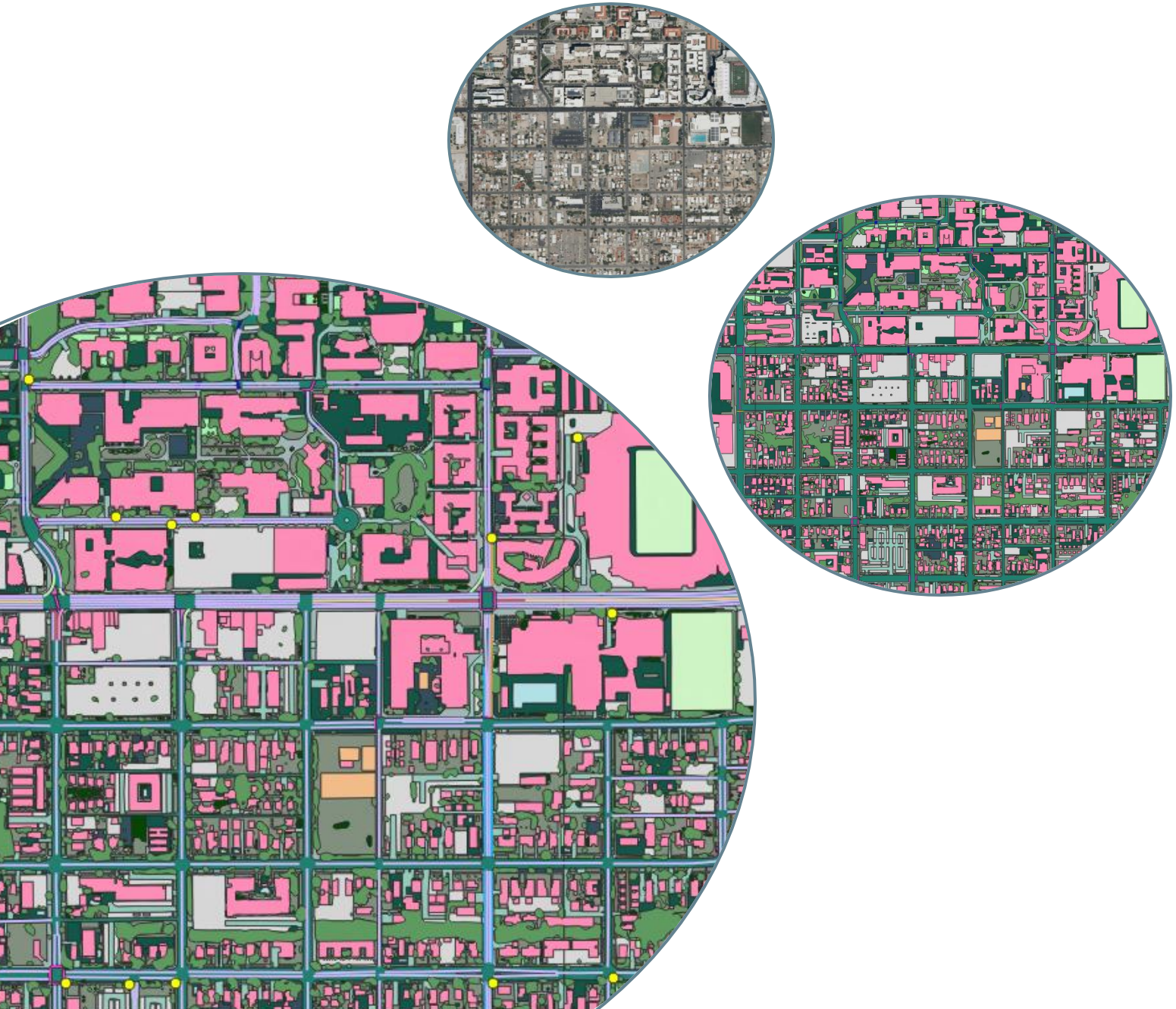


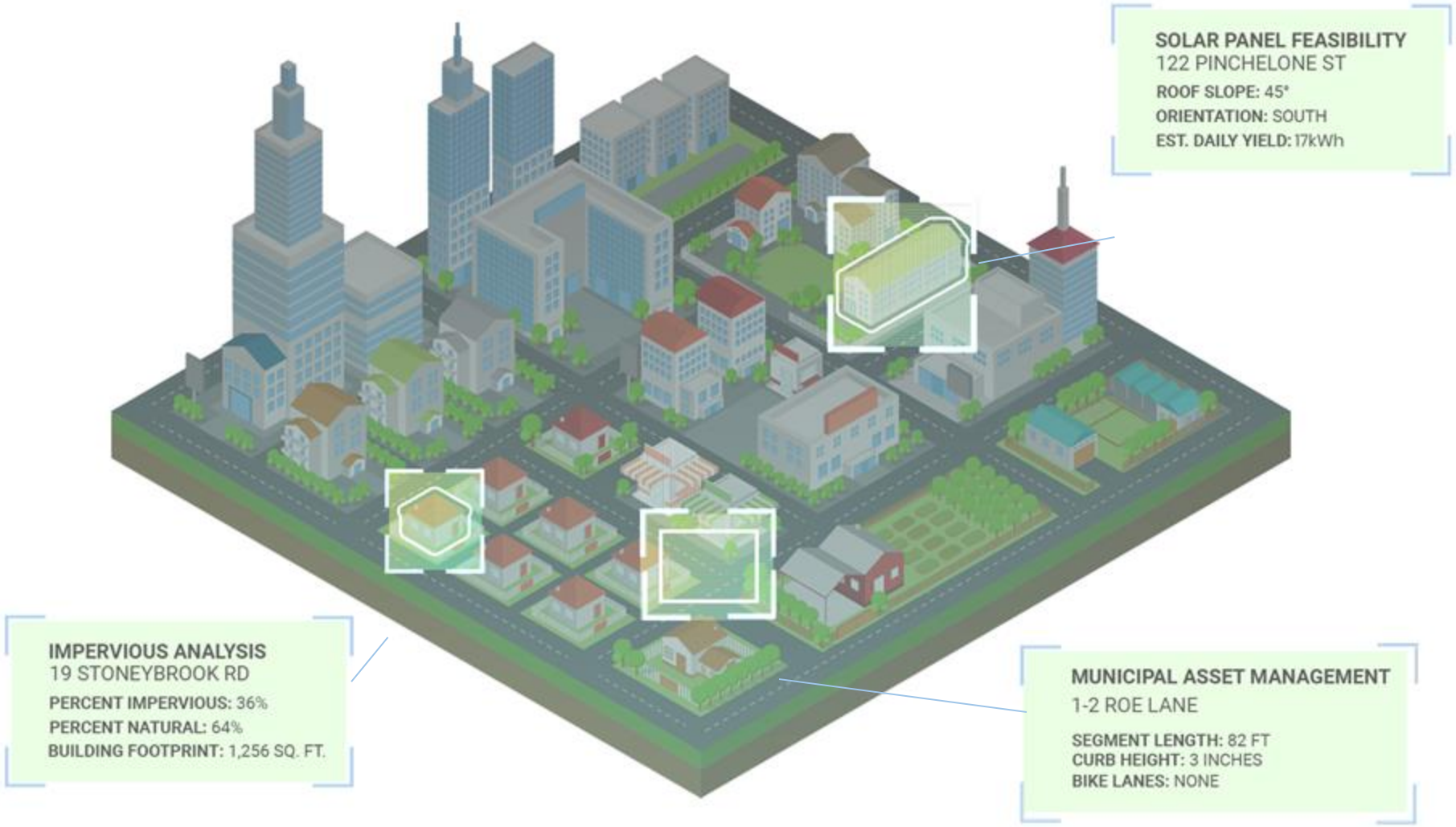
Data Driven Decision Making for Enhanced Planning

November 7th 2023

Abigail Coholic – Senior Director
abigail@ecopiatech.com

Providing a digital source of truth for the physical world

Ecopia



Existing options for vectorization –end users are continuously having to make trade-offs between accuracy, speed, and the cost of data creation

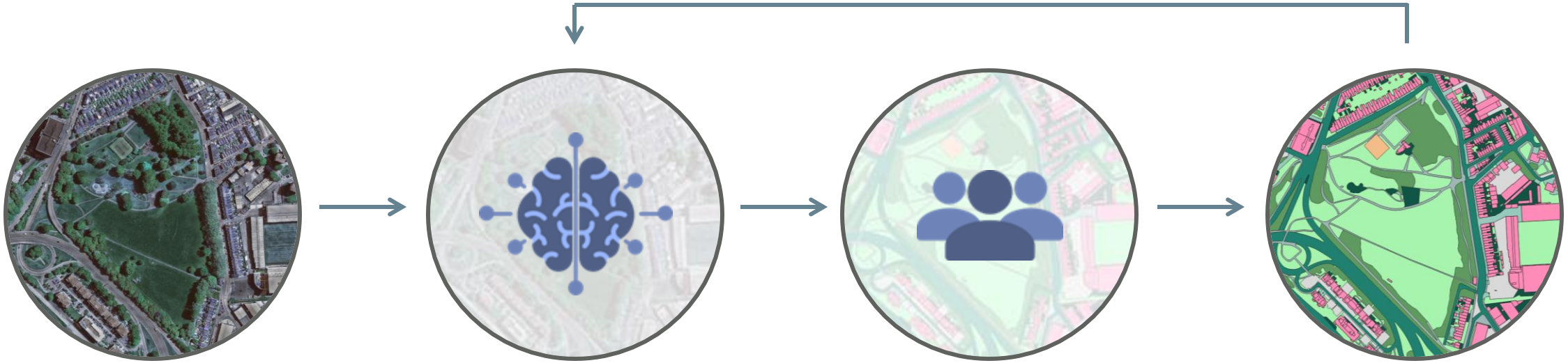
Ecopia

	Manual Digitization	Automated Softwares
≥ 95% Accuracy	✓	✗
Normalized Data	✗	✓
Fast Country Wide Extraction Capabilities	✗	✓
Low Price	✗	✓
Ability to Update Data Quickly	✗	✗

Ecopia's Vectors – No need to compromise, your customers receive the highest quality data, which is kept up-to-date, for the lowest price

	Ecopia
Highest Accuracy A geometric accuracy of 95% or higher is guaranteed	✓
Normalized Data Features consistently defined and precisely extracted by cut	✓
Fast Country Wide Extraction Capabilities +50 Country-wide datasets available off-the-shelf	✓
Lowest Price Cost Efficiencies achieved through automation allow for pricing that outcompetes or matches off-shore teams	✓
Ability to Update Data Quickly Advanced AI systems allow data to be refreshed as soon as new imagery has been acquired	✓

Ecopia's core AI technology delivers the same results you receive from GIS/CAD Professionals but at national scales



High-Resolution Imagery ①

Next-Generation Artificial Intelligence ②

Distributed Human Annotation ③

High-Precision Digital Map ④

A distributed, highly scalable, accurate mapping system. AI is leveraged to create operational datasets for critical real-world commercial applications.

Ecopia's capabilities over the past decade have been developed by combining the best-in-class PhD geomatics experts with top AI researchers and practitioners who have worked for renown firms and top universities.

Ecopia continuously expands its geographic coverage, and the features extracted from imagery

3D and 2D mapping initiatives conducted in 100+ countries, at record speeds while maintaining +95% accuracy

2016
Australia

+16 million 2D Buildings
+7 million km2
Mapped in 6 months (2016)
Updated annually for 5 years

956% Growth in Speed.

2018
USA

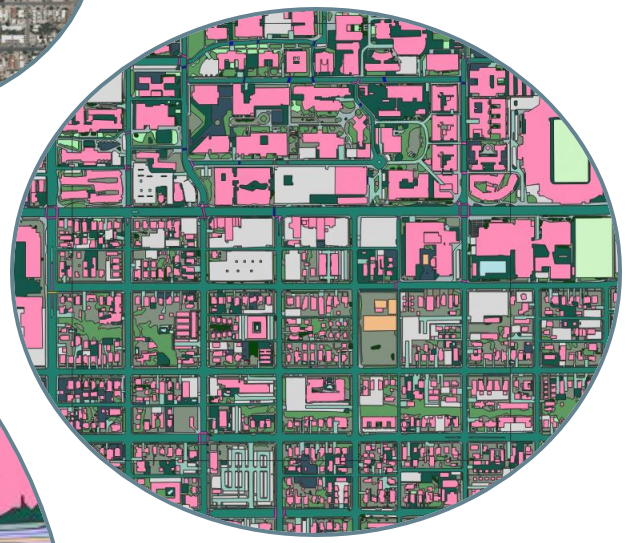
+169 million 2D Buildings
+6 million km2
Mapped in 6 months
Updated annually

1300% Growth in Capabilities.

2022
USA

+173 million 3D Buildings
+6 million km2 of Land Cover*
Created stereo aerial imagery
Updated annually

Ecopia



Empowering Planning across the State of Illinois

IDOT & CMAP collaborate to create, provide, and maintain a first of its kind comprehensive transportation infrastructure layer

Ecopia

Illinois Department of Transportation

Goal: Equally equip its partner transportation agencies with the best tools available on the market to advance their ability to make data-backed decisions.

