
# USE OF WIM DATA IN SOUTHERN AFRICA

## Current / Future

Louw Kannemeyer

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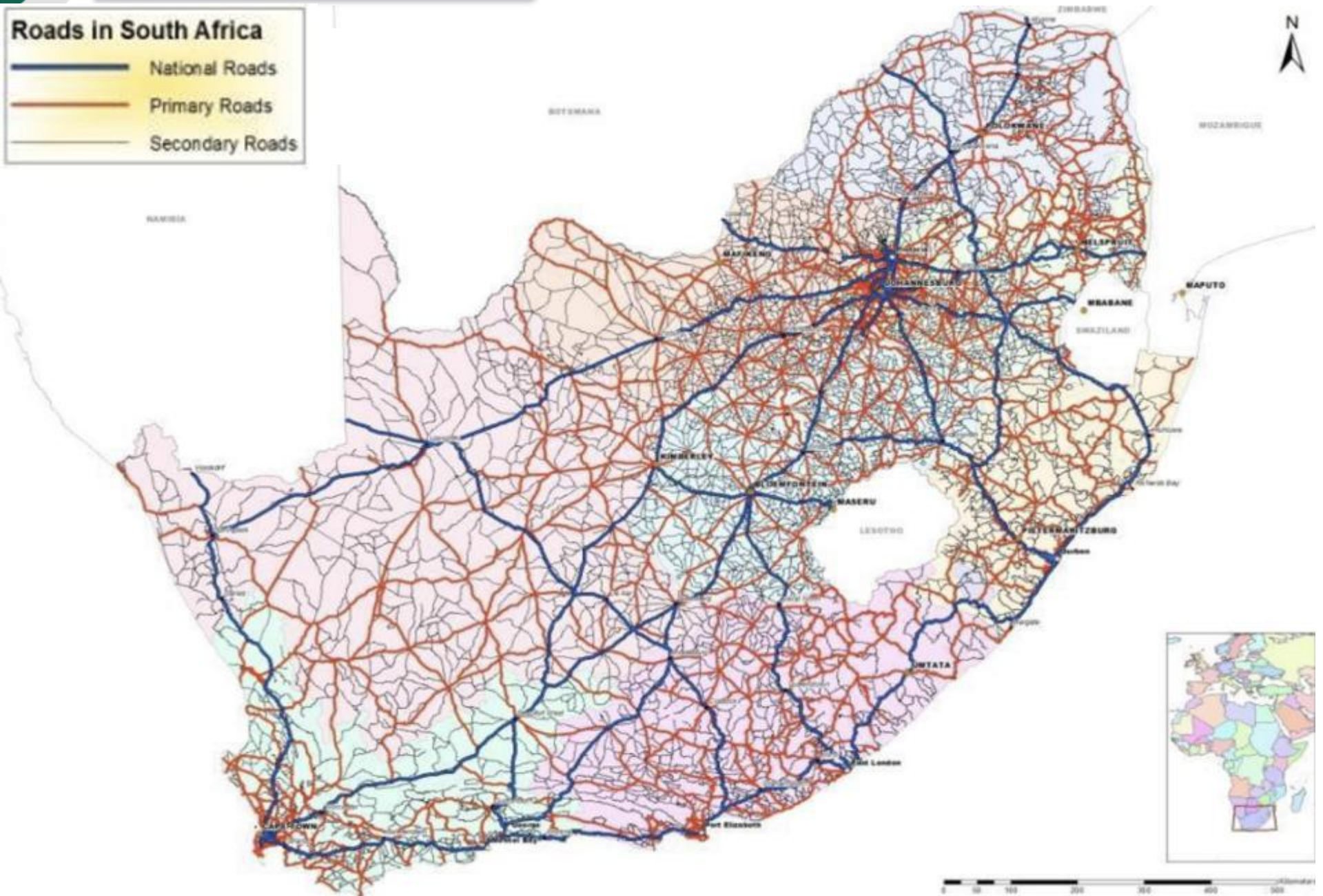
# Roads in South Africa



# South African road network 2022

| Authority | Paved | Gravel | Total |
|---|---|---|---|
| **SANRAL** | **22,262** | **0** | **22,262** |
| Provinces – 9 | 46,511 | 226,273 | 272,782 |
| Metros – 8 | 51,682 | 14,461 | 66,143 |
| Municipalities | 37,680 | 219,223 | 256,903 |
| **Total** | **158,124** | **459,957** | **618,081** |
| **Unproclaimed (estimated)** | | **131,919** | **131,919** |
| **Estimated total** | **158,124** | **591,876** | **750,000** |

1. **Unproclaimed roads** = Public roads not formally gazetted by any authority
2. Although the SANRAL network represents only **3.6% of the 618,081km** proclaimed network, it carries **34.5% of the annual vehicle kilometres** driven in South Africa.
3. Currently, more than **70% of the long-distance road freight** in South Africa is transported on the SANRAL road network.

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# South African road network 2022

**South Africa has the 11th longest total and 19th longest paved road network in the world – Maintaining such an extensive network come at a cost**

The National Development Plan states that roads represent one of the largest public infrastructure.

**RSA road replacement cost >R2 trillion**

| Rank | Country | Road Length (km) |
|---|---|---|
| **World** | | 64 285 009 |
| 1 | United States | 6 853 024 |
| 2 | India | 5 903 293 |
| 3 | China | 5 012 500 |
| 4 | Brazil | 1 751 868 |
| 5 | Russia | 1 529 373 |
| 6 | Japan | 1 215 000 |
| 7 | Canada | 1 042 300 |
| 8 | France | 965 446 |
| 9 | Indonesia | 950 974 |
| 10 | Australia | 920 217 |
| **11** | **South Africa** | **750 000** |
| 12 | Thailand | 702 210 |
| 13 | Spain | 683 175 |
| 14 | Germany | 644 480 |
| 15 | Sweden | 579 564 |
| 16 | Italy | 487 700 |
| | ... | |
| 35 | DRC | 153 497 |
| 49 | Zimbabwe | 97 418 |
| 57 | Tanzania | 86 060 |
| 76 | Angola | 51 429 |
| 81 | Namibia | 44 138 |
| 86 | Zambia | 40 454 |
| 96 | Mozambique | 32 059 |
| 107 | Madagascar | 21 269 |
| 117 | Botswana | 17 916 |
| 121 | Malawi | 15 450 |
| 151 | Lesotho | 5 622 |
| 160 | Swaziland | 3 594 |
| 173 | Mauritius | 2 149 |
| 194 | Seychelles | 508 |
| **Remaining SADC** | | **571 563** |

