



NATIONAL CENTER FOR SMART GROWTH RESEARCH AND EDUCATION

To: Maryland Department of Planning
From: National Center for Smart Growth Scenarios Team
Subject: Methods Used for Estimating Employment Capacity in Maryland

This document provides an overview of how employment capacity was estimated for the state of Maryland as part of the Maryland Scenarios Project.

1 Background

In the Maryland Scenarios Project, the National Center for Smart Growth (NCSG) is constructing models for assessing how key driving forces will shape growth patterns, public finances, and environmental quality in Maryland. A series of scenarios based on certain assumed values of the key driving forces are under development. Scenarios will assess, among other things, the likelihood and impacts of different residential and employment patterns. Those patterns might be largely defined by historical and current zoning, or they may be unconstrained by existing land-use regulations.

This document addresses a “build-out” scenario: housing and employment capacity under current conditions. It looks at the employment component of build out, and complements work done by the Maryland Department of Planning (MDP) to address housing capacity using its residential growth model. This document describes the methods used to estimate employment capacity for each of the counties in the state of Maryland. In short, the methods to estimate the capacity of buildable land to accommodate future employment (i.e., to estimate employment capacity) are based on the assumption that future employment will occur at average historical densities (as estimated by the analysis reported below). Employment capacity of undeveloped land is calculated based on the type of undeveloped land and the observed capacity of that to accommodate existing employment (i.e., the employment density).

2 Framework

In planning analysis, the proper use of information depends on an understanding of the data and analytical techniques used to develop that information. That point is particularly true in this project.

Before we explain how we estimate employment capacity, we explain the role of undeveloped but developable land and what we mean by employment and by capacity. Defining these concepts lays the framework for the data and methods used in this analysis.

2.1 The role of undeveloped, developable land in development

Fundamental to our evaluation are several reasonable but rebuttable assumptions that are typical of all evaluations of this type:

If employment growth is to be significant in some area over the long run, buildings will have to be constructed to accommodate that employment growth. In the short run it is possible that excess building supply and increased employment densities in existing buildings can accommodate employment growth. Over the long run, however, significant growth will require new built space.

Buildings require sites. For many reasons it is typically easier and less expensive to build on undeveloped developable sites than on sites that already have buildings on them.

Thus, it is typical for land-use and transportation planners to consider the supply of undeveloped developable land in planning. For example, it is common practice for standard four-step transportation models to require as inputs an estimate of employment growth by transportation analysis zone (TAZ), and for those estimates to be based in part—and sometimes primarily—on the amount of undevelopable developable land in the TAZ.

These points suggest not only the importance of land supply to transportation modeling and planning, but also some of its limitations. In particular, real estate development does not happen wherever buildable land is in ample supply—there has to be demand for real estate products as well, and that demand is a result of many factors. One must be careful with growth forecasts based only on the supply of land.

It is not that supply-side forecasts of development ignore demand—rather, they assume that demand will be there if the land under evaluation is close to land that has already been developed. For example, the Maryland Department of Planning has a state growth model that forecasts residential development primarily as a function of residential developable land, its zoning, and assumptions about the percentage of the maximum allowed density that will develop on the undeveloped developable land. It conditions its estimates to some degree by proximity to developed land, in large part because urban levels of residential zoning are generally in urban places, and thus close to places where residential demand has manifested itself as residential development.

2.2 Defining Employment Capacity

Estimating “employment capacity” must start with definitions of “employment” and of “capacity.” In this document, the term *employment* is used interchangeably with the term *jobs*. Employment is the universe of full-time jobs, at the place of work (or job site). Rather than using employment at the level of a census tract or traffic analysis zone (TAZ), we consider employment at the job site level. We discuss data and methods for acquiring and adjusting employment data in later sections, and in appendices to this document.

