University of the Sunshine Coast
Australia

Behaviour by design: Understanding the factors influencing user behaviour at level crossings

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Understanding risk at level crossings

- Non-compliant road user behaviour viewed as precursor to level crossing collisions / fatalities
- Lack of large datasets to inform risk-based decision making / risk modelling
- Human Factors approaches can support understanding of the issues & appropriate interventions to influence behaviour

The old view on safety

- Human error is the primary cause of all incidents
- To understand failure, you must examine failure only
- Systems are safe
- Unreliable and erratic humans make them unsafe
- Systems can be made safer by restricting humans through procedures, automation etc

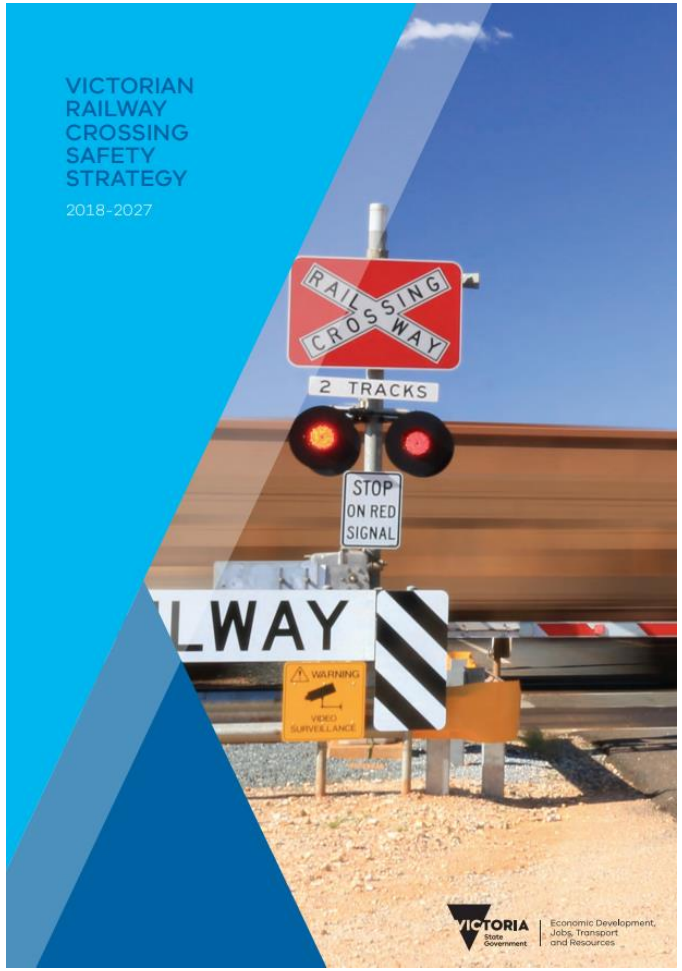
The new view on safety

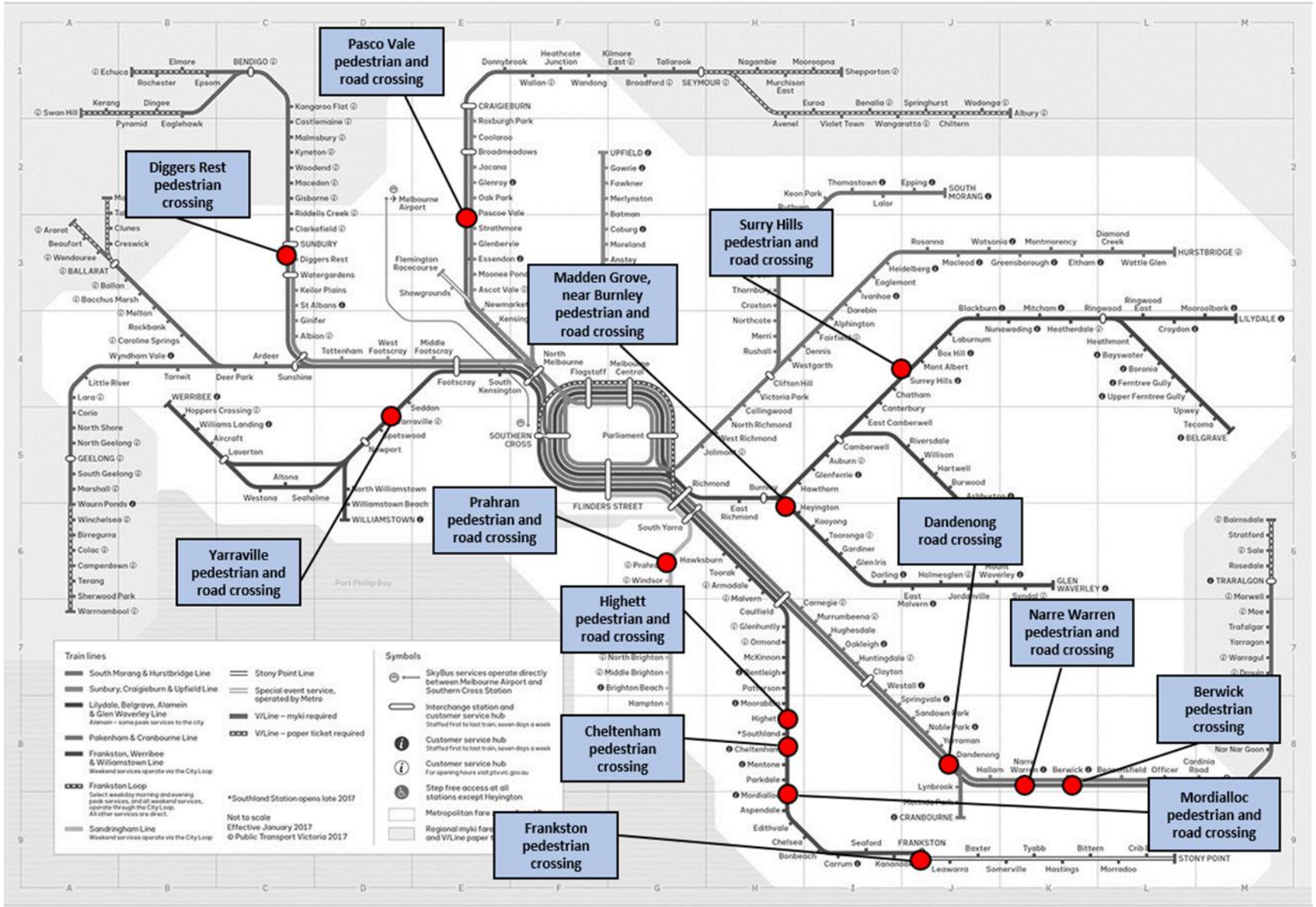
- Human error is a symptom of systemic issues (it is a consequence not a cause)
- Incidents are created by multiple interacting factors
- To understand ‘failure’, look at why people’s actions made sense to them at the time
- Systems are complex, inefficient, and unsafe
- Humans create safety through practices at all levels of a system

