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For UPP 508 at University of Illinois at Chicago
December 4, 2009

Finding potential new bike parking facility locations

Introduction

I will show you how to use Geographic Information Systems (GIS) to methodically and systematically find potential new locations at which to install bike parking facilities (BPF). The project is heavily dependent on the availability of several datasets: land use polygons classified by type; locations of existing bike parking facilities[1]; and locations of bikeways (on-street facilities are preferable to all other types). With these datasets, we can use GIS to locate places of popular destinations types along bikeways that are not currently served by a BPF. These places represent "good locations" for a new BPF.

Problem

This GIS project addresses a specific problem: Imagine you're the project manager at an agency tasked with finding good locations for the 1,000 bike racks your agency just purchased. Your city has an extensive bikeway network and your goal is to optimize the facilities. Bikeways tend to attract bicyclists to the roadways on which they're installed over roadways lacking facilities[2]. You also need to install them where bicyclists are likely to use them; particularly at the most popular types of destinations for bicycle trips. It's possible to determine these types without conducting a survey: destinations popular for bicycle trips are often the same destinations for trips made by automobile and other transportation modes. For this project, I have selected three categories, based on the data available: Shopping centers, mixed use, and education facilities. If the land use data had a classification for fast food, restaurants, and grocery stores, I would have included these as a fourth category for the analysis.

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[1] A Bicycle Parking Facility (BPF) is the presence of at least one bike rack at a discrete location.
[2] The accuracy of this statement is heavily dependent on the route options a bicyclist has for a particular trip. Many bicyclists take into consideration the route deviation required by an "out of the way" bikeway.

Desired Output

The project will be designed to output a table of street addresses. With this information, a staff member can perform an on-site survey of the location and determine the location's physical suitability for installing a new BPF.

Method

The project will involve several steps in a suitable GIS application[3]. It's helpful to create a conceptual workflow prior to beginning work in the software (see "Abbreviated Workflow" box). I don't have the skills to create a multi-threaded, visual workflow; a list works better for me. I constantly referred to this while working on the project to ensure I was moving on the right track.

Abbreviated Workflow

- Gather data
- Clip land uses in Chicago
- Select desired land use types
- Add a buffer on bikeways
- Clip land use polygons
- Select land use near existing bike parking facilities
- Invert selection

Spending time to carefully craft a framework for the project will reduce the amount of tangents and misdirections you might experience. I reviewed this workflow after the project and found it to reflect 90% of the tasks I performed. Absent from the workflow are the steps involving the reverse geocoding process; I missed this task because I didn't know until part way through the project that the land use dataset I used lacked street addresses.

Step 1 - Gather Data

See the attached **GIS Project Materials Index** for a complete list and description of the data I used. All of the data save for BPF locations were already projected with identical Geographic and Projected coordinate systems. Because I knew the BPF locations were geocoded using the World Geodetic System of 1984, I could run the Project tool in ArcCatalog using one of the built in transformation libraries.

Step 2 - Land Uses

The land use data contains over 97,000 records. The first task would be to eliminate, by clipping, all land use polygons outside your area of analysis. For this project I clipped the data to the city

[3] I used ESRI's ArcGIS Deskstop suite, specifically ArcMap version 9.3.

limits of Chicago. Using the land use dataset's data dictionary I used the "Select By Attributes" function to choose the land use types that I determined would be the most popular destinations for bike trips:

- Retail (smaller shopping centers, excluding enclosed malls). Code 1212.
- Mixed Use (typically retail on ground floor, office or residence above). Codes 1231, 1232.
- Education (schools of all levels). Code 1320.

I would have liked that the land use data include food and restaurant categories, two other popular trip destinations.

Step 3 - Bikeway Buffer (A)

As I mentioned in the problem statement, the project needs to optimize the bikeway network of on-street and off-street facilities. The City of Chicago divides the bikeway network into seven classes: two represent proposed facilities and are not released to the public. Of the remaining five classes, I excluded recommended routes from the analysis[4]. I applied a buffer to all of the included bikeway classes in order to select the desired land use types that are near bikeways.
In the first try, I specified a buffer only 10 feet wide. Zooming in, I could see that the buffer failed to overlap the desired land uses polygons. Because they don't overlap, I wouldn't be able to use a tool that selects all of the desired land uses adjacent to a bikeway. This probably happened because different organizations, using different methodologies, created the land use and bikeway datasets.

Step 3 - Bikeway Buffer (B)

On the second attempt, I specified a buffer of 40 feet. Inspecting the map, I determined that this buffer captured all of the desired land uses. Using the Clip tool, I eliminated the parts of the polygons outside of the buffer because those parts are too distant from the street (bikeway) and BPFs can only be installed on sidewalks. The remaining land use polygons now represent all of the desired land uses adjacent to a bikeway.

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[4] See the "Notes from December 3, 2009" section in the Project Log for a discussion on why I excluded recommended routes. See the GIS Project Materials Index for a detailed description of the bikeway classes I included.

