Technical Appendix:

Scenario Modeling Process

Envision Tomorrow Software

Vibrant NEO 2040 used the open source software Envision Tomorrow (ET) to model its scenarios. ET enables users to create alternative spatial scenarios and analyze how their community's current growth patterns and future policies will affect land use, housing, demographics, economic growth, development feasibility, fiscal health, transportation, environmental factors, and quality of life. ET includes both analysis and scenario design tools. The analysis tools enable users to analyze aspects of their current community using commonly accessible GIS data, such as tax assessor parcel data and census data. The scenario design tools enable users to "paint" alternative future development scenarios on the landscape and compare scenario outcomes in real-time.

Originally developed by Fregonese Associates in Portland, OR, Envision Tomorrow has been in use and under steady development for over 10 years. In the last 3 years, the functionality and model outputs available in ET have been greatly expanded through research and development funded by a series of HUD Sustainable Communities Regional Planning Grant awards in Salt Lake City, UT; Austin, TX; Kansas City, MO; and most recently in Northeast Ohio with Vibrant NEO 2040. A growing community of users across the country has established Envision Tomorrow as a national platform for scenario planning that will continue to evolve. Many of the recently added analytical modules are based on research conducted by Dr. Arthur Nelson and Dr. Reid Ewing, both at the University of Utah.

Key attributes of Envision Tomorrow include:

User Friendly

Envision Tomorrow may seem complex initially, but with a relatively small investment of time, new users are able to get up to speed quickly.

The Brains are in the Spreadsheets

Planners know spreadsheets, not code. For this reason, Envision Tomorrow has kept most of the calculation elements in the Scenario Spreadsheet, which is linked to ArcGIS via an extension. Modifying assumptions and even adding new model outputs is easier within a spreadsheet than within lines of code. In addition, the tool has an unparalleled level of transparency since the equations are open and visible to the user.

A Linked System of Spreadsheets

The Envision Tomorrow platform includes three types of interlinked spreadsheets:

- the building-level Prototype Builder Spreadsheets
- the scenario-level Scenario Builder Spreadsheet
- individual impact modules such as the Fiscal Impact Model and the Travel Models which can be dynamically linked to the scenario spreadsheet

The smallest unit of analysis in the scenarios is the building. Individual buildings are modeled in a template spreadsheet called a Prototype Builder. This template spreadsheet is a simplified, planning-level pro forma, similar to pro formas used by developers to evaluate the financial feasibility of a development project. The Prototype Builder includes both the physical attributes of buildings, such as height and landscaping, and also the financial attributes, such as rents and construction costs.

The Prototype Builder can be used as a handy stand-alone tool for evaluating financial feasibility based on current or proposed zoning. It also serves as the template for creating a library of Building Types to be used in any scenario planning process. Depending on the scale of the scenario planning effort, a Prototype Library could include only a handful of generic, or "prototypical," Building Types to a library of 40-50 very specific Building Types. This library of building data is loaded into the Scenario Spreadsheet through the use of a push-button macro. Once loaded, each building spreadsheet is dynamically linked to the Scenario Spreadsheet. This means that if the user edits any of the building spreadsheets, the changes are automatically reflected in the Scenario Spreadsheet and the Scenarios themselves.

The ESRI ArcGIS Extension

The Envision Tomorrow extension for ESRI's ArcGIS is a relatively simple interface that enables users to select and "paint" different Development Types onto the scenario layer. The extension is also responsible for establishing a dynamic connection to the Scenario Spreadsheet, so as the user paints, information about how much area the user has painted is automatically recorded, which in turn, results in changes in the scenario model outputs charts and graphs.

Building Types

With input from local experts, the Project Team created a library of building prototypes custom tailored to Northeast Ohio. A range of over 50 potential Building Types were identified based on local experience and conversations with developers and planning professionals. From this list, a smaller subset of 26 was chosen to represent the range of Building Types in the region. The Project Team then performed extensive market research to determine the following building attributes for each of the Building Types:

Physical Inputs:

- Lot dimensions
- Height
- Building uses
- Residential unit mix and average sizes (for buildings with residential uses)
- Square feet per employee (for buildings with employment)
- Parking requirements
- Parking configuration (surface versus structured)
- Parking space efficiency

Financial Inputs:

- Construction costs by land use
- Land cost
- Residential and commercial rents
- Residential sales prices
- Parking construction costs

For each Building Type, a range was identified for each of the above parameters to capture variations across the region. For example, “Multi-family Senior Housing” ranges in rent from $0.95 to $1.40 per square foot in order to account for price differences between Northeast Ohio’s major metropolitan markets.

While it is impossible to capture every unique building being built in a city or region, the Building Types established through the Project Team’s market research captured the broad trends of new construction in Northeast Ohio. Each building contains a range of parameters, such as average rent and housing unit density. These buildings are then mixed, in various combinations, to create Development Types, which are used to paint alternative development scenarios.

BUILDING TYPE DETAILS

		MIXED-USE		COMMERCIAL				
		RESIDENTIAL OVER COMMERCIAL	OFFICE OVER COMMERCIAL	NEIGHBORHOOD MAIN STREET	STRIP SHOPPING CENTER	FREE STANDING RETAIL	LIFESTYLE CENTER / MALL	HOTEL
								
Max/Min Lot Size (acres)		0.25 - 1.5	0.25 - 1.5	-	-	-	-	0.25 - 5.0
Building Height (stories)		3-10	3-10	1-2	1	1-2	2-3	4-10
Housing Unit Sizes		600 - 2,800 s.f.	-	-	-	-	-	100-250 rooms
Housing Unit Density (units/acre)		25-80	-	-	-	-	-	-
FAR		-	-	0.6 - 0.5	0.5 - 0.3	0.4 - 0.2	0.4 - 0.2	-
Parking Standards (spaces per unit or sq ft employment)		1.5 / unit 2/1,000 s.f. comm.	3-5/1,000 s.f. office 2/1,000 s.f. comm.	2-3 / 1,000 s.f.	3.5-5.5 / 1,000 s.f.	4-6 / 1,000 s.f.	4-6 / 1,000 s.f.	1.25 / room
Landscaping (%)		-	-	5 -10 %	10 - 15 %	10 - 15 %	15 - 20 %	5 - 15 %
Land Costs ($/sq ft)		$10-45	$10-45	$3-20	$3-20	$3-20	$3-20	$3-20
Site Development Cost ($/sq ft)		$12-18	$13-20	$6-8	$5-7	$5-7	$6-9	$11-18
Vertical/Building Construction Cost ($/sq ft)		$120-180	$130-200	$65-85	$55-70	$55-70	$65-90	$110-180
Tenant Improvements ($/sq ft)		$40-80	$40-80	$30-60	$30-60	$30-60	$40-80	
Rents/Lease ($/sq ft)	Per Month	$1.10-2.00	-	-	-	-	-	-
	Per year	$18-30 (comm.)	$12-25 (office) $18 - 30 (comm.)	$12-25	$12 -25	$12-25	$18 -30	-
Sales Price ($/sq ft)		$160-200	-	-	-	-	-	-
Parking Costs ($/Space)	Surface	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500
	Structured	$15,000	$15,000	-	-	-	$15,000	$15,000
	Internal	$18,000	$18,000	-	-	-	-	-
	Underground	$24,000	$24,000	-	-	-	$24,000	$24,000

BUILDING TYPE DETAILS

		BUSINESS/INDUSTRIAL				INSTITUTIONAL/PUBLIC			ADAPTIVE RE-USE		
		BUSINESS DISTRICT / OFFICE PARK	HOSPITAL / MEDICAL CENTER	LIGHT INDUSTRY	HEAVY INDUSTRIAL	EDUCATION	CIVIC / PUBLIC USE / RECREATION	CULTURAL / ASSEMBLY	MALL / BIG BOX / STRIP REUSE	WAREHOUSE / LOFT RESIDENTIAL CONVERSION	OFFICE BUILDING RESIDENTIAL CONVERSION
											
Max/Min Lot Size		-	-	-	-	-	-	-	-	-	-
Building Height		-	-	-	-	-	-	-		-	-
Housing Unit Sizes		-	-	-	-	-	-	-	-	-	-
Housing Unit Density		-	-	-	-	-	-	-	-	-	-
FAR		-	-	> 0.25	> 0.25	-	-	-	-	-	-
Parking Standards (spaces per unit or sq ft employment)		3-5 / 1,000 s.f.	4-5 / 1,000 s.f.	1.5 / 1,000 s.f.	1.5 / 1,000 s.f.	2-4 / 1,000 s.f.	4-6 / 1,000 s.f.	1-3 / 1,000 s.f.	3-5 / 1,000 s.f.	1.25-2 / unit	1.25-2 / unit
Landscaping (%)		10 - 25 %	10 - 25 %	10 - 30 %	10 - 40 %	20 - 30 %	0.25	10 - 25 %	10 -15 %	5 - 10 %	5 - 10 %
Land Costs ($/sq ft)		$1-10	$2-10	$1-10	$1-10	$1-10	$-10	$1-10	$4-20	$4-20 .	$4-20
Site Development Cost ($/sq ft)		$8-10	$9-12	$6-8	$7-11	$15-25	$15-25	$15-25	$4-7	$5-7	$5-7
Vertical/Building Construction Cost ($/sq ft)		$80-110	$90-120	$60-85	$70-110	$150-250	$150-250	$150-250	$40-75	$50-75	$50-75
Tenant Improvements ($/sq ft)		$40-80	$80-150	$30-60	$45-100	-	-	-	$30-60	-	-
Rents/Lease ($/sq ft)	Per Month	-	-	-	-	-	-	-	-	$1.10-2.00	$1.10-2.00
	Per year	$12-25	$18-30	$4-12	$6-15	-	-	-	$12-25	-	-
Sales Price ($/sq ft)		-	-	-	-	-	-	-	-	-	-
Parking Costs ($/Space)	Surface	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500
	Structured	$15,000	$15,000	-	-	$15,000	$15,000	$15,000	$15,000	-	-
	Internal	$18,000	-	-	-	$18,000	-	-	-	$18,000	$18,000
	Underground	$24,000	$24,000	-	-	$24,000	$24,000	$24,000	-	-	-

BUILDING TYPE DETAILS

		RESIDENTIAL								
		MULTI-FAMILY MARKET RATE	MULTI-FAMILY TOWNHOMES MARKET RATE	MULTI-FAMILY SENIOR HOUSING	MULTI-FAMILY STUDENT HOUSING	MULTI-FAMILY AFFORDABLE MEDIUM DENSITY	MULTI-FAMILY MIXED INCOME MEDIUM DENSITY	SINGLE-FAMILY LARGE LOT	SINGLE FAMILY STANDARD LOT	SINGLE-FAMILY COMPACT LOT
										
Max/Min Lot Size		0.5 - 5.0 acre	1,200 - 3,000 s.f. / unit	1.5 - 3.0 acre	1.0 - 10 acre	1.5 - 15 acre	1.5 - 15 acre	+ 0.5 acres	8,000 s.f. - 0.5 acres	2,500 - 8,000 s.f.
Building Height (stories)		3-5	1-3	2-4	3-5	2-5	2-5	1-3	1-3	1-3
Housing Unit Sizes (sq. ft.)		600 - 2,800	1,000 - 2,500	600 - 1,000	600 - 1,200	700 - 1,700	600 - 2,200	+1,800	1,400 - 2,800	1,200 - 2,800
Housing Unit Density (units per acre)		25-80	10-25	20-30	40-70	10-25	15-40	<2	2-5	5-15
Parking Standards (spaces per unit or sq ft employment)		1-1.5 / unit	1-2 / unit	1 / unit	0.75 / unit	1 / unit	1-1.5 / unit	2-3 spaces	2 spaces	1-2 spaces
		1.5 / unit 2/1,000 s.f. comm.	3-5/1,000 s.f. office 2/1,000 s.f. comm.	2-3 / 1,000 s.f.	3.5-5.5 / 1,000 s.f.	4-6 / 1,000 s.f.	4-6 / 1,000 s.f.	1.25 / room	-	-
Landscaping (%)		-	-	-	-	-	-	-	-	-
Land Costs ($/sq ft or $/lot)		$4-30 / s.f.	$3-10 / s.f.	$4-15 / s.f.	$5-20 / s.f.	$3-15 / s.f.	$3-15 / s.f.	$30,000 - 250,000 / lot	$12,000 - 30,000 / lot	$1,000 - 12,000 / lot
Site Development Cost ($/sq ft)		$12-15	$11-14	$11-14	$12-14	$12-15	$12-15	$11-22	$9-14	$10-15
Vertical/Building Construction Cost ($/sq ft)		$120-150	$110-140	$110-140	$120-140	$120-150	$120-150	$110-220	$95-140	$100-150
Tenant Improvements ($/sq ft)		-	-	-	-	-	-	-	-	-
Rents/Lease ($/sq ft)	Per Month	$1.10-2.00	$0.95-1.40	$0.95-1.40	$1.10-1.60	$0.35-0.60	$0.35-1.10	-	-	-
	Per year	-	-	-	-	-	-	-	-	-
Sales Price ($/sq ft or $/unit)		$140-180 / s.f.	$140-180 / s.f.	-	-	-	-	>$250,000 / unit	$160,000-250,000 / unit	$110,000-250,000 / unit
Parking Costs ($/Space)	Surface	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	-	-	-
	Structured	$15,000	-	-	-	-	-	-	-	-
	Internal	$18,000	-	-	-	-	-	-	-	-
	Underground	$24,000	-	-	-	-	-	-	-	-

Development Types

Development Types can be thought of as representations of typical neighborhoods found in a region. They can exist at the scale of a few city blocks to an entire census tract and are used to create a painting palette within Envision Tomorrow. Wrapped up within these Development Types are the Building Types discussed previously as well as roadway characteristics. Roadway characteristics include factors like lane width, number of lanes, sidewalks, and bicycle lanes. Also included are net land reductions for parks and other public spaces.

Development Types have attributes ranging from average lot size to residential energy consumed. The attributes are derived based on the mix of Building Types included as well as the street characteristics and amount of open space and civic uses included. The building level attributes are aggregated to the Development Type level as weighted averages using the user-defined mix of Building Types contained in the Building Mix tab of the Scenario Spreadsheet.

For Vibrant NEO 2040, a range of Development Types were identified based on market research performed by the Project Team. This market research entailed a detailed survey of existing neighborhoods, densities, and development patterns, including street characteristics and mix of uses. Through an iterative revision process that included local stakeholders and NEOSCC staff, the Project Team created 25 Development Types that span the following categories:

- Mixed-Use
- Residential
- Retail
- Office/Industrial
- Institutional/Public
- Adaptive Reuse
- Abandonment/Vacancy
- Protected open space

Each Development Type includes a range of different Building Types
Fregonese Associates

NEO 2040 Development Type Descriptions

Downtown Commercial Core

Mixed-use regional economic centers with a variety of high-density building stock. Centrally located in an urban core and pairs predominantly office space with related retail. Increasingly features multi-family residential uses.

City Architecture

Business / Commerce District

Commercial campuses and districts that have grown up adjacent to freeway interchanges and along existing arterial roads and transit corridors. Many of them may be deteriorating or adjusting to new market conditions. These districts are found in many types of communities. They often have a concentration of multi-story office buildings that may include limited retail to serve those employed in the district. They may also consist of free standing retail or small strip retail centers. They often feature extensive landscaping and large surface parking lots with related stormwater retention basins. Many of these districts were developed incrementally by individual property-owners and developers and lack a master plan or overall organizational framework that connects the individual developments, minimizes environmental impacts, enables transit access, and manages commuter traffic flows effectively.

City Architecture

Transit Oriented District

Nodes and corridors, organized around transit that have the potential to be densely developed, mixed-use districts. Examples of catalyzing infrastructure include express bus, bus rapid transit and streetcar lines. Development is typically a mix of commercial retail, office, and residential uses. The transit focus of the neighborhood encourages complete live-work-play communities that are walkable and convenient for many age groups and family sizes.

City Architecture

Medical / Institutional Center

Medical and institutional centers and the associated development and services that emerge around them. Larger campuses are typically located in legacy cities, but smaller campuses and satellites develop in suburbs and smaller cities and towns. Large campuses tend to become regional centers for research, science, medicine, and innovation. They employ large numbers of people in many levels of employment and often serve as regional economic generators. Smaller centers may build around associated uses and cause related development, like medical office space, to occur.

City Architecture

New Town Center

Contemporary version of the traditional town center. Creates a central, public space in areas that have no existing centers or cultural assets but do have a growing population to support a district that consolidates commercial, civic, and cultural activities.

Zach Vesoulis (http://commons.wikimedia.org/wiki/File:New_shopping_area_hudson_oh.jpg)

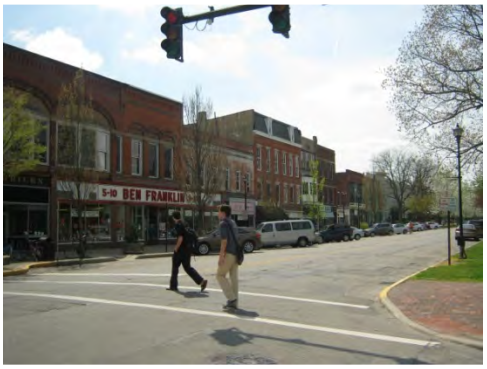
Western Reserve Town Center

Traditional town or small city centers that developed around central spaces like town squares or public greens. Often these communities serve a civic function as county seats and can be cultural or economic centers. Typically, these communities grew at the same time period as the region's legacy cities and often suffer similar issues of aging building stock and infrastructure, leaving many in need of rejuvenation. Redevelopment and opportunities to re-establish these communities exist, with many successful examples throughout the region.

City Architecture

University / College Town

Neighborhoods surrounding a university or college. Combines the needs of students and educators with nearby communities to provide various housing options and amenities. Typically high density, compact, and mixed-use in legacy cities and established cities and towns.



Sasaki Associates

Neighborhood Main Street

Neighborhood-scale streets that function as main access corridors to community retail and cultural assets like theaters, while incorporating multiple modes of access and walkable environments. Historically, they were developed as streetcar commercial districts, with residential incorporated in the form of mixed-use buildings along the streetcar route and lower density one- and two-family residential development on adjacent side streets.

City Architecture

Arterial Commercial District

Commercial strips that develop based on proximity to vehicular access points like highways and major arterial roads. Typically a series of strip retail centers and outparcels, these centers tend to be built new and without an overall planning strategy. Many have become outdated and subsequently abandoned, rather than renovated, before their physical life expectancy is reached.

City Architecture

Lifestyle Center / Mall District

Commercial developments that combine a variety of retail options into a major commercial center. Indoor malls and their outdoor equivalent, the lifestyle center, allow consumers to go to one central location that offers multiple shops, department stores, restaurants, etc. Allows consumers to park and walk around, enjoying a fully retail environment. Modern lifestyle centers often incorporate outdoor spaces, entertainment, and recreation to complete the experience and allow consumers time to take a break while remaining in the retail center. Many are beginning to create live-work-play environments by adding mixed-use office space and residential to their retail program.

City Architecture

Corporate Campus

Commercial office space with multiple buildings clustered together. May be a single corporation with multiple departments and buildings or several corporations occupying one campus. Typically located adjacent to similar uses like light industrial, commercial, and retail. They are places with good access to highways. Usually located away from dissimilar uses like residential neighborhoods and shopping centers. Have large parking lots or garages and are set back from roads with few connections to the adjacent roadway network. May require facilities for shipping and truck traffic, and some green space and landscaping may be

incorporated into the site's layout. Usually has a large number of employees who commute daily to the site. May have associated supportive retail.

City Architecture

Light Industrial Business Park

Commercial campuses that mix together office buildings, light industrial warehouses, distribution centers, and consumer goods production. They are often large employment centers and are found in nearly every type of community. They develop near access points to regional transportation networks—highways, rail corridors, and shipping channels. Often designed to accommodate heavy truck traffic volumes. Many legacy cities with vacated industrial land could benefit from the redevelopment of those areas into Light Industrial Business Parks, bringing jobs and activity back into the core of the cities.

City Architecture

Heavy Industrial Development

Industrial districts that are traditionally embedded in the urban cores of the legacy cities, but have since spread out across the region. Compact residential neighborhoods historically grew up or were developed around these sites to provide housing for workers in close proximity to their employment. Many of the companies in these districts produce materials and products, such as steel, chemicals, machined goods, and industrial equipment, which are used by other firms rather than by consumers directly. Facilities are often large-scale and require extensive road, rail, and port infrastructure to support them. During the two-decade period from the late 1970s to the late 1990s, the region saw many of these companies close, relocate, or downsize substantially resulting in widespread abandonment of these districts. The resulting concentrations of abandoned heavy industrial land can be found in each of the region's legacy cities and many of its 1st ring suburbs.

Sasaki Associates

Downtown Residential Neighborhood

Residential communities located in core urban areas. These areas can take advantage of existing building stock by renovating, restoring, and infilling the historical fabric. Residents have the ability to travel easily, often by walking, to amenities like retail and parks.

City Architecture

Suburban Multi-Family Neighborhood

Residential neighborhoods that grew along major transit corridors connected to a dense downtown central business district. Typically found in legacy cities and their 1st ring suburbs. Various types of housing from standard lot single-family, duplexes, and a mix of multi-family options. Schools, city halls, parks, and other community amenities are often embedded in the residential fabric.

City Architecture

Senior Living Community

Residential communities for aging populations with needs not easily met by traditional residential neighborhoods. Residents range in age and circumstances. Many such households are made up of empty-nesters who have downsized from larger homes or grandparents raising their grandchildren and have unique intergenerational needs.

City Architecture

Mixed-Income Neighborhood

Residential neighborhoods, typically with existing public infrastructure and aging housing stock, that may be transitioning through waves of renovation, restoration, demolition, or replacement. Smaller lot sizes that maintain proximity of neighbors and original fabric. Housing of a type and scale that may no longer meet the needs and demographic characteristics of the contemporary market. Tend to be within legacy cities or older suburbs.

City Architecture

Compact Residential Neighborhood

Residential neighborhoods, typically with existing public infrastructure, with aging housing stock that may be transitioning through waves of renovation, restoration, demolition, or replacement. Smaller lot sizes that maintain proximity of neighbors and original fabric, but type and size of housing may no longer be appropriate to meet changing needs and demographics. Tend to be within legacy cities or older suburbs.

City Architecture

Suburban Subdivision

New planned residential communities that are developed all at once, rather than by individual builders. Typically they are developed in new locations that are not traditionally or formerly residential, so they require new infrastructure to be installed. Housing sizes vary from moderately-scaled developments to large lots with significant separation between homes.

City Architecture

Rural Residential Development

Typically occurs in townships where land use is predominately rural or agricultural. Homes are spread out on large lots often as part of a farm or estate. Connections to retail, civic, and commercial amenities are distant. Infrastructure is limited— water and sewer utilities are not typically available. Most properties have their own well supply and septic system.

Ken Lund, http://www.flickr.com/photos/kenlund/7984528214/

Open Space (parks and conservation)

Areas like national and state parks, nature preserves, high quality wetlands and habitats, and local parks. Found throughout the region in a variety of forms. Provide ecological functions and recreational areas for residents. May be connected with bicycle and trail networks, scenic railways, waterways, and roads. Ecologically and culturally sensitive assets that increase value and the quality of nearby neighborhoods and communities. In more densely developed areas, parks may be small pockets with plazas that serve as social gathering spaces and landscaping that softens the urban environment. Also play an important role of maintaining outdoor recreation in communities for families, exercise, events, dog walking, etc.

CSVR

Sasaki Associates

Abandonment 55%

Indicates a loss of 55% of existing housing units, jobs, and population. It was applied to areas most at risk for job and population loss to simulate extreme levels of abandonment.

City Architecture

Abandonment 35% + 10% Vacancy

Indicates a loss of 35% of existing housing units and a loss of 45% of existing population and jobs. It represents a moderately high level of abandonment combined with housing and job vacancy.

Vacancy 20%

Used to simulate a moderate shrinkage of a neighborhood or business district. While no housing units are assumed to be demolished, this Development Type removes 20% of existing jobs and population.

Sasaki Associates

DEVELOPMENT TYPE DETAILS

	HOUSING UNITS / GROSS ACRE	JOBS / GROSS ACRE	MIXED USE SCORE	AVERAGE FAR	LAND USE COMPOSITION (%)										ABANDONMENT + VACANCY RATE	REDEVELOPMENT RATE (%)
					MIXED USE	MULTI-FAMILY	2-3 FAMILY ATTACHED	SINGLE FAMILY	RETAIL	OFFICE	INDUSTRIAL	CIVIC	EDUCATIONAL	HOTEL		
Downtown Commercial Core	8.7	110.3	99%	2.7	31%	-	-	-	15%	46%	-	7%	-	7%	0%	71%
Business / Commerce District	-	100.9	37%	1.7	-	-	-	-	21%	79%	-	-	-	-	0%	46%
Transit Oriented District	28.3	40.5	62%	2.3	22%	66%	1%	-	8%	7%	-	-	-	-	0%	59%
Medical / Institutional Center	-	175.2	9%	2.2	-	-	-	-	3%	97%	-	-	-	-	0%	58%
Western Reserve Town Center	11.1	13.8	67%	0.9	14%	67%	-	1%	12%	-	-	9%	-	-	0%	25%
University / College Town	43.3	8.5	59%	2.0	22%	69%	-	-	5%	-	-	-	8%	-	0%	51%
New Town Center	19.6	29.7	96%	1.5	27%	29%	7%	-	23%	9%	-	12%	-	-	0%	39%
Neighborhood Main Street	15.6	51.4	80%	1.8	23%	55%	-	-	15%	7%	-	5%	-	-	0%	46%
Arterial Commercial District	-	13.2	19%	0.5	-	-	-	-	86%	6%	-	1%	-	7%	0%	12%
Lifestyle Center / Mall District	8.8	27.3	26%	0.9	-	5%	-	-	91%	3%	-	1%	-	-	0%	22%
Corporate Campus	-	135.0	29%	1.6	-	-	-	-	14%	87%	-	-	-	-	0%	41%
Light Industrial Business Park	-	20.1	22%	0.5	-	-	-	-	9%	10%	81%	-	-	-	0%	14%
Heavy Industrial Development	-	15.0	13%	0.6	-	-	-	-	5%	2%	94%	-	-	-	0%	15%
Downtown Residential	52.9	6.7	51%	2.9	40%	58%	-	-	11%	-	-	-	-	-	0%	78%
Suburban Multi-Family	30.8	9.2	74%	1.6	27%	52%	3%	-	5%	-	-	8%	10%	-	0%	43%
Senior Living Community	13.6	3.1	19%	0.7	-	91%	3%	-	3%	-	-	3%	-	-	0%	19%
Mixed-Income Neighborhood	19.5	9.1	44%	1.2	11%	80%	1%	-	2%	-	-	3%	4%	-	0%	33%
Compact Residential	11.3	2.8	46%	0.7	8%	76%	3%	3%	3%	-	-	-	9%	-	0%	18%
Suburban Subdivision	3.7	-	0%	0.2	-	-	-	100%	-	-	-	-	-	-	0%	6%
Rural Residential Development	1.8	0.9	13%	0.1	-	-	-	96%	-	-	-	2%	2%	-	0%	3%
Abandonment 55%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	55%	0%
Abandonment 35% (+10%)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	45%	0%
Vacancy 20%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20%	0%
Open Space	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0%	100%
Household Growth 20%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-20%	0%

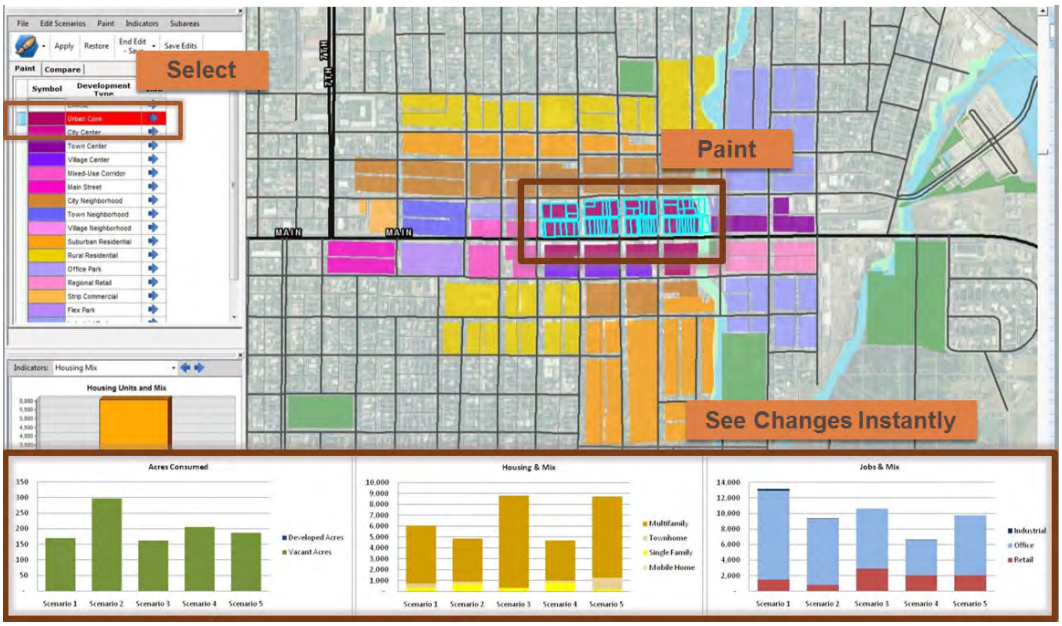
Mechanics of Scenario Painting

Envision Tomorrow consists of an ESRI ArcGIS extension and a linked series of spreadsheets. Scenario "painting" occurs when a user activates the Envision Tomorrow tool in GIS and applies a selected Development Type to polygons or "cells" overlaid on an aerial map image. In Vibrant NEO 2040, the Project Team used 2.5 acre grid cells in developed areas and 40 acre grid cells in rural areas. The Development Types that the user paints represent either greenfield development or redevelopment.

