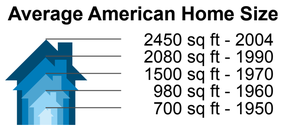
Tiny Housing and Underutilized Urban Land

Evaluating Publically Owned Parcels through Geospatial Technologies

Purpose:

Since the 1950's the scale of the average American house size proportionate to family members has tripled in size. Increasingly, larger home footprints have resulted in significant reductions of permeable surfaces, further depleting water aquifers, causing more storm water runoff, and making communities more susceptible to major flooding. The material demands of modern housing are proportionately high, as well as the energy costs of heating and cooling these structures. Additionally, the cost of construction has increased along with the scale of built form, inflating the price of modern housing.



Objectives:

The Tiny House movement has gained popularity among a surprisingly large number of Americans interested in simplifying their lifestyle, reducing overhead expenses, limiting overall impact on the environment, and improving quality of life. With growing concern for the environment, stratifying social classes and degrading sense of community, the Tiny House movement offers an alternative to the contemporary housing market. While there are numerous benefits and reasons various groups of people are attracted to tiny houses, the movement has been limited by opposing zoning regulations and building codes. In fact, beyond improving mobility, the primary reason tiny houses are commonly built on a trailer foundation is to navigate around restrictive zoning codes that set irrational standards for minimum housing sizes. The foundational goal for this project was to construct a GIS model that could analyze the existing community conditions and evaluate underutilized parcels in the interest of developing alternative methods of affordable public housing. Based on contemporary planning values, I believed that the ideal location for siting a cottage style community would be within close proximity of mixed use centers.

This project utilizes geospatial technologies in the form of Geographic Information Systems to explore alternatives to traditional forms of housing development that encourage sustainable choices, while also working to fill gaps in housing equality. This project evaluates parcels owned the by the Tacoma Housing Authority (THA) to determine the potential for experimental public housing and infill development strategies using micro-housing. Criteria was set to evaluate each parcel based on its spatial relationship with community indicators and current extent of lot utilization. This project is intended to serve as a guide for policy makers, local governments, and non-profit organizations interested in exploring experimental cottage style tiny house developments within the city of Tacoma.

Methods:

To determine the ideal site location, the primary data collection involved selecting key indicators that could be used to evaluate existing services and neighborhood amenities. This data was then used to determine which areas in the city had the highest quality conditions for a communal housing development. Data used in the site selection process was based on four foundational characteristics: community quality and character, transportation oriented development, career advancement opportunities through education and workforce training, and anchoring institutions for economic stability. Datasets were compiled for each of these key categories through publicly accessible GIS data, tabular information, online search engines and yellowpages. Once data had been assembled into a .dbf format in Microsoft Excel, tabular data was imported into ArcGIS and geocoded to provide a spatial location with each facility.

After data was properly prepared, the first analysis conducted involved using the Network Analyst extension within ArcGIS to evaluate the walk time required to reach the each of the selected variables. Using a Tacoma Streets and Trails layer, a network dataset was built for conducting a Service Area analysis for each of the variables used in assessing the four foundational characteristics. Service buffers were created at 1, 5 , 10, 15, 20, 25, and 30 minute increments from the community service facility or amenity of interest, producing a polygon service area for each variable.

The output of these Service Areas was then exported to create a permanent polygon shapefile for each variable. Finally, the polygon Service Areas for each variable were converted into rasterized grids, and reclassified to create a field that could be referenced in final calculations. Raster data created from the Network Analysis was then analyzed using the Raster Calculator tool within the Spatial Analyst toolset, here the fourteen individual raster datasets were added to calculate the grid cell value of each overlaying variable, and weighted according to overall importance in promoting community stability and sustainable housing.

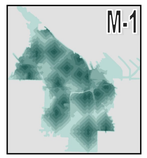


Figure M-1: Density Raster of Mixed-use Centers, created from prior Service Area analysis of the 18 planned Mixed-use development centers in the city. Darker coloring indicates a closer proximity to the specific facility or amenity and an overall higher grid cell value.

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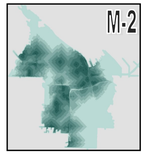

Figure M-2: Density raster of Workforce Training Facilities, produced by adding the Service Area analyses of Higher Education, Vocational Schools, Career Training and Employment Services.

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Figure M-3: Density raster of Sound Transit Sounder Stations, one of many components used to evaluate access to alternative transportation.