Step 4 - Existing Bike Parking Facilities

Now I want to find all of the desired land uses that are not in a convenient distance to an existing BPF. I determined this distance to be 50 feet[5]. Use the Select By Location tool to select all land uses within 50 feet of a BPF. In the Attribute Table, invert (or switch) the selection so that now all land uses *not* within 50 feet of a BPF are selected. These land use polygons far away from existing BPF are the places I should survey to see if I can install a new bike rack. These are the locations I want in the output table.

With these locations, calculate the coordinates of the centroid in the Attribute Table using the Calculate Geometry function so there's some semblance of a geographic location. I call these data "potentials," as in potential new locations for bike parking facilities.

Desired Outcome

The table of potentials looks like this: A feature ID, their respective land use types, and their geographic coordinates. Geographic coordinates are not helpful to the staff member who had to perform the on-site survey. Street addresses are more useful. I could use a GPS device, but I don't have that equipment and addresses are easier to comprehend and locate. The solution is to use reverse geocoding. See the table "Before RG" in the Output Table file.

Finding Addresses

A website called BatchGeocode.com will perform reverse geocoding: it accepts geographic coordinates and returns to the user approximated street addresses. It hooks into a system offered by Google's Maps division. The process will turn the table of coordinates into a table of street addresses. This table is described in the **GIS Project Materials Index**. See the table "After RG" in the Output Table file.

Limitations

The GIS project as I just described isn't without limitations.

- Because the provided land use data lacks street addresses, I had to reverse geocode. This introduces another level of data inaccuracy and returns only approximations.

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[5] I don't have research that supports using this distance. In the Bicycle Parking Program at the City of Chicago, it is our policy to avoid installing bike parking facilities further than this from the destination. Anecdotally, we've often witnessed bicyclists lock their bicycles to inferior objects in what we see as a demonstration of the desire for convenience.

- The online reverse geocoder has a limit of how many requests can be made by all users in a single day.
- The reverse geocoding process, like forward geocoding, gives only an approximation based on the data available. See three examples of these approximations in the Output Table file (attached).
- The centroid calculation technique I used to determine the land use polygons' addresses (by reverse geocoding) only tells me about the center of the polygon and may even exist outside the polygon depending on its shape. This can be overcome by using the Feature to Point tool (and specifying the point to be inside the polygon) instead of using Calculate Geometry. It will also be overcome with a staff member's on-site survey who will find the best location at the site.

Conclusion

This project shows how geographic information systems can be used to develop a process for selecting potential good locations for new bike parking facilities. This process should be considered another way a bike parking program can use to find locations for bike parking. It can be used in concert with existing and other methods to find locations for bike parking. Additionally, I have mentioned several ways how the process I developed for the project can be expanded and enhanced. This process is especially helpful because it outputs a table that shows the locations that meet my program's criteria for installing BPFs: good locations near bikeways and away from existing BPFs.

It's time to survey!

Credits: I would like to thank Nina and Diego for imagining the concept and helping me design the workflow.

Appendix A - List of tools and functions used

Tools (T) and functions (F) in ArcGIS ArcMap.

- Project T
- Select By Attributes F
- Buffer T
- Clip T
- Select By Location F
- Switch Selection F
- Calculate Geometry F
- Export as DBF F

GIS Project Materials Index

This document lists and describes the materials in the project entitled "Finding potential new bike parking locations." The index is divided into the Maps, Tables, and Data Sources sections.

Maps

Maps are available visually in ArcMap-native MXD, as well as PDF and PNG formats. The maps' filenames are prefixed with "map01."

Map F is the most descriptive map and the only map included in the printed report. You should inspect this map first. The remaining maps show the procession of the tasks performed to obtain the final map and output table.

A

This map is not included. This map document includes all of the data necessary to produced the data in the succeeding maps as well as the output tables. It is only available as MXD.

B

This map shows the City of Chicago and all land use polygons of the four desired types:

- 1212 – Retail Centers
- 1231 – Urban Mix with dedicated parking
- 1232 – Urban Mix without dedicated parking
- 1320 – Education Facilities

Each type is symbolized.

C

This map shows the City of Chicago, major roads, and selected bikeway classes:

- 1 – On-street bike lane – Indicated on the road pavement with a left and right stripe, containing a bicycle symbol and arrow indicating the direction of traffic.
- 2 – Marked shared lane – Indicated on the road pavement with a right stripe, with a bicycle symbol and two chevron symbols several feet to the left.
- 5 – Off-street trail. The Lakefront Trail falls under this category. These facilities are also known as multi-use paths or trails.
- 7 – Access path (these are short off-street routes that lead bicyclists to off-street trails are most often found leading to the Lakefront Trail via under or overpasses).

Each type is symbolized. Class 4 is available in the shapefile data but was excluded for this analysis. Skipped values, 3 and 6, indicate proposed routes and are protected information.

Only selected Class 1 and 5 bikeways are labeled. Roads are not labeled.

