

Environmental Equity and Air Toxics

– by Rachel Russell

Introduction

Problem

In the late 1970s and through the 1980s, people in the United States turned increasing attention toward toxic chemicals in the environment. Highly publicized toxic exposure incidents generated new standards for monitoring and regulating discharge of toxic chemicals into the environment. Given information about the location and proximity of harmful agents, researchers began to wonder whether any correlations existed between pollution and groups of people. Were some groups of people exposed to toxins more than others?

What if you were moving to a new area, say around Los Angeles, California? Would where you could afford to live affect your exposure to industrial hazards? Would the racial makeup of your neighborhood leave you more vulnerable to exposure to air toxics?

It may be tempting to assume that decades later people in the United States experience environmental equity. But rather than assume, in this lab you will examine the spatial relationship between air toxics and median income or race/ethnicity in Los Angeles County.

Location

Los Angeles County, California

Time to complete the lab

Six to eight hours

Keywords: environmental equity, environmental racism, environmental justice, race and ethnicity, social inequity, toxic release inventory, public health

Prerequisites

Intermediate GIS skills

Data used in this lab

- Cities (Esri)
- Counties (Esri)
- Freeways (Esri)
- Highways and streets (Census)
- Hydrology (US Geological Survey [USGS])
- Places
- Census tracts (Esri)
- Toxic Release Inventory sites (US EPA)
- State plane coordinate system, California Zone 5, NAD83

Student activity

A series of dramatic national and international toxic exposure incidents from the late 1970s through the 1980s mobilized the environmental justice movement in the United States to pressure the government to monitor and regulate toxic chemicals released into the environment. In response to these calls for more information from communities located near hazardous facilities, the Environmental Protection Agency (EPA) created the Emergency Planning and Community Right-to-Know Act (EPCRA) in 1986. This law informs residents of industrial hazards in their area, including location and quantity of chemicals, to help communities prepare for emergencies. This data is made available through the Toxic Release Inventory (TRI), a self-reported database (for more information, see www.epa.gov/TRI/triprogram/whatis.htm).

As the environmental justice debate continued, researchers began to investigate who in the United States was most impacted by toxic materials. *Toxic Waste and Race in the United States* (1987), a report by the United Church of Christ, showed that people of color in the United States were disproportionately exposed to pollution, or experienced environmental racism (for an updated version of this report, see www.ejnet.org/ej/twart.pdf). Inequality in exposure to pollution was later linked to income and the economic power to choose where to live.

In this lab, you will use US Census 2000 data on income and race and the EPA's Toxic Release Inventory data for 2003. You will:

- Create a graduated symbol map of toxic air emissions at TRI sites.
- Make a choropleth map based on income and overlay the graduated symbols.
- Do a spatial join of TRI_Sites.shp with Tracts.shp to create a TRI_Tracts.shp file.

- Use the TRI_Tracts.shp file to map the relationship between presence of air toxics and income data.
- Create a graduated symbol map of toxic air emissions at TRI sites within Los Angeles County.
- Make a pie chart graph that shows the presence of air toxics and risk of exposure for each race/ethnicity group.

PREPARE YOUR WORKSPACE

When doing a GIS project, it is good practice to store all your information within a single folder on your computer or storage device and back it up frequently.

COLLECT AND PROCESS DATA

The *LA.mxd* file and all its data are in a folder called *LA*. This can serve as your work area.

If you create new shapefiles, export the data and use the same coordinate system as the layer's source data. Make sure the output shapefile is placed in the same folder as all your other data (*LA* folder).

Be sure to use relative paths so that the project is transferable to any workstation. Do this using *File* » *Document Properties* » *Data Source Options* » *Store relative path names to data sources*. Make sure that the GIS preferences are always set to *relative paths*. Also check the box that states *Make relative paths the default for new map documents I create*.

GRADUATED SYMBOL MAP

ANALYZE

Create a graduated symbol map using *TRI_Sites.shp* to show which sites have the greatest and least amounts of air toxics emissions.

- 1 Using the ArcMap application, open *LA.mxd*. Double-click the *TRI_Sites* layer to bring up *Layer Properties*.
- 2 On the *Symbology* tab, click *Quantities* and click *Graduated Symbols*.
- 3 For the *Fields Value*, choose *Total Air Pollution*.

- 4 The default classification is *Natural Breaks*, but you can experiment with the type and number of classes you wish to display. Three to five classes are optimal.

There are several methods for classifying your data, so take some time to examine the other classification schemes. Using *Manual* classification, determine how various breaks affect the interpretation of the data. Once you have familiarized yourself with the classification window, return the classification to *Natural Breaks* and move on to the next step.

