Reconnecting Rockford’s Riverfront

A Street Network Analysis of Historic Industrial Neighborhoods in Rockford, Illinois

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**EXECUTIVE SUMMARY**

“Rockford (population 150,115) was once a thriving manufacturing community with industrial and commercial facilities along the banks of the Rock River and the area's rail corridors. The city's economy has been declining for nearly three decades. There are an estimated 125 industrial brownfields, 200 former gas station sites, and 50 potentially contaminated small commercial sites within the city. These sites include several large industrial concentrations along the river and rail corridors. As of August 2009, the unemployment rate for the city was 16.9 percent. The concentration of brownfields and aging housing stock are impacting neighborhoods. Brownfield assessments are expected to serve as a catalyst for the target neighborhoods to move forward with redevelopment plans.”

—United States EPA Brownfields Assessment, 2010

The City of Rockford, Illinois has identified five census tracts that have the greatest concentration of brownfields within the city – 70 acres of brownfield (primarily former industrial sites) have been identified on 81 parcels within these five tracts. The EPA defines brownfields as “real property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant.”

The brownfield-cluttered tracts are among the poorest in the city; even before the recession (2005), unemployment was over 20%. One third of the families live below the poverty level, and median household income is below $20,000. Almost 50% of the population over 18 never finished high school. The City of Rockford, in an EPA grant application, is blunt about the effects of the brownfields in this area. "In many ways, Brownfields such as the South Main Street/Water Power District area form physical and psychological barriers between adjacent neighborhoods to the south and west and the Downtown ... this area is particularly foreboding to pedestrians" (Morrissey 7).

This analysis examines whether the tracts with the greatest concentration of brownfields – as identified by the City of Rockford – suffer from decreased street connectivity due to the presence of abandoned industrial buildings, and hence decreased access to areas of greater social and economic opportunity.
INTRODUCTION

Brownfields and Surrounding Communities

Although many brownfield cleanup projects take place on abandoned industrial properties, most of these former industrial sites are located within existing communities that often suffer from blight associated with the properties, including illegal dumping, contamination, community health issues, and lack of services and environmental enforcement activity. The brownfield redevelopment process is a “rare and robust opportunity for environmental and community economic development goals to converge” (DePass 602). Brownfield redevelopment is seen as a way to “rework the city’s built environment while remediating contaminants and transforming “socially and economically neglected neighborhoods” (581).

In a 2010 letter to the EPA, Rockford mayor Larry Morrissey wrote that it “is no coincidence that the Targeted Brownfields Area and, especially, the Near West and Southwest Targeted Subarea demonstrate such high levels of economic need. The combination of the concentration of Brownfields, lack of basic retail and other services, the aging housing stock and general lack of investment by the private sector have resulted in a precipitous decline in the viability of these neighborhoods. This trend will continue unless these Brownfields are assessed, cleaned and redeveloped” (Morrissey 8).

The “Southwest Targeted Subarea” detailed above consists of five census tracts in the Southwest section of Rockford, which are generally bordered by the Rock River to the East and downtown Rockford to the North. Rockford has depended on the Rock River for manufacturing since the 1860s, when a dam was constructed to harness the power of the river water. Furniture manufacturing soon followed, and was eventually replaced by manufacturing centers for machine tools and agricultural equipment. A large cluster of multi-story industrial buildings and accompanying freight and passenger railyards developed on the west side of the city along the river, just south of downtown – again, in and near the targeted area. The area’s dependence on manufacturing left it particularly vulnerable to economic downturns and shifts in national economic powers – in January 1983, Rockford’s unemployment reached 25.5%, signifying the beginning of the end of a once-dominant manufacturing economy (Wall Street Journal, 1/16/09).

The abandoned industrial buildings and railyards increase both the reality and perception of separation – there are only two well-traveled roads that connect large portions of the study area to the city’s downtown, and just one bridge connecting this area to the East.
Brownfields and Connectivity

Brownfields are commonly found close to traditional manufacturing-heavy transit systems such as freight rail and navigable rivers – and much further from the interstate highway systems that businesses have come to favor in recent years for transportation (Meyer 5). Transportation access isn’t just a problem for business; for many residential neighborhoods surrounding brownfields, street infrastructure and general transportation access also suffered as the location fell out of favor with industry. Poor infrastructure is often accompanied by contamination, crime and related problems (10).

