



What  
could  
possibly  
go  
wrong?











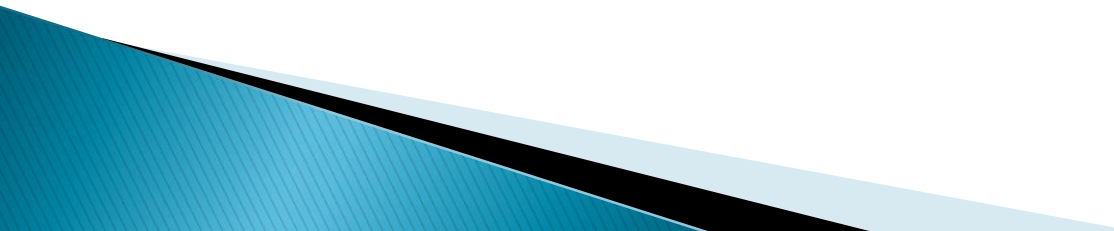


# Using Crash Data to Manage Organisation Risk

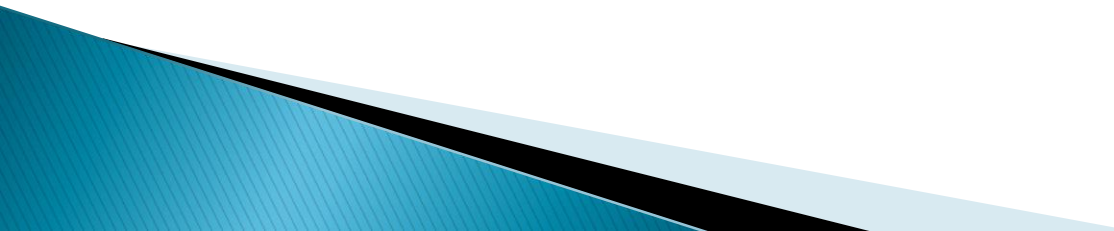
A Case Study – WA Police Toyota Troop Carrier

Keith Simmons

# Agenda

- ▶ Background
  - ▶ Situation
  - ▶ What the data told us
  - ▶ The project to reduce risk
  - ▶ Residual risk after treatments
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# Background

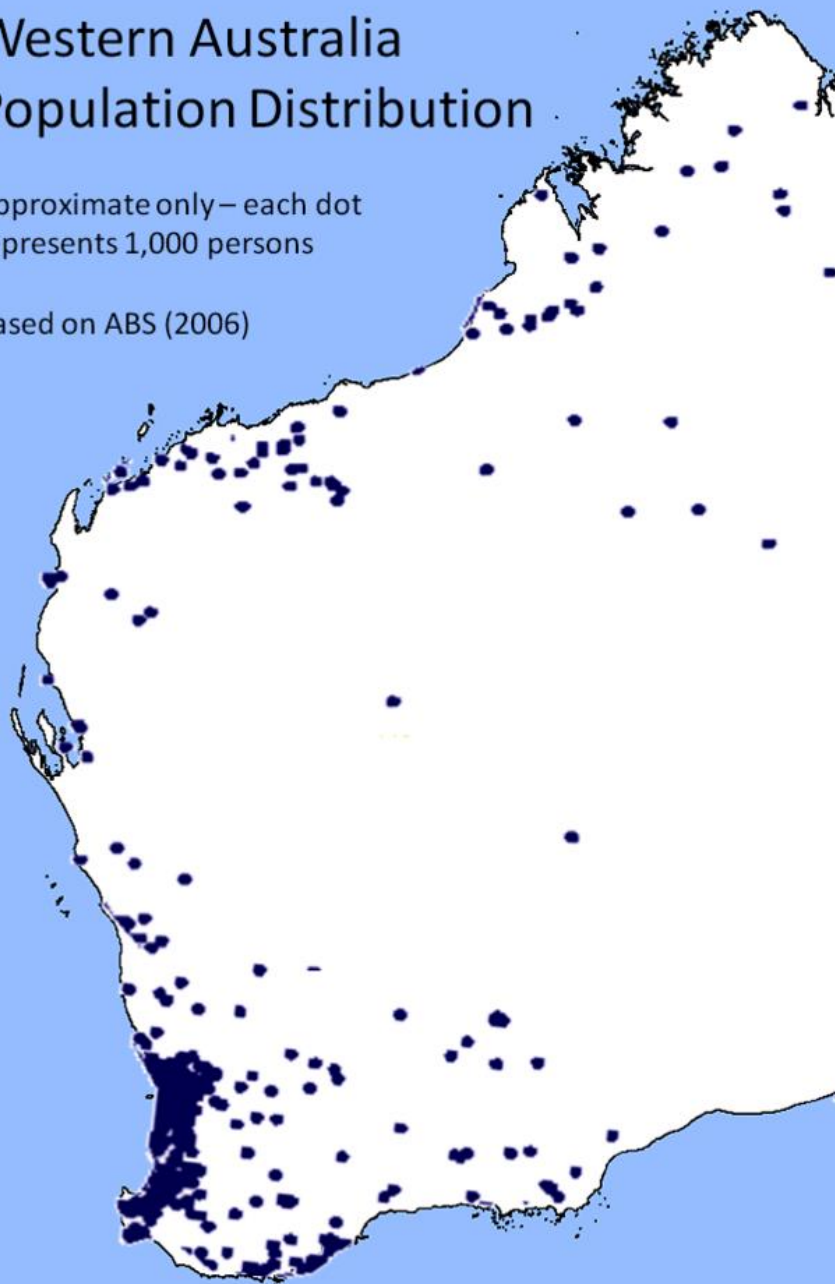
- ▶ WA covers 1 / 3 the area of mainland Australia
  - ▶ Has only 10% of the national population
  - ▶ Most concentrated around Perth and a few major regional centres
  - ▶ Remainder in small communities scattered throughout WA
- 