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Figure M-4: Output raster from raster calculations shows the combined grid cell value of the fourteen input raster datasets to display areas with the greatest density of amenities, indicating areas of focus for public housing and the development of tiny house communities.

In addition to Mix-Use Centers, Workforce Training, and Sounder Stations, eleven other variables were considered in the site selection and raster calculation process. These include: Public Schools, Anchor Institutions, Libraries, Farmers Markets, Parks and Open Space, Grocery Stores, Pharmacies, Health Care Services, Pierce Transit Bus Stops, Link Rail and Park and Ride stops.

Figure M-5: This is one example of underutilized lots in the city of Tacoma, that could serve as a hub for parking tiny houses and increasing access to affordable public housing.

Figure M-6: Individual parcels ranked through the zonal statistics application based on proximity to designated key areas, are here symbolized from a red to green scale based on their unique grid cell value. Red indicating the worst score and green indicating lots of with the greatest services and amenities.

To determine the current extent of property usage and site density, parcels owned by the Tacoma Housing Authority first had to be spatially referenced to an existing tax parcel. Attribute data for each particular THA lot was spatially joined from Tacoma parcels. Then, using Zonal Statistics within the Spatial Analyst toolset, calculations were made to evaluate each lot based on its geographic relationship to the condition variables. After each lot received a base score, the Layer Editor tool within ArcGIS was used to digitize the footprint of buildings accompanying each parcel of interest. The process was used to calculate overall lot coverage, with a lower coverage ratio representing underutilized lots that hold potential for non-traditional infill development in the form of tiny houses. Using an existing zoning layer for the city of Tacoma, THA parcels were also evaluated on their existing zoning in order to determine potential developmental limitations. This analysis was replicated for parcels classified as vacant residential, offering another avenue for the Tacoma Housing Authority to pursue the development of the proposed tiny community housing development.

Data Sources:

Pierce County GIS data portal; City of Tacoma, Economic Development Department; Washington State Geospatial Data Archive; and Google Earth

Results:

The foundational analysis conducted to evaluate existing conditions in the city of Tacoma provided a general understanding of the services and amenities available in different areas of the city. Through the process of raster calculations, the fourteen primary rasters (as shown in figures M1-4) were totaled to find the overall grid cell value, and display areas of interest for the development of public housing. The raster calculations produced two primary areas of interest: the Hilltop to Downtown area and the STW mixed-use center off 56th in south Tacoma. Other areas of significance included: James Center on 6th Ave., Proctor, and the Lower Portland Ave. mixed-use centers. Analysis of individual Tacoma Housing Authority parcels and their overall lot coverage revealed that out of the 27 initial THA own parcels the average lot coverage was 28 %, with an average lot size of .13 acres. Of those lots, only 7 were found within the noted key areas shown to contain the best site conditions. Further analysis revealed one of the larger lots owned by the housing authority at .2 acres and a lot coverage of 17%, presented the greatest potential for an experimental tiny house community. As for the vacant residentially zoned lots, the analysis found 12 of the original 141 parcels, to be located in the key areas. Of those 12 vacant residential lots, 10 were currently undeveloped, and two with existing structures on the property.

Figure R-1: THA lots shown after running zonal statistics. Red symbolizes lots with a lower score in relation to development potential, while green shows lots with the greatest potential for the development.

Figure R-2: THA owned houses were digitized to calculate floor area, then referenced with lot area to determine the overall lot utilization and potential for infill development using tiny houses.

Figure R-3: The THA lot that was determined to have the greatest potential for infill development and overall rating is shown here, with one arrangement option for staging a tiny house community.

Limitations:

This project is meant to serve as a guide for the analysis of public housing, as well as site selection for experimental public housing options. Although the focus of this project was on assessing lots currently owned by the Tacoma Housing Authority for the development of a tiny house community, this project does not offer solutions for existing policies and regulations that restrict such development. Additionally, variables used in determining the overall conditions of the city and areas of specific interest for public housing development, were chosen based on their contribution to transit oriented development and accessibility.

Acknowledgments:

I would like to acknowledge and extend my gratitude to all those who helped me to complete this program. Particularly, GIS professors, Matthew Kelley and Greg Lund, who helped me learn, grow, and implement my own ideas in the world of GIS. I'd also like to thank the Tacoma Housing Authority for allowing me to use data on their parcels.