

# **ArcGIS Online for Organizations and Business Analyst Integration: The RacerGISOnline Example**

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The Audwin and Rae Helton Center for GIS Laboratory,  
Lutz Hall, Room 224, University of Louisville, Louisville, KY 40203  
30 Sep 2013, 1:00 to 5:00

## **Learning Objectives and Agenda**

Esri is in the process of integrating its location analytics solutions with its ArcGIS Online for Organizations system. Business Analyst Online and Community Analyst have been restructured on the AGO-O platform and some of the most useful data and most commonly used analytical tools are now available directly within AGO-O. Participants in this workshop will learn to use some of these tools and integrate these systems more effectively.

- I. Overview of online resources and session content**
- II. Using Business Analyst Online for Site Screening – LITGL in the Minneapolis St Paul CBSA**
  - a. The Living in the Green Lane scenario
  - b. Selecting geographic region for analysis
  - c. Exploring the market environment with color coded maps
  - d. Placing a site and creating alternative trade areas around it
  - e. Selecting an alternative site and trade area with Smart Map Search
  - f. Compare sites with reports
  - g. Making a purchase decision for available site
- III. Integrating Business Analyst Online and ArcGISOnline for Organizations (AGO) Content**
  - a. Swapping data
    - i. Exporting data from BAO
    - ii. Adding enterprise maps to Business Analyst Online and Community Analyst
  - b. Maps for Office in MS Excel
  - c. Location Analytics Insights
  - d. Accessing BAO data and functions in AGO-O
    - i. The Demographics and Lifestyle Group
    - ii. Buffering to create trade areas
    - iii. Data enrichment
  - e. Concluding discussion, observations, projections

# Trade area and site reporting

## *Mapping the business environment: population and potential site characteristics*

— by Fred L. Miller

## Introduction

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### Problem

Janice Brown and Steven Bent wish to open a new retail home center in the Minneapolis-St. Paul area. Their green home center, *Living in the Green Lane*, would focus its product and service lines on environmentally friendly technologies, building techniques and home maintenance support. Janice and Steven must develop a business plan to persuade bankers and investors to support this initiative. Their first task is to define a profile for green home-building consumers and seek concentrations of these households in the area. Then they must identify an appropriate site for a retail store to serve this target segment. Their preference is to renovate an existing retail facility to demonstrate the value of the green building techniques and products to be featured in their store.

Janice has researched “green consumers” and chosen income, education, and home value as the demographic factors she will use in defining *Living in the Green Lane*’s target customers. She has asked you to use the business GIS tools provided by the Twin Cities Redevelopment Task Force to evaluate the market area in general as well a specific facility that is available for purchase from the Task Force.

Specifically, you will use online resources to perform color-coded mapping of relevant demographic variables, define a market area for the task force site, select an alternative potential location and compare the two locations to determine if Janice and Steven should purchase the task force site.

### Location

Minneapolis St Paul Core Based Statistical Area

### Time to complete the lab

Four to six hours.

### Prerequisites

Introductory experience with a geographic information system, and introductory familiarity with business analysis terminology.

## Data used in this lab

- Demographic and consumer spending data at various levels of geography
- Major highway and streets
- Demographic, lifestyle and American Community Survey data
- Standard reports

# Student activity

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In the context of a new entrepreneurial enterprise, environmental scanning assesses the consumer and competitive characteristics of a market area to determine its ability to sustain the enterprise profitably. In the case of a new physical retail operation such as Living in the Green Lane, this process focuses on analyzing the characteristics of the market area in general and potential sites in particular.

For a traditional retailer in a modern urban environment, these questions are inherently spatial. The service area for the enterprise is geographically constrained. Groups of target market households and spending on the firm's products and services are distributed unevenly across the market area. The transportation infrastructure in the market area makes some areas more convenient to shoppers than others. Finally the location and size of retail attractors (shopping centers and malls) and competitors (retailers selling similar goods) create opportunities and threats in the competitive environment.

Janice's and Steven's desire to renovate an existing location is consistent with the objectives of the Twin Cities Redevelopment Task Force<sup>1</sup> (TCRTF). This nonprofit organization contributes to the area's economic development by renovating and reusing commercial facilities in the Twin Cities area. By offering tax incentives to organizations willing to invest in these properties, the Task Force seeks to stimulate economic activity while revitalizing the area's existing assets.

To support its objectives, the Task Force helps potential purchasers of these facilities with the market assessment and planning processes necessary to determine the financial feasibility of renovation. Business GIS is an important part of this service. The Task Force subscribes to an online Integrated Business GIS system and uses this resource to help potential purchasers assess market opportunities relative to the stock of available commercial properties. This is the resource Janice and Steven will use as they develop their business plan.

Janice's research on "green consumers" in the United States reveals segmentation patterns among consumers based on environmental interests. The 2007 GfK Roper Green Gauge Report identifies five distinct segments relative to environmental issues. The two segments with the highest level of environmental concern are True Blue Greens, with the strongest explicit commitment to environmental goals, and Greenback Greens, whose commitment is less ardent but who are willing to spend more on environmentally friendly products. Together these two segments comprised about 40 percent of U.S. households in 2007.<sup>2</sup>

Janice further discovered that, relative to home building, green consumers also divided themselves into three segments: Forest Greens, though relatively small in number, have a strong environmental commitment, and are willing to invest in green building practices solely for the sake of the environment. Greenback Greens are more cost conscious, but are willing to invest in green technologies that save them money. The most affluent of the three segments, Healthy Greens, are willing to invest in green building practices as part of an overall commitment to health and wellness (Schaffer, 2007). Demographically, Forest Greens and Healthy Greens tend to have higher levels of income, education, and home value than Greenback Greens (Kannan, 2007).

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<sup>1</sup> The people and organizations described in this document, including the Twin Cities Redevelopment Task Force, are fictional. Any resemblance to actual individuals or organizations is coincidental.

In this lab, you will focus on displaying, classifying and symbolizing the distribution of key demographic characteristics across the Twin Cities area and using this information to evaluate two potential sites.

## Conventions used in the data

**ACS** American Community Survey, the US Census Bureau's program for annual data releases

**CBSA** Core Based Statistical Area

**CY** Current Year data

**FY** Future Year projections, which are five years beyond the current year.

**HH** Household

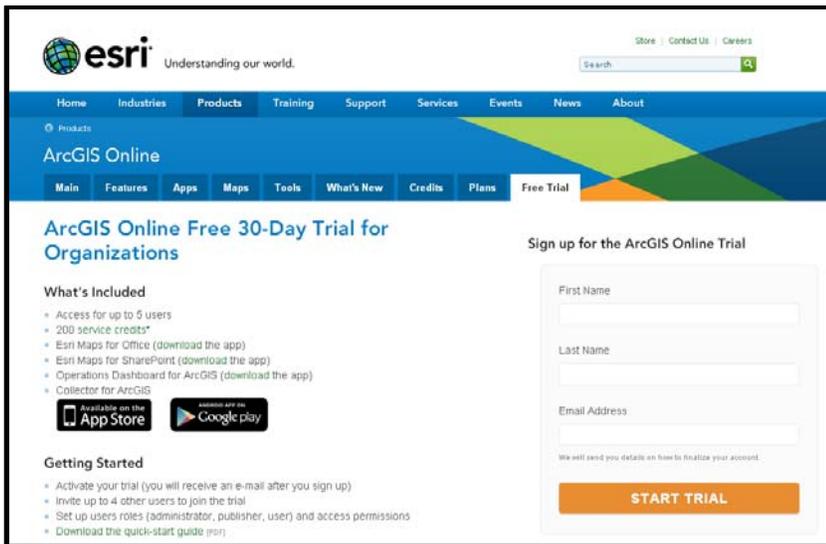
## Prepare your workspace

This lab uses the Business Analyst Online system to perform the analysis. To prepare, confirm with your instructor that you have access to an Esri Global Account with a Business Analyst Online subscription.

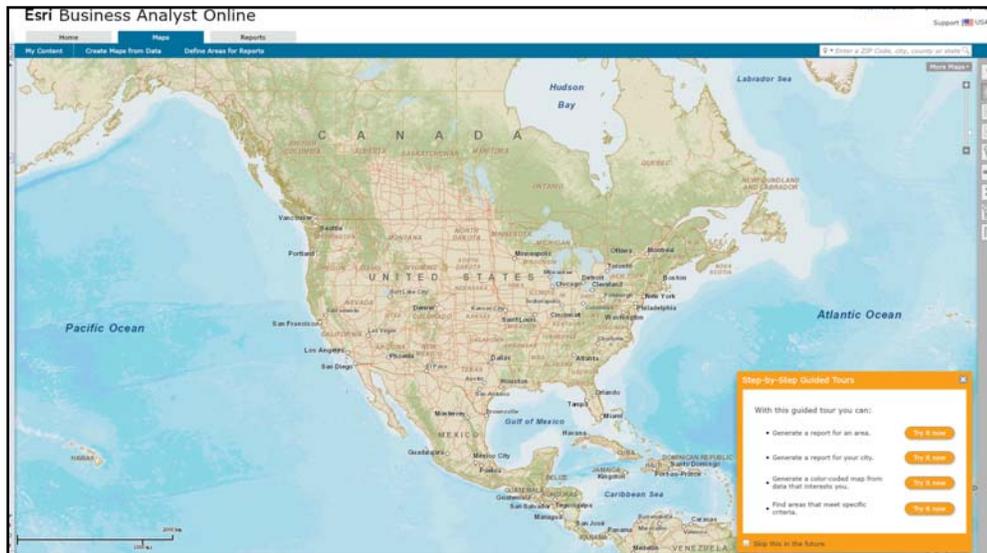
### SELECT A GEOGRAPHIC REGION FOR ANALYSIS

Both Janice and Steven reside in the Minneapolis area and have extensive professional contacts there as well. For these reasons they wish to build their first store in this area. Accordingly, you will focus your analysis on the Minneapolis-St. Paul CBSA.

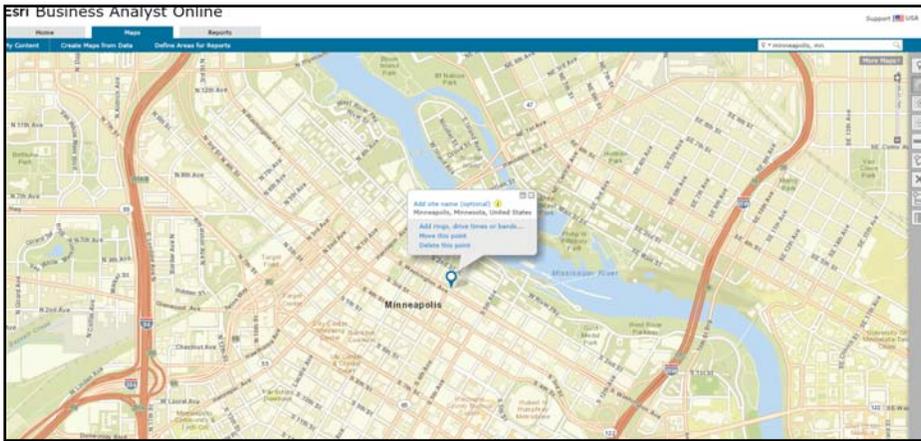
- 1 Open your browser and navigate to <http://bao.esri.com>. Click the Try It Now button on the new Business Analyst Online option.
- 2 If you have an ArcGIS Online for Organizations (AGO) account, use it to login. If not, click the **free ArcGIS Online trial** to open the page below and create a temporary AGO subscription. When you are ready, enter the Username and Password for your AGO account to log in to the new Business Analyst Online system.



- 3 Click the Get Started button on the Business Analyst Online (BAO) home page. You may take any of the guided tours in the lower right corner you wish, then close that box. Unless you specify that you wish to skip it, you will see these options each time you open BAO.



- 4 Enter *Minneapolis, MN* in the Search field at the upper right of the map and hit Enter to zoom to that city. The Minneapolis – St. Paul area will be the focus of your work in this exercise. Close the pop up window that marks this location. You are ready to begin mapping demographic measures for this market area.



