HIGHWAY FACTORS AND RAILROAD GRADE CROSSING GROUP CHAIRMAN'S FACTUAL REPORT

Valhalla, NY

DCA15MR006

(27 pages)

NATIONAL TRANSPORTATION SAFETY BOARD
OFFICE OF HIGHWAY SAFETY
AND
OFFICE OF RAILROAD, PIPELINE & HAZARDOUS MATERIALS INVESTIGATIONS
WASHINGTON, D.C.

HIGHWAY FACTORS AND RAILROAD GRADE CROSSING GROUP CHAIRMAN'S FACTUAL REPORT

A. CRASH INFORMATION

Location:	Commerce Street Grade Crossing on the Metro-North Harlem Line, Valhalla, Westchester County, New York
Vehicle #1:	2011 Mercedes ML350
Vehicle #2:	Metro-North passenger train 659
Operator #2:	Metro-North Railroad
Date:	February 3, 2015
Time:	Approximately 06:26 p.m. EST
NTSB #:	**DCA15MR006**

B. HIGHWAY FACTORS AND RAILROAD GRADE CROSSING INVESTIGATIVE GROUP

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C. CRASH SUMMARY

For a summary of the crash, refer to the *Crash Summary Report* in the docket for this investigation.

D. DETAILS OF THE INVESTIGATION

The Highway Factors and Railroad Grade Crossing Factual Report provides the reader with a factual record of the highway and railroad grade crossing conditions that existed at the time of the crash. The broad areas covered in the Highway Factors and Railroad Grade Crossing Factual Report include prefatory data, highway data, railroad data, federal and state oversight for highway-rail grade crossing warning systems, pre-crash grade crossing inspections, post-crash examination and testing, railroad maintenance records, damages, and post-crash actions.

1. Prefatory Data

1.1. Crash Location

The crash occurred at the Commerce Street and Metro-North railroad grade crossing (DOT crossing number 529-902V) at railroad milepost number (MP) 26.60 in Valhalla, Westchester County, New York. **Figure 1** is a crash map that illustrated the crash location.

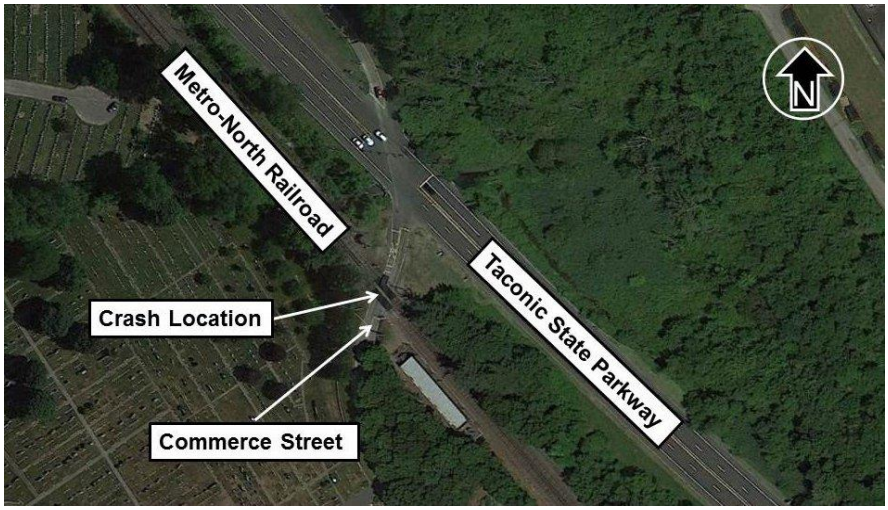


Figure 1 – Crash Map (Source: modified from Google Earth)

1.2. 24 Hour Traffic Volume at Commerce Street and Taconic State Parkway Intersection

Table 1 summarizes a 24 hour traffic volume at the Commerce Street and Taconic State Parkway intersection. The 24 hour traffic volume was taken from a traffic study that was conducted by the New York State Department of Transportation (NYSDOT) on Thursday, February 19, 2015. The traffic study began at 12:00 a.m. on February 19, 2015 and ended at 12:15 a.m. on February 20, 2015.

Table 1 – 24 Hour Traffic Volume at the Commerce Street and Taconic State Parkway Intersection

Approach	Direction	Movement	Average Daily Traffic Volumes
Commerce Street Eastbound Approach			
Commerce Street	EB	Left Turn	109
Commerce Street	EB	Thru	295
Commerce Street	EB	Right Turn	11
Total			415
Commerce Street Westbound Approach			
Commerce Street	WB	Left Turn	783
Commerce Street	WB	Thru	288
Commerce Street	WB	Right Turn	86
Total			1,157

Approach	Direction	Movement	Average Daily Traffic Volumes
Taconic State Parkway Southbound Approach			
Taconic State Parkway	SB	Left Turn	25
Taconic State Parkway	SB	Thru	7,172
Taconic State Parkway	SB	Right Turn	180
Total			7,377
Taconic State Parkway Northbound Approach			
Taconic State Parkway	NB	Left Turn	10
Taconic State Parkway	NB	Thru	7,665
Taconic State Parkway	NB	Right Turn	1,008
Total			8,683

1.3. Roadway Classification

Taconic State Parkway is a restricted four lane divided principal and limited access parkway for passenger car vehicles only, while Commerce Street is an unrestricted two-lane undivided minor arterial.

1.4. Direction of Travel of Metro-North Train and Crash Vehicle

Figure 2 illustrates the direction of travel of the Metro-North train and the SUV involved in the February 3, 2015 crash.

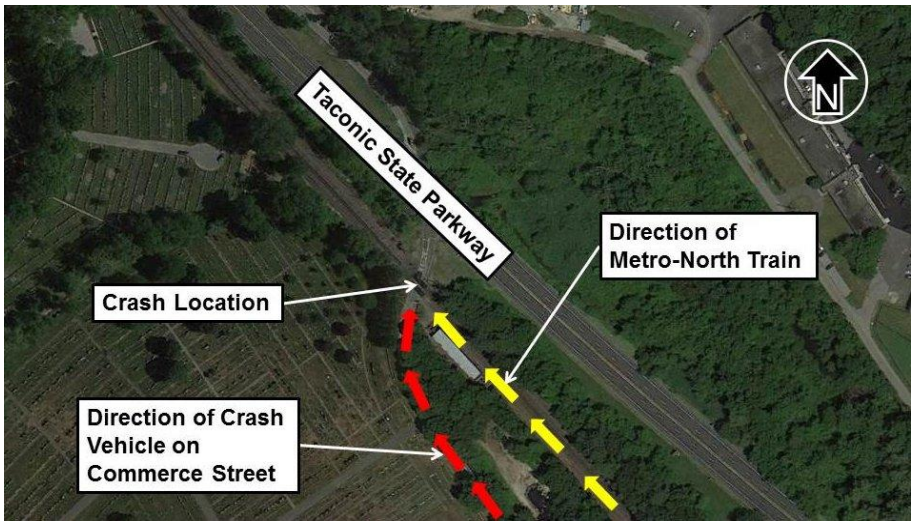


Figure 2 - Direction of travel map (Source: modified from Google Earth)

2. Highway Data

2.1. Highway Design

Commerce Street in the vicinity of the grade crossing contained an undivided 2-lane cross section. The 2-lane cross section consisted of one eastbound through lane and one westbound through lane. The eastbound and westbound through lanes were separated by solid

yellow double lines that were each 6-inch wide. An edge line separated the through lane and shoulder. The edge line consisted of a 6-inch wide solid white line. The total width of the 2-lane cross section was approximately 18 feet wide west of the grade crossing and approximately 20 feet wide east of the grade crossing.

