



# Southern African Transport Conference

[www.satc.org.za](http://www.satc.org.za)

7 - 10 July 2025

Mobility Solutions to  
Southern African Challenges

## IMPLEMENTATION OF WIM SYSTEMS FOR DIRECT ENFORCEMENT OF WEIGHT LIMITS ON THE BQE CONCRETE CANTILEVER STRUCTURES



Tanvi Pandya, P.E. DBIA, Executive Director  
Design Build/Emergency Contracts,  
Bridges Division, New York City Dept. of Transportation



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





**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  
**Patrick Lou**, Research Associate, and Senior Str. Engineer



Kistler Instrument Corp.



Design Support

# BQE PROJECT BACKGROUND

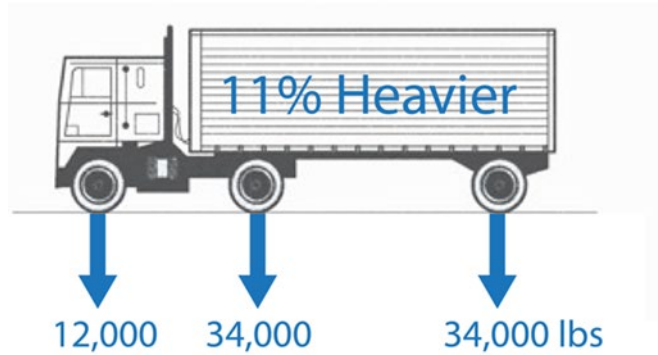
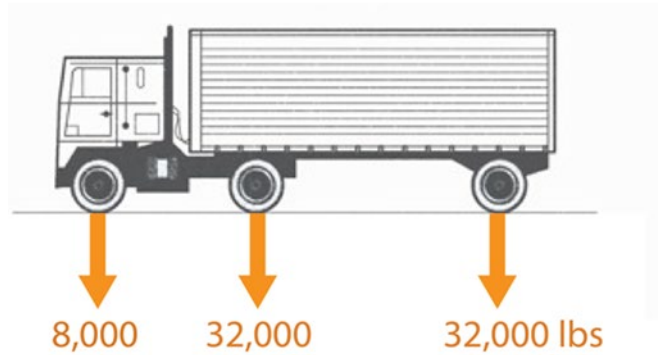
# BQE PROJECT BACKGROUND

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.

