

ANTT-Labtrans-ISWIM Webinar

Wednesday October 30th, 2024

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



TANVI PANDYA, P.E., DBIA (NYCDOT)

AGENDA



- Team Introduction
- BQE Project Background
- Data Collection: WIM Sensors
- From Data Collection to Direct Enforcement
- Implementation of Direct 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.

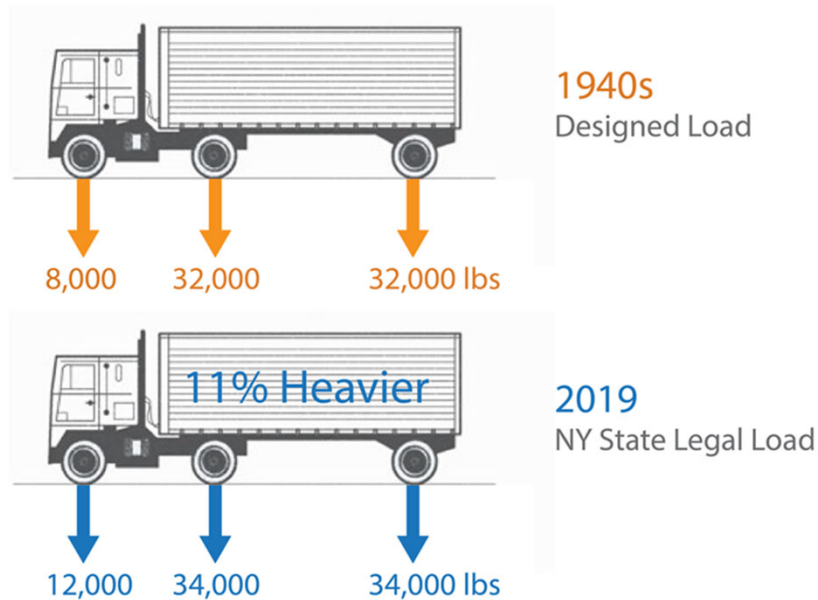
BQE PROJECT BACKGROUND

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.

