

New Zealand



IPWEA

INSTITUTE OF PUBLIC WORKS
ENGINEERING AUSTRALASIA

ROAD INFRASTRUCTURE
MANAGEMENT FORUM

Our Carbon Equation

Computer Vision and AI integrated with Renewal and Maintenance Planning

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RIMS

Roading Infrastructure Management Support

in association with

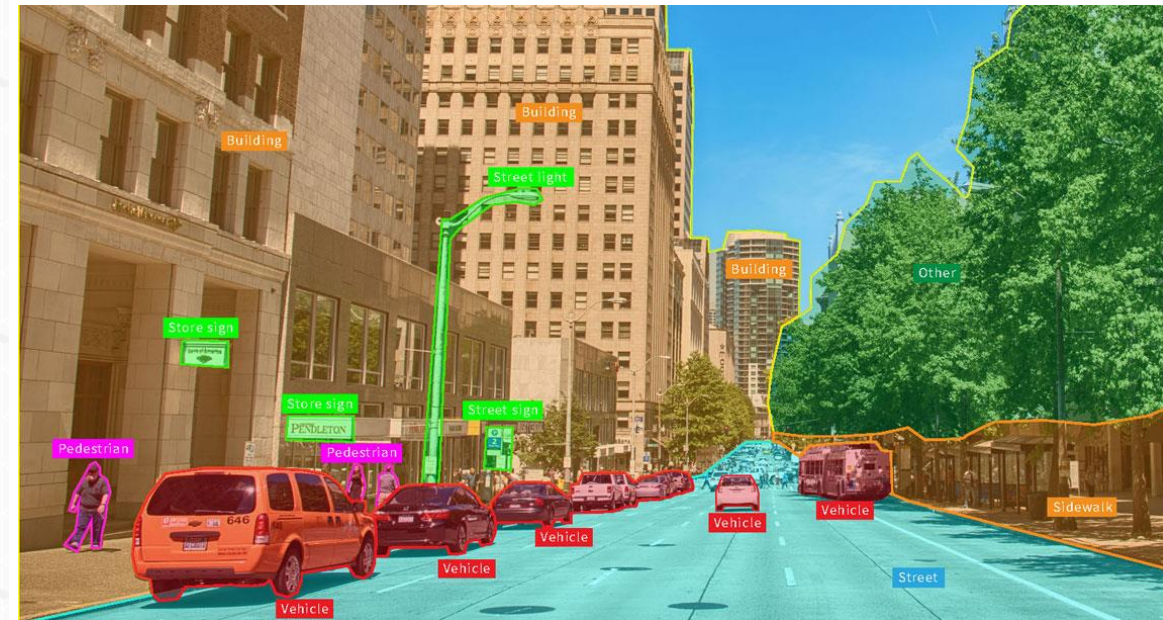
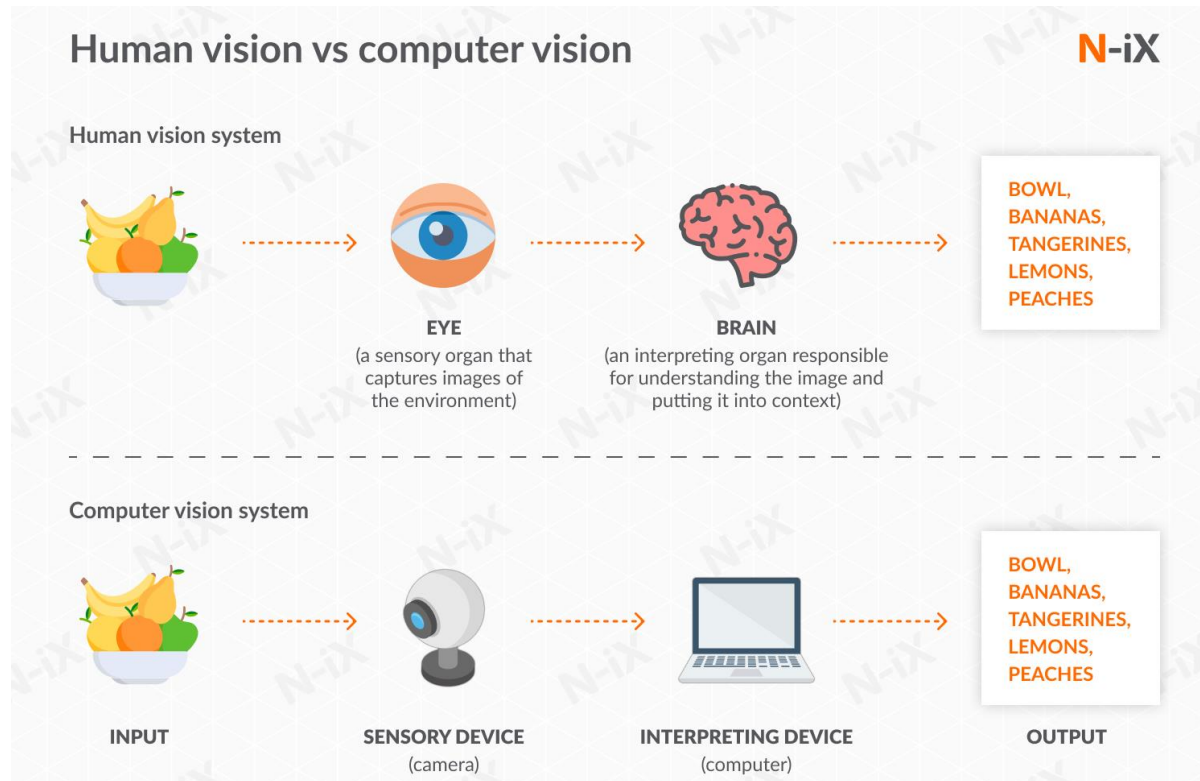


