Maximizing transportation resources for Queens College Students

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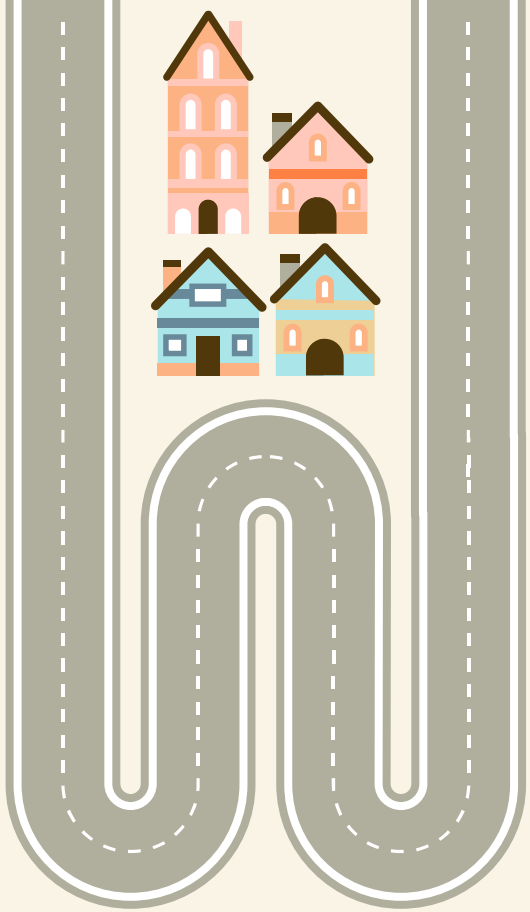
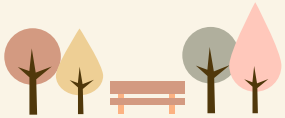
Background Information

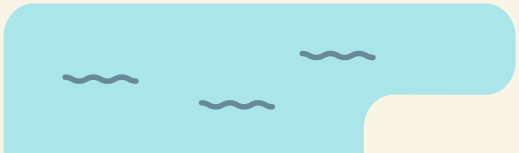
- Approximately around 80% students who goes to Queens College consider themselves as low-income students.
- Most of them uses Q44 mainly, It’s the most common bus for students who commute daily.
- The ridership in Q44 reaches it peak during early September as many students come back to school and commute to campus and also go to their jobs through this bus.
- The Q44 bus route is near high schools and hospital and many more stores which is why during rush hour the delay happens mostly.

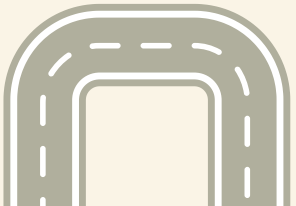
Are late buses really more than just a small setback?

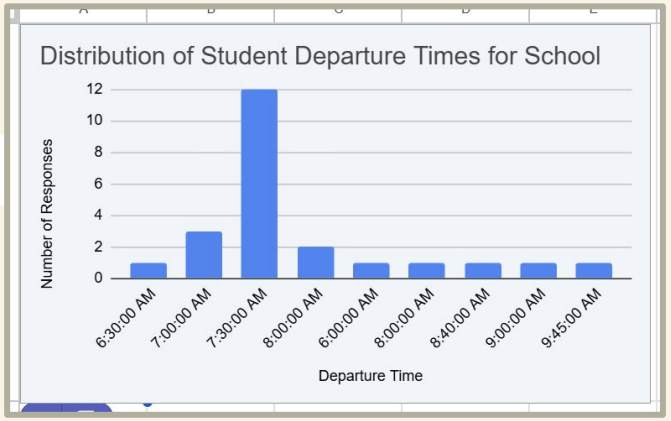


YES!