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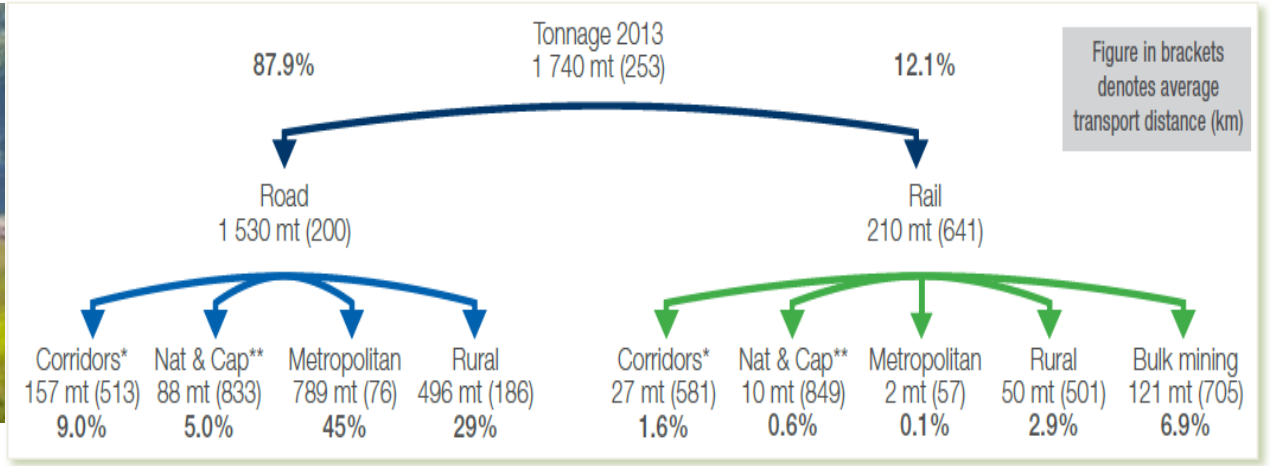
# South African road use

## Freight flow on road and rail (10th State of Logistics Survey 2014)




Person trips recorded in the National Household Travel Survey (2013) by transport mode:

- Minibus taxis: 41.6%
- Private vehicles: 23.4%
- Walking: 18.5% (*along road corridors)*
- Buses: 10.2%
- Trains: 4.4%
- Other: 1.9%

| Mode choice factor | Percentage |
|---|---|
| Travel time | 32.6 |
| Travel cost | 26.1 |
| Flexibility | 9.2 |
| Other | 32.1 |

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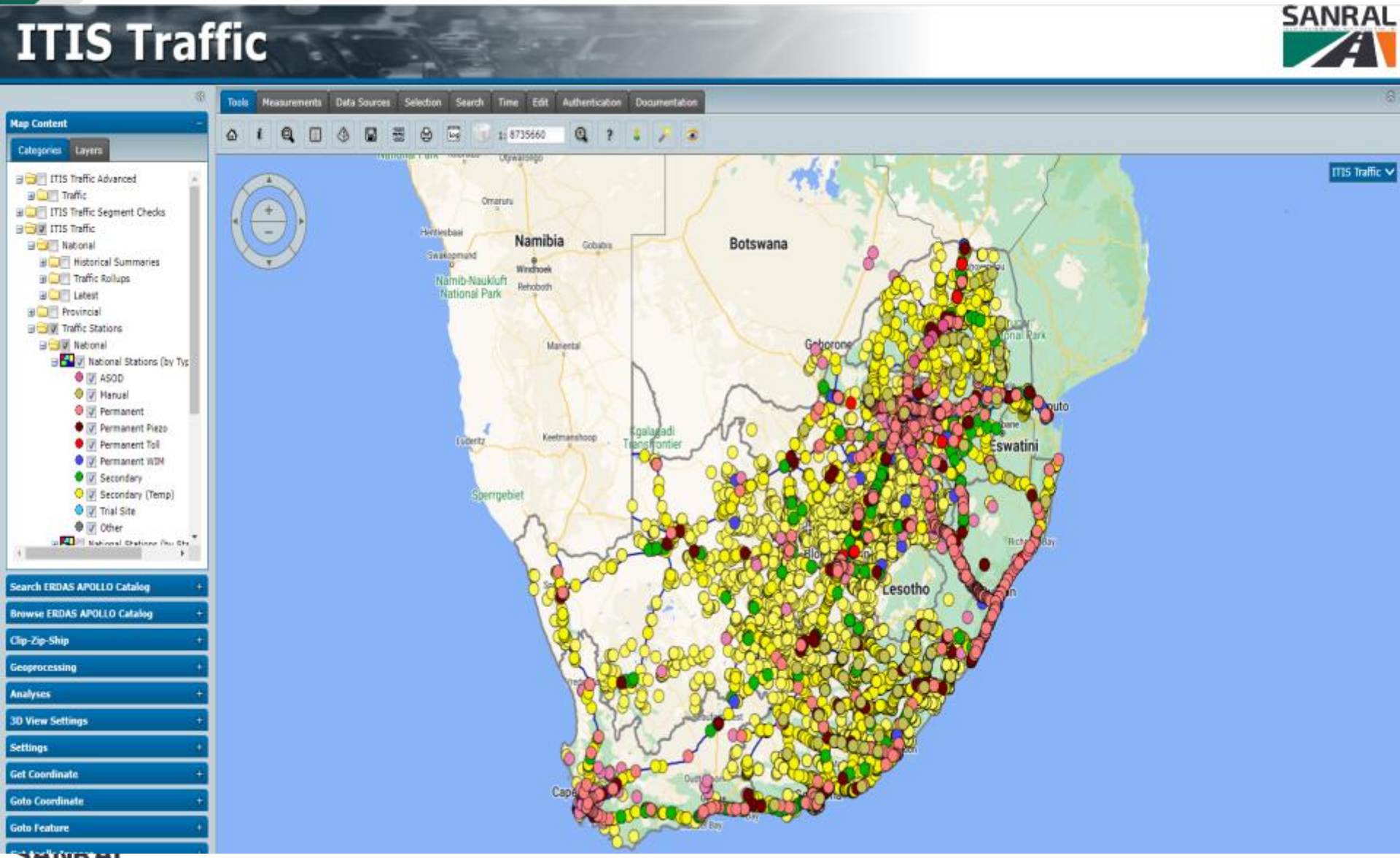
Road transport accounts for **87.9%** of freight and **93.7%** of person trips

