City of Daytona Beach Small-Area Population Estimates and Projections

Prepared For

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INTRODUCTION

The University of Florida's Bureau of Economic and Business Research (BEBR) produces the official estimates and projections of residential population for the State of Florida through a contract with the Florida Legislature. That contract funds the development of estimates at the state, county and city levels, and projections at the state and county levels. Because this data is often required at much smaller levels of geography for many planning activities and other purposes, BEBR also develops estimates and projections for smaller geographic units.

The City of Daytona Beach requires small-area population estimates and projections to plan for smart growth and the development of their future infrastructure needs. This project generated those data using a GIS-based model which develops forecasts based on historical growth by census tract, constrains and directs population change using property parcel-level build-out analysis, and controls population totals to BEBR's 2020 city forecast. The purpose of this document is to describe the methods used by BEBR to develop small-area population estimates and projections for City of Daytona Beach.

CITY POPULATION FORECAST

BEBR produced a city-wide forecast of population through 2045 as a control for the small-area model forecast. The launch year was 2020, which we estimated using parcel-level data and controlled to the 2020 BEBR estimate. The projections were made for 2025, 2030, 2035, 2040 and 2045. The methods used were similar to those used for BEBR's official state and county forecasts. Different projection techniques were used over different historical base periods and the results were averaged. Each of the techniques is a good predictor of growth in different situations and growth patterns, so using a combination was the best way to avoid the largest possible errors resulting from the least appropriate techniques for each census tract (Sipe and Hopkins 1984). Base periods of ten and five years were used due to volatility in prior estimates, including large population reductions from the 2000 and 2010 decennial censuses. The following techniques were used for the city forecast:

1. **Linear Projection Method:** The Linear Projection Method assumes that the future change in the number of persons for each census tract will be the same as during the base period (Rayer and Wang, 2020). Two linear trends were calculated, one using a base period of 2010-2020, and a second using a base period of 2015-2020.

2. **Exponential Projection Method:** The Exponential Projection Method assumes that population will continue to change at the same percentage rate as the average annual rate during the base period (Rayer and Wang, 2020). Two exponential trends were calculated, one using a base period of 2010-2020, and a second using a base period of 2015-2020.

3. **Share-of-Growth Projection Method**: The Share-of-Growth Projection Method assumes that each census tract's percentage of the city's total growth will be the same in the future as over the base period (Rayer and Wang, 2020). However, if population change is negative at the tract level and positive at the city level (or vice versa), higher city-level

projections would result in larger declines in tract projections. This is counterintuitive, so the "Plus-minus" variant of the Share-of-Growth Method was used (Smith, Tayman and Swanson, 2001). Two Share-of-Growth trends were calculated, one using a base period of 2010-2020, and a second using a base period of 2015-2020.

4. **Shift-Share Projection Method:** The Shift-Share Projection Method assumes that each census tract's future percentage of the city's total annual growth will change by the same annual amount as over the base period (Rayer and Wang, 2020). One Shift-Share trend was calculated using a base period of 2010-2020.

5. **Average of the Projection Extrapolations:** Seven calculations were made and averaged in the forecast. Although all seven were included in the averages, the three using a base period of 2015-2020 were also averaged separately and weighted more in the short term to capture the higher than average growth over that period. The three calculations based on the more recent base period alone represented 80% of 2025 forecast, 60% of the 2030 forecast, 40% of the 2035 forecast, and 20% of the 2040 forecast. The 2045 forecast weighted all seven calculations equally. The results are shown in Table 1.