We used the term “unutilized capacity” to refer to employment that could be accommodated on undeveloped but developable land if this land was built out at the same density as developed land in the same zones. Though we use the term “capacity” as it is typically used in these types of studies, in the physical sciences, capacity and yield are identical: a one liter beaker always has the capacity of one liter, and if filled it will yield one liter when poured. But though an acre of land has a fixed capacity to accommodate only one acre of development, the intensity / density of that development can change substantially across land parcels, and over time on the same parcel. We use the term *yield* to try to reflect the idea that land's ability to accommodate employment is not a fixed capacity, but a yield that can change as external conditions and parcel inputs change.

Whether called capacity or yield, our estimates depend on estimates of existing employment density, which means the number of employees (the numerator) per developed acre of land (the denominator). Unlike housing unit density, employment is not enforced through zoning regulation. Thus, unutilized capacity is determined by applying the current employment density of developed land to undeveloped developed acreage.

2.3 Estimating Employment Capacity on a Local Scale

Local governments often use floor area ratios (FARs) to estimate employment capacity. FAR provides the allowable ratio of floor area to lot size and can be used to determine a maximum building square footage for any given lot. Then, estimates of built-space-per-employee (by industry type) or site-level employment data can be used to estimate employment capacity for any given lot or group of lots. This method works when measuring employment capacity for an individual municipality or county, but it cannot work at the state level unless it is done by or for all the individual municipalities and counties a state comprises. Since only a few local estimates using this method exist in Maryland, we cannot use this method for our statewide modeling.

2.4 Estimating Employment Capacity at the State Level

Estimating employment capacity is not often attempted at the state level. To estimate unutilized employment capacity in the state of Maryland, we apply existing employment densities by zoning classification to undeveloped developable acreage in each zone. This approach relies on the assumption that the future will be like the past. To estimate unutilized capacity using this approach we use site level employment information, parcel data, and zoning data. In the next section, we describe the general data used to locate employees, identify undeveloped developable land (and developed land), calculate current employment density, and calculate unutilized employment density.

3 Methods

This section provides a general overview of the methods used to calculate unutilized employment capacity for the state of Maryland. Our methods require data in four categories:

Employment

Undeveloped developable and developed land

Employment density

Unutilized land capacity.

3.1 Employment

To calculate current employment density, we used disaggregate employment data at the job-site level. We used modified Quarterly Census of Economic Wages (QCEW, formerly referred to as ES 202) employment data obtained from the Maryland Department of Labor, Licensing and Regulation for the second quarter of 2008. This dataset provides the location of employees at a job site point. See appended memo for further information about these data, especially on the extensive work we did on cleaning the raw data to get employment properly tied to the ground.

3.2 Undeveloped developable and developed land

Property parcel data was used to classify parcels as developed, undeveloped and developable, and undeveloped but undevelopable, and to estimate the acreage in these three categories. Briefly, these three categories are defined as:

Developed: parcels on which there is a structure valued over \$10,000

Undeveloped Undevelopable: parcels without a structure valued over \$10,000 that are not buildable because of environmental constraints or protected status

Undeveloped Developable: parcels without a structure valued over \$10,000 that are not environmentally or legally constrained from development

To categorize parcels and calculate areas, we used the Master Parcel Database (based on Maryland PropertyView) which is maintained by Maryland Department of Planning and used in its Residential Growth Model. An appendix of this document provides further information about the assumptions used to divide land into developed, undeveloped undevelopable, and undeveloped undevelopable. Developed land was used to calculate employment per acre (density), and undeveloped developable acres were used to calculate unutilized capacity.

3.3 Employment Density

Employment densities can be calculated several different ways. Often, when FARs are used to calculate employment capacity, industry standard employment densities are employed. In this analysis, we considered using three different types of employment densities based on different scales of zoning classification:

Generalized zoning classifications (attributed by the Maryland Department of Planning) that classify areas into broad categories like commercial, low-density residential, and industrial.

