

CVSA-ISWIM-FHWA WIM Webinar

Thursday November 30th 2023

IMPLEMENTATION OF WIM SYSTEMS
FOR AUTOAMTED ENFORCEMENT OF OVERWEIGHT TRUCKS
ON THE BQE CONCRETE CANTILEVER STRUCTURES



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DAWN HARRISON, P.E. (NYCDOT)

AGENDA



- Team Introduction
- BQE Project Background
- Data Collection: WIM Sensors
- From Data Collection to Automated Enforcement
- Implementation of Automated Enforcement
- Closing Remarks

TEAM INTRODUCTION



Tanvi Pandya, Executive Director, BQE, Design Build & Emergency Contracts

Dawn Harrison, Director, Design & Planning , BQE, Design-Build & Emergency Contracts

Shane Trotman, Civil Design Lead, BQE/, Design-Build & Emergency Contracts



Hani Nassif, Professor & Director of RIME Group and Associate Director of C2SMART

Kaan Ozbay, Professor and Director of C2SMART



Chaekuk Na, Senior Research Associate

Peng Lou, Research Associate, and Senior Str. Engineer



Alex Schumacher, Project Manager & Application Specialist, Kistler Instrument Corp.

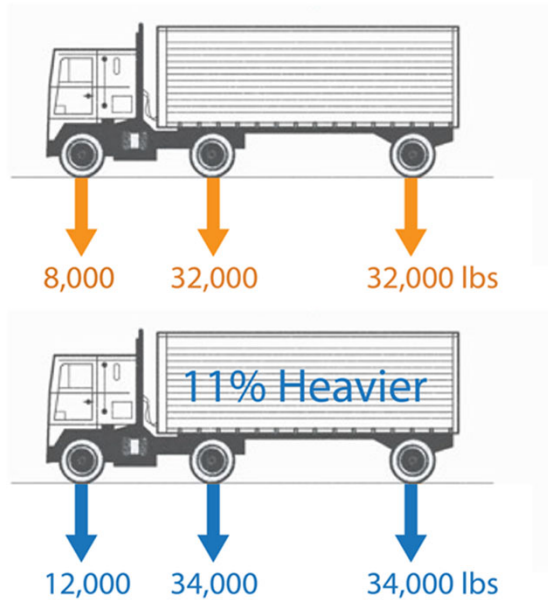
BQE PROJECT BACKGROUND

The BQE is one of the most heavily traveled roadways in New York City, and beyond, with an average daily volume of **130,000 vehicles**, including up to 13,000 trucks:



Key freight route: peak volume of up to 1,100 trucks per hour (500-600 per direction) during weekday mornings.

BQE PROJECT BACKGROUND



1940s
Designed Load

2019
NY State Legal Load

Truck Loading: Then & Now

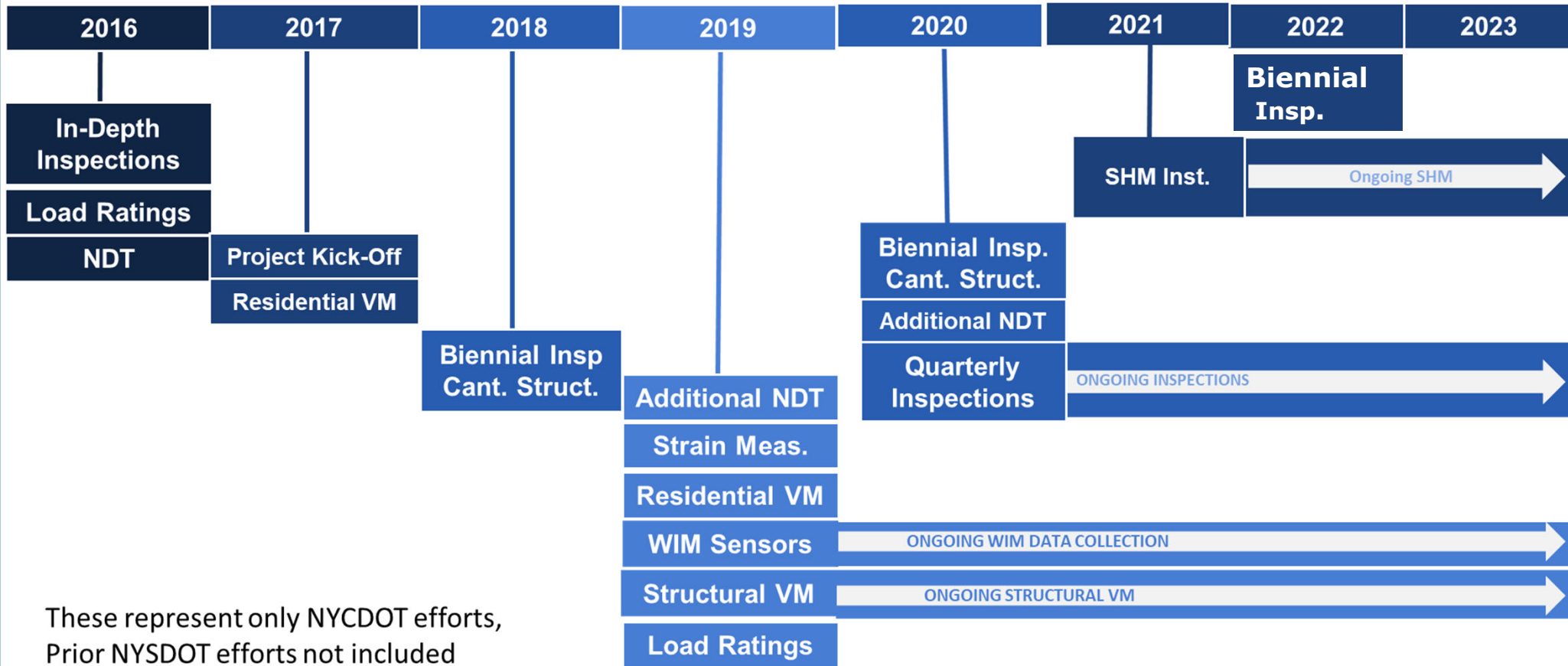
- Based on A.A.S.H.O. 1941 Specifications
- Designed and constructed – 1948 – 1954
- NYS legal load is significantly higher than structure's designed load, and proliferation of overweight trucks continues



