CITY FOR THOUGHT:

A Place-Based GIS Approach to Identifying Educational Opportunity Centers and its Applications to School Oriented Development (SOD)

BACKGROUND

Louis Kahn, one of the last great American modernist architects, lamented the crumbling of American institutions that once held significant meaning to their users. Churches and town halls are no longer at the center of neighborhood life. Rarely do we gather in public spaces to discuss neighborhood issues. Today, planners attempt to attract residents to neighborhood meetings with inconsistent success. Such efforts are incomplete without rethinking the physical make-up of our communities. I believe that Waterbury and small cities like it are in a favorable position to uncover neighborhoods from the certain kind of disenfranchisement that occurs where opportunity is scarce. Increased investment in universal education infrastructure, entirely free of traditional higher learning institutions, is one approach a city might take in order to reinvigorate learning as an institution. While Waterbury is invested in restoring the physical inventory of its schools, it must recognize that a school is more than a building, a community is larger than its school-age population, and its school-age population needs more than cinder block walls to flourish. In the face of exorbitantly high tuition costs at American public and private colleges alike, all residents should have access to high-quality learning centers. Increasing inventory of third places near schools, increasing access to libraries, art spaces, open spaces, and and retooling these places for the twenty-first century would provide the people of Waterbury a much needed network for independent thought and community action. City for Thought is a conceptual proposal intended to offer Waterbury an overview of existing educational opportunity zones and to encourage growth within these zones.

WHAT IS SOD?

School oriented development, much like transit oriented development (TOD), has been proposed to urbanize suburban districts where sprawling public primary and secondary school campuses are not uncommon. By orienting communities around a learning center, school oriented development provides smaller districts opportunities for meaningful residential density. Smaller cities that do not have mass transit beyond flexible bus routes might use school oriented development to establish new neighborhood centers and densify existing ones. School oriented development also offers opportunities for public-private partnerships, where municipalities have control over vast tracts of underutilized space within city owned school parcels. City for Thought seeks to extend beyond the limitations of school parcels by taking into account where other physical learning factors might already exist, thus identifying educational opportunity zones as potential community centers.

WHERE IN THE WORLD?