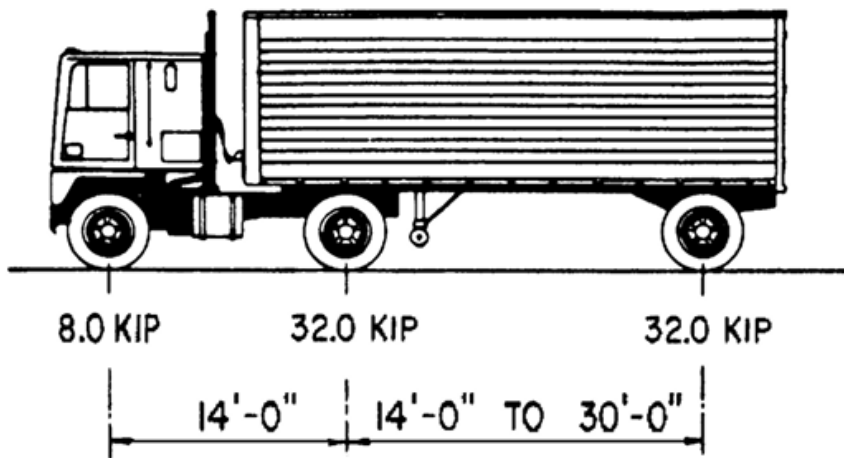


Truck Loading: Then & Now

- 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



The Truth About Truck Loads



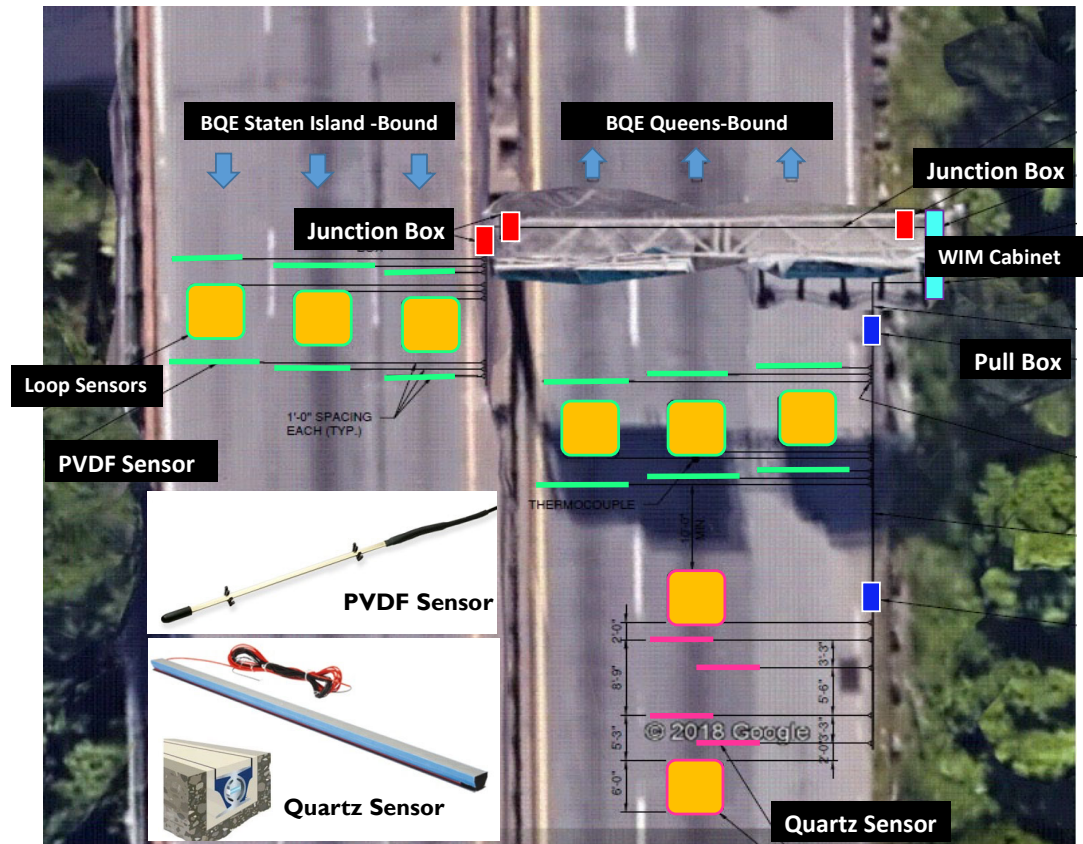
Standard HL-93 AASHTO Design Truck Load



Actual Site-Specific loads

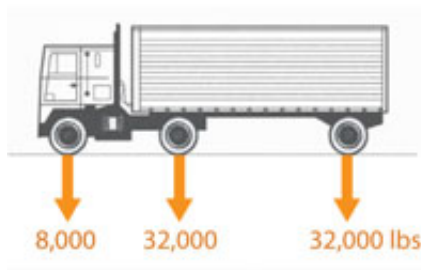
Pilot Study: WIM installed near Pearl St on the BQE

- 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



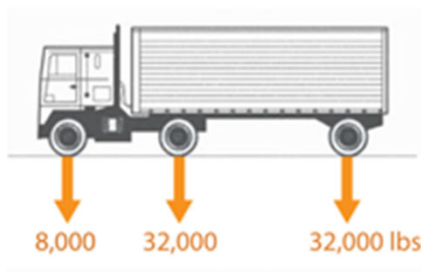
Comparison of Load Factors

- 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 DIRECT ENFORCEMENT

Paving the Way & Breaking Ground

Rules and Regulations

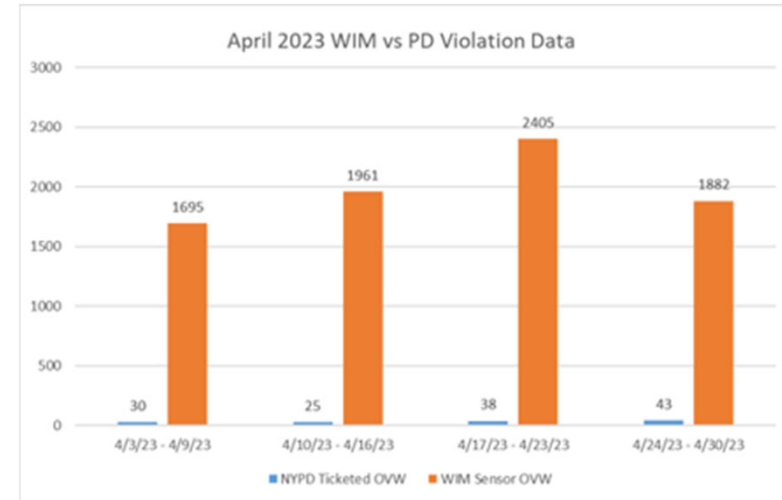
- Truck Movement is governed by regulations at the federal, state and local level for vehicles permitted to operate within a jurisdiction by:
 - Size
 - Weight
 - Length
 - Height
 - Width
- Both the City and State issue oversize and overweight permits for the routing of overweight loads on roadways 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 Methods