Chicago Metropolitan Agency for Planning

Goal: Expand and Optimize data acquisition, preferably using automated tools, to speed up the planning process and reduce time and purchasing costs.

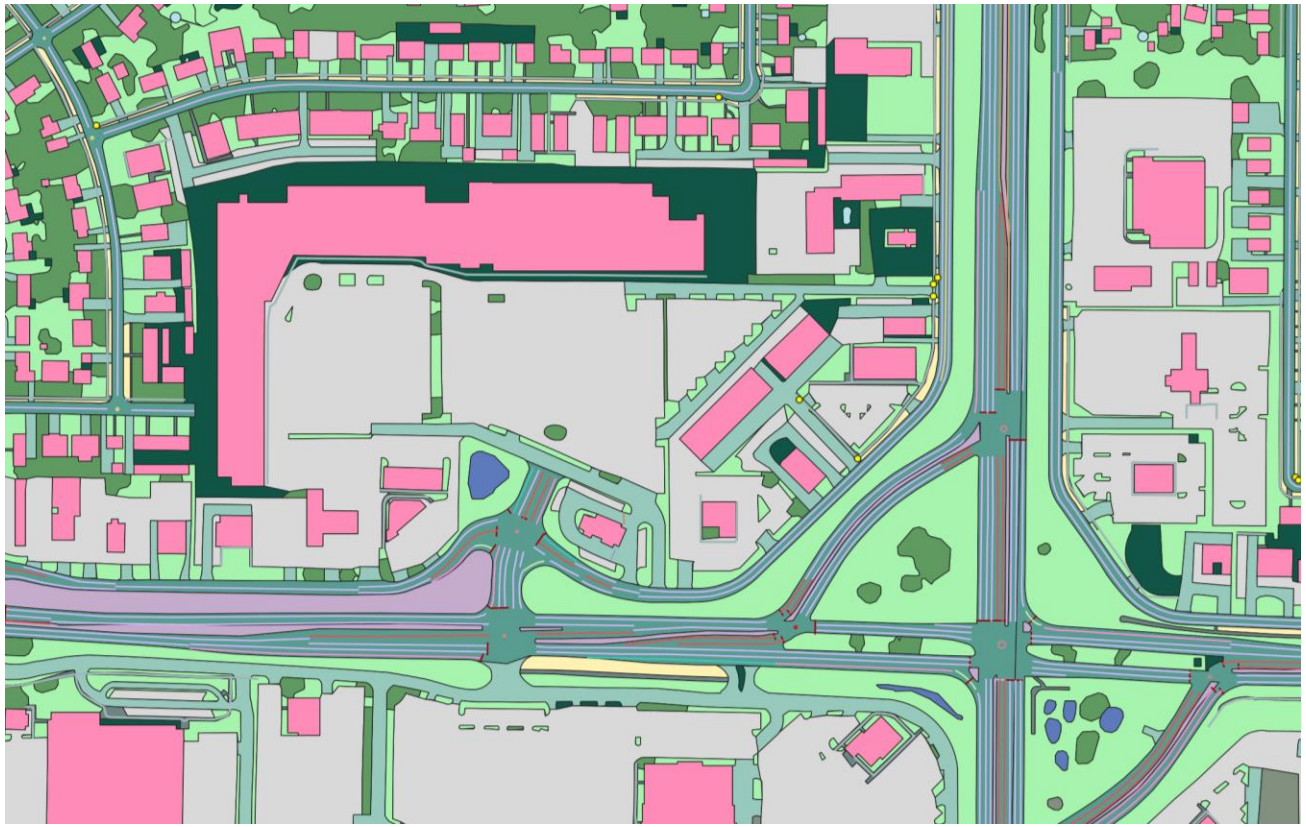
Immediate use cases for Vector Data

1. Travel Demand Modelling
2. Improved Multimodal Access Planning
3. Safety Assessments
4. Stormwater and Climate Resilience Impact Assessments

IDOT & CMAP collaborate to create, provide, and maintain a first of its kind comprehensive transportation infrastructure layer

This project was funded by the state's Research and Planning Grant, leveraging NOAA as a contract vehicle. Through this the transportation agencies received:

- Access to 15cm high resolution imagery, captured in 2021, 2023 and 2025
- 40 vector features, updated to reflect changes as new imagery is collected in 2023 and 2025
- Access to Ecopia's platform to run their quality assurance and analytics
- State, MPO and Municipal Sharing of the data to optimize its usage and return on investment



A screenshot of the vector layers delivered in St. Louis, Illinois.

IDOT & CMAP collaborate to create, provide, and maintain a first of its kind comprehensive transportation infrastructure layer

Ecopia

The following tables outline the depth of transportation features that Ecopia extracts and maintains for the State of Illinois

Land Cover Features	
Building Footprints	Railway (Polygon)
Building Geocodes	Railway Centerline
Road Edge (Polygon)	Sports Field (Polygon)
Road (Centerline)	Swimming Pool (Polygon)
Sidewalk Edges (Polygon)	Pavement (Polygon)
Sidewalk (Centerline)	Grass (Polygon)
Parking Lot (Polygon)	Water (Polygon)
Driveway (Polygon)	Bareland (Polygon)
Bridges (Polygon)	Tree Canopy (Polygon)

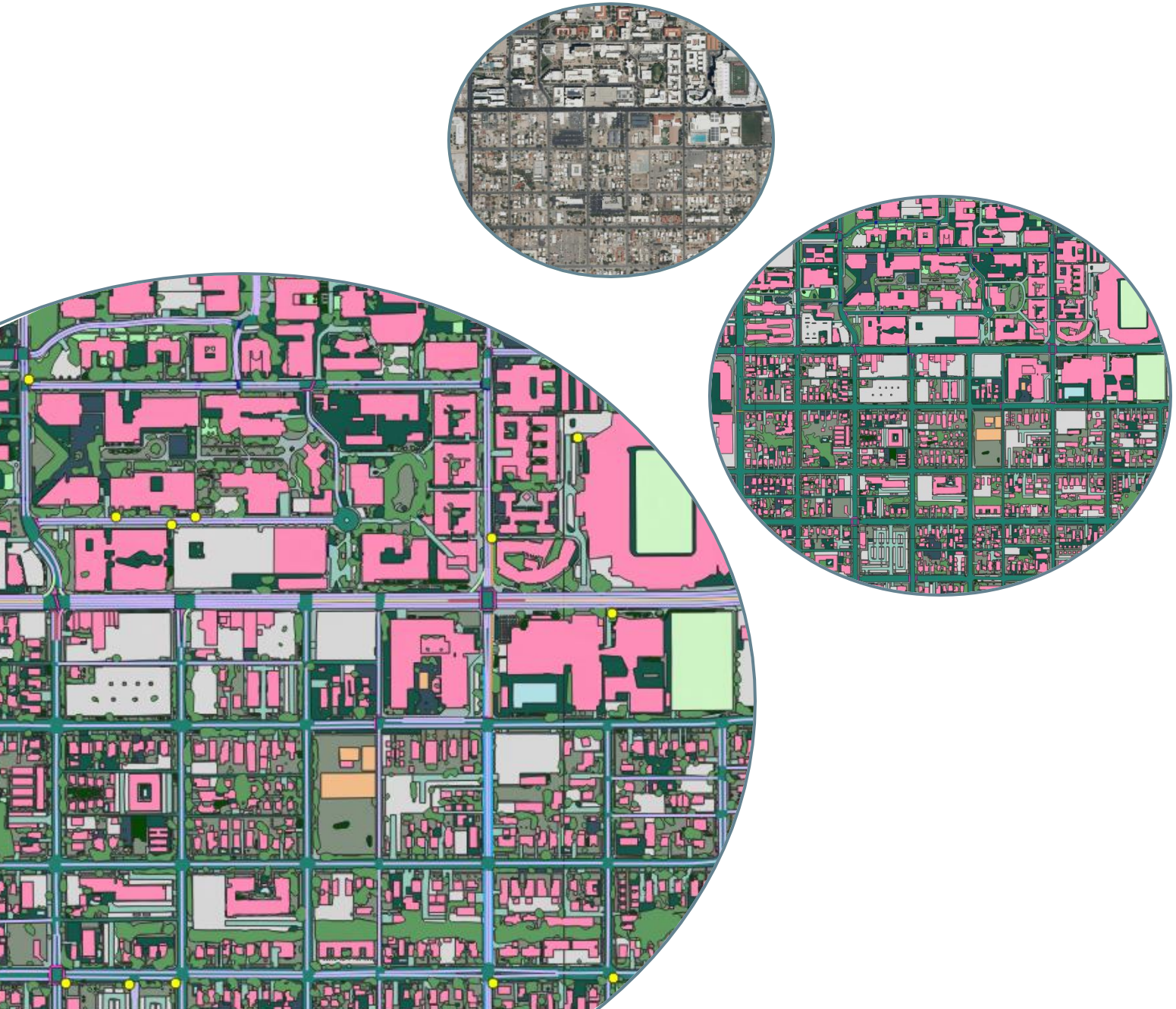
Advanced Transportation Features		
Left Turn Lane (Centerline)	Stop Line (Centerline)	Stop Controlled Intersection (Centroid)
Right Turn Lane (Centerline)	Standard Crosswalk (Polygon)	Light Controlled Intersection (Centroid)
Middle Turn Lane (Centerline)	Planted Raised Median (Polygon)	Uncontrolled Intersection (Centroid)
Slip Turn Lane (Centerline)	Planted Painted Median (Polygon)	Planting Strip (Polygon)
Through Lane (Centerline)	Unplanted Raised Median (Polygon)	Bike Lane (Polygon)
Continental Crosswalk (Polygon)	Unplanted Painted Median (Polygon)	Bike Lane (Centerline)
Zebra Crosswalk (Polygon)	Shoulder (Polygon)	
Dashed Crosswalk (Polygon)	Truncated Domes (Point)	

IDOT & CMAP collaborate to create, provide, and maintain a first of its kind comprehensive transportation infrastructure layer

Ecopia

A screenshot of the vector layers delivered in St. Louis, Illinois.

Ecopia



Partnering to enhance Travel Demand Modelling across Illinois

Comprehensive and Current Building Footprints from Ecopia to enhance Illinois' Regional Land Use and improve the accuracy of Trip Generation

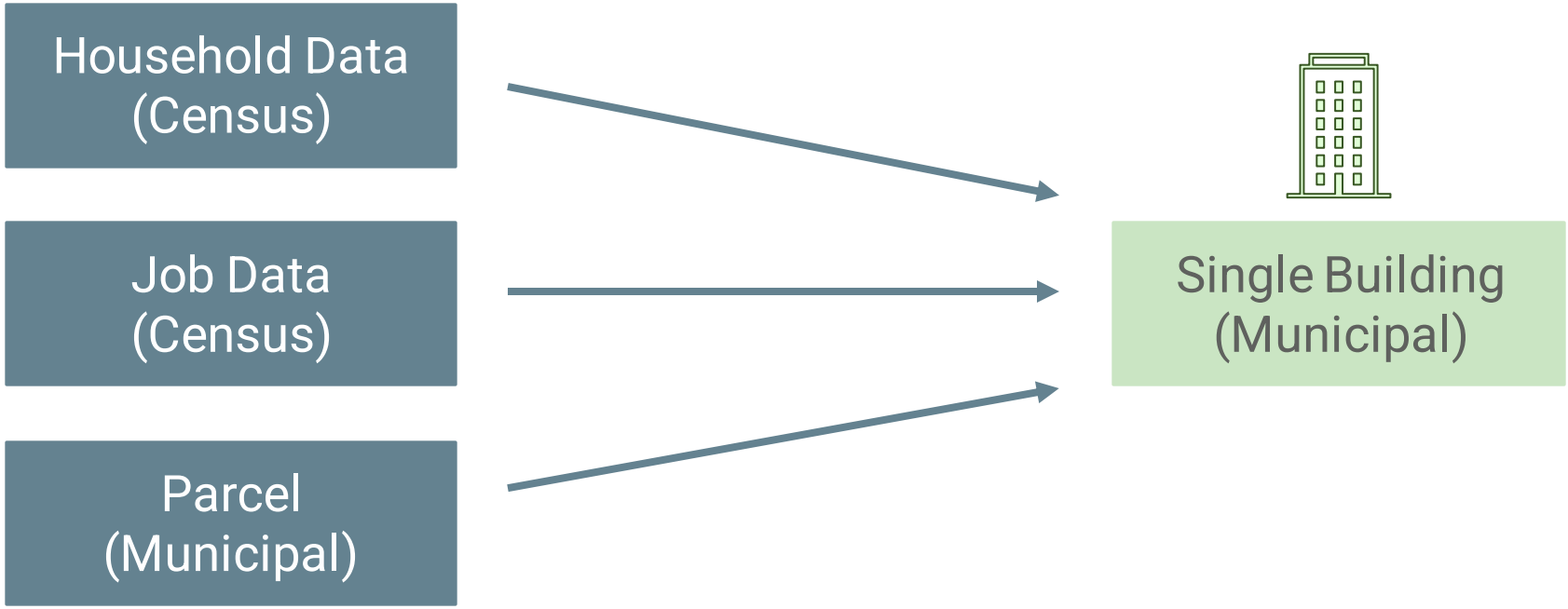
The Travel Demand Model team is looking to most accurately answer:

*As **a household**, how many **jobs** do you have **access** to by **car and rail**?*

Improving the data sources used to answer this question, allows for better predictions about urban growth and decline, which in turn allows infrastructure investment to be optimized. This optimization of investment further contributes to the economic success of the transportation agencies region.