Table 1. Daytona Beach Population Estimates and Projections

Year	Daytona Beach
1980	54,176
1985	56,978
1990	61,991
1995	63,306
2000	64,112
2005	65,129
2010	61,005
2015	63,534
2020	70,235
2025	76,633
2030	82,526
2035	88,023
2040	93,266
2045	98,264

GEOSPATIAL SMALL-AREA POPULATION ESTIMATION AND FORECASTING MODEL OVERVIEW

The Geospatial Small-Area Population Estimation and Forecasting Model ("Model") was used to estimate and project permanent residential population at the parcel level, and then normalize those projections to BEBR's latest city population estimates and forecasts. First, a Build-out Submodel was developed to estimate the maximum residential development potential at the parcel level. Current permanent population was estimated, and then build-out values were forecasted with the Build-out Submodel. Areas which cannot physically or lawfully allow residential development (built-out areas, water bodies, public lands, commercial areas, etc.) were excluded from the Build-out Submodel. Conversely, the Growth Drivers Submodel identified areas where growth is more likely to occur based on proximity to certain spatial features (e.g., roads) that tend to drive growth to certain areas.

Growth was projected based on a combination of historic growth trends (using an approach similar to what BEBR uses for its county level forecasts), and spatial constraints and influences, which both restrict and direct growth. Population growth calculations were controlled to BEBR's city forecast, which was developed for this project in five-year increments to the year 2045.

BUILD-OUT SUBMODEL

The Build-out Submodel was developed to forecast maximum residential density at build-out, based on the latest property data, future land use, development data and trends. It was built using county property appraiser's GIS parcel database, including the associated tax roll information. Existing housing units were identified using data provided by the property appraiser which was vetted by city planners (see Figure 1).

BEBR applied average unit occupancy and average household size from the 2010 decennial census tract data to convert housing units to population. BEBR then controlled the city population total to BEBR's official 2020 population estimate, resulting in a slightly upward adjustment of 2.6%. This is likely attributable to an increase in unit occupancy since the 2010 Census.

Figure 1. Parcels shaded by maximum allowable housing units per acre (yellow is low, tan is medium, and brown is high)

GROWTH DRIVERS SUBMODEL

The Growth Drivers Submodel is a raster (cell-based) GIS model representing development potential. The submodel is a continuous surface of 10-meter cells containing values of 0-100, with '100' having the highest development potential and '0' having the lowest development potential (see Figure 2). It influences the Model by factoring in the attraction of certain spatial features, or growth drivers on development. These drivers were identified from transportation and land use/land cover data. They include the following:

1. Proximity to roads and interchanges prioritized by level of use (with each road type modeled separately)
2. Proximity to existing residential development
3. Proximity to existing commercial development (based on parcels with commercial land use codes deemed attractors to residential growth)
4. Proximity to coastal and inland waters
5. Proximity to large planned developments

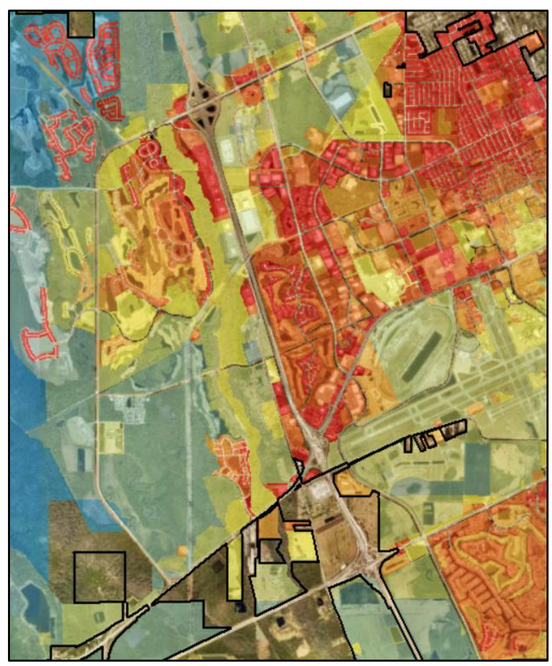

Figure 2. Parcels shaded by growth driver values (high development potential in red, moderate in yellow and low in blue)

Data used for generating the Growth Drivers Submodel are listed in Table 1 below.