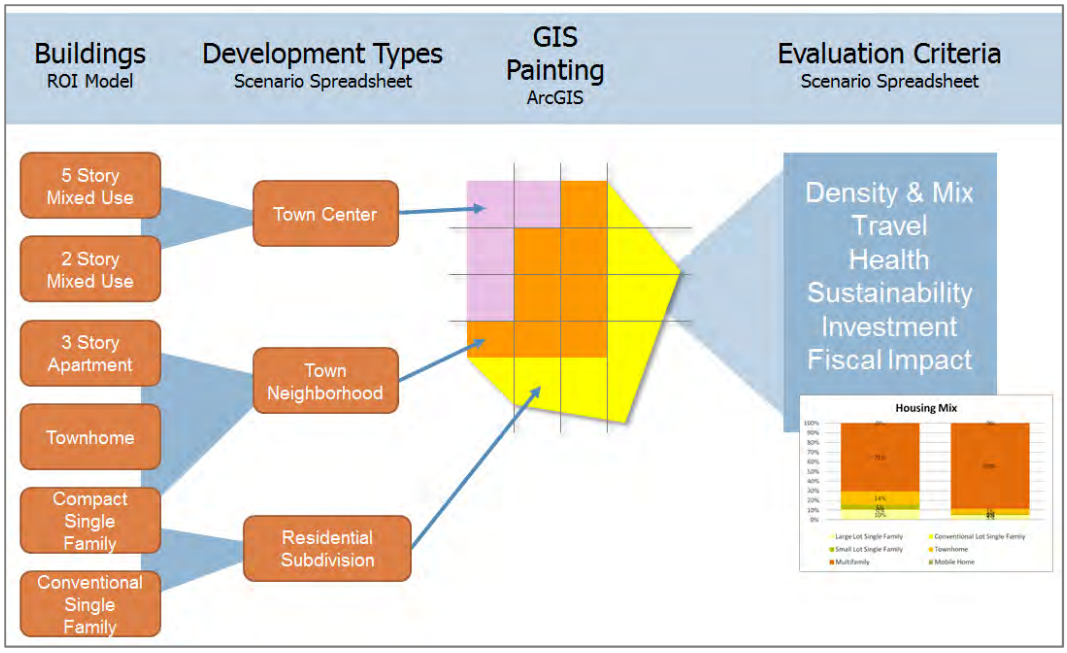
The first time a user opens a scenario geodatabase using Envision Tomorrow, a series of tables that hold information related to Development Type attributes are created within the geodatabase. This is the mechanism by which the Scenario Spreadsheet and the ArcGIS add-in communicate. Based on this information, the Envision Tomorrow can track the following:

- What currently exists in the painted area?
- How much of what exists is redeveloped?
- How much of what exists is being replaced by something new?

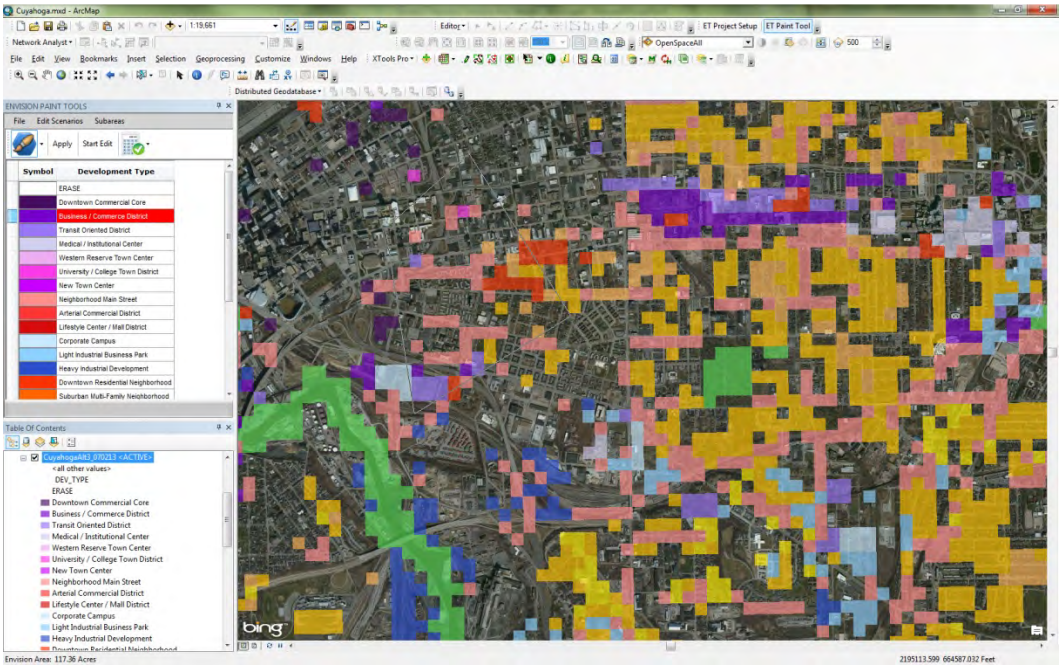
This information is then relayed back to the Scenario Spreadsheet in real-time where the user can see how many housing units, jobs, and people they have "painted" and how many they have removed with abandonment or "redeveloped" as a result of painting.



Envision Tomorrow screenshot
Fregonese Associates



Relationship between data inputs, GIS allocation, and analysis
Fregonese Associates

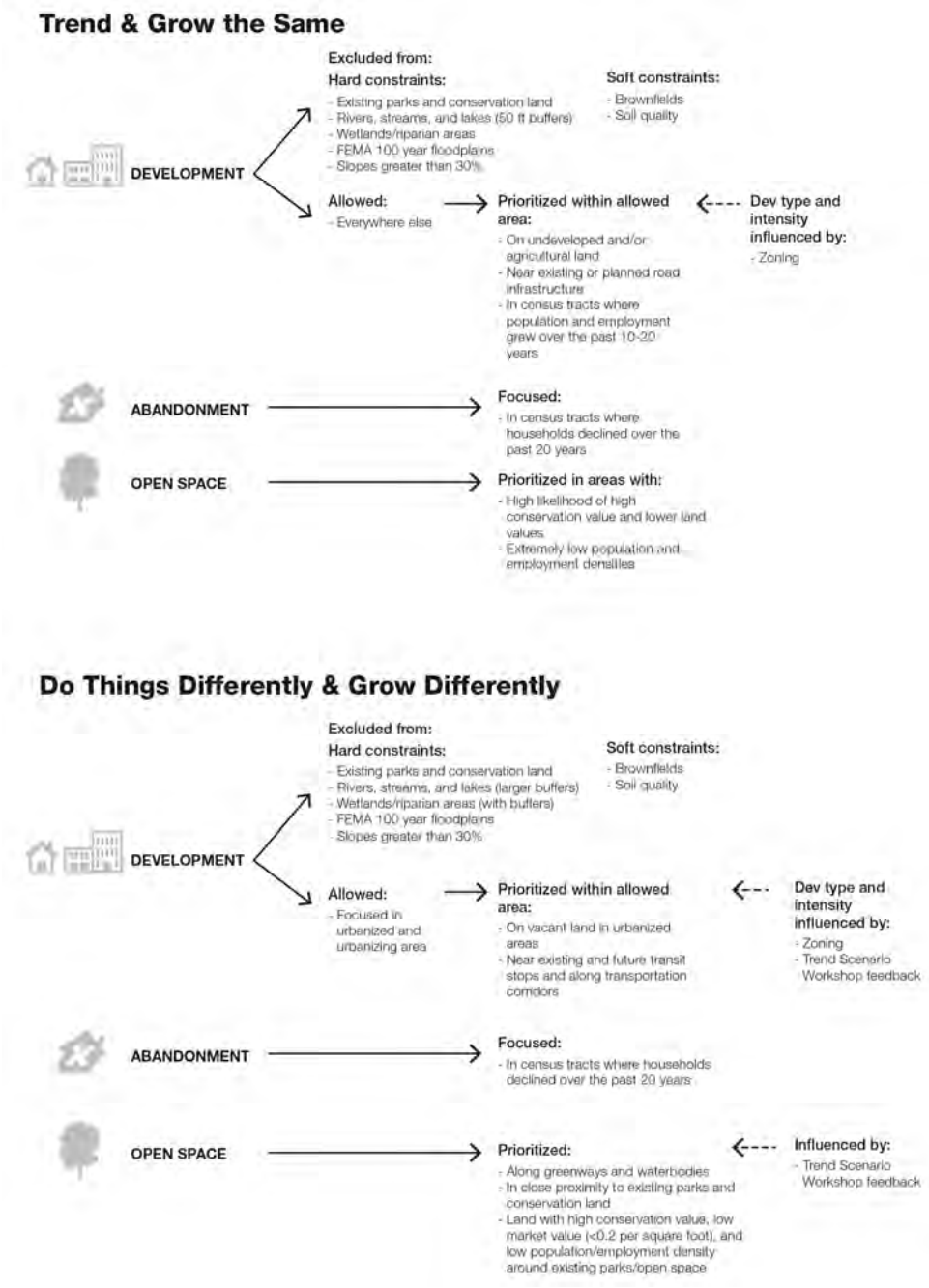


Envision Tomorrow screenshot showing Vibrant NEO scenario development in progress
Fregonese Associates

Painting Inputs

GIS-based polygon, line, and point data guided the Project Team in "painting" future growth, conservation, vacancy, and abandonment in areas where such phenomena might plausibly occur. This was done both visually, using aerial imagery, and by using the data inputs described below, grouped by scenario.

Overview of Spatial Guides:

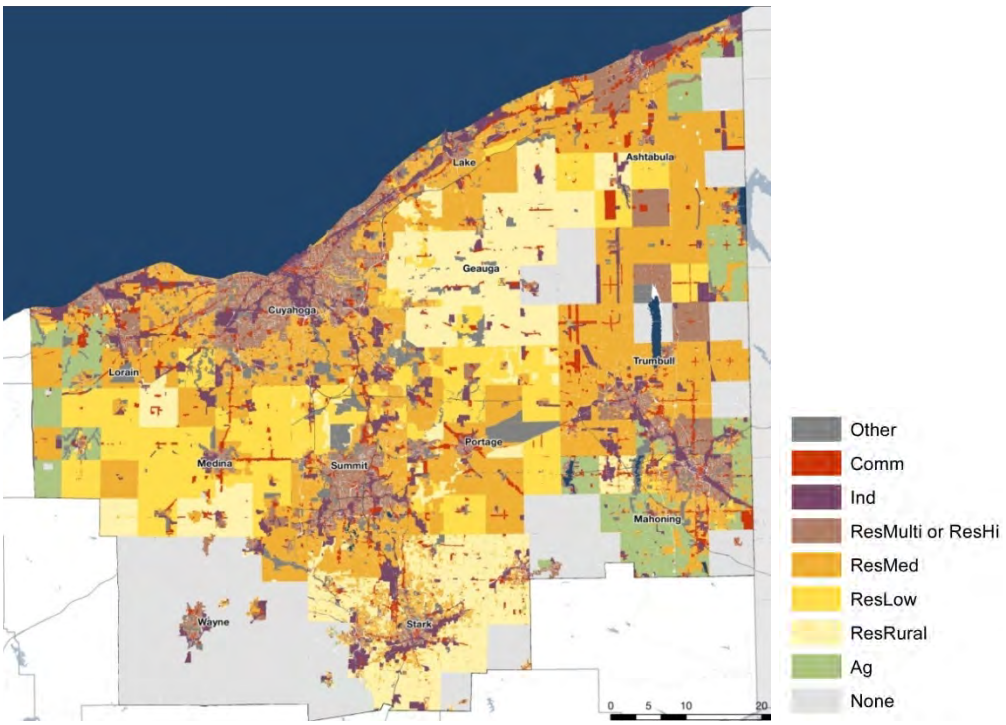


Inputs for All Scenarios

Zoning

NEOSCC prepared generalized regional zoning data. The Project Team used zoning to guide the placement of different intensities and styles of housing and employment:

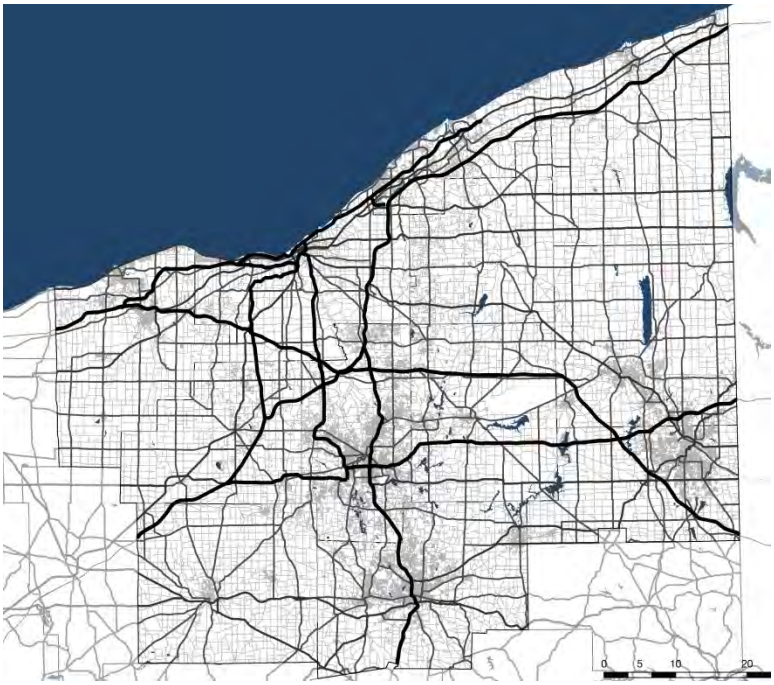
- Multi-family and compact single-family/townhome Development Types were placed in "ResMulti," "ResHi," and "ResMed" zoned areas
- Standard and large-lot subdivisions were placed in areas zoned "ResMed" and "ResLow"
- Large lot and rural development was placed in areas zoned "ResLow," "ResRural," and "Ag"
- Retail employment was painted in areas zoned "Ind" and "Comm"
- Office was painted in areas zoned "Comm"
- Industrial employment was painted in areas zoned "Ind"



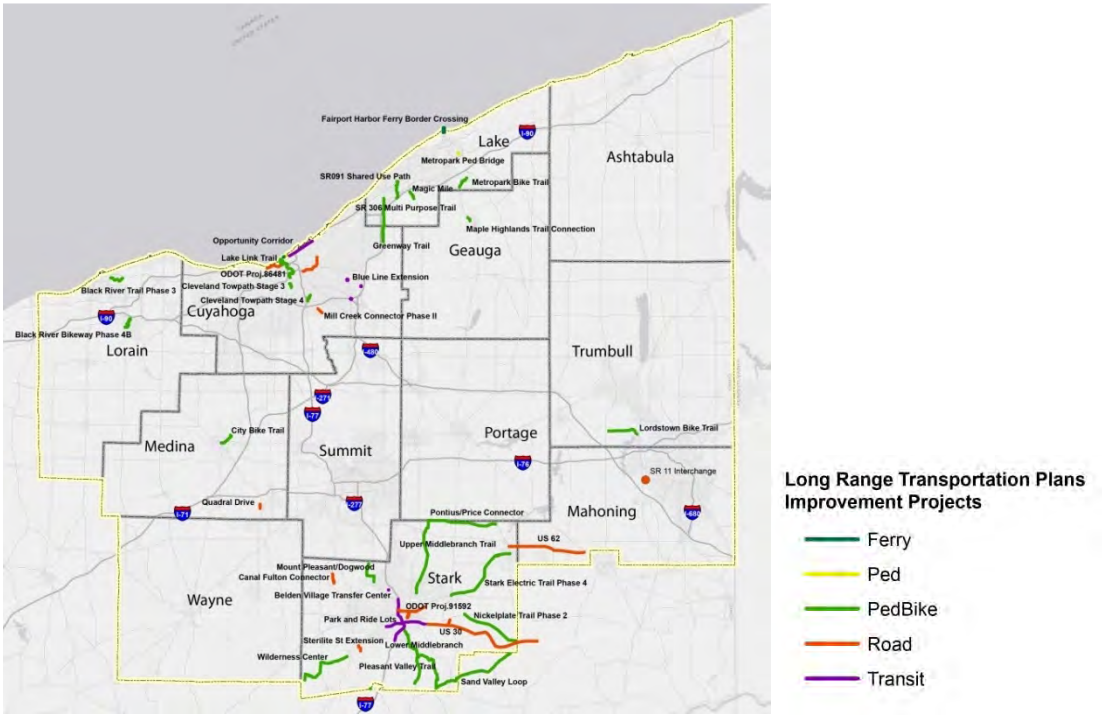
Zoning
Data Source: Compiled by NEOSCC from individual county files provided by county auditors

Existing and Planned Transportation Infrastructure

To the greatest extent possible, new development was clustered around existing and planned transportation infrastructure. Existing transportation includes major arterials and highways, public transportation routes, and public transportation stops. The future transportation data is based on Long Range Transportation Plans. Planned future projects include highway and trail projects. Future highway construction from local transportation plans was considered to have an equal impact on attracting new development as existing transportation infrastructure. There were, however, only a small number of these projects in the data received, so the impact on the scenarios was minimal.



Map of existing road infrastructure
Data Source: NEOSCC



Map of future transportation projects
Data Source: NEOSCC and region's MPOs (projects included in Long-Range Transportation Plans)

Development Constraints

The Project Team divided constraints into two categories: hard and soft constraints. The Project Team removed hard constraint areas from the buildable land in the scenario. Soft constraints were not restricted from painting but were included as guiding layers.

Hard Constraints:

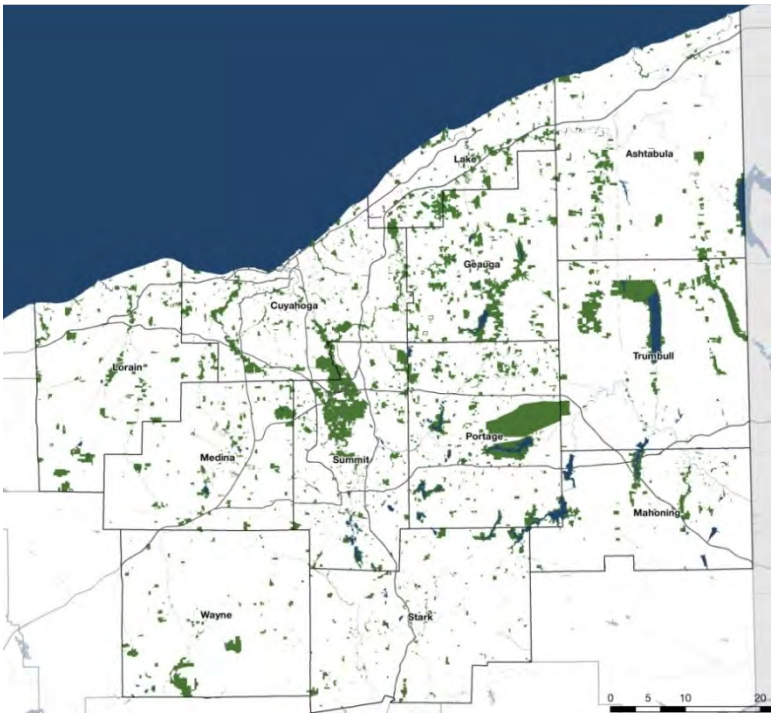
- Rivers, streams, and lakes
- Wetlands/riparian areas
- FEMA 100 year floodplains
- Slopes greater than 30%
- Existing parks/open space

Soft Constraints:

- Brownfields
- Soil quality

Existing Parks and Conservation Land

In all scenarios, no new development, abandonment, or conservation occurred on existing parks and conservation land.



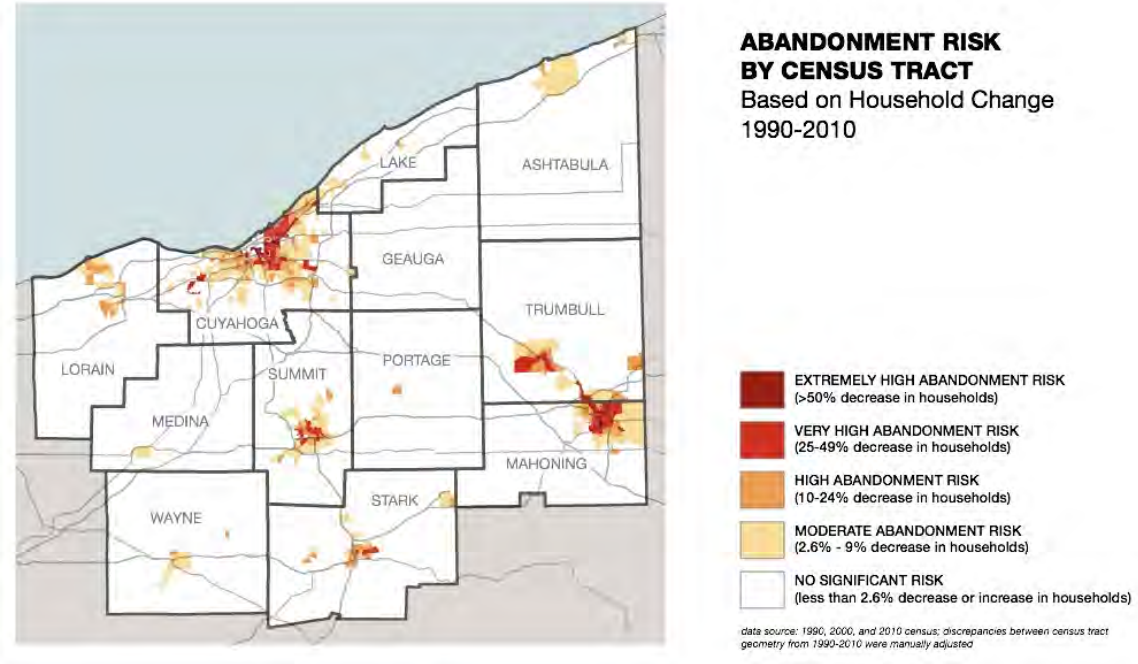
Existing parks and conservation land
Source: Compiled by Sasaki Team; data from NEOSCC, Western Reserve Land Conservancy, and Youngstown State University

Abandonment Risk

Distributing county-level control totals within each county was based on an abandonment risk layer. Abandonment risk was associated with census tracts that lost households between 1990 and 2010.

The relative amount of household decline correlates with the magnitude of abandonment in the scenarios. The higher the percentage of household decline per census tract, the greater the number of abandoned units predicted through 2040. Census tracts that declined in households by more than 50% from 1990 – 2010 were considered for the "55% Abandonment" Development Type. Census tracts that experienced less severe declines (household changes between 0 and -50%) were candidates for a mix of 35% abandonment and vacancy.

Abandonment was focused in legacy downtown areas and surrounding neighborhoods where the housing stock was presumed to be older.



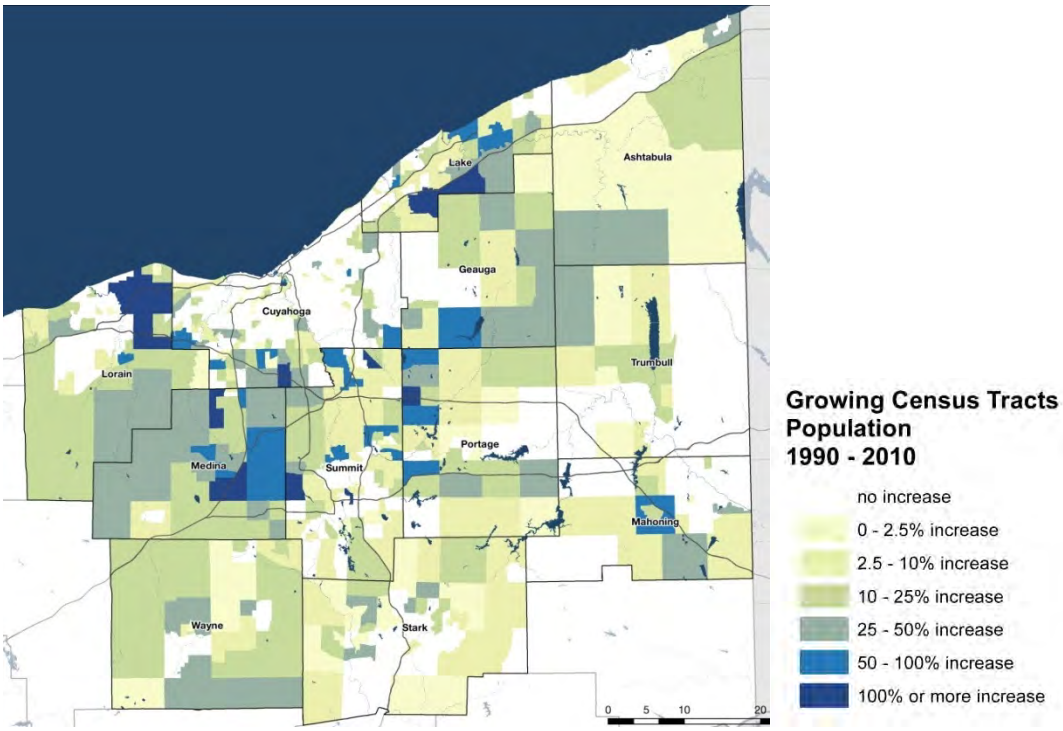
Abandonment Risk
Data Source: US Census 1990, 2000, and 2010; TIGER shapefiles

Inputs Unique to Trend and Grow the Same

The Trend and Grow the Same scenarios continue the region's recent trends in development. The result is the expansion of low density housing and commercial development on previously undeveloped land.