D

This map shows the clipped desired land use types in the City of Chicago. This map essentially shows where maps B and C overlap.
This is the map that generated the resulting table of the desired land use types adjacent to Bikeways (classes 1, 2, 5, and 7).

E

This map is similar to map D with the addition of Bikeways. Only selected Class 1 and 5 bikeways are labeled.

F (final map)

This map is similar to map E with the addition of major roads. Only selected Class 1 and 5 bikeways are labeled. Roads are not labeled.

Tables

The three tables described below are found in the file, "Output Table."

"Potential Locations"

Also called "Complete address list after reverse geocoding function."
This worksheet shows the complete table of street addresses representing desired land use types near bikeways in the City of Chicago. The most reliable piece of information is the geographic coordinates because the street addresses are estimates.[6] This data is represented by Maps D, E, and F. The printed report only includes the first of 18 pages.

Before RG"

Also called "Sample address list before reverse geocoding function."
This worksheet has a sample list with locations identical to those in the "After Reverse Geocoding" worksheet but without the information obtained from the reverse geocoding function.

"After RG"

Also called "Sample address list after reverse geocoding function."

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[6] The reverse geocoding function is run through the BatchGeocode.com website using the Google Maps API.

This worksheet has a sample list of street addresses obtained through the reverse geocoding function. The function has multiple output limitations. Three are identified and noted in the Remarks column.

Data Sources

I used data from only two sources.

City of Chicago

Data procured from the City of Chicago website, <http://www.cityofchicago.org>. Look under Departments, find the Department of Innovation and Technology. From there, select GIS Team and then look under the Data section.

- Bikeways network (shapefile)
- City boundary (shapefile) - This dataset was used to clip the CMAP Land Use data.
- Roads (shapefile) - This dataset was used only for map display purposes and comes from the larger Transportation dataset.
- Existing bike parking facilities (Excel) - I had access to the complete, unfiltered database, but now the data is publicly available in a machine-readable format at <http://www.chicagobikes.org/bikeparking>.

The first three shapefiles are all conveniently projected with NAD1983 Illinois StatePlane Feet East. The bike parking facilities information contained geographic coordinates using the WGS1984 geographic coordinate system and was projected to NAD1983 Illinois StatePlane Feet East using ArcGIS's built in transformation between the two coordinate systems.

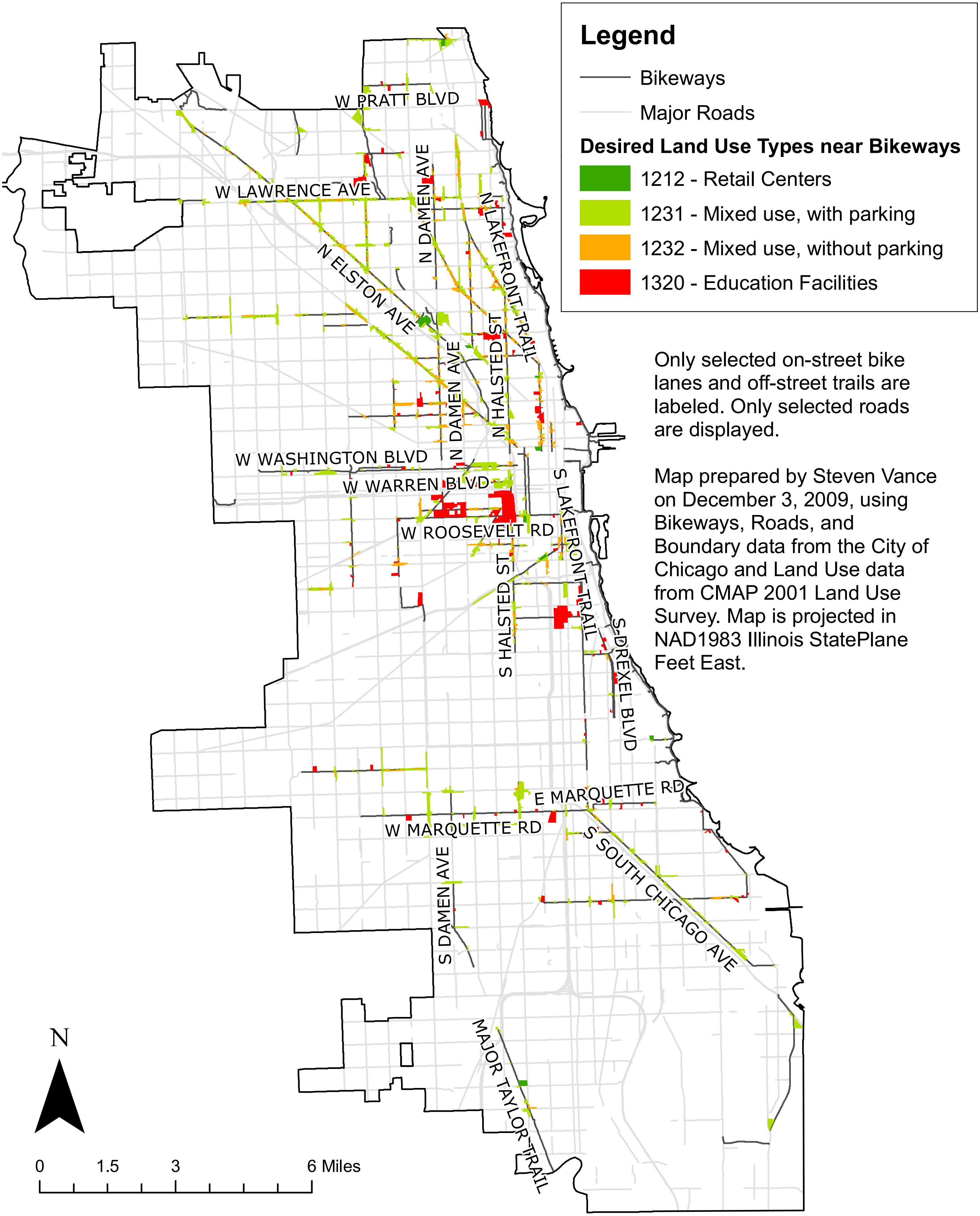
Chicago Metropolitan Agency for Planning

