NJ 2020 SHSP

Lane Departure Emphasis Area

Completed Priority Action 1.C.1.a.

List of fixed objects previously collected, data collection process, and recommendation for best practices.

Driving Toward ZERO Deaths

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Best Practices for Fixed Object Inventory Collection Processes

Introduction

As part of the New Jersey 2020 Strategic Highway Safety Plan, the Lane Departure Emphasis Area Team performed a review of the NJ state, MPO, counties, and municipalities practices for collecting fixed object inventory. The Emphasis Area Team reviewed the types of fixed object data being collected as part of this effort. This document includes information on types of fixed objects collected, collection processes, and recommendations on best practices.

1. Fixed Object Inventory Collection Practices

The Emphasis Area Team reached out to all 21 counties, the big municipalities and the three MPOs in the State for their fixed object inventory collection processes. Some responded while some claimed that they did not have any processes for collecting fixed object inventory or do not have a formal ongoing process for collecting fixed objects inventory.

This section provides information on the processes and tools used by the various agencies in New Jersey to collect fixed object data.

A. *New Jersey Department of Transportation* – Utilizes Image Feature Data Extraction to inventory assets for their roadways. NJDOT uses four cameras mounted on ground vehicles to capture forward right, forward left, forward center, and rear center directions. Camera locations are calibrated to a high degree of accuracy, both within the camera pair and to each other. The fixed object features are extracted as points into shapefile format.
B. *Delaware Valley Regional Planning Commission* – Utilizes PSEG pole data to identify high-frequency utility pole crash locations.
C. *Mercer County* – Utilizes QL2 LiDAR DEM, Google's Tensorflow AI technology and Street view data for their data collection. Mercer County also manually extracts data from videologs
D. *Hudson and Monmouth Counties*- Utilizes Cartegraph software to for their fixed objects data management
E. *Elizabeth City* - Utilizes VueWorks which is a web-enabled GIS, Enterprise Asset
F. *Middlesex County* – Has utilized aerial ortho imagery, oblique imagery, and street level imagery to perform manual feature extraction of fixed objects.
G. *Salem County* – Utilizes street level imagery for their fixed object data collection.
H. Mercer – Have no formal ongoing processes, utilize automated feature extraction of data.
I. *North Jersey Transportation Planning Authority (NJTPA)* - Conducted a Sign Management Program in the years 2012-2014 to develop or update existing sign management systems. The effort included data collection of county-owned signs. NJTPA also led an effort in 2014 to develop an asset management data model supported with data available from counties. As part of this effort, there was outreach via a survey to inventory available data from the NJTPA counties. Most data available included bridges, signs, guiderail, inlets, outfalls, signals, and pavement. NJTPA is currently collecting curve data and advisory speed warning signs data.[4]

Other Processes:

J. Management software for their fixed objects data management.
K. Identify and utilize low-cost fixed objects data collection.
L. Identify new technology for collecting fixed objects data.
M. *Cape May County* - Does not have any existing processes for collecting fixed object inventory.

N. *Burlington County* - Does not have any existing processes for collecting fixed object inventory.

Assessment: There is no uniformity for populating all the existing fixed objects data statewide. There is no established process for sharing fixed objects data being collected by the various agencies. The processes as enumerated above were evaluated and analyzed by the Emphasis Area Team as follows:

Numbers: A & F - are different ways of doing the same thing. #A applies only to State and County highways, where NJDOT has previously obtained videologs, and thus is not a statewide strategy. #F will be at the discretion of local jurisdictions and thus uneven in coverage and quality. For statewide coverage and consistent data processing, it was estimated a contract between $10-20m would be necessary. This cost might be reduced if the vendor could train and use machine learning (#H) to extract roadside features. Any Request for Proposal for such should require proposals to include pilot data collection results compared to human performance (QC metrics).

Numbers: D & E - are data management software applications, not data collection tools. If this reference is to locally collected and managed data already stored in those systems, then data will be at the discretion of local jurisdictions and thus uneven in coverage and quality.

Number: C - is a specific way of doing #H and requires purchase of data from Google, the availability and quality of which we do not know.

Number: B.- this project merely analyzed crash records and filtered locations where a utility pole was identified as the fixed object hit. No information was generated on where the pole was in relation to the road. This would be cheap and would be easy to do statewide for other fixed object types. The cost for this, for Mercer County, in DVRPC's UPWP was about $40k. Multiplying this by 30 is about $1.2m statewide. We multiply by 30, rather than 21 (counties) because Mercer is small. In GIS, this kind of analysis should take about the same amount of human labor to do statewide as it would be to do for one county, more computing time, of course.

Numbers: J, K and L - are not specific and cannot be evaluated and recommended.

. For statewide access to the existing fixed objects inventory, a data tool and conversion component is recommended. The conversion component shall be able to dynamically calculate the Route milepost of any given geographic coordinate (latitude/longitude) taken from each agency's fixed objects data and upload the fixed objects data to a centralized database (e.g., NJDOT Database or cloud environment).