# Western Australia Population Distribution

Approximate only – each dot  
represents 1,000 persons

Based on ABS (2006)



# Background

- ▶ WA covers 1 / 3 the area of mainland Australia
  - ▶ WA only has 10% of the national population
  - ▶ Most population is concentrated around Perth and a few major regional centres
  - ▶ The rest are in small communities scattered throughout WA
  - ▶ There are 187,000 kms of roads connecting these communities ranging from major sealed highways to little more than two wheel ruts through the scrub
- 





# Background

- ▶ WAPOL operate 71 Toyota Troop Carrier PC
- ▶ Regional and Remote Police Station vehicle
- ▶ Travel 1.25 Million kms per year
- ▶ Fitted for long range patrol operations:
  - Dual fuel tanks and batteries,
  - Water tank, and 40 l car fridge,
  - Second spare wheel (on roof rack),
  - Recovery kit and Tool kit,
  - First Aid kit and other emergency equipment
  - Police Communications, HF, VHF, Data and EPIRB
  - Detainee compartment (cage).









# WAPOL Situation

- ▶ Feb 2005 – Nov 2013 WAPOL experienced 17 rollover crashes involving Troop Carrier PC
- ▶ 8 Serious Injuries, 7 Minor Injuries,
- ▶ Fortunately – no fatalities to date
- ▶ Rollover crashes have high consequence:
  - 24% of all light vehicle occupant fatalities result from rollover crashes, yet only 2.4% of all police reported crashes are rollovers
- ▶ Needed a frame of reference – used MUARC Study into VICPOL Vehicle Stability (2000)

# MUARC Phase 1 Report

- ▶ Sept 2000 MUARC Report on VICPOL vehicle Safety
- ▶ Followed double fatality crash in which Commodore Divvy Van – on its side – slid roof first into a pole.
- ▶ Full range of in-service vehicles analysed for rollover crash risk
- ▶ Uses US NHTSA Mengert Safety Rating for Static Stability and Dynamic handling methodology
- ▶ Results showed Rodeo Divvy Van more dangerous than Commodore.
- ▶ Led to significant improvement in fleet vehicle safety across all Australian police jurisdictions
  - Seminal Study for police fleet management