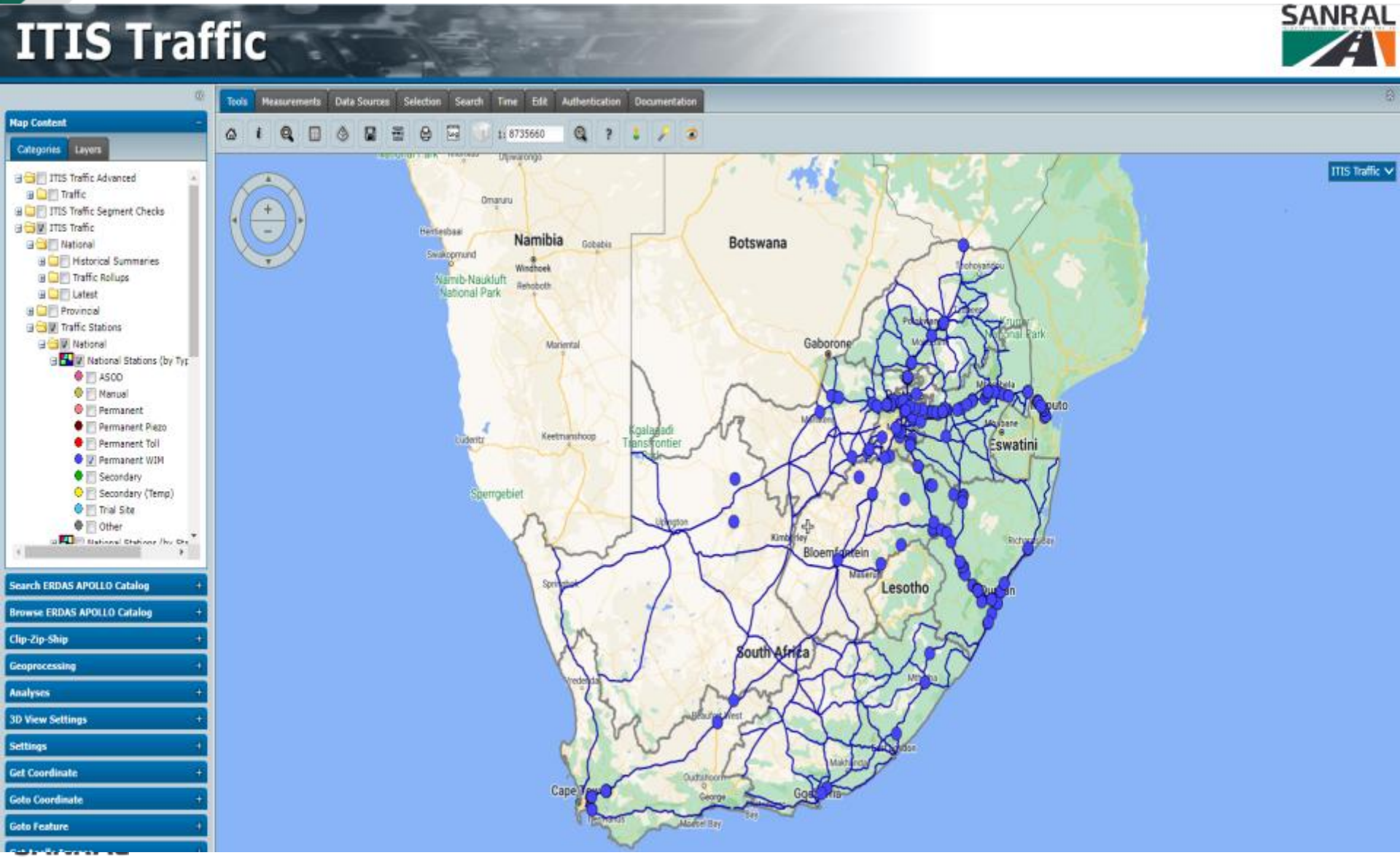
# Traffic Monitoring Stations




**Accurate Traffic Data – Most Important Data Item**

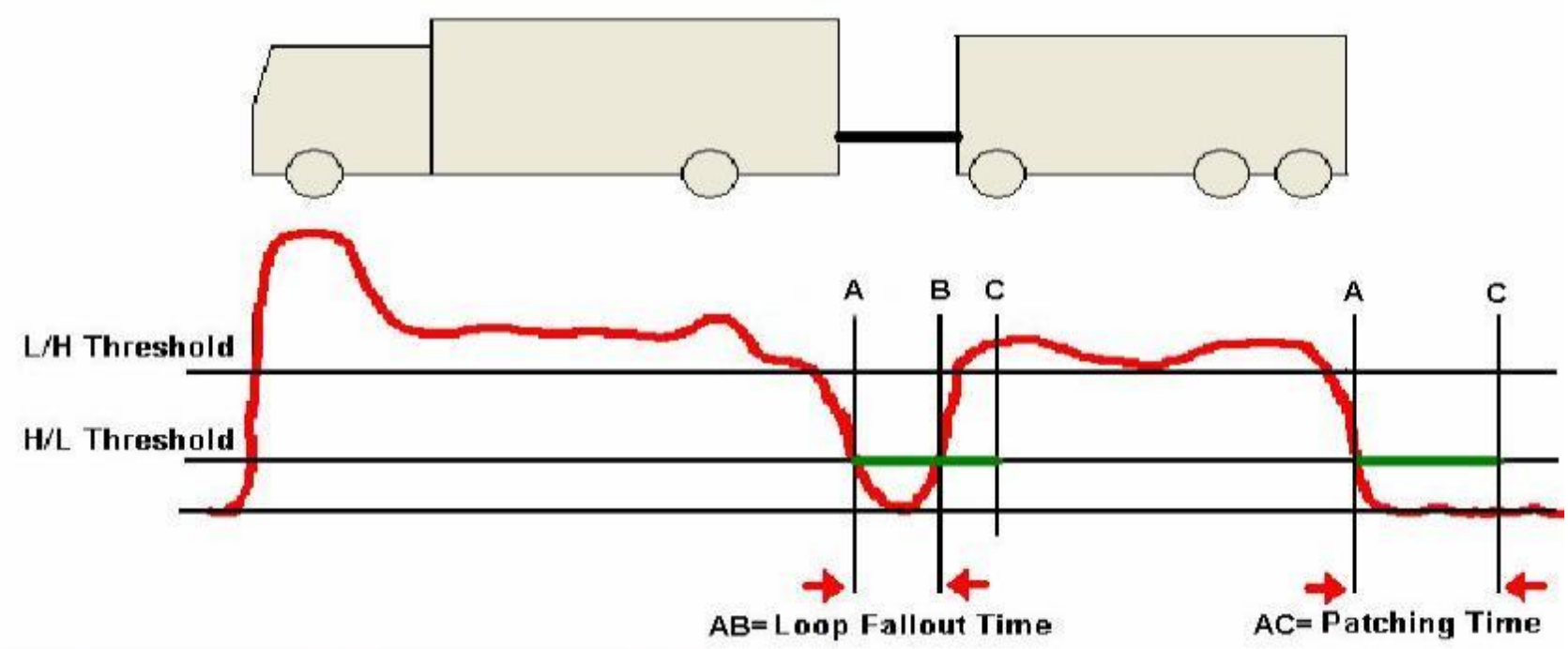
**Capacity Analysis / Pavement Design / Life Cycle Economics / Toll Income**