Zoning classifications that are unique to each county and defined by the zoning code, like Rural Residential (RR). A zoning classification might apply to areas of the county that are not contiguous; thus there are different areas with the same zoning classification.

Zoning polygons that are individual areas with same zoning classification and generalized zoning. These polygons are not based on political boundaries like census tracts, but on permissible land uses in the region.

We judged the first method to be too coarse: it would apply state averages to very different counties. We judged the last method to be too fine: it would imply that densities idiosyncratic to a specific polygon were somehow inherent to that polygon and would continue into the future. To smooth out the variation and still provide fine-scale estimates, we used employment per acre ratios by zoning classification within each county. Employment density was obtained by determining the current ratio of employment to developed acre (regardless of land use) for each zoning classification within a county.

3.4 Unutilized Employment Capacity

It is often assumed that employment only falls on land zoned for office, commercial, and manufacturing. While residential zones are not primarily intended for employment, many employment sites fall in areas zoned residential. This can occur for several reasons:

Employment sites may have existed when zoning boundaries were drawn (grandfathering)

Jurisdictions do not zone for institutional uses like churches and schools, and these often fall in residential zones

Geocoding errors result in misclassification of employment location.

Because of the long-term goal of integrating this employment capacity model with MDP's Residential Growth Model, we calculate three different types of estimates of

employment capacity, each of which treats employment capacity in residential zones differently.

Estimate #1 (Maximum Capacity): We assume under this estimate that the future will be like the past, regardless of zoning classification. Employment densities in the future will continue at the same levels as the present.

Estimate #2 (Minimum Capacity): we do not assign employment to residential zones, assuming that all existing employment on residential zones was grandfathered, and assign half the calculated employment density to mixed use zones.

To calculate unutilized employment capacity we:

Apply the zoning classification level employment per acre ratio to each individual zoning polygon and calculate two separate estimates, discussed above.

Apply the employment per acre ratio to each individual undeveloped developable parcel. Each parcel in a particular zoning classification receives the same employment per acre ratio. This ratio is simply multiplied by the acreage of each undeveloped developable parcel.

This attributes unutilized capacity to individual undeveloped developable parcels and permits aggregation at several scales from the parcel to the zoning classification to the county.

4 Limitations

There can be little doubt that NCSG has done more work than has been done previously to try to make estimates of employment capacity at a statewide level in Maryland. MDP, MDOT, DLLR, and MDBED are the most likely agencies to have attempted such work; to our knowledge neither they nor any other agency or institution has attempted to make these estimates. Thus, our estimates are certainly much better than competing estimates: no competing estimates exist.

But despite the substantial work to get the estimates as far as we have, they still have some undeniable limitations. Users of the estimates must be aware of these limitations and the kinds of certainties they introduce into any conclusions drawn from them:

Assumption that future employment density, by zoning designation, will be the same in the future as it is now. This is the most important assumption in our analysis. Our numbers provide estimates of unutilized capacity if undeveloped developable acres are developed at the same densities in the future. Arguments for why they might be developed at lower densities are weak relative to the arguments for why they might be developed at higher densities (e.g., infill of underutilized land; continued shift from manufacturing to services (offices); increasing transportation costs for commuters and freight; public policy encouraging higher density). Thus, even if there were no other

problems with the analysis, the application of existing employment densities to developable land is likely to underestimate employment capacity.

No estimates of redevelopment. Think of redevelopment as the intensification of use on already *developed* land. Our analysis looks only at *undeveloped* land that is not protected or constrained. Thus, there is employment capacity on developed land that we are not estimating.

Treatment of polygons zoned as mixed-use. Mixed-use zones accommodate both residential and non-residential development. In Estimate #1, we allocate employment to mixed use zones at the current density. In Estimate #2, we allocate employment to mixed use zones at one-half the current density.

Incomplete or missing zoning data. Zoning data are unavailable for several municipalities across the state. For technical reasons, we treat these municipalities as a single zone, which means our estimates are reasonable on average for the state, but could be off substantially for some municipalities.

