

City of Syracuse Supplemental Pavement Rating

2019-2020 Unified Planning Work Program



Syracuse Metropolitan Transportation Council

City of Syracuse

Supplemental Pavement Rating

Documentation

A Chapter of the Upcoming Bridge and Pavement Condition Management System Report

December 2019

2019-2020 Unified Planning Work Program

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Introduction

Each program year, the Syracuse Metropolitan Transportation Council publishes a Bridge and Pavement Condition Management System (BPCMS) report to serve as a comprehensive clearinghouse for condition information on selected bridges and pavements throughout the Metropolitan Planning Area (MPA). Throughout its history, the BPCMS has contained different types of information varying in scope, depending on the needs of member agencies, federal regulations, and data collection methods. Most recently, the Pavement section of the report has included condition information on all federal-aid eligible roads in the MPA.

This year, in addition to compiling data on federal-aid eligible roads, the SMTC undertook a new effort – providing ratings on the entirety of the City of Syracuse’s road system. In keeping with past data collection efforts by the City, roads were rated on a block-by-block basis. The City indicated that having consistent pavement ratings will allow the Department of Public Works and other City entities to make data-driven decisions for street repair, reconstruction, and preventative maintenance.

Rating Scale

The SMTC rates pavement using the NYSDOT’s *Surface Score* rating scale, which is a windshield survey providing ratings ranging from 1 (impassible) to 10 (new pavement). The ratings on this scale are given based on the frequency and severity of surface cracking. The survey is completed at posted speed limits while within the vehicle, no additional testing is conducted as a part of the Surface Score Analysis. The *Surface Score* process also includes a provision for a roadway’s *dominant distress*, but that information is not recorded as a part of the SMTC’s data collection effort for the City.

The *Surface Score* categorizes ratings based on the 1-10 values. Roads with a score of 9 or 10 are considered Excellent, 7-8 are considered Good, 6 is considered Fair, and 1-5 are considered Poor. SMTC

staff have attended several trainings with NYSDOT staff to rate pavement using this scale. In addition to the 1-10 values, the SMTC applies a value of “0,” or Unrated, to a very small percentage of roads. In most instances, Unrated roads are either under construction at the time of rating, or consist of materials not suited for pavement rating, such as brick or concrete bridge deck.

Rating	Condition Description
9-10 Excellent	No or slight pavement distress.
7-8 Good	Minor to moderate distress occurring infrequently to occasionally.
6 Fair	Moderate to severe distress occurring occasionally to frequently.
1-5 Poor	Severe or very severe distress occurring frequently. Travel may be impaired.

Figure 1 – An overview of the Surface Score. Source: NYSDOT Pavement Rating Manual.

In the past, City staff collected pavement ratings on a partial basis, approximately 25% per year. Research by SMTC staff suggests that a 1-10 scale loosely based on the *Surface Score* was the basis of this rating operation. However, a review of past and more recent data collected by the SMTC on federal-aid eligible roads indicated inconsistencies between the two scales. Although the NYSDOT scale has values of 1 through 10, in practice, ratings of 4-10 are used most often with 3 only reserved for severe deterioration. A score of 1 would indicate an impassible road, and a rating of 2 is applied to a road which cannot be passed at posted speed without damage to the vehicle. When reviewing older datasets, SMTC staff discovered ratings of 1 and 2, and extensive use of 3 in the City’s data,

which suggests that although the City's rating scale may have originated with the *Surface Score*, the two scales drifted apart over time.

Rating Process

In prior years, SMTC staff collected ratings using a paper-based system. Routes were specifically designed to traverse federal-aid eligible roads in a certain order, and their surface score recorded. Ratings were then transferred to a Microsoft Access database, which in turn could be joined to a geographic information system (GIS) using a unique identifier for each segment. This method worked well for the approximately 120 centerline miles that the SMTC was rating prior to this year. However, with initial estimates of over 400 for total City-owned mileage, a new electronic system was introduced for the data collection process.

