THE OHIO STATE UNIVERSITY

Mapping Ghost Neighborhoods: Using AI and GIS to create 3D models of neighborhoods damaged by urban highways and urban renewal in the 20th century

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From Rasters to Rows: New Methods and Applications in Automated Data Extraction
15-16 August 2024
Federal Reserve Bank Philadelphia

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Shelbi Toone – Ohio History Connection

Emeriti

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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- A wealth of data locked in historical documents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

Bancplan Loans — A Low Cost Service for the Individual
THE OHIO NATIONAL BANK -- BANCPLAN LOAN DEPT.
Formerly The State Industrial Bank
21 W. Gay St. (15) Member F. D. I. C. MA. 5133

ERNEST L. PRENTICE
GENERAL BUILDING CONTRACTOR
214 West Royal Forest Blvd. LA 9652
Residential and Industrial Construction

INDUSTRIAL SHEET METAL • PIPING • PLUMBING • HEATING • DUCT WORK • AIR CONDITIONING
THE HUFFMAN-WOLFE CO.
MAin 5252
609 N. HIGH ST.

MORREY Jewelers
114 N. High
MAin 6871
DIAMONDS — WATCHES
Over 31 Years of Service to Columbus

City directory for Mt. Vernon Ave, Columbus,1951

Source: Columbus Metropolitan Library

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

- fire proof construction. (OR FIRE RESISTIVE CONSTN)
- 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 constn
- (CONC) — Concrete or reinforced concrete constn
- (TILE) — Tile building.
- NUMBER OF STORIES — Brick building with frame cornice.
- TWO STORIES AND EIGHT COMPOSITION ROOF — " " " stone front.
- SINGLY ROOF — " " " frame side. (DIVIDED BY FRAME PARTITION)
- (VEN'D) — Brick veneered building.
- BRICK 1ST — " and frame building.
- FRAME, BRICK LINED — Frame building, brick lined.
- F=FLAT S=STORE — " " metal clad.
- D=DWELLING — Frame building.
- A=B AUTO IN RR'HT — Iron building.
- LOFT — Tenant building occupied by various manufacturing or occupancies
- (ASB. CL.) — Frame building covered with asbestos
- NON COMBUSTIBLE ROOF COVERING OF METAL, SLATE, TILE OR ASBESTOS SHINGLES — Brick building with brick or metal cornice.

DWELLINGS.

DWELLING | DWELLING & STORE | DWELLING | DWELLING & STORE

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.
- 70' 5 — 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.
- S — Superior construction. { Built of non-inflammable material *"throughout,"* except flooring and trim.
- Communications protected by single fire-proof doors { With designation of floors.
- " " double " "
- IRON SHUTTERS. IRON DOOR. — 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.
- IRON. FRAME. — 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.

A

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

G x

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

Brick ..... 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 ..... 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 ..... 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 lamp-black, 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 ..... Frame

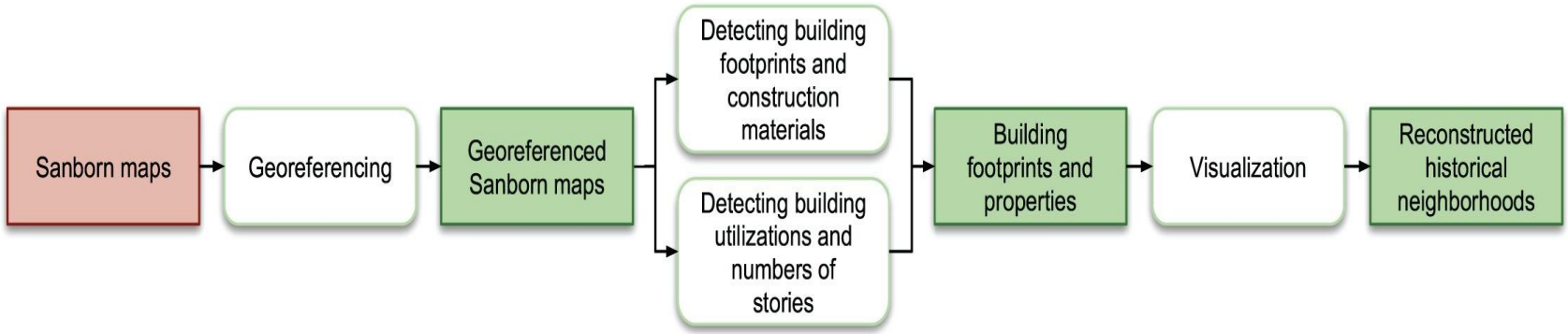
Chemical laboratories. Coffee and Spice mills. Drug mills. Fireworks on sale. Match factories. Oil-boiling houses. Planing and Moulding mills. Printing-ink factories. Sash, blind and door factories. Saw mills. Tar-boiling houses. Turpentine distilleries. Varnish making. Window-shade factories.