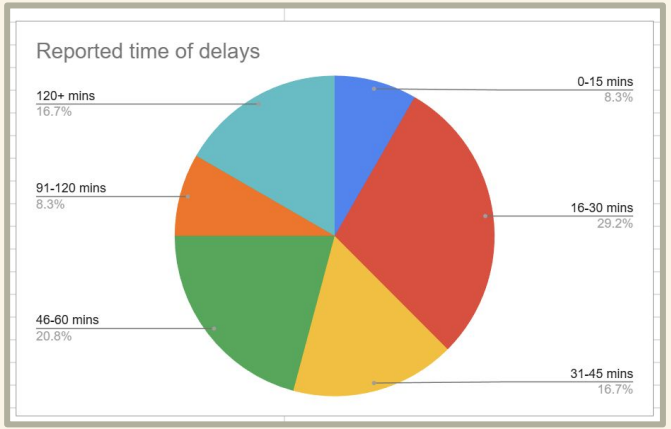


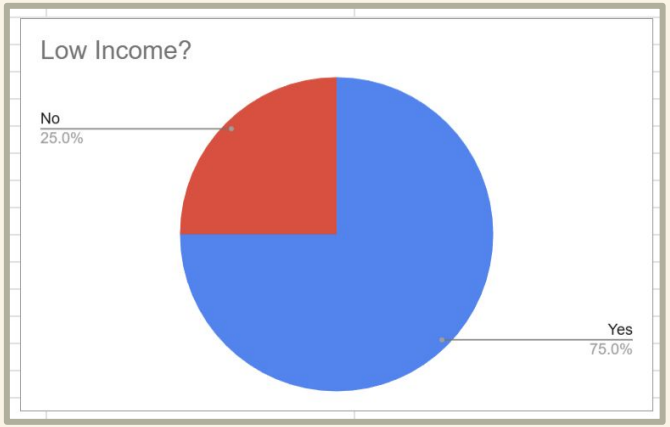






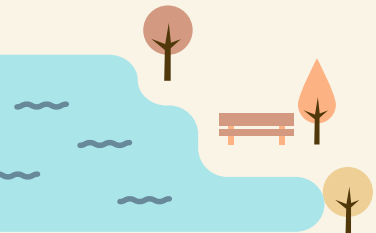
Most CUNY students travel during rush hour and for those who are FGLI, a 20 min–2 hr delay means missed classes, lost opportunities, and harder paths to break cycles.





Our Question

How do repeat exempt vehicle violations on the Q44+ bus route near Queens College during peak commuting hours contribute to student delays, and what is the potential reduction in delays from installing AI cameras at identified hotspots?



Our Plan

01

Which MTA ACE routes strongly impact FGLI Queens College students?

02

Identifying the top 250 repeat offenders 5 km away from Queens College.

03

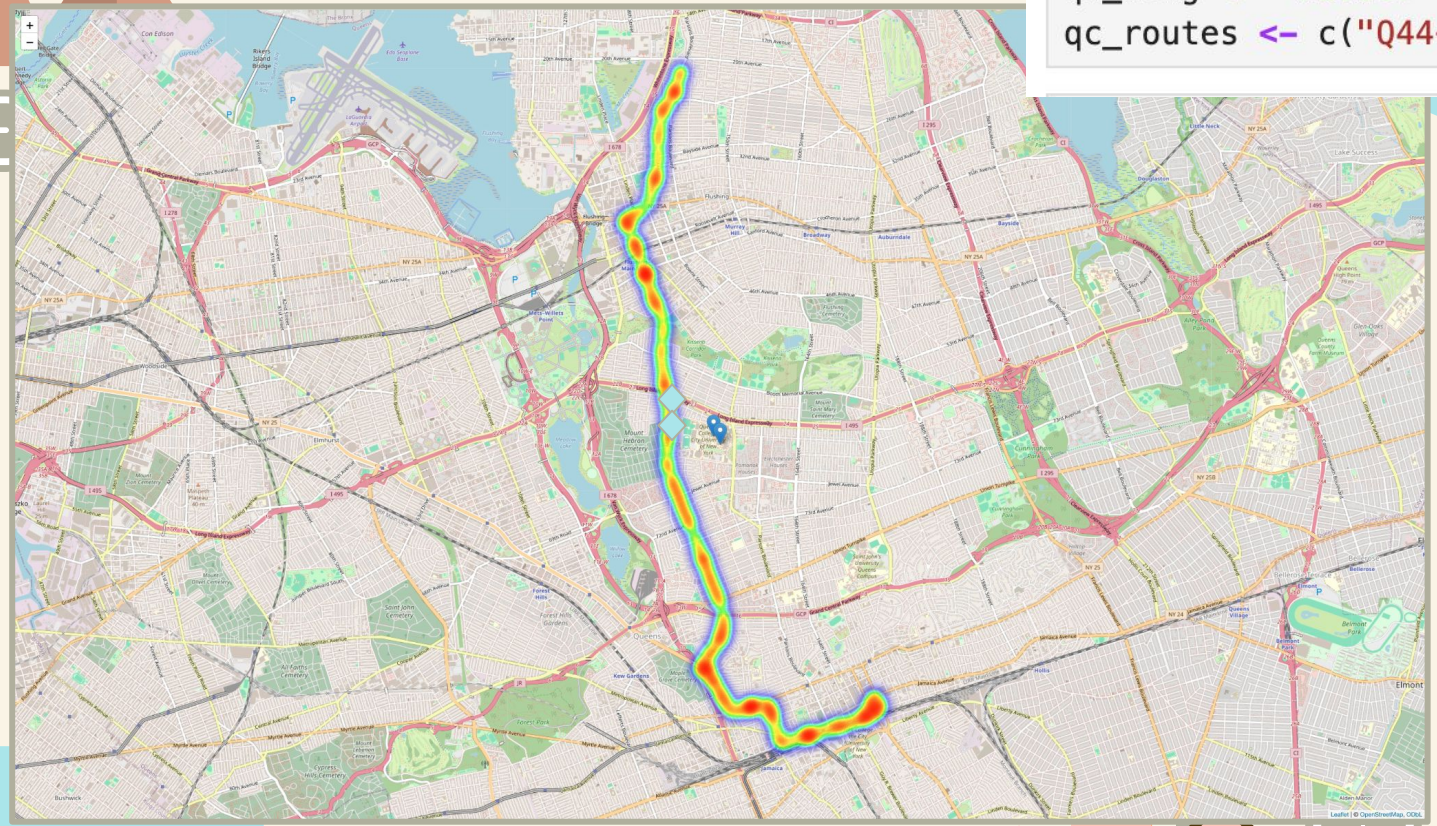
Calculate the delays and its impact on students.