- **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 Direct Enforcement

LEGISLATION



CALIBRATION & CERTIFICATION



IMPLEMENTATION

DIRECT ENFORCEMENT LEGISLATION

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

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 consideration with national weights and measure for handbook update

DIRECT ENFORCEMENT - IMPLEMENTATION

DIRECT ENFORCEMENT IMPLEMENTATION

BQE Direct Enforcement System Installation

WIM System Installation: November 2022

Calibration: December 2022

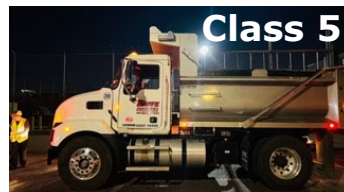
System Validation & Back Office Configuration
: January ~ July 2023



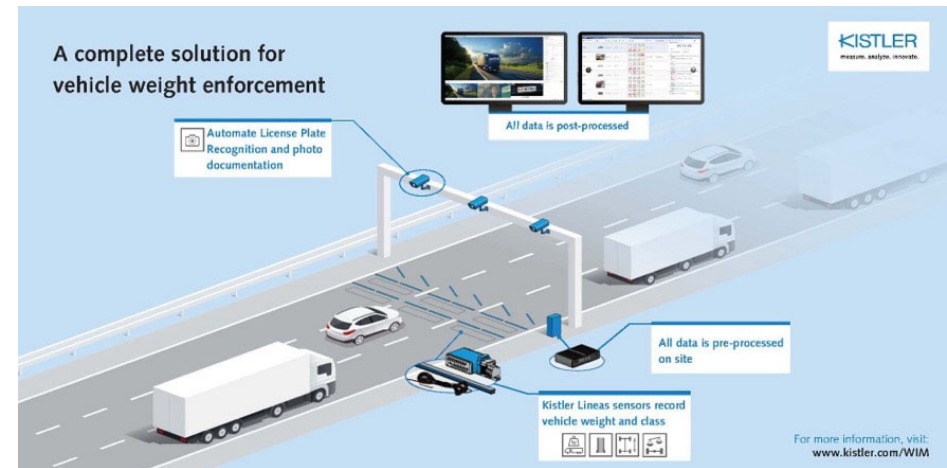
Class 9



Class 6



Class 5



SYSTEM CERTIFICATION

Certification by NYS Ag.: October 2023 & April 2024

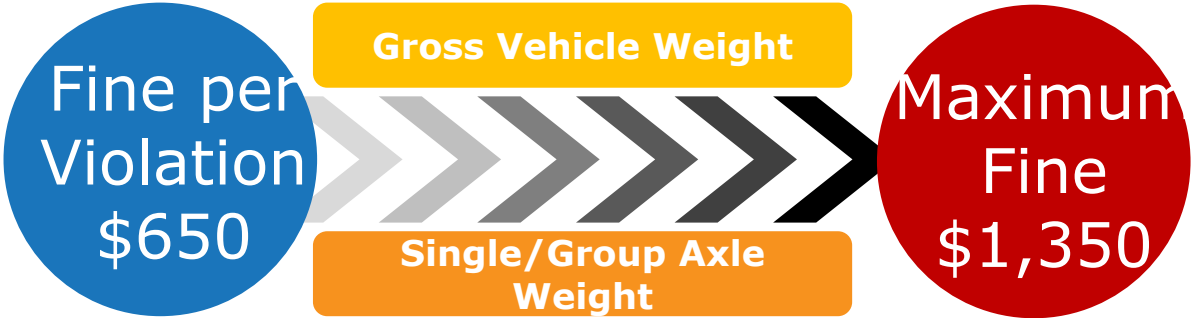
Test runs were viewed from multiple cameras along with direct feed from the data logger
Concurrent logging of data by inspectors into their verification tabulation

