rationale for selecting this source of assumptions is that, because any alternative scenario deviating from the trend indicated by market forces would require policy coordination to realize, it makes sense to use a community vision that has already been presented to stakeholders and used as the subject of some consensus-building process (i.e. public workshops, etc.).

Draft forecast results were reviewed with the French Broad River MPO's Prioritization Sub-committee, a group which effectively served as a technical advisory board providing local knowledge and familiarity with growth trends to the study team. Web-based (i.e. ArcGIS Online) maps (see Figures 5-10) were provided to allow for offline review and comments via e-mail as well as in real-time during meetings held via teleconference. The group was briefed on the underlying methodology as well as input data and assumptions for both the baseline and alternative scenarios. Much of the initial feedback regarding the baseline forecast centered on concerns regarding the model's handling of land supply and potential allocation of growth to more outlying zones with a high percentage of protected lands and hills or mountains. Accordingly, many adjustments and refinements to the capacity constraint routine were implemented (including, ultimately, a manual adjustment intended to completely zero out supplier profit for certain zones almost completely covered by national forest).

However, in fact the most challenging technical struggle faced in preparing the baseline forecast was the exact opposite tendency: if allowed to run multiple iterations of land use re-allocation with updated job and household densities, the model would place increasingly implausible amounts of development in downtown Asheville, with no sign of converging on an equilibrium solution. That phenomenon also occurred if accessibility measures were re-calculated dynamically using land use allocation model results. Only if the actual origin-destination impedances were updated based upon re-running the travel model with the updated spatial distribution of jobs and households did the land use allocation model converge upon a reasonable equilibrium solution. This suggests that highway congestion, while perhaps not as severe as in some larger metropolitan areas, is an important constraint and driving force shaping real estate market dynamics in the greater Asheville metro region.

For exactly this reason, the alternative scenario based upon 2040 "efficient growth" results was not evaluated using feedback to the travel demand model (and only limited feedback within the land use model). Instead, the spatial distribution of jobs and housing by type (single-family and multi-family) output by the GroWNC model at the parcel level was summarized to TAZs and used to generate a "seed" real estate supply stock inventory matching new regional control totals for 2045. Experiments with adding more feedback in terms of updating land use allocation based upon revised zonal variables derived from initial allocation results found that the model tended to drift away from the seed and towards results similar to the business as usual case rather than converging on a different equilibrium solution. This dynamic highlights the observation that, as noted previously, realization of an alternative land use "vision" for the region depends upon coordination with local stakeholders to identify policies and regulations that might countervail trends and market forces pointing in a different direction.

However, feedback from FBRMPO's prioritization committee regarding the results of evaluating the "efficient growth" scenario indicated surprise at some results: fewer households and jobs were allocated to high-density and existing urban locations than expected, with declines in Asheville relative to the baseline 2045 forecast. Since the mode in which the scenario was evaluated was tied so closely to the input "seed" distribution of households and jobs, the ultimate explanation for this behavior lies in the assumptions used as input to the GroWNC process: specifically, growth had been allocated to areas with existing urban services (e.g. wastewater/sewer connections); not "smart growth" neighborhoods per se. Recognizing the dissatisfaction and lack of consensus around this scenario as an alternative to business as usual, Manhan Group worked with FBRMPO staff to develop a third scenario for consideration.

The basis for this third scenario was simple, and leveraged a prior effort by MPO staff to identify areas in the region with good walkability, based upon factors such as density of development, street design, and sidewalk coverage. Two types of “WalkUp” zones were defined: “Walkable” areas, and “Transitional” areas moving towards that status. Assuming that such neighborhoods would continue along that trend, both were considered future walkable areas for the purpose of constructing scenario inputs. A revised developer cost function was then asserted assuming arbitrarily lower costs (or higher revenues) for all residential development in walkable zones. Note that this modification to the cost function was not based upon any empirical analysis of developer behavior; experiments with adding walkability to the standard supply models used for the baseline forecast were inconclusive at best, yielding parameter coefficient estimates with less statistical significance. The amount of cost reduction associated with walkability was calibrated off-model to produce a reasonable level of increased development based upon conversations with FBRMPO staff about what might be achievable within the region.