Comprehensive and Current Building Footprints from Ecopia to enhance Illinois' Regional Land Use and improve the accuracy of Trip Generation

To answer "as a household, how many jobs do you have access to by car and rail?" one starts by aggregating information on households, jobs and parcels and tying those back to a single structure.



Comprehensive and Current Building Footprints from Ecopia to enhance Illinois' Regional Land Use and improve the accuracy of Trip Generation

To be able to tie the Census and Parcel data back to an individual building, the MPOs need access to building footprint polygons across their entire region.

Retrieve Building Data from Assessors Office

For CMAP, this meant reaching out and following up with 284 municipalities and could take +10 weeks.

Step 1

Step 2

Normalize Results

Due to the variances in sophistication and data structures across offices it is necessary to normalize the building data across the entire region.

Input into UrbanSim

Once the data has been retrieved and normalized, it is finally ready to go into your Travel Demand Model Platform. In Illinois, this is UrbanSim.

Step 3

Comprehensive and Current Building Footprints from Ecopia to enhance Illinois' Regional Land Use and improve the accuracy of Trip Generation

Assessors' office face the same time, cost and accuracy trade-offs highlighted earlier. Therefore, this building data tends to be out-of-date.

Traditional Assessors Workflows for Building Footprint Generation

Assessors Sketches Submitted (Non-Geospatial format)

↓

Survey Engineers sent out to Physically Assess Property

↓

Building Footprints captured from aerial imagery (every 3 to 5 years)

Ecopia AI-Enabled Building Footprint Generation

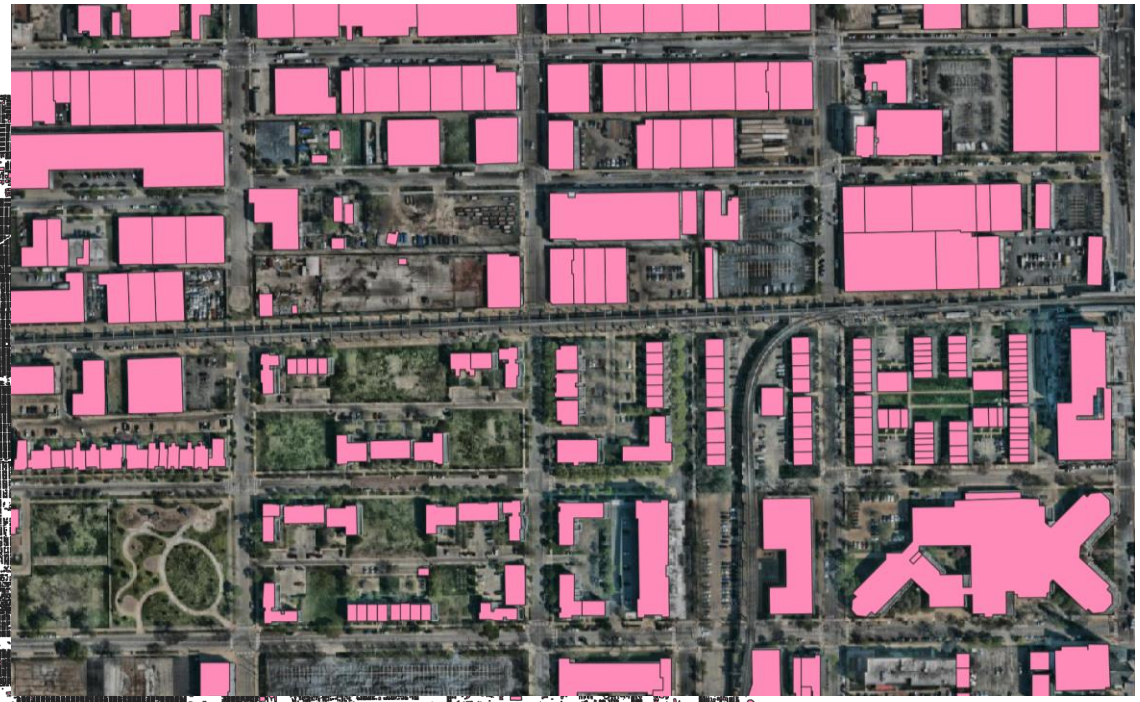
Sources most current imagery from aerial partners (6 months to 1 year old)

↓

Run AI-enabled workflow to extract/update building footprints across region (4 weeks)

Comprehensive and Current Building Footprints from Ecopia to enhance Illinois' Regional Land Use and improve the accuracy of Trip Generation

Assessors' office face the same time, cost and accuracy trade-offs highlighted earlier. Therefore, this building data tends to be out-of-date.



Future Application: 3D Data for Freight Model Calibration and Trip Generation Rate Stabilization in Warehousing

The regional travel demand model is also used to estimate existing and future activities of trucks across regional networks, relying heavily on trip generation and distribution of flows as main components. A reliable estimation of volume and types of trucks traveling across major corridors or regions is essential to support:

1. SAFETY
2. INFRASTRUCTURE IMPROVEMENT PROJECTS
3. AIR QUALITY ANALYSIS AND MITIGATION
4. EQUITY

Future Application: 3D Data for Freight Model Calibration and Trip Generation Rate Stabilization in Warehousing

While square footage has been the most readily accessible data point for assigning a trip generation metric, it misses important factors around warehouses function that cause variance in the number of trips, and therefore demand on infrastructure.

The following 3 Warehouse Functions have a large variance in trip generation across your region.

Freight Route Starting Point

Freight Route End Point

Transloading Point

Future Application: 3D Data for Freight Model Calibration and Trip Generation Rate Stabilization in Warehousing

To support the continued accelerated growth of E-commerce and Just-In-Time Delivery, companies are expanding and building high-cube warehouse facilities.

The city of LA found that ***between 2020 and 2021*** there was a ***10% growth*** in the ***square footage*** of ***High-Cube Warehouses***.

Therefore, SCAG commissioned the South Coast Air Quality Management District to refine its current modelling process, to incorporate this variance in trip generation based on different warehouse facilities.

Future Application: 3D Data for Freight Model Calibration and Trip Generation Rate Stabilization in Warehousing

The South Coast Air Quality Management District was forced to rely primarily on square footage to try to account for this variance, and therefore could not achieve the correlation statistics required of the ITE Trip Generation Manual. The Study found that in order to properly determine trip generation they should incorporate:

1

The Number of parking spaces on the property with a commercial vs. passenger distinction

This data allows for an accurate capacity of the facility to be determined as it establishes the number of trucks that can be hosted (commercial parking space) and the number of employees at the facility (passenger parking spaces).

2

The Number of building-adjacent parking spaces

If possible, this data can distinguish loading bays from "staging" parking spaces allowing to distinguish active truck movement from temporary storage.

3

Ceiling Heights and Length-to-Width Ratios

If possible, this data can distinguish loading bays from "staging" parking spaces allowing to distinguish active truck movement from temporary storage.

Future Application: 3D Data for Freight Model Calibration and Trip Generation Rate Stabilization in Warehousing

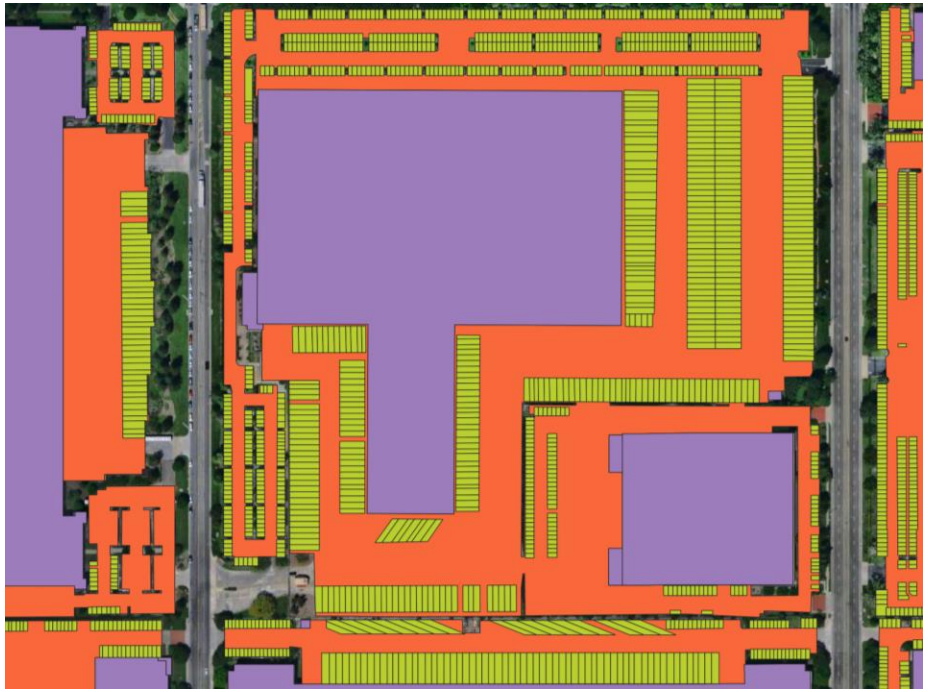
The thresholds listed below, allow for further segmentation of Warehouses and an accurate freight trip generation model. However, a full 3D model of a region and advanced parking data would have historically been economically unviable.

	Standard Warehouse/Storage	Transload Facility	Short-Term Storage	Cold Storage	Fulfillment Center	Parcel Hub
Ceiling Height	Typically, between 28 and 40 feet	Typically, lower than for other HCW	Typically, between 28 and 34 feet, with some facilities in excess of 40 feet	Typically, higher (70-100 feet) to maximize efficiency of refrigeration; frozen food tends to have a higher ceiling than produce handling	Often as high as 40 feet in order to accommodate up to three levels of interior mezzanines	Typically, not as tall as other HCW; commonly between 18- and 20-feet range; racking not usually provided (i.e. floor-stack only)
Number Of Docks	Low number of dock positions to overall facility, 1:20,000 square feet or lower	Typical dock-high loading door ratio is 1:10,000 square feet; common range between 1:5,000 & 1:15,000 square feet		Typically, 1:10,000 square feet or lower		
Length vs. Depth		Typical length vs. depth ranges between 3:1 and 2:1; shallower than Standard	Typical length vs. depth is 2:1; shallower than Standard			Typical configuration is cross-dock; building typically shallower (150-300 feet across) than other HCWs

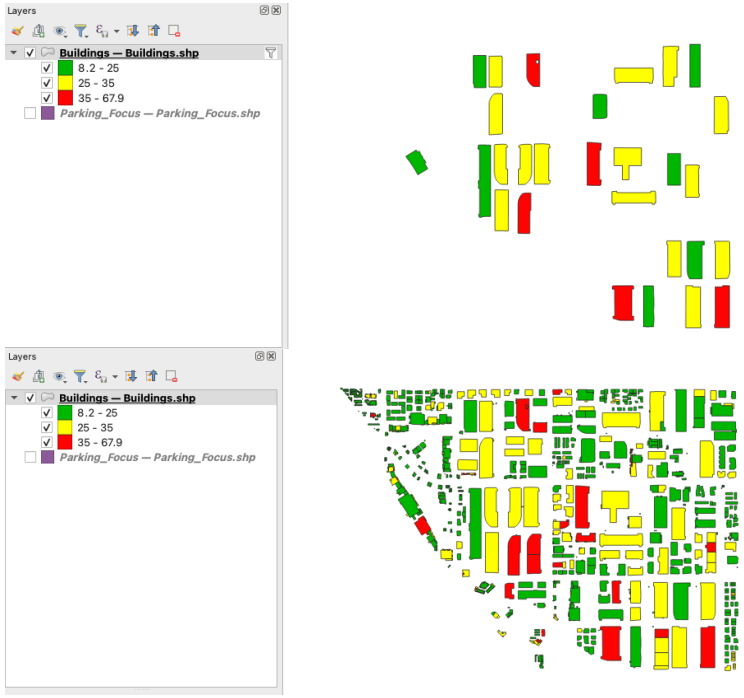
Future Application: 3D Data for Freight Model Calibration and Trip Generation Rate Stabilization in Warehousing

By leveraging Ecopia's multilayered 3D Buildings and individual parking spot delineation, SCAG was able to refine their results by two of the three main factors that would support improved co-relation and therefore further refine the freight trip generation model.