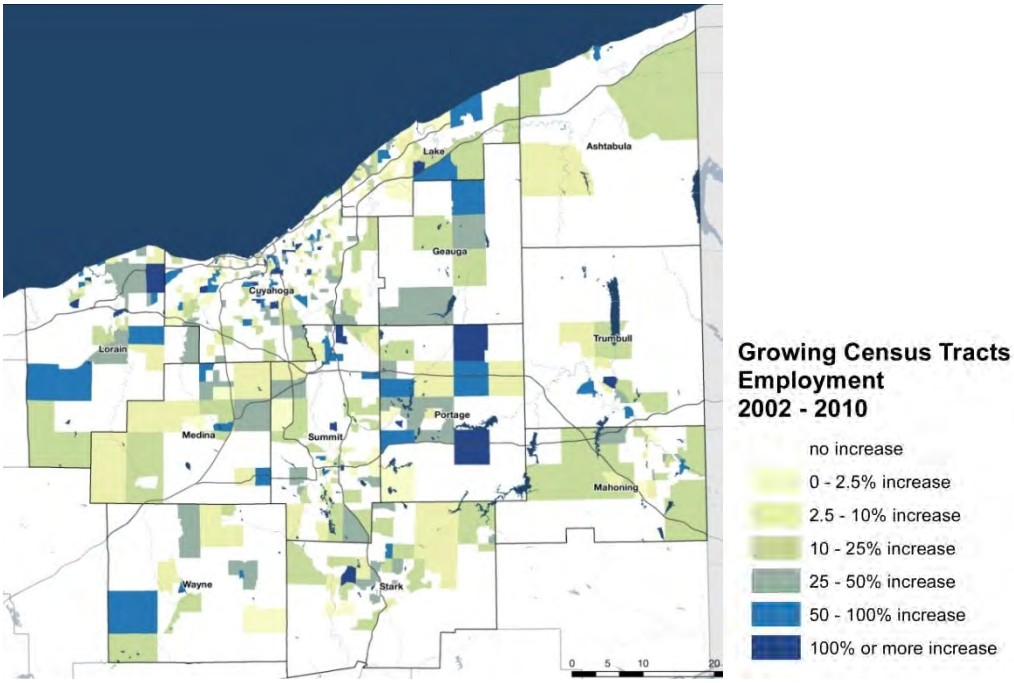
Existing Development Patterns

Current patterns of population and employment growth at the census tract level influenced where future growth occurred in the Trend and Grow the Same scenarios. Layers for trends in population and employment growth were created based on census and Longitudinal Employer-Household Dynamics (LEHD) data. Census tracts that grew the most (changes close to, or more than, 100%) received more employment and housing unit growth. The painting of growth in areas with declining population or employment was avoided.



Growing Census Tracts – Population

Data Source: Census 1990, 2000, and 2010 (census tract level); TIGER 2010 census Tracts

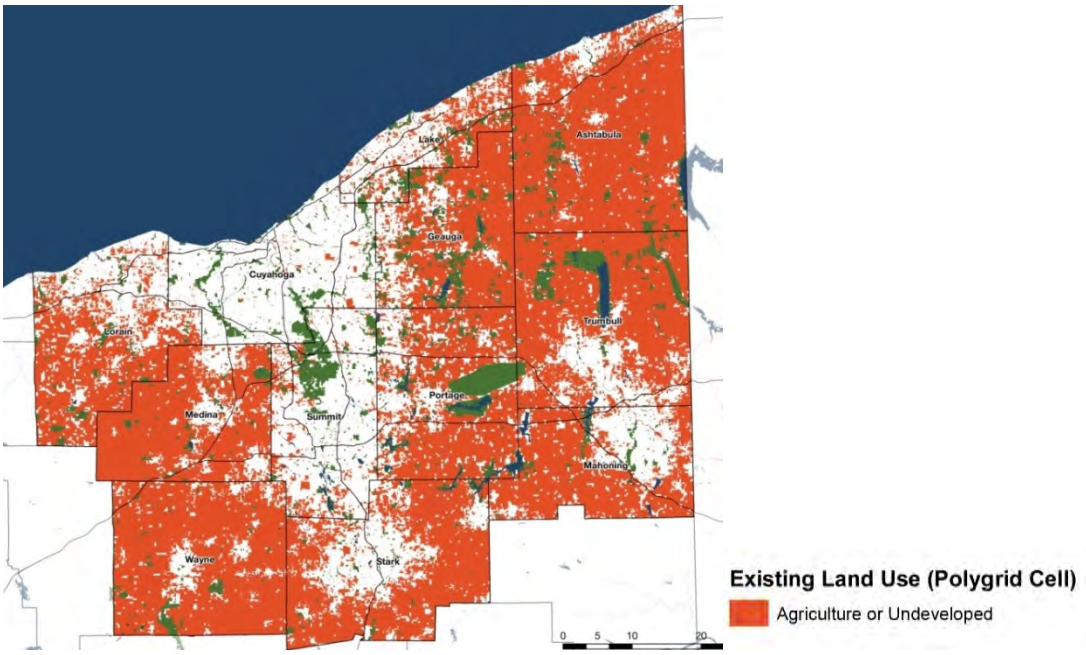


Growing Census Tracts – Employment

Data Source: LEHD 2010 release (oh_wac_S000_JT00_2010.csv and oh_wac_S000_JT00_2002.csv); used data from 2002 and 2010; TIGER 2010 census Tracts

Undeveloped and Agriculture Land

Land that is currently undeveloped or used for agriculture was prioritized for future development in the Trend and Grow the Same Scenarios.



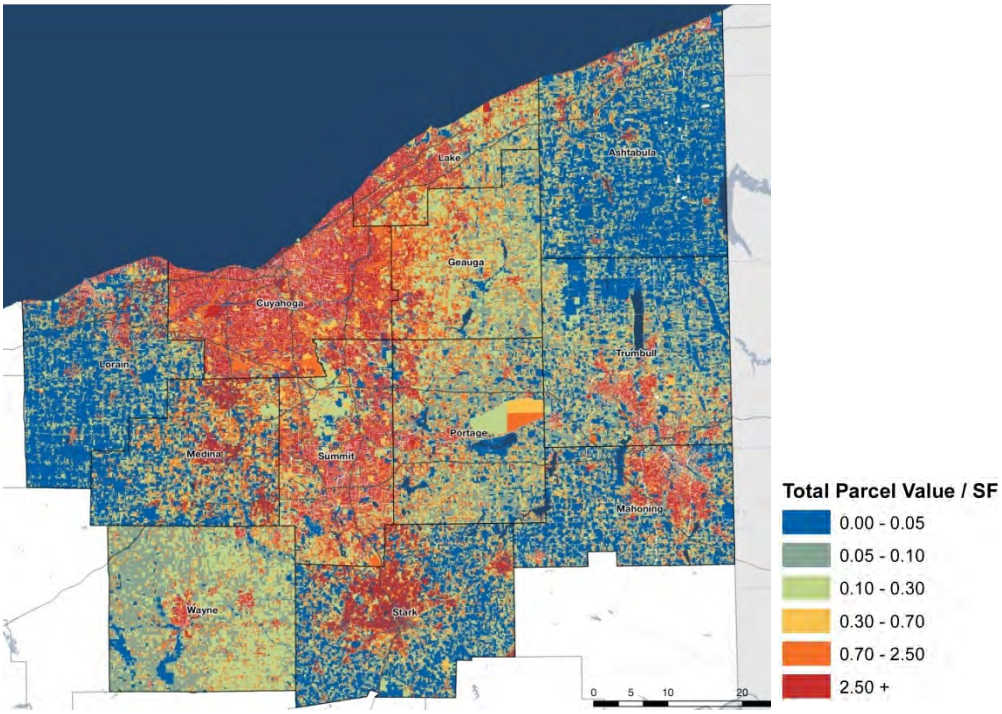
Land available for new development

Data Source: NEOSCC and county auditors

Conservation Attractiveness

In Trend and Grow the Same, conservation is prioritized where land values are relatively low and conservation value is high. The parcel layer was used to identify low cost land. Conservation value was based upon a combination of many different factors including soil characteristics, proximity to water bodies, geological features, vegetation characteristics, contiguous conservation area, etc. Land that is both low cost and of high conservation value were prime targets for conservation in the Trend and Grow the Same scenarios. Additional criteria included population and employment densities.

Existing parks and protected open space was used as a mask for new conservation land. Because these areas were assumed to already be conserved or protected, they were never locations for new, future parks or conservation land (even if they met all the above criteria).

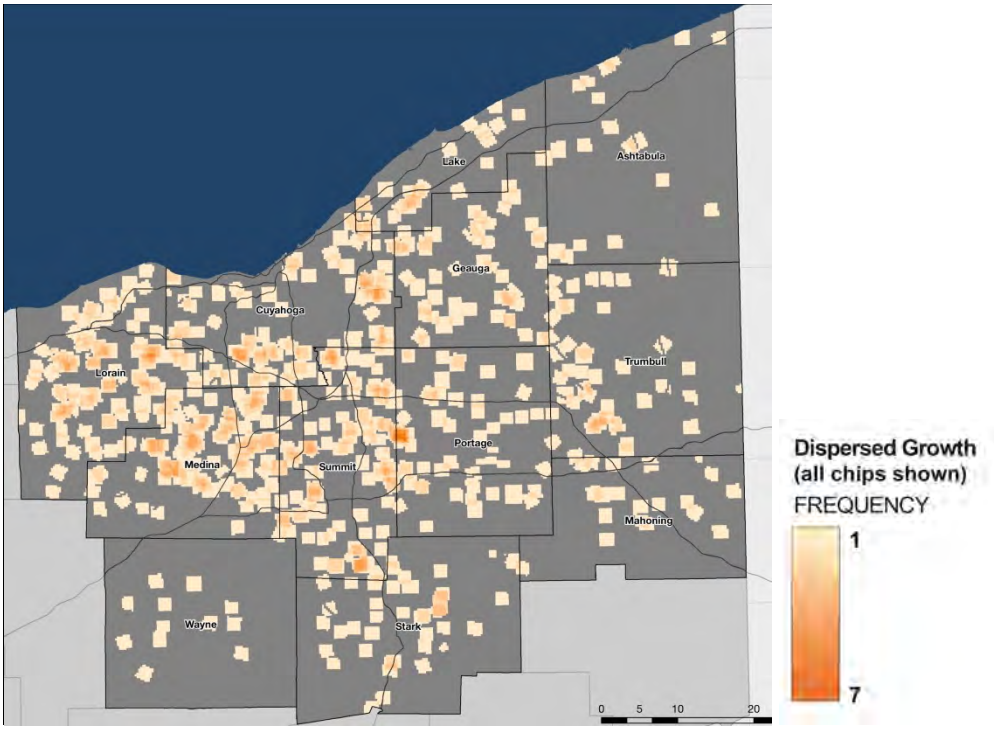


Land Values
Data Source: NEOSCC and county auditors

Inputs Unique to Grow the Same

Dispersed Housing from Trend Scenario Workshop

The Project Team observed two urban design trends from the Trend Scenario Workshop. The majority of attendees expressed a preference for transit and pedestrian oriented, higher density housing development, while a minority view wanted to continue with lower density, auto-oriented development. In order to differentiate scenarios and test different housing bundles, the Project Team isolated each approach in separate scenarios. Grow the Same largely follows the pattern of low density housing from the workshop, using the game pieces placed on maps as a guide:[1]



Dispersed Housing game pieces from Trend Scenario Workshop
Data Source: Workshop participants, digitized by Sasaki Team

1 See the Trend Scenario section of the main report for more information about this workshop exercise.

Inputs Unique to Do Things Differently and Grow Differently

Do Things Differently and Grow Differently focus on reinvestment and prioritizing places with existing, viable infrastructure. These broad goals match themes communicated by the attendees of the Trend Scenario Workshop, including:

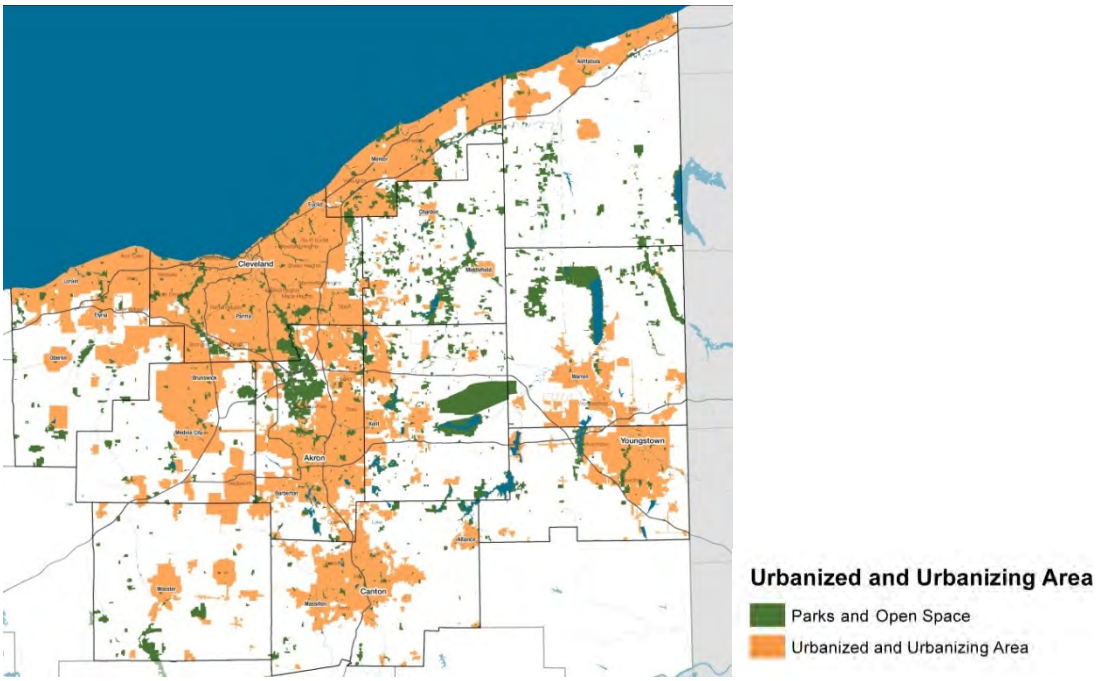
- Reinvest in legacy communities
- Balance auto-oriented development with communities that support walking, biking, and public transportation
- Protect natural and agricultural resources

Urbanized and Urbanizing Areas

The initial modeling step for the two "differently" scenarios focused investment in "Urbanized and Urbanizing Areas," protecting high quality natural landscapes and valuable agriculture in rural areas. The proposed Urban and Urbanizing Land Area is home to 83% of the region's current population and 90% of its jobs.

The Urbanized and Urbanizing Areas in Northeast Ohio was constructed by:

1. Starting with the 2010 US census definition and boundary of "Urbanized Land"
2. Establishing a ½ mile buffer around the perimeters to acknowledge a transition zone
3. Subtracting areas that are currently unsewered by public systems and not planned for future sewer expansion
4. Adding those areas within and adjacent to this land that are either identified in the regions' 208 water quality plans as having public sewer systems or designated for future expansion of public sewers
5. Removing all parks and conservation land



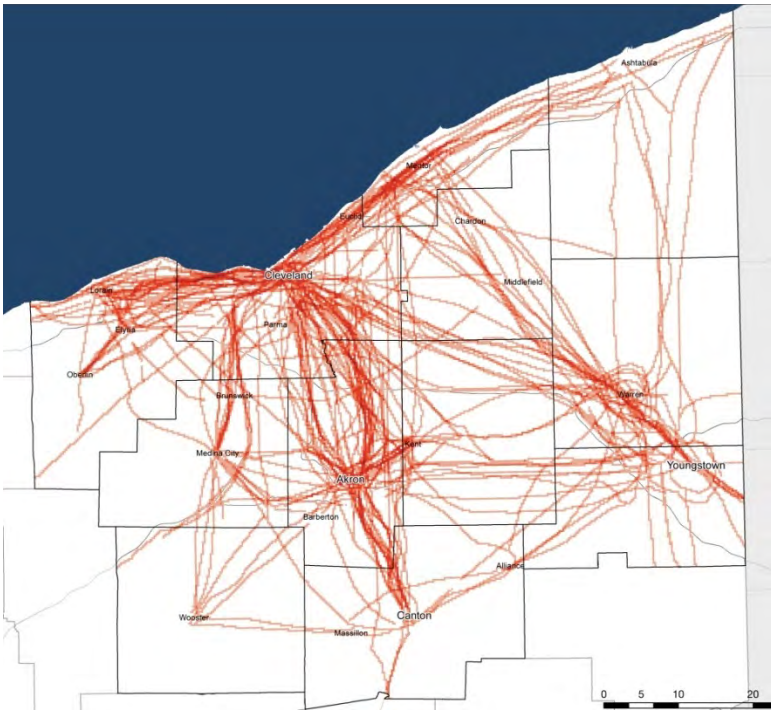
Urbanized and Urbanizing Area
Source: Sasaki Team and NEOSCC

Expanded Transportation Network

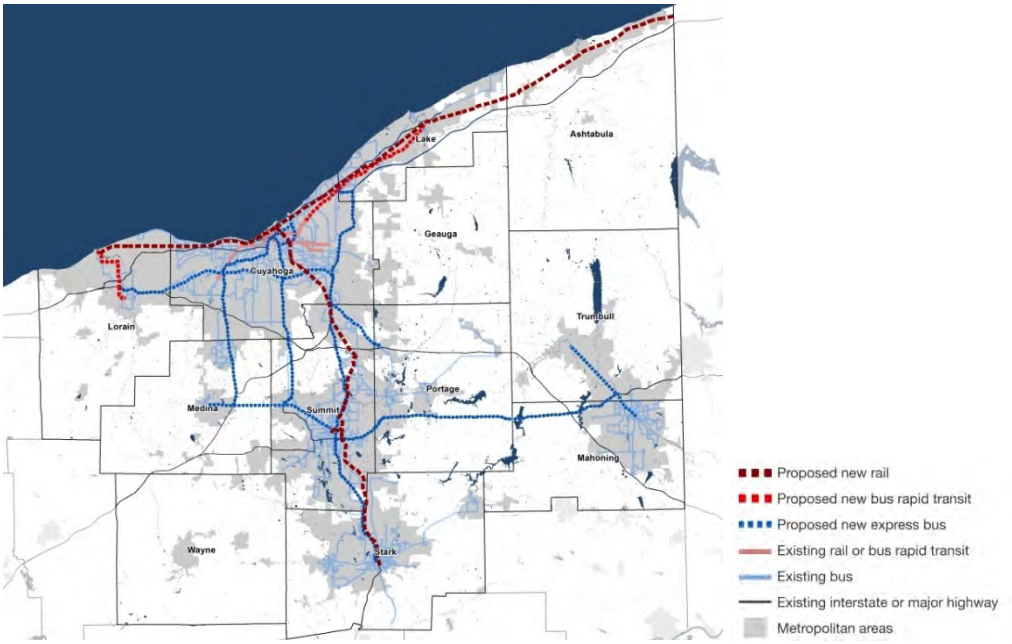
Representing a significant additional investment in public transportation, the transportation strategy proposed for Do Things Differently and Grow Differently forms a broad T-shaped network connecting the communities in the counties contiguous to Lake Erie as well as the Cleveland-Akron-Canton corridor. No new major roads are proposed for either scenario. Commuter rail connects communities along Lake Erie and south from Cleveland down to Canton. Express bus and bus rapid transit connect many of the smaller communities around the Cleveland and Akron metro areas and extend a commuter bus line from Akron to Youngstown.

These lines were designed in conjunction with the priority investment areas and urban design strategy described below. They link many of the region's current employment nodes. Since these nodes are within the proposed priority investment areas, they are likely to experience additional development even in the face of low-to-moderate employment growth. The resulting increases in job density in these nodes will make serving them with commuter rail or express bus more feasible. The proposed alignments and modes apply to both scenarios.

The transit lines respond to recommendations in the Analysis of Impediments to Fair Housing Choice and the preferences expressed by the majority of the Trend Scenario Workshop attendees. Proposed public transit networks improve the connections between jobs and people (specifically by increasing public transit options), enhance connectivity along the region's major nodes and corridors, and spark economic development locally through infrastructure investment.



Trend Scenario Workshop transit lines drawn by attendees
Source: Workshop Participants, digitized by Sasaki Team



Do Things Differently and Grow Differently transit routes
Source: Sasaki Team and NEOSCC

Transit influenced development in the Do Things Differently and Grow Differently Scenarios. Specifically development in these two scenarios was prioritized near current and proposed public transit in the following ways:

- 1,200 foot buffers were created around existing transit lines that have headways of 15 minutes or better. Redevelopment was focused in these corridors.
- New growth was clustered around future transit lines and stops. Development was prioritized where certain factors suggested redevelopment potential – large swaths of undeveloped land, appropriate zoning, and proximity to infrastructure

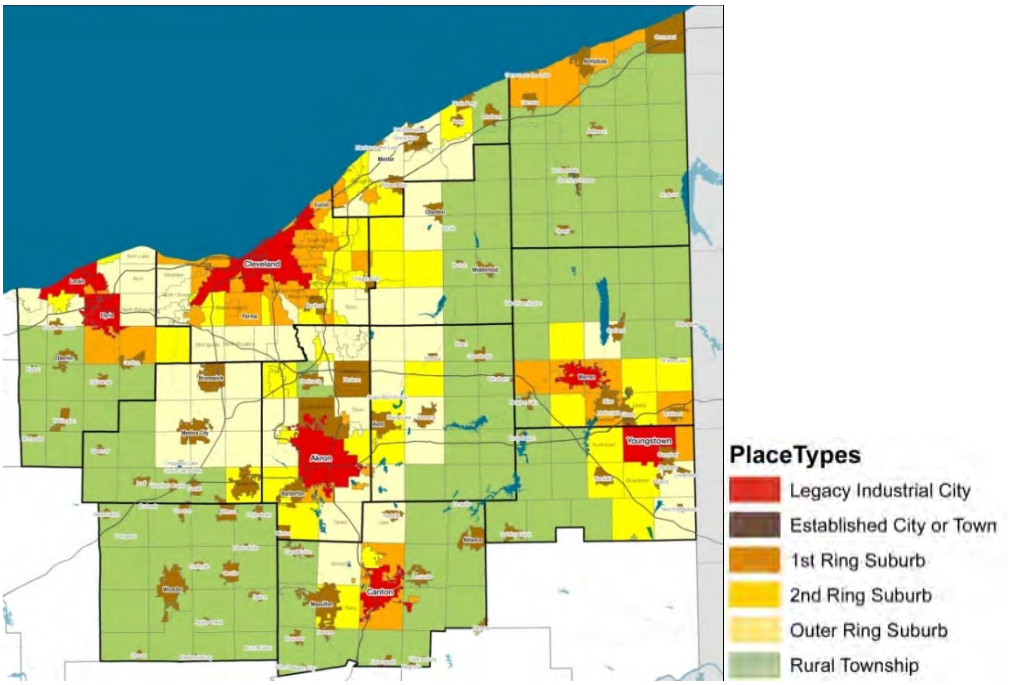
Place Types: Urban Design and Development Mix

In Do Things Differently and Grow Differently, the Project Team switched to an infill pattern focused on accessibility, local context, and existing infrastructure, all of which are focused on the priority investment areas described in the previous section. To achieve this, the Project Team used the six Vibrant NEO 2040 Place Types:[2]

2 These place types were defined using a process developed by the Quality Connected Places Workstream and refined by the Project Team in consultation with local planning and economic development practitioners.

- Legacy Cities
- 1st Ring Suburbs
- 2nd Ring Suburbs
- Outer Ring Suburbs
- Established Cities and Towns
- Rural Townships

Neighborhoods within legacy cities were further sub-categorized as stable, unstable, transitioning, or downtown/cultural center.



Place Types in Northeast Ohio
Source: NEOSCC and the Sasaki Team

Community Categorization by Growth Patterns:

City Architecture

Legacy City
(Pre 1910)
Akron, Canton, Cleveland, Elyria, Lorain, Warren, Youngstown

City Architecture

1st Ring Suburbs
(1910-1959)
Cleveland Heights, Wickliffe, Sheffield, Parma, Mogadore, East Canton, Howland, etc.

City Architecture

2nd Ring Suburbs
(1950-1969)
Orange, Eastlake, Norton, Fairlawn, Boardman, Liberty, North Olmsted, etc.

City Architecture

Outer Ring Suburbs
(1970-present)
Bainbridge, Avon, Westlake, Twinsburgh, Bazetta, etc.

Sasaki Associates

Established Cities & Towns
(varies)
Medina, Painesville, Ravenna, Wooster, Niles, Ashtabula, Kent, Oberlin, etc.