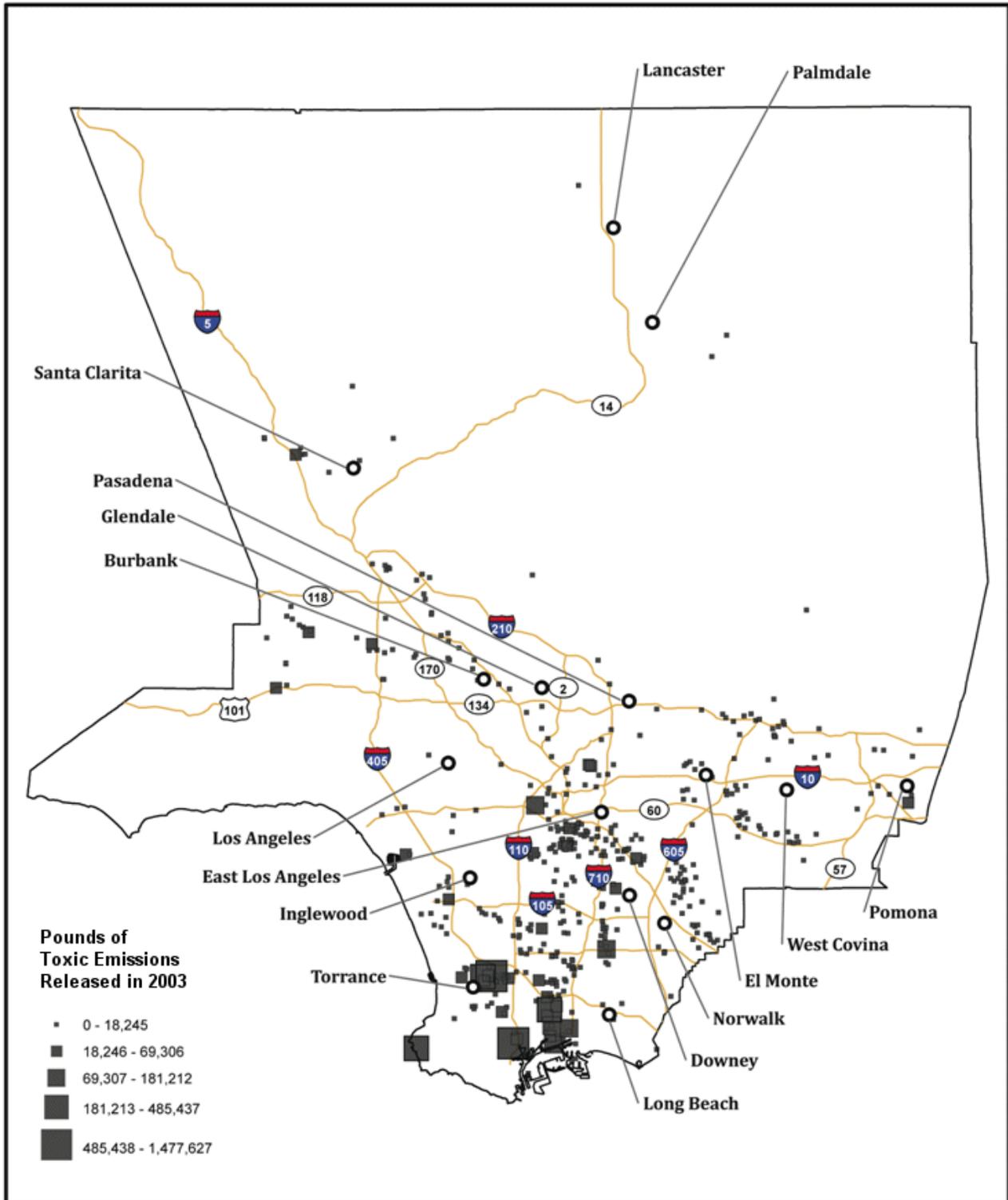
- 5 Experiment with the *Symbol Size From* values. This changes the size of the symbols.
- 6 Experiment with the template. This will allow you to change the visual variables of the graduated symbol.
- 7 Click *Label* and select *Format Labels*. Your data is numeric but does not need six decimal places. Change it to 0 decimal places.
- 8 Check the *Show thousands separators* box. When it comes time to generate a map, this will make your legend look much better.
- 9 Clear the *Show plus sign* box, as there are no sites with negative toxic air emissions.

VISUALIZE

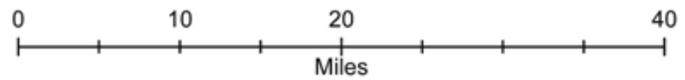
Your graduated symbol map includes spatial information that helps the map reader reference the location of the TRI sites. Use the cities and major highways for reference information. Select key cities (e.g., a selection of those with a population over 100,000) to provide reference information.

- 1 Make sure the *County* layer is checked (visible). A bookmark has been created called *Los Angeles* that will zoom the data frame's extent to this area.
- 2 Include the following map elements: a title, legend and legend title, scale bar, north arrow, data sources, and your name ("Cartography by" or ©).
- 3 Using the default settings for your legend will result in more information than you need. Clean it up by doing the following:
 - Right-click the legend and select *Properties*.
 - On the *General* tab, change the title to something applicable.
 - Also on the *General* tab, make the air toxic site layer (*TRI Sites*) the only one in the legend.
 - On the *Items* tab, click the *Style* button and choose the style called *Horizontal Single Symbol Label Only*.

Air pollution sites in Los Angeles county



Cartography by: Joe Mapsalot
Data Sources: EPA Toxic Release Inventory 2003, Esri



CHOROPLETH MAP—INCOME

ANALYZE

Create a choropleth map of median income by tract.

- 1 Double-click the *Tracts* layer to bring up *Layer Properties*.
- 2 On the *Symbology* tab, click *Quantities* and click *Graduated colors*.
- 3 For *Fields Value*, choose *median income*.

No normalization is needed.

- 4 Use the default classification of *Natural Breaks* and experiment with the number of classes you wish to display. Three to five classes are optimal.
- 5 Take some time again to examine what happens when using the other classification schemes. Optionally, you could use *Manual* and choose the breaks that you think most appropriately display your data.
- 6 Experiment with the *Color Ramp* values so that your colors are readily identifiable.

Use a color ramp that is sequential, meaning light colors represent low values and dark colors represent high values. For more advice on color ramps, see the ColorBrewer website at colorbrewer2.org/. Also, choose a color ramp that does not conflict with your graduated symbol color. Do an image search for 'color wheels' and use opposite (complementary) colors. For example, a green color ramp was chosen for the 'Air pollution sites and median income in Los Angeles County' map that follows because it contrasts with the red graduated symbols. Green and red are on opposite sides of the color wheel.