A report on environmental hazards and urban redevelopment prepared for the U.S. Department of Urban Development (now the U.S. Office of Housing and Urban Development) states that, “population dynamics suggest that the residents of those areas are disproportionately poor and minority. Thus the brownfields problem and the linked issues of cleanup and redevelopment inequitably affect the least-advantaged groups among us, and those least able to exercise the “mobility” option” The repairs and initiatives that could help increase both the physical and social mobility of residents are limited because both the real and perceived dangers of contamination that limit new development (Urban Institute, Ch. 1).

Connectivity Analysis Methods

There is extensive literature on transportation network connectivity, ranging from truck route shipping efficiency to neighborhood pedestrian paths Recent interest in the built environment’s impact on public health and physical activity have produced a number of GIS analysis protocols, which include density, pedestrian infrastructure, land-use mix, street pattern and recreational facilities (TREC 99). “Access points” are a measure of the amount of connections an area has to its surroundings -- i.e., how many times a path or street leads to or from a designated area, such as a parcel or census block. They create "a measurement geography, generally a grid cell, and measure how porous its edges are" (133).

PROBLEM STATEMENT/RESEARCH QUESTION

My hypothesis is that the five census tracts identified by the City of Rockford have lower street connectivity than the city average due to the presence of known brownfields. I will attempt to verify or disprove this hypothesis by using descriptive maps to identify select demographic characteristics of these tracts (compared to the rest of the city) and analyzing street connectivity in these tracts (compared to the rest of the city).
METHODOLOGY

GIS Overview

This GIS analysis in this report will help do the following:

1) Locate Rockford within the State of Illinois
2) Locate the Census Tract Study Area within the City of Rockford
3) Compare Income Demographics (2000 Census, SF1) of the Study Area to the City of Rockford
4) Compare Racial and Ethnic Demographics (2000 Census, SF1) of the Study Area to the City of Rockford
5) Compare Street Connectivity of the Study Area to the City of Rockford
6) Compare connectivity levels to geography size
7) Identify locations of known brownfield cleanup sites within the City of Rockford.

Data Decisions

A critical point in this analysis hinged upon accepting the City of Rockford’s statement of brownfield density in the study area. The source of this statement was a public letter from the city’s major to the EPA, asking for funds to clean-up targeted brownfield locations and to complete the city’s first comprehensive brownfields assessment. Given the official nature of the letter – and the looming physical presence of historic, abandoned industrial buildings in the study area – this was not a difficult statement to accept. This decision was also influenced by the fact that there is not a complete, publicly available database of brownfield locations in the city – just current cleanup sites, as reported to the EPA.

To conduct the analysis, I needed to acquire the following data:

Rockford Location
- City Shapefile
- State of Illinois Shapefile

Descriptive Maps
- Census Data by Census Tract: Income
- Census Data by Census Tract: Race/Ethnicity
- Rail shapefiles
- Hydrology (Rock River) shapefiles
- Right of way (or block-level) shapefiles

Connectivity Indicators
- Census Tract Shapefiles and databases
Census Blocks Shapefiles and databases
- Streets files
- Brownfield cleanup site locations

Data Sources
- WINGIS (Winnebago County GIS Consortium)
- US Census
- US EPA
- University of Illinois Urbana-Champaign

Street Network Analysis: Number of Access Points and Access Point Counts

“Access points are a measure of the amount of connection an area has to its surroundings. Access point measures create a measurement geography, generally a grid cell, and measure how porous its edges are” (TREC 133). The analysis techniques used in this report are adapted from the University of Minnesota’s Transdisciplinary Research on Energetics + Cancer, which created a set of GIS protocols to measure “environmental variables associated with food, youth, and physical activity” (5).