Calculation at state scale. Attempting to estimate employment capacity at state scale requires broad generalization. That could be improved prototype analysis at a fine scale for selected counties, but did not have the budget or time for that type of analysis.

Appendices

The appendices provided below discuss the data used and assumptions employed in greater detail. These appendices provide details on the four steps used to estimate employment capacity in the state in transit stations. The step-by-step instructions are meant for GIS users or individuals familiar with Structured Query Language.

The appendices are generally organized around the steps of the analysis:

Dataset preparation and Calculation of unutilized employment capacity (Appendix A)

Allocate employment to undeveloped developable parcels (Appendix B)

Appendix A: Prepare Datasets

In this step, datasets are prepared for use in analyzing future job capacity, using a GIS Model. The three spatial layers are used: zoning (County zoning polygon layer); parcels (MDP Master Parcel Database point file); and jobs (DLLR QCEW point file). A separate set of layers exists for each county and this task is repeated for each county. In preparation of the datasets, a unique ID is created for each zoning polygon, which carries through the remainder of the analysis.

Input Data

Three major datasets were needed for the analysis: (1) a GIS shapefile of county and municipal zoning districts, (2) a GIS shapefile of parcel points, and (3) a GIS shapefile displaying the locations and amounts of current employment.

Zoning

GIS zoning district boundary shapefiles for many counties and municipalities were obtained from the Maryland Department of Planning through a Memorandum of Understanding Agreement with the Maryland Association of Counties. Zoning boundaries for Prince George's and Montgomery Counties were obtained directly from the county. To ensure consistency with the Maryland Department of Planning Residential Growth Model, we used the same zoning boundaries as MDP. While MDP provided zoning for 21 counties and some municipalities, we did not acquire zoning boundaries for all municipalities because MDP does not have 100 percent of municipal zoning boundaries. In this case, the municipality was treated as a single zoning polygon regardless of the type of use.

Parcels

Property parcel data was used to determine whether a parcel was developed, undeveloped, or undevelopable, and the acreage of each parcel. The Maryland State Department of Assessments and Taxation maintains a statewide parcel point database

called Property View which contains a variety of characteristics about parcels including valuation, size, ownership, and land use type. The Property View data set serves as the basis of information for an enhanced, cleaned up database called the Master Parcel Database, which is used by MDP for the Residential Growth Model. The Master Parcel Database is updated on a rolling basis, so the data used in the analysis does not represent data from a single year across the whole state. The parcel data used encompass range from 2004 through 2007.

Employment

The DLLR QCEW data used in this analysis dates from the second quarter of 2008, which was the most recent data available at the time of processing. QCEW data was obtained from DLLR as a database (.dbf) file which staff at NCSG geocoded into a GIS shapefile. Each point in the GIS shapefile shows the location of a particular employer and provides the number of employees working at that site, in addition to other information such as North American Industry Classification (NAICS) code. Adjustment factors were applied to each QCEW employment count to compensate for points that could not be geocoded and for employees that the QCEW dataset does not count. Appendix C1-A describes the entire clean-up process in more detail and is recommended reading for understanding the estimates of existing employment.

Output Data

Data were organized in a logical and consistent manner and creates outputs necessary to the calculation of future employment capacity. Assumptions were made during this process, consistent with the MDP Residential Growth Model. First, a parcel is considered developed only if it has an improved value of \$10,000 or more. Parcels that are considered developed are, by default, undevelopable. This means that we do not consider redevelopment in this analysis, which we discussed in the Limitations section of this document. Second, a parcel is considered undeveloped developable only if it is not protected or constrained. A parcel may be protected from development for several reasons including being owned by the Department of Natural Resources, its proximity to the Chesapeake Bay, or the presence of utilities or steep slopes. The following five GIS layers are created through this step:

Developed Parcels: This table counts the number of all parcels (including residential) within a zoning polygon by Zoning_ID that have an improved value of \$10,000 or more and sums their area. This layer is used to calculate current employment density.