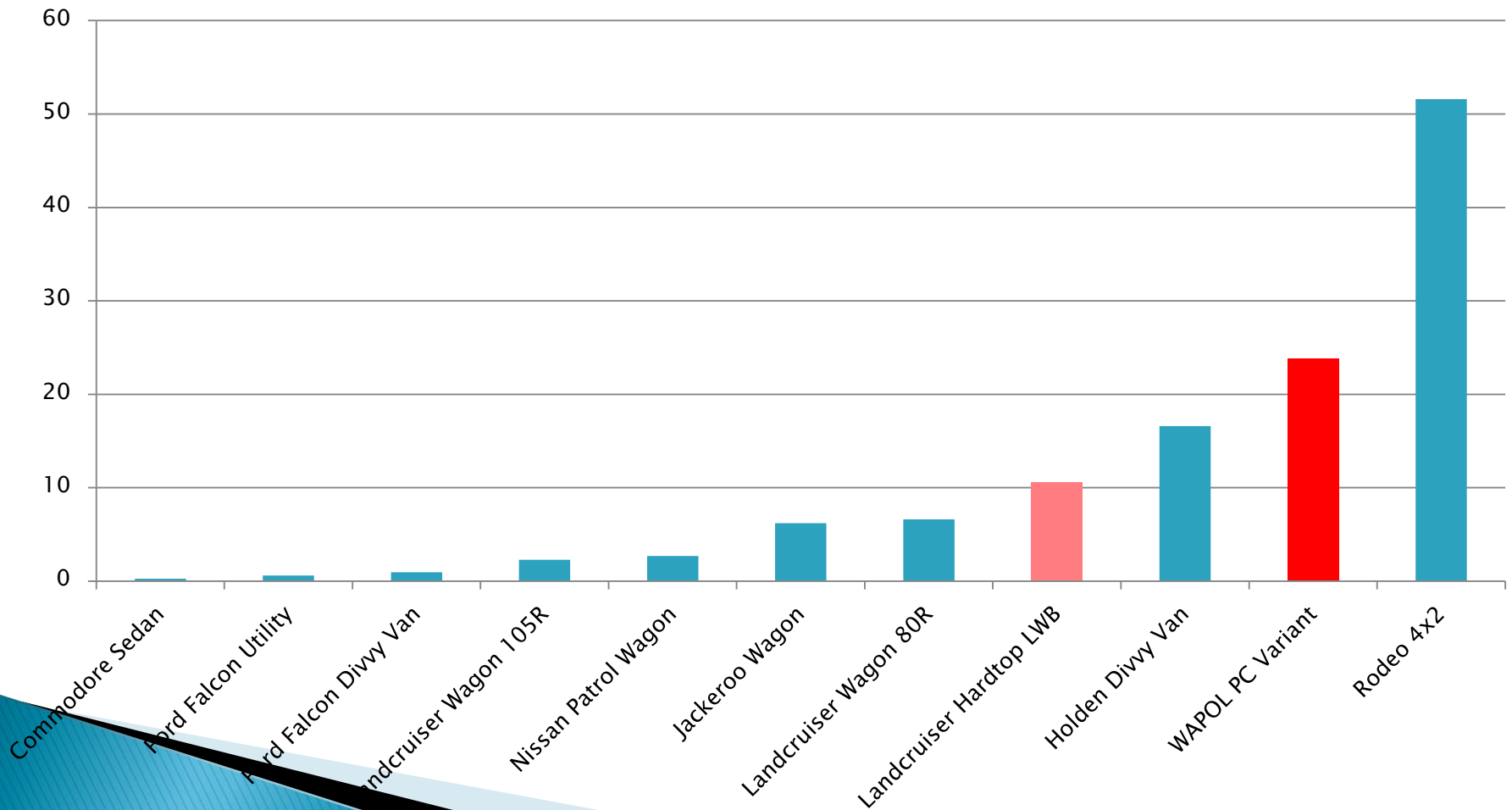
# What the Data told us: Crash Involvement

- ▶ Rollover Rate – **23.8** per 10,000 veh months
  - Compares to VICPOL rate of 10.6 / 10,000 months
  - Compares to commercial use 4WDs of 0.8
  - Compares to NZ population estimate – 4WDs of 0.25



