NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION

Transportation Needs Index | Methodology & Technical Documentation

This information describes the approach used by the Office of Innovation for the underlying data analysis in Version 1 of the Transportation Needs Index.

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Introduction

Transportation is a vital component of any community, ensuring that residents can access work, education, healthcare, and other essential services. However, certain communities face significant challenges in accessing reliable and affordable transportation. This is particularly true for Overburdened Communities (OBCs), where transportation barriers can have even greater impacts. These communities could benefit from electric vehicle-based mobility programs using car shares, shuttles, micro transit, and shared bicycle and scooter fleets.

To identify potential gaps in transportation access, the Office of Innovation and the Department of Environmental Protection collaborated on developing a statewide transportation needs index to identify potential gaps in transportation access. The index uses publicly available data that determines OBCs combined with data on households with zero vehicles, people with disabilities, density, senior and youth population, and access to transit. This document provides the methodology, technical documentation, and data sources used to build this index.

Methodology

The transportation needs index aims to identify transportation needs in a community by analyzing local data, such as poverty levels and zero-vehicle households, in relation to the proximity of transit service, including bus stops and passenger rail stations. This method modifies an approach taken by the Jersey City on the Move transportation study undertaken in 2022.

Transportation Needs Index

The first version of the index of transportation needs has been developed using the following, equally weighted factors:

- Poverty level
- Zero-vehicle households
- Population density
- Senior and youth population
- Population with disabilities

All factors use Min-Max normalization that rescales each factor to a [0, 1] range. This is achieved by subtracting the minimum value of the factor and then dividing by the range of the factor (i.e., the difference between the maximum and minimum values). A composite score is then calculated by adding the scores and dividing by 5 (the total number of factors).

Example of a hypothetical block group:

Factor	Value
Poverty level	0.83
Zero vehicle households	0.44
Population density	0.89
Senior and youth population	0.29
Population with a disability	0.45

This example would have a composite score of .58. After calculating the composite scores for all block groups, the block groups can be sorted and divided into three groups composed of the bottom, middle and top thirds representing low, medium, and high need.

Transit Access

Subsequently, we conduct a geospatial analysis of transit access by overlaying the location of NJ Transit bus stops/stations and rail stations, using a .25-mile radius circle for bus stops/stations and .5 mile radius for rail stations. This creates a map with "transit coverage areas" overlaid. Transit access for each block group is then calculated by determining the percentage of the area that is covered by the transit access area. We then sort and rank the block groups by their relative access to transit, dividing them into three groups representing low, medium, and high transit access.

Transportation needs / transit access comparison

The final step is to combine the two parameters of transportation needs and transit access to identify target block groups. Using the previously presented categories of high, medium, and low transportation need and high, medium, and low transit access, we create the following matrix.

	Transit Access		
Transportation Needs	High need + low access	High need + medium access	High need + high access
	Medium need + low access	Medium need + medium access	Medium need + high access
	Low need + low access	Low need + medium access	Low need + medium access

The most salient combinations are high need/low access, high need/medium access, medium need/low access, and medium need/medium access. One could reasonably deduce that block groups matching these combinations would most benefit from additional transit access investment.

Technical Documentation

This section outlines each step undertaken for the analysis of transportation needs and transit access for New Jersey block groups. The analysis combines geospatial data, American Community Survey (ACS) data, and Overburdened Communities (OBC) criteria to identify and prioritize block groups with high needs and limited transit access.

1. Project Configuration

- Project CRS: EPSG:3424 (NAD83 / New Jersey State Plane).
- Ensuring consistent projection across all datasets was critical for accurate geospatial analysis and area calculations.

2. Data Preparation in QGIS

2.1 Importing and Reprojecting Layers

1. Block Groups:
    - Imported shapefiles of block groups from the New Jersey Geographic Information Network (NJGIN) Open Data Portal.
2. County Borders:
    - Imported shapefiles of county borders from the NJGIN Open Data Portal.
3. Transit Stations:
    - Imported GeoJSON files for NJ Transit rail, light rail, bus stations and bus stops from the NJGIN Open Data Portal.
    - Reprojected transit layers to EPSG:3424 using the Reproject Layer tool.