# 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



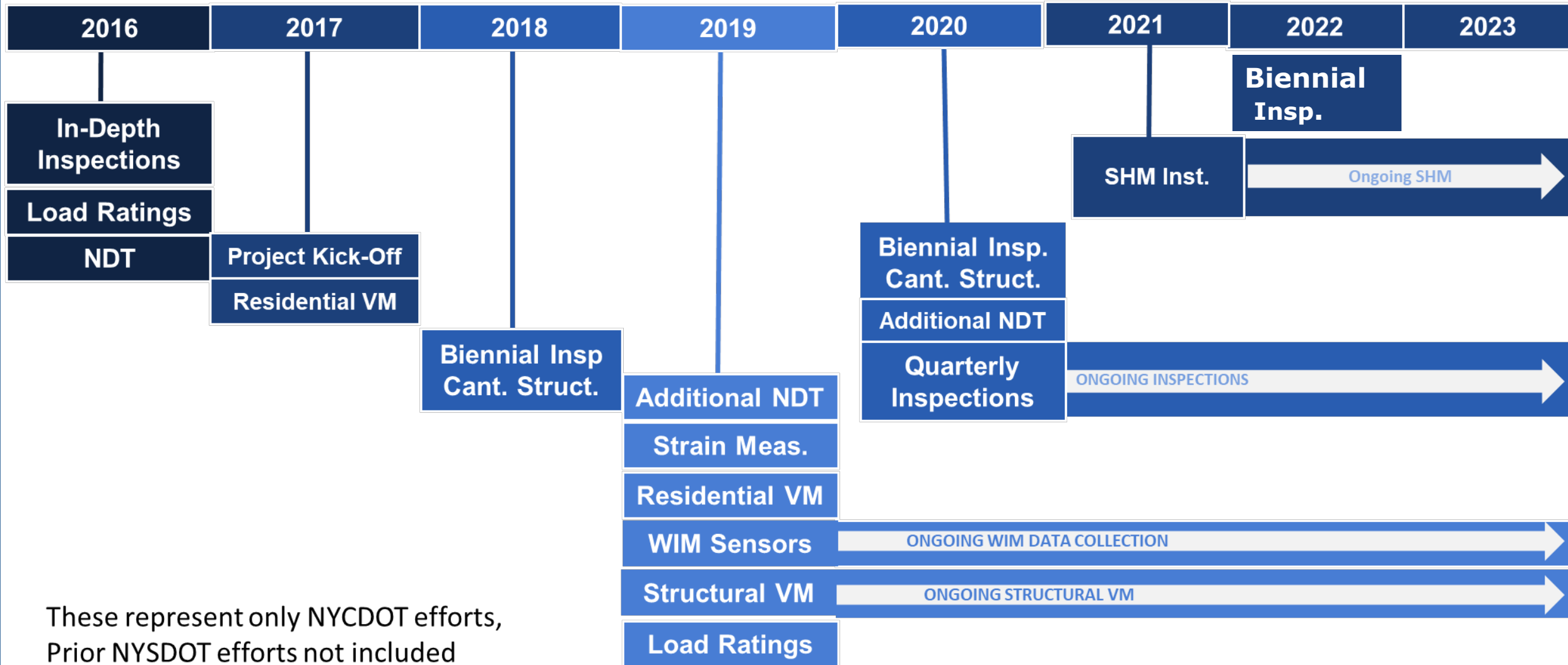
# DATA COLLECTION: WIM SENSORS

## *The Truth About Truck Loads*

# STRUCTURAL ASSESSMENT



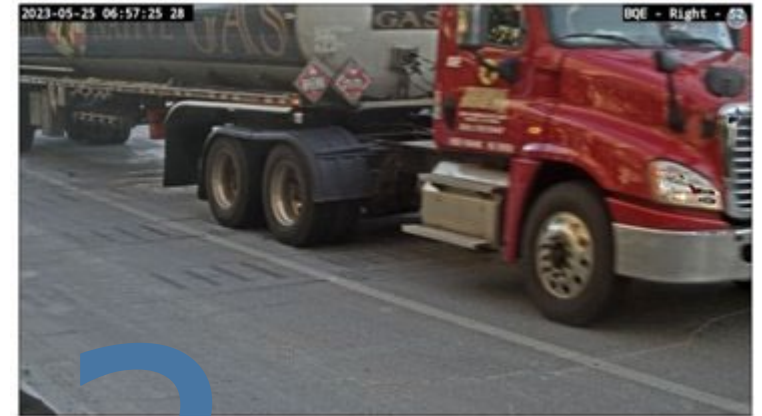
BQE Health Monitoring efforts have been on-going since the Project Kick-Off in the Fall of 2017



These represent only NYCDOT efforts, Prior NYSDOT efforts not included

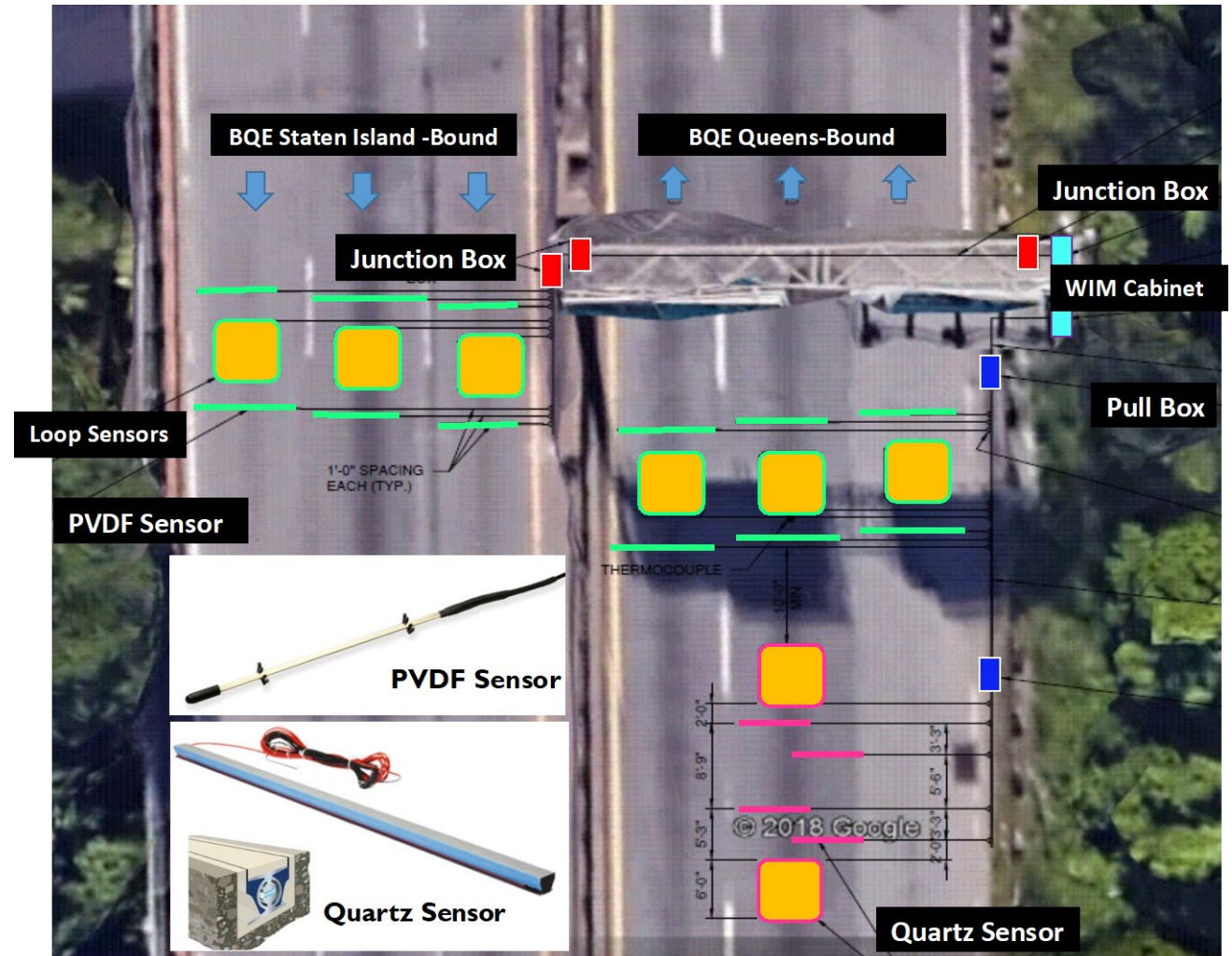
# BQE TRUCK WEIGHT DESIGN & LEGAL LOAD

- As the approaches end of useful life, data collection & enforcement efforts provide for continued lifespan of structure
- New York State legal load is significantly higher than structure's design load, and proliferation of overweight trucks continues
- So the question arose, what is the actual live load?