Initial household population estimates derived from the forecast model outputs were based upon the future distribution of household agents by size input as control totals for the region, as allocated to zones by the land use model. However, MPO staff review of these results flagged an overall level of population inconsistent with prior expectations based upon state OSBM projections, as well as derived forecasts updated by Metro to account for greater labor force estimates implied by Moody’s Analytics economic projections. Moody’s Analytics did not provide a forecast of households by size category for use in this study, and while Metro assumed continual average household size declines throughout the forecast period in developing estimates of total regional households by year, this trend was not supported by Woods and Poole forecasts, which show average household sizes declining until 2021, then increasing through 2040, and then declining again from 2041 through 2045, but ultimately ending higher than observed in 2015 for all counties (except Transylvania). An experimental approach developed by Manhan Group for disaggregating household forecasts by size category using observed headship rates applied to population forecasts by age group also yielded size distributions requiring implausible average sizes for the largest household group in order to reconcile household forecasts with population projections, apparently due to internal inconsistencies within the Census ACS PUMS data used to develop headship rates.

Accordingly, a simplified approach was taken to deriving household population estimates from allocated households by TAZ. This approach initially applies the base year (2015) persons per household to future year households for each zone (substituting the county average persons per household for TAZs with no households in the base year to avoid division by zero errors). This initial population estimate is scaled to match a target regional population forecast for 2045, based upon subtracting 12,460 residents in group quarters from the Metro total population forecast of 672,146. This essentially corresponds to holding the group quarters population constant, as consistent with assumptions used by OSBM in their forecast.

Summary of forecast results by local jurisdiction

The table on the following page presents allocated 2045 household population for the three forecast scenarios as well as 2015 household population according to the data present in the socio-economic zonal layer used as input to the region’s travel demand model. To report results by city and county, the TAZ-level results were first spatially disaggregated to Census blocks, and then re-aggregated to GIS boundary polygons provided by FBRMPO staff.

TABLE 1. Household population by local jurisdiction (city or county) and scenario

County/City	Year 2015 Base	2045 Baseline	2045 EG Update	2045 "WalkUps"
BUNCOMBE	**247,277**	**347,587**	**349,784**	**352,887**
Asheville	85,127	135,317	120,158	141,264
Biltmore Forest	1,511	2,283	1,998	2,286
Black Mountain	8,031	10,852	11,057	10,438
Montreat	787	1,098	1,084	975
Weaverville	3,544	3,655	4,923	4,560
Woodfin	4,824	6,546	7,025	7,318
Other Buncombe	143,454	187,837	203,538	186,046
HAYWOOD	**59,812**	**74,804**	**82,717**	**84,917**
Canton	4,070	4,017	5,606	5,718
Clyde	1,250	1,422	1,736	1,838
Maggie Valley	1,194	1,724	1,645	1,540
Waynesville	9,364	12,558	13,036	15,481
Other Haywood	43,933	55,084	60,694	60,340
HENDERSON	**110,993**	**157,314**	**154,990**	**153,454**
Flat Rock	3,280	4,693	4,520	4,414
Fletcher	7,000	9,336	11,086	9,794
Hendersonville	13,202	19,007	18,371	22,162
Laurel Park	2,200	3,431	3,032	3,116
Mills River	7,152	10,048	10,242	9,188
Other Henderson	78,159	110,799	107,739	104,780
MADISON	**19,754**	**27,067**	**27,195**	**26,146**
Hot Springs	547	869	753	689
Mars Hill	1,187	1,506	1,634	1,730
Marshall	802	1,090	1,105	1,466
Other Madison	17,218	23,602	23,703	22,260
TRANSYLVANIA	**32,676**	**52,913**	**45,000**	**42,282**
Brevard	7,250	11,653	9,982	10,581
Rosman	494	813	680	848
Other Transylvania	24,933	40,447	34,339	30,853
Grand Total	**470,513**	**659,686**	**659,686**	**659,686**

As mentioned previously, all three 2045 scenarios share the same regional control totals of population, only differing in where residents are allocated. In general, the efficient growth scenario allocates more people to Madison, Haywood and Buncombe counties (though not Asheville), whereas the “WalkUps” scenario allocates more population to Buncombe and Haywood. These results closely follow the spatial distribution of households in each scenario, summarized in the table on the following page.