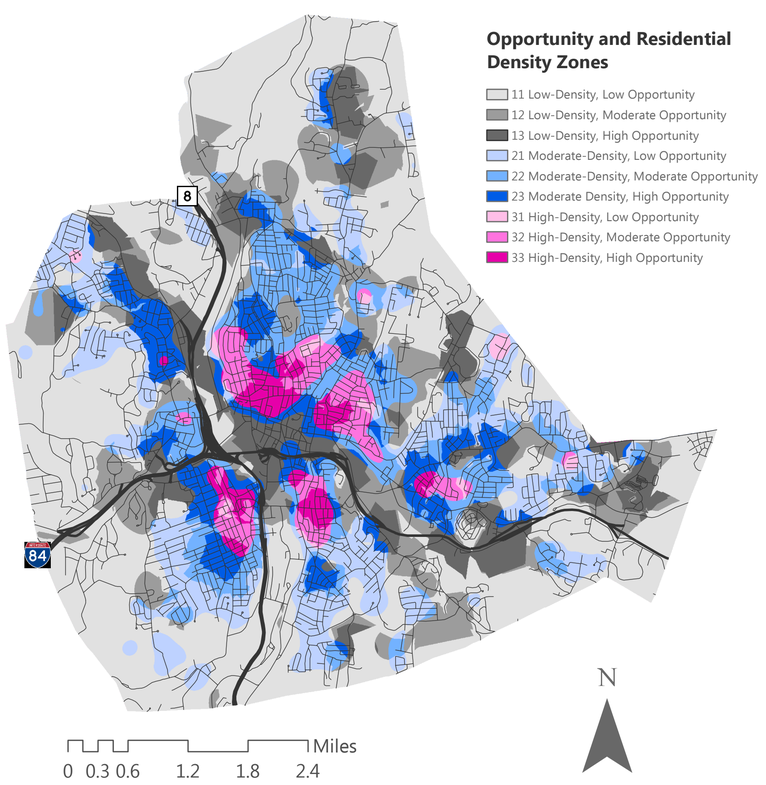
METHODOLOGY

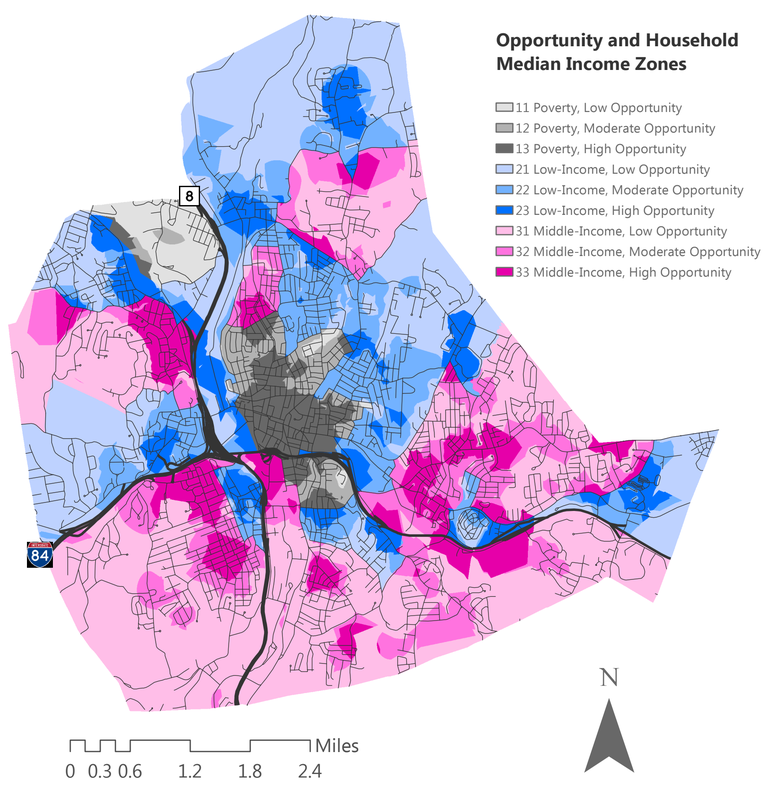
1. Building an Educational Opportunity Index using Network Analyst

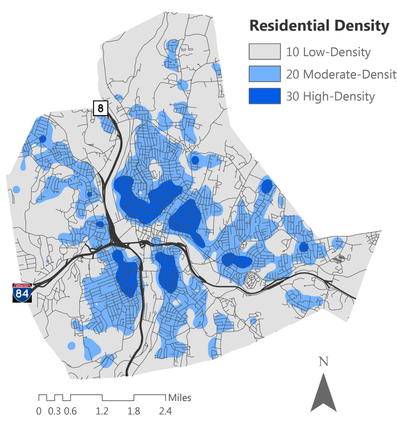
City for Thought utilizes nine unique thought factors in order to derive an educational opportunity index. A thought factor is defined as a physical space, community resource, or network that fosters a comprehensive learning environment. These thought factors include public primary schools, public secondary schools, colleges, private schools, public library locations, third places , cultural institutions, open space, and physical access. With the exception of physical access, each of these layers begins as a set of geocoded points. In the case of open space, points were derived using the Production Create Points at Intersections tool. This tool created points where open space polygons intersect streets, thereby coding potential access points. Network analyst was used to derive a walkshed polygon for each point layer, which was then converted to a raster with values reclassified as either 0 (regions outside of the walkshed) or 1 (regions within the walkshed). The network analyst impedance distance is set at either ¼ mile or ½ mile, depending on the thought factor.

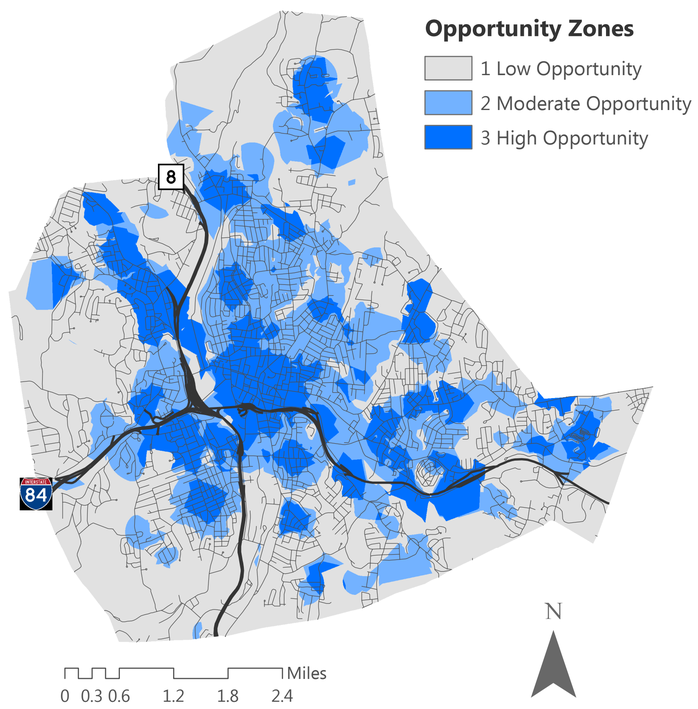
Physical access is a separate thought factor summed from two distinct factors: 1. a walkshed raster of ¼ mile distance for regional bus stops calculated using network analyst and 2. a sidewalk kernel density raster, derived from a sidewalk line layer. These two distinct raster layers were added and reclassified so as to create a final physical access raster with values 0 (regions that do not benefit from physical access factors) and 1 (regions that do benefit from physical access factors).

