



ROAD INFRASTRUCTURE
MANAGEMENT FORUM

Our Carbon Equation

Application of a pavement wear maintenance cost tool under HPMVs

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RIMS

Roading Infrastructure Management Support

in association with

IDS 
Infrastructure
Decision Support

Background

- 2018 - Greater Wellington Regional Council (GWRC) retendered Public Bus routes
- Some routes required use of High Capacity Urban Buses (HCUBs) to reduce vehicle congestion on critical routes
- WCC engaged IDS to assess impact of HCUBs on pavement wear

HCUBs



2 Axle Electric DD
80 pax
12.2t Tare weight

3 Axle Diesel DD
100 pax
14.9t Tare weight



HCUBs

- 80 – 100 passengers
- Operate under HPMV permits
- VDAM Rule for Passenger Service Vehicles (General Access limits in brackets)
 - Maximum mass on a single axle with large single tyre – 7.2t (7.2t)
 - Maximum mass on a single axle with dual tyres – 12t (9t)
 - Maximum total mass on a tandem axle set (dual tyres + single tyre) – 16 or 18t (14.5t)

HCUBs



12t

7.2t

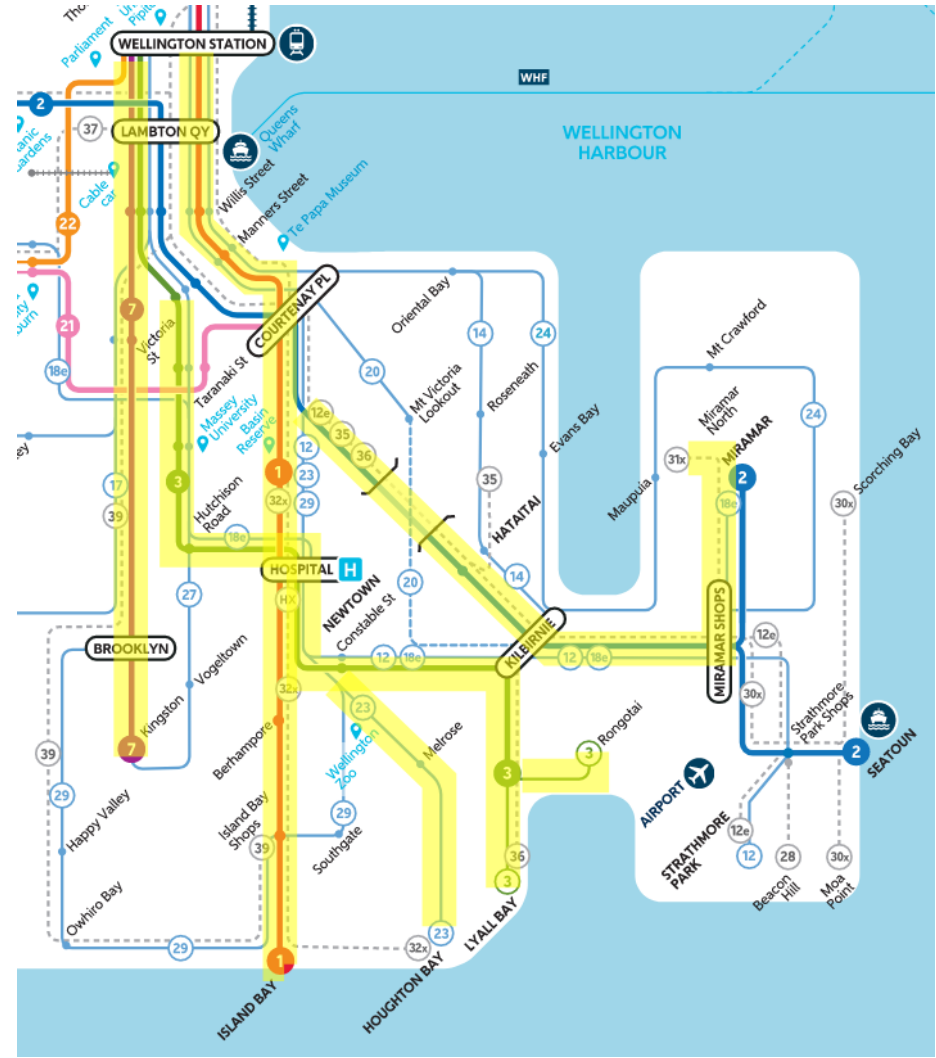


18t

7.2t

Our Carbon Equation

HCUB Network



Our Carbon Equation

IDS Pavement Wear Model

- RCAs don't control/limit vehicles that comply with GA limits
- Assumption that wear/maintenance costs covered by BAU funding processes
- Only applicable when axle loads exceed GA limits
- Based on ESA approach but with variable power value dependant on pavement condition

