THE OHIO STATE UNIVERSITY

Using machine learning to extract data from historical maps:
The Ghost Neighborhoods of Columbus project

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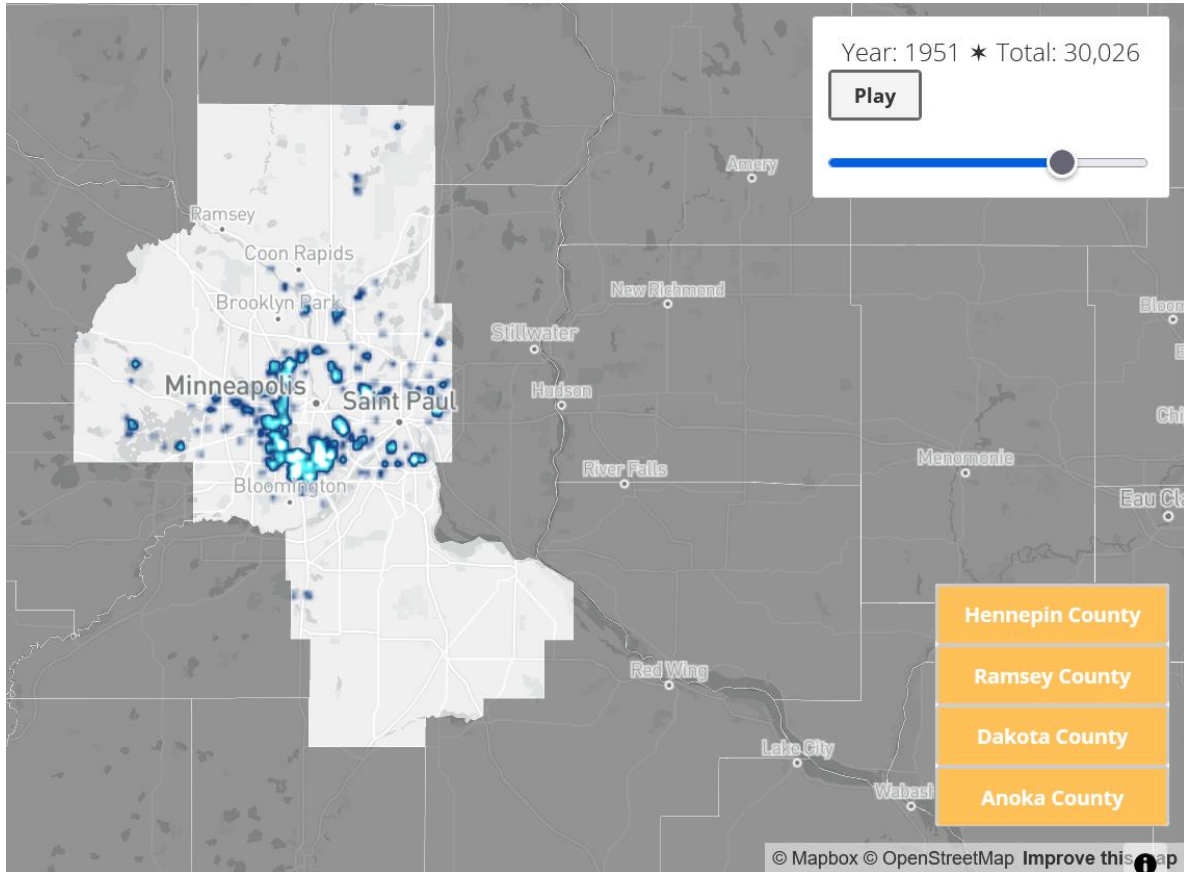
MORPC Data Day
7 February 2024

Introduction

"Soft" urban data

- City directories

- Real estate deeds

- Tax records

- Maps

- Newspapers

- A wealth of data locked in historical documents

- Increasingly available as scanned documents

City directory for Mt. Vernon Ave, Columbus,1951
Source: Columbus Metropolitan Library

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MAPPING PREJUDICE
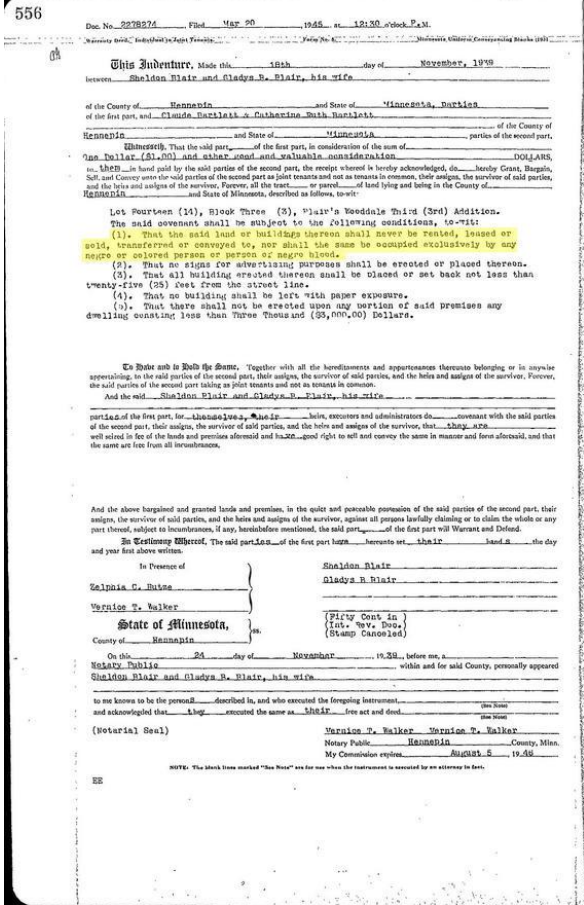
Visualizing the hidden histories of race and privilege in the built environment

