Rehabilitation Options

September 12, 2019

DRAFT

Today's Agenda

- Recap our previous discussions
- Identify commonalities among all options
- Review the options
- Compare differences across options
- Discussion

Developing Rehabilitation Options

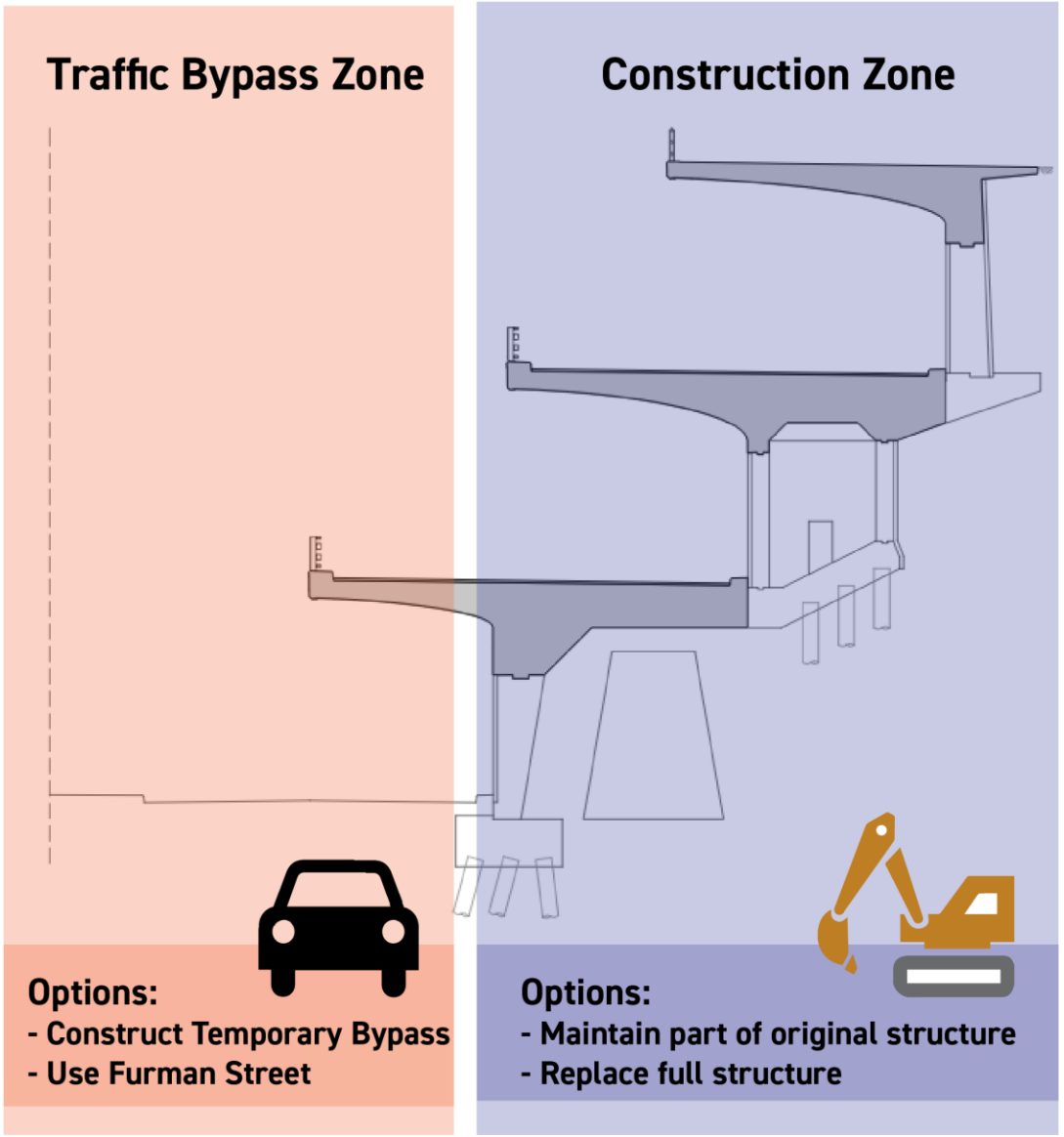
- Established criteria to evaluate options:
  - Initial cost
  - Future maintenance & service life
  - Strength of structure (i.e. truck type, size)
  - Safety
  - Construction Impacts

Developing Rehabilitation Options

- Potential benefits that cannot be realized with rehabilitation:
  - Maximum vibration reduction
  - Full improvement to interchanges
  - Full improvement to connections between highway and arterial roadways
  - Increased and improved local connections for bikes and pedestrians
  - Vertical clearance improvements

What have we discussed?

- Given planning and construction timeframe, a short service life (<20 yrs) presents a challenge
- Longer duration solution requires removal of traffic from one level at a time at a minimum
- Two lanes of traffic during construction on the corridor provide flexibility



What stays the same across options?

Regardless of the option chosen, some benefits and pain-points remain the same:

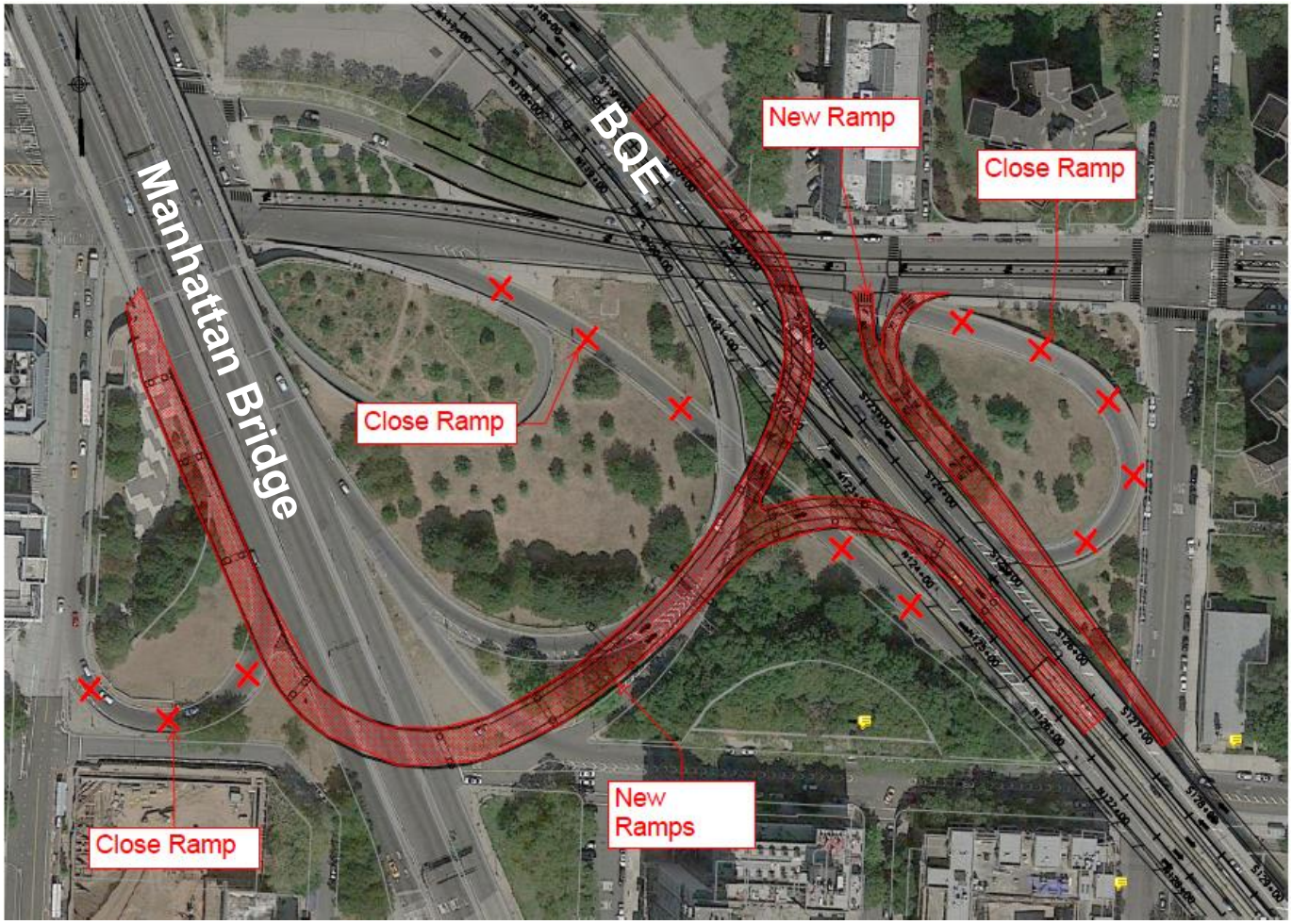
- Three bridges must be replaced
- Better connections to Manhattan Bridge are possible
- The promenade must be replaced
- All options are capable of carrying legal truck loads
- Atlantic Avenue Interchange
  - Options C and C1: Limited at-grade changes possible; major reconfiguration requires replacement of portions of BQE
  - Options F and G: Full reconfiguration envisioned

Common Pain Point: Replacing the Bridges

- Joralemon Street
- Columbia Heights
- Old Fulton/ Cadman Plaza

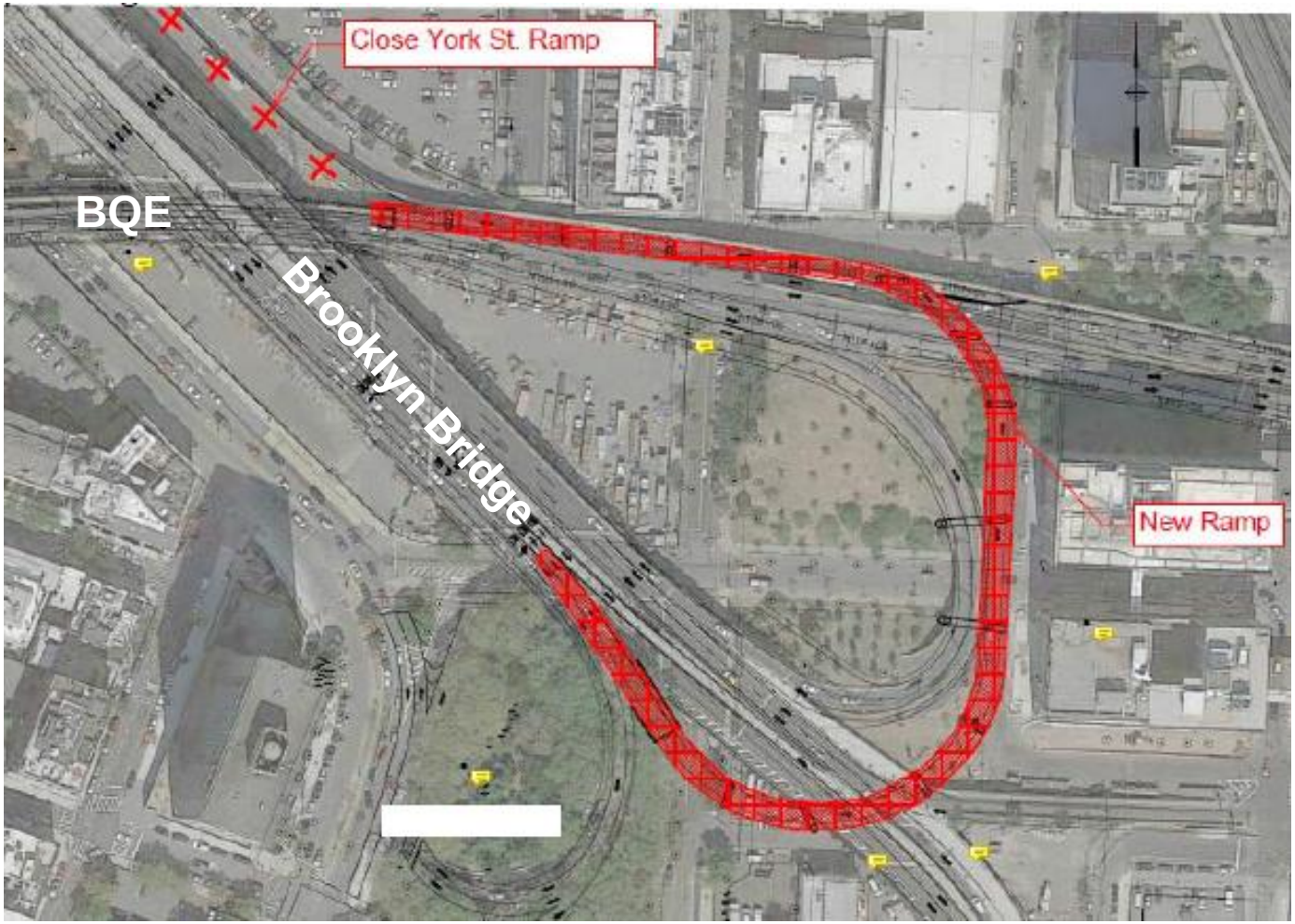
Common Benefit: Better Connections

All options allow for better connections to the Manhattan Bridge

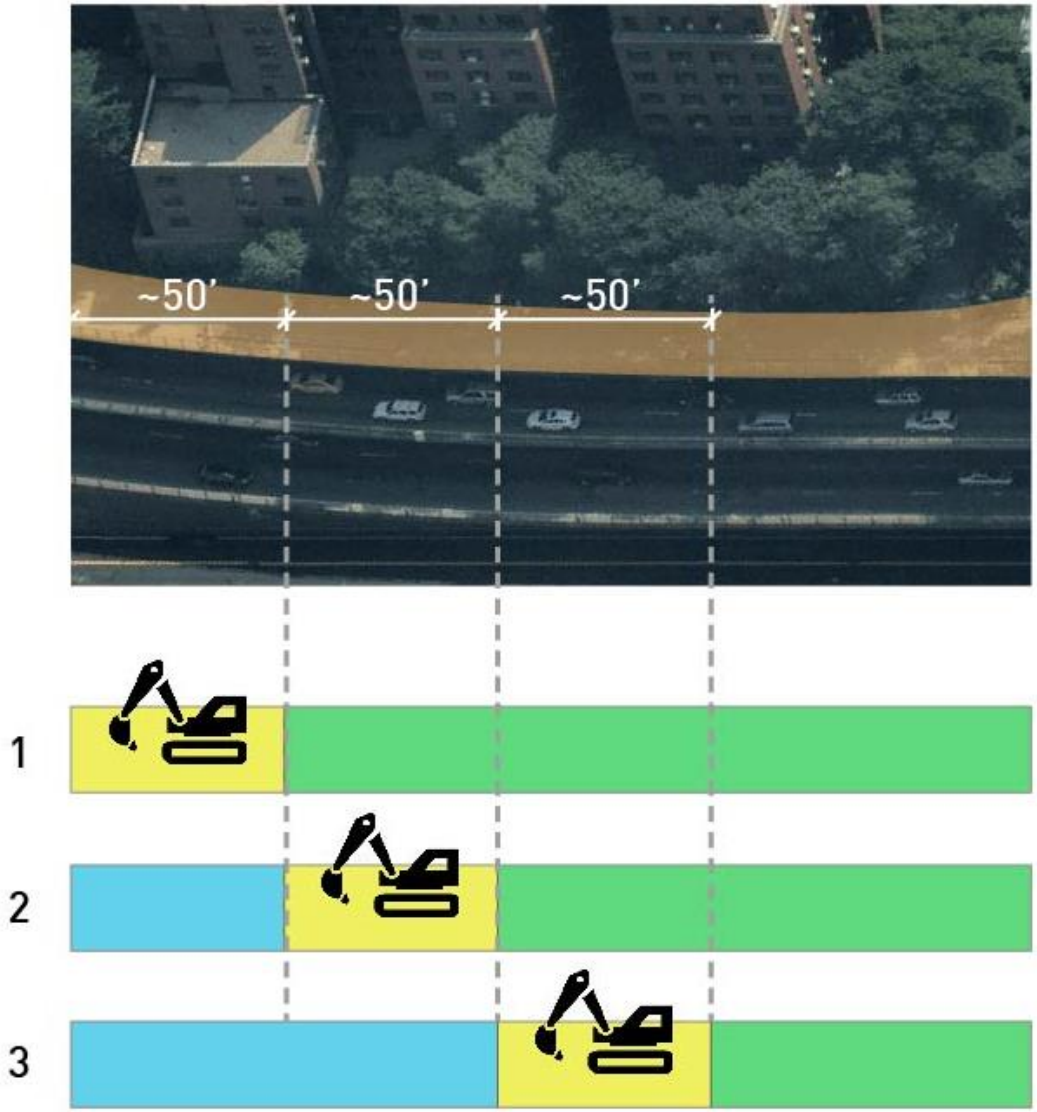


Common element: Connections to the Brooklyn Bridge

Brooklyn Bridge direct connection requires replacement of a section of BQE



Common Pain Point: Replacing the Promenade



The Promenade can be replaced in segments except option F

So, what are the options?

Option Previously Discussed

Rehabilitation Options (Cantilevers Remain)

- Option A – Deck Preservation
- Option B – Partial Depth Deck Replacement
- Option D – Full Depth Deck Replacement with temporary bypass
- Option E – Full Depth Deck Replacement with on-street detours

Partial Replacement Options (Turns into Framed Structure)

- **Option C – Partial Structure Replacement/Additional Columns**
- **Option C1 – Partial Structure Replacement/ additional columns & temporary bypass structure**

Complete Replacement Options (Framed Structure)

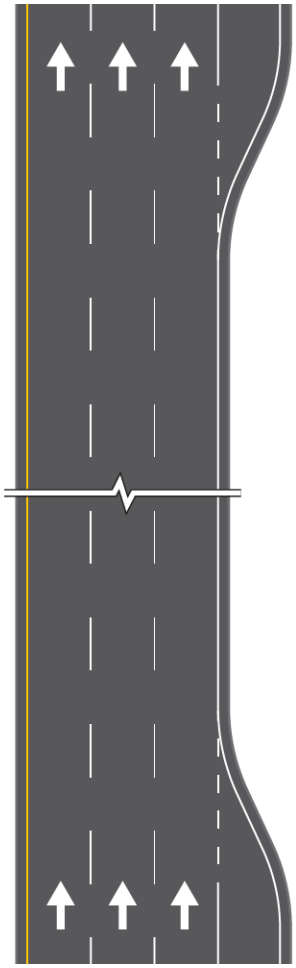
- Option F – Elevation Temporary Roadway (9/27/18 Presentation)
- Option G – Incremental Method (9/27/18 Presentation)
- **Option G1- Complete Replacement with 2 lane double decker temporary bypass**

How Does it Impact the Neighborhood

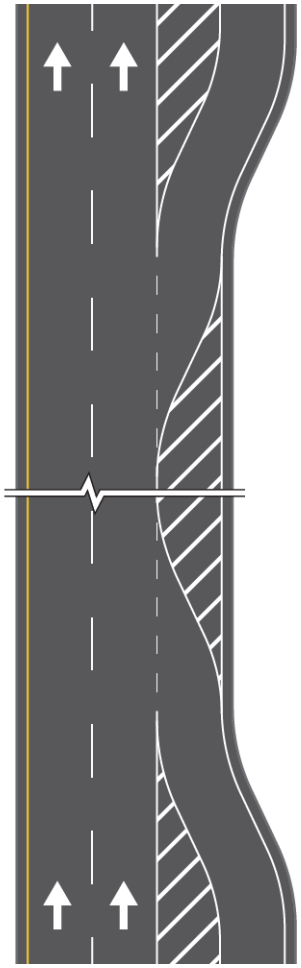
Bypass does not continue into Northern Brooklyn Heights Neighborhood

How Does it Impact the Neighborhood

Existing



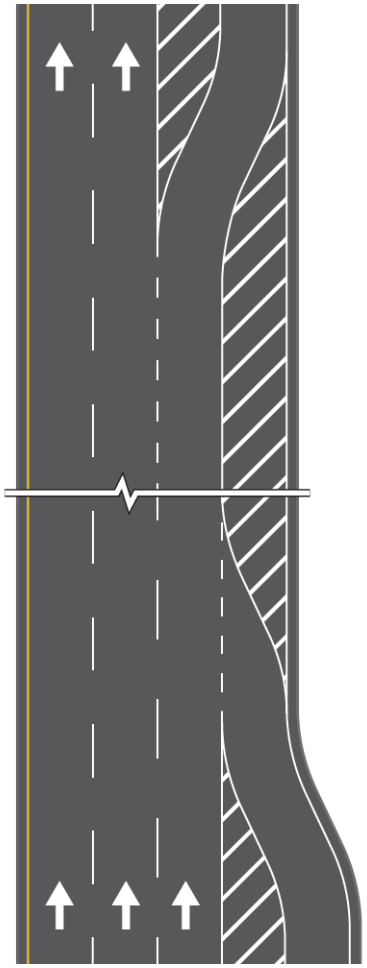
Two-Lane Condition



- Dedicated acceleration and deceleration lanes
- Minimizes weaves
- Allows for shoulder at times

- Leads to:
  - Fewer crashes
  - Fewer delays
  - Fewer spill-overs to local communities

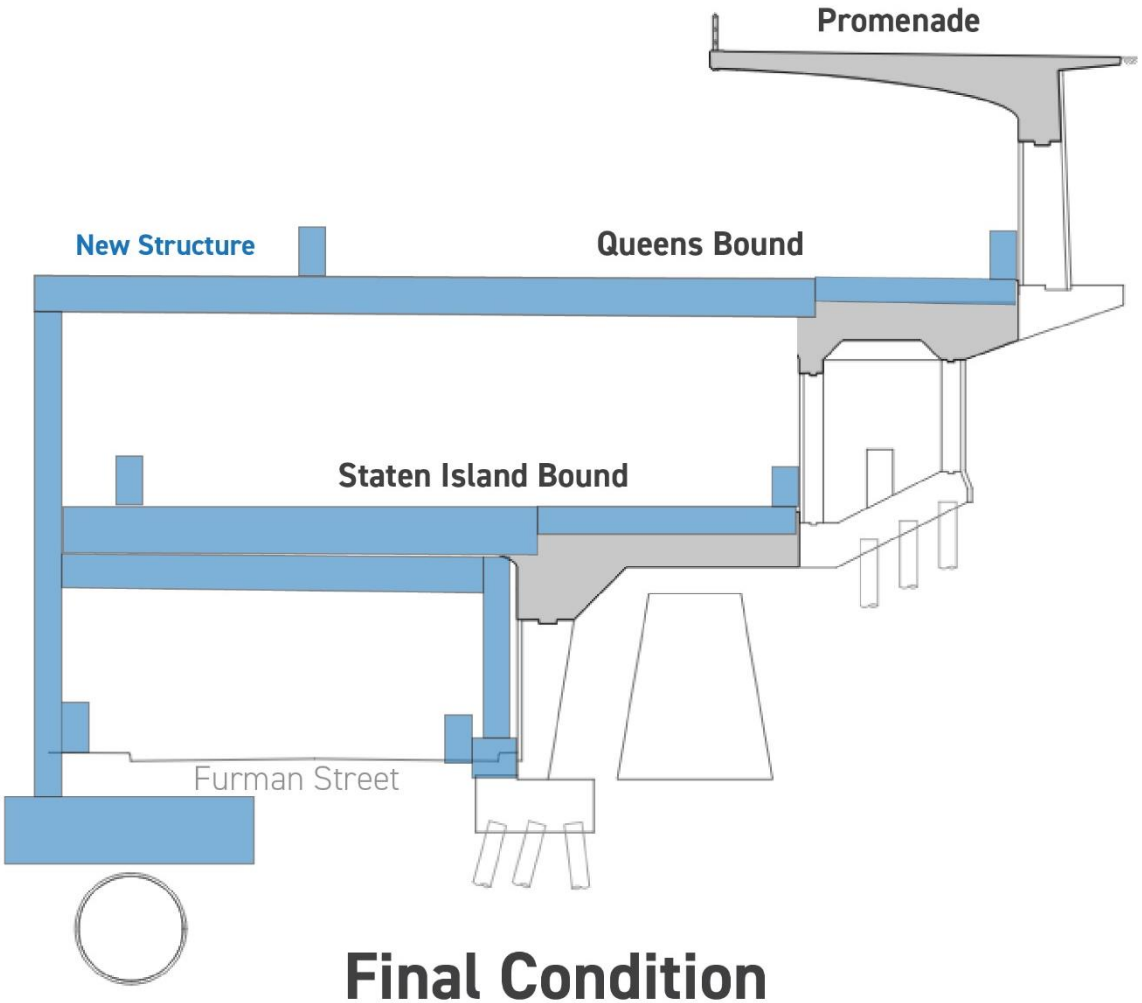
September 2018



- In the above option given the queues, the ramp traffic may end up taking up shoulder.

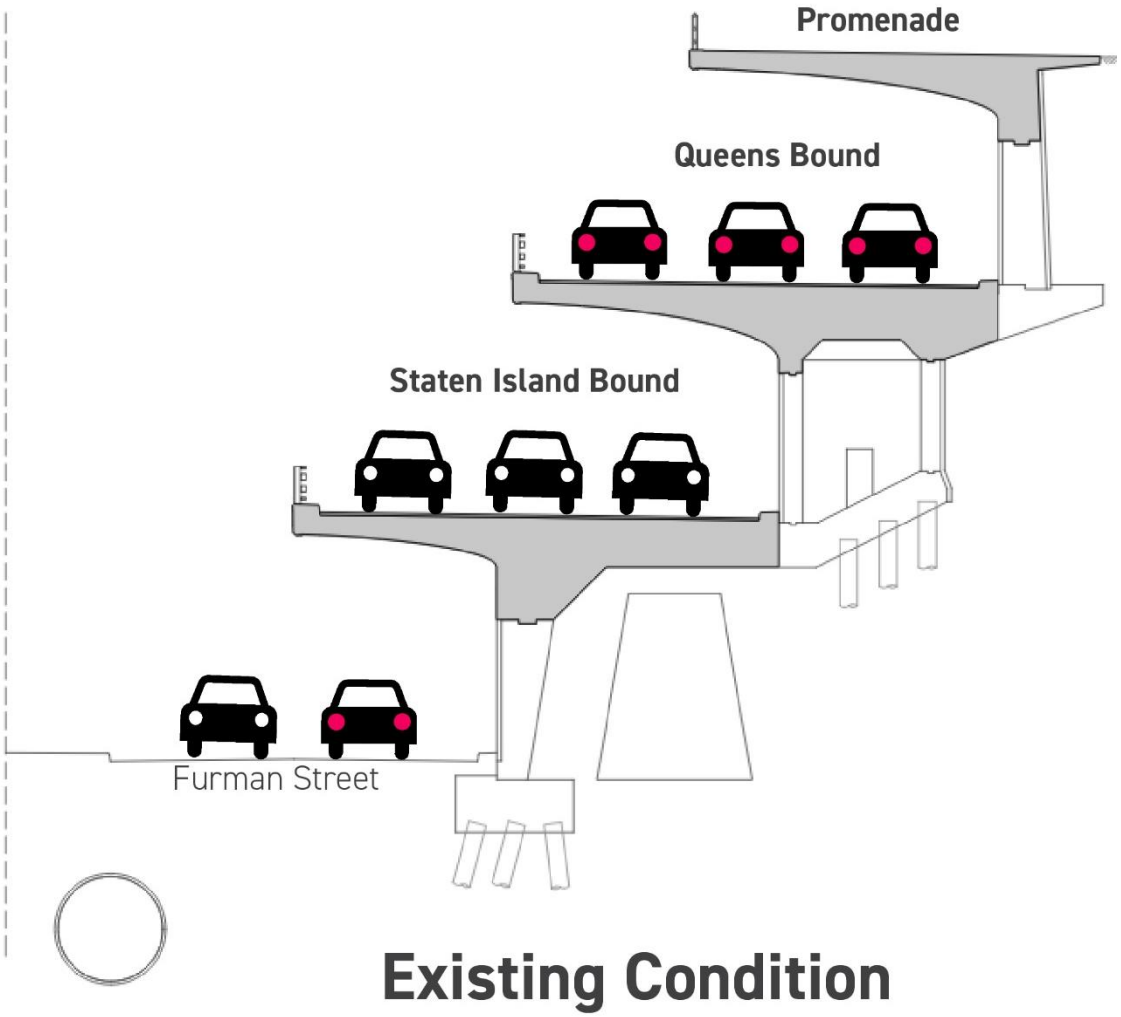
C. Partial Structure Replacement

What is it?