04

Finding the most important factor to predict repeat offenses.

```
qc_lat <- 40.736
qc_long <- -73.817
qc_routes <- c("Q44+")
```

1.



2.

```r
violations_qc <- mta_data %>%
  mutate(
    first_occurrence = mdy_hms(`First Occurrence`, truncated = 3), #time
    is_exempt = str_detect(`Violation Status`, "(?i)EXEMPT"), #finding to see if it is exempt
    dist_to_campus_km = sqrt((`Violation Latitude` - qc_lat)^2 + (`Violation Longitude` - qc_long)^2) * 111
  ) %>% #finding the distance away from campus
  filter(
    `Bus Route ID` %in% qc_routes,  # Q44+ only
    is_exempt,                      # Exempt vehicles
    dist_to_campus_km <= 5          # Within 5 km
  )
```

```r
dim(violations_qc)
head(violations_qc)
```

34305 · 18

A tibble: 6 × 18

Violation ID	Vehicle ID	First Occurrence	Last Occurrence	Violation Status	Violation Type	Bus Route ID	Violation Latitude	Vi Lon
<int>	<chr>	<chr>	<chr>	<chr>	<chr>	<chr>	<dbl>	
489741945	3f877f70d9b253515a945be807c9c62d5814949f810310f6fe3f8bbe33a39104	08/20/2025 10:50:45 PM	08/20/2025 11:32:43 PM	EXEMPT - OTHER	MOBILE BUS STOP	Q44+	40.76253	-73
489741818	9efab913d2329aae1a294cc0316679b86dcdccc7e7294f3ec6b96d79db49850f	08/20/2025 11:15:31 PM	08/20/2025 11:19:56 PM	EXEMPT - BUS/PARATRANSIT	MOBILE BUS STOP	Q44+	40.70529	-73.
489740582	e9f61fd7d4d8df0a7d76bf2ac1b8c8b0d808cc51376310d77627c6f28f474911	08/20/2025 10:12:48 PM	08/20/2025 10:19:47 PM	EXEMPT - BUS/PARATRANSIT	MOBILE BUS STOP	Q44+	40.70259	-73
489740523	b6e7951e7990abd20c90f8de0b99d0f402d064c8880ad45ea48ef3a56f683669	08/20/2025 10:00:53 PM	08/20/2025 10:06:10 PM	EXEMPT - BUS/PARATRANSIT	MOBILE BUS STOP	Q44+	40.70527	-73
489739375	3f877f70d9b253515a945be807c9c62d5814949f810310f6fe3f8bbe33a39104	08/20/2025 08:04:45 PM	08/20/2025 08:22:51 PM	EXEMPT - OTHER	MOBILE BUS STOP	Q44+	40.76253	-73
489738933	e9f61fd7d4d8df0a7d76bf2ac1b8c8b0d808cc51376310d77627c6f28f474911	08/20/2025 07:48:43 PM	08/20/2025 08:32:30 PM	EXEMPT - BUS/PARATRANSIT	MOBILE BUS STOP	Q44+	40.70270	-73

3.