Overview

- What is Computer Vision and AI?
- How can this be used with Tactical Decision making?
- How can this be used in Operational and Strategic decision making?
- How can carbon savings be gained from this technology?
- The future?

What is Computer Vision and AI?

- From an engineering perspective, Computer Vision seeks to understand and automate tasks the human visual system can do
- Computer Vision is a form of Artificial Intelligence (AI) using neural networks to surpass humans in detecting and labelling objects.



Our Carbon Equation

How can this be used in Road Maintenance?

Video Survey Network



Video Processing



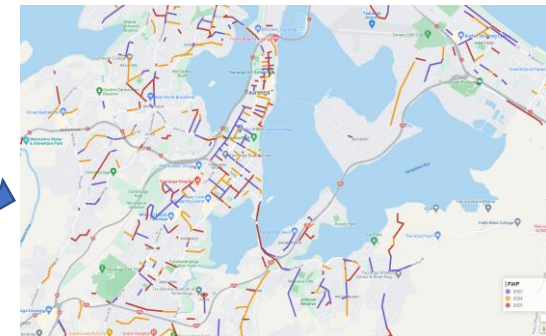
Computer Vision Inferencing



Work Management



Network Condition



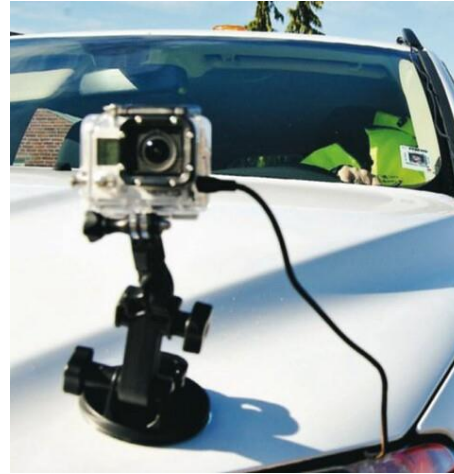
Future Planning

 **Post-Processing of Inferencing outputs**

Our Carbon Equation

How can this be used for Road Maintenance?