Table T.2.3: Maintenance Tolerances for Accuracy		Test Result
Load Description at 100% Compliance	Tolerance	
Axle Load	± 20 %	✓
Axle Group Load (including bridge formula)	± 15 %	✓
Gross Vehicle Weight	± 10 %	✓



DIRECT ENFORCEMENT INITIATION

**Direct OW Enforcement at BQE
Since Nov. 14, 2023**



System calculates based on federal bridge formula the maximum GVW for truck configuration and differentiates between tandem and single axle

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#
[Redacted]

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

VIOLATION DATE	VIOLATION TIME	FINE AMOUNT
11/13/2023	01:36:06 AM	\$650.00

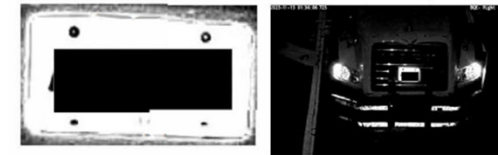
LOCATION
EB BQE (I-278) MP 2.9 Lane 2; Interstate route 278 specifically from the vicinity of Atlantic Avenue to the vicinity of Sands Street in Kings County, NY

Axle Weights Measured (lbs.)	Maximum Axle Weight (lbs.)
Sensor Set 1: Tandem - 47,960 lbs	Single Axle: 22,400 lbs; Tandem-Axle: 36,000 lbs;
Sensor Set 2: Tandem - 49,460 lbs	

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.

There are no points associated with this Notice.



USDOT #
[Redacted]

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]		\$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)

Each violation reviewed by NYCDOT personnel to ensure integrity of package

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)

CLOSING REMARKS

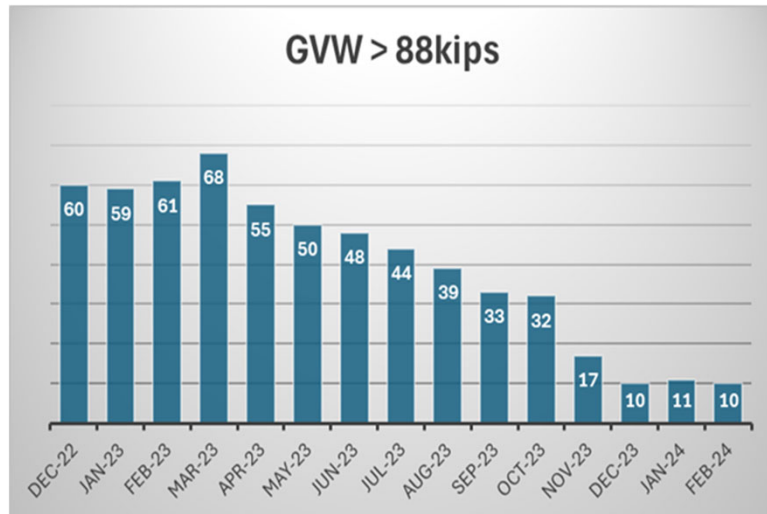
So what's the impact?