Parking Space Geometries

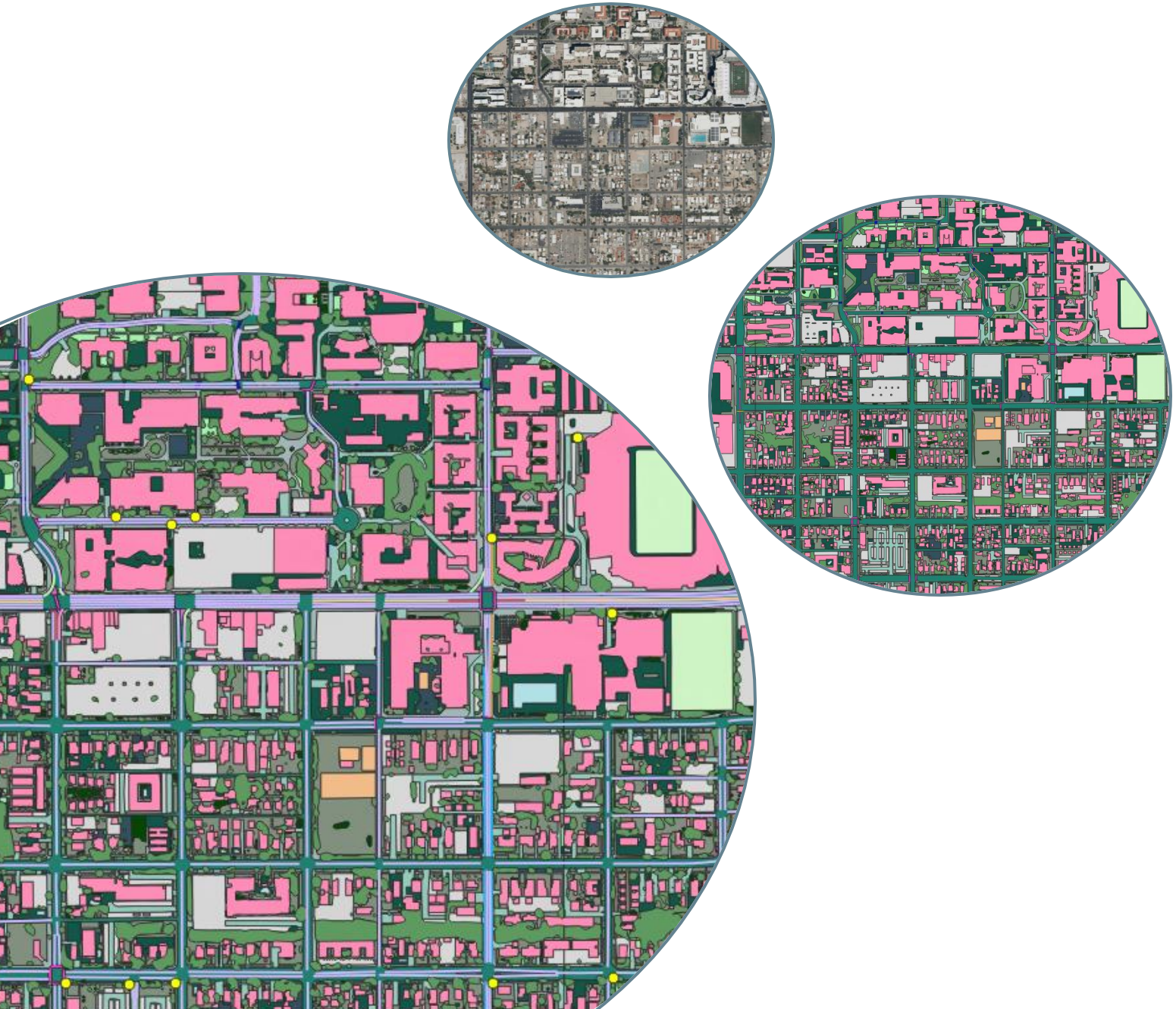


Ceiling Height Filtering



For Illinois, this data was interesting as they have highly ambitious CO2 emission reduction goals, and freight and congestion are huge contributors to their region's emissions.

Ecopia



Tracking Pedestrian Asset Inventories to support Multimodal Access and ADA Compliance

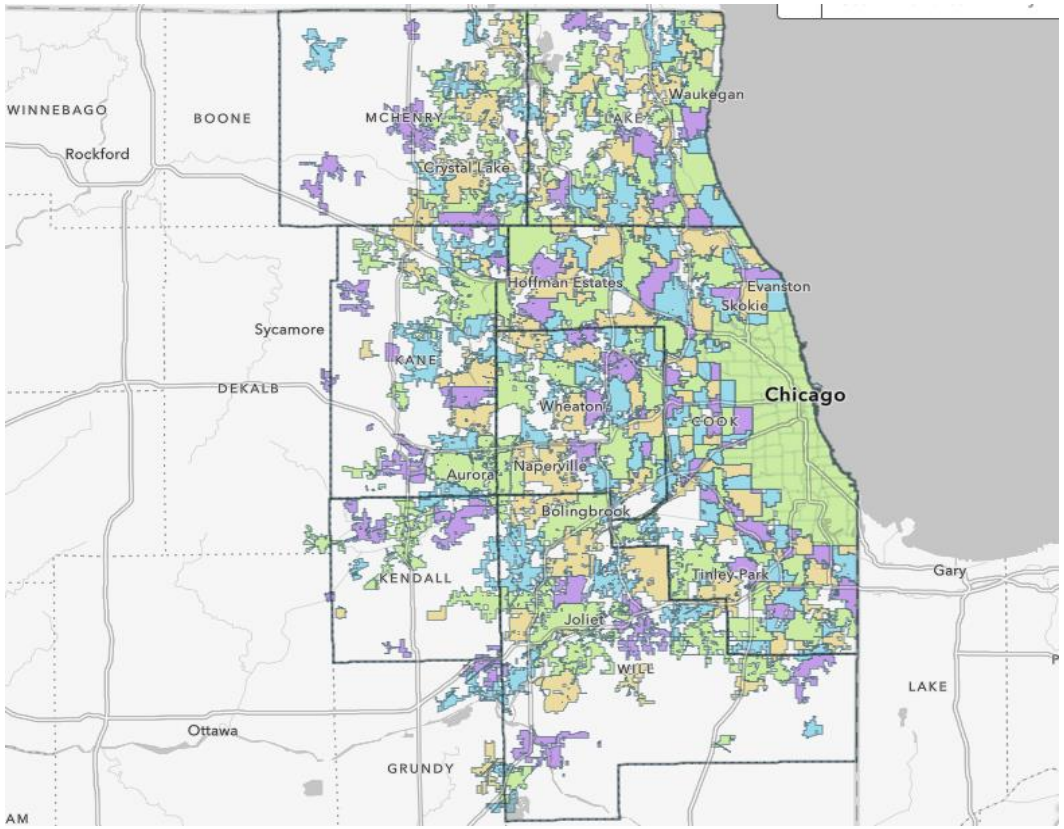
Advancing the state of Pedestrian Mobility across the Greater Chicago region with detailed infrastructure data

Since 2016, MPOs across Illinois have been working to establish a complete sidewalk inventory within their jurisdictions to:

1	**Improve their Pedestrian Infrastructure** To understand the options for expanding modalities of travel across the region, a detailed understanding of the current state of infrastructure is necessary.
2	**Ensure Compliance with Title 2 of the Americans with Disabilities Act** Title 2 of the ADA requires state and local governments to give people with disabilities an equal opportunity to benefit from all of transportation programs, services, and activities. As most claims filed tend to be focused on pedestrian infrastructure, it is critical to understand gaps in current infrastructure and have data to evidence the regions commitment to its Transition Plan.

Advancing the state of Pedestrian Mobility across the Greater Chicago region with detailed infrastructure data

As a result of the huge area CMAP is responsible for, the scalability of data analysis approaches was always top of mind as she had to not be able to just understand the infrastructure now, but also track its improvements as the city began to increase its accessibility.

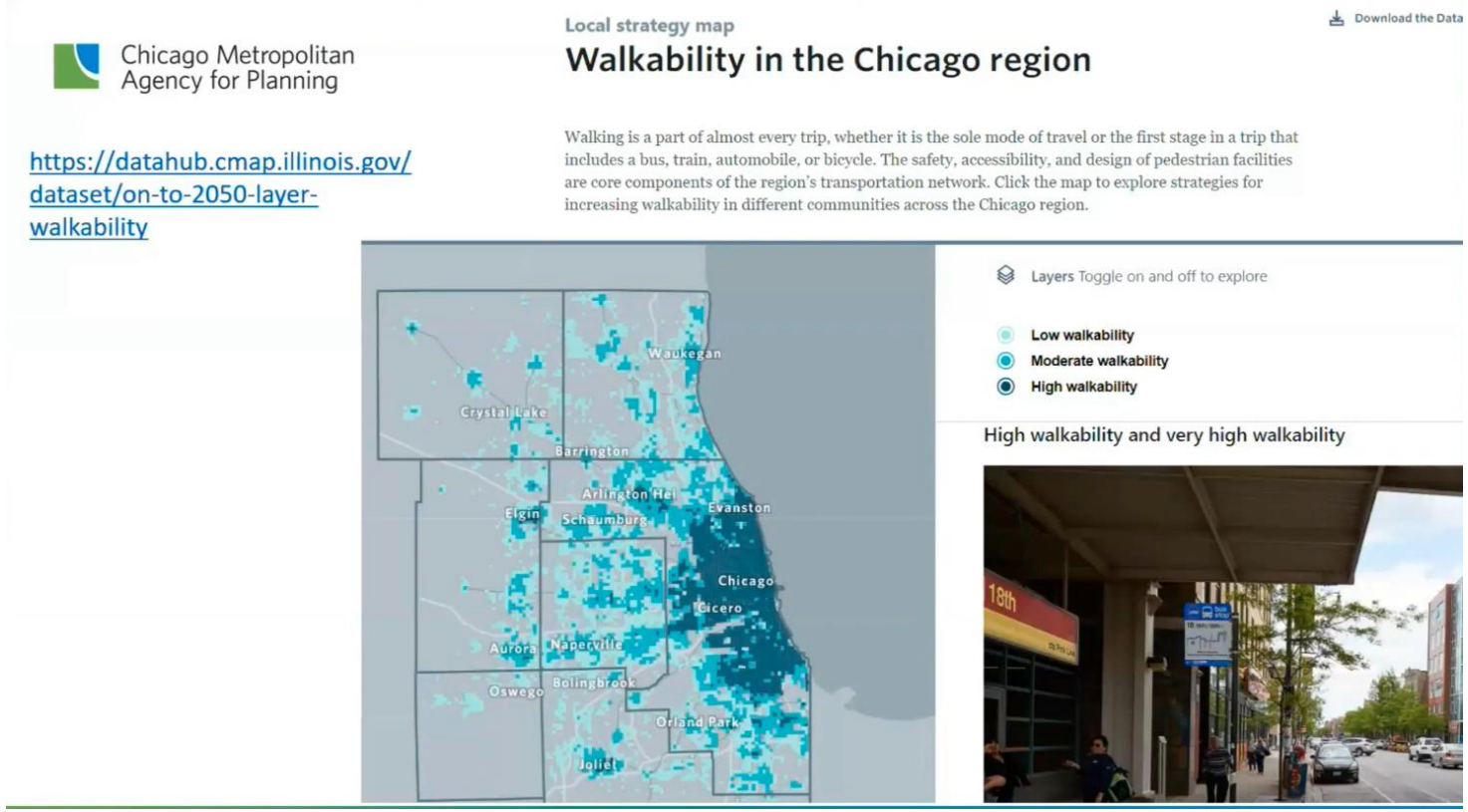


A screenshot of the 284 municipalities CMAP is responsible for.

Advancing the state of Pedestrian Mobility across the Greater Chicago region with detailed infrastructure data

The first approach the team at CMAP took was to assign a walkability score to the region by conducing an intersection density rating.

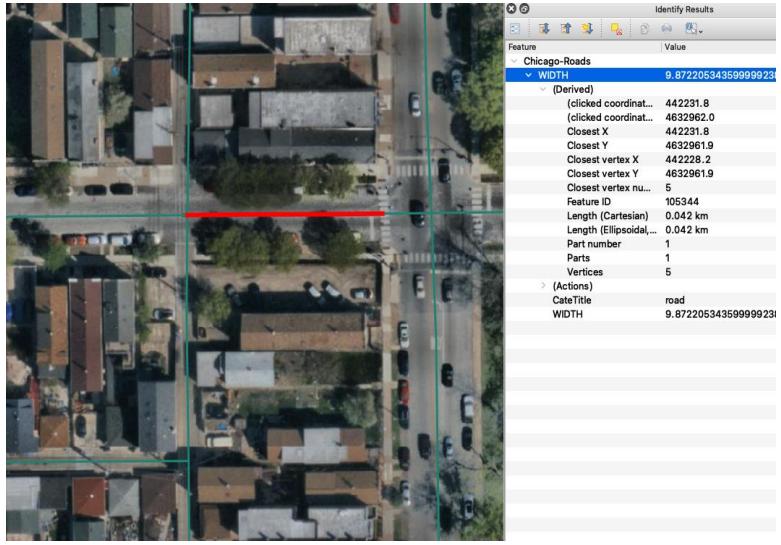
In this workflow, one would leverage the existing road centerline file, run a script to identify all the intersections in the road and then rank that roads walkability based on the number of intersections. The higher the number of intersections within a prescribed length, the assumption was that the more walkable the area would be.