Ken Lund,
http://www.flickr.com/photos/kenlund/7984528214/

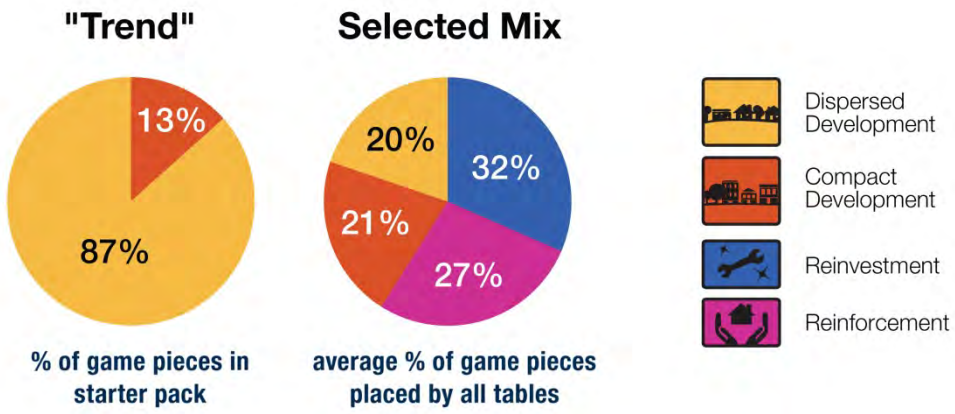
Rural Townships
(varies)
Parkman, Wellington, Westfield, Hiram, Wyndham, Saybrook, Jackson, Gustavus

Each place type has a set of suitable Development Types, which were established through local case studies, community master plans, and on-going regional investment efforts. This set, the Development Type mix, becomes the guiding palette for painting the alternative scenarios. The following chart shows the Development Types associated with each place type:

"Place Type" Mix Matrix

Development Type	Place Type								
	Legacy City – Stable Neighborhood	Legacy City - Unstable Neighborhood	Legacy City – Transitioning Neighborhood	Legacy City – Downtown/ Cultural Center	1st Ring Suburb	2nd Ring Suburb	Outer Ring Suburb	Established City or Town	Rural Township
Downtown Residential Neighborhood				X					
University / College Town District				X				X	
Mixed – Income Neighborhood	X	X	X	X	X	X		X	
Suburban Multi-Family Neighborhood						X	X		
Compact Residential Neighborhood	X	X	X		X	X		X	
Suburban Subdivision						X	X		X
Senior Living Community	X	X	X	X	X	X	X	X	
Rural Residential Development							X		X
Transit Oriented District	X	X	X	X	X				
Downtown Commercial Core				X					
Western Reserve Town Centers								X	
Neighborhood Main Street	X				X			X	X
Lifestyle Center / Mall District						X	X		
Arterial Commercial District			X		X	X	X	X	X
New Town Center								X	
Business / Commerce Districts			X	X	X	X		X	
Corporate Campuses			X			X	X		
Medical / Institutional Centers				X		X		X	
Light Industrial Business Park			X		X	X	X	X	
Heavy Industrial Development	X	X							
Parks and Conservancy	X	X	X	X	X	X	X	X	X

These Development Types are aspirational: the Project Team is not proposing to demolish existing communities and replace them with an idealized mix, but where there is room to reinvest in existing communities as a result of abandonment, the scenarios apply a balanced mix of development that responds to the feedback received at the Trend Scenario Workshop. The majority of participants was unsatisfied with the default, trend-based game pieces and traded them in for more compact, reinvestment, and reinforcement pieces.



Average game pieces placed per table compared with "Trend" development distribution

The place type matrix above reflects the preferred development mix indicated by workshop attendees.

Riparian Buffers

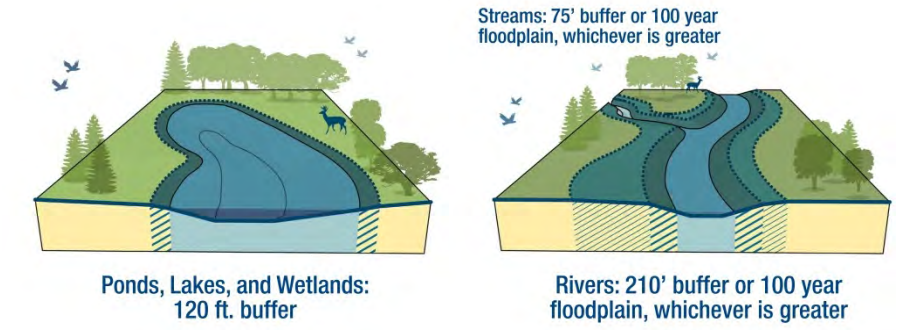
Do Things Differently and Grow Differently use similar constraints as the Trend and Grow the Same Scenarios, but the riparian buffer distances are expanded.

With a region the size of Northeast Ohio, the Project Team believes—and were told at the Trend Scenario Workshop—that there is no need to sacrifice sensitive ecological land or high value agriculture to accommodate new growth, especially when there is an excess supply of land that is already served by infrastructure that is at less-than-full capacity. This issue is addressed at first pass within the model by implementing the priority investment areas within the region's existing Urban and Urbanizing Area and adopting measures to protect the rural areas.

Within these conservation areas, the Project Team proposes that the region's communities consider measures that will protect watersheds and aquifers, preserve high value farm land, and promote the stewardship of open spaces and habitats.

One key theme that emerged from the Trend Scenario Workshop and ImagineMyNEO results was protecting water. The Do Things Differently and Grow Differently scenarios prohibit new development in sensitive environmental areas adjacent to waterbodies. These constraints are adapted from model ordinances from Chagrin River Watershed Partners.[3]

3 http://www.crwp.org/index.php/member-services/model-regulations

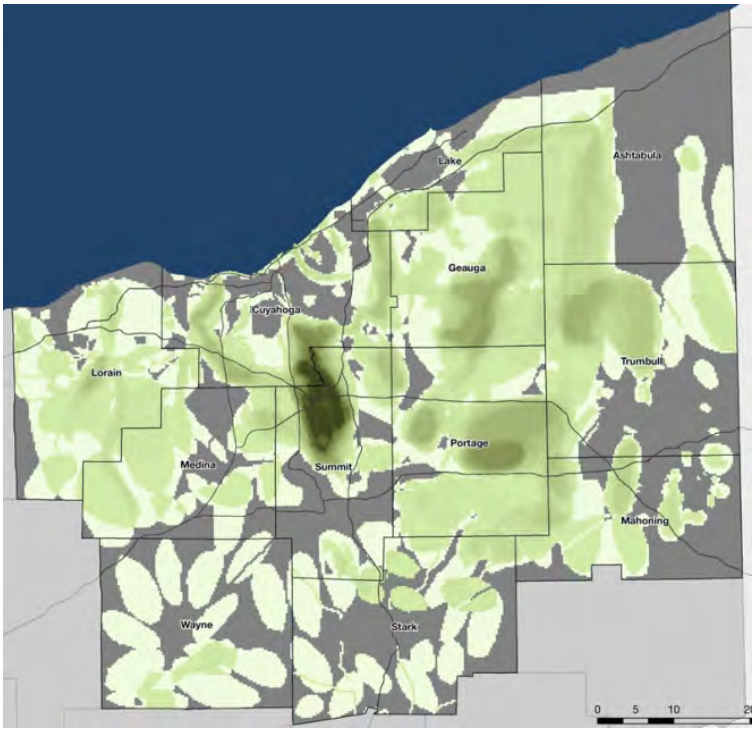


Buffer Distances

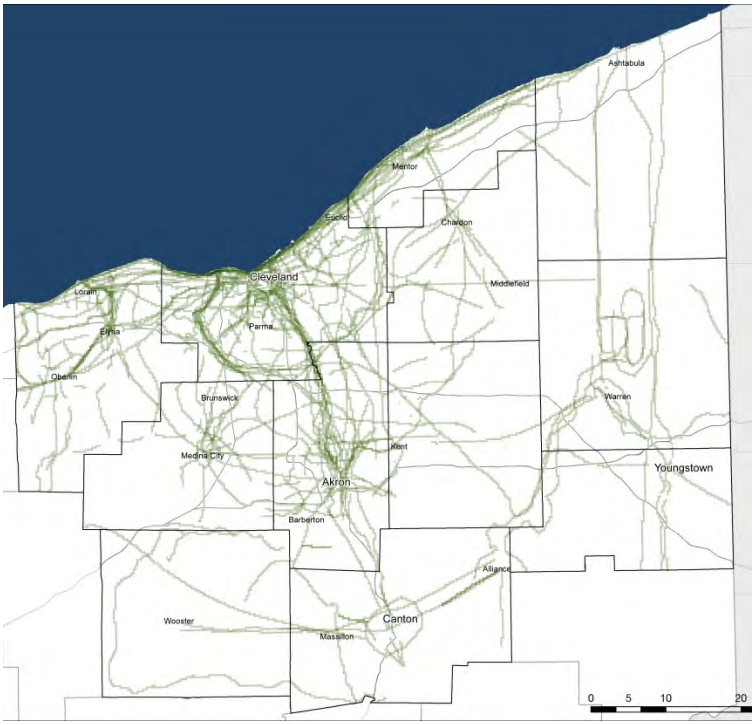
Water buffers zoom-in, Ashtabula County

Expanded Greenway Network

Another guiding theme related to conservation that emerged from the Trend Scenario Workshop was a desire to improve the linkages between the region's existing protected natural areas. The following image shows the areas where the Trend Scenario Workshop participants drew desired open space protection and greenways:



Trend Scenario Workshop conservation hot spots
Data Source: Workshop participants, digitized by Sasaki Team

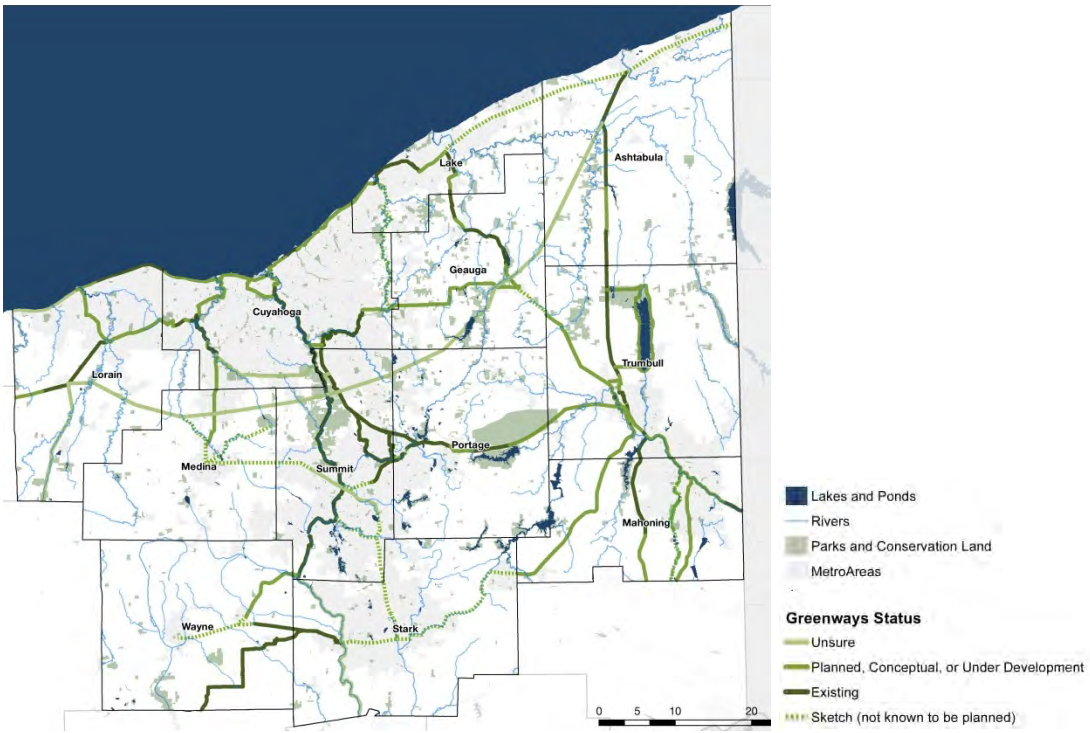


Trend Scenario Workshop bicycle and pedestrian paths
Data Source: Workshop participants, digitized by Sasaki Team

Two major corridors of emphasis are Cleveland to Canton—passing through the Cuyahoga National Valley Park—and the Mahoning River Valley.

Goals of the greenway network:

1. Identify a regional greenway network that reflects popular preference as expressed both by the Trend Scenario Workshop attendees and the bikeway plans and maps prepared by the region's four Metropolitan Planning Agencies.
2. Incorporate established national, multi-county, and county-level trail and route networks.



Proposed Greenways
Source: Sasaki Team and NEOSCC

In making these connections, the following factors were prioritized:

- desired connections and greenways sketched by workshop participants
- planned routes by MPOs
- riparian corridors

Conservation

In addition to the Trend Scenario Workshop feedback and the greenway network described above, conservation in the "differently" scenarios was also based on plant community value, land prices, and hydrological value. One additional element for Do Things Differently and Grow Differently is an emphasis on larger, contiguous patches. From a biotic perspective, large, high-quality patches are typically better than small, distributed patches.

New conservation allocation followed these guidelines:

1. Bring vacant land within 100 feet of existing protected open space into conservation
2. Bring vacant land around proposed greenways into conservation
3. Add land with high conservation value, low market value, and low population/employment density (as low as possible then gradually increase until enough land becomes available) around existing parks/open space until the conservation land target was met.

Land Use Categories

The Project Team converted existing land use information and future, "painted" Development Types into a set of uniform land use categories in order to make it easier to represent the scenarios visually. These categories were developed with several factors in mind:

- Ensure land use classifications will work well with both existing conditions as well as future Development Types
- Keep total number of categories to a small enough set that colors can be distinguishable from one another on maps (improving legibility of maps)
- Select categories that are most representative of the region

The final set of land use categories includes:

- **Mixed Use (MU):** More than 1 land use on single parcel (or within a Development Type for future land uses)
- **Commercial (C):** commercial uses, excluding vacant commercial land, as well as land use codes in 400s, excluding a few uses that are more appropriate in other land use categories.[4] A full cross-walk can be found below.
- **Industrial (I):** industrial uses, excluding vacant industrial land; generally, land use codes in 300s
- **Residential: Urban or Multifamily (ResU):** medium to high density residential; includes 1) any multi-family or 2) single-family residential with a lot size less than 2 acres (equivalent of 5 UPA)
- **Residential: Suburban (ResS):** low density residential; single-family lot more than or equal to 0.2 and less than 1 acre (1-5 UPA)
- **Residential: Rural (ResR):** very low density residential; single family lot on 1 acre or more (< 1 UPA)
- **Agriculture (AG):** active agriculture uses, generally land use codes in 100s
- **Parks and Conservation:** publicly-owned parks, active recreation (including golf courses), and conservation land
- **Abandoned Parcel (Vacant - previously developed):** These are unused residential, commercial, and industrial parcels that were previously developed or have poor/very poor condition structures.
- **Other Unbuilt:** This is a "catch-all" category for any remaining parcels without structures. It includes, for example, rural land like forests that is not developed or conserved, cemeteries, utility easements, and vacant industrial or commercial parcels with no improvement value
- **Other Built:** This is a "catch-all" category for any remaining parcels with improvements (usually structures, but parking lots, roads, and rail lines are included in this category as well). It includes, for example, public buildings (schools, government buildings), hospitals, roads, parking, and airports
- **Water:** bodies of open water

For example photos of each land use, see the "Trend Scenario" section of the main report.

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4 For example, commercial camp grounds are classified as "unbuilt other," multi-family residential is "residential: urban or multifamily," and nursing homes and private hospitals are "built other" to be consistent with other hospitals.

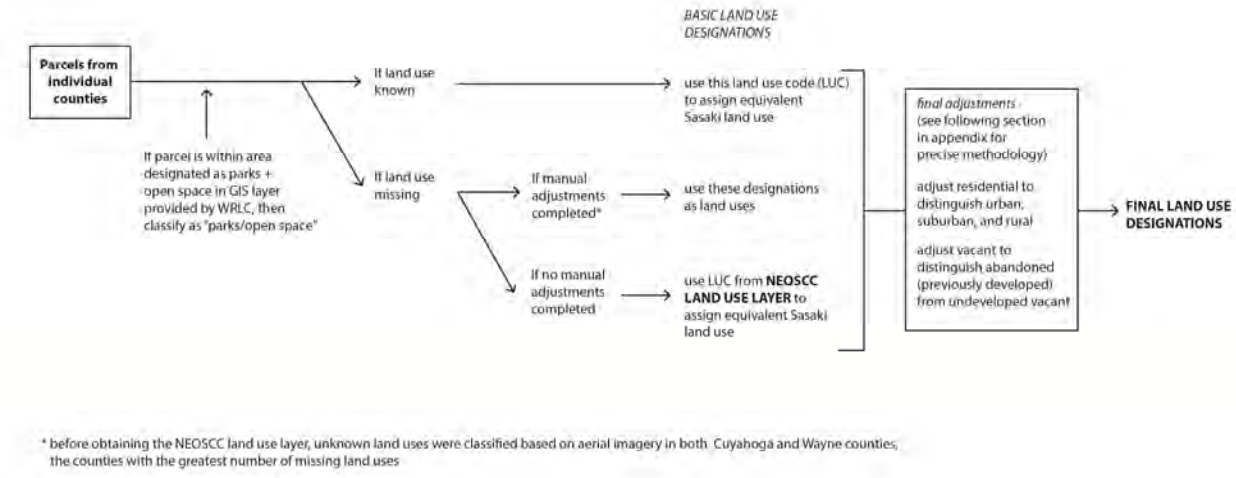
After developing this list, both existing parcel information and future Development Types were classified with the new land use categories.

The following table shows how Development Types were matched with land use categories:

Development Types and Corresponding Land Uses

Development Type	Land Use
Downtown Residential Neighborhood	Residential: Urban or Multifamily
University / College Town District	Mixed Use
Mixed – Income Neighborhood	Residential: Urban or Multifamily
Suburban Multi-Family Neighborhood	Residential: Urban or Multifamily
Compact Residential Neighborhood	Residential: Urban or Multifamily
Suburban Subdivision	Residential: Suburban
Senior Living Community	Residential: Urban or Multifamily
Rural Residential Development	Residential: Rural
Transit Oriented District	Mixed Use
Downtown Commercial Core	Commercial
Western Reserve Town Centers	Mixed Use
Neighborhood Main Street	Mixed Use
Lifestyle Center / Mall District	Commercial
Arterial Commercial District	Commercial
New Town Center	Mixed Use
Business / Commerce Districts	Commercial
Corporate Campuses	Commercial
Medical / Institutional Centers	Other Built
Light Industrial Business Park	Industrial
Heavy Industrial Development	Industrial

The following diagram provides a summary of the method used to match parcel data to the land use categories.



Detailed Conversion Process

Where possible, land use codes were used to assign equivalent land uses as follows:

Converting Land Use Information to Sasaki Land Use Categories

LUC	Land Use Description	Sasaki Land Use
0	0 Platted Lot	Unused*
1	1 Unplatted -0 to 9.99 acres	Unused*
2	2 " 10 to 19.99 acres	UBO
3	3 " 20 to 29.99 acres	UBO
4	4 " 30 to 39.99 acres	UBO
5	5 " 40 or more acres	UBO
100	100 Agricultural vacant land	UBO
101	101 Cash – grain or general farm	AG
102	102 Livestock farms other than dairy and poultry	AG
103	103 Dairy farms	AG
104	104 Poultry farms	AG
105	105 Fruit and nut farms	AG
106	106 Vegetable farms	AG

5 * Additional analysis required. More information is available following this table.

LUC	Land Use Description	Sasaki Land Use
107	107 Tobacco farms	AG
108	108 Nurseries	AG
109	109 Green houses, vegetables and floraculture	AG
110	110 Agricultural vacant land “qualified for current agricultural use value”	AG
111	111 Cash – grain or general farm “qualified for current agricultural use value”	AG
112	112 Livestock farms other than dairy and poultry “qualified for current agricultural use value”	AG
113	113 Dairy farms “qualified for current agricultural use value”	AG
114	114 Poultry farms “qualified for current agricultural use value”	AG
115	115 Fruit and nut farms “qualified for current agricultural use value”	AG
116	116 Vegetable farms “qualified for current agricultural use value”	AG
117	117 Tobacco farms “qualified for current agricultural use value”	AG
120	120 Timber or forest lands not qualified for the Current Agricultural Use Value program pursuant to section 5713.31 of the Revised Code or the Forest Land Tax program pursuant to section 5713.23 of the Revised Code	UBO
121	121 Timber land taxed at its “current agricultural use value” as land used for the growth of noncommercial timber pursuant to section 5713.30(A)(1) of the Revised Code	UBO
122	122 Timber land taxed at its “current agricultural use value” as land used for the commercial growth of timber	UBO
123	123 Forest land qualified for and taxed under the Forest Land Tax program in compliance with the program requirements in place prior to November 7, 1994	UBO
124	124 Forest land qualified for and taxed under the Forest Land Tax program in compliance with the program requirements in place on or after November 7, 1994	UBO
190	190 Other agricultural use	AG
199	199 Other agricultural use “qualified for current use value”	AG
210	210 Coal lands – surface and rights	UBO
220	220 Coal rights – working interest	UBO
230	230 Coal rights – separate royalty interest	UBO
240	240 Oil and gas rights – working interest	UBO
250	250 Oil and gas rights – separate royalty interest	UBO
260	260 Other minerals	UBO
300	300 Industrial – vacant land	Unused*
310	310 Food and drink processing plants and storage	I
320	320 Foundries and heavy manufacturing plants	I
330	330 Manufacturing and assembly, medium	I
340	340 Manufacturing and assembly, light	I
350	350 Industrial warehouses	I

6 * Additional analysis required. More information is available following this table.

LUC	Land Use Description	Sasaki Land Use
360	360 Industrial truck terminals	I
370	370 Small shops (machine, tool & die, etc.)	I
380	380 Mines and quarries	I
390	390 Grain elevators	I
399	399 Other industrial structures	I
400	400 Commercial – vacant land	Unused*
401	401 Apartments – 4 to 19 rental units	ResU
402	402 Apartments – 20 to 39 rental units	ResU
403	403 Apartments – 40 or more rental units	ResU
410	410 Motels and tourist cabins	C
411	411 Hotels	C
412	412 Nursing homes and private hospitals	BO
415	415 Trailer or mobile home park	ResU
416	416 Commercial camp grounds	UBO
419	419 Other commercial housing	ResU
420	420 Small (under 10,000 sq. ft.) detached retail stores	C
421	421 Supermarkets	C
422	422 Discount stores and junior department stores	C
424	424 Full line department stores	C
425	425 Neighborhood shopping center	C
426	426 Community shopping center	C
427	427 Regional shopping center	C
429	429 Other retail structures	C
430	430 Restaurant, cafeteria and/or bar	C
435	435 Drive-in restaurant or food service facility	C
439	439 Other food service structures	C
440	440 Dry cleaning plants and laundries	C
441	441 Funeral homes	C
442	442 Medical clinics and offices	C
444	444 Full service banks	C
445	445 Savings and loans	C
447	447 Office buildings – 1 and 2 stories	C
448	448 Office buildings – 3 or more stories – walk up	C
449	449 Office buildings – 3 or more stories – elevator	C

7 * Additional analysis required. More information is available following this table.

LUC	Land Use Description	Sasaki Land Use
450	450 Condominium office units	C
452	452 Automotive service station	C
453	453 Car washes	C
454	454 Automobile car sales and services	C
455	455 Commercial garages	BO
456	456 Parking garage, structures and lots	BO
460	460 Theaters	C
461	461 Drive-in theaters	C
462	462 Golf driving ranges and miniature golf courses	UBO
463	463 Golf courses	OS
464	464 Bowling alleys	C
465	465 Lodge halls and amusement parks	C
480	480 Commercial warehouses	I
482	482 Commercial truck terminals	I
490	490 Marine service facilities	I
496	496 Marina (small boat)	C
499	499 Other commercial structures	C
500	500 Residential vacant land	Unused*
510	510 Single family dwelling	R*
520	520 Two family dwelling	ResU
530	530 Three family dwelling	ResU
550	550 Condominium residential unit	ResU
560	560 House trailers or mobile homes affixed to real estate	ResU
599	599 Other residential structures	ResU
600	600 Exempt property owned by United States of America	UBO
610	610 Exempt property owned by state of Ohio	UBO
620	620 Exempt property owned by counties	UBO
630	630 Exempt property owned by townships	UBO
640	640 Exempt property owned by municipalities	UBO
645	645 Exempt property owned or acquired by metropolitan housing authorities	ResU
650	650 Exempt property owned by board of education	BO
660	660 Exempt property owned by park districts (public)	OS
670	670 Exempt property owned by colleges, academies (private)	BO

8 * Additional analysis required. More information is available following this table.

LUC	Land Use Description	Sasaki Land Use
680	680 Charitable exemptions – hospitals – homes for aged, etc.	BO
685	685 Churches, etc., public worship	BO
690	690 Graveyards, monuments, and cemeteries	UBO
700	700 Community urban redevelopment corporation tax abatements (R.C. 1728.10)	UBO
710	710 Community reinvestment area tax abatements (R.C. 3735.61)	BO
720	720 Municipal improvement tax abatements (R.C. 5709.41)	BO
730	730 Municipal urban redevelopment tax abatements (R.C. 725.02)	BO
740	740 Other tax abatements (R.C. 165.01 and 303.52)	BO
800	800 Agricultural land and improvements owned by a public utility other than a railroad	UBO
810	810 Mineral land and improvements owned by a public utility other than a railroad	UBO
820	820 Industrial land and improvements owned by a public utility other than a railroad	I
830	830 Commercial land and improvements (including all residential property) owned by a public utility other than a railroad	C
840	840 Railroad real property used in operations	BO
850	850 Railroad real property not used in operations	BO
860	860 Railroad personal property used in operations	BO
870	870 Railroad personal property not used in operations	BO
880	880 Public Utility personal property other than rail-roads	BO
170	(unknown)	AG
393	(unknown)	I
409	(unknown)	C
431	(unknown)	C
432	(unknown)	C
458	(unknown)	C
511	(unknown)	R*
580	(unknown)	R*
611	(unknown)	BO
705	(unknown)	BO
801	(unknown)	UBO
821	(unknown)	UBO
841	(unknown)	UBO
118	(unknown)	AG
306	(unknown)	I
405	(unknown)	C

9 * Additional analysis required. More information is available following this table.

LUC	Land Use Description	Sasaki Land Use
407	(unknown)	C
413	(unknown)	C
434	(unknown)	C
459	(unknown)	C
470	(unknown)	C
471	(unknown)	C
472	(unknown)	C
481	(unknown)	C
489	(unknown)	C
497	(unknown)	C
498	(unknown)	C
501	(unknown)	R*
502	(unknown)	R*
505	(unknown)	R*
508	(unknown)	R*
512	(unknown)	R*
518	(unknown)	R*
521	(unknown)	R*
522	(unknown)	R*
540	(unknown)	R*
545	(unknown)	R*
562	(unknown)	R*
579	(unknown)	R*
655	(unknown)	BO

* additional analysis needed; see following section

Additional Analysis for Residential and Unused

In some cases, additional layers of analysis were required to assign equivalent land uses when a single land use category corresponded to multiple scenario land use categories:

*** Residential**: Additional layers of analysis based on lot size used to separate urban, suburban, and rural residential

- → Urban Residential = Parcels less than 0.2 acres (> 5 UPA)
- → Suburban Residential = Parcels more than or equal to 0.2 acres, but less than 1 acre (1-5 UPA)
- → Rural Residential = Parcels greater than or equal to 1 acre (≤1 UPA)

* **Unused**: Additional layers of analysis used to separate vacant, previously developed land ("abandoned") from vacant land that has not been developed. These parcels were separated into the two following categories:

→ **Abandoned Parcel** (vacant, previously developed) includes:
  - Vacant industrial or vacant commercial parcels (LUC 300 or 400) with improved value
  - Vacant residential parcels less than ½ acre that were in census tracts that lost population (assumption that larger lots may never have been developed, so the Project Team used a smaller lot size cut-off to be more conservative in reclassifications)
  - Residential, commercial, or industrial parcels with poor condition buildings
    - Poor condition = condition listed as poor, very poor, sound value,[10] and unsound value

→ **Vacant, not previously developed** - These parcels fall into the **"Other Unbuilt"** classification. Includes:
  - Vacant commercial or industrial parcels with no improved value
  - Remaining vacant residential parcels (do not meet criteria for vacant, previously developed)
  - Forest land that is not conserved (LUC 120-124)

10 Despite the occurrence of the term "sound" within the phrase "sound value", Dan Meaney of Cuhayoga County Planning Commission recommended that "[the Project Team] should assume that buildings that are sound or unsound are in very poor condition or are not habitable." (these labels are only used in Cuyahoga County; all other counties use "poor" and "very poor").