Behavioural assessments project

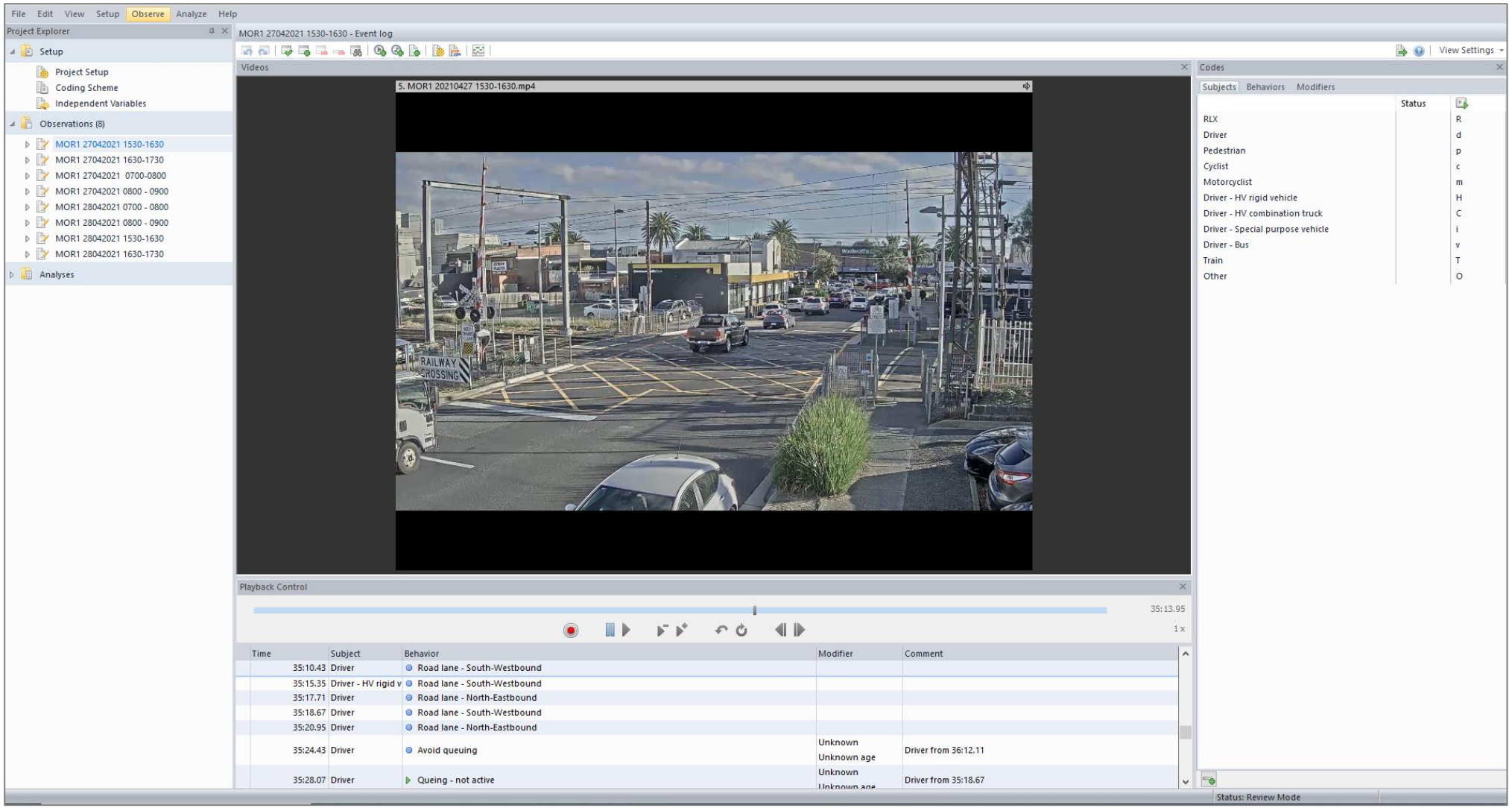
- Contributes to knowledge
  - Causes of incidents and effectiveness of safety measures are well understood
  - Broadly available and consistent evidence base for risk-based prioritisation of responses

- Specific aim: Observe and analyse level crossing road and pedestrian users' behaviours to improve knowledge of infrastructure and motivating factors that influence behaviour





Data collection & analysis



Behaviours observed (13 sites, 120 hours)

Non-compliant behaviours	Frequency
Near miss - pedestrian	1
Bypass booms / gates – cyclists	4
Bypass booms / gates - pedestrians	109
Pedestrian fail to stop	523
Late through flashing lights – drivers	75
Late through flashing lights - cyclists	10
Late through flashing lights - motorcyclists	2
Queuing – active - drivers	14
Through flashing lights – drivers	215
Through flashing lights – cyclists	4
Through flashing lights – motorcyclists	2
Pedestrians on road / on tracks	1050
Fail to dismount	216
Queuing – not active	350
Fail to wait – end of cycle – drivers	379
Fail to wait – end of cycle – cyclists	70
Fail to wait – end of cycle - motorcyclists	15
Pedestrian fail to wait – end of cycle	2846
Cyclist past stop line	15
Technical queuing - drivers	255
Technical queuing - motorcyclists	8
Technology engagement*	1411
Other non-compliant behaviour	31