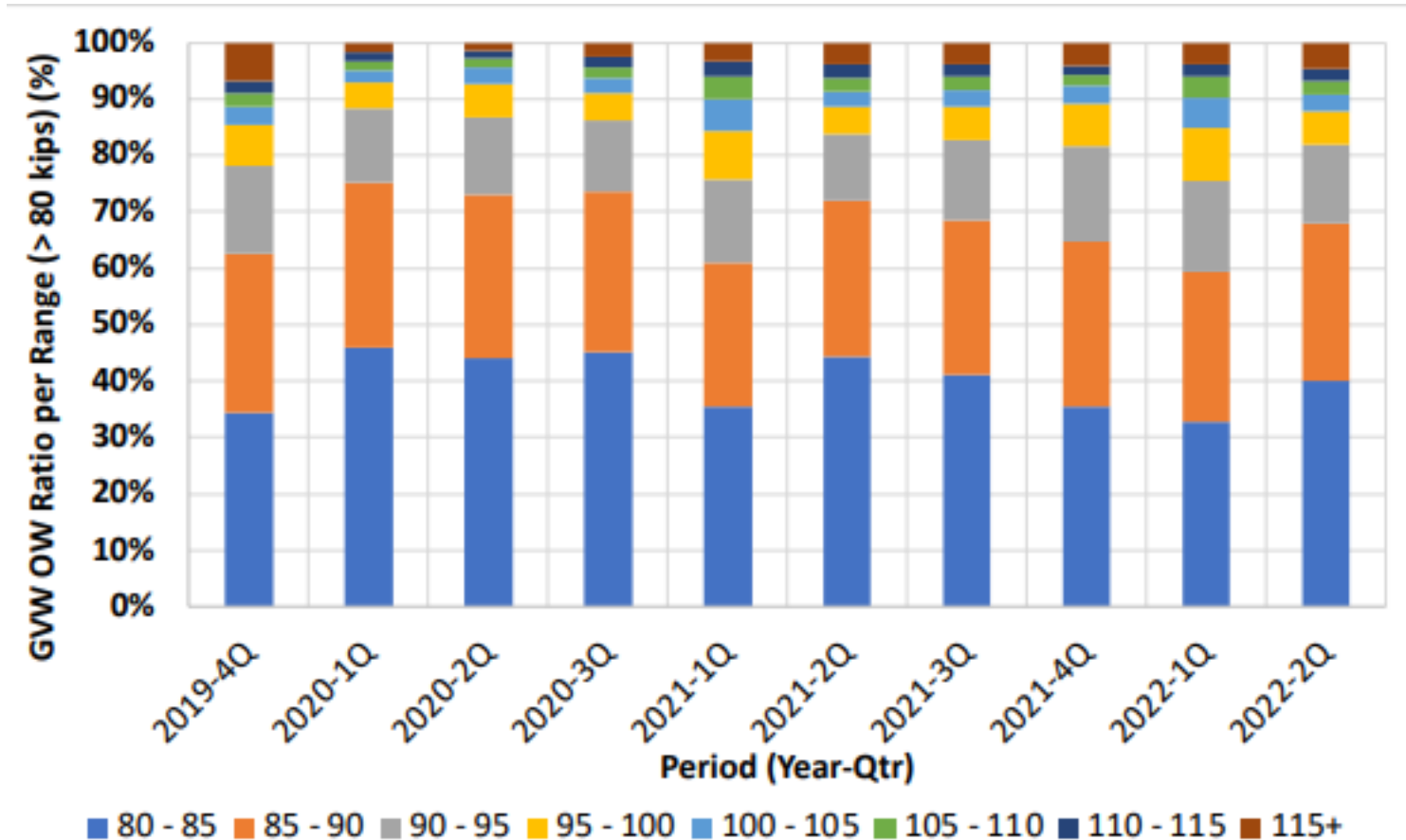
## Pilot Study: WIM installed on the BQE