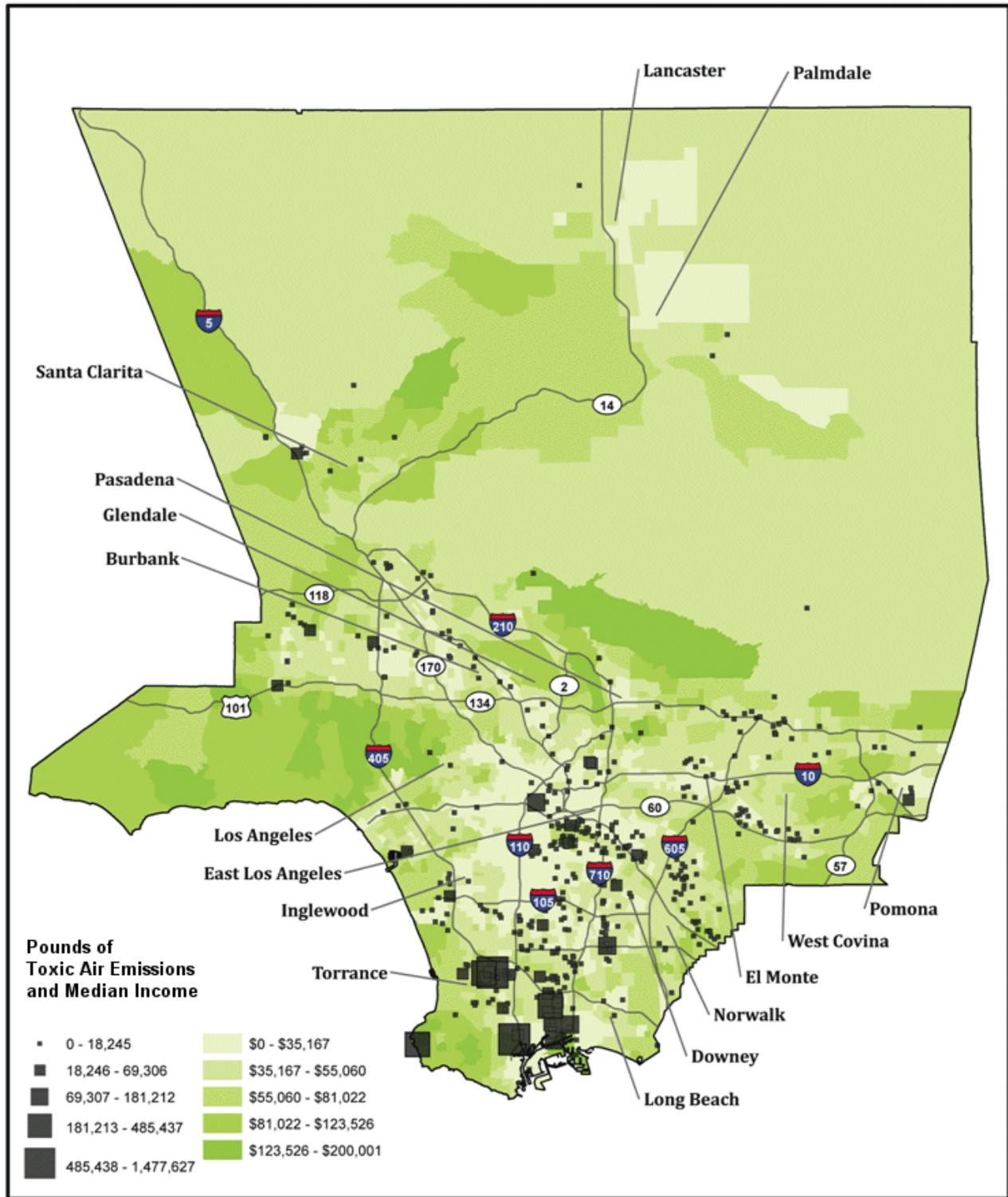
- 7 Click *Label* and select *Format Labels*. Set *Category* to *Currency*.
- 8 You do not need the *.00* after each category. To remove it, click each currency range under *Label*. Then manually delete the *.00*.

VISUALIZE

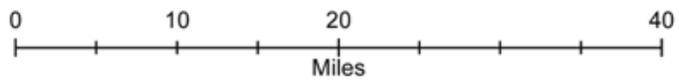
Your choropleth map should include the following:

- The reference information already created for the graduated symbol map
 - The air pollution graduated symbols
- 1 Make sure the *County* layer is above the *Tracts* layer so that it is visible and provides a clean outline of the county.
 - 2 Edit the existing legend properties. Make sure to add the *Tracts* layer to the legend.
 - 3 Also, on the *Items* tab of the legend properties, you can place *Tracts* in a new column. Depending on how you have laid out your page, this may make it easier to place the legend.
 - 4 Include the same map elements as in the previous map, but update the title and legend heading.

Air pollution sites and median income in Los Angeles county



Cartography by: Joe Mapsalot
Data Sources: EPA Toxic Release Inventory 2003, Esri



RELATIONSHIP BETWEEN AIR POLLUTION AND INCOME

ANALYZE

- 1 Perform a spatial join of *TRI_Sites* and *Tracts*. Open the *Search* window, type *Spatial Join*, click the *Search* button, and click the *Spatial Join (Analysis)* tool.
- 2 Populate the *Spatial Join* dialog box as follows:
 - Set *Target Features* to *Tracts*.
 - Set *Join Features* to *TRI_Sites*.
 - Set *Output Feature Class* to *\LA\TRI_Tracts.shp*.
 - Change *Join Operation* to *JOIN_ONE_TO_MANY*.
 - Check the *Keep All Target Features* box.
 - Select *INTERSECT* for *Match Option*. Click *OK*.

This join operation is required because some polygons contain more than one pollution site. First, create a layer that has a tract number linked to each pollution site, then, using dissolve, combine like tract numbers to obtain a sum of all pollution released.