# Traffic Monitoring Stations - WIM




**Current Active WIM Stations – Data Gap is Obvious**

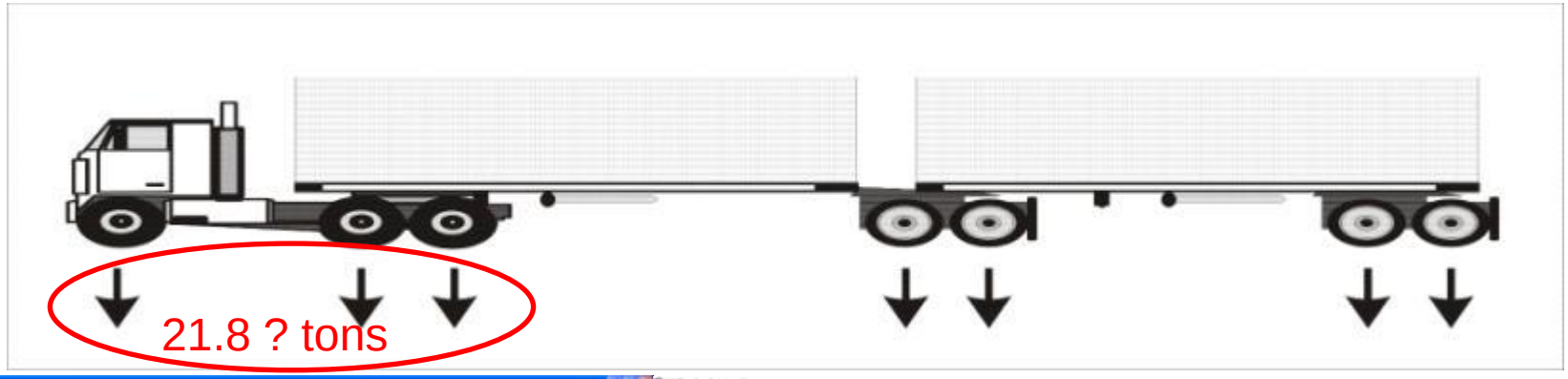
# Typical WIM Station




# WIM – Systematic Deviations

Main Problem - Systematic deviations in WIM observations due to quality/calibration of WIM installation.

- Post-processing calibration
- “Truck-Tractor” (TT) method - Calibration based on load observations of population sample of articulated trucks of a certain type and size



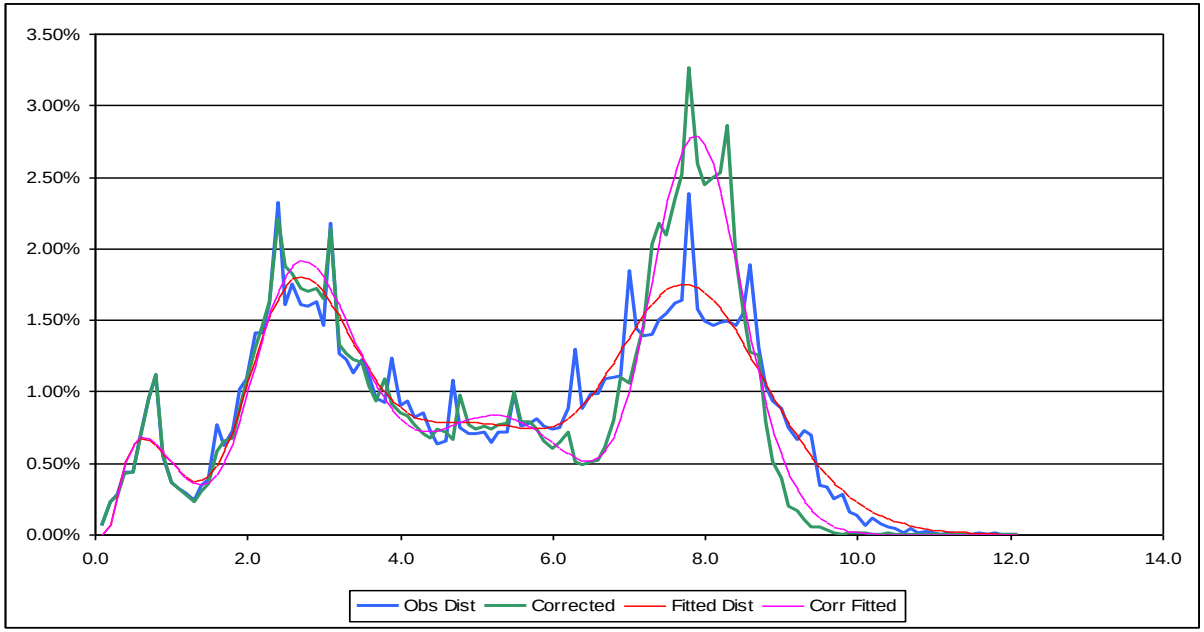

# WIM - Random Deviation

Axle load distribution

- WIM Random errors and variation in dynamic loads result in:
  - Measured axle distribution wider than actual static load distribution
  - Particularly at higher end of distribution
  - Results in overestimation of percentage “overloaded” axles