BQE PROJECT BACKGROUND



BQE Health Monitoring efforts have been on-going since the Project Kick-Off in the Fall of 2017

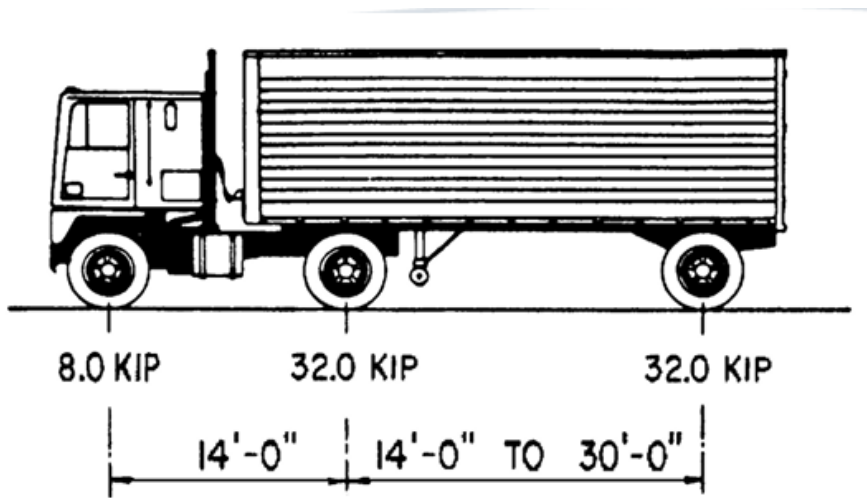


These represent only NYCDOT efforts, Prior NYSDOT efforts not included

DATA COLLECTION: WIM SENSORS

The Truth About Truck Loads

The Truth About Truck Loads



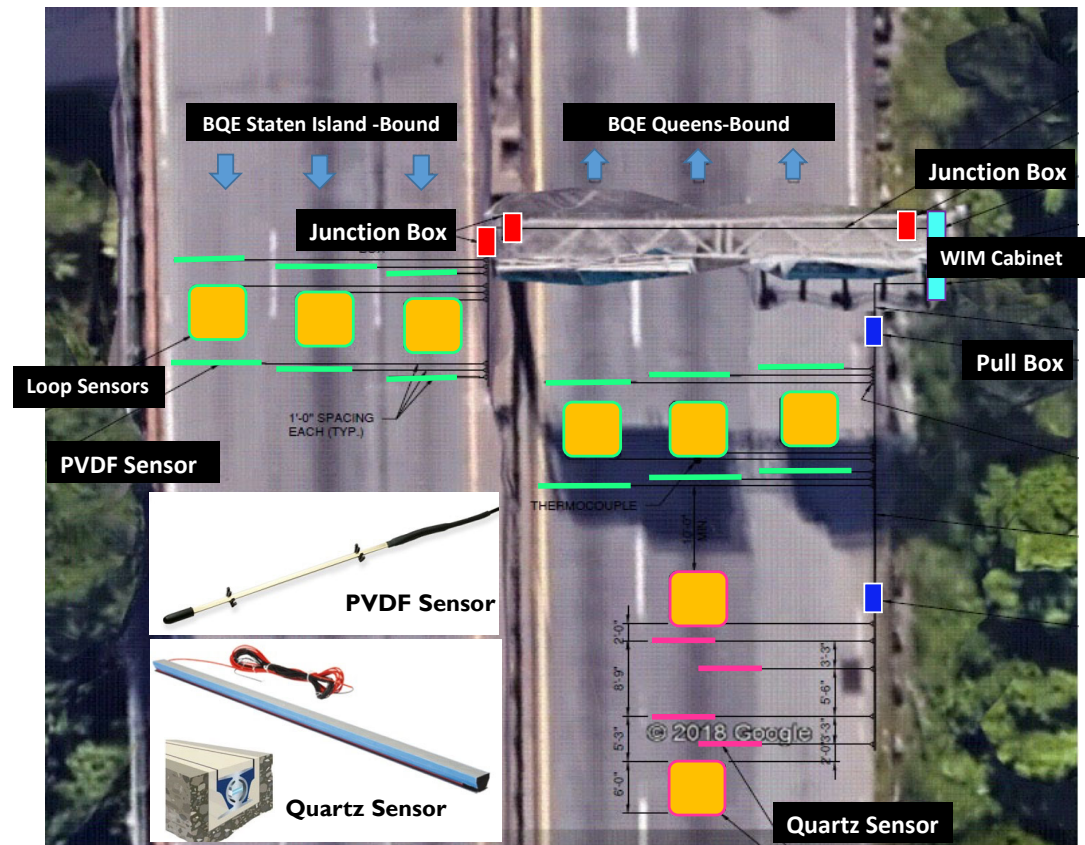
Standard HL-93 AASHTO Design Truck Load



Actual Site-Specific loads

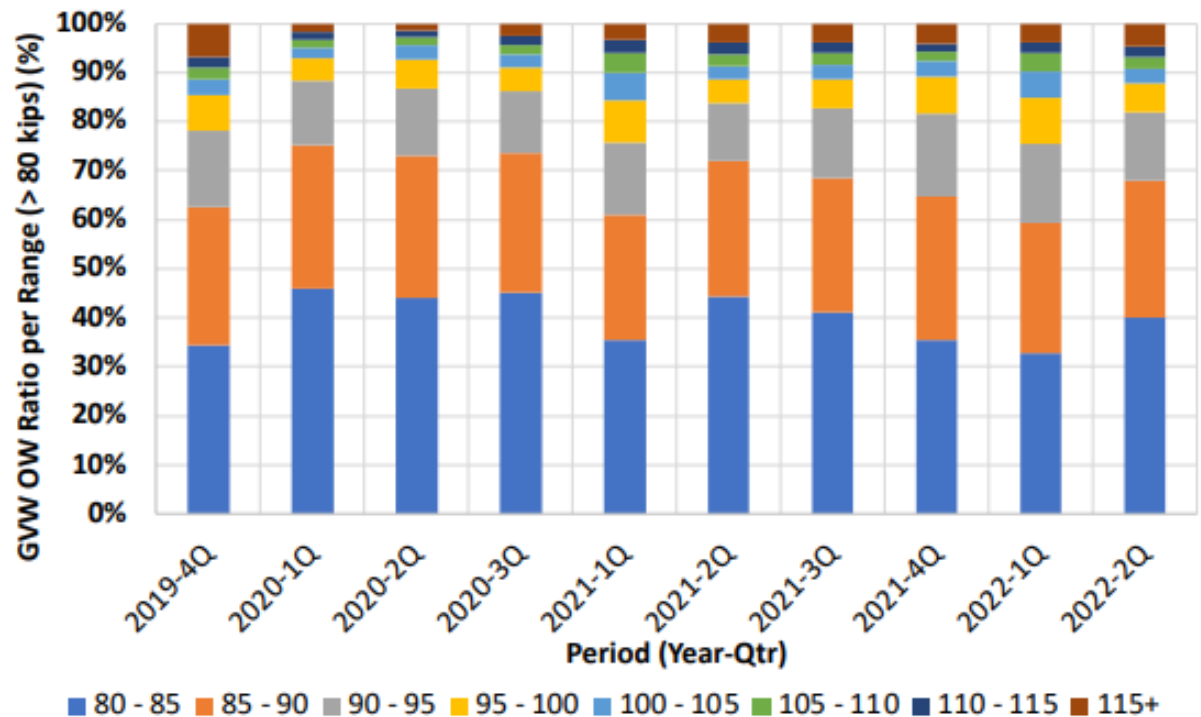
Pilot Study: WIM installed near Pearl St on the BQE

- One QB lane: **Quartz Sensor**
- Remaining Lanes: **PVDF Sensors**