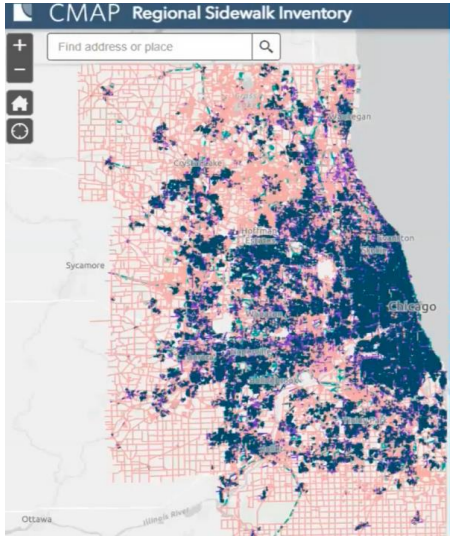


A screenshot of the walkability rankings originally established by CMAP in 2016.

Advancing the state of Pedestrian Mobility across the Greater Chicago region with detailed infrastructure data

Through discussions with partners across the region, it was agreed that this model was far too simplistic and didn't align with data standards. Therefore, the team established a new workflow to gather data that would be more detailed and accurate:





Step 1

Acquire Nearmap aerial imagery.

Step 2

Overlay road centerline file on Nearmap imagery and have 10 engineers survey the full 30,000 square mile region to mark sidewalks along the road.

Step 3

Analyze current state of Sidewalk infrastructure and plan for improvements based on Sidewalk ranking.

Advancing the state of Pedestrian Mobility across the Greater Chicago region with detailed infrastructure data

The new process was a monumental achievement, however the CMAP team was still looking to achieve more scalability. While the data was quite accurate they were still missing:

An efficient way to update the data

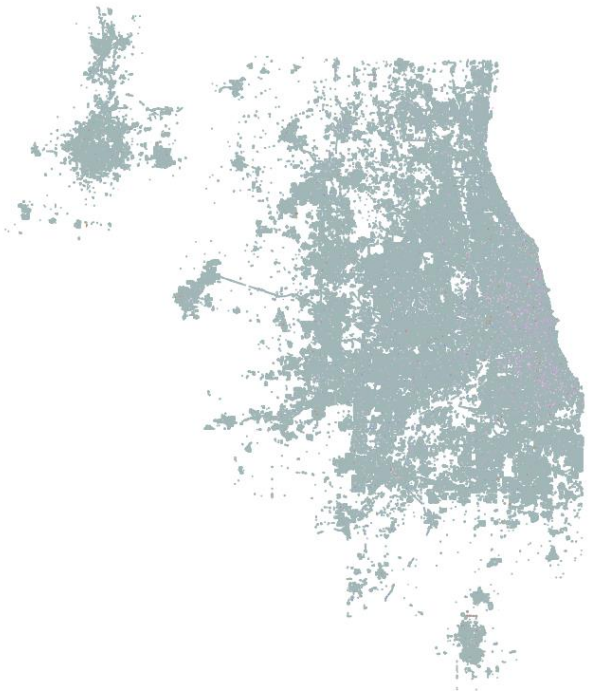
The manual method ***took over a year and 10 full time staffs time to complete***, making it expensive and hard to repeat. Additionally, the year timeline it took for this team to create the data, meant that it would be hard to maintain the data at a regular interval.

Geometries of the Pedestrian Infrastructure and its Locations throughout the Region

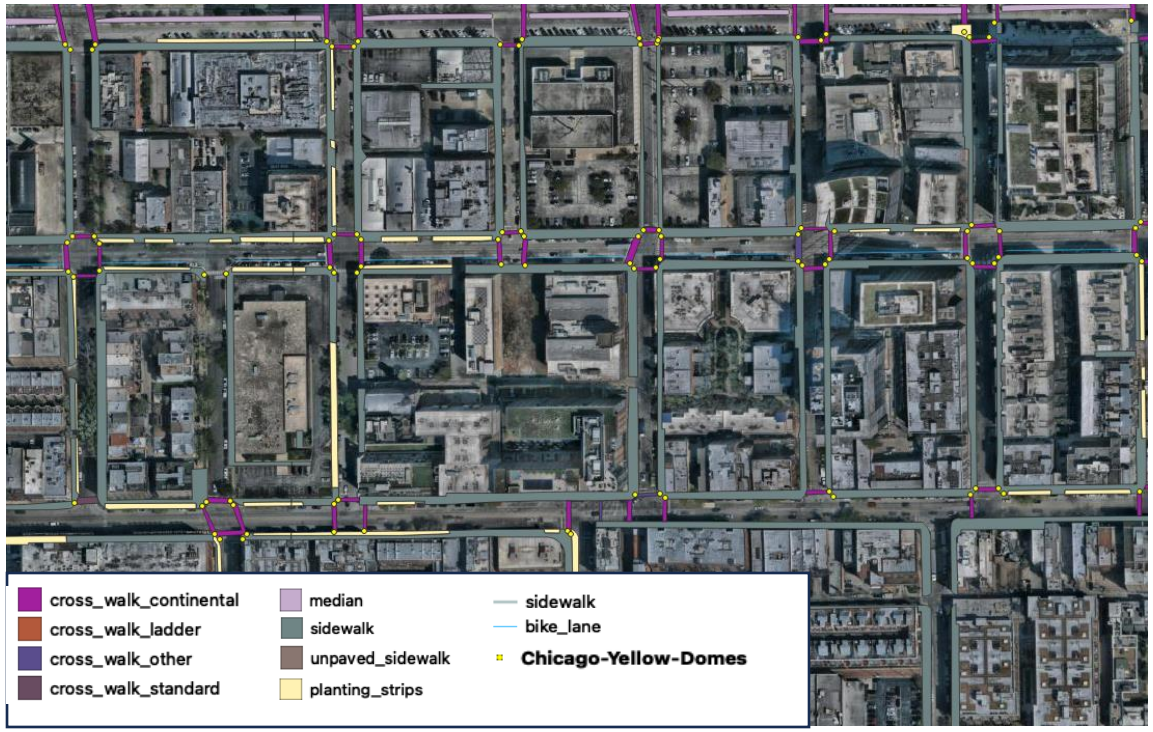
The previous method provided much more detail on the actual presence of a sidewalk, but its size (width) and location was not recorded. Width was particularly important as this is a key compliance metric for the ADA.

Advancing the state of Pedestrian Mobility across the Greater Chicago region with detailed infrastructure data

Despite the Ecopia's AI-enabled systems were leveraged to create a full pedestrian infrastructure network across the entire 30,000 sqm.



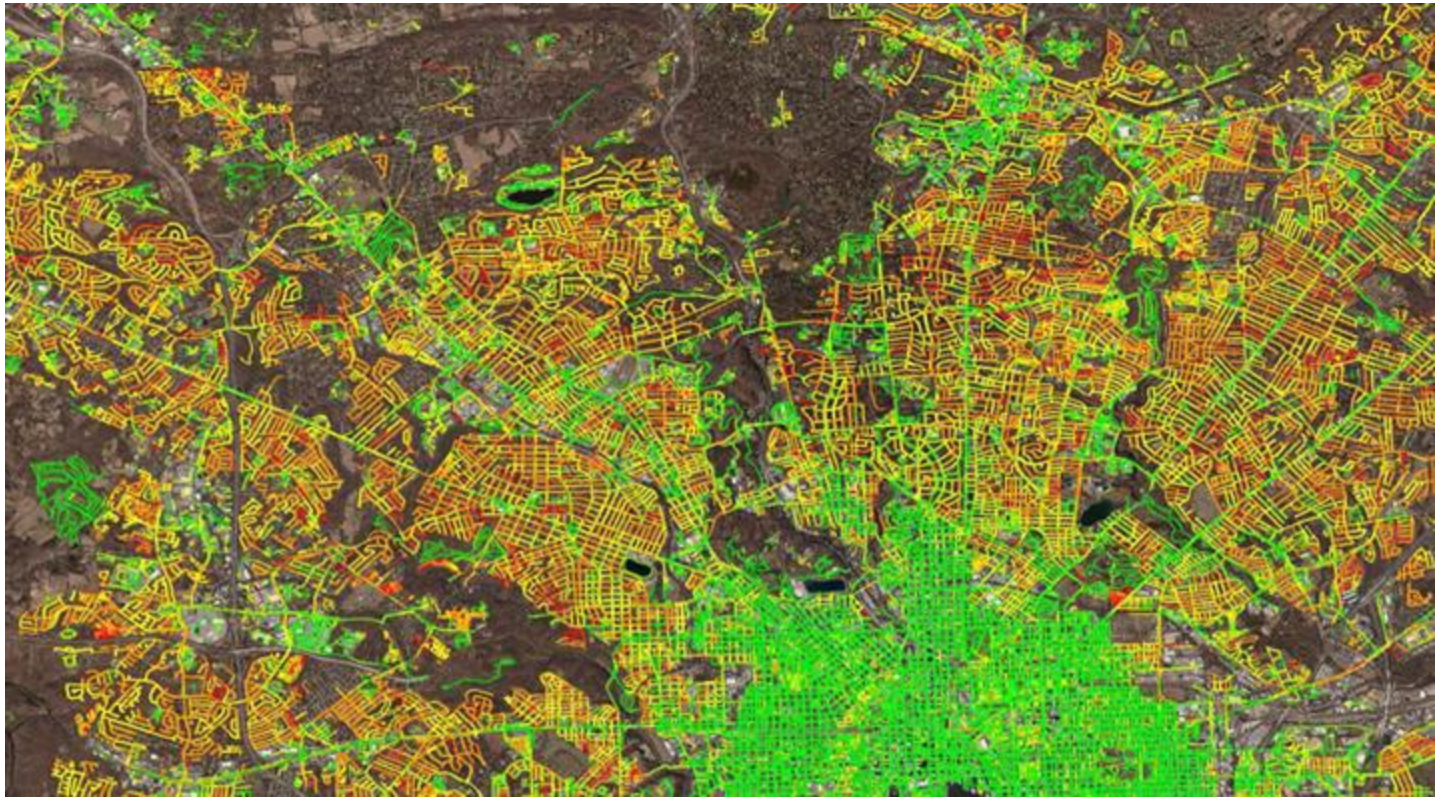
A zoomed-out screenshot of the full data created across the CMAP region.



A zoomed-in screenshot of the pedestrian infrastructure across the CMAP region.

Advancing the state of Pedestrian Mobility across the Greater Chicago region with detailed infrastructure data

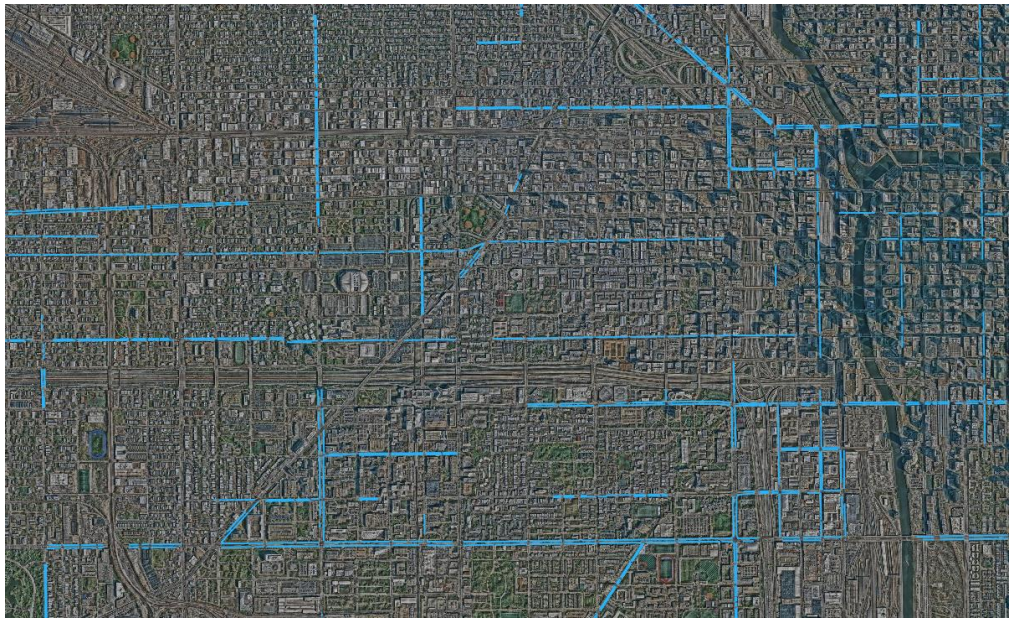
These individual feature vectors (instead of features tied to the road centerline) allow for advanced, asset specific analysis to be completed at scale. For example, with all the individual widths of the sidewalk data, it is feasible to quickly determine the level of ADA compliance and prioritize improvements. Then, as sidewalks are updated, and so is the vector data, there is evidence to demonstrate the regions commitment to bringing itself into full compliance.