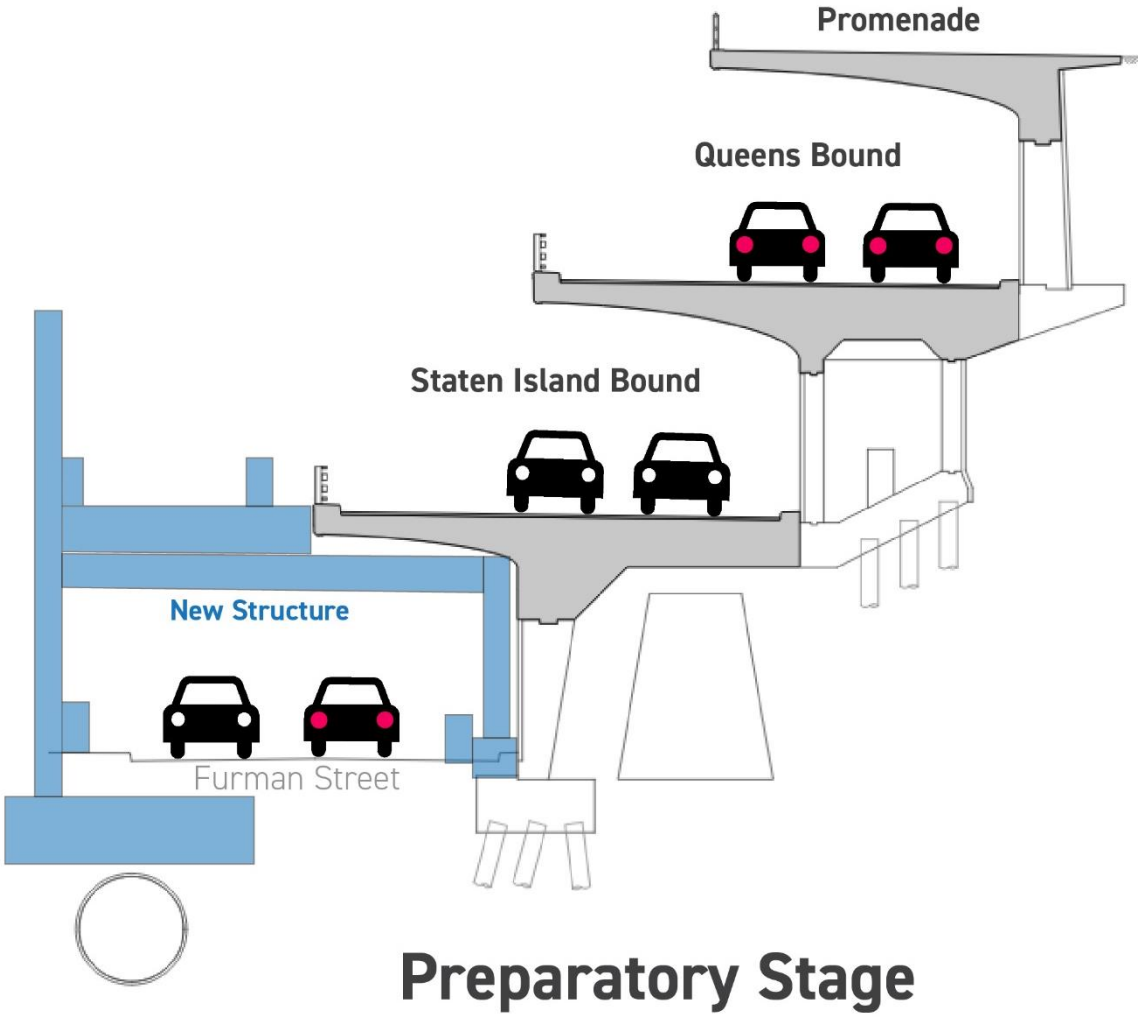


Final Condition

How?

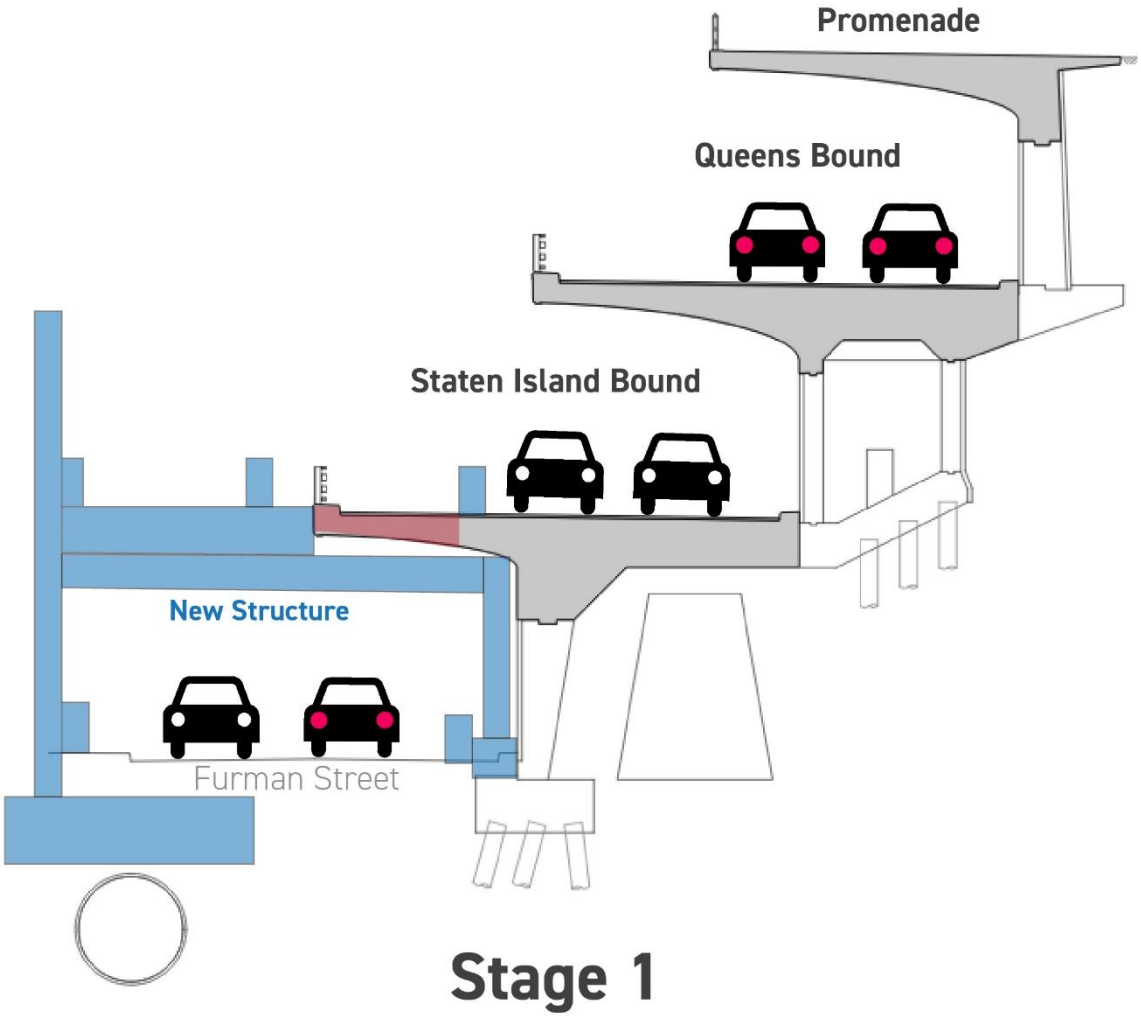

Promenade
Queens Bound
Staten Island Bound
Furman Street
Existing Condition

How?

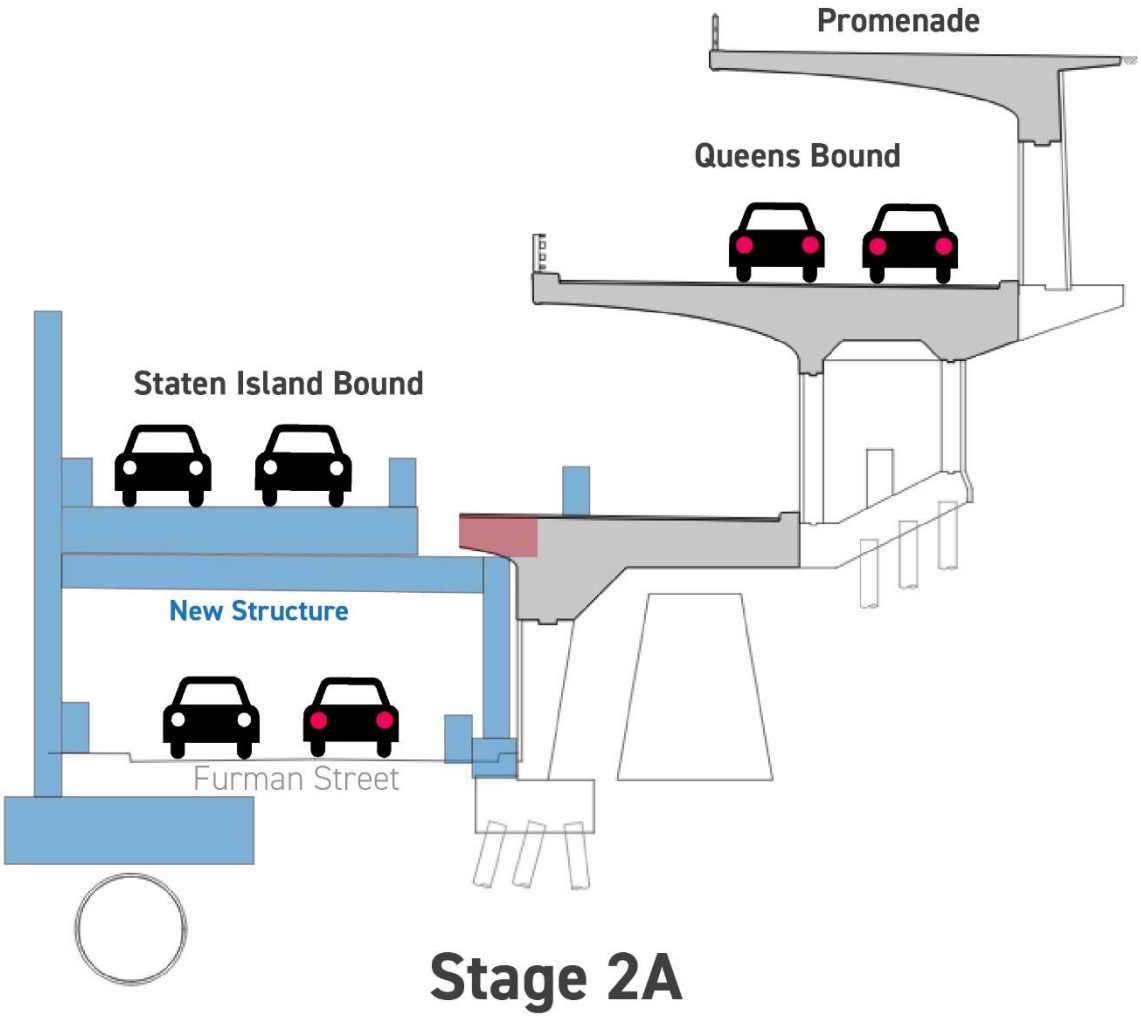


Preparatory Stage

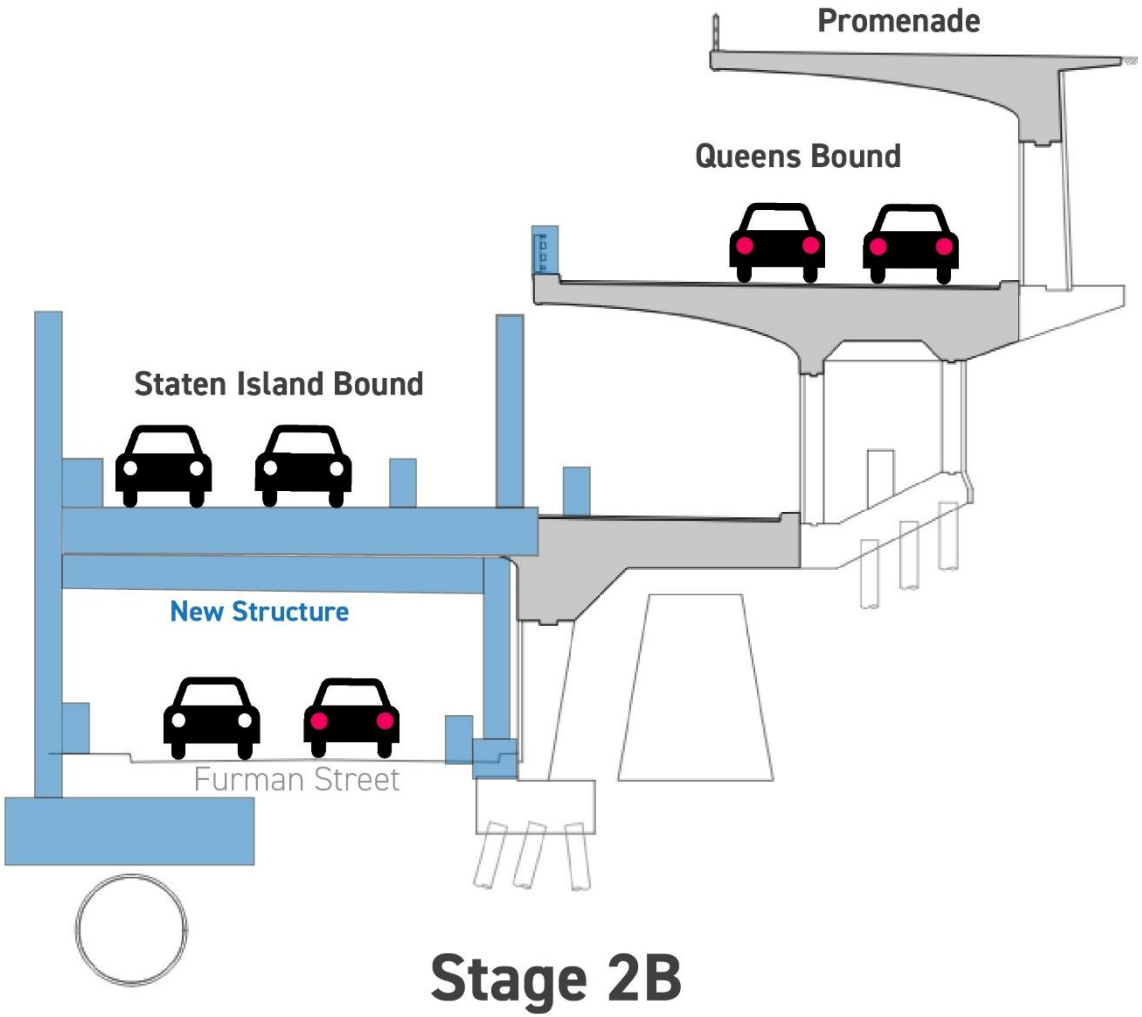
How?


Promenade
Queens Bound
Staten Island Bound
New Structure
Furman Street
Stage 1

How?

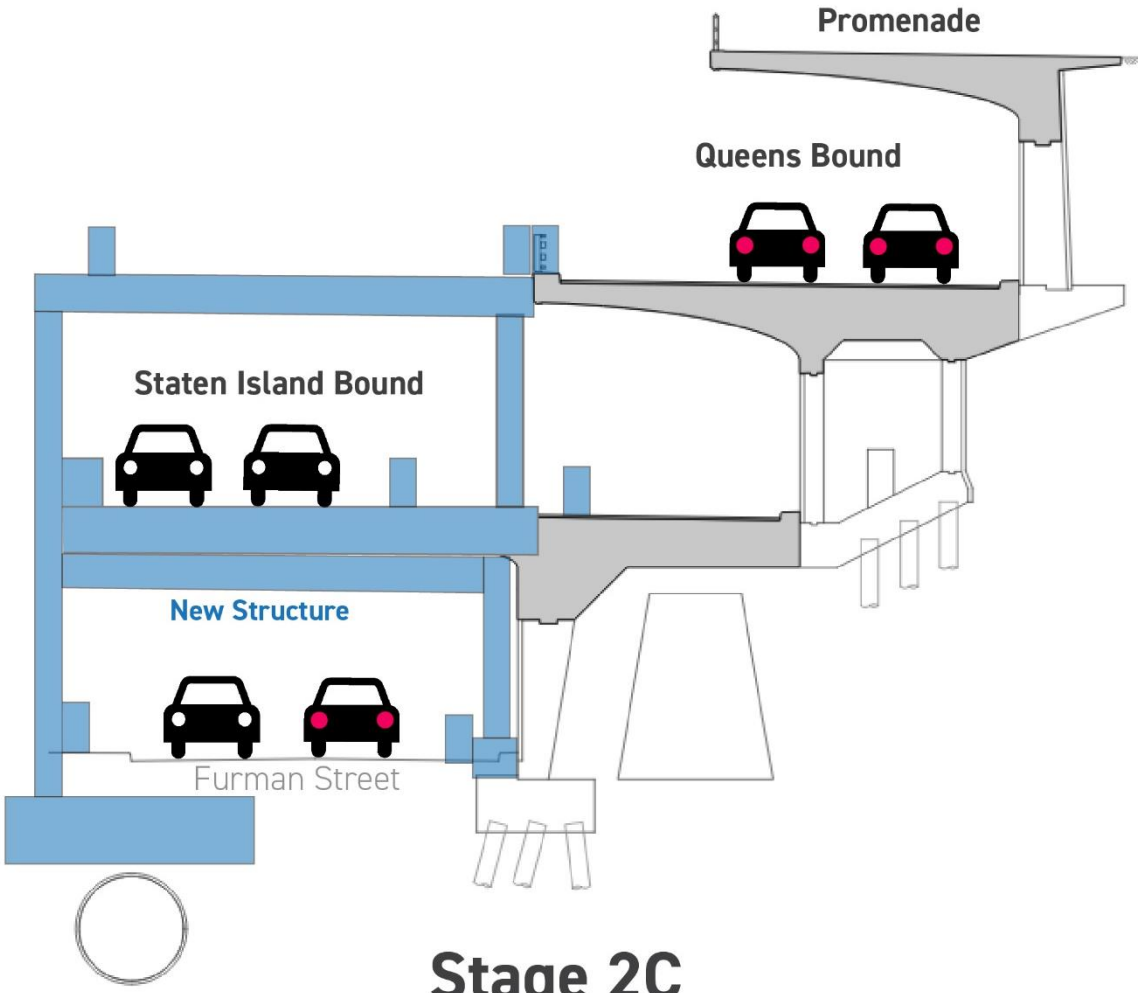

Promenade
Queens Bound
Staten Island Bound
New Structure
Furman Street
Stage 2A

How?


Promenade
Queens Bound
Staten Island Bound
New Structure
Furman Street

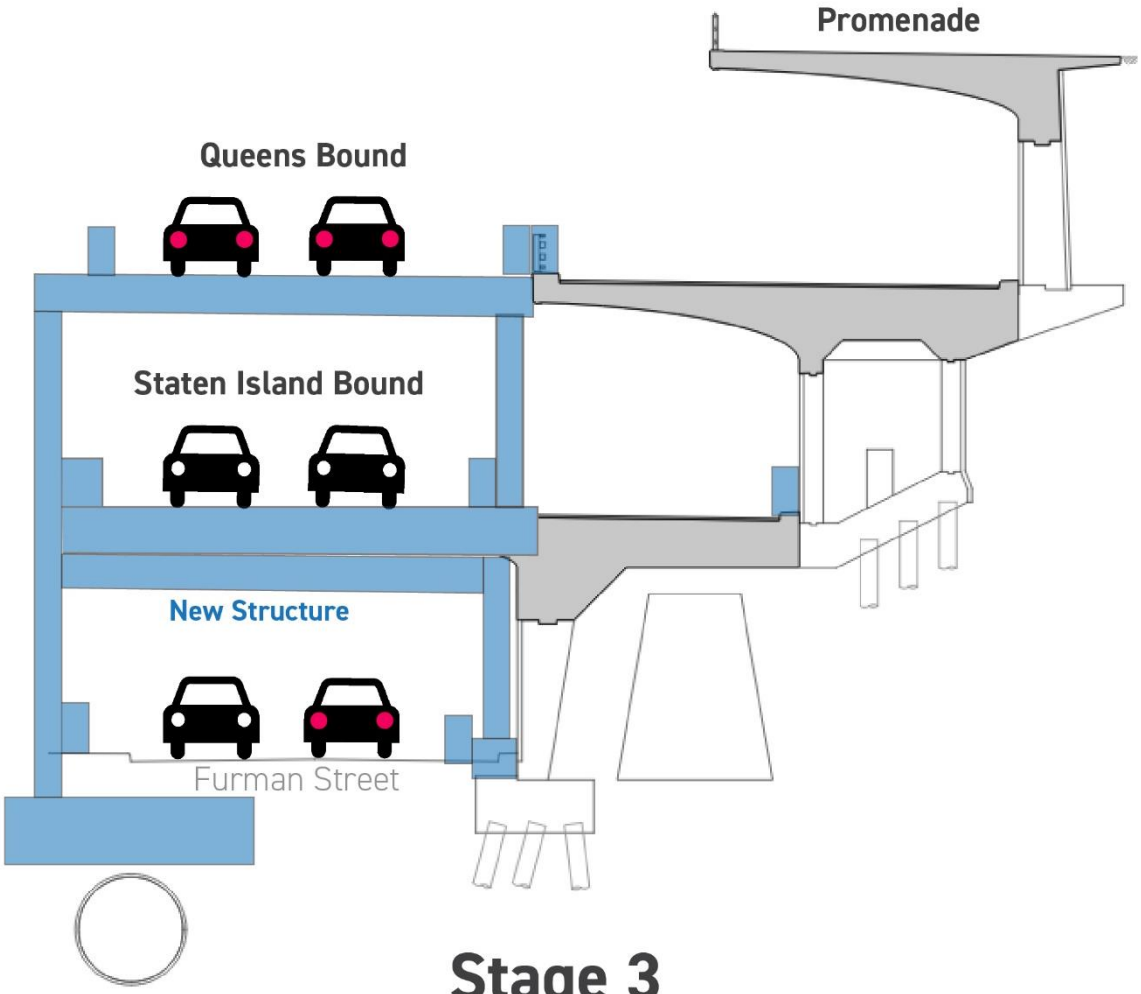
Stage 2B

How?


Promenade
Queens Bound
Staten Island Bound
New Structure
Furman Street

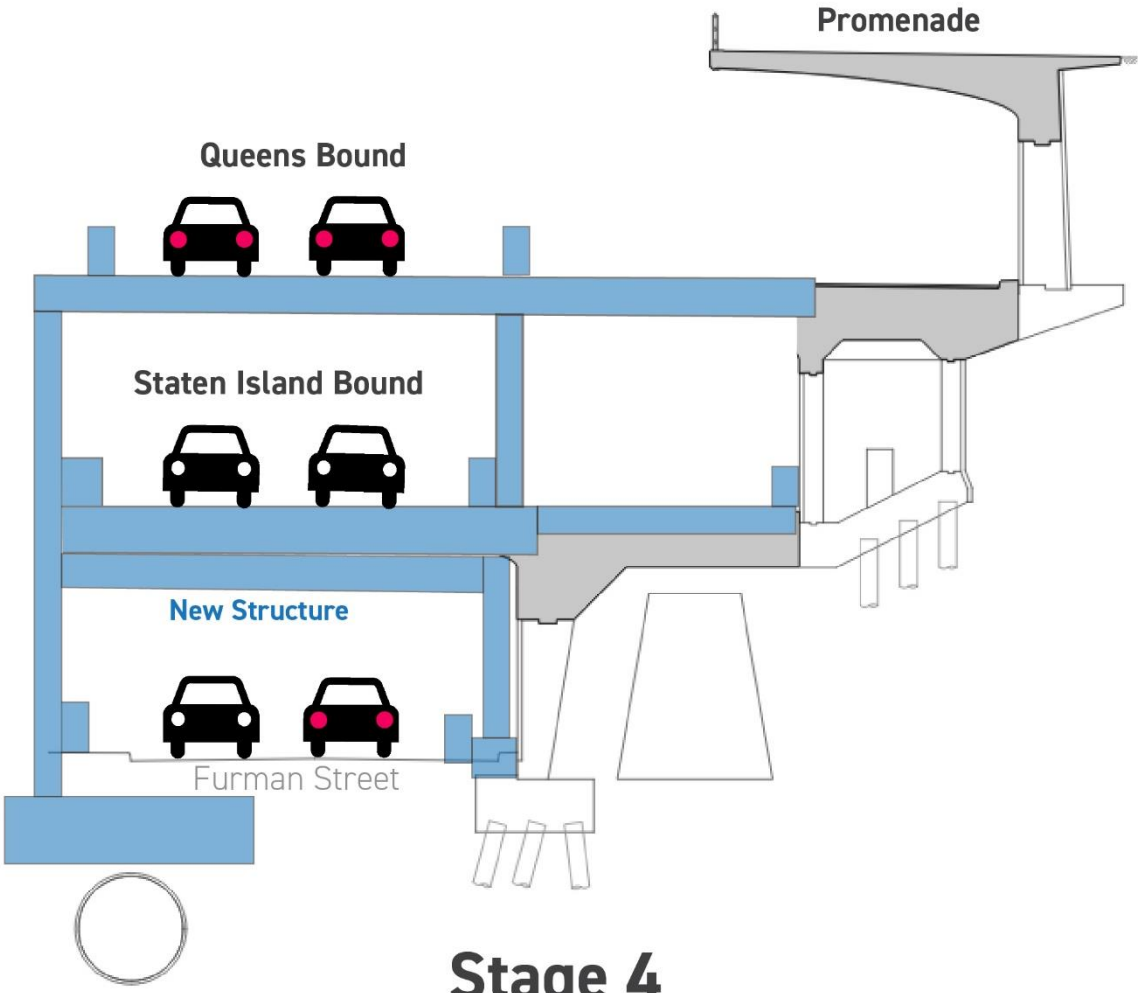
Stage 2C

How?