- 3 Open the *Search* window and locate the *Dissolve (Data Management)* tool.
- 4 Populate the *Dissolve* dialog box as follows:
 - Set *Input Features* to *TRI_Tracts.shp*.
 - Set *Output Feature Class* to *\LA\Tract_Pollution.shp*.
 - In *Dissolve_Field(s)*, place a check mark beside *TRACT*.
 - Click the drop-down menu for *Statistics Field(s)* and select *SUM_SUM_TO*.
 - Under *Statistic Type*, choose *SUM*. After this, you can run the tool.

One approach to this analysis examines the percentage of toxic air released per tract in Los Angeles County. Create an empty field and calculate tract pollution divided by county pollution.

- 5 Open the *Search* window and locate the *Add Field (Data Management)* tool.
- 6 Populate the *Add Field* dialog box as follows:
 - Set *Input Table* to *Tract_Pollution.shp*.
 - Set *Field Name* to *Pollution*.
 - Set *Field Type* to *Float*. Click *OK*.

- 7 Right-click the *Tract_Pollution* layer and click *Open Attribute Field* to open the layer's attribute table.
- 8 Right-click *SUM_SUM_TO* and choose *Statistics*.
- 9 Write down the sum of all air pollution in the county.
- 10 Right-click the new *Pollution* field and click *Field Calculator*.
- 11 In *Fields*, double-click *SUM_TOTAL_*.
- 12 Click the slash (/) button.
- 13 Just after /, type in the sum of all air pollution in the county as determined from the *Statistics* step above.
- 14 At the end of this, add **100*.
- 15 Click *OK*. This will populate the *Pollution* row with a percentage value of the total pollution in a tract divided by the total pollution in the county.
- 16 To check to make sure you did this step correctly, right-click and select *Pollution » Statistics*. The sum should equal 100.
- 17 Close the attribute table when done.

The US Census Fact Sheet shows that the median household income for the county in 2000 was \$42,189.

<http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk>

To complete the analysis, combine median income and pollution data using their common tract IDs, then create two new data layers for comparing pollution between above- and below-median income tracts.

- 18 Right-click the *Tract_Pollution* layer and choose *Joins and Relates » Join*.

- 19 Populate the *Join Data* dialog box with the following:
 - Select *Join attributes from a table*.
 - In *Step 1*, choose *TRACT* as the field that the join will be based on.
 - In *Step 2*, select the original *Tracts* layer as the table to join to this layer.
 - In *Step 3*, choose *TRACT* as the field to base the join on.
 - Keep all records and click *OK*.

- 20 Identify tracts that are above and below the median income using *Selection » Select By Attributes*.

- 21 Set *Layer* to *Tract_Pollution*.

- 22 Double-click *Tracts.P053001*.

- 23 Click the greater-than symbol (>).

- 24 Add a space, then type *42189* (with no comma).

- 25 Click *Apply* then *OK*. This will select all tracts with household income above the county median.

- 26 Right-click *Tract_Pollution*.

- 27 Go to *Data » Export Data » Export Selected Features* and name the file *abovemedian.shp*, then put it in the *LA* folder. Make sure *Save as Type* is set to shapefile.

- 28 Click *OK*.

- 29 Click *Yes* to load this new shapefile.

- 30 Go to *Selection » Clear Selected Features*.

- 31 Go to *Selection » Select By Attributes*.

- 32 Set *Layer* to *Tract_Pollution*.

- 33 Double-click *Tract.P053001*.

- 34 Click <.

- 35 Add a space, then type *42189* (with no comma).

- 36 Click *Apply*, then *OK*. This will select all tracts with household income below the county median.
- 37 Right-click *Tract Pollution*.
- 38 Go to *Data » Export Data » Export Selected Features* and name the file *belowmedian.shp*, then put it in the *LA* folder.
- 39 Click *OK*.
- 40 Click *Yes* to load this new shapefile.
- 41 Go to *Selection » Clear Selected Features*.
- 42 Right-click the *belowmedian* layer and open its attributes.
- 43 Right-click and select *Pollution » Statistics*. Write down the sum. The sum is the total percentage of air pollution in tracts below the median household income.
- 44 Right-click the *abovemedian* layer and open its attributes.
- 45 Right-click and select *Pollution » Statistics*. Write down the sum. The sum is the total percentage of air pollution in tracts above the median household income.
- 46 Use the percentage information obtained for incomes below and above the median household to write your analysis.

VISUALIZE

Make a map showing the relationship of air pollution to income above and below the median.