SMTC staff consulted with other metropolitan planning organizations (MPOs) across New York State for information. Staff at several other MPOs conduct pavement rating surveys for their member agencies using a variety of different techniques. Mobile data collection techniques have advanced significantly in recent years, pioneered by ESRI, the leading producer of GIS software. Whereas some MPOs were collecting data in the field using a laptop computer installed with desktop GIS software, a similar process is now possible using smaller electronic devices, such as tablets or smartphones. Improved GPS receivers allow for Bluetooth communication with these devices, improving positional accuracy of data. Other MPOs also indicated that staff compiled photologs of pavement conditions as a part of their survey using GPS-enabled cameras.

To facilitate the data collection effort, the SMTC purchased two iPads, two Bad Elf Pro GPS units, and two GoPro Hero 7 Black cameras, as well as various accessories. Two of each were purchased to allow two teams to collect data simultaneously. The purpose of each of these pieces of equipment are described below.

- An *Apple iPad* was used as the main instrument of data collection. The iPad was installed with ESRI's Collector application, which allowed for mobile data collection in the field. Collector allows a user to use the application in an offline mode, so mobile cellular data was not needed for the SMTC's operation. A base map of the City of Syracuse was loaded into the application, as well as the most recent ratings available on the federal-aid system. The application allowed for a point to be placed in order to indicate a rating; staff placed a new point on every block to facilitate block-by-block data collection. Previously-placed points were visible so that progress could be monitored.
- The *Bad Elf GPS Pro+* was connected via Bluetooth to the iPad in order to obtain better positional accuracy. SMTC staff needed confidence that points representing a rating were placed on the proper block segment. In practice, the Bad Elf unit provided an approximate locational accuracy of 10-15 feet, which allowed for greater confidence in the placement of the ratings on the map.
- The *GoPro Hero 7 Black* camera is equipped with GPS capabilities. The camera was affixed to the hood of the surveying vehicle and was programmed to capture a photo every ten seconds. The location of these photos were later mapped using GIS software.



Figure 2 – Data collection tools used by the SMTC. From left: GoPro Hero 7 Black, Apple iPad with ESRI Collector, Bad Elf GPS Pro+.

From Rating to Maps and Spreadsheets

The BPCMS not only stores pavement rating data, but also provides an analysis of the information collected. GIS software allows for the mapping and analysis of datasets with a spatial component, such as the pavement ratings. Over the course of the data collection process, no additional information was gathered besides a location and a rating. In order for meaningful conclusions to arise from the data, ancillary information about the road on which a rating was collected is needed.

The SMTC has access to numerous sources of road information. Nearly all these sources maintain data in a line format, as roads in a GIS are traditionally visualized as centerline. In order to successfully merge the point data collected from the rating process with the existing conditions in the line data, a GIS process called a *spatial join* was performed. In a spatial join, attributes from one geographic feature are joined to another geographic feature through a spatial relationship. In this situation, when a rating point intersects a road segment line, identifying information from the point (the rating) will be added to the data already attributed to the line. Since rating data points were collected with varying degrees of locational accuracy throughout the City and did not always fall directly on the road centerline, a join tolerance was established to ensure that each point successfully connected with the appropriate line segment. A series of trials were performed to find the optimal join tolerance for this process, which yielded a result of 15 meters. Therefore, any point within approximately 45 feet of any given GIS centerline was joined to that centerline. Only one rating can be attributed to a given road segment. If, during the process of the spatial join, one of the road centerline segments contained more than one rating point of different values, SMTC staff chose the most applicable rating for that segment. This process also resulted in the splitting of some segments or the creation of new segments.



Figure 3 - A visualization of the spatial join technique. Data associated with the orange points would transfer to the gray road network due to their spatial relationship. Data associated with the green points would fail to associate, and data from the purple points would cause a data conflict. Source: SMTC.

Ultimately, the SMTC utilized its own road network file to provide additional information on road segments. The SMTC's file contains several fields which will be beneficial to analysis, and since it is maintained locally and reviewed regularly, has a greater degree of accuracy than some statewide files.