Ghost Neighborhoods project

Objectives

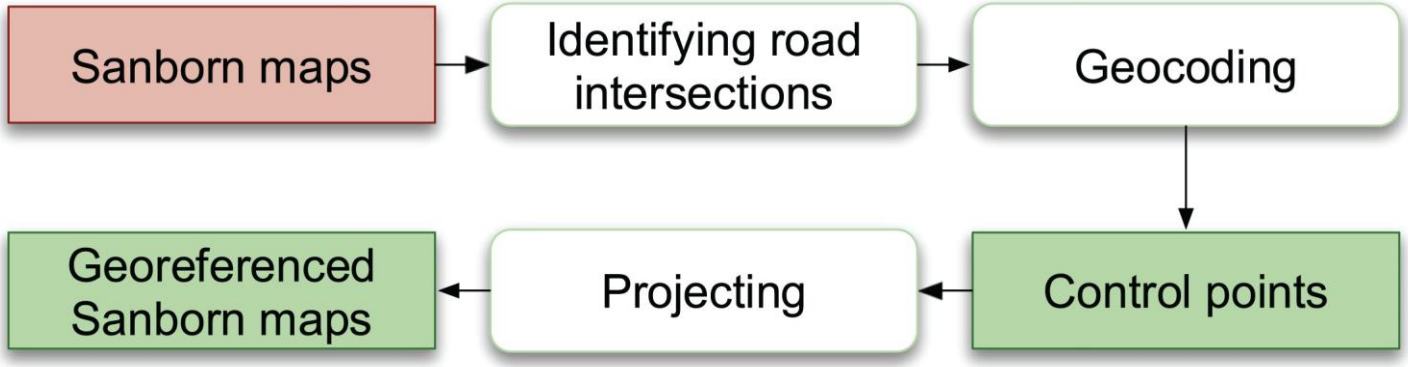
- Reconstruct historical neighborhoods damaged by highways, redlining, urban renewal
  - Historical Sanborn Fire Atlas data
  - Machine learning, GIS + 3D urban modeling
  - Columbus, and beyond
- High resolution digital reconstructions
  - Parcels, buildings – footprint, floors, construction material,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

Methods: General workflow



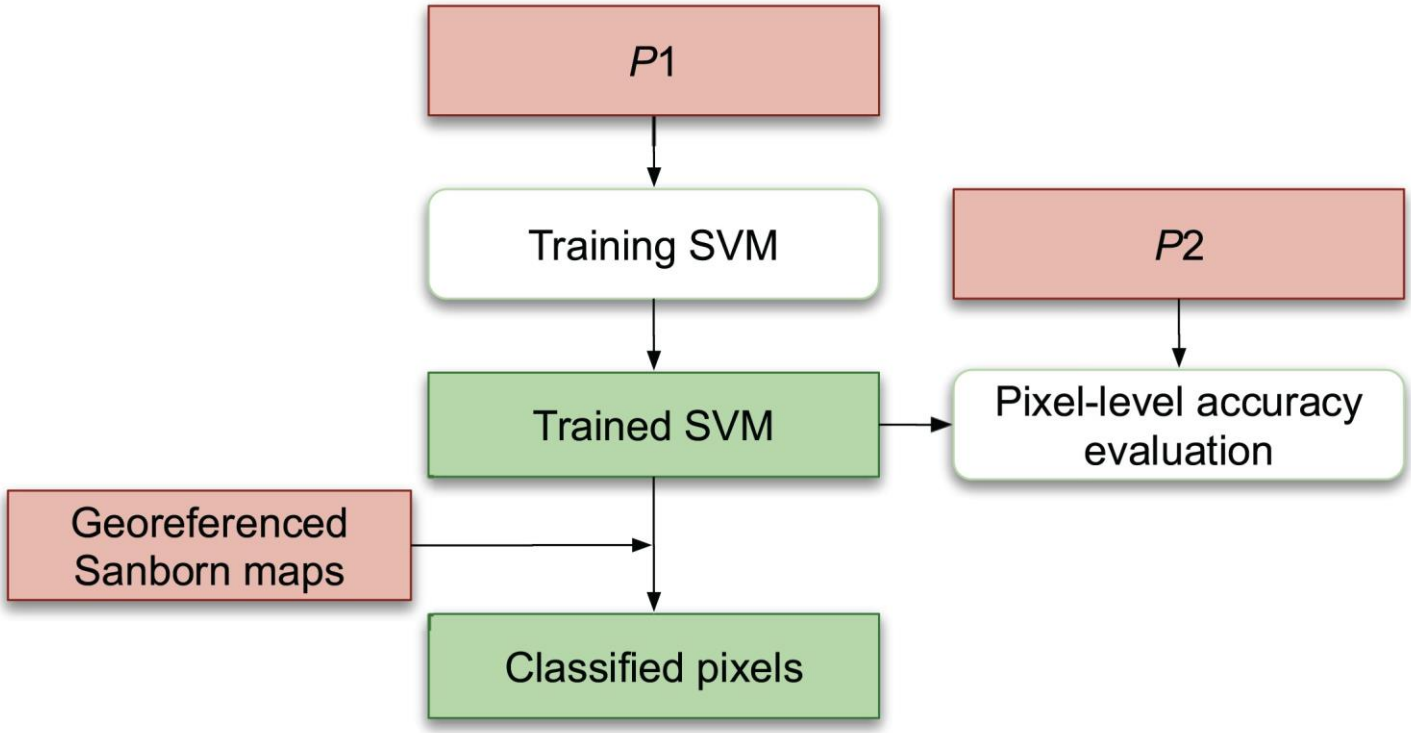
Orange-pink rectangle: input data
Open rounded rectangle: operation
Green rectangle: Intermediate or final output.

