

New Jersey Town Centers Distributed Energy Resource Microgrids Potential: Statewide Geographic Information Systems Analysis

Technical Report

October 2014



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Executive Summary

This technical report presents the findings of an analysis of potential locations for distributed energy resources in the Sandy-affected region of New Jersey, as defined by the U.S. Department of Housing and Urban Development. The analysis conducted for this project uses spatial statistics to identify clusters of public facilities and buildings located in low- or moderate- income areas that, taken together, comprise “town centers” that may be suitable for community microgrids. A town center is defined as a geography that includes statistically significant public buildings and facilities that overlap or are adjacent to low-to-moderate income census tracts. For each town center, a potential anchor is identified. An anchor could be a wastewater treatment plant or a statistically significant public facility or building that uses a large amount of energy. This analysis identifies 24 town centers in 17 municipalities in the 9 Sandy-affected counties in New Jersey.

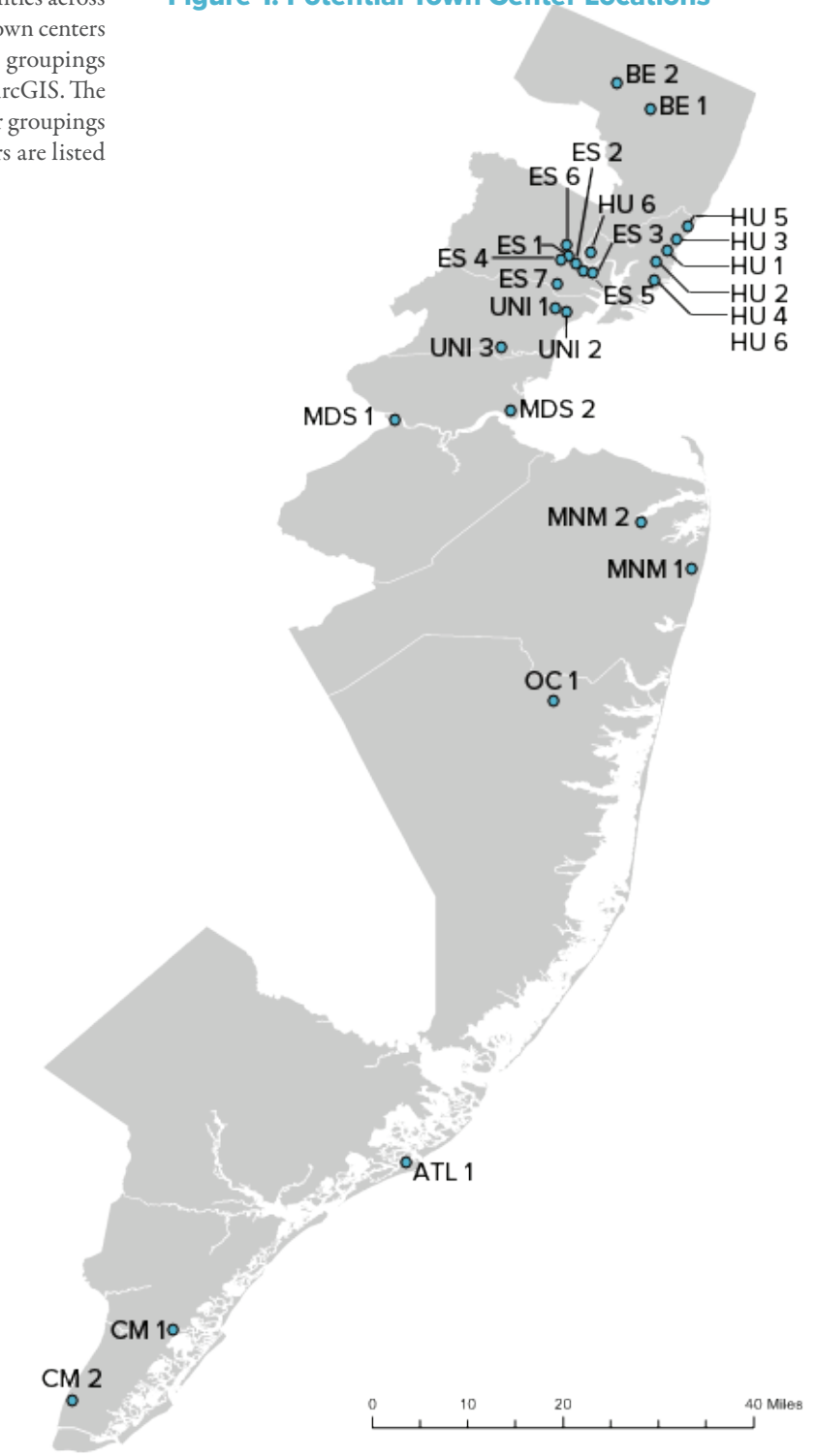
This report also presents the methodology used to identify the 24 town centers. The methodology describes data collection, data processing, how errors were identified and reconciled, the spatial statistics tests used to identify spatial patterns, and the way that town centers were defined, identified and prioritized. The appendices present 36 additional locations that were identified but were not prioritized as town centers.

The project did not attempt a detailed site-by-site evaluation of each facility and building’s electric and thermal consumption, but was based on geospatial methods and best practices for community microgrid planning methods. As such, the findings in this report represent the first phase of a screening study. Subsequent studies will need to assess daily and hourly energy needs and evaluate the technical and financial feasibility of installing distributed generation at the proposed sites.

Findings

This analysis identified 24 town centers in 17 municipalities across the 9 Sandy-affected counties in New Jersey. These 25 town centers were narrowed down from a list of 62 “hotspots” and groupings that resulted from a Cluster-Outlier analysis in ESRI’s ArcGIS. The 24 town centers are presented in this chapter. All other groupings that were not prioritized and identified as town centers are listed in the Appendix.

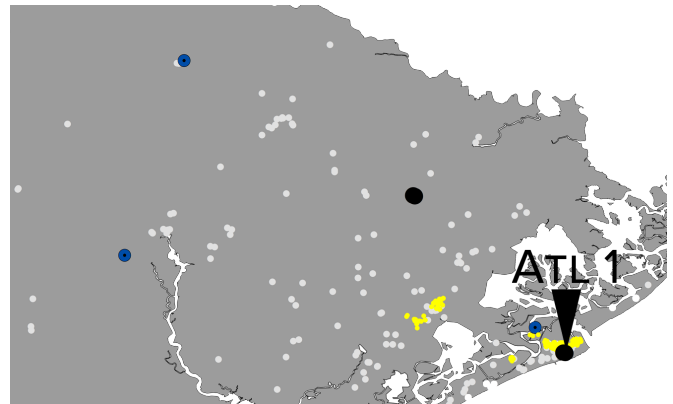
Figure 1. Potential Town Center Locations



Atlantic County

The population in Atlantic County is concentrated near Atlantic City, resulting in only 1 potential town center. This town center has a large number of public housing units and has a total of 3 inpatient healthcare facilities including the anchor. Overall population density of Atlantic County is 494.1 person per square mile compared to 1,185 persons per square mile.

Figure 2. ATL 1

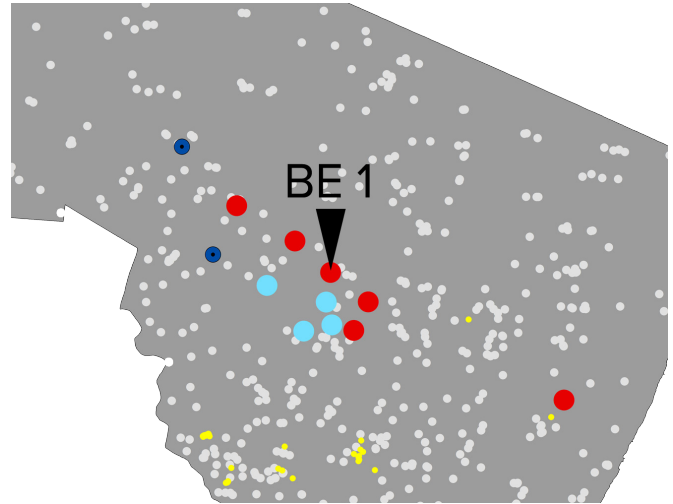


ATL 1 is located in Atlantic City. The anchor for the town center is Institute for Human Development - Women's Residential Drug Treatment Center. This town center includes 1 school, 1 fire station and 1 emergency dispatch service in addition to the anchor. It has 216 public housing units and all of the facilities are in LMI census tracts.

Bergen County

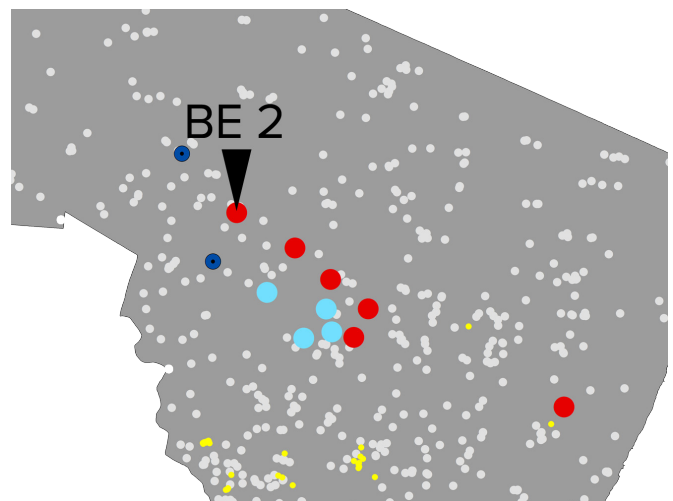
Two town centers were identified in Bergen County. These town centers are obvious choices because they include statistically significant “clusters” (high-highs) and “outliers” (low-highs and high-lows). Where there are “high” facilities, there are potential anchors. BE 1 and BE 2 both include a diversity of buildings, including those that could potentially serve as shelters (e.g. schools) and a number of public housing units.

Figure 3. BE 1



BE 1 is located in the town of Paramus. Bergen Medical Center is the potential anchor. The town center has 5 facilities including 1 vocational facility, 1 ambulance dispatch service, 1 shelter and 1 Department of Human Services office. There are no public housing units in this town center and none of the facilities are in LMI census tracts.

Figure 4. BE 2

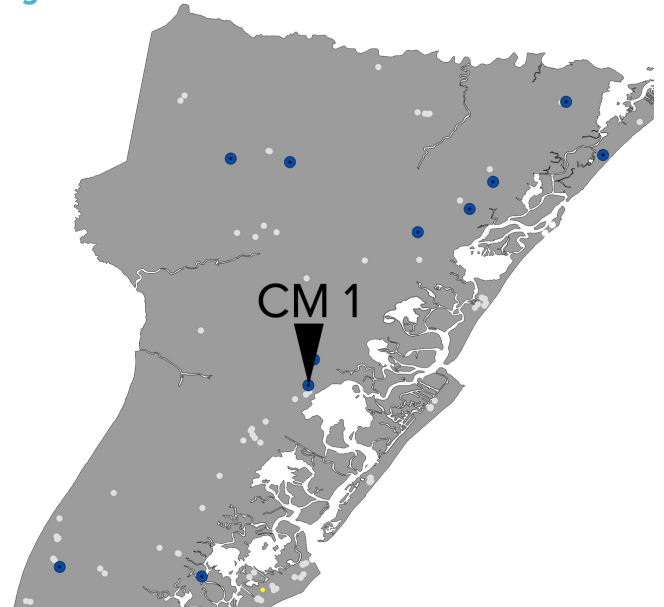


BE 2 is a town center located in Ridgewood. It is anchored by the Valley Hospital. In addition to the anchor, there are 3 schools in this town center. There are no public housing units and none of the facilities are located in LMI census tracts.