What is a Covenant?   About the Project

Year: 1951 ✳ Total: 30,026

Play

Hennepin County

Ramsey County

Dakota County

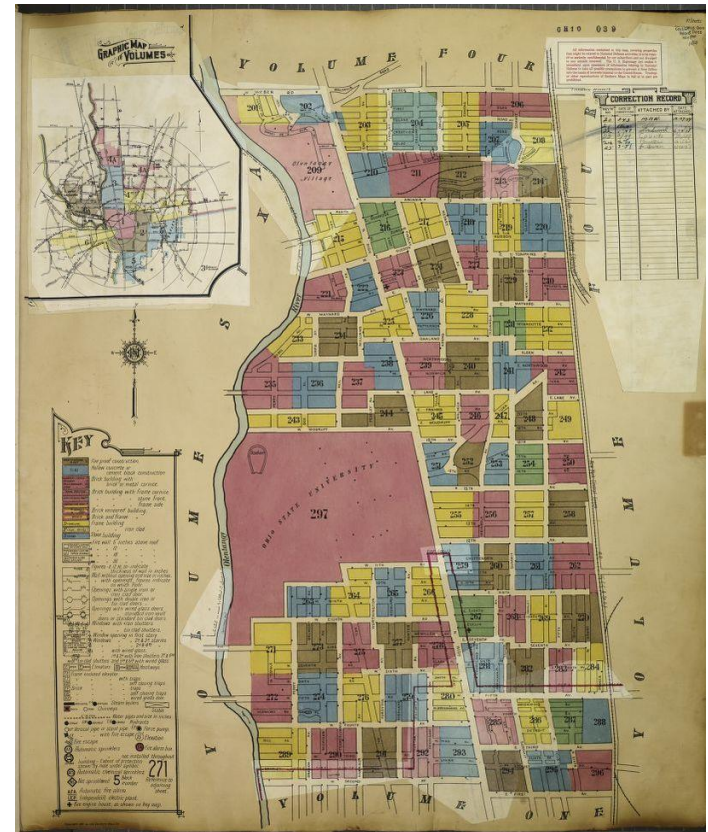Anoka County

© Mapbox © OpenStreetMap **Improve this map**

Introduction

Sanborn Fire Insurance maps

- Building level maps
- Columbus: 1887, 1891, 1901, 1921-1922, 1940, 1951, 1961

Availability

- OSU Library – print and microfilm
- Ohio Public Library Information Network – B&W only
- Library of Congress – *full color high resolution scans*

KEY

TILE (4); BRICK (4); PYROBAR (4)	Fire proof construction. (OR FIRE RESISTIVE CONST'N)
ADOBE	Adobe building.
HEIGHT OF BUILDING IN FEET FROM GROUND TO ROOF LINE	Stone building.
(C. BR.)	Concrete, lime, cinder or cement brick
(C. B.)	Hollow concrete or cement block const'n
(CONC)	Concrete or reinforced concrete const'n
(TILE)	Tile building.
NUMBER OF STORIES 4	Brick building with frame cornice.
TWO STORIES AND 8 FT COMPOSITION ROOF	" stone front.
	" " frame side. (DIVIDED BY FRAME PARTITION)
SHINGLE ROOF X	Brick veneered building.
(VEND)	" and frame building.
BRICK LB'T	Frame building, brick lined.
FRAME, BRICK LINED	" " metal clad.
F FLAT S STORE	Frame building.
D DWELLING	Iron building.
A in B AUT'N IN B'M'T	Tenant building occupied by various manufacturing or occupancies
LOFT	Frame building covered with asbestos
(ASB. CL.)	
NON-COMBUSTIBLE ROOF COVERING OF METAL, SLATE, TILE OR ASBESTOS SHINGLES	Brick building with brick or metal cornice.

DWELLINGS.

☞ Framed air-shafts are shown but colored over. Brick air-shafts are left white.

CLASSIFICATION OF BUILDINGS
Shown by varying number of dots or circles. Classed by New York Board of Fire Underwriters as follows:

BRICK	FRAME
1st Class (.) Slate or metal roof, coped walls.	1st Class (.) Slate or metal roof.
2nd " (..) " " walls not coped.	2nd " (..) Shingle roof.
3rd " (...) Shingle roof.	

Frame Buildings with BRICK FRONTS.

Height of Buildings, in Stories and feet (74 ft. 6 in. and over).

Fronts of marble or other stone.

Iron Fronts.

"Dotted line." Interior brick wall, omitted on one or more floors.

Superior construction. { Built of non-inflammable material "throughout," except flooring and trim. }

Communications protected by single fire-proof doors. { With designation of floors. } " " double " }

Openings exposing Buildings.

Elevators with steam or other power. { Where enclosed with Brick or Fire-proof material a heavy line is drawn around them. }

Hatchways or "Dumb-waiters."

Sky-lights in Roof only.

" over Opening in floor.

Smoke-houses. Retorts, and Ovens.

Mansard Roofs. Corrugated Iron. Steam-boilers.

REFERENCE.

SPECIAL HAZARDS.

NAMES of Manufactories, &c., are written on buildings, when there is sufficient space, and their construction classified by the same marks as on Dwellings. Other Specially Hazardous Risks are COLORED GREEN, the varying number of dots (brick) and crosses (frame) showing the comparative danger from fire by occupancy.

NOTE.—In classifying a building as a Special, its CONSTRUCTION is obliterated, necessitating a series of letters, as follows:

BRICK		FRAME	
A Construction = to 1st class Warehouse.		G Construction = to 1st class Store or Dwelling.	
B " " = " 2nd "			
C " " = " 3rd "		H " = to 2nd class Store or Dwelling.	
D " " = 1st " Store or D'w'g.			
E " " = " 2nd "			
F " " = " 3rd "			

Brick (.) (x) Frame

Bakeries (ovens in building). Breweries. Cooperages. Drug stores (retail, with privilege of compounding). Dyeing establishments. Fur dressers. Glass stainers. Hat finishers. Hay (open stock, loose). Lamp sellers (privilege for kerosene &c.) Laundries. Malt houses. Manufactories of Baskets, Bonnet-frames, Boots and shoes, Caps, Clothing, Combs, Envelopes, Feather dusters, Fringe &c., Gas fixtures, Gold pens, Hats, Hemp, Jewelry cases, Morocco, Paper bags, Pocket-books, Ruffling and ruches, Segars, Shirts, Tobacco, Umbrellas, Vinegar, Watches, Watch-cases, Writing ink. Map mounting and varnishing. Metal mills. Molasses houses. Photographers. Private stables. Smoke-houses. Tanneries. Tin-shops. Wheelwrights. Wire workers. Wool-pullers.

Brick (.:) (x) Frame

Bleaching works. Book-binderies. Brass and iron foundries. Coppersmiths. Cotton presses. Fulling mills. Junk shops. Letter-press printers. Lithographers. Livery and Cartmen's stables. Machine shops. Manufactories of Agricultural Implements. Artificial flowers, Brooms, Brushes, Carriages, Cedar-ware, Floor-cloth, Grates, Guns, Hoop-skirts, Jewelry, Lamps, Musical instruments, Oil-cloths, Paper boxes, Paper collars, Paper patterns, Patent Medicines, Plated ware, Rope and cordage, Safes, Silverware, Starch, Stoves, Tin cans, Upholstery. Oil stores (petroleum and products). Print works. Rag stores. Slaughter houses. Snuff mills. Type and stereotype foundries. (And generally buildings not occupied by workers of light wood.)

