

بِسْمِ اللّٰهِ الرَّحْمٰنِ الرَّحِیْمِ

اللہ کے نام سے شروع جو نہایت مہربان اور رحم کرنے والا ہے
**In the Name of Allah, the Most Gracious,
the Most Merciful**



GOVERNMENT OF PAKISTAN
MINISTRY OF COMMUNICATIONS



Presentation At 14th Transport Sector Coordinating
Committee (TSCC) of CAREC

ROAD ASSET MANAGEMENT SYSTEM The Case Of Pakistan

by

Ikramus Saqlain Haider

Director (RAMS), NHA Pakistan

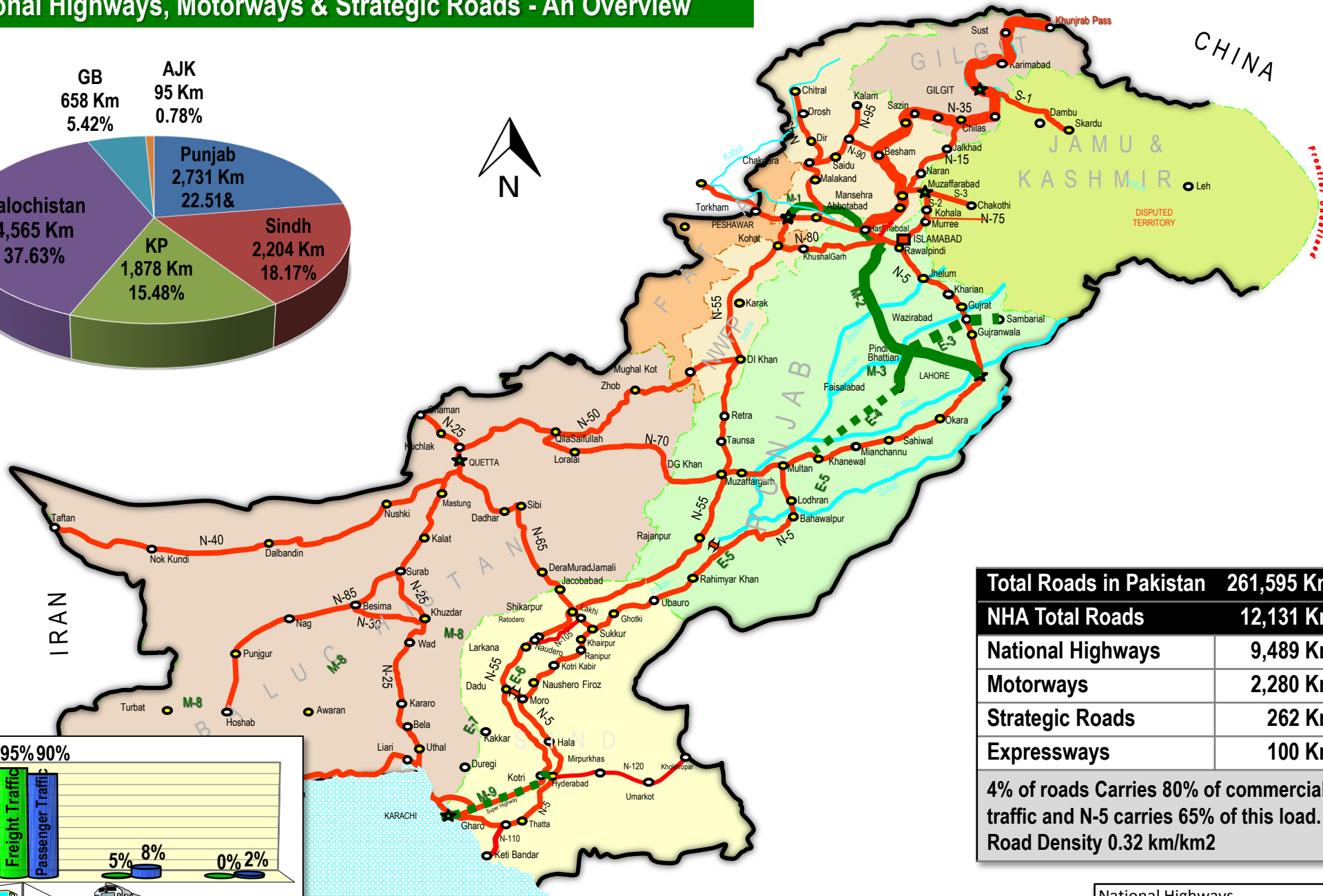
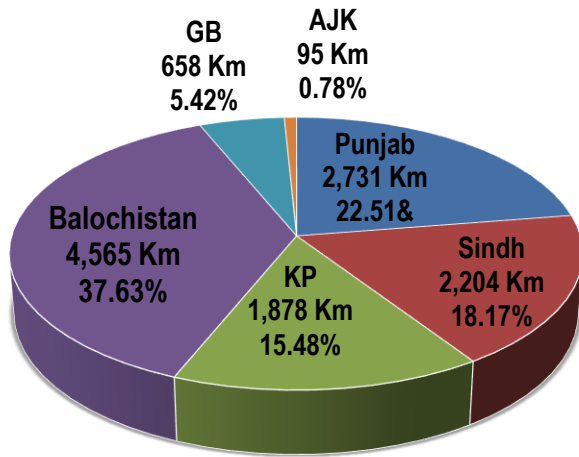
Ulaanbaatar, Mongolia, 30th April, 2015



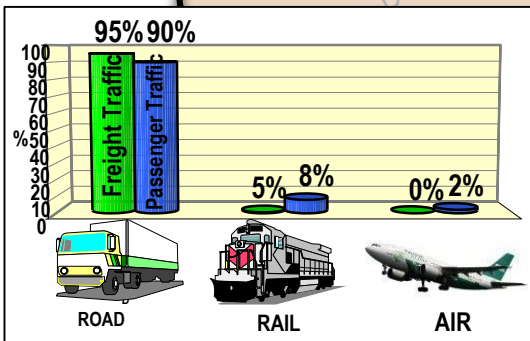
National Highways, Motorways & Strategic Roads - An Overview



National Highways, Motorways & Strategic Roads - An Overview

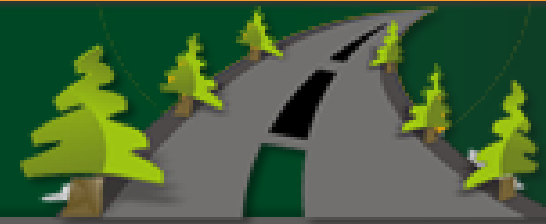


Total Roads in Pakistan	261,595 Km
NHA Total Roads	12,131 Km
National Highways	9,489 Km
Motorways	2,280 Km
Strategic Roads	262 Km
Expressways	100 Km
4% of roads Carries 80% of commercial traffic and N-5 carries 65% of this load. Road Density 0.32 km/km²	