Cape May County

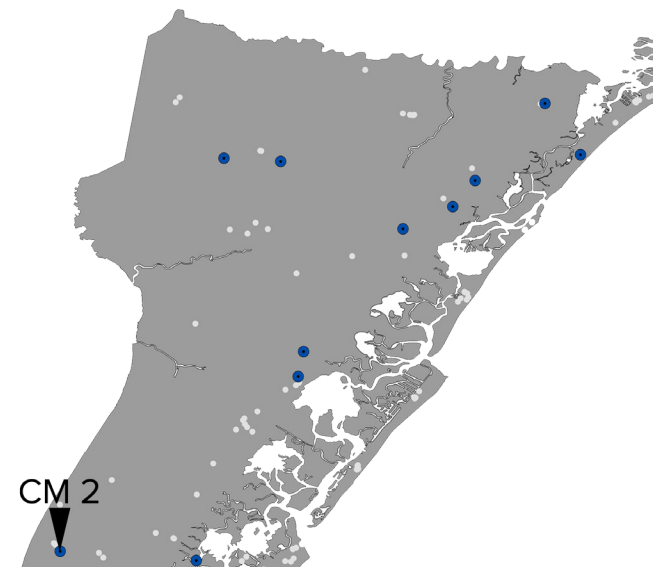
Cape May County does not have any town centers that fit the criteria discussed in Chapter 2. The facilities and they are spread apart across the county. This is due to Cape May's low population density of 382 people per square mile compared to New Jersey's 1,185 people per square mile. As a result there were only 2 potential town center where two facilities are within a 0.5 mile radius of a suitable anchor. Due to the lack of public housing or LMI census tracts in vicinity of some other potentials for an anchor, they were not included as Tier 1 town centers.

Figure 5. CM 1



CM 1 is anchored at Cape May County Municipal Utilities Authority. It includes the Cape May County Fire Academy and 1 vocational institute. There are no public housing units in this town center. There are no facilities in LMI census tracts.

Figure 6. CM 2

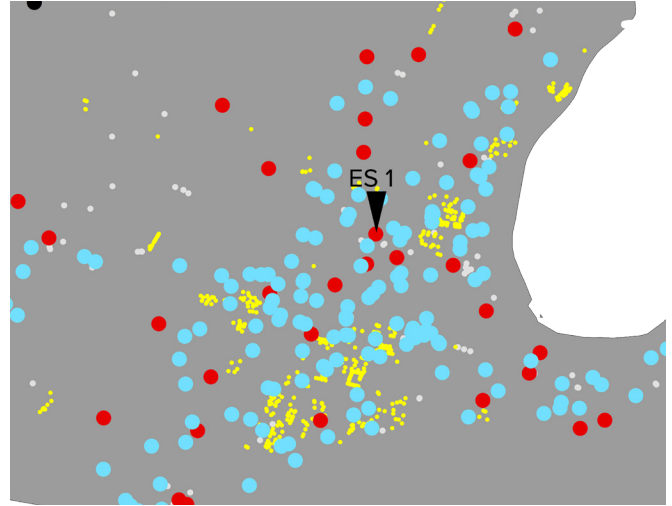


CM 2 is located in Lower Township and anchored at Lower Township Municipal Utilities Authority. It includes the 1 municipal building and 1 school. There are no public housing units in this town center. There are no facilities in LMI census tracts.

Essex County

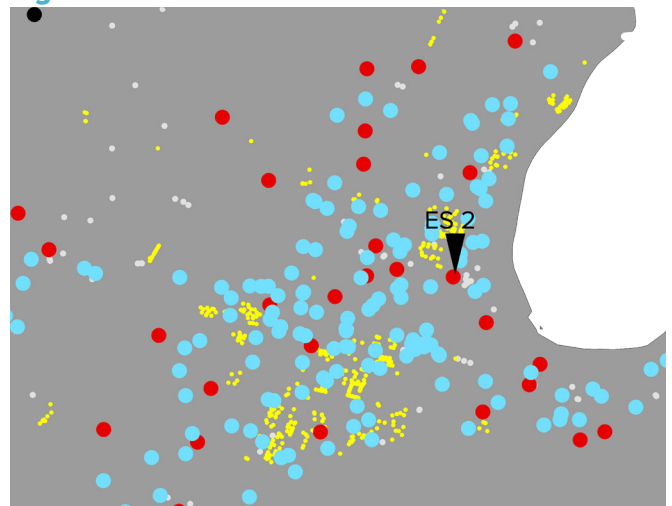
It is important to note that much of data for Essex county from the MOD IV dataset are missing. Thus the results here are concentrated in Newark — the municipality for which most of the required data are available. Nonetheless, the town centers presented here are still suitable for microgrids. The town centers presented here are in close proximity to each other. All of the anchors for each town center are unique, though some of the buildings and facilities included in the buffer for the one town center may also be included in the buffer for other town centers.

Figure 7. ES 1



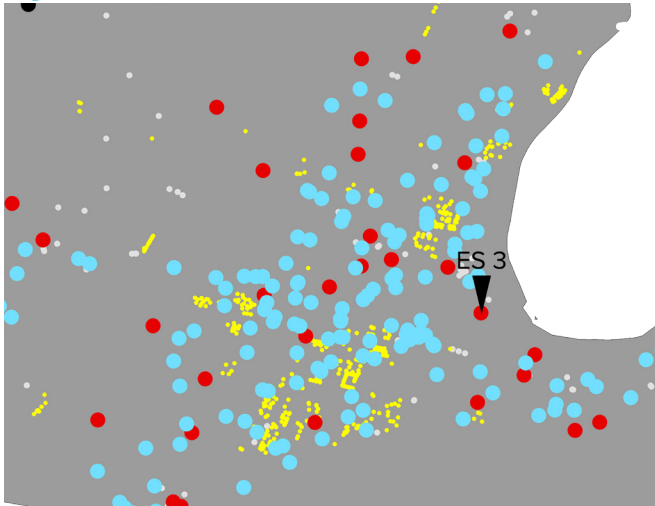
ES 1 is located in Newark and is anchored at Essex County Juvenile Detention Center. It has 30 facilities including 17 schools, 4 university buildings, 2 ambulance dispatch services, 2 fire department engines, 1 municipal building, 1 library, 1 charity center and 1 inpatient healthcare facility.

Figure 8. ES 2



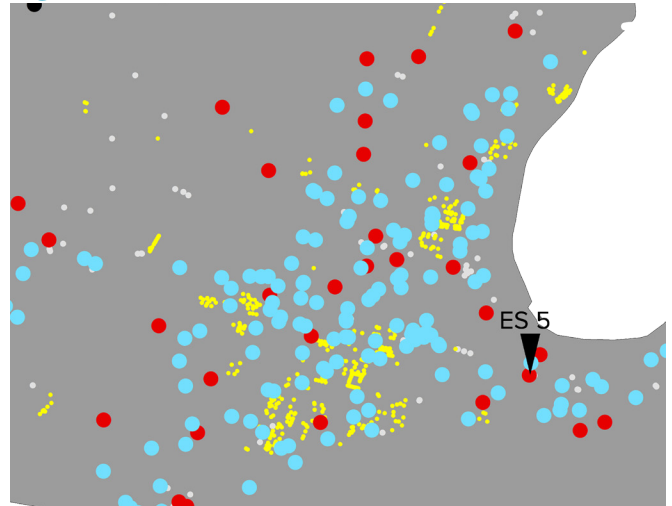
ES 2 is located in Newark and it is anchored at St. Michael's Medical Center. It has 26 facilities including 13 schools, 5 NJIT buildings, 2 museums, 1 fire and rescue, 1 library, 1 performance art center, 1 municipal building and 1 sports arena. There are 880 public housing units in this town center. Nine of the facilities are in LMI census tracts.

Figure 9. ES 3



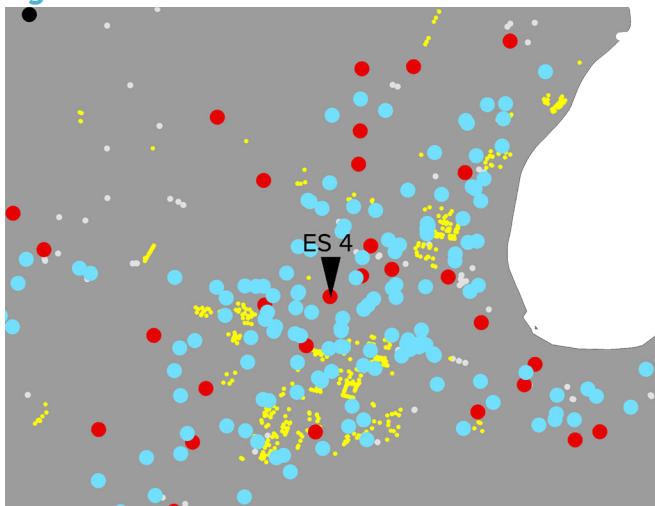
ES 3 is located in Newark and anchored at Mount Carmel Guild Behavioral Healthcare System. This town center has 20 facilities, including 9 schools, 3 municipal buildings, 2 athletic centers, 1 performing arts center, 1 museum and 1 library. There are 10 public housing units in this town center. Six of the facilities are in LMI census tracts.

Figure 11. ES 5



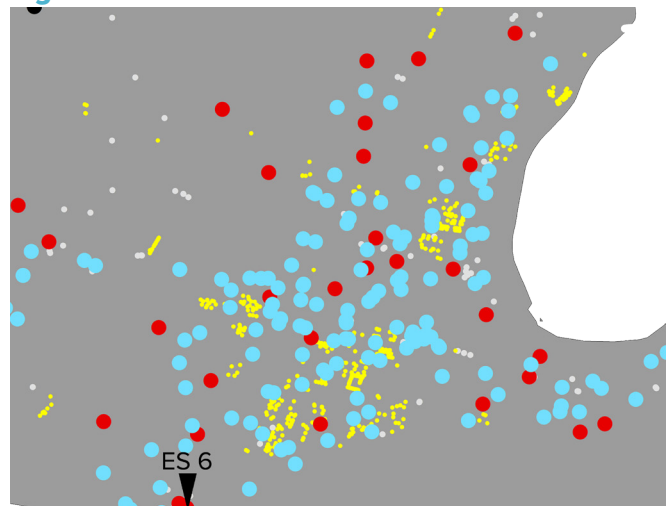
ES 5 is located in Newark. There are 12 facilities in the town center. It is anchored at Children's Hospital of New Jersey and includes 1 additional inpatient health care facility along with 10 schools, 1 municipal building and 1 library. There are no public housing units in this town center. Out of the 12 facilities, 8 are in an LMI census tract.

Figure 10. ES 4



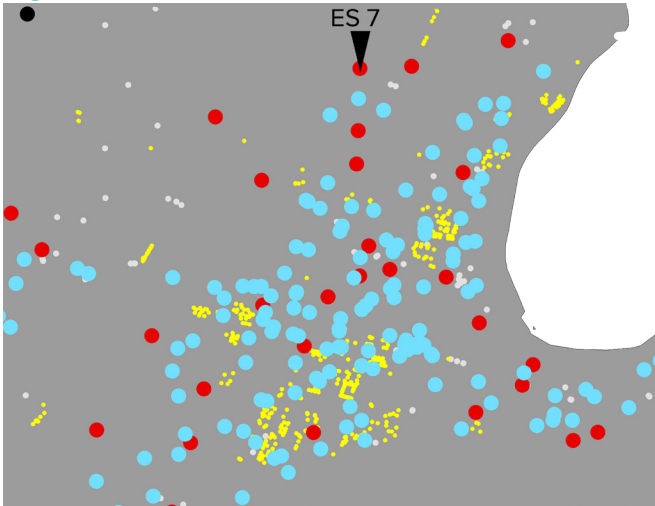
ES 4 is located in Newark and the University Hospital is the potential anchor. There are 18 facilities in this town center including 1 fire station, 1 library, 15 schools and 29 public housing units. Of these, 18 public housing units and 14 facilities are in LMI census tracts.

Figure 12. ES 6



ES 6 is located in Newark. There are 10 facilities in the town center. It is anchored at Saint James Hospital and includes 8 schools and 1 fire department. It has no public housing units. All of the facilities are in LMI census tracts.