- 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



# 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 DIRECT 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.

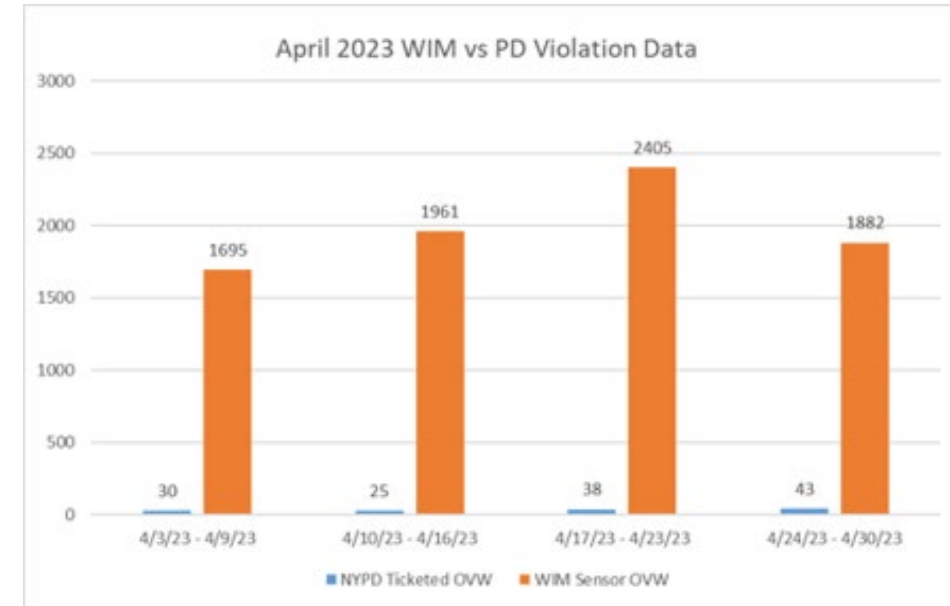


# BQE TRUCK WEIGHT LIMITS ENFORCEMENT-TRADITIONAL

- **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.



Less than **2% of overweight trucks** identified along the BQE corridor by NYPD using portable scales

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
<b>Calibration</b> (10/17/2020) - Trucks: C9, C9S, C6, C5 <sup>a</sup> , C5 <sup>b</sup>	No. of Test	30	30	42
	Max Error (%)	4.4	12.4	8.0
	Compliance (%)	100	100	100
<b>RE-Calibration</b> (12/07/2021) - Trucks: C9, C7	No. of Test	6	6	9
	Max Error (%)	4.7	5.8	9.6
	Compliance (%)	100	100	100
<b>ASTM E1318</b> <b>Type III</b>	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<sup>a</sup>= bigger Class 5, C5<sup>b</sup>= smaller Class 5

- 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
- Direct weight limit 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**

- 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
- 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

- 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

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

Demonstration of the calibration process from the proposal in April 2023  
 2024 NIST Proposal added a higher accuracy class similar to OIML, Class 5 with 5% for GVW

# CALIBRATION DEMONSTRATION

Existing Madison is OW screening site used for calibration proposal demonstration



**WIM on Mainline**



**WIM on Ramp**



**Static Scale**

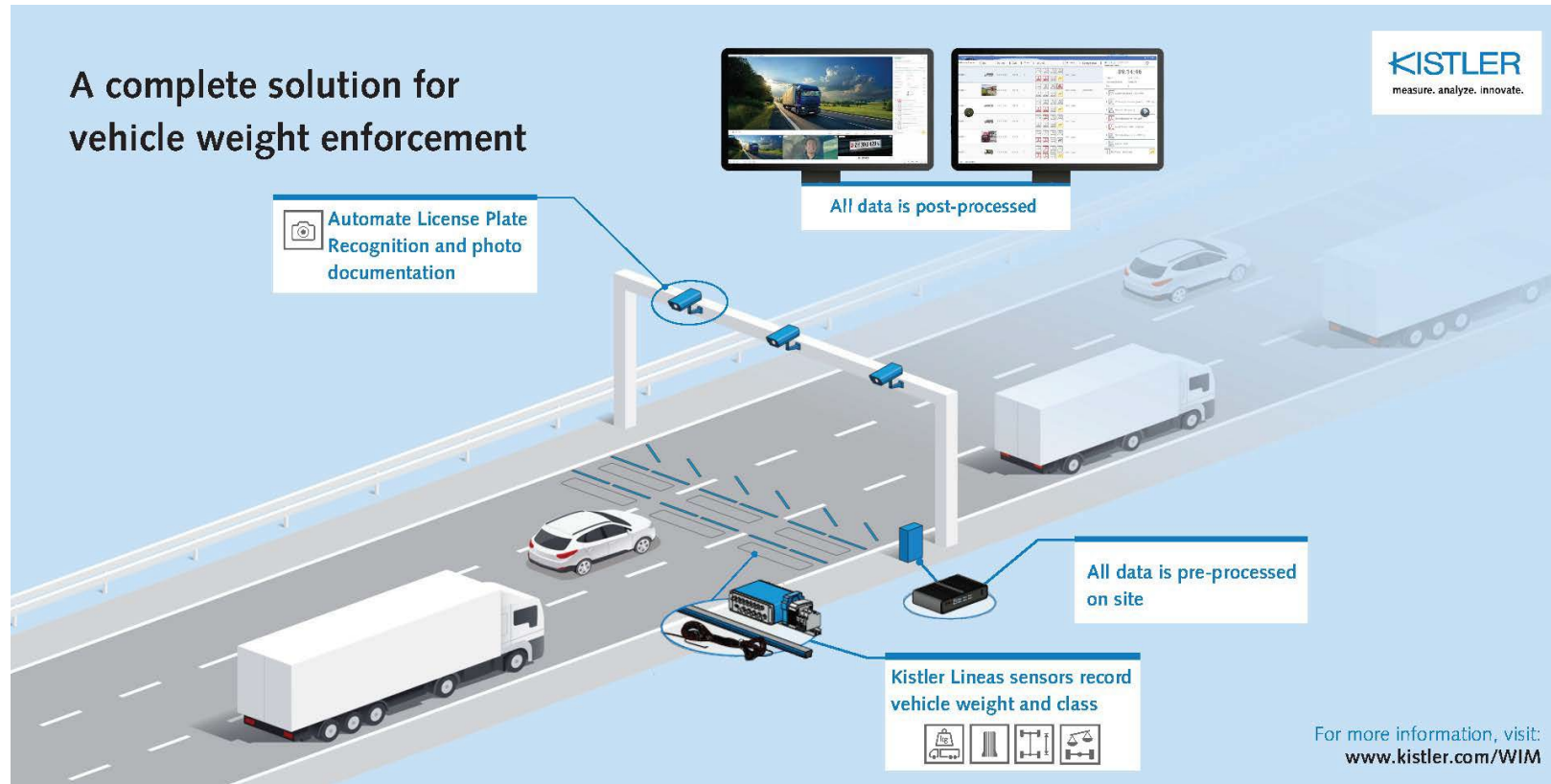
- NIST Handbook 44 update to be voted on next month!
- ASTM Code update is also currently in progress