- Video capture of road network (GPS enabled)



- Computer Vision will provide general labelling of road distress types
- **However**, post-processing of the outputs is key for using data
 - Location of distress (geospatial, linear, lane / wheelpaths)
 - Size of distress (estimated area)
 - User Interaction with CV results (further training of the CV base knowledge set)

Our Carbon Equation



Section: Training Network, 304 - 000001.22 @, From 1237 to 2577, All

| | 01.12.20 | 02.12.20 | 03.12.20 | 04.12.20 | 05.12.20 | 06.12.20 | 07.12.20 |
|--|-----------------------|----------|----------|----------|----------|----------|----------|
| RAI_P402_Training_304 | | | | | | | |
| Storage_P401 | No resources assigned | | | | | | |
| All Work in LSP Mode | 134 | 64 | 64 | 74 | 64 | 104 | 64 |
| Network Work in LSP Mode | 1.7 | 1.4 | 1.3 | 1.7 | 1.7 | 1.6 | 1.5 |
| Accidents | 20 | 6 | 5 | 6 | 2 | 22 | 2 |
| Network Work LSP Mode | 1.23 | 1.28 | 1.26 | 1.26 | 1.26 | 1.26 | 1.27 |
| Not Open Work Lane | 11 | 17 | 13 | 13 | 13 | 13 | 14 |
| Excavate, Clearing, Paving, Laydown, Closing | [Timeline bars] | | | | | | |
| Work in Progress, Closed | [Timeline bars] | | | | | | |
| Resources | [Timeline bars] | | | | | | |
| Network | [Timeline bars] | | | | | | |
| Training | [Timeline bars] | | | | | | |
| RAI_P402_Training_304 | [Timeline bars] | | | | | | |
| RAI_P402 | [Timeline bars] | | | | | | |
| Storage_P401 | [Timeline bars] | | | | | | |
| Storage_P402 | [Timeline bars] | | | | | | |
| Storage_P403 | [Timeline bars] | | | | | | |
| Storage_P404 | [Timeline bars] | | | | | | |
| Storage_P405 | [Timeline bars] | | | | | | |
| Storage_P406 | [Timeline bars] | | | | | | |
| Storage_P407 | [Timeline bars] | | | | | | |
| Storage_P408 | [Timeline bars] | | | | | | |
| Storage_P409 | [Timeline bars] | | | | | | |
| Storage_P410 | [Timeline bars] | | | | | | |
| Storage_P411 | [Timeline bars] | | | | | | |
| Storage_P412 | [Timeline bars] | | | | | | |
| Storage_P413 | [Timeline bars] | | | | | | |
| Storage_P414 | [Timeline bars] | | | | | | |
| Storage_P415 | [Timeline bars] | | | | | | |
| Storage_P416 | [Timeline bars] | | | | | | |
| Storage_P417 | [Timeline bars] | | | | | | |
| Storage_P418 | [Timeline bars] | | | | | | |
| Storage_P419 | [Timeline bars] | | | | | | |
| Storage_P420 | [Timeline bars] | | | | | | |