Figure 13. ES 7

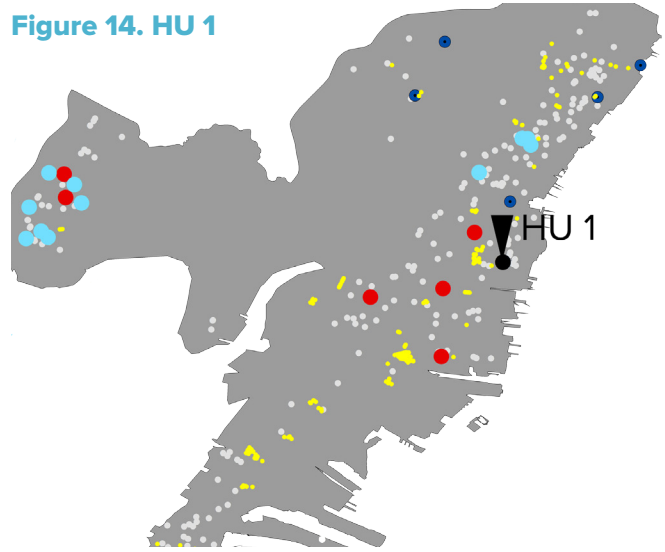


ES 7 is located in Newark and is anchored at Columbus Hospital. It has 6 facilities including 1 fire department station and 4 schools. There is no public housing in this town center. Two of the facilities are in LMI census tracts.

Hudson County

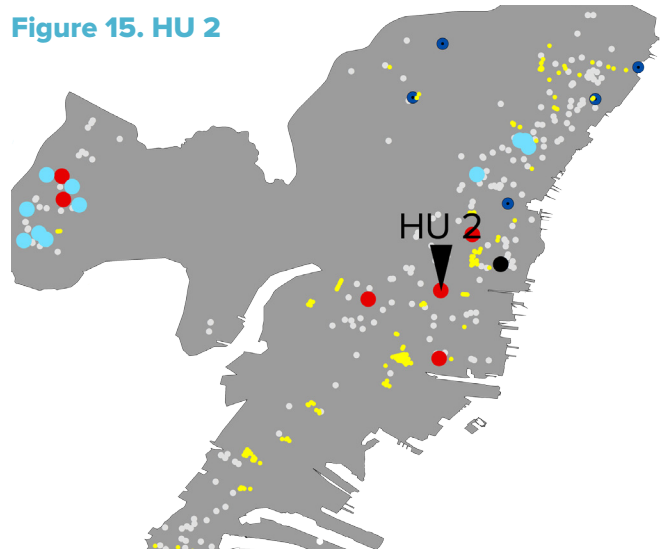
There are 6 town centers in Hudson County. The high number of town centers is, in part, a function of the density of development in the county. HU1 and HU2 are obvious choices because there are a large number of different types buildings in proximity to the anchor and there is also a great number of public housing units in the vicinity. Similarly, HU3, HU5 contains a waste water treatment plant, which gives off waste heat that can be used to generate energy for nearby facilities in the town center. HU4 and HU6 all contain a diversity of buildings that are important for life safety.

Figure 14. HU 1



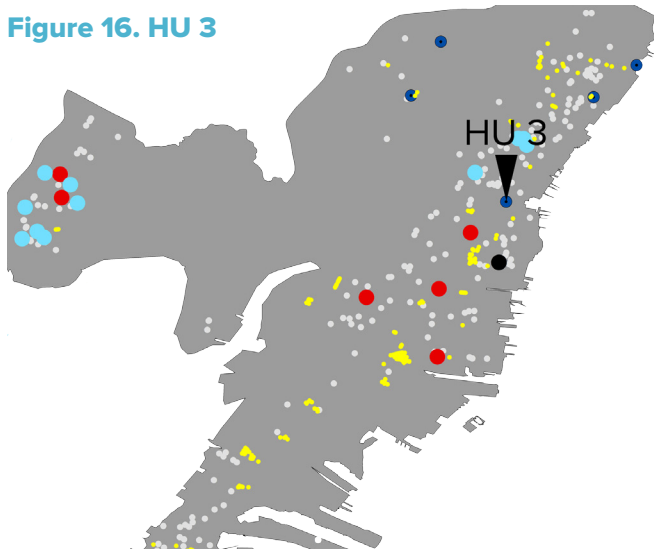
HU 1 is located in Hoboken, anchored by Hoboken University Medical Center. There are 15 facilities in this town center which include 8 schools, 2 fire department engines, 1 library, 1 ambulance dispatch service and 1 fire department headquarter. It has 1058 public housing units, all of which along with 1 facility are in LMI census tracts.

Figure 15. HU 2



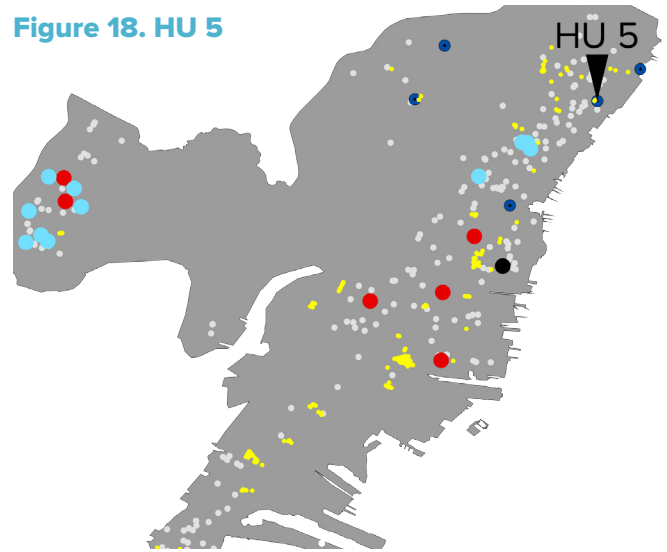
HU 2 is located Jersey City, anchored at Christ Hospital and the town center has 3 schools. There are 384 public housing units in this town center and all of them along with the anchor and 2 of the facilities are in LMI census tracts.

Figure 16. HU 3



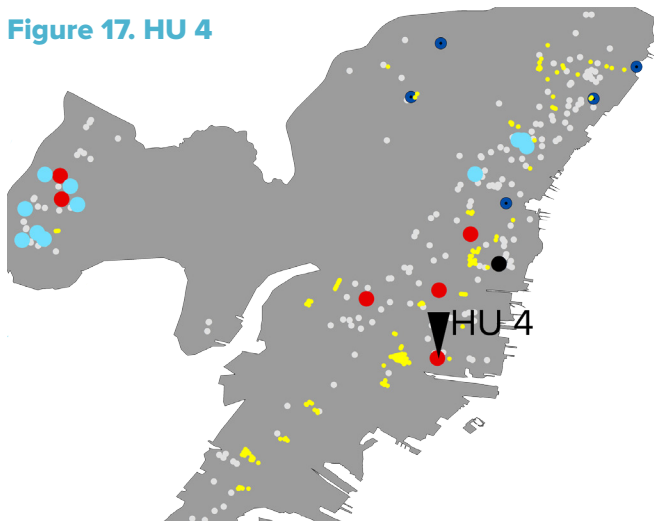
HU3 is a town center in Jersey City. It is anchored at the Jersey Adam Street waste water treatment plant and it includes 5 schools, 4 fire stations, 1 library and 192 public housing units. The public housing units as well as 1 of the facilities is in LMI census tracts.

Figure 18. HU 5



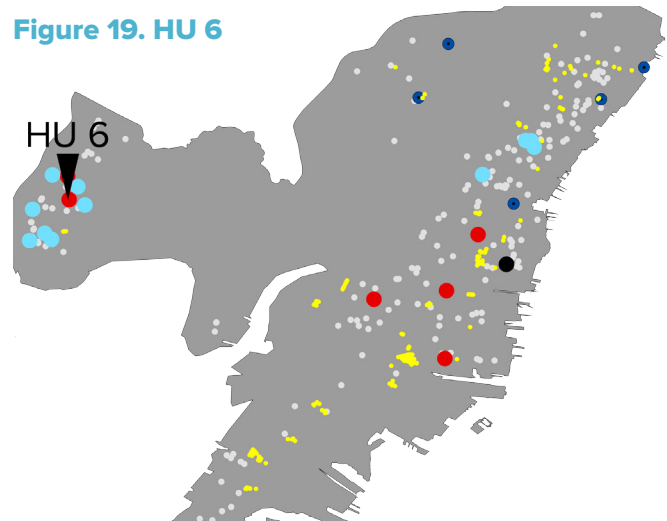
HU 5 is a town center in Union City. It is anchored at North Hudson Sewerage Authority sewage treatment plant. It has 19 facilities including 14 schools, 3 fire and rescue squads, 1 emergency medical service and 1 municipal building. There are 84 public housing units in this town center. Ten of the facilities, including the anchor, are located in LMI census tracts.

Figure 17. HU 4



HU 4 is located in Jersey City. The town center is anchored by the Jersey City Medical Center and includes 4 schools, 1 fire department engine and 192 public housing units. The anchor and public housing units are located in LMI census tracts.

Figure 19. HU 6

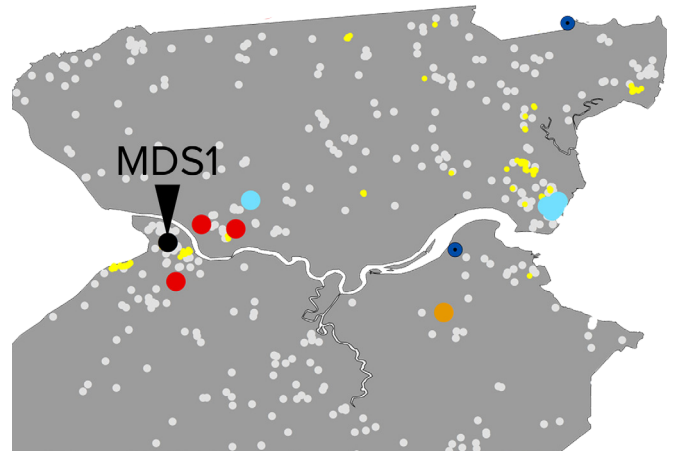


HU 6 is located in Bayonne and Bayonne Medical Center is the potential anchor for this town center. There are 13 other facilities in this town center including 8 schools, 1 municipal building, 1 public library, 1 ambulance dispatch center and 1 fire department. There are 126 public housing units in this town center. None of the facilities are in LMI census tracts. Although not located in LMI census tracts, HU6 is identified as a town center because it has a large number of public housing units within the 0.5 mile buffer.

Middlesex County

Middlesex County has one town center; It is a mix of similar facilities. It is anchored by hospital and has a great diversity of facilities, it contains a number of different types of buildings and facilities, many of which are located in LMI census tracts.

Figure 20. MDS 1

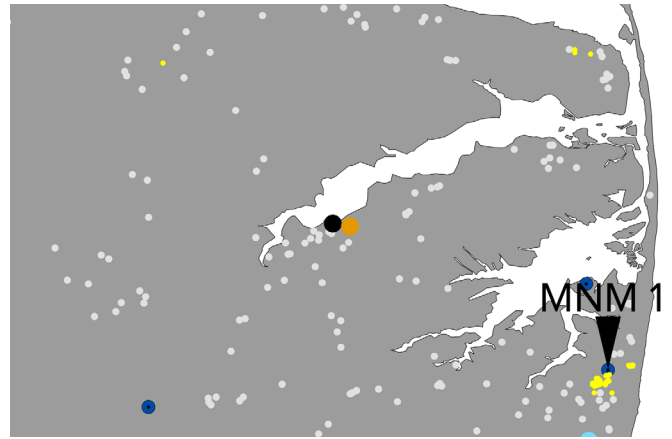


MDS 1 is located in New Brunswick with Robert Wood Johnson University Hospital as the potential anchor. This town center has 21 buildings which includes 7 Rutgers University buildings, 3 additional inpatient health care facilities, 1 city hall, 6 schools and 2 emergency dispatch services. There are also 26 public housing units in this town center. All of the public housing units and 7 of the facilities are located in LMI census tracts.

Monmouth County

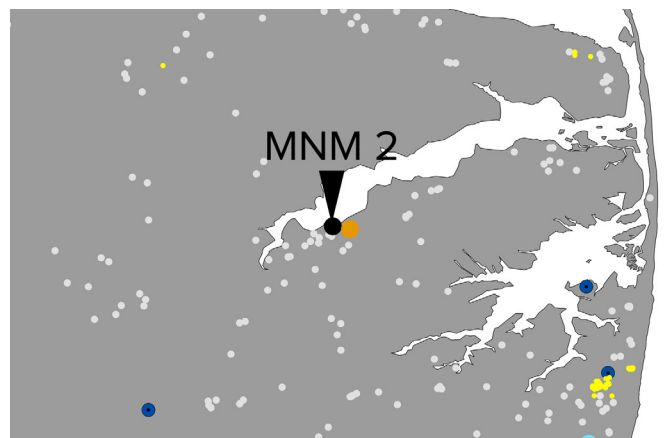
Monmouth County has two town centers. MNM 1 is anchored at a waste water treatment plant in proximity of a large number of public housing units, and MNM 2 is anchored at an inpatient healthcare facility. They are obvious choices because they contain highly critical facilities that also high energy consumers, in close proximity of public housing units and other critical services.