	Households			
County/City	**Year 2015 Base**	**2045 Baseline**	**2045 EG Update**	**2045 "WalkUps"**
BUNCOMBE	**108,859**	**151,435**	**151,944**	**153,391**
Asheville	41,235	64,449	57,566	66,927
Biltmore Forest	629	934	821	938
Black Mountain	3,597	4,761	4,881	4,573
Montreat	480	657	651	584
Weaverville	1,631	1,645	2,231	2,042
Woodfin	2,007	2,645	2,725	2,932
Other Buncombe	59,279	76,344	83,069	75,397
HAYWOOD	**26,129**	**32,125**	**35,618**	**36,546**
Canton	1,765	1,713	2,395	2,441
Clyde	557	621	762	807
Maggie Valley	704	993	955	880
Waynesville	4,339	5,702	5,951	7,043
Other Haywood	18,764	23,096	25,555	25,376
HENDERSON	**47,768**	**66,420**	**65,725**	**65,085**
Flat Rock	1,652	2,317	2,243	2,221
Fletcher	3,002	3,929	4,684	4,146
Hendersonville	6,689	9,402	9,165	10,923
Laurel Park	1,147	1,752	1,558	1,616
Mills River	2,946	4,058	4,154	3,710
Other Henderson	32,332	44,962	43,922	42,468
MADISON	**8,588**	**11,567**	**11,650**	**11,203**
Hot Springs	253	394	343	313
Mars Hill	481	597	652	718
Marshall	393	521	534	720
Other Madison	7,461	10,054	10,121	9,453
TRANSYLVANIA	**14,694**	**23,332**	**19,941**	**18,654**
Brevard	3,584	5,646	4,863	5,075
Rosman	191	309	259	321
Other Transylvania	10,918	17,378	14,818	13,259
Grand Total	**206,037**	**284,879**	**284,879**	**284,879**

As with households and household population, the same regional employment control total is used for all three 2045 scenarios. The “efficient growth” scenario allocates more employment to Henderson County; every other county in the region experiences less than in the baseline forecast in this scenario. By contrast, the “WalkUps” scenario allocates more jobs to Haywood and Buncombe (and Asheville city) than in the baseline forecast. This result follows the pattern of the household allocation results, which is interesting since the walkability cost discount was applied in the residential market only.

County/City	Total Employment Year 2015 Base	2045 Baseline	2045 EG Update	2045 "WalkUps"
BUNCOMBE	**174,813**	**231,415**	**230,954**	**235,704**
Asheville	119,925	158,850	157,952	164,146
Other Buncombe	39,426	50,401	50,978	51,796
Black Mountain	5,740	8,365	8,186	7,519
Weaverville	4,204	6,301	6,510	4,584
Woodfin	4,017	5,227	5,118	5,021
Biltmore Forest	1,280	1,809	1,757	2,076
Montreat	221	463	452	562
HAYWOOD	**25,267**	**33,465**	**33,127**	**32,644**
Other Haywood	10,674	13,569	13,639	15,193
Waynesville	10,037	13,743	13,466	11,026
Canton	3,426	4,661	4,561	4,863
Maggie Valley	754	971	949	1,171
Clyde	377	521	511	391
HENDERSON	**48,540**	**62,607**	**64,050**	**57,221**
Other Henderson	18,695	24,169	23,671	24,015
Hendersonville	18,469	24,829	24,964	20,792
Fletcher	6,777	7,270	8,958	5,813
Mills River	3,217	4,417	4,575	4,541
Flat Rock	716	1,012	990	1,113
Laurel Park	667	909	892	947
MADISON	**7,616**	**10,120**	**9,892**	**11,942**
Other Madison	4,855	6,745	6,593	7,983
Mars Hill	1,188	1,463	1,430	1,700
Marshall	937	1,249	1,220	1,446
Hot Springs	636	663	648	814
TRANSYLVANIA	**14,416**	**19,263**	**18,847**	**19,359**
Brevard	9,571	12,640	12,372	11,554
Other Transylvania	4,768	6,492	6,347	7,656
Rosman	77	132	129	148
Grand Total	**270,652**	**356,870**	**356,870**	**356,870**

Zone-level socio-economic land use allocation

GIS maps of the zone-level allocations produced by the Manhan Group model were an important interim product shared with the FBRMPO prioritization committee (as well as, ultimately, the TCC and Board) to facilitate review of draft socio-economic forecasts. Such maps are presented on the following pages.