Community Trajectory Designations in the Regional Vision

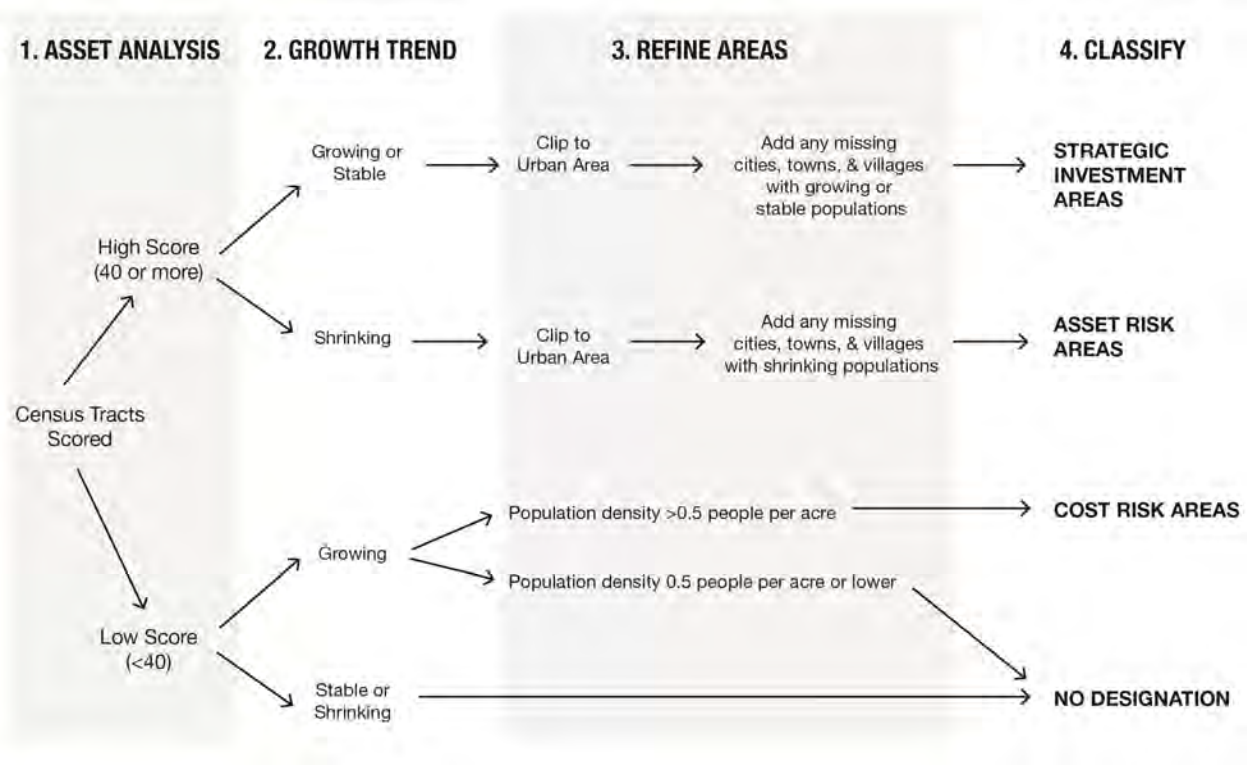
For the Regional Vision, the Project Team categorized areas according to their current trajectories in order to connect the Recommendations to the varied local conditions, opportunities and challenges of different communities. The designations are as follows:

- **Strategic Investment Areas**: areas that have a stable or growing population and a high density of community assets and existing infrastructure that supports current and likely future development. These characteristics make them ideal candidates for investment.

- **Asset Risk Areas**: areas that face declining population and employment yet also have a high density of community assets and existing infrastructure that would support reinvestment and future population growth.

- **Cost Risk Areas**: areas that have experienced rapid population growth but lack existing infrastructure to support that growth. As a result, additional development in these communities requires investment in new infrastructure and community facilities. Any new development must be carefully planned to ensure long-term financial stability.

A four-stage process was used to determine which areas fell into these three categories:



1. *Existing Assets Analysis*

A multi-criteria analysis was used to assess existing assets. "Assets" were defined quite broadly: they included existing infrastructure, cultural amenities, and quality of life factors. The analysis considered the following criteria at the census tract level:

Open House Place Type Evaluation: Derived from feedback recorded at the Alternative Scenarios Open Houses, the score for this factor was based on the percentage of attendees that believed the region should invest in each Place Type.

Intersection Density: Total number of intersections within each tract (including 3-way intersections) divided by the tract acreage. This factor was used a proxy to measure pre-existing infrastructure investment. The higher the density, the higher the score.

Frequent Transit: Stops were identified on transit routes with service every 15 minutes or better. Identified stops were summed at the tract level and divided by tract acreage. The higher the density, the higher the score.

Jobs-Worker Balance: Jobs-worker balance is the ratio of jobs to employed residents at the tract level, within a one-mile radius. For this analysis, the optimal balance (score 9) was considered to be 1:1, with diverging ratio values classified along an equal interval scale in either direction.

Wage-Income Balance: Wage-income balance is the ratio of worker wages to employed resident incomes at the tract level, within a one-mile radius. For this analysis, the optimal balance was considered to be 1:1, with diverging ratio values classified along an equal interval scale in either direction.

Workshop Game Piece Placement: Locations where at least two Trend Scenario Workshop tables placed compact growth, reinvestment, reinforcement, or transportation received a score of 9. Locations where attendees placed dispersed growth received a score of 0. Locations where attendees placed no game pieces placed received a score of -9.

Community Asset Density: Community assets—such as institutions, museums, significant architecture, public plazas, etc.—were mapped by NEOSCC and assigned a level of significance by the Project Team on a scale of 1 to 4. These scores were summed to the tract level and then reclassified on a 0-9 scale. The more asset-rich a tract, the higher the score.

EXISTING ASSETS ANALYSIS CRITERIA		
FACTOR	**SCALE**	**WEIGHT**
Open House Place Type Evaluation	1 to 9	3
Intersection Density	1 to 9	2
Frequent Transit Stop Density	1 to 9	2
Jobs-Worker Balance	1 to 9	1
Wage-Income Balance	1 to 9	1
Trend Scenario Workshop Game Piece Placement	-9 to 9	1
Community Asset Density Evaluation	0 to 9	1

All of these factors were weighed according to their perceived significance, combined, and converted to a composite score for each census tract. Places with higher scores have higher levels of existing infrastructure and community assets and are the kinds of places into which workshop participants said the region should invest. Lower scores mean that new development will tend to be more costly from a local government budget perspective and/or lack amenities and place characteristics identified as desirable according to public feedback. The distribution of scores formed a natural break at 40: tracts with scores less than 40 were either designated as "Cost Risk Areas" or undesignated; tracts with scores equal to or greater than 40 were either designated as "Strategic Investment Areas" or "Asset Risk Areas". These post-asset analysis designation splits were determined based on local growth trends (see Step 4 below).

2. *Growth Trends*

In addition to the asset analysis, tracts were also classified based on growth trends. Growth is measured as the change in total activity (jobs + people) at the census tract level from 2000 to 2010. Tracts that lost 5% or more of their total activity were classified as "shrinking" and tracts that gained 10% or more activity were classified as "growing." Tracts that lost less than 5% or grew less than 10% were classified as "stable."

3. *Tract Adjustments*

Many common demographic factors are measured at the census-tract scale, which makes it a convenient geography for analysis. Census tract boundaries, however, do have some limitations. Most importantly, census tract boundaries are shaped to include approximately equal numbers of residents; as a result, they do not necessarily align with community character, especially in small towns and rural areas. For instance, one census tract might include part of a small town, a few suburban subdivisions, and then a much larger area of rural residential, agricultural land, and undeveloped open space.

The Project Team's multi-criteria analysis results in a single score for each census tract, even though it may include many different kinds of places, some of which would likely score very high if considered independently. To account for the limitations of the census tract geographies, existing towns and villages were added back into consideration for strategic investment and asset risk designation. These communities were seen as important places for regional investment by workshop participants and have

significant existing infrastructure. In addition to adding these areas, the Project Team also clipped census tracts to the Urbanized and Urbanizing Area boundary[11] to focus attention on areas with greater amounts of existing infrastructure.

For tracts that scored low in the asset analysis, the Project Team removed growing places with extremely low population densities from consideration as "Cost Risk Areas." Since there are so few residents in these areas, adding even a single home is a significant increase in population in percentage terms. Because population growth is so small in absolute terms, however, these places are not at risk for high costs associated with future development, as long as growth remains minimal in absolute terms.

4. *Final Classification*

Places that are stable or growing and have a high asset score were labeled as "Strategic Investment Areas." Places that are shrinking yet have a high asset score were labeled as "Asset Risk Areas." Places that are growing yet have a low asset score were labeled as "Cost Risk Areas." Places that are stable or shrinking and have a low asset score were not classified.

11 See the "Regional Vision" section of the main report for a detailed explanation of the Urban and Urbanizing Area.

Scenario Control Totals

The Project Team worked with NEOSCC and a team of local experts to generate a set of forecasts for the 12-county Northeast Ohio region over the next thirty years. The forecasts cover population, households, employment, building permits, and units of residential abandonment. These forecasts dictated the quantities of Development Types applied within each of the scenarios.

Population Control Totals

Trend Scenario

The Project Team extrapolated population trends between 1990 and 2010 to arrive at control totals for the Trend Scenario. This time period was selected as the best representation of the region as "stabilized yet challenged" and was long enough to capture several 'market cycles', a critical factor for a long-range forecast.

Specifically, the percent annual population growth/decline is run-out over the thirty year forecast period to determine the net growth/decline figure for each of the counties. The forecast indicates that counties which have been growing in population over the last twenty years will county to grow, and counties that have been declining will continue to decline. The forecast yields a net population increase of approximately 93,000 people for the region by 2040.

POPULATION	Ashtabula	Cuyahoga	Geauga	Lake	Lorain	Mahoning	Medina	Portage	Stark	Summit	Trumbull	Wayne	TOTAL	Net
1990	99,821	1,412,140	81,129	215,499	271,126	264,806	122,354	142,585	367,585	514,990	227,813	101,461	3,821,309	
2000	102,728	1,393,978	90,895	227,511	284,664	257,555	151,095	152,061	378,098	542,899	225,116	111,564	3,918,164	96,855
2010	101,497	1,280,122	93,389	230,041	301,356	238,823	172,332	161,419	375,586	541,781	210,312	114,520	3,821,178	-96,986
annual rate 1990-2010	0.1%	-0.5%	0.7%	0.3%	0.5%	-0.5%	1.7%	0.6%	0.1%	0.3%	-0.4%	0.6%	0.0%	
2020	102,346	1,218,815	100,198	237,676	317,713	226,803	204,525	171,750	379,652	555,695	202,072	121,668	3,838,914	**17,736**
2030	103,201	1,160,444	107,505	245,566	334,959	215,388	242,734	182,744	383,762	569,967	194,154	129,263	3,869,686	**30,772**
2040	104,065	1,104,868	115,345	253,717	353,141	204,546	288,083	194,441	387,916	584,605	186,546	137,332	3,914,606	**44,921**

Grow the Same Scenario

This scenario assumes that population growth improves relative to the Trend Scenario and that growth in the region mirrors that of the United States overall. It can be thought of as a "constant-share" scenario because the region continues to capture its current share of projected future US population growth.[12] The share of the overall growth allocated to each county is consistent with the county distribution used for the Trend, meaning that counties with increasing capture in the Trend Scenario will also increase in Grow the Same. The overall forecast yields a net population increase of approximately 875,000 residents within the region by 2040, a figure that well surpasses the Trend forecast.

POPULATION	Ashtabula	Cuyahoga	Geauga	Lake	Lorain	Mahoning	Medina	Portage	Stark	Summit	Trumbull	Wayne	TOTAL	Net
1990	99,821	1,412,140	81,129	215,499	271,126	264,806	122,354	142,585	367,585	514,990	227,813	101,461	3,821,309	
2000	102,728	1,393,978	90,895	227,511	284,664	257,555	151,095	152,061	378,098	542,899	225,116	111,564	3,918,164	96,855
2010	101,497	1,280,122	93,389	230,041	301,356	238,823	172,332	161,419	375,586	541,781	210,312	114,520	3,821,178	-96,986
2020	110,010	1,310,089	107,702	255,475	341,506	243,788	219,842	184,612	408,083	597,310	217,204	130,779	4,126,401	**305,223**
2030	118,148	1,328,506	123,074	281,130	383,470	246,581	277,888	209,210	439,340	652,513	222,272	147,983	4,430,115	**303,714**
2040	124,847	1,325,515	138,380	304,386	423,665	245,395	345,615	233,272	465,385	701,353	223,800	164,758	4,696,370	**266,255**

12 Moody's Economy.com

Do Things Differently Scenario

Do Things Differently uses the same method and overall regional totals as the Trend Scenario, but county-level forecasts change slightly. Regional totals in Trend and Grow the Same were apportioned to counties based on trends, but the "differently" scenarios used today's share of population and jobs by county and held it constant out to 2040.

POPULATION	Ashtabula	Cuyahoga	Geauga	Lake	Lorain	Mahoning	Medina	Portage	Stark	Summit	Trumbull	Wayne	TOTAL	Net
1990	99,821	1,412,140	81,129	215,499	271,126	264,806	122,354	142,585	367,585	514,990	227,813	101,461	3,821,309	
2000	102,728	1,393,978	90,895	227,511	284,664	257,555	151,095	152,061	378,098	542,899	225,116	111,564	3,918,164	96,855
2010	101,497	1,280,122	93,389	230,041	301,356	238,823	172,332	161,419	375,586	541,781	210,312	114,520	3,821,178	-96,986
share 2010	2.7%	33.5%	2.4%	6.0%	7.9%	6.2%	4.5%	4.2%	9.8%	14.2%	5.5%	3.0%	100.0%	
2020	101,968	1,286,064	93,822	231,109	302,755	239,932	173,132	162,168	377,329	544,296	211,288	115,052	3,838,914	**17,736**
2030	102,785	1,296,372	94,575	232,961	305,182	241,855	174,520	163,468	380,354	548,659	212,982	115,974	3,869,686	**30,772**
2040	103,979	1,311,421	95,672	235,666	308,724	244,662	176,546	165,366	384,769	555,028	215,454	117,320	3,914,606	**44,921**

Grow Differently Scenario

The Grow Differently Scenario's regional population is the same as Grow the Same, while its county-level apportionment is the same as Do Things Differently.

POPULATION	Ashtabula	Cuyahoga County,	Geauga	Lake	Lorain	Mahoning	Medina	Portage	Stark	Summit	Trumbull	Wayne	TOTAL	Net
1990	99,821	1,412,140	81,129	215,499	271,126	264,806	122,354	142,585	367,585	514,990	227,813	101,461	3,821,309	
2000	102,728	1,393,978	90,895	227,511	284,664	257,555	151,095	152,061	378,098	542,899	225,116	111,564	3,918,164	96,855
2010	101,497	1,280,122	93,389	230,041	301,356	238,823	172,332	161,419	375,586	541,781	210,312	114,520	3,821,178	-96,986
2020	109,604	1,382,374	100,849	248,416	325,427	257,899	186,097	174,313	405,587	585,057	227,111	123,667	4,126,401	**305,223**
2030	117,671	1,484,120	108,271	266,700	349,380	276,881	199,795	187,142	435,439	628,118	243,827	132,770	4,430,115	**303,714**
2040	124,744	1,573,318	114,779	282,729	370,378	293,522	211,802	198,390	461,609	665,869	258,481	140,749	4,696,370	**266,255**

Employment Control Totals

Trend Scenario

Like population, the Project Team extrapolated trends[13] from 1990-2010 to create its Trend Scenario employment forecast. The percent annual employment growth/decline is run-out over the thirty year forecast period to determine the net growth/decline figure for each of the counties. The forecast yields a net employment increase of approximately 108,000 jobs for the region by 2040. This figure represents a much improved economy relative to the 2000s but significantly lags the explosive job growth that the region experienced in the 1990s.

EMPLOYMENT	Ashtabula	Cuyahoga	Geauga	Lake	Lorain	Mahoning	Medina	Portage	Stark	Summit	Trumbull	Wayne	TOTAL	Net
1990	29,344	779,932	24,652	85,659	90,924	105,048	36,309	41,116	156,707	231,577	89,122	40,367	1,710,757	
2000	40,376	840,764	35,273	106,869	111,805	113,990	56,039	56,251	183,534	278,172	96,873	55,679	1,975,625	264,868
2010	31,932	714,251	34,073	97,474	97,330	100,992	59,788	53,335	156,539	266,402	73,976	45,606	1,731,698	-243,927
annual rate 1990-2010	0.4%	-0.4%	1.6%	0.6%	0.3%	-0.2%	2.5%	1.3%	0.0%	0.7%	-0.9%	0.6%	1.2%	
2020	33,311	683,514	40,061	103,980	100,701	99,023	76,726	60,748	156,455	285,733	67,396	48,476	1,756,124	**24,426**
2030	34,750	654,100	47,103	110,922	104,189	97,092	98,466	69,192	156,371	306,467	61,401	51,528	1,791,580	**35,456**
2040	36,252	625,951	55,385	118,327	107,798	95,198	126,369	78,812	156,287	328,707	55,938	54,772	1,839,796	**48,215**

13 Bureau of Labor Statistics

Grow the Same Scenario

This scenario assumes that employment growth improves relative to the Trend Scenario and that growth in the region mirrors that of the United States overall. It can be thought of as a "constant-share" scenario in which the region continues to capture its current share of US employment with national forecast figures.[14] The share of the overall growth allocated to each county is consistent with the county distribution used for the Trend, meaning that counties with increasing capture in the Trend Scenario will also increase in Grow the Same. The overall forecast yields a net employment increase of approximately 500,000 jobs for the region by 2040, a figure that well surpasses the Trend forecast.

EMPLOYMENT	Ashtabula	Cuyahoga	Geauga	Lake	Lorain	Mahoning	Medina	Portage	Stark	Summit	Trumbull	Wayne	TOTAL	Net
1990	29,344	779,932	24,652	85,659	90,924	105,048	36,309	41,116	156,707	231,577	89,122	40,367	1,710,757	
2000	40,376	840,764	35,273	106,869	111,805	113,990	56,039	56,251	183,534	278,172	96,873	55,679	1,975,625	264,868
2010	31,932	714,251	34,073	97,474	97,330	100,992	59,788	53,335	156,539	266,402	73,976	45,606	1,731,698	-243,927
2020	37,069	760,617	44,580	115,710	112,060	110,193	85,381	67,600	174,104	317,964	74,999	53,944	1,954,221	**222,523**
2030	40,371	759,908	54,723	128,865	121,043	112,798	114,394	80,385	181,666	356,042	71,333	59,863	2,081,391	**127,170**
2040	43,994	759,638	67,214	143,599	130,821	115,530	153,359	95,644	189,666	398,911	67,885	66,470	2,232,731	**151,340**

Do Things Differently Scenario

This scenario uses the same method and overall regional totals as the Trend Scenario, but the county-level forecasts change slightly. Regional totals in Trend and Grow the Same were apportioned to counties based on trends, but Do Things Differently and Grow Differently took today's share of population and jobs by county and held it constant out to 2040.

EMPLOYMENT	Ashtabula	Cuyahoga	Geauga	Lake	Lorain	Mahoning	Medina	Portage	Stark	Summit	Trumbull	Wayne	TOTAL	Net
1990	29,344	779,932	24,652	85,659	90,924	105,048	36,309	41,116	156,707	231,577	89,122	40,367	1,710,757	
2000	40,376	840,764	35,273	106,869	111,805	113,990	56,039	56,251	183,534	278,172	96,873	55,679	1,975,625	264,868
2010	31,932	714,251	34,073	97,474	97,330	100,992	59,788	53,335	156,539	266,402	73,976	45,606	1,731,698	-243,927
annual rate 1990-2010	1.8%	41.2%	2.0%	5.6%	5.6%	5.8%	3.5%	3.1%	9.0%	15.4%	4.3%	2.6%		
2020	32,382	724,326	34,554	98,849	98,703	102,417	60,631	54,087	158,747	270,160	75,019	46,249	1,756,124	**24,426**
2030	33,036	738,950	35,251	100,845	100,696	104,484	61,855	55,179	161,952	275,614	76,534	47,183	1,791,580	**35,456**
2040	33,925	758,837	36,200	103,559	103,406	107,296	63,520	56,664	166,311	283,032	78,594	48,453	1,839,796	**48,215**

Grow Differently Scenario

The Grow Differently Scenario's regional employment is the same as Grow the Same, while its county-level apportionment is the same as Do Things Differently.

EMPLOYMENT	Ashtabula	Cuyahoga	Geauga	Lake	Lorain	Mahoning	Medina	Portage	Stark	Summit	Trumbull	Wayne	TOTAL	Net
1990	29,344	779,932	24,652	85,659	90,924	105,048	36,309	41,116	156,707	231,577	89,122	40,367	1,710,757	
2000	40,376	840,764	35,273	106,869	111,805	113,990	56,039	56,251	183,534	278,172	96,873	55,679	1,975,625	264,868
2010	31,932	714,251	34,073	97,474	97,330	100,992	59,788	53,335	156,539	266,402	73,976	45,606	1,731,698	-243,927
2020	36,035	806,032	38,451	109,999	109,837	113,969	67,471	60,189	176,654	300,635	83,482	51,466	1,954,221	**222,523**
2030	38,380	858,484	40,954	117,158	116,984	121,386	71,861	64,105	188,150	320,198	88,914	54,816	2,081,391	**127,170**
2040	41,171	920,906	43,931	125,676	125,491	130,212	77,086	68,766	201,831	343,480	95,380	58,801	2,232,731	**151,340**

14 Moody's Economy.com

Employment Mix Targets

Employment mix targets for the scenario modeling process were separated into 3 broad categories: retail, office, and industrial. In the Trend and Grow the Same scenarios, the existing employment mix was used as a target for future employment growth.

Existing Employment Mix

	RETAIL JOBS	OFFICE JOBS	INDUSTRIAL JOBS
WAYNE	8,060 (24% of all jobs)	12,822 (38% of all jobs)	12,834 (38% of all jobs)
MEDINA	13,822 (31% of all jobs)	18,200 (41% of all jobs)	12,629 (28% of all jobs)
GEAUGA	6,386 (24% of all jobs)	8,376 (32% of all jobs)	11,509 (44% of all jobs)
PORTAGE	11,966 (32% of all jobs)	11,413 (31% of all jobs)	13,843 (37% of all jobs)
ASHTABULA	6,568 (30% of all jobs)	8,559 (39% of all jobs)	6,699 (31% of all jobs)
LORAIN	21,090 (30% of all jobs)	30,311 (43% of all jobs)	19,405 (27% of all jobs)
CUYAHOGA	119,561 (21% of all jobs)	339,955 (58% of all jobs)	122,251 (21% of all jobs)
SUMMIT	53,235 (26% of all jobs)	105,699 (52% of all jobs)	45,376 (22% of all jobs)
MAHONING	22,354 (31% of all jobs)	35,384 (49% of all jobs)	14,620 (20% of all jobs)
TRUMBULL	22,147 (35% of all jobs)	22,637 (35% of all jobs)	19,058 (30% of all jobs)
STARK	35,320 (30% of all jobs)	52,976 (45% of all jobs)	28,955 (25% of all jobs)
LAKE	23,000 (33% of all jobs)	24,397 (35% of all jobs)	21,837 (32% of all jobs)

Data source: Census County Business Patterns

For the Do Things Differently and Grow Differently scenarios, a place type painting guide was developed by the Project Team to delineate the style of development appropriate for each jurisdiction within the region.[15] While control total numbers were used to guide overall employment quantities in these scenarios, employment mix was a dependent variable. Instead of specific employment mix targets, the place type painting guide was used as a way to guide the style and type of employment painted in these

15 For more information about Development Types and Place Type compatibility, see Place Types: Urban Design and Development Mix in the Scenario Guiding Layers section of the Technical Appendix.

scenarios. As the place type painting guide was based on local knowledge and workshop input, employment mix naturally gravitated away from a primarily retail and industrial focus toward high tech, medical, and office/service jobs.

Households Control Totals

Trend Scenario

The forecast for households uses a slightly different methodology in that it "pivots" off of employment forecast rather than using a historic trend. The logic used by the Project Team and panel of advisors is that the rapid level of household expansion over the past twenty years, despite simultaneously declining populations, is a trend that cannot extend unabated. For this reason, households are forecasted using the average regional job-to-household ratio (1.2) for the past 20 years. This means that for every 1.2 new jobs that are expected to come to the region over the next 30 years, the region will grow by 1 household. This methodology yields a forecast of 90,000 new households by 2040.

HOUSEHOLDS	Ashtabula	Cuyahoga	Geauga	Lake	Lorain	Mahoning	Medina	Portage	Stark	Summit	Trumbull	Wayne	TOTAL	Net
1990	36,760	563,243	26,906	80,421	96,064	101,136	41,742	49,229	139,573	199,998	86,056	35,619	1,456,747	
2000	39,397	571,457	31,630	89,700	105,836	102,587	54,542	56,449	148,316	217,788	89,020	40,445	1,547,167	90,420
2010	39,363	545,056	34,264	94,156	116,274	98,712	65,143	62,222	151,089	222,781	86,011	42,638	1,557,709	10,542
share 1990	2.5%	38.7%	1.8%	5.5%	6.6%	6.9%	2.9%	3.4%	9.6%	13.7%	5.9%	2.4%		
share 2000	2.5%	36.9%	2.0%	5.8%	6.8%	6.6%	3.5%	3.6%	9.6%	14.1%	5.8%	2.6%		
share 2010	2.5%	35.0%	2.2%	6.0%	7.5%	6.3%	4.2%	4.0%	9.7%	14.3%	5.5%	2.7%		
rate	0.0%	-1.8%	0.2%	0.3%	0.4%	-0.3%	0.7%	0.3%	0.1%	0.3%	-0.2%	0.1%		
share 2020	2.5%	33.2%	2.4%	6.3%	7.9%	6.0%	4.8%	4.3%	9.8%	14.6%	5.3%	2.9%		
share 2030	2.5%	31.3%	2.6%	6.6%	8.3%	5.7%	5.5%	4.6%	9.8%	14.9%	5.1%	3.0%		
share 2040	2.5%	29.5%	2.7%	6.8%	8.8%	5.4%	6.2%	4.9%	9.9%	15.2%	4.9%	3.2%		
2020	39,911	523,263	37,499	99,534	124,675	95,236	76,392	67,897	154,017	230,242	84,102	45,506	1,578,276	**20,567**
2030	40,694	503,623	41,044	105,629	134,028	92,168	88,423	74,127	157,882	239,203	82,591	48,716	1,608,129	**29,853**
2040	41,751	486,053	44,987	112,615	144,584	89,503	101,509	81,069	162,843	249,963	81,496	52,354	1,648,726	**40,597**

Grow the Same Scenario

Grow the Same uses a similar methodology to the Trend in that household growth forecast is derived from the employment forecast using the average regional job to household ratio (1.2). This methodology yields a forecast of 420,000 new households by 2040.