The distance from the farthest eastern rail to the centerline of the intersection of Commerce Street and Taconic State Parkway was approximately 109 feet.

2.2. Speed Limit

The posted speed limit for Commerce Street was 30 miles per hour (mph). The posted speed limit for Taconic State Parkway was 50 mph.

2.3. Signage and Pavement Markings in the Vicinity of the Grade Crossing

Figure 3 illustrates the signage in the vicinity of the grade crossing. On the eastbound approach to the grade crossing, a 'Do Not Stop on Tracks' sign was located approximately 65 feet from the nearest rail and a grade crossing advance warning symbol was located approximately 160 feet from the nearest rail. On the westbound approach to the grade crossing, a 'Do Not Stop on Tracks' sign was located approximately 31 feet from the nearest rail, a 'Town Speed Limit 30' sign was located approximately 70 feet from the nearest rail, and a grade crossing advance warning symbol was located approximately 90 feet from the nearest rail.

The Town of Mount Pleasant Traffic & Safety Department installed the 'Do Not Stop on Tracks' signs on both approaches to crossing in the month of June 2010 as denoted by a sign installation sticker attached to the back of the sign panel. The signs, at the time, met the Federal Manual on Uniform Traffic Control Devices (FED MUTCD) and New York State Supplement to the Manual on Uniform Traffic Control Devices (NYS MUTCD) standards. On March 16th, 2011, the NYS MUTCD adopted and now only permits the installation of a 'State Law – Do Not Stop on Tracks' sign. However, the revised or current NYS MUTCD does not require a mandatory replacement of the FED MUTCD sign with the new instituted by NYS MUTCD.

The pavement markings in the vicinity of the grade crossing consisted of grade crossing pavement marking symbols located in the eastbound through lane and westbound through lane. The center of the eastbound through lane grade crossing pavement marking symbol was located approximately 252 feet from the nearest rail and beyond the horizontal curve that turns to the right. The center of the westbound through lane grade crossing pavement marking symbol was located approximately 45 feet from the nearest rail.

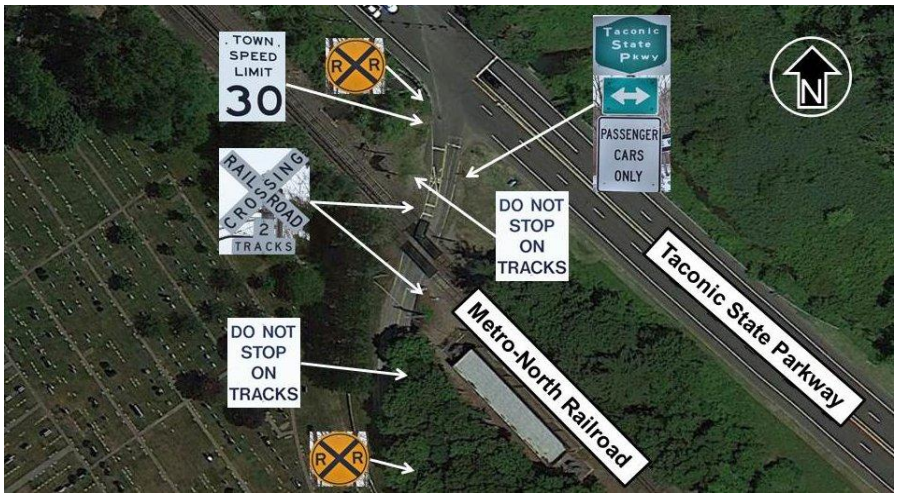


Figure 3 - Signage map (Source: modified from Google Earth)

Attachment 21 - Commerce Street Grade Crossing Signs denotes the type, owner, MUTCD type, MUTCD number, and dimensions of the signs as shown in **Figure 3**.

2.4. Crossing Angle

The crossing of Commerce Street and the Metro-North railroad formed an angle that was approximately 62 degrees (see **Figure 4**).

2.5. Stop Lines

On the eastbound approach to the grade crossing, a white stop line was located approximately 4 feet from the automatic gate. On the westbound approach to the grade crossing, a white stop line was located even with the automatic gate. The white stop lines were approximately 16 inches wide and 10 feet long.

The FED MUTCD recommended the following regarding stop lines:[1]

"Section 8B.28 Stop and Yield Lines

Guidance:
If a stop line is used, it should be a transverse line at a right angle to the traveled way and should be placed approximately 8 feet in advance of the gate (if present), but no closer than 15 feet in advance of the nearest rail."

2.6. Jurisdiction and Maintenance of Commerce Street and Grade Crossing

The Town of Mount Pleasant has jurisdiction and maintenance of Commerce Street up to the railroad right-of-way.[2] Metro-North has jurisdiction and maintenance within the railroad right-of-way including the grade crossing.

[1] *Manual on Uniform Traffic Control Devices for Streets and Highways*, U.S. Department of Transportation, Federal Highway Administration; 2009 Edition; page 766.
[2] The Town has always assumed the distance between the grade crossing and the Taconic State Parkway as being under NYSDOT control since this area of Commerce Street is within the Taconic State Parkway right-of-way.

2.7. Scene Diagram

Figure 4 illustrates a scene diagram of the grade crossing and the Commerce Street and Taconic State Parkway intersection.