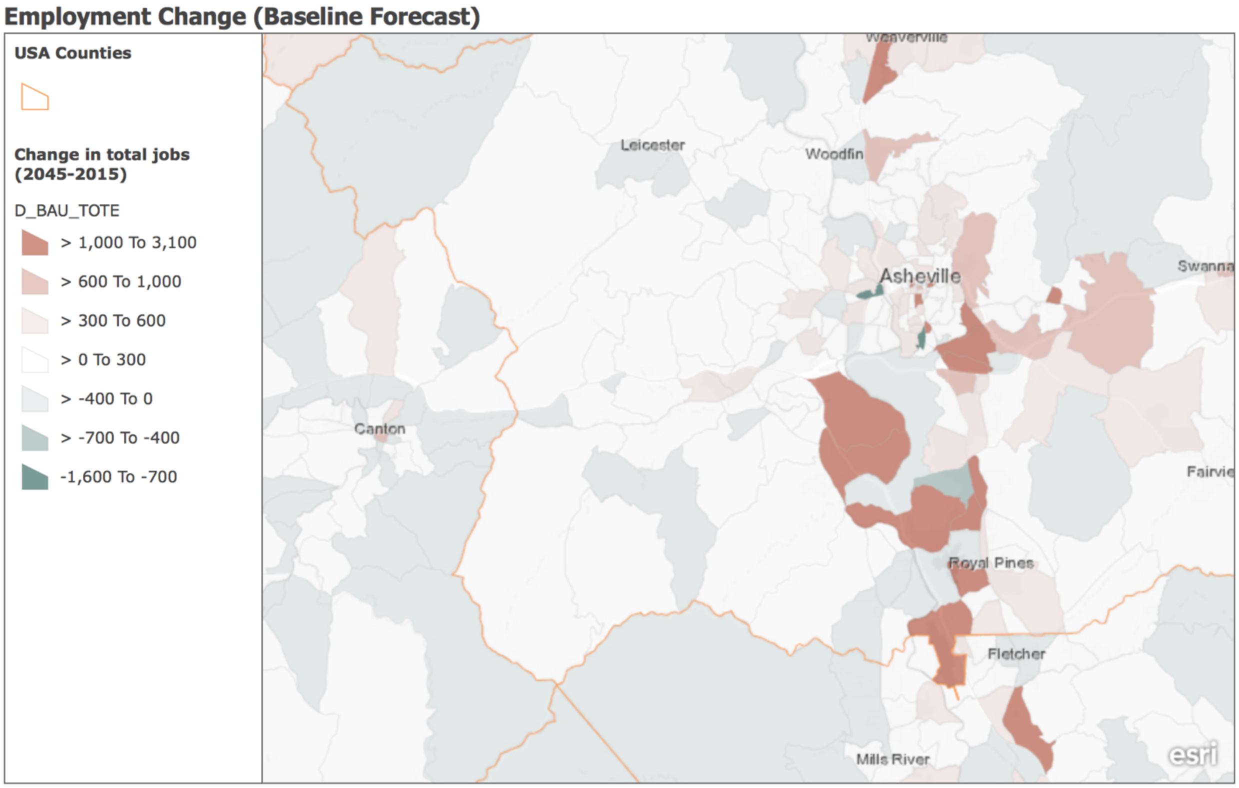


Figure 5. *Employment change, 2045-2015, by zone (Baseline forecast)*

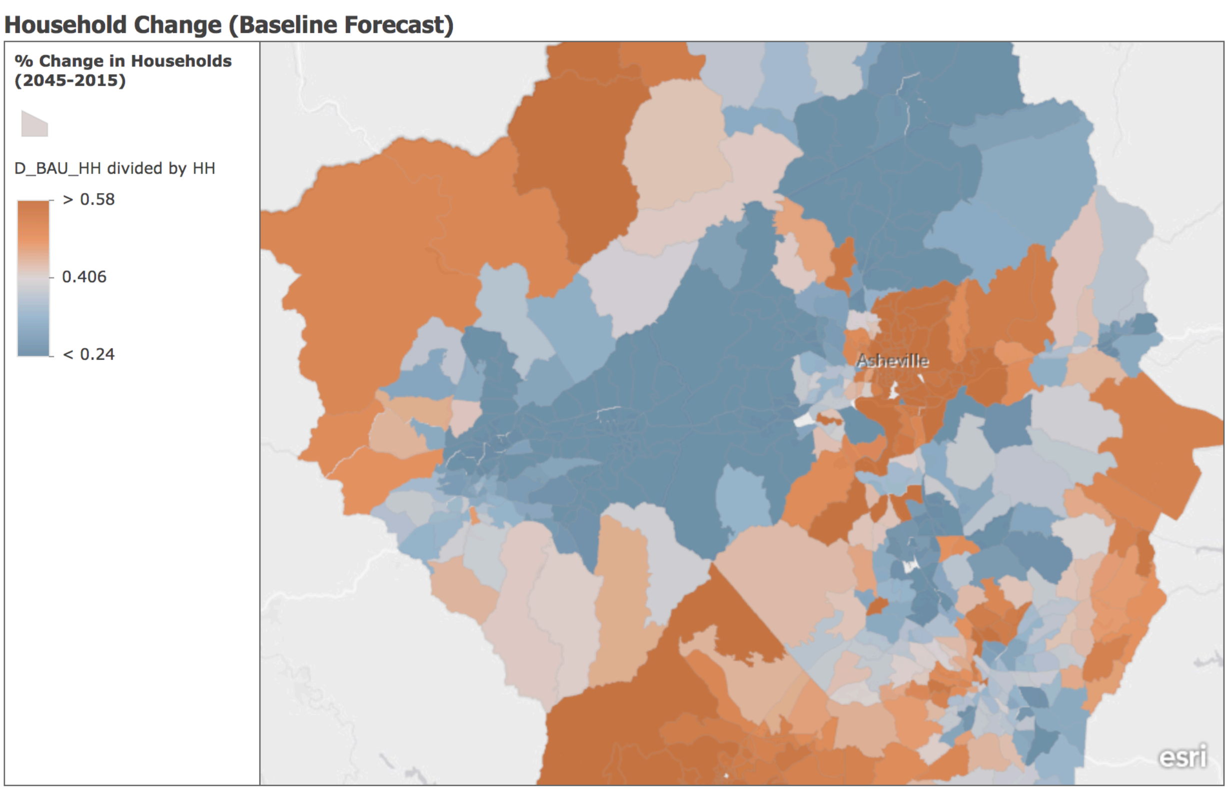


Figure 6. *Household change, 2045-2015, by zone (Baseline forecast)*