Table 2. GIS datasets used in the Growth Drivers Submodel

Growth Driver	Data Source
Roads and Limited Access Road Interchanges	Florida Department of Transportation (FDOT) Major Roads: Functional Classification (FUNCLASS), and FDOT Limited Access Road Interchanges
Existing Residential Land Uses	County Property Appraiser Parcel Data
Selected Existing Commercial Land Uses	County Property Appraiser Parcel Data
Coastal and Inland Waters	Land Cover Data, and Florida Geographic Data Library (FGDL) Coastline Data
Large Planned Developments	City of Daytona Beach and BEBR

Each of the drivers listed in Table 1 were used as independent variables in a logistic regression equation. Dependent variables included existing residential units built during or after 1995 as the measure of "presence", and large undeveloped vacant parcels outside of large planned developments were used to measure "absence". The resulting equation could then be applied back to each of the regional grids resulting in a single regional grid with values 0 through 100, for which a value of 0 represented the lowest relative likelihood of development, and a value of 100 represented the highest relative likelihood of development.

This submodel encompasses the City of Daytona Beach and its surrounding areas to account for the presence or absence of growth drivers outside the city that could influence growth within it. This submodel was used by the Model to rank undeveloped parcels based on their development potential, which is explained in the Growth Calculation Methodology section. Note that growth can still occur in areas assigned relatively low values from this submodel based on the historical growth trends.

GEOSPATIAL SMALL-AREA POPULATION ESTIMATION AND FORECASTING MODEL

The Geospatial Small-Area Population Estimation and Forecasting Model ("Model") integrates the Build-out Submodel and the Growth Drivers Submodel with the Population Projection Engine™, which makes the projection calculations using a combination of those submodel values, historic growth trends, and growth controls from BEBR's city-level forecast.

Historic Growth Trends

The census tract level historic growth trends were derived from historic census population counts for 1990, 2000 and 2010, and parcel-based population estimates for 2020. For 1990, 2000 and 2020, census block population estimates were summarized at the 2010 tract level and combined with the 2010 tract population estimates. For 2020, population was estimated by applying average unit occupancy and persons per household (from tract-level data from the 2010 Census) to parcel-based housing unit counts by census tract, and then adding population in group quarters. The population within the city limits was then calibrated to the 2020 BEBR estimate for the city, an increase of 2.6%. These estimates were used to produce tract level projections using different demographic extrapolation methods.

A similar approach was taken to calculating the tract-level historic trends as was used for the city projections. However, in this case five projection techniques (Linear, Exponential, Constant Share, Share-of-Growth and Shift-Share) were tested over three base periods (1990-2020, 2000-2020 and 2010-2020). Different combinations of these were used to hindcast 2020 population, and the combination that produced the most accurate 2020 hindcast was used to forecast 2020-2045. Because of the volatility of population growth between 1990 and 2000, 1990 was eliminated from the base period. And due to the extreme results of the Shift-Share forecasts, that method was also eliminated.

The four demographic extrapolation methods selected for projecting small-area population utilized by the model were Linear, Exponential, Constant Share and Share-of-Growth. The launch year was 2020, which we estimated using parcel-level data and controlled to the 2020 BEBR estimate. The projections were made for 2025, 2030, 2035, 2040 and 2045. Again, this approach is similar to the one used for our city forecast and our official county forecasts. The methods and base periods used for the tract-level calculations were the following:

1. **Linear Projection Method:** One linear trend was calculated using a base period of 2010-2020.

2. **Exponential Projection Method:** One exponential trend was calculated using a base period of 2000-2020.

3. **Constant Share Projection Method:** The Constant Share Projection Method assumes that each census tract's percentage of the city's total population will be the same in the future as over the base period (Rayer and Wang, 2020). One constant share trend was calculated based on the 2010 shares.

4. **Share-of-Growth Projection Method**: One Share-of-Growth trend was calculated using a base period of 2010-2020.

5. **Average of the Projection Extrapolations:** Four calculations were made, the highest and lowest were excluded (to reduce the more extreme results that tracts can produce), and the remaining two were averaged. A few tracts showed a slight declining trend in population, likely due to redevelopment and/or changes in occupancy, household size, or proportion of seasonal residents. Rather than extrapolate these negative trends, they were reset to no change.