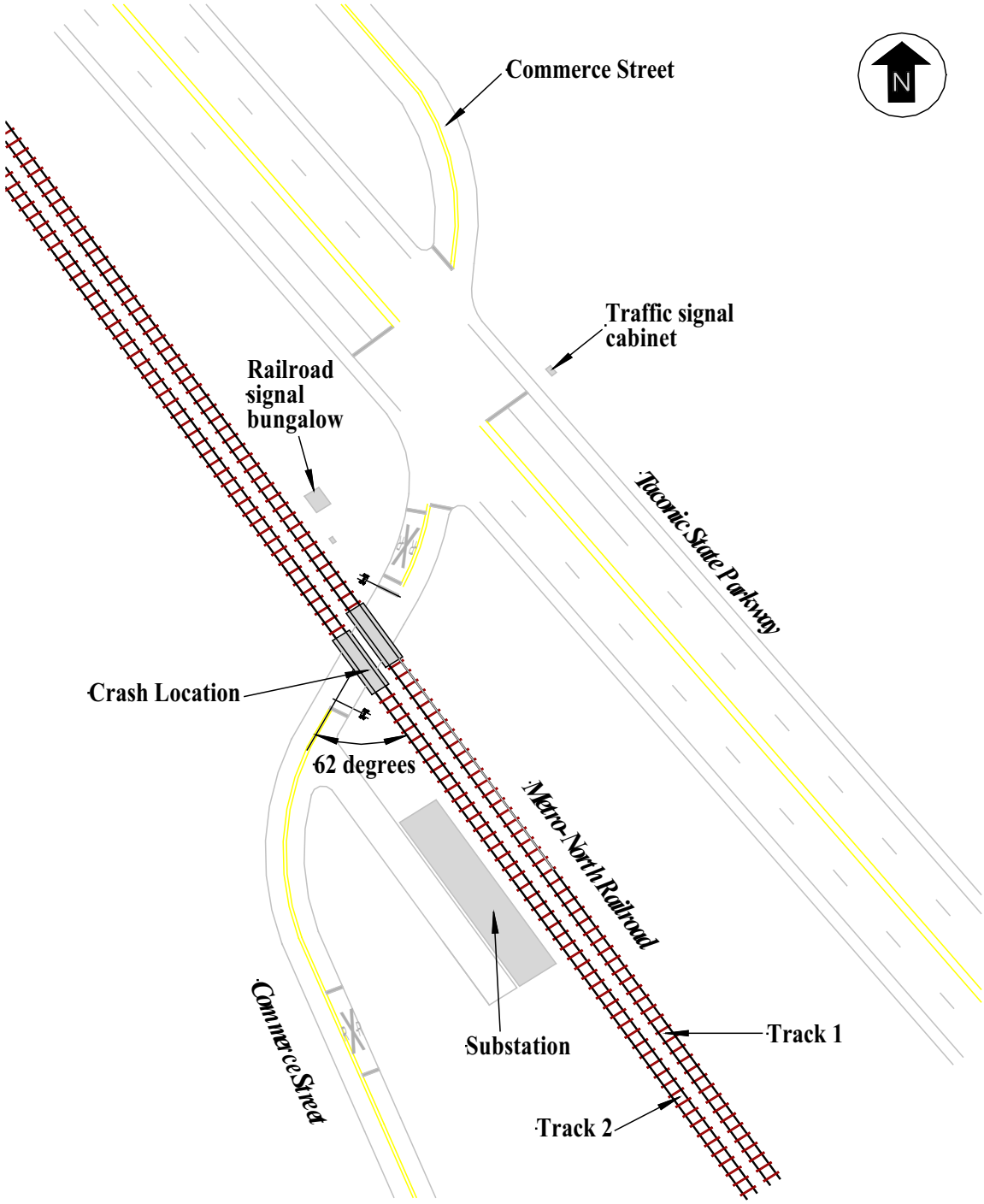


Figure 4 – Scene diagram of the grade crossing and the Commerce Street and Taconic State Parkway intersection (not to scale)

3. Railroad Data

3.1. U.S. DOT Crossing Inventory Information

Table 2 summarizes the U.S. DOT crossing inventory information at the Commerce Street and Metro-North railroad, highway-rail grade crossing.

Table 2 - U.S. DOT Crossing Inventory Information

Subject	Crossing Inventory Information
Crossing Number	529902V
Railroad	Metro-North Commuter Railroad
Type and Position	Public At Grade
Division	
Subdivision	River
Railroad Milepost	26.60
State	New York
County	Westchester
City	Valhalla
Street or Road Name	Commerce Street
Highway Type	Local Road
Latitude	41.0862756
Longitude	-73.7880329

3.2. Description of Railroad Signal System

Metro-North train movements were governed by operating rules, general orders, timetable instructions and signal indications. The signal system was monitored and operated remotely from Grand Central Terminal. The Harlem Line of Metro-North was oriented in a north/south timetable direction and was about 82 miles between Grand Central Terminal (New York City) and Wassaic Station (Amenia, New York). Maximum authorized speed for passenger trains was 60 miles per hour with permanent speed restrictions identified in the timetable. No foreign railroads operated on the Metro-North Harlem Line. Scheduled trains (revenue and deadhead) operating over the Commerce Street highway-rail grade crossing are listed in **Table 3**.

Table 3 – Metro-North Train Count

WEEKDAY	Train Counts
Northbound	53
Southbound	54
Total weekday	107
WEEKEND	
Northbound	29
Southbound	29
Total weekend	58
Total Per 7 days	651

Main tracks north of Grand Central Terminal utilized a signal system known as cab signals without wayside signals. Speed information was transmitted through the rails to the head-end of a train. Metro-North used four cab signal aspects, displayed in the train operating cab. A normal cab aspect indicated maximum authorized speed as designated in the timetable. A limited cab aspect indicated reduce speed to 45 mph. A medium cab aspect reduced speed to 30 mph. A restricted cab aspect required a train engineer to operate at 15 mph or less, with the ability to stop the train short of a number of conditions that included a train ahead or a stop signal.

The Metro-North Railroad Operations Control Center (OCC) was located in New York City. The OCC rail traffic controllers used a Traintrack software package to coordinate train movements on the Harlem Line.

3.3. Description of Highway-Rail Grade Crossing Warning System

The Metro-North two main tracks through the hamlet of Valhalla within the town of Mount Pleasant, New York were oriented in a timetable north/south direction with the Taconic State Parkway running parallel along the east side of the tracks. Commerce Street was an east/west, two-lane asphalt road that intersected the railroad tracks at MP 26.6 and met the Taconic State Parkway at a traffic intersection. The grade crossing inventory number at Commerce Street was AAR #529 902V. The Commerce Street highway-rail grade crossing was equipped with an active grade crossing warning system consisting of flashing lights and gates. Eight, 12-inch flashing light-emitting diode (LED) light units, and 2 gate arms mounted on two signal masts were arranged to provide warning for both directions of highway traffic on Commerce Street. A single gate arm extends across the westbound direction of Commerce Street while the second gate arm extends across the eastbound direction of traffic approaching the railroad tracks. Each aluminum/fiberglass gate arm had alternating red and white retroreflective striping and were equipped with three, 3-inch LED light units mounted along the top. When the grade crossing warning system was activated, the light unit mounted at the tip of the gate arms was constantly lit, while the other two light units flashed alternately.

The roadway crossing surface was constructed of rubber slabs and the railroad tracks were built to approximately 13-feet track centers. The grade crossing warning devices operated on 100 hertz signal power and were equipped with a standby battery backup system. Both signal masts had signs affixed with an 800 number to report emergencies.

Train detection and warning system activation was configured using overlay track circuits and provided a minimum of 35 seconds of warning time for trains traveling at the maximum authorized timetable speed of 60 mph. The warning times were extended for trains approaching at slower speeds. The south approach track circuits (for northbound trains) extended approximately 3,078 feet from the center of the Commerce Street crossing. The north approach track circuits (for southbound trains) extended approximately 3,088 feet from the center of the Commerce Street crossing. Whistle boards were located approximately 1,340 feet from the crossing for northbound trains.

The vertical distance from the road surface to the bottom of the 12 inch diameter flashing light roundels was approximately 8 feet. The 12 inch diameter flashing light roundels were spaced approximately 30 inches apart measured from the center of the lenses.

The center of the post-mounted flashing light unit was located approximately 18 feet from the nearest rail on the westbound approach to the grade crossing and 17 feet from the nearest rail on the eastbound approach to the grade crossing.

3.4. Description of Highway Traffic Signal System

The Taconic State Parkway/Commerce Street highway intersection was equipped with both 8-inch and 12-inch traffic signals controlled with a Siemens 2070L Advanced Transportation Controller (ATC) microprocessor controller. The traffic signals directed highway traffic in all directions through the intersection. The highway traffic controller and signals operated on commercial power.