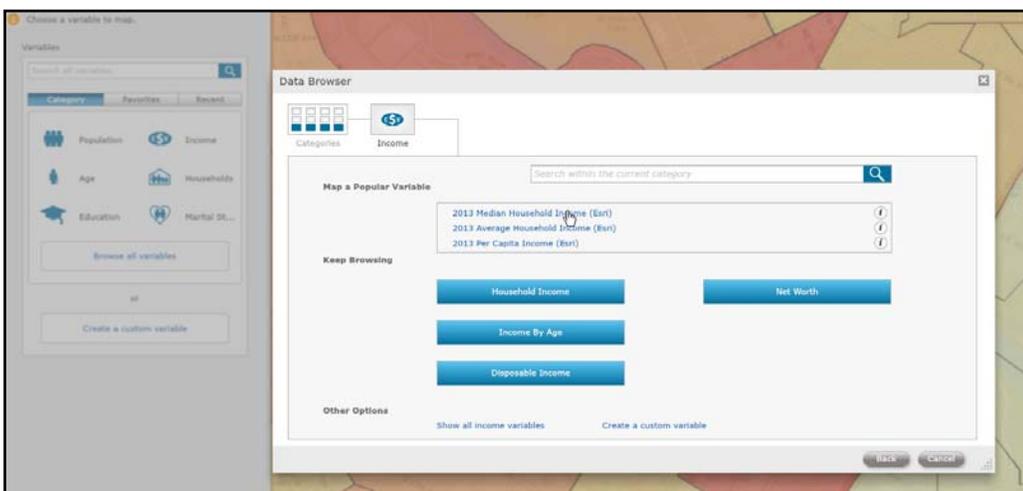
## CREATE COLOR CODED MAPS OF INCOME AND HOME VALUE

The Minneapolis – St. Paul Core Based Statistical Area (CBSA) is the service area of the Twin Cities Redevelopment Task Force. Recall that the green-consumer segments Janice and Steven have chosen as their initial targets are distinguished by higher levels of income, education, and home value. You will use the color-coded mapping feature to study the distribution of these characteristics.

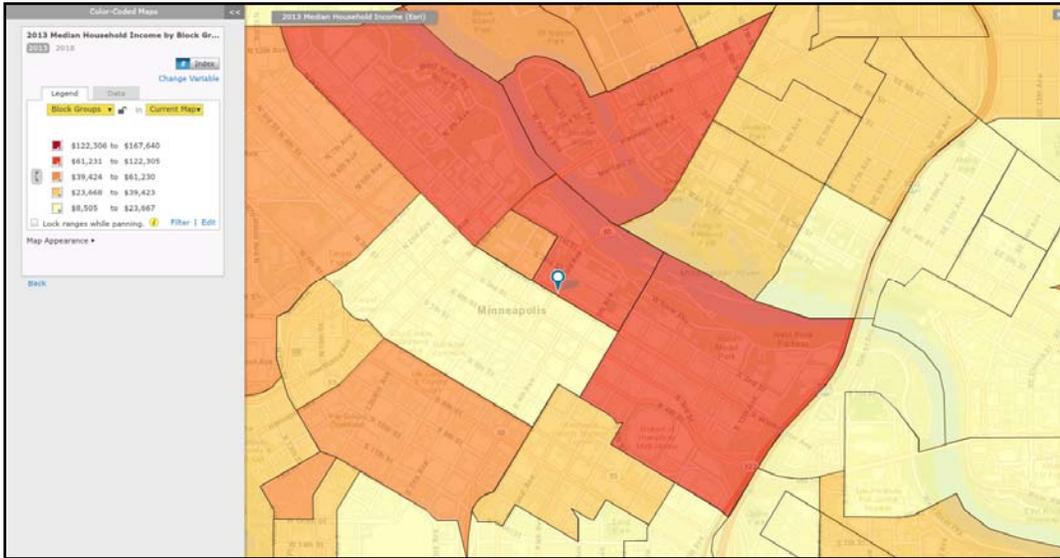
- 1 Click the Create Maps from Data tab, then the Color-Coded Maps box to open the settings pane for this function.

The command pane allows you to designate settings for the variable depicted in the map, the level of geography at which it will be presented, the color scheme you wish to use, and the level of transparency of the map layer relative to the layers underneath it. By adjusting these settings, you will create thematic maps of income and home value at various levels of geography.

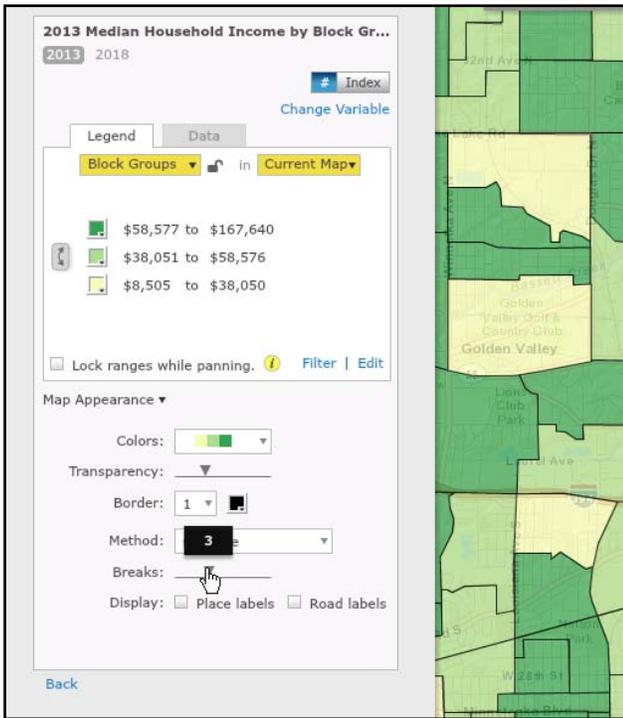
Among the categories listed, click on the Income option. In the resulting window, select CY Median Household Income (Esri) as the measure to map. When your screen resembles the one below, click on this attribute to close the window and display a map of this measure.



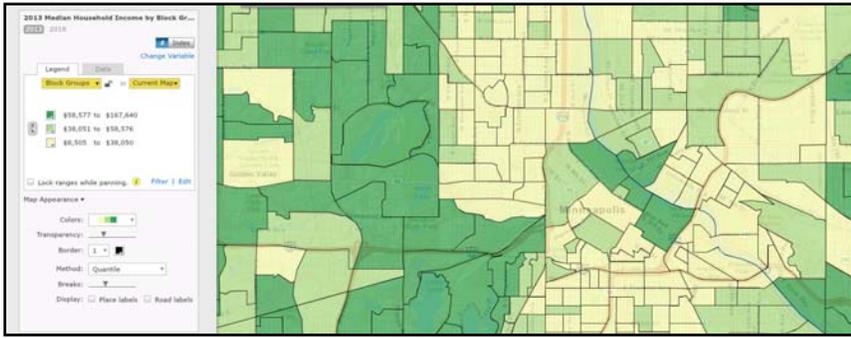
- 2 Your initial map should resemble the one below, though the colors might be different. Notice in the legend that this map displays values for CY Median Household Income at the Block Group level. You may zoom out and pan around the area to see this distribution of this measure at wider geographic levels.



- 3 You wish to edit the appearance of the map to make it more useful. To do so, expand the Map Appearance command, change the Colors field to a graduated green scheme, select Quantiles in the Method: field, move the Breaks: tool to 3 classes and set the Transparency: scale to about 50. Your Map Appearance window should resemble the one below.



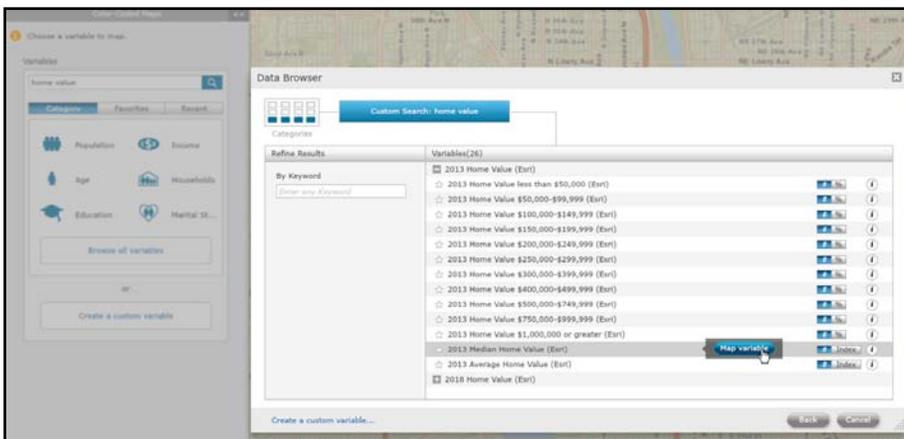
The color-coded map, also called a thematic map, changes automatically as you adjust the settings. It should resemble the one below, though the extent and transparency of your map might vary.



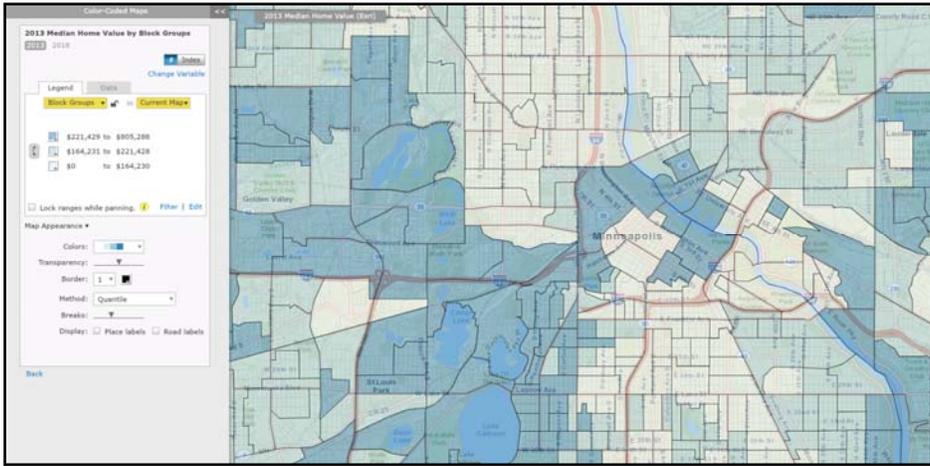
Review the contents of the map. It displays the value of CY Median Household Income in the Minneapolis-St. Paul study area. In this map, each feature represents a block group, though the geographic unit (block groups, census tracts, ZIP Codes, counties, states) will vary as you zoom in and out of the map. Recall that the median is the value that divides a set of features in half. For example, a median household income of \$54,119 for a block group means half the households in that block group have incomes above that figure and half below.

The Quantile method places the same number of geographic units into each of the classes designated. Thus your selections placed roughly one third of the features into each of three classes. This means that the median value for the features and about 17 percent of the features above and below this value are in the middle classification, while the top and bottom 33 percent of features are in the highest and lowest classification respectively.

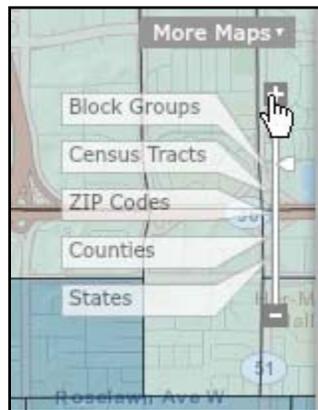
- 4 High home value is another characteristic of green consumers. To display this measure, click the Change Variable command at the top right of the Color-Coded Maps window. There is no obvious category for this variable so type *home value* in the Search field and click the Search icon. Expand the resulting attribute categories until you see CY Median Home Value (Esri) as illustrated below. Select that attribute and click the Map Variable command to create the map.



- 5 Using the Map Appearance tools, adjust the settings to the Quantiles method with 3 Breaks, a Transparency setting of your choice and a graduated blue scale color scheme. Your map should resemble the one below, though its extent and transparency might vary.