The basic formula behind access points is as follows:

\[
\text{Number of Access Points} = \text{Number of times a road crosses the edge of the measurement geography.}
\]

Analysis Methods:
- Intersect study area street layer with census tract layer (or similar geography layer, such as census blocks)
- Create an “access point” layer from the intersection that identifies the location of access points
- Sum access point for each census tract (or similar study geography) and create a new “access field count” field in the attribute table
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POPULATION | 2000

Study Area | U.S. Census Tracts 25-29

City of Rockford

City Population
150,115

Study Area Population
14,678

Population (2000)
- 1453 - 2500
- 2501 - 3500
- 3501 - 5000
- 5001 - 7100

Rock River

Study Area
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MEDIAN FAMILY INCOME | 2000

City of Rockford MFI
$45,479

Study Area MFI
$25,434

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NAD 1983 Illinois West FIPS 1202 Feet
Data Sources: WINGIS, US Census, University of Illinois-Urbana Champaign
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HISPANIC POPULATION | 2000

City Population
White - 72.8%
Black - 17.4%
Hispanic (any race) - 10.2%

Study Area | U.S. Census Tracts 25-29

Hispanic (2000)
- 2% - 6%
- 7% - 13%
- 14% - 24%
- 25% - 47%

Study Area
Rock River

Data Sources: WINGIS, US Census, University of Illinois-Urbana Champaign
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WHITE POPULATION | 2000

Study Area | U.S. Census Tracts 25-29

City Population
White - 72.8%
Black - 17.4%
Hispanic (any race) - 10.2%

Data Sources: WINGIS, US Census, University of Illinois-Urbana Champaign

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NAD 1983 Illinois West FIPS 1202 Feet
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ACCESS POINTS BY CENSUS TRACT

Rockford, Illinois

Mean City Access Points
72 per census tract

Mean Study Area Access Points
74 per census tract

City of Rockford

Study Area | U.S. Census Tracts 25-29

Access Points
- 0 - 29
- 30 - 66
- 67 - 96
- 97 - 140

Study Area
Rock River

Data Sources: WINGIS, US Census, University of Illinois-Urbana Champaign

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NAD 1983 Illinois West FIPS 1202 Feet
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ACCESS POINTS BY CENSUS BLOCK

Study Area | U.S. Census Tracts 25-29
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STREET NETWORK | ACCESS POINTS BY CENSUS TRACT

Study Area | U.S. Census Tracts 25-29

City Mean Access Points
72 per census tract

Study Area Mean Access Points
74 per census tract

Data Sources: WINGIS, US Census, University of Illinois-Urbana Champaign

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STREET NETWORK | ACCESS POINTS BY CENSUS BLOCK

City Mean Access Points
9 per census block

Study Area Mean Access Points
9 per census block

Study Area | U.S. Census Tracts 25-29

Access Points
- 0 - 4
- 5 - 8
- 9 - 12
- 13 - 22

Rock River
Streets
Rail Tracks

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NAD 1983 Illinois West FIPS 1202 Feet
Data Sources: WINGIS, US Census, University of Illinois-Urbana Champaign
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BROWNFIELD CLEANUP SITES | ACCESS POINTS BY CENSUS TRACT

Study Area | U.S. Census Tracts 25-29

Brownfield cleanup locations, 2010. Location size not to scale. Does not include brownfield sites without cleanup plans.

City of Rockford

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NAD 1983 Illinois West FIPS 1202 Feet
Data Sources: WINGIS, US Census, EPA, University of Illinois-Urbana Champaign
ANALYSIS

My original hypothesis was that the five census tracts identified by the City of Rockford would have lower street connectivity than the city average due to the presence of known brownfields. I attempted to verify or disprove this hypothesis by using descriptive maps to identify select demographic characteristics of these tracts (compared to the rest of the city) and analyzing street connectivity in these tracts (compared to the rest of the city).

Descriptive Map Analysis

The study area fit the description of the previously mentioned HUD report that characterized neighborhoods surrounding brownfields as “areas that are disproportionately poor and minority.” The median family income of the study area census tracts in 2000 was $25,434 – a full $20,000 less than the median family income for the city as a whole. While this number is an average of the five tracts, it cannot be attributed to disproportionate impact – none of the tracts made it above the bottom quarter of median family income distribution in the city. Though not a part of the analysis, it is of interest to note that the area of the city with the highest concentration of high-income census tracts is near a highway interchange that connects Rockford to Chicago, which is approximately 80 miles to the southeast of the city.