Employment Change (Alternative Scenario)

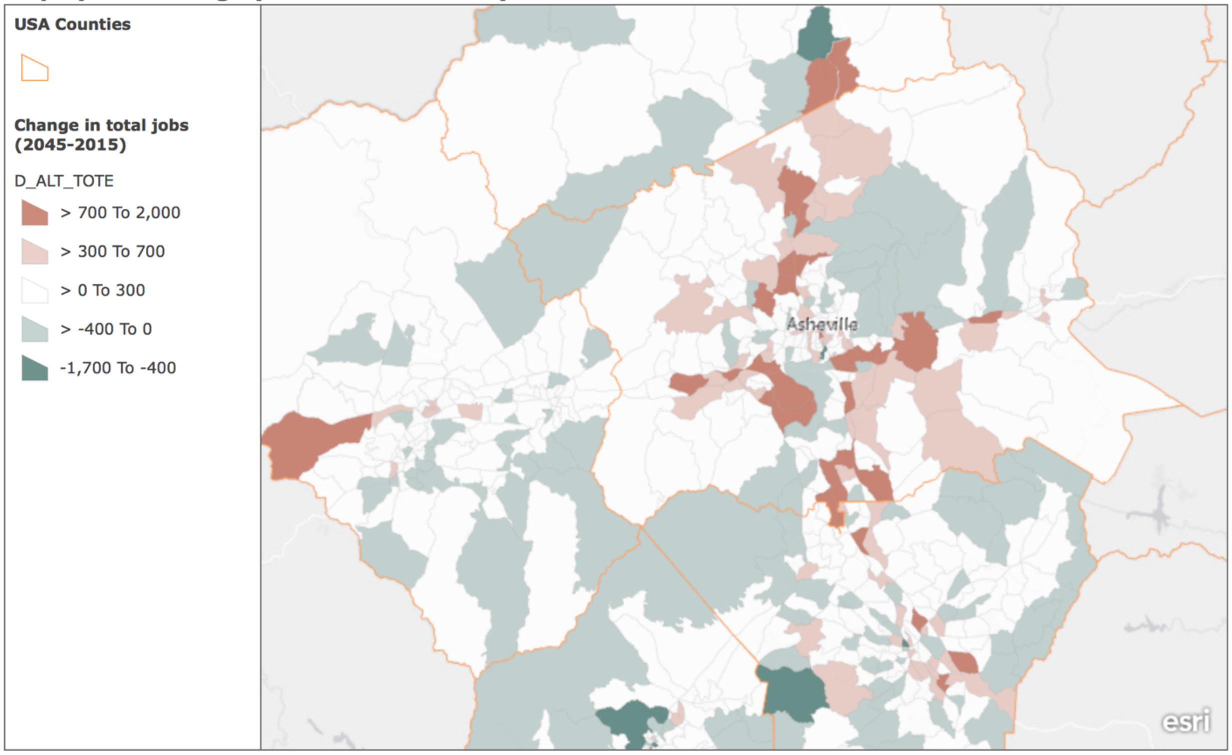


Figure 7. *Employment change, 2045-2015, by zone (Efficient Growth scenario)*

Household Change (Alternative Scenario)