# What the Data told us: Crash Involvement

Rollover Crashes per 10,000 Vehicle Months

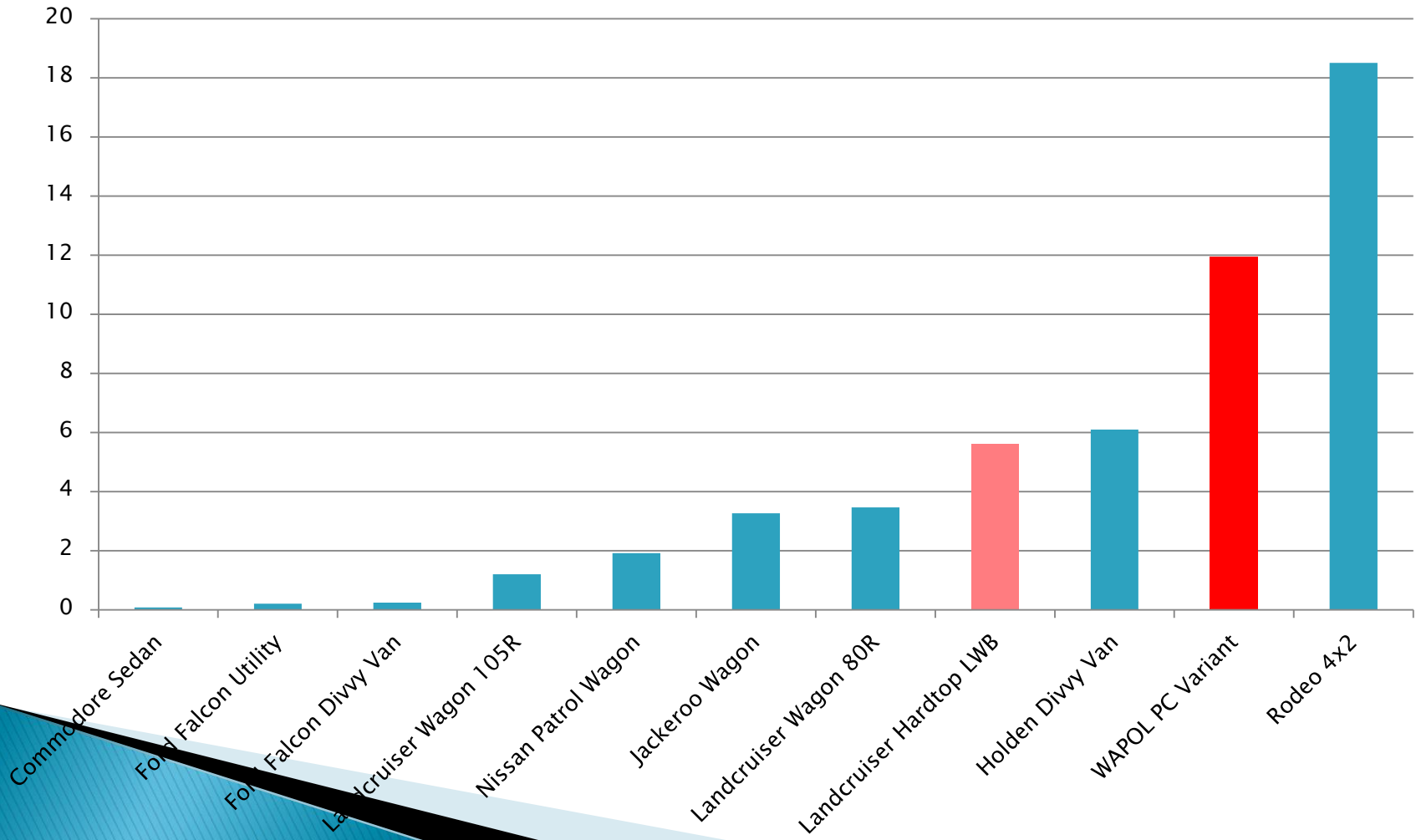


# What the Data told us: Crash Involvement

- ▶ Rollover Rate – **11.9** per 10 million kms
  - Compares to VICPOL rate of 6.1 / 10 million kms
  - Compares to Australian 4WDs of 0.6 (in work role)