## **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

# DIRECT ENFORCEMENT - IMPLEMENTATION

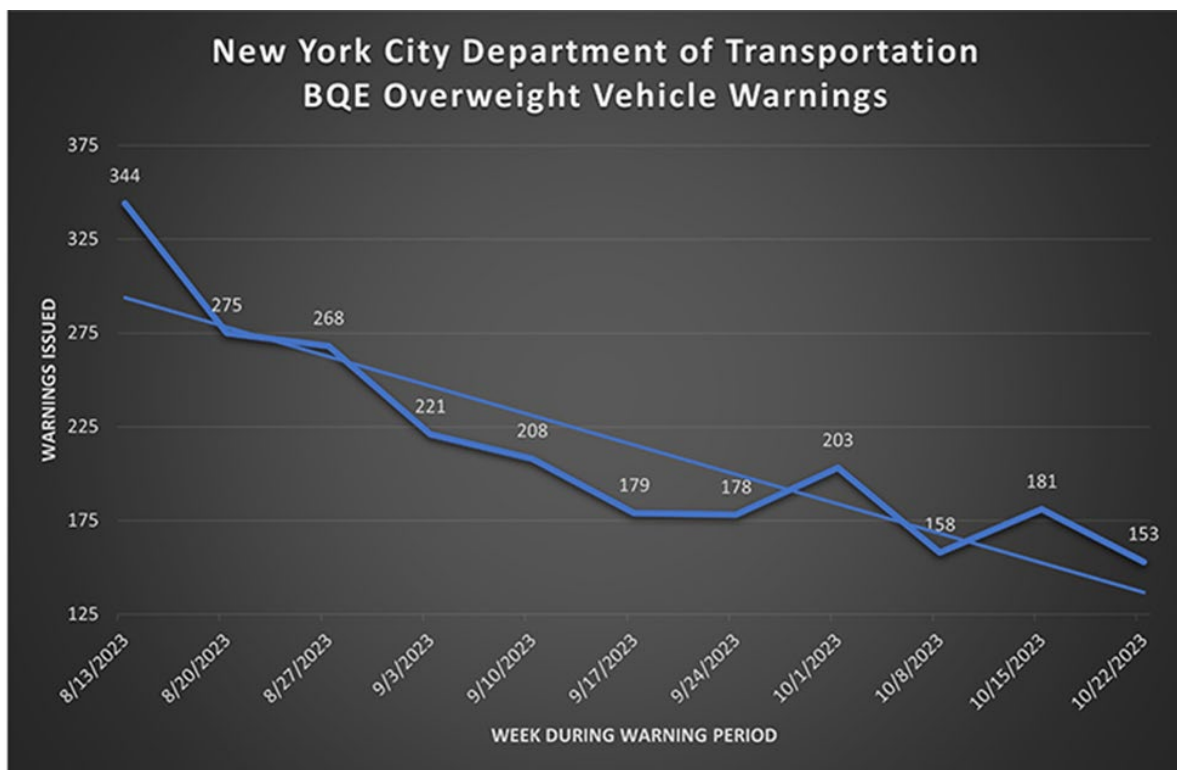
## QB system installation completed in October 2022



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

# WARNING PERIOD

- 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  
I  
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.

Sensor Set 1	Gross Vehicle Weight Measured
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 8/2023, 4/2024 & 11/2024
- 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

Table N.1.6 Minimum Number of Test Runs per Each Test Vehicle	
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)



# WIM SITE CALIBRATION-WORK PLAN



**Certification Test Date**

- 10/27/23 ~ 10/29/23

**Site Location**

- BQE QB Direct Enforcement System

**Number of Runs per Lane**

- 30 Full Load = 20 runs; Half Load = 10 runs
- High Speed = 15 runs; Low Speed = 15 runs