Although the SMTC has confidence in its road network file, it is not authoritative or the system of record for road ownership and is intended for planning purposes only. As such, road ownership and maintenance stems from multiple different sources, and is not completely verified. The SMTC's file contains road centerline data for more than just public highways, such as private roads that were not intended for pavement rating. Without an authoritative, central repository of data on road ownership and maintenance, additional sources and professional judgement were used to determine roads which are City-owned and/or maintained, and thus fit for inclusion in the pavement survey.

In addition to providing geographic analyses for pavement ratings, there are advantages to maintaining data in non-spatial formats for those without GIS software. Instead of noting location

through a map, non-spatial formats require descriptions of segment start and endpoints. The SMTC’s road file, as a primarily spatial file, does not inherently have this capability.

Research on older files yielded spreadsheets from 2014 which contained both an identifier field and road segment information such as road name and segment termini. This identifier field is also present in the SMTC’s file, which allows for the relay of information from one file to another. However, road names and segment start and endpoints did not always match the spatial data – in these instances, the spatial data is considered the more reliable of the two.

Results

Figures 4 and 5 below illustrate pavement ratings by category and mileage for the City of Syracuse. Mileage totals are given as linear centerline miles, not lane miles – a single rating is applied to a mile of pavement, regardless of the number of lanes or pavement width. Mileage totals are not engineering- or survey-grade, and should be considered for planning purposes only. The SMTC is constantly updating the roads database to better and more accurately depict conditions on the ground, and therefore, small deviations in road measurements from year-to-year are to be expected.

Category	Miles	Percent
Excellent	47.079	11.99%
Good	152.120	38.73%
Fair	101.049	25.73%
Poor	89.394	22.76%
Unrated	3.145	0.80%
Total Miles	392.787	100%
Weighted Average Rating		6.6 (Fair)

Figure 4 – Pavement ratings by centerline miles in the City of Syracuse.

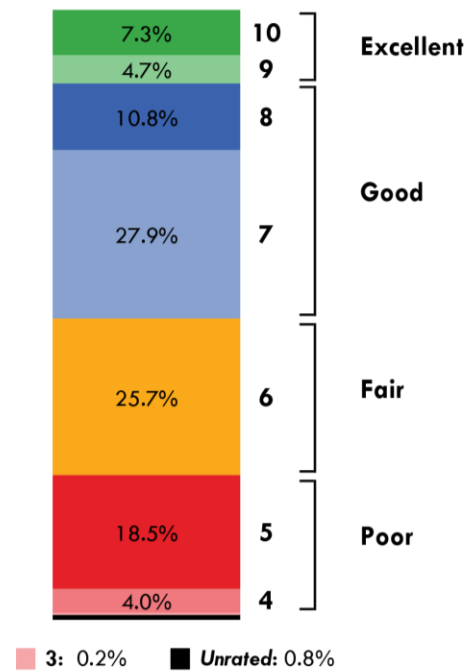


Figure 5 – Percentages by individual score.

Federal-aid eligibility on roadways is based on functional classification. There are ten functional classification codes used to describe the road network. Functional classification is the process by which streets and highways are grouped into classes or systems according to the character of service they are intended to provide. Arterials generally have higher design standards than other roads, often with multiple lanes and some degree of access control. Collectors provide a lower degree of mobility than arterials and are designed for travel at lower speeds and for shorter distances. Collectors are typically two-lane roads that collect and distribute traffic from the arterial system. Roads which do not fall into one of these categories are classified as Local. Local, when used in this sense, has no bearing on the ownership of the road – only its functional classification.