- 6 If you wish to view these data at different levels of geography, you may do so by using the drop down menu under the Legend, illustrated on the left below, or the Zoom bar in the upper right corner of the map, illustrated on the right below. Use one of these two methods to change the geographic level of the map to Census Tracts.



- 7 You may change the Geography level using the drop-down box to the left of the Colors box or by adjusting the Zoom bar at the top right of the map. Use one of these two methods to change the geographic level of the map to Census Tracts.

The Legend reflects the new geography level and three classes in the data, each with approximately the same number of features as specified by the Quantile method.

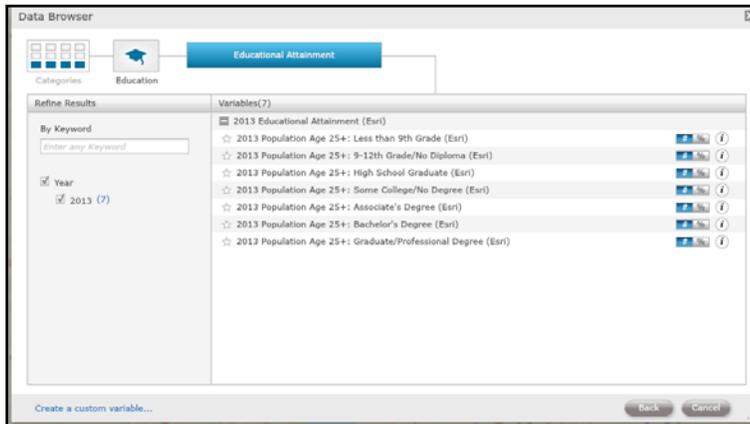
- 8 Scroll around the map to view the distribution of home values across the Minneapolis-St. Paul area. Note that, as you move the cursor around the map, the boundary of the geographic unit beneath it and the value of the variable being mapped are displayed in a pop-up window.

**Question 1:** *What variations in median household income and median home value do you observe in the Minneapolis-St. Paul area? Which parts of the region are most attractive for Living in the Green Lane? Why?*

## CREATE COLOR CODED MAPS OF EDUCATIONAL ATTAINMENT AND HOME IMPROVEMENT SPENDING

These basic mapping functions allow you to explore the characteristics of the chosen market area in some depth. However, BAO also offers tools which allow greater customization of map design which allow you to calculate customized attributes and display attributes from different perspectives. These will be useful as you consider the how educational attainment and annual household spending on home improvement vary in the Minneapolis-St. Paul region.

- 1 As green consumers tend to be highly education, you also wish to explore the distribution of adults with college degrees in the market area. Click on the Change Variable command again, then click on Education icon and click on the Educational Attainment button to see the attributes available in this category, as illustrated below.

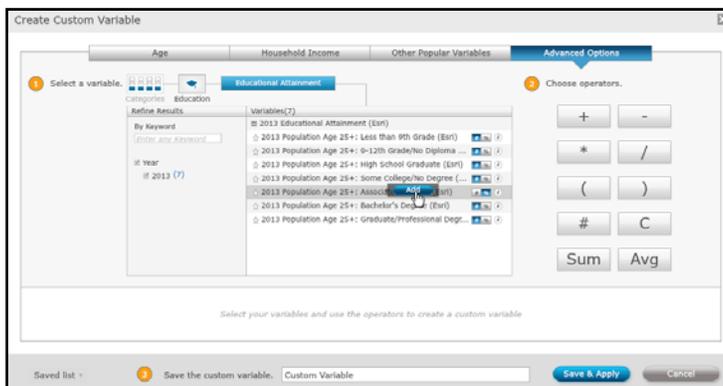


Note that there are three different attributes which report adults who hold Associate's, Bachelor's and Graduate/Professional degrees respectively. As you are interested in the percentage of adults who hold any of these degrees, you wish to combine them into a single attribute.

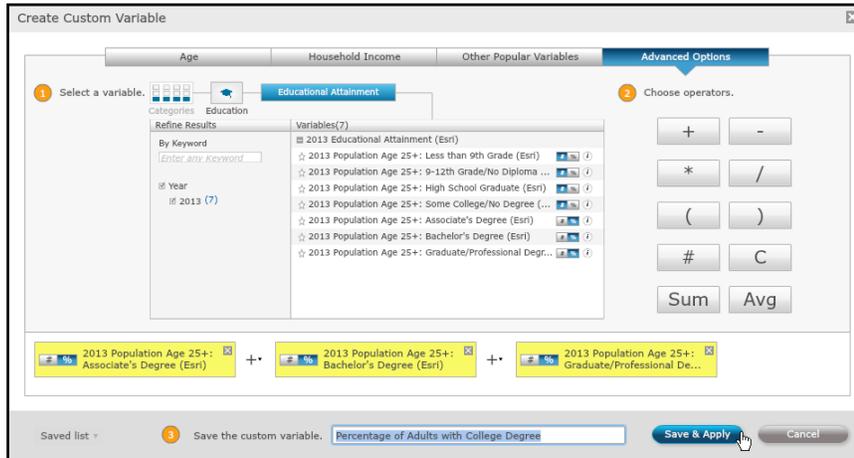
- 2 Click the Create a custom variable button and, in the resulting box, click on Advanced Options. Click the Education icon, then click the Educational Attainment button and expand the CY Educational Attainment (Esri) category to view its attribute list.

You wish to calculate the percentage of adults with a college degree by combining the percentages for the three attributes listed above.

- 3 Select the Associate's Degree attribute, confirm that the % option is selected (this option reports the value as a percentage of adults, while the # option is an absolute number) and click the Add button as illustrated below to add it to the calculation. When it appears in the box at the bottom click the Add operator button.



Repeat this process to add the Bachelor's Degree and Graduate/Professional Degree attributes to the equation, separated by an Add operator. In the Save the custom variable text box at the bottom of the window, enter *Percentage of Adults with College Degree* to save the custom variable for future use. When the window resembles the one below, click Save & Apply.



BAO maps the values of the custom variable and displays them in the same map format you have seen. You may make any adjustments you wish in the Map Appearance box.

You have mapped all the distinguishing characteristics of green consumers. You will add a fourth map which displays annual household home improvement spending, as this is the category for which LITGL will be competing.

- In the Color-Coded Maps pane, click on Change Variable. Type *home improvement* in the text field and search for that string. Expand the CY Housing (Consumer Spending) category to view the available variables. Select CY 2013 Home Improvement Materials – Owners and Renters and click Map Variable. This variable is appropriate here in that LITGL plans to concentrate on material sales and rely on external installers and service providers.

Adjust the Map Appearance settings as you wish. The map shows total annual purchases of home improvement materials in the geographic areas you have selected. To understand the distribution of this variable more fully you may choose different ways to display it.

- In the Color-Coded Maps pane, locate these tabs  just above the legend. The depressed and highlighted # option indicates that the map is displaying total purchases in each geographic area. As you are also interested in average purchases by households in the region, click the Avg tab and note the effect on the map and the legend.

The map display adjusts to the new variable and the legend reflects the new data classes, which are now determined by the average household home improvement expenditures in each geographic area. Clearly, the households with high average purchases would be good customers for LITGL.

- Click the Index tab and observe the changes in the map and legend. The values in the legend are based on a scale where 100 means that the average household purchases in an area are exactly equal to average household purchases on a national level. Values greater than 100 indicate average household purchases above the national average, while values less than 100 indicate purchase levels below that average. So the Index value of 124 for the block group selected in the map below means that average household home improvement purchases in this block group are 24% above the national average.



Use these maps and their data to answer the following question.

**Question 2:** *What variations in educational attainment and annual home improvement purchases do you observe in the Minneapolis-St. Paul area? Which parts of the region are most attractive for Living in the Green Lane? Why?*

### DEFINE ALTERNATIVE TRADE AREAS AROUND A POTENTIAL SITE

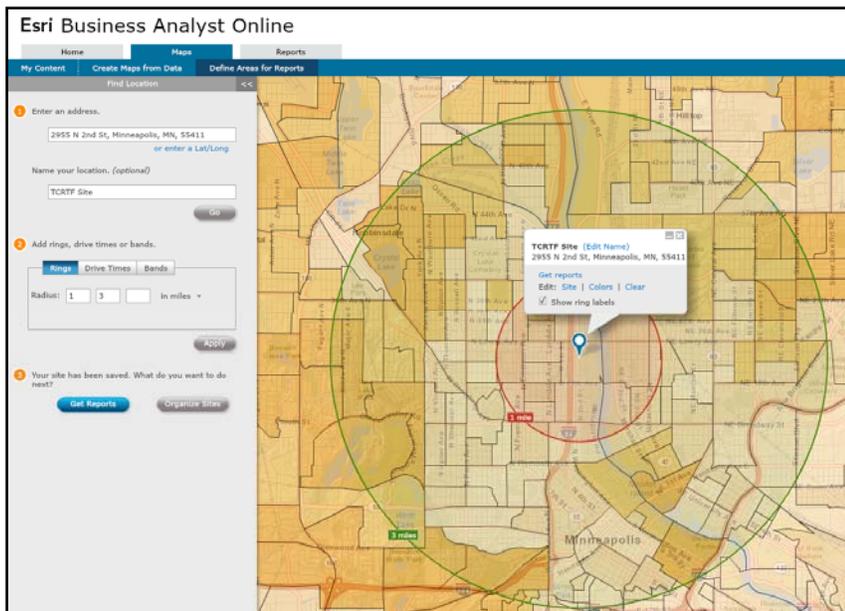
The Twin Cities Redevelopment Task Force offers tax incentives to entrepreneurs who revitalize existing facilities in the area. One such facility, at 2955 N. Second Street in Minneapolis, matches the criteria for the first Life in the Green Lane store. Janice and Steven wish to evaluate the trade area served by this location to determine if it also matches the profile of their target consumers. You will define alternative trade areas for this site and select the most appropriate one for further study.

- 1 In the Maps tab, click the Define Areas for Reports command, then click the Find Location option. In the resulting pane, enter **2955 N 2nd St, Minneapolis, MN 55411** in the Enter an address field and **TCRTF Site** in the optional Name your location field, then click Go.

The address is geocoded and identified on the map with a placemark and a pop-up window. You are ready to create trade areas around this point.

- 2 In the pop-up window, click the Add rings, drive times or donuts option (or go to step 2 in the Find Location pane).
- 3 Click the Rings tab, enter **1** miles as the first radius, **3** as the second, and delete the entry for the third radius, as you wish to use only two rings. Click Apply.

Notice the changes. The address you entered is assigned to a specific latitude/longitude location on the map (a process known as geocoding), the map zooms to that location, and two rings are drawn around the site at 1 and 3 mile radii.

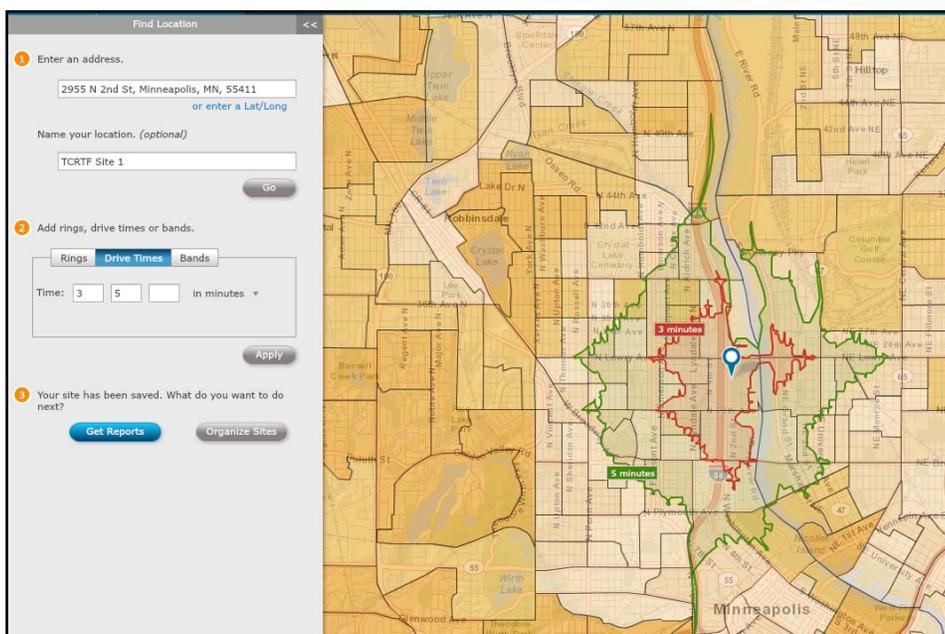


Examine this trade area for a moment. Note that it is bisected by an expressway running north and south, but serviced by smaller roads to the east and west. Further, more than a third of each ring lies across the Mississippi River, where access to the site would be limited to routes crossing the river. These factors suggest that the site might not be equally accessible to customers equidistant from it and, therefore, that the ring model might not be the most appropriate for this site.