Land use data came from Chicago Metropolitan Agency for Planning's 2001 land use inventory, available on the Blackboard for the class, UPP 508. The shapefile is conveniently projected with NAD1983 Illinois StatePlane Feet East.

These pages follow:

- Map F
- Output Tables
    - Potential Locations - "Complete address list after reverse geocoding function" - Only the first of 18 pages is included.
    - Before Reverse Geocoding - "Sample address list before reverse geocoding function"
    - After Reverse Geocoding - "Sample address list before reverse geocoding function"
- Project Log

Desired Land Use Types near Bikeways in Chicago



Complete address list after reverse geocoding

Prepared by Steven Vance on December 3, 2009

Land Use	Address	City	State	ZIP Code	Longitude	Latitude
1232	5233 W Lawrence Ave	Chicago	IL	60630	-87.75922816820	41.96782787134
1231	5007 W Lawrence Ave	Chicago	IL	60630	-87.75309118510	41.96789694833
1231	5689 N Elston Ave	Chicago	IL	60646	-87.76762866439	41.98473905253
1231	4711 S Drexel Blvd	Chicago	IL	60615	-87.60379367100	41.80937828835
1320	2834 W Pratt Blvd	Chicago	IL	60645	-87.70095951064	42.00487726520
1320	2701-2727 W Pratt Blvd	Chicago	IL	60645	-87.69800234002	42.00482934141
1231	1801-1831 Howard St	Chicago	IL	60202	-87.67653465486	42.01935253109
1212	1721-1759 Howard St	Chicago	IL	60202	-87.67460806948	42.01934145465
1231	1833-1899 Howard St	Chicago	IL	60202	-87.67722155659	42.01936077871
1231	2752 W Pratt Blvd	Chicago	IL	60645	-87.69941258832	42.00491056084
1231	2414 W Pratt Blvd	Chicago	IL	60645	-87.69055540733	42.00508017866
1231	2332 W Pratt Blvd	Chicago	IL	60645	-87.68972792709	42.00509425185
1231	2401-2425 W Pratt Blvd	Chicago	IL	60645	-87.69035429086	42.00497400960
1231	2775-2799 N Southport Ave	Chicago	IL	60614	-87.66346356029	41.93225202383
1231	2141-2143 Howard St	Chicago	IL	60202	-87.68468106238	42.01943220572
1231	1761-1799 Howard St	Chicago	IL	60202	-87.67587168404	42.01934449031
1320	5000-5098 N Spaulding Ave	Chicago	IL	60625	-87.71111137596	41.97361967819
1320	5122-5198 N Kedzie Ave	Chicago	IL	60625	-87.70875941558	41.97567937123
1231	730-798 W Armitage Ave	Chicago	IL	60614	-87.64832748372	41.91829311284
1231	1201 W Cortland St	Chicago	IL	60614	-87.65864400726	41.91708763906
1231	2135 S Archer Ave	Chicago	IL	60616	-87.63296146099	41.85365611315
1231	3219-3221 N Clark St	Chicago	IL	60657	-87.65106256397	41.94050692061
1231	953 Howard St	Evanston	IL	60202	-87.68469372224	42.01948268799
1320	13-39 E 33rd Blvd	Chicago	IL	60616	-87.62585517785	41.83466807441
1231	7900-7914 S Damen Ave	Chicago	IL	60620	-87.67322394225	41.75014116776
1231	3034 N Clark St	Chicago	IL	60657	-87.64901086915	41.93751883422
1231	6447-6499 S Dr Martin Luther King Jr Dr	Chicago	IL	60637	-87.61547810085	41.77708657146
1231	773 E Oakwood Blvd	Chicago	IL	60653	-87.60727353268	41.82270353329
1231	118 E 18th St	Chicago	IL	60616	-87.62309167042	41.85791569554
1231	2031-2099 Howard St	Chicago	IL	60645	-87.68215354648	42.01939907208
1231	3145 W Pratt Blvd	Chicago	IL	60645	-87.70775714302	42.00462242839

Only the first of 18 pages is included.