Especially compliant behaviours	Frequency
Avoid queuing	406
Dismount	51
Quick stop – lights flashing	11
Wait for flashing lights at end of cycle	210
Stop before stop line	10
Other especially compliant behaviour	6

Positive safety behaviours	Frequency
Assisting other users	10
Check for trains before crossing	623
Check for trains during crossing	916
Removing distractions	9
Other positive safety behaviour	3

Queuing examples


CYCLISTS DISMOUNT
2 TRACKS DO NOT CROSS WHILE LIGHTS ARE FLASHING OR ALARM SOUNDING
STOP ON RED SIGNAL
TAXI

Entering crossing late


STOP
ON RED SIGNAL
END
P
AREA
Stop

Pedestrian bypasses

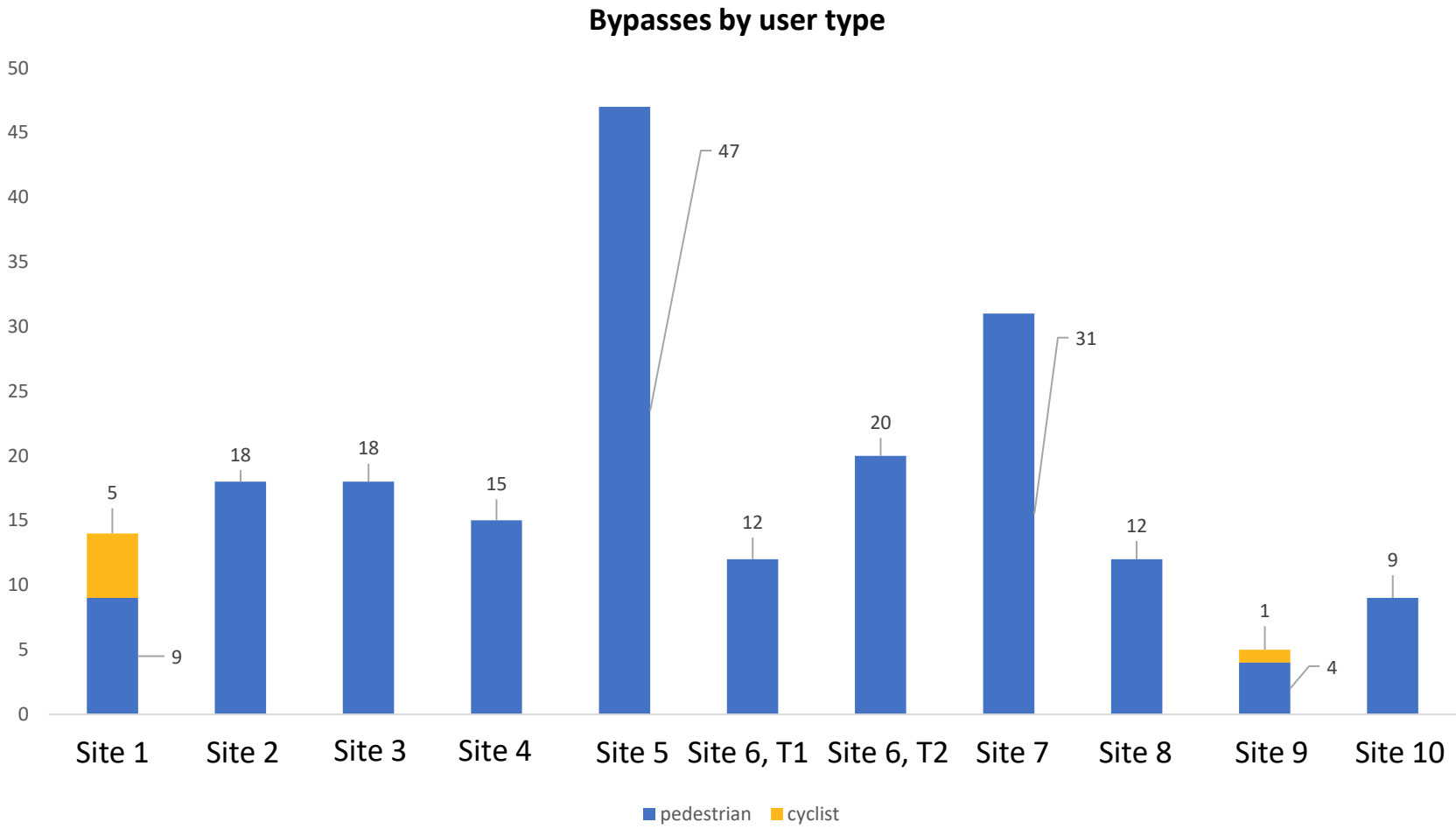

HAPPY FOUR
STOP


PT

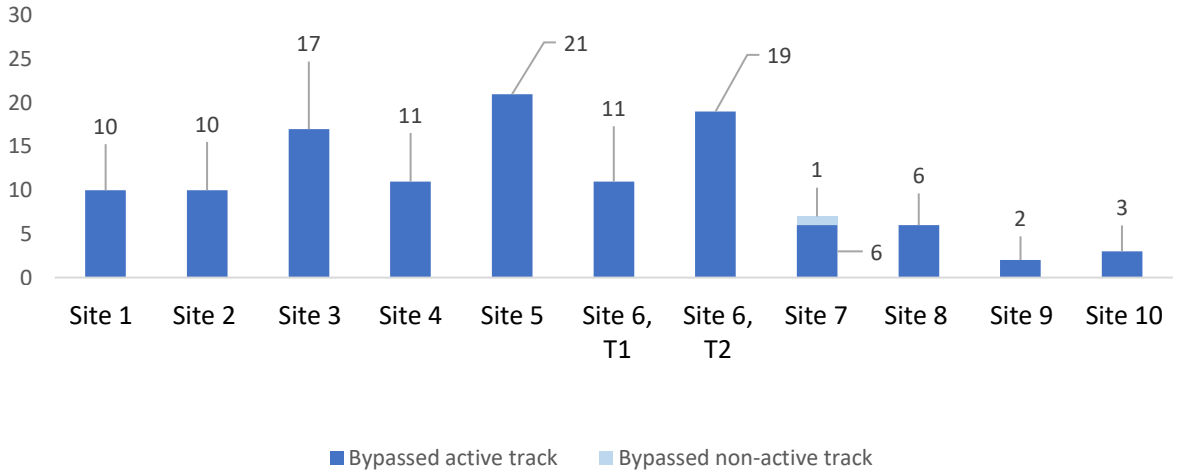
Risk factors

Hypothesis	Supported?
Queuing when *roadworks* in progress	✓
Queuing where *adjacent non-signalised intersection/s* present	✓
Enter the crossing late (after onset of flashing lights) where a *high frequency of crossing closures*	✓
Pedestrians bypass boom barriers / gates where *no emergency escape gate latches* present	✓
Gate latches have unintended consequence of pedestrians bypassing the pedestrian infrastructure and crossing via the road	✗