Growth Calculation Methodology

After the development of the Build-out Submodel, the Growth Drivers Submodel, and the historical growth trends, the Population Projection Engine™ tool was used to make the growth calculations. The methodology for calculating growth for each projection increment included the following steps:

1. Applying projected tract-level population growth to parcels within each tract.

2. Checking growth projections against build-out population and reducing any projections exceeding build-out to the build-out numbers.

3. Summarizing the resulting population growth and comparing it against BEBR's citywide population growth.

    a. If the sum of the model's small-area projections exceeded the BEBR city projection, projected growth for all tracts was reduced proportionally.

    b. If the sum of the model's projections were less than the city projections, the Growth Drivers Sub-model would be repeatedly applied until the BEBR projected growth for each five-year increment was reached. This process involved raising the populations of parcels in which growth driver values in the highest decile had available capacity for growth.

PROJECTION DELIVERABLES

The final population projections were delivered in GIS format (Esri file geodatabase), with a single feature class containing parcel-level results. This format is useful for quality assuring the results and inputs, for maintaining the projection inputs over time, and for graphically depicting projected patterns of future population growth (see Figure 3).

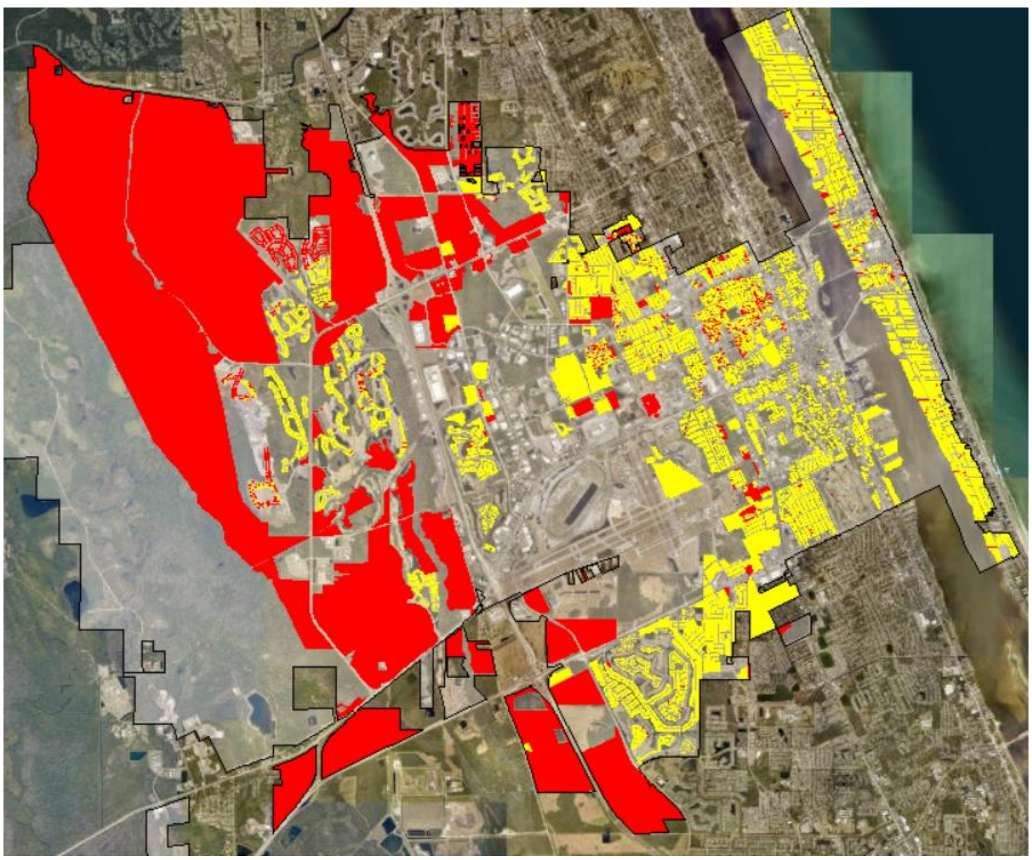

Figure 3. Parcels Showing Current and Projected Population (current residential development in yellow and projected future residential development in red)

The parcels in the GIS deliverable are linked to data in an attribute table. An example of this data is shown in Figure 4 below.