Methods: Georeferencing



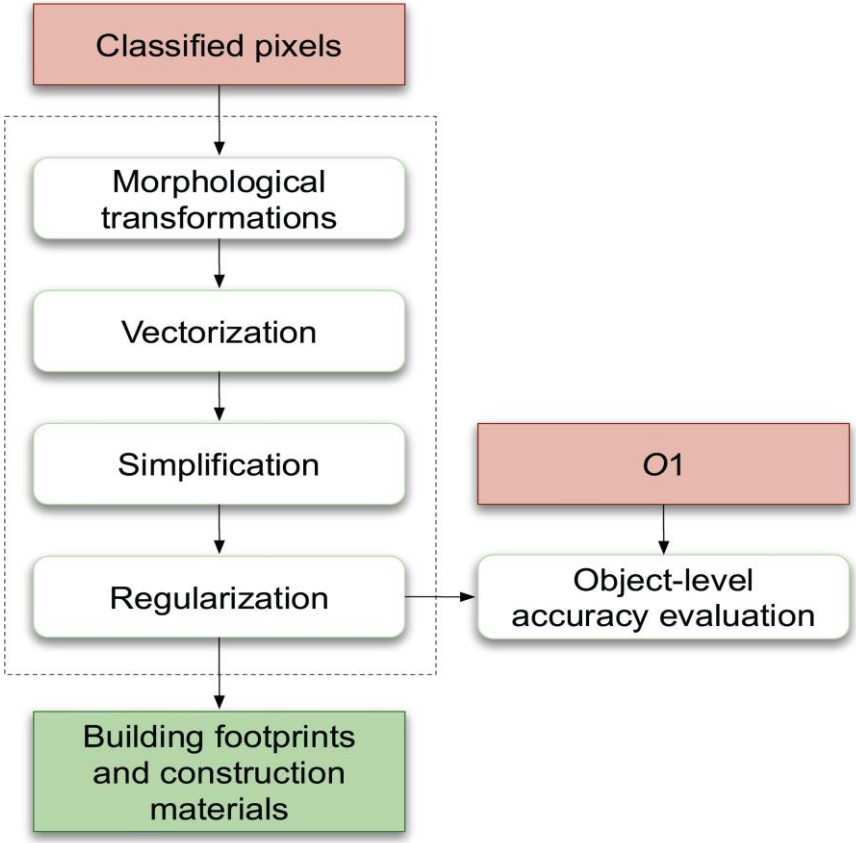
Orange-pink rectangle: input data
Open rounded rectangle: operation
Green rectangle: Intermediate or final output.

Methods: Pixel-based classification



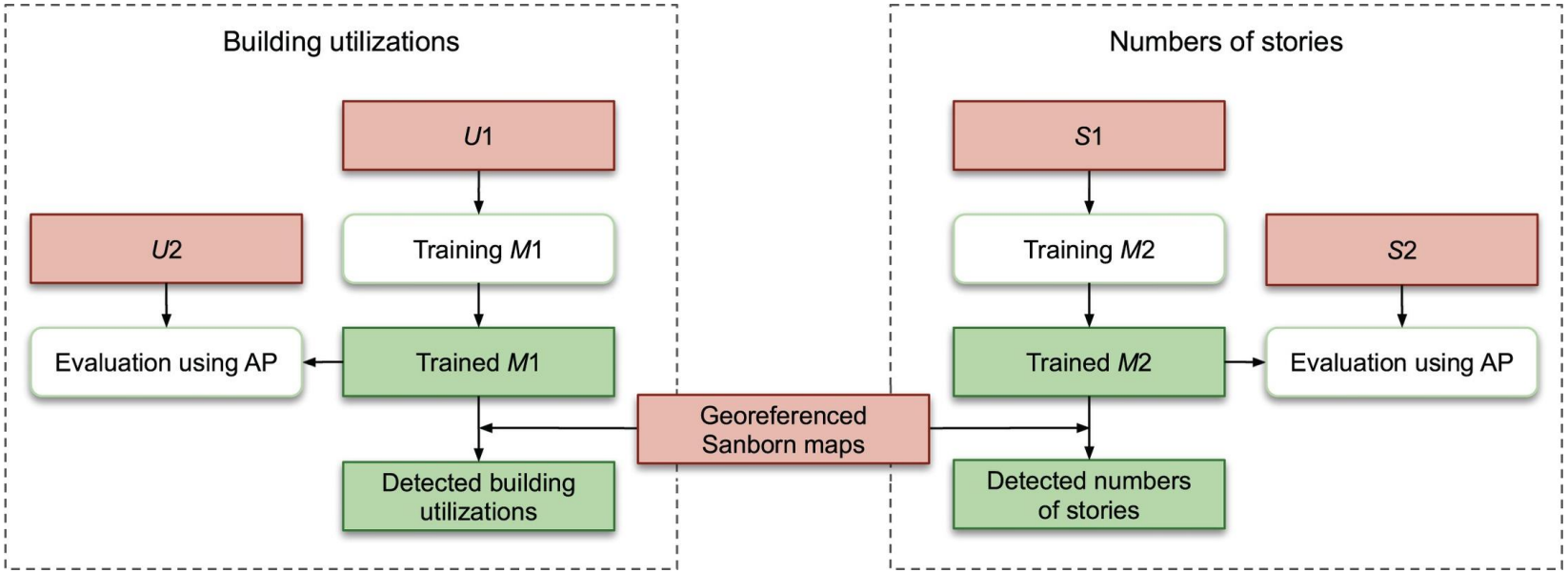
Orange-pink rectangle: input data
Open rounded rectangle: operation
Green rectangle: Intermediate or final output
P1: Training data
P2: Evaluation data