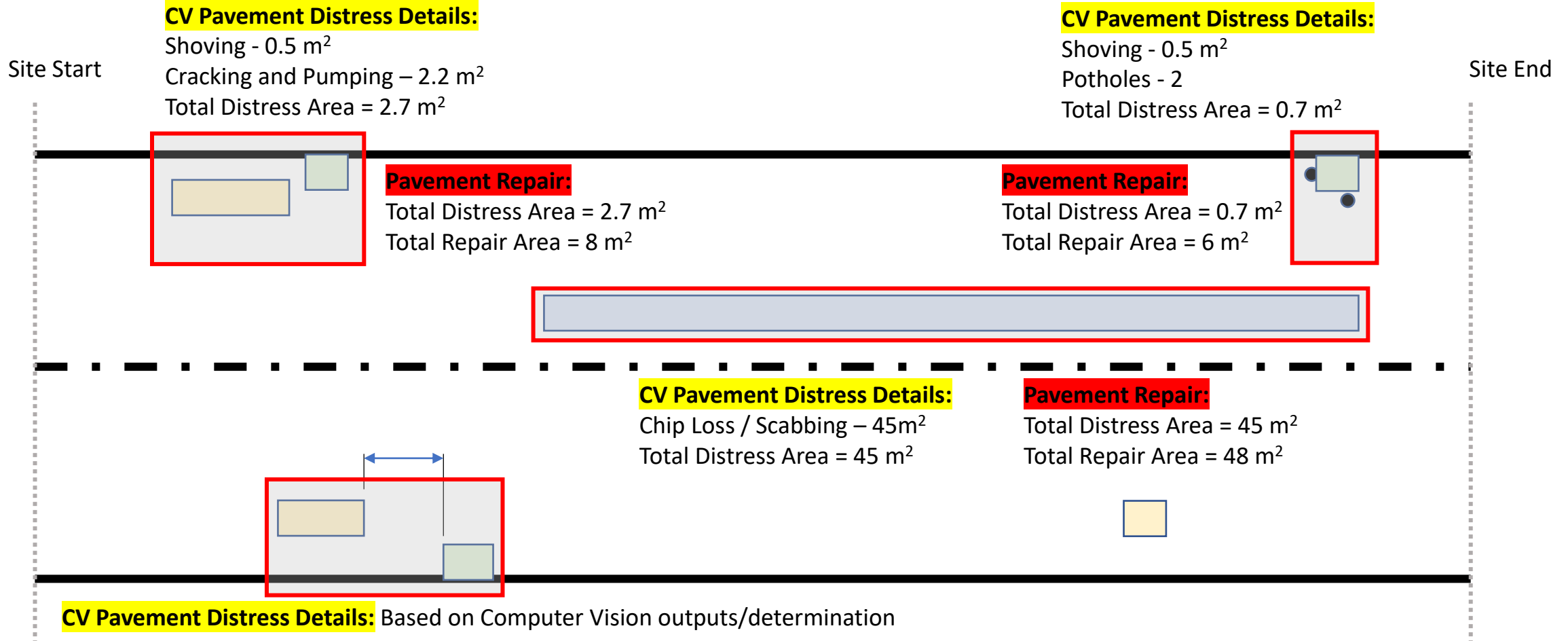
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Potential use of outputs?

Post-Processing can be used to determine:

- Patching and pre-seal repair programme
- Estimated quantity of repairs on the network
- Indicative distress quantity on network
- First-cut Net Present Value (NPV) determination for sites

