The Collaborative Syntax:

Using GIS Modeling and Walkway Network Analysis to Rearticulate and Assess Demand for Pedestrian Service Improvements and Walkability in Arnold Creek

March 16, 2014

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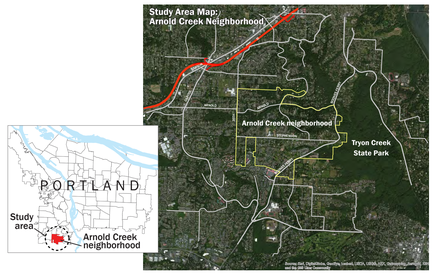
Project Description

This project blends a variety of GIS modeling, network analysis, and public participation GIS tools and techniques to identify and assess deficiencies in pedestrian transportation services in Portland's Arnold Creek neighborhood. In addition, the project seeks to identify and evaluate the impact potential infrastructure improvements would have on the walkway network for residents.

Specifically, we attempt to create a GIS walkway network model that:

- Realistically reflects the populations, pathways, and destinations connected to the pedestrian transportation system while accurately measuring the network's impedances
- Provides a platform which allows citizen concerns and proposals to be articulated and evaluated in a GIS format
- Produces meaningful outputs that demonstrate the quantifiable impact of proposed infrastructure projects.



Study Area

The Arnold Creek neighborhood is a bedroom community of 2,729 residents in Southwest Portland. Its suburban development pattern consists of mostly of low density single family housing with a disconnected street pattern that favors minimal automobile traffic within the neighborhood while high-speed transport corridors line the edges. This street pattern, a lack of sidewalks and safe crosswalks, and relatively few walkable amenities and destinations within the neighborhood, add up to a pedestrian-unfriendly environment.

Methodology

Setting up the GIS walkway network model

The primary datasets used in our GIS walkway network model were created by various agencies of the City of Portland and were collected through the Civic Apps website. These datasets included: Address, Street Centerline, TSP Street Classification, Parks and other destinations, such as public schools. Grocery store destinations were created by our team.

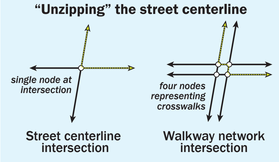
After establishing these origins, routes, and destinations, the next step of creating the network model required the verification of nodes, connectivity groups, and topological accuracy of the network segments. This process was carried out by using the Node Verification tool that is a part of GIS Jammers software.

Once verified, the walkway network was generated via an automated tool that "unzips" the street centerline file and creates crosswalks at street intersections and midblocks.

The walkway network segments were then weighted to represent impedances caused by network distance, automobile traffic, and, in some cases, the presence or absence of sidewalks.

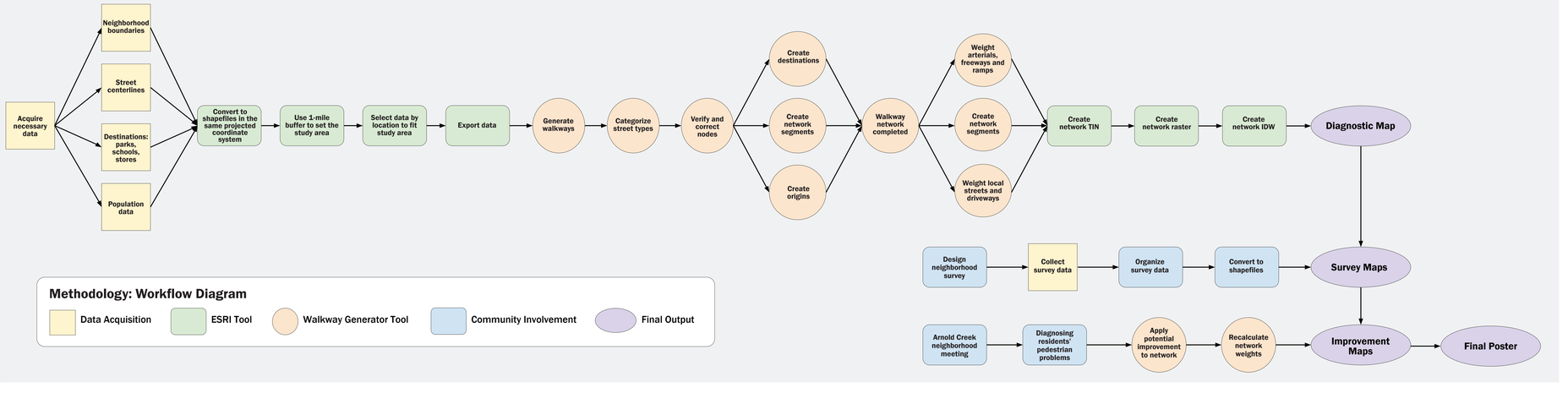
(right)