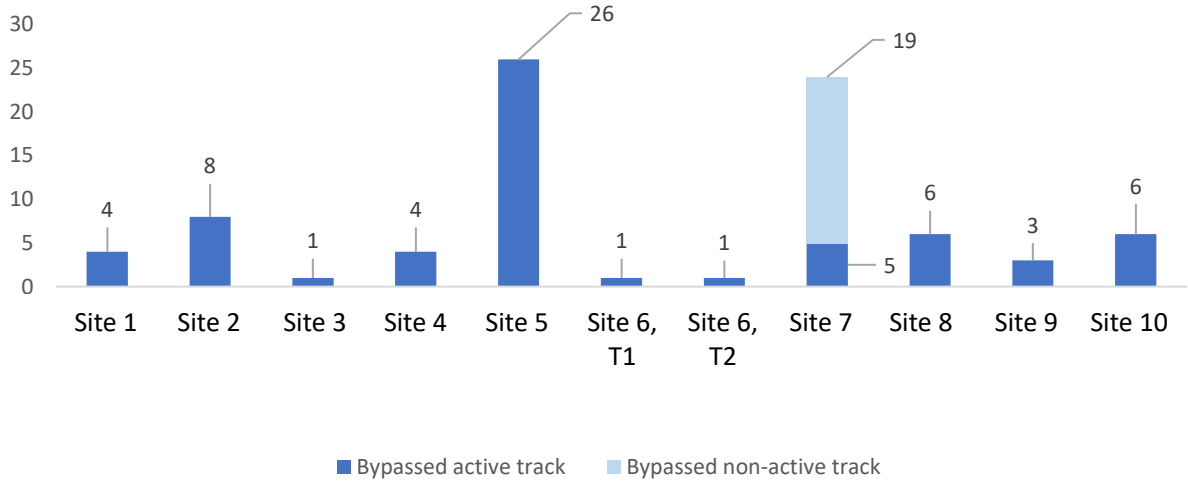
Pedestrian & cyclist bypass analysis

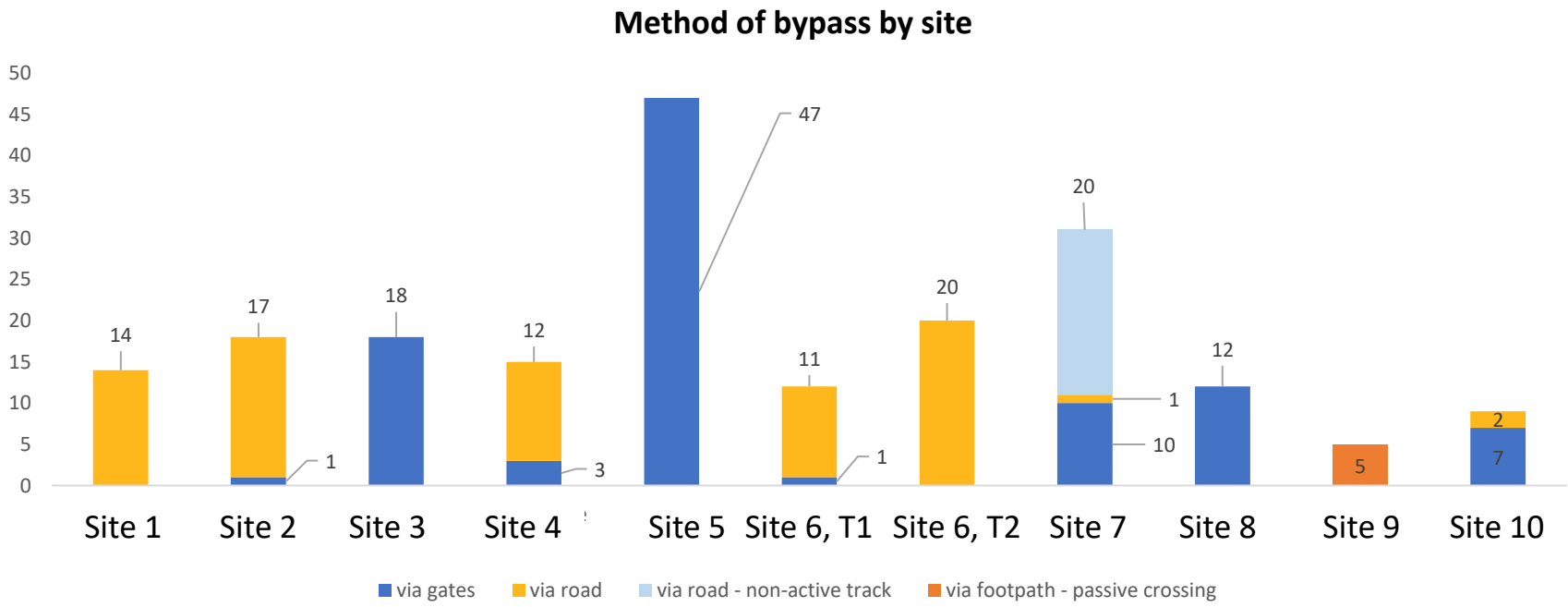


Bypasses during AM peak

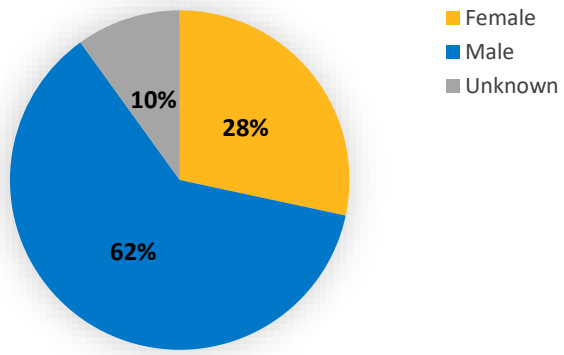


Bypasses during PM peak

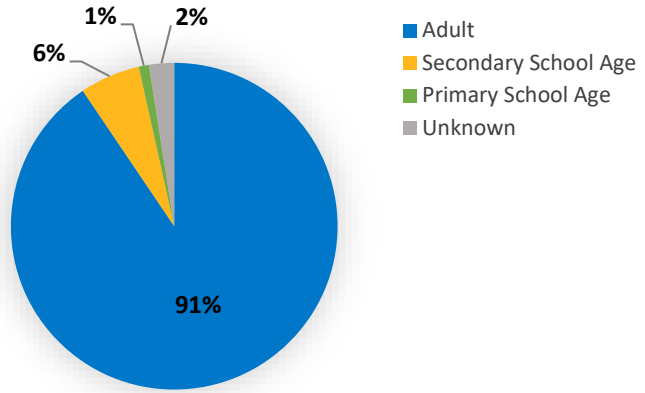



Method of bypass by site
50
45
40
35
30
25
20
15
10
5
0
14
17
1
18
12
3
47
11
1
20
20
1
10
12
5
2
7
Site 1
Site 2
Site 3
Site 4
Site 5
Site 6, T1
Site 6, T2
Site 7
Site 8
Site 9
Site 10
via gates
via road
via road - non-active track
via footpath - passive crossing