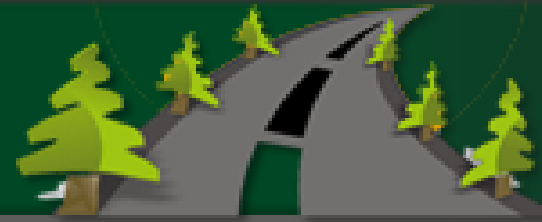
National Highways
Motorways
Planned

Road Network



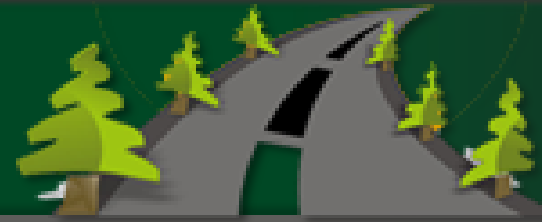
Area	796,096 Sq-Km
Total Road Network	261,595 Kms
National Highways & Motorways	12,131 Kms
Roads have dominant share in both transport of passengers (<u>90%</u>) and the Goods (<u>95%</u>) followed by rail.	
Total Number of Vehicles	8.5 Million
<u>55.4%</u> are two Wheelers and <u>44%</u> four Wheelers	
Annual growth rate	9 %

Road As An Asset



- ❑ An efficient road transport system is seen by most countries as an essential pre-condition for general economic development and considerable resources are devoted to road construction and improvement.**
- ❑ The resultant road network usually have an asset value that represent a significant proportion of national wealth, and the road sub-sector should make an important contribution to gross national product (GNP).**

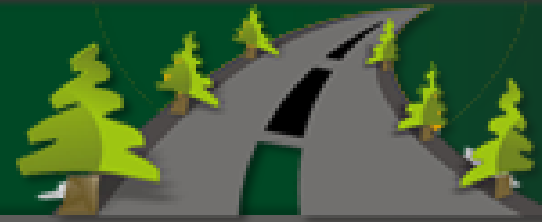
Road As An Asset (cont'd)



- **The asset management approach emphasizes the preservation, upgrading, and timely replacement of highway assets through cost-effective planning and resource allocation decisions.**

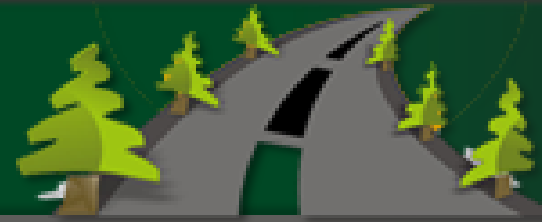
–“Asset management looks at all of the assets, and not solely from an engineering perspective, but from the user perspective as well.”

What is Road Management



- **Purpose**: To optimise the overall performance of the network over time.
- **Goal**: To improve the development and performance of the road sector and its use of resources, within the context of national objectives, in order to minimise transport costs.

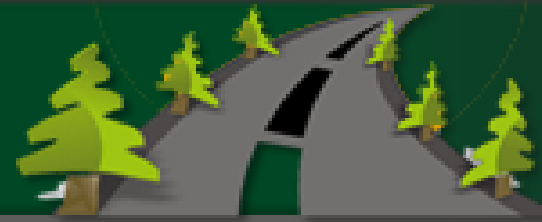
Why Road Asset Management;



The Need

- **Aging Infrastructure**
- **Growing Congestion**
- **Funding Shortfall**
- **Focus on System Performance**
- **Asset Management is Imperative**

Key Statistics from



EMERGING COUNTRIES

- **Transport sector is 5 to 10 per cent of GDP.**
- **Every Rupee not spent on maintenance increases transport costs by Four Rupees.**
- **Transport fuels and machinery account for 40% of import bill.**

The Impacts of Road Maintenance

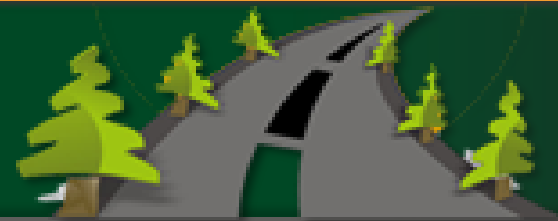


The effects of road Maintenance can be assessed in terms of the various impacts:

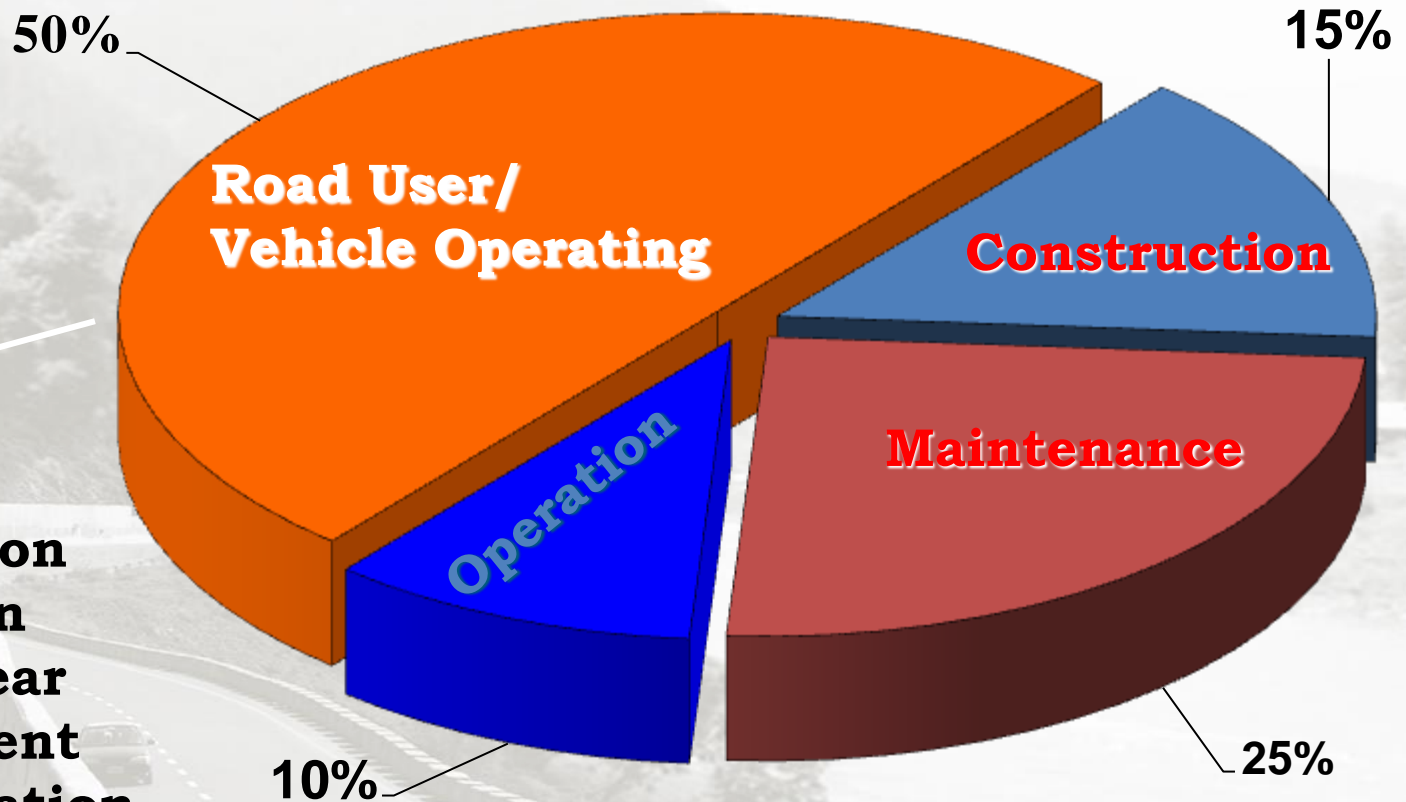
- **Level of service (road condition)**
- **Socio economic impacts**
- **Road user costs**
- **Accident levels and costs**
- **Road administration costs**