Brick (:::) (x) Frame

Box repairing. Cabinet-making. Carpenters' shops. Distilleries. Flax mills. Flour or Grist mills. Japanners. Lard refineries. Manufactories of Artificial hair, Bagging, Candles, Chairs, Clocks, Confectionery, India-rubber or gutta-percha, Ivory or lampblack, Looking-glass and Picture frames, Oiled clothing, Organs, Paper-hangings, Perfumery, Pianos, Soap, Trunks. Oil mills. Paper mills. Rectifying establishments. Sugar refineries. Tallow-melting or chandleries. Wholesale druggists (with compounding). Woolen mills. (And generally risks where much heat or light wood is used.)

Brick (::::) (x) Frame

Chemical laboratories. Coffee and Spice mills. Drug mills. Fireworks on sale. Match factories. Oil-boiling houses. Planing and Moulding mills. Printing-ink factories. Sash, blind and door factories. Saw mills. Tar-boiling houses. Turpentine distilleries. Varnish making. Window-shade factories.

Ghost Neighborhoods project

Objectives

- Reconstruct historical neighborhoods damaged by highways, redlining, urban renewal
  - Historical Sanborn Fire Atlas data
  - Machine learning, GIS + 3D urban modeling
  - Columbus, and beyond
- High resolution digital reconstructions
  - Parcels, buildings – footprint, floors, construction material, usage
- Products
  - 3D urban model (LOD 4 – External detail)
  - Realistic/immersive visualizations
  - Built environment measurements and analytics

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Methods: General workflow
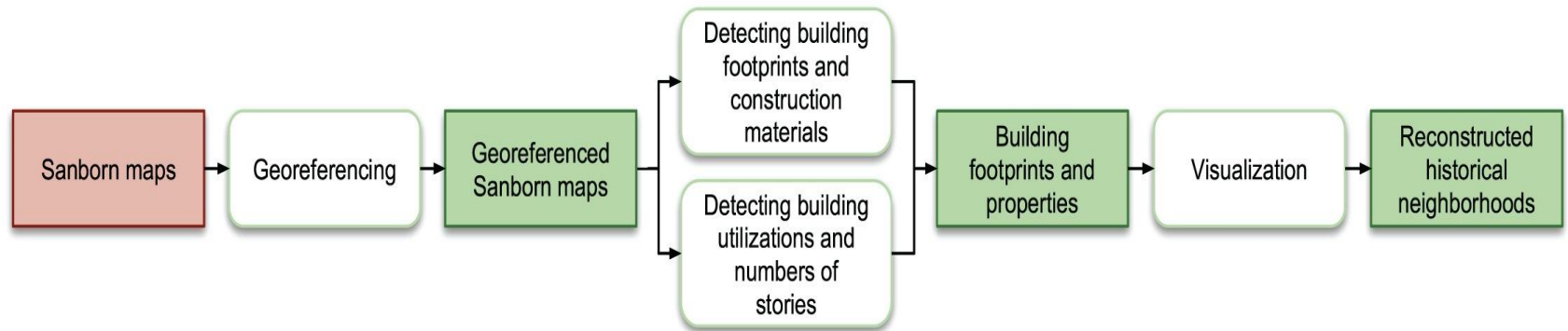
Orange-pink rectangle: input data
Open rounded rectangle: operation
Green rectangle: Intermediate or final output.

Methods: Georeferencing
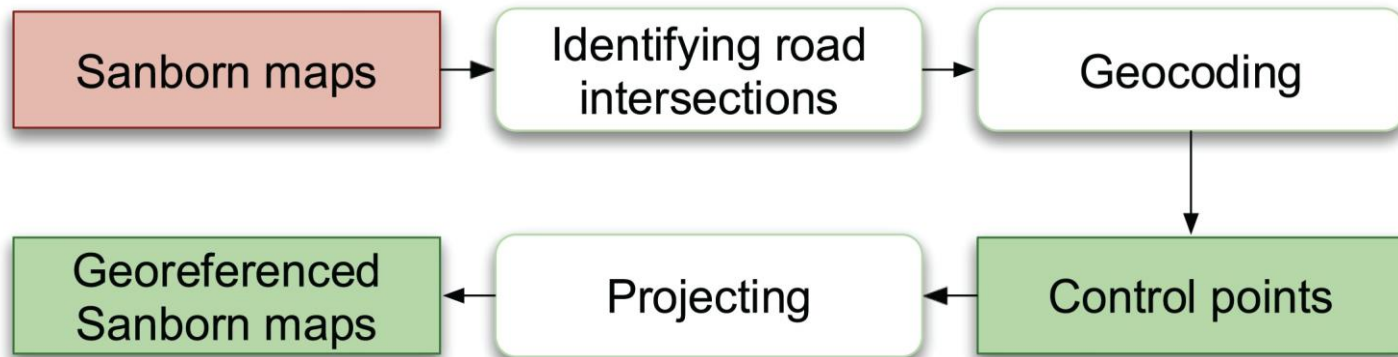
Orange-pink rectangle: input data
Open rounded rectangle: operation
Green rectangle: Intermediate or final output.