Promenade
Queens Bound
Staten Island Bound
New Structure
Furman Street

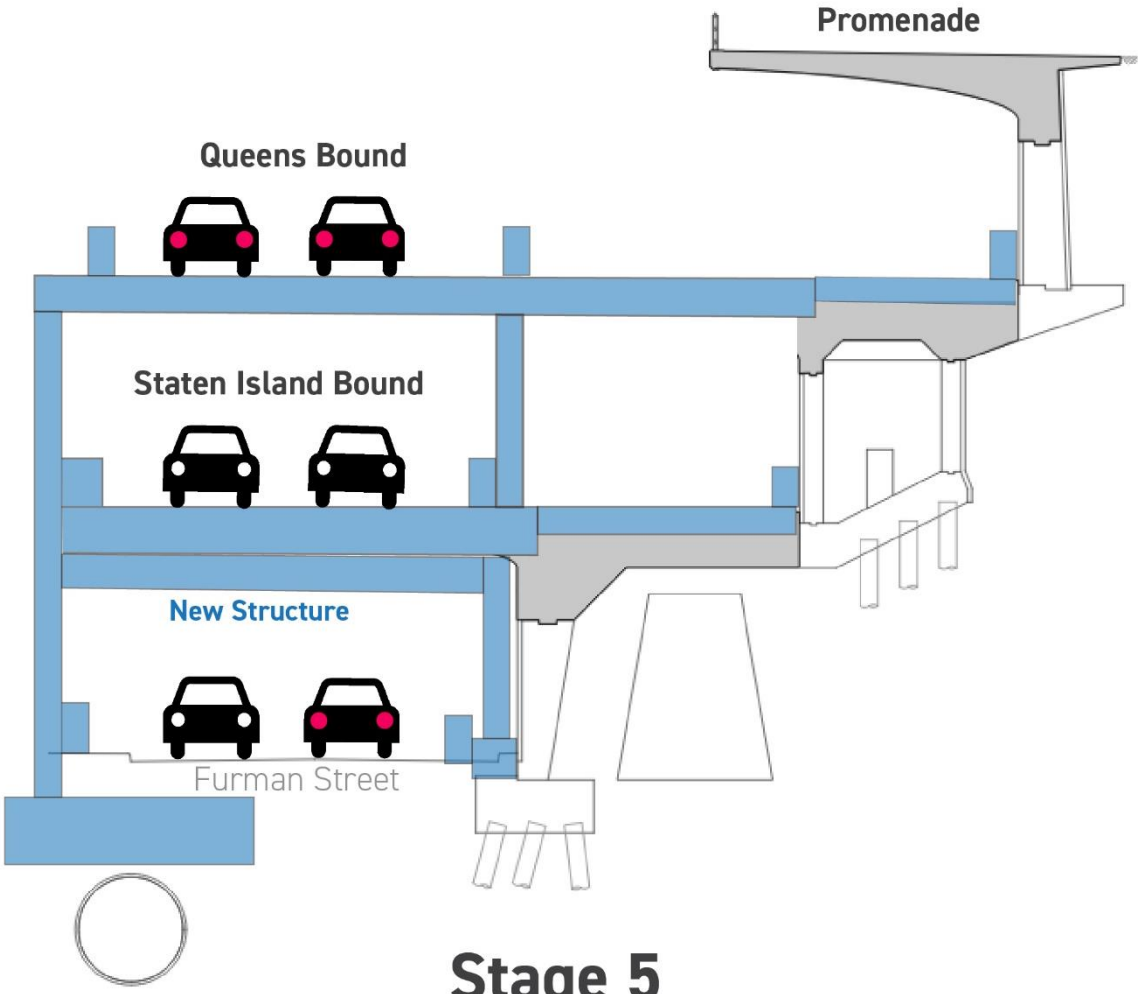
Stage 3

How?


Promenade
Queens Bound
Staten Island Bound
New Structure
Furman Street

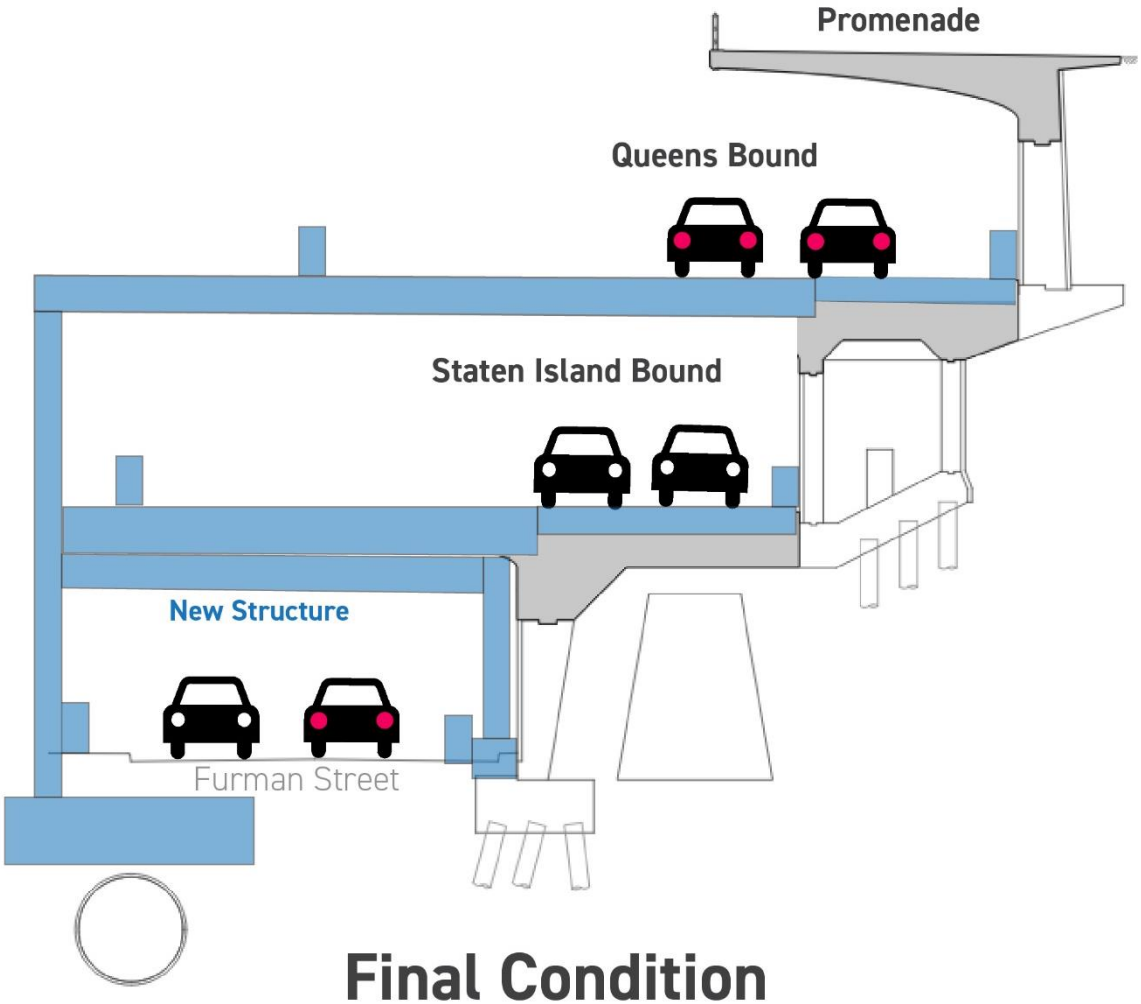
Stage 4

How?


Promenade
Queens Bound
Staten Island Bound
New Structure
Furman Street

Stage 5

How?



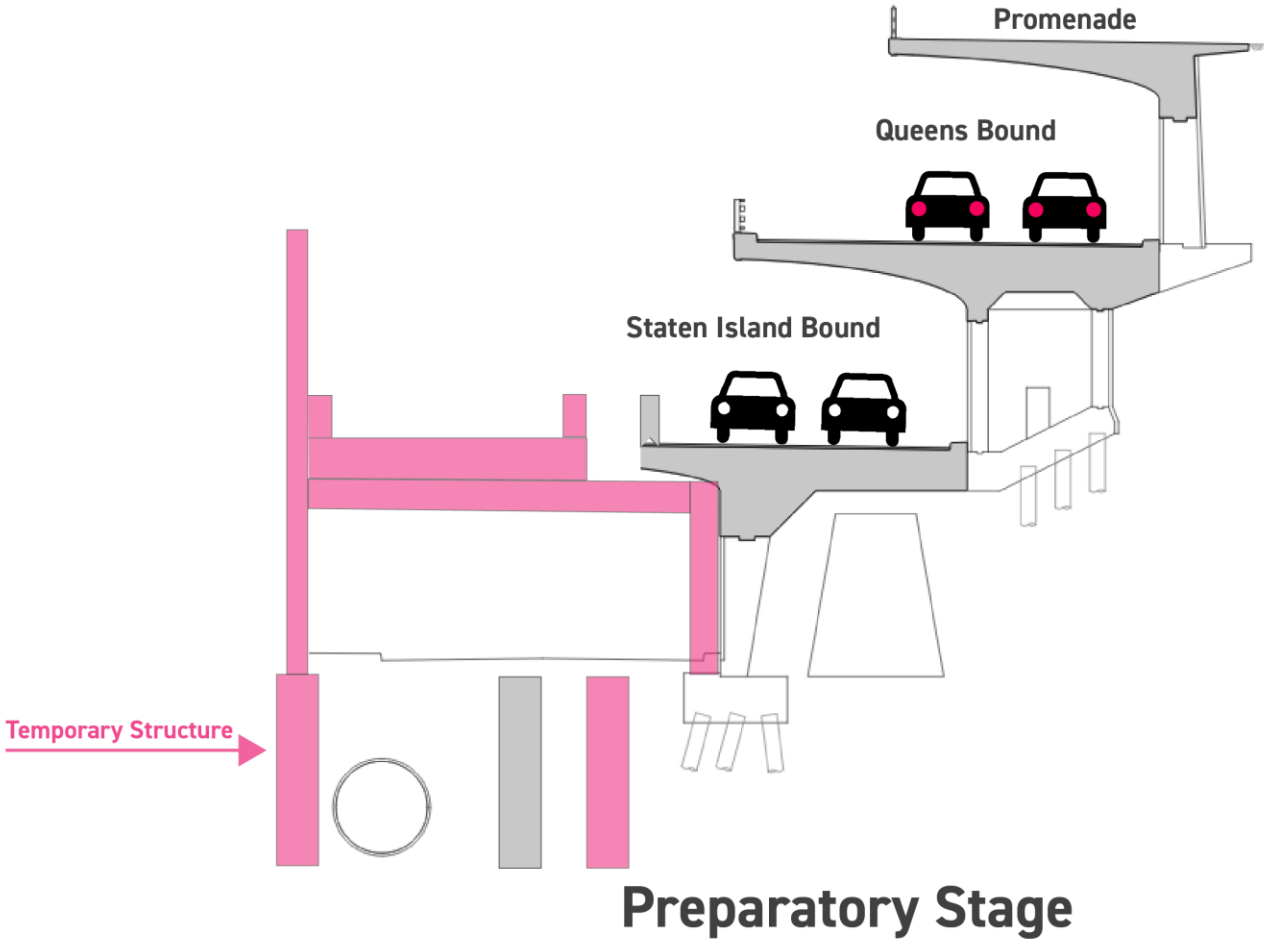
Final Condition

Considerations

- Requires permanent columns every 50 feet
- Difficult to control the final aesthetics
- Overnight/weekend work
- Very similar to full replacement, but some benefits are left out
- DEP needs clearance for sewer interceptor