The highway traffic signal system had a simultaneous preemption connection with the highway-rail grade crossing warning system. The railroad train detection circuits provided a relay contact that opened a traffic signal circuit and triggered the highway traffic controller to initiate the preemption sequence of the traffic signals. The train detection circuits triggered the preemption circuit when a train was detected on one of the approach track circuits and simultaneously activated the grade crossing warning devices.

Depending on the traffic signal phase in effect when a train was detected, the clearance phase (Phase 7) could take a maximum of 7 seconds to initiate as the other signal phase were cycled to red. The highway traffic controller preemption phase, sequenced the traffic lights to provide a clearance phase (6 seconds minimum/10 seconds maximum green then 4 seconds yellow) for traffic on Commerce Street in the eastbound direction. The highway signals for traffic approaching the grade crossing westbound on Commerce Street were sequenced to red and remained at red while the grade crossing warning was activated.

3.5. Grade Crossing Warning System Data Log

The railroad warning equipment for the Commerce Street crossing was equipped with a Safetran, Sears II data logger. The data logger provided the capability to record information associated with the previous train movements through that location. The crossing data log captured train movement information through the Commerce Street crossing from February 2, 2015 at 8:05:32 p.m. until the time of the accident for both main tracks. The three previous train movements and the accident train are listed in **Table 4**.

Table 4 - Crossing Data Log

Time	Direction	Track	Event	Warning Time/Flash rate
6:07:56	North	Main 2	Train detected on approach track circuit	47 seconds / 46 flashes per minute
6:10:21	North	Main 1	Train detected on approach track circuit	40 seconds / 46 flashes per minute
6:16:58 pm	North	Main 1	Train detected on approach track circuit	40 seconds / 46 flashes per minute
6:26:16 pm	North	Main 2	Train 659 detected on approach track circuit	39 seconds / 45 flashes per minute

The data logs recorded northbound train 659 occupying the southern approach track circuit on main track number 2, for the Commerce Street grade crossing warning system at 6:26:16 pm. The data log recorded the flashing light units operating at 45 flashes per minute. The data indicated the warning devices activated for 39 seconds before the train occupied the island circuit (paved roadway).[3]

3.6. Metro-North Operations Control Center Data Log

Post-crash data was downloaded from the computer aided dispatching system at the Metro-North OCC. The signal and train control data for control point (CP) 124 and CP 130 indicated the rail traffic controller lined CP 124 for a northbound route on main track 2 at 6:21:37 pm. At 6:22:18, the data indicated train 659 occupying the track circuit for the route. At 6:26:16, data indicated train 659 occupied track circuit 2662. A track block was established at 6:27:21 between CP 124 and CP 130.

4. Federal and State Oversight for Highway-Rail Grade Crossing Warning Systems

4.1. Federal Regulations

Federal Railroad Administration (FRA) regulations in Title 49, Code of Federal Regulations, Part 234 – Grade Crossing Signal System Safety imposed the minimum maintenance, inspection, and testing standards for highway-rail grade crossing warning systems.

> *Part 234.217, Flashing Light Units*
> *(a) Each flashing light unit shall be properly positioned and aligned and shall be visible to a highway user approaching the crossing.*
> *(b) Each flashing light unit shall be maintained to prevent dust and moisture from entering the interior of the unit. Roundels and reflectors shall be clean and in good condition.*

[3]The island circuit refers to a short track circuit that spans the length of the paved roadway on each of the railroad tracks at a highway-rail grade crossing.

(c) All light units shall flash alternately. The number of flashes per minute for each light unit shall be 35 minimum and 65 maximum.

Part 234.219, Gate Arm Lights and Light Cable
Each gate arm light shall be maintained in such condition to be properly visible to approaching highway users. Lights and light wire shall be secured to the gate arm.

Part 234.221, Lamp Voltage
The voltage of each lamp shall be maintained at not less than 85 percent of the prescribed rating for the lamp.

Part 234.223, Gate Arm
Each gate arm, when in the downward position, shall extend across each lane of approaching highway traffic and shall be maintained in a condition sufficient to be clearly viewed by approaching highway users. Each gate arm shall start its downward motion not less than three seconds after flashing lights begin to operate and shall assume the horizontal position at least five seconds before the arrival of any train at the crossing. At those crossings equipped with four quadrant gates, the timing requirements of this section apply to entrance gates only.

Part 234.225, Activation of Warning Systems
A highway-rail grade crossing warning system shall be maintained to activate in accordance with the design of the warning system, but in no event shall it provide less than 20 seconds warning time before the grade crossing is occupied by rail traffic.

4.2. New York State Requirements

The provisions of the FED MUTCD were adopted by the State of New York in 2007.[4] Deviations from the FED MUTCD were published in the New York State Supplement to the MUTCD (NYS MUTCD).[5] Together the two documents comprise the manual and specifications for a uniform system of traffic control devices within the State of New York. The NYS MUTCD provides for conditions where New York regulations do not allow or support the use of certain devices as described in the FED MUTCD or where more restrictive guidance is desired.

[4]When used in this Manual, the text headings of Standard, Guidance, Option, and Support shall be defined as follows:

A. Standard – a statement of required, mandatory, or specifically prohibitive practice regarding a traffic control device.
B. Guidance – a statement of recommended, but not mandatory, practice in typical situations, with deviations allowed if engineering judgment or engineering study indicates the deviation to be appropriate.
C. Option – a statement of practice that is a permissive condition and carries no requirement or recommendations.
D. Support – an informational statement that does not convey any degree of mandate, recommendation, authorization, prohibition, or enforceable condition.

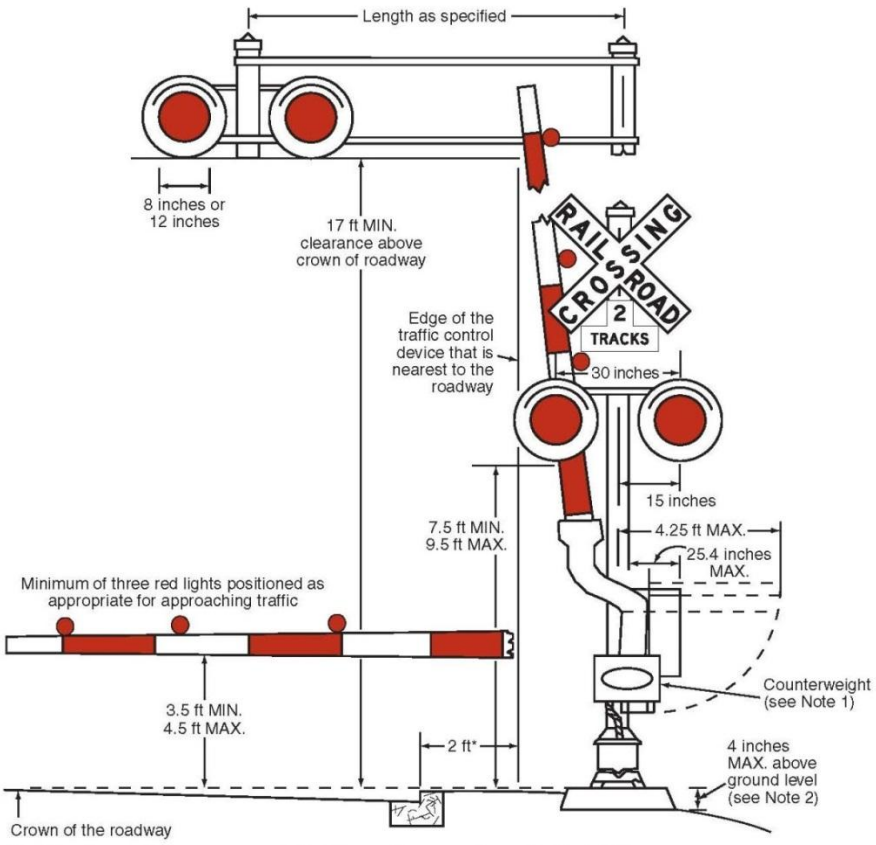
[5]New York State Supplement to the Manual on Uniform Traffic Control Devices for Streets and Highways (2009 Edition), Effective March 16, 2011, New York State Department of Transportation.