Methods: Post-processing



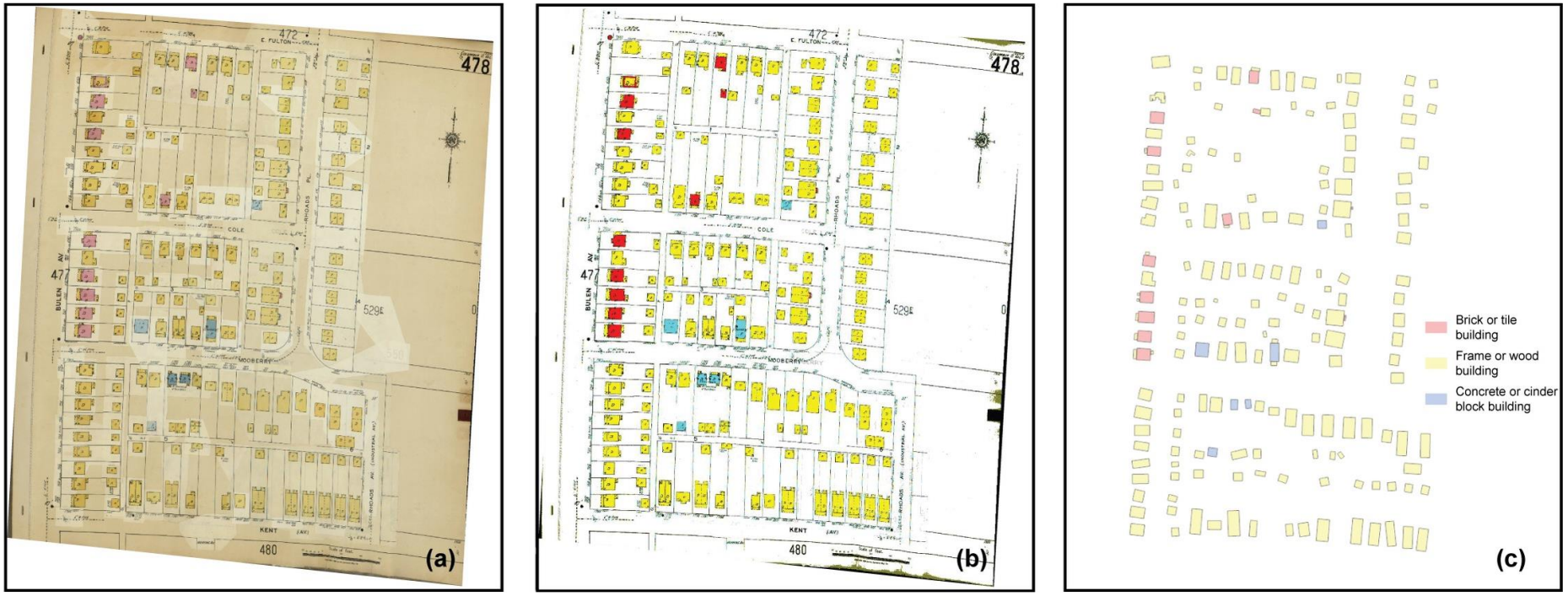
Orange-pink rectangle: input data
Open rounded rectangle: operation
Green rectangle: Intermediate or final output
O1: Manually identified buildings

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

Version 1:
Abstract buildings

Version 2:
Realistic buildings

Version 3:
Accurate buildings

Accurate buildings

Enhancements

- Accurate textures
- Building heights
- Data
  - Ground-level imagery – historic and current
  - Architectural designs (when available)
  - Newspapers, advertisements (commercial buildings)
  - Books, art

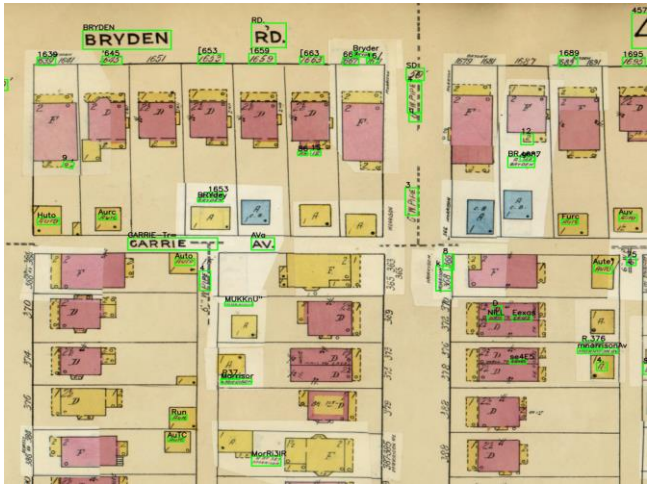
Continuing work

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)

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.