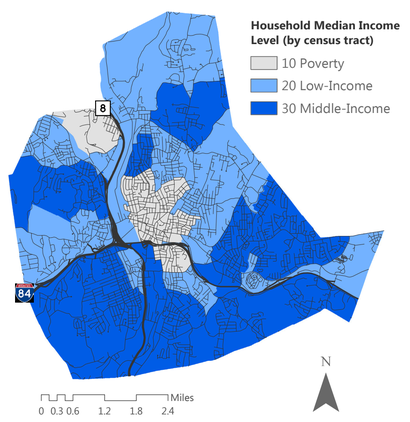
Each of the nine factors were assigned weights determined by the level of influence that the factors wield in creating a comprehensive learning environment. These nine weighted factors were summed using map algebra in order to arrive at a final education opportunity index. The opportunity index was reclassified into three classes, 1 (low opportunity) through 3 (high opportunity).











Household Median Income ($)	Raster Value	HMI level*
0 – 26,000	10	Poverty
26,000 – 45,000	20	Low-Income
45,000 – 78,000	30	Middle-Income

*Based on state median income guidelines for a family of 4

2. Analyzing Access within Educational Opportunity Zones

City for Thought's education opportunity zones do not indicate real access to educational opportunity. Rather, each zone can be understood as a density of thought factors within a region. Many of the cultural institutions in Waterbury's historic downtown may be inaccessible to impoverished and low-income populations due to cost barriers, despite their close proximity. In order to address this, median household income is visualized as an indicator of one factor that might impact real access to thought factors.

In order to represent access to education within educational opportunity zones in a meaningful way, the Opportunity Index and Median Household Income Level rasters were summed using map algebra to create a final raster with unique values. These unique values demonstrate regions of both educational opportunity and median household income level.

3. Comparing Opportunity Zones to Residential Density

Residential density is mapped as a useful tool for school oriented development suitability. By directly comparing relative opportunity zones to residential density, planners gain useful information about the areas in which people live.

In City for Thought, the most appropriate method for deriving a residential density map was determined by the attributes of the data available. A new field "units" was estimated based on the existing field specifying parcel type. For parcels missing information, a Google street view audit was conducted in order to estimate the number of units within each residential parcel. Utilizing the Create Random Points tool, as many points as there are units were assigned within each residential parcel boundary. This point layer was used to create a kernel density map, which after reclassification became the final residential density raster with values 10 (low-density), 20 (moderate-density), and 30 (high-density).

The opportunity index and residential density rasters were summed to arrive at a final raster that compares opportunity zones to existing residential density.

APPLICATIONS

City for Thought analyses present an alternative place-based approach to identifying potential neighborhood centers. Planners might use this method to identify regions appropriate for growth and development, based on community needs and to ask important questions. How, for example, can we grant more access to low-income populations to the high-opportunity downtown core? Where can we add residential density downtown?

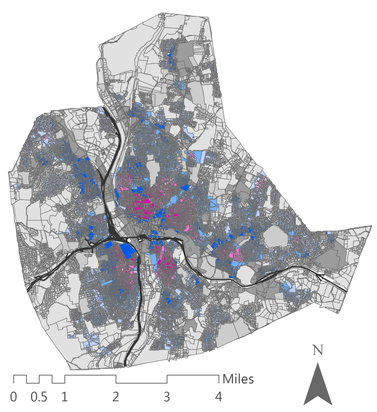
While a number of applications are conceivable, one example utilizes the final opportunity and residential density zones raster. First, zonal statistics (majority) is calculated using Waterbury parcels as the input feature zone layer and the opportunity and density zones raster as the input value raster. A new raster that more closely aligns with parcel delineations is created in order to avoid error in the following steps. A table of this raster data is created by running the zonal statistics as table tool (majority). This table is joined with the Waterbury parcel layer, creating a new parcel map with unique values assigned to each parcel. As in the opportunity and residential zones raster, these values represent opportunity and residential density zone levels. A planner can then select parcels using this field, thereby providing a method for analyzing existing parcels and determining parcels suitable for future growth.