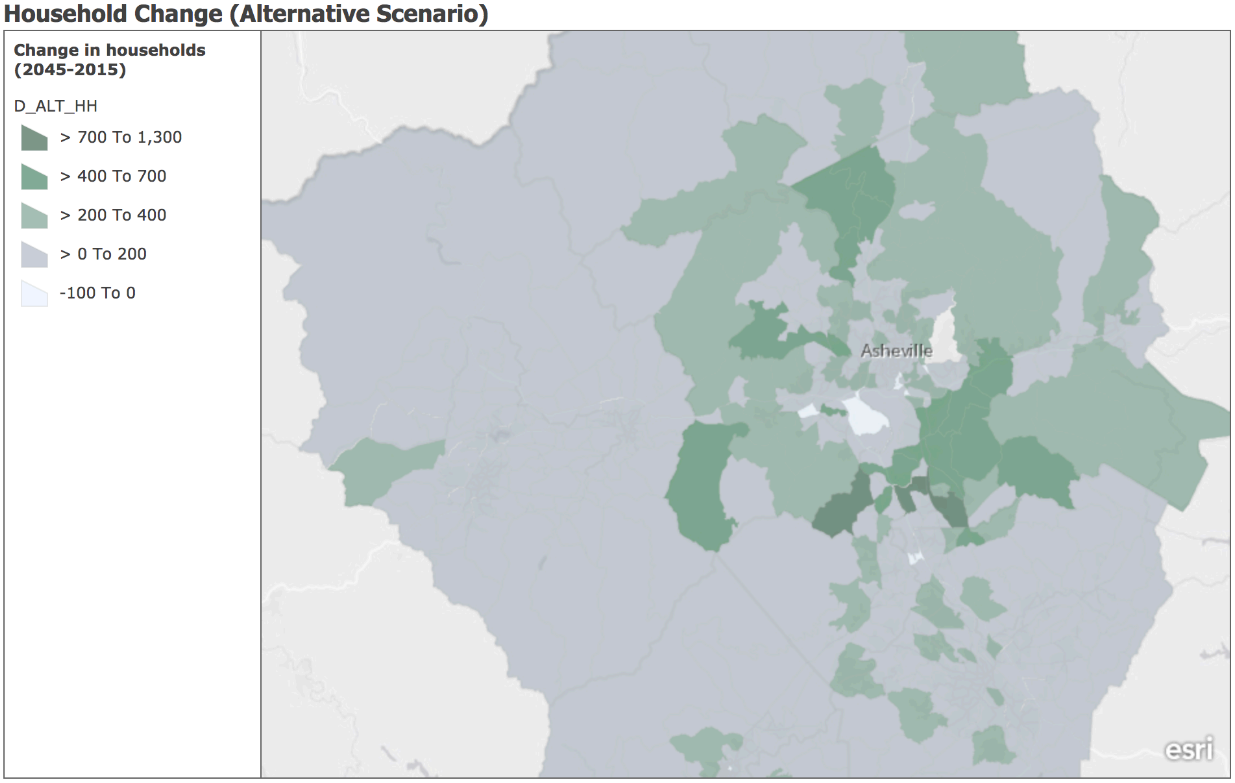


Figure 8. *Household change, 2045-2015, by zone (Efficient Growth scenario)*

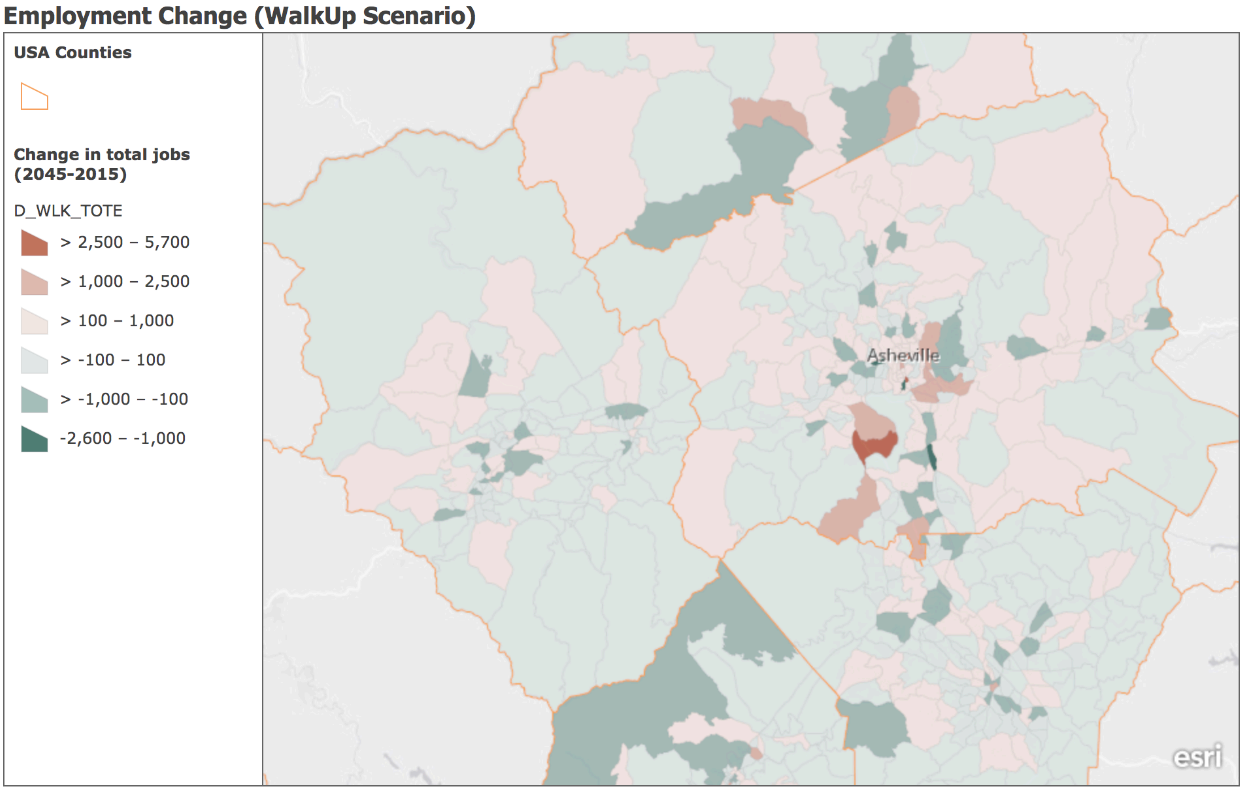


Figure 9. *Employment change, 2015-2045, by zone (WalkUp scenario)*

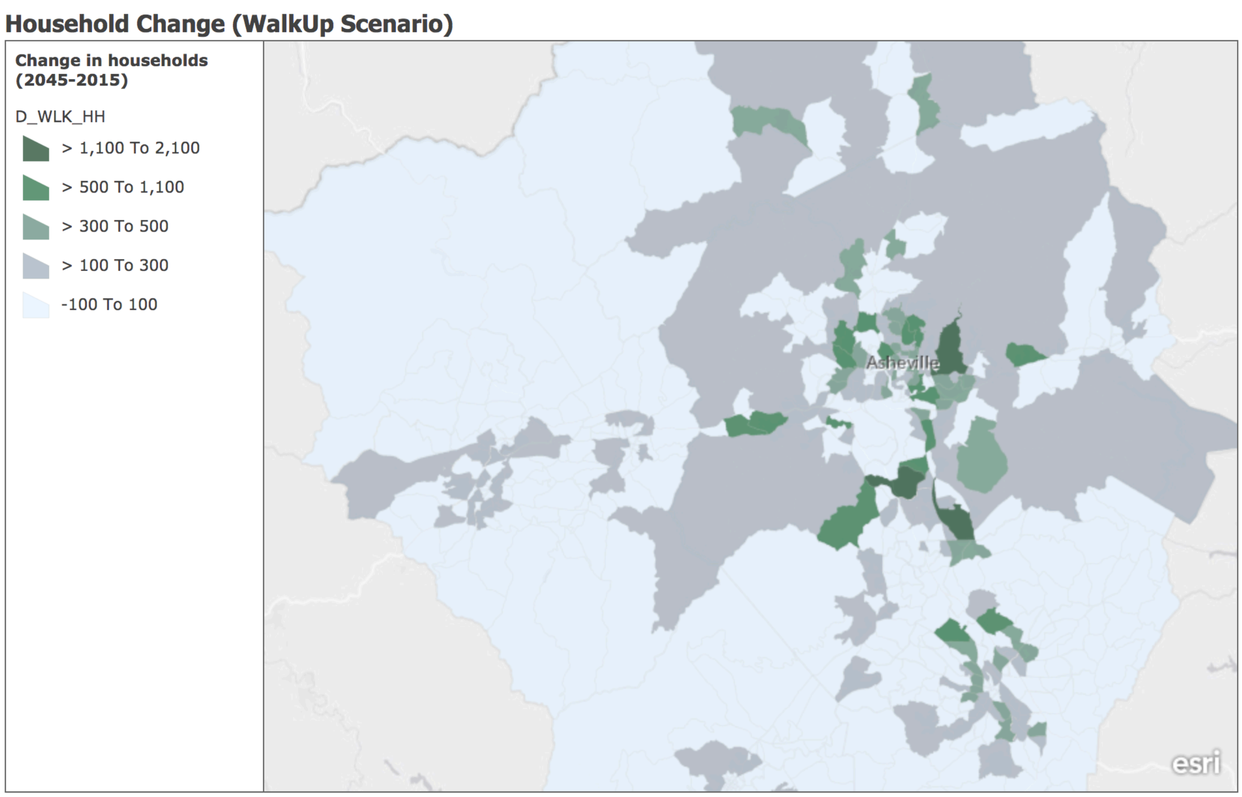


Figure 10. *Household change, 2015-2045, by zone (WalkUp scenario)*

Conclusions and Possible Future Directions

Manhan Group and its sub-consultant, Metro Analytics, have worked diligently to provide a land use forecast for the five-county French Broad River MPO study area rooted equally in prior work by MPO staff and consultants as well as economic analysis of current trends in the region's labor, travel, and real estate markets. In so doing we have attempted to strike a balance between "normative" planning—that is, strategic thinking using generalizations about what might happen in the future, assuming it will be similar to what has happened in the past—and "positive" planning: choosing an endpoint that offers a compelling alternative to allowing what usually happens to occur. For the latter process to be a success, planners must next identify which set of conditions are likeliest to guide growth and development toward a preferred alternative future. The land use model developed in this study can be used to support this search, since it is sensitive to the following policy levers:

- *Regional demand*. Although the transportation project pipeline evaluated in this study using TREDIS did not affect the anticipated control totals of employment in a significant manner, it is possible that other projects or plans could do so. These changes as well as alternative household demographic profiles can be tested to see how they affect land use allocation.
- *Housing characteristics*. Although not modified in any of the scenarios tested here, some attributes describing the features of single-family and multi-family housing are included in the residential bid function, so changes to the size or age of housing can be tested in the future.
- *Land use visions.* The "efficient growth" scenario demonstrates how a specific assumed or desired distribution of land use can be evaluated using the bid-auction models to translate housing and workspaces by type into socio-economic inputs for travel modeling. Other scenarios, including local comprehensive plans and proposed developments, can easily be tested in a similar manner.
- *Taxes and subsidies.* The "WalkUps" scenario illustrates a very simple example of using an economic incentive (in this case, a reduction in developer "costs" for walkable areas) to guide the real estate market towards a planning goal. With further recalibration and refinement of the economic components of the model (particularly the price and cost models), much more can be done, including "shadow pricing" exercises to find the optimal set of taxes or subsidies required to achieve a more specifically defined regional vision.
- *Transportation projects.* The highway network was assumed to be the same between all three scenarios; however, feedback with the region's travel model was instrumental in achieving the equilibrium necessary to produce the baseline forecast. It is widely considered a "best practice" under NEPA and other Federal regulations to test the impact of regionally-significant highway projects using an integrated land use model such as this one, in order to quantify the potential "secondary and tertiary effects" of improved local accessibility on induced growth and demand.

Manhan Group has ample experience with all of these use cases and would be happy to assist FBRMPO or any of its state and local partners in implementing the necessary model customizations to facilitate and streamline the forecasting process in order to develop and evaluate additional scenarios. We will also be happy to answer any questions or concerns that may arise during the process of moving from socio-economic forecasting to developing and adopting a long-range plan. It has been a pleasure serving the people of Greater Asheville and Western North Carolina through the conduct of this study.