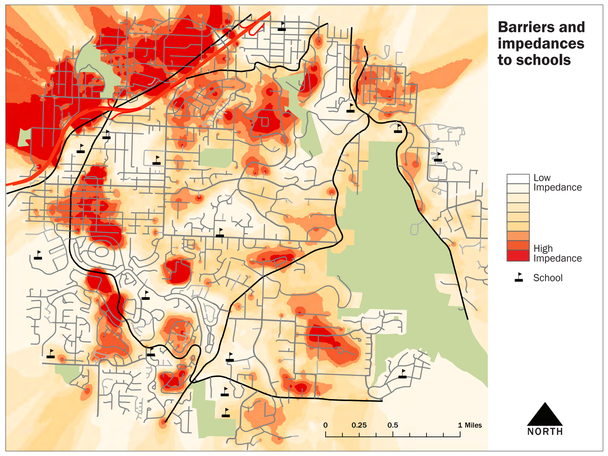
"Unzipping" the street centerline



A topologically correct walkway network model accounts for the ability of pedestrians to traverse either side of the street going either direction, and recognizes that there are four possible pedestrian crossings (nodes) at an intersection, rather than just one.

Parker and Vanderslice, 2010





GIS network analysis of barriers and impedances

After the walkway network was weighted we applied various GIS spatial analysis tools to identify and assess factors that could be considered barriers to pedestrian activity.

Specifically, after rasterizing the vector walkway network we applied an Inverse Distance Weighting tool which allowed us to create a slope surface where each cell value depicted a measure of impedance, a function of the difference between euclidean and effective network distance from origins to school destinations along the walkway network. Our resulting map diagnoses "pedestrian unfriendly" areas with poor street connectivity and/or lack of sidewalks and safe crossings on high traffic volume streets.

An earlier version of this analysis was critiqued by Arnold Creek residents for inaccurately representing the area's walkability. Some limitations of this approach were revealed: first, the difficulty of correctly weighting of impedance values of walkways to reflect the perceived safety issues of certain streets; and second, the need to incorporate alternative walkways that are not included in formal datasets, such as trails in parks, on private property, or through open spaces.

(above)

Conducting a geo-survey

We used an online survey tool to collect spatial information from Arnold Creek residents, who answered questions about their walking routes by drawing lines and points on a map using the Suprmap.org website.

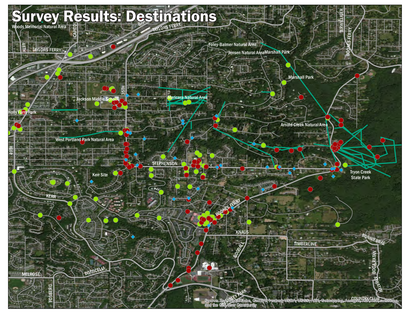
The maps to the right summarize the 43 survey responses and show the neighborhood's well-traveled walkways, areas of concern, and proposed infrastructure improvements.

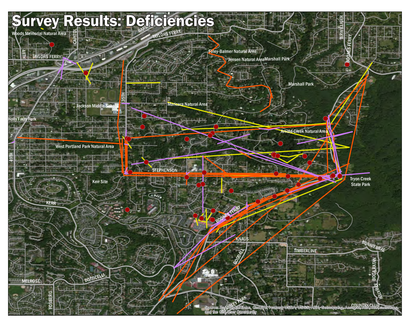
Survey results legend

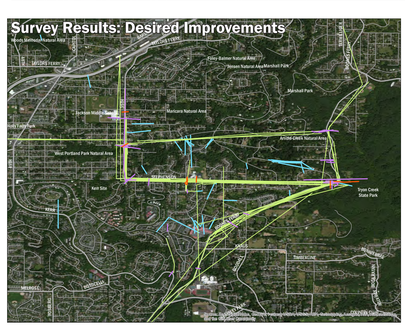
Destinations
- Mark the intersection nearest to your home
- Mark destinations you would like to go to but you are unable to walk to them
- Mark destinations you frequently walk to
- Mark park trails you use as part of your walking routes

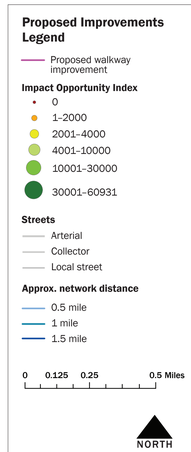
Deficiencies
- Mark barriers to walking routes
- Mark the worst pedestrian crossings
- Mark the worst streets for walking
- Mark paths to transit stops needing improvement