# What the Data told us: Crash Involvement

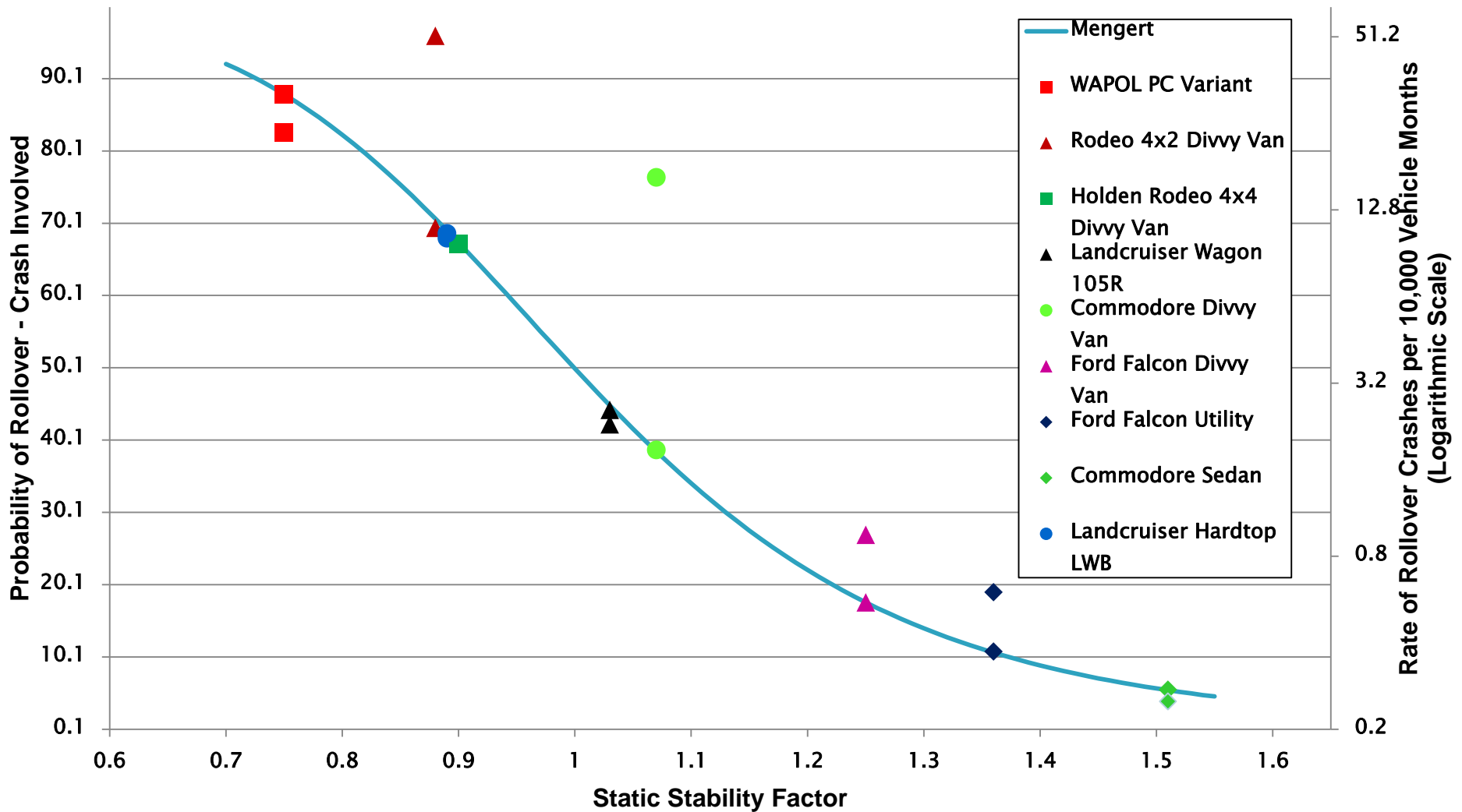
Rollovers per 10 Million kms Travelled



# Vehicle Stability Analysis

- ▶ Static Stability Factor (SSF)  
**Track Width / 2 CG Height**
- ▶ WAPOL Troop Carrier between 0.83 and 0.67  
**Average SSF = 0.75**
- ▶ US NHTSA (Mengert) Rollover Probability  
$$P_{\text{rollover}} = 100 / (1 + \text{SSF}^{6.9})$$
- ▶ WAPOL Troop Carrier **88% likely** to roll over  
(if involved in a crash or loss of control event)





Mengert Probability. Plot of Mengert Statistical Estimate of Probability of Rollover for Crash Involved Vehicle versus Actual Rollover Rate per 10,000 Vehicle Months for the MUARC Study Vehicles and WAPOL PC Variant.