Methods: Pixel-based classification
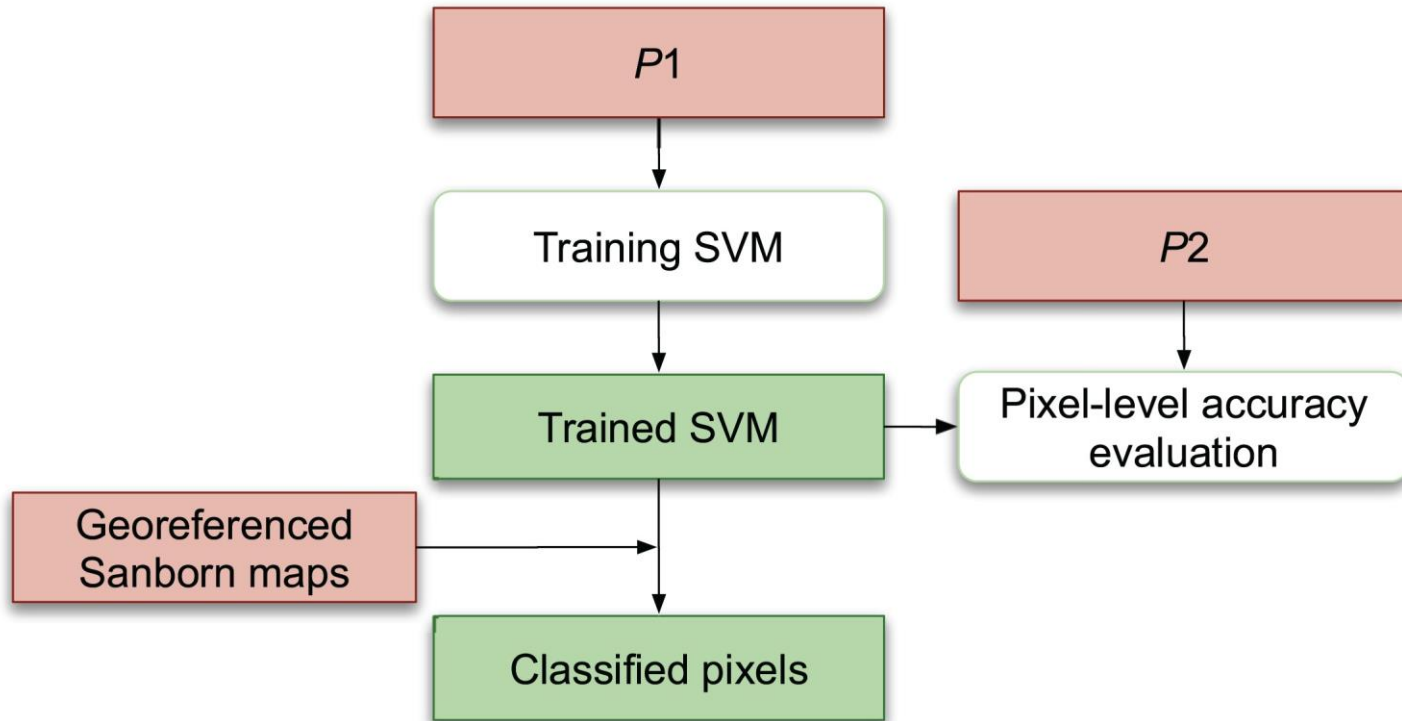
Orange-pink rectangle: input data
Open rounded rectangle: operation
Green rectangle: Intermediate or final output
P1: Training data
P2: Evaluation data

Methods: Post-processing
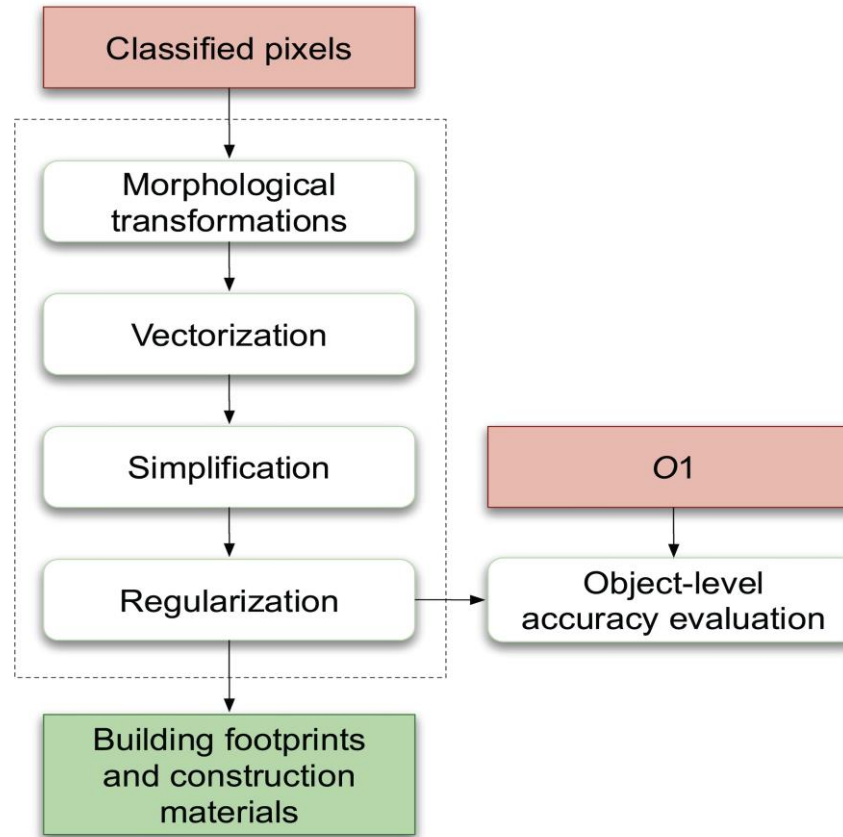
Orange-pink rectangle: input data
Open rounded rectangle: operation
Green rectangle: Intermediate or final output
O1: Manually identified buildings