- Installation completed in 2019 with C2SMART/Rutgers Team involved in related research with FHWA on sensors
- Analysis provided by Rutgers/C2SMART Team assisted in site-specific live load factors for LRFR
- Site selected met following conditions:
 1. Section of roadway on grade & tangent
 2. Gantry provided support for conduits
- SIB connected to equipment on QB side of road



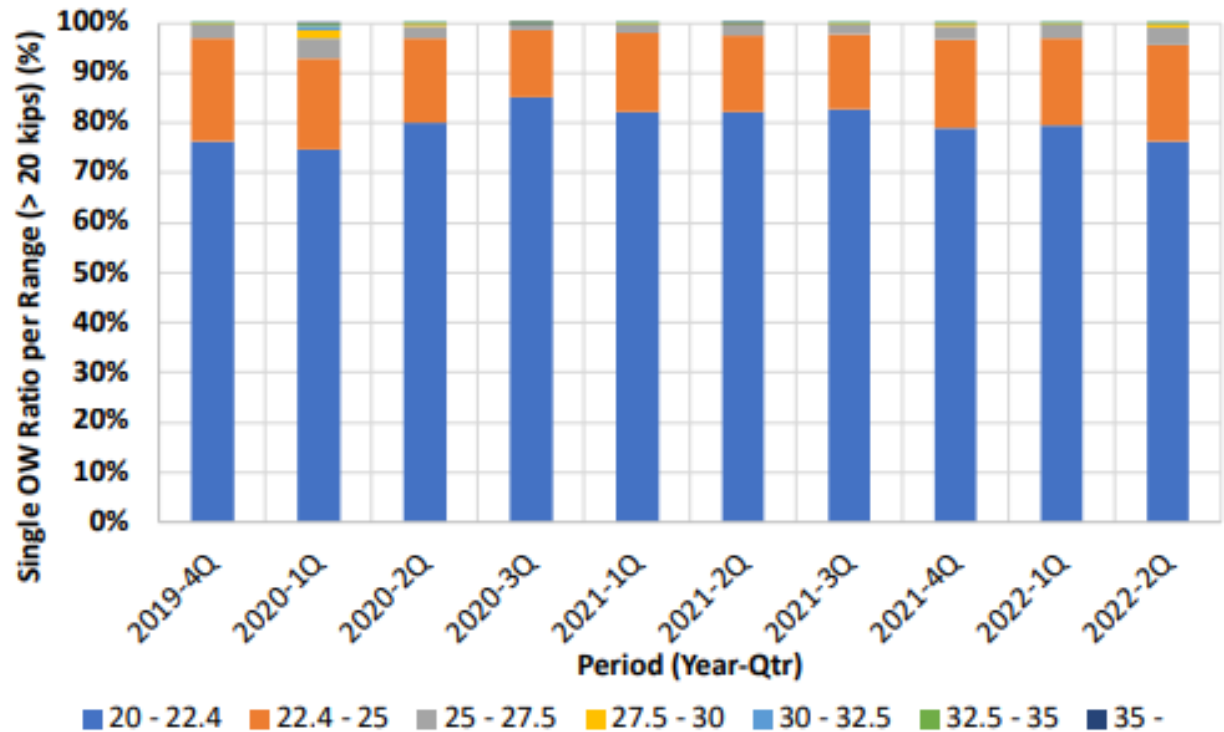
Breakdown of Gross Vehicle Weight Violations

- Roughly 40% of OW, GVW between 80 – 85 kips
- Roughly 30% of OW GVW between 85 – 90 kips
- Remainder of OW GVW over 90 kips, with GVW as high as 120 kips
- OW percentages stay relatively constant, with only minor fluctuations