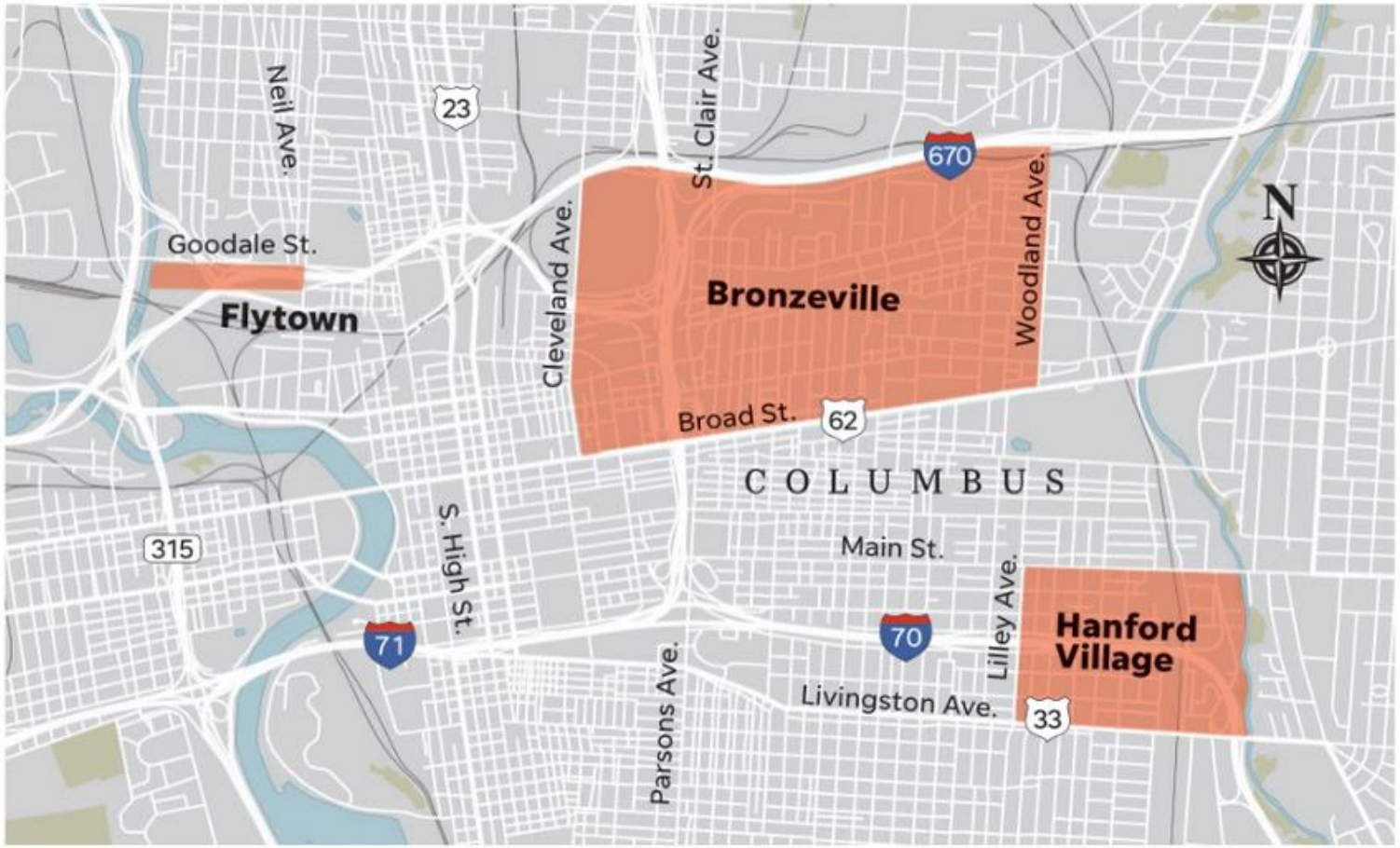
Erica Thompson, The Columbus Dispatch

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.



SOURCE: COLUMBUS METROPOLITAN LIBRARY, DISPATCH ARCHIVES

TAKÉ UDA/USA TODAY NETWORK; AND GETTY IMAGES

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

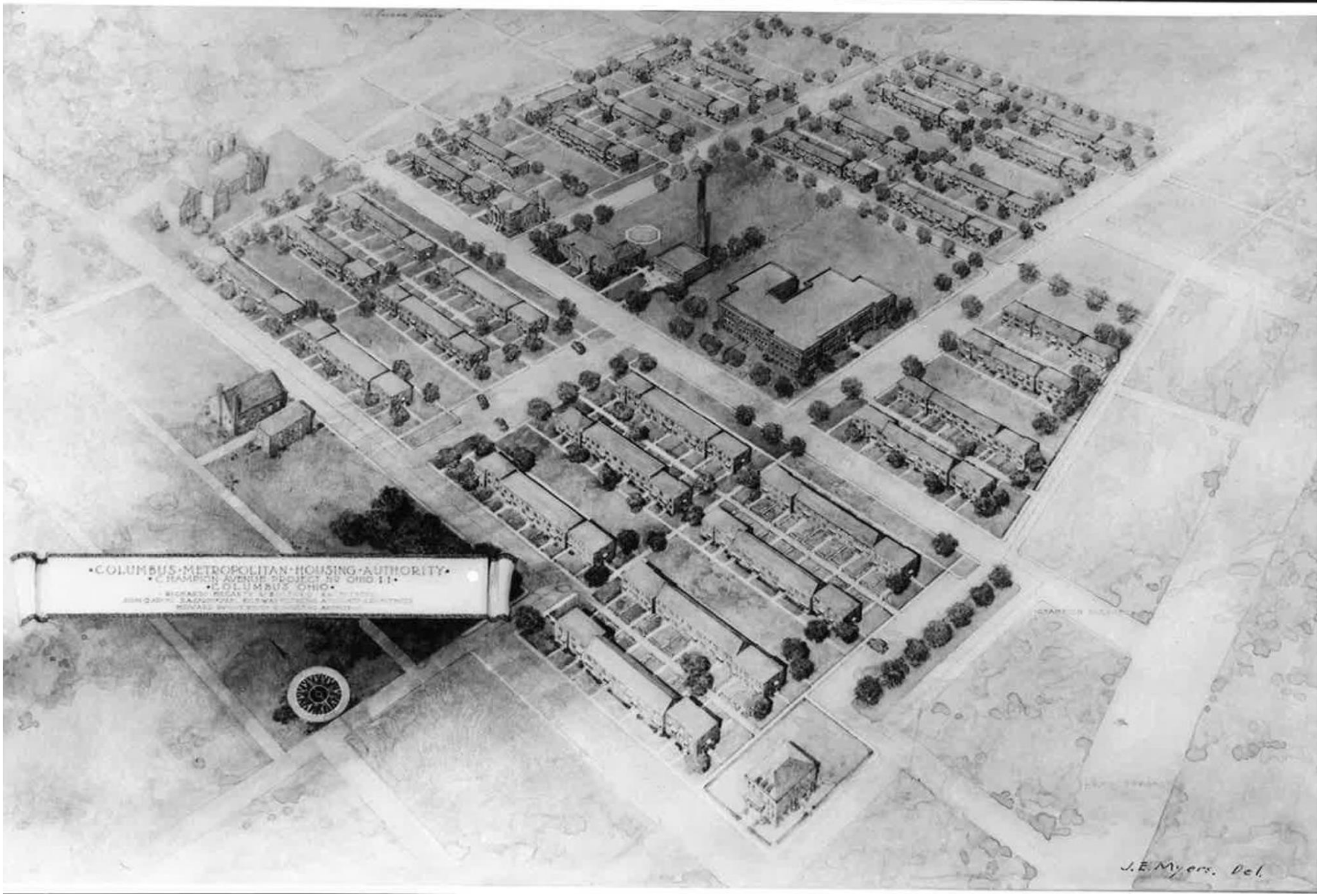
IVAN H. GORE, Realtor

ADams 4023 Room 1340 17 S. High St.