The FED MUTCD and the 2007 Railroad-Highway Grade Crossing Handbook recommended a minimum distance of 12 feet from the center of the post-mounted flashing light system to the center of the railroad tracks.

The FED MUTCD recommended the following regarding flashing light signals, gates, and traffic control signals:[6]

> *"Section 8C.02 Flashing-Light Signals*
> *Standard:*
> *If used, the flashing-light signal assembly (shown in Figure 8C-1) on the side of the highway shall include a standard Crossbuck (R15-1) sign, and where there is more than one track, a supplemental Number of Tracks (R15-2P) plaque, all of which indicate to motorists, bicyclists, and pedestrians the location of a grade crossing.*

Figure 8C-1. Composite Drawing of Active Traffic Control Devices for Grade Crossings Showing Clearances



*For locating this reference line on an approach that does not have a curb, see Section 8C.01.

Notes:

1. Where gates are located in the median, additional median width may be required to provide the minimum clearance for the counterweight supports.
2. The top of the signal foundation should be no more than 4 inches above the surface of the ground and should be at the same elevation as the crown of the roadway. Where site conditions would not allow this to be achieved, the shoulder side slope should be re-graded or the height of the signal post should be adjusted to meet the 17-foot vertical clearance requirement.

(Source: 2009 FED MUTCD)

[6] *Manual on Uniform Traffic Control Devices for Streets and Highways*, U.S. Department of Transportation, Federal Highway Administration; 2009 Edition; page 769, 771, and 772.

If used, flashing-light signals shall be placed to the right of approaching highway traffic on all highway approaches to a grade crossing. They shall be located laterally with respect to the highway in compliance with Figure 8C-1 except where such location would adversely affect signal visibility.

Each red signal unit in the flashing-light signal shall flash alternately. The number of flashes per minute for each lamp shall be 35 minimum and 65 maximum. Each lamp shall be illuminated approximately the same length of time. Total time of illumination of each pair of lamps shall be the entire operating time. Flashing-light units shall use either 8-inch or 12-inch nominal diameter lenses."

"Section 8C.04 Automatic Gates

Standard:

The automatic gate (see Figure 8C-1) shall consist of a drive mechanism and a fully retroreflectorized red- and white-striped gate arm with lights. When in the down position, the gate arm shall extend across the approaching lanes of highway traffic.

In the normal sequence of operation, unless constant warning time detection or other advanced system requires otherwise, the flashing-light signals and the lights on the gate arm (in its normal upright position) shall be activated immediately upon detection of approaching rail traffic. The gate arm shall start its downward motion not less than 3 seconds after the flashing-light signals start to operate, shall reach its horizontal position at least 5 seconds before the arrival of the rail traffic, and shall remain in the down position as long as the rail traffic occupies the grade crossing.

When the rail traffic clears the grade crossing, and if no other rail traffic is detected, the gate arm shall ascend to its upright position, following which the flashing-light signals and the lights on the gate arm shall cease operation.

Gate arms shall be fully retroreflectorized on both sides and shall have vertical stripes alternately red and white at 16-inch intervals measured horizontally.

Standard:

Gate arms shall have at least three red lights as provided in Figure 8C-1.

When activated, the gate arm light nearest the tip shall be illuminated continuously and the other lights shall flash alternately in unison with the flashing-light signals.

The entrance gate arm mechanism shall be designed to fail safe in the down position.

Guidance:

The gate arm should ascend to its upright position in 12 seconds or less.

In its normal upright position, when no rail traffic is approaching or occupying the grade crossing, the gate arm should be either vertical or nearly so (see Figure 8C-1).

The gates should cover the approaching highway to block all highway vehicles from being driven around the gate without crossing the center line."

Part 8 of the NYS MUTCD contained the guidelines for traffic control for railroad and light rail transit grade crossings where more restrictive guidance was required by the State of New York.

> *"Section 8C.08 Rail Traffic Detection*
> *Standard:*
> *... When automatic gates are installed, the length of time the flashing light signals and gate arm lights shall operate before arrival of any rail traffic at the grade crossing shall be a function of the minimum track clearance distance as follows: Where the minimum track clearance distance is 35 feet or less, the flashing light signal shall operate for at least 27 seconds before the arrival of rail traffic at the crossing. Where the minimum track clearance distance is more than 35 feet, the flashing light signal shall operate for at least 20 seconds plus one second for each 5 feet of clearance distance before the arrival of rail traffic at the crossing."*
>
> *"Section 8C.09 Traffic Control Signals at or near Highway-Rail Grade Crossings*
> *Guidance:*
> *Displays in the traffic control signal faces in advance of and beyond the crossing should be timed to allow highway traffic to clear the crossing prior to arrival of any rail traffic.*
> *Standard:*
> *...A traffic control signal at an independent crossing shall normally display either circular green or circular flashing yellow indications in the highway faces and circular red indications in the train approach faces. Upon train actuation, the highway faces shall transition to red indications and the train approach faces shall transition to circular yellow indications. If the highway faces normally display flashing yellow indications, a green interval of at least 4 seconds shall precede the clearance to the railroad phase. At the termination of the railroad phase, the traffic control signal shall revert to normal operation."*

5. Pre-crash FRA Grade Crossing Inspections

A year of previous inspection records (April 2014 to March 2015) were provided by the FRA regarding highway-rail grade crossing warning systems on the Metro-North Harlem Line. The inspections records indicated six grade crossing inspections were conducted and resulted in 7 defects being noted.

Inspection records indicate no inspections were conducted by FRA inspectors at the Commerce Street grade crossing during the year prior to the crash. In addition, no records were provided regarding joint inspections by Metro-North Railroad and New York State Department of Transportation to test the preemption operation for the traffic signal at the Commerce Street intersection.

6. Post-crash Examination & Testing

On February 4, 2015, representatives from Metro-North Railroad, the FRA, New York Public Transportation Safety Board and NTSB conducted a field examination and investigation of the highway-rail grade crossing warning system and highway traffic light pre-emption system at Commerce Street.

The post-crash examination of the grade crossing warning equipment at Commerce Street found the signal bungalow and all flashing light units locked and secured with no evidence of vandalism or tampering. Track components were inspected and track circuits were verified.

Approach track circuits were measured and verified in both track direction approaching the roadway. Testing determined the flashing light units were operating at 44 flashes per minute. Lamp voltage measurements for the flashing light units were recorded. Lighting circuit voltages on the east signal mast measured 10.2 volts AC. Lighting circuit voltages on the west signal mast measured 10.4 volts. .