Sample address list before reverse geocoding function

ID	Land Use	Longitude	Latitude
0	1232	-87.75922816820	41.96782787134
1	1231	-87.75309118510	41.96789694833
2	1231	-87.76762866439	41.98473905253
3	1231	-87.60379367100	41.80937828835
4	1320	-87.70095951064	42.00487726520
5	1320	-87.69800234002	42.00482934141
6	1231	-87.67653465486	42.01935253109
7	1212	-87.67460806948	42.01934145465
8	1231	-87.67722155659	42.01936077871
9	1231	-87.69941258832	42.00491056084
10	1231	-87.69055540733	42.00508017866
11	1231	-87.68972792709	42.00509425185
12	1231	-87.69035429086	42.00497400960
13	1231	-87.66346356029	41.93225202383
14	1231	-87.68468106238	42.01943220572
15	1231	-87.67587168404	42.01934449031
16	1320	-87.71111137596	41.97361967819
17	1320	-87.70875941558	41.97567937123
18	1231	-87.64832748372	41.91829311284
19	1231	-87.65864400726	41.91708763906
20	1231	-87.63296146099	41.85365611315
21	1231	-87.65106256397	41.94050692061
22	1231	-87.68469372224	42.01948268799
23	1320	-87.62585517785	41.83466807441
24	1231	-87.67322394225	41.75014116776
25	1231	-87.64901086915	41.93751883422
26	1231	-87.61547810085	41.77708657146
27	1232	-87.64224653212	41.67921611058

Prepared by Steven Vance on December 3, 2009.

Sample address list after reverse geocoding function

Land Use	Address	City	State	ZIP Code	Longitude	Latitude	Remarks
1232	5233 W Lawrence Ave	Chicago	IL	60630	-87.75922816820	41.96782787134	
1231	5007 W Lawrence Ave	Chicago	IL	60630	-87.75309118510	41.96789694833	
1231	5689 N Elston Ave	Chicago	IL	60646	-87.76762866439	41.98473905253	
1231	4711 S Drexel Blvd	Chicago	IL	60615	-87.60379367100	41.80937828835	
1320	2834 W Pratt Blvd	Chicago	IL	60645	-87.70095951064	42.00487726520	
1320	2701-2727 W Pratt Blvd	Chicago	IL	60645	-87.69800234002	42.00482934141	Reverse geocoding function returned a range of street addresses. This may mean that no parcel at this coordinate was found and the function selected the street segment instead.
1231	1801-1831 Howard St	Chicago	IL	60202	-87.67653465486	42.01935253109	
1212	1721-1759 Howard St	Chicago	IL	60202	-87.67460806948	42.01934145465	
1231	1833-1899 Howard St	Chicago	IL	60202	-87.67722155659	42.01936077871	
1231	2752 W Pratt Blvd	Chicago	IL	60645	-87.69941258832	42.00491056084	
1231	2414 W Pratt Blvd	Chicago	IL	60645	-87.69055540733	42.00508017866	
1231	2332 W Pratt Blvd	Chicago	IL	60645	-87.68972792709	42.00509425185	
1231	2401-2425 W Pratt Blvd	Chicago	IL	60645	-87.69035429086	42.00497400960	
1231	2775-2799 N Southport Ave	Chicago	IL	60614	-87.66346356029	41.93225202383	
1231	2141-2143 Howard St	Chicago	IL	60202	-87.68468106238	42.01943220572	
1231	1761-1799 Howard St	Chicago	IL	60202	-87.67587168404	42.01934449031	
1320	5000-5098 N Spaulding Ave	Chicago	IL	60625	-87.71111137596	41.97361967819	
1320	5122-5198 N Kedzie Ave	Chicago	IL	60625	-87.70875941558	41.97567937123	
1231	730-798 W Armitage Ave	Chicago	IL	60614	-87.64832748372	41.91829311284	
1231	1201 W Cortland St	Chicago	IL	60614	-87.65864400726	41.91708763906	
1231	2135 S Archer Ave	Chicago	IL	60616	-87.63296146099	41.85365611315	
1231	3219-3221 N Clark St	Chicago	IL	60657	-87.65106256397	41.94050692061	
1231	953 Howard St	Evanston	IL	60202	-87.68469372224	42.01948268799	This address is outside of Chicago and is a result of the reverse geocoding function. The actual land use polygon is within Chicago.
1320	13-39 E 33rd Blvd	Chicago	IL	60616	-87.62585517785	41.83466807441	
1231	7900-7914 S Damen Ave	Chicago	IL	60620	-87.67322394225	41.75014116776	
1231	3034 N Clark St	Chicago	IL	60657	-87.64901086915	41.93751883422	
1231	6447-6499 S Dr Martin Luther King Jr Dr	Chicago	IL	60637	-87.61547810085	41.77708657146	
1232	Major Taylor Trail	Chicago	IL	60643	-87.64224653212	41.67921611058	A street address was not found by the reverse geocoding function.