Janice and Steven wish to evaluate a trade-area model that more accurately reflects the accessibility of potential customers to this site. You will create another study area that uses drive times to create an alternative trade-area definition.

- 4 In the pop up window, click Site. Then click the Drive Times tab, enter **3** minutes in the first drive-time box, **5** in the second, and delete the entry for the third, as you wish to use only two drive-time polygons. Click Apply.

A new map with drive-time trade areas appears. Close the pop up window to see the new trade areas better. Notice that these polygons reflect the limited access across the river, follow major highways for longer distances and minor roads for shorter distances.



- To return to the first map, click the Rings tab, then click Apply. To review the second map, click Drive Times, then click Apply. Toggle the two maps to compare the trade-area models.

Note that the 5-minute drive time area extends to the 3-mile ring to the north and south along the expressway, but falls short of that ring to the east and west. Further, the trade area is larger on the west side of the river, reflecting more limited access on the east side resulting from the funneling of traffic over the river bridges.

Janice and Steven believe that this is the most appropriate trade-area model to use for comparative purposes. Express your agreement or disagreement with this decision by answering the following question.

**Question 3:** Which approach to market area definition, rings or drive times, is more appropriate for this analysis? Why?

## USE SMART MAP SEARCH TO SELECT AN ALTERNATIVE SITE AND TRADE AREA

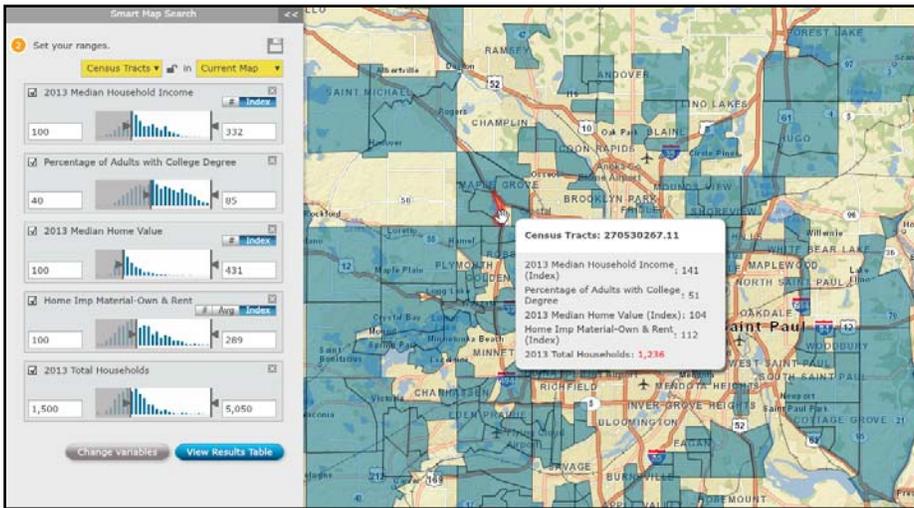
The thematic maps of income, home value, educational attainment and home improvement purchases allow you to explore the distribution of these variables in the market area. However, your target customers have high values for all these measures. You will use Smart Map Search to identify locations with this attractive combination of characteristics.

- Zoom out in the map to see a larger portion of the market area. If necessary, change the map unit to Census Tracts. Click the Maps tab on the menu bar, then click Create Maps from Data option and the Smart Map Search tool to open the appropriate tool pane. Using the search and selection techniques add the following attributes and measures to the list button and the Get Started button.

Attribute	Threshold
CY Median Household Income: Index	Minimum value of 100
CY Median Home Value: Index	Minimum value of 100
Percentage Adults with College Degree; Number	Minimum value of 40%
CY Home Imp Materials – Own & Rent: Index	Minimum value of 100
CY Total Households: Number	Minimum value of 1,500

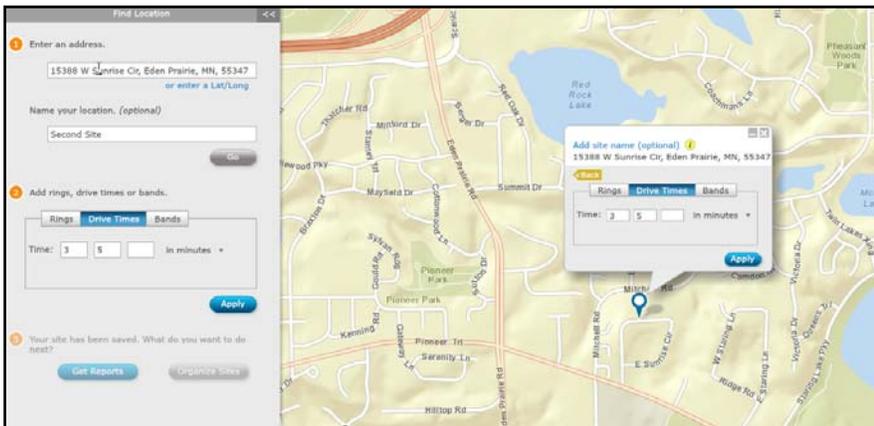
Consider the import of these combined search criteria. When applied together, they will identify census tracts ; 1) with 1,500 or more households, 2) with income, home value and home improvement purchases above the national averages where, and 3) with 40% or more of adults have a college degree. These are clearly attractive customers for LITGL.

Review the Smart Map Search settings and the map below, which display the results at the Census Tract level. Confirm that the settings in the Smart Map Search pane match the criteria stated above. Note the pop up window for a census tract which displays the values for each attribute and highlights in red those that fall below the specified criteria.

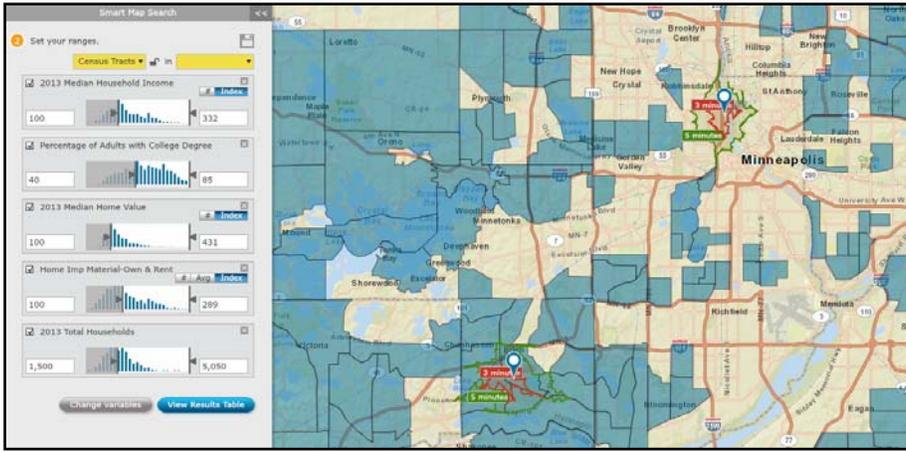


- Adjust the settings in your pane to match those above. Revise them individually and collectively to view the results as they are reflected in the map. This feature allows you to test adjustments in criteria and their impact on the selection process. When you are finished, return the threshold values to those specified above. The resulting map displays those census tracts that meet these selection criteria.
- Navigate around the map and locate a concentration of selected census tracts. Click the Define Areas for Reports tool, then the Find Location option. Click on the Pin tool  in the upper right corner of the map, then click on a location with the concentration of census tracts you have identified.

The map zooms into the location you selected. Specify that you wish to create 3 and 5 minute drive times around this site and name it *Second Site* in the Name your location field. When your map resembles the one below, though likely in a different location, click the Apply button to create the drive time trade areas.



- Close the pop up window and Find Location pane. Click Create Maps from Data and Smart Map Search tool to return to the Smart Map pane. Zoom out in the map display so that both potential sites are visible in the map as well. Your map should resemble the one below, though the location you selected might be different.



Use this map to answer the following question.

**Question 4:** *Are there clusters of census tracts which appear to present substantial market opportunities based on these characteristics? Why did you select this location as a second potential site?*

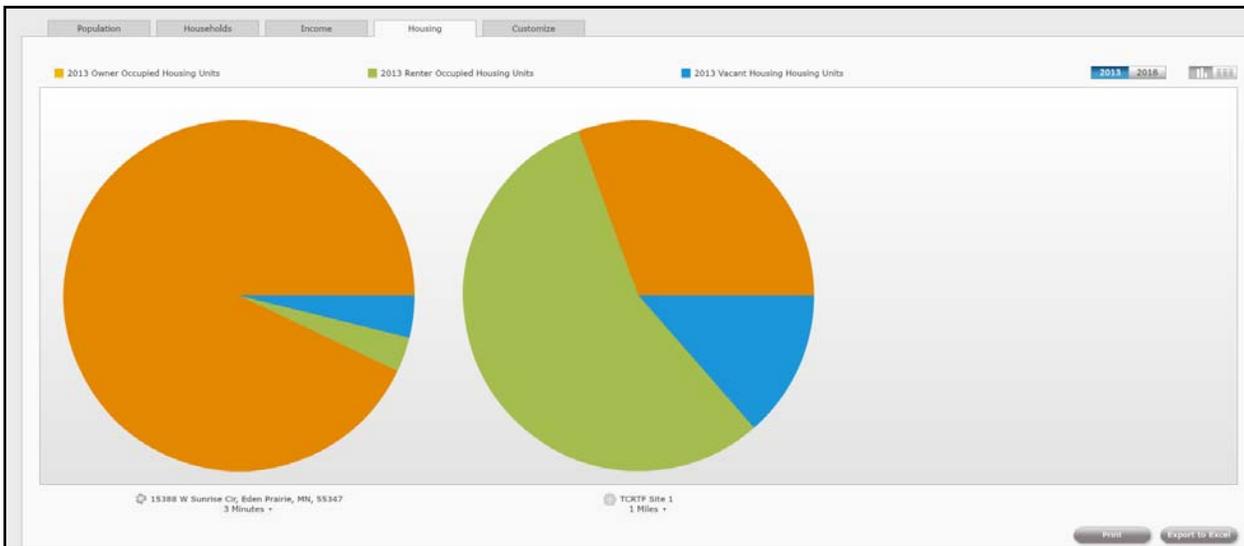
## COMPARE SITES WITH REPORTS

With your help, Janice and Steven have identified alternative trade areas. One site is eligible for Task Force incentives and the other is located within a concentration of attractive customers. The next step is to compare the characteristics of these trade areas relative to their criteria for segment selection, income, home value and education. You also wish to learn more about the consumer expenditure patterns and retailing environment in the two areas. You will begin with the Comparison Report function, which creates quick, graphically oriented comparisons of the two areas. You will then order formal reports for more detailed comparison.

- 1 Click the Reports tab, then click Comparison Reports to open the Comparison Report Setup window. Select the TCRTF Site and the second site for comparison. Do not select either of the two optional components. When your page resembles the one below, click the Population button to see the first chart.

- 2 Review the comparative population for the two sites. Notice that you can toggle between CY and FY values with the button in the upper right of the chart. Click the Households, Income and Housing tabs in turn and review the data graphs for each area.