Post-Processing – Patching and Preseal Repairs

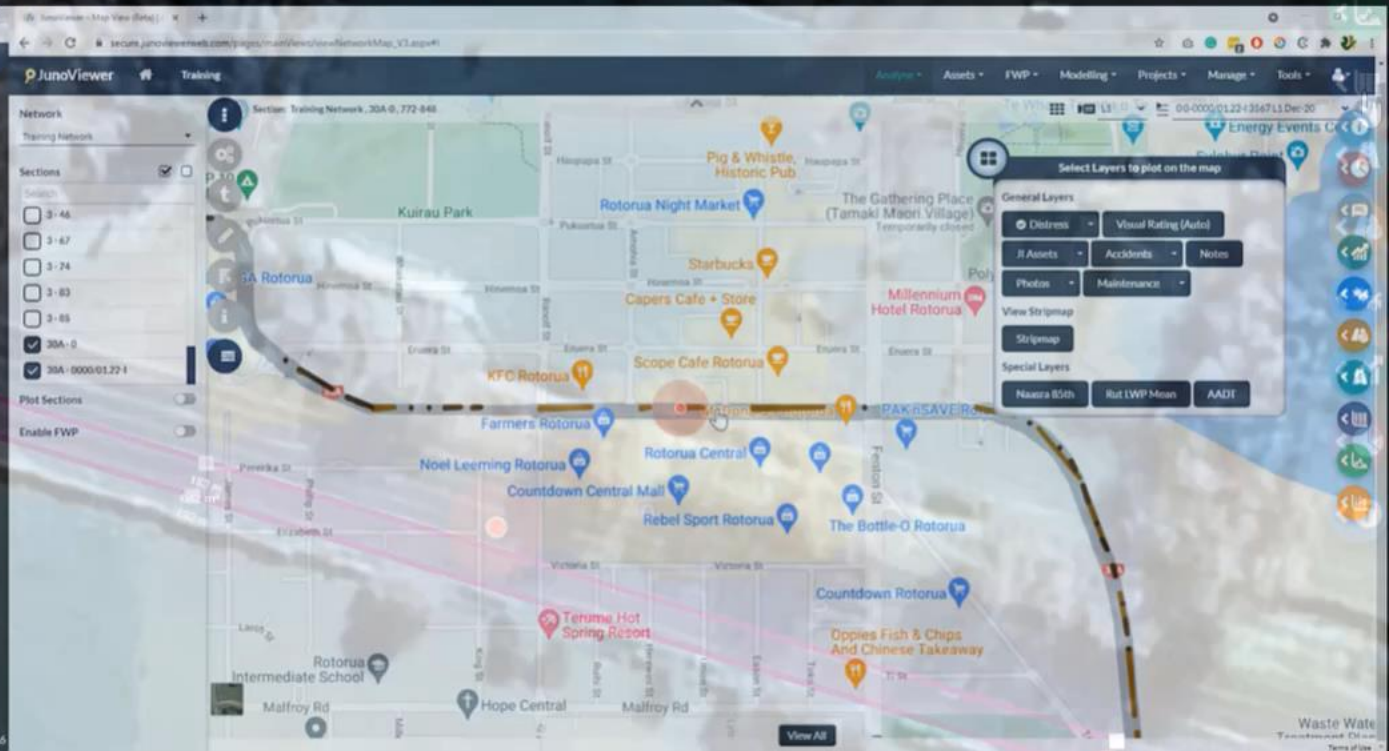


Pavement Repair: Post-processing to determine, can be based on

- Distance between distress types
- Distress types
- Size of plant used for repair type
- Distance from Depot

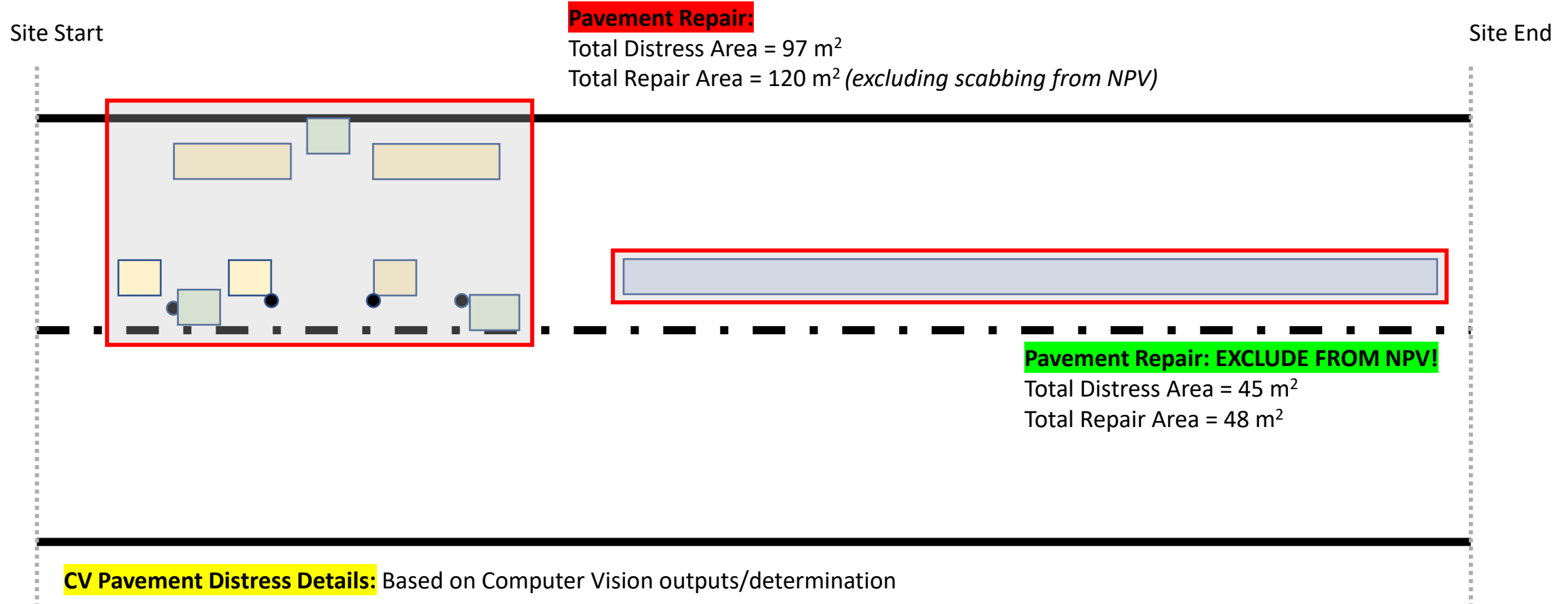
Section: AUCK ALLIANCE_002-0000_16170-16355