Hanford Village in 1961 – with current day I-70

Poindexter Village (1940)

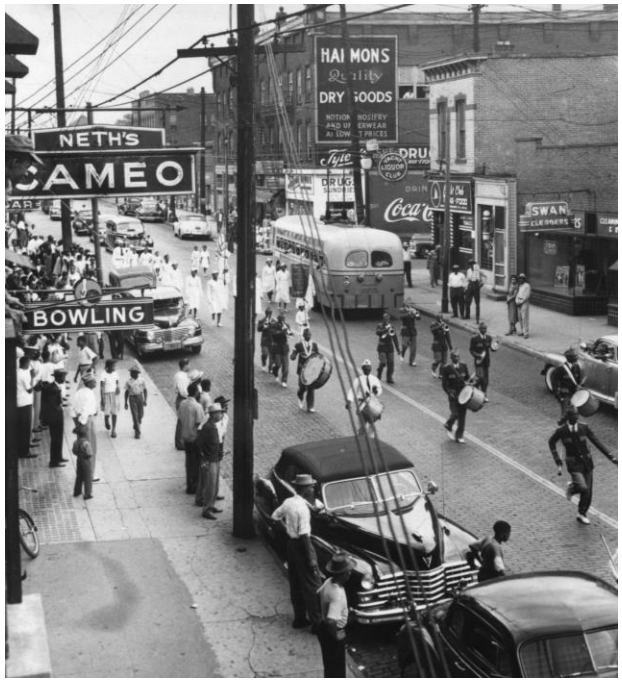
- First public housing project in Ohio; second in US
- All but two buildings torn down in 2013
- Museum and Cultural Center in 2027
- Partner: Ohio History Connection



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

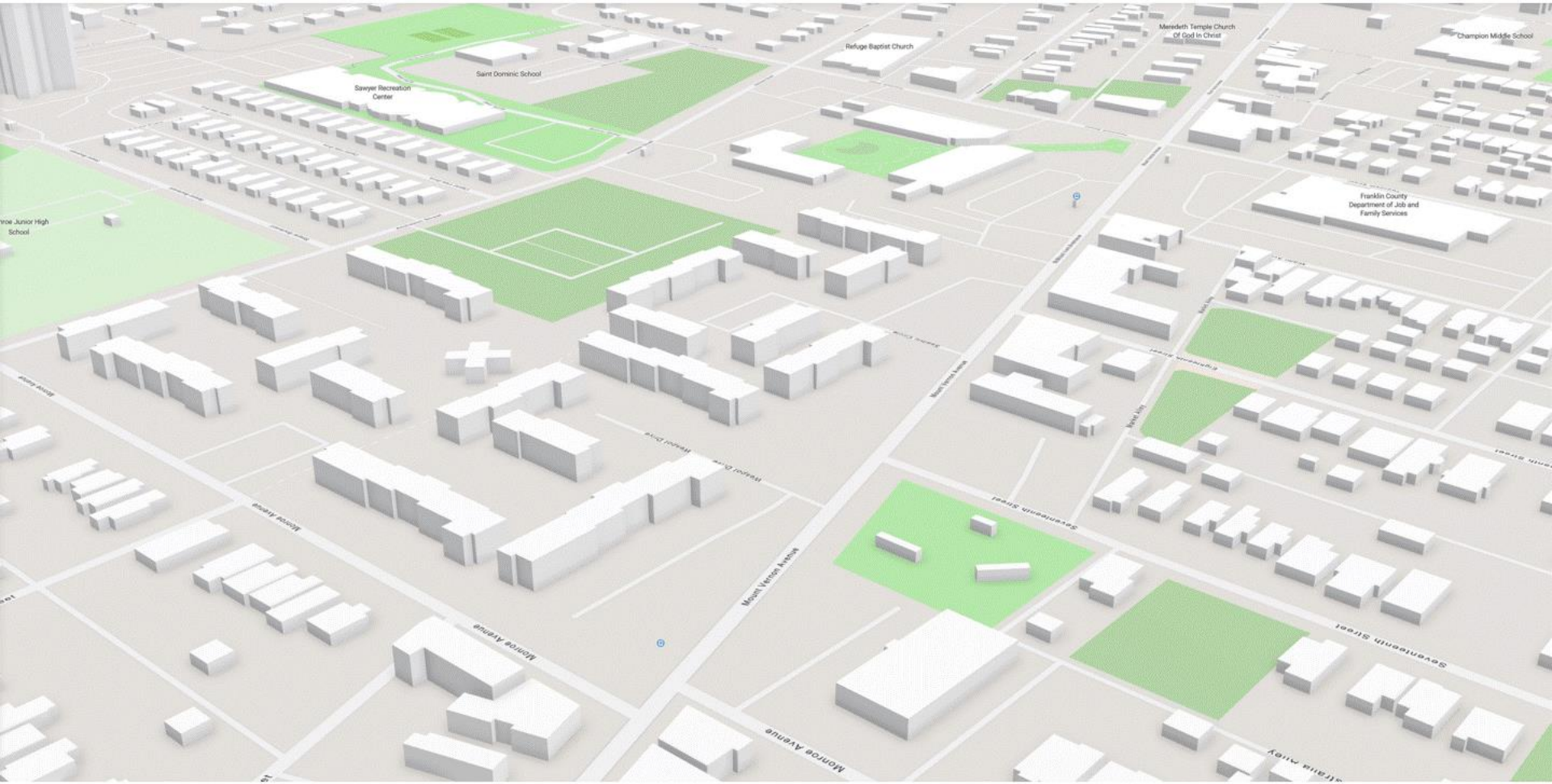
Mt. Vernon Ave Historical Marker
Photographer: William Fischer Jr.