Post-crash testing measured the start of the descent time for the gate arms to be 4 seconds after the flashing light units were activated. The gate arms were in a full horizontal position 13 seconds after the flashing light units were activated. The signal group did not identify any obstructions to the preview to the flashing light units from either direction.

7. Railroad Maintenance Records

Railroad maintenance records were provided for monthly, quarterly, and annual inspections and tests for the Commerce Street crossing warning equipment. Previous monthly inspections were performed on January 29, 2015; January 2, 2015; December 3, 2014; November 4, 2014; and October 14, 2014. The last quarterly inspection was performed on November 4, 2014. Monthly inspections required wires, lights and signs to be inspected. In addition inspection of the operation of the crossing, gate arms and stand-by power supply was required. Quarterly inspections required all tests from a monthly inspection and in addition it required the approach track circuits to be verified.

A yearly inspection was performed on October 14, 2014. The yearly inspection required testing of the flashing light unit flash rate, lamp voltages, measurement of the gate arms and warning times. On November 18, 2014, a yearly track circuit frequency test was recorded.

Insulation resistance tests records indicated cables were meggered on September 29 and October 6, 2014. 4-year relay tests were performed on April 22, 2014. The maintenance records did not indicate any deficiencies with the warning system.

Grade crossing malfunction reports were reviewed for the previous 12 months. The reported grade crossing reports are listed in **Table 5**. All malfunction report records indicated they were addressed in a timely manner as required by FRA regulations and the crossing was tested and returned to service.

Table 5 - Commerce Street Crossing Malfunction Reports

Date	Reported Malfunction	Resolution
2/14/14	Car slid off crossing pad due to ice and snow	Car removed and crossing tested and returned to service.
6/4/14	Gate arm struck by vehicle and on the ground	Shear pin replaced and gate arm reattached. Crossing tested and returned to service.
6/6/14	Damaged gate arm	Shear pin replaced and gate arm reattached. Crossing tested and returned to service.
6/8/14	Gates reported down by Police	Replaced DC/DC regulator for 1BOR receiver. Crossing tested and returned to service.
6/12/14	Gate arm struck by vehicle and on the ground	Gate repaired. Crossing tested and returned to service.
6/24/14	Truck hit gate arm and broke it	Gate repaired. Crossing tested and returned to service.

8. Damages

The highway-rail grade crossing warning system, the highway traffic signal system and the railroad cab signal system did not sustain any ($0) damages as a result of the accident.

9. Post-crash Actions

9.1. Preemption of the Traffic Signal at the Commerce Street and Taconic State Parkway intersection

The traffic signal at the Commerce Street and Taconic State Parkway intersection contains two preemptions:

Preemption #1 – Preemption #1 is activated by a loop detector (see **Figure 5**) in the pavement of the westbound lane of Commerce Street for vehicles turning from Taconic State Parkway onto Commerce Street or traveling through the intersection toward the grade crossing. Preemption #1 is designed to clear vehicles traveling westbound that may be stacked on Commerce Street prior to the grade crossing allowing those vehicles to clear the grade crossing before any further vehicles can turn or travel through the intersection onto Commerce Street, avoiding the potential of vehicles being trapped in the intersection. If a vehicle stays on the loop detector for 5 seconds the traffic signal will terminate the active green phase, run the corresponding yellow and red clearances and rest in red for every approach. It will stay red for a minimum of 2 seconds and a maximum of 45 seconds.[7] Once a vehicle moves off of the loop detector or it reaches its

[7]The yellow time depends on which phase is active when the preemption starts. For the Taconic State Parkway the yellow time is 5 seconds and for Commerce Street the yellow time is 4 seconds.

maximum time the traffic signal will turn green on the Taconic State Parkway and cycle normally.

Preemption #2 - Preemption #2 is activated by the railroad and provides green time for vehicles traveling eastbound on Commerce Street to clear the queue (cars). If the train preemption is activated the traffic signal will terminate the active green phase, run the corresponding yellow and red clearances, and turn green for vehicles traveling eastbound on Commerce Street only. This phase will remain green for a minimum of 6 seconds and a maximum of 10 seconds. Once a vehicle moves off of the loop detector (see **Figure 5**) located in the pavement of the eastbound lane of Commerce Street between the grade crossing and Taconic State Parkway, or it reaches its maximum time the traffic signal will run the yellow and red clearance times and turn green on the Taconic State Parkway and cycle normally.

Figure 5 illustrates the location of the loop detectors at the Commerce Street and Taconic State Parkway intersection.

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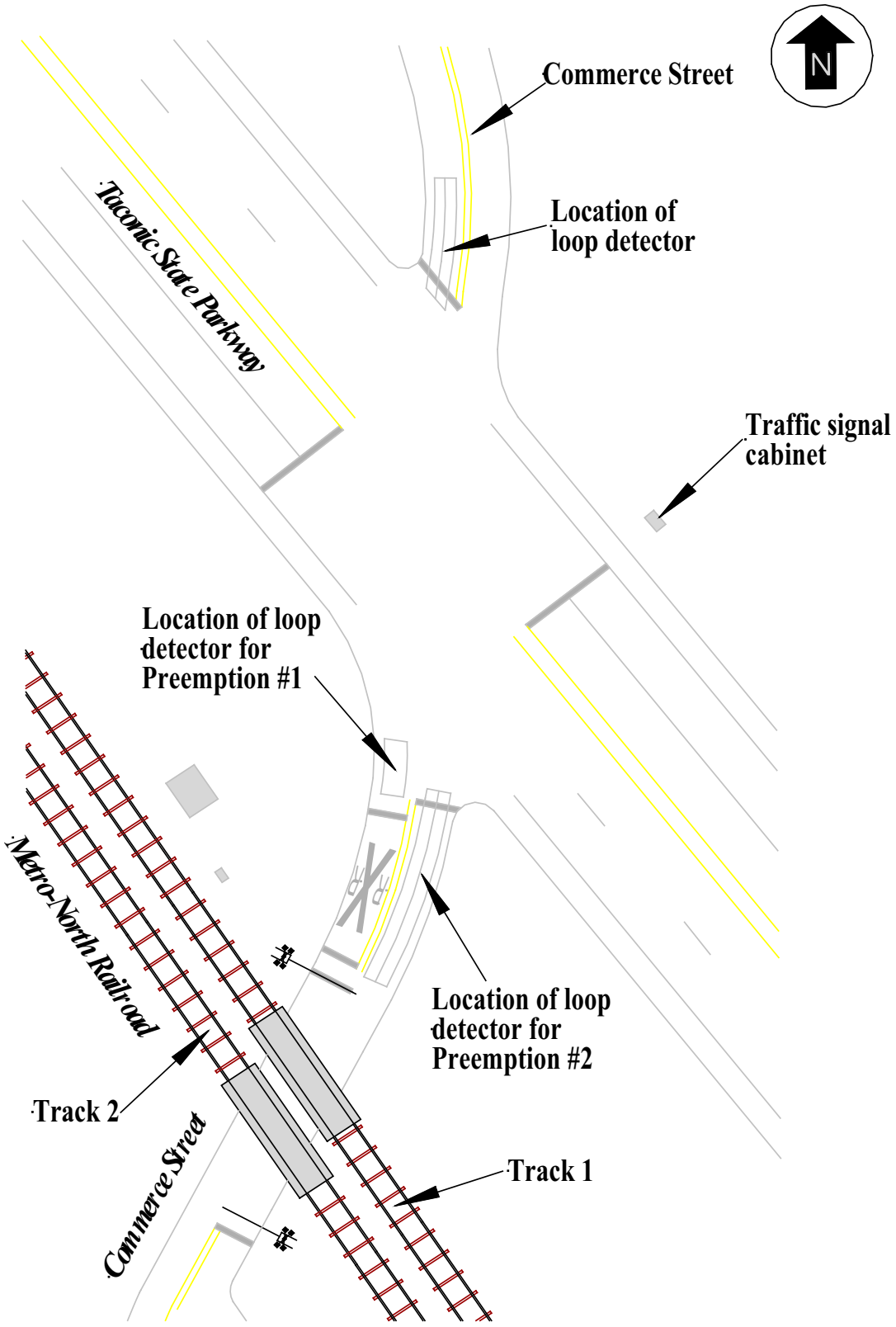