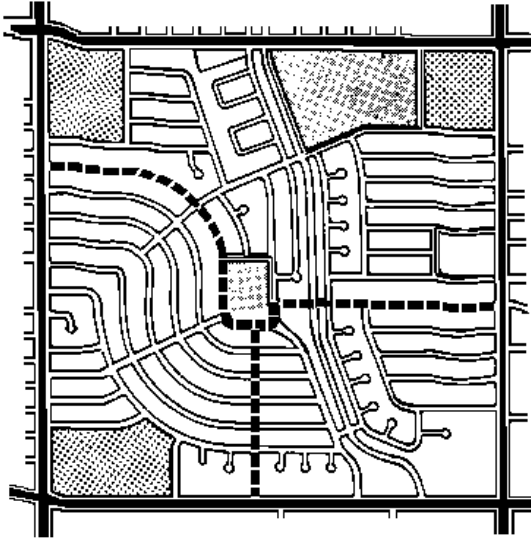


Figure 6 - An illustration of the relationship between functional classifications. The thick lines represent arterials, the dotted lines are collectors, and the hollow lines are locals. Source: FHWA.

Additionally, roads are classified as urban or rural, largely based on urban area boundaries from the US Census. All roads in the City of Syracuse have an urban classification. All urban roads with a functional classification other than Local are considered federal-aid eligible. Figure 7 illustrates rating category by functional classification in the City of Syracuse, and Figure 8 shows rating categories on the federal-aid eligible system. Note that the federal-aid system is only approximately one third of the City's entire network.

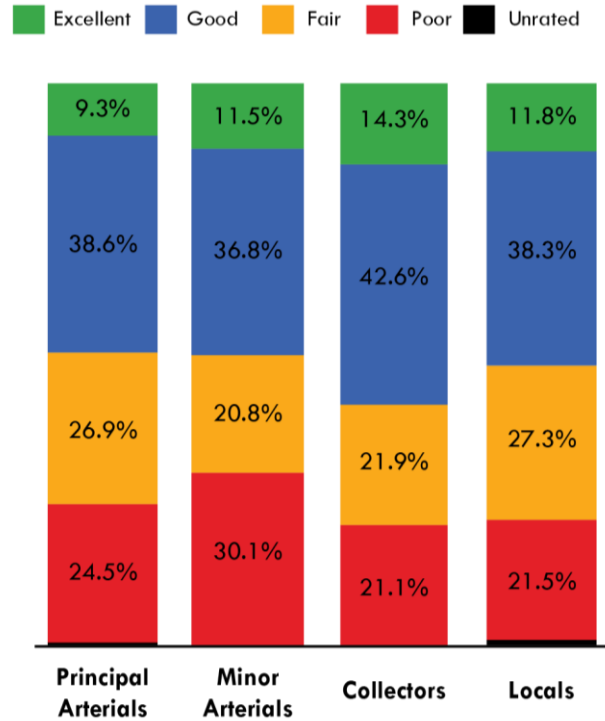


Figure 7 - Percent of pavement centerline miles in each rating category by functional classification.

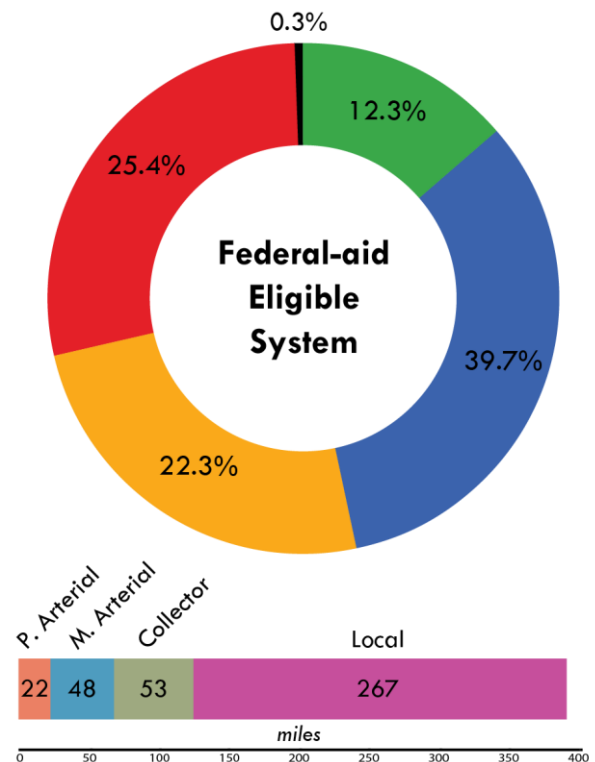


Figure 8 - Percent of pavement centerline miles in each rating category on the federal-aid system, and number of miles on the road network in each functional class.