Prepared by Steven Vance on December 3, 2009.

Procedures for Final Project (Project Log)
November 12, 2009
Steven Vance

Opened new, blank map at SEL2058 on ArcGIS 9.3, build 1770.

Problem: Find good locations (popular destinations) on the bikeway away from existing bike parking facilities.
Two final products:

Projected Workflow

1. A GIS session is created with the following data: the Chicago bikeway network, the locations of existing bike parking facilities and the number of bike racks and spaces at each, and lastly a land use survey whose data is formatted using polygons.
2. The relevant land use types are identified and selected (using a Select By Attributes function) so that all other land use types are no longer featured in the GIS session. These relevant land use types will come from commercial and retail categories, or whatever categories are identified as being the largest attractor of non-recreational trips on bike
3. A buffer of 10 feet is added to the bike routes polylines. This is so that we can find all of the attracting land use types (commercial, retail) and select them. The land use data is then clipped using the bike route buffer to create a dataset that lists all preferential land uses along bike routes.
4. Using the Select By Location function, the land use polygons that are within 50 feet of a bike parking facility are selected. Export this selection as a layer called "landuse_with_bikeparking." Invert the selection by using the Switch Selection. Now, only land use polygons that are not within 50 feet of a bike parking facility are selected. Export this selection as a new layer called "landuse_without_bikeparking."

Data:

- bikeways051409.shp. Data comes from CDOT Bike Program. This data has been cleaned by CDOT for public consumption. Data current as of 05-14-2009.
    - Rows: 763
    - Cols: 16
    - The TYPE field has 5 unique values. These are bikeway classes. The classes are:
        - 1 on street bike lane
        - 2 on street shared lane
        - 4 recommended bike route
        - 5 off street trail
        - 7 access path
    - The skipped or missing values indicate proposed routes and are protected information.
- bikeracks_b.xls
    - Rows: 5221
    - Cols: 10

-
    - Has ID field that represents the RackID, which represents a bike parking facility installation with one or more bike racks.
- bikeracks_b.dbf
    - Rows: 5221
    - Cols: 11
- bikeracks.shp or .xls. Data comes from CDOT Bike Program. I still need to get this data from the
- landuse_chicago_mycodes.shp
    - Rows: 5076
    - Col: 7
    - This shapefile represents all land use polygons in Chicago that matched the land use codes I wanted: 1212, 1231, 1232, and 1320. See below for their names. See LU01_scheme.doc for their definitions.
- landuse_chicago.shp
    - Rows: 16809
    - Cols: 7, was 9
    - Because this shapefile is generated via clip from landuse.shp, the Shape_Leng and Shape_Area fields are most likely very inaccurate. Remove these fields. Can add later and redo geometry.
- landuse.shp
    - Rows: 97766
    - Cols: 9
    - Has Shape_Leng and Shape_Area fields. Must recalculate these.

  Version 2.1 of the 2001 Land Use Inventory in ArcGIS shapefile format. Includes the following DBF tables to serve as lookup tables:
  LanduseDomainList.dbf: Lookup table for LANDUSE field
  Landuse2DomainList.dbf: Lookup table for LANDUSE2 field
  OpenSpaceDomainList.dbf: Lookup table for OS_OWNCODE field
  See other files in the /landuse/ folder, including readme.doc, LU01_scheme.doc.

Tasks

- 11/13/2009 7:11 PM
- In MySQL administration, gather data for bikeracks.xls.
    - Use query: SELECT id, `lat`, `long`, type_A3, type_A5, type_B, type_plaza, type_plazaMini, type_plazaHalf, type_wall FROM `rack_routeplan` WHERE date_installed > 0 OR historical = 1
    - Then click Export at the bottom of the page. Select Microsoft Excel 2000, check "Put field names in first row."
    - Save file as bikeracks_a.xls
    - Open file. Convert all "numbers stored as text" to numbers.
    - Save file as bikeracks_b.xls, choosing Microsoft Excel 2003 format (for some reason Excel thought this was a Web page/HTML document).
    - Close Excel.
- Open ArcMap with a new, blank map.
- Add bikeracks_b.xls to Table of Contents (TOC)
    - Open this table and verify it has the correct number of rows.
    - Export as DBF file. Name it bikeracks_b.dbf