Figure 21. MNM 1



MNM 1 is located in Long Branch. It is anchored at Long Shore Sewage Treatment Authority waste water treatment plant. It includes 1 emergency dispatch service and 2 schools. It also includes 287 public housing units, out of which 230 units are in LMI census tracts along with 2 of the facilities.

Figure 22. MNM 2

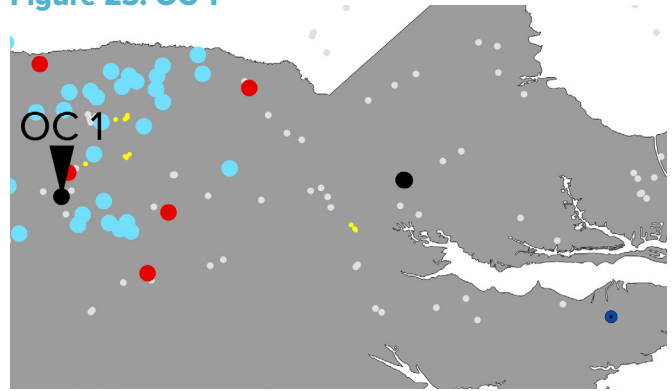


MNM 2 is anchored at Riverview Medical Center. It includes 1 school, 5 emergency dispatch services and 1 library. There are no public housing units in this town center. There are no public housing units in this town center and none of the facilities are in LMI census tracts.

Ocean County

Ocean County has a population density of 442.2 people per square mile, while New Jersey has a density of 1,185 people per square mile. Most of this population in Ocean is concentrated in the north eastern part of the county. As a result we have only one town centers — OC 1. It is anchored at a inpatient healthcare facility and has 2 more similar facilities in the vicinity along with other critical services.

Figure 23. OC 1

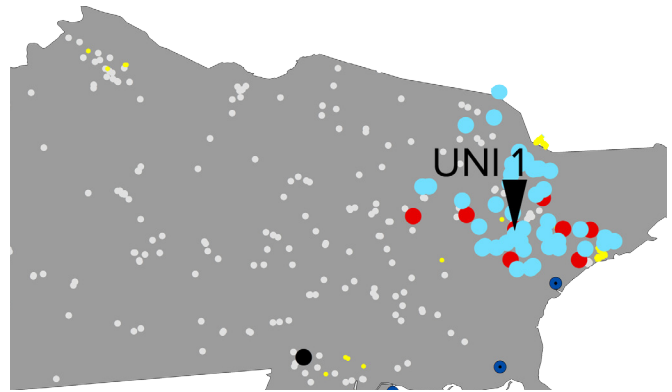


OC 1 is located in Lakewood and its potential anchor is Fountainview Rehab Center. This town center has 9 buildings which includes 2 additional inpatient facilities, 5 schools and 1 fire department. There are no public housing facilities in this town center and 4 of the facilities are in an LMI census tracts.

Union County

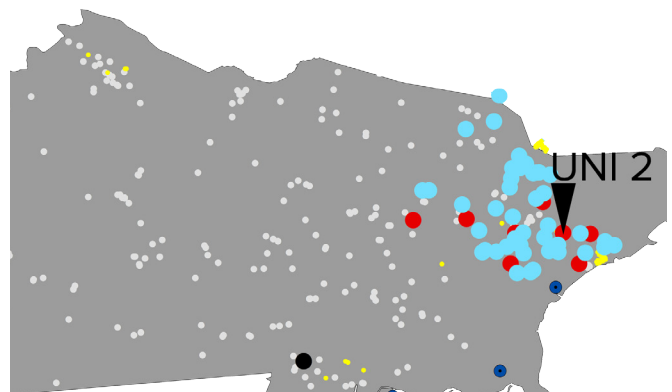
There are four town centers in Union County. Both are anchored by medical facilities, contain a diversity of buildings and facilities, and include a large number of public housing units. UNI 1 is given priority as has more public housing units than UNI 2. Both of them are located in Elizabeth. UNI 4 does not have a hot spot but has been included due to the presence of a great number of public housing in the vicinity.

Figure 24. UNI 1



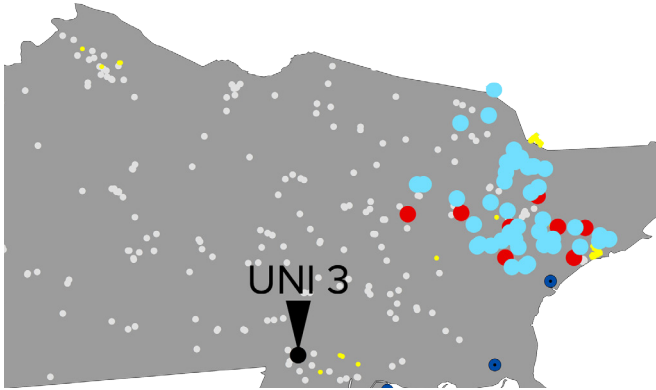
UNI1 is located in Elizabeth. The anchor is Trinitas Hospital. There are 13 facilities in the neighborhood comprised of 1 library, 1 museum and 10 schools. There are 249 public housing units in the town center. In this town center, 8 facilities are in LMI census tracts.

Figure 25. UNI 2



UNI2 is located in Elizabeth and the anchor is Trinitas Hospital - Newpoint Campus. The town center has 7 facilities it includes 6 schools in addition to the anchor. There are 126 public housing units in the town center. All facilities as well as the public housing units are in LMI census tracts.

Figure 26. UNI 3



UNI 3 is located in Rahway and the anchor is Robert Wood Johnson Hospital. The town center has 9 facilities it includes 1 additional inpatient healthcare facility, 4 schools, 1 fire department station and 1 library. There are no public housing units in the town center. None of the facilities are in LMI census tracts.

Methodology

Data Collection

The first step in the analysis was data collection. The data collected include geographical, feature, socio-economic and energy consumption data.

Geographic Data

This study focuses on the 9 Sandy-affected counties of New Jersey, as defined by HUD. Geographic data include county boundary files for these counties: Atlantic, Bergen, Cape May, Essex, Hudson, Middlesex, Monmouth, Ocean and Union. The shapefiles for these administrative boundaries were downloaded from New Jersey Geographic Information Network website (NJGIN).

Feature Data

Feature data includes all of the public facilities and buildings that could be part of a town center. As per the guidelines of this analysis, only buildings that are open to the public or could serve a public purpose, such as sheltering, during an emergency were considered. Private commercial and industrial buildings were not included in this analysis. The data were derived from three sources. The New Jersey Geographic Information Network (NJGIN), hosts data from the Homeland Security Infrastructure Program (HSIP). HSIP shapefiles were downloaded for police stations, fire stations, hospitals, correctional facilities and emergency shelters. The MOD IV dataset is maintained by the New Jersey Department of the Treasury and includes property data by county. MOD IV data for each of the 9 counties under study were also downloaded from NJGIN. The following building types were selected from the MODIV dataset for this analysis: municipal buildings, community centers, emergency shelters, educational institutions, public safety buildings, correctional facilities, recreational centers, libraries and museums.

The New Jersey Department of Environmental Protection provided a dataset of waste water treatment plants located in New Jersey. This dataset was clipped to the 9 counties under study. There are 98 waste water treatment plants in the final dataset.

Public housing units were obtained from HUD. The data is from year 2012.

Socio-Economic Data

In order to comply with the Community Development Block Grant-Disaster Recovery, 80% of the investments must be made in low-or moderate-income areas. HUD provides a dataset of low-and moderate income census tracts, in which at least 51% of the

population is classified as low- or moderate - income according to annually revised income limits for HUD programs. The 2014 revised income limits were used for this analysis. There were 335 census tracts that are classified as low-and moderate income census tracts.

Energy Consumption

Energy consumption data were collected in order to classify building energy load. The Energy Information Administration's Commercial Building Energy Consumption Survey (CBECS) was used because it was more accessible than obtaining utility data for the large number of buildings and facilities that were compiled for this analysis. (CBECS) is conducted quadrennially to provide basic statistical information about energy consumption and expenditures in U.S. commercial buildings and information about energy-related characteristics of these buildings. The survey is based upon a sample of commercial buildings selected according to the sample design requirements described below. A "building," as opposed to an "establishment," is the basic unit of analysis for the CBECS because the building is the energy-consuming unit. The latest complete dataset available is for 2003.

Data Processing

Once all of the data were collected, they were processed for use in the analysis. Most of the data processing was performed in ESRI's ArcGIS.

First, all building and facility data were clipped to the geography under study. For instance, NJGIN included hospitals for the entire state of New Jersey. These data were clipped to the 9 relevant counties. A total of 3510 facilities were identified in the area under study. Similarly, the low- and moderate-income data downloaded from HUD were joined to the census tracts within the study area.

Second, all data were transformed into point features in the Feature to Point or Polygon to Point tools in ArcGIS. Some of the raw data files were polygons, such as the MOD IV data. All data needed to be symbolized as point data for the purpose of this analysis.

Third, the building and facility data that were collected were disaggregated and reclassified to conform to CBECS categories. The buildings and facilities in the MOD IV dataset had to be further broken down or disaggregated into useful building types for this analysis. For instance all of the public buildings and facilities in MOD IV database are classified as "public buildings",

but this broad category included schools, libraries, senior centers, town halls, academic institutions, museums, correctional facilities and youth centers. These were isolated into separate layers for each type of public building listed in Table 1. Then, these layers were reclassified to conform to CBECs categories for building types. The CBECs categories include: education, inpatient health facilities, office, service, public assembly, and public safety and order. Table 1 illustrates how each building and facility type were processed and reclassified according to the CBECs categories.

Once all of the raw files were obtained, the data were processed so that they could be used in this analysis. First, all files were clipped to the geography under study—the nine Sandy-affected counties in New Jersey, as defined by the U.S. Department of Housing and Urban Development (HUD). In some cases, polygon features were converted to point features. In other cases, information was disaggregated and re-classified. For instance, the public buildings were downloaded as part of the MOD IV tax dataset for New Jersey. It included schools, libraries, senior centers, town halls,

academic institutions, museums, correctional facilities and youth centers. These were then isolated into separate layers for each type of public building listed above. All of the data were then classified into the following six categories: education, inpatient health facilities, office, service, public assembly, and public safety and order. Table 1 shows how each building type was reclassified into the six categories.

This analysis used tools from the spatial statistics toolset in ESRI's ArcGIS. The specific tool used is called a cluster-outlier analysis. A cluster-outlier analysis is a spatial statistics tool that identifies statistically significant hot spots, cold spots, and spatial outliers using the Anselin Local Moran's I statistic.

In order to run, this tool requires each data point to have a numerical classification, which can either be a weight or a simple categorical classification. For the purpose of this analysis, categorical classifications were used based on electric and thermal load and on criticality for each facility and building type. This section describes the method for assigning these classifications.

Table 1. Data Reorganization

Building Type/ Facility	Source	Feature Class	CBECs Category
Police stations	HSIP	Point	Public Safety and Order
Fire stations	HSIP	Point	Public Safety and Order
Hospitals	HSIP	Point	Inpatient Healthcare Facility
Schools (public and private)	MOD IV + Google Earth	Point	Education
Universities	MOD IV + Google Earth	Point	Education
Correctional facilities	HSIP	Point	Public Safety and Order
Emergency shelters	HSIP	Point	Shelter
Community and/or recreational centers	MOD IV	Point	Shelter
Senior centers	MOD IV	Point	Shelter
Libraries	MOD IV	Point	Shelter
Museums	MOD IV	Point	Shelter
Municipal buildings	MOD IV	Point	Shelter
Waste water treatment plants	NJDEP	Point	Waste Water Treatment Plant
Public Housing	HUD	Point	Public Housing

Classify by Electric and Thermal Load

Each of the facilities and buildings were then processed so that they could be used for analysis. Facilities and buildings were first classified by electric and thermal load. The Energy Information Administration’s Commercial Building Energy Consumption Survey (CBECS) (2003) was used to classify electric and thermal load. The CBECS is intended to provide basic statistical information about energy consumption and expenditures in U.S. commercial buildings. The latest complete dataset is available for 2003. In further studies, daily, hourly and sub-hourly electric and thermal loads should be acquired from distribution utilities and property owners in order to assess technical feasibility more precisely.