Select No Videos to Select



Interaction With Map

Post-Processing – NPV Determination



CV Pavement Distress Details: Based on Computer Vision outputs/determination

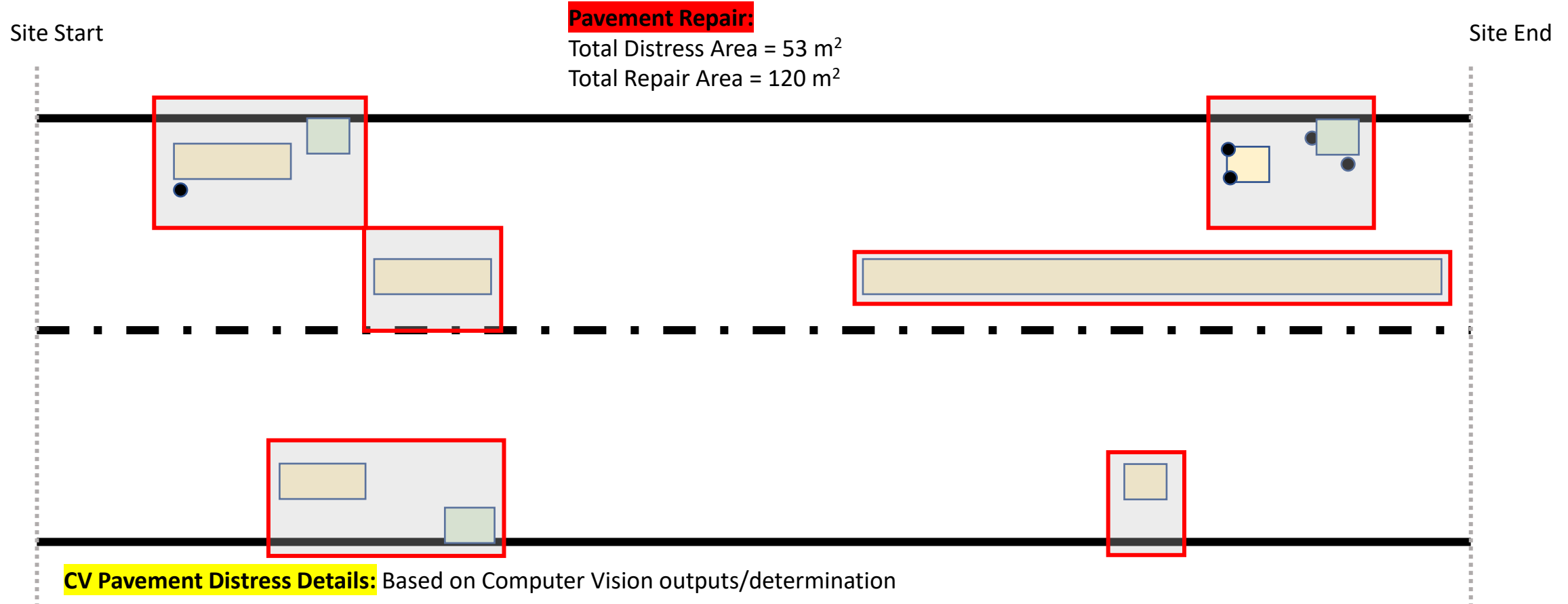
Pavement Repair: Post-processing to determine