Methods: Building use and number of stories
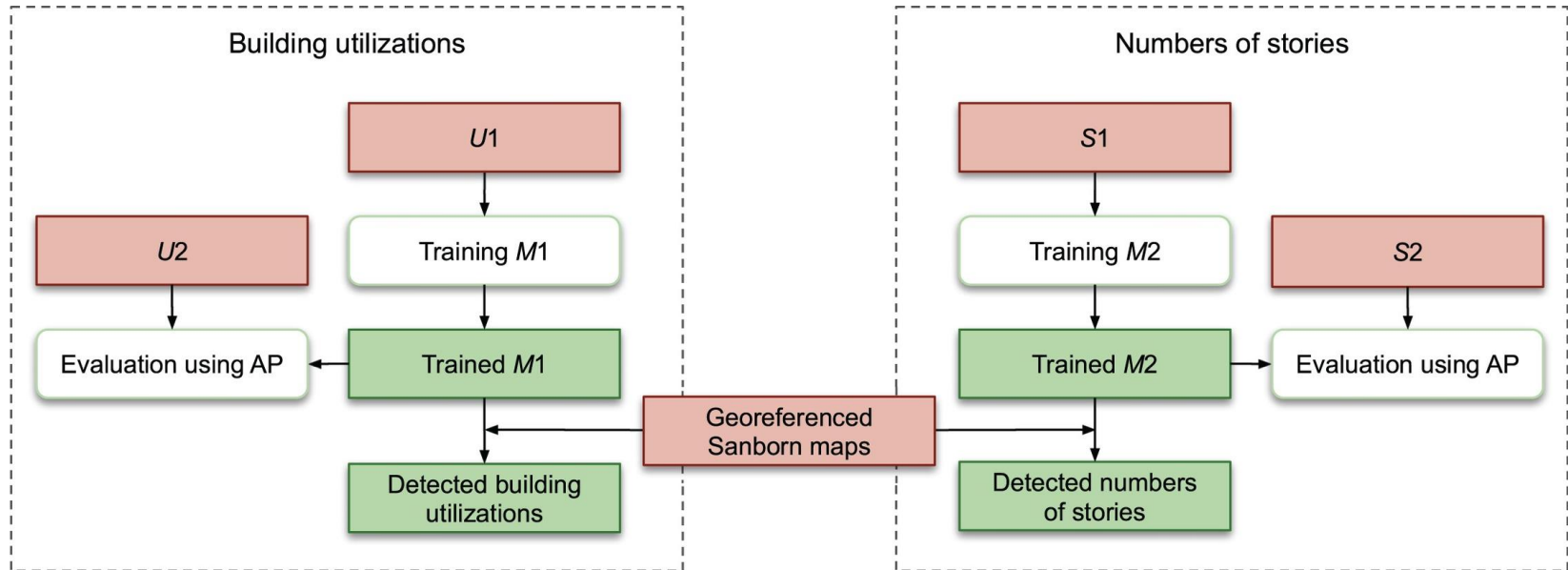
Orange-pink rectangle: input data
Open rounded rectangle: operation
Green rectangle: Intermediate or final output
U1, S2: Training data
U2, S2: Evaluation data

Results
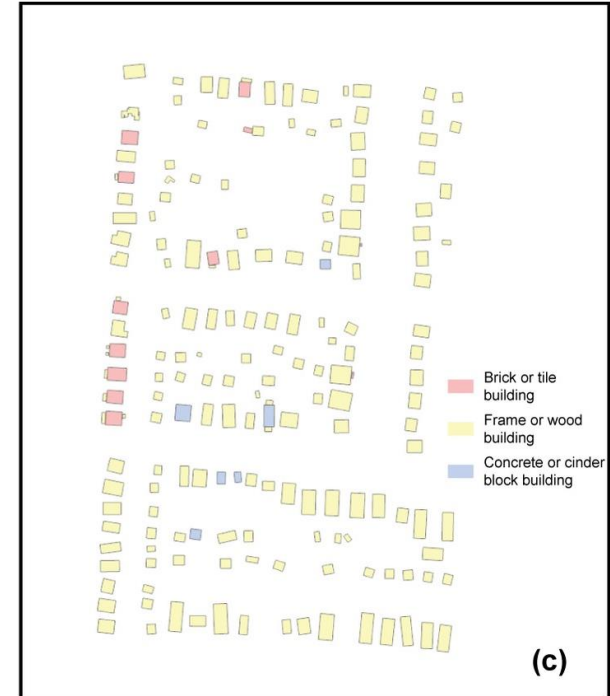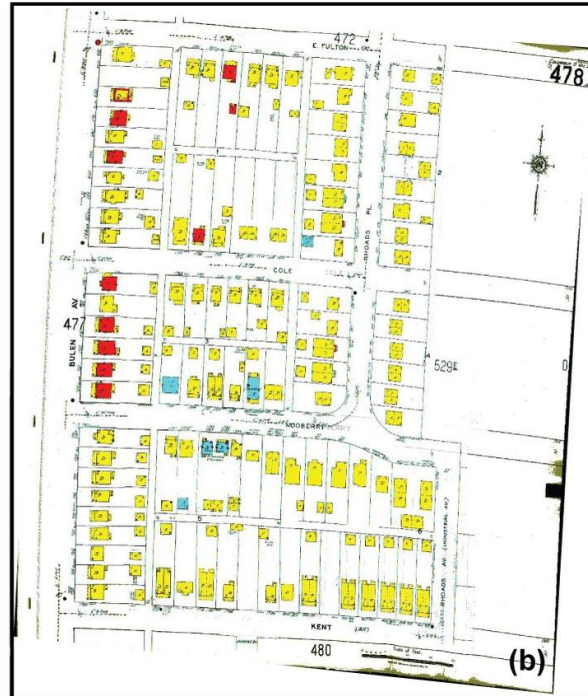
Detected building footprints and construction materials on a georeferenced Sanborn map

(a) georeferenced Sanborn map, (b) pixel-based classification (c) vector building objects after post-processing.

Results

Detected building utilizations and numbers of stories

White text indicates confidence scores

First generation product:
Abstract buildings

Second generation product:
Realistic buildings

Third generation product:
More accurate buildings

THE OHIO STATE UNIVERSITY

Department of Geography
Center for Urban and Regional Analysis (CURA)

Continuing work

Enhancements

- Accurate textures

- Building heights

- Data

  - Ground-level imagery – historic and current

  - Architectural designs (when available)

  - Newspapers, advertisements (commercial buildings)

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Continuing work

Other improvements

- Street addresses

- Building descriptions

- Missing streets

- Landscapes surrounding the buildings

Current study sites

- Hanford Village in 1961

- Poindexter Village in 1940

- Mt Vernon Ave in 1951

- Flytown in 1921
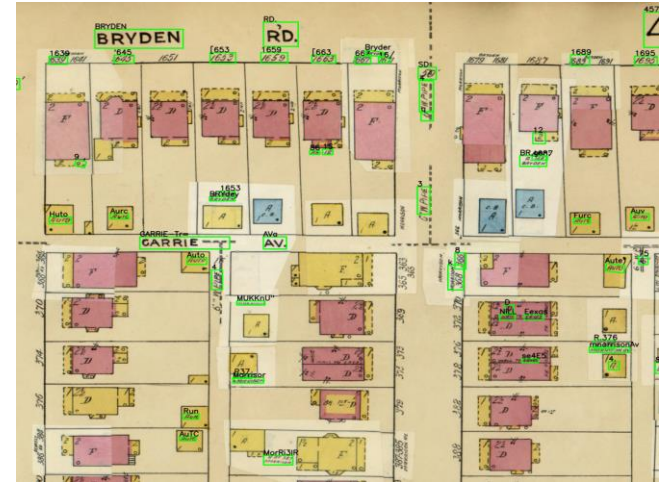
Orthophoto of near east side, Columbus, 1955 (Source: Ohio Department of Transportation)

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How highways destroyed Black neighborhoods in the '60s, as told by elders who were there

Residents of Hanford Village and King-Lincoln/Bronzeville experienced the destruction of their neighborhoods due to the construction of freeways.