“Expectation-Maximization-Smoothing” (EMS) algorithm

- Applies a numeric technique using so-called “deconvolution” method
  - Wim errors basically “convolutes” or distorts the static load

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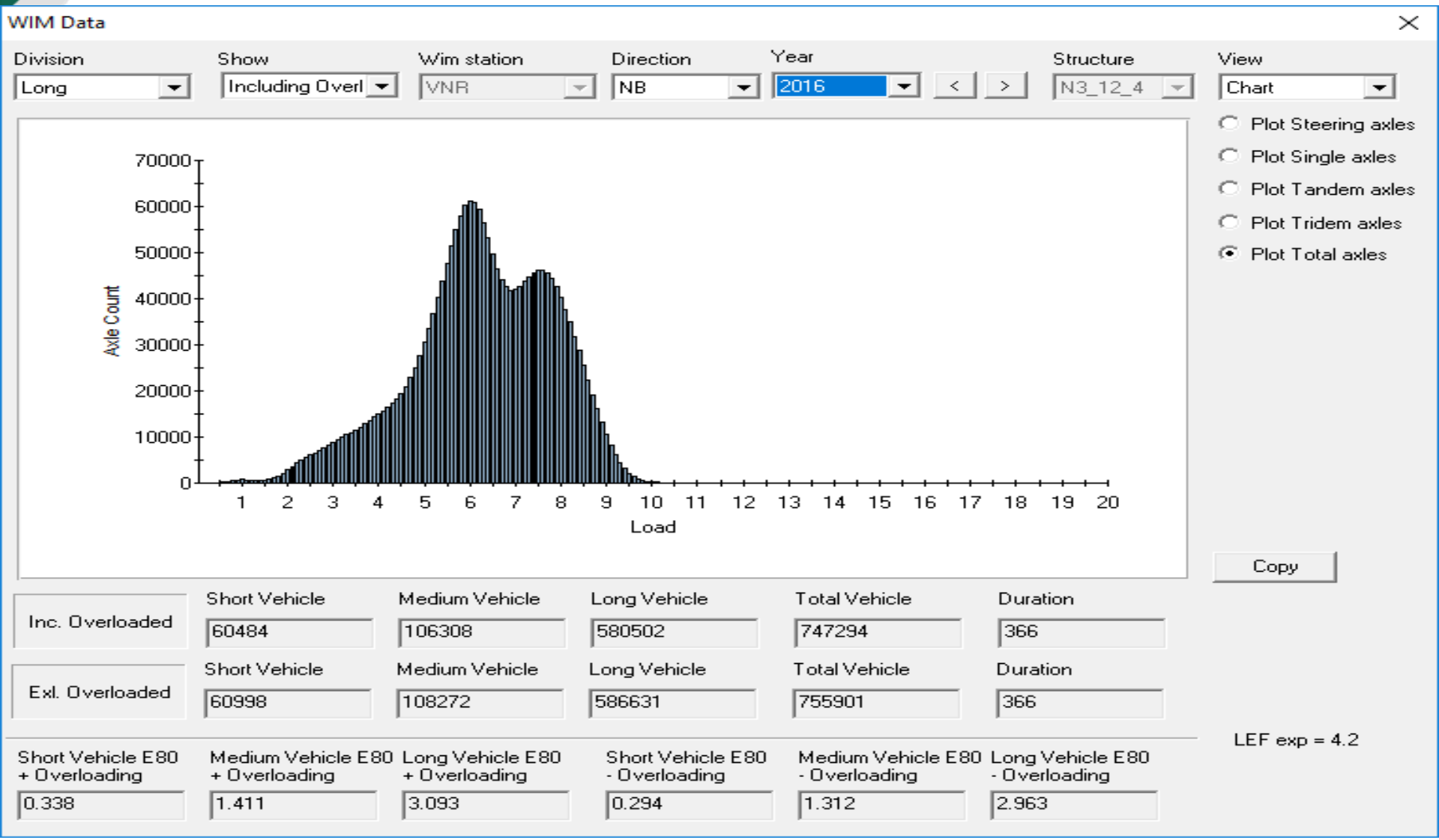
**Random Deviation Correction Important When Quantifying Overload Damage**

# SANRAL OVERLOAD SOFTWARE

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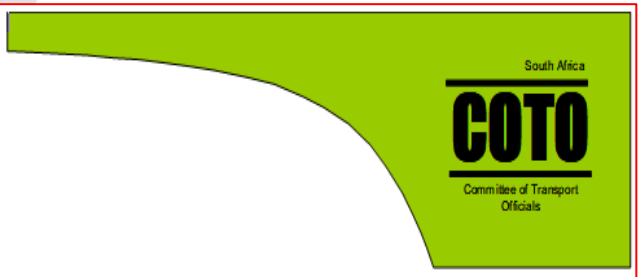
**15 to 30 % Vehicles Overloaded – Only 2% loaded beyond Prosecution Grace**