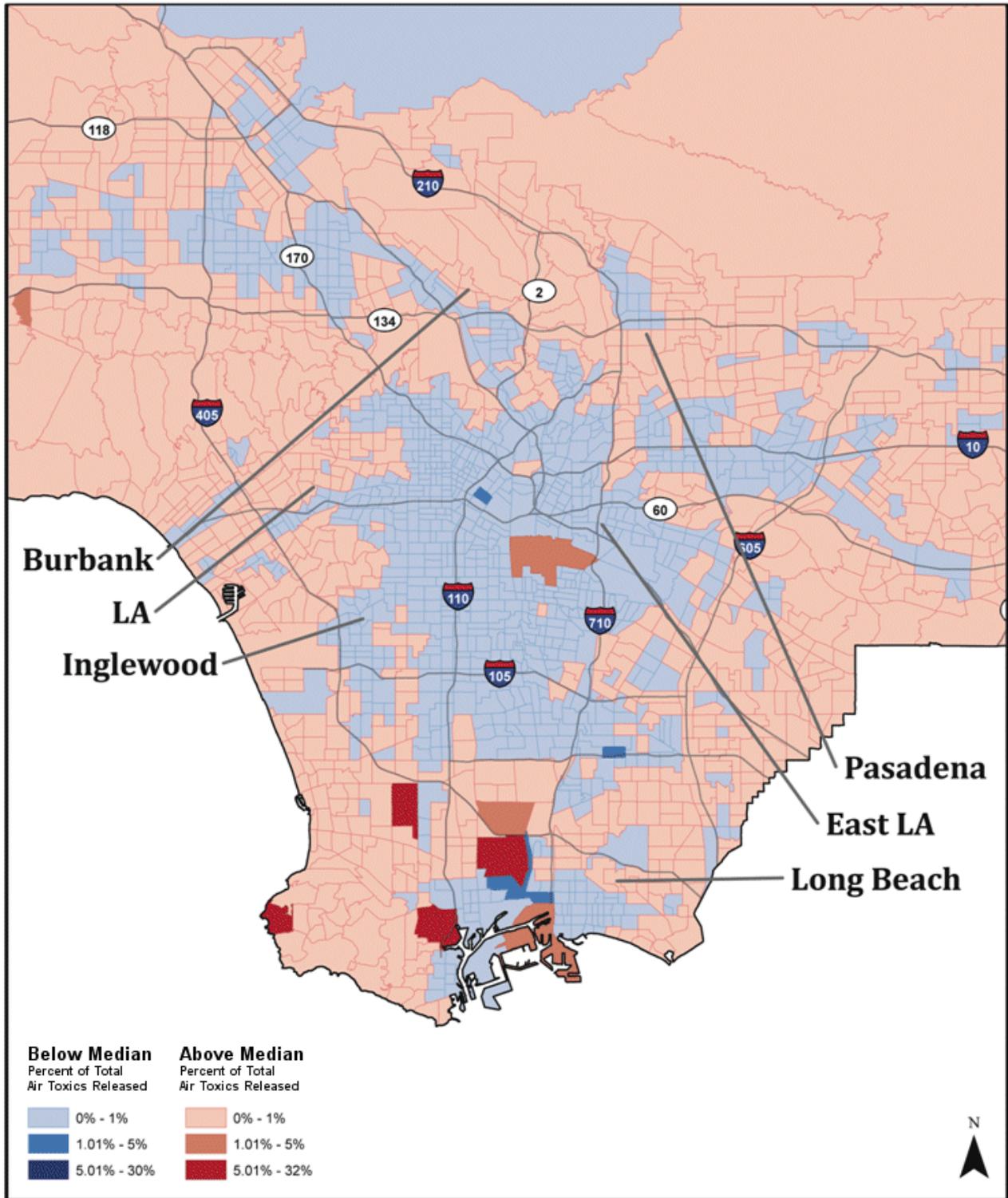
- 1 Open the properties for the *abovemedian* layer.
- 2 Go to *Symbology » Quantities » Graduated Colors*.
- 3 Go to *Value » Pollution*.

No normalization is needed.

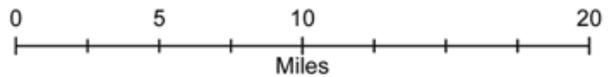
- 4 Under *Classification*, select 3 classes. Click *Classify » Manual*.

- 5 Go to *Break Values* » 1, 5, 32.
- 6 Click *OK* to get back to the *Symbology* dialog box.
- 7 Click *Label* » *Format Labels* » *Percentage*.
- 8 Click *Numeric Option* and set the number of decimal places to 2.
- 9 Click *OK* twice to get back to the *Symbology* dialog box.
- 10 Choose a sequential color ramp (as before).
- 11 Under *Symbol*, double-click each of the three colored boxes and give them a 0.4 colored outline that is similar to the fill color.
- 12 Make sure that the outline color and line weight are the same for all. Click *OK*.
- 13 Open the properties for the *belowmedian* layer.
- 14 Repeat steps 2 through 12.
- 15 Use the above and below median symbols in the map legend.

Median income and percent of total air pollution in Los Angeles county



Cartography by: Joe Mapsalot
Data Sources: EPA Toxic Release Inventory 2003, Esri



CRITICAL THINKING

Question 1: *Are there any shortcomings in this approach to analyzing the problem?*

Question 2: *What could be done differently to improve the legitimacy of the analysis?*

Question 3: *What problems exist for low-polluting tracts that lie adjacent to high-polluting tracts? How would you take this analysis further to address this problem?*

RELATIONSHIP BETWEEN AIR POLLUTION AND RACE/ETHNICITY

ANALYZE

- 1 Perform a spatial join of *TRI_Sites* and *Tracts*. Open the *Search* window, type *Spatial Join*, click the *Search* button, and click the *Spatial Join (Analysis)* tool.
- 2 For *Target Features*, select *Tracts*.
- 3 For *Join Features*, select *TRI_Sites*.
- 4 For *Output Feature Class*, enter `\LA\TRI_Tracts.shp`. Make sure you rename the file *TRI_Tracts.shp* and place it in the *LA* folder (your common work area).
- 5 Change *Join Operation* to *JOIN_ONE_TO_MANY*.
- 6 Check *Keep All Target Features*.
- 7 Select *INTERSECT* for *Match Option* and click *OK*.

This join operation is required because some polygons contain more than one toxic release site. For this analysis, find the percentage of population by race within each tract, then determine how much pollution that population was exposed to in 2003.

- 8 Open the *Search* window and locate the *Add Field (Data Management)* tool.
- 9 For *Input Table*, select *TRI_Tracts*.
- 10 For *Field Name*, select *Per_His*.

- 11 For *Field Type*, select *Float*.
- 12 Click *OK*.
- 13 Repeat the process, adding fields for *Per_White*, *Per_Black*, and *Per_Asian*.
- 14 Open the layer properties for *TRI_Tracts* and click the *Definition Query* tab. Select the *Query Builder* button.
- 15 Use *Query Builder* to create the following expression: "*P004001*" > 0.
- 16 Click *OK* twice.

This hides tracts that have zero population and prevents any errors in the following steps.

- 17 Open the attribute table for *TRI_Tracts*, right-click the field *Per_His*, and select *Field Calculator*.