Pavement Wear Model - Inputs

- Network → RAMM carriageway segments excluding State Highway pavements
- Network condition → Geosolve pavement assessment
- Cost data → WCC RAMM Contractor records + uplift for contract/WCC overhead costs
- HVKT
- BVKT → Peak hour services on network excluding State Highways
- Bus loading patterns - initial assessment from GWRC then reassessed with ticket data

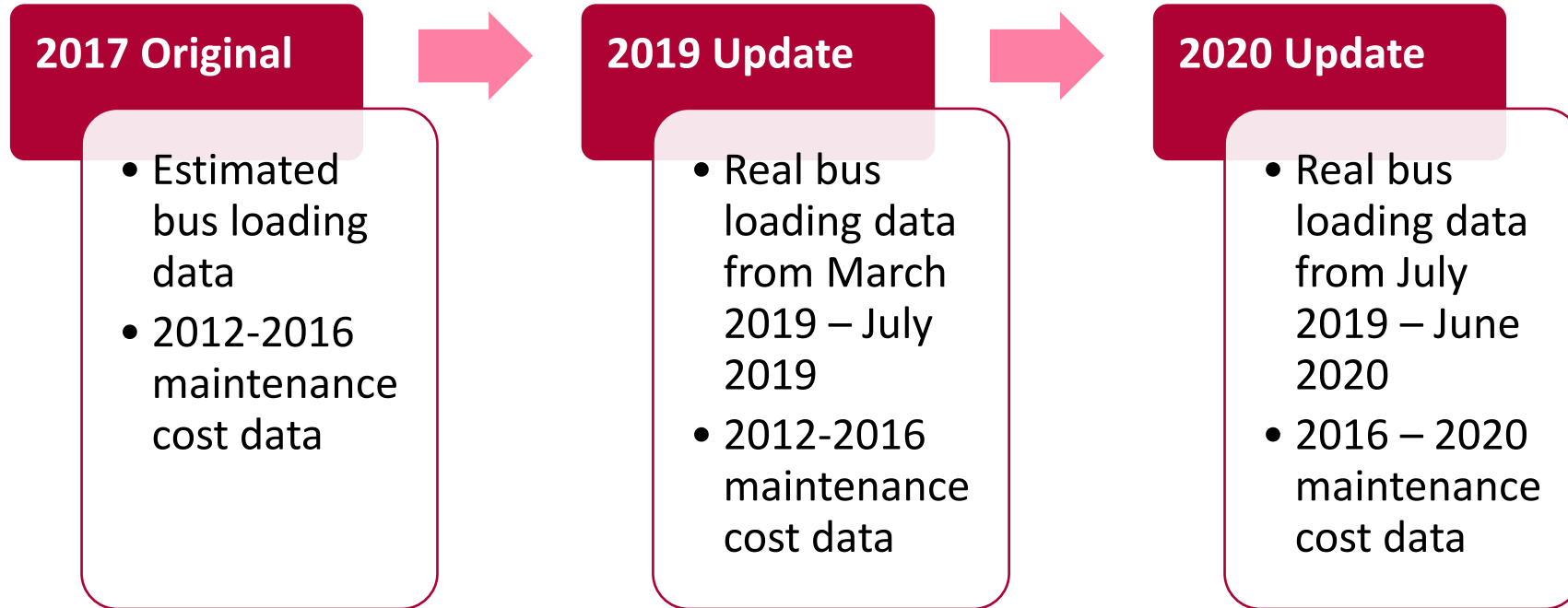
Pavement Wear Model – GA Calculation Engine