Each facility and building type were classified according to the building types defined in CBECS: education, inpatient health facilities, office, service, public assembly, and public safety and order. Energy consumed per square foot for each building type based on data from CBECS was used to create categorical classifications. The classifications are listed in Table 2.

Classify by Criticality

Next, buildings were classified by criticality using Federal Emergency Management Agency’s (FEMA) definition, which defines facilities and buildings as critical based on their centrality for life safety. According to FEMA, Category I buildings include buildings and structures whose failure would represent a low hazard to human life. Category II buildings include those that are not specifically included in other categories. Category III includes buildings and structures that represent a substantial hazard to human life in the event of failure. Category III includes buildings with higher concentrations of occupants, such as schools, colleges,

adult education, and daycare facilities. Category IV buildings and structures are the most critical for life safety. These include essential facilities such as hospitals, fire and police stations, rescue and other emergency service facilities, water supply facilities and others.

Identify Potential Errors and Recalibrate

Next, data were inspected for completeness, inconsistencies and duplicates. The MOD IV data is reported on a county-by-county basis, and some counties have more complete data than others. For instance, Essex County does not have very complete data. However, Newark—located in Essex County—was the most complete of all the municipalities in the county. It is difficult to know how many facilities and buildings were missing from the MOD IV, but a visual inspection in Google Earth helped to identify over 20 additional buildings that were not included in the original list of facilities and buildings. Another task was to identify inconsistencies and duplicates. In some cases, there were fields that appeared to be the same but had one field that was different—for instance, a parcel could be identified as both a “borough hall” and a “boro hall”. Where it was possible to verify that identity of each parcel, inconsistencies and duplicates were removed. There is still some potential room for error, particularly for buildings and facilities that may be co-located on one parcel and share a parcel or building ID, such as a fire station and ambulance dispatch center that may be co-located on the same parcel. Visual inspections helped to clarify some, but not all, of these challenges.

Table 2. Categorical Classification of Facilities and Buildings Based on Energy Consumption and Criticality

Principal Building Activity	Energy Consumption (1000s BTU per square foot)	Energy Consumption Classification	Criticality Classification
Service	77	1	1
Education	83.1	2	3
Office	92.9	3	2
Public Assembly	93.9	4	3
Public Safety & Order	115.8	5	4
Inpatient Health Facility	249.2	6	4

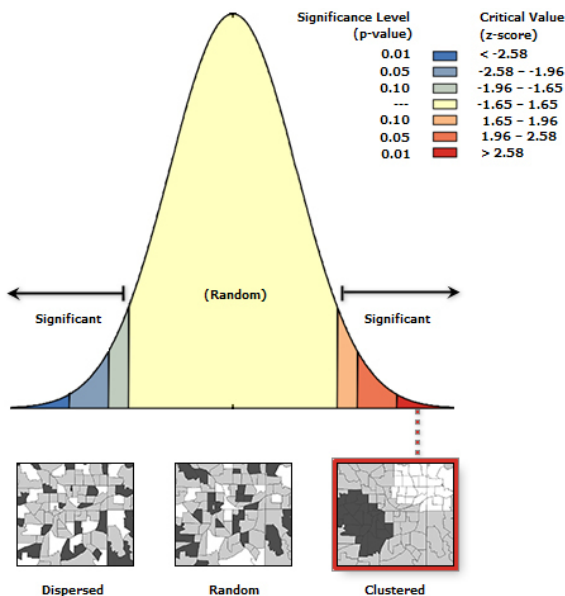
Test for Spatial Patterns

Once all of the facilities and buildings were compiled, processed and ready for use a set of spatial statistics tests were run to check the presence of spatial clustering in the data set. The analysis was run on all facilities and buildings except for public housing units and waste water treatment plants. These are both critical and consume a high amount of energy and are therefore treated independently by layering them of the output of the cluster-outlier analysis.

Two tests were conducted to assess whether the data were organized in a spatial pattern: spatial autocorrelation and incremental spatial autocorrelation. Both tests were performed in ESRI's ArcGIS.

The test of spatial autocorrelation tested the null hypothesis, which is that the attributes being studied—energy consumption and criticality—are randomly distributed among all the facilities or features in the study area. Said another way, the spatial processes that promote the observed pattern of attributes is due to chance and there is no spatial clustering in the dataset. The test provides three statistical values that allow users to reject or accept the null hypothesis: the z-score and p-value. A z-score represents the number of standard deviations the clustering is from the mean. A p-value is the probability of obtaining the z-score and allows you to reject or accept the null hypothesis. A p-value less than 0.01 is a very strong presumption against the null hypothesis. The third

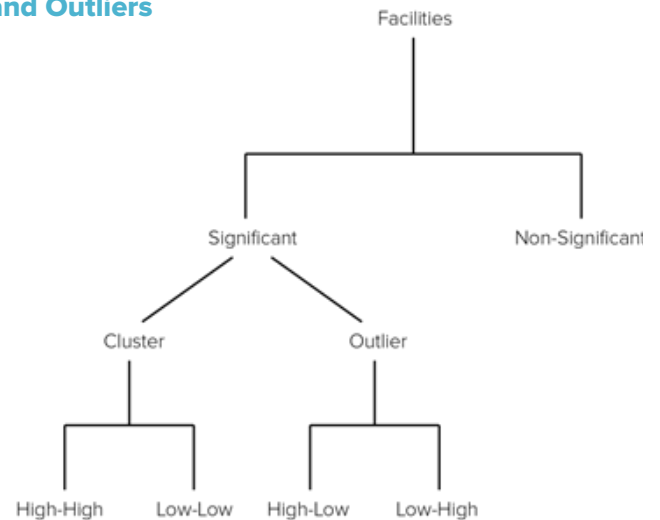
Figure 27. Spatial AutoCorrelation Output



statistic that it provides is called the Moran's Index, which is a value of spatial correlation. Figure 27 shows the results of the test of spatial autocorrelation. .

The report shows a z-score of 22.19, a p-value of 0.00 and a Moran's Index of 1.05. The high z-score indicates that there is less than a 1% chance that the spatial pattern could be the result of random chance. The p-value indicates that the null hypothesis can be rejected. The Moran's Index indicates that the attributes are correlated spatially. This means that the spatial patterns are not random and that the analysis could proceed with the existing data and classifications described above.

Figure 28. Disposition of Facilities as Clusters and Outliers



The incremental spatial autocorrelation test was conducted to identify distance at which the clustering identified in the spatial autocorrelation test is most prominent. This test confirmed that the clustering was most prominent at 0.5 mile, i.e. when facilities were 0.5 miles away, clustering was most prominent.

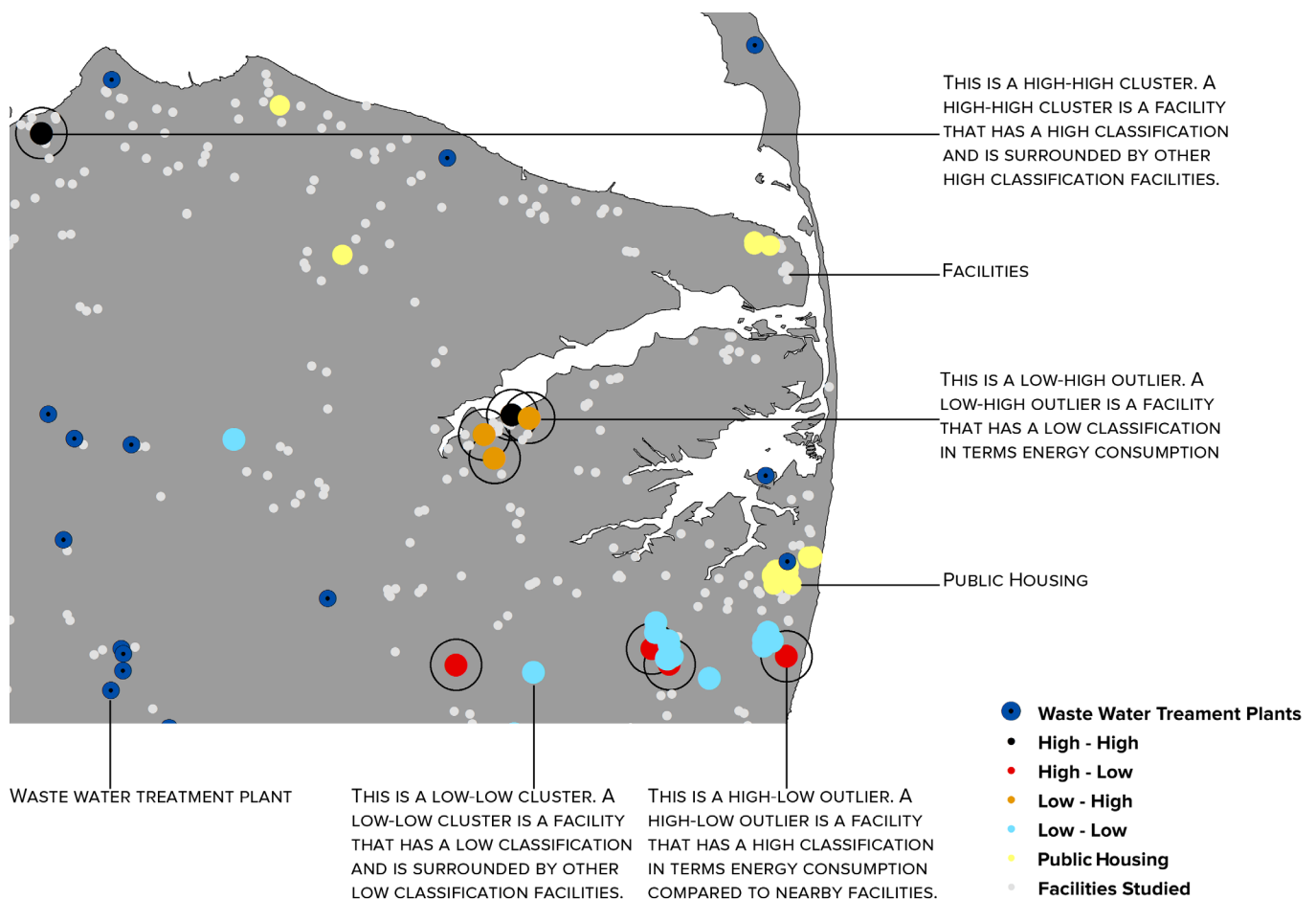
Once it was confirmed that the spatial processes underlying the data were not random, a cluster-outlier analysis was run in ArcGIS. The output indicates spatial groupings and whether the groupings are similar or different. There are two types of groupings: clusters and outliers. These can be further broken down into four types of clusters and outliers. The output of this analysis assigns a classification to each facility, denoting whether the facility is a high-high, high-low, low-high, or low-low. This classification is illustrated in Figure 30.

A cluster is a group of facilities that have similar classification. Because it is based in similarity, a cluster could be a “high-high” or a “low-low”. For instance, if the tool identifies clusters and outliers based on the energy consumption attribute, a high-high feature is one that consumes a lot of energy (5 or 6) surrounded by other features that consume a lot of energy (5 or 6). It could be an inpatient health facility nearby to another inpatient health facility or a facility classified as public safety and order. It could also be two or more facilities that do not consume much energy—a low-low cluster.

An outlier is a facility that is surrounded by facilities with dissimilar values. An outlier could be a “high-low” or a “low-high” grouping. A high-low could be an inpatient health facility nearby to a service or educational building or facility.