**Statistics - Screened Sample versus Population**

# COTO TMH Standards

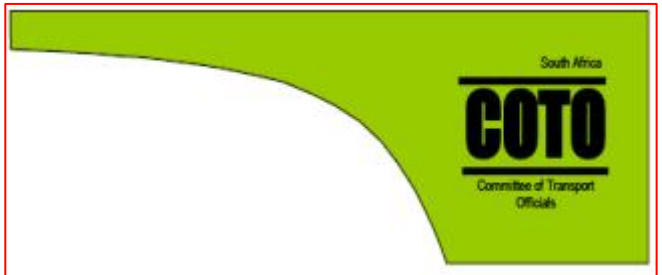



## TMH 3

## Specifications for the Provision of Traffic and Weigh-in-Motion Monitoring Service

Version 1.0
December 2013

Committee of Transport Officials

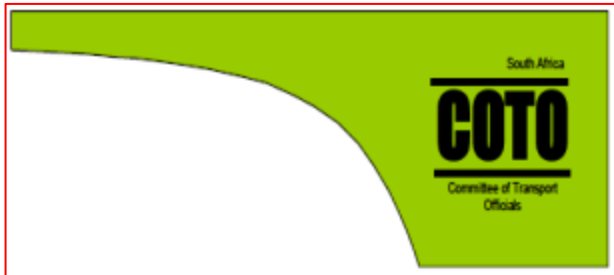



## TMH 8

## Traffic and Axle Load Monitoring Procedures

Version 1.0
Oct 2014

Committee of Transport Officials



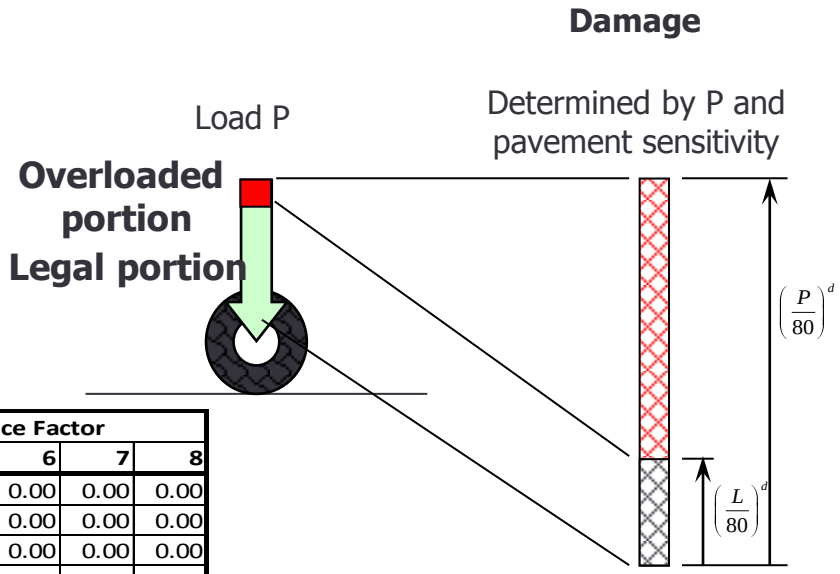

## TMH 14

## South African Standard Automatic Traffic Data Collection Format

Version 3.00
November 2013

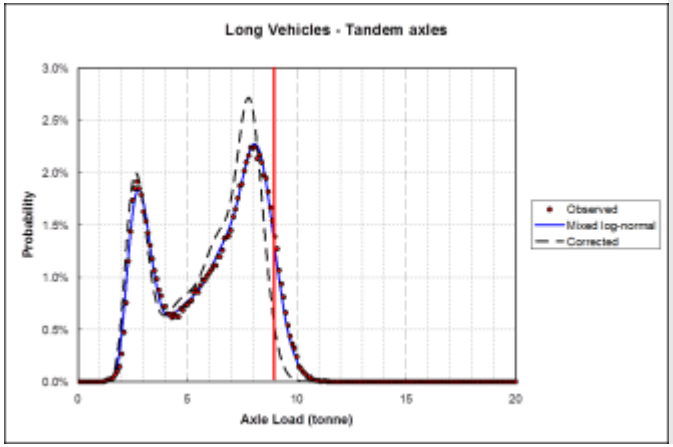
Committee of Transport Officials

# CURRENT WIM USE – PAVEMENT DESIGN




| Axle Load | Load Equavalence Factor | | | | | | |
|---|---|---|---|---|---|---|---|
| | 2 | 3 | 4.2 | 5 | 6 | 7 | 8 |
| 1 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 0.06 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 3 | 0.13 | 0.05 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 |
| 4 | 0.24 | 0.12 | 0.05 | 0.03 | 0.01 | 0.01 | 0.00 |
| 5 | 0.37 | 0.23 | 0.13 | 0.08 | 0.05 | 0.03 | 0.02 |
| 6 | 0.54 | 0.39 | 0.27 | 0.21 | 0.15 | 0.11 | 0.08 |
| 7 | 0.73 | 0.62 | 0.51 | 0.45 | 0.39 | 0.33 | 0.28 |
| 8.2 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| 9 | 1.20 | 1.32 | 1.48 | 1.59 | 1.75 | 1.92 | 2.11 |
| 10 | 1.49 | 1.81 | 2.30 | 2.70 | 3.29 | 4.01 | 4.89 |
| 11 | 1.80 | 2.41 | 3.43 | 4.34 | 5.83 | 7.82 | 10.49 |
| 12 | 2.14 | 3.13 | 4.95 | 6.71 | 9.82 | 14.37 | 21.03 |
| 13 | 2.51 | 3.98 | 6.93 | 10.01 | 15.88 | 25.17 | 39.91 |
| 14 | 2.91 | 4.98 | 9.46 | 14.51 | 24.77 | 42.29 | 72.20 |

Default LEF = 4.2 used




This refers to the vertical load applied to the road surface by a vehicle tyre. The higher the axle load/tyre load, the deeper the penetration into the pavement structure.

A lower order road pavement tender to have higher sensitivity (load equivalence factor)

30 % Overload, but most within 5% Grace Limit, on average only 2.5% prosecutable.

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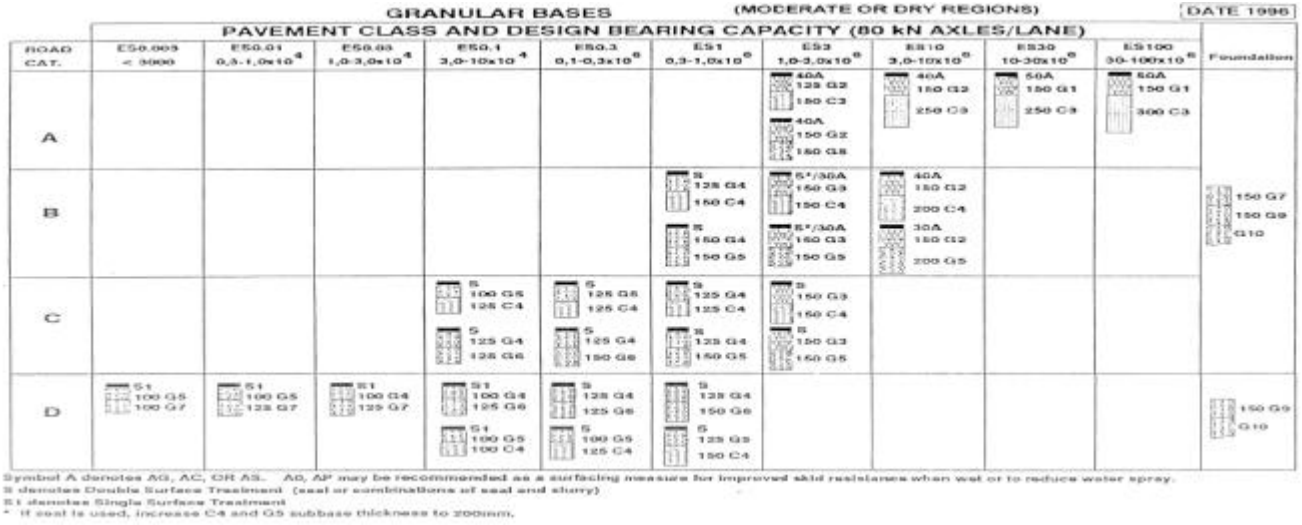
# CURRENT WIM USE – PAVEMENT DESIGN