Option C1 Partial Replacement with Temporary Bypass

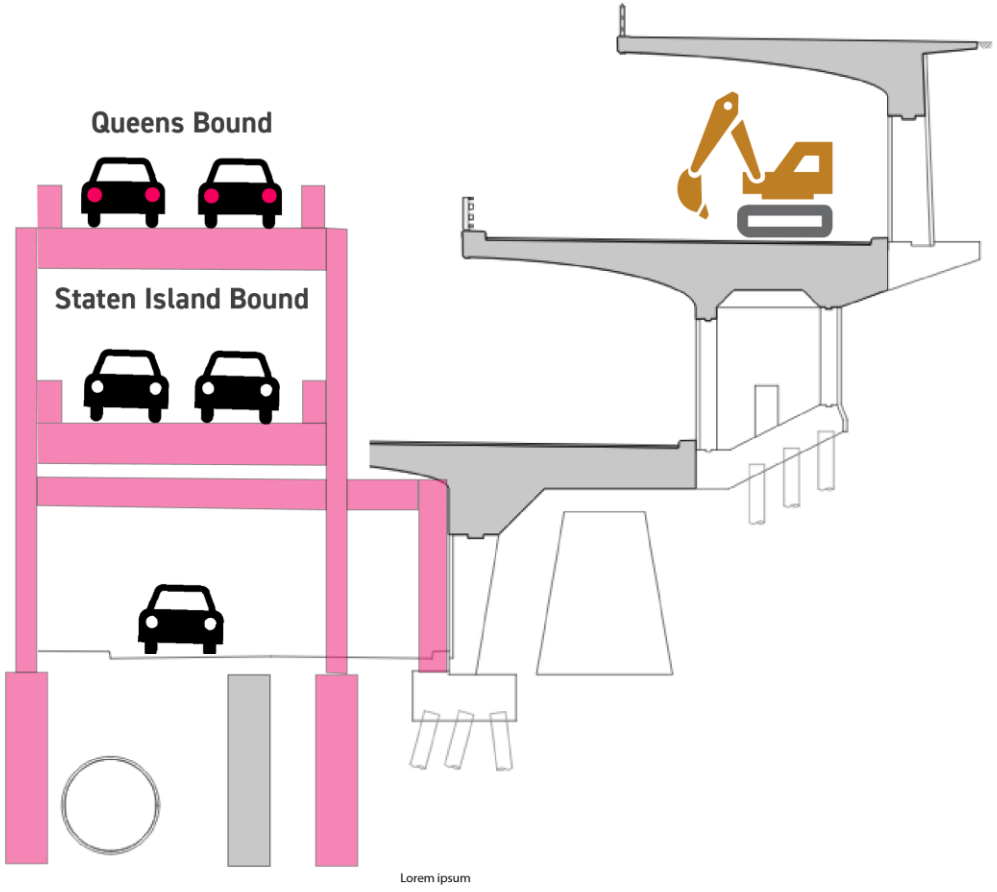
Option C1



Preparatory Stage

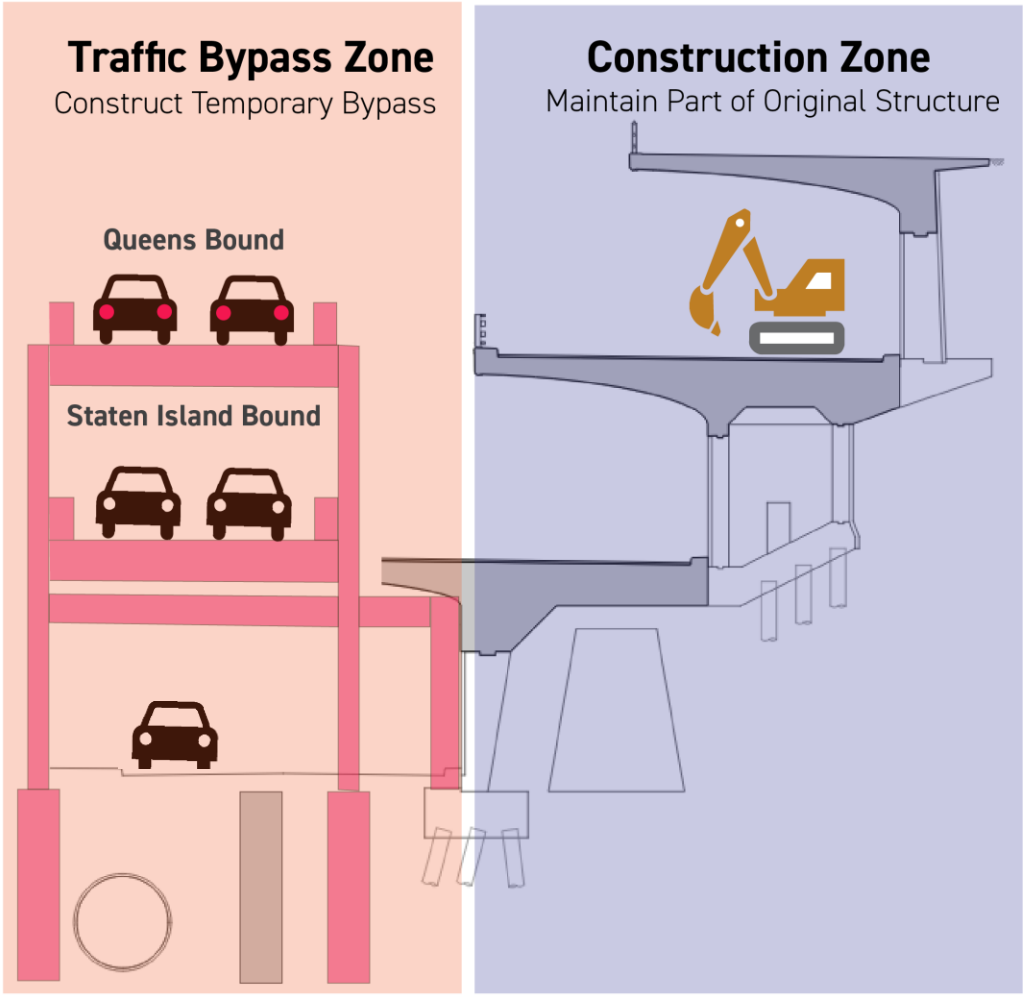
Diagrammatic Representation

Option C1



Diagrammatic Representation

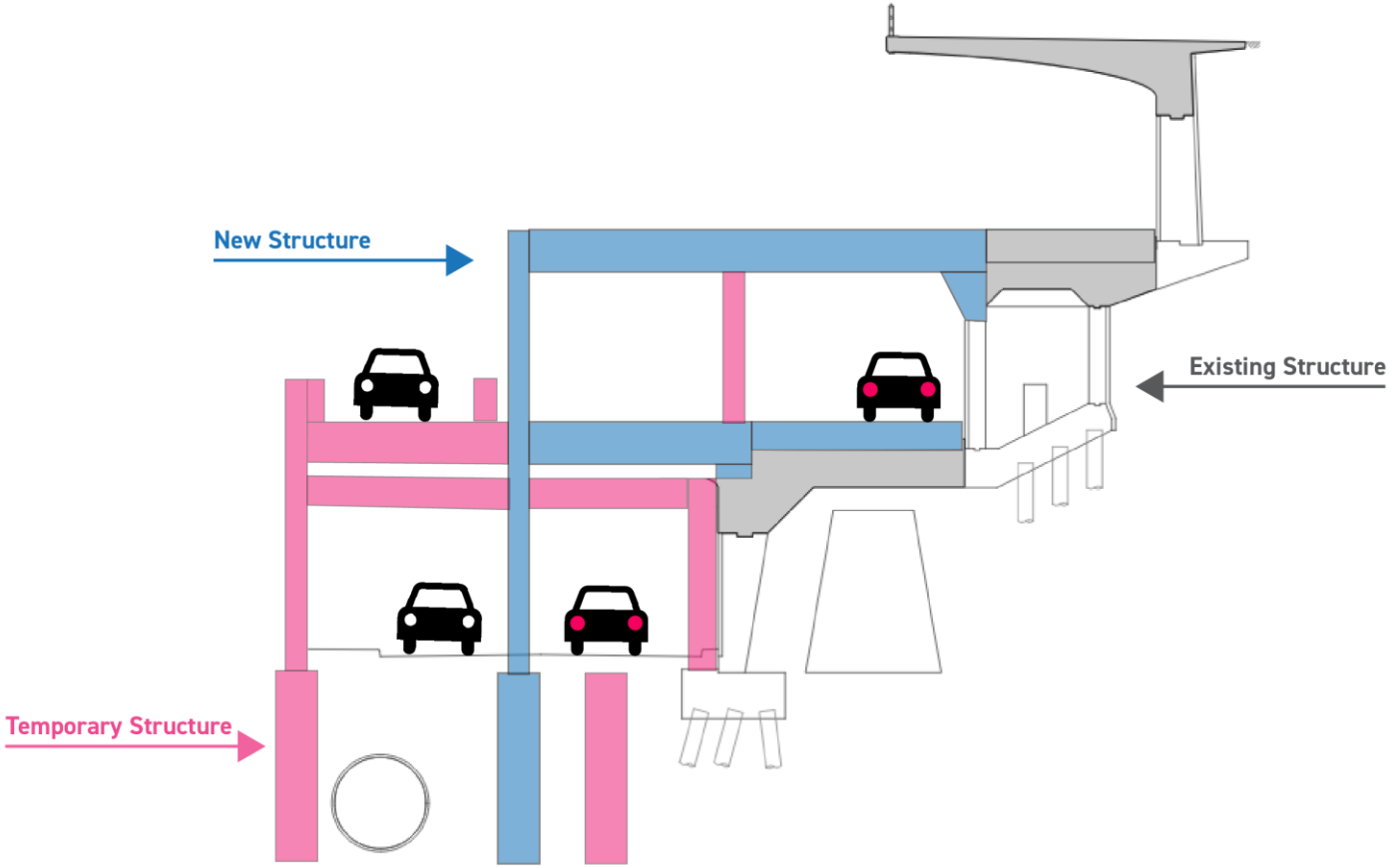
Option C1



During Construction

Diagrammatic Representation

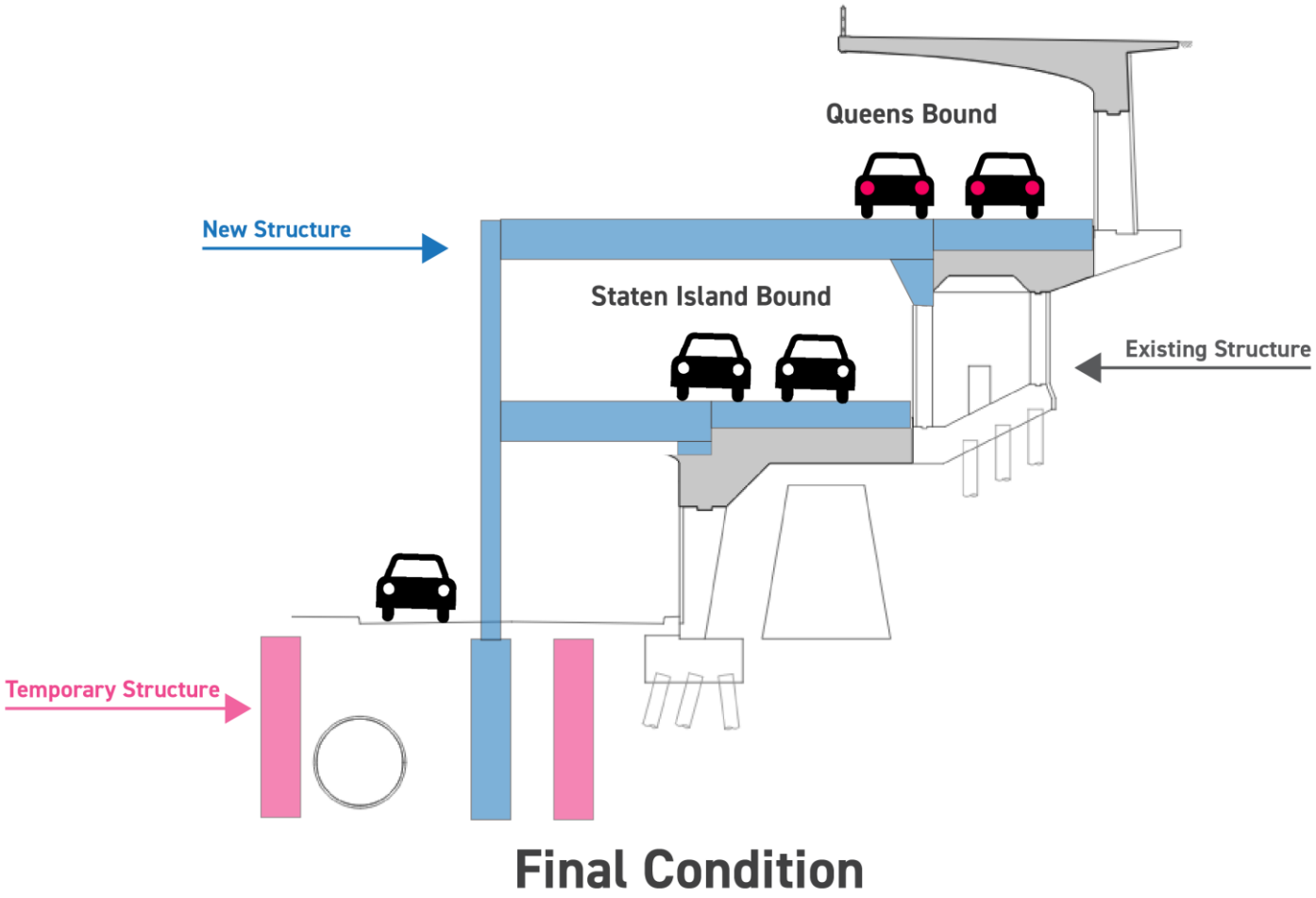
Option C1



Intermediate Stage

Diagrammatic Representation

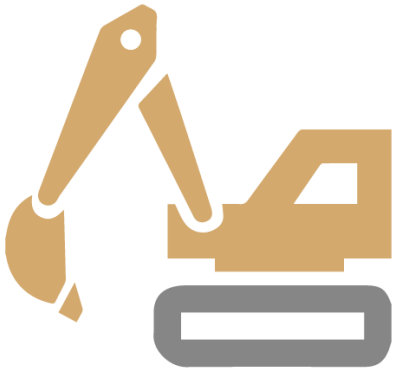
Option C1



Diagrammatic Representation

Option C and C1

Duration



8-10 Yrs

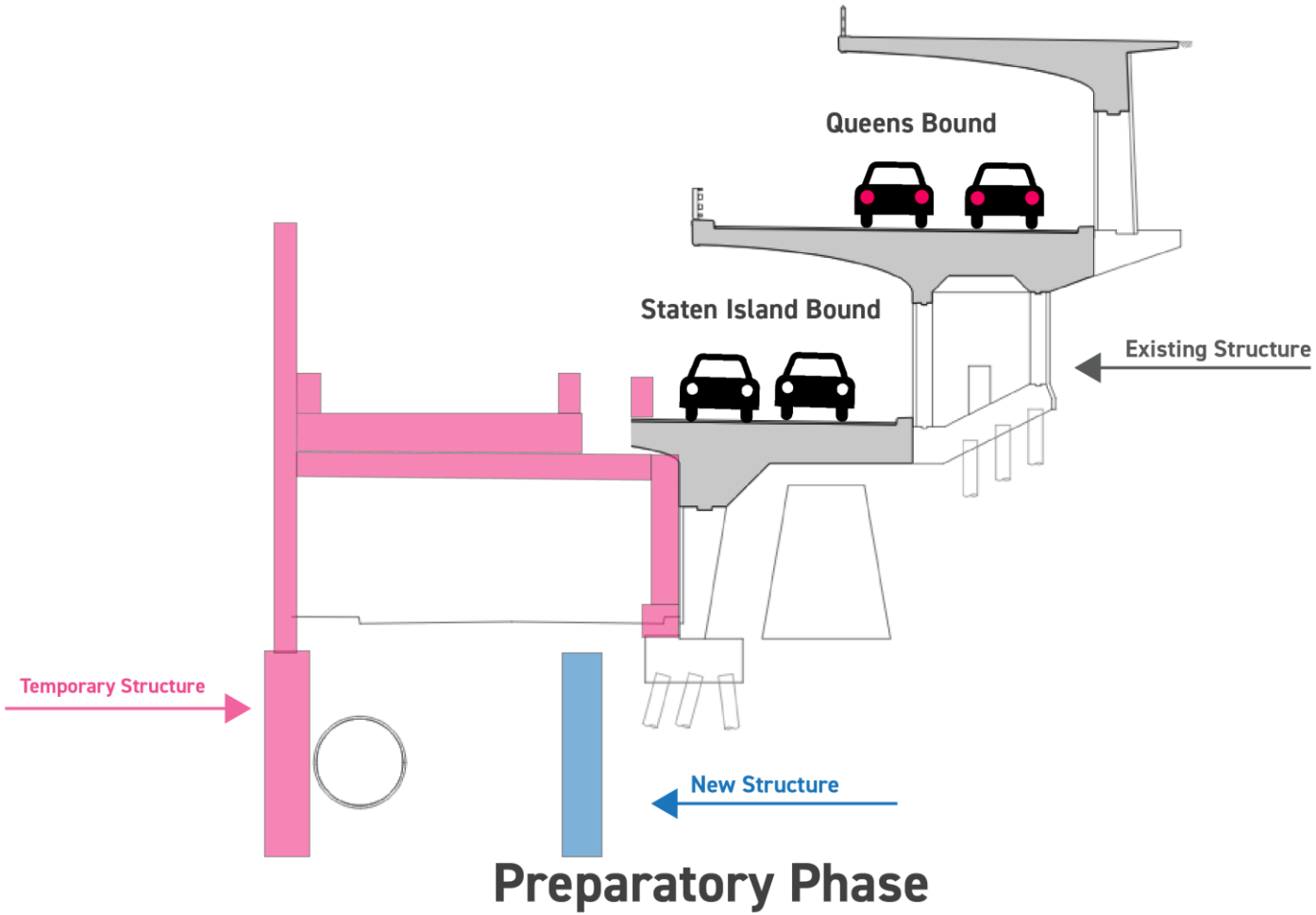
Cost

$2.7B-$3.2B

Option G1

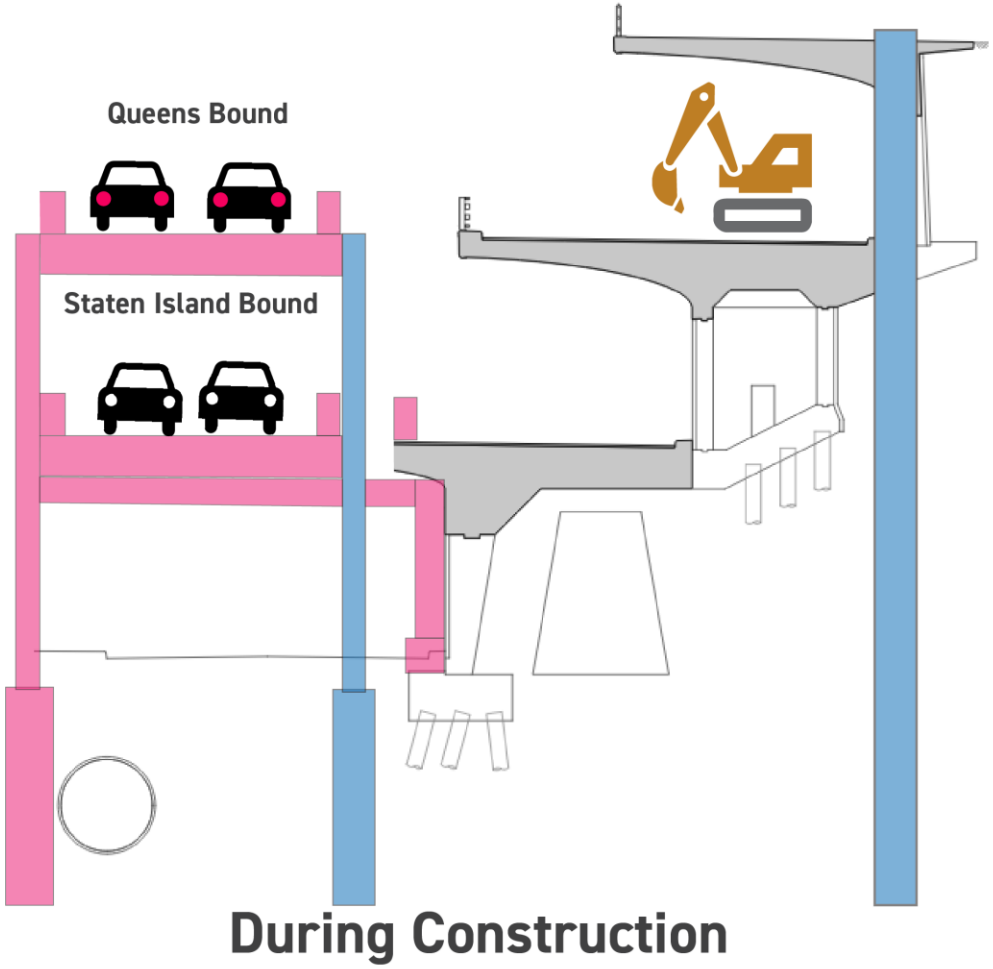
Incremental Replacement with 2 lane temporary

Option G1



Diagrammatic Representation

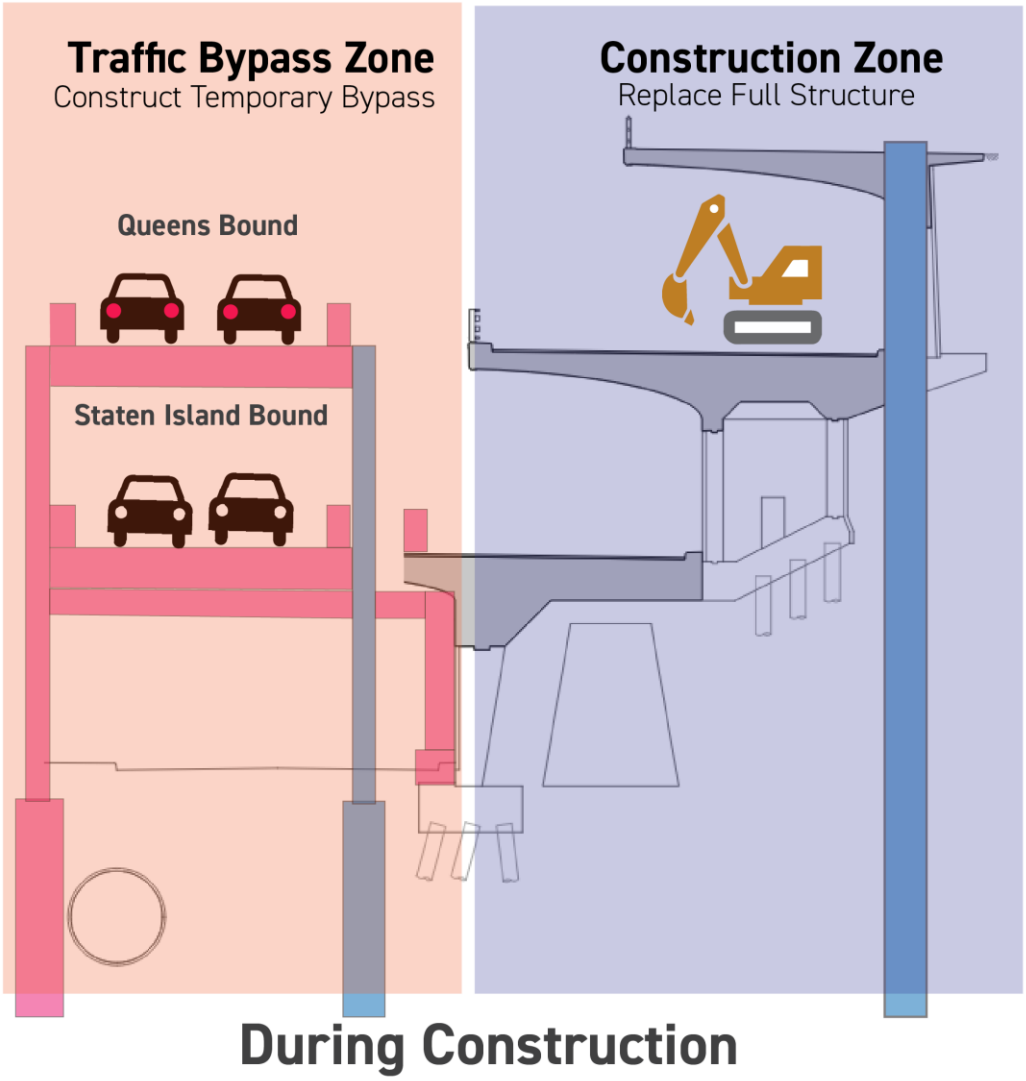
Option G1



During Construction

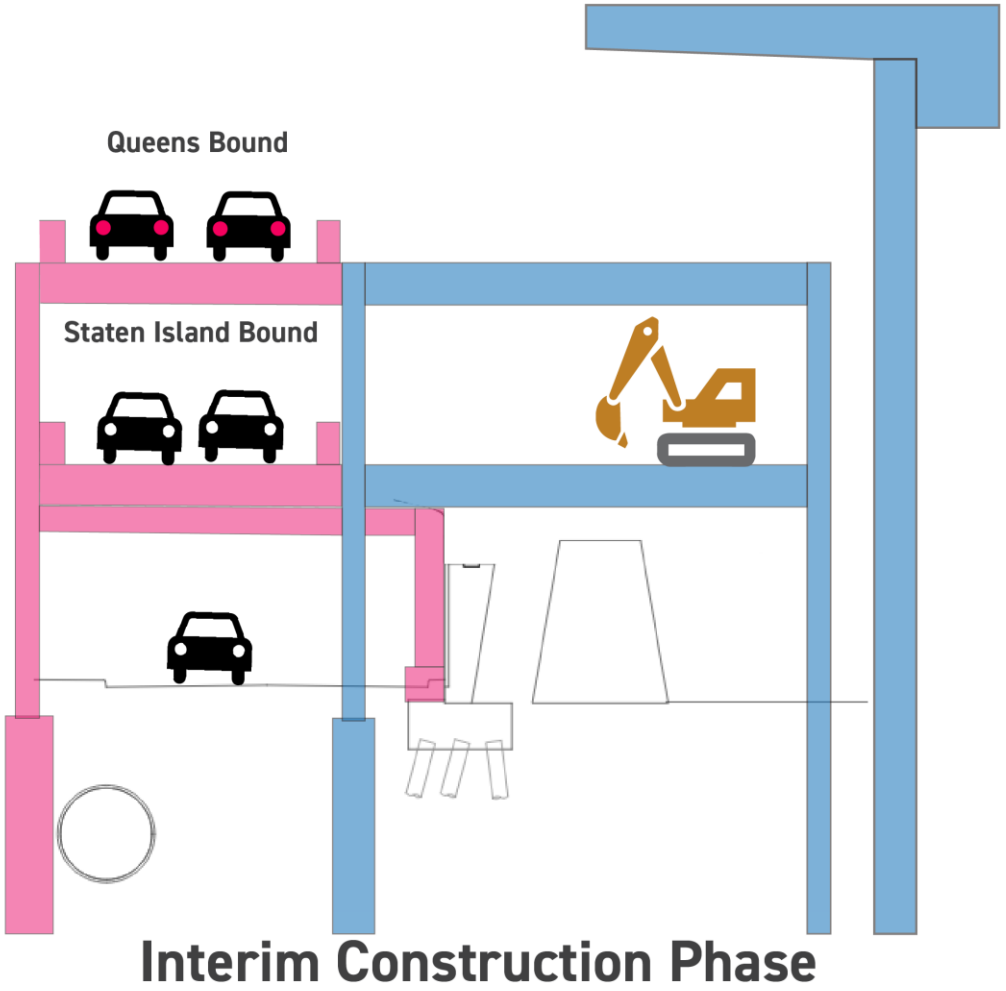
Diagrammatic Representation

Option G1



Diagrammatic Representation

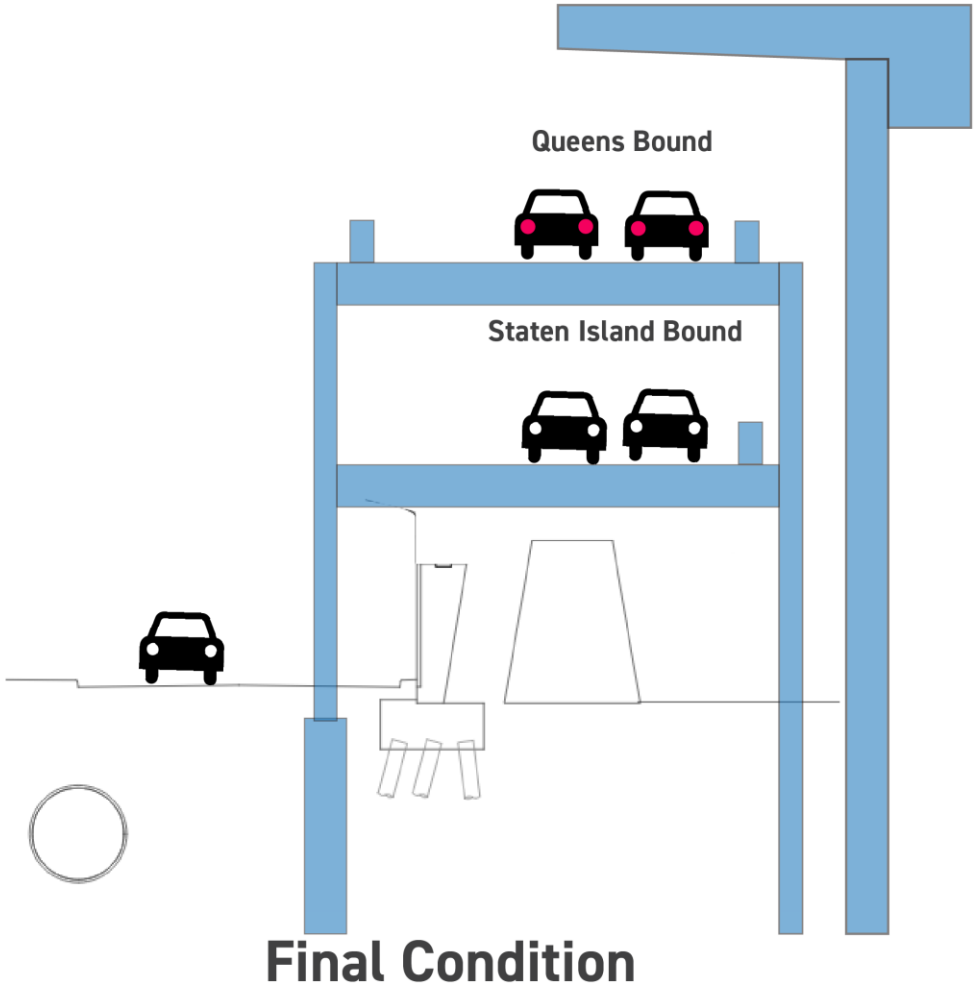
Option G1



Interim Construction Phase

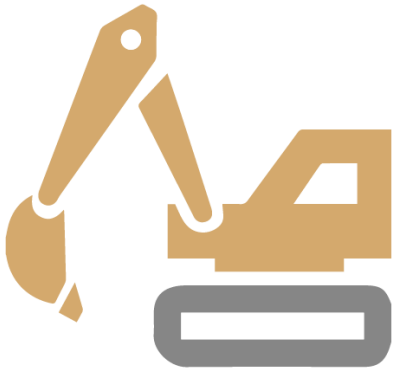
Diagrammatic Representation

Option G1



Diagrammatic Representation

Duration



8-10 Yrs

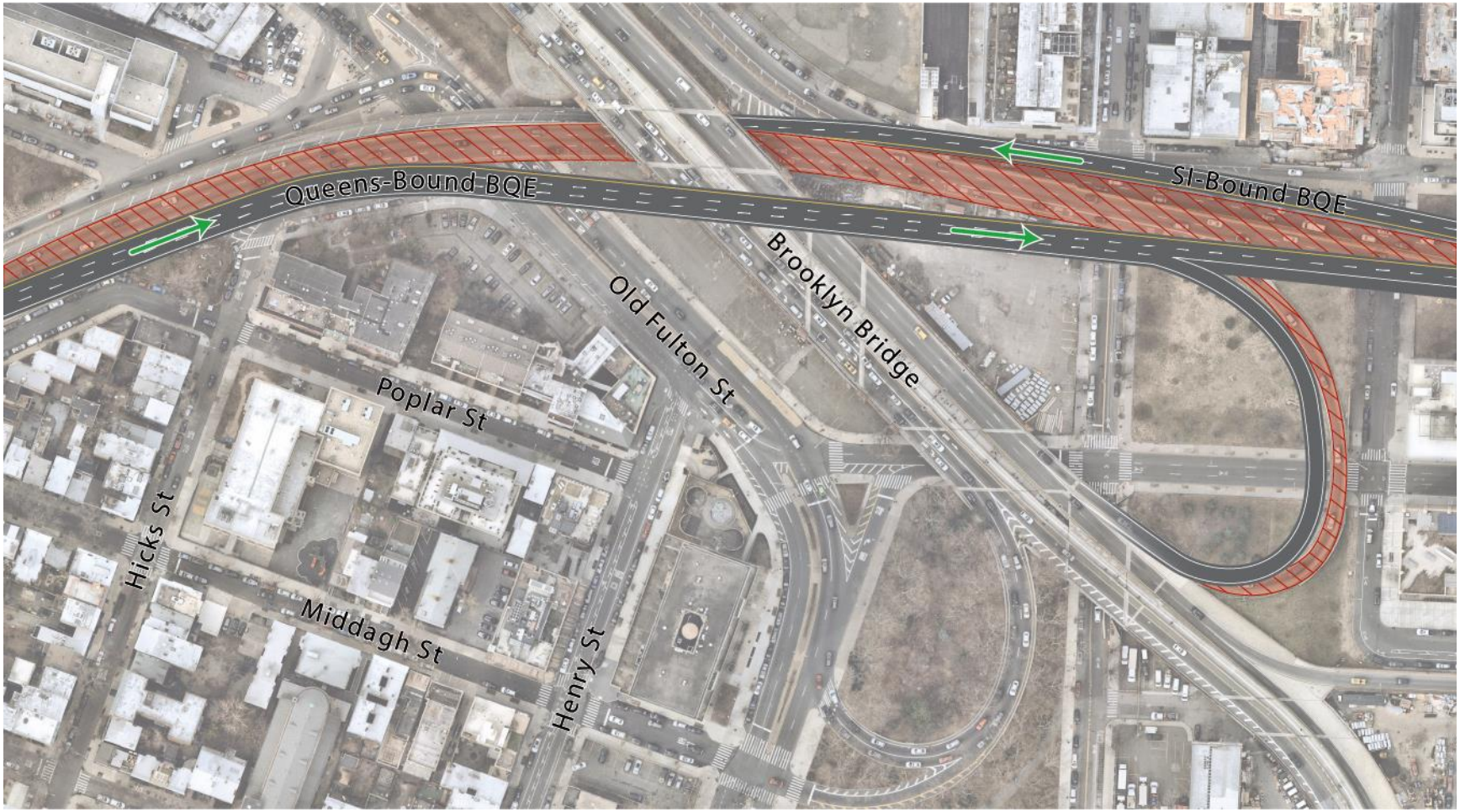
Cost

$3.2B-$3.7B

So, what happens beyond Furman Bypass

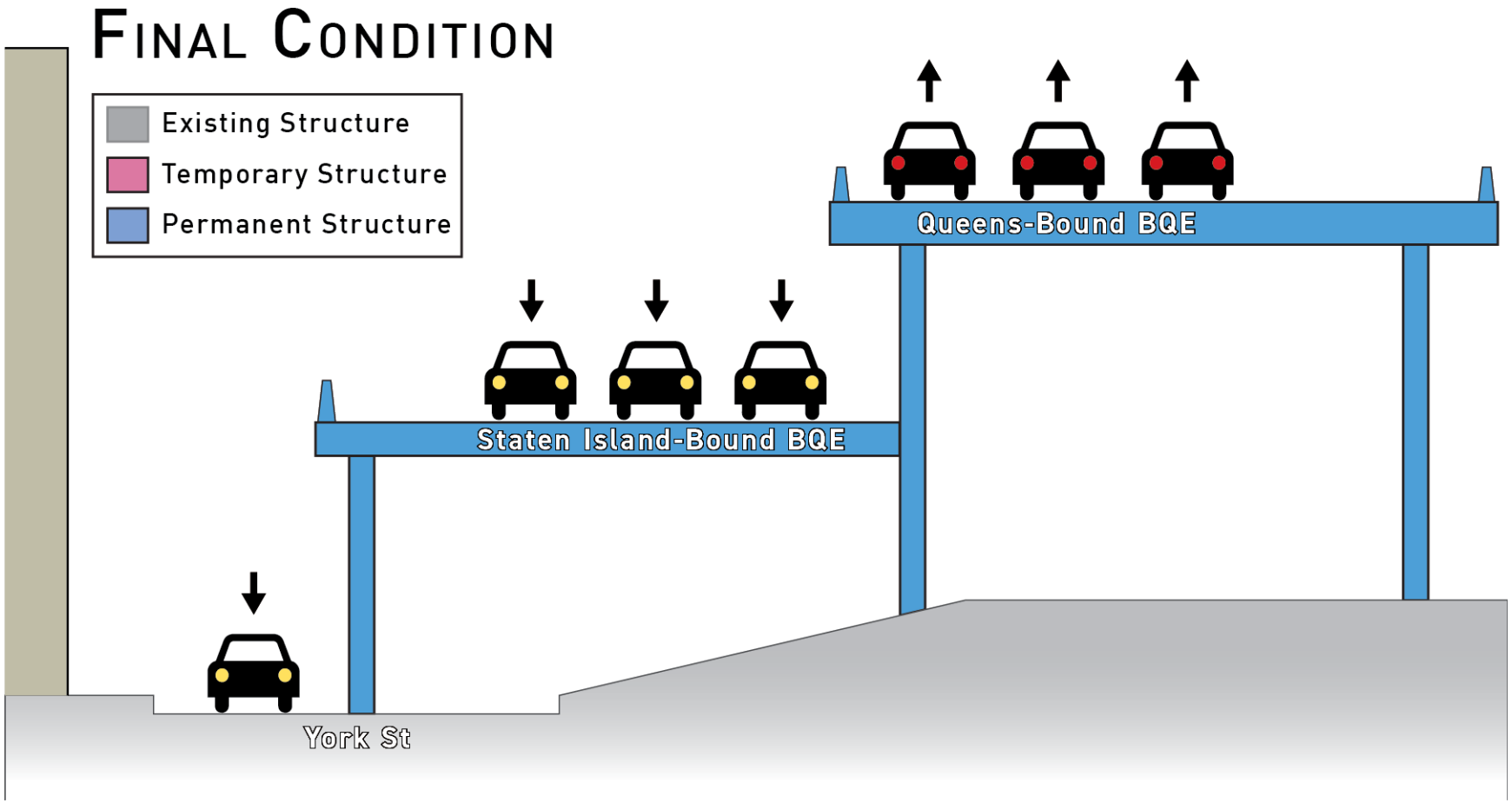
Columbia Heights Staging

North of Columbia Heights Staging



SI Bound – At-grade Section, Lane by Lane
QB – Bypass past Columbia Heights Bridge

North of Columbia Heights Staging



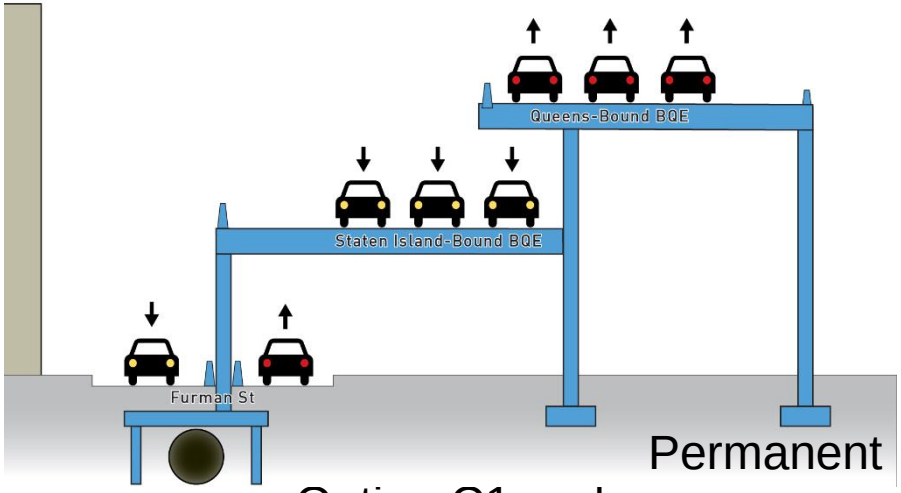
SIB along York Street on partial Temporary
QB on Temporary bypass

South of Joralemon Condition

Option C

Option C1 and G1

Option C



Option C1 and G1

Comparison to Temporary Elevated Roadway

	C1 (Partial Structure Replacement with Bypass)	F (Temporary Elevated Roadway)	G1 (Complete Replacement with Incremental)
Construction Duration	8-10 Years	6-8 Years	8-10 Years
Construction Cost	$2.7B - $3.2B	$3B - $3.3B	$3.2B - $3.7B
Service Life	40 Years	100 Years	100 Years
Promenade Impacts	Closure in sections	Complete closure during construction	Closure in sections
Atlantic Ave Interchange	Limited Improvements	Full reconfiguration	Full reconfiguration
Improved Vertical Clearances	No	Yes	Yes
Vibration Mitigation	Limited	Yes	Yes
360 Furman/ Furman Street Impacts	Distance from 360 Furman during construction: 5 ft; final distance: 20 ft Furman Street would likely be one lane		

Questions?

The BQE: What's going on right now?

Service Life Analysis

- Assesses the current and future amount of degradation in the:
  - Decks
  - Walls
  - Foundations
- Evaluates the durability of rehabilitation options

WIM

- Estimates the current and future traffic loads on the BQE

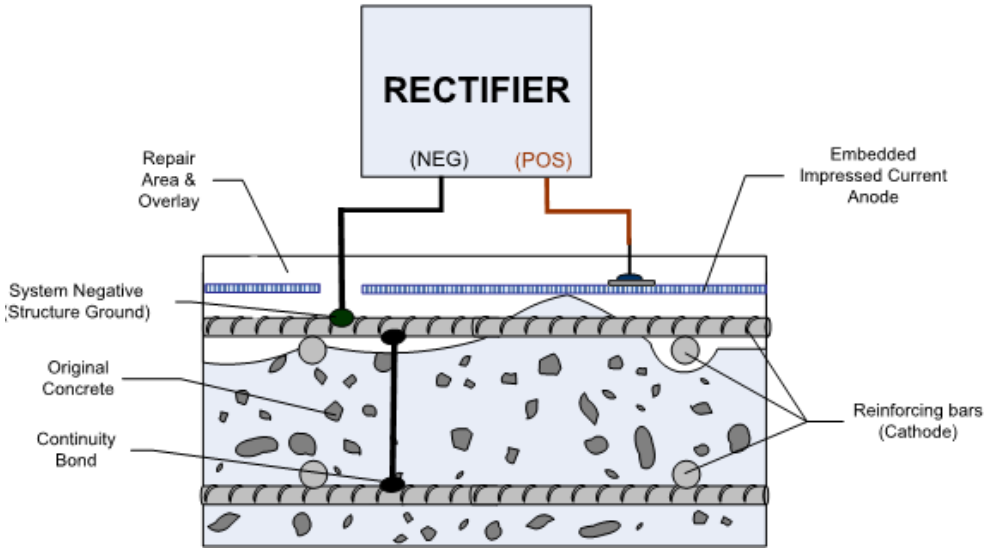
Probabilistic Structural Evaluation

Option A Preservation Method

What is it?