ENFORCEMENT DATA

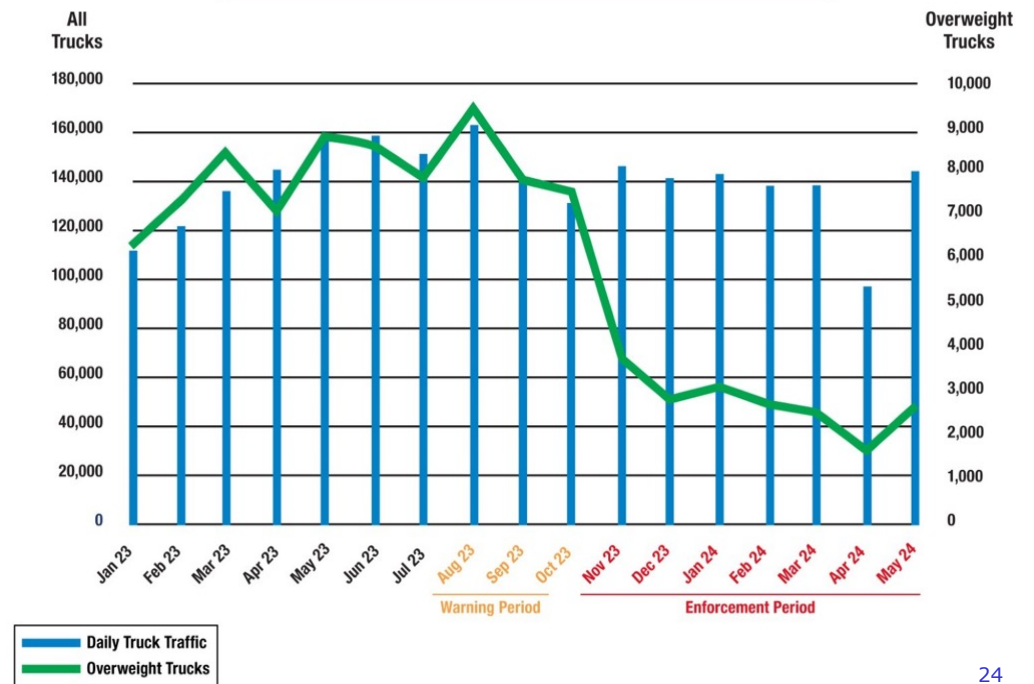
Direct Enforcement – Impact

After the violations began to be issued, a dramatic decrease has been seen in the number of OW vehicles

More decrease of the extreme heavy trucks (GVW > 88 kips)



**Monthly Truck vs. Overweight Truck Traffic:
Brooklyn Queens Expressway Triple Cantilever**



ON-GOING EFFORTS



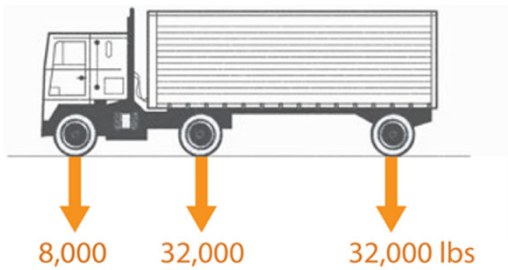
- NYCDOT is the first agency in the nation to implement WIM for automated enforcement
- Installation for SIB direction expected to be completed this year. A 90-day warning period will begin in early 2025 followed by violations being issued.
- Discussions with local partner agencies to pursue wider implementation
- 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 !

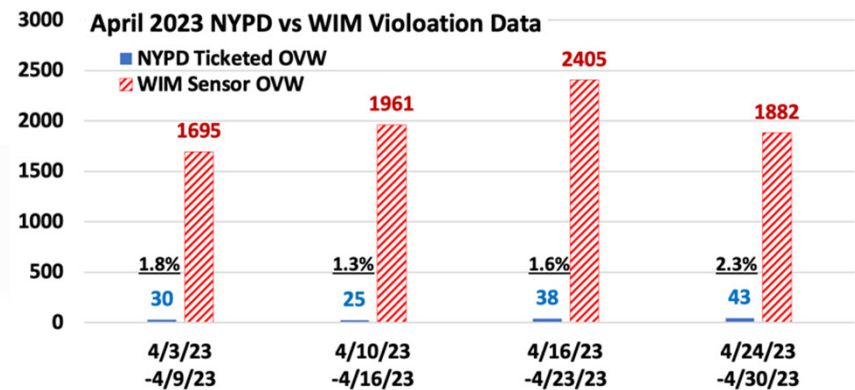
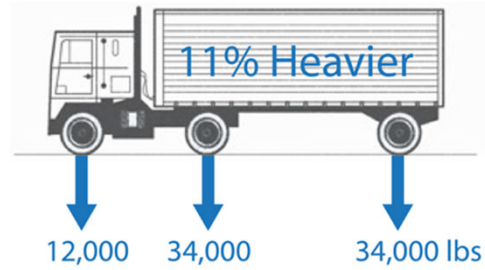
The Truth about Truck Loads and Enforcement

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

Standard HL-93 AASHTO Design Truck Load



NYS Legal Load



- The 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

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 must consider actual loads in their assessment
 - Highway Safety Personnel need to ensure vehicles are following safety standards but may not be aware of the infrastructure implications
 - Department of Agriculture reviews Handbook 44 which would set the standards for technology but are not involved in safety or infrastructure needs
 - Technology/Theoretical discussions don't always connect with decision makers

Who steps up to connect these seemingly disconnected aspects to achieve the goal?