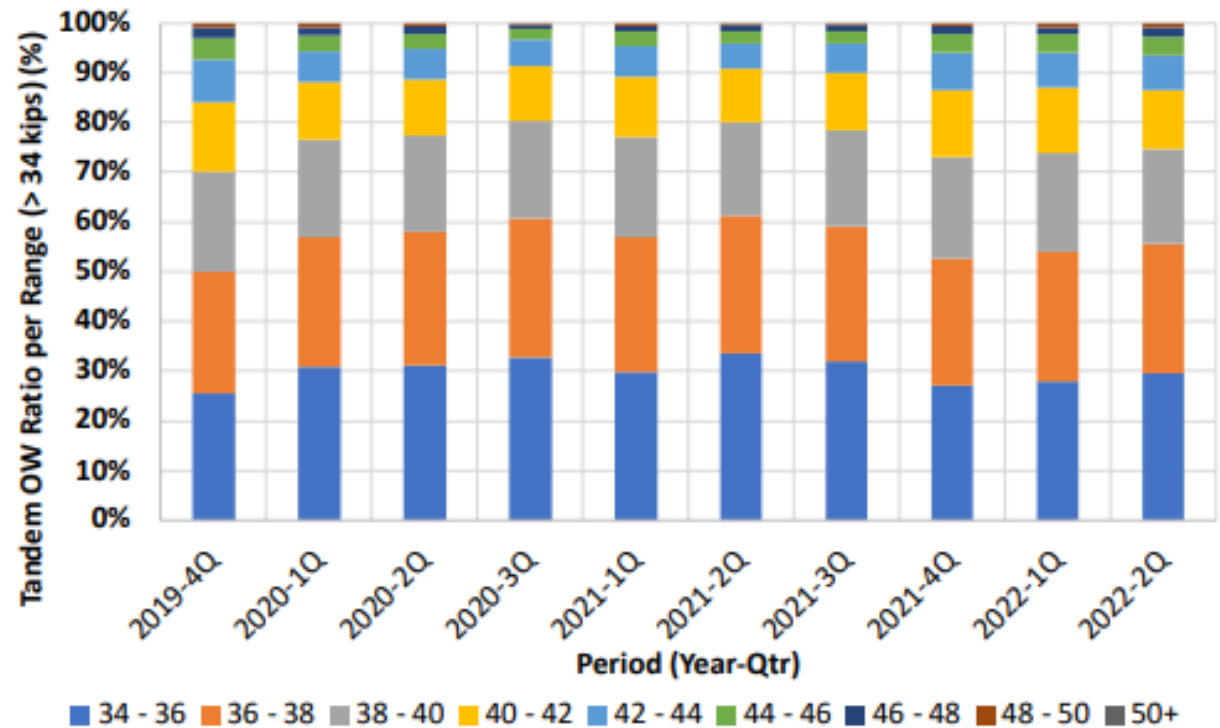
Breakdown of Single Axle Violations (FBF)

- Roughly 75% of OW SA have weights between 20 – 22.5 kips
- Roughly 20% of OW SA have weights between 22 -22.5 kips
- Remainder of OW SA have weights in excess of 22.5 kips, with a maximum > 35 kips
- OW percentages stay relatively constant, with only minor fluctuations



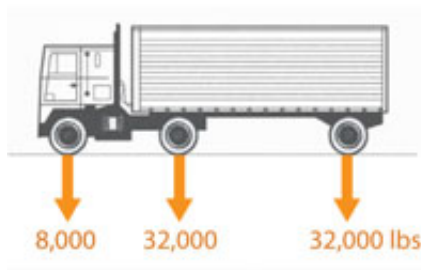
Breakdown of Tandem Violations (FBF)

- Roughly 30% of OW Tandems have weights between 34 - 36 kips
- Roughly 25% of OW Tandems have weights between 38-40 kips
- Remainder of OW Tandems have weights in excess of 40 kips, with a maximum > 50 kips
- OW percentages stay relatively constant, with only minor fluctuations



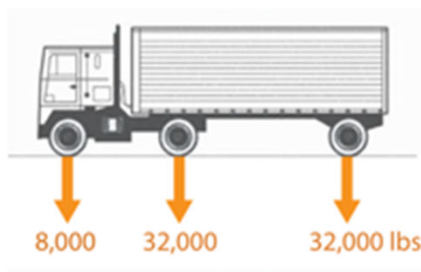
Comparison of Load Factors

- In Bridge design, the standard HL-93 truck load is typically used for analysis, amplified by a **load factor**: (a statistically-determined factor of safety).



X Load Factor_{standard}

- When site-specific loads are calculated using WIM, the standard HL-93 truck load is amplified further to account for the new variation in loads.



X Load Factor_{WIM}

Comparison of Load Factors

Comparing the **standard load factors** with the **load factors calculated to account for site-specific loads** gives a quantitative measure of the effect of site-specific WIM loads on design

LRFD Rating	HL-93 (standard)	Site-Specific (WIM)	% Increase
Staten-Island Bound	1.75	2.13	22%
Queens-bound	1.75	2.31	32%

FROM DATA COLLECTION TO AUTOMATED ENFORCEMENT

Paving the Way & Breaking Ground

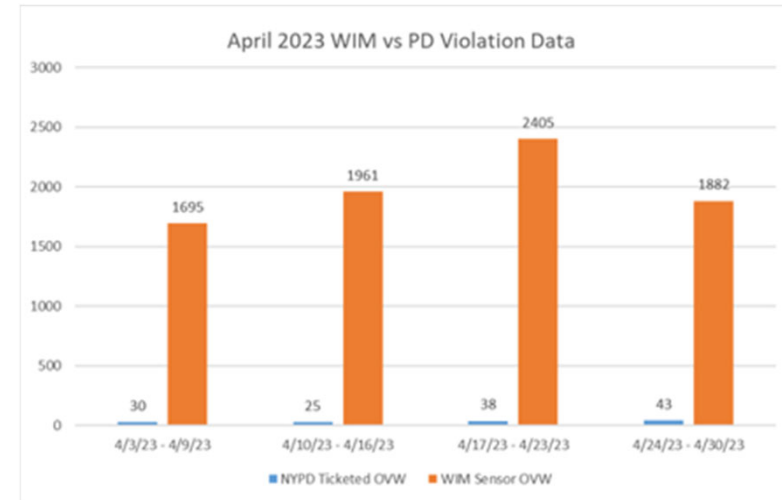
Rules and Regulations

- Truck Movement is governed by regulations at the federal, state and local level for vehicles permitted to operate within a jurisdiction by:
 - Size
 - Weight
 - Length
 - Height
 - Width
- Both the City and State issue oversize and overweight permits for the routing of overweight loads on roadways under their jurisdiction.
- NY State issues divisible loads permits, and, pursuant to State law, the City has grandfathered divisible overweight permits since the 1980s, of which there are a limited number in use today.



BQE Truck Weight Limits Enforcement-to-date

- **Enforcement:** Executive Order 51 issued in January 2020 to provide for strict enforcement of existing weight restrictions on BQE
- **Following the Executive Order, the following notification was sent to all permit holders**
 "To all who currently have a valid NYC DOT Annual Overweight Load and or Annual Special Hauling / Crane permit, Vehicles with NYC DOT Annual Overweight Load and or Annual Special Hauling / Crane permits **are NOT permitted** to travel on the BQE / I-278 from Sands St. to Atlantic Avenue in both directions until further notice."
- New York City's highway network presents operational challenges to law enforcement personnel with limited available space to safely conduct truck stops.