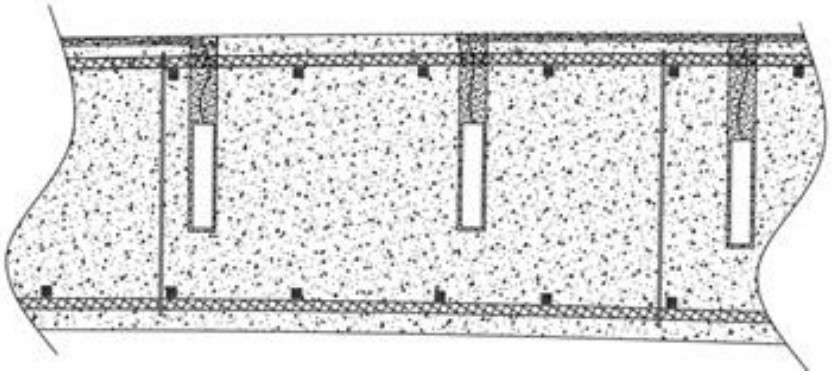
Impressed Current Cathodic Protection (Active)

- Requires power supply
- The Electrical Components require Regular Monitoring and Maintenance
- Highest Service Life extension ~ 40 years



What is it?

Passive Galvanic Cathodic Protection



Considerations

Active System

- Requires constant monitoring and maintenance (i.e. “fine tuning a piano”)
- DOTs throughout the country have abandoned this method

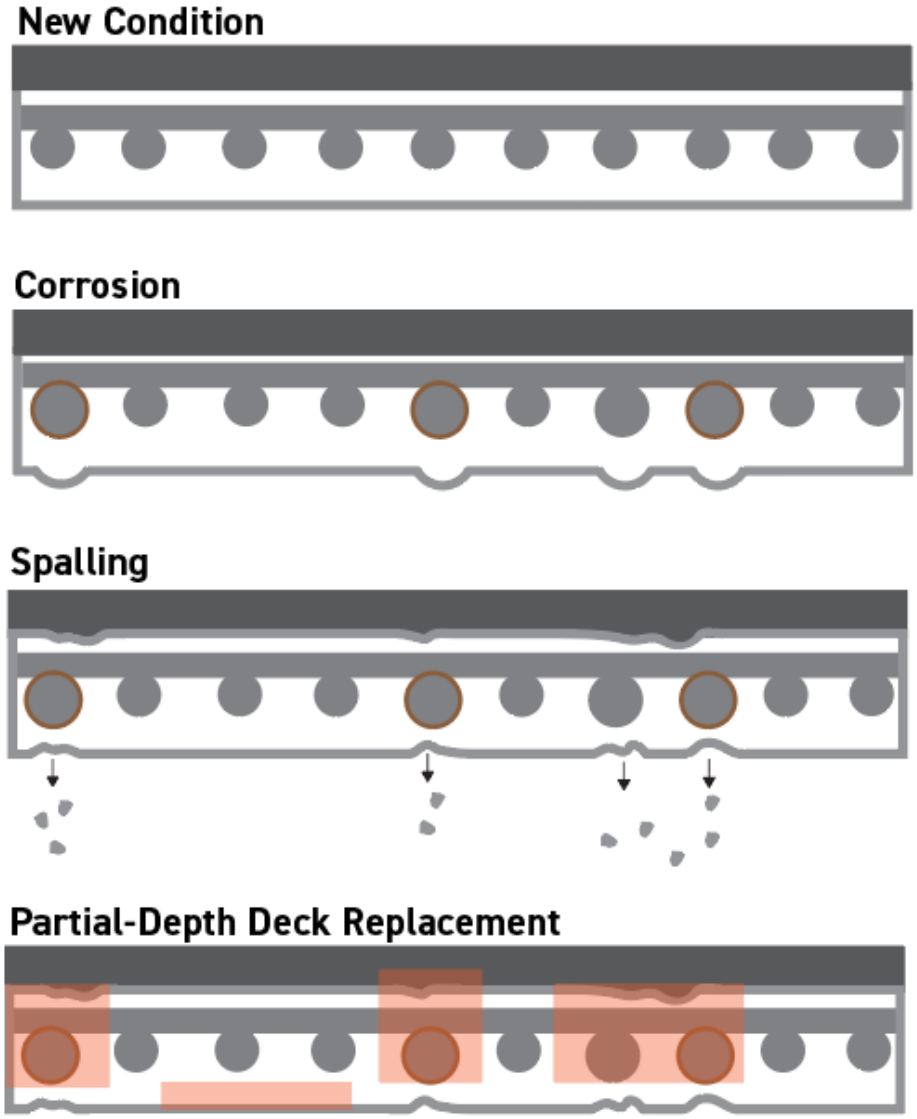
Passive System

- Does not address existing corrosion in the structure
- Installation is dependent on the type of system
- Requires removal of loose and deteriorated concrete
- Even if you arrest corrosion, larger trucks still impact the structure

2. Option B Partial-Depth Deck Replacement

What is it?

- Replacement of deteriorated deck sections only
  - Like fixing a cavity in a tooth



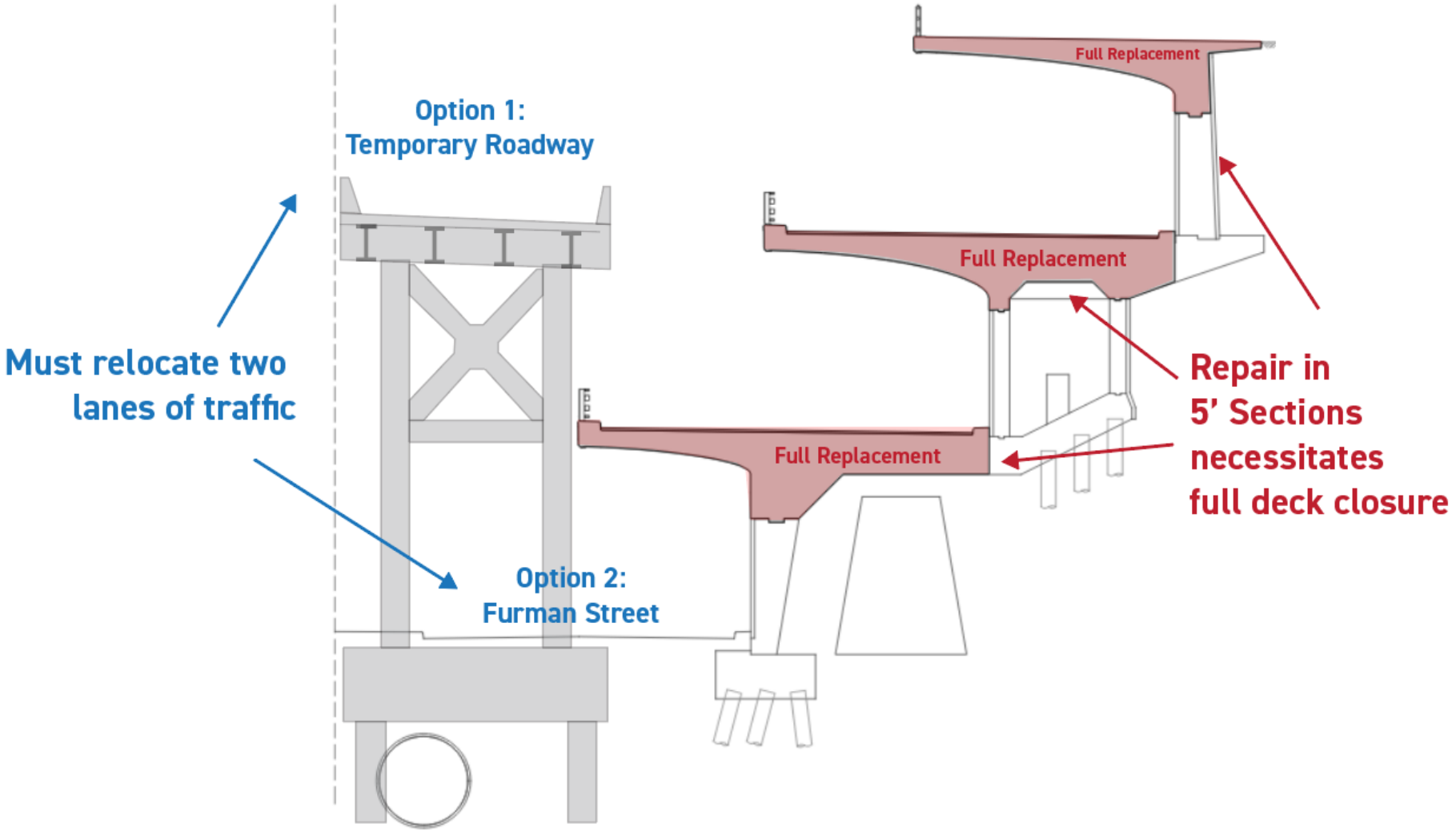
Considerations

- Shortest service life
- Hard to know what conditions will be discovered
- Unrepaired structure continues to decay at unknown rate
- Deck “Halo”
  - Area surrounding the repaired section decays at a rapid rate

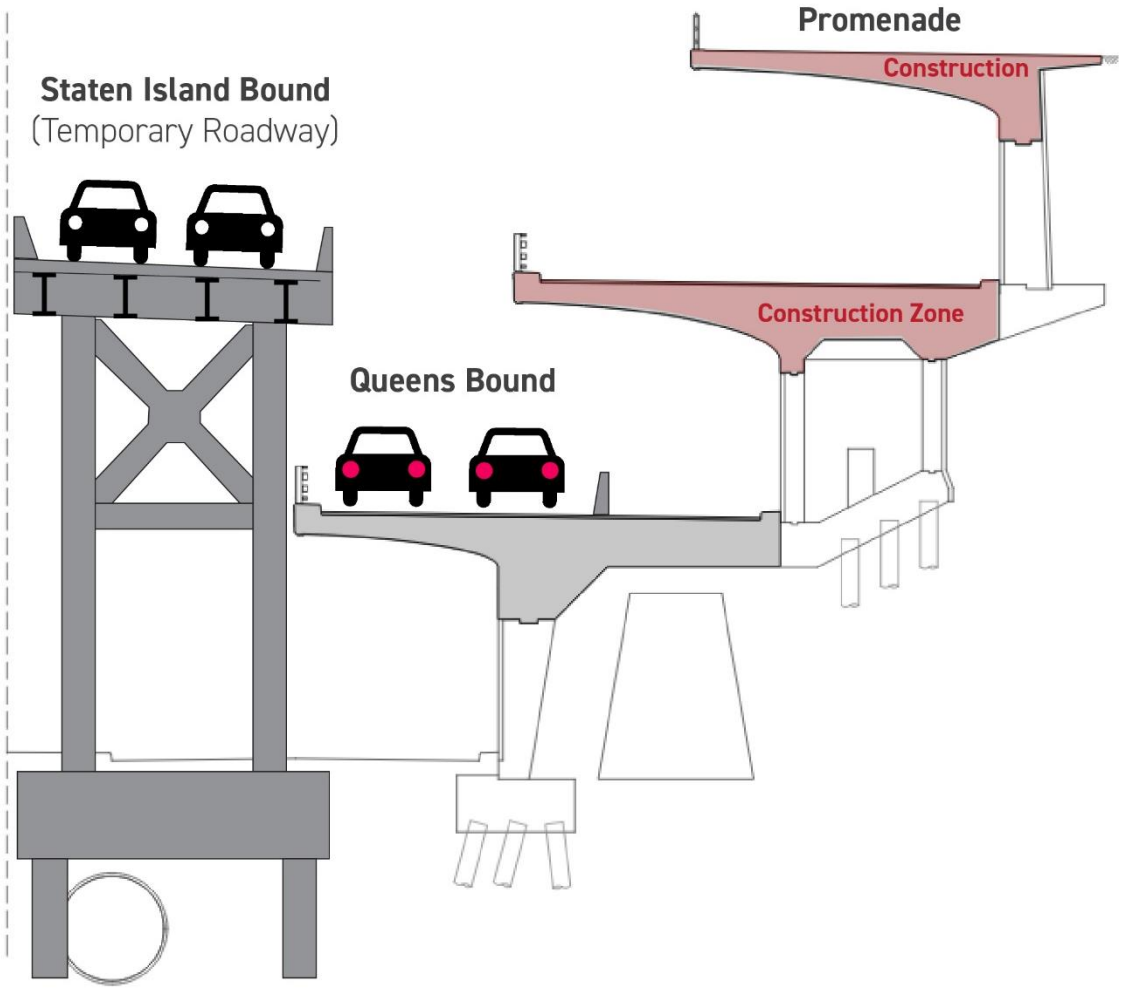
Figure 5. Deck showing halo effect.

Option D Complete Deck Replacement with Temporary Bypass

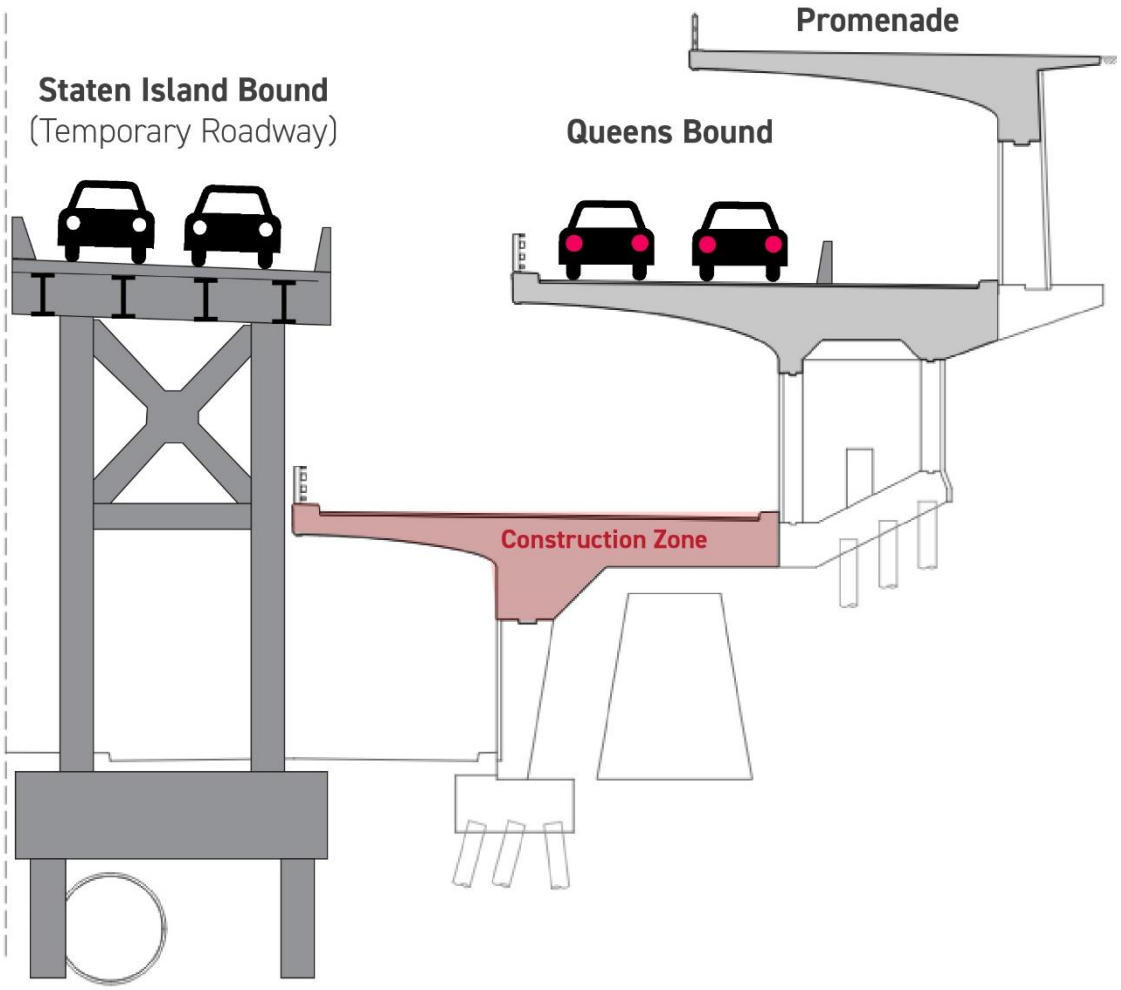
What is it?


Option 1:
Temporary Roadway
Must relocate two lanes of traffic
Option 2:
Furman Street
Full Replacement
Full Replacement
Full Replacement
Repair in 5' Sections necessitates full deck closure

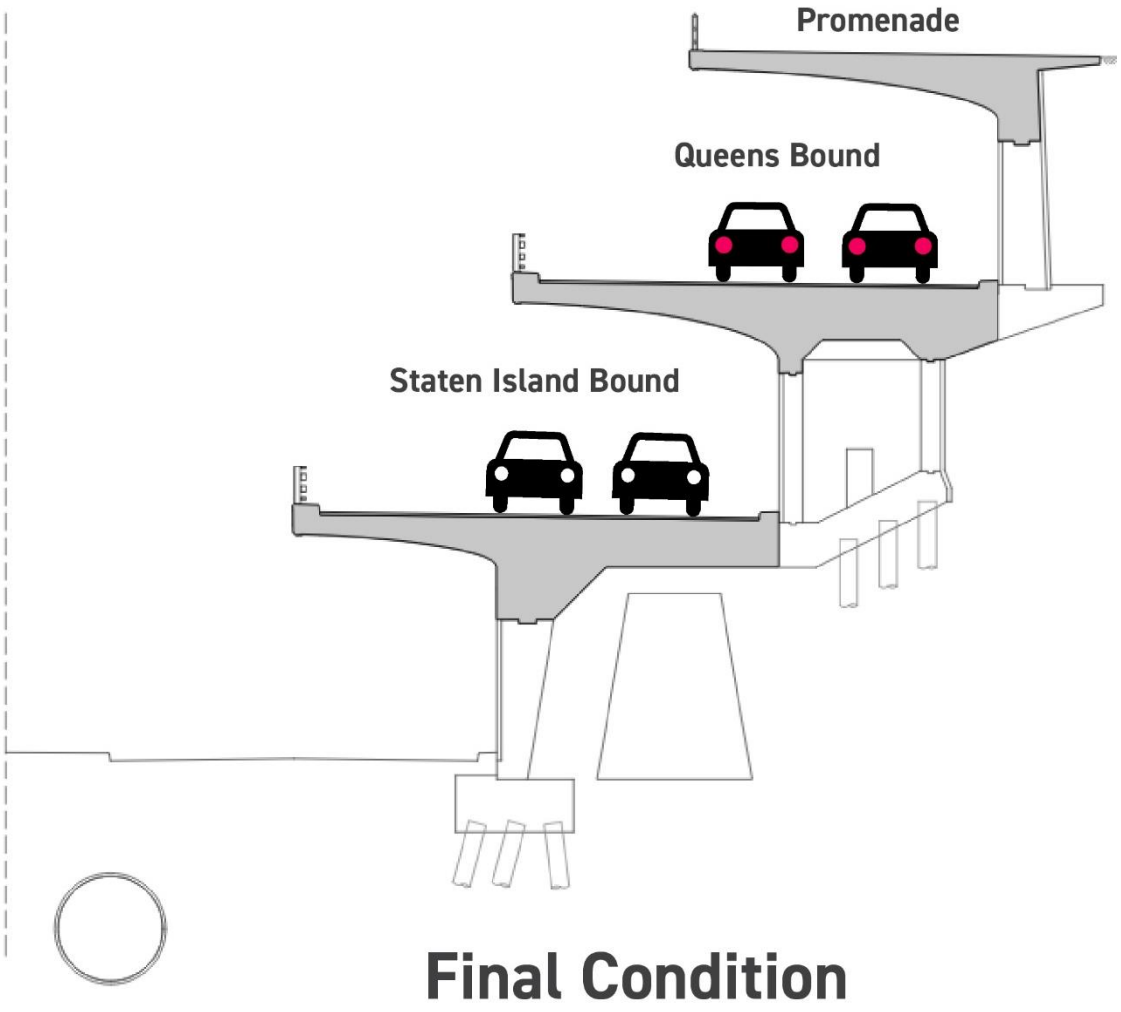
Option D


Promenade
Construction
Staten Island Bound
(Temporary Roadway)
Construction Zone
Queens Bound

Option D


Promenade
Staten Island Bound
(Temporary Roadway)
Queens Bound
Construction Zone

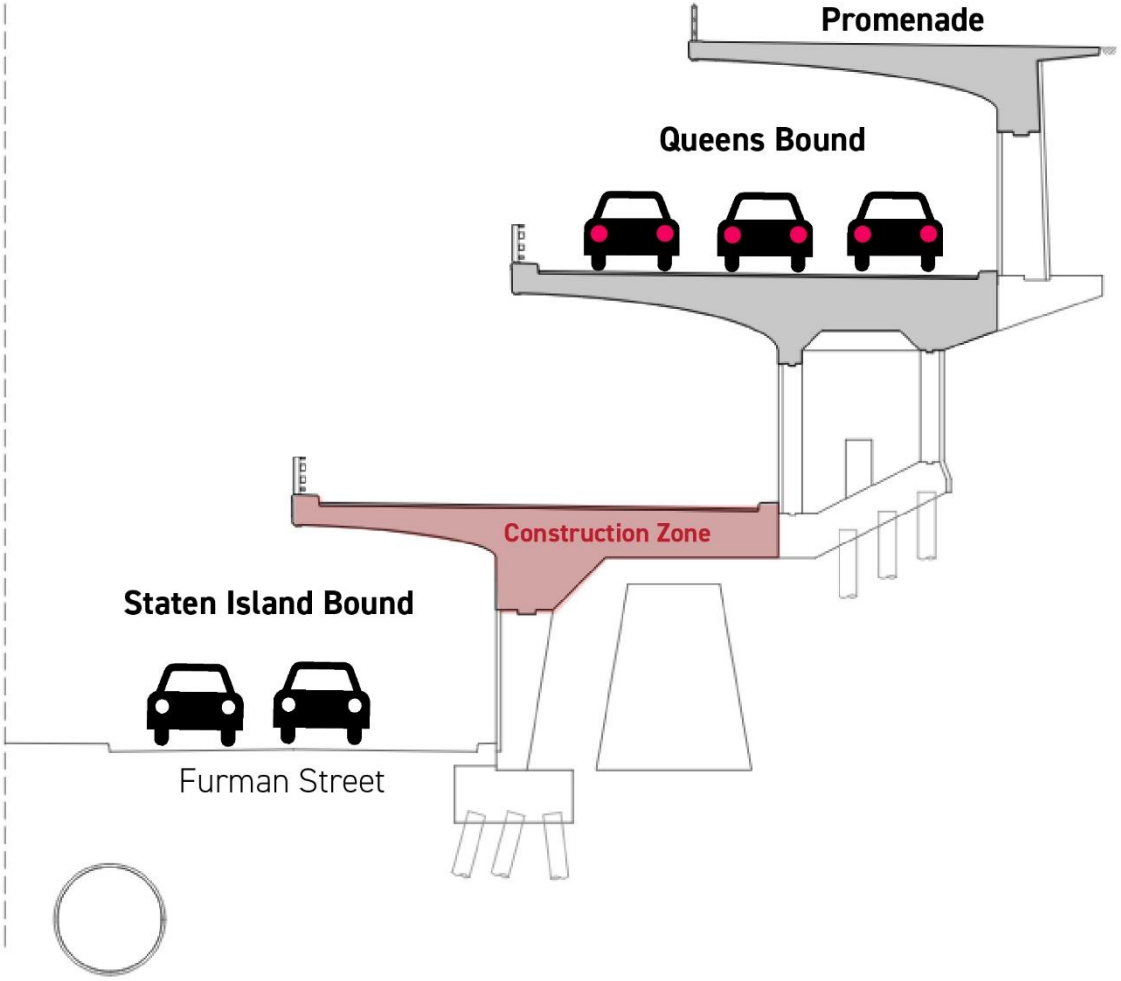
Option D



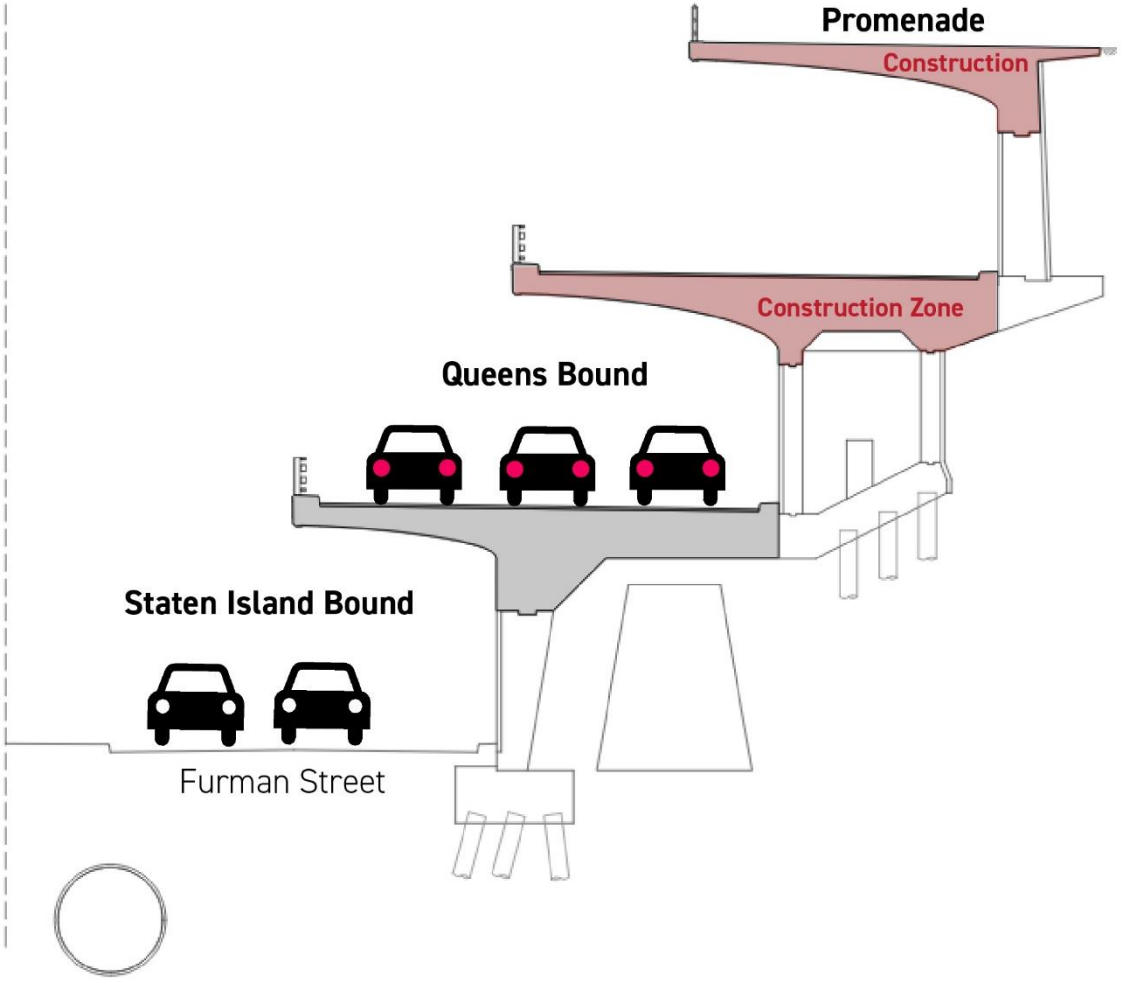
Final Condition

Option E Complete Deck Replacement with Local Detours

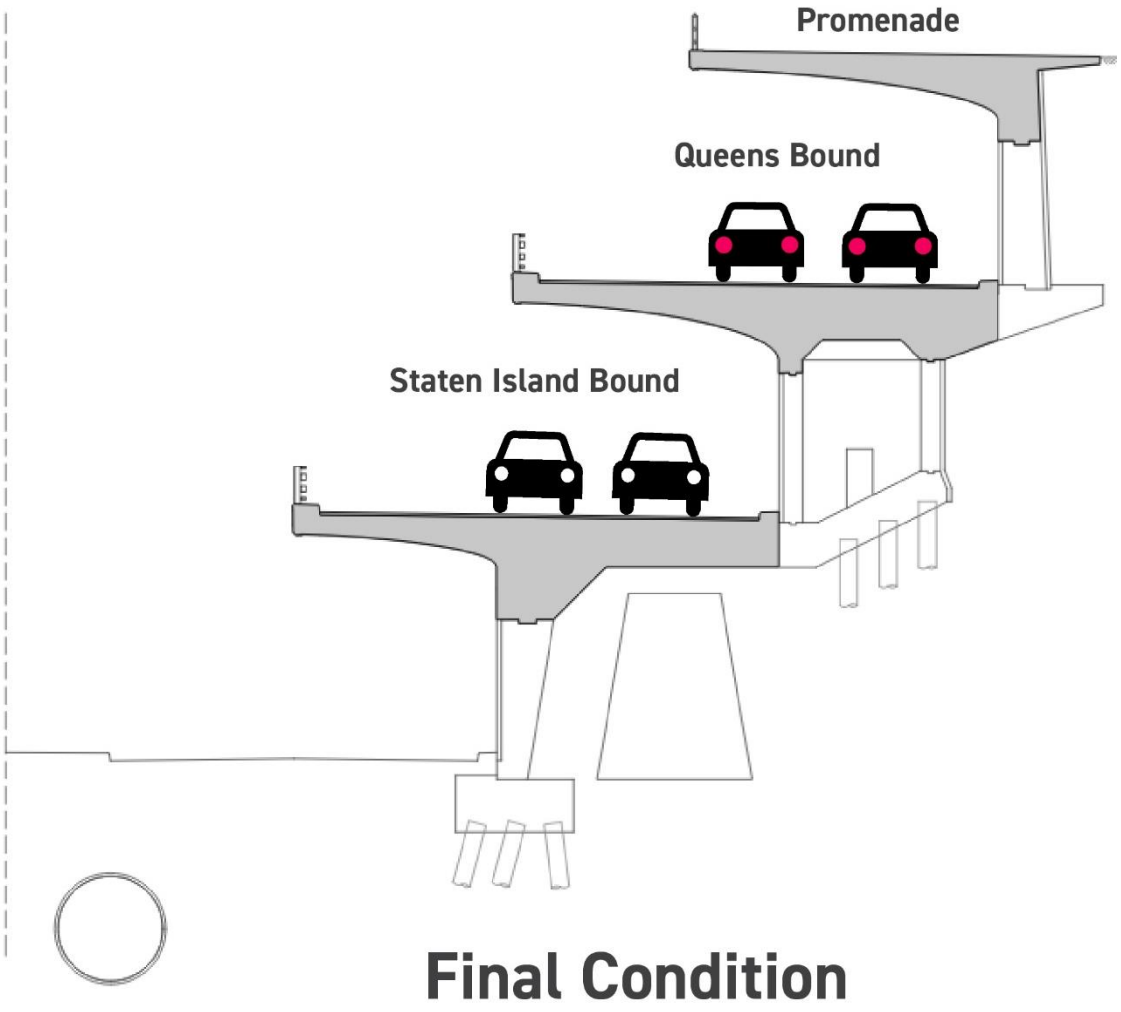
Option E


Promenade
Queens Bound
Construction Zone
Staten Island Bound
Furman Street

Option E


Promenade
Construction
Construction Zone
Queens Bound
Staten Island Bound
Furman Street