Figure 5 – Location of loop detectors at the Commerce Street and Taconic State Parkway intersection (not to scale)

Under one scenario in which Preemption #1 activates, and Preemption #2 activates immediately thereafter, the NYSDOT has confirmed that Preemption #2 (or activation by the railroad) does not receive first priority and Preemption #1 continues to operate normally. Under this scenario, the traffic signal at the Commerce Street and Taconic State Parkway intersection was not in compliance at the time of the crash with the 2009 federal MUTCD that requires *"when multiple or successive preemptions occur, train activation shall receive first priority*."

The NYSDOT indicated the following in an email to NTSB investigators dated April 13, 2015:

> *"We are starting to look at all signals in Region 8 with railroad preemption and make any adjustments as necessary. We anticipate being done with W-354 TSP @ Commerce* (Commerce Street and Taconic State Parkway intersection) *by Friday 4/17* (April 17). *We anticipate being finished with the other locations by the end of June."*

The NYSDOT provided a detailed description of the railroad preemption adjustments that are being done to the Commerce Street and Taconic State Parkway traffic signal and all signals with railroad preemption in Region 8 in an email to NTSB investigators dated May 15, 2015:

> *"We are reviewing all Region 8 signals with railroad preemption, including Taconic State Parkway @ Commerce St, to ensure all of the intersections have the railroad preemption as the highest priority. All of these intersections will be converted to a 2070 model controller if they do not already have one and the railroad preemption will be preemption #1. In the 2070 controller the preempts possess an implied priority order with the lowest numbered preempt (#1) having the highest priority. For any intersections with multiple preempts we will confirm that the override higher # preempt is set to off. When this parameter is set to off any additional preempts (#2-10) cannot interrupt higher number preempts."*

Figure 6 illustrates a map of all eleven regions in New York State. Region 8 (Poughkeepsie) is located in the southeastern portion of the state. Region 8 (Poughkeepsie) encompasses the counties of Columbia, Dutchess, Orange, Putnam, Rockland, Ulster, and Westchester.

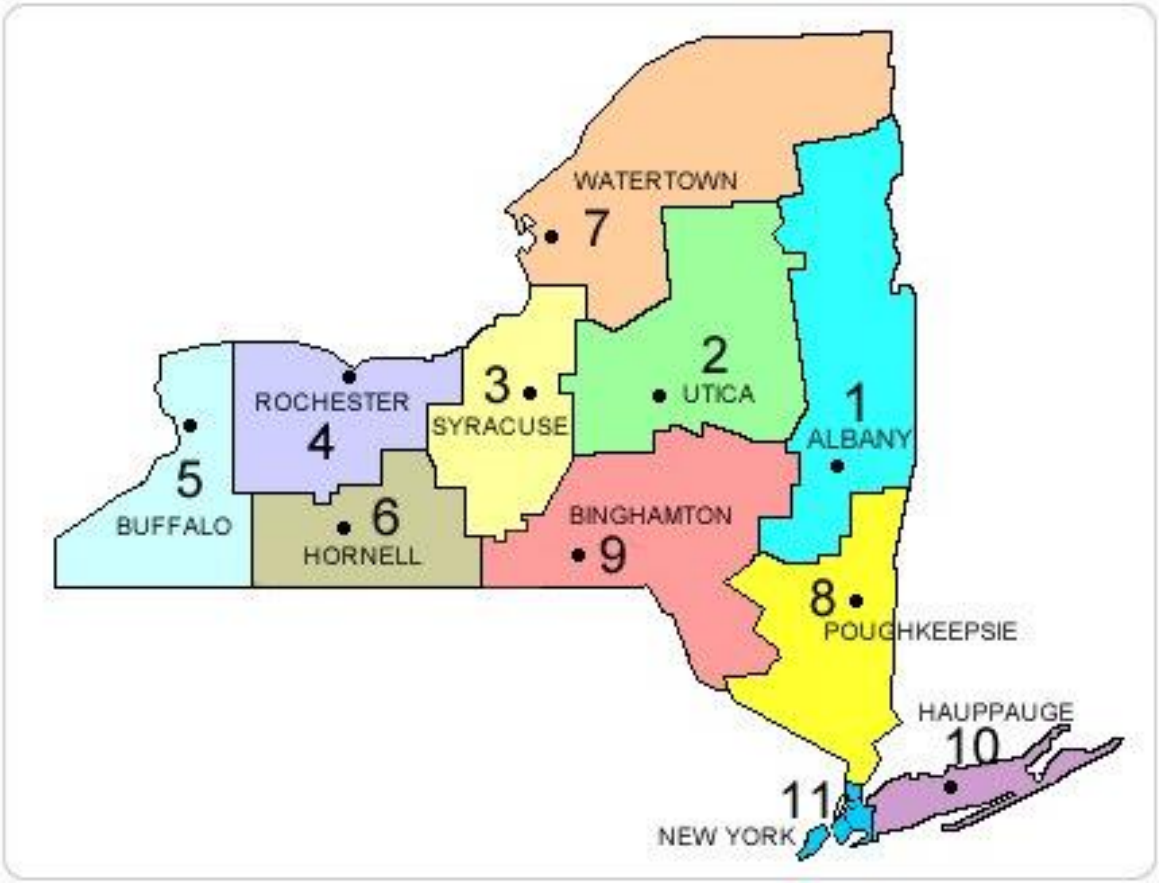

Figure 6 - Map of all eleven regions in New York State (Source: NYSDOT)

9.2. Closure of the Commerce Street Grade Crossing

The Town of Mount Pleasant is conducting a volume, speed, and vehicle classification count study on Commerce Street just south of the grade crossing to be completed by September 2015. The volume, speed, and vehicle classification count study was performed to assist in determining the feasibility of closing the Commerce Street grade crossing. The volume, speed, and vehicle classification count study began at 10:54 a.m. on March 10, 2015 and ended at 12:00 p.m. on March 17, 2015.

Table 6 summarizes the volume count on Commerce Street just south of the grade crossing.