Run #	Lane Run #	Date & Time	Lane	Load	Speed
10/27, 11 PM – 12 AM			All trucks filled up the tank & weighed at the reference scale		
10/28, 1:51 AM ~ 3:18 AM			7 runs were dismissed.		
1	R1	10/28 @ 3:35 AM	Right	Full	Low
				Half	Low
2	R2	10/28 @ 3:53 AM	Right	Full	Low
				Half	Low
3	R3	10/28 @ 4:15 AM	Right	Full	Low
				Half	Low
10/27, 4:20 AM – 4:50 AM			Half trucks weighed at the reference scale & Full truck break		
4	R4	10/28 @ 4:54 AM	Right	Full	High
5	R5	10/28 @ 5:07 AM	Right	Full	High
6	R6	10/28 @ 5:20 AM	Right	Full	High
7	R7	10/28 @ 5:32 AM	Right	Full	High
8	R8	10/28 @ 5:48 AM	Right	Full	High
9	R9	10/28 @ 6:02 AM	Right	Full	Low
10	R10	10/28 @ 6:17 AM	Right	Full	Low
11	R11	10/28 @ 6:31 AM	Right	Full	Low
12	R12	10/28 @ 6:47 AM	Right	Full	Low
13	R13	10/28 @ 7:02 AM	Right	Full	Low
10/28, 7:30 AM – 8 AM			Full trucks left and weighed at the reference scale		
10/28, 10:30 PM – 11 PM			All trucks filled up the tank & weighed at the reference scale		
14	L1	10/29 @ 12:29 AM	Left	Full	Low
				Half	Low
15	L2	10/29 @ 12:40 AM	Left	Full	Low
				Half	Low
16	L3	10/29 @ 1:00 AM	Left	Full	Low
				Half	Low
17	L4	10/29 @ 1:15 AM	Left	Full	Low
				Half	Low
18	L5	10/29 @ 1:30 AM	Left	Full	Low
				Half	Low
19	L6	10/29 @ 1:47 AM	Left	Full	High



Run #	Lane Run #	Date & Time	Lane	Load	Speed
				Half	High
20	L7	10/29 @ 2:03 AM	Left	Full	High
				Half	High
21	L8	10/29 @ 2:17 AM	Left	Full	High
				Half	High
22	L9	10/29 @ 2:29 AM	Left	Full	High
				Half	High
23	L10	10/29 @ 2:41 AM	Left	Full	High
				Half	High
10/29, 2:55 AM – 3:25 AM			All trucks break		
24	L11	10/29 @ 3:32 AM	Left	Full	Low
	R14		Right	Half	Low
25	L12	10/29 @ 3:50 AM	Left	Full	Low
	R15		Right	Half	Low
26	L13	10/29 @ 4:03 AM	Left	Full	High
	R16		Right	Half	High
27	L14	10/29 @ 4:16 AM	Left	Full	High
	R17		Right	Half	High
28	L15	10/29 @ 4:54 AM	Left	Full	High
	R18		Right	Half	High
29	L16	10/29 @ 5:1- AM	Left	Full	High
	R19		Right	Half	High
30	L17	10/29 @ 5:28 AM	Left	Full	High
	R20		Right	Half	High
10/29, 6 AM – 6:30 AM			Half trucks left and weighed at the reference scale		
31	L18	10/29 @ 5:42 AM	Left	Full	Low
32	L19	10/29 @ 5:59 AM	Left	Full	Low
33	L20	10/29 @ 6:12 AM	Left	Full	Low
34	R21	10/29 @ 6:32 AM	Right	Full	Low
35	R22	10/29 @ 6:47 AM	Right	Full	Low
36	R23	10/29 @ 7:02 AM	Right	Full	High
37	R24	10/29 @ 7:15 AM	Right	Full	High
38	R25	10/29 @ 7:30 AM	Right	Full	High
39	R26	10/29 @ 7:43 AM	Right	Full	High
40	R27	10/29 @ 7:56 AM	Right	Full	High
10/29 @ 8 AM – 8:30 AM			Full trucks left and weighed at the reference scale		

# SYSTEM CERTIFICATION – INSPECTOR VIEW

- Testing consisted of field visit, witnessing of reference scale weighment, 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.		✓



# 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](http://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.)		Maximum Axle Weight (lbs.)
Sensor Set 1: Tandem - 47,960 bs		Single Axle: 22,400bs; 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

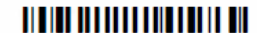
Detach and mail this coupon with your payment

**DO NOT MAIL CASH**

Write on the front of your payment:  
1) the 10-digit Notice Number  
2) Your Rate Number  
3) Your State of Registration  
4) Your Rate 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]			\$650.00
NOTICE NUMBER	VERSION	ISSUED	DUE DATE
4500000215	1	11/14/2023	12/14/2023
PLATE NUMBER	STATE	TYPE	WIM SYSTEM ID
[REDACTED]	US-NY	COMMERCIAL	870501