USMANI ASSOCIATES
OF PAKISTAN (2010)

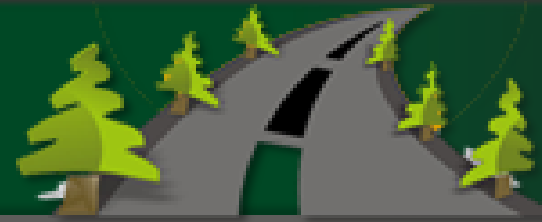
Components of Total Road



Transport Costs in the Economy



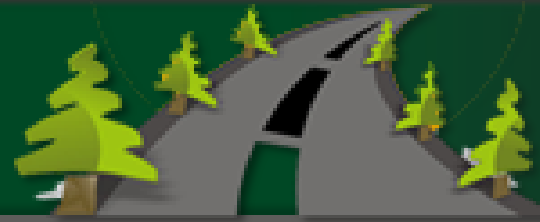
- Fuel Consumption
- Oil Consumption
- Tyres Wear & Tear
- Parts Replacement
- Vehicle Depreciation
- Travel Time
- Accidents



SOME CHALLENGES



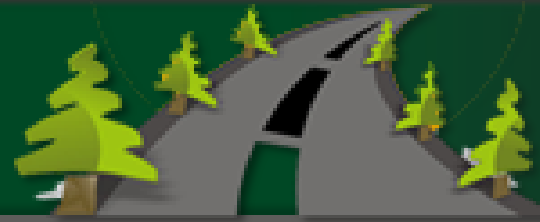
OVERLOADING



WEATHER EXTREMITIES