Only **14.6% of overweight trucks** identified along the BQE corridor by NYPD using portable scales

Steps to Automated Enforcement

LEGISLATION



CALIBRATION & CERTIFICATION



IMPLEMENTATION

WIM Calibration Results- 2019 WIM Installation

- Four (4) Quartz sensors were installed in the center lane of the BQE Corridor in 2019.
- The site had no pavement preparation and severe rutting existed
- Quartz sensors were able to comply with accuracy requirements for all standards (ASTM Type III & OIML).
- The max. error for GVW is 4.4% which meets the max. tolerance of 6%. The single axle and tandem axle meet the tolerance of 15% and 10%, respectively for ASTM type III.

Standards		GVW	Sgl	Tan
Calibration (10/17/2020) - Trucks: C9, C9S, C6, C5 ^a , C5 ^b	No. of Test	30	30	42
	Max Error (%)	4.4	12.4	8.0
	Compliance (%)	100	100	100
RE-Calibration (12/07/2021) - Trucks: C9, C7	No. of Test	6	6	9
	Max Error (%)	4.7	5.8	9.6
	Compliance (%)	100	100	100
ASTM E1318 Type III	Target Accuracy at 95% Compliance	6%	15%	10%



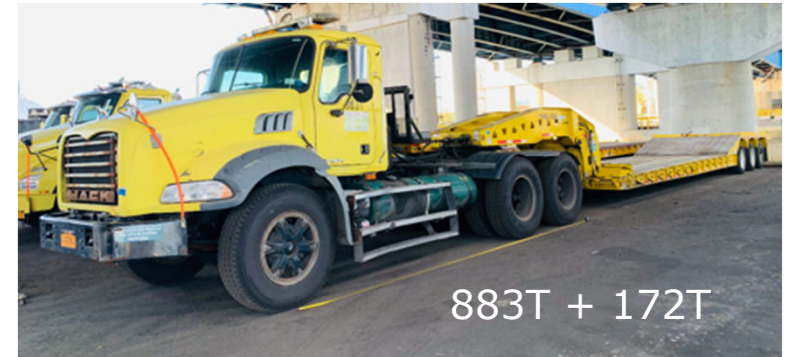
(Notes for the Table) C = FHWA Classification, e.g., C9 = Class 9, C9S = Class 9 Split Tandem, C5^a= bigger Class 5, C5^b= smaller Class 5

Calibration Trucks

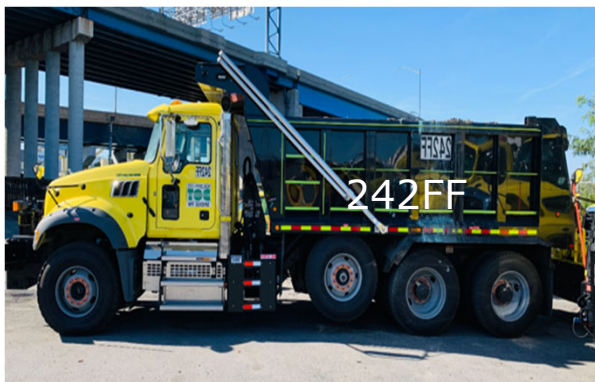
R1, Class 9, Type 3S2
(**ASTM**, **NIST**, **COST** and **OIML**)



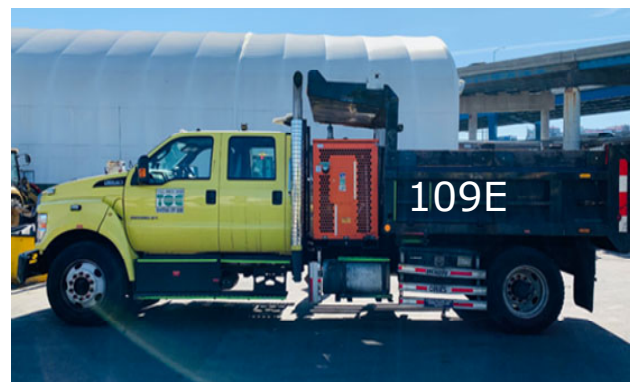
R2, Class 9, Type 3S2 Split
(**ASTM**, **COST** and **OIML**)



R3, Class 6, Dump Truck
(**COST** and **OIML**)



R4, Class 5
(**NIST**, **COST** and **OIML**)



R5, Class 5
(**NIST**, **COST**, and **OIML**)