2.2 Transit Buffer Analysis

1. Buffer Creation:
    - Used the Buffer Tool to create:
        - 0.5-mile radii around rail stations.
        - 0.25-mile radii around bus stations and bus stops.
2. Merge and Dissolve Buffers:
    - Merged the rail and bus buffer layers into a single layer using the Merge Vector Layers tool.
    - Dissolved overlapping buffer areas using the Dissolve tool to create a unified transit coverage layer.
3. Intersection with Block Groups:

- Intersected the transit coverage layer with the block group shapefile using the Intersection Tool to calculate transit coverage within each block group.

3. Data Analysis in R

3.1 Data Preparation

1. Download ACS Data:
   - Downloaded relevant ACS datasets (poverty, vehicle ownership, population, age, and disability data).
   - Manually removed variable descriptions from files, ensuring only variable names and data remained.
2. Download Overburdened Communities in New Jersey (OBC) Data:
   - Downloaded OBC dataset.

3.2 R Script Workflow

1. Data Integration:
   - Imported the block group dataset and merged it with:
     - ACS datasets using GEOID20.
     - OBC data using Block Group identifier.
2. Derived Variables:
   - Calculated the following:
     - Poverty Level: Percentage of population below 200% of the poverty level.
     - Zero-Vehicle Households: Percentage of households without vehicles.
     - Population Density: Total population divided by block group land area, as calculated in QGIS.
     - Senior and Youth Population: Percentage of population under 18 or over 65.
     - Population with Disabilities: Percentage of population with disabilities.
3. Normalization:
   - Applied Min-Max normalization to each derived variable to rescale values between 0 and 1.
4. Composite Needs Index:
   - Calculated a composite index as the average of the normalized variables.
5. Categorization:
   - Categorized block groups into tertiles for access and needs (Low, Medium, High).
   - Combined these categories into a 3x3 matrix representing nine combinations (e.g., High Need, Low Access).
6. Export Results:
   - Saved the final dataset as Final_Needs_Index_Data.csv.

4. Final Steps in QGIS

4.1 Join Final Dataset

- Imported Final_Needs_Index_Data.csvinto QGIS and joined it with the block group layer.

4.2 Create PDF Layout

1. Design Maps:
    - Created PDF layouts displaying:
        - Gradients for the five derived variables (Poverty Level, Zero-Vehicle Households, Population Density, Senior and Youth Population, Population with Disabilities).
        - Composite Needs Index.
        - Access Index.
        - Block groups classified as High Need, Low Access, Medium Need, Low Access, or High Need, Medium Access.
        - OBC block groups in the above categories.
    - Included county borders for context.
2. Clean Attribute Table:
    - Removed unnecessary fields from the attribute table to streamline the dataset.
3. Export as GeoPackage:
    - Exported the final cleaned dataset as a GeoPackage.

Appendix

Data Sources

Data	Source	Identifier/tabulation	Link
Poverty level	American Community Survey 2022	Percent Low Income	C17002 | Poverty
Minority identification	NJDEP OBC spreadsheet	Percent Minority	NJDEP OBC .xls
Limited English	NJDEP OBC spreadsheet	Percent Households with Limited English Proficiency	NJDEP OBC .xls
Block Area	NJDEP OBC spreadsheet	Shapefile Area	NJDEP OBC .xls
Population	American Community Survey 2022	Population	B01003 | Population
Households with zero vehicles	American Community Survey 2022	No vehicle available	B25044 | Tenure by Vehicles Available
Senior and youth population	American Community Survey 2022	age < 18, age ≥ 65	B01001 | Sex by Age (senior and youth)
Block groups geospatial	NJGIN Open Data		NJGIN Open Data Portal
Population with disabilities	American Community Survey 2022	Total above and below poverty level with a disability	B23024 | Poverty by Disability Status
NJ Transit bus stops by line	NJGIN Open Data		Bus Stops of NJ Transit by Line
NJ Transit Light Rail Stations	NJGIN Open Data		Light Rail Stations of NJ Transit
NJ Transit Rail Stations	NJGIN Open Data		NJ Transit Rail Stations