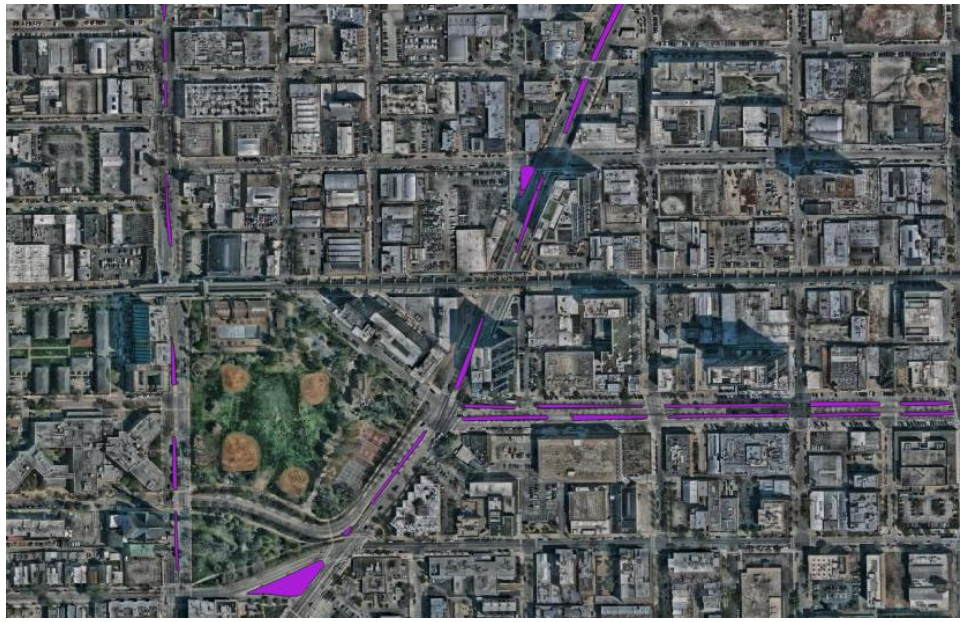
Compliant with 1990 Standards (<3ft) ADA Compliant Sidewalks (≥6 ft) PROWAG Standard (<4ft)

Advancing the state of Pedestrian Mobility across the Greater Chicago region with detailed infrastructure data

The additional features such as bike lane centerlines with a width attribute, medians with and without canopy, crosswalks and their types and truncated dome locations paint an even more detailed picture of what assets exist in the city which allow for non-automotive travel for both people with and without disabilities.

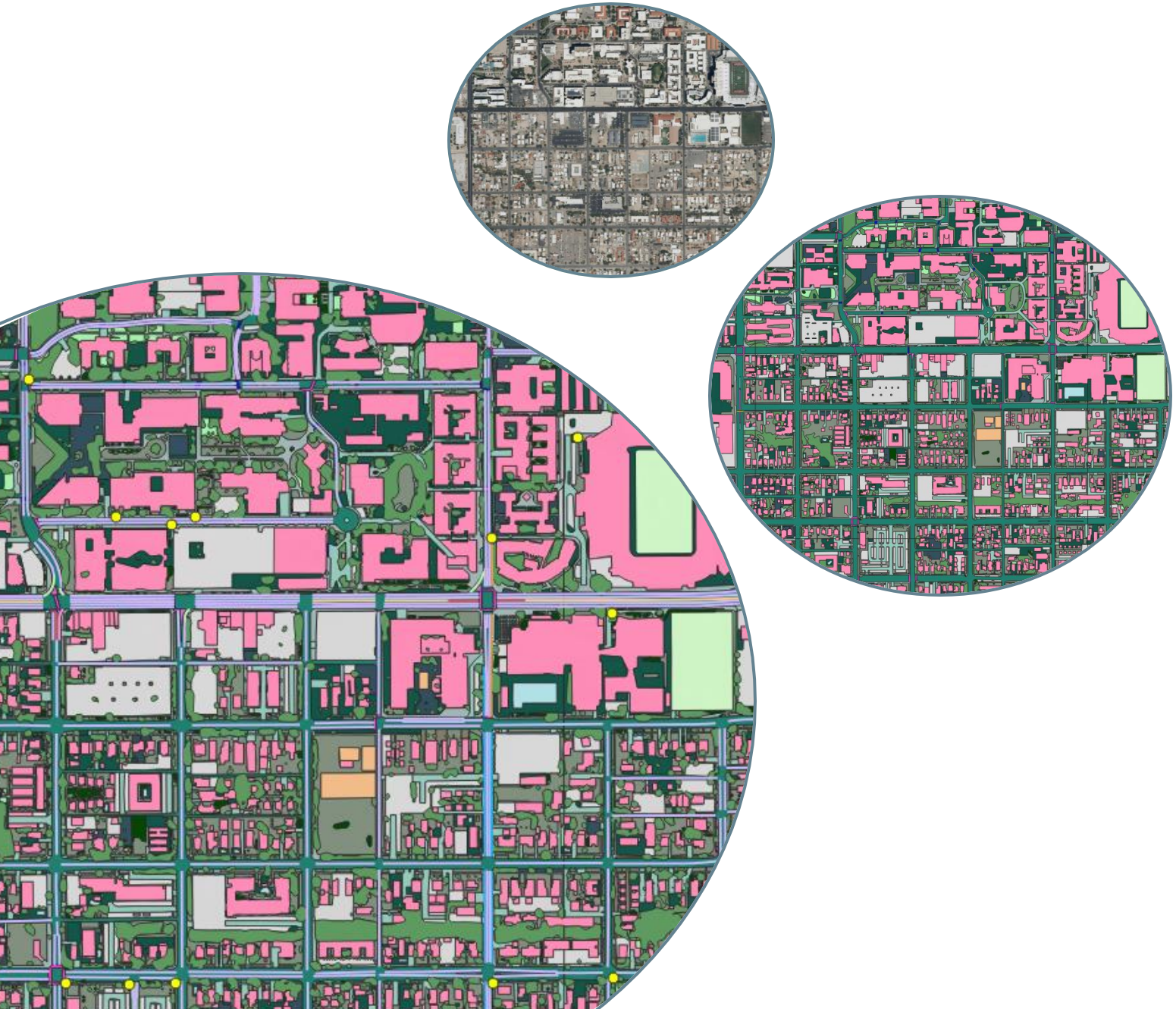


A screenshot of the bike lanes across downtown Chicago demonstrates many gaps within the network.



A screenshot of the medians (planted) across downtown Chicago demonstrates areas that are leveraging these breaks in the road and the success of their implementation can be further tracked when coupled with additional data like pedestrian fatalities, transit satisfaction etc.

Ecopia



Bringing Safety Assessments in alignment with USDOT's Vision Zero Goals

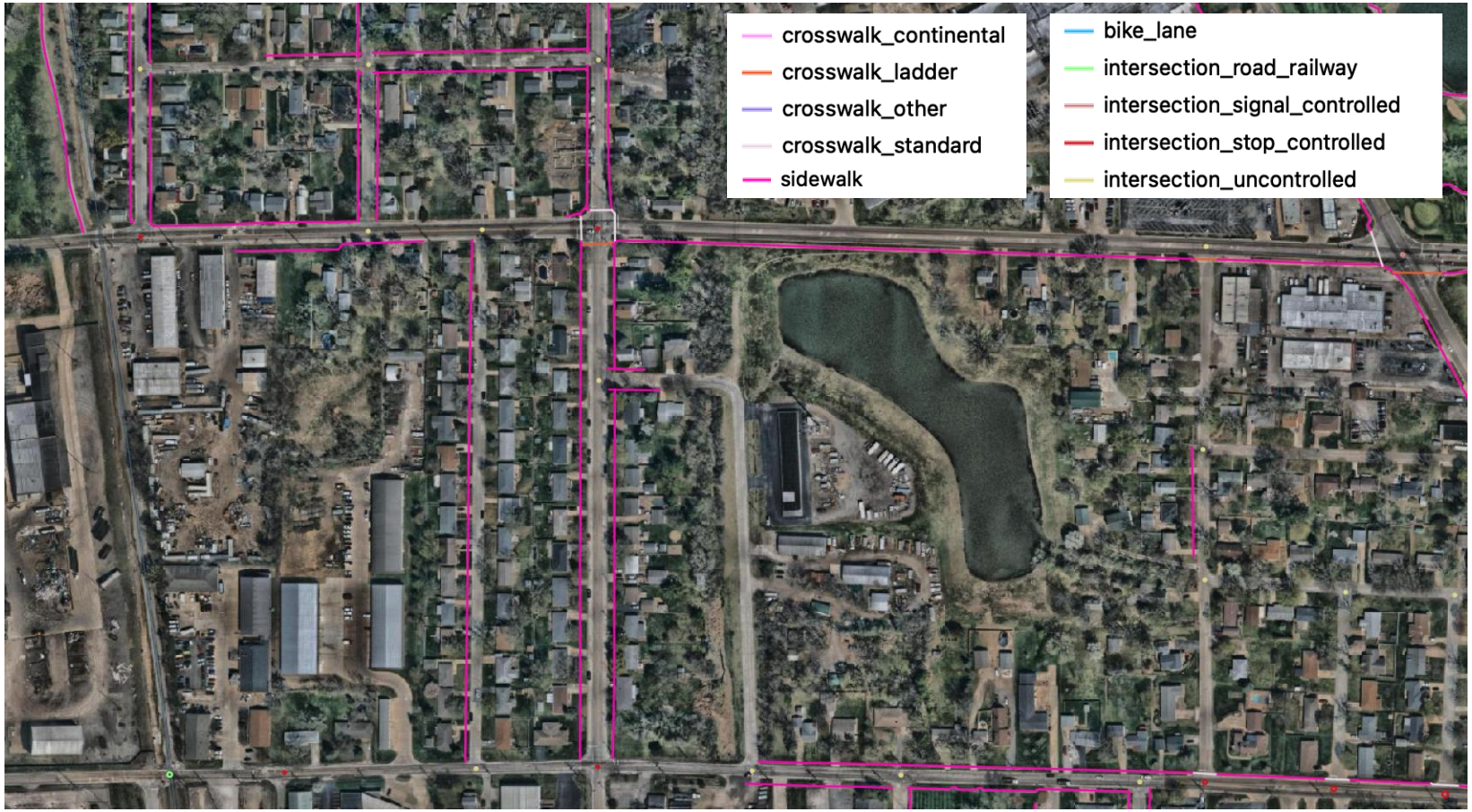
Striving towards complete networks to greatly reduce pedestrian crashes

To reduce abrupt crossings and unauthorized sharing of vehicular pathways by pedestrians, IDOT needed its MPOs to complete a network gap analysis.

The FHWA found that providing ***walkways separated from travel lanes*** can ***prevent up to 88% of crashes*** involving ***pedestrians*** walking along roadways, and reduces head-on, sideswipe, and fixed object crashes.