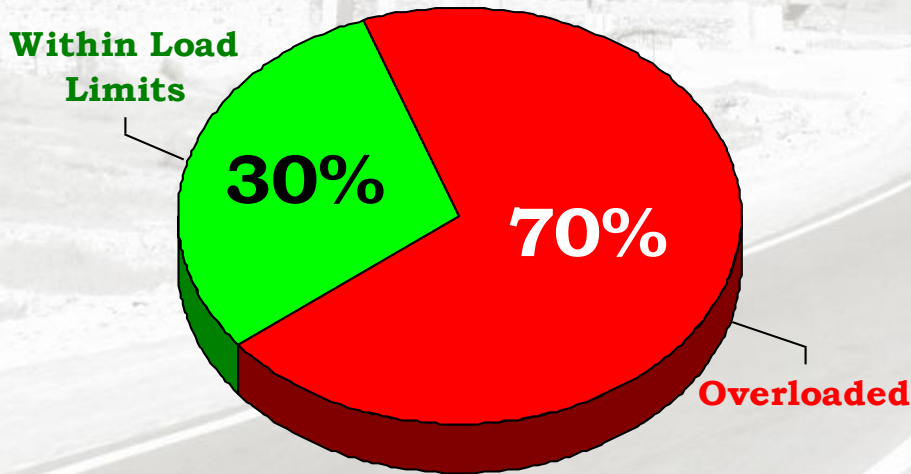


PERCENTAGE OF FREIGHT VEHICLES BY COMPOSITION

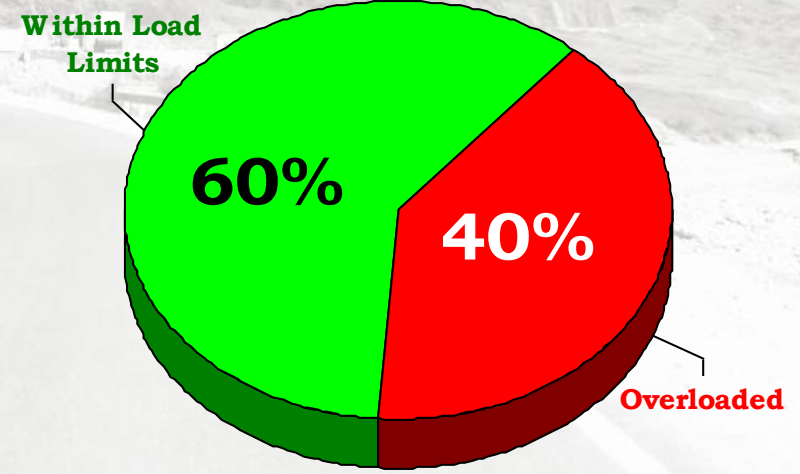


OVERLOADED PERCENTAGE

TRUCKS 2 & 3 AXLES



TRUCKS 4, 5 & 6 AXLES



CONSEQUENCES



CONSEQUENCES



CONSEQUENCES



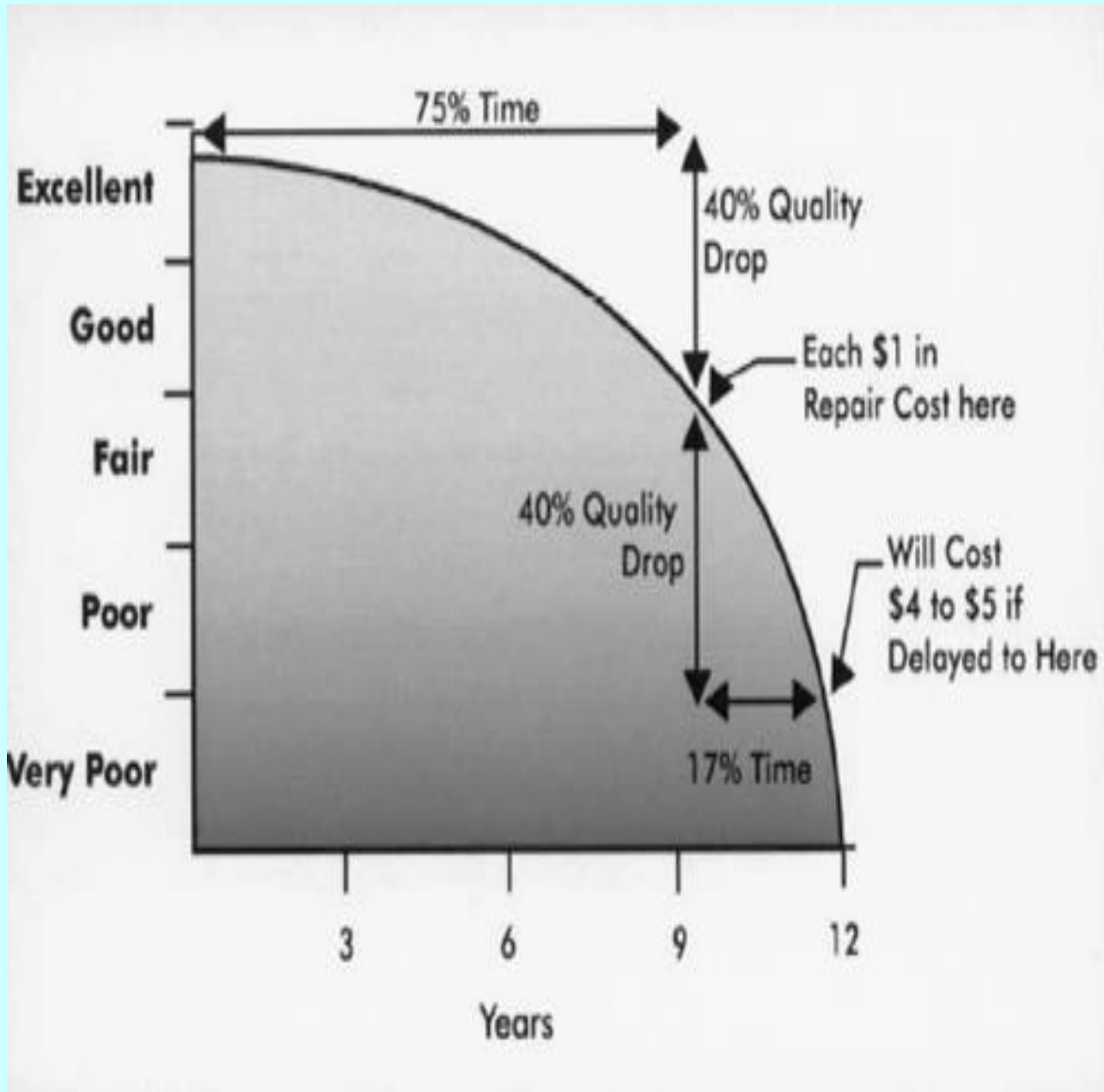
CONSEQUENCES



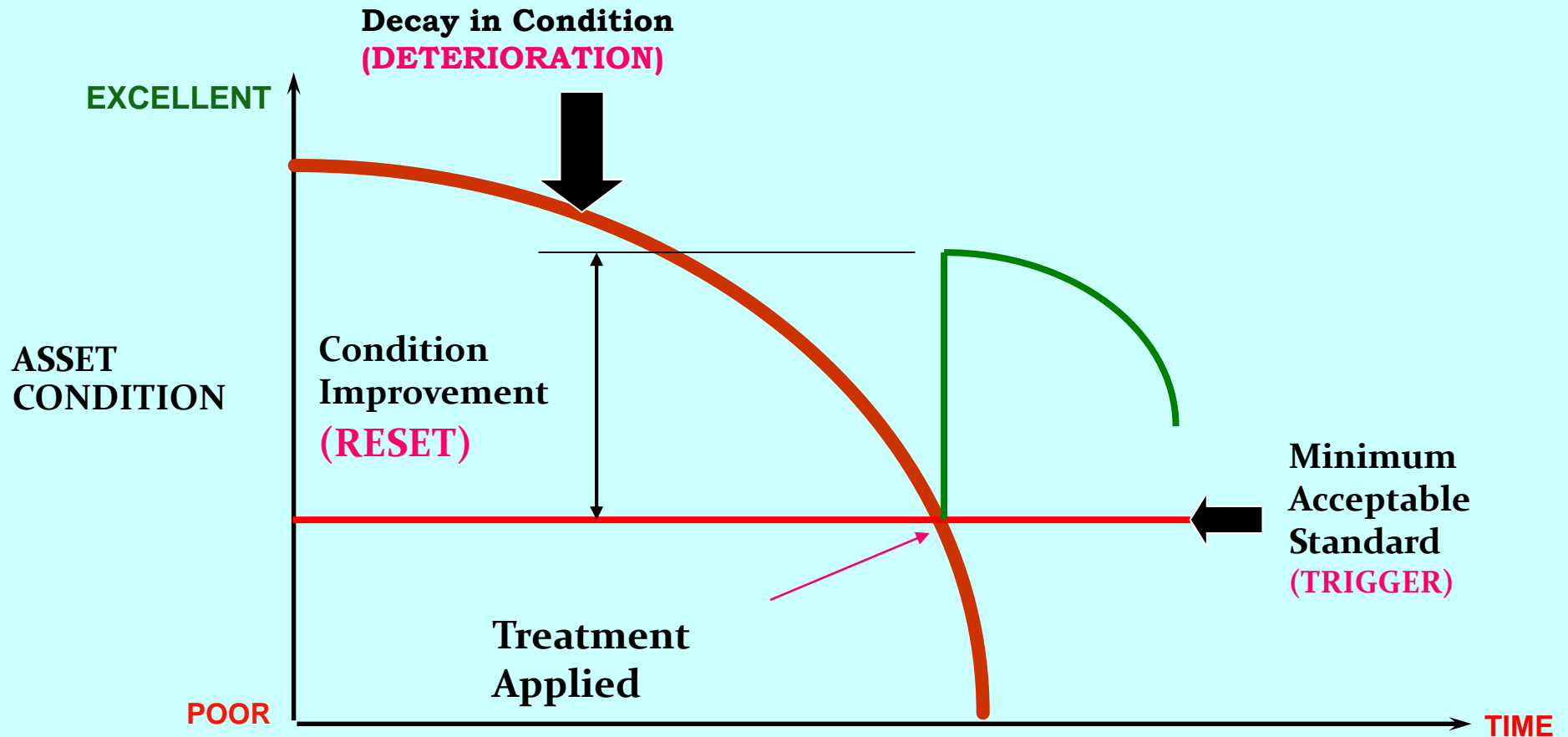
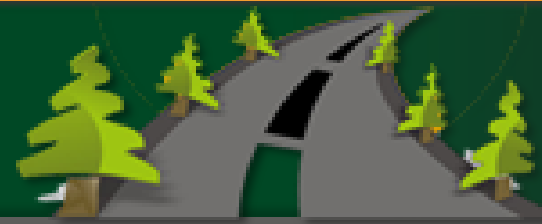
What Sort of Road is this?