To do any calculation, you must remember the following associations between census categories and race/ethnicity categories:

P004001	P004002	P004005	P004006	P004008
Total population	Hispanic or Latino	Not Hispanic or Latino; White alone	Not Hispanic or Latino; Black or African-American alone	Not Hispanic or Latino; Asian alone

- 18 In the *Field Calculator*, double-click *P004002*.
- 19 Single-click the slash (/).
- 20 Double-click *P004001* (do not use any commas).

This builds the expression *Total Hispanic Population/Total Population*.

- 21 Click *OK*.

The *Per_His* field will be populated with the percentage of Hispanics or Latinos present in each tract.

- 22 Repeat the process, adding fields for *Per_White*, *Per_Black*, and *Per_Asian*.

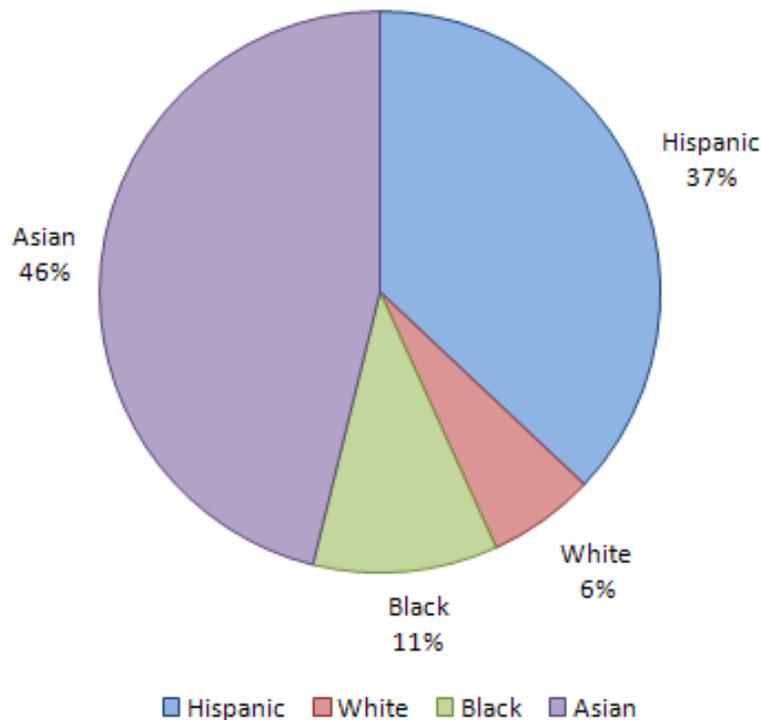
- 23 Open the *Search* window and locate the *Add Field (Data Management)* tool.
 - 24 For *Input Table*, select *TRI_Tracts*.
 - 25 For *Field Name*, enter *Poll_His*.
 - 26 For *Field Type*, select *Float*.
 - 27 Click *OK*.
 - 28 Repeat the process, adding fields for *Poll_Whit*, *Poll_Blac*, and *Poll_Asia* (Note: Only nine characters can be used in a field).
 - 29 Right-click the field *Poll_His* and click *Field Calculator*.
 - 30 In the *Field Calculator*:
 - Double-click *Per_His*
 - Click the asterisk (*)
 - Double-click *SUM_TOTAL_*
 - Click *OK*
- The *Poll_His* field will be populated with the amount of pollution in a tract in terms of the percentage of Hispanics or Latinos present in each tract.
- 31 Repeat the process, adding fields for *Poll_Whit*, *Poll_Blac*, and *Poll_Asia*.

VISUALIZE

- 1 Open *Layer Properties* for *TRI_Tracts*.
- 2 Click the *Fields* tab and check only the fields *Poll_His*, *Poll_Whit*, *Poll_Blac*, and *Poll_Asia*.
- 3 Close *Layer Properties*.
- 4 Open the *TRI_Tracts* attribute table.
- 5 Click *Table Options* (upper left corner) and select *Export*.
- 6 Export the attributes to the *LA* folder as a DBF file.

- 7 Using Excel, total the values for *Poll_His*, *Poll_Whit*, *Poll_Blac*, and *Poll_Asia*.
- 8 Make a pie chart graph that shows the amount of air toxics for each race/ethnicity group. Make sure to rename each group appropriately.
 - In Excel, find the sum of each column; this will give you the total potential air toxics exposure for Hispanic, White, Black, and Asian populations.
 - Next calculate the sum of these four categories to obtain the total air toxics released in L.A. County.
 - Finally, divide the amount of air toxic exposure per race by the total air toxics released in L.A. County to obtain the percentage by which each race was exposed to pollution in 2003.

Percent of exposure to pollution in LA County



CRITICAL THINKING

Question 4: *Are there any shortcomings in this approach to analyzing the problem?*

Question 5: *What could be done differently to improve the legitimacy of the analysis?*

Question 6: *How would you take the analysis a step further?*

Submit your work

Submit a short written report that answers the question, “Is there a spatial relationship between air pollution and income or race/ethnicity in Los Angeles County?” The report must include

- Answers to the questions posed in the activity
- A graduated symbol map of air pollution
- A choropleth map of median income overlaid with the air pollution graduated symbols
- A map showing the relationship between above- and below-median income and air pollution
- A pie chart graph that shows the amount of pollution for each race/ethnicity group

Credits

Images

“Air pollution sites in Los Angeles county” created by the author; Los Angeles county and road data courtesy of U.S. Census; toxic release data courtesy of Data.gov.

“Air pollution sites and median income in Los Angeles county”; Los Angeles demographic and county data courtesy of U.S. Census.

“Median income and percent of total air pollution in Los Angeles county”; Los Angeles demographic, road, and county data courtesy of U.S. Census.