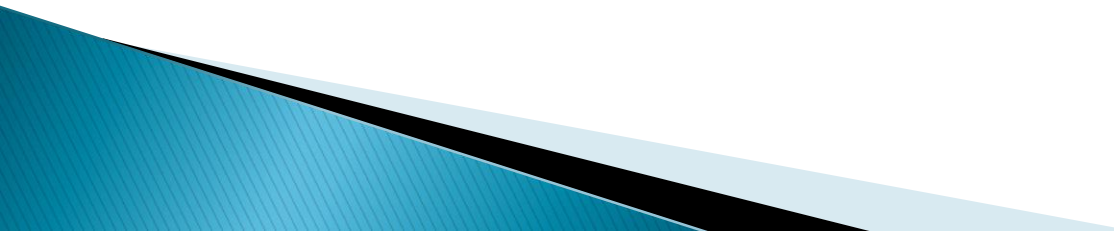
# Other factors – WAPOL Troopy

- ▶ No ESC, EBA, EBD, (only just got ABS)
- ▶ No side airbags and Low roof strength
  - severe head injury risk plus excursion/ejection likely
- ▶ No seat belt pre-tensioner
- ▶ Tubed tyres (7.50x16) on split rims
  - Prone to slow leak and catastrophic failure
- ▶ Narrow rear track (95mm less than front)
  - Increases sway and poor tracking
  - Induces oversteer at turns
- ▶ Nose up attitude (30mm up at front)
- ▶ Limited suspension body roll control
  - Excessive body roll induces rear axle steer / oversteer
- ▶ Roof mounted second spare – high CoG
- ▶ EPIRB and HF radio dependent on operator

# Review of 17 Crash Narratives

- ▶ ESC may have affected 15 (88%)
- ▶ Improved stability = improved outcome (90%)
- ▶ Side airbags (HPT) reduce injuries 10 (59%)
- ▶ Window security film 4 (23%)
  - Includes the most serious injury
- ▶ Wider rear track may improve 12 (70%)
- ▶ Wheel / Tyre package may improve (50%)
- ▶ Others?
  - Police vehicle rammed by offender 2 / 17
  - Driver fainted 1 / 17

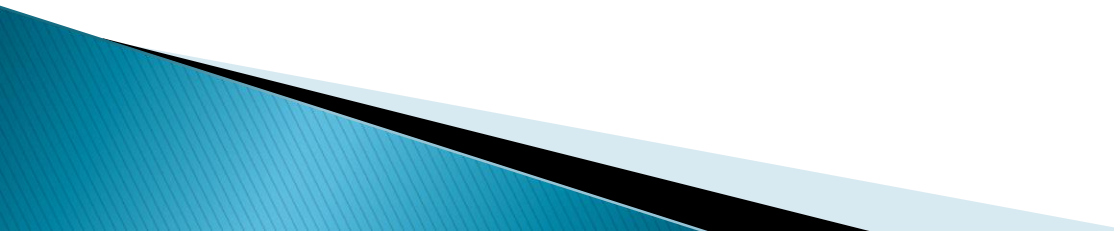
# What the Data told us: Safety Risk

- ▶ Using WAPOL Corporate Risk System:
  - ▶ **Consequence – 4A – Death or extensive injuries likely**
  - ▶ **Likelihood – 4 – Will probably occur in most circumstances at least once in 6 months**
- 



# Using Crash Data to Drive Risk Management

Did not want knee jerk reaction – In order to manage the risk, WAPOL needed to understand:

- ▶ User requirements for remote police vehicle
  - ▶ Severity and nature of rollover crashes
  - ▶ Root causes of the rollover crashes
  - ▶ Contributing factors
  - ▶ Root causes of injuries
  - ▶ Contributing factors
  - ▶ Other elements affecting Safe System
- 

# Outback Visit Program

- ▶ Goldfields – Esperance
  - Kalgoorlie (District HQ and Station)
  - Leonora
  - Laverton
  - Warburton
  - Warrakurna
  - Blackstone
- ▶ Kimberley
  - Broome (District HQ and Station)
  - Derby
  - Looma
  - Fitzroy Crossing
  - Halls Creek
  - Warmun
  - Kununurra
  - Wyndham