HOUSEHOLDS	Ashtabula	Cuyahoga	Geauga	Lake	Lorain	Mahoning	Medina	Portage	Stark	Summit	Trumbull	Wayne	TOTAL	Net
1990	36,760	563,243	26,906	80,421	96,064	101,136	41,742	49,229	139,573	199,998	86,056	35,619	1,456,747	
2000	39,397	571,457	31,630	89,700	105,836	102,587	54,542	56,449	148,316	217,788	89,020	40,445	1,547,167	90,420
2010	39,363	545,056	34,264	94,156	116,274	98,712	65,143	62,222	151,089	222,781	86,011	42,638	1,557,709	10,542
share 1990	2.5%	38.7%	1.8%	5.5%	6.6%	6.9%	2.9%	3.4%	9.6%	13.7%	5.9%	2.4%		
share 2000	2.5%	36.9%	2.0%	5.8%	6.8%	6.6%	3.5%	3.6%	9.6%	14.1%	5.8%	2.6%		
share 2010	2.5%	35.0%	2.2%	6.0%	7.5%	6.3%	4.2%	4.0%	9.7%	14.3%	5.5%	2.7%		
rate	0.0%	-1.8%	0.2%	0.3%	0.4%	-0.3%	0.7%	0.3%	0.1%	0.3%	-0.2%	0.1%		
share 2020	2.5%	33.2%	2.4%	6.3%	7.9%	6.0%	4.8%	4.3%	9.8%	14.6%	5.3%	2.9%		
share 2030	2.5%	31.3%	2.6%	6.6%	8.3%	5.7%	5.5%	4.6%	9.8%	14.9%	5.1%	3.0%		
share 2040	2.5%	29.5%	2.7%	6.8%	8.8%	5.4%	6.2%	4.9%	9.9%	15.2%	4.9%	3.2%		
2020	44,129	578,562	41,462	110,053	137,851	105,301	84,466	75,073	170,294	254,575	92,990	50,315	1,745,071	**187,362**
2030	46,869	580,043	47,272	121,657	154,366	106,154	101,841	85,375	181,839	275,499	95,124	56,108	1,852,146	**107,076**
2040	50,129	583,589	54,015	135,213	173,597	107,463	121,878	97,337	195,520	300,122	97,850	62,859	1,979,573	**127,427**

Do Things Differently Scenario

This scenario uses the same methodology as Trend, except that it assumes that county level capture rates track to the 2010 figures, rather than continuing the 1990 – 2010 trend as they do in the Trend scenario. The rationale is that with different policies in the future, the large urban counties, such as

Cuyahoga, may not return to the capture rates they experienced in the 1990's, but through additional investment should at least be able to stem the tide of decline and achieve 2010 share levels. As such, the overall figures for the region are the same but the distribution across counties varies slightly from Trend.

HOUSEHOLDS	Ashtabula	Cuyahoga	Geauga	Lake	Lorain	Mahoning	Medina	Portage	Stark	Summit	Trumbull	Wayne	TOTAL	Net
1990	36,760	563,243	26,906	80,421	96,064	101,136	41,742	49,229	139,573	199,998	86,056	35,619	1,456,747	
2000	39,397	571,457	31,630	89,700	105,836	102,587	54,542	56,449	148,316	217,788	89,020	40,445	1,547,167	90,420
2010	39,363	545,056	34,264	94,156	116,274	98,712	65,143	62,222	151,089	222,781	86,011	42,638	1,557,709	10,542
share 2010	2.5%	35.0%	2.2%	6.0%	7.5%	6.3%	4.2%	4.0%	9.7%	14.3%	5.5%	2.7%		
2020	39,883	552,253	34,716	95,399	117,809	100,015	66,003	63,044	153,084	225,722	87,147	43,201	1,578,276	**20,567**
2030	40,637	562,698	35,373	97,204	120,038	101,907	67,252	64,236	155,979	229,992	88,795	44,018	1,608,129	**29,853**
2040	41,663	576,904	36,266	99,658	123,068	104,480	68,949	65,858	159,917	235,798	91,037	45,129	1,648,726	**40,597**

Grow Differently Scenario

This scenario uses the same methodology as Grow the Same, except that it assumes that county level capture rates track to 2010 figures, rather than continuing the 1990 – 2010 trend as they do in Grow the Same. As such, the overall figures for the region are the same, but the distribution across counties varies slightly from Grow the Same.

HOUSEHOLDS	Ashtabula	Cuyahoga	Geauga	Lake	Lorain	Mahoning	Medina	Portage	Stark	Summit	Trumbull	Wayne	TOTAL	Net
1990	36,760	563,243	26,906	80,421	96,064	101,136	41,742	49,229	139,573	199,998	86,056	35,619	1,456,747	
2000	39,397	571,457	31,630	89,700	105,836	102,587	54,542	56,449	148,316	217,788	89,020	40,445	1,547,167	90,420
2010	39,363	545,056	34,264	94,156	116,274	98,712	65,143	62,222	151,089	222,781	86,011	42,638	1,557,709	10,542
share 1990	2.5%	38.7%	1.8%	5.5%	6.6%	6.9%	2.9%	3.4%	9.6%	13.7%	5.9%	2.4%		
share 2000	2.5%	36.9%	2.0%	5.8%	6.8%	6.6%	3.5%	3.6%	9.6%	14.1%	5.8%	2.6%		
share 2010	2.5%	35.0%	2.2%	6.0%	7.5%	6.3%	4.2%	4.0%	9.7%	14.3%	5.5%	2.7%		
2020	44,098	610,615	38,385	105,481	130,259	110,585	72,978	69,706	169,262	249,577	96,356	47,767	1,745,071	**187,362**
2030	46,803	648,082	40,741	111,953	138,252	117,370	77,456	73,983	179,648	264,891	102,269	50,697	1,852,146	**107,076**
2040	50,023	692,670	43,543	119,656	147,764	125,446	82,785	79,073	192,007	283,115	109,305	54,185	1,979,573	**127,427**

Building Permits Control Totals

Trend Scenario

Forecasting building permits is a particularly challenging endeavor because of the highly cyclical nature of the home building business. Here, the Project Team established a ratio of building permits to household growth for each county in the region. This ratio is useful because it establishes a metric for quantifying the degree to which the building industry has produced units in excess of new household growth. This metric is applied to the forecast for household growth in order to predict the level of building permits over the next thirty years. One exception to the methodology is for counties that had significant building over the last 20 years despite a significant decline in households. For these four counties, the forecast assumes that building permits will happen at a rate of 80% of what occurred during the 2000s. This methodology yields a forecast of 292,000 new building permits by 2040, a rate slightly below 100,000 per decade.

BUILDING PERMITS	Ashtabula	Cuyahoga	Geauga	Lake	Lorain	Mahoning	Medina	Portage	Stark	Summit	Trumbull	Wayne	TOTAL
1990-1999	2,746	26,335	5,219	10,311	12,084	8,488	14,005	8,405	13,070	26,245	5,644	5,436	137,988
2000-2009	2,322	16,526	3,309	7,477	15,650	4,842	12,463	5,904	10,729	17,733	3,744	4,246	104,945
%change	-15.4%	-37.2%	-36.6%	-27.5%	29.5%	-43.0%	-11.0%	-29.8%	-17.9%	-32.4%	-33.7%	-21.9%	-23.9%
permits per new hh	1.9	80% of 2010	1.2	1.3	1.4	80% of 2010	1.1	1.1	2.1	1.9	80% of 2010	1.4	
2010-2019 forecast	1,066	13,221	3,750	6,965	11,528	3,874	12,724	6,250	6,052	14,402	2,995	3,956	**86,783**
2020-2029 forecast	1,525	13,221	4,108	7,894	12,836	3,874	13,608	6,861	7,986	17,296	2,995	4,427	**96,632**
2030-2039 forecast	2,057	13,221	4,570	9,047	14,485	3,874	14,800	7,645	10,252	20,770	2,995	5,018	**108,735**

Grow the Same Scenario

The approach in Grow the Same acknowledges the fact that differences in housing stock and neighborhood conditions can influence the degree of intra-county churn, even in a high growth scenario. For example, if a healthy county gets a positive economic shock, the new growth is likely to be from in-migration, not from existing households that abandon their current houses; however, in a struggling county with poor housing stock or extremely unattractive neighborhoods, a positive shock is more likely to result in households moving to newer houses within the same county, leaving behind truly abandoned properties. Based on this, the Project Team assumes that the higher the ratio of permits to households, the higher the degree of abandonment. Historically, this ratio ranged from 1.1 to about 1.5 across the region. Here the Project Team places all counties into three categories: 1.1 for those that historically experienced very low abandonment, 1.3 for those that experienced moderate abandonment, and a varying rate greater than 1.3 for those counties that experienced high rates of abandonment. This variable rate uses the ratio of 1990s abandonment to 2000s abandonment and takes a percentage of the Trend abandonment. The rationale for this is that the 1990s provides a case study for the behavior of a macro housing market in relatively good times, and the 2000s provide a case study for the housing market in relatively bad times. In Cuyahoga for example, there were about 18,000 households abandoned in the 1990s and about 43,000 abandoned in the 2000s, which makes the 1990s abandonment about 40% of the abandonment in the 1900s. In the Trend, Cuyahoga lost about 95,000 households between 2013 and 2040: in the alternative forecast the Project Team is assuming 40% of this abandonment, which equals about 40k. For those counties that were considered struggling—Cuyahoga, Mahoning, and Trumbull—the permit-to-household ratio is set by the expected level of abandonment using these historical case studies. This methodology yields a forecast of 550,000 new building permits by 2040, the most of any of the scenarios.

BUILDING PERMITS	Ashtabula	Cuyahoga	Geauga	Lake	Lorain	Mahoning	Medina	Portage	Stark	Summit	Trumbull	Wayne	TOTAL
1990-1999	2,746	26,335	5,219	10,311	12,084	8,488	14,005	8,405	13,070	26,245	5,644	5,436	137,988
2000-2009	2,322	16,526	3,309	7,477	15,650	4,842	12,463	5,904	10,729	17,733	3,744	4,246	104,945
%change	-15.4%	-37.2%	-36.6%	-27.5%	29.5%	-43.0%	-11.0%	-29.8%	-17.9%	-32.4%	-33.7%	-21.9%	-23.9%
permits per new hh	1.1	2.2	1.1	1.1	1.1	3.1	1.1	1.1	1.3	1.3	1.6	1.1	
2010-2019 forecast	5,242	73,714	7,918	17,486	23,734	20,426	21,255	14,136	24,967	41,332	11,167	8,445	**269,823**
2020-2029 forecast	3,015	3,256	6,391	12,765	18,167	2,644	19,112	11,333	15,008	27,202	3,413	6,372	**128,678**
2030-2039 forecast	3,586	7,802	7,417	14,911	21,155	4,059	22,041	13,158	17,786	32,010	4,362	7,427	**155,713**

Do Things Differently Scenario

Do Things Differently mirrors the Trend Scenario, except that the permit to new household ratio is capped at 1.3. The rationale is that "doing things differently" will likely involve more focused reinvestment in struggling urban counties and less "overbuilding" in the townships. This methodology yields a forecast of 120,000 new building permits by 2040, the least of any of the scenarios.

BUILDING PERMITS	Ashtabula	Cuyahoga	Geauga	Lake	Lorain	Mahoning	Medina	Portage	Stark	Summit	Trumbull	Wayne	TOTAL
1990-1999	2,746	26,335	5,219	10,311	12,084	8,488	14,005	8,405	13,070	26,245	5,644	5,436	137,988
2000-2009	2,322	16,526	3,309	7,477	15,650	4,842	12,463	5,904	10,729	17,733	3,744	4,246	104,945
%change	-15.4%	-37.2%	-36.6%	-27.5%	29.5%	-43.0%	-11.0%	-29.8%	-17.9%	-32.4%	-33.7%	-21.9%	-23.9%
permits per new hh	1.3	80% of 2010	1.2	1.3	1.3	80% of 2010	1.1	1.1	1.3	1.3	80% of 2010	1.3	
2010-2019 forecast	676	13,221	524	1,610	1,996	3,874	973	905	2,593	3,824	2,995	732	**33,922**
2020-2029 forecast	981	13,221	761	2,337	2,897	3,874	1,412	1,313	3,764	5,550	2,995	1,062	**40,168**
2030-2039 forecast	1,334	13,221	1,035	3,178	3,939	3,874	1,920	1,786	5,119	7,548	2,995	1,445	**47,393**

Grow Differently Scenario

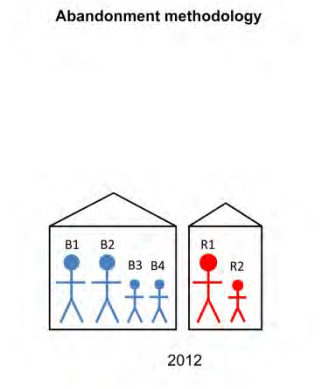
This scenario uses a "ratio of ratios" technique. Here the forecast creates a metric for Grow Differently by taking the permits-to-new-household ratio from Grow the Same (fast growth, no policy change) and dividing it by the ratio of the Trend metric to the Do Things Differently metric. This approach assumes that the impact from new policies for Grow Differently will be proportional to the impact from policies in Do Things Differently. This methodology yields a forecast of 430,000 new building permits by 2040, about 120,000 fewer than Grow the Same.

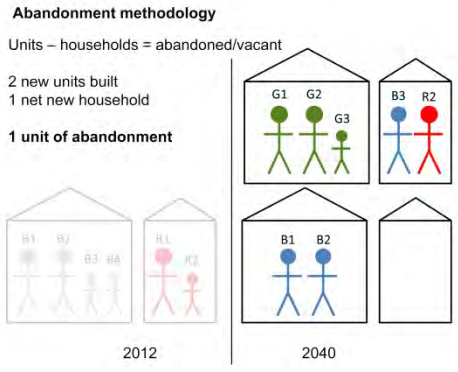
BUILDING PERMITS	Ashtabula	Cuyahoga	Geauga	Lake	Lorain	Mahoning	Medina	Portage	Stark	Summit	Trumbull	Wayne	TOTAL
1990-1999	2,746	26,335	5,219	10,311	12,084	8,488	14,005	8,405	13,070	26,245	5,644	5,436	137,988
2000-2009	2,322	16,526	3,309	7,477	15,650	4,842	12,463	5,904	10,729	17,733	3,744	4,246	104,945
%change	-15.4%	-37.2%	-36.6%	-27.5%	29.5%	-43.0%	-11.0%	-29.8%	-17.9%	-32.4%	-33.7%	-21.9%	-23.9%
permits per new hh	0.70	1.00	1.10	1.11	1.17	1.00	1.09	1.16	0.94	0.99	1.00	1.06	
2010-2019 forecast	3,292	65,559	4,553	12,585	16,383	11,873	8,573	8,712	17,089	26,623	10,345	5,444	**191,034**
2020-2029 forecast	1,881	37,467	2,602	7,192	9,363	6,785	4,899	4,979	9,767	15,215	5,912	3,111	**109,174**
2030-2039 forecast	2,239	44,588	3,097	8,559	11,142	8,075	5,831	5,925	11,623	18,107	7,036	3,703	**129,924**

Vacancy and Abandonment

Trend Scenario

The vacancy and abandonment forecast is calculated as the difference between building permits and net new household growth. The forecast also accounts for natural vacancy and unit replacement at a level of 7%. This means that a county forecast to have 10,000 new permits over the next decade and 8,000 new households would generate approximately 1,300 units of abandonment. The forecast assumes that as the new units become available, if there are not enough new households to fill them, existing households will transfer into newer properties leaving a portion of the older housing stock abandoned. This methodology yields a forecast of 180,000 additional abandoned units by 2040 for the Trend Scenario, about 60,000 per decade.





ABANDONMENT	Ashtabula	Cuyahoga	Geauga	Lake	Lorain	Mahoning	Medina	Portage	Stark	Summit	Trumbull	Wayne	TOTAL
1990-1999	109	18,121	495	1,032	2,312	7,037	1,205	1,185	4,327	8,455	2,680	610	47,568
2000-2009	2,356	42,927	675	3,021	5,212	8,717	1,862	131	7,956	12,740	6,753	2,053	94,403
2010-2019 forecast	444	34,088	252	1,099	2,321	7,078	584	137	2,700	5,933	4,694	811	**60,142**
2020-2029 forecast	635	31,935	276	1,246	2,584	6,670	624	151	3,563	7,125	4,297	908	**60,014**
2030-2039 forecast	857	29,865	307	1,428	2,916	6,268	679	168	4,574	8,556	3,881	1,029	**60,527**

Grow the Same Scenario

The abandonment forecast methodology for Grow the Same is the same as the Trend Scenario. This methodology yields a forecast of 93,000 additional abandoned units by 2040.

ABANDONMENT	Ashtabula	Cuyahoga	Geauga	Lake	Lorain	Mahoning	Medina	Portage	Stark	Summit	Trumbull	Wayne	TOTAL
1990-1999	109	18,121	495	1,032	2,312	7,037	1,205	1,185	4,327	8,455	2,680	610	47,568
2000-2009	2,356	42,927	675	3,021	5,212	8,717	1,862	131	7,956	12,740	6,753	2,053	94,403
2010-2019 forecast	110	35,048	166	366	496	12,407	444	296	4,014	6,645	3,406	177	**63,573**
2020-2029 forecast	63	1,548	134	267	380	1,606	400	237	2,413	4,373	1,041	133	**12,595**
2030-2039 forecast	75	3,709	155	312	442	2,465	461	275	2,859	5,146	1,330	155	**17,386**

Do Things Differently Scenario

The abandonment forecast methodology for Do Things Differently is the same as the Trend Scenario. This methodology yields a forecast of 22,000 additional abandoned units by 2040, a significant reduction in abandonment relative to the Trend Scenario because of the decreased number of building permits.

ABANDONMENT	Ashtabula	Cuyahoga	Geauga	Lake	Lorain	Mahoning	Medina	Portage	Stark	Summit	Trumbull	Wayne	TOTAL
1990-1999	109	18,121	495	1,032	2,312	7,037	1,205	1,185	4,327	8,455	2,680	610	47,568
2000-2009	2,356	42,927	675	3,021	5,212	8,717	1,862	131	7,956	12,740	6,753	2,053	94,403
2010-2019 forecast	109	5,099	35	254	321	2,299	45	20	417	615	1,650	118	**10,981**
2020-2029 forecast	158	1,849	51	369	466	1,711	65	29	605	892	1,137	171	**7,503**
2030-2039 forecast	214	-1,910	70	502	633	1,030	88	39	823	1,213	544	232	**3,479**

Grow Differently Scenario

The abandonment forecast methodology for Do Things Differently is the same as the Trend Scenario. This methodology yields a forecast of **negative** 22,000 additional abandoned units by 2040, meaning it is the only scenario where the amount of abandonment is actually reduced compared to current levels.

ABANDONMENT	Ashtabula	Cuyahoga	Geauga	Lake	Lorain	Mahoning	Medina	Portage	Stark	Summit	Trumbull	Wayne	TOTAL
1990-1999	109	18,121	495	1,032	2,312	7,037	1,205	1,185	4,327	8,455	2,680	610	47,568
2000-2009	2,356	42,927	675	3,021	5,212	8,717	1,862	131	7,956	12,740	6,753	2,053	94,403
2010-2019 forecast	-1,673	-4,589	113	379	1,251	-831	138	618	-2,280	-2,036	-724	-65	**-9,700**
2020-2029 forecast	-956	-2,623	65	216	715	-475	79	353	-1,303	-1,164	-414	-37	**-5,544**
2030-2039 forecast	-1,138	-3,121	77	258	851	-565	94	421	-1,551	-1,385	-493	-44	**-6,597**

Parks and Conservation Land

Currently, 7% of the region is in conservation. The conservation forecasts reflect the assumptions of each scenario and the information available about Northeast Ohio land conservation provided by the Western Reserve Land Conservancy.[16]

16 "Common Ground: The land protection report for northern Ohio" (December 2012) + GIS shapefile of existing parks and conservation land.

Trend: assumes that historical trends continue. If historical trends of conservation continue, 10% of the region's land will be in conservation by 2040.

Grow the Same: assumes that policies and planning strategies remain the same, but population and employment growth increase significantly. The Western Reserve Land Conservancy has expressed the opinion that the 10% projection is still reasonable for this scenario, even in the face of higher growth pressures.

Do Things Differently: assumes that new policies and planning strategies will facilitate conservation efforts, supported further by low growth pressures (and land prices). This is an ideal situation for a more aggressive forecast: 15% of the region's land conserved by 2040.

Grow Differently: assumes that new policies and planning strategies will facilitate conservation efforts but that higher growth pressure will have a countervailing force on land prices. Therefore, the forecast is more aggressive than if policies and planning strategies remain unchanged, but less than it would be under low growth: the result is a forecast of 12.5% of the region's land conserved by 2040.

The scenarios assume that the county distribution of conservation efforts will remain the same as they have over the past 20 years. For example, Ashtabula County accounted for 11.9% of conservation in the NEO region that occurred since 1990, so the Project Team assumed that 11.9% of the total estimated conservation in the Trend Scenario until 2040 will occur in this county.

Conservation Forecasts

County	Share of Recent Conservation	New Conserved Acres: 2010 - 2040		
		Trend and Grow the Same 10% of region conserved	Do Things Differently 15% of region conserved	Grow Differently 12.5% of region conserved
Ashtabula	11.9%	14,646	34,458	24,552
Cuyahoga	6.7%	8,177	19,239	13,708
Geauga	25.6%	31,450	73,994	52,722
Lake	8.0%	9,778	23,006	16,392
Lorain	8.4%	10,322	24,286	17,304
Mahoning	1.1%	1,311	3,084	2,197
Medina	6.1%	7,488	17,618	12,553
Portage	7.5%	9,175	21,587	15,381
Stark	3.2%	3,894	9,161	6,527
Summit	10.5%	12,935	30,433	21,684
Trumbull	8.3%	10,206	24,011	17,108
Wayne	2.7%	3,269	7,691	5,480
TOTAL IN NEO (acres)		**122,652**	**288,566**	**205,609**

Technical Appendix:

Fiscal Impact Tool

Description of the Fiscal Impact Tool (FIT)

The purpose of the Fiscal Impact Tool (FIT) is to quantify the short- and long-term changes in revenue and spending associated with municipal services, environmental protection, economic development, transportation, and infrastructure. A very real challenge for regional modeling efforts is that many projects and services are paid for on the local level, and in any given scenario, some communities may see more success than others. For this reason, the fiscal impact analysis must ultimately tell a regional story that underscores the collective gains of multi-jurisdictional cooperation.

The FIT is a spreadsheet that interfaces with the Scenario Spreadsheet[17] outputs. It is modeled after the Federal Reserve Board's "Fiscal Impact Tool." It includes FIPS-driven fiscal lookup tables for the entire U.S. It circumvents irregularities of local budget reporting and makes fiscal analysis efficient and standardized. The inputs include local tax rates and municipal population as well as scenario outputs relating to population, employment, and the property value of new construction. The application uses this information to calculate both projected future revenue and increases to per capita operations and maintenance costs. The ratio of total revenues and total costs allows users to compare current conditions and multiple future development scenarios.

Linkages between Envision Tomorrow and the FIT

The fiscal impact of a scenario is broadly determined by two categories: development location and Development Type. Locational factors include a differentiation in taxing structures in incorporated versus unincorporated areas, presence of existing infrastructure, and the value of existing structures in a given area. The revenues and expenditures created by development in unincorporated areas can vary dramatically from those impacts from development within municipal boundaries, thus the FIT draws a hard line between the two. Users of the tool are prompted to adjust the share of revenue attributed to the county and the share of ongoing expenditures borne by it. Moreover, a distinction is made between

17 See Envision Tomorrow Software at the beginning of the Scenario Modeling Process section of the Technical Appendix for a description of the Scenario Spreadsheet and other model components.

the costs of redevelopment versus greenfield development. Costs are assumed to be higher on undeveloped land as greater infrastructure investments would likely have to occur. In order to account for the loss of existing tax base through abandonment or redevelopment, the approximate value of existing structures is tracked when a user "paints" over them. While locational factors can tell us a lot about the costs of developing in a certain area, they only give us half the picture.

The style of development, i.e. what Development Type is painted, also plays a significant role in fiscal impact. Those engaged in local public finance know that there can be vast differences in the revenues and expenditures resulting from different styles of construction. Single-family subdivisions rarely yield as much revenue as denser multi-family housing, and expenditure considerations can differ between office, industrial, and retail uses. A range of Development Type attributes are tracked in Envision Tomorrow and are then fed into the FIT. Information related to the new population being added to a scenario, the value of all new construction, and the cost of providing new infrastructure are unique to each Development Type.

The FIT spreadsheet is linked to the Envision Tomorrow Scenario spreadsheet so that when a user paints a Development Type, the fiscal impact of that Development Type is seen immediately. The user can also track individual input variables in order to gain a better understanding of the unique fiscal conditions that are influencing model outputs.

The Fiscal Impact Tool relies on the following outputs from Envision Tomorrow:

- Population
- Development Mix (Sq. Ft.) – Based on Building Types
    - Residential
    - Retail
    - Office
    - Industrial
    - Public/Civic
    - Educational
    - Hotel/Hospitality
- Employment Mix – Based on Development Type density and employment mix
    - Retail
    - Office
    - Industrial
    - Public/Civic
    - Educational
    - Hotel/Hospitality
- Housing Units – based on Development Type density and housing mix
- Project Value - based on Building Types
    - Residential
    - Commercial
- Infrastructure Costs – based on streets assumptions for each Development Type
    - Roads
    - Water Lines
    - Sewer Lines

Tool Customizations

Functional Population

In order to assess the impact of population and activity increases in an area, it is not adequate to simply consider new residential population or even residents plus workers. Rather, it is important to take into consideration the variable demands that different resident and employment groups make on local infrastructure based on their commute and travel habits. The FIT uses a method called "functional population" to rationally attribute demand by land use and estimate aggregate demand for a community. Functional population is the equivalent number of people occupying a space within a community on a 24-hour-per-day, seven-day-per-week basis.

Scenario Ramp-up

It is not within the scope of the FIT to make assumptions as to when exactly within the scenario horizon development will take place. This is an important factor to consider as it impacts the net present valuation of development. In the absence of more nuanced assumptions, a smooth ramp-up of scenario expenditures and revenues was assumed - for example, 3.3% per year over a period of 30 years.

Variable Tax Rates

The issue of varying tax structures across jurisdictions was not approached lightly. Each scenario was modeled at the county-aggregate level. This means that the complete fiscal impact of each scenario was considered for the county as a whole – including cities, villages, townships, and special districts. Very early on, the Project Team encountered the issue of reporting the varying tax rates of many different jurisdictions as one value. Since the model only allows for a single county and municipal rate for each tax category (sales, income, and property), a weighted average method was used.

In addition to county-level data provided through the 2010 Census of Governments, the Project Team used publicly-available data from the following sources:

- State Auditor of Ohio – Summarized 2011 annual financial data for all jurisdictions
- Ohio Department of Taxation – Sales tax and property tax rates for all jurisdictions
- Assessor's Data– Assessed land and building valuation at the parcel level as an input to property tax calculations
- Longitudinal Employer-Household Dynamics Data (census)– Counts of employment by location as an input to municipal income tax calculations

Data from these sources was used to establish a thorough database of tax rates, revenues, and expenditures for every jurisdiction in the region. These were then weighted by population to create weighted tax rates for the municipalities in each county.