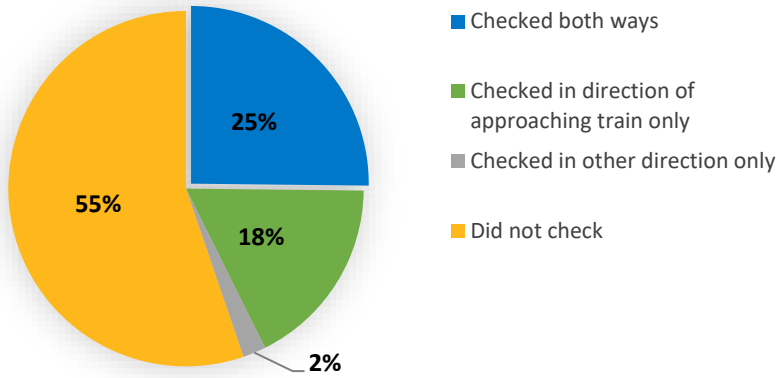
Gender



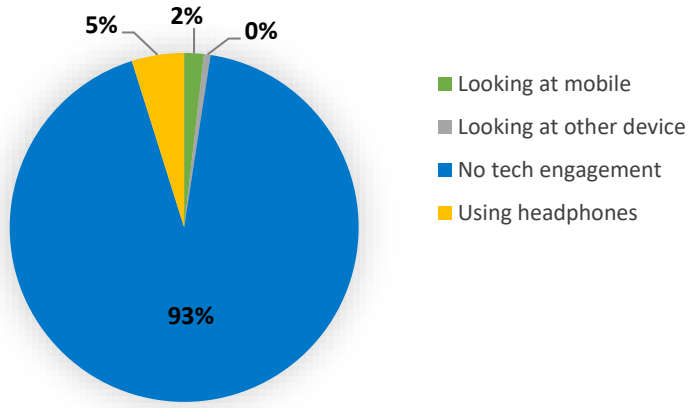
Age group



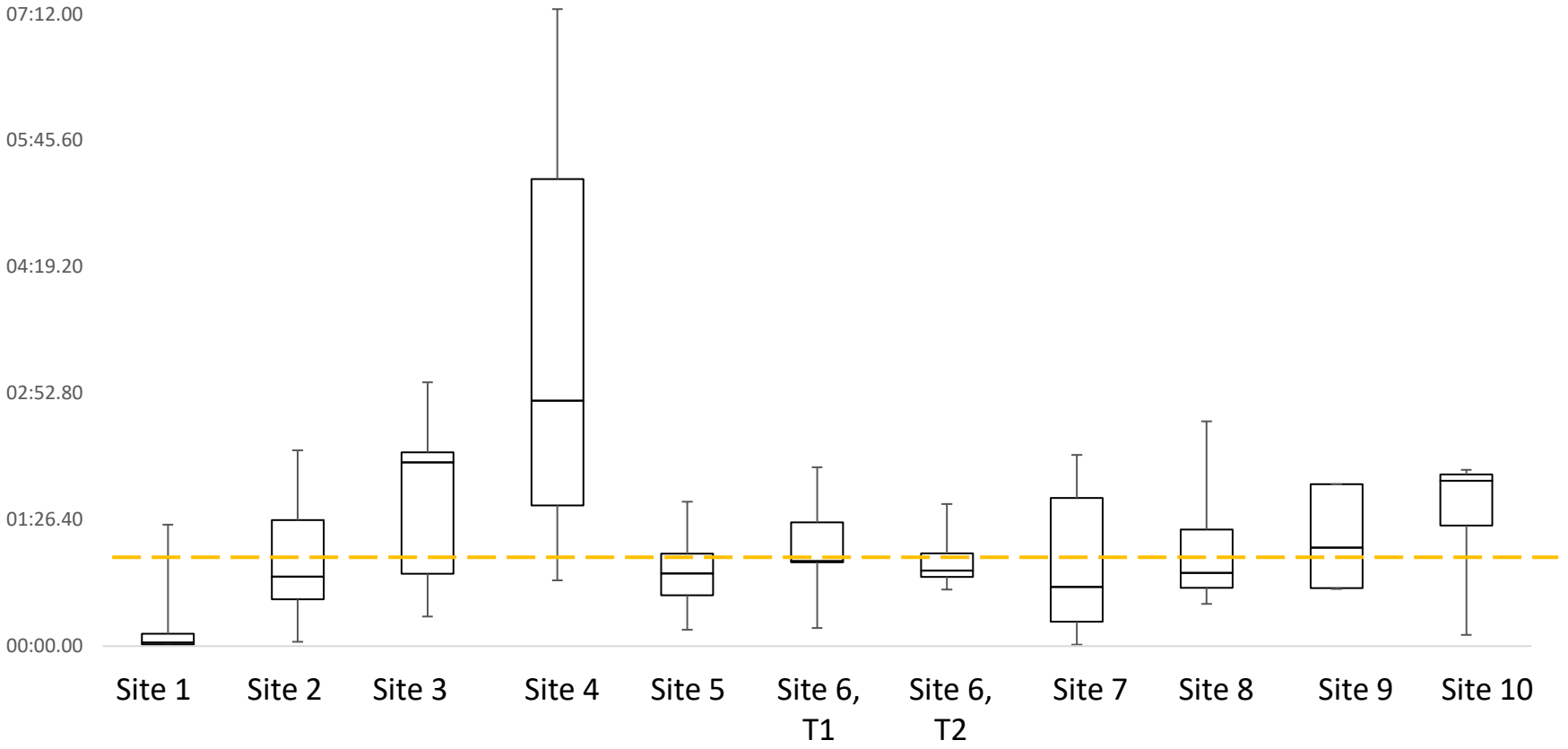
Checking for trains (*N* = 143)



Technology engagement (*N* = 165)



Wait times



Over half of sites had median wait time less than 1 min before bypassing

Synthesis of site recommendations

- Changes to infrastructure
- Education & enforcement initiatives
  - Where infrastructure change not effective or not practicable
  - Demographics to support targeting
  - Consider reward of positive behaviours
- Safety management improvements
  - Improved communication & coordination
  - Operational protocols
  - Data & research requirements

Next steps

- Rural level crossing analysis
- Coronial data review
- Potential for automated data processing

Thank you

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The opinions given are those of the authors, and do not represent the opinions of Metro Trains, the VRCSSC or its members.