Erica Thompson, The Columbus Dispatch
Published 6:00 AM EST Dec. 3, 2020 | **Updated 6:00 AM EST Dec. 3, 2020**

Born in 1949 in Hanford Village, an African American neighborhood on the Near East Side, Shirley Mixon had a childhood right out of a book about 1950s suburbia.

Neighborhoods ripped apart

The construction of interstate highways frequently divided predominantly Black neighborhoods, including Hanford Village, Bronzeville and Flytown — shown here with their approximate original boundaries.
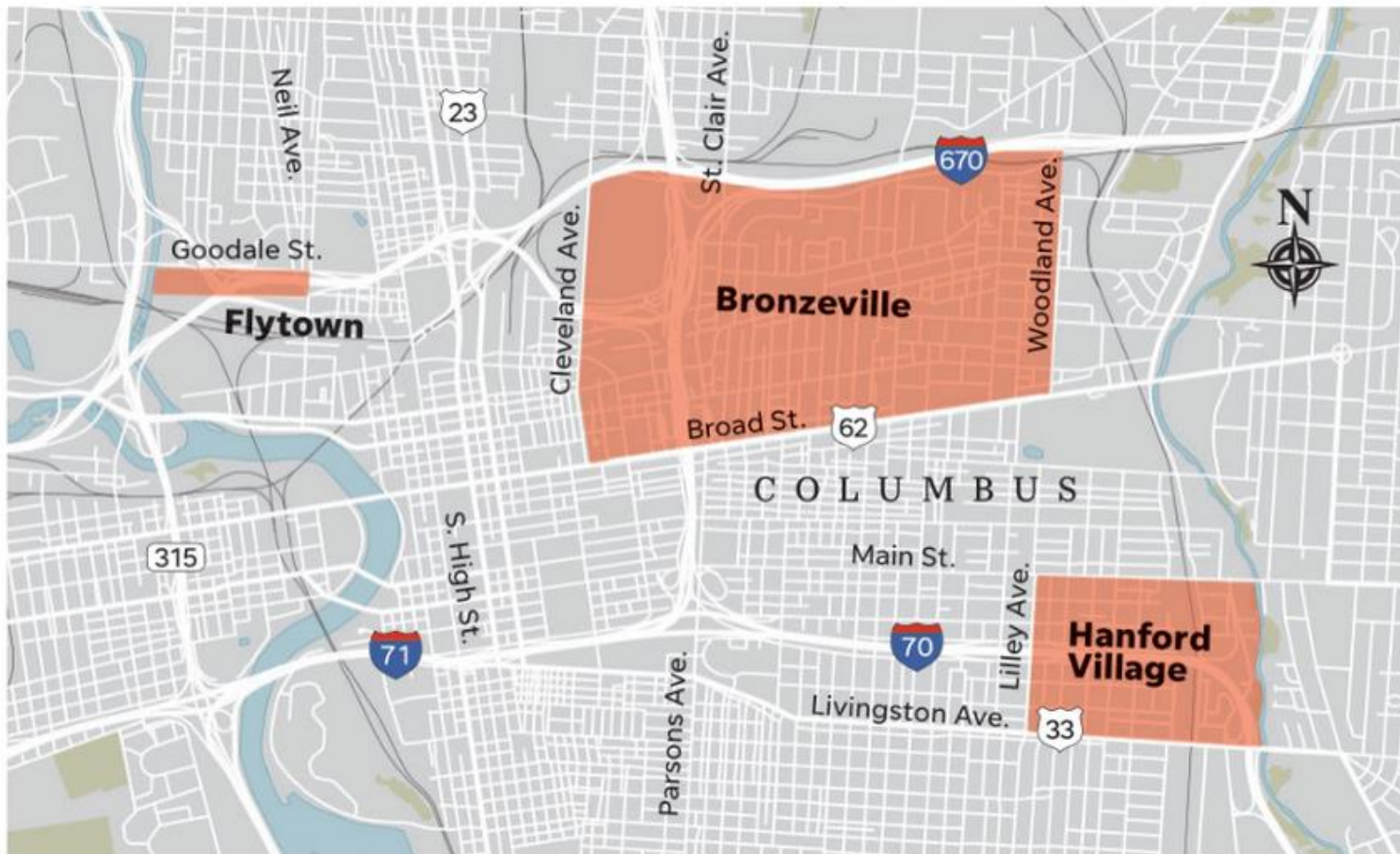
Columbus Dispatch December 3, 2020

NEW HANFORD VILLAGE

Nelson Road, Between Main and Livingston Aves.

Negro War Veterans

146 new 1½-story single homes are being built here for you. Only a few remain to be purchased under the GI Bill of Rights for only $125 cash and $42.88 per month. Open for inspection each day. This may be your last chance to secure one. Go out and select your home.

HANFORD CONSTRUCTION COMPANY
IVAN H. GORE, Realtor
Room 1340

ADams 4023   17 S. High St.

OHIO HISTORICAL MARKER

HANFORD VILLAGE

Although the highway divides us, our memories are never lost

Hanford Village was founded in the early 1900s just east of Columbus proper with its own mayor, police force, fire department, businesses, and park. After World War II, a subdivision of Hanford became a segregated community for returning African American veterans to settle using the G.I. Bill. Hanford then became one of the few places involved in an all African American post-war housing development program in the United States. During the 1960s, President Dwight D. Eisenhower's Federal Interstate Highway System Act resulted in construction of Interstate 70 which split Hanford Village into two sections and tore apart the community. However, since the division, the residents of the village have worked to maintain its sense of community and unity.