Income Tax

One major difference between different jurisdictional types in Northeast Ohio is that unincorporated areas do not collect income tax. As a result, the Project Team made the assumption that any scenario development occurring outside existing city or village boundaries would not be subject to income tax collection. As a proxy for this, the Project Team used the municipal population ratio – the ratio of residents residing in incorporated areas to those residing in unincorporated areas – and assumed that this ratio would remain constant into the future. This ratio was then used to create an effective income tax rate, weighted by population.

Future income tax revenue was projected as follows:

- [annual average wage by sector] x [scenario employment by sector] x [weighted average income tax rate]
- Weighted average based on municipal population ratio – incorporated versus unincorporated population in county

Sales Tax

Sales tax revenue was calculated based on the total payroll in each scenario, an assumption about the percentage of consumer dollars spent subject to sales tax, and an assumption about the amount of sales tax leakage out of each county. This led us to calculate future sales tax revenue as follows:

- Annual sales tax revenue = [Total payroll in scenario] x [Sales Tax Rate] x [% consumer dollars spent subject to sales tax] - [Leakage out of county]
- Leakage out of county was based on workers working in the county but living elsewhere
- Payroll based on County Business Patterns (CBP) data and scenario employment by sector

Property Tax

Given the variable millage rates for commercial and residential property, the Project Team broke out future property tax revenue projections accordingly. Assessment ratios, based on local research, were set at 35% for all property types. Again, a weighted average was used to account for the variability in millage rates between different jurisdictions. Future property tax revenue was calculated as follows:

- Annual scenario property tax revenue = [market value of scenario construction] x [millage rate] x [assessment ratio]

Capital Outlays

Envision Tomorrow tracks capital outlays for new infrastructure in the following categories:

- Roads – lane miles of new roadway
- Utilities – miles of overhead electric
- Water/Sewerage – linear feet of pipe

Each Development Type has associated road lane miles per vacant acre assumptions. The utility, water, and sewerage factors listed above increase proportionally with miles of new roadway. Assumptions were made for each Development Type as to the percentage of new roads built within that Development Type that would likely be publicly financed. These assumptions were made based on the experience of local developers and the Project Team.

Road Financing by Development Type	
Development Type	**% Publicly Financed**
Downtown Commercial Core	100%
Business / Commerce District	100%
Transit Oriented District	100%
Medical / Institutional Center	65%
Western Reserve Town Center	100%
University / College Town District	85%
New Town Center	75%
Neighborhood Main Street	100%
Arterial Commercial District	100%
Lifestyle Center / Mall District	50%
Corporate Campus	75%
Light Industrial Business Park	95%
Heavy Industrial Development	95%
Downtown Residential Neighborhood	100%
Suburban Multi-Family Neighborhood	75%
Senior Living Community	75%
Mixed-Income Neighborhood	75%
Compact Residential Neighborhood	85%
Suburban Subdivision	75%
Rural Residential Development	90%

Capital outlays from the FIT are extremely sensitive to the per mile and lane-mile costs associated with different infrastructure types. These cost figures are also notoriously difficult to track down as they vary based on location, time of year, and terrain. The table below lists the Project Team's assumptions:

New Infrastructure Capital Costs	Unit	Cost
New Roadway	Lane Mile	$ 1,700,000
Streetscape	Linear Foot	$ -
Sewerage	Linear Foot	$ 100
Utilities - above-ground	Mile	$ 600,000
Water Lines	Linear Foot	$ 227

Data sources: Department of Public Works, Baltimore, MD; Arkansas DOT; Department of Public Works, Ipswich, MA; Western Massachusetts Electric Company

Operations and Maintenance

Baseline assumptions for operations and maintenance (O&M) costs come from the Census of Governments (2010) data that resides in the FIT. These baseline assumptions for total O&M costs are tracked in the following expenditure categories:

- Education
- Hospitals
- Roads
- Police
- Fire
- Parks
- Sewerage
- Solid Waste
- Utilities

For each of the above expenditure categories, the total expenditure is divided by the functional population residing within the county to produce a "per functional capita" effective expenditure rate. Future O&M is assumed unchanged unless there is an increase in the yearly capital expenditure associated with a given O&M category. This is based on the broad assumption that increases in the size and complexity of built infrastructure will inherently increase maintenance costs. For example, if average yearly capital outlay for utilities increases over the scenario horizon, then there will be a proportionate increase in O&M costs for utilities. Future O&M is calculated as follows for each expenditure category:

- Future per capita O&M = [Baseline per capita O&M] x [% change in average annual capital outlay]

Select List of FIT Model Outputs

30-Year Cost-to-Revenue Ratio	Existing	Trend	Grow the Same	Do Things Differently	Grow Differently
Ashtabula	-3.14%	-24.80%	-22.29%	-0.75%	-3.86%
Cuyahoga	1.39%	-60.43%	15.09%	15.78%	24.14%
Geauga	-1.12%	-23.47%	-33.20%	-1.52%	-13.77%
Lake	-3.21%	-32.31%	-11.53%	1.70%	2.34%
Lorain	1.61%	-13.06%	-3.84%	8.93%	9.94%
Mahoning	-1.80%	-69.85%	-6.31%	9.50%	4.84%
Medina	6.10%	-22.53%	-26.85%	12.06%	6.81%
Portage	-3.59%	-13.61%	-19.54%	-4.76%	-4.17%
Stark	0.82%	-28.04%	-10.14%	10.20%	6.23%
Summit	-3.58%	-15.31%	3.43%	7.79%	9.95%
Trumbull	-6.63%	-69.98%	-6.12%	8.58%	22.11%
Wayne	-5.05%	-17.06%	-13.91%	-2.55%	0.86%
Region	-0.34%	-33.68%	-6.39%	10.40%	13.79%
Ashtabula - Trumbull - Mahoning	-3.94%	-60.08%	-11.00%	7.49%	9.12%
Wayne - Summit - Portage - Stark	-2.64%	-17.90%	-3.83%	14.48%	21.58%
Cuyahoga - Lorain - Lake - Geauga - Medina	1.25%	-38.97%	-8.06%	9.71%	12.74%

30-Year Total Revenue	Existing	Trend	Grow the Same	Do Things Differently	Grow Differently
Ashtabula	$ 316,299,000	$ 324,650,804.26	$ 346,858,911.52	$ 320,229,634.32	$ 341,016,122.00
Cuyahoga	$ 8,797,812,000	$ 8,660,084,297	$ 8,994,185,093	$ 8,909,568,807	$ 9,388,208,923
Geauga	$ 246,184,000	$ 272,371,186	$ 290,686,491	$ 249,691,494	$ 261,899,217
Lake	$ 916,539,000	$ 940,435,353	$ 1,026,882,094	$ 931,574,954	$ 981,611,750
Lorain	$ 1,292,333,000	$ 1,374,183,905	$ 1,455,091,779	$ 1,311,081,287	$ 1,388,102,971
Mahoning	$ 830,147,000	$ 817,979,246	$ 872,003,057	$ 847,284,382	$ 901,072,818
Medina	$ 674,417,000	$ 816,036,453	$ 881,979,520	$ 682,356,084	$ 718,541,836
Portage	$ 634,379,000	$ 682,853,972	$ 725,383,354	$ 641,049,511	$ 673,401,752
Stark	$ 1,261,698,000	$ 1,293,581,528	$ 1,383,411,966	$ 1,284,606,527	$ 1,366,125,855
Summit	$ 2,524,238,000	$ 2,652,985,105	$ 2,821,605,288	$ 2,562,741,562	$ 2,713,884,877
Trumbull	$ 720,774,000	$ 708,385,922	$ 744,694,586	$ 734,279,807	$ 779,364,492
Wayne	$ 487,158,000	$ 513,484,614	$ 539,989,802	$ 493,102,450	$ 514,696,709
Region	$ 18,701,978,000	$ 19,057,032,383	$ 20,082,771,941	$ 18,967,566,500	$ 20,027,927,322
Ashtabula - Trumbull - Mahoning	$ 1,867,220,000	$ 1,851,015,972	$ 1,963,556,555	$ 1,901,793,823	$ 2,021,453,432
Wayne - Summit - Portage - Stark	$ 4,907,473,000	$ 5,142,905,218	$ 5,470,390,410	$ 4,981,500,050	$ 5,268,109,193
Cuyahoga - Lorain - Lake - Geauga - Medina	$ 11,927,285,000	$ 12,063,111,194	$ 12,648,824,976	$ 12,084,272,626	$ 12,738,364,697

30-Year Total Expenditure	Existing	Trend	Grow the Same	Do Things Differently	Grow Differently
Ashtabula	$ 326,548,000	$ 340,789,015.24	$ 368,558,567.77	$ 330,246,458.75	$ 352,339,420.01
Cuyahoga	$ 8,677,047,000	$ 8,780,888,888	$ 8,813,234,864	$ 8,737,643,321	$ 9,099,642,859
Geauga	$ 248,976,000	$ 285,618,962	$ 319,583,671	$ 252,571,251	$ 268,419,151
Lake	$ 946,956,000	$ 995,825,008	$ 1,074,640,863	$ 960,215,808	$ 1,008,832,621
Lorain	$ 1,271,888,000	$ 1,373,181,726	$ 1,443,558,533	$ 1,286,247,404	$ 1,355,782,553
Mahoning	$ 845,362,000	$ 868,609,851	$ 891,396,631	$ 858,105,633	$ 911,224,873
Medina	$ 635,622,000	$ 826,249,236	$ 928,920,620	$ 641,581,476	$ 676,791,554
Portage	$ 658,021,000	$ 716,679,224	$ 775,471,953	$ 665,293,968	$ 698,876,075
Stark	$ 1,251,413,000	$ 1,312,450,913	$ 1,391,940,401	$ 1,268,648,791	$ 1,347,595,956
Summit	$ 2,617,998,000	$ 2,782,103,712	$ 2,899,601,121	$ 2,644,510,795	$ 2,779,750,098
Trumbull	$ 771,981,000	$ 785,009,326	$ 797,319,698	$ 780,813,494	$ 813,907,876
Wayne	$ 513,052,000	$ 547,270,500	$ 576,180,186	$ 518,714,894	$ 539,355,138
Region	$ 18,764,864,000	$ 19,614,676,361	$ 20,280,407,108	$ 18,944,593,296	$ 19,852,518,174
Ashtabula - Trumbull - Mahoning	$ 1,943,891,000	$ 1,994,408,192	$ 2,057,274,897	$ 1,969,165,586	$ 2,077,472,169
Wayne - Summit - Portage - Stark	$ 5,040,484,000	$ 5,358,504,349	$ 5,643,193,661	$ 5,097,168,448	$ 5,365,577,267
Cuyahoga - Lorain - Lake - Geauga - Medina	$ 11,780,489,000	$ 12,261,763,820	$ 12,579,938,550	$ 11,878,259,262	$ 12,409,468,738

New Road Lane Miles Contructed - Publicly Funded	Existing	Trend	Grow the Same	Do Things Differently	Grow Differently
Ashtabula	-	60.3	187.3	14.6	62.3
Cuyahoga	-	216.2	560.1	146.0	606.7
Geauga	-	196.9	349.0	19.5	66.1
Lake	-	294.7	543.9	59.1	190.0
Lorain	-	338.6	592.9	60.5	236.3
Mahoning	-	97.3	332.5	68.8	180.7
Medina	-	678.6	970.1	21.7	104.2
Portage	-	266.6	472.3	24.8	117.9
Stark	-	245.7	635.3	95.5	289.2
Summit	-	501.6	900.0	91.6	332.9
Trumbull	-	59.0	173.0	44.6	147.0
Wayne	-	138.3	255.5	35.3	89.7
Region	-	3,093.7	5,971.8	682.0	2,422.8
Ashtabula - Trumbull - Mahoning	$ -	$ 217	$ 693	$ 128	$ 390
Wayne - Summit - Portage - Stark	$ -	$ 1,152	$ 2,263	$ 247	$ 830
Cuyahoga - Lorain - Lake - Geauga - Medina	$ -	$ 1,725	$ 3,016	$ 307	$ 1,203

Average Annual Property Tax Revenue per Household	Existing	Trend	Grow the Same	Do Things Differently	Grow Differently
Ashtabula	$ 1,768.79	$ 2,029.53	$ 2,275.94	$ 1,908.43	$ 2,076.62
Cuyahoga	$ 2,837.23	$ 3,338.46	$ 3,355.75	$ 3,023.36	$ 3,381.22
Geauga	$ 3,162.28	$ 3,706.15	$ 3,933.72	$ 3,743.58	$ 3,518.72
Lake	$ 2,643.44	$ 3,149.55	$ 3,301.64	$ 2,860.40	$ 3,050.67
Lorain	$ 2,124.41	$ 2,776.93	$ 2,983.99	$ 2,296.97	$ 2,593.04
Mahoning	$ 1,664.93	$ 2,081.94	$ 2,399.74	$ 1,890.38	$ 2,078.18
Medina	$ 3,012.18	$ 3,740.36	$ 3,852.29	$ 3,104.71	$ 3,202.30
Portage	$ 2,343.20	$ 2,805.48	$ 2,998.51	$ 2,480.05	$ 2,691.04
Stark	$ 2,025.96	$ 2,429.62	$ 2,735.22	$ 2,188.23	$ 2,467.01
Summit	$ 2,426.85	$ 3,038.40	$ 3,302.39	$ 2,614.01	$ 2,877.29
Trumbull	$ 1,759.37	$ 2,093.96	$ 2,257.79	$ 1,955.62	$ 2,188.64
Wayne	$ 1,790.01	$ 2,247.54	$ 2,453.41	$ 1,922.06	$ 2,115.16
Region	$ 2,434.03	$ 2,952.01	$ 3,114.90	$ 2,621.45	$ 2,882.18
Ashtabula - Trumbull - Mahoning	$ 1,723	$ 2,076	$ 2,317	$ 1,920	$ 2,122
Wayne - Summit - Portage - Stark	$ 2,225	$ 2,738	$ 3,001	$ 2,391	$ 2,650
Cuyahoga - Lorain - Lake - Geauga - Medina	$ 2,745	$ 3,287	$ 3,372	$ 2,937	$ 3,228

Average Per Capita Yearly Road O&M	Existing	Trend	Grow the Same	Do Things Differently	Grow Differently
Ashtabula	$ 69	$ 123	$ 236	$ 82	$ 127
Cuyahoga	$ 75	$ 91	$ 117	$ 84	$ 118
Geauga	$ 33	$ 112	$ 179	$ 41	$ 62
Lake	$ 129	$ 319	$ 490	$ 167	$ 258
Lorain	$ 73	$ 181	$ 265	$ 91	$ 156
Mahoning	$ 22	$ 32	$ 61	$ 29	$ 43
Medina	$ 50	$ 298	$ 406	$ 58	$ 88
Portage	$ 48	$ 146	$ 231	$ 62	$ 95
Stark	$ 38	$ 69	$ 119	$ 49	$ 74
Summit	$ 40	$ 85	$ 122	$ 48	$ 69
Trumbull	$ 39	$ 55	$ 85	$ 52	$ 77
Wayne	$ 50	$ 133	$ 196	$ 68	$ 101
Region	$ 60	$ 127	$ 186	$ 72	$ 107
Ashtabula - Trumbull - Mahoning	$ 38	$ 61	$ 107	$ 48	$ 72
Wayne - Summit - Portage - Stark	$ 41	$ 93	$ 143	$ 52	$ 77
Cuyahoga - Lorain - Lake - Geauga - Medina	$ 77	$ 157	$ 223	$ 91	$ 134

Average Per Capita Yearly Utility O&M	Existing	Trend	Grow the Same	Do Things Differently	Grow Differently
Ashtabula	$ 133	$ 155	$ 200	$ 138	$ 159
Cuyahoga	$ 95	$ 97	$ 102	$ 96	$ 102
Geauga	$ 78	$ 141	$ 197	$ 84	$ 101
Lake	$ 145	$ 182	$ 214	$ 152	$ 172
Lorain	$ 233	$ 274	$ 309	$ 240	$ 265
Mahoning	$ 281	$ 296	$ 334	$ 292	$ 311
Medina	$ 351	$ 494	$ 557	$ 356	$ 375
Portage	$ 125	$ 174	$ 214	$ 133	$ 150
Stark	$ 131	$ 152	$ 184	$ 138	$ 156
Summit	$ 324	$ 358	$ 386	$ 330	$ 346
Trumbull	$ 396	$ 408	$ 431	$ 405	$ 426
Wayne	$ 346	$ 396	$ 435	$ 357	$ 377
Region	$ 194	$ 235	$ 263	$ 199	$ 214
Ashtabula - Trumbull - Mahoning	$ 299	$ 311	$ 345	$ 309	$ 329
Wayne - Summit - Portage - Stark	$ 240	$ 274	$ 306	$ 246	$ 263
Cuyahoga - Lorain - Lake - Geauga - Medina	$ 137	$ 183	$ 206	$ 141	$ 153

Average Per Capita Yearly Sewerage O&M	Existing	Trend	Grow the Same	Do Things Differently	Grow Differently
Ashtabula	$ 21	$ 27	$ 40	$ 22	$ 28
Cuyahoga	$ 163	$ 165	$ 168	$ 164	$ 168
Geauga	$ 0	$ 20	$ 38	$ 2	$ 8
Lake	$ 99	$ 111	$ 121	$ 101	$ 107
Lorain	$ 111	$ 122	$ 135	$ 113	$ 122
Mahoning	$ 181	$ 186	$ 198	$ 185	$ 190
Medina	$ 110	$ 154	$ 174	$ 111	$ 117
Portage	$ 116	$ 133	$ 147	$ 118	$ 124
Stark	$ 121	$ 129	$ 140	$ 124	$ 129
Summit	$ 146	$ 156	$ 165	$ 147	$ 152
Trumbull	$ 118	$ 122	$ 130	$ 121	$ 126
Wayne	$ 71	$ 85	$ 95	$ 74	$ 79
Region	$ 132	$ 139	$ 149	$ 134	$ 139
Ashtabula - Trumbull - Mahoning	$ 125	$ 126	$ 138	$ 129	$ 135
Wayne - Summit - Portage - Stark	$ 127	$ 137	$ 148	$ 129	$ 135
Cuyahoga - Lorain - Lake - Geauga - Medina	$ 139	$ 144	$ 151	$ 141	$ 145

Average Increase in Annual Tax Burden Increase per Household	Existing	Trend	Grow the Same	Do Things Differently	Grow Differently
Ashtabula	-	55%	167%	13%	54%
Cuyahoga	-	6%	17%	3%	2%
Geauga	-	214%	397%	22%	72%
Lake	-	76%	143%	15%	43%
Lorain	-	51%	94%	9%	25%
Mahoning	-	14%	49%	10%	22%
Medina	-	152%	218%	5%	19%
Portage	-	90%	165%	13%	36%
Stark	-	34%	87%	12%	30%
Summit	-	31%	57%	5%	14%
Trumbull	-	11%	31%	8%	19%
Wayne	-	52%	92%	11%	24%
Region	-	45%	84%	8%	19%
Ashtabula - Trumbull - Mahoning		21%	67%	10%	27%
Wayne - Summit - Portage - Stark		41%	84%	9%	23%
Cuyahoga - Lorain - Lake - Geauga - Medina		48%	86%	6%	14%

Total Capital Cost of New Development (30 year total)	Existing	Trend	Grow the Same	Do Things Differently	Grow Differently
Ashtabula	-	$ 194,163,537	$ 596,450,176	$ 46,115,172	$ 197,698,905
Cuyahoga	-	$ 815,738,676	$ 2,227,492,449	$ 455,240,959	$ 2,155,797,111
Geauga	-	$ 595,886,556	$ 1,102,220,788	$ 60,511,632	$ 207,621,202
Lake	-	$ 913,226,395	$ 1,694,988,784	$ 211,284,257	$ 625,345,519
Lorain	-	$ 1,122,872,000	$ 2,103,606,314	$ 208,557,585	$ 914,381,417
Mahoning	-	$ 306,355,787	$ 1,107,281,533	$ 212,549,955	$ 570,406,377
Medina	-	$ 2,221,974,077	$ 3,194,760,694	$ 73,240,495	$ 332,405,138
Portage	-	$ 826,765,853	$ 1,513,129,239	$ 120,846,795	$ 376,972,759
Stark	-	$ 800,816,737	$ 2,083,359,454	$ 285,562,944	$ 901,047,800
Summit	-	$ 1,669,334,927	$ 3,057,326,578	$ 292,544,340	$ 1,069,012,907
Trumbull	-	$ 207,615,670	$ 610,932,680	$ 157,302,919	$ 484,316,389
Wayne	-	$ 498,844,913	$ 877,169,206	$ 107,932,229	$ 297,629,905
Region	-	$ 10,173,595,128	$ 20,168,717,897	$ 2,231,689,281	$ 8,132,635,427
Ashtabula - Trumbull - Mahoning	-	$ 708,134,993	$ 2,314,664,389	$ 415,968,046	$ 1,252,421,671
Wayne - Summit - Portage - Stark	-	$ 3,795,762,431	$ 7,530,984,478	$ 806,886,308	$ 2,644,663,370
Cuyahoga - Lorain - Lake - Geauga - Medina	-	$ 5,669,697,705	$ 10,323,069,029	$ 1,008,834,927	$ 4,235,550,386

Annual O&M for New Dev in 2040 (full build-out)	Existing	Trend	Grow the Same	Do Things Differently	Grow Differently
Ashtabula	-	$ 30,675,023	$ 86,877,385	$ 8,535,406	$ 76,057,390
Cuyahoga	-	$ 280,822,905	$ 221,384,852	$ 160,297,857	$ 1,282,302,338
Geauga	-	$ 66,299,666	$ 132,672,713	$ 6,312,382	$ 50,097,883
Lake	-	$ 142,325,011	$ 267,477,132	$ 23,285,587	$ 156,672,199
Lorain	-	$ 241,346,562	$ 381,882,536	$ 27,811,723	$ 205,837,826
Mahoning	-	$ 49,254,262	$ 33,223,419	$ 20,858,536	$ 175,998,688
Medina	-	$ 431,221,454	$ 690,134,573	$ 12,969,338	$ 113,206,367
Portage	-	$ 116,844,086	$ 251,134,944	$ 12,204,452	$ 107,767,291
Stark	-	$ 130,244,202	$ 267,868,899	$ 28,791,456	$ 252,089,481
Summit	-	$ 397,160,919	$ 655,021,338	$ 60,368,127	$ 465,658,366
Trumbull	-	$ 22,497,886	$ 18,518,881	$ 13,124,857	$ 96,406,782
Wayne	-	$ 66,542,185	$ 127,866,679	$ 7,762,846	$ 63,138,300
Region	-	$ 1,975,234,162	$ 3,134,063,351	$ 382,322,569	$ 3,045,232,910
Ashtabula - Trumbull - Mahoning	-	$ 102,427,172	$ 138,619,684	$ 42,518,800	$ 348,462,859
Wayne - Summit - Portage - Stark	-	$ 710,791,392	$ 1,301,891,861	$ 109,126,881	$ 888,653,437
Cuyahoga - Lorain - Lake - Geauga - Medina	-	$ 1,162,015,598	$ 1,693,551,806	$ 230,676,888	$ 1,808,116,614

Annual Revenue for New Dev in 2040 (full build-out)	Existing	Trend	Grow the Same	Do Things Differently	Grow Differently
Ashtabula	-	$ 35,902,234	$ 126,060,692	$ 16,106,360	$ 101,353,473
Cuyahoga	-	$ (556,332,730)	$ 789,676,557	$ 424,524,109	$ 2,259,258,400
Geauga	-	$ 156,978,507	$ 259,690,531	$ 21,255,961	$ 89,305,371
Lake	-	$ 216,255,429	$ 459,870,565	$ 62,994,456	$ 267,628,601
Lorain	-	$ 337,698,259	$ 651,893,353	$ 74,302,083	$ 377,318,278
Mahoning	-	$ (47,837,058)	$ 170,369,549	$ 68,784,496	$ 279,695,396
Medina	-	$ 577,424,249	$ 820,075,124	$ 31,350,253	$ 175,001,510
Portage	-	$ 205,063,538	$ 369,024,460	$ 27,086,019	$ 158,503,938
Stark	-	$ 140,835,062	$ 516,521,802	$ 97,012,111	$ 433,841,000
Summit	-	$ 556,268,953	$ 1,158,776,063	$ 152,132,140	$ 745,473,512
Trumbull	-	$ (49,065,181)	$ 105,715,501	$ 57,096,203	$ 240,859,514
Wayne	-	$ 115,963,491	$ 226,838,839	$ 26,161,174	$ 117,564,065
Region	-	$ 1,689,154,754	$ 5,654,513,034	$ 1,058,805,366	$ 5,245,803,058
Ashtabula - Trumbull - Mahoning	-	$ (61,000,005)	$ 402,145,742	$ 141,987,059	$ 621,908,384
Wayne - Summit - Portage - Stark	-	$ 1,018,131,044	$ 2,271,161,163	$ 302,391,444	$ 1,455,382,515
Cuyahoga - Lorain - Lake - Geauga - Medina	-	$ 732,023,715	$ 2,981,206,130	$ 614,426,862	$ 3,168,512,159

Technical Appendix:

Other Scenario Model Outputs

Scenario model outputs measure the impacts of new development and changes in land use across the region. Each Development Type includes a range of information about its component buildings, streets, and open spaces, and these attributes facilitate the measurement of a broad range of variables. The following is a list of the scenario model outputs calculated by the Project Team (excluding fiscal impact model outputs, which are described separately in the Fiscal Impact Tool section of the Technical Appendix):

Current Land Use

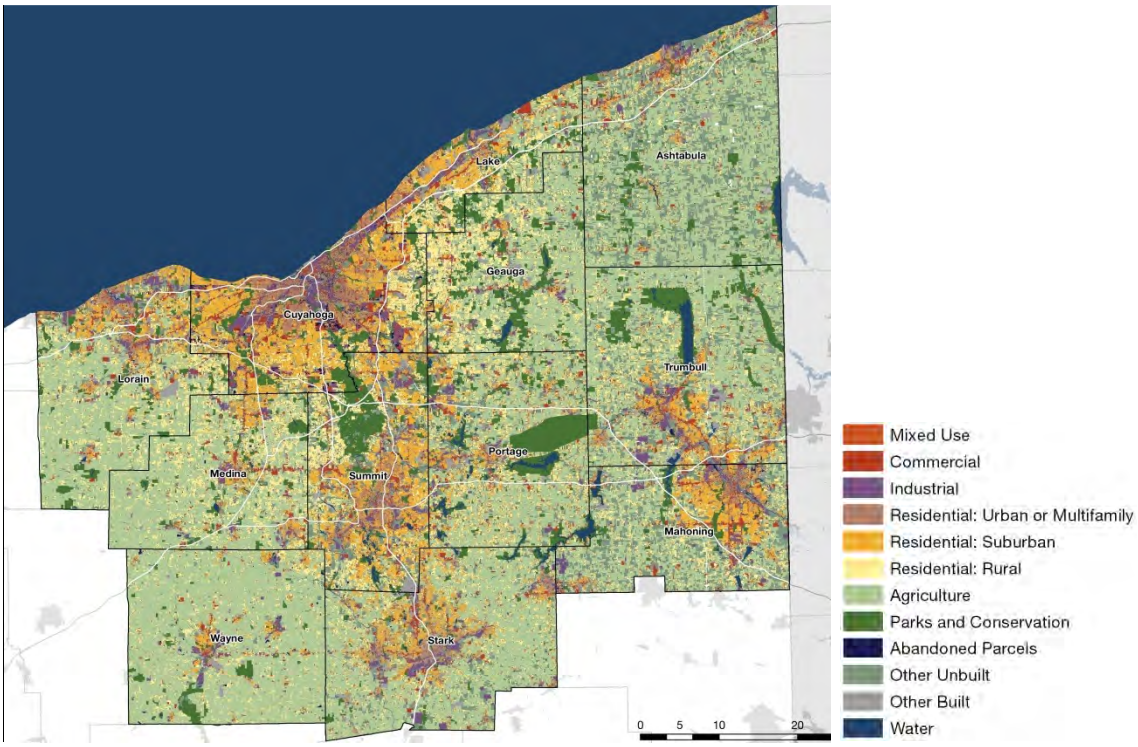
Data inputs: current parcel land use (source: NEOSCC with updates by the Sasaki Team)

Data for all parcels in the region was compiled by NEOSCC. The Project Team made minor updates to parcel land uses to add information for parcels that were missing land use descriptions (primarily in Wayne County). The Project Team added a new category of simplified land use classifications: mixed-use, commercial, industrial, residential: urban or multifamily, residential: suburban, residential: rural, agriculture, parks and conservation, abandoned parcel, other unbuilt, other built, and water. Parcels with no description or areas of the region that were not within parcels (like many road rights-of-way) were classified as unknown or not classified.[18]

These simplified categories were the basis of all land use mapping and reporting. Areas for each land use type were calculated across the region as a whole.