## 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)

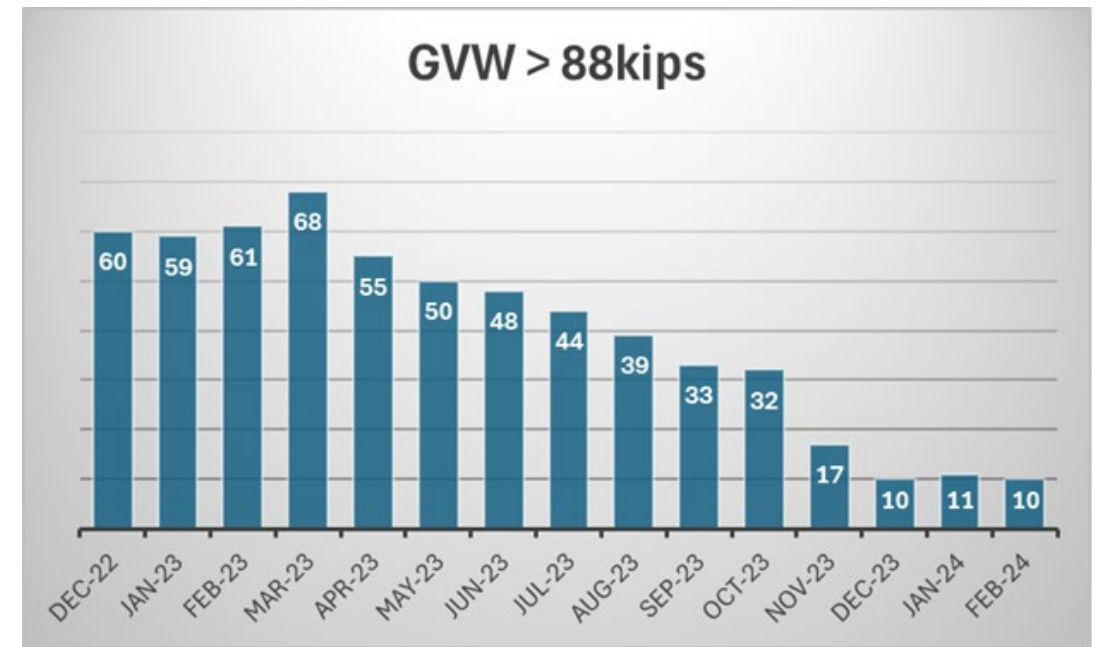
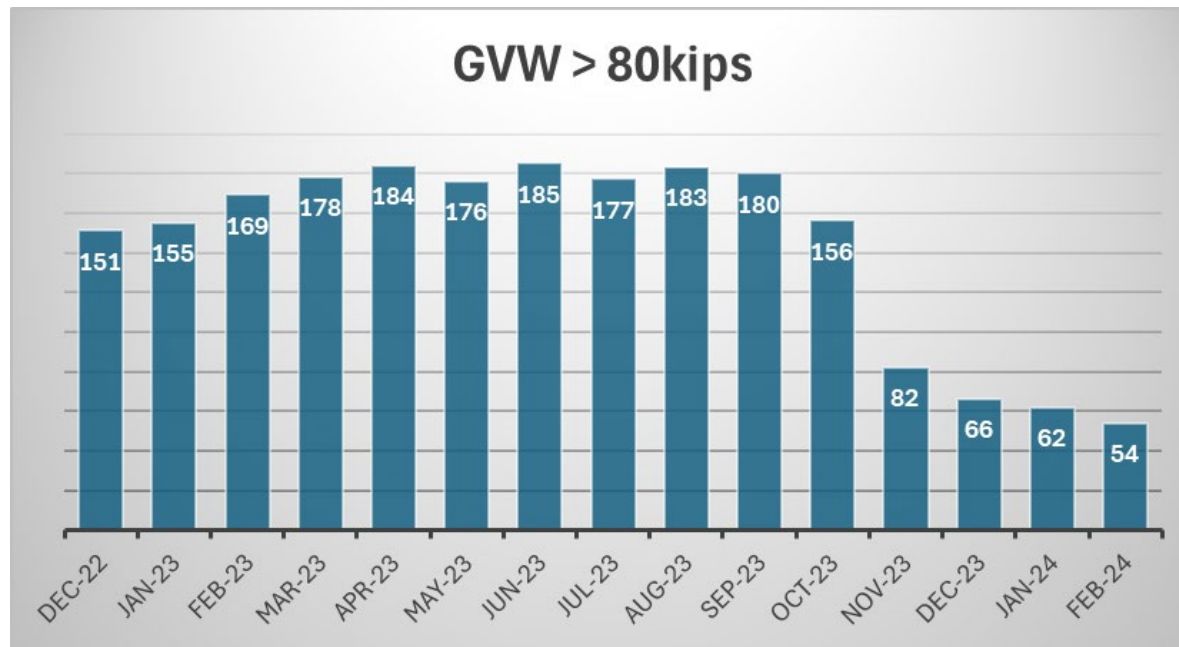
## Axle Weight Violations

- 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

# DIRECT ENFORCEMENT - IMPACT

- Dramatic decrease has been seen in the number of OW vehicles after implementation
- Approx. 3025 violations issued to-date
- Only 24 dismissed



Impact on site specific live loads are being reviewed, longer term analysis is underway

- NYCDOT is the first agency in the nation to implement WIM for automated enforcement
- SIB direction violations began to be issued on June 22, 2025.
- **Wider implementation via updated NYS legislation passed in 2025!**
- Outreach with Freight partners to foster a culture of regulatory compliance and even the playing field
- NYCDOT is actively working with authorizing/regulatory entities to progress relevant standards on the WIM installation, calibration, and enforcement process.