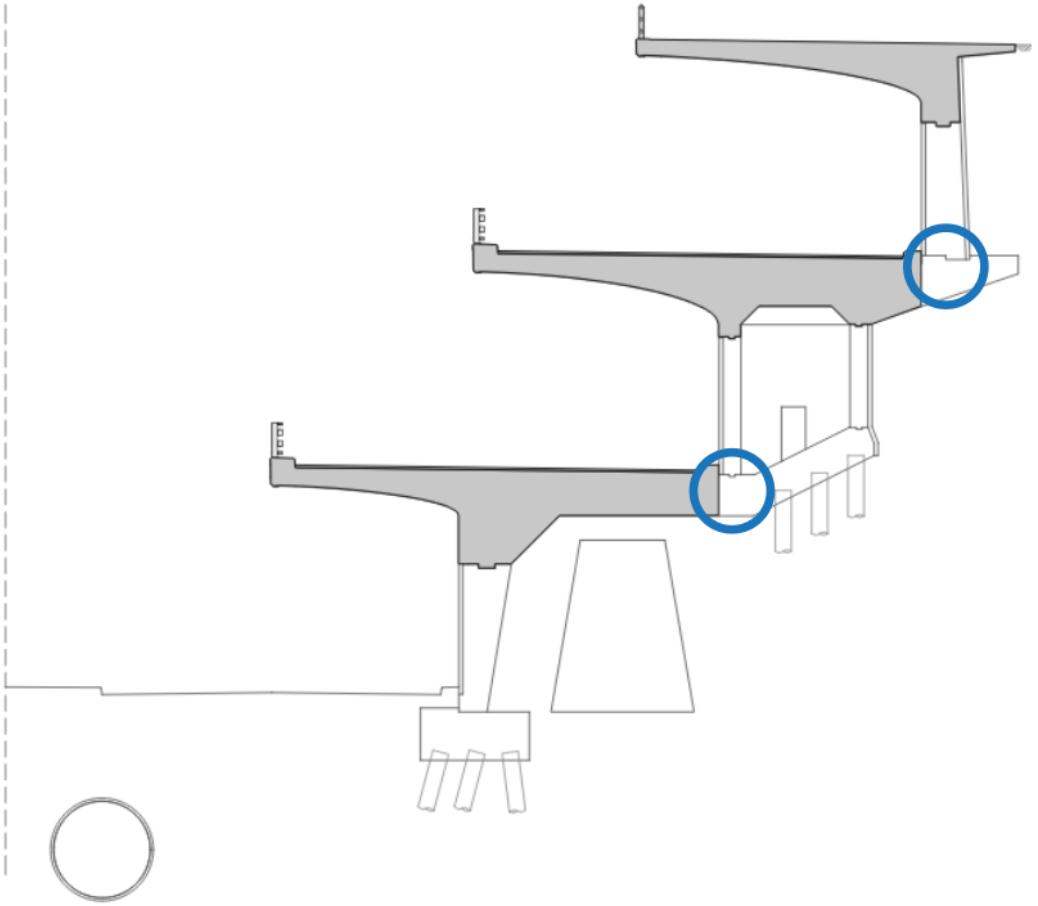
Option E



Final Condition

Considerations for D & E

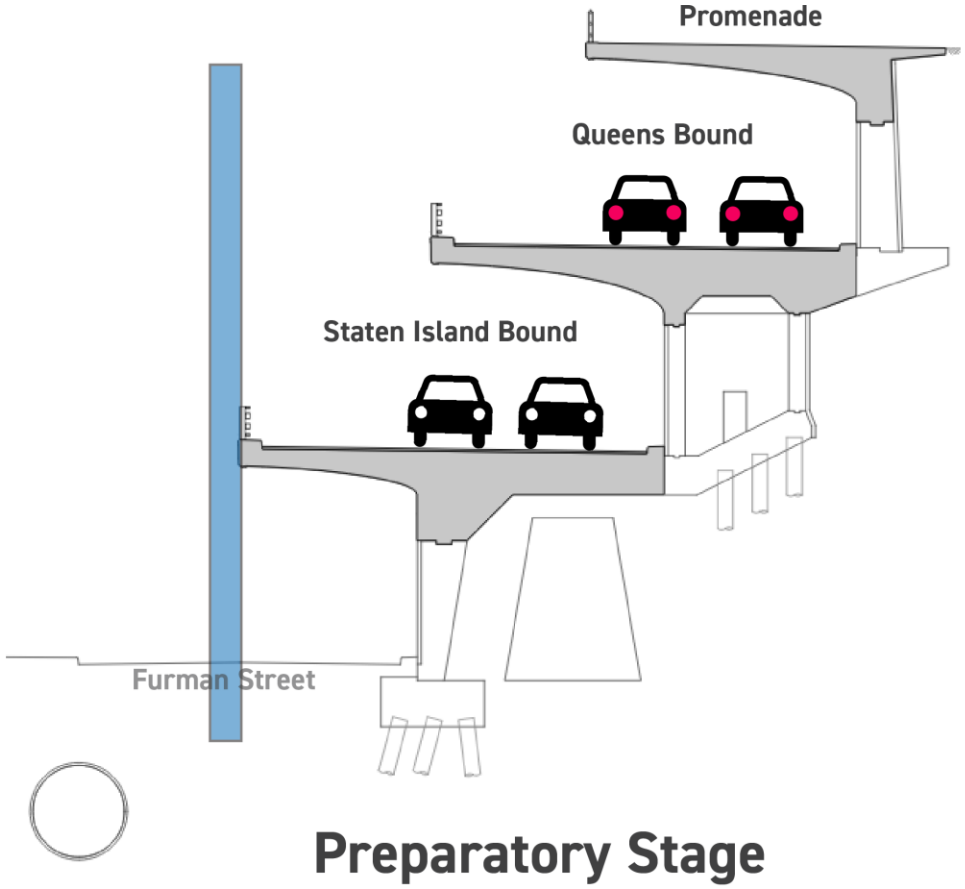
- Where does the weak point move?
- Still has joints which are prone to corrosion
- Vibrations still remain
- Lightweight concrete may get better load capacity, but there are limitations
- Lane widths remain at <12’



Option F

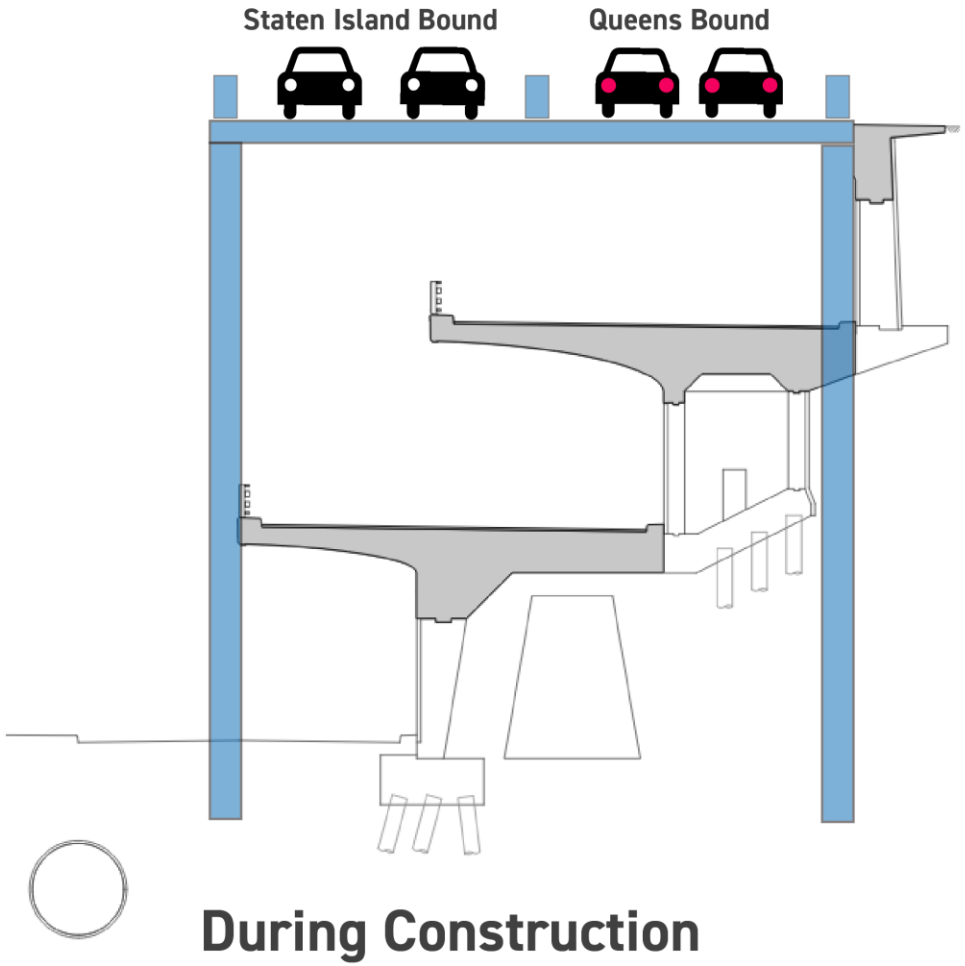
Temporary Elevated Roadway, Presented 9/27/18