Conversely, a low-high could be a service or educational building or facility nearby an inpatient health facility. Figure 30 shows how to interpret the outputs of a cluster-outlier analysis. This analysis was run using the energy consumption classification while the criticality of each facility was assessed manually. High criticality classification does not ensure high energy consumption classification. Using criticality classification with the cluster-outlier tool does not allow identification of anchors, which need to be chosen based on their energy consumption. Identifying anchors using the energy consumption classification in cluster-outlier analysis and manually assessing for criticality is more efficient. This method also generates a priority for the town centers within the county — higher the criticality - higher the priority.

Figure 29. Interpreting Cluster Outlier Analysis

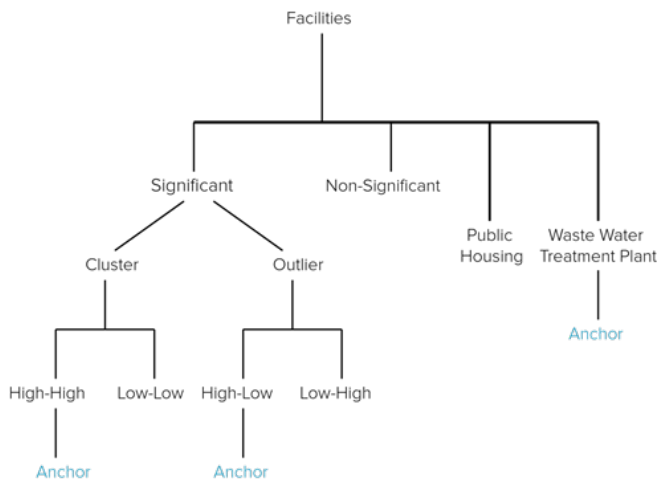


Identify Anchors and Potential Town Centers

The output of the cluster analysis was mapped. Two other types of facilities were added to the map as layers on top of the output: public housing units and waste water treatment plants. Potential town centers were identified based on these data. Each town center was identified and assigned an “anchor”. An anchor is a facility that consumes a large amount of electric or thermal energy, e.g., a hospital. The first step in the process of identifying potential town centers was identification of their potential anchors. Anchors are:

- ▶ Facilities classified as statistically significant high-highs or high-lows according to the cluster-outlier test based on the energy consumption data;
- ▶ Waste water treatment plants.

Figure 30. Disposition of Facilities as Anchors



Certain geographies in the study area have low population density—such as Cape May County. Geographies that are low density typically have fewer public buildings and facilities. This means that the cluster-outlier analysis may not identify any clusters or outliers in those areas. This is because the spatial processes underway are sensitive to both density and the scale of the geography. Consequently, in places that have low population density, there may be few if any clusters, outliers or anchors. A different method was used in low density areas to counterbalance this.

Next, a 0.5 mile buffer was applied around the anchor. All of the buildings and facilities inside each buffer were inventoried.

Prioritization of Town Centers

Sixty two potential town centers were identified at end of Step 5. To narrow this list down, potential town centers were prioritized into 4 tiers.

Tier 1 includes groupings that are “obvious” locations for town centers. This means that they meet the strict definition of a town center.

Tier 1 facilities:

- ▶ Have a minimum of two facilities within a 0.5 mile buffer zone around it; and
- ▶ Have an anchor that has an energy consumption classification of 6; or
- ▶ Have an anchor that is a waste water treatment plant.

The results of Tier 1 are presented in-depth in this technical report. The Appendix lists all of the facilities that are in the other three tiers.

Tier 2 facilities are those that could serve as town centers but are not prioritized as highly as Tier 1. There are two reasons why groupings that could be classified as Tier 2. First, Tier 2 anchor facilities consume a lot of energy and are critical, but did not appear as significant in the output of the cluster-outlier facilities. Second a grouping could be classified as Tier 2 because the anchor is a waste water treatment plant or inpatient healthcare facility and neither the anchor nor nearby facilities are located in low-to-moderate income census tracts or have public housing units in the buffer zone. .

Tier 2 facilities are either :

- ▶ Inpatient healthcare facilities that did not appear as significant in the cluster-outlier analysis--they are neither clusters nor outliers. The inpatient health facilities may be located in, or have neighboring facilities within, the 0.5 mile buffer in low-to-moderate income census tracts. Public housing may also be within the 0.5 mile buffer of the healthcare facility;
- ▶ Waste water treatment plants that have at least two other facilities within the buffer. Neither the plant nor nearby facilities are located within low-to-moderate income census tracts.

Tier 3 groupings are anchored by emergency service facilities. They are classified as Tier 3 because there is more variability in the amount of energy that emergency services consume, and it is difficult to discern the size of the facility in the data

Tier 3 facilities are:

- ▶ Emergency Services (fire safety, ambulance dispatch, etc.) that appeared as clusters or outliers and have two or more facilities in the buffer. They may or may not be located in low-to-moderate income census tracts.

Tier 4 groupings do not have an anchor that was significant according to the output of the cluster-outlier analysis.

Tier 4 facilities are:

- ▶ Emergency Services that did not appear as significant in the cluster-outlier analysis—they are neither clusters nor outliers—but have two or more facilities in the buffer.

The prioritization is indicated by the town center's alphanumeric designation. For example, town center HU1 is in a higher tier than HU4.

Next Steps

This study is intended to identify town centers and the in the Sandy-affected region to enhance community resilience. As such, the project did not attempt a detailed site-by-site evaluation of each facility and building's electric and thermal consumption, but was based on geospatial methods and best practices for community microgrid planning methods. Additional studies should assess the:

- ▶ Potential location of suitable town centers in the other counties of New Jersey;
- ▶ State of existing underground infrastructure where pipes and wires may be placed to connect neighboring buildings and facilities;
- ▶ Daily, hourly and sub-hourly electric and thermal loads, and the simultaneity of loads;
- ▶ Energy efficiency investments that can be made first to reduce demand and to appropriately size a microgrid or CHP facility;
- ▶ Net energy savings and other revenue streams to support the financing of microgrid or CHP facility;
- ▶ Total capital costs, net of expected savings.

Appendix

Town Centers					
County	ANCHOR	FACILITIES	PUBLIC HOUSING UNITS	Facilities in LMI	TIER
Atlantic County	ABSECON EMERGENCY SERVICES	5	0	0	4
	EGG HARBOR CITY FIRE DEPARTMENT	6	0	0	4
	ELWOOD ELEMENTARY/MIDDLE SCHOOL WASTE WATER TREATMENT PLANT	3	0	0	2
	FOLSOM VOLUNTEER COMPANY	3	0	0	4
	LANDISVILLE VOLUNTEER FIRE COMPANY 1	3	60	0	4
	LINWOOD VOLUNTEER FIRE COMPANY 1	4	0	0	4
	MAYS LANDING COMPANY 1	3	0	0	4
	PLEASANTVILLE FIRE DEPARTMENT/PLEASANTVILLE EMERGENCY MEDICAL SERVICES	8	290	8	4
	SHORE MEMORIAL MEDICAL CENTER	9	0	0	2
	UNION BEACH FIRE DEPARTMENT - UNION BEACH FIRE COMPANY 1	8	0	0	4
Bergen County	ACCESS AMBULANCE	10	160	2	4
	AERO AMBULANCE SERVICE	4	0	3	4
	ALLENDALE BORO FIRE DEPARTMENT	4	0	0	4
	BERGEN COUNTY UTILITIES AUTHORITY	4	0	0	4
	BERGENFIELD VOLUNTEER AMBULANCE CORP	10	0	4	4
	BOGOTA HOOK AND LADDER COMPANY 1	9	0	0	4
	BOGOTA HOSE COMPANY 3	3	0	0	4
	CABLE VISION OF OAKLAND	4	0	0	4
	CHAPEL HILL ESTATES SEWAGE TREATMENT PLANT	3	0	0	2
	CITY OF GARFIELD FIRE DEPARTMENT COMPANY 1	5	150	4	4
	CITY OF GARFIELD FIRE DEPARTMENT COMPANY 5	9	0	0	4
	CLIFFSIDE PARKS FIRE DEPARTMENT/CLIFFSIDE PARK AMBULANCE COMPANY	12	354	4	
	CLOSTER AMBULANCE CORP	3	0	0	4
	CRESSKILL EMERGENCY MEDICAL SERVICES	7	0	0	4
	DEMAREST AMBULANCE CORPS	8	0	8	4
	DUMONT FIRE DEPARTMENT INDEPENDENT COMPANY	7	0	0	4
	EAST RUTHERFORD FIRE DEPARTMENT - GROVE STREET FIREHOUSE AND EMERGENCY SQUAD	10	143	0	4
	EMERSON VOLUNTEER FIRE DEPARTMENT	6	0	0	4
	EMERSON VOLUNTEER FIRE DEPARTMENT	6	0	0	4
	ENGLEWOOD CLIFFS FIRE DEPARTMENT	4	0	0	4
ENGLEWOOD FIRE VOLUNTEER AMBULANCE CORP	7	0	0	4	
FAIRVIEW EMERGENCY RESPONSE UNIT	19	0	6	4	
FORT LEE FIRE DEPARTMENT COMPANY 1	7	0	0	4	
FORT LEE FIRE DEPARTMENT COMPANY 2	4	0	0	4	

	FORT LEE FIRE DEPARTMENT COMPANY 3	6	0	0	4	
	FRANKLIN SQ SHOPPING CENTER WASTE WATER TREATMENT PLANT	5	0	5	2	
	GARFIELD VOLUNTEER AMBULANCE CORPS	10	271	0	4	
	GLEN ROCK BOROUGH AMBULANCE CORPS	8	0	0	4	
	HACKENSACK FIRE DEPARTMENT/HACKENSACK VOLUNTEER AMBULANCE CORPS - HEADQUARTERS	9	2	404	4	
	HACKENSACK UNIVERSITY MEDICAL CENTER	4	404	0	2	
	HAKENSACK FIRE DEPARTMENT ENGINE COMPANY 5	3	0	1	4	
	HARRINGTON PARK FIRE DEPARTMENT + HARRINGTON VOLUNTEER AMBULANCE CORP	3	0	0	4	
	HASBROUCK HEIGHS FIRE DEPARTMENT	3	0	0	4	
	HASBROUCK HEIGHTS FIRE DEPARTMENT/HASBROUCK HEIGHTS FIRST RESPONDERS	6	0	0	4	
	HAWORTH FIRE DEPARMENT / HAWORTH AMBULANCE CORPS	3	0	3	4	
	HILLSDALE VOUNTEER FIRE DEPARTMENT	4	0	0	4	
	HO-HO-KUS AMBULANCE CORPS	3	0	0	4	
	HOLY NAME HOSPITAL	4	0	0	2	
Bergen County	KESSLER INSTITUTE FOR REHABILITATION INCORPORATED - NORTH FACILITY	3	0	0	2	
	LEONIA VOLUNTEER FIRE DEPARTMENT	6	0	0	4	
	LITTLE FERRY VOLUNTEER FIRE DEPARTMENT FOOK AND LADDER COMPANY 1	4	0	0	4	
	LODI AMBULANCE AND RESCUE SQUAD	9	80	8	4	
	LODI BORO FIRE DEPARTMENT	19	180	18	4	
	LODI FIRE DEPARTMENT - FIRE COMPANY 1	11	135	8	4	
	LODI FIRE DEPARTMENT - HOSE COMPANY 2	9	8	120	4	
	LYNDHURST POLICE EMERGENCY SQUAD	8	99	5	4	
	MAYWOOD FIRE DEPARTMENT STATION 1/ MAYWOOD FIRST AID SQUAD	4	0	0	4	
	MIDLAND PARK FIRE DEPARTMENT	5	0	0	4	
	MONTVALE FIRE DEPARTMENT	4	0	0	4	
	MOONACHIE BOROUGH FIRE DEPARTMENT	5	0	0	4	
	NEW MILFORD FIRE DEPARTMENT COMPANY 2	6	0	0	4	
	NEW MILFORD VOLUNTEER AMBULANCE CORP	9	0	0	4	
	NORTH ARLINGTON FIRE DEPARTMENT	7	0	0	4	
	NORTHVALE FIRE DEPARTMENT	4	0	0	4	
	NORTHWEST BERGEN COUNTY UTILITIES AUTHORITY WASTE WATER TREATMENT PLANT	7	0	0	2	
	NORWOOD EMERGENCY MEDICAL SERVICES	4	0	4	4	
	Bergen County	OAKWOODS KNOLLS WASTE WATER TREATMENT PLANT	5	0	0	2
		OLD TAPPAN VOLUNTEER FIRE DEPARTMENT	3	0	0	4