- **Localised Failures** – Maintenance to repair

VS Widespread Failures – Justified for NPV and Pavement Renewal

Our Carbon Equation

Post-Processing – NPV Determination



CV Pavement Distress Details: Based on Computer Vision outputs/determination

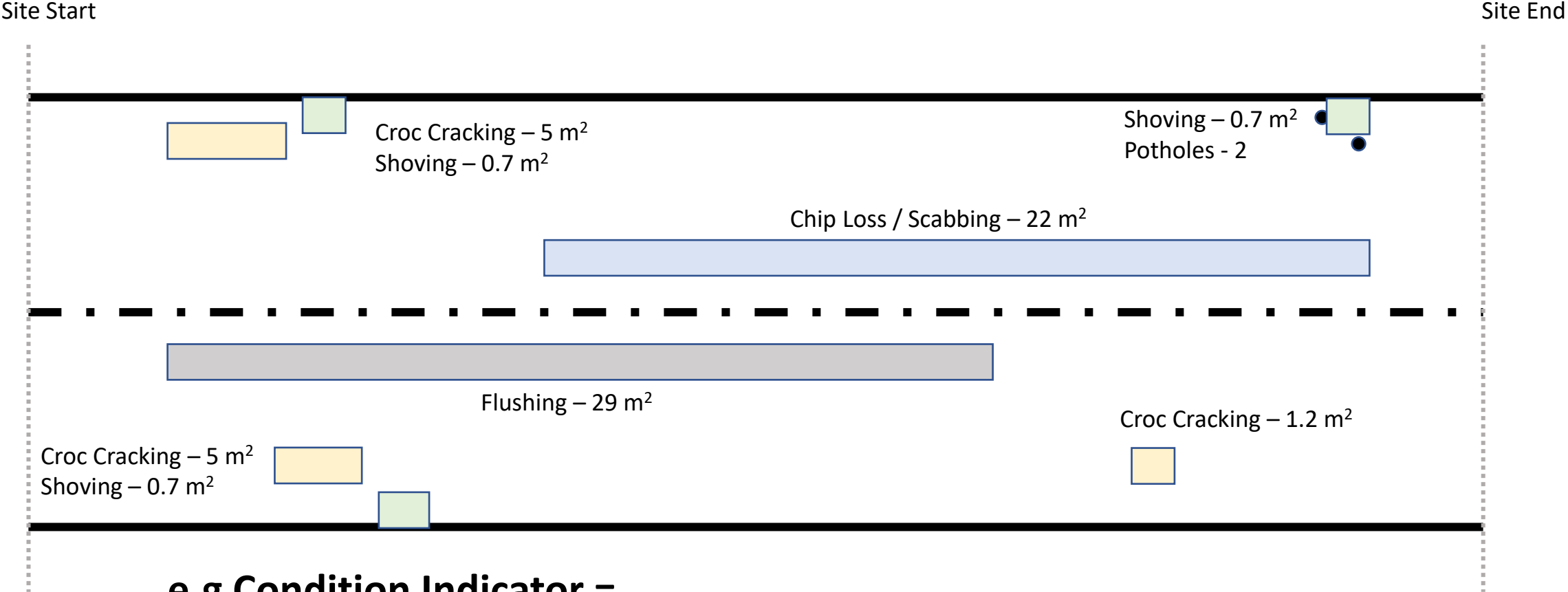
Pavement Repair: Post-processing to determine

- Localised Failures – Maintenance to repair

vs **Widespread Failures** – Justified for NPV and Pavement Renewal

Our Carbon Equation

Network Condition – Performance Indicators



e.g Condition Indicator =

Sum (Area of Distress Types * Weightings (if applicable))