Roadway Deficiencies

- Nonstandard Lane widths
- Nonstandard shoulder widths
- Nonstandard vertical clearances
- Nonstandard Horizontal & Vertical curves
- Nonstandard sight distances
- Nonstandard acceleration lanes



Sources of Data: NYC Department of City Planning, NYC GIS, ESRI, NYS or thos, 2016

Madison SWEF WIM Demonstration



NIST, Dept of Ag (NYS, MN, WI) representative attended demo.



FROM DATA COLLECTION TO AUTOMATED ENFORCEMENT

Madison Demo Results – Full Load Case

Run # Main Line	Class 9 11,380 lb 31,900 lb 29,400 lb 72,680 lb				Class 6 12,120 lb 33,260 lb 45,380 lb				Class 5 8,160 lb 19,040 lb 27,200 lb				
	Compliance Speed (mph)	20% AW1	15% AW2+3	15% AW4+5	10% GVW	Compliance Speed (mph)	20% AW1	15% AW2+3	10% GVW	Compliance Speed (mph)	20% AW1	20% AW2	10% GVW
1	65	-5.0%	-1.6%	1.5%	-0.9%	62	-7.4%	-0.1%	-2.1%	62	-0.6%	-1.2%	-1.0%
2	65	-1.9%	-2.5%	4.0%	0.2%	64	-3.8%	-1.4%	-2.0%	62	2.0%	2.6%	2.4%
3	65	-5.0%	-1.4%	-0.9%	-1.8%	61	-7.7%	-5.1%	-5.8%	61	3.8%	1.6%	2.3%
4	65	-7.3%	-2.4%	-1.4%	-2.8%	61	-8.2%	-5.2%	-6.0%	62	-5.8%	0.8%	-1.2%
5	65	-6.7%	-2.2%	-6.4%	-4.6%	59	-5.7%	-2.7%	-3.5%	58	-6.3%	2.7%	0.0%
6	65	-5.9%	-1.4%	1.1%	-1.1%	62	-6.6%	1.4%	-0.7%	62	3.1%	2.8%	2.9%
7	63	0.8%	-3.5%	0.5%	-1.2%	58	-9.4%	-1.7%	-3.8%	62	-2.6%	-0.9%	-1.4%
8	63	-1.0%	-1.6%	-3.0%	-2.1%	61	-0.9%	-2.4%	-2.0%	62	3.3%	2.1%	2.5%
9	65	-7.1%	-4.2%	-7.7%	-6.1%	63	-1.0%	2.4%	1.5%	62	5.2%	-2.2%	0.0%
10	64	-1.4%	-2.7%	-1.8%	-2.1%	62	-9.4%	0.0%	-2.5%	63	2.6%	3.5%	3.2%
11	64	-3.8%	-4.9%	0.1%	-2.7%	65	-4.2%	-5.1%	-4.8%	63	4.3%	2.4%	3.0%
12	62	-3.4%	-1.2%	-1.2%	-1.5%	61	-9.9%	-2.8%	-4.7%	64	-6.7%	0.9%	-1.4%
13	60	-5.6%	-2.7%	-3.5%	-3.5%	60	-8.5%	-1.8%	-3.6%	60	3.5%	2.1%	2.5%
14	60	-3.7%	-0.8%	-5.7%	-3.3%	60	-7.1%	-2.3%	-3.5%	58	-8.2%	1.1%	-1.7%
15	54	-4.8%	-3.2%	-1.1%	-2.6%	58	-11.3%	-2.0%	-4.5%	55	-8.7%	-4.3%	-5.6%
16	60	-9.2%	-5.9%	-2.6%	-5.1%	60	-6.6%	-1.5%	-2.9%	60	-6.4%	1.5%	-0.9%
17	60	-2.9%	-2.3%	-1.7%	-2.2%	60	-5.9%	-1.7%	-2.8%	58	-10.0%	6.1%	1.3%
18	60	-8.5%	-2.5%	1.5%	-1.8%	59	-7.1%	-1.3%	-2.9%	60	-0.8%	2.0%	1.2%
19	60	-9.5%	-4.0%	-7.8%	-6.4%	60	-11.0%	-3.1%	-5.2%	62	3.1%	1.0%	1.7%
20	60	-8.7%	-5.1%	-7.0%	-6.4%	60	-7.9%	-0.9%	-2.8%	60	6.0%	1.2%	2.7%

100% compliance for single, tandem and gross vehicle weight for the fully loaded case.