The Housing report, appearing as two pie charts, reflects the distribution of owner-occupied, rental, and vacant housing units in the 5-minute drive-time trade areas around the two sites. Your screen should resemble the one below. The buttons at the bottom of the chart allow you to print it or export the data to MS Excel.



The report provides an overview of site differences.

**Question 5:** Based on the graphs and tables in the comparison report, which of the two market areas appears to be the more attractive for Living in the Green Lane?

- To order more detailed comparative reports on the two locations, click the Standard Reports tab to open the Report Table of Contents.

Esri Business Analyst Online

Home Maps Reports

My Content Standard Reports Comparison Reports

Select sites  
Selected Sites: 2  
Select All | None

15388 W Sunrise Cir, E... TCRTF Site 1  
15388 W Sunrise Cir, E... 2955 N 2nd St, Minnea...  
3, 5 minutes Add More Sites...

2 Add reports View: All Reports Search for reports

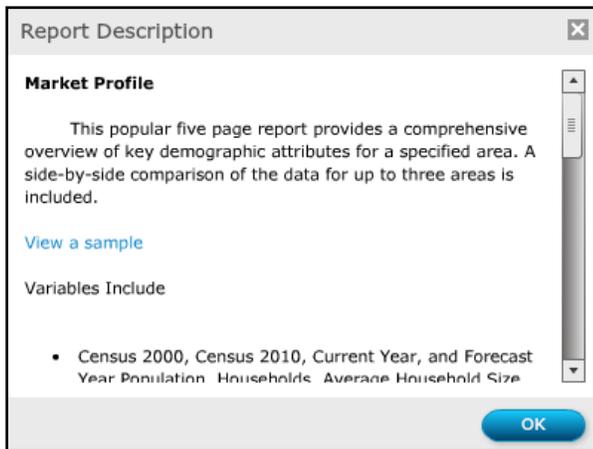
Report Name	Vintage
Add ☆ 2010 Census Profile	DATA
Add ☆ Age 50+ Profile	DATA
Add ☆ Age By Sex By Race Profile	DATA
Add ☆ Age by Sex Profile	DATA
Add ☆ Automotive Aftermarket Expenditures	DATA
Add ☆ Business Locator	DATA
Add ☆ Business Summary	DATA
Add ☆ Community Profile	DATA
Add ☆ Demographic and Income Comparison Profile	DATA
Add ☆ Demographic and Income Profile	DATA
Add ☆ Detailed Age Profile	DATA
Add ☆ Disposable Income Profile	DATA
Add ☆ Dominant Tapestry Site Map	DATA
Add ☆ Electronics and Internet Market Potential	DATA
Add ☆ Executive Summary	DATA
Add ☆ Financial Expenditures	DATA
Add ☆ Financial Investments Market Potential	DATA
Add ☆ Graphic Profile	DATA
Add ☆ Health and Beauty Market Potential	DATA
Add ☆ House and Home Expenditures	DATA
Add ☆ Household Budget Expenditures	DATA
Add ☆ Household Income Profile	DATA
Add ☆ Housing Profile	DATA
Add ☆ Major Shopping Center Locator	DATA
Add ☆ Major Shopping Center Map	DATA
Add ☆ Market Profile	DATA
Add ☆ Medical Expenditures	DATA

By default the menu lists all available reports. The list on your screen may not match this list exactly. To view subsets of related reports, select the category you wish to review by using the drop-down menu in the View area. The most relevant reports for site-selection applications include the following:

Business reports include site maps and summaries of businesses by classification in selected study area. Consumer Spending reports include information on consumer spending in several categories. Demographics reports include information on population characteristics in selected study areas. Some focus on specific measures such as income, net worth, employment, age, and race, while others such as the Executive Summary and Market Profile reports provide general overviews of the demographic characteristics of the trade areas. Maps reports provide a collection of maps displaying the selected sites and their surroundings. Tapestry Segmentation reports provide information on the Tapestry Segmentation composition of the trade areas, while the remaining categories focus on detailed data such as traffic and site map information.

- 4 In addition to listing available reports, this screen displays the available trade-area options in a row across the top. The entries there include the two sites you have identified. By running the same report for each of these sites, you can compare the two sites directly to each other.

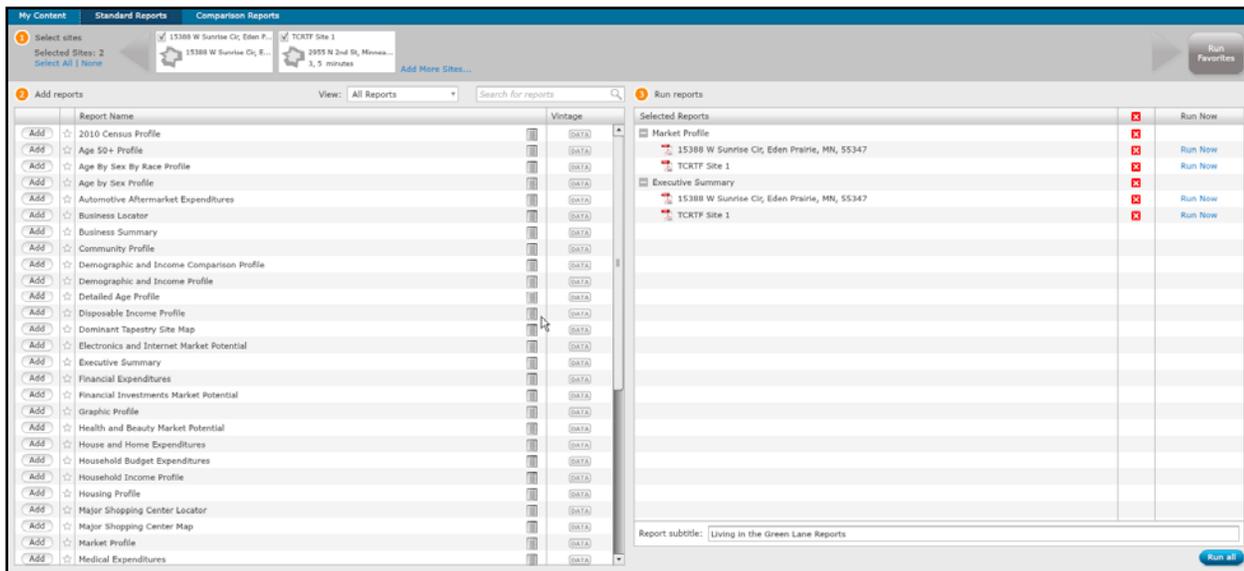
In the Report Table of Contents, you may view the information on the data in the report by clicking the DATA button in the Vintage column. Select a report and click on its title to view the Report Description as illustrated by the Market Profile report below. Click the View a sample link to see a sample report in pdf format. This shows the specific data you will see if you order that report for your potential sites.



Take a few minutes to review other available reports. Although we will use a few reports to illustrate their value, you may also order additional reports to assess their value in the site-selection process. When you have finished your review, continue to the next step.

- 5 Select the two potential sites in the bar above the Reports Table. Click the Add button to the left of the Market Profile report and the Executive Summary report to add them to the Selected Reports list at the right of the screen.
- 6 Enter *Living in the Green Lane Reports* in the Report subtitle box.

Your screen should resemble the one below.



7 Click Run All. The reports are processed and a message in the far right column of this window notifies you when they are complete and ready to open. Open the reports and use them to compare these two potential locations for the first LITGL store. Use them to answer the following question.

**Question 6:** *Based on the Market Profile and Executive Summary reports, which of the two market areas has the more favorable demographic characteristics relative to Living in the Green Lane’s target customer profile? Explain.*

## MAKE A PURCHASE DECISION ON THE TCRTF SITE

Janice and Steven must decide whether to purchase the TCRTF site for Living in the Green Lane’s first store or continue the search for a more attractive site. Review the maps and reports you have created to recommend a course of action to them. If the site you selected is more attractive than the TCRTF site, or if other regions of the market area offer additional potentially attractive sites, you should recommend foregoing this property and continuing the search for a suitable location. If the TCRTF site is superior to the one you selected and few remaining opportunities exist, you should recommend acquisition of this site.

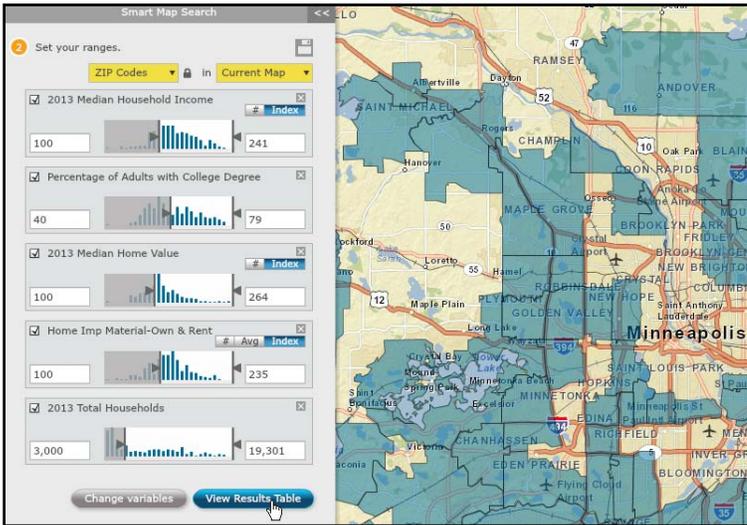
**Question 7:** *Based on all the maps, graphs and reports you have generated in this analysis, do you recommend that Janice and Steven buy the TCRTF site? Explain.*

## FF: SEEKING A SECOND SITE BY INTEGRATING BAO AND ONLINE ENTERPRISE DATA

Fast forward three years.

Janice and Steven decided against purchasing this facility, chose another location and built a highly successful Living in the Green Lane store. They have also acquired an ArcGIS Online for Organizations subscription with a supplemental BAO subscription. They now wish to select the site for a new store by using the Business Analyst Online system integrated with enterprise data from the past three years. Specifically, they want to extract BAO data to their AGO-O systems, add customer and competitor information to BAO, map new potential sites, access BAO data and tools within AGO-O and leverage this integration to inform the site decision for the second store.

To invite target customers to LITGL’s home shows, Janice and Steven wish to identify ZIP codes with high numbers of such customers. The Smart Map Search below, which is based on the one you created earlier, identifies these ZIP codes. To extract these results, you would click the View Results Table button at the bottom of the charts, as illustrated below to view the table.



You may then choose to view the entire table, sort the records based on the priority of your targeting criteria, then click Export to Excel, as illustrated below, to download the data into an MS Excel file for additional analysis.

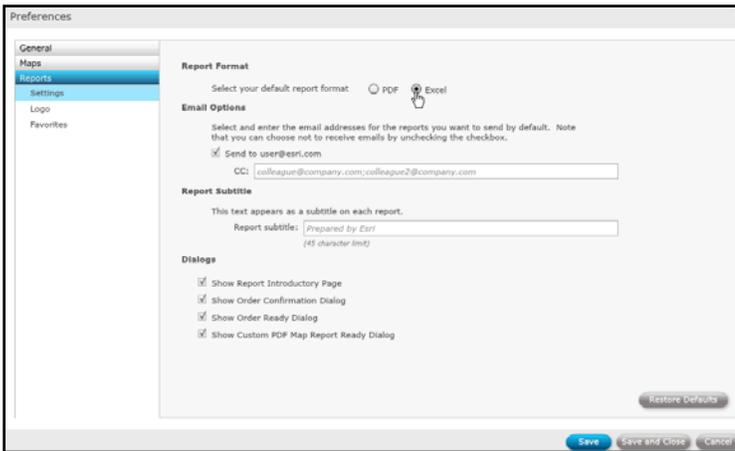
66 ZIP Codes match your criteria.