Another conceivable application is made possible by converting the opportunity and residential density zones to polygons. Thought factor feature layers can then be joined to these polygons in order to provide more information about each physical location. Here, primary and secondary school layers were joined to these polygons in order to determine the zone in which each point lies. Crosby high-school lies within a low-density residential, low-opportunity zone. Crosby is in need of a more robust network of thought provoking places and housing nearby. All other secondary schools lie within low-density residential, high opportunity zones. These schools already have a dense network of thought provoking places at their doorsteps and might benefit greatly from increased residential inventory nearby. Such findings can help planners identify community centers and parcels most in need of attention.

Secondary School Analysis

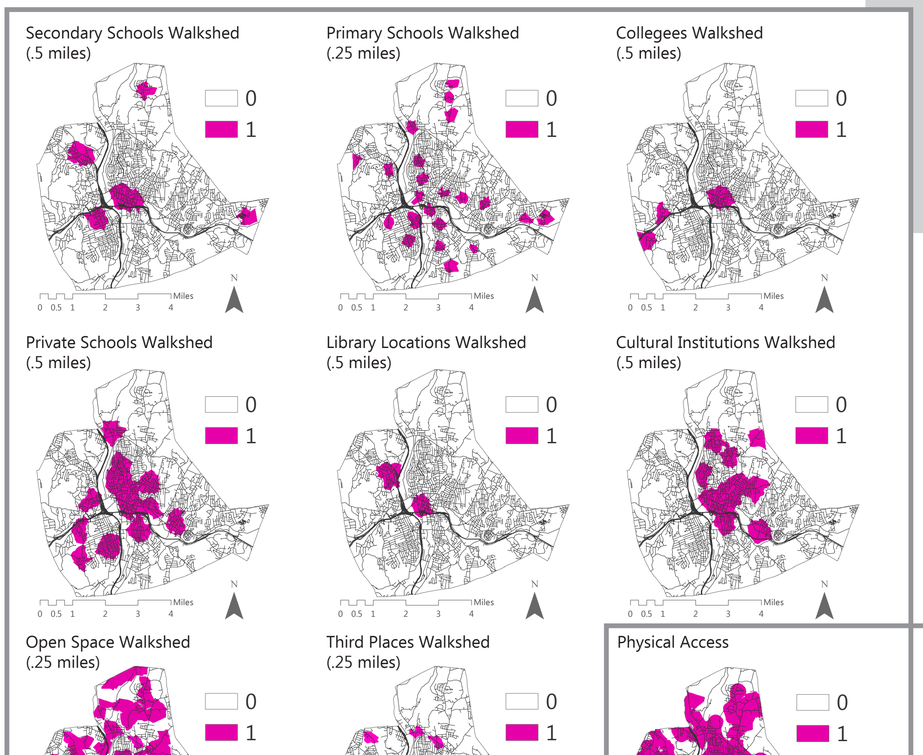
FID	Secondary School	Grid Code
0	Wilby High-School	13
1	Kaynor Technical H-S	13
2	Waterbury Arts Magnet School	13
3	Enlightenment School	13
4	Kennedy High-School	13
5	Crosby High-School	11

Parcels Joined to Opportunity and Residential Zones



LIMITATIONS

City for Thought is not a study of people or of vulnerable populations. Additional qualitative research through hands-on collaboration with community members is necessary in order to adequately address the needs of neighborhoods. Within the analysis itself, the zones mapped are undoubtedly affected by a number of inaccuracies. While deriving the walksheds with network analyst, it became apparent that large distances between points and roads caused imprecision in the shape of the resulting polygon. It should also be understood that the opportunity index calculated is arbitrary. The arbitrary nature of the index also provides an opportunity wherein community members might "weigh-in" on the final equation used to derive the opportunity raster. The residential density raster is truly a rough estimation of residential density, given the unavailability of exact unit counts for all residential parcels. While the limitations are many, the concept of City for Thought presents a lens through which more questions surrounding place-based educational opportunity networks and School Oriented Development might be asked.



Thought Factor	Walkshed	Weight
Public Primary Schools	.25 miles	.1
Public Secondary Schools	.5 miles	.2
Colleges	.5 miles	.05
Private Schools	.5 miles	.05
Public Library Locations	.5 miles	.2
Cultural Institutions	.5 miles	.1
Third Places	.25 miles	.15
Open Space Intersections	.25 miles	.05
Physical Access	See below	.15

Physical Access	Walkshed Impedance
Distinct Regional Bus Stops	.25 miles
Sidewalk Kernel Density	N/A

Cartographer:
Max D. Tanguay-Colucci, 2014

Sources: UCONN MAGIC, CTDEP, Naugatuck Valley Council of Governments, Waterbury GIS

Projection Information: NAD_1983_StatePlane_Connecticut_FIPS_0600

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