Calculate delays and student impact

[28]:
```
#Estimate delays (1.5 min/violation) and student impact (45 students/bus) for the top 250 repeat offenders.

# Calculate delays
repeats_with_delay <- repeats_qc %>%
  mutate(
    total_delay_min = violation_count * 1.5,  # 1.5 min per violation
    students_affected = total_delay_min * 45   # 45 students per bus
  )

# Summarize
total_delay_hours <- sum(repeats_with_delay$total_delay_min) / 60
total_student_hours <- sum(repeats_with_delay$students_affected) / 60
cat("Total delay from top 250 repeats:", round(total_delay_hours, 1), "hours\n")
cat("Total student-hours lost:", round(total_student_hours, 1), "\n")

# Display table
DT::datatable(repeats_with_delay, options = list(pageLength = 10))
```

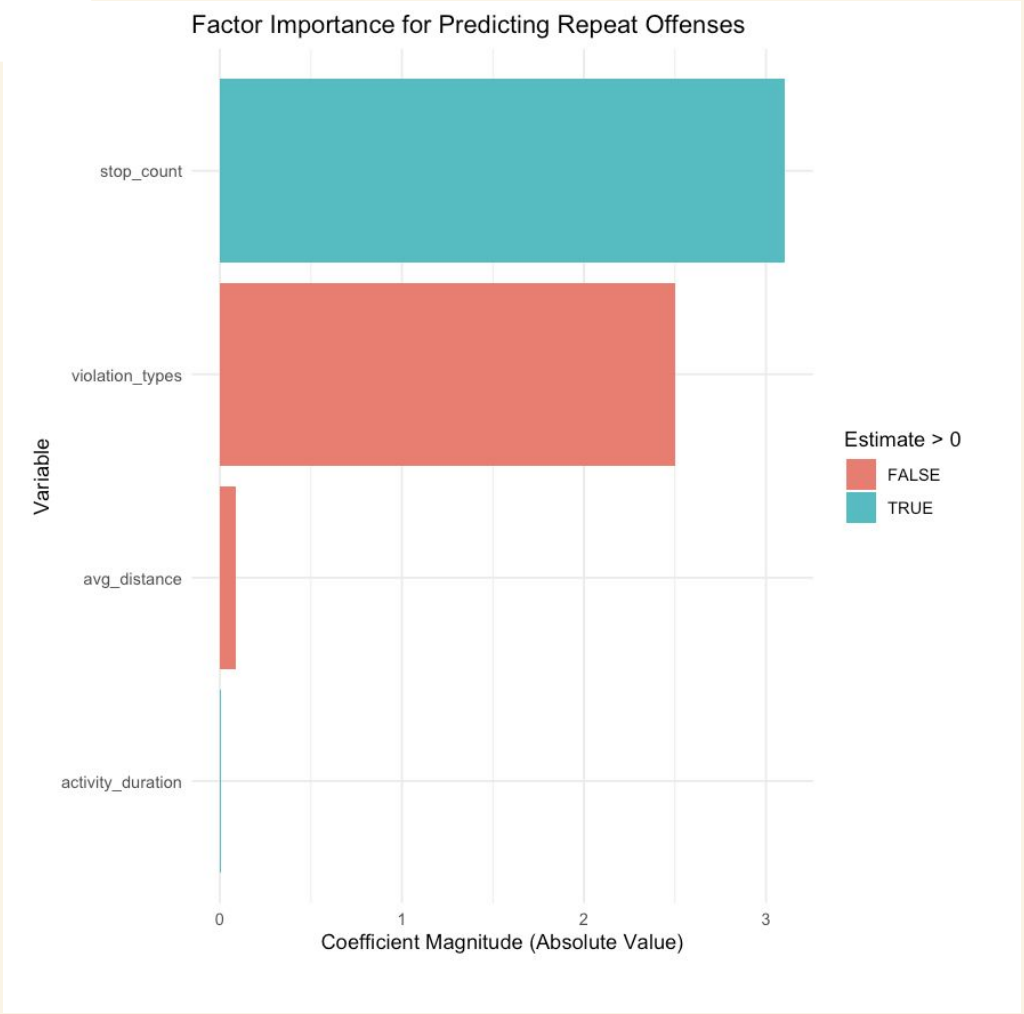
```
Total delay from top 250 repeats: 279 hours
Total student-hours lost: 12552.8
```