CENTENNIAL HIGH SCHOOL AP US HISTORY CLASS 2008/09
THE OHIO HISTORICAL SOCIETY
2009   110-25

Hanford Village in 1961 – with current day I-70

Poindexter Village (1940)

- First public housing project in Ohio; second in US
- All but two buildings torn down in 2013
- Museum and Cultural Center in 2027
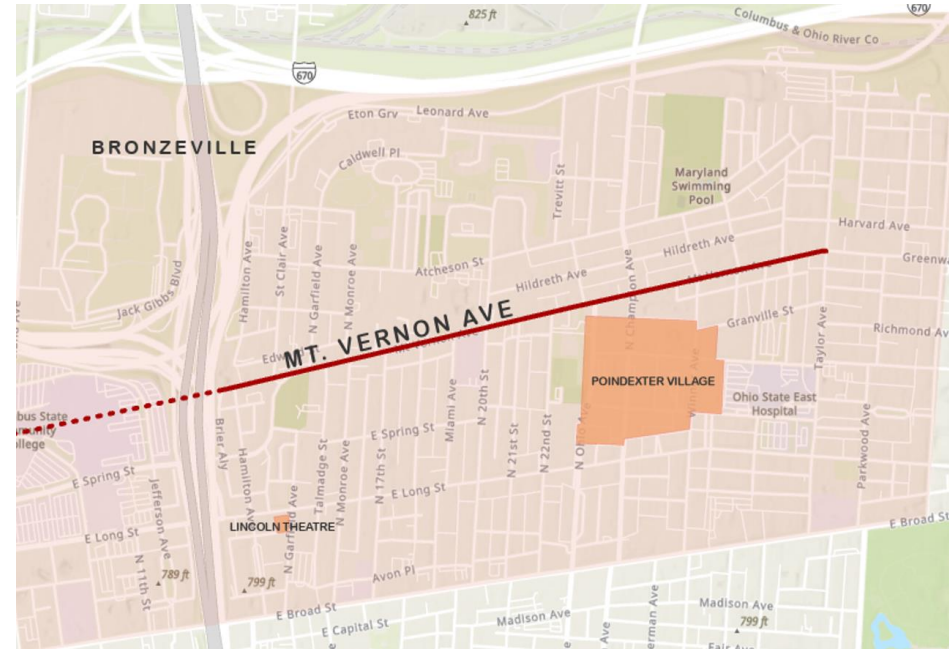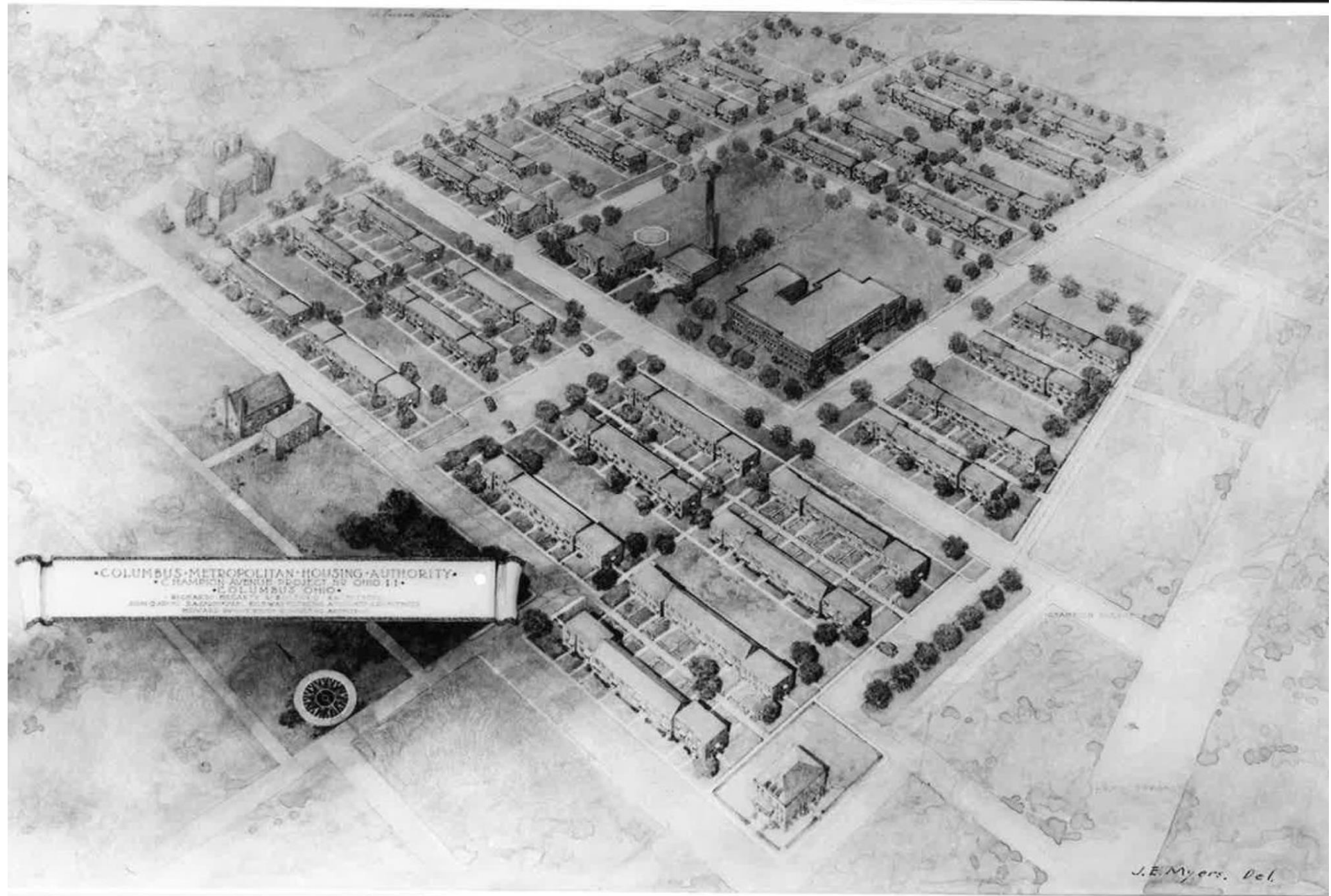
Poindexter Village - 1940

Mt. Vernon Ave (1951)

- Photorealistic 3D streetscape
- Co-design process
- Support: OSU BETHA award
- Partner: Columbus Landmarks Foundation

Mt. Vernon Ave (1949)
Photographer: Marlon Richardson

Mt. Vernon Ave Historical Marker
Photographer: William Fischer Jr.

Mt. Vernon Ave study site in 1978: a $13m "urban renewal" project
Source: Columbus Metropolitan Library

3D model of Mt. Vernon Ave study site, 1951 (in progress)

Flytown: Looking southwest from Goodale Park at the intersection of Goodale and Dennison
March 3, 1957 (prior to construction)

Flytown: Looking southwest from Goodale Park at the intersection of Goodale and Dennison
September 8, 1959 (after construction)

Flytown (1921) Building footprints and construction material

Archives and interviews

Other data

- Business permits
- Street imagery
- Historical documents
- National Historic GIS
- Stories, memories from residents

Platform: Story Maps

One of the outstanding business enterprises in Hanford is Bolender's Food Market, located on Bowman Avenue.