18 See Land Use Categories in the Scenario Modeling Process section of the Technical Appendix for descriptions of these categories and the methodology for categorizing land uses.

Current Land Use Map



Current Land Use Composition		
	Acres	**Percent**
Unknown / not classified	123,250	3%
Abandoned	1,474,280	1%
Other Built	96,430	5%
Mixed Use	82,370	0%
Industrial	1,080	2%
Commercial	185,630	3%
Residential: Urban or Multifamily	655,750	3%
Residential: Suburban	321,940	6%
Residential: Rural	525,700	14%
Parks and Conservation	217,620	8%
Other Non-Built	129,270	17%
Agriculture	27,170	38%

Future Land Use

Data inputs: current parcel land use (NEOSCC with updates by the Sasaki Team) and future scenario land uses (Sasaki Team)

Future scenarios are comprised of Development Types allocated across the region. To determine the future land use composition of the region, Development Types were classified into equivalent land use types according to the following table:

Development Types & Equivalent Land Uses

Development Type	Land Use
Downtown Residential Neighborhood	Residential: Urban or Multifamily
University / College Town District	Mixed Use
Mixed – Income Neighborhood	Residential: Urban or Multifamily
Suburban Multi-Family Neighborhood	Residential: Urban or Multifamily
Compact Residential Neighborhood	Residential: Urban or Multifamily
Suburban Subdivision	Residential: Suburban
Senior Living Community	Residential: Urban or Multifamily
Rural Residential Development	Residential: Rural
Transit Oriented District	Mixed Use
Downtown Commercial Core	Commercial
Western Reserve Town Centers	Mixed Use
Neighborhood Main Street	Mixed Use
Lifestyle Center / Mall District	Commercial
Arterial Commercial District	Commercial
New Town Center	Mixed Use
Business / Commerce Districts	Commercial
Corporate Campuses	Commercial
Medical / Institutional Centers	Other Built
Light Industrial Business Park	Industrial
Heavy Industrial Development	Industrial
Abandonment: 35%	35% of developed area abandoned; 65% of developed area remains current land use
Abandonment: 55%	55% of developed area abandoned; 45% of developed area remains current land use
Open Space	Parks and Conservation

The future acreage of each land use type was calculated using the following formula:
Future land use acres = Existing land use acres + Acres of new development – Acres redeveloped – Acres Conserved – Acres Abandoned

For instance, to determine the future amount of urban residential, the Project Team started with the current area of urban residential, added the areas of new urban residential developments, subtracted the areas of any current urban residential areas redeveloped in the scenarios (as a mixed-use building, for instance), and subtracted the area of urban residential that was abandoned. Any urban residential conserved would also be subtracted (although in reality, urban residential was highly unlikely to be converted to conservation or park land).

Overall land use composition was determined by dividing the area of each land use by the total area of the region.

Land Use Composition

	Current	Trend	Grow the Same	Do Things Differently	Grow Differently
Unknown / not classified	3%	3%	3%	3%	3%
Abandoned	1%	2%	1%	1%	1%
Other Built	5%	5%	5%	5%	5%
Mixed Use	0%	0%	0%	0%	0%
Industrial	2%	2%	2%	2%	2%
Commercial	3%	2%	3%	2%	2%
Residential: Urban or Multifamily	3%	3%	3%	3%	3%
Residential: Suburban	6%	7%	8%	6%	7%
Residential: Rural	14%	14%	15%	13%	13%
Parks and Conservation	8%	12%	12%	16%	14%
Other Non-Built	17%	15%	14%	15%	15%
Agriculture	38%	35%	34%	35%	35%

Additional Land Use Information

	Existing acres	Trend				Grow the Same				Do Things Differently				Grow Differently			
		2040 acres	New Dev Acres	New Dev Acres Composition	Percent change 2010 to 2040	2040 acres	New Dev Acres	New Dev Acres Composition	Percent change 2010 to 2040	2040 acres	New Dev Acres	New Dev Acres Composition	Percent change 2010 to 2040	2040 acres	New Dev Acres	New Dev Acres Composition	Percent change 2010 to 2040
Unknown / not classified	123,252	123,252	-	0%	0%	123,252	-	0%	0%	123,252	-	0%	0%	123,252	-	0%	0%
Agriculture	1,474,278	1,358,979	-	0%	-8%	1,311,007	-	0%	-11%	1,332,866	-	0%	-10%	1,350,110	-	0%	-8%
Commercial	96,433	94,015	5,169	6%	-3%	103,376	11,275	6%	7%	92,075	1,344	7%	-5%	95,076	3,323	4%	-1%
Industrial	82,369	82,412	6,460	7%	0%	90,204	10,853	6%	10%	80,296	2,383	12%	-3%	85,709	7,128	9%	4%
Mixed Use	1,075	1,222	276	0%	14%	1,318	298	0%	23%	1,879	839	4%	75%	5,162	4,122	5%	380%
Other Built	185,632	174,802	25	0%	-6%	177,648	77	0%	-4%	173,160	20	0%	-7%	174,615	78	0%	-6%
Other Non-Built	655,747	581,117	-	0%	-11%	550,017	-	0%	-16%	566,861	-	0%	-14%	557,317	-	0%	-15%
Parks and Conservation	321,938	447,943	126,031		39%	446,320	124,382		39%	611,110	289,172		90%	532,758	210,820		65%
Residential: Rural	525,698	550,572	40,727	44%	5%	585,681	73,449	42%	11%	480,110	3,164	15%	-9%	492,370	2,432	3%	-6%
Residential: Suburban	217,625	258,593	35,601	39%	19%	299,942	71,809	41%	38%	239,146	9,314	45%	10%	284,533	53,687	67%	31%
Residential: Urban or Multifamily	129,269	103,156	3,637	4%	-20%	111,998	6,971	4%	-13%	112,315	3,442	17%	-13%	118,859	9,552	12%	-8%
Abandoned	27,171	63,190	-	0%	133%	39,730	-	0%	46%	27,425	-	0%	1%	20,733	-	0%	-24%
Total New Developed Acres			91,894				174,732				20,507				80,323		

Detailed GIS methodology:

1. To reconcile geometries, union future developed polygrid cells with current parcels
2. Create new field in parcels that included both existing land use and future Development Type (field calculation = “exlu_new dev type”)
3. Summarize area of all parcels by this field
4. For areas that were redeveloped, determine what percent of the area remains unchanged and what percent changed to a new land use:
    i. For existing parks and conservation land, 0% of the land area changes to a new land use (any existing park or conservation area was restricted from future development in all scenarios)
    ii. For other “undeveloped” areas that were developed (agriculture, unbuilt other, and abandoned) – 100% of area developed into new land use
    iii. For developed areas that were redeveloped, the percent of land developed into the new land use depends on the redevelopment rate of the Development Type[19]:
    iv. For areas/parcels that were abandoned:

19 See Development Types in the Scenario Modeling section of the Technical Appendix for a complete list of redevelopment rates. For example, Downtown Commercial Core has a 71% redevelopment rate; a redevelopment rate of 71% means that 71% of the area “painted” with downtown commercial core changes from its current land use to “mixed use”; the remaining 29% retains its current land use.

- With 35% Development Type: 35% of developed area abandoned; 65% of developed area remains current land use
- With 55% Development Type: 55% of developed area abandoned; 45% of developed area remains current land use
- Parcels painted with 20% vacancy did not change land use

v. Parcels that were not "painted" with a new, future Development Type did not change land use

5. Calculate the net change in each land use
6. Add the net change to each existing land use to determine future land use

Urbanized Land

Data inputs: current parcel land use (NEOSCC with updates by the Sasaki Team) and future scenario land uses (Sasaki Team)

In this calculation, the percentage of urbanized land in the region is based on land use composition. "Urbanized" land includes all areas that are currently developed. Land uses included were: abandoned, other built, mixed use, industrial, commercial, urban or multi-family residential, and suburban residential. Rural residential was not included because of its low density. To calculate urbanized land, the areas of abandoned, other built, mixed-use, industrial, commercial, urban or multi-family residential, and suburban residential land uses were added. The following tables show an example calculation aggregating land uses into urbanized versus non-urbanized areas:

Land Use	Current Composition
Unknown	3%
Abandoned	**1%**
Other Built	**5%**
Mixed Use	**0%**
Industrial	**2%**
Commercial	**3%**
Residential: Urban or Multifamily	**3%**
Residential: Suburban	**6%**
Residential: Rural	14%
Parks & Conservation	8%
Other Unbuilt	17%
Agriculture	38%

Land Use	Current Composition
Unknown	3%
Urbanized	19%[20]
Residential: Rural	14%
Parks & Conservation	8%
Other Non Built	17%
Agriculture	38%

20 Urbanized area total shown may not exactly equal sum of separate land use due to rounding.

Urbanized Land 2040					
Land Use	**Current**	**Trend**	**Grow the Same**	**Do Things Differently**	**Grow Differently**
Unknown	3%	3%	3%	3%	3%
Urbanized	**19.3%**	**20.2%**	**21.5%**	**18.9%**	**20.4%**
Residential: Rural	13.7%	14.3%	15.3%	12.5%	12.8%
Parks and Conservation	8.4%	11.7%	11.6%	15.9%	13.9%
Other Unbuilt	17.1%	15.1%	14.3%	14.8%	14.5%
Agriculture	38.4%	35.4%	34.1%	34.7%	35.2%

Infill or Adjacent Development, Redevelopment, and Leapfrog Acres

Data inputs: current parcel land use (NEOSCC with updates by the Sasaki Team) and future scenario land uses (Sasaki Team)

This scenario model output classifies all new development into three categories:

- **Redevelopment**: Non-rural development that occurs on currently developed or abandoned land
- **Infill or Adjacent Development**: Non-rural development that occurs on currently undeveloped land that is within 500 feet of existing development
- **Leapfrog Development**: All other development (including all rural development)

Selections in GIS were used to select cells with non-rural new development that fell within 500 feet of existing development. The development within these cells was compared to current land uses to determine whether the development occurred on currently developed or abandoned land (this development was considered redevelopment) or on currently undeveloped land (this development was

considered infill or adjacent). For cells that were redeveloped, redevelopment rates were taken into account to determine how much of current development was redeveloped.[21]

Total acres of redevelopment and infill/adjacent were calculated for each scenario. Any development that was beyond 500 feet of existing development and all rural residential development was categorized as leapfrog development.

Redevelopment, Infill, and Leapfrog Development

		Trend	Grow the Same	Do Things Differently	Grow Differently
Total Development (acres)		92,500	174,732	20,507	80,323
Redevelopment	Acres	4,287	5,064	4,339	13,688
	% of all development	4.6%	2.9%	21.2%	17.0%
Infill or Adjacent Development	Acres	24,083	47,865	8,874	34,425
	% of all development	26%	27%	43%	43%
Leapfrog Development	Acres	64,130	121,803	7,294	32,210
	% of all development	69%	70%	36%	40%

Acres of Outward Migration

Data inputs: current parcel land use (NEOSCC with updates by the Sasaki Team) and future scenario land uses (Sasaki Team)

This scenario model output measures the outward spread of development. It calculates new urbanized development that occurs beyond the existing urban "footprint." It is similar to "leapfrog" development in the previous calculation, but it does not include rural residential. This calculation measures new urbanized land developed at least 500 feet away from existing development and is calculated by subtracting rural development from all leapfrog development.

New Urbanized Land Beyond Existing Urban Areas

Trend	Grow the Same	Do Things Differently	Grow Differently
23,403 (acres)	48,354 (acres)	4,130 (acres)	29,778 (acres)

21 See Development Types in the Scenario Modeling section of the Technical Appendix for a list of redevelopment rates.

High-value Ecological Land Impacted

Data inputs: current parcel land use (NEOSCC with updates by the Sasaki Team), future scenario land uses (Sasaki Team), and ecological characteristics (various—see description below)

This scenario model output measures the quantity of land of high ecological value lost to development. Ecological value was inferred based upon a combination of many different layers including soil characteristics, proximity to waterbodies, geological features, vegetation characteristics, and contiguous conservation areas. High-value ecological land impacted is calculated by identifying areas of high ecological value that were developed in each scenario.

GIS calculation method:

1. Starting with union of parcels and polygrid cells, restrict layer to cells that are BOTH:
    - Currently unbuilt, developable (current land use = agriculture, vacant, or undeveloped other)
    - Developed in the scenario (Development Type is NOT: blank, vacancy 20%, abandonment 35%, abandonment 55%, or open space)
2. Export layer
3. Clip layer, using high ecological value land
4. Result = vacant land that was high ecological value that was developed
5. Dissolve into single shape
6. Record total land area

High Value Ecological Land Lost			
Trend	**Grow the Same**	**Do Things Differently**	**Grow Differently**
6,281 acres	11,994 acres	546 acres	3,344 acres

Acres of Significant Agricultural Land Lost

Data Inputs: current parcel land use (NEOSCC with updates by the Sasaki Team), future scenario land uses (Sasaki Team), and Soil Data (NRCS / USDA)

This scenario model output measures the acres of significant agricultural land developed in each scenario. Farmland classifications are based upon soil surveys from the Natural Resources Conservation Service (NRCS), which are developed in combination with input from local agencies. “Significant” agricultural land in this calculation includes areas of prime farmland, farmland of local importance, and farmland of unique importance. Acres of significant agriculture land lost is calculated by identifying areas of significant agricultural land that were developed in each scenario.

GIS calculation method:

1. Starting with union of parcels and polygrid cells, restrict layer to cells that are BOTH:
    - Currently unbuilt, developable (current land use = agriculture, vacant, or undeveloped other)
    - Developed in the scenario (Development Type is NOT: blank, vacancy 20%, abandonment 35%, abandonment 55%, or open space)
2. Export layer
3. Clip layer, using significant agriculture layer
4. Result = land that was significant agricultural land that was developed
5. Dissolve into single shape
6. Record total land area

Significant Agricultural Land Lost			
Trend	**Grow the Same**	**Do Things Differently**	**Grow Differently**
31,099 acres	60,037 acres	4,743 acres	18,813 acres

River Corridors and Water Bodies Impacted

Data inputs: current parcel land use (NEOSCC with updates by the Sasaki Team), future scenario land uses (Sasaki Team), and buffer layer developed by the Sasaki Team[22]

This scenario model output measures the number of acres of land adjacent to waterbodies developed. These adjacent areas are:

- Along rivers: 210' buffer or 100 year floodplain, whichever is greater
- Along streams: 75' buffer or 100 year floodplain, whichever is greater
- Around lakes, ponds, and wetlands: 120' buffer

Rivers Corridors and Water Bodies impacted is calculated by identifying buffer areas adjacent to waterbodies that were developed in each scenario.

GIS calculation method:

1. Starting with union of parcels and polygrid cells, restrict layer to cells that are BOTH:
    a. Currently unbuilt, developable (current land use = agriculture, vacant, or undeveloped other)

22 Waterbody polygons used as basis of buffer layer included: wetland, pond, and lakes: CONUS (aerial extent of wetlands and surface waters) from U.S. Fish and Wildlife Service, Rivers: Ohio Department of Transportation GIS files, 2006; Streams: U.S. Census Bureau TIGER/Line files, 2010

    b. Developed in the scenario (Development Type is NOT blank, vacancy 20%, abandonment 35%, abandonment 55%, or open space)
2. Export layer
3. Clip layer, using water buffer layer (all buffers dissolved into single layer)
4. Result = vacant land that was within water body or buffer area that was developed
5. Dissolve into single shape
6. Record total land area

Floodplains, Waterbodies, and Buffers Developed			
Trend	**Grow the Same**	**Do Things Differently**	**Grow Differently**
14,796 acres	29,207 acres	0 acres	0 acres

In Do Things Differently and Grow Differently, development was restricted from these sensitive areas as a rule.

New Impervious Surface

Data inputs: future scenario land uses (Sasaki Team)

This scenario model output measures the acres of new impervious surface generated by each scenario. Sources of new impervious surface include new roadways, driveways, parking lots, and buildings.

The Development Types used to model the scenarios each have a specific per-acre impervious surface attribute. This attribute is applied to the total acreage by Development Type to calculate the total area of new impervious surface. Development Types that require more area for parking or more floor area to accommodate people and jobs will create more new impervious surfaces in a scenario.

Calculation method:

1. Tabulate the average impervious surface per acre for each Development Type
2. Tabulate the acreage painted by Development Type
3. Cross-multiply and sum

New Impervious Surface (acres)			
Trend	**Grow the Same**	**Do Things Differently**	**Grow Differently**
28,315	55,143	8,120	30,815

New Energy Use

Data inputs: future scenario land uses (Sasaki Team)

Building energy use measures the energy used for heating and cooling, hot water, lighting, appliances and computers, and other general uses. Building energy use can be costly in terms of both household budgets and environmental impact, so it is useful to compare the energy efficiency of buildings in each scenario. This scenario model output measures the amount of energy consumed per household or employee per year.

The Residential Energy Consumption Survey from the US Energy Information Administration provides regional averages for residential energy use per household. The regional average is weighted for each Development Type based on household square footage. The Commercial Buildings Energy Consumption Survey provides regional averages for commercial energy use per employee, broken down by employment type. A weighted average is calculated for retail, office, and industrial. These assumptions for both housing and employment are applied at the building level and aggregated to the scenario level for calculation.

Calculation method:

1. Tabulate the average building energy use by Building Type
2. Scale to Development Type
3. Tabulate average energy use by Development Type
4. Tabulate acreage painted by Development Type
5. Cross-multiply and sum

Energy Use from New Buildings				
	Trend	Grow the Same	Do Things Differently	Grow Differently
Energy use from new homes (BTU/year)	27,604,568,511	54,224,318,874	9,104,520,377	37,418,532,187
Energy use from other new buildings (BTU/year)	1,725,788,341	8,598,697,680	1,915,548,039	9,360,332,220
New energy use from buildings in 2040 (BTU /year)	**29.3 billion**	**62.8 billion**	**11 billion**	**46.8 billion**

Carbon Emissions

Data inputs: future scenario land uses (Sasaki Team)

This scenario model output calculates the carbon impact in each scenario due to building energy use. Each Development Type includes information about average energy use, and this information is aggregated to the scenario level to quantify total energy use in each scenario. Typical energy mix is also taken into account. The amount of carbon dioxide produced depends on the energy source. The Energy

Information Administration (EIA) provides values for tons of carbon dioxide emitted per million BTUs of energy use for each energy source (coal, propane, natural gas, etc.). Coal emits more carbon dioxide per unit of energy than natural gas, while wind and solar emit no carbon dioxide at all.

Calculation method:

1. Tabulate mix of energy sources for each development type
2. Quantify total CO2 emissions per development type (multiply mix of each energy source – coal, propane, natural gas, etc. – by the tons of CO2 per type)
3. Multiply by the total quantity of each development type

Carbon Emissions from New Buildings

	Trend	Grow the Same	Do Things Differently	Grow Differently
Carbon emissions from new homes (tons/year)	2,574,951	5,058,038	849,269	3,490,397
Carbon emissions from new jobs (tons/year)	160,981	802,086	178,682	873,131
New carbon emissions from buildings in 2040 (tons/year)	2,736,000	5,860,000	1,028,000	4,364,000

Average Daily Household VMT

Data inputs: future scenario land uses (Sasaki Team); road intersections (derived from ESRI road network); transit stops (NEOSCC); 10, 20, and 30 minute network buffers (derived from ESRI road network); and Traffic Analysis Zones (TAZs) (NEOSCC)

Average daily household vehicle miles traveled (VMT) is determined by trip length and the number of trips taken by automobiles across the region. Calculated at the Traffic Analysis Zone (TAZ) level, this scenario model output employs Envision Tomorrow's Household 7D model to estimate trips by mode. The Household 7D model takes into account land use, road network, and transit service changes over time.

Calculation method:

1. Aggregate the land use attributes to the TAZ layer:
    a. Average household size, income, workers
    b. Existing and scenario activity density within 1 mile ([job+pop]/area)
2. Use the layers supplied to compute the following:
    a. Percent of regional employment accessible within a 10 minute auto trip (select employment at the block level using network travel buffers)
    b. Percent of 4 way intersections, total intersection density
    c. Transit stop density
3. Using the calculated variables above estimate total VMT for each TAZ as follows:

4. Linear Regression Model of Log Household VMT (for households with positive VMT)

	Coefficient	Standard Error	t-Ratio	p-Value
constant	2.51	0.185	13.6	<0.001
Ln(hhsize)	0.760	0.017	45.4	<0.001
hhworkers	0.158	0.011	14.9	<0.001
Ln(hhincome)	0.172	0.012	14.2	<0.001
Ln(actden1mi)	-0.102	0.014	-7.20	<0.001
intden1mi	-0.000767	0.000148	-5.17	<0.001
Ln(int4w1mi)	-0.0951	0.0161	-5.91	<0.001
stopden1mi	-0.000942	0.000442	-2.13	0.033
Ln(emp10mina)	-0.0525	0.0088	-5.95	<0.001
pseudo-R2 0.36				

5. Divide by the number of households in each TAZ.

VMT per household per day			
Trend	Grow the Same	Do Things Differently	Grow Differently
23.7	25.4	22.5	22.0

Average Weekly Non-auto Trips

Data inputs: future scenario land uses (Sasaki Team); road intersections (derived from ESRI road network); transit stops (NEOSCC); 10, 20, and 30 minute network buffers (derived from ESRI road network); and Traffic Analysis Zones (TAZs) (NEOSCC)

Average weekly non-auto trips are based on three separate sub-models within the Household 7D model: bike trips, walk trips, and transit trips. While each model is calculated separately, there is an overlap in model sensitivity to different variables.

Calculation method:

1. Aggregate the land use attributes to TAZ layer:
    a. Average household size, income, workers
    b. Existing and scenario activity density within 1 mile ([job+pop]/area)
    c. Existing and scenario land use mix (entropy)
2. Use the layers supplied to compute the following:

a. Percent of regional employment accessible within a 30 minute transit trip (select employment at the block level using network travel buffers)
b. Percent of 4 way intersections, total intersection density
c. Transit stop density

3. Using the calculated variables above estimate total VMT for each TAZ as follows:

Negative Binomial Model of Household Walk Trips

	Coefficient	Standard Error	t-Ratio	p-Value
constant	-3.64	0.38	-9.55	<0.001
hhsize	0.424	0.012	36.2	<0.001
lnhhincome	-0.0892	0.0233	-3.83	<0.001
entropy1/4mi	0.379	0.067	5.69	<0.001
lnactden1mi	0.279	0.027	10.5	<0.001
int4w1mi	0.0114	0.0013	9.01	<0.001
stopden1mi	0.00507	0.00075	6.72	<0.001
pseudo-R2 0.26				

Negative Binomial Model of Household Bike Trips

	Coefficient	Standard Error	t-Ratio	p-Value
constant	-5.91	0.37	-15.9	<0.001
hhsize	0.472	0.025	18.7	<0.001
entropy1/4mi	0.406	0.162	2.50	0.012
actden1mi	0.000006	0.000002	2.81	0.005
lnint4w1mi	0.726	0.084	8.64	<0.001
pseudo-R2 0.18				

Multilevel Model of Household Transit Trips

	Coefficient	Standard Error	t-Ratio	p-Value
constant	-0.837	0.759	-1.10	0.32
lnhhsize	0.575	0.063	9.06	<0.001
hhworkers	0.255	0.039	6.60	<0.001
lnhhincome	-0.462	0.037	-12.3	<0.001
entropy1/4mi	0.321	0.115	2.80	0.005
stopden1/4mi	0.00229	0.00043	5.34	<0.001
lnactden1/2mi	0.161	0.045	3.59	<0.001
lnint4w1mi	0.299	0.071	4.21	<0.001
lnemp30mint	0.129	0.025	5.11	<0.001
pseudo-R2 NA				

Average non-auto trips per week per household			
Trend	**Grow the Same**	**Do Things Differently**	**Grow Differently**
8.5	8.2	10.0	9.6

Percent of Jobs and Residents Near Transit

Data Inputs: current parcel land use (NEOSCC with updates by the Sasaki Team), future scenario land uses (Sasaki Team), current public transit infrastructure (NEOSCC), future public transit infrastructure (Sasaki Team)

This calculation measures the number of residents and jobs located near transit. “Near” transit access is defined as:

- ¼ Mile (5 minute walk) of frequent local bus service (runs every 15 min or less), or
- ½ Mile (10 minute walk) of BRT stops, commuter rail stops, or express bus stops

Buffers and spatial selections in GIS were used to calculate the number of residents and jobs located within these distances in each scenario.

Detailed GIS calculation method:

1) Construct buffers around transit features:
    - 1/4 mile buffer existing frequent (15 min or less) local bus routes
    - 1/2 mile buffer existing high-frequency transit (BRT and rail) stations
    - 1/2 mile buffer proposed BRT stations
    - 1/2 mile buffer proposed commuter rail stations
    - 1/2 mile buffer proposed express bus stops
2) Add field, populate with dummy attribute for each mode (0=NO, 1=YES)
3) Spatial join field to gridcell per presence of transit technology by scenario specification
4) Dissolve by gridcell

Access to Frequent Transit Service

	Current	Trend	Grow the Same	Do Things Differently	Grow Differently
Population with frequent transit access (percent of all people)	32.5%	25.5%	25.2%	35.1%	34.3%
Jobs with frequent transit access (percent of all jobs)	49.6%	40.8%	39.4%	50.0%	52.9%