Sources of supplied data

LA\Cities.shp, Data from ESRI Data & Maps 2008, courtesy of US Census

LA\County.shp, Data from ESRI Data & Maps 2008, derived from TeleAtlas and US Census

LA\Freeways.shp, Data from Esri Data & Maps 2008, courtesy of U. S. Bureau of Transportation Statistics

LA\Highways.shp, Data courtesy of U.S. Census

LA\Hydrology.shp, Data courtesy of U.S. Geological Survey

LA\LA.mxd, Data from ESRI Data & Maps 2008, U.S. Bureau of Transportation Statistics, U.S. Census, and U.S. Geological Survey, United States Environmental Protection Agency; .mxd created by Riley Peake.

LA\LA_TRI.xls, Data courtesy of United States Environmental Protection Agency

LA\Places.shp, Data from Esri Data & Maps 2008, courtesy of U.S. Census

LA\Streets.shp, Data courtesy of U.S. Census.

LA\tgr06037lkA.dbf,

LA\Tracts.shp Data from Esri Data & Maps 2008, derived from Tele Atlas and U.S. Census.

LA\TRI_Sites.shp Data courtesy of United States Environmental Protection Agency

Instructor resources

Updates for 2013 edition

This lab activity has been updated to clarify some of the instructions and to work with ArcGIS 10.1.

Environmental equity and income

Additional information

Note that one tract (670322) is skewing the analysis, as it represents over 27 percent of all air pollution in the county. It only has 4,630 people and an income of \$128,365. This could be a bonus question; ask the students how they might change their analysis to account for this outlier.

Other possible analyses might include

- Classify income into four categories based on median/standard deviation to look at finer-resolution income data as related to air pollution.
- While TRI sites are stationary sources of pollution, air pollution is not. Wind and other air movements can distribute air pollution to neighboring census tracts. Create a buffer around *TRI_Sites* to examine TRI sites' potential zones of impact and their census attributes.
- Symbolize *abovemedian* and *belowmedian* by graduated colors using *SUM_SUM_TO* as the *Value* field and normalize using *P004001* (Total Population) to analyze population density versus pounds of pollution.

Environmental equity and race/ethnicity

Additional information

Other possible analyses may include

- The instructor could request that a choropleth map be made for each race/ethnic group using the *Poll_His*, *Poll_Whit*, *Poll_Blac*, and *Poll_Asia* data as well.
- Change the data manipulation of race/ethnicity by aggregating the data to White Non-Hispanic versus all other groups. This would create a single choropleth map by race/ethnicity.

References and further reading

Understanding Los Angeles—Resources

Anderson, S. 1998. "A City Called Heaven: Black Enchantment and Disrepair in Los Angeles." In *The City: Los Angeles and Urban Theory at the End of the Twentieth Century*, eds. Scott, A. J., and E. Soja. Berkeley: University of California Press, 336–364.

Davis, M. 1990. *City of Quartz: Excavating the Future in Los Angeles*. New York: Verso, 267–322.

Fulton, W. 2001. *The Reluctant Metropolis*. Baltimore: The Johns Hopkins University Press, 285–311.

Gottlieb, R. 2007. *Reinventing Los Angeles: Nature and community in the global city*. Boston: MIT Press, 235–290.

Waldinger, R., and M. Bozorgmehr. 1996. "The Making of a multicultural metropolis." In *Ethnic Los Angeles*, eds. Waldinger, R., and M. Bozorgmehr. New York: Russell Sage Foundation, 3–37.

Feature films: *Chinatown*, *Bladerunner*.

Multimedia links: African-American history in Los Angeles

Early black history in Los Angeles: www.youtube.com/watch?v=Wh_X80eY8N8

1965 Watts riots newsreel: www.youtube.com/watch?v=BbE1AfALWbM

1992 L.A. civil unrest: www.youtube.com/watch?v=bIJdLIoF7tI

Be advised, YouTube comments are not always monitored.

Feature film: *Devil in a Blue Dress*.

The environmental justice movement

The following articles provide a brief introduction to the environmental justice movement in Los Angeles. These articles focus on air toxins, health risks, and environmental racism and can help students explain, interpret, and analyze data.

Morello-Frosch, R., M. Pastor, and J. Sadd. 2001. "Environmental Justice and Southern California's 'Riskscape': The distribution of air toxics exposures and health risks among diverse communities." *Urban Affairs Review* 36(4): 551–578.

Pulido, L. 2000. "Rethinking Environmental Racism: White privilege and urban development in Southern California." *Annals of the Association of American Geographers* 90(1): 12–40.

Pulido, L. 2004. "Environmental Racism and Urban Development." In *Up Against the Sprawl: Public policy and the making of Southern California*, eds. Wolch, J. R., M. Pastor, and P. Dreier. Minneapolis: University of Minnesota Press, 71–98.

Sadd, J. L., M. Pastor, T. Boer, and L. D. Snyder. 1999. "Every Breath You Take...: The demographics of toxic air releases in Southern California." *Economic Development Quarterly* 13(2): 107–123.

Multimedia links: Environmental justice movement

BBC News: "1984: Hundreds die in Bhopal chemical accident"

news.bbc.co.uk/onthisday/hi/dates/stories/december/3/newsid_2698000/2698709.stm

Al Jazeera English: "Bhopal gas leak survivors demand compensation"

www.youtube.com/user/AlJazeeraEnglish#play/search/1/10Vj-UXSD2o

Article: "Blast rocks Bayer plant; Injuries reported; Area roads closed; Residents told to shelter in place", in the *WV Gazette*

<http://www.wvgazette.com/News/Bayerexplosion/200904270376>

News article: "1 killed, 1 injured in W.Va. chemical plant blast, by Tom Breen, in *USA Today*

http://www.usatoday.com/money/economy/2008-08-29-2213076513_x.htm

Multimedia: "Breathless in LA: Sierra Club Chronicles" (first 4:30)

www.youtube.com/watch?v=K9U1D5gih8w

References for further reading

You can search the help text for these terms for more information.