- Right-click the bikeracks_b in TOC and click "Display XY Data." The function will automatically select the correct fields, but just in case, for me it selected long as X, lat as Y.
  - Select a predefined coordinate system: GCS WGS 1984. (This would be the same as Define Projection tool.)
  - bikeracks_b Events layer was created
  - Now, we need to project it onto our source data, which will be StatePlane Illinois FIPS East (Feet) NAD 1983.
- Open ArcToolbox and select the Project tool.
  - Input: bikeracks_b Events
  - Output: bikeracks_c
  - Output Coordinate System: NAD_1983_StatePlane_Illinois_East_FIPS_1201_Feet
  - Conversion Method: NAD_1983_to_WGS_1984_1
  - Click okay.
  - WARNING 000632: Datum conflict between map and output.
- 11/13/2009 7:31 PM
- Since the Data Frame adopted the GCS of the bikeracks_b.dfb file, then the view will be inaccurate.
  - Close ArcMap – don't save.
  - Open ArcMap with a new, blank map.
  - Add Data: bikeracks_c.shp, cityboundary.shp, transportation.shp, landuse.shp
  - Now the view is accurate!
- Save map as map01a.mxd
- NOTE: It appears that FID 3236 (id 4566) is showing outside the city limits. I'm going to ignore this for now. It probably has an inaccurate XY coordinate.
- 11/13/2009 7:47 PM
- Exported map as is. Saved as map01a_01.png
- I have more land use data than I need – it seems to show land use data for six counties. I'm going to clip off the areas outside of Chicago.
  - Input: landuse
  - Clip Feature: cityboundary
  - Output: landuse_chicago
  - Click okay.
- It seems that I have all the data I need on this map. Now I need to identify the appropriate land use codes. I have the data dictionary for the land use codes which came with the landuse shapefile. I want to find codes that represent commercial, retail, and schools. Open file LU01_scheme.doc.
- I want the following codes:
  - 1212 – Retail Centers. I interpret this as strip mall, of which Chicago has a lot of. A Jewel or Dominick's grocery store is over 30,000 square feet and along with a Staples or Kmart, the 100,000 square feet threshold to be included in this category is easily reached. Unfortunately, though, these strip malls are very bike unfriendly because they are usually far back from the street so a bicyclist must ride through a parking lot that endangers bicyclists. Right now, the City of Chicago cannot install on private property and since the distance

between the street/sidewalk (where the City owns the right of way property) is too great, we abstain from installing bike racks here.
  - 1231 – Urban Mix with dedicated parking
  - 1232 – Urban Mix without dedicated parking
  - 1320 – Education Facilities
- Select these records using Select By Attributes. Use this query: "LANDUSE" = '1212' OR "LANDUSE" = '1231' OR "LANDUSE" = '1232' OR "LANDUSE" = '1320'
- Export this selection as a new shapefile called landuse_chicago_mycodes.shp (mycodes) and add this data to the map.
- Turn off all layers except for mycodes , bikeways, and cityboundary to see where these land use polygons lie. I noticed they follow the street grid. I expected this. They don't follow just any street, though, they follow the arterials (1 mile) and secondary arterials (half mile).
- There are 5 classes of bikeways (see listing above in data dictionary).
  - For the first buffer, I'm going to exclude recommended routes and only include on-street or off-street facilities. In Properties>Definition Query, insert "TYPE" <> '4'
  - For second buffer, I should select different classes. UPDATE: I never created a second buffer that used a different bikeway class, but I did create two buffers (one 10 feet wide, but replaced with one 40 feet wide).
- 11/13/2009 8:22 PM
- Create first buffer.
  - Input: bikeways
  - Output: bikeways_buffer_exclude4.shp
  - Distance: Linear Unit: 10 feet.
  - Site Type: Full
  - End Type: Round (this is default option. I'm choosing this because ArcView, ArcEditor don't have Flat capability)
  - Dissolve Type: All (I need all of the buffers in a single shape so it's easier for me to select the bike rack features within the buffer).
  - No Dissolve Fields. If I knew more about what I was doing, it seems like this would be a place that would save me time over creating multiple buffers because this would create multiple buffers (1 per bikeway class) in the same execution of this tool.
  - Click okay.
  - Executing: Buffer bikeways E:\UPP508_GIS\FinalProject_2\data\bikeways_buffer_exclude4.shp "10 Feet" FULL ROUND ALL #
Start Time: Fri Nov 13 20:24:25 2009
Executed (Buffer) successfully.
End Time: Fri Nov 13 20:24:37 2009 (Elapsed Time: 12.00 seconds)
  - Took screenshot: map01a_02.png
- Buffer is created. I zoom in around UIC at Halsted and Taylor and I find that the 10 foot buffer is not enough. I will delete this shapefile and try again, but with 40 feet.
  - Same parameters as above, but now 40 feet.