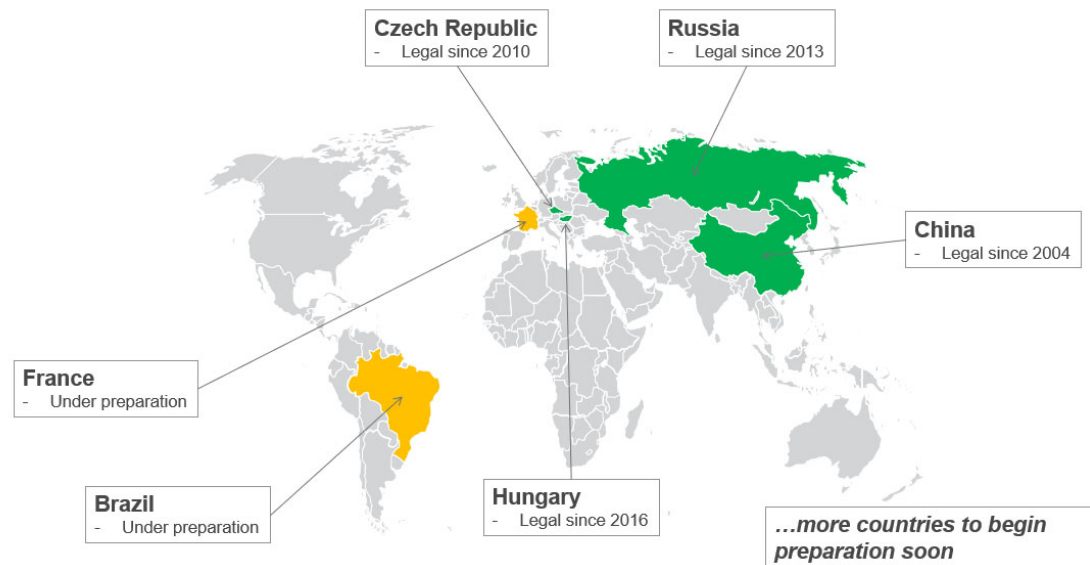


Fleet Services

FROM DATA COLLECTION TO AUTOMATED ENFORCEMENT

- The combination of calibration results and the prevalence of overweight vehicle created the opportunity to push for direct enforcement legislation.
- While traditional static scales may be more accurate, the space constraints and personnel requirements severely limit the actual enforcement of truck weight limits
- Automated weight enforcement benefits:
 - Legally operating trucking companies, law enforcement, drivers, general public
 - Also benefits non-compliant trucking companies
 - Typical enforcement weighing methods take the driver out of service for hours
 - Need to foster a culture of regulatory compliance and even the playing field

Why direct enforcement is timely: Leverage technology for more efficient use of resources



NYS Legislation Overview

Amended in 2023: S6246/A6225

Dec 23, 2021	APPROVAL MEMO.151	Approved.
Dec 22, 2021	SIGNED CHAP.773	
Dec 10, 2021	DELIVERED TO GOVERNOR	
Jun 08, 2021	Returned To Senate Passed Assembly Home Rule Request Ordered To Third Reading Rules Cal.536 Substituted For A2316a	
Jun 03, 2021	Referred To Codes DELIVERED TO ASSEMBLY PASSED SENATE HOME RULE REQUEST	
May 24, 2021	AMENDED ON THIRD READING 2740B	
Apr 26, 2021	ADVANCED TO THIRD READING	
Apr 21, 2021	2ND REPORT CAL	
Apr 20, 2021	1ST REPORT CAL.707	
Apr 08, 2021	PRINT NUMBER 2740A	
Apr 08, 2021	AMEND AND RECOMMIT TO TRANSPORTATION	
Jan 25, 2021	REFERRED TO TRANSPORTATION	Introduced.

- Establishes a weigh-in-motion (WIM) demonstration program on I-278 in Kings County (Brooklyn, NY), imposing monetary liability for failure of an operator to comply with gross vehicle weight and/or axle weight restrictions; and
- The installation and operation of up to (16) sixteen weigh-in-motion violation monitoring systems within the vicinity of the Atlantic Ave. interchange to Sands St.
- Calibration & Certification of Calibration Required every 6 months
- **Violations**
 - GVW at least **10%** above gross vehicle weight restrictions
 - FHWA GVW Limit = 80 kips or Federal Bridge Formula
 - Axle/Tandem weights at least **20%** overweight restrictions
 - At least two independent weight measurements obtained by the WIM monitoring system

Calibration & Certification – Technical Considerations

State Department of Agriculture typically certifies all commercial as well as enforcement equipment using NIST Handbook 44 Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices

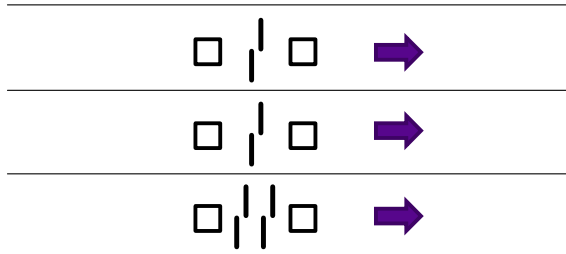
- Existing NIST Handbook 44 currently has a tentative code for screening of vehicles
- ASTM 1318:
 - Type IV system potentially for automated enforcement for speeds of 2 – 10 mph.
 - The Type 3 system is defined as a system to be used for screening for weight violations only
- OIML R134-1: A comprehensive existing standard available for reference
- August 2022 Formal effort for update of NIST Handbook 44 to address code for direct enforcement

Comparison of Various WIM Calibration Standards

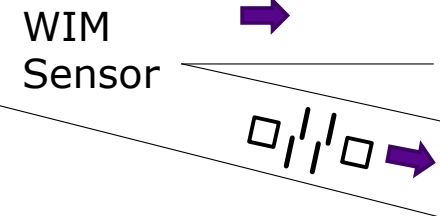
Standard	ASTM E1318	NIST HB 2.26 Proposed	OIML R134-1
Accuracy Tolerance (target requirement)	Type III (Enforcement on mainline) <ul style="list-style-type: none"> • GVW 6%; • Single 15%; • Tandem 10%; • Wheel 20% @ 95% compliance	Class <ul style="list-style-type: none"> • GVW 10%; • Single 20%; • Tandem 15% @ 100% compliance	Class F10* <ul style="list-style-type: none"> • GVW 5% (verification) and 10% (in service) • Axle (S/T) 8% (verif.) and 16% (in service) @ 100% compliance
Truck GVW	90%+ of GVWR (72+ kips)	Loading (full) and unloading (partially loaded)	Loading (full) and unloading (empty)
Calibration Test	Minimum 12 runs (2 trucks) <ul style="list-style-type: none"> • 6 runs per truck • 2 runs at 3 speeds in the lane center • 2 runs at 2 speeds on the edge (left/right) 	Minimum 90 runs (3 trucks min) <ul style="list-style-type: none"> • 30 runs per truck • Combination of runs at 2 speeds and 2 loading conditions 	Minimum 90 runs (3 trucks) <ul style="list-style-type: none"> • 30 runs per truck • 5 runs at 3 speeds and 2 loading conditions

Demonstration of the calibration process from the proposal was conducted in Madison WI in April 2023

Existing Madison SWEF is OW screening site. Demonstration utilized existing configuration.