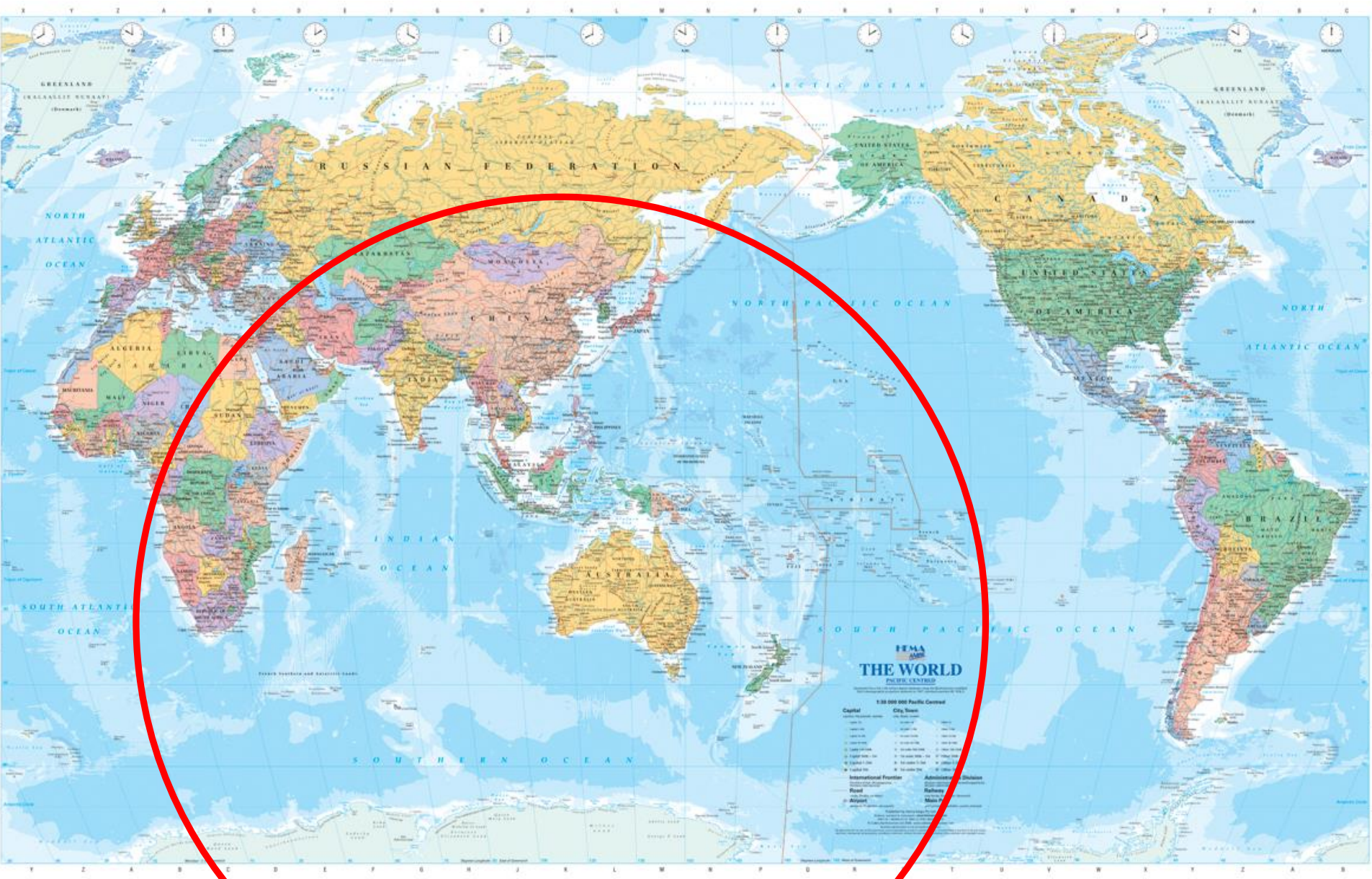
# The Project Experience:

- ▶ In 10 days, we:
- ▶ Flew 11,167 kms
- ▶ Drove 4953 kms





# Where else could we have gone?





# Outback Visit Program


**Police Overwhelmingly told us:**

- **Driver Training Package and preparation for outback driving was inappropriate and lacking**
- **Safer (alternate) vehicles are highly desired by user**
- **Want genuine 4 door 5 seat vehicles**
- **Some Landcruiser 70 Series required for mobility**

# Recommended Solutions

- ▶ Introduction of new vehicle types
  - Double cab utility
  - 4 door / 5 seat cabin
  - Fitted with outback / patrol module
  - 3 prisoner module, with 2 side doors (trailer use)
  - Large Storage compartment:
    - Slide out drawer for fridge, recovery gear and tool box
    - Grab bins for First Aid, RFDS and Snake Bite Kits
    - Reversing Camera / Prisoner Camera and intercom
    - 2 Spare wheels mounted at rear

# Recommended Solutions

- ▶ Ford Ranger Double cab diesel auto 4x4
    - 5 Star Safety
    - SSF 1.2 Rollover Probability 22%
  - ▶ Toyota 79 Series Double Cab Utility
    - 3 Star Safety – no ESC, no SIAB
    - SSF 1.08 Rollover Probability 37%
  - ▶ Vehicle Allocation / tasking to be risk based
    - Longer, high speed tasks use safer vehicle
    - High mobility tasks use Landcruiser
    - Reduced exposure further lowers risk
- 