- Executing: Buffer bikeways E:\UPP508_GIS\FinalProject_2\data**bikeways_buffer_exclude4_b.shp** "40 Feet" FULL ROUND ALL #
  Start Time: Fri Nov 13 20:26:59 2009
  Executed (Buffer) successfully.
  End Time: Fri Nov 13 20:27:07 2009 (Elapsed Time: 8.00 seconds)
- The 40 foot buffer is great. It now overlaps the land use polygons at UIC at Halsted and Taylor. NOTICE: The new name of the buffer shapefile above in bold.
- Now I want to clip all of the land use polygons that are inside the buffer. This means that all land use polygons outside the buffer will disappear (but still be in the original layer).
  - Input Features: landuse_chicago_mycodes
  - Clip Features: bikeways_buffer_exclude4_b
  - Output: landuse_inside_buffer_exclude4_b.shp
  - Click okay.
  - Executing: Clip landuse_chicago_mycodes bikeways_buffer_exclude4_b E:\UPP508_GIS\FinalProject_2\data\landuse_inside_buffer_exclude4_b.shp #
    Start Time: Fri Nov 13 20:33:20 2009
    Reading Features...
    Cracking Features...
    Assembling Features...
    Executed (Clip) successfully.
    End Time: Fri Nov 13 20:33:31 2009 (Elapsed Time: 11.00 seconds)
  - Took screenshot: map01a_03.png
- Now hide the layer, landuse_chicago_mycodes.
- In the new landuse layer, there are 1122 records. That means there are 1122 land use polygons that are of the four desired codes and within 40 feet of a bikeway (excluding recommended routes). Compare that number to the original 5076 records of the four desired codes.
- Display the bikeracks layer.
- Now, Select By Location (SBL), features from landuse_inside_buffer_exclude4_b that are within a distance of the features in the bikeracks_c layer. Check off "apply buffer" and input 50 feet.
  - Click Apply.
  - Open the attribute table for landuse_inside_buffer_exclude4_b
  - 484 records selected, within 50 feet of bike parking facility. This means that there are 638 land use polygons (of the desired codes) that are NOT within 50 feet of a bike parking facility, and could probably use one.
  - With SBL still open, change 50 to 100 and click Apply. Open the attribute table.
  - 604 records selected, within 100 feet of bike parking facility. This means that there are 518 land use polygons (of the desired codes) that are NOT within 50 feet of a bike parking facility, and could probably use one.
  - I'm going back to 50 feet because I want more locations to survey for potential installation of a bike parking facility (with one or more bike racks). This is in case I have to reject a significant portion of the locations.

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- After changing the buffer back to 50 feet, open the attribute table and click Options>Switch Selection. This new selection of 638 records are the locations to survey for potential installation of a bike parking facility.
- Export this selection as potential_638.shp
  - Delete fields: WAT_NAME, OS_OWNCODE
- Zoom to layer. Then symbolize these polygons with a wide outline so you can see them.
- Took screenshot: map01a_04.png
- Now that I know all the potential locations, how do I find them or get their addresses?
  - Reverse geocode: Turn an XY into an address?
- BatchGeocode.com/reverse
  - Add fields "lat" and "lon" to potential_638, Double, 18, 11.
  - Calculate Geometry: lon = X, lat = Y; do this in Decimal Degrees.
  - Export as potential_638_rg.dbf (rg = reverse geocode)
  - Open in Excel. Copy all records, then paste into BatchGeocode.com/reverse.
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- BatchGeocode.com/reverse continues…
  - Only run ~100 records at a time. For every batch, you must insert the Excel header row at the top.
  - Click Validate Source.
  - Ensure the webpage mapped your data to the right fields. BG automatically creates the new fields you need (address, city, state, ZIP) after you click Run Reverse Geocoder.
  - Click Run Reverse Geocoder. Let it run.
  - Highlight all the results and paste these into a new worksheet in the same Excel document.
  - There's a daily limit to the number of records the website can geocode. So do it early in the morning, when the limits resets!
- 11/13/2009 9:39 PM
- Took screenshot: map01a_05.png. Shows the potential locations to survey.

Notes from December 3, 2009

- The project manager should determine if the Bikeways type "recommended routes" should be included in the analysis. Recommended routes are not always signed on the roadway (some are part of the "signed route network;" all signed routes are recommended routes, but the reverse is not true; the signed route network includes green background signs that list a destination, distance and direction; the signed route network does not have traffic authority signs like "bike lane begins") and are most often discovered by bicyclists through a survey of the Chicago Bike Map. Recommended routes lack pavement markings and traffic authority signs (like "bike lane begins") indicating their presence.
- This iteration of the analysis excluded recommended routes.
- What I recommend: Bikeway class can be used as a tiered process or screening method. First, the analysis should only include on-street facilities, most likely to be

near the desired land use types. This includes only the types "bike lanes" and "marked shared lanes." Second, the analysis should include the on and off-street facilities of types "access trail" and "off-street trail" (planners may also know this as a multi-use path) – these two types are the least likely to be in the vicinity of desired land use types. Finally, the last analysis can include recommended routes.

- To make map01d:
    - The map isn't very convincing showing the small, narrow slivers of the land use polygons I want. So my plan is to intersect (really, Select by Location) the full sized polygons with the narrow ones so that the narrow ones regain their original size. All of the polygons that aren't near bikeways won't appear.
    - Select features from landuse_chicago_mycodes.shp that intersect features from landuse_inside_buffer_exclude4_b.shp
    - Then, right click landuse_chicago_mycodes.shp and choose Selection>Create New Layer from Selected Features.
    - Rename the newly created layer "Desired Land Use Types near Bikeways."
- Reverse geocoding limitations: Sometimes returns name of trail. See Major Taylor and Valley Line in the Excel document.