ZIP Codes	2013 Median Household I...	Percentage of Adults with...	2013 Median Home Value...	Home Imp Material-Own...	2013 Total Households
55424 MINNEAPOLIS	241	79	264	235	3,604
55347 EDEN PRAIRIE	226	73	203	216	11,199
55391 WAYZATA	208	66	256	203	6,222
55439 MINNEAPOLIS	204	76	240	203	3,473
55331 EXCELSIOR	206	65	236	201	6,823
55311 OSSEO	223	67	179	199	12,222
55436 MINNEAPOLIS	186	69	214	181	5,704
55317 CHANHASSEN	202	69	192	180	7,255
55127 SAINT PAUL	190	55	140	180	7,004
55346 EDEN PRAIRIE	206	67	168	176	6,706
55129 SAINT PAUL	207	73	180	174	7,181
55245 MINNETONKA	189	61	168	172	8,536
55115 SAINT PAUL	179	58	163	170	3,425
55446 MINNEAPOLIS	196	72	186	169	7,629
55044 LAKEVILLE	201	58	153	169	15,982
55364 MOUND	164	47	157	158	6,175
55123 SAINT PAUL	199	68	151	157	9,309
55449 MINNEAPOLIS	178	57	130	155	8,909
55447 MINNEAPOLIS	173	64	163	155	8,752
55304 ANDOVER	180	43	130	154	15,380
55442 MINNEAPOLIS	173	64	171	152	5,472
55082 STILLWATER	154	52	154	152	13,575
55372 PRIOR LAKE	181	50	148	151	11,331
55374 ROGERS	184	52	155	150	4,850

Transparency: [dropdown] Overlay color: [color picker]

Buttons: Back, Export to Excel

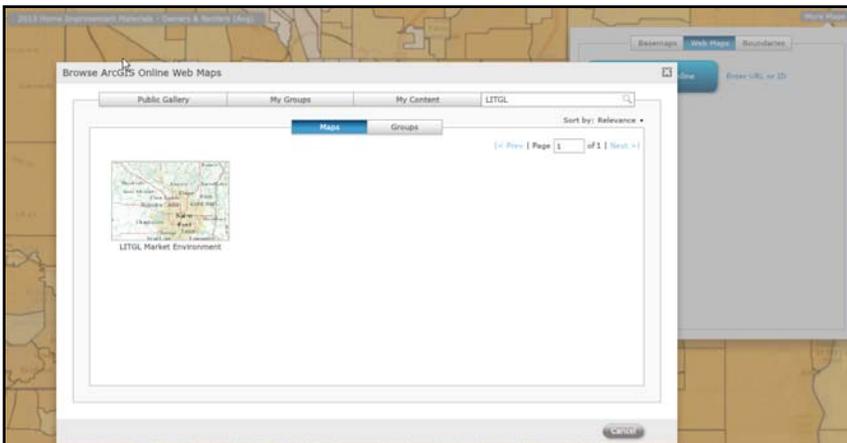
It is also possible to use an MS Excel format for reports generated by the BAO system. This allows for customized formatting of those reports, as well as customizing reports from several BAO reports and integrating data from other sources. To create reports in this format, you would adjust the settings in the Preference pane, as illustrated below, to designate that specification.



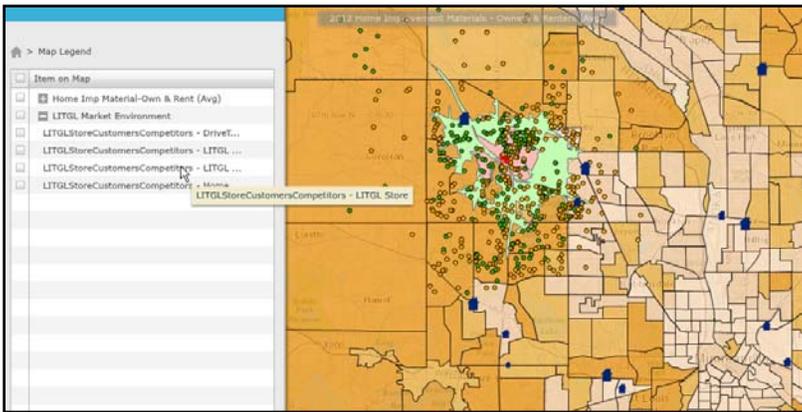
These techniques allow LITGL to leverage BAO data and reports across the enterprise. Janice and Steven also want you to import enterprise data into BAO and add it to the maps you created there. You will do so by adding AGO-O content and by importing enterprise data directly.

- 1 Starting with the maps under the MyContent tab, recreate the Average Household Home Improvement Purchases of Materials map you created previously.

In the upper right corner of the map, expand the More Maps drop down menu, Click Web Maps, then Browse ArcGIS Online, to open an ArcGIS Online Web Maps window. In the search field at the right of the toolbar enter LITGL and click the Search icon. The search returns the map LITGL Market Environment, as illustrated below. When your screen matches this, click that map to import it into BAO.

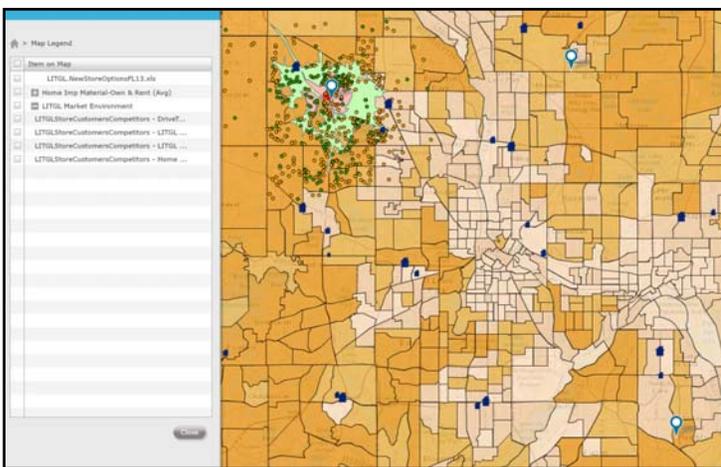


This operation adds the map to BAO. If you don't see the resulting symbols, click on the Legend button at the bottom of the vertical menu bar at the right of the map.  Zoom into the map as illustrated below to view LITGL's first store, 3 and 5 minute drive time trade areas around that store, its customers classified by purchase levels and competing home centers which are sized based on sales volume. These layers reflect the performance of that store over the past three years in this competitive environment.



Janice and Steven have identified two potential locations which meet the size specifications for the planned second store. You will add them to the map to enable further analysis.

- Click the Maps tab, then the Define Area for Reports tab, then the Import File option. Click the Browse button and navigate to the **LITGL.NewStoreOptionsFL13.xls** file on the Desktop. Click Open then Import. Confirm the matching fields for the geocoding operation, then click Next. The results of geocoding are displayed. Click Add matches to the map, click Next in the following window, click No, Save as layer in the next window, enter **Potential Sites** as the name of the layer and click Save to view the resulting map, illustrated below.

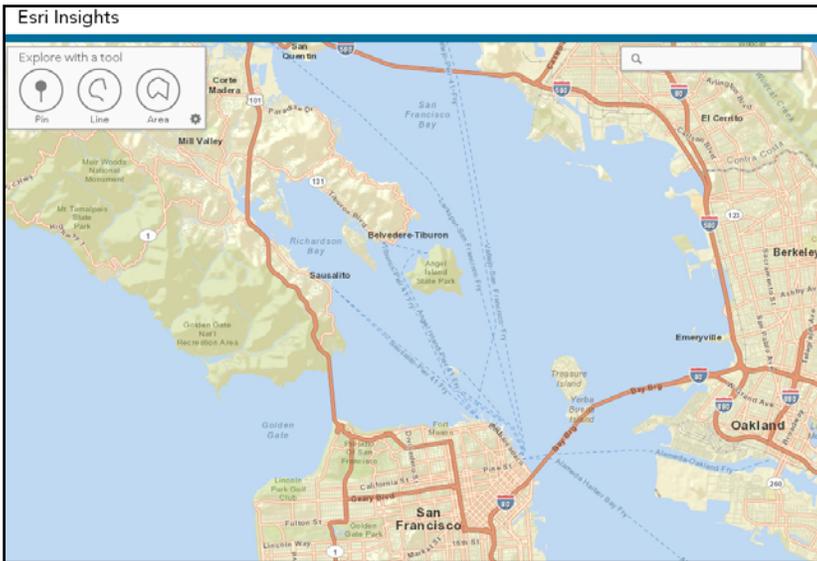


Note that the three new placemarks on the map indicate the locations of LITGL’s existing store and two potential locations for the second store. These locations may be evaluated within BAO using the techniques you employed previously. However, for instructional purposes you will use other approaches to understand the ways in which this analysis can be performed using only the tools within ArcGIS Online for Organizations.

The significance of the following procedures is that they do NOT require a BAO subscription and can be performed by anyone in the enterprise with an ArcGIS Online for Organizations account.

## PROFILING LOCATIONS WITH LOCATION ANALYTICS INSIGHTS AND REPORTS

**Location Analytics Insights** is a Web site supported by Esri’s Location Analytics team to provide quick access to some of the basic tools in the field. To reach it, navigate to <http://la.arcgis.com/insights/> and sign in with your AGO-O account to reach the initial map below.

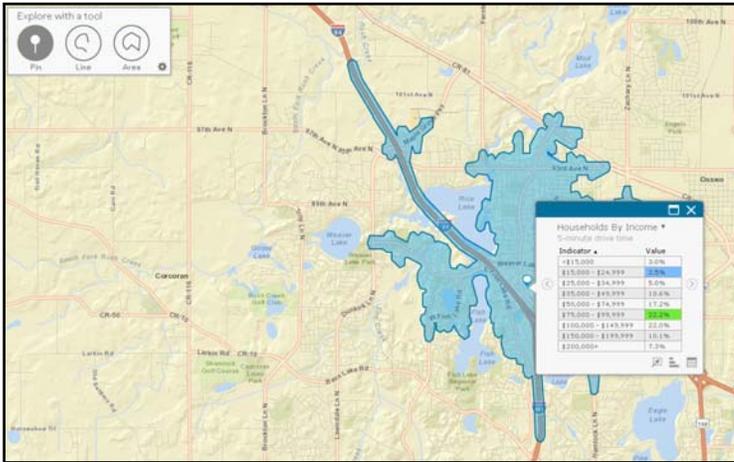


This system provides some summary information and sample BAO reports for user defined market areas. You will use it to evaluate the market area of the current LITGL store. Click Export to Excel, as illustrated below, to download the data into an MS Excel file for additional analysis.

- 1 In the Search field at the top right of the map, type the address *8061 Wedgewood Ln N, Maple Grove, MN, 55369*. This is the address of LITGL’s current store and is the first record in the csv file you used to map current and potential sites previously.
- 2 Click on the Configure Infographics button  at the bottom right of the Explore with a tool box at the upper left of the map to open that pane. At the bottom of the pane, select Drive Times in the Show data for: window and a Radius of 5 minutes. When the pane resembles the one below, click OK.



- 3 In the Explore with a tool box, click the Pin option, then click on the map at the intersection of Wedgewood Lane and 80<sup>th</sup> Avenue. The map immediately turns blue and an Age Pyramid graph opens to display the age and gender distribution of the population within a 5 minute drive time of LITGL's store.
- 4 Use the Zoom tool at the upper right of the map to zoom out until you see the full extent of this market area as illustrated below. Use the forward and back arrows in the Infographics window to display the other characteristics of this market area.



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The Infographics tool provides an overview of trade area characteristics. You may also create reports from the BAO collection based for that market area.

- 5 Click the Create Report icon  at the lower right of the Infographics window. Select the Executive Summary report (note the range of BAO reports available to you) and specify a 5 minute Drive Times market area. Click the Create report button to create the report and, when prompted, designate a location to save it. Review the report, noting that the format is identical to the Executive Summary report you used previously.