Table

DB_Projections

PARCEL_NUM	BO_ID	GEOID10	GIS_ACRES	WAT_ACRE	DRY_ACRES	PD_NAME	DOR_L	DOR_DESC	YEAR_	UNIT_	FLU_BO	POP_PER_	DU_AC_BO	DU_BO	POP_BO	DRIVERME	POP20	POP25	POP30	POP35	POP40	POP45	NC
04153301030010	14898	12127081200	0.761764	0	0.761764		1000	COMMERCIAL	0	0	HI INT *	1.293596	40	30.470549	39.41658	96	0	7.973321	15.384281	22.362952	28.74802	32.720677	Vacar
17153200000080	7304	12127083205	14.286855	9.931468	4.355387		0000	VACANT RESIDE	0	0	L1 - R	2.153244	5.233876	18.236444	39.267519	87.3125	0	0.483298	0.933314	1.357041	1.76386	2.15867	
25143232000001	1081	12127081101	1.003012	0	1.003012		0900	COMMON AREA	0	0	L2 - R	1.155631	31.903904	32	37.944111	91.833333	37.944111	37.944111	37.944111	37.944111	37.944111	37.944111	
30153200000013	9605	12127083205	14.952759	1.949204	13.003555	PRESERVE AT LPG	5600	AGRICULTURE/V	0	0	LI - U	2.153244	1.156863	17.298299	37.247463	56.585714	0	0.458435	0.885301	1.28723	1.673121	2.04762	
05153301380110	15554	12127081200	0.934601	0	0.934601		0300	MULTIFAMILY > 1	1973	28	OFFICE *	1.293596	29.959295	28	37.164814	98.5	37.164814	37.164814	37.164814	37.164814	37.164814	37.164814	
08153205000001	4884	12127083205	81.830685	38.568672	43.262013	MINTO COMMUNITIE	0900	COMMON AREA	0	0	LI - U	2.153244	0.207554	16.984304	36.571355	67.902439	0	0	0	0	0	0	
09153210000100	5278	12127082301	8.06556	0	8.06556	TOMOKA TOWN CE	1000	COMMERCIAL	0	0	IC	1.668243	2.709234	21.85149	36.453601	77.945946	0	2.702932	5.262547	7.764003	10.225306	12.673195	
03153213000005	3317	12127082301	1.107983	0.029472	1.078511		1000	COMMERCIAL	0	0	MU	1.668243	19.391574	20.914026	34.889683	82.2	0	2.586972	5.036775	7.430915	9.786624	12.129495	Vacar
03153213000020	3319	12127082301	1.337269	0.263143	1.074126		1000	COMMERCIAL	0	0	MU	1.668243	19.391574	20.829002	34.747841	88	0	2.576455	5.016298	7.400705	9.746837	12.080183	Vacar
	141	12127083205	4.156016	1.990047	2.165969	Avalon Park	8000	INSTITUTIONAL	0	0	LI - U	2.153244	3.831204	15.922545	34.285129	40.666667	0	0.421976	0.814892	1.184855	1.540056	1.884771	
391533A6000001	24294	12127082201	0.753089	0	0.753089		0900	COMMON AREA	0	0	L1 - R	1.388079	31.86873	24	34.18226	96	34.18226	34.18226	34.18226	34.18226	34.18226	34.18226	
40153304030010	24379	12127082201	0.906006	0	0.906006		0300	MULTIFAMILY > 1	1984	24	L3 - R	1.388079	26.489883	24	34.18226	95.75	34.18226	34.18226	34.18226	34.18226	34.18226	34.18226	

0 (12 out of 25890 Selected)

DB_Projections

Figure 4. Attribute table sample showing population projections and associated data for parcels within the City of Daytona Beach

CONCLUSIONS

Small area estimates and projections of population provide an essential foundation for planning and decision making. BEBR implemented the Geospatial Small-Area Population Estimation and Forecasting Model because it was the ideal tool for this purpose. Controlling to BEBR's city estimates and projections provided consistency with other estimates and projections, while at the same time providing the spatial precision needed for a wide range of planning and other purposes.

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