	ORADELL VOLUNTEER FIRE DEPARTMENT	5	0	0	4
	PALISADES FIRE DEPARTMENT	3	95	0	4
	PARAMUS FIRE COMPANY 2	3	0	0	3
	PARAMUS FIRE COMPANY 3	5	0	0	4
	PARAMUS RESCUE SQUAD	9	0	0	4
	PARAMUS VOLUNTEER AMBULANCE CORPS INCOPORATED	3	0	0	3
	PENAL INSTITUTION AT 200 NORTH STREET, HACKENSACK, NJ	3	0	0	4
	RAMSEY VOLUNTEER FIRE DEPARTMENT - WESTSIDE	6	0	0	4
	RIDGEFIELD FIRE DEPARTMENT FIREHOUSE 2	5	0	3	4
	RIDGEFIELD FIRE DEPARTMENT FIREHOUSE 3	4	0	0	4
	RIDGEFIELD FIRE DEPARTMENT HOSE COMPANY 3	6	0	0	4
	RIDGEFIELD FIRE DEPARTMENT TRUCK 2	6	0	0	4
	RIDGEFIELD PARK FIRE DEPARTMENT HOSE COMPANY 2	9	0	0	4
	RIDGEWOOD FIRE DEPARTMENT - HEAD- QUARTERS	5	0	0	4
	RIVER EDGE AMBULANCE SERVICE	7	0	0	4
	RIVER VALE TOWNSHIP FIRE DEPARTMENT	4	0	0	4
Bergen County	SADDLE BROOK FIRE DEPARTMENT ENGINE COMPANY 1	6	0	0	4
	SADDLE RIVER FIRE DEPARTMENT	4	0	0	4
	SELECT SPECIALITY HOSPITAL - NORTH- EASTERN NEW JERSEY	8	0	0	2
	SOUTH HACKENSACK AMBULANCE CORPS	6	0	0	4
	TEANECK AMBULANCE CORPS	7	0	0	4
	TEANECK FIRE DEPARTMENT	3	0	0	4
	TEANECK FIRE DEPARTMENT COMPANY 4	3	0	0	4
	TENAFLY VOLUNTEER AMBULANCE CORP	4	0	0	4
	TOWNSHIP OF WASHINGTON VOLUNTEER AMBULANCE CORP	4	0	0	4
	TRI-BOROUGH AMBULANCE CORPS	9	0	0	4
	WESTWOOD VOLUNTEER AMBULANCE CORPS	5	0	0	4
	WOOD-RIDGE FIRE DEPARTMENT EMER- GENCY SQUAD	8	0	0	4
	WYCKOFF VOLUNTEER FIRE DEPARTMENT - FIRE PROTECTION COMPANY 1	3	0	0	4
	AVALON RESCUE SQUAD	5	0	0	4
	CAPE MAY FIRE DEPARTMENT	4	55	0	4
	FAIR LAWN FIRE DEPARTMENT COMPANY 1	3	0	1	4
	MAHWAH FIRE DEPARTMENT FIRE COM- PANY 1	3	0	0	4
	LOWER TOWNSHIP MUNICIPAL UTILITIES AUTHORITY	3	0	0	4

Cape May County	LOWER TOWNSHIP RESCUE SQUAD	3	0	0	4
	MIDDLE TOWNSHIP AMBULANCE CORPS	6	0	0	4
	NORTH WILDWOOD FIRE DEPARTMENT	6	0	0	4
	NORTH WILDWOOD VOLUNTEER FIRE COMPANY	3	0	0	4
	OCEAN CITY FIRE RESCUE SERVICES DEPARTMENT - HEADQUARTERS	7	61	0	4
	SEA ISLE AMBULANCE CORPS	7	0	0	4
	SOUTH EGG HARBOR VOLUNTEER FIRE COMPANY 26-5	3	0	0	4
	STONE HARBOR RESCUE SQUAD	6	0	0	4
	UPPER TOWNSHIP RESCUE SQUAD	4	0	0	4
	WILDWOOD CREST VOLUNTEER FIRE COMPANY 1	4	0	4	4
	WILDWOOD FIRE DEPARTMENT STATION 3 - 2 WILDWOOD VOLUNTEER FIRE COMPANY	3	170	0	4
	WILDWOOD FIRE DEPARTMENT STATION 3 - HEADQUARTERS	4	0	3	4
Essex County	CITY OF EAST ORANGE FIRE DEPARTMENT	4	368	0	4
	CLARA MAAS MEDICAL CENTER	3	927	0	2
	EAST ORANGE FIRE DEPARTMENT	4	114	3	3
	IRONBOUND AMBULANCE SQUAD	13	0	12	3
	IRVINGTON FIRE DEPARTMENT STATION 2	3	664	2	3
	IRVINGTON FIRE DEPARTMENT STATION 4	4	71	1	3
	KESSLER INSTITUTE FOR REHABILITATION INCORPORATED - EAST ORANGE FACILITY	5	0	1	2
	NEWARK FIRE DEPARTMENT 27	10	0	10	3
	NEWARK FIRE DEPARTMENT ENGINE 11	20	273	11	3
	NEWARK FIRE DEPARTMENT ENGINE 12	15	1157	4	3
	NEWARK FIRE DEPARTMENT ENGINE 13	6	0	6	3
	NEWARK FIRE DEPARTMENT ENGINE 15	7	70	5	3
	NEWARK FIRE DEPARTMENT ENGINE 16	6	677	3	3
	NEWARK FIRE DEPARTMENT ENGINE 17	9	45	5	3
	NEWARK FIRE DEPARTMENT ENGINE 18	12	47	4	3
	NEWARK FIRE DEPARTMENT ENGINE 26	14	0	7	3
	NEWARK FIRE DEPARTMENT ENGINE 6	25	637	9	3
NEWARK FIRE DEPARTMENT ENGINE 9	16	211	16	3	
NUTLEY VOLUNTEER EMERGENCY AND RESCUE SQUAD	3	0	0	3	
Hudson County	CITY OF BAYONNE FIRE DEPARTMENT STATION 4	6	350	0	4
	CITY OF BAYONNE FIRE DEPARTMENT ENGINE STATION 2	6	471	0	4
	CITY OF BAYONNE FIRE DEPARTMENT STATION 6	6	285	0	4
	JERSEY CITY FIRE DEPARTMENT ENGINE 14 LADDER 7	5	809	2	3
	JERSEY CITY FIRE DEPARTMENT ENGINE 6 LADDER 2	5	48	5	4

Hudson County	JERSEY CITY FIRE DEPARTMENT ENGINE 7 LADDER 3	6	0	3	4
	JERSEY CITY FIRE DEPARTMENT ENGINE 9	9	373	3	4
	JERSEY CITY FIRE DEPARTMENT FIRE DEPARTMENT ENGINE 11	5	0	4	4
	JERSEY FIRE DEPARTMENT ENGINE 15 LADDER 9	11	218	6	3
	MCCABE AMBULANCE SERVICE	6	166	0	4
	MEADOWVIEW PSYCHIATRIC HOSPITAL	3	175	0	2
	NORTH HUDSON EMERGENCY MEDICAL SERVICES	4	1303	1	4
	NORTH HUDSON REGIONAL FIRE AND RES- CUE DEPUTY 1/ ENGINE 4 / LADDER 2	24	458	21	4
	NORTH HUDSON REGIONAL FIRE AND RESCUE ENGINE 1	10	96	2	4
	NORTH HUDSON REGIONAL FIRE AND RESCUE ENGINE 11	24	1541	8	4
	NORTH HUDSON REGIONAL FIRE AND RESCUE ENGINE 5	26	389	22	4
	NORTH HUDSON REGIONAL FIRE AND RESCUE LADDER 5	4	0	0	4
	SEACAUCUS FIRE DEPARTMENT HOSE COMPANY 2	4	100	0	4
	Middlesex County	ALERT AMBULANCE SERVICE - METUCHEN	4	0	4
AVENEL FIRE DISTRICT 5		3	0	0	4
BRISTOL-MYERS SQUIBB EMERGENCY SERVICES		3	0	3	4
CARTERET FIRE DEPARTMENT		18	0	2	4
CARTERET FIRE DEPARTMENT - HOUSE 3		3	0	0	4
COLONIA DISTRICT 12 FIRST AID SQUAD		3	70	0	4
DUNELLEN FIRE DEPARTMENT		9	0	9	4
EAST BRUNSWICK FIRE DISTRICT 1 - OLD BRIDGE VOLUNTEER FIRE COMPANY HOUSE 1		4	0	0	4
EAST BRUNSWICK INDEPENDENT FIRE COM- PANY FIRE DISTRICT 2 - DUNHAMS CORNER STATION 830		3	0	3	4
EAST BRUNSWICK RESCUE SQUAD		5	0	0	4
EDISON FIRST AID SQUAD 1		7	0	0	4
EDISON FIRST AID SQUAD 2		4	0	0	4
FRIENDLY MEDICAL CARE TRANSPORTATION		5	0	3	3
GALLANT MOBILE TRANSPORTATION		3	202	0	4
HIGHLAND PARK FIRST AID SQUAD		6	124	0	3
INTERSTATE MEDICAL TRANSPORT		6	0	0	4
ISELIN FIRE DISTRICT 9 HOUSE 1		9	75	0	4
JOHN FITZGERALD KENNEDY MEDICAL CENTER		3	0	0	2
LAURENCE HARBOR FIRE DEPARTMENT		5	0	0	4
MADISON PARK VOLUNTEER FIRST AID SQUAD		3	0	0	4
METUCHEN VOLUNTEER FIRE DEPARTMENT	6	0	1	4	

Monmouth County	MIDDLESEX BORO RESCUE SQUAD	6	0	2	4
	MILLTOWN RESCUE SQUAD	4	0	0	4
	MONMOUTH JUNCTION VOLUNTEER FIRE DEPARTMENT STATION 20	4	0	0	4
	NEW MARKET VOLUNTEER FIRE COMPANY STATION 1	4	0	0	4
	NORTH BRUNSWICK FIRST AID RESCUE SQUAD	3	0	0	4
	OLD BRIDGE FIST AID AND RESCUE	5	0	0	4
	OLD BRIDGE TOWNSHIP EMERGENCY MEDICAL SERVICES	3	0	2	4
	OLD BRIDGE VOLUNTEER FIRE COMPANY ENGINE 2	7	0	0	4
	PERTH AMBOY FIRE DEPARTMENT STATION 2	3	420	3	4
	PERTH AMBOY PUBLIC ASSISTANCE CENTER	9	0	0	4
	PLAINSBORO RESCUE SQUAD INCORPORATED	4	0	0	4
	PUBLIC ASSISTANCE CENTER, PERTH AMBOY	11	0	0	4
	PUBLIC SAFETY BUILDING	11	175	9	4
	RARITAN BAY MEDICAL CENTER - PERTH AMBOY DIVISION	9	100	7	2
	SAINT JOHNS FIRST AID SQUAD	4	75	0	4
	SAINT PETER'S UNIVERSITY HOSPITAL	13	0	13	2
	SAYERVILLE FIRE DEPARTMENT HOSE COMPANY 1	3	0	2	4
	SOUTH AMBOY FIRE DEPARTMENT SNORKEL FIRE COMPANY	5	72	0	4
	SOUTH AMBOY FIRE DEPARTMENT - PROTECTION FIRE COMPANY	4	0	2	4
	SOUTH OLD BRIDGE VOLUNTEER FIRE COMPANY ENGINE 2	7	0	0	4
	SOUTH PLAINFIELD RESCUE SQUAD	5	0	0	4
	SOUTH RIVER RESCUE SQUAD	6	0	6	4
	SPOTSWOOD MEDICAL SERVICES	3	0	0	4
	SUNNY TRANSPORTATION SERVICE	3	0	0	4
	WOODBIDGE DEVELOPMENTAL CENTER	4	0	2	2
	WOODBIDGE FIRE DEPARTMENT STATION 1	5	345	0	4
	ABERDEEN TOWNSHIP HOSE AND CHEMICAL COMPANY STATION 1	7	0	0	4
	ALLENHURST FIRE DEPARTMENT AND FIRST AID SQUAD	3	0	1	4
	ALLENTOWN FIRST AID SQUAD	4	0	0	4
	ATLANTIC HIGHLANDS FIRE DEPARTMENT AND FIRST AID SQUAD	4	0	0	4
	AVON BY THE SEA FIRST AID AND SAFETY SQUAD	5	0	0	4
	BAYSHORE REGIONAL SEWERAGE TREATMENT PLANT	4	0	0	2
BELMAR FIRST AID SQUAD	14	50	4	4	