Select report: Executive Sum...  
 Format: PDF  
 Show data for: Drive Times  
 Radius: 5 minutes  
 Create report

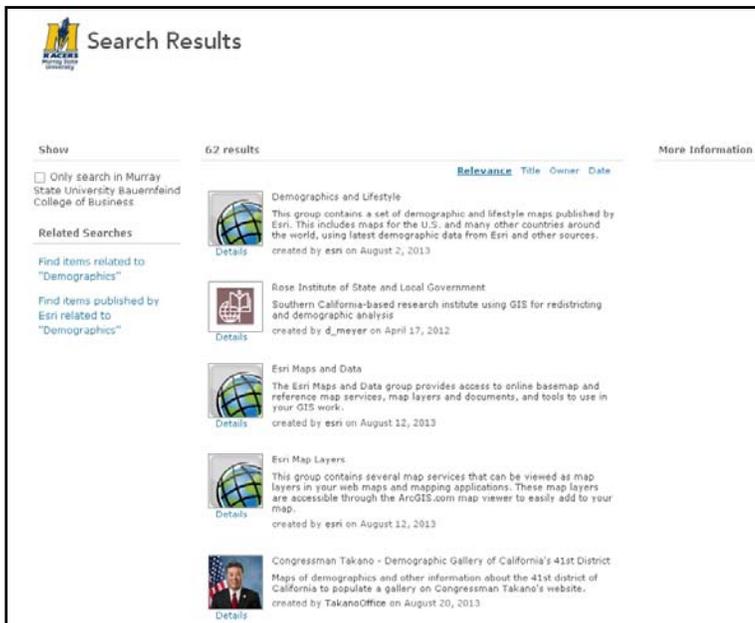
Review this process and answer the following question

**Question 8:** How could you use the Location Analytics Insights system to map and evaluate the market areas of the two potential locations for LITGL's second store?

# EVALUATING POTENTIAL SITES WITH ARCGIS ONLINE FOR ORGANIZATIONS

Location Analytics Insights provides quick insights into location characteristics, but offers limited map design and sharing capabilities. ArcGIS Online for Organizations does provide those functions and can also access BAO type data and analytical tools for use in location analysis. You will use those tools to gather information about LITGL's current store and two potential sites for a second one.

- 1 Login to your AGO-O system. The illustrations below are extracted from Murray State's RacerGISOnline systems and may differ in appearance slightly from yours.
- 2 In the Search field at the top right of the screen, type *Demographics*. Then click in the window to open its drop down menu and select Search for Groups, then click the Search icon. The results should include the Demographics and Lifestyle group illustrated below. NOTE: Be sure the option to search only within your organization's content is NOT selected, as this group is maintained by the Esri Data team.



- 3 Click on the Demographics and Lifestyle group to open its contents. This group is maintained by Esri Data and includes 2013 data for a variety of demographic attributes for the United States as well as a collection of core demographic attributes for many countries in the world. This collection is frequently updated with new countries or new data for the United States. Take a moment or two to browse through the collection to get a sense of its breadth.
- 4 Type *median income* in the Search box and click the icon. Find the USA Median Household Income map, expand the open menu below it and select, Open in ArcGIS.com map viewer, as illustrated below, to open the map in your system.

**Demographics and Lifestyle** SHARE

This group contains a set of demographic and lifestyle maps published by Esri. This includes maps for the U.S. and many other countries around the world, using latest demographic data from Esri and other sources.

**Group Content**  
 8 results for "median income" ✖

Relevance **Title** Owner Rating Views Date

All Results  
 Maps  
 Layers  
 Apps  
 Tools  
 Files

Show ArcGIS Desktop Content

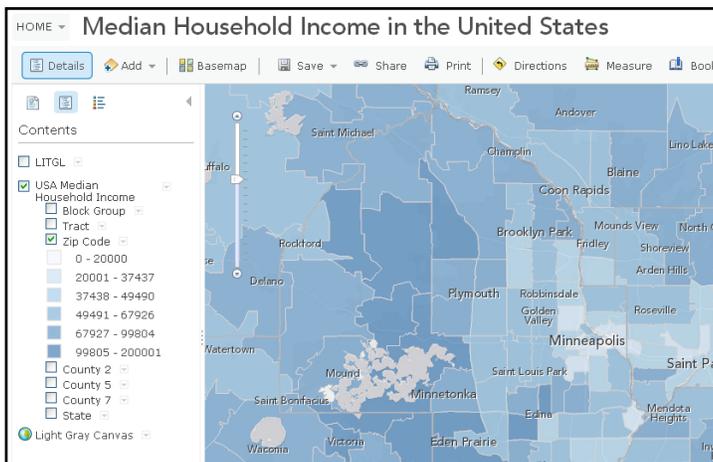
**Group Details**  
 esri  
 Status: public  
 Contributors: All members  
 Tags: Demographics, Lifestyle, USA, United States, Europe  
 1 Member  
 esri

**USA Median Household Income**  
 This map layer shows the median household income in the U.S. in 2013 in a multiscale map (by state, county, ZIP Code, tract and block group). ArcGIS Online subscription required.  
 Map Images by esri  
 Last Modified: July 4, 2013  
 ★★★★★ (2 ratings, 0 comments, 5,338 views)

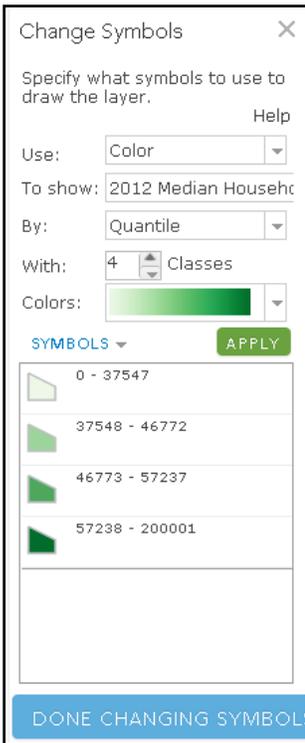
**Median Household Income in the United States**  
 This map shows the median household income in the U.S. in 2013 in a multiscale map (by state, county, ZIP Code, tract and block group). ArcGIS Online subscription required.  
 Web Map by esri  
 Last Modified: July 16, 2013  
 ★★★★★ (2 ratings, 0 comments, 499 views)  
 Open in ArcGIS.com map viewer  
 Open in ArcGIS Explorer Online  
 Open in ArcGIS 10 For Desktop

**Median Disposable Income**  
 This map layer shows the median disposable income in the U.S. in 2013 in a multiscale map (by state, county, ZIP Code, tract and block group). ArcGIS Online subscription required.  
 Map Images by esri  
 Last Modified: July 4, 2013  
 ★★★★★ (0 ratings, 0 comments, 2,558 views)

- Type *Minneapolis, MN* in the Search window at the upper right of the map and click the Search icon to zoom the map to the Minneapolis area. Close the pop up window that appears in the map.
- The map should display data at the block group level. You wish to work at the ZIP code level. To do so, click Content, expand the Median Household Income layer, turn off all layers except Zip Code and zoom in until the map displays data. It will resemble the one below.

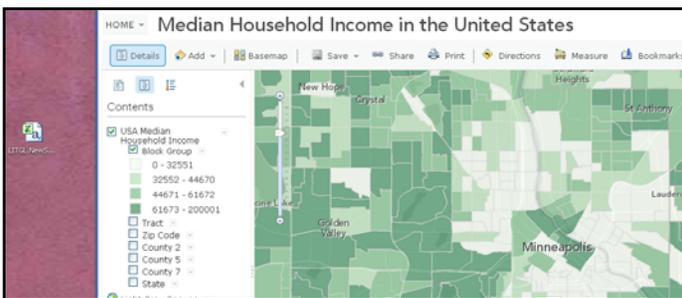


Open the drop down menu for the Zip Code layer and select Change Symbols. In that window, select Quantile in the By: field, designate 4 classes and a green color scheme to reflect the display settings you used previously. When your pane resembles the one below, click the Done Changing Symbols button to register the changes in the map. You may adjust the transparency of the layer by changing the settings of the USA Median Household Income header.



The map now displays one of the key characteristics of green consumers. You are now ready to add the locations of LITGL’s current and potential locations to the map.

- 7 Reduce the size of the map window so you can see it and your Desktop simultaneously. Locate the LITGL.NewStoreOptionsFL13.csv file on your desktop as illustrated below, then drag and drop that file onto the map, then maximize it. NOTE: You may also use the Add button to locate and import this file into the map with the same result.



Each of the locations now appears on the map. The one in the upper left is the current LITGL store and the other two locations are potential facilities for the second store. The location whose market area more closely resembles the current successful store is the more attractive site for the second store.

- 8 To create market areas around these locations, open the drop down menu for the LITGL layer and select Perform Analysis to open that pane.
- 9 Expand the Use Proximity tab, then click Create Drive-Time Areas to open that pane. Set 5 minutes as the drive time, retain the other default values, then enter *LITGL and Potential Store Market Areas* as the layer name, and save the result in a location of your choice in your AGO-O content. NOTE: In the illustration below it is saved in a BAO- My Sites folder, indicating another point of integration between BAO and AGO-O. When your pane resembles this one, click Run Analysis

Create Drive-Time Areas

---

Create areas around LITGL

1. Measure:

**Driving time**

Driving distance

To output multiple areas for each point, type sizes separated by spaces (2 3.5 5).

Use typical traffic conditions for

[See availability.](#)

2. Areas from different points:

**Overlap**

Dissolve

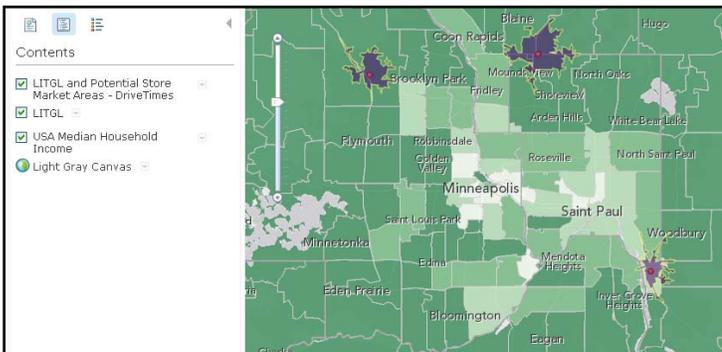
Split

3. Result layer name

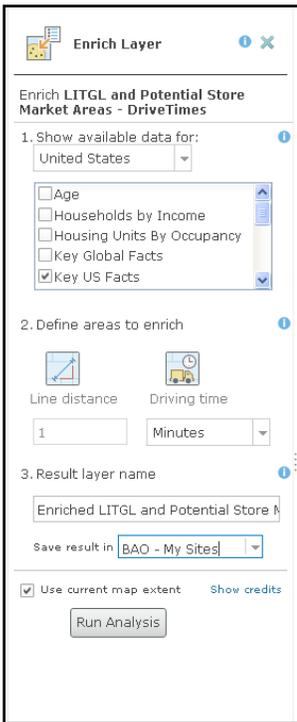
Save result in

Use current map extent [Show credits](#)

The drive time trade areas are created and added to the map as illustrated below. You may now add relevant data to these areas through the geo-enrichment process.

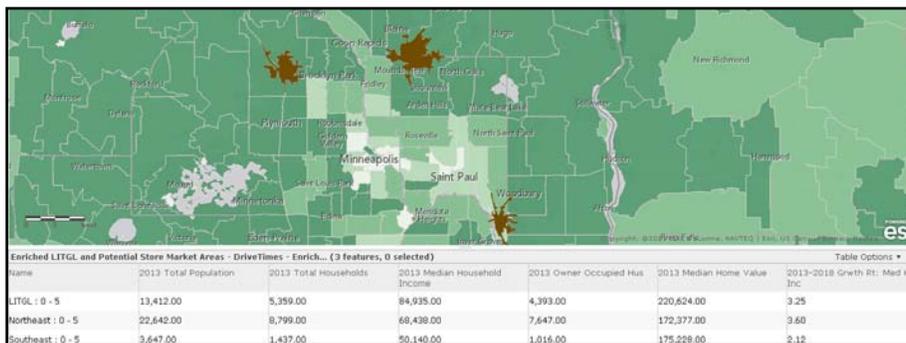


- 10 Open the drop down menu for the new trade areas layer, select Perform Analysis, then Date Enrichment and click the Enrich Layer tool to open that window. Select United States in the Show available data field, Key US Facts in the data selection field, enter a title and saved folder location of your choice. NOTE: The Define areas to enrich settings apply only to point layers. They do not affect your settings for this polygon layer. When your pane resembles the one below, click Run Analysis.