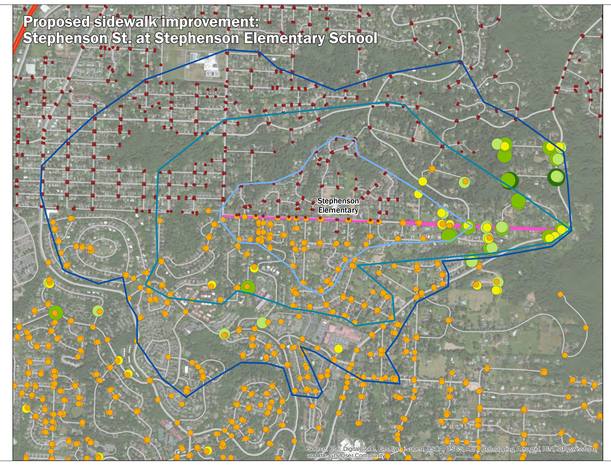
Desired improvements
- Mark where you would like to see new sidewalks installed
- Mark where you would like to see marked crosswalks installed
- Mark where you would like to see crossing guards staffed
- Mark walking route(s) you would like to take but cannot because they are through non-public property

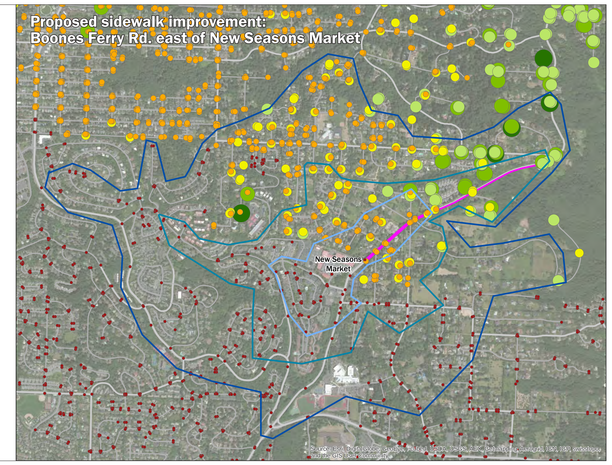












(above)
"What-if" analyses of proposed sidewalk improvements

We weighted the walkways so that each route from an intersection to a destination received an impedance value based on distance, crossings, vehicle traffic volume, and presence or absence of sidewalks. Then we recalculated the impedances to reflect the installation of a proposed sidewalk improvement project.

The graduated circle symbols represent the "impact Opportunity index" — the difference between before-and-after scenarios multiplied by the number of affected residences. The larger the impact, the more benefit the project would potentially bring to the community.

Based on input from Arnold Creek residents, we chose two potential sites for sidewalk improvements:

- At Stephenson Elementary School, adding a sidewalk on the south side of the street to the west of the school, and on both sides east of it
- Both sides of Boones Ferry Road (a high-traffic road that residents describe as dangerous for pedestrians) east of the shopping center anchored by New Seasons Market

Conclusions

Towards a collaborative syntax in walkway network service planning

To enhance the usefulness of the analytical approach used in this project, we have identified several directions for further research and conceptual development:

Strengthening the analysis

- Accurately identify and represent additional impedances caused by various factors
- Incorporate additional factors such as demographics, multiple destinations, alternative walkway paths and trails, safety, and improvement impacts on other transport modes

Data collection

- Developing strategies to collect and incorporate information not typically included in datasets available from public agencies or community mapping sources, such as those generated from public input processes, Open Street Map, block audits, and GPS routes

Increasing resonance with citizens, civic organizations, urban planners, and policy makers

- Evaluate the usefulness and coherency of the Improvement Value and Impact Opportunity Index metrics in comparison with other currently available indicators
- Evaluate how easily citizens, civic organizations, urban planners, and policy makers can understand and interpret these indicators

Simulation

- Real-time analysis in the context of public meetings, planning charrettes, and online could enable better iterative decision making and greatly expand the capacity of citizens and planners to collaborate in problem solving to add value in urban planning processes

Data Sources

CivicApps.org *(http://www.civicapps.org)*

City of Portland Bureau of Technical Services *(https://www.portlandoregon.gov/bts/article/268487)*

SW Neighborhoods, Inc. and the Arnold Creek Neighborhood Association *(http://swni.org/arnold_creek/about)*

Portland State University Suprmap *(http://suprmap.org)*

References

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Acknowledgements

We are very grateful for the guidance of Scott Parker of the GIS Jammers. An engineer and creator of the GIS Walkway Network Analysis software application toolkit, Scott provided instruction and supervised the network analysis and other elements of this project.

We would also like to thank the Arnold Creek residents who participated in our geo-survey, and the members of the Arnold Creek Neighborhood Association Active Transportation Committee who met with us on March 10, 2014 to discuss the survey data, propose more improvement projects, and provide feedback on our results.

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