Table 6 - Volume Count on Commerce Street just south of the grade crossing

Time of Day	March 10		March 11		March 12		March 13		March 14		March 15		March 16		March 17	
	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB
0:00	-	-	0	4	0	1	2	0	4	3	4	0	0	0	1	1
1:00	-	-	0	0	1	0	0	3	1	2	1	3	0	0	0	0
2:00	-	-	0	1	0	0	0	0	1	1	1	0	0	0	0	1
3:00	-	-	0	0	0	0	1	0	1	1	0	0	0	0	1	0
4:00	-	-	1	0	1	0	1	0	1	0	0	0	0	0	1	0
5:00	-	-	0	0	1	0	1	1	2	0	1	2	0	3	1	2
6:00	-	-	15	10	12	9	15	8	2	1	2	1	16	9	10	7
7:00	-	-	32	47	32	42	29	43	2	16	5	3	39	33	36	50
8:00	-	-	36	53	28	52	36	42	13	12	3	12	35	37	34	25
9:00	-	-	24	41	21	41	30	37	15	12	6	8	26	24	23	26
10:00	-	-	26	27	22	21	24	33	16	16	19	25	20	24	14	13
11:00	28	19	37	27	28	27	29	27	23	28	7	19	25	27	26	23
12:00	32	29	38	32	26	42	27	39	21	20	28	34	20	29	-	-
13:00	35	23	33	31	25	33	26	42	12	33	19	29	40	30	-	-
14:00	30	25	32	20	34	37	35	23	15	21	19	24	17	34	-	-
15:00	47	27	51	32	42	32	40	42	19	20	24	39	50	35	-	-
16:00	59	41	55	31	52	39	49	51	28	30	16	17	47	45	-	-
17:00	71	49	59	57	48	56	54	48	14	13	20	13	65	48	-	-
18:00	26	32	25	39	30	42	27	37	9	14	12	16	23	35	-	-
19:00	14	17	18	14	16	24	19	16	7	5	13	6	17	21	-	-
20:00	10	14	12	2	11	12	14	16	5	6	6	3	10	20	-	-
21:00	10	9	11	9	10	6	11	10	1	7	4	6	3	8	-	-
22:00	3	6	4	7	4	4	12	12	5	4	5	1	2	6	-	-
23:00	3	4	4	3	4	2	7	5	7	3	2	1	8	2	-	-
Total	**368**	**295**	**513**	**487**	**448**	**522**	**489**	**535**	**224**	**268**	**217**	**262**	**463**	**470**	**147**	**148**
Daily	**663**		**1,000**		**970**		**1,024**		**492**		**479**		**933**		**295**	

Table 7 summarizes the speed count on Commerce Street just south of the grade crossing.

Table 7 - Speed Count on Commerce Street just south of the grade crossing

Speed	Northbound Lane	Southbound Lane	Combined
1 to 5 mph	0	2	2
6 to 10 mph	23	12	35
11 to 15 mph	32	47	79
16 to 20 mph	0	0	0
21 to 25 mph	175	141	316
26 to 30 mph	750	727	1,477
31 to 35 mph	1,209	1,261	2,470
36 to 40 mph	592	662	1,254
41 to 45 mph	108	120	228
46 to 50 mph	12	16	28
51 to 55 mph	0	2	2
85% Speed mph	**31 mph**	**31 mph**	**31 mph**

Table 8 summarizes the vehicle classification count on Commerce Street just south of the grade crossing.

Table 8 - Vehicle Classification Count on Commerce Street just south of the grade crossing

Vehicle Classification	Northbound Lane	Southbound Lane	Combined	Percent
Bikes	6	17	23	0.4%
Cars and Trailers	2,115	1,966	4,081	69.6%
2 Axle Long	549	715	1,264	21.6%
Buses	28	29	57	1.0%
2 Axle 6 Tire	155	229	384	6.6%
3 Axle Single	5	12	17	0.3%
4 Axle Single	1	0	1	0.0%
Less than 5 Axle Double	7	10	17	0.3%
5 Axle Double	1	1	2	0.0%
No Class	4	11	15	0.2%
Totals	**2,871**	**2,990**	**5,861**	**100%**

The Town of Mount Pleasant indicated the following in an email to NTSB investigators dated April 30, 2015 regarding the closure of the Commerce Street grade crossing:

> *"We are preparing an internal report of the grade crossings in relation to their attributes (attached draft), noted deficiencies, traffic volumes (attached sketch), etc. with the likelihood of recommending to the Town Board for the closure of Commerce Street and Cleveland Avenue crossings. Just in final stages of completing the intersection capacity analysis of the re-routed traffic to determine potential impacts of the closures.*
>
> *In discussing with the Supervisor, once report is complete, we will seek a resolution for the Town Board to petition the State to seek immediate closure of Commerce Street with Cleveland Avenue following after required improvements have occurred. Under State law this will require NYSDOT Commissioner to officially start process for grade crossing procedures."*

Table 9 summarizes an internal report prepared by the Town of Mount Pleasant of the grade crossings in relation to their attributes.

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Table 9 - Internal report prepared by the Town of Mount Pleasant of the grade crossings in relation to their attributes

	Crossing Location							
	Stevens*		Commerce		Lakeview		Cleveland	
Approach	WB	EB	WB	EB	WB	EB	WB	EB
Distance to TSP – (a)	156 feet		82 feet		218 feet		87 feet	
Grade % - (b)	-0.4%	-2.0%	-2.0%	3.0%	-7.0%	3.0%	-8.0%	7.5%
Total Grade %	2.4%		5.0%		10.0%		15.5%	
Angle of Approach – (c)								
Left (degrees)	104	112	118	116	76	75	114	134
Right (degrees)	75	69	62	64	105	106	67	43
Approach Speed (mph)	14	14	31	31	15	15	13	13
Safe Stopping Distance								
Sight Distance – (d)								
X-ing at SB, Looking left	125	130	330	110	620	760	650	65
X-ing at SB, Looking right	455	265	110	90	900	300	78	40
Volume								
24 hr	757	716	535	489	1,184	1,472	127	136
AM Peak	122	102	42	39	62	127	2	13
PM Peak	142	132	48	54	139	105	16	7
% Non-Auto	4.9%	1.0%	4.8%	3.4%	0.4%	1.5%	2.6%	1.6%
AM–Delay (v/s) & LOS – (e)	38.2 - D	34.2 - C	30.6 - C	46.0 - D	47.4 - D	62.1 - E	32.7 - C	29.0 – C
PM–Delay (v/s) & LOS – (e)	63.3 - E	29.6 - C	48.7 - D	28.0 - C	56.0 - E	48.6 - D	35.5 - D	27.7 – C
Other Notes:	No Other Access		Building Restricts Sight Distance				Pedestrian Signal on TSP	
			Secondary Access for TSP Closure				Building Restricts Sight Distance	
							School Bus Drop-Off Adj. to Loc.	
							Commuter Lot & Station Nearby	

* - Counts were conducted over Easter holiday and roadway is entrance to Catholic cemetery.

Table 9 Decoder:

(a) – Distance measured from the center of first track to the edge line of the TSP.
(b) – Measured over the first 100 feet of roadway approach.
(c) – Angle measured from the center line of rail to center of road.
(d) – Due to safety concerns, the sight distance was estimated using Google street view and Town topographical maps.
(e) – As per 2005 NYSDEC Dam Closure Traffic Study.

END OF HIGHWAY FACTORS AND RAILROAD GRADE CROSSING FACTUAL REPORT