| Trucks Per Day | Design Axles over 20 Years | TRH 4 Design Pavement | Life Time (Years) |
|---|---|---|---|
| 10 | 174 970 | ES0.3 | 0.2 |
| 50 | 874 852 | ES1 | 1 |
| 100 | 1 749 704 | ES3 | 2 |
| 500 | 8 748 522 | ES10 | 10 |
| 1000 | 17 497 044 | ES30 | 20 |
| 2000 | 34 994 088 | ES100 | 40 |
| 3000 | 52 491 132 | ES100 | 60 |
| 4000 | 69 988 176 | ES100 | 80 |
| 5000 | 87 485 220 | ES100 | 100 |

| Truck | ADTT Split | E80 Per Heavy |
|---|---|---|
| Short | 46.00% | 0.4 |
| Medium | 16.00% | 1.4 |
| Long | 38.00% | 3 |

**20 year design period with 4% Growth**




The Design Bearing capacity RANGE of higher order roads tend to be wide, indicated less sensitivity for sudden increase in number of axle loads, and thus in most instances staying within same pavement design class.

The problem is lower order roads suddenly experiencing major jump in truck traffic, typical of mining activities.

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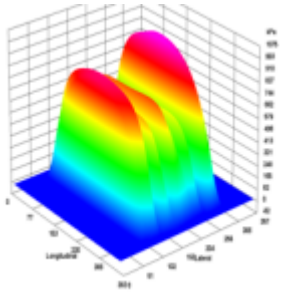
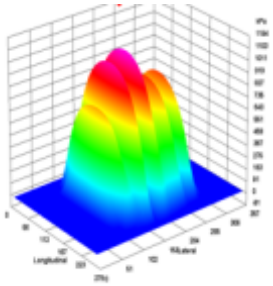
# FUTURE WIM USE – PAVEMENT DESIGN

Pavement Design/Maintenance

- Old – Axle Load Histogram reduced to Equivalent Standard Axle Load per vehicle - E80
- **Future** – SARDS Complete Axle Load Histograms used along with Tyre Contact Stress (How load is transferred to Pavement !!!)

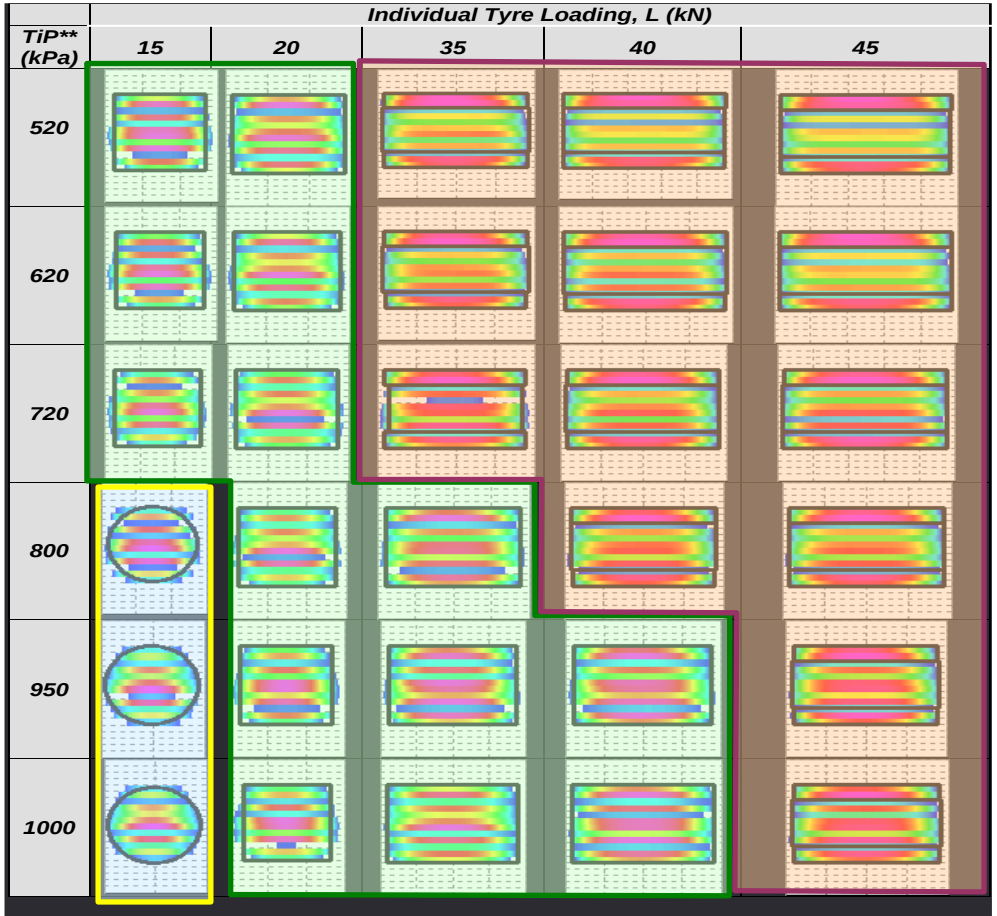


**m-shape:**
**- Triple rectangular**



**n-shape:**
**- Single rectangular**

**n-shape:**
**- Single Circular**

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# FUTURE WIM USE

Overload Control

- **Old** – Screeners at Static Weigh Bridges
  - 50 to 100 km impact radius
  - Construction/Operational Costs
  - Human Factor