Striving towards complete networks to greatly reduce pedestrian crashes

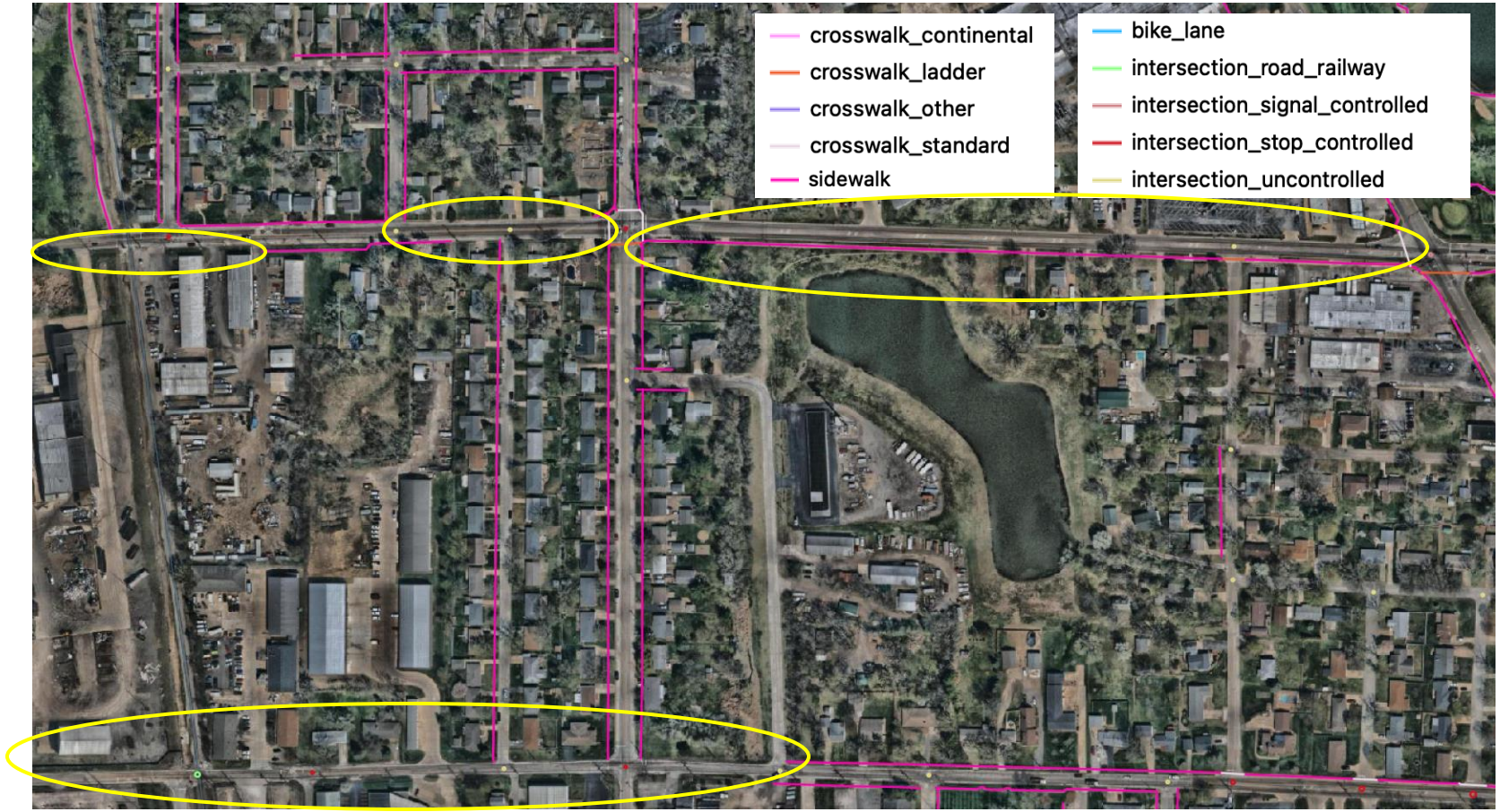
Vector data provides both visual indications of gaps as well as a foundational base for analytics to be run on top of to categorize the severity of network gaps.



A screenshot of the pedestrian related features Ecopia extracted that need to be analyzed to determine areas for improved safety.

Striving towards complete networks to greatly reduce pedestrian crashes

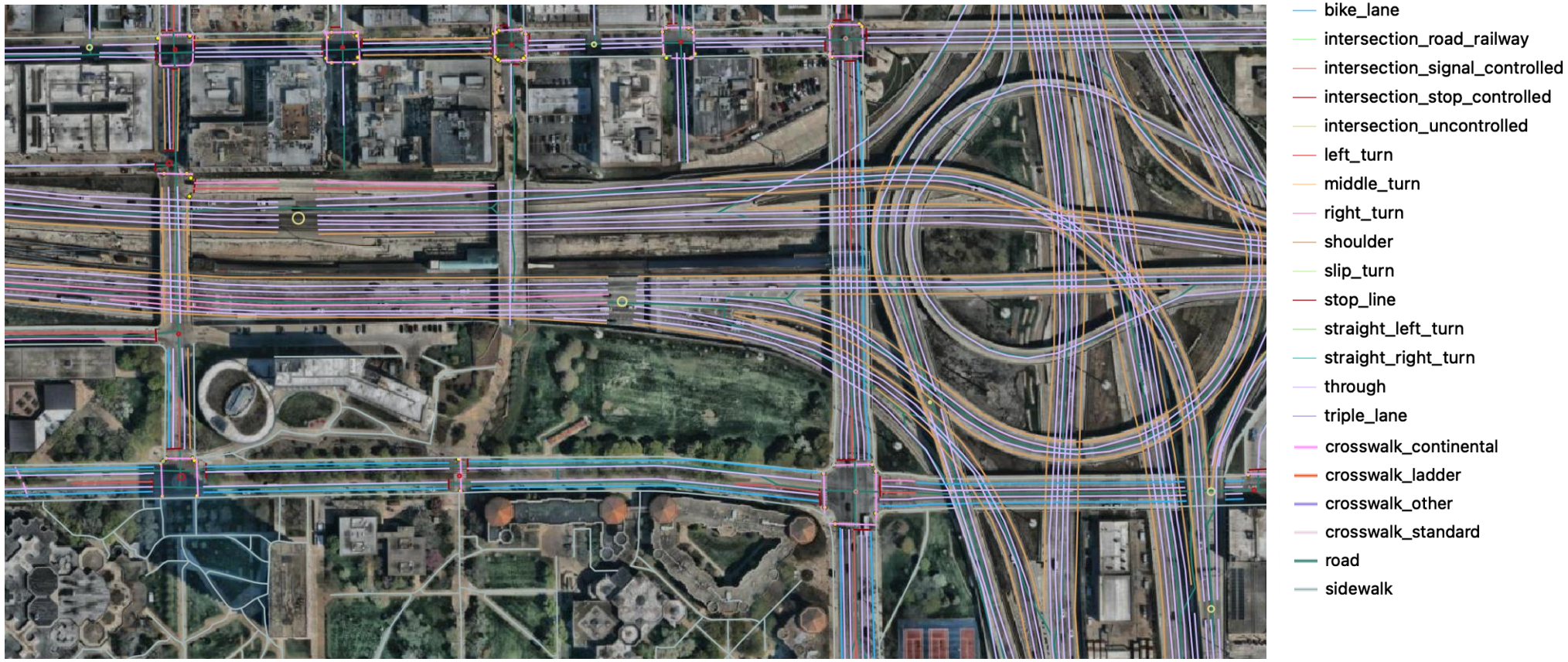
Vector data provides both visual indications of gaps as well as a foundational base for analytics to be run on top of to categorize the severity of network gaps.



A screenshot of the gaps in the infrastructure Ecopia's full network enables.

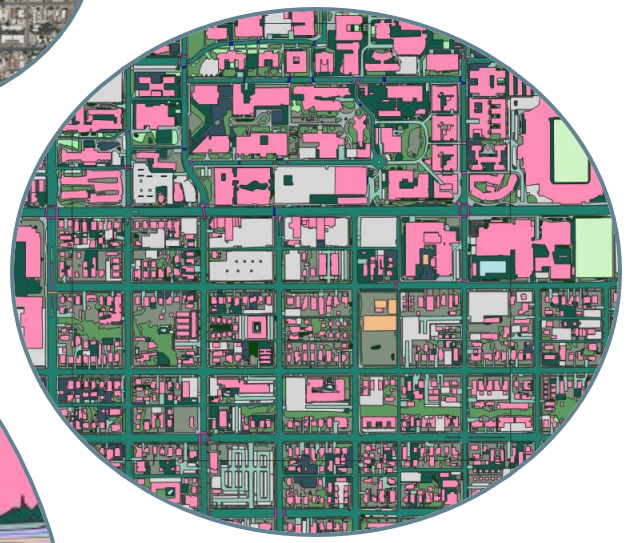
Striving towards complete networks to greatly reduce pedestrian crashes

The move away from centerline tied crash data enables a richer picture into the causes and potential solutions to crashes on our streets.



A screenshot of Ecopia's advanced lane data across Bloomington, Illinois.

Ecopia



High Fidelity Vulnerability Assessments & Climate Resiliency Planning

Leveraging High Resolution Land Cover to better assess climate risk across the State

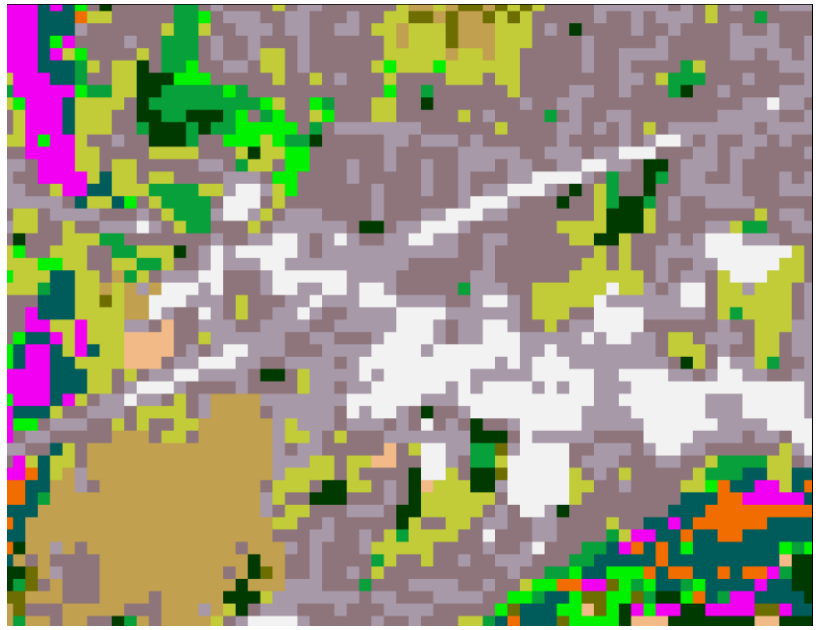
To better adapt our city's and nation's transportation infrastructure from the rising temperatures, fires, droughts, flooding, and severe weather that are exacerbated by climate change, a detailed understanding of the built and natural environment are critical.

Increases in Flooding

The increase in paved surfaces is resulting in less water absorption and therefore more flooding. This lack of water absorption is also polluting water sources. ***In 2022 Floods cost the US 2.1 Billion dollars.***

Growing Heat Islands

Paved surfaces absorb and re-emit the sun's heat more than natural landscapes, resulting in hotter cities and fatalities related to sicknesses induced by extreme heat. ***These medical costs have been estimated at 1 Billion dollars annually.***



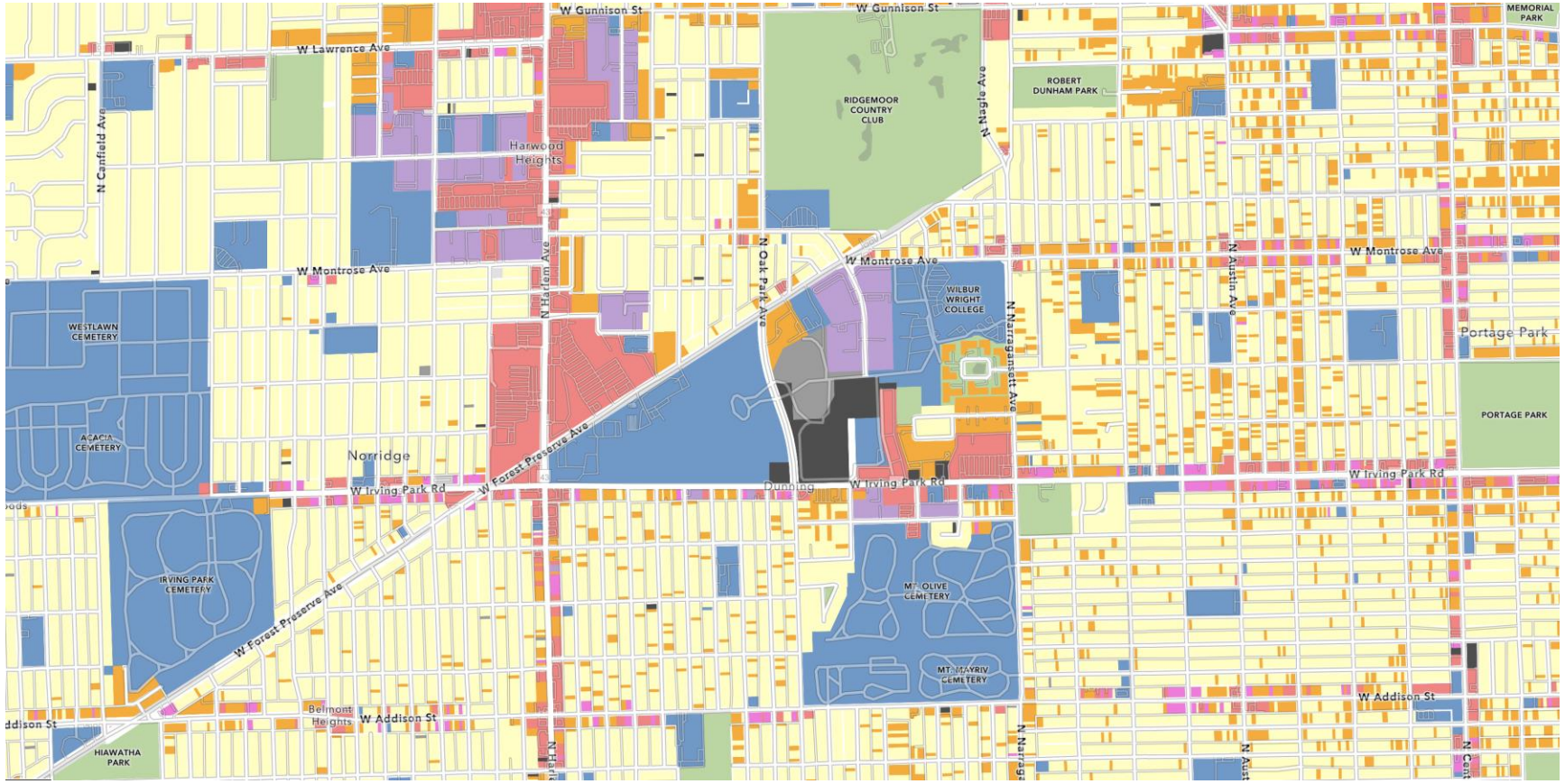
A screenshot of Traditional 30m land cover used for environmental analysis.