52

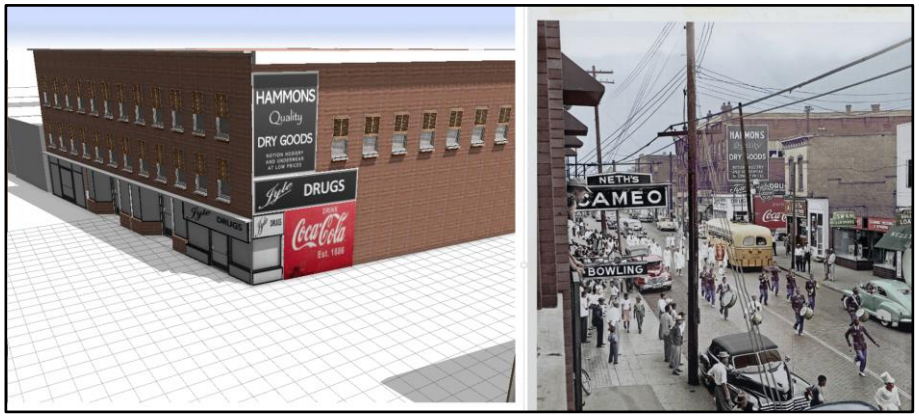
Mt. Vernon Ave study site in 1978: a $13m “urban renewal” project

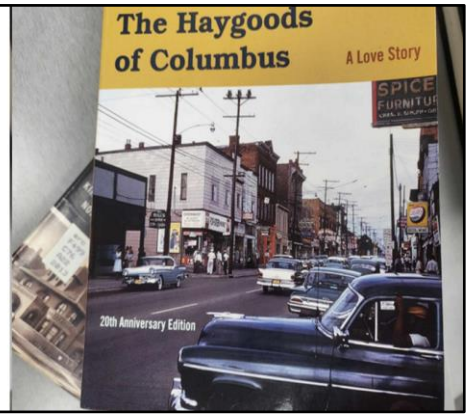
Source: Columbus Metropolitan Library

Atcheson Street
Mount Vernon Avenue
Market Alley
Twentieth Street
Franklin County Department of Job and Family Services
brick or tile
frame or wood
concrete and cinder block



Mt. Vernon Ave building density 2024 vs 1951





Using historical photographs to recreate building textures

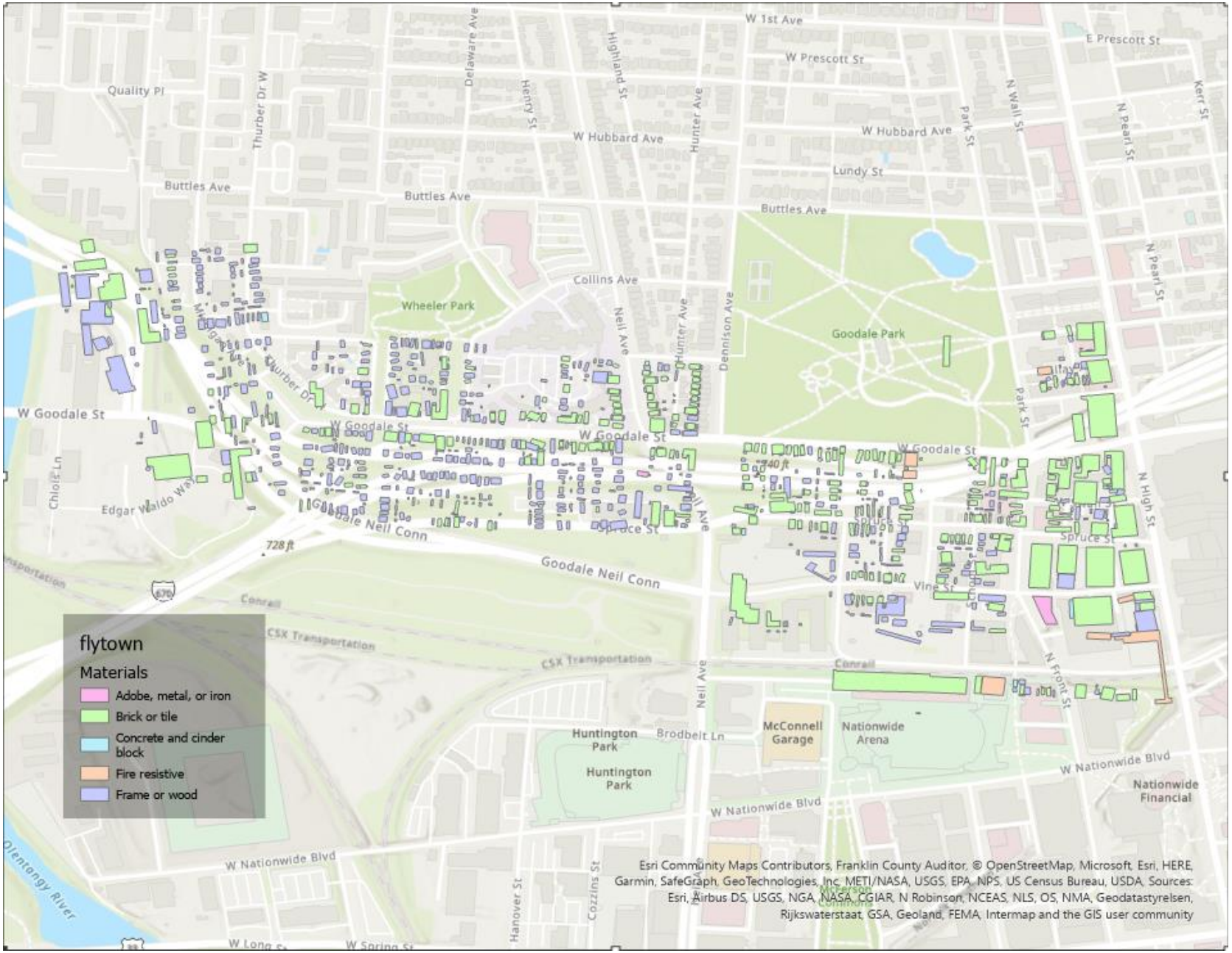
3D model of Mt. Vernon Ave study site, 1951 (in progress)

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

Source: Columbus Metropolitan Libraries

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

Source: Columbus Metropolitan Libraries



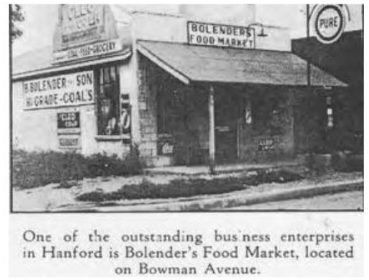
Flytown (1921) Building footprints and construction material

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.