In the 2000 Census, Rockford’s three largest racial and ethnic groups broke down as follows:

- White: 72.8%
- Black: 17.4%
- Hispanic (any race): 10.2%

Two of the four census tracts with the highest concentration of black residents in the city were in the study area – and the two other tracts directly bordered the study area. The map indicates a city with deep divisions between black and non-black population, with the Rock River serving as the physical and social separator.

The two census tracts with the greatest concentration of Hispanic residents were also within the study area. While there is a strong Hispanic presence throughout most of the study area, the division does not appear to be quite as stark as for black residents; there are tracts throughout most of the city with concentrations of Hispanic residents of at least 7-13% (the second quartile of division of concentrations).

In a city that is 72.8% white, it is striking to note that four of the five census tracts in the study area have white populations of only 17-30%.
Connectivity Map Analysis

Access points were symbolized for both census tracts and census blocks. The average number of access points for each census tract in the study area to an area outside the tract was 74; the average number of access points for each census tract in the city of Rockford was 72. Concurrently, the average number of access points for each census block in the study area to an area outside the census block was 9; the average number of access points for each census block in the city of Rockford was also 9. Census tracts (and blocks) along the Rock River’s west side (part of the study area) exhibited significantly lower connectivity than average. Based on the map of city-wide access points, this is not simply a function of the river inhibiting access; there are five census tracts along the river that have enough access points to outside areas to fall into the highest quartile of distribution.

The location of current brownfield cleanup sites is highly concentrated in the study area, with an almost equal amount directly across the river from the study area on the city’s East side.

When streets and rail locations were overlayed with census block access points, a clear pattern of low access points emerged around rail tracks.

I looked for a possible relationship between census block size (geography) and number of access points – while there appears to be an occasional relationship (larger geography size sometimes indicating more access points), I would need to do a more rigorous statistic analysis to state anything conclusive.

CONCLUSION AND RECOMMENDATION

While access point analysis may be a useful tool for measuring the number of times a geography “accesses” another place, it does not (nor could it) measure the quality of access. The historic grid of the streets in the study area may have helped to increase the number of access points in the analysis, despite the clear presence of low-access area surrounding the railways and river. Further study should include access point analysis as part of a greater suitability analysis that looks at the economic and social opportunity on the other side of the access point.
REFERENCES


Lawrence J. Morrissey, City of Rockford Mayor, to Deborah Orr, EPA Region V, Chicago, 15 October 2010, City of Rockford Website.

“The Effects of Environmental Hazards and Regulation on Urban Redevelopment.” Prepared by the Urban Institute, Northeast-Midwest Institute, University of Louisville and University of Northern Kentucky for the U.S. Department of Urban Development. August 1997.

APPENDIX

DATA SOURCES

WINGIS
Data Obtained: Parcels, Right of Way, Streets, Census Blocks, Census Tracts, Illinois Census Tracts, Illinois Census Tracts SF1 Database
Source Description: Cooperative intergovernmental framework for the purpose of coordinating, creating, staffing, funding and maintaining a comprehensive GIS in Winnebago County, IL.
Website: http://ims.wingis.org/
Contact: Sarah Brown, GIS Technician, SBrown@co.winnebago.il.us
Data Production:
  Right of Way: Not available in metadata
  Street Centerlines: Created for Winnebago County 911
  Census Blocks: not available in metadata
  Census Tracts: not available in metadata

US Census
Data Obtained: Winnebago County Places (Cities), Winnebago County Rail, Winnebago County Hydrology, Winnebago County Census Tracts SF3 Data
Website: www.census.gov
Data Production:
  TIGER/Line Shapefiles

United States EPA
Data Obtained: Brownfields Cleanup Sites database for Rockford, IL
Source Description: Brownfields Grant Fact Sheet Search
Website: http://cfpub.epa.gov/bf_factsheets/index.cfm

University of Illinois Urbana-Champaign/Illinois Natural Resources Geospatial Data Clearinghouse
Data Obtained: Illinois State Outline
Source Description: Compiled by the University of Illinois at Urbana-Champaign
Website: http://www.isgs.uiuc.edu/ndhihome/
Data Production: Not available in metadata
ANALYSIS