# Recommended Solutions



**FORD RANGER**



**TOYOTA LANDCRUISER 70 SERIES**




# Prototype Module



09/11/20

# Recommended Solutions

- ▶ Troop Carrier PC must be supported for 2 years (or more) as alternate vehicles phased in
  - ▶ Improving Existing Vehicles:
    - Fit Solid Wheel / Tubeless Tyre package
    - Inflated to appropriate pressures (38F/40R)
    - Lower Centre of Gravity Height
    - Increase Rear Track Width
    - Improve Suspension height and body roll control
    - Impose Speed Limits on unsealed roads
    - Fit security film to cabin windows
    - Impose limitations on use (Urgent Duty only when human life threatened – no Pursuits)
- 

# Troop Carrier Development Project

- ❑ **Alternate Wheel/Tyre (265 / 75R16 AT)**
  - ❑ Improved stability, steering response, roadholding and ride under all conditions.
  - ❑ Wider tyre with lower aspect ratio provides more stable footprint, especially on gravel
- ❑ **Alternate Spring / Shock Combination**
  - ❑ Improved body roll control under all conditions,
  - ❑ Removed rear axle steer and oversteer effect,
  - ❑ Improved ride, stability and handling / steering response, especially on corrugations







# Troop Carrier Development Project

## ☑ Alternate Wheel/Tyre Package

- ☑ Improved stability, steering response, roadholding and ride.
- ☑ Lower tyre aspect ratio provides more stable footprint

## ☑ Alternate Spring / Shock Combination

- ☑ Improved roll control, removed rear axle steer and oversteer effect, improved ride, stability and handling / response

## ☑ Wider Rear Track

- ☑ Improved stability, handling, response, and
  - ☑ Significantly improved off-road handling / tracking
- 

# Additional Measures

## ▶ Training

- Logical Training Progression
  - Formal vehicle familiarisation at Station level
  - Driver Competency Assessment at Station level
  - Additional 4WD off-road and Recovery Training at District level after familiar with vehicle on gravel roads
- Outback Driving Training Video

# Additional Measures

## ► Policy

- Greater use of High Mobility / Patrol Trailers
- Speed Limits and vehicle use restrictions
- Stow and secure equipment properly

## ► Vehicle Equipment

- Tyre Pressure Monitoring Systems
- Wheel Nut Indicators
- Signage
  - Seat Belts
  - Stability Warning
  - Speed and Use restrictions



# Residual Risk After Treatments

- ▶ Improved Troop Carrier
  - Consequence – 3 – Moderate (Serious injury possible)
  - Likelihood – 2 – Unlikely (once in 3 years)

**Residual Risk = MEDIUM**



# Residual Risk After Treatments

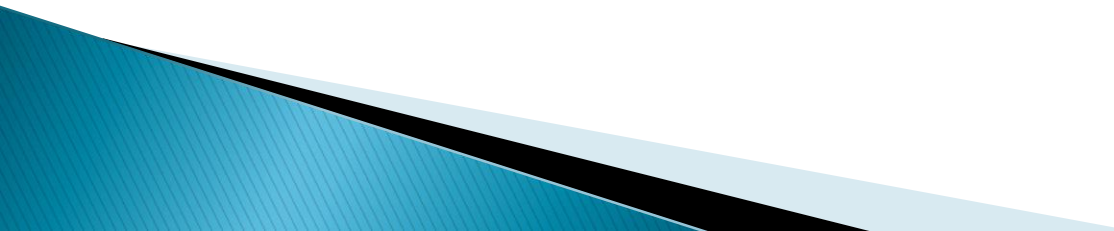
- ▶ Improved Troop Carrier
  - Consequence – 3 – Moderate (Serious injury possible)
  - Likelihood – 2 – Unlikely (once in 3 years)

**Residual Risk = MEDIUM**

- ▶ Replacement Vehicles
  - Consequence – 2 – First Aid injury possible
  - Likelihood – 2 – Unlikely (once in 3 years)

**Residual Risk = LOW**

# Implementing Recommendations

- ▶ The recommendations made are subject to review by WAPOL
  - ▶ Implementation of the recommendations requires consideration in terms of fleet management and operational context.
  - ▶ Prototype vehicles subject to evaluation.
- 

# Using Crash Data to Manage Organisation Risk

## ► Acknowledgements:

- WA Police
  - Mr Gary Lord, Director Assets
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  - Mr Nigel D'Cruz, A/Asst Director Fleet and Equipment Services
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- KND Consulting
  - Mr Paul Green and Mr Ian Dyk

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► Questions ???





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