2. Types of Fixed Object Data Collected

The following is a comprehensive list of the types of fixed objects data being collected by the various organizations in New Jersey:

1) Fence
2) Guiderail
3) Curb

4) Barrier Wall
5) Retaining Wall
6) Shoulder
7) Rumble Striping
8) Raised Pavement Marker
9) Delineator
10) Island Pavement
11) Median
12) Barrier Curb
13) Noise Wall
14) Attenuator
15) Headwall
16) Callbox
17) Traffic Signals, Signs, and Posts
18) Inlets
19) Manhole
20) Sidewalk
21) Rockwall
22) Tree
23) Fire Hydrant
24) Mail Box
25) Chain Link Fence
26) Bus Shelter
27) Bridge Overhead Structure
28) Utility Poles - Electrical Line Service and Meter Cable Line
29) Advertising Billboard

3. Best Practices Recommendations

In addition to the review of fixed object inventory processes and fixed object data types, the Emphasis Area Team performed a review of fixed object crash data for the years 2015 to 2019 to develop recommendations for best practices.

A review of fixed object crash data for the NJTPA region revealed that majority of fixed object crashes were related to utility poles, guiderail, fence/wall/gate/railing, traffic barriers/concrete medians, and traffic signs. A review of crash data from Mercer County for the years 2003 to 2013 revealed that utility pole crashes represented nearly two percent of all crashes.

The Mercer County data collections might be valuable in itself but it falls short of requirements for a 'systemic' crash reduction program, as defined by FHWA. For that, we need to put the crashes together with roadway and roadside characteristics. GPI is in the process of doing that for horizontal curves, first in south Jersey (complete for 2 MPOs) then NJTPA and the Statewide (underway). The data and recommendations from these data collection and analysis efforts are central to the purpose of this committee. GPI asked first, where are the curves and what are their characteristics (from accelerometer data in specially equipped collection vehicles), such as tangent, radius, superelevation, posted speed? They also collected (visually, as presumed) several roadside attributes. They then put characteristics together with crashes to identify constellations of cha racteristics associated with crash locations to identify locations with similar constellations which may not (yet) have experienced crashes and recommended systemic mitigation.

However, NJDOT SLD data tells us, more on every public road, how wide a cartway is (centerlines are pretty accurate, + # lanes, + lane width, + shoulder width for most roads) and posted speed. For state routes, much more information is available. We don't know how precise the pole location information is that utility companies maintain, but if we could get that we could identify conditions where roadway characteristics and utility pole locations most frequently lead to crashes.

Similar analyses could be done with other existing datasets. QL2 aerial lidar data is now available statewide and extracted DEMs could be used to identify roadside cut and fill areas. Lidar DSMs could be used to identify individual trees or forested areas, and individual utility poles, for that matter. We also have NJDEP's Land Use/Land Cover data (GIS polygons) extracted from aerial imagery. These data are public and free (well, LULC was developed by AISGIS under State Contract to NJDEP). Nearmap (aerial imagery provider) flies the entire state with a 3" pixel and uses AI to extract sidewalks, pavements, roof types, swimming pools, and more for tax assessors. They might be able to universally identify guiderail and fire hydrants and more if we paid them.

We might have some existing datasets (Lidar & LULC) that can be used to identify the prevalence of roadside hazards across the entire state road network. Other data could be developed through commercial remote sensing operations, either aerial (Nearmap) or mobile lidar or photogrammetry (GPI, Baker, Google, others) and features extracted with human labor or machine learning.

4. Recommendations for the Fixed Objects Data Collection

The Emphasis Area Team reviewed the current processes for fixed object data collection and recommended the following four data collection methods:

1) NJDOT Manual Feature Data Extraction using State Route/street-level imagery.[1]
2) Automated Feature Data Extraction using street-level imagery. Utilize a method that relies on any existing authoritative fixed-object data source maintained/published by non-NJDOT entities. Another example of an authoritative data source is NJ Transit's inventory of bus stop shelters. This "method" should not be limited to just PSEG pole data as the sole authoritative non-NJDOT data source (Mercer County)[2]
3) Utilization of existing authoritative fixed-object inventory data sources maintained or published by NJDOT or non-NJDOT entities. (Mercer and Middlesex Counties)[3]
4) Automated (or manual) planimetric feature data extraction utilizing low-altitude high-resolution aerial photography and/or LIDAR data, where feasible. [Features that could be extracted using this method may include objects such as, but are not limited to, utility structures, fences, walls, retaining walls, billboards, large overhead signs, bus stop shelters, monuments, guard rails, drainage ditches]

Conclusion and Next Step:

1. A partnership with Nexar and Mercer County as a pilot project to implement the machine learning algorithms for change detection for roadway features, including MUTCD signs, specialty signs we may designate, construction zone equipment and traffic delays, roadway stripes and markings, potholes, and other features (fixed objects) that we may 'teach' the machine to identify. They can associate our asset IDs to the features their cameras identify and alert us if they detect a knockdown or other absence or condition. Data collected will be stored in the cloud with minimal cost. Right now, their (Nexar) cameras capture the streets of Manhattan every 5 minutes.

2. A potential next step has been identified to work with Mercer County also as a test case or pilot project to implement the best practices regarding inventory of reflective markers on poles.

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