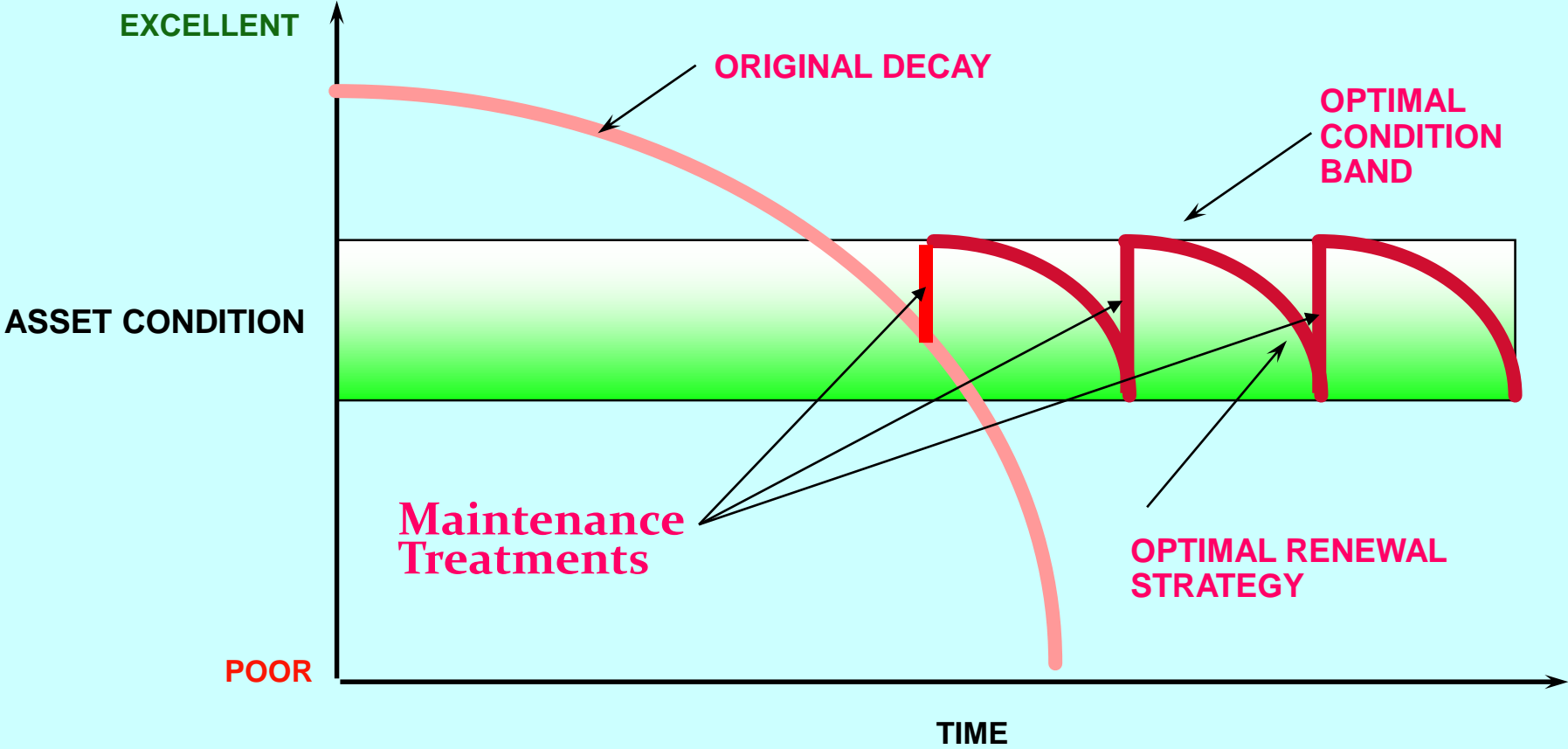
Deighton's Water Model



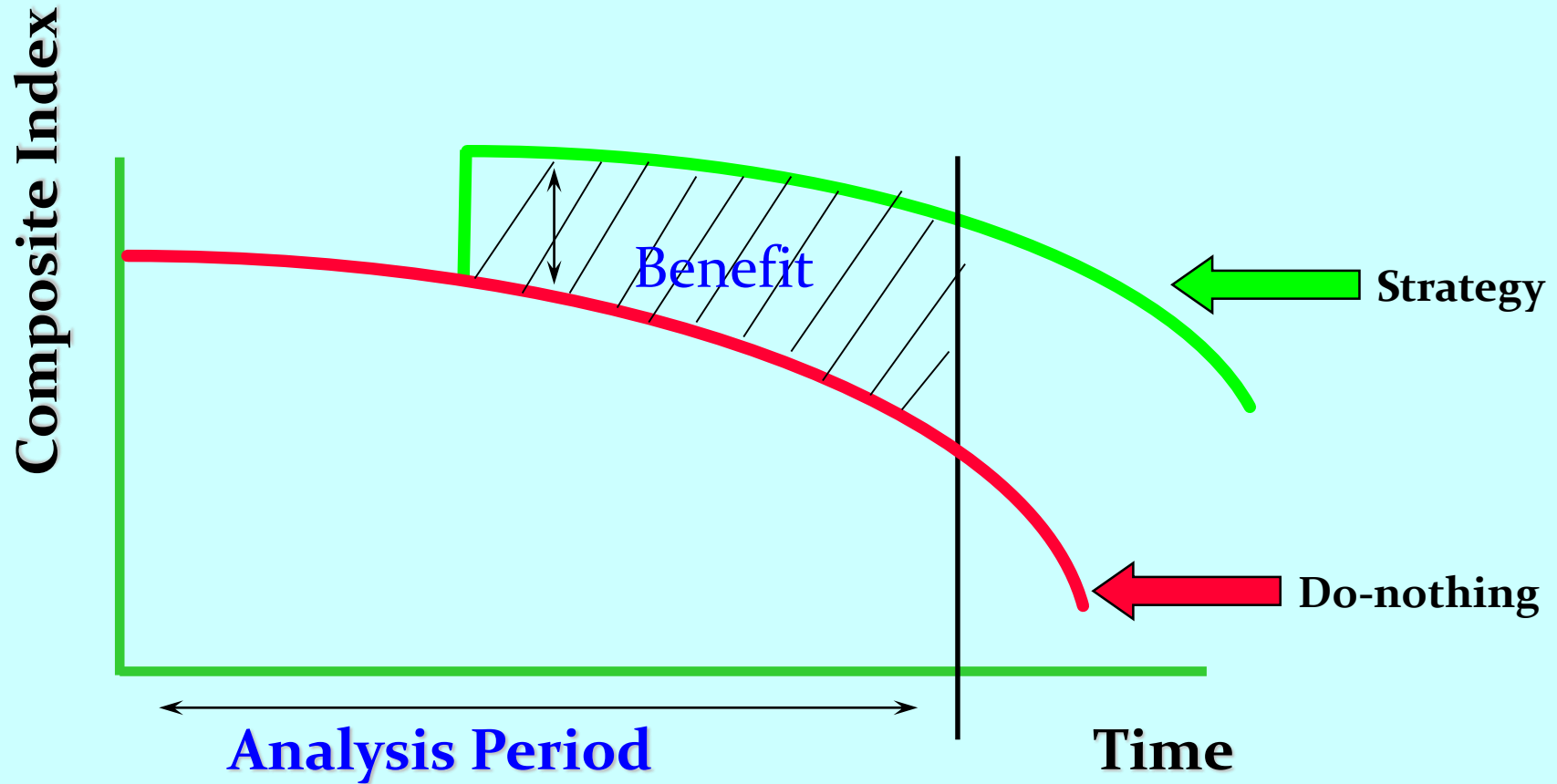
Treatments, Triggers and Resets



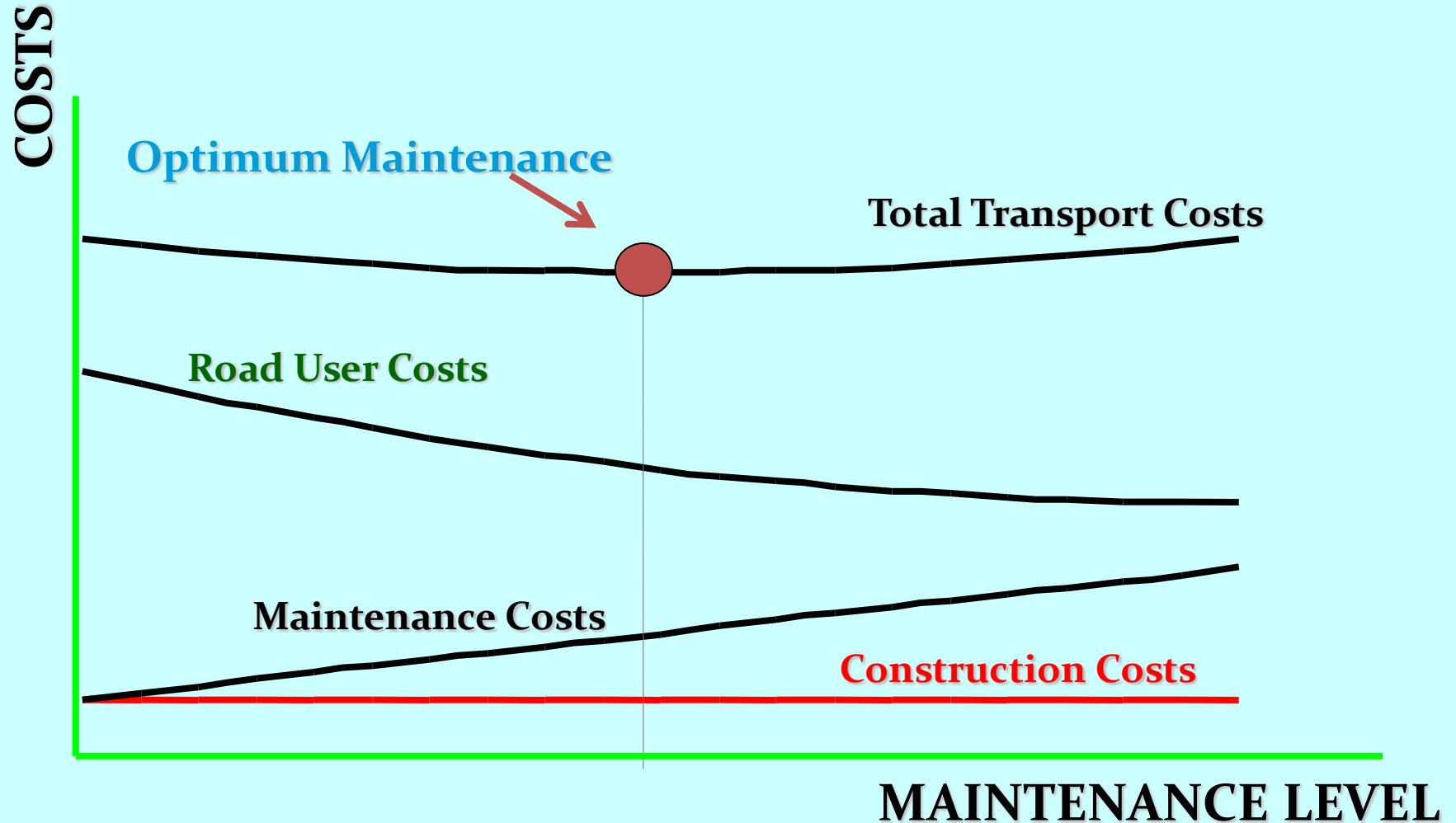
Deterioration Management



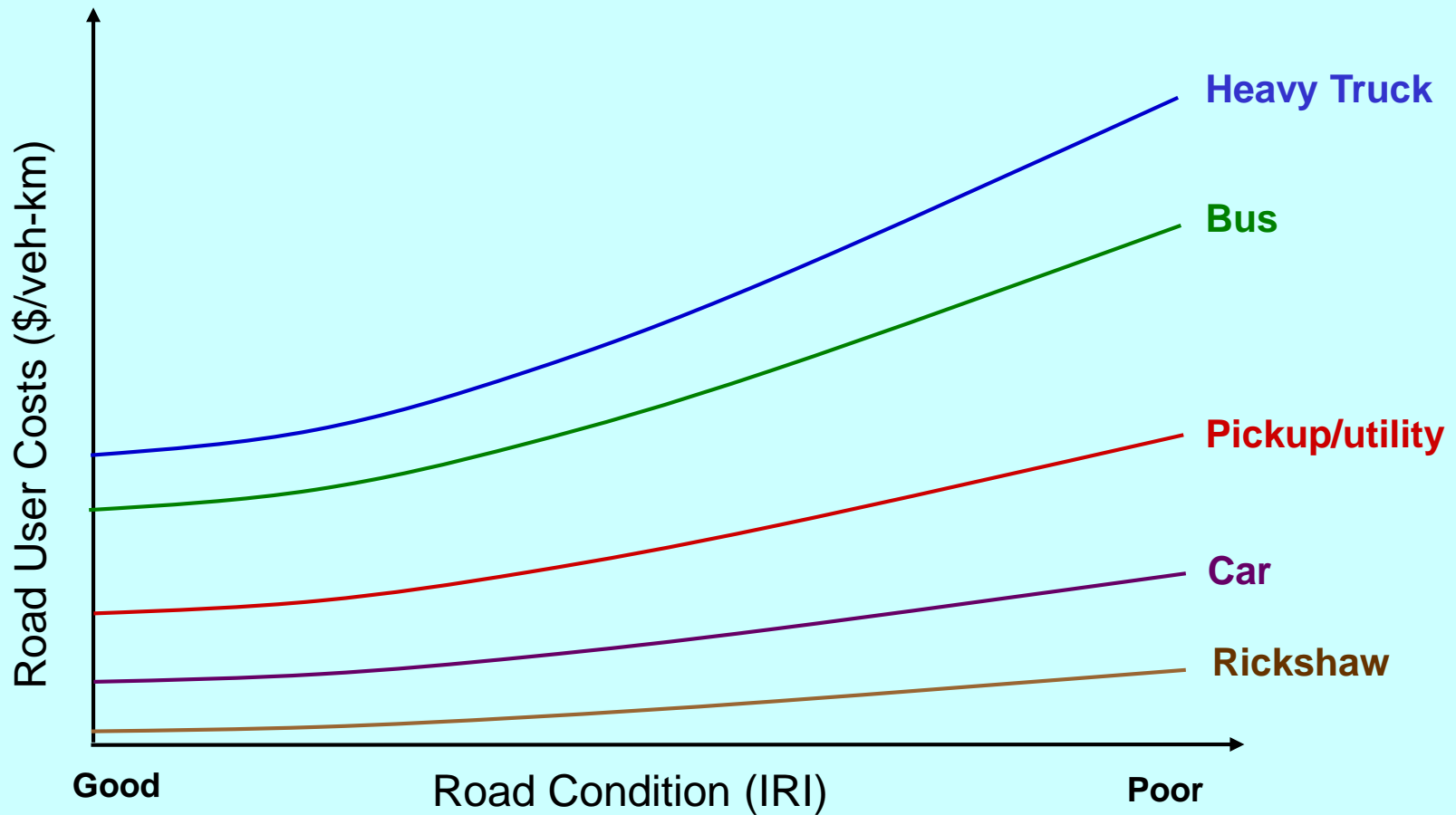
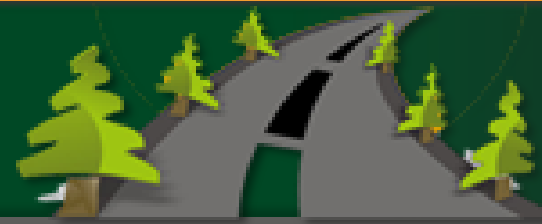
Requirement - Optimization based on user defined parameter Using Area Under Curve (AUC)

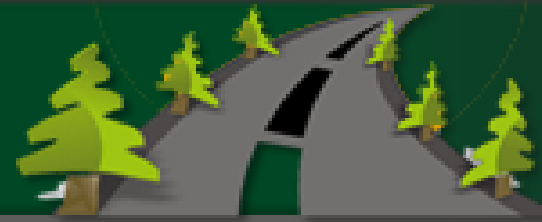


Requirement - Optimization to Minimize Total Transportation Cost (TTC)



Impact of Road Condition