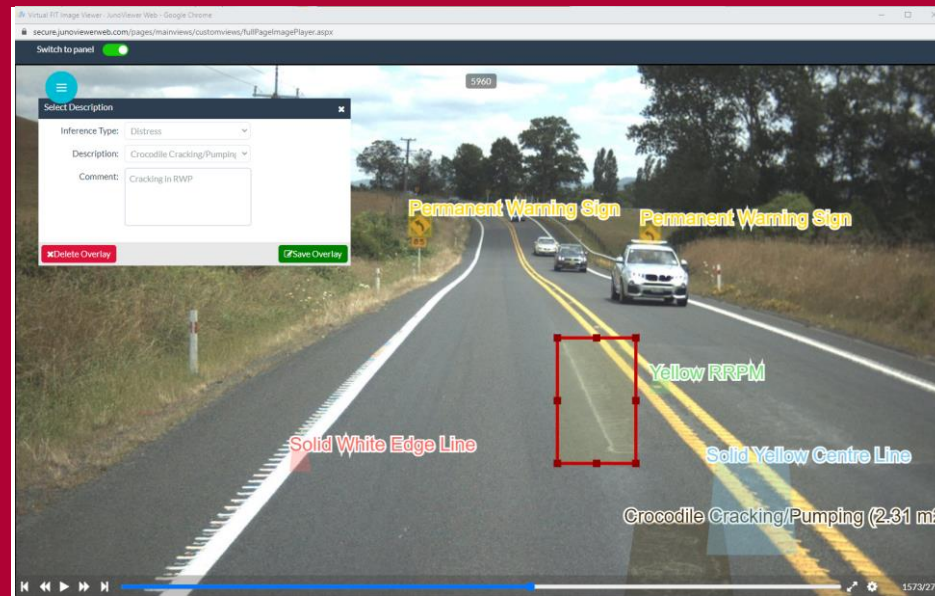
/ Sum (Total Site Area)

Our Carbon Equation

Benefits of Computer Vision for Road Maintenance

- Safety – less exposure of staff on site, less time (more targeted time) on the network
- Carbon Savings
 - Less visits to site, less idling and driving
 - Operations going to correct locations
 - Built-in efficiencies in programme development
- Economic Evaluation – ensuring sites provide economic value for renewal
- Network Performance – monitoring of network performance
- Combination with other Datasets – smarter asset management and knowledge
- Deterioration Forecasting – using predictive analytics and machine learning techniques

Thank you!



Section: AUCK ALLIANCE, 002 - 0018, From 0 to 13776, All

| Pavement_Master_ASM (All) | R024-21/22 | R024-21/23 |
|---------------------------|------------|---------------------|
| NLTP_ASM_2023_21/23 (All) | CS-2021 | R048-26/27_CS-21/28 |
| Minor_Div_Mat23 (All) | SM-2021 | SM-21/23 |
| Passer 80m | 79 | 106 |
| Rut Mean in L&R 80m | 10.0 | 13.3 |
| Rut Mean in R&F 80m | 13.1 | 10.0 |
| Texture Mean in Lane 80m | 1.4 | 1.5 |
| Score SIC 1ap 80m | 0.42 | 0.54 |
| Asphalts | 1 | 2 |

Showing TrendReport: AUCK ALLIANCE, 002-0018, From 0-13776
Date Range: Last 50 Years Group by days: 120 days Lane: All

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Section: AUCK ALLIANCE, 002 - 0018, From 5768 to 6320, All

| Pavement_Master_ASM (All) | R024-21/22 | R024-21/23 | R024-21/24 |
|---------------------------|------------|------------|------------|
| Passer 80m | 79 | 106 | 104 |
| Rut Mean in L&R 80m | 10.0 | 13.3 | 10.0 |
| Rut Mean in R&F 80m | 13.1 | 10.0 | 12.3 |
| Texture Mean in Lane 80m | 1.4 | 1.5 | 1.8 |
| Score SIC 1ap 80m | 0.42 | 0.54 | 0.50 |
| Asphalts | 1 | 2 | 3 |

FWP info

- Section Name: 002-0018
- FWP Version: Pavement_Master_ASM
- Lane: All
- Area Group Name: Regional
- Area Name: Manurewa Cemetery 002-0018-0076-02
- Treatments XAL: 2021-R024

FWP Years @ Pavement_Master_ASM

- 2022
- 2023
- 2024
- 2025
- 2026
- 2027

Maintenance

- Block_of_Transverse_Cracks
- Crocodile_Cracking/Pumping
- Scabbing
- Potholes
- Fluishing

Our Carbon Equation