# CLOSING REMARKS

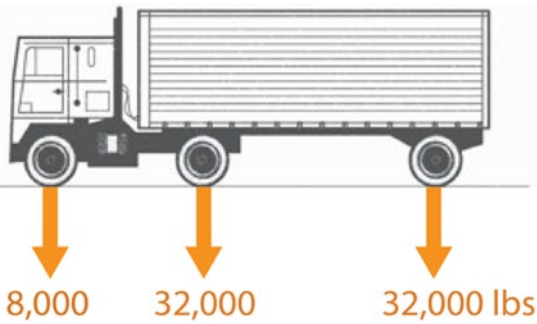
*So what now?*

# NEED IS CLEAR

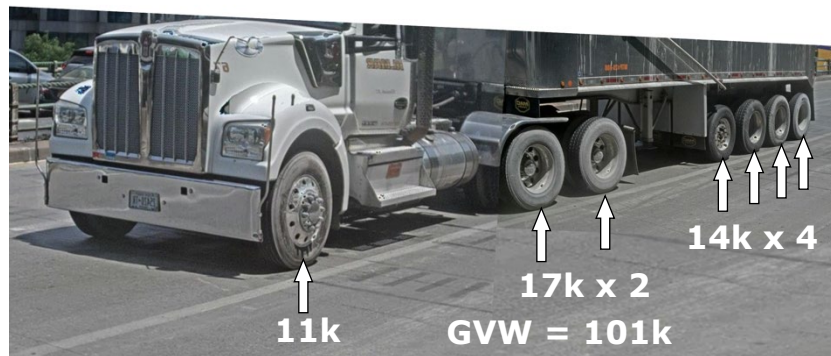
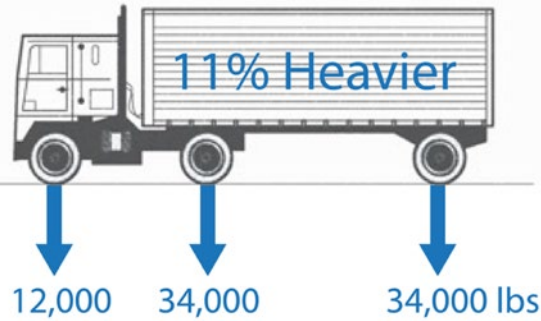
The Truth about Truck Loads and Enforcement:

Legal load has been increased significantly, and the actual load is higher than structure's design load.

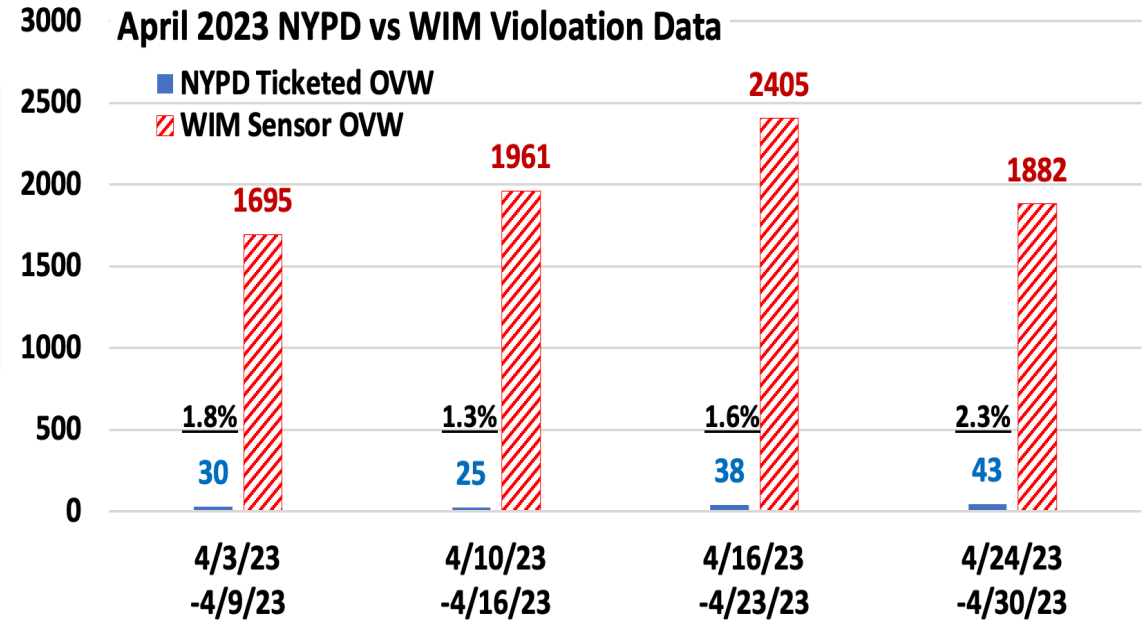
**Standard HL-93 AASHTO Design Truck Load**



**NYS Legal Load**



Enforcement by Portable Scale (NY)



- The wide gap between number of violations issued compared to the actual volume of overweight vehicles on the road does not drive a culture of compliance and creates an uneven playing field

- Protecting our infrastructure and safer highways requires efficient means to enforce truck weight limits along with other related enforcement
- Wide implementation requires integrated approach to be implemented
- Industry/Manufacturers need to think about
  - System Design/Installation
  - Violation Identification/Processing Software and Dashboards
  - Certification of the System
  - Maintenance of Systems including software updates
  - Pavement Design to achieve/maintain accuracy
  - Structural Analysis with Site Specific Live Loads

Thank you!