Mapping Quantitative Data

http://resources.arcgis.com/en/help/main/10.1/index.html#/About_symbolizing_layers_to_represent_quantity/00s500000034000000/

Graduated Symbol Mapping

<http://resources.arcgis.com/en/help/main/10.1/index.html#/00s5000000240000000>

Spatial Join

<http://resources.arcgis.com/en/help/main/10.1/index.html#/00080000000q000000>

Add Field

<http://resources.arcgis.com/en/help/main/10.1/index.html#/001700000047000000>

Field Types

<http://resources.arcgis.com/en/help/main/10.1/index.html#/003n0000001m000000>

Field Calculator

<http://resources.arcgis.com/en/help/main/10.1/index.html#/00170000004m000000>

Relative Paths

<http://resources.arcgis.com/en/help/main/10.1/index.html#//01m10000000s000000>

Data information

The EPA Toxic Release Inventory data dates back to 2000; however, 2003 is the first year that air pollution data was provided.

Only the racial/ethnic groups that exceeded 1 percent of the total population for the county were included in this dataset. Thus, "Not Hispanic: American Indian and Alaska Native alone" and "Not Hispanic: Native Hawaiian and Other Pacific Islander alone" were removed.

Cities.shp

Who created the data: Esri

Date and time: 20040301

Publisher and place: Esri, Redlands, California, USA

Series name: Esri® Data & Maps

Series issue: 2004

Access constraints: Access granted to licensee only

Use constraints:

The data is provided by multiple third-party data vendors under license to Esri for inclusion in Esri Data & Maps for use with Esri software. Each data vendor has its own data licensing policies and may grant varying redistribution rights to end users. Please consult the redistribution rights below for this dataset provided in Esri Data & Maps. As used herein, *geodata* shall mean any digital dataset consisting of geographic data coordinates and associated attributes.

Note: While the symbol is turned on, you should just use information from this layer as a label to reference locations on the map. After a point has been labeled, make the symbol invisible by selecting No Color in the symbology.

County.shp

Who created the data: Tele Atlas North America, Inc.; Esri (dissolved from tracts.shp file)

Date and time: 20081001

Publisher and place: Esri, Redlands, California, USA

Series name: Esri Data & Maps

Series issue: 2008 Update—World, Europe, United States, and Mexico

Access constraints: Access granted to licensee only

Use constraints:

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Freeways.shp

Who created the data: Tele Atlas North America, Inc.; Esri

Date and time: 20080401

Publisher and place: Esri, Redlands, California, USA

Series name: Esri Data & Maps

Series issue: 2008 World, Europe, United States, Canada, and Mexico

Access constraints: Access granted to licensee only

Use constraints:

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Hydrology.shp

Who created the data: US Geological Survey in cooperation with US Environmental Protection Agency; Esri

Date and time: 20040301

Publisher and place: Esri, Redlands, California, USA

Series name: Esri Data & Maps

Series issue: 2004

Access constraints: Access granted to licensee only

Use constraints:

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Note: This may not be needed unless you want to reference a specific TRI site that is near a hydrologic feature.

Streets.shp

Who created the data: US Census 2000

Downloaded at: esri.com/data/download/census2000-tigerline/index.html

Access and use constraints: esri.com/data/download/census2000-tigerline/disclaimer.html and www.census.gov/geo/www/tiger/rd_2ktiger/tlrdmeta.txt

Note: You may just want to use Freeways as the transportation reference data; however, to highlight a specific TRI site, this data may be useful.

Tracts.shp

Who created the data: Tele Atlas North America, Inc.; Esri

Date and time: 20081001

Publisher and place: Esri, Redlands, California, USA

Series name: Esri Data & Maps

Series issue: 2008 Update—World, Europe, United States, and Mexico

Access constraints: Access granted to licensee only

Use constraints:

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Note: Attribute data comes from US Census 2000.

Median income data comes from Summary File 3: “P53 Median household Income in 1999 dollars.”
Census Category = P053001.

Race and ethnicity data come from Summary File 1: "P4. HISPANIC OR LATINO, AND NOT HISPANIC OR LATINO BY RACE [73] – Universe: Total."

P004001	P004002	P004005	P004006	P004008
Total population	Hispanic or Latino	Not Hispanic or Latino; White alone	Not Hispanic or Latino; Black or African-American alone	Not Hispanic or Latino; Asian alone

TRI_SITES.shp

2003 TRI data files: US Environmental Protection Agency (www.epa.gov/tri/)

Data compiled by: Chris Lukinbeal

Use constraints: "The information collected under The Emergency Planning and Community Right-to-Know Act of 1986 and the Pollution Prevention Act of 1990 can be used by the public to identify facilities and chemical disposal or other releases and other waste management patterns that warrant further study and analysis." (www.epa.gov/tri/triprogram/FactorsToConPDF.pdf)

Note: Air pollution (SUM_TOTAL_) is measured in pounds.

US EPA Notice to data users

" * TRI data reflect the quantities of TRI chemicals that are disposed of, released to the environment, or managed (for example, treated, or recycled). TRI data do not include information about public exposure to chemicals.

* Release estimates alone are not sufficient to determine exposure or to calculate potential risks to human health and the environment. TRI data, in conjunction with other information, such as the toxicity of the chemical, the release medium (e.g., air), and site-specific conditions, can be used as a starting point in evaluating exposures that may result from releases of toxic chemicals.

* TRI chemicals vary widely in toxicity and have different potential to remain in the environment, so that quantities released or managed by a facility are not always the best indication of whether a chemical may pose harm to humans or the environment. Many facilities limit the contamination and potential human exposure by managing the chemicals in certain ways, e.g., in well designed and managed landfills."
www.epa.gov/tri/tridata/