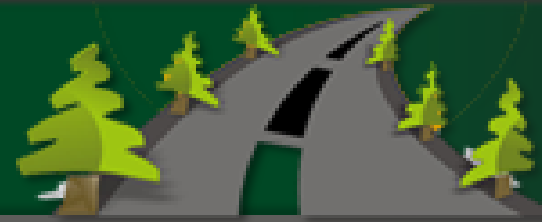




Pavement performance depends on:

- **Traffic volumes and loading**
- **Road pavement strength**
- **Maintenance standards**

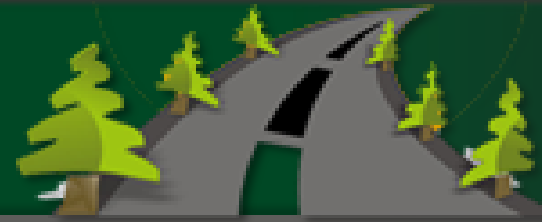
NETWORK ANALYSIS PROCESS



Main components include:

- **Forecasting of Revenue Generation/Investment Statement**
- **Road and Bridge Distress Survey**
- **Roughness Measurement Survey**
- **Strength Evaluation Survey**
- **Traffic Survey**
- **Historical Data**
- **Performance Standards**
- **Feedback from Stakeholders**
- **Treatment Rules**

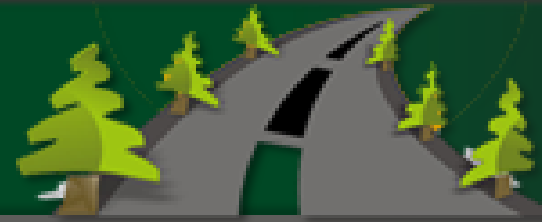
Data Collection



Data, being the vital thing for the study, was collected. This data comprises of the following.

- **Pavement Condition Data**
- **Traffic Data**
- **Falling Weight Deflectometer Data**
- **Roughness Data**
- **Economic Data**
- **Revenue Data From Toll Plazas**

Pavement Condition Data

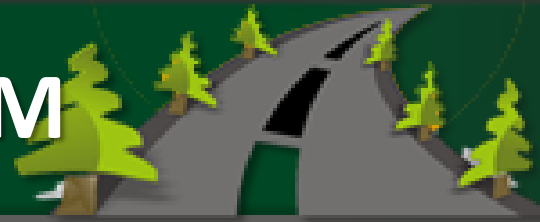


Pavement Distress type, Extent and Severity is recorded for EACH KM of the every Road.