Show 10 entries Search:

	Vehicle ID	violation_count	total_delay_min	students_affected
1	729afe2bc01420ab8c66a36692cfc829ea5a0f829b17c705e85beb53caf45423	552	828	37260
2	d3394e8be16cf7189dccc9b3621153fcffb272574bc3079a8a3aa63839f249e0	499	748.5	33682.5
3	80228a16bca871e024130c63ddf5552024720ac5f9b583df1c7b35bfdb52d630	444	666	29970
4	1ff22289fd4c31a9404d9470c08cddf9bec229181bf1054605ed0afafaaa7605	247	370.5	16672.5
5	b274337d1e7fcd20a3dd7a23f4c43553b2234a9c4935028d947e368e8156a83d	232	348	15660
6	58428b9d48d2ac0c9c2213135b018758add2fbc612d48c082dff2624cddbfd16	196	294	13230
7	a0d302f41d928ef753f174c829474b0a90c3ae6d76ceb2bbce002370b7f7b264	167	250.5	11272.5
8	c61d7f2b095752319ea064c9fdaa4013066a46cc6ad274376d01d100ba65dfd0	138	207	9315
9	1ef67d49a3ae37531196dd43a654bd3ccbc14ba05c9847ada319c21d8b0078ef	130	195	8775
10	7eb12b78f11bc97acf8ce0fa70650184e2a34f23e5eab879ebbef0eada899757	128	192	8640

Showing 1 to 10 of 250 entries Previous 1 2 3 4 5 … 25 Next

4.


Factor Importance for Predicting Repeat Offenses
stop_count
violation_types
avg_distance
activity_duration
Variable
0
1
2
3
Coefficient Magnitude (Absolute Value)
Estimate > 0
FALSE
TRUE

4.

[89]:
```
# Model 3: Add stop count
repeat_model3 <- lm(violation_count ~ avg_distance + violation_types + activity_duration + stop_count, data = train)
summary(repeat_model3)
```

```
Call:
lm(formula = violation_count ~ avg_distance + violation_types +
    activity_duration + stop_count, data = train)

Residuals:
   Min     1Q Median     3Q    Max
-33.07  -0.38  -0.18  -0.11 520.64

Coefficients:
                    Estimate Std. Error t value Pr(>|t|)
(Intercept)        0.8604348  0.6679098   1.288    0.198
avg_distance      -0.0846454  0.1470299  -0.576    0.565
violation_types   -2.5012190  0.4450080  -5.621 1.98e-08 ***
activity_duration  0.0040909  0.0008937   4.578 4.79e-06 ***
stop_count         3.1039736  0.0982029  31.608  < 2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 11.16 on 6565 degrees of freedom
Multiple R-squared:  0.2248,    Adjusted R-squared:  0.2243
F-statistic:   476 on 4 and 6565 DF,  p-value: < 2.2e-16
```

Our Findings

2.

Total delay from top 250 repeats: 279 hours
Total student-hours lost: 12552.8

3.

Stop counts of the exempt vehicles are predicted to be the most important reason for repeated offenses

1.