Option F



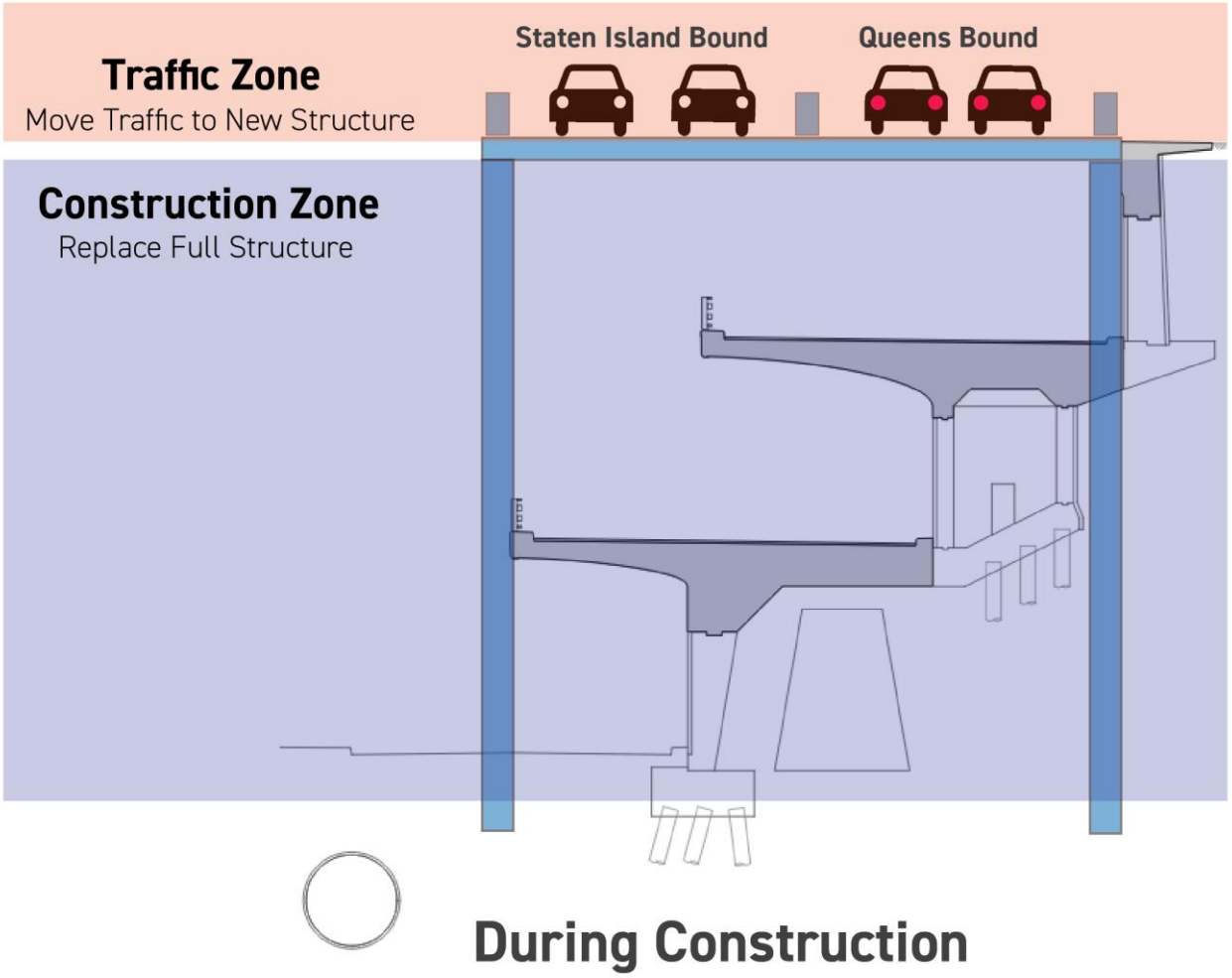
Diagrammatic Representation

Option F



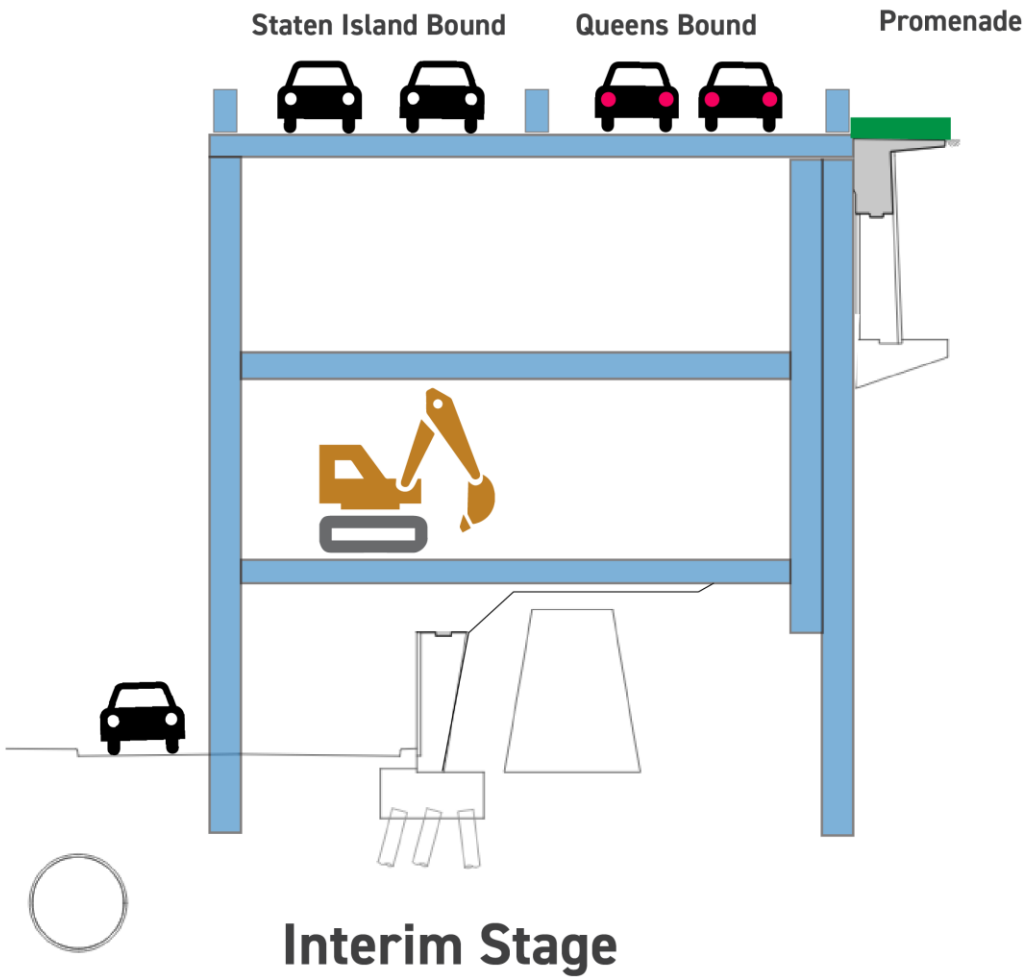
Diagrammatic Representation

Option F



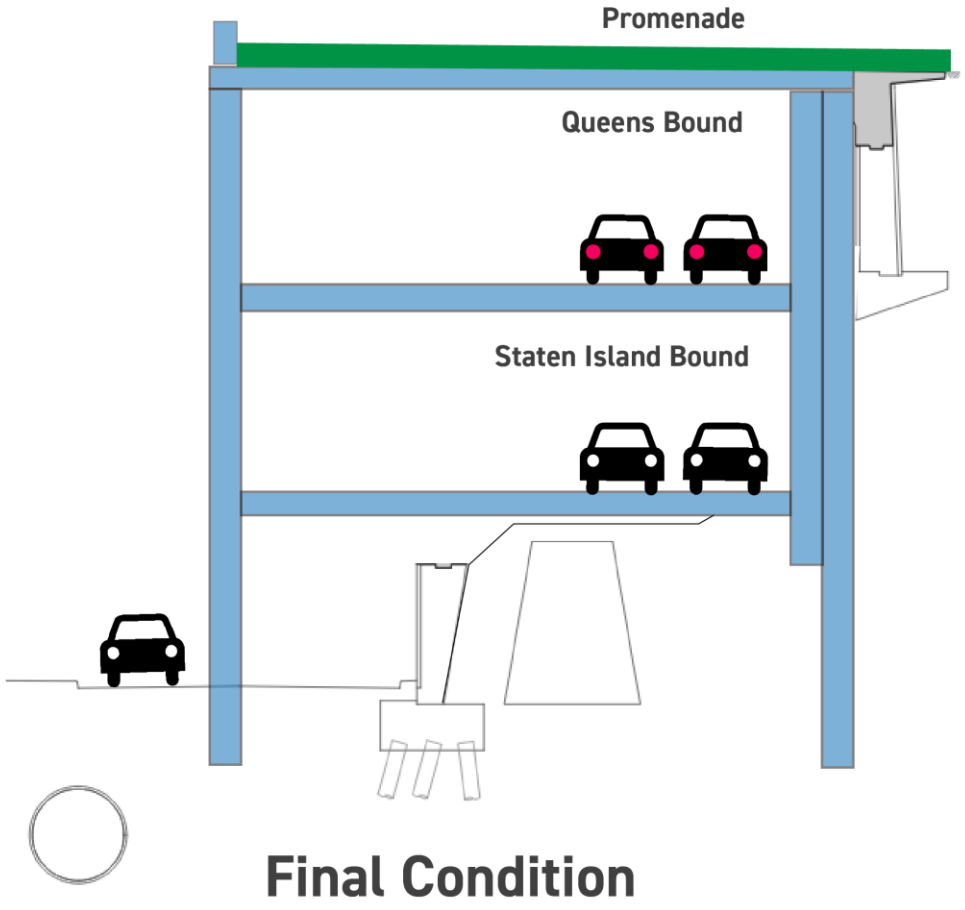
Diagrammatic Representation

Option F



Diagrammatic Representation

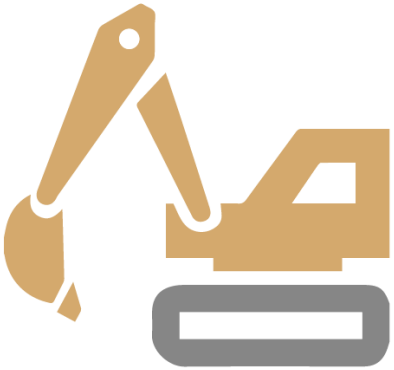
Option F



Diagrammatic Representation

Option F

Duration



6-8 Yrs

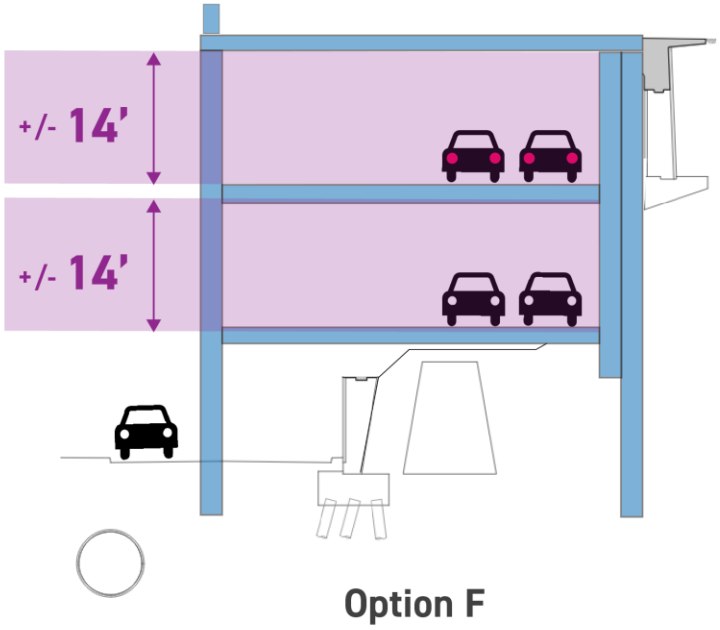
Cost

$3.0B-$3.3B

Option F

Vertical Clearance

Benefit for Potential Gains over Existing Condition



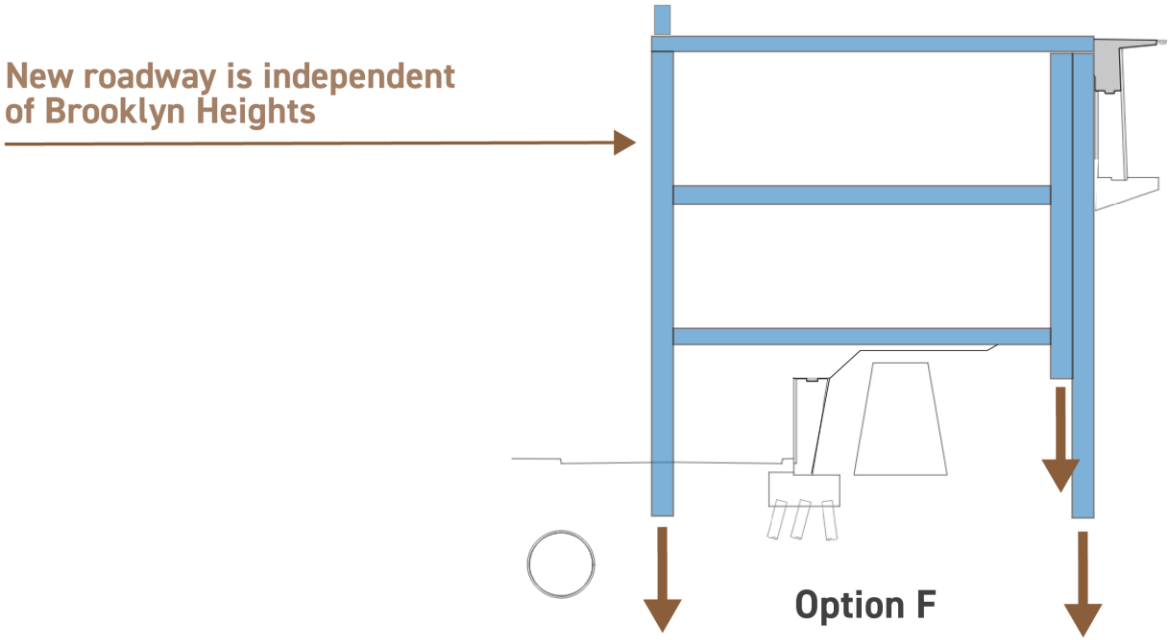
Option F

Diagrammatic Representation

Option F

Vibration Mitigation

Maximum Benefit Realized

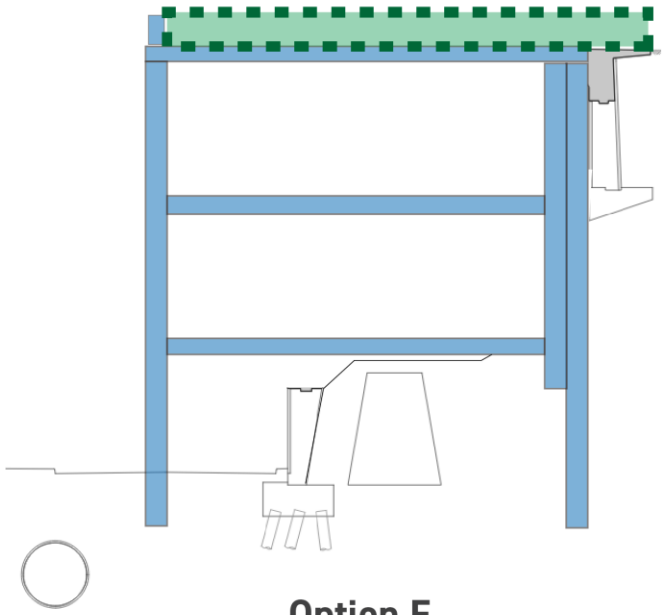


Diagrammatic Representation

Option F

Open Space Improvements

Opportunity for Expanded Promenade



Option F

Diagrammatic Representation

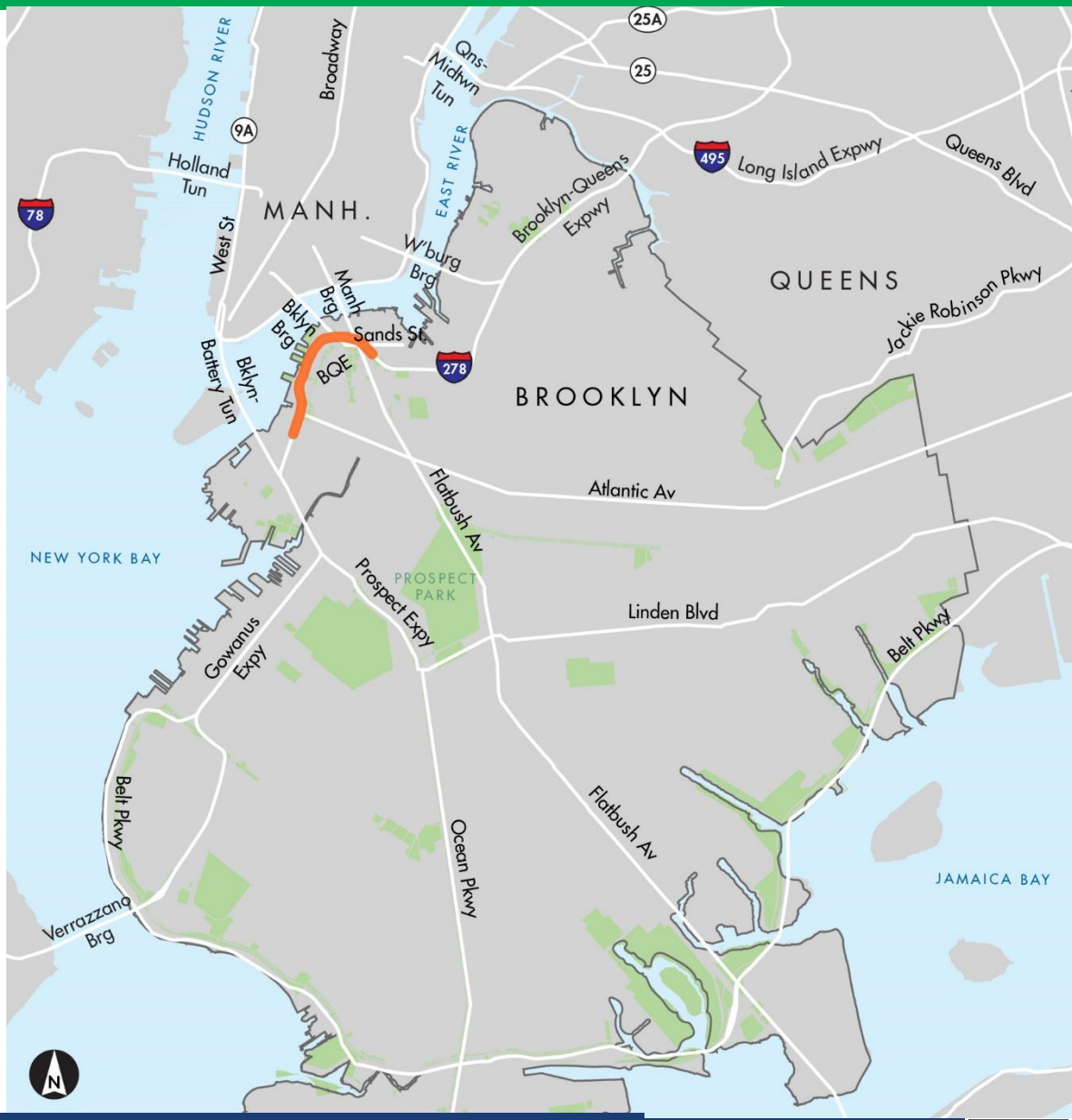
Option F – New Open Space Opportunity

Opportunity for new open space on the north end of the structure

So, where are we?

Framing Our Challenge

- As the only interstate in Brooklyn, the BQE is an important link in the network
- At 70+ years, it is well over its design-life

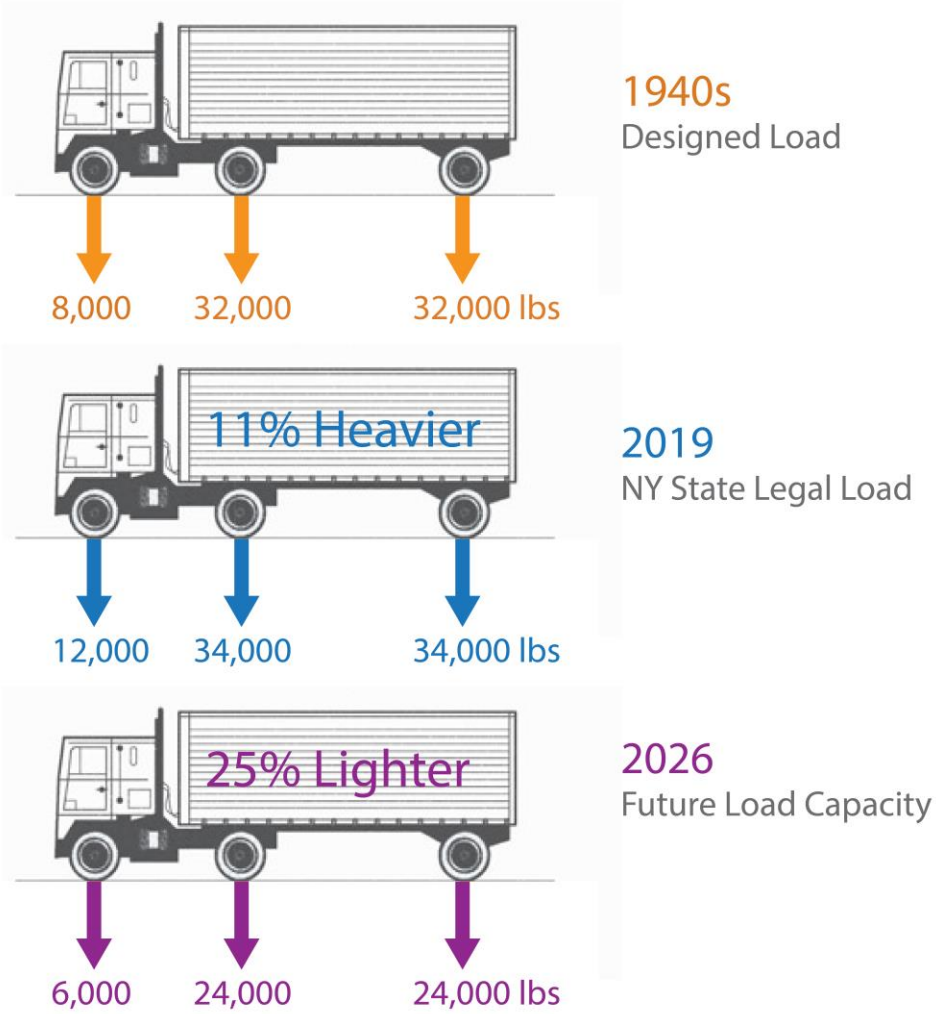


Framing Our Challenge

- Trucks rely heavily on the route and worsen the cantilever's deteriorated condition
- Compared to opening day, the BQE has:
  - **MORE** trucks
  - **BIGGER** trucks
  - **HEAVIER** trucks
  - **FASTER** trucks

Framing Our Challenge

- The BQE carries a load greater than what it was designed for
- A large population of heavier, “illegal” trucks also use the road



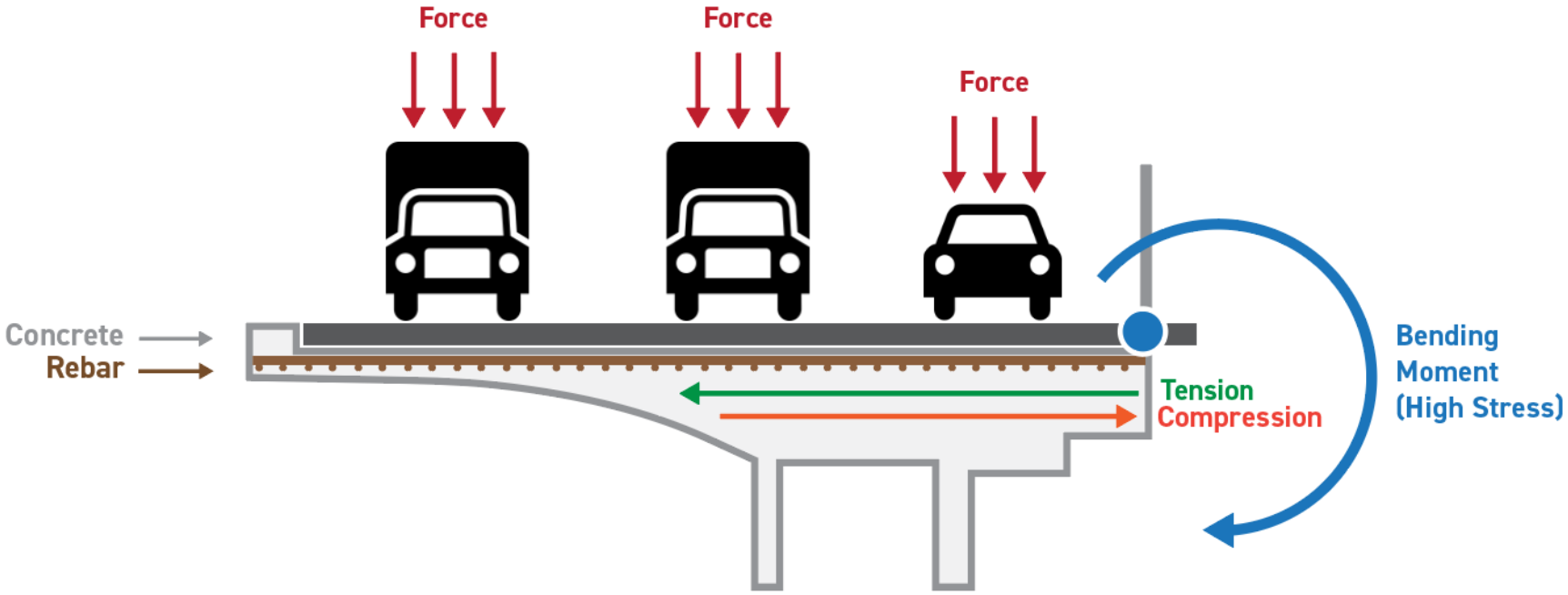
Framing Our Challenge

- Furthermore, BQE Triple Cantilever is a uniquely engineered structure

Framing Our Challenge

In simple terms, what is a cantilever?

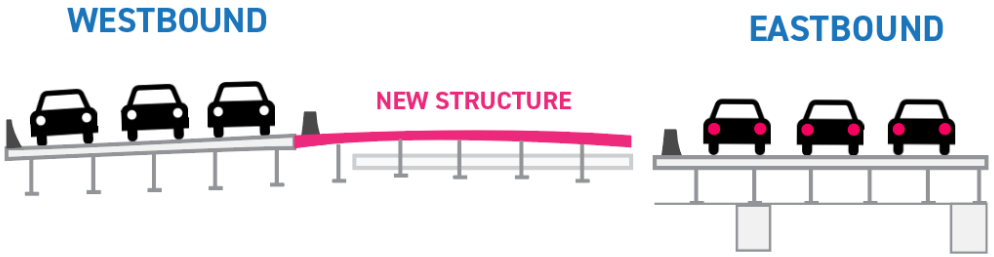
- A deck supported by an anchor at one end



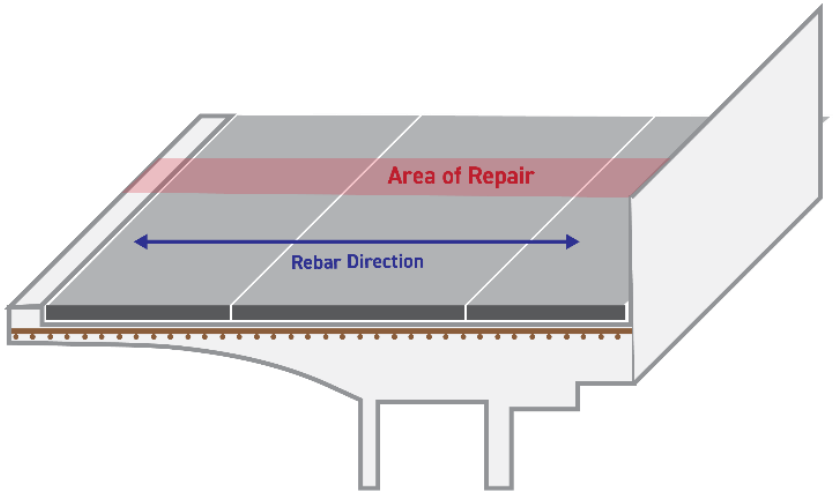
Framing Our Challenge

Why does it make our lives so difficult?

- Traditional lane-by-lane rehabilitation is not an option



Belt Parkway Repair
(shift traffic)

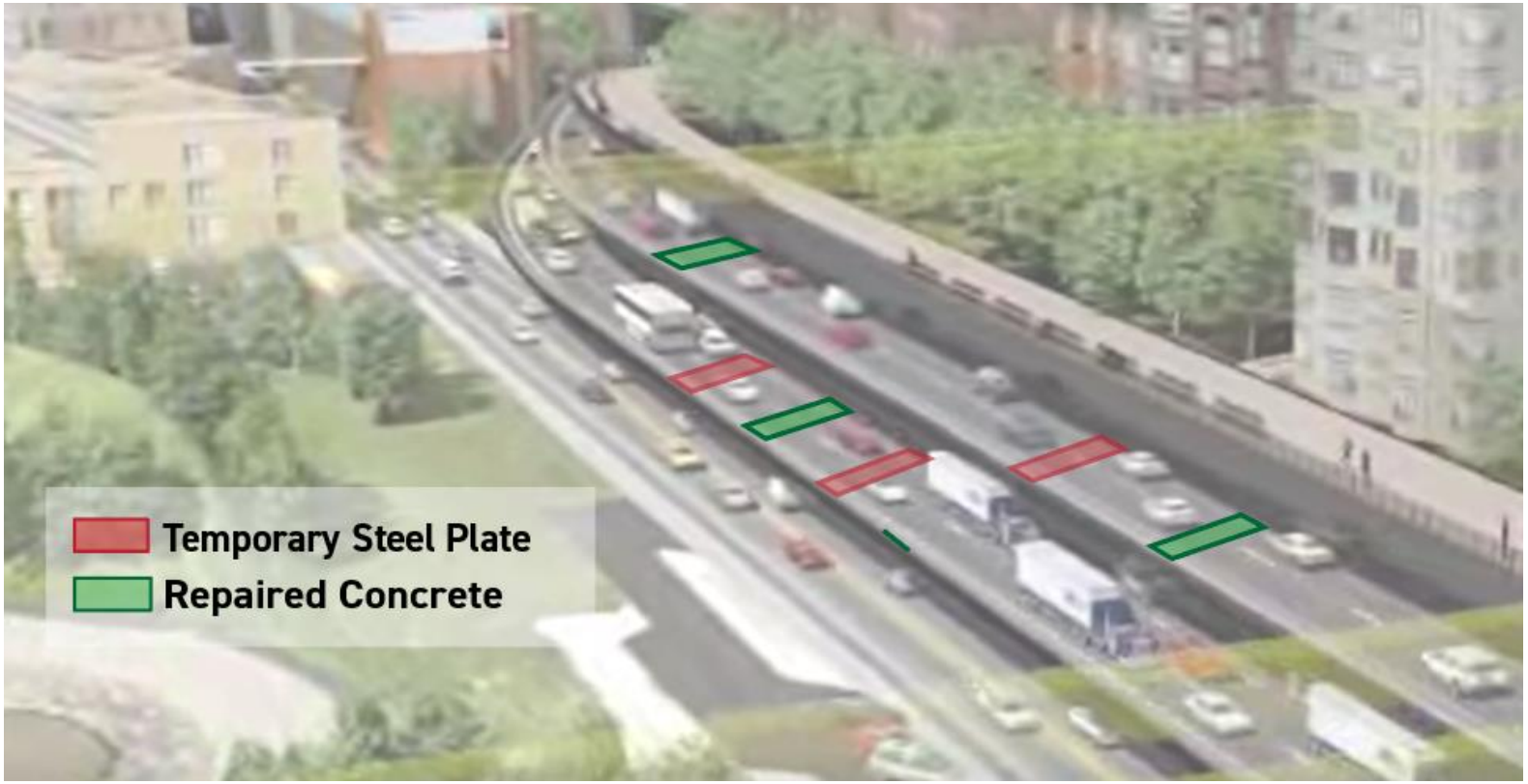


Triple Cantilever Repair
(Full Closure Required)

Framing Our Challenge

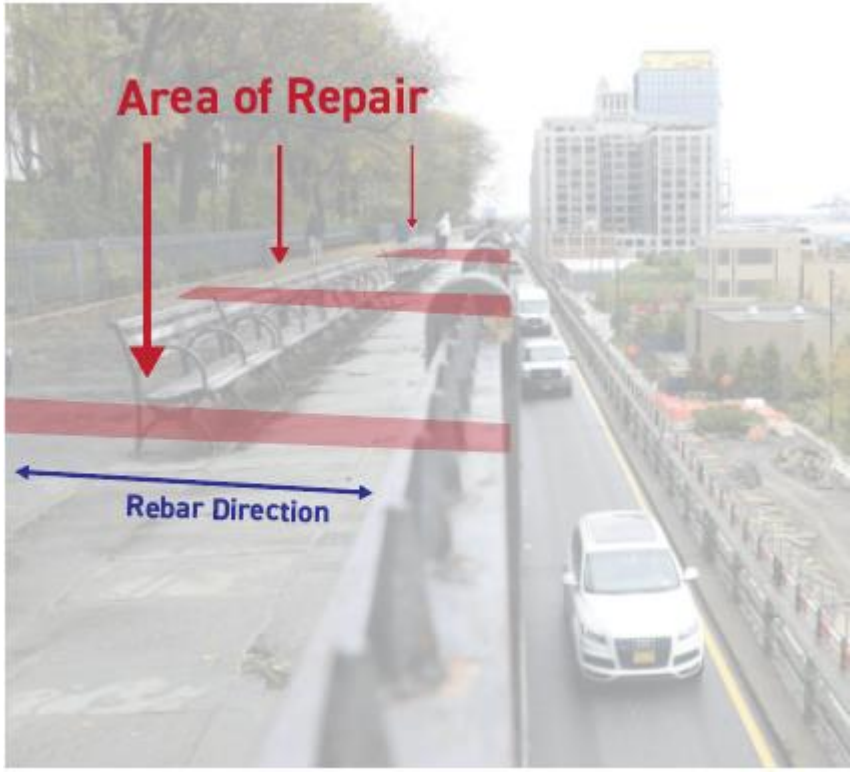
Why does it make our lives so difficult?

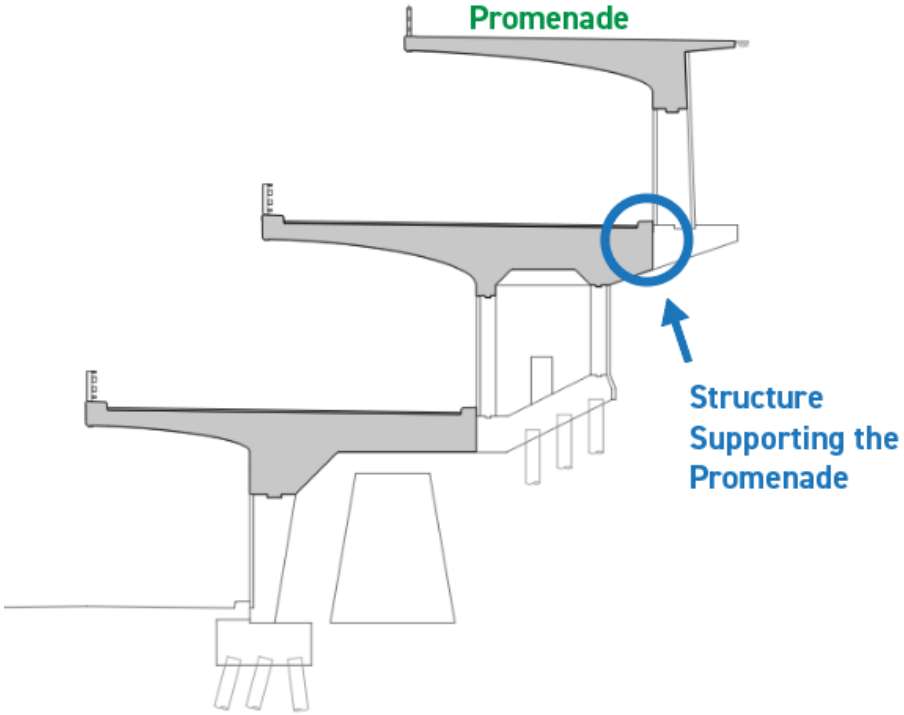
- Only small sections can be completed to ensure stability



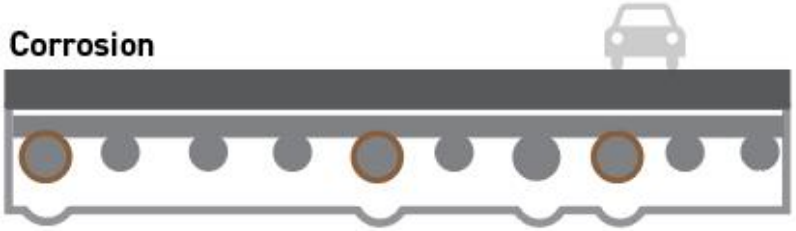
Framing our challenge

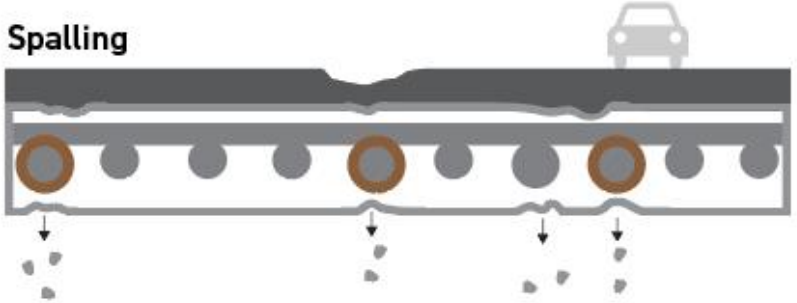
- The Promenade is tied to the structure and must also be repaired in segments.