The lovely home of Fred Clay, present Hanford mayor, is shown here. Mr. Clay was also mayor from 1937 to 1939.

Shirley Mixon, 71, grew up in the predominantly Black neighborhood Hanford Village and saw it divided by the construction of I-70 in the 1960s.
DORAL CHENOWETH, THE COLUMBUS DISPATCH

A wedding day photograph of Ann and Linwood Walker, who had a home together on Jefferson Avenue, which was later razed.
FAMILY PHOTOGRAPH

Source: Columbus Dispatch; Columbus Metropolitan Libraries

Future directions

Future opportunities

- Other highway corridors

- Other streetscapes - e.g., Linden, Hilltop

- Franklinton Flood of 1913

- 3D GIS of historic Columbus (entire city)

- (Present day: ESRI Urban model)

Research questions

- Loss of wealth-generating activities

- Environmental justice – e.g., urban heat island, hidden environmental hazards

- Historic urban landscapes, building inventories

March 1913: the West Side and riverfront in ruins
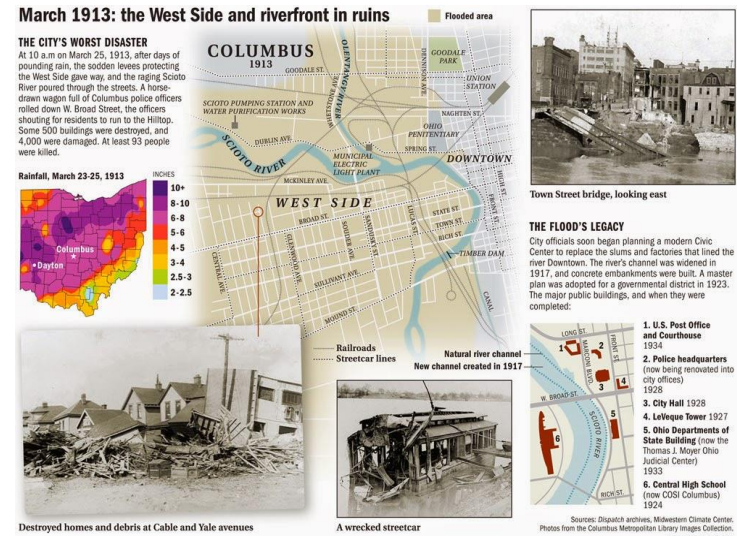
Ghost Neighborhoods

- Leverage historic map data with AI and GIS

- Digitally recreate neighborhoods damaged by redlining, urban renewal and urban highways

- Engagement, understanding and repair

- Create scientific database of historic built environments

Open access paper

Lin, Y., Porr, A., Li, J., Logan, G., Xiao, N. and Miller, H.J. (2023) "Creating high resolution, three-dimensional digital models of historic urban neighborhoods from Sanborn Fire Insurance maps using machine learning," *PLoS ONE*, 18(6): e0286340

Includes link to repository with code and data
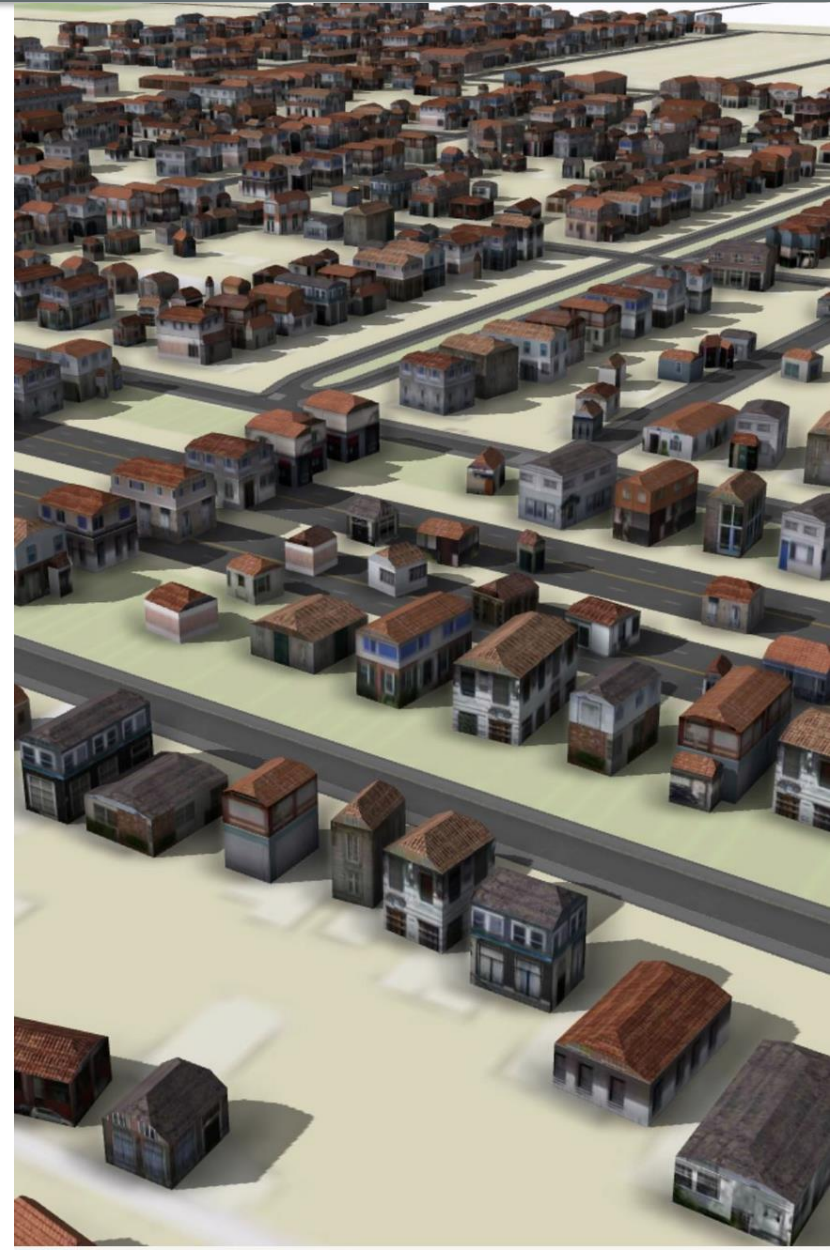
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