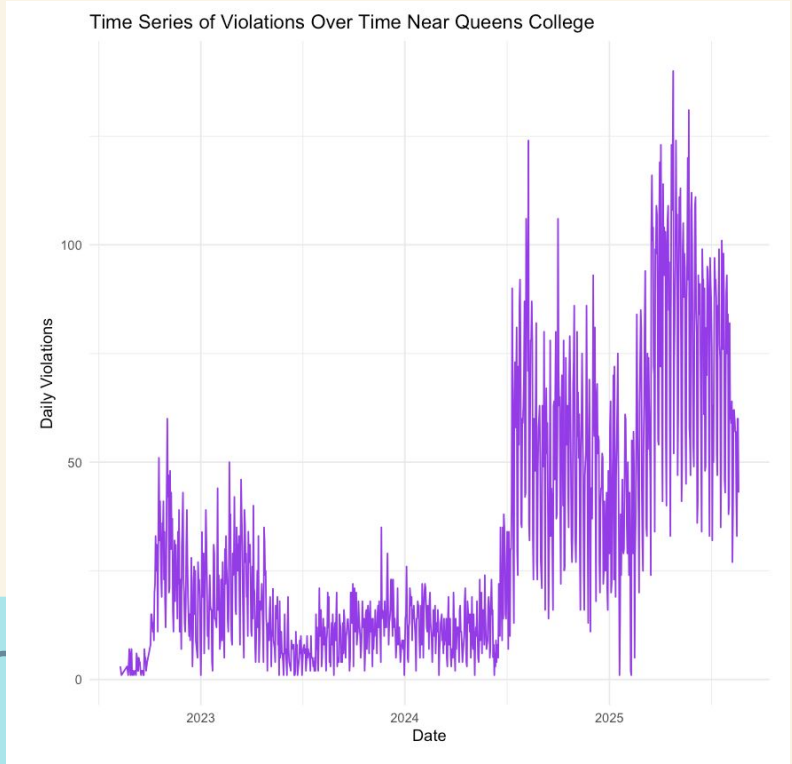
The highest number of violation type near Queens College is mobile bus stop

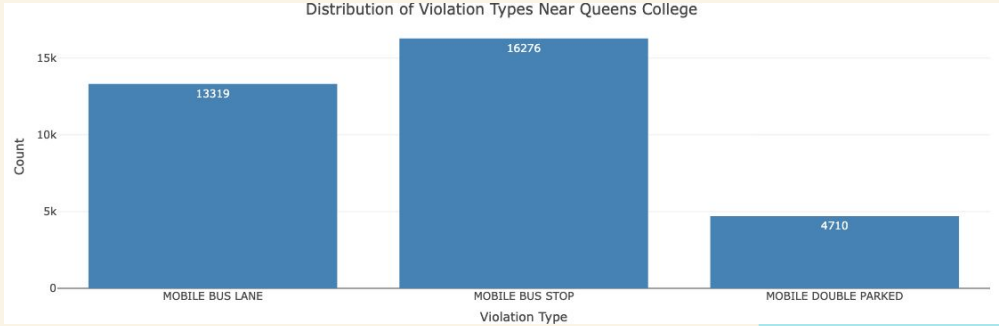
4.

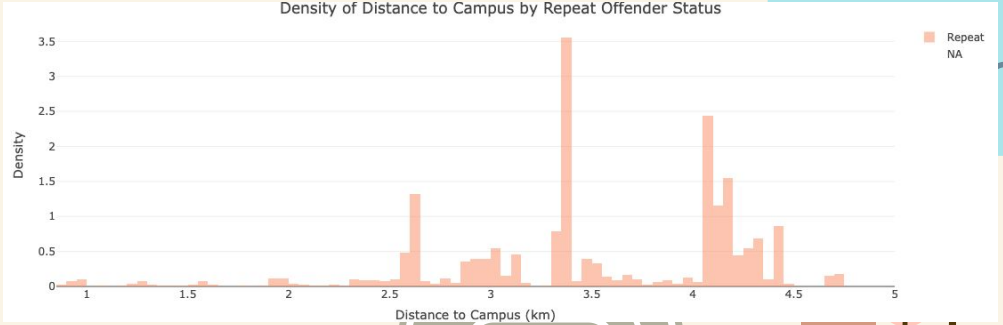
Violations has an upward trend over the years: 2023-2025

Visuals...

Important Graphs







Recommendations

1.

Deploy 3 AI cameras at Main St near QC to capture license plates & issue $50 fines for >3 min stops

2.

Extend Automated Camera Enforcement to Q17 & Q25 (major QC routes).

3.

Launch a “Good Driver Score” tied to city services—reward consistent compliance with toll discounts/credits. Behavioral change through penalties + rewards.

4.

6-month test, measure delay reduction from 279 baseline hours lost.

5.

Frame enforcement as an equity investment for 80% FGLI students.

Visuals...

Call to Action

01

Install 3 AI cameras at Main St hotspots by 2026 → cut 279 hours of delays, save 12,552.8 student-hours

02

Extend ACE to Q17/Q25 routes to fight the upward trend in violations

03

Collaborate with Queens College/MHC++ to monitor the pilot and publish results transparently.

04

Recognize every 20 minutes saved = a class attended, a job shift kept, a cycle broken.

Thanks!

Do you have any questions?

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