Following Distresses with measuring units are identified for Data Collection

- **Cracking** (%age of length effected & Crack Width)
- **Rutting** (Length of Rutted Portion & Rut Depth)
- **Potholes** (Number of Potholes in KM)
- **Ravelling** (%age of length effected & Disintegration Type)
- **Edge Step** (%age length effected & Depth)
- **Erosion from Original Edge** (%age length effected & Depth)
- **Drainage Condition** (Performance Indicator)

PAVEMENT CONDITION SURVEY FORM



ROUTE: _____ From Km. _____ To Km. _____ Date: _____

Km. _____					Km. _____					Km. _____					Km. _____					Km. _____							
<u>Carriageway Classification</u>					<u>Carriageway Classification</u>					<u>Carriageway Classification</u>					<u>Carriageway Classification</u>					<u>Carriageway Classification</u>							
Pavment Type		A	S	R	Pavment Type		A	S	R	Pavment Type		A	S	R	Pavment Type		A	S	R	Pavment Type		A	S	R			
Carriageway Width (meter)					Carriageway Width (meter)					Carriageway Width (meter)					Carriageway Width (meter)					Carriageway Width (meter)							
Left Shoulder		A	T	E	Left Shoulder		A	T	E	Left Shoulder		A	T	E	Left Shoulder		A	T	E	Left Shoulder		A	T	E			
Right Shoulder		A	T	E	Right Shoulder		A	T	E	Right Shoulder		A	T	E	Right Shoulder		A	T	E	Right Shoulder		A	T	E			
Rutting		Length (m)					Rutting		Length (m)					Rutting		Length (m)					Rutting		Length (m)				
		100	250	500	750	1000			100	250	500	750	1000			100	250	500	750	1000			100	250	500	750	1000
Upto 15 mm							Upto 15 mm								Upto 15 mm												
15 - 30 mm							15 - 30 mm								15 - 30 mm												
30 - 50 mm							30 - 50 mm								30 - 50 mm												
> 50 mm							> 50 mm								> 50 mm												
Cracked Area		Length (m)					Cracked Area		Length (m)					Cracked Area		Length (m)					Cracked Area		Length (m)				
		100	250	500	750	1000			100	250	500	750	1000			100	250	500	750	1000			100	250	500	750	1000
Upto 1/4 of Pavement Width							Upto 1/4 of Pavement Width								Upto 1/4 of Pavement Width												
Upto 1/2 of Pavement Width							Upto 1/2 of Pavement Width								Upto 1/2 of Pavement Width												
Upto 3/4 of Pavement Width							Upto 3/4 of Pavement Width								Upto 3/4 of Pavement Width												
Full width							Full width								Full width												
Pothole (No.)		3	5	7	10	> 10	Pothole (No.)		3	5	7	10	> 10	Pothole (No.)		3	5	7	10	> 10	Pothole (No.)		3	5	7	10	> 10
Ravelling		Length (m)					Ravelling		Length (m)					Ravelling		Length (m)					Ravelling		Length (m)				
		100	250	500	750	1000			100	250	500	750	1000			100	250	500	750	1000			100	250	500	750	1000
Agg/Binder started to wear							Agg/Binder started to wear								Agg/Binder started to wear												
Surface texture is lightly rough & pitted							Surface texture is lightly rough & pitted								Surface texture is lightly rough & pitted												
Surface texture is moderately rough & pitted							Surface texture is moderately rough & pitted								Surface texture is moderately rough & pitted												
Surface texture is heavily rough & pitted							Surface texture is heavily rough & pitted								Surface texture is heavily rough & pitted												
Edge Step (depth)		Length (m)					Edge Step (depth)		Length (m)					Edge Step (depth)		Length (m)					Edge Step (depth)		Length (m)				
		100	250	500	750	1000			100	250	500	750	1000			100	250	500	750	1000			100	250	500	750	1000
Upto 25 mm							Upto 25 mm								Upto 25 mm												
25 - 50 mm							25 - 50 mm								25 - 50 mm												
50 - 100 mm							50 - 100 mm								50 - 100 mm												
> 100 mm							> 100 mm								> 100 mm												
Edge Erosion (width from edge of pavement)		Length (m)					Edge Erosion (width from edge of pavement)		Length (m)					Edge Erosion (width from edge of pavement)		Length (m)					Edge Erosion (width from edge of pavement)		Length (m)				
		100	250	500	750	1000			100	250	500	750	1000			100	250	500	750	1000			100	250	500	750	1000
Upto 50 mm							Upto 50 mm								Upto 50 mm												
50 - 100 mm							50 - 100 mm								50 - 100 mm												
100 - 200 mm							100 - 200 mm								100 - 200 mm												
> 200 mm							> 200 mm								> 200 mm												
Drainage		Length (m)					Drainage		Length (m)					Drainage		Length (m)					Drainage		Length (m)				
		100	250	500	750	1000			100	250	500	750	1000			100	250	500	750	1000			100	250	500	750	1000
Good							Good								Good												
Fair							Fair								Fair												
Poor							Poor								Poor												

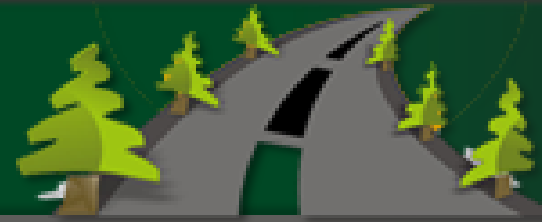
Legend

Pavement Type A = Asphalt, S = Surface Treated, R = Rigid Shoulder A = Asphalt, T = Treated, E = Earthen Pothole 1 Pothole = 1 Sqft

Pictorial View of Pavement Condition Survey

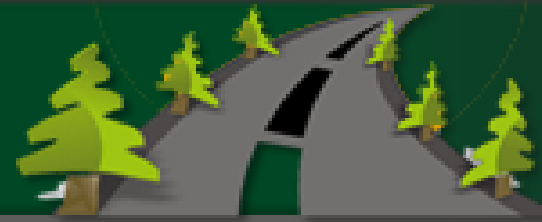


Traffic Data



- **24 Hours Classified Traffic Counts at Chosen Stations is Carried Out.**
- **Axle Load Data is Collected from NH&MP and NHA Weigh Stations.**

HWD Data



- **HWD data is collected by NHA.**
- **Dynatest Heavy Weight Falling Weight Deflectometer is used to collect the data.**

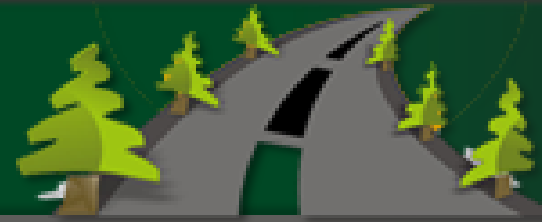
Constructed by:

USMANI ASSOCIATES
OF PAKISTAN (2010)

HWD Machine



Pavement Roughness Data