	BRADLEY BEACH VOLUNTEER FIRE DEPARTMENT	9	0	0	4
	BRANDYWINE ASSISTED LIVING AT COLTS NECK	6	0	0	4
	BRIELLE FIRE COMPANY 1	3	0	0	4
	CLIFWOOD VOLUNTEER FIRE COMPANY	4	0	0	4
	EATONTOWN FIRE DEPARTMENT	5	0	0	4
	ELBERON FIRST AID AND EMERGENCY SQUAD INCORPORATED	5	0	0	5
	ENGLISHTOWN BORO FIRE DISTRICT 1	3	0	0	4
	ENGLISHTOWN MANALAPAN FIRST AID SQUAD	4	0	0	4
	FAIR HAVEN FIRST AID SQUAD	7	0	0	4
	FARMINGDALE - HOWELL FIRST AID SQUAD	4	0	0	4
	FREEHOLD FIRST AID EMERGENCY SQUAD	9	85	2	4
	HAZLET FIRE COMPANY STATION 39-1	4	0	0	4
	HIGHLANDS FIRE DEPARTMENT	7	115	0	4
	HIGHLANDS FIRST AID SQUAD	6	115	6	4
	HOLMDEL BOARD OF EDUCATION VILLAGE SCHOOL SEWAGE TREATMENT PLANT	3	0	0	2
	HOLMDEL FIRE COMPANY STATION 2	3	0	0	4
	HOWELL TOWNSHIP FIRE DISTRICT 3 SOUTHARD FIRE DEPARTMENT	3	0	0	4
	KEANSBURG FIRE COMPANY 1	7	80	7	4
Monmouth County	KEYPORT FIRE DEPARTMENT STATION 22 - 7 RARTITAN HOSE COMPANY	8	0	3	4
	LEONARDO FIRST AID AND RESCU SQUAD INCORPORATED	7	0	0	4
	LITTLESILVER RESCUE SQUAD	3	0	0	4
	LONG BRANCH FIRE DEPARTMENT STATION 25 - 290 NEPTUNE HOSE COMPANY	8	0	0	4
	LONG BRANCH FIRE DEPARTMENT STATION 25 - 975 WEST END ENGINE COMPANY	12	0	0	4
	LONG BRANCH FIRE DEPARTMENT STATION 25-OLIVER BYRON ENGINE COMPANY	5	0	0	4
	MANASQUAN FIRE DISTRICT 1 MANASQUAN HOOK AND LADDER 1	10	0	0	4
	MARLBORO PSYCHIATRIC HOSPITAL / MARLBORO PSYCHIATRIC HOSPITAL WASTE WATER TREATMENT PLANT	3	0	0	2
	MATAWAN FIRE DEPARTMENT HOOK AND LADDER COMPANY	7	0	0	4
	MIDDLETOWN FIRST AID SQUAD	4	0	1	4
	MIDDLETOWN TOWNSHIP FIRE DEPARTMENT STATION 1 - NAVESINK HOOK AND LADDER COMPANY 1	3	0	0	4
	MIDDLETOWN TOWNSHIP FIRE DEPARTMENT STATION 10 - LINCROFT FIRE COMPANY	5	0	0	4
	MIDDLETOWN TOWNSHIP FIRE DEPARTMENT STATION 11 - OLD VILLAGE FIRE COMPANY	3	0	0	4
	MONMOUTH BEACH FIRE DEPARTMENT	5	0	0	4

	MORGANVILLE VOLUNTEER FIRE DEPARTMENT	3	0	0	4	
	NEPTUNE TOWNSHIP FIRE DEPARTMENT STATION 34 - 4 UNEXCELLED FIRE COMPANY	12	165	11	4	
	NORTH CENTERVILLE VOLUNTEER FIRE COMPANY 1	4	0	0	4	
	OAKHURST RESCUE SQUAD	4	0	0	4	
	OCEAN GROVE FIRE DEPARTMENT	3	0	0	4	
	OCEANPORT FIRST AID AND RESCUE SQUAD	5	0	0	4	
	PORT MONMOUTH FIRST AID	6	0	0	4	
	RED BANK VOLUNTEER FIRE DEPARTMENT STATION 5 - UNION HOSE COMPANY	9	0	5	4	
	ROOSEVELT FIRST AID SQUAD	10	0	0	4	
	ROOSEVELT BORO WATER TREATMENT PLANT	5	0	0	2	
	RUMSON VOLUNTEER FIRE DEPARTMENT - RUMSON FIRE COMPANY	7	0	0	4	
	SEA GRIT FIRE COMPANY 1 STATION 44 - 1	3	0	0	4	
	SHARK RIVER HILL FIRST AID SQUAD	4	0	0	4	
Monmouth County	SHREWSBURY HOSE COMPANY 1	3	0	0	4	
	SOUTH ABERDEEN EMERGENCY MEDICAL SERVICES	6	0	0	4	
	SPECIALITY HOSPITAL AT MONMOUTH/ MONMOUTH MEDICAL CENTER	14	0	0	2	
	SPRING LAKE BOROUGH FIRE DEPARTMENT STATION 2	7	0	3	4	
	TINTON FALLS EMERGENCY MEDICAL SERVICES	6	0	0	4	
	TOWNSHIP OF OCEAN SEWERAGE AUTHORITY	4	0	0	4	
	UNION BEACH FIRE DEPARTMENT - UNION BEACH FIRE COMPANY 1	4	0	0	4	
	WALL FIRE COMPANY - SATELLITE STATION	7	0	2	4	
	WALL FIRE COMPANY 1 - HEADQUARTERS	3	0	0	4	
	WALL TOWNSHIP FIRST AID AND RESCUE SQUAD	3	0	0	4	
	WALL TOWNSHIP MEDICAL SERVICES - WALL POLICE HEADQUARTER STATION	3	0	0	4	
	WEST LONG BRANCH FIRST AID SQUAD	11	0	0	4	
		BARNEGAT FIRST AID SQUAD	5	0	0	4
		BAY HEAD FIRE COMPANY	5	0	0	4
		BAYVILLE FIRST AID SQUAD	4	0	0	4
		BEACH HAVEN FIRST AID SQUAD	8	0	0	4
Ocean County	BRICK TOWNSHIP POLICE EMERGENCY MEDICAL SERVICES	4	0	4	4	
	ISLAND HEIGHTS FIRST AID SQUAD	6	0	0	4	
	JACKSON ACRES WASTE WATER TREATMENT PLANT	3	0	0	2	
	JACKSON TOWNSHIP FIRST AID SQUAD	3	0	0	4	
	LACEY TOWNSHIP EMERGENCY MEDICAL SERVICES	5	0	0	4	

Ocean County	LAKESIDE TOWNSHIP FIRE DEPARTMENT 64	8	206	8	4
	LAKESIDE TOWNSHIP FIRE DEPARTMENT 66	3	0	0	4
	LANOKA HARBOR MEDICAL SERVICES INCORPORATED	3	0	0	4
	LAVALLETTE FIRST AID SQUAD	4	0	0	4
	MANCHESTER FIRST AID SQUAD	3	0	3	4
	MYSTIC ISLAND FIRE DISTRICT 2	3	0	0	4
	NEW EGYPT MIDDLE SCHOOL TOWNSHIP WASTE WATER TREATMENT PLANT	3	0	3	2
	NORTHEAST METRO AMBULANCE	6	0	0	4
	OCEAN GATE FIRST AID SQUAD	4	0	0	4
	OCEAN MEDICAL CENTER	3	0	0	4
	PLUMSTED TOWNSHIP FIRE DISTRICT 1	3	0	0	4
	POINT BOROUGH FIRST AID SQUAD	7	0	0	4
	POINT PLEASANT BEACH FIRE COMPANY 2 STATION 43	12	0	0	4
	POINT PLEASANT FIRE COMPANY 1	6	0	0	4
	SHIP BOTTOM VOLUNTEER FIRE COMPANY 1 STATION 46	4	0	0	4
	SILVERTON EMERGENCY MEDICAL SERVICES	3	0	0	4
	SOUTH TOMS RIVER FIRST AID SQUAD	3	0	3	4
	STAFFORD TOWNSHIP VOLUNTEER FIRE COMPANY 1	5	0	0	4
	TOMS RIVER FIRST AID SQUAD	11	0	0	4
	TUCKERTON FIRE COMPANY 1 INCORPORATED	3	0	0	4
	WATERTOWN VOLUNTEER FIRE COMPANY 1	7	0	0	4
	WEST TUCKERTON VOLUNTEER FIRE COMPANY STATION 71	7	0	0	4
	WHITTING VOLUNTEER FIRE COMPANY 1	3	0	1	4
	BERKELEY HEIGHTS FIRE DEPARTMENT	7	0	0	4
	CHILDREN'S SPECIALIZED HOSPITAL	6	0	0	2
	CLARK VOLUNTEER EMERGENCY SQUAD	3	0	0	4
CLARK VOLUNTEER FIRE DEPARTMENT STATION 1	3	0	0	4	
CRANFORD FIRST AID SQUAD	5	0	0	4	
ELIZABETH FIRE DEPARTMENT	6	225	3	4	
ELIZABETH FIRE DEPARTMENT	7	0	0	4	
ELIZABETH FIRE DEPARTMENT STATION 2	9	0	6	3	
ELIZABETH FIRE DEPARTMENT STATION 3	5	71	3	3	
ELIZABETH FIRE DEPARTMENT STATION 3	5	2	71	3	
ELIZABETH FIRE DEPARTMENT STATION 5	8	102	8	3	
ELIZABETH FIRE DEPARTMENT STATION 6	7	0	5	3	
ELIZABETH FIRE DEPARTMENT STATION 8	8	0	3	3	
EMTAC AMBULANCE - UNION	4	0	0	4	
FANWOOD RESCUE SQUAD	3	0	0	4	
GARWOOD FIRE DEPARTMENT	4	0	0	4	

Union County	HILLSIDE FIRE DEPARTMENT	5	0	2	4
	KENILWORTH FIRE DEPARTMENT	4	0	0	4
	LINDEN FIRE DEPARTMENT STATION 1	5	0	2	4
	LINDEN FIRE DEPARTMENT STATION 2	6	0	1	4
	NATIONWIDE AMBULANCE SERVICE INCORPORATED	4	0	0	4
	NEW PROVIDENCE FIRE DEPARTMENT	3	0	0	4
	NEW PROVIDENCE WASTE WATER TREATMENT PLANT	4	0	0	2
	PLAINFIELD FIRE DEPARTMENT STATION 4	3	0	2	4
	PLAINFIELD FIRE DIVISION	10	248	0	4
	PLAINFIELD RESCUE SQUAD	8	223	0	4
	RAHWAY FIRE DEPARTMENT	6	0	0	4
	ROSELLE FIRE DEPARTMENT	4	0	0	4
	ROSELLE PARK FIRE DEPARTMENT ENGINE 1	8	0	0	3
	ROSELLE PARK FIRST AID SQUAD	5	0	0	4
	SCHERING-PLOUGH EMERGENCY RESCUE SQUAD	3	0	1	4
	SCOTCH PLAINS FIRE DEPARTMENT STATION 2	3	0	0	4
	SCOTCH PLAINS RESCUE SQUAD	3	0	0	4
	SPRINGFIELD FIRE DEPARTMENT	8	0	0	4
	TOWNSHIP OF UNION FIRE DEPARTMENT / EMERGENCY MEDICAL UNIT STATION 1	3	0	0	4
	UNION COUNTY FIRE SCIENCE TRAINING ACADEMY	10	0	0	4
	UNION FIRE DEPARTMENT STATION 3	3	0	0	4
	WESTFIELD FIRE DEPARTMENT STATION 1	7	0	0	4
	SUMMIT OAKS HOSPITAL	5	165	0	2
	WINFIELD FIRE ASSOCIATION	4	0	0	4