A screenshot of Ecopia's 15cm land cover in the exact area as the 30m land cover.

Leveraging High Resolution Land Cover to better assess climate risk across the State

The severe implications of increased pavement and extreme weather events necessitated increased granularity in land cover models for MPOs across Illinois' Flood Vulnerability indexes and Long-Range Resiliency Plan.

- Single-Family Residential
- Multi-Family Residential
- Commercial
- Mixed Commercial/Residential
- Industrial
- Institutional
- Open Space
- Agricultural
- Water
- Transportation/Communication/Utilities
- Under Construction
- Vacant

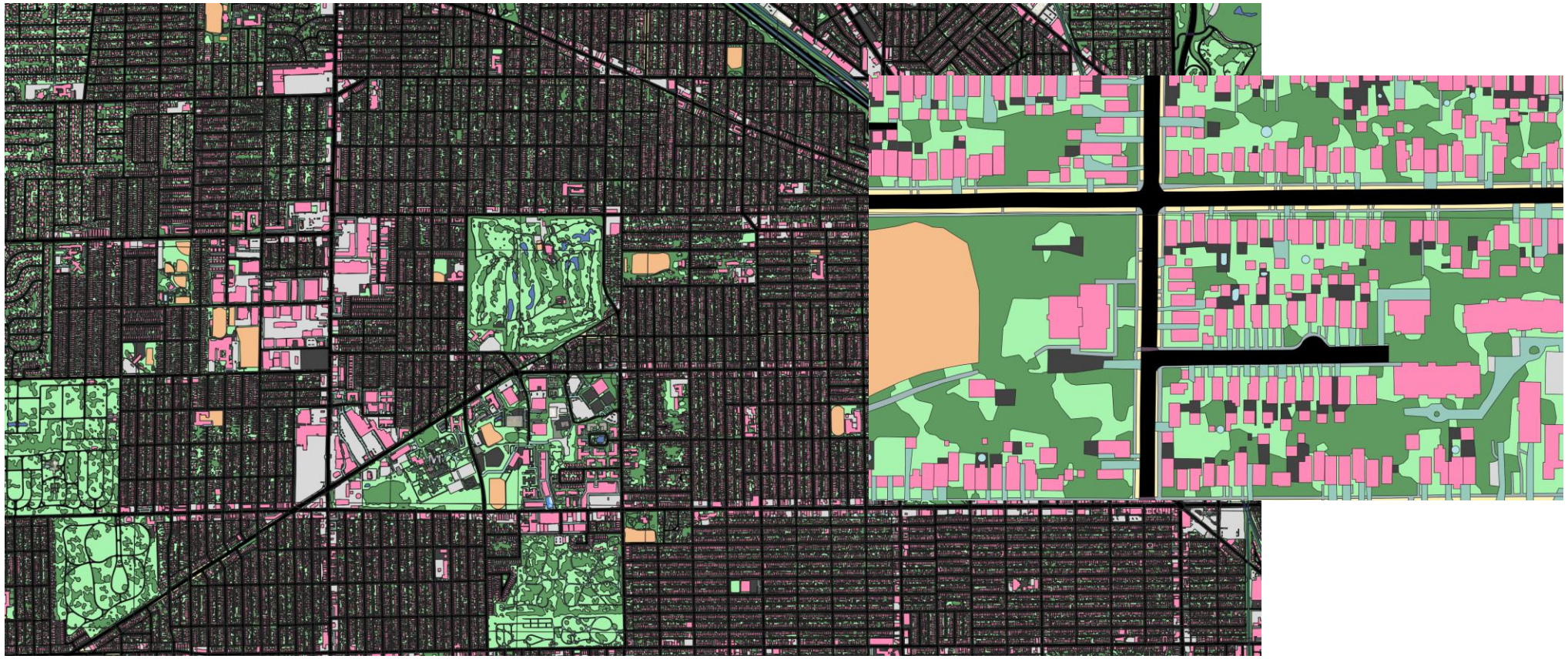


A screenshot in Norridge, Illinois, of the development-type centric land use vectors historically used by the planners in Illinois.

Leveraging High Resolution Land Cover to better assess climate risk across the State

The severe implications of increased pavement and extreme weather events necessitated improved land cover models for MPOs across Illinois' Flood Vulnerability indexes and Long-Range Resiliency Plan.

- bareland
- bridge
- building
- cross_walk_continental
- cross_walk_ladder
- cross_walk_other
- cross_walk_standard
- driveway
- forest
- grass
- median
- parking
- pavement
- planting_strips
- railway
- road
- sidewalk
- sport_ground
- swimming_pool
- unpaved_driveway
- unpaved_parking
- unpaved_road
- unpaved_sidewalk
- water

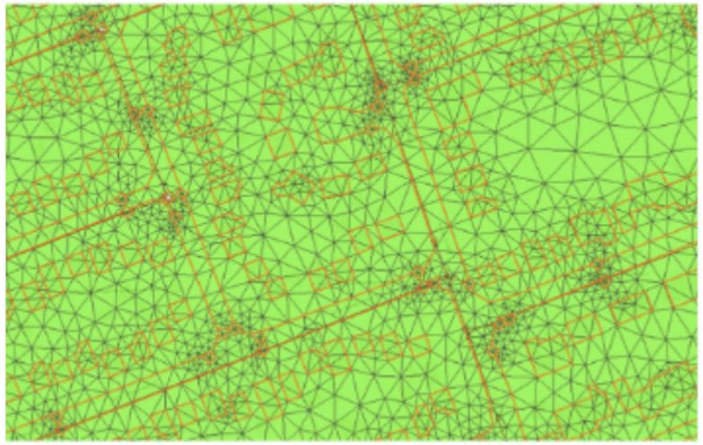


A screenshot in Norridge, Illinois, of the advanced land use vectors that provide detailed information about the built and natural environment.

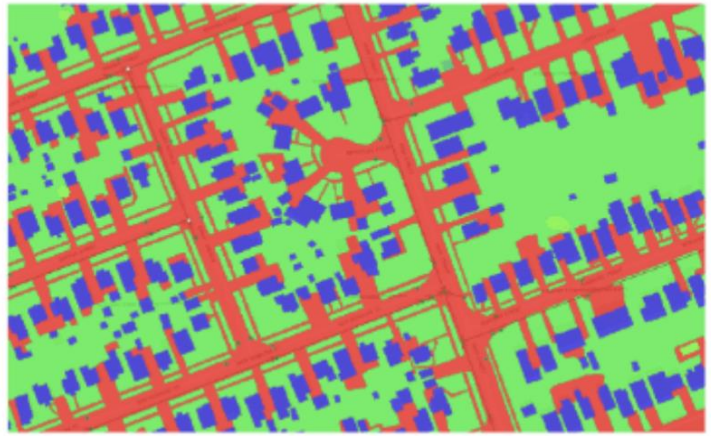
Leveraging Land Cover to better assess climate risk across the State

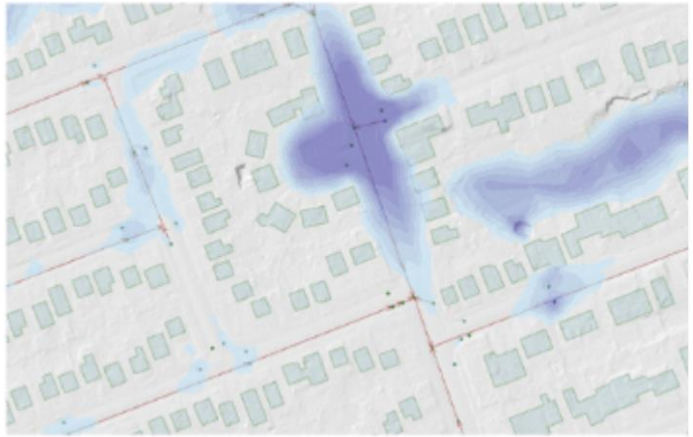
This land cover data is then used by the MPOs partner engineering firms, in conjunction with different water related datasets, to run flood models that represent reality.

Input 1:
Flexible 2D mesh to model surface flow.

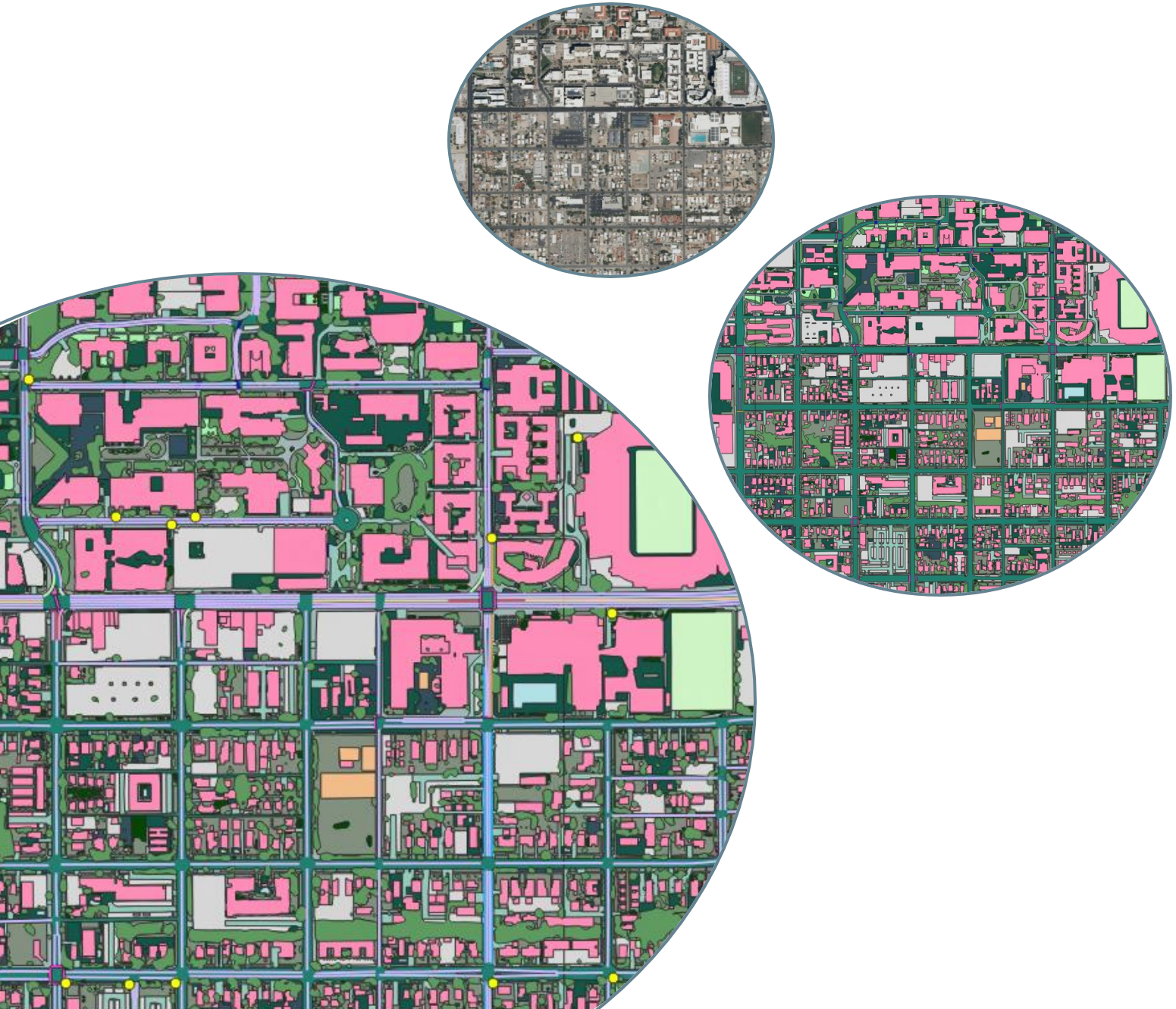


Input 2:
The IFM's surface roughness layer derived from Ecopia's land cover data.





Output:
Layer of flood extents based on the other two layers and including the area's pipe network.



Questions?

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