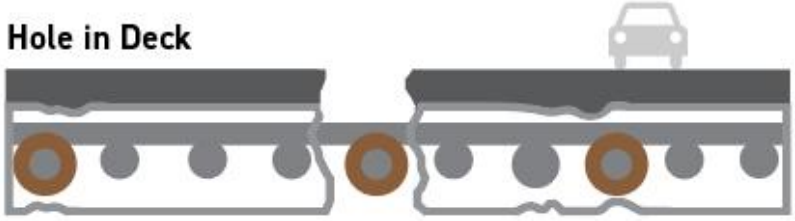




Framing Our Challenge

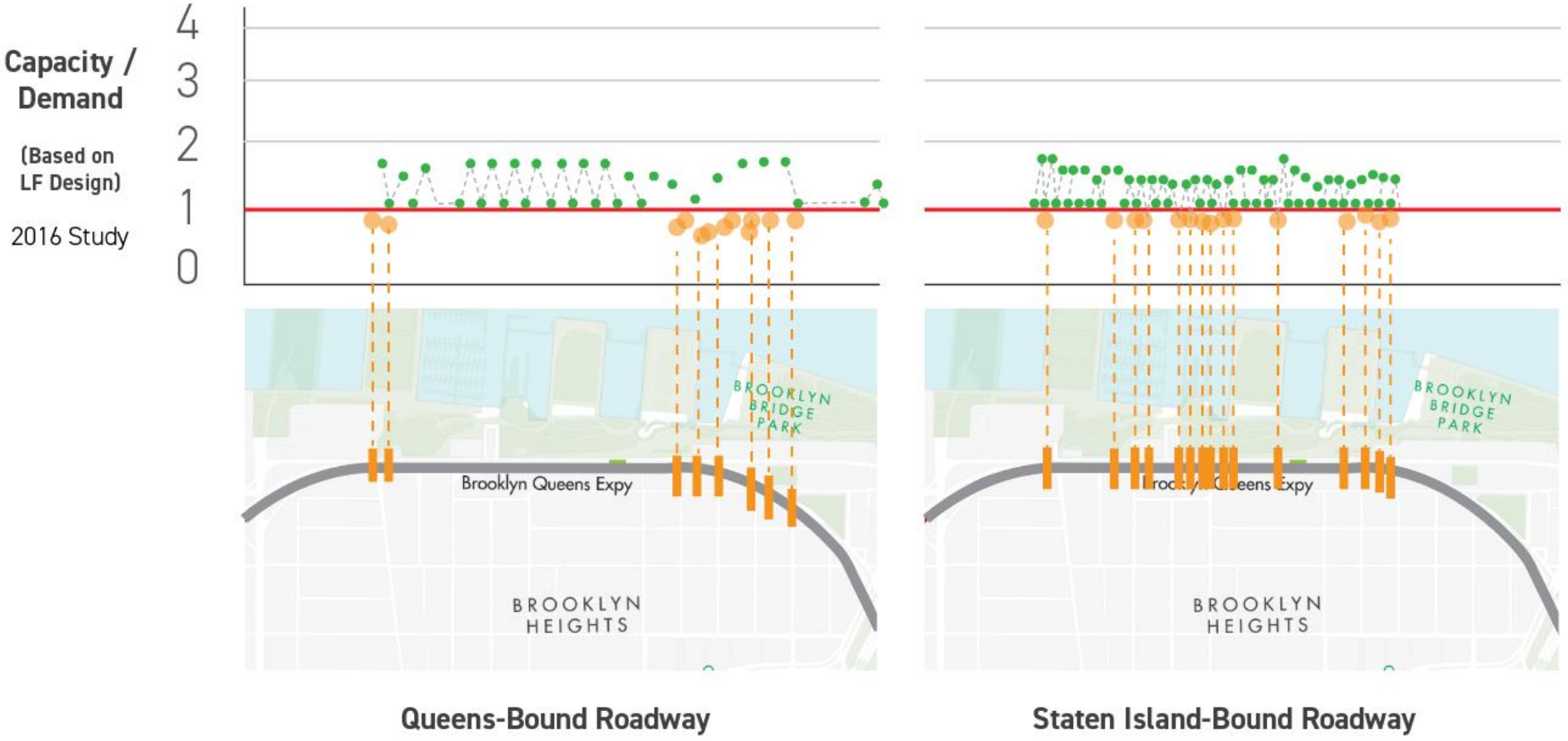






Framing Our Challenge

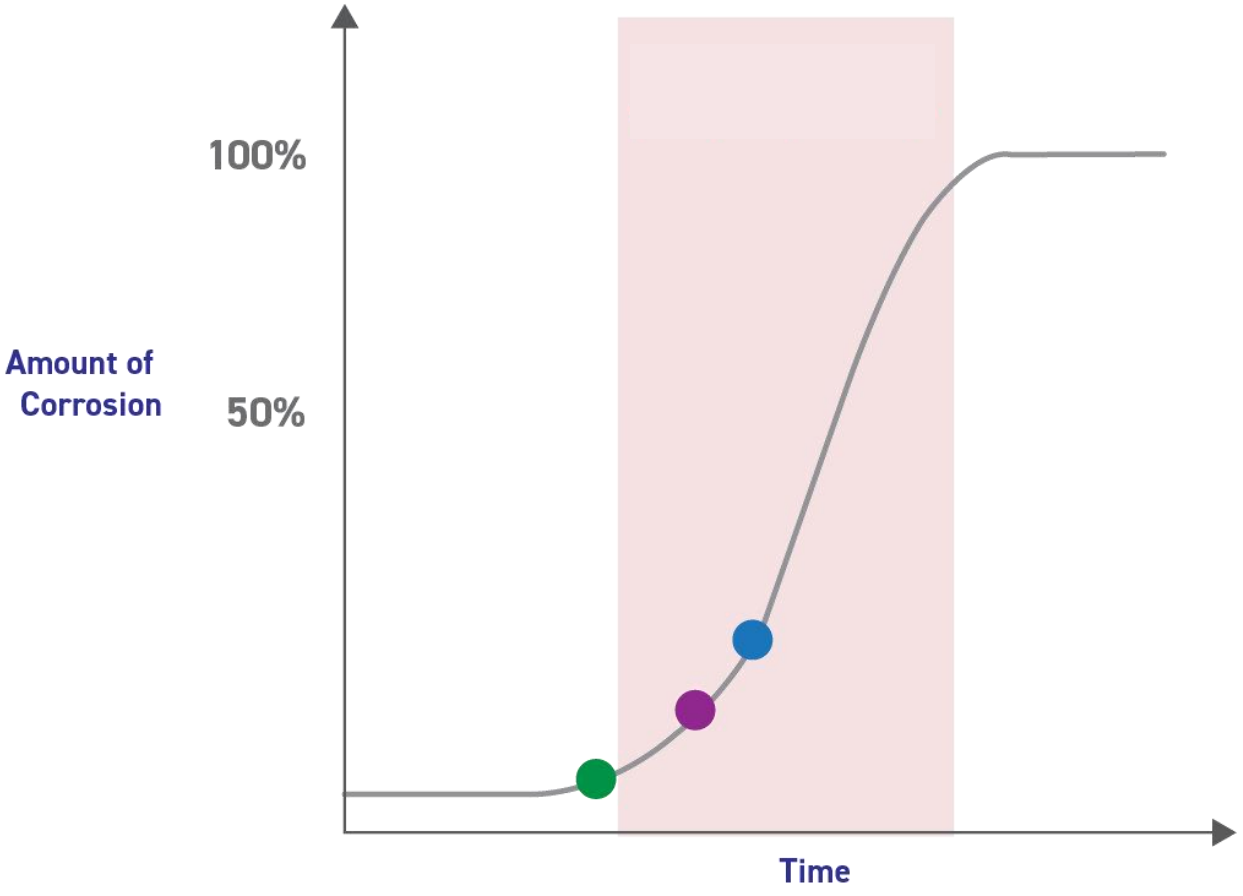
- Many parts of the bridge handle the current load, but heavier loads add risk
- These areas are predicted to increase through 2026

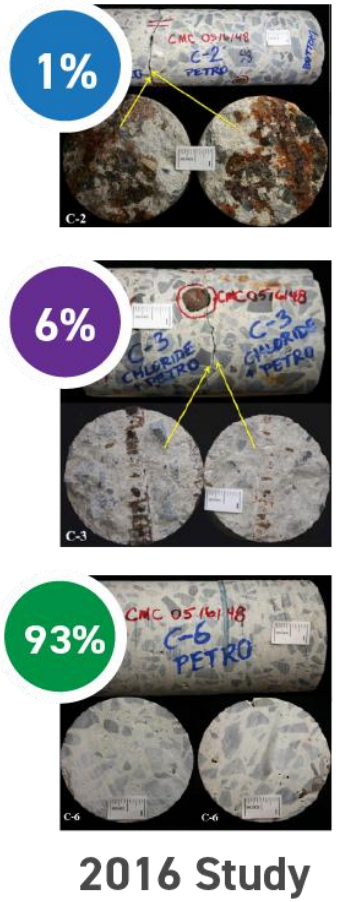


Framing Our Challenge

What's going on right now?

- Corrosion continues at an accelerated pace



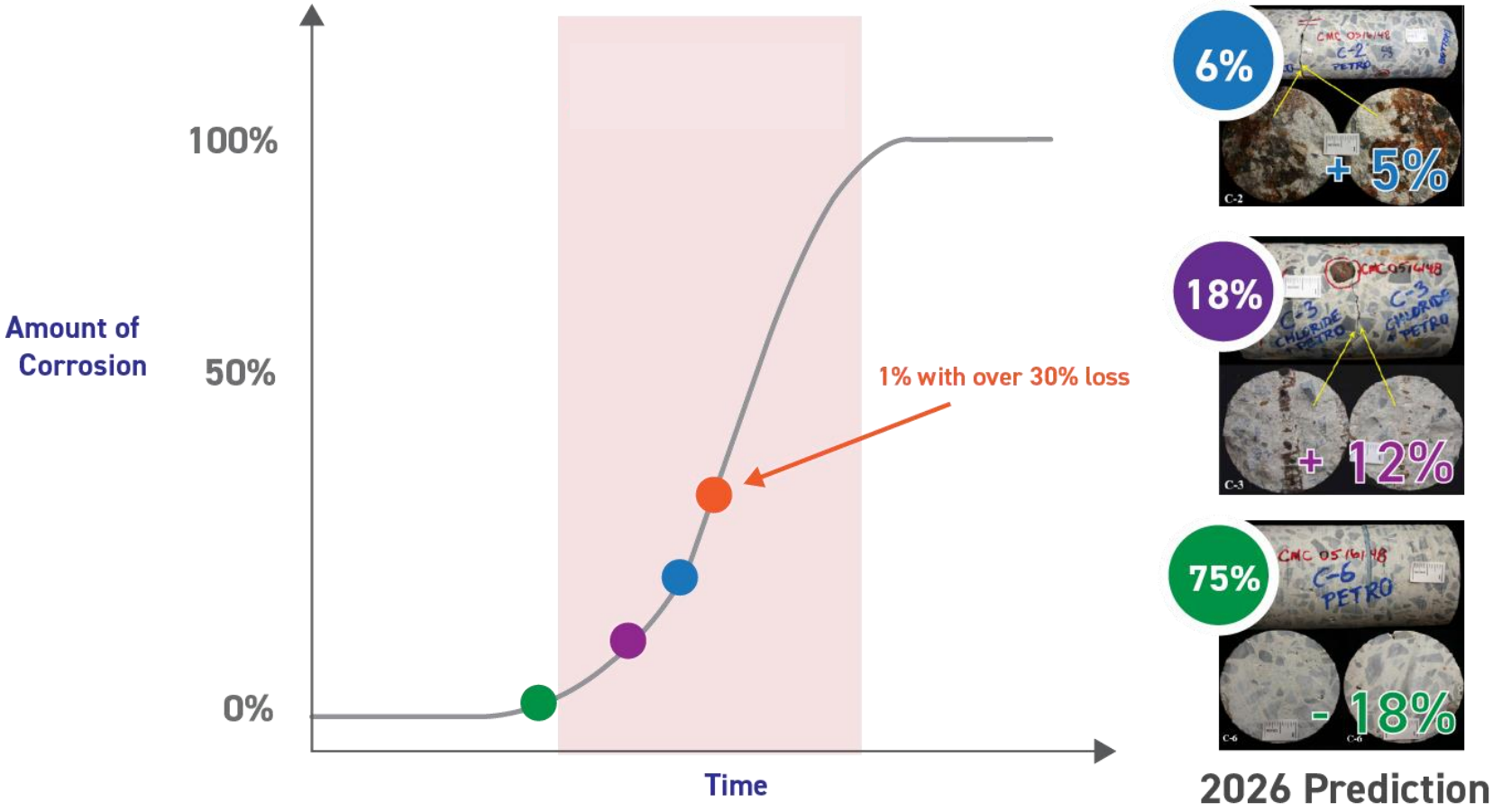


2016 Study

Framing Our Challenge

What's going on right now?

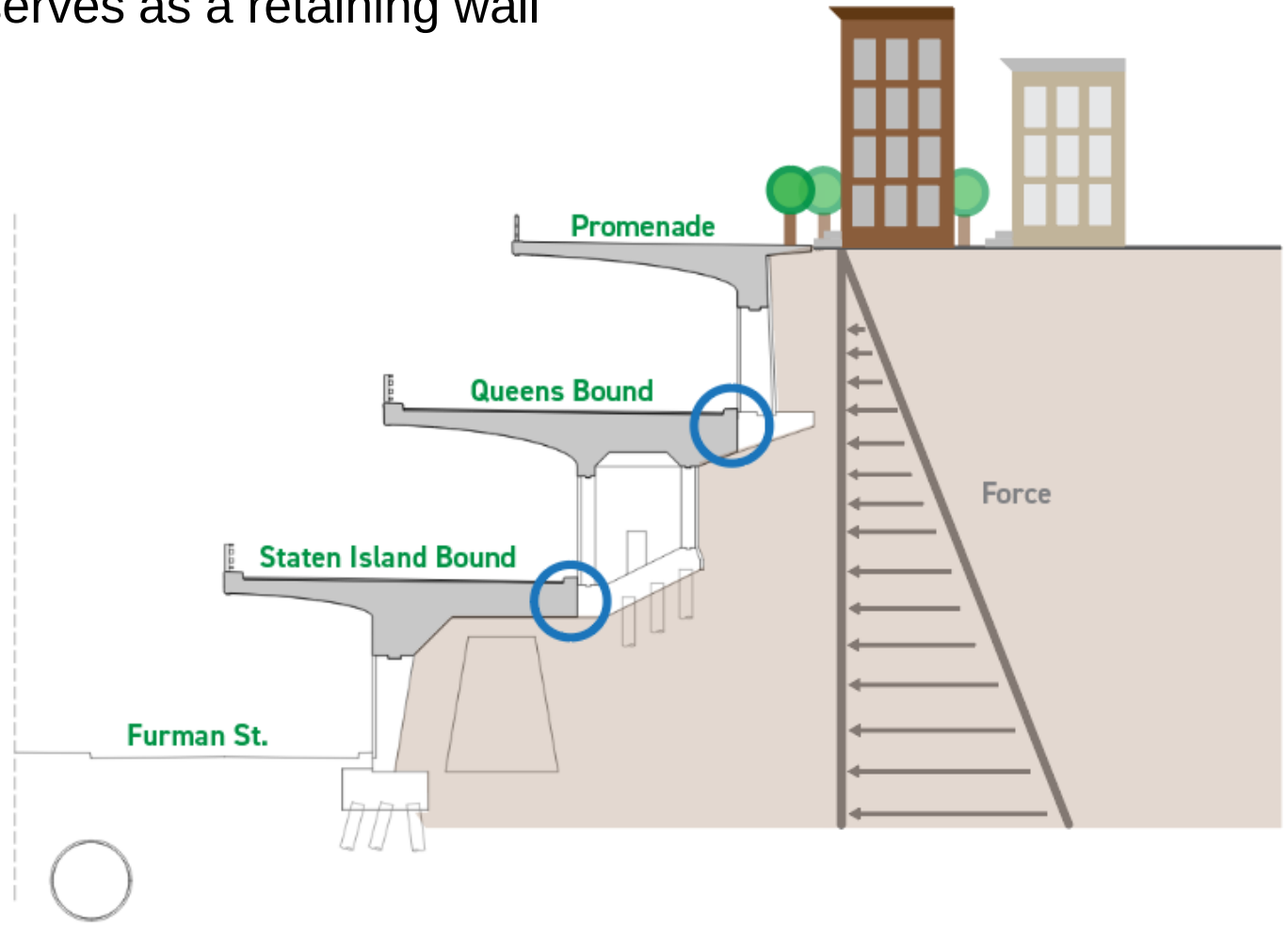
- Corrosion continues



Framing Our Challenge

What makes the BQE unique?

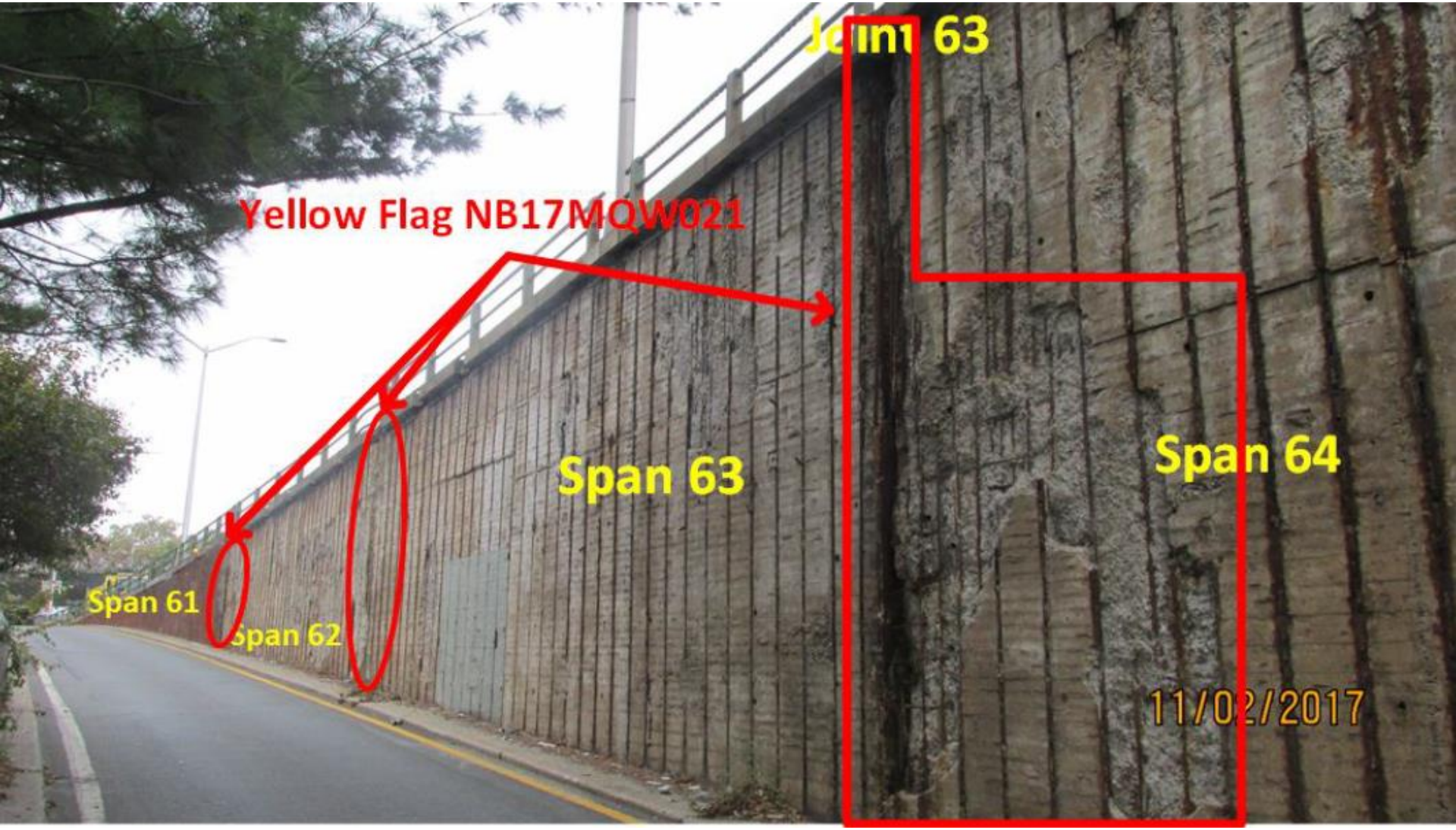
- A *single* reinforced concrete structure with three Cantilevers that serves as a retaining wall



Current Safety Inspections

Yellow Flag Condition – Hicks Street Retaining Wall

Framing Our Challenge

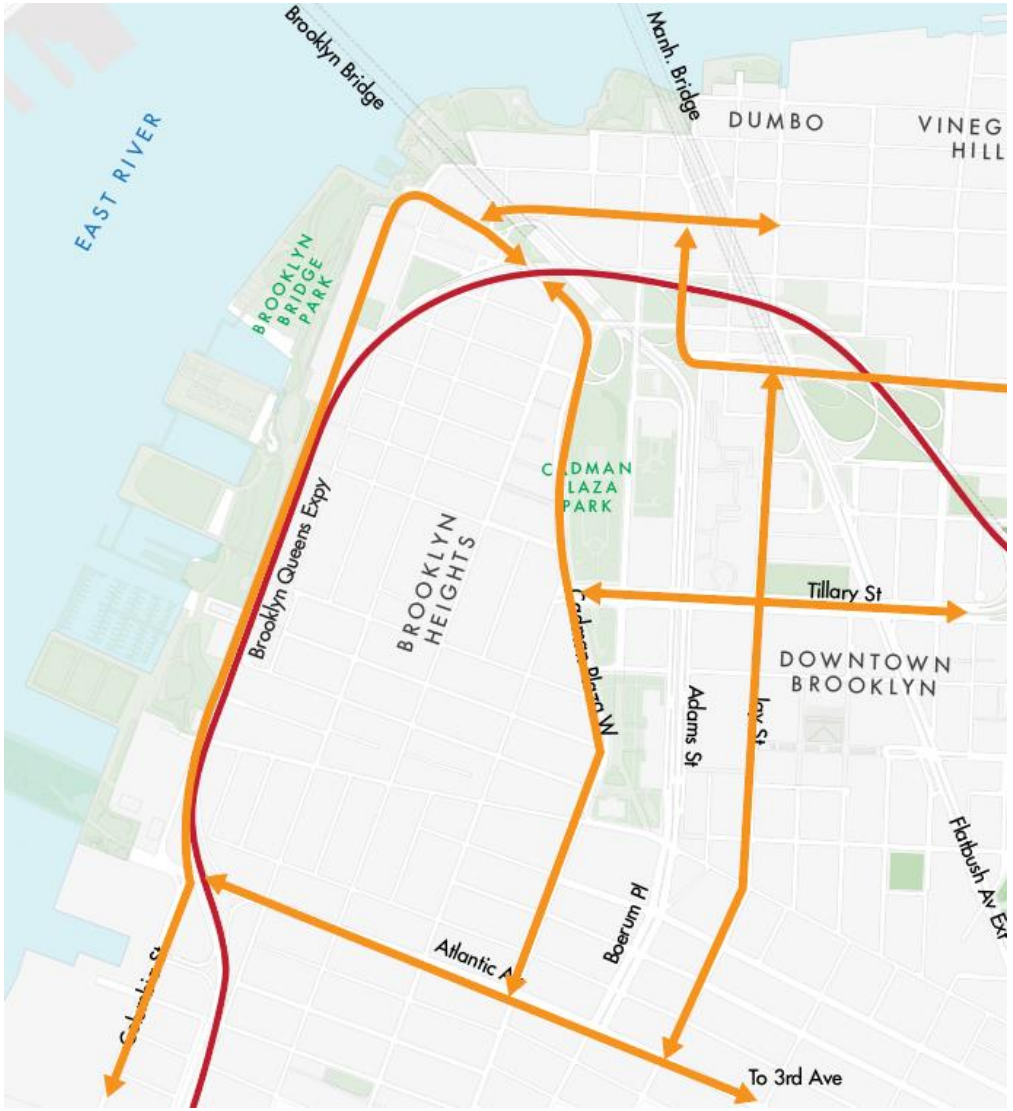


Framing Our Challenge

Framing Our Challenge

If not addressed, the anticipated progression is:

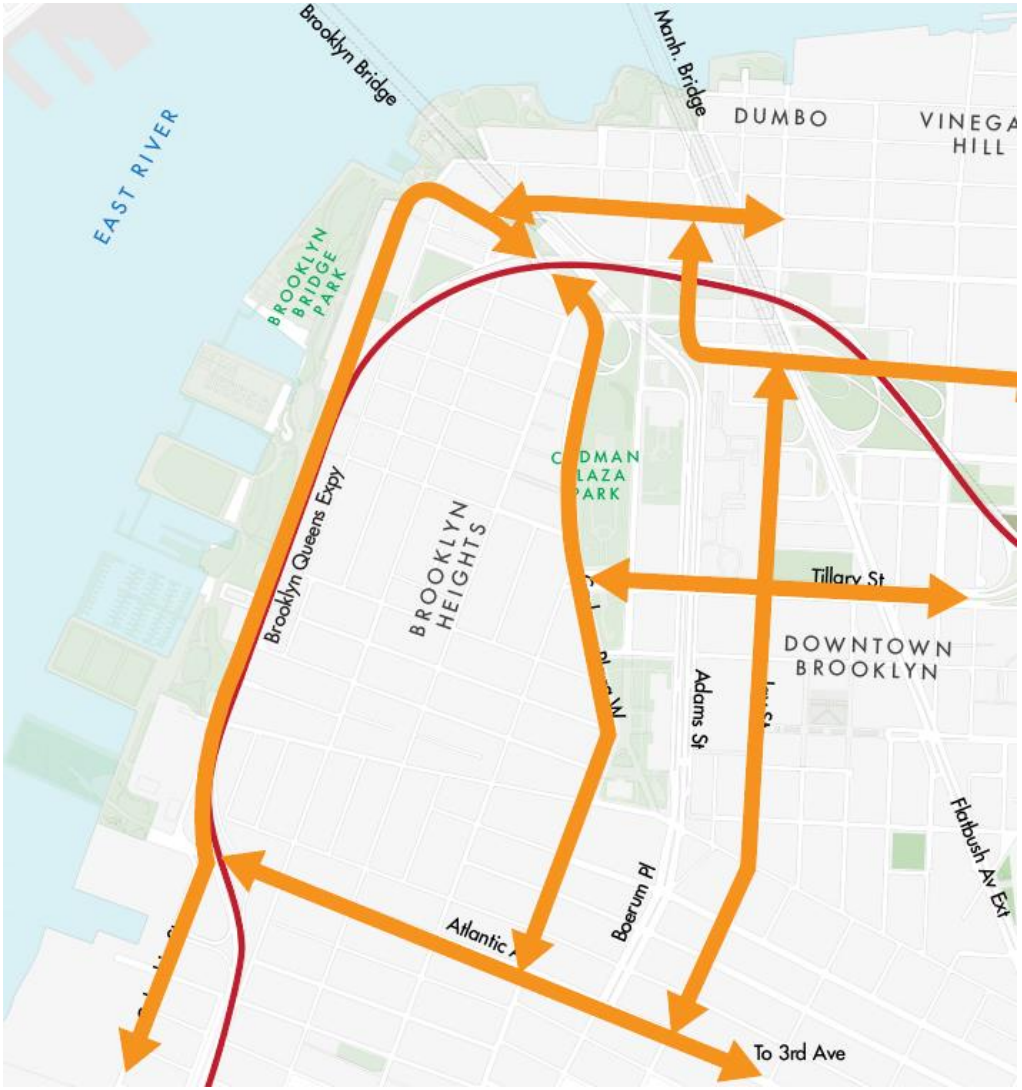
1. Large trucks removed



Framing Our Challenge

If not addressed, the anticipated progression is:

1. Large trucks removed
2. All trucks removed



Framing Our Challenge

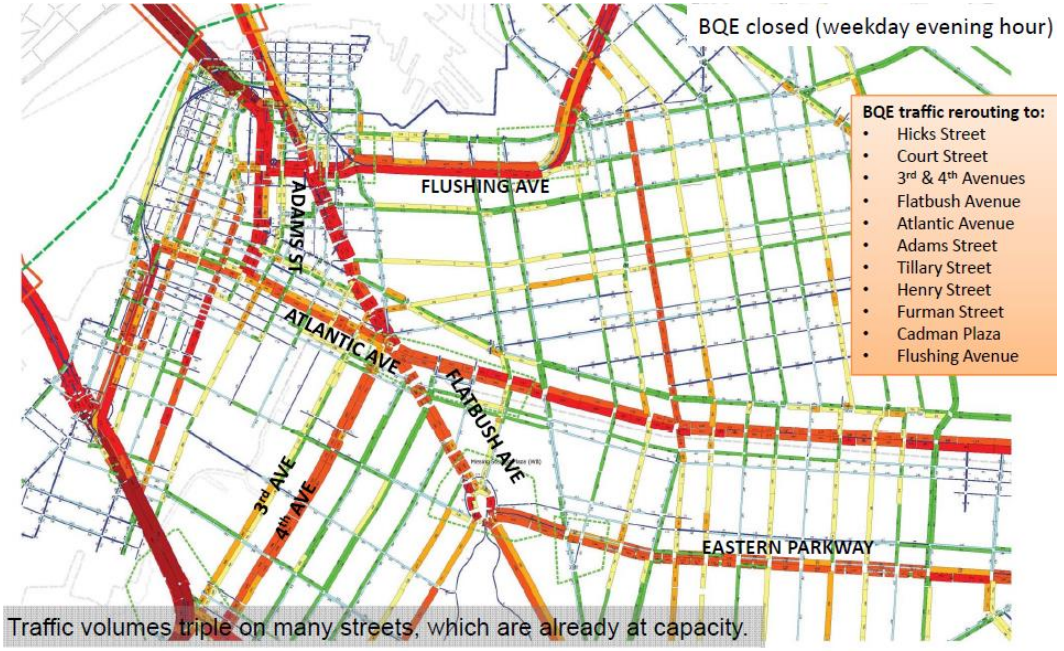
If not addressed, the anticipated progression is:

1. Large trucks removed
2. All trucks removed
3. All traffic removed

Framing Our Challenge

The Inevitable Case

- Any one of these scenarios involve trucks pushed to local streets
  - Congestion



Framing Our Challenge

The Inevitable Case

- Any one of these scenarios involve trucks pushed to local streets
  - Congestion
  - Physical impacts to local streets

Framing Our Challenge

The Inevitable Case

- Any one of these scenarios involve trucks pushed to local streets
  - Congestion
  - Physical Impacts to local streets
  - Safety: Trucks & people do not mix

Framing Our Challenge

The nature of structures – when they're strong, they're strong. When they're weak, they're difficult to predict with certainty.

Framing Our Challenge

When does this all happen?

- Conditions continue to deteriorate at an unknown rate
- Eventually, traffic will need to be removed
  - DOT's belief, based on available information, is 2026
- Could be sooner, could be later
- It can be debated, but must be addressed

Refining predictions

- DOT is Conducting risk-based assessment of structural failure
  - WIM sensors
  - Probabilistic Evaluations
  - Load and Resistance Factor Rating analysis
- Engage service life expert
  - Existing structure
  - Rehabilitation/Reconstruction schemes