Projection
All shapefiles were projected at:
Projected Coordinate System: NAD 1983 State Plane Illinois West FIPS 1202 Feet
Geographic Coordinate System: GCS North American 1983

Rockford Within the State of Illinois
Data Used: Illinois Boundary (Illinois Natural Resources Geospatial Data Clearinghouse), Winnebago County Places (Census), Rockford Right of Way (WINGIS)
Actions:
1. Open ArcCatalog and check if those data are defined and projected correctly
2. Open ArcMap
3. Add the following data: Illinois Boundary (Illinois Natural Resources Geospatial Data Clearinghouse), Winnebago County Places (Census), Rockford Right of Way (WINGIS)
4. Clip Winnebago County Places to Rockford Right of Way to create a Rockford boundary map
5. Symbolize

Study Area (Census Tracts 25-29) Within the City of Rockford
Data Used: Rockford boundary map (created in Index Map), Illinois Census Tracts (WinGIS), Illinois Census Tracts Database, Winnebago County Hydrology (Census)
Actions:
1. Open ArcCatalog and check if those data are defined and projected correctly
2. Open ArcMap
3. Add the following data: Rockford boundary map (created in Index Map), Illinois Census Tracts (WinGIS), Winnebago County Hydrology
4. Clip Illinois Census Tracts to Rockford boundary map
5. Join Illinois Census Tracts Database to Illinois Census Tracts
6. Open Illinois Census Tracts attribute table, select Census Tracts 25, 26, 27, 28, 29
7. Create new layer from census tract selection, name Rkfd_CensusTracts_25-29
8. Delete Illinois census tracts layer
9. Clip Winnebago County Hydrology to Rockford Boundary Map to create a new Rockford Hydrology Layer
10. Delete Winnebago County Hydrology layer
Median Family Income Demographics in Rockford (2000 Census)

Data Used: Illinois Census Tracts (WINGIS), Winnebago County Census Tracts SF3 Data (Census), Rockford boundary map (created in Index Map)

Actions:
1. Open ArcCatalog and check if those data are defined and projected correctly
2. Open ArcMap
3. Add the following data: Rockford boundary map (created in Index Map), Illinois Census Tracts, Winnebago County Census Tracts SF3 Database
4. Clip Illinois Census Tracts to Rockford boundary map to create Rkfd_CensusTracts layer
5. Delete Illinois Census Tracts
6. Join Rkfd_CensusTracts to Illinois Census Tracts database
7. Symbolize all census tracts in the city according to income

Population

Data Used: Rkfd_CensusTracts, Illinois Census Tracts SF1 Database

Actions: Open ArcCatalog and check if those data are defined and projected correctly
1. Open ArcMap
2. Add the following data: Rkfd_CensusTracts, Illinois Census Tracts SF1 database
3. Join Rkfd_CensusTracts to Illinois Census Tracts database
4. Symbolize all census tracts in the city according to distribution of total population

Black Population

Data Used: Rkfd_CensusTracts, Illinois Census Tracts SF1 Database

Actions
1. Open ArcCatalog and check if those data are defined and projected correctly
2. Open ArcMap
3. Add the following data: Rkfd_CensusTracts, Illinois Census Tracts SF1 Database
4. Join Rkfd_CensusTracts to Illinois Census Tracts database
5. Symbolize all census tracts in the city according to distribution of Black population

Hispanic Population

Data Used: Rkfd_CensusTracts, Illinois Census Tracts SF1 Database

Actions:
1. Open ArcCatalog and check if those data are defined and projected correctly
2. Open ArcMap
3. Add the following data: Rkfd_CensusTracts, Illinois Census Tracts SF1 database
4. Join Rkfd_Census Tracts to Illinois Census Tracts database
5. Symbolize all census tracts in the city according to distribution of Hispanic origin population

**White Population**
Data Used: Illinois Census Tracts SF1 Database, Rkfd_CensusTracts
Actions:
1. Actions: Open ArcCatalog and check if those data are defined and projected correctly
2. Open ArcMap
3. Add the following data: Rkfd_CensusTracts (created in Income Demographics), Illinois Census Tracts database
4. Join Rkfd_Census Tracts to Illinois Census Tracts database
5. Symbolize all census tracts in the city according to distribution of White Non-Hispanic population