- Maintenance costs are reconciled against HVKT and pavement strength
- ESA using variable damage exponent based on %length of network for different pavement strengths
- Lower damage exponent for stronger pavements
- Higher exponent for weaker pavements
- Output - \$/ESA/km

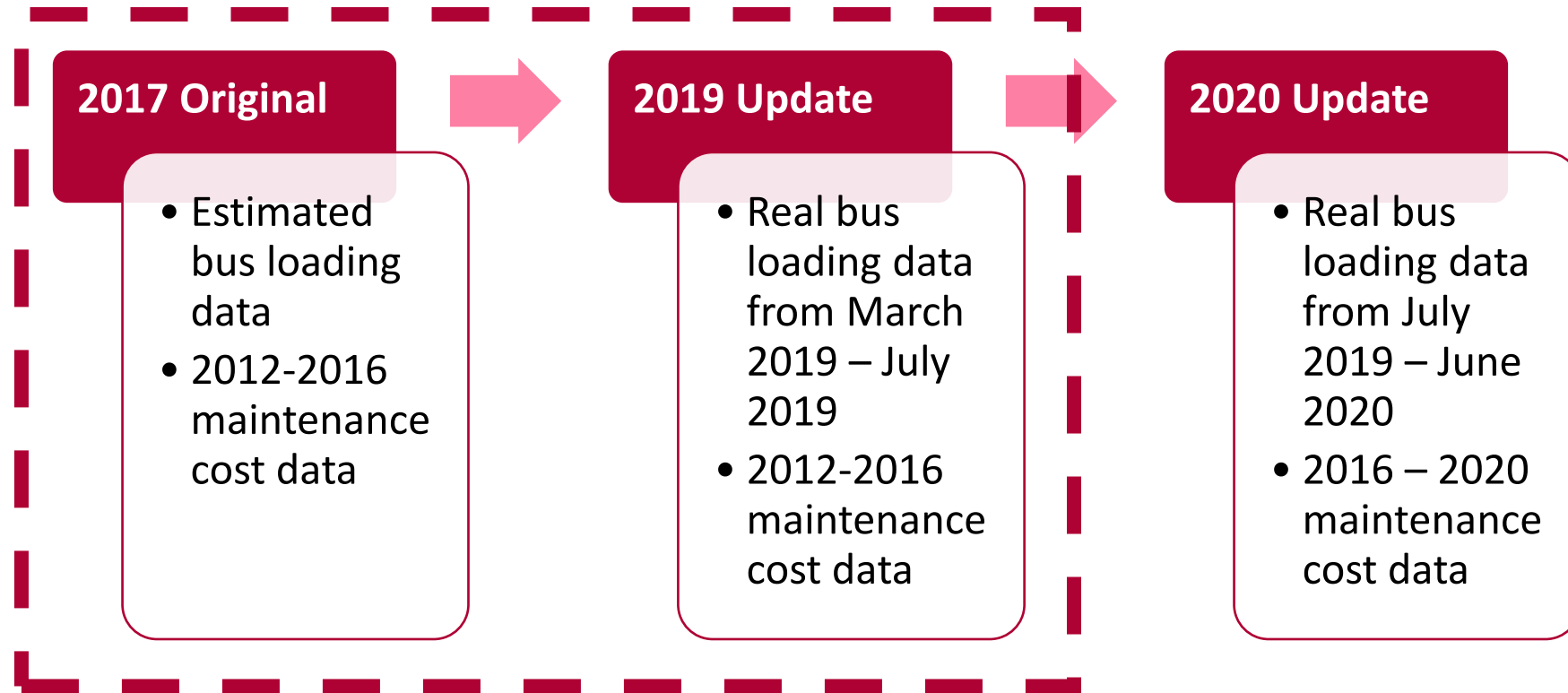
Pavement Wear Model – HCUB Calculation Engine

- New ESA calculation based on HCUB axle loads
- Efficiency factor for bigger buses (same pax/freight task)
- Ticket data for loading levels + HCUBs in service → BVKT
- New maintenance costs calculated
- Weighted average costs for different levels of loading above GA limits
- Annual cost increase = HCUB cost – GA cost

Assessment Updates



Assessment Updates



Loading Data Information

- Date and Time
- Bus Type (Diesel Double Decker (DDD) or Electric Double Decker (EVDD))
- Bus Stop ID
- Route
- Number of Passengers on board

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Loading Data Assumptions

- Number of cash-paying passengers is low
- Number of people forgetting to tag on and off with Snapper cards is low
- Bus loading for the entire year will be similar to that of March 2019 – July 2019.