- **Future** – WIM Direct Enforcement (WIMe)
  - Direct Weight Enforcement integrate with Average Speed over Distance (ASOD) – 250+ Installations
    - Been trialled over past 8 years
    - National Regulator Compulsory Standards Type Approval for ASOD and WIM-E
  - Realtime Integration to SANRAL Central Operations Centre
    - Realtime Tracking of Load Movements Country Wide (OD)
    - Direct Enforcement (Speed/Load)
    - Insurance Fraud
    - Security Applications
    - Abnormal Permits Enforcement
    - Industry Self Regulation Verification
    - ???
- **SANRAL Research Project – Overload Processes and Technologies (2021-2023)**

# PROGRESS - ASOD TIMELINE

**LEGAL METROLOGY ACT**

Section 22 (2) (c) The Chief Executive Officer may, in consultation with the submitter, set requirements and conditions pertaining to the use thereof, for measuring instruments where these are not prescribed, until such time as a legal metrology technical regulation is published in terms of section 15.

- NRCS Application for ASOD - March 2017
- Develop interim requirements with industry stakeholders and NRCS – 2018
- Started pilot project for ASOD – December 2018
- ASOD Interim Requirement approved on 1 March 2019
- Submit Type Approval Application to NRCS – August 2019
- **COVID**
- Receive Type Approval – March 2021
- Receive On-Site Verifications – December 2021
- Request approval of Director of Public Prosecutions (DPP) – March 2022
- Receive DPP approval to proceed with prosecutions – April 2022
- **Live data stream to SANRAL COC Back-Office – April 2022**
- All Back Office procedures in place – resolving Traffic Officer Assignment (National/Provincial/Local), revenue splitting, start or end point locality

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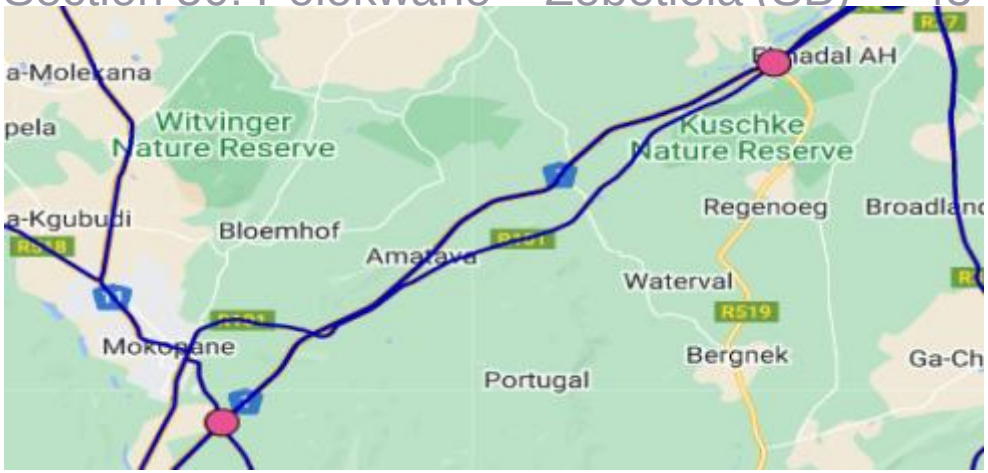
# ASOD PILOT PROJECT

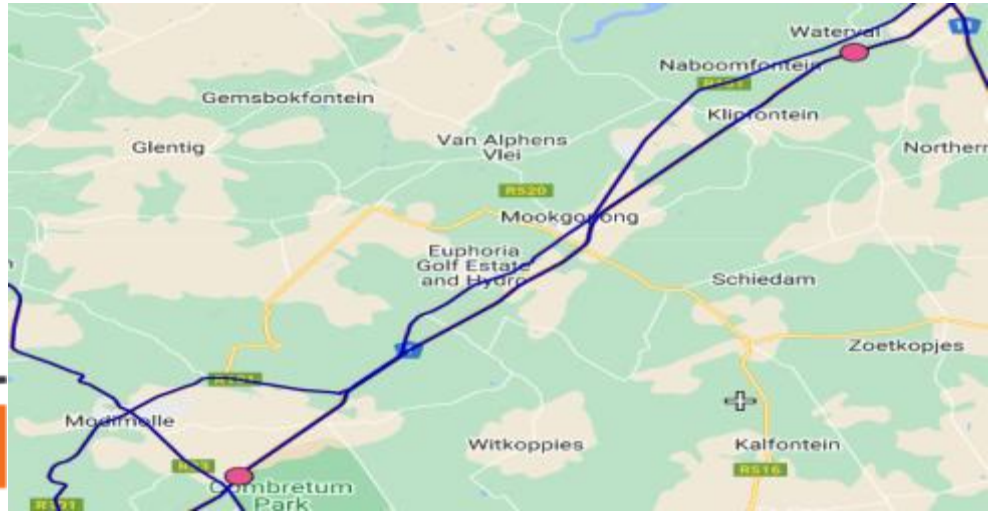
Section 49: Zebetiela – Polokwane (NB) = 43 503m
Section 50: Polokwane – Zebetiela (SB) = 43 442m




NB ADT = 7758
SB ADT = 7096

**24 000 Offences / month**
**186 km/h**

Section 51: Kranskop – Nyl (NB) = 65 262m
Section 52: Nyl - Kranskop (SB) = 65 255m




NB ADT = 5164
SB ADT = 4750

**44 000 Offences / month**
**209 km/h**

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# PROGRESS - WIMe (Direct Enforcement) TIMELINE

- NRCS circulated interim specification – August 2018
- NRCS notified workgroup that OIML R134 will be used for interim specification
  - Draft document sent for comments – May 2020
  - Submit comments to NRCS – June 2020
- New draft OIML R134 circulated for comments – November 2021
  - Submit comments to NRCS – January 2022
  - No clear focus on High Speed WIM – Accuracy Requirements
  - No Indication of how long will be in draft ?
- South Africa currently considering using adjusted TMH 3 (local standard) approach
  - 1st Phase: GVM only as in other parts of the world
  - Based on high-speed data accuracies achieved under South African Conditions (Pavement Design/Deflections/Roughness) will guide us on if axle groups or even individual axles (???) are possible into the future.

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# Thank you

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