As a reference, Map 1 at the end of this document shows pavement ratings for the City. Additional maps can be provided upon request.

In addition to this document, the SMTC is publishing the pavement ratings collected onto a web-based application using the ESRI ArcGIS Online platform. City officials and members of the public will be able to visit the web application and select any road segment, and find the rating, additional information, and a picture of the pavement on that segment at the time of data collection. It is anticipated that this web tool will launch in early 2020.



Figure 9 – An example of the type of photo collected as a part of the rating process.

National Transportation Performance Measures and Other Data Collection Methods

While the SMTC and NYSDOT have used the *Surface Score* method of pavement rating in the past, there are other, more intensive data collection methods that are also in use. The Federal Highway Administration published a final rule establishing performance measures for State Departments of Transportation to manage pavement performance on the National Highway System. These performance measures are defined using the terms *Good*, *Fair*, and *Poor*, but these terms are not analogous to the Good, Fair, and Poor used in the *Surface Score* scale. As this data becomes available,

the SMTC intends to report it, and care should be taken to not confuse the two different scales utilized in these different data collection methods.

Recommendations

The purpose of this data collection effort undertaken by the SMTC was to assist the Department of Public Works and other City agencies with making data-driven decisions for street repair, reconstruction, and preventative maintenance. Having a complete dataset from 2019 also allowed a baseline to be established for future years to help monitor pavement conditions and deterioration. However, these efforts and associated analyses could be supplemented with the availability of additional information and resources. Thus, the following suggestions are given to initiate dialogue.

AN AUTHORITATIVE SYSTEM OF RECORD FOR ROADWAYS IN THE CITY.

Some of the issues which prevent a more accurate and fuller analysis stem from the lack of an authoritative system of record with roadway information and attributes. A description of each road owned by the city, separated into segments, with attributes such as pavement width, shoulder width, pavement type, number of lanes, type of striping, snow storage width, presence of curbing, and presence of median could provide for more in-depth analysis of pavement conditions. As additional ratings are collected in future years, relationships between pavement type and condition, pavement width and paving cost, and the effect of curbing could all be examined with this type of data.

INVESTIGATION OF DIFFERENT PAVING TECHNIQUES AND PRACTICES, AND DEVELOPMENT OF AN ASSET MANAGEMENT SYSTEM.

An effort to collect information from other municipalities or infrastructure think tanks on pavement repair and conditions could, along with the ratings collected, create an effective asset management system. Building a model which

investigates different paving techniques and practices and their effects on total cost could help indicate better choices and provide options for doing more with less. The Cornell Local Roads Program is an excellent resource which should, at a minimum, be consulted.

LOCATION-BASED IDENTIFICATION OF ROADWAYS.

Currently, information received from the City cannot easily be displayed in geographic form. Listings of completed and planned work, when paired with both ratings and geographic locations on a map can quickly and efficiently illustrate successes and shortcomings to constituents and officials. A permanent unique identifier for each roadway segment or a comprehensive linear

referencing system would unlock the potential in existing data.