Loading Data Transformation



Our Carbon Equation

2019 Update Result:

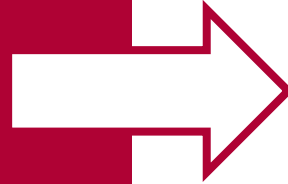
\$58,645

Estimated additional
annual pavement
maintenance cost

2019 Update Result:

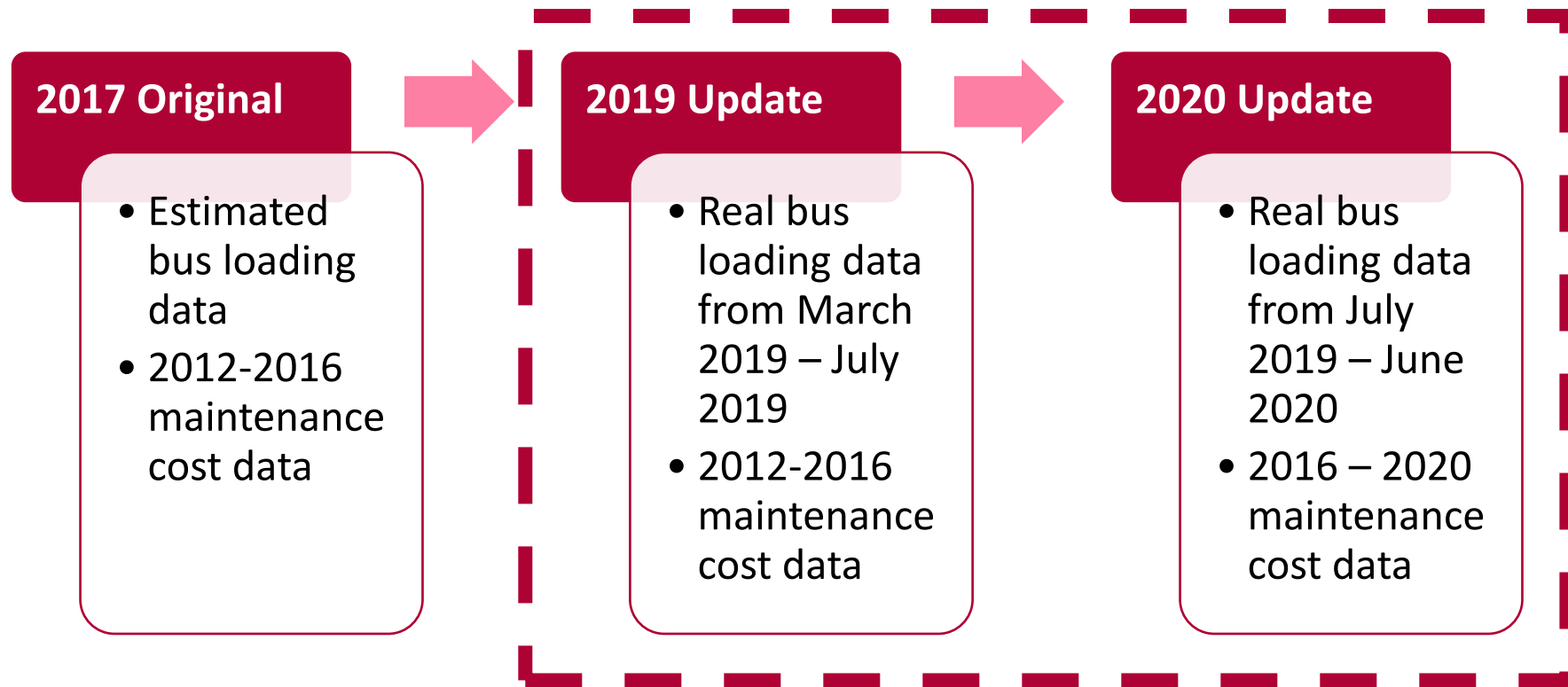
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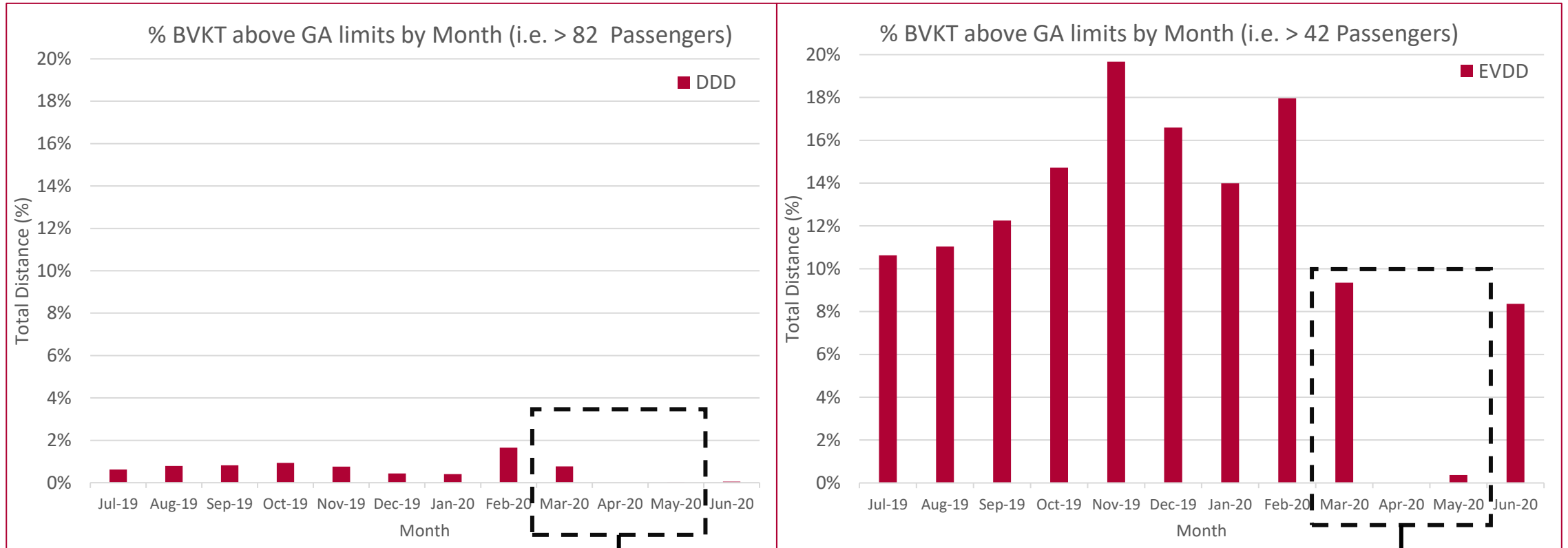


- Significantly lower than 2017 study (\$166,750)
 - Loading distributions lower than estimated values in previous study
 - DDD and EVDD roll-out was slower than expected

Assessment Updates



Effect of COVID-19 on Bus Loading



7-week Nationwide Lockdown

Our Carbon Equation

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- 5-year period from 2016-2020
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Working with the Data

- Determine which relate to pavement maintenance
- Determine which applied to carriageways on DDD and EVDD bus routes
- Increase costs by 25% (to cover WCC (10%) and Contractor (15%) overheads)

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\$11.6M (\$3.4M for 2012 – 2016)

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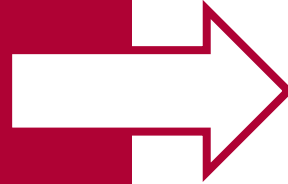
\$124,870

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2020 Update Result:

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Estimated additional
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2017 Original Result:

\$166,750

2019 Update Result:

\$58,645

- Lies between the Original 2017 and the 2019 Update
 - Loading distributions lower, partially due to COVID-19
 - Increased maintenance costs
- Approx. 1.1% expected increase in annual maintenance cost

Thank you to...

Wellington City Council (Transport & Infrastructure)
Greater Wellington Regional Council

Thank you for listening

Are there any questions?