Developed Exempt Parcels Greater than 200 Acres: The exempt table is derived from the Developed Parcel layer and only considers exempt parcels 200 acres or less. We only consider parcels that are 200 acres or less because we assume that large parcels like reservoirs and large state parks will not be created in the future. The numbers of parcels are counted within each zoning polygon by Zoning_ID and their areas summed.

Undeveloped Undevelopable Parcels: This table includes parcels that have an improved value of less than \$10,000 and are restricted from future development due to the parcel being classified as protected. The numbers of parcels are counted within each zoning polygon by Zoning_ID and their acreage summed. No employment is allocated to these parcels.

Undeveloped Developable Parcels: The parcels included in this layer have an improved value less than \$10,000 and are not protected. The numbers of parcels are counted within each zoning polygon by Zoning_ID and their acreage summed. Parcels in this table are the locations where future development will take place. This layer is used to calculate future employment capacity.

Employment: The final layer counts the number of job sites and sums the number of employees within each zoning polygon by Zoning_ID. This layer is used to calculate current employment density.

The final step prior to calculating unutilized employment capacity is joining these tables back to the zoning layer by the common unique zoning polygon ID.

Step by Step Instructions

Manual Process: The following steps are to be conducted within a GIS environment. Step one describes the preparation of the zoning layer, step two describes the preparation of the various parcel layers, step three describes the process of calculating for calculating the number of parcels and acres for each zoning polygon within the various parcel layers, and step four describes the process of calculating unutilized employment capacity for each zoning polygon.

Prepare the Zoning Layer

Create a new *text* column called Zoning_ID. Zoning_ID is a unique identifier and is calculated by combining ZONING and OBJECT_ID (separated by a hyphen).

Prepare the Parcel Layers

Add the column CRITAREA (text) to county layers that do not include it.

Parcel point files must be clipped to the boundary of the county zoning layer.

Spatially join the zoning layer to the parcel point layer in order to add the Zoning_ID column to the parcel point layer from the zoning layer.

Calculate Acreage for the Parcel Layers

Create a table of *all* parcels that will represent the universe of parcels for the examined county, and sums the GENZONE, ZONING, and ACRES of the points within the zoning polygon by summarizing the ZONING_ID column.

Create the following four columns in the *all* table:

GENZONE (text) is equal to the first GENZONE.

ZONING (text) is equal to the first ZONING.

P_ALL (double) is equal to the count of ZONING_ID.

A_ALL (double) is equal to the sum of ACRES.

Select the *developed* parcels from the *all* parcel layer by using the query of "NFMIMPVL" >= 10000.

Create a table of the *developed* parcels that counts the *developed* points within a zoning polygon, and sums the ACRES of the points within the zoning polygon by summarizing the ZONING_ID column.

Create the following four columns in the *developed* table:

P_D (double) is equal to the count of Zoning_ID.

A_D (double) is equal to the sum of ACRES.

Select the *developed exempt* parcels from the *developed* parcel layer by using the query of ("LU" = 'E' OR "LU" = 'EC') AND "ACRES" < 200.

Create a table of the *developed exempt* parcels that counts the *developed exempt* points within a zoning polygon, and sums the ACRES of the points within the zoning polygon by summarizing the ZONING_ID column.

Create the following two columns in the *developed exempt* table:

P_DE (double) is equal to the count of ZONING_ID.

A_DE (double) is equal to the sum of ACRES.

From the *all* parcel layer, select the *undeveloped* parcels by using the query of "NFMIMPVL" < 10000.

Select the *undeveloped developable* parcels from the *undeveloped* parcel layer by using the query of ("PROT" = 'AGDIST' OR "PROT" = 'APT' OR "PROT" = ' ') AND ("CRITAREA" NOT LIKE 'RCA')

Create a table of the *undeveloped developable* parcels that counts the *undeveloped developable* points within a zoning polygon, and sums the ACRES of the points within the zoning polygon by summarizing the ZONING_ID column.

Create the following two columns in the *undeveloped developable* table:

P_UD (double) is equal to the count of ZONING_ID.

A_UD (double) is equal to the sum of ACRES.

Select *undeveloped undevelopable* parcels by using reversing the selection used for locating the *undeveloped undevelopable* parcels from the *undeveloped* layer.

Create a table of the *undeveloped undevelopable* parcels that counts the *undeveloped undevelopable* points within a zoning polygon, and sums the ACRES of all points within the zoning polygon by summarizing the ZONING_ID column.

Create the following two columns in the *undeveloped undevelopable* table:

P_UD (double) is equal to the count of ZONING_ID.

A_UD (double) is equal to the sum of ACRES.

Join the following tables to the *all* parcels table based on the ZONING_ID column:

Developed parcels table.

Developed exempt parcels table.

Undeveloped developable parcels table.

Undeveloped undevelopable parcels table.

Export the joined table as a *final* table and delete any extraneous columns.

Calculate Unutilized Employment Capacity for the Zoning Polygons

Employment points must be spatially joined to the nearest polygon in the zoning layer in order to append the Zoning_ID column to the employment point layer.

Create a table of all *employment* that counts all employment points within a zoning polygon, and sums the AdjEmp of all points within the zoning polygon by summarizing the ZONING_ID column of the employment point layer that has been spatially joined to the zoning layer.

Create the following two columns in the *employment* table:

JOBSITES (double) is equal to the count of ZONING_ID.

JOBS (double) is equal to the sum of AdjEmp.

Create a table of all *zone employment* that aggregates all employment in a zoning class, and sums the AdjEmp of all points within the zoning class by summarizing the spatially joined ZONING column of the employment point layer that has been spatially joined to the zoning layer.

Create the following column in the *zone employment* table:

JOBS (double) is equal to the sum of AdjEmp.

Create a table of all *zone developed acres* that aggregates all developed acres in a zoning class, and sums the A_D of all points within the zoning class by summarizing the ZONING column of the *final* table.

Create the following column in the *zone developed acres* table:

A_D (double) is equal to the sum of A_D.

Create a table of *zone employment acres* that determines the jobs per developed acre at a zoning class level for the analyzed county by joining the *zone employment* table to the *zone developed acres* table by the ZONING column.

Create the following three columns in the *zone employment acres* table:

Z_A_D (double) is equal to the sum of A_D.

Z_JOBS (double) is equal to the sum of JOBS.

JA_RATIO (double) is equal to Z_JOBS divided by Z_A_D; zoning classes with a Z_A_D value of zero should be given a JA_RATIO value of zero.

Create the Combined Output Table

Create a *combined* table that represents the joining of the *employment* table to the *final* table by the ZONING_ID column and the joining of the *zone employment acres* table to the *final* table by the ZONING columns.

Calculate any <null> values in the JOBSITES, JOBS, and A_UD columns in the resulting *combined* table as zeros.

Create the following five columns in the *combined* table:

CLASS (text with a length of one) is equal to R when GENZONE is equal to VERY LOW DENSITY RESIDENTIAL, LOW DENSITY RESIDENTIAL, MEDIUM DENSITY RESIDENTIAL, HIGH DENSITY RESIDENTIAL, LEAST PROTECTIVE, MODERATELY PROTECTIVE, or MOST PROTECTIVE; equal to M when GENZONE is equal to MIXED USE; and equal to C when GENZONE is equal to all other cases.

ZNJC_MAX (double) is equal to JA_RATIO multiplied by A_UD.

ZNJC_MIN (double) is equal to JA_RATIO multiplied by A_UD when CLASS is equal to C; JA_RATIO multiplied by one-half of A_UD when CLASS is equal to M; and zero when CLASS is equal to R.

ZTJC_MAX (double) is equal to JOBS plus ZNJC_MAX.

ZTJC_MIN (double) is equal to JOBS plus ZNJC_MIN.

Appendix B: Allocate Employment to Undeveloped Developable Parcels

Based on the employment per acre ratios calculated at the zonal level, the employment is then distributed to *undeveloped developable* parcel points. The existing employment could be allocated to developed parcels, or remain at actual employment locations provided by the QCEW data.

In Estimate #1, or maximum capacity, employment is allocated to all parcels (residential, mixed use, and nonresidential) by multiplying the jobs per acre ratio by the total number of undeveloped developable acres in the zoning polygon. In Estimate #2, or minimum capacity, employment is allocated to nonresidential parcels by multiplying the jobs per acre ratio by the total number of undeveloped developable acres in the parcel. Also in Estimate #2, mixed use parcels receive one-half the employment per undeveloped developable acre as the nonresidential parcels; whereas, the undeveloped developable parcels of the residential class are not designated any employment. A parcel is classified as residential, mixed use, or nonresidential based on the generalized zone in which the parcel point.

Employment is allocated to developed parcels by multiplying the employment per acre ratio by the number of acres in the parcel. This allows us to create maps and perform analysis at a fine scale.

Step By Step Instructions

Initial Data Source

Open the *combined* table in a Microsoft Excel spreadsheet

Creating a Comma Separated File (.csv)

Create a new spreadsheet in Excel

Paste contents (as values) of **[BaCo Value]**

Delete all fields in the file **except:**

ZONING_ID

CLASS

JA_RATIO

Expand all columns clicking on column tab

Adjust the JA_RATIO column to display the entire column and format the ratio figure so that it contains only four decimal places.

Save as the .csv file.

Prepare Shapefiles for Manipulation

In ArcGIS, open the .mxd file for county is being manipulated.

Add the county-specific .csv file to the .mxd file.

Join the .csv file to the *undeveloped developable* parcels and export the parcel layer into the county-specific geodatabase.

Allocate New Employment to Undeveloped Developable Parcels

In ArcGIS, open the attribute table for the created *undeveloped developable* parcels shapefile.

Create the following columns in the *undeveloped developable* parcels shapefile:

GNJC_MAX (double) is equal to the unutilized employment capacity with complete residential build-out.

GNJC_MIN (double) is equal to the unutilized employment capacity with no residential build-out and half mixed use build-out.

Calculate each of the two new fields using the Field Calculator function:

GNJC_MAX

GNJC_MAX equals to JA_RATIO multiplied by ACRES

Note: Ensure that you are choosing the ACRES column between PFIH and LANDAREA columns.

GNJC_MIN

Use the Select by Attributes feature to select CLASS equals C.

Use the Field Calculator function on the selected features and enter that GNJC_MIN is equal to GNJC_MAX

Clear the selected features and use the Select by Attributes feature to select Class equals R.

Use the Field Calculator function on the selected features and enter the value of zero for GNJC_MIN.

Clear the selected features and use the Select by Attributes feature to select Class equals M.

Use the Field Calculator function on the selected features and enter that GNJC_MIN equals to half of GNJC_MAX.

Clear the selected features.

Use the Statistics function in the attribute table to compare the sums for GNJC_MAX and GNJC_MIN to the sums of ZNJC_MAX and ZNJC_MIN, respectively. These numbers should be near identical, but slight differences will likely occur due to rounding of the figures.

Create Maps

In ArcGIS:

Use a graduated color symbology and select the color scheme from yellow to green to navy blue.

Change the lowest color to mango and the second lowest color to solar yellow.

Change the symbol sizes from a range between two and twelve point.

Use the Manual Classification option with six categories

Ranges: 0, 10, 25, 50, 100

Maximum (value will vary)

Add the county and PFA boundaries to the map.