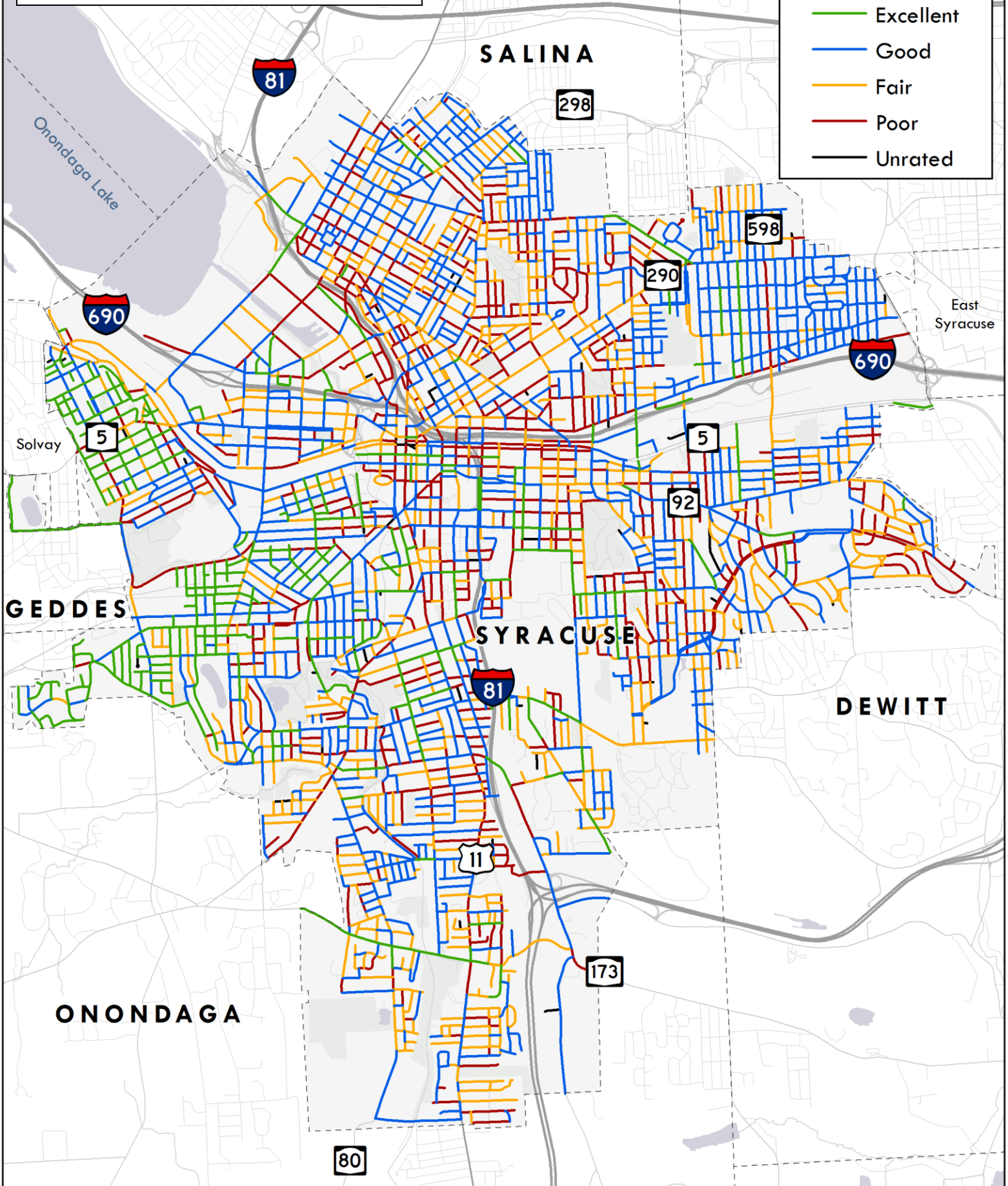
A GIS FOR THE CITY.

Perhaps the best way to incorporate many of these suggestions and recommendations would be a buildout of a GIS network for the City of Syracuse's assets. An authoritative road centerline file (with appropriate attributes) which could link to existing and historic DPW data would be a huge asset to both the City as a whole and to this pavement rating project and analysis. A number of cities across the country have been able to incorporate GIS into their record keeping and decision making, and such a buildout would complement the City's commitment to data-driven problem solving.

Map 1: City Pavement Ratings

RATING CATEGORY

- Excellent
- Good
- Fair
- Poor
- Unrated



This map is for planning and presentation purposes only. The SMTC does not guarantee the accuracy or completeness of this data or map.

Data sources:
SMTC 2019