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

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

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

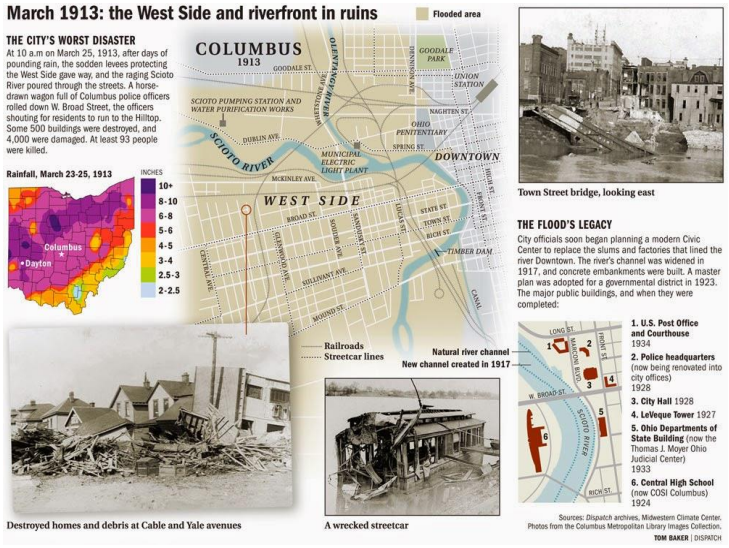
Future directions

Future opportunities

- Other highway corridors
- Historic weather events
- 3D GIS of historic Columbus (entire city)
- Other cities & towns (Sanborn: 10K towns)

Research questions

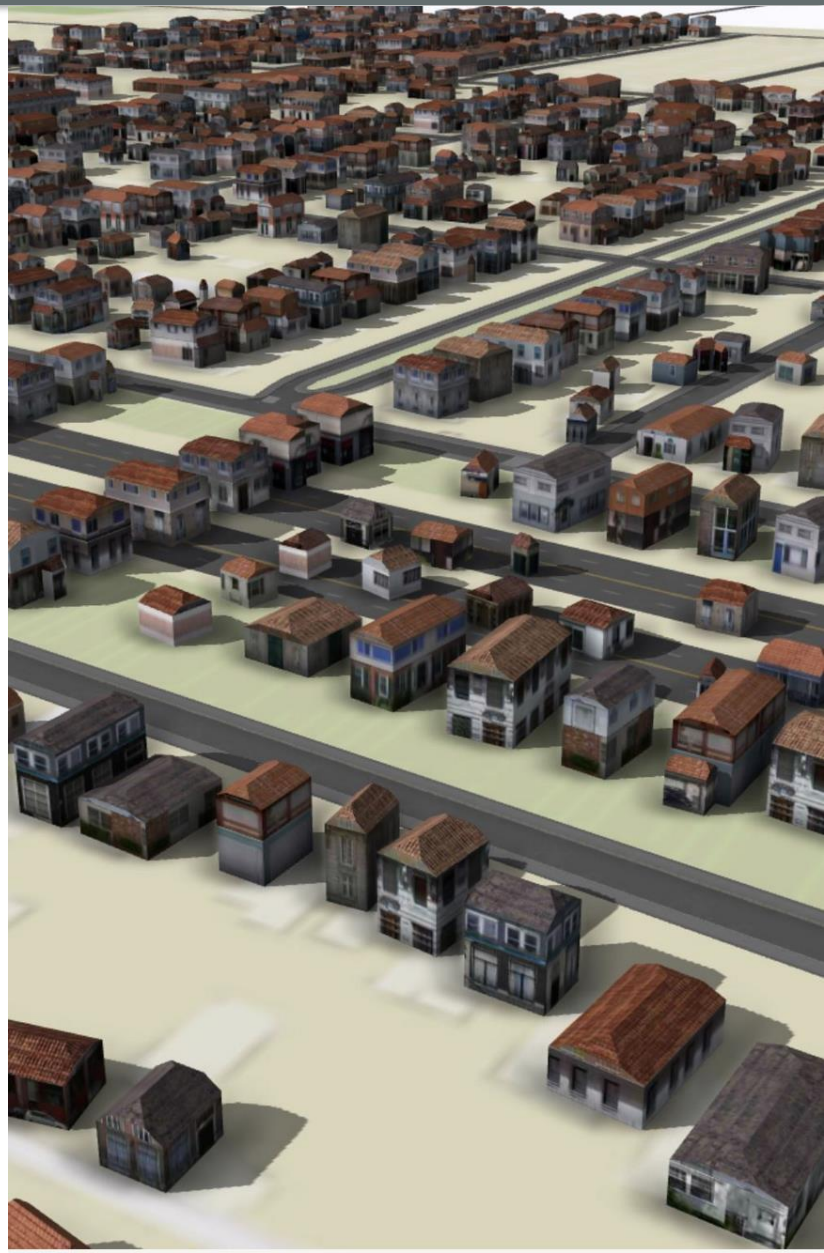
- Loss of wealth-generating activities
- Environmental justice – e.g., urban heat island, hidden environmental hazards
- Historic urban landscapes, building inventories



The Great Flood of 1913

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