WIM Sensor USDOT Camera LPR Camera



Calibration/Certification Progress

- NIST Handbook update effort is still in progress.
- ASTM Code update is also currently in progress

In the meantime:

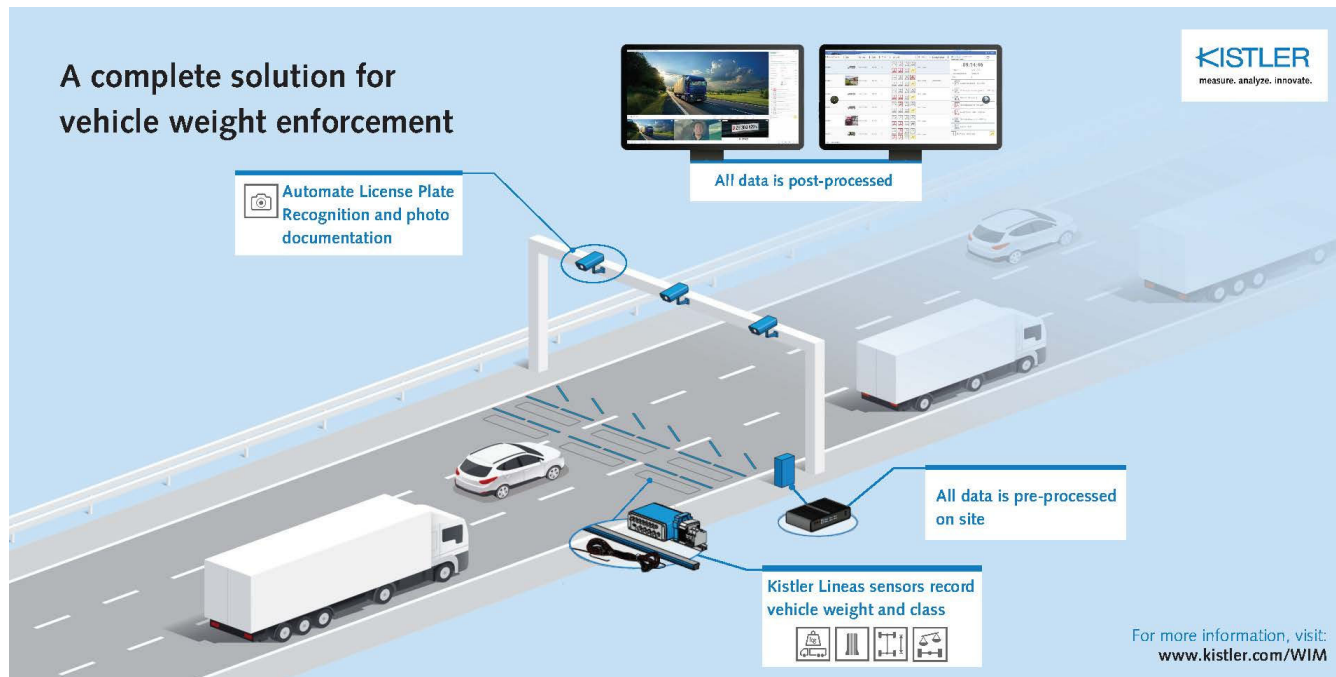
- NYCDOT entered a MOA with NYS Dept of Agriculture to certify the system as a pilot.
- They have the authority to test/certify equipment outside of the handbook guidelines.
- Until the handbook is updated, they will use the most recent version of the proposed standard under informational status with national weights and measure for handbook update

AUTOMATED ENFORCEMENT - IMPLEMENTATION

AUTOMATED ENFORCEMENT - IMPLEMENTATION



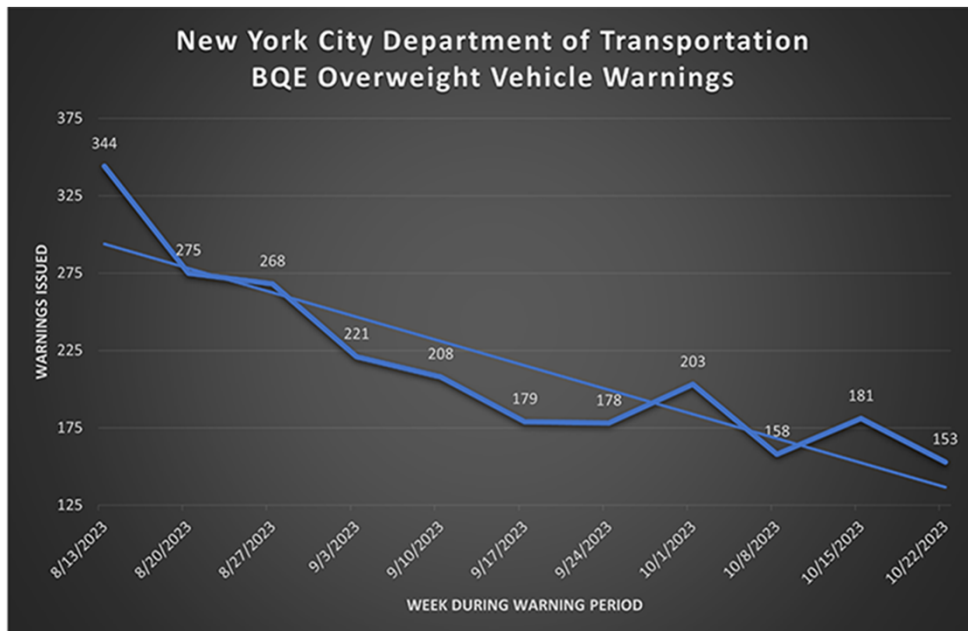
Sample System Configuration: Followed the legislative requirements for evidentiary package & code requirements – QB system installation in October 2022



The related system programming completion along with administration platform development completed in summer of 2023

Warning Period

- WIM system is currently installed in the QB direction
 - 90-day warning period began on **August 10, 2023** ended on **November 8 2023**.
- Warning notices did not carry a fine and will not accrue points or any other liability on vehicle registration.



New York City Department of Finance
Weigh-In-Motion Enforcement Program
PO Box 3641 Church Street Station New York,
NY 10008-3674

W
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M

WARNING NOTICE

Owner's Name
Owner's Address
City, State, Zip

PLEASE TAKE NOTE: In accordance with New York State Vehicle and Traffic Law section 385-a, the photographed vehicle has been detected by the NYCDOT Weigh-in-Motion violation monitoring system located on that portion of Interstate Route 278 (also known as the Brooklyn-Queens Expressway) specifically from the vicinity of Atlantic Avenue to the vicinity of Sands Street in Kings County (Brooklyn), NY traveling:

- at least 10% above the gross vehicle weight limit (80,000 lbs.) at the above stated date and time.

	Gross Vehicle Weight Measured
Sensor Set 1	
Sensor Set 2	

This is a Warning Notice.