**Access Points by Census Tract**
*Basic Formula:* Number of Access Points = Number of times a road crosses the edge of the measurement geography.
Data Used: Rockford Streets (WinGIS), Rockford Hydrology (WinGIS), Rkfd_CensusTracts
Actions:
1. Open ArcCatalog and check if those data are defined and projected correctly
2. Open ArcMap
3. Add the following data: Rockford Streets (WinGIS), Rkfd_CensusTracts, Rockford Hydrology (WinGIS) (created in a previous step by clipping Winnebago County Hydrology to Rockford boundary)
4. Open ArcToolbox by clicking on the icon
5. Navigate to the Intersect tool (Analysis Tools -> Overlay) and open the tool by double-clicking on it.
6. Click on the down-arrow by the Input Features box and select Rkfd_Census_Tracts
7. Again, click on the down-arrow by the Input Features box and select the Streets_Census-Tracts
8. Name output layer AccessPoints_CensusTracts
9. Set the JoinAttributes option to ALL.
10. Accept the XY Tolerance default.
11. Set the Output Type to POINT.
12. Click OK.

Summarize Access Point Counts - Use the Spatial Join to calculate the number of access points for each study-site
15. Right-click on Rkfd_Census_Tracts and select Joins and Relates -> Join
16. Under “What do you want to join to this layer?”, choose Join data from another layer based on spatial location.
17. Under 1. Choose the layer to join to this layer, or load spatial data from disk:, click the downarrow and select the Access Point layer from the list.
18. Click the radio button for “Each polygon will be given a summary of the numeric attributes of the points that fall inside it, and a count field showing how many points fall inside it”.
19. Leave all the check boxes under How do you want the attributes to be summarized? unchecked.
20. Name output layer AccessPointSummary_CensusTracts
21. Click OK.
22. The output layer will contain one polygon for each census tract. One of the attributes of this layer will be the number of access points falling inside the study-site.
23. Symbolize according to number of access points in each census tract

Access Points by Census Blocks
Follow same process as “access point by census tracts”, substituting census blocks for census tracts.

Size of Census Blocks
Data Used: Rkfd_Census Blocks
1. Open ArcCatalog and check if those data are defined and projected correctly
2. Open ArcMap
3. Add the following data: Rkfd_Census Blocks
4. Symbolize according block size

Brownfield Cleanup Sites (both city and study area)
Data Used: Rockford Brownfields Addresses (US EPA), Rkfd_CensusTracts, Rockford Streets
Actions:
1. Open ArcCatalog, Search for “Create New Address Locator”
2. Double click Create New Address Locator, a new window will popup, select US Streets with Zone as address locator style and click OK button.
3. In the new window name the service as Rkfd_Streets_Brownfields, add Rockford Streets shape file as the reference data
4. Open ArcMap
5. Click on Tool Menu, point mouse to Geocoding and click Address Locator Manager
6. Click Add button in the Address Locator Manager, click Look In dropdown menu, select Address Locators, look for Rkfd_Streets_Brownfields
7. Click Tool menu, point mouse to Geocoding, and then click Geocode Addresses, select Rkfd_Brownfields.dbf
8. Save output shape file as Rkfd_brownfields_location.shp
9. Manually check 3-4 addresses to determine location accuracy

Overlay Brownfield Locations with Census Tract Connectivity
Data: Rkfd_brownfields_location shapefile, AccessPointSummary_CensusTracts
1. Open ArcCatalog and check if those data are defined and projected correctly
2. Open ArcMap
3. Add the following data: Rkfd_brownfields_location shapefile (created in “Brownfield Cleanup Sites” step), AccessPointSummary_CensusTracts
4. Note that projections are not reliable due to Rkfd_brownfields_Location shapefile
5. Symbolize according to number of access points in each census tract, with an overlay of brownfield locations

POSSIBLE INACCURACIES

Brownfield cleanup site locations were created using geocoding, and therefore have a “borrowed” projection – they should not be used for purposes beyond descriptive maps