The results of the geo-enrichment process are added to the map as a new layer. You will use these results to determine which of the two potential site trade areas more closely resembles that of the current store.

- 11 Open the drop down menu for the new enriched layer, then click Show Table to open the data table at the bottom of the map. This table contains several demographic measures for all three trade areas. You will limit this display to those attributes most relevant to your decision.
- 12 Open the Table Options drop down menu at the top right of the table, then click Show/Hide Columns to open a list of available attributes with checks by the ones that are currently displayed. From those attributes, select Name, CY Total Population, CY Total Households, CY Median Household Income, CY Owner Occupied Housing Units, CY Median Home Value and CY-FY Grwth Rt: Med Hh Inc (the projected growth rate in median household income between the Current Year and the Future Year). Your map and table should resemble the one below.



Use the data in the table to answer the following question.

**Question 9:** How could you use the ArcGIS Online for Organizations system to map and evaluate the market areas of the two potential locations for LITGL's second store? Which of these market areas more closely resembles that of LITGL's current store?

## EVALUATING POTENTIAL SITES WITH ESRI MAPS FOR OFFICE

As this analysis illustrates, ArcGIS Online for Organizations offers a significant suite of tools using BAO-based data and analytical tools. It is a very useful system for users with some background and skill with GIS tools. However, in most organizations, the MS Office suite is a much more widely used resource. Through the Esri Maps for Office add-in, users of MS Excel and PowerPoint have access to some of the same BAO-based technologies that are available in AGO-O. In this part of the exercise, you will use some of these capabilities to duplicate the analysis you performed previously with AGO-O resources.

- 1 Open MS Excel, and load the LITGL.NewStoreOptionsFL13.csv file from your Desktop.
- 2 Click the Esri Maps tab on the main toolbar at the top of the screen to open the Maps for Office add-in. Click on the Sign In ArcGIS button on the command ribbon and sign in to your ArcGIS Online for Organizations account.
- 3 Click the Insert Map command to insert a map into the Excel worksheet then enlarge and center the map. Your first step will be to create a color-coded map of Median Household Income, just as you did in the AGO-O exercise.
- 4 In the Esri Maps pane on the right, click the Search option, select United States in the Show available data for: field, click the Key USA Facts option to see relevant maps. Select a Map Service for Median Household Income and, when your screen resembles the one below, click the Add button to add this attribute to the map.



- 5 Zoom in to and center the Minneapolis area, noting as you do that the map display is scale dependent as were the layers you used previously in AGO-O.

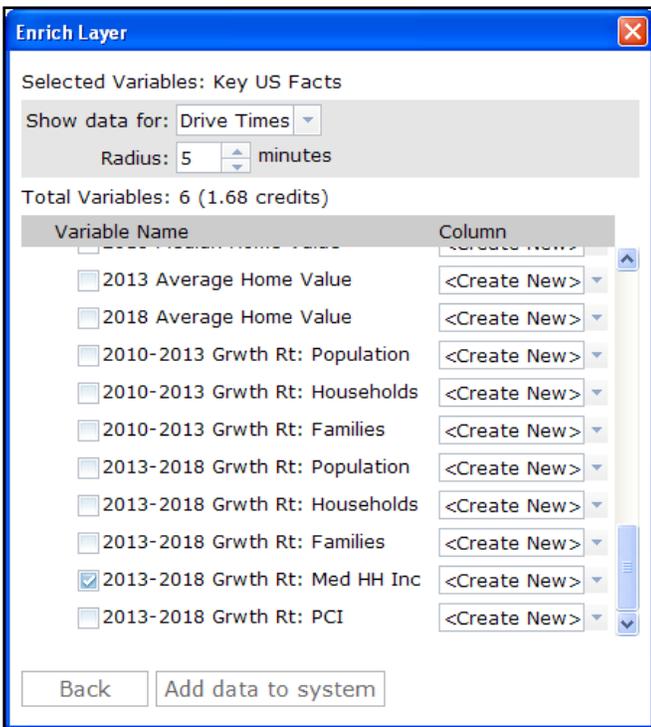
You will now add the data from the worksheet to the map to show the locations of LITGL's current store and potential sites.

- 6 Click the Add Excel Data command, select Table 2 as the data source and click Next. Confirm that Address is the Location Type, then click Next. In the next window, confirm that the first row of the range contains headers, that all locations are in the United States and that the columns are accurately aligned with address information. When your screen resembles the one below, click Add to geocode the addresses and add them to the map.



The map now displays the three locations. As before the one to the northwest is LITGL’s current store and the other two are potential locations. You will use the Enrich layer command to add market area data to all three locations.

- Right click the Table1 layer in the Map Contents pane and rename it Current and Potential Stores. With this layer selected in the Map Contents window, click the Enrich Layer button in the Esri tool ribbon. Select Key US Facts, then click Next. In the Enrich Layer window, click the edit command at the end of the Show data for: and specify a 5 minute drive time, unselect all the variables in the list, then select CY Total Population, CY Total Households, CY Median Household Income, CY Owner Occupied Housing Units, CY Median Home Value and CY-FY Grwth Rt: Med Hh Inc (the projected growth rate in median household income between the Current Year and the Future Year). When this window resembles the one below, click Add Data to the System.



The map and table should resemble the one below. Note that the values for the market areas are identical to those you calculated in the AGO-O system previously.

A	B	C	D	E	F	G	H	I	J	K	
1	Name	Address	City	State	ZIP	2013 Total Popul	2013 Total Households	2013 Median Household	2013 O <sub>h</sub>	2013 Median Home Value	2013-2018 Growth
2	LITGL	8061 Wedgewood Ln N	Maple Grove	MN	55369	13412	5359	84935	4393	220624	3.25
3		Southeast 727 20th Street	Newport	MN	55055	3647	1437	50140	1016	175238	2.12
4		Northeast 3575 85th Ave NE	St Paul	MN	55126	22642	8799	68438	7647	172377	3.6

Use the data in the table to answer the following question.

**Question 10:** *How could you use the Esri Maps for Office system to map and evaluate the market areas of the two potential locations for LITGL's second store? Which of these market areas more closely resembles that of LITGL's current store?*

This completes the exercises in this workshop. As you have no doubt observed in this process there are significant analytical, design and sharing tools in these systems that we have not covered in this focused exercise. From top to bottom in the systems we have covered the opportunities for designing problem-specific content and sharing it with decision makers throughout the organization are integrated comprehensively across the BAO, AGO-O and Maps for Office tools. Collectively, they have great promise to bring the benefits of location analytics to professionals across the enterprise. They also transform GIS professionals in those enterprises from specialists who design custom analyses and reports to facilitators who manipulate external and enterprise data into Web-based solutions that can be used directly by decision makers across the organization.

The movement toward these technologies is strong and gaining momentum, supporting the notion that this generation of tools and those that follow will finally scale the traditional barriers to broad based application of location analytics within organizations.

## Submit your work

Submit answers to the following questions in an MS Word document:

**Question 1:** *What variations in median household income and median home value do you observe in the Minneapolis-St. Paul area? Which parts of the region are most attractive for Living in the Green Lane? Why?*

**Question 2:** *What variations in educational attainment and annual home improvement purchases do you observe in the Minneapolis-St. Paul area? Which parts of the region are most attractive for Living in the Green Lane? Why?*

**Question 3:** *Which approach to market area definition, rings or drive times, is more appropriate for this analysis? Why?*

**Question 4:** *Are there clusters of census tracts which appear to present substantial market opportunities based on these characteristics? Why did you select this location as a second potential site?*

- Question 5:** *Based on the graphs and tables in the Comparison Reports, which of the two market areas appears to be the more attractive for Living in the Green Lane?*
- Question 6:** *Based on the Market Profile and Executive Summary reports, which of the two market areas has the more favorable demographic characteristics relative to Living in the Green Lane's target customer profile? Explain.*
- Question 7:** *Based on all the maps, graphs and reports you have generated in this analysis, do you recommend that Janice and Steven buy the TCRTF site? Explain.*
- Question 8:** *How could you use the Location Analytics Insights system to map and evaluate the market areas of the two potential locations for LITGL's second store?*
- Question 9:** *How could you use the ArcGIS Online for Organizations system to map and evaluate the market areas of the two potential locations for LITGL's second store? Which of these market areas more closely resembles that of LITGL's current store?*
- Question 10:** *How could you use the Esri Maps for Office system to map and evaluate the market areas of the two potential locations for LITGL's second store? Which of these market areas more closely resembles that of LITGL's current store?*

## Business GIS References

American FactFinder Site (explains ACS data estimates and intervals)

[http://factfinder.census.gov/jsp/saff/SAFFInfo.jsp?geo\\_id=01000US&\\_geoContext=01000US&\\_street=&\\_county=&\\_cityTown=&\\_state=&\\_zip=&\\_pageId=sp1\\_acs&\\_submenuId=&\\_ci\\_nbr=null](http://factfinder.census.gov/jsp/saff/SAFFInfo.jsp?geo_id=01000US&_geoContext=01000US&_street=&_county=&_cityTown=&_state=&_zip=&_pageId=sp1_acs&_submenuId=&_ci_nbr=null)

Business GeoInfo Newsletter

<http://www.esri.com/industries/business/community/newsletter.html>

Directions Magazine, look for articles on business applications of GIS <http://www.directionsmag.com/>

ESRI Business GIS site – resources for business applications of GIS <http://www.esri.com/industries/business/index.html>

ESRI Demographic Update Methodology: 2010-15

<http://www.esri.com/library/whitepapers/pdfs/demographic-update-methodology-2010.pdf>

ESRI Trend Analysis: 2010-15

<http://www.esri.com/library/whitepapers/pdfs/trend-analysis-2010-2015.pdf>

GIS Cafe Newsletter – electronic GIS newsletter, look for business applications

<http://www.gisafe.com/>

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## Business Analyst Resources

Business Analyst Resource Center

<http://resources.esri.com/businessAnalyst/>

Business Analyst blog

<http://blogs.esri.com/Dev/blogs/businessanalyst/default.aspx>

ESRITV on YouTube – a YouTube channel with GIS tutorials

[http://www.youtube.com/my\\_subscriptions?pi=0&ps=20&sf=added&sa=0&dm=2&s=0LIVYnA7kaE&masthead=1&as=1](http://www.youtube.com/my_subscriptions?pi=0&ps=20&sf=added&sa=0&dm=2&s=0LIVYnA7kaE&masthead=1&as=1)

ESRI Case Study. *Redlands Chamber of Commerce: ESRI Business Analyst Online Helps Attract New Business to Redlands.*

<http://www.esri.com/library/casestudies/redlands-chamber-of-commerce.pdf>

Miller, Fred L., Getting to Know ESRI Business Analyst, ESRI Press, Redlands, CA, 2010.

Thurston, Kathie. *ESRI Business Analyst Online Successfully Fills Commercial Vacancies* podcast

[http://www.esri.com/news/podcasts/podcast.html#user\\_thurston](http://www.esri.com/news/podcasts/podcast.html#user_thurston)

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Pyke, Chris. *GIS Assists Green Building* podcast

[http://www.esri.com/news/podcasts/podcast.html#user\\_pyke](http://www.esri.com/news/podcasts/podcast.html#user_pyke)

Roderick, Brent. 2009. *Discover Retail Opportunities with Esri's Retail MarketPlace Data.*

<http://www.esri.com/news/arcwatch/0809/retail-marketplace-data.html>

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Schaffer, Paul. 2007. New study: Americans reach environmental turning point, companies need to catch up. *Environmental News Network*, August 22.

[http://enn.com/top\\_stories/article/22186/print](http://enn.com/top_stories/article/22186/print)

South Bend Small Business Development Center

<http://www.esri.com/library/casestudies/southbend.pdf>

Thompson, Simon. *Why GIS is Important to Retailers* podcast

[http://www.esri.com/news/podcasts/podcast.html#staff\\_s-thompson-3](http://www.esri.com/news/podcasts/podcast.html#staff_s-thompson-3)