There are no penalties associated with this Notice.

There are no points associated with this Notice.

No response or action is necessary.

Please be advised that Weigh-in-Motion violations may subject you to a fine.

System Certification

- WIM system was tested using the procedure submitted to NWM S&T Committee on 8/14/2023
- Weighed at local static scale for reference
- Test completed over 2 nights NYCDOT attenuator truck for traffic management
- Fleet of 6 trucks -10 runs of the full fleet of 6 followed by 10 runs of 3 fully loaded trucks per lane

Load Condition	Speed
Half Load (10 runs)	High Speed Vmax (5 runs)
	Low Speed Vmin (5 runs)
Full Load (20 runs)	High Speed Vmax (10 runs)
	Low Speed Vmin (10 runs)



System Certification – Inspector View

- Testing consisted of field visit, witnessing of reference scale weighing, measurement of axle spacing of each truck
- Test runs were viewed from multiple cameras along with direct feed from the data logger
- Test completed over 2 nights with assistance from NYCDOT attenuator truck for traffic management
- Concurrent logging of data by inspectors into their verification tabulation

Table T.2.3 Maintenance Tolerances for Accuracy		Test Result
Load Description*	Tolerance as a Percentage of Applied Test Load	
Axle Load	± 20 %	✓
Axle Group Load (including bridge formula)	± 15 %	✓
Gross Vehicle Weight	± 10 %	✓
* All weight readings shall be 100% in compliance.		✓



AUTOMATED ENFORCEMENT - IMPLEMENTATION



Violations

- Violations began to be issued on November 14, 2023; overweight trucks captured on the BQE WIM system (QB direction only) will be subject to a \$650 fine per violation.
- Separate violations can be issued for exceeding both axle/tandem and gross weight

New York City Department of Finance
Weigh-In-Motion Enforcement Program
PO Box 3641 Church Street Station
New York, NY 10008-3641



**NOTICE OF LIABILITY / CERTIFICATE
CHARGING THE LIABILITY**

View your records online at
www.wimviolations.nyc.gov
NOTICE #: 4500000215
PIN: 8839

#BWCFGHJ
#45000002158#



ISSUE DATE: 11/14/2023 DUE DATE: 12/14/2023

PLEASE TAKE NOTE:

In accordance with New York State Vehicle and Traffic Law section 385-a, the photographed vehicle has been detected by the NYCDOT Weigh-In-Motion (WIM) violation monitoring system located on that portion of interstate route 278 (also known as Brooklyn-Queens Expressway) specifically from the vicinity of Atlantic Avenue to the vicinity of Sands Street in Kings County (Brooklyn), NY traveling at least 20% above the axle weight limit (22,400 lbs. for a Single Axle and 36,000 lbs. for a Tandem-Axle) at the stated date and time.

You are liable to pay a monetary penalty for the amount shown. This amount is due within 30 days of the date of this Notice. Photographs evidencing the plate and violation are shown. Please see the additional pages of this Notice for further instructions.

VIOLATION DATE	VIOLATION TIME	FINE AMOUNT
11/13/2023	01:36:06 AM	\$650.00
LOCATION EB BQE (I-278) MP 2.9 Lane 2; Interstate route 278 specifically from the vicinity of Atlantic Avenue to the vicinity of Sands Street in Kings County, NY		
Axle Weights Measured (lbs.) Sensor Set 1: Tandem - 47,960 bs		Maximum Axle Weight (lbs.) Single Axle: 22,400 lbs; Tandem-Axle: 36,000lbs;
Sensor Set 2: Tandem - 49,460 bs		

There are no points associated with this Notice.



USDOT #



Make your check or money order payable to the
NYC Department of Finance

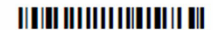
Detach and mail this coupon with your payment

DO NOT MAIL CASH

Write on the front of your payment:
1) the 10-digit Notice Number
2) Your Plate Number
3) Your State of Registration
4) Your Plate Type

Insert this tear off coupon in the enclosed envelope

NYC DEPARTMENT OF FINANCE
Weigh-In-Motion
Enforcement Program
PO BOX 3641
CHURCH STREET STATION
NEW YORK, NEW YORK 10008-3641



NAME		AMOUNT DUE	
[Redacted Name]		\$650.00	
NOTICE NUMBER	VERSION	ISSUED	DUE DATE
4500000215	1	11/14/2023	12/14/2023
PLATE NUMBER	STATE	TYPE	WIM SYSTEM ID
[Redacted Plate]	US-NY	COMMERCIAL	870501

Notice Requirements

Gross Vehicle Weight Violations

- Date and time of violation
- License plate photograph
- GW Measured per sensor set
- Allowable maximum Weight per bridge formula
- Link to website for view record online
- NOL issued to Owner / Responsible Party (Rental)

Axle Weight Violations

- Date and time of violation
- License plate photograph
- Each Axle Weight Measured per sensor set
- Allowable maximum for the axle in violation per bridge formula
- Additional tabulation of axle spacing and weights for identification of axle in question, e.g., tandem
- Link to website for view record online
- NOL issued to Owner / Responsible Party (Rental)

Each violation reviewed by NYCDOT personnel to ensure integrity of package

CLOSING REMARKS

So what now?

- NYCDOT is the first agency in the nation to implement WIM for automated enforcement
- Installation for SIB direction is anticipated for spring 2024 and will be followed by a 90-day warning period following installation.
- Outreach with Freight partners to foster a culture of regulatory compliance and even the playing field
- NYCDOT is actively working with authorizing entities, including, FHWA, to educate and inform the industry on the WIM installation, calibration, and enforcement process.

This is Only the Beginning !

CLOSING REMARKS



- Protecting our infrastructure and safer highways requires efficient means to enforce truck weight limits along with other related enforcement
- There is a gap in communications in achieving this goal –
 - For instance –
 - DOT needs to protect bridges from overweight vehicles, may or may not be involved in weight enforcement
 - Highway Safety Personnel need to ensure vehicles are following safety standards
 - Department of Agriculture reviews Handbook 44 which would set the standards for technology
 - Who talks to all three to ensure all goals are being achieved?
- For now, what we ask of you: Reach out to your respective state DOT, Highway Safety or Department of Agriculture to connect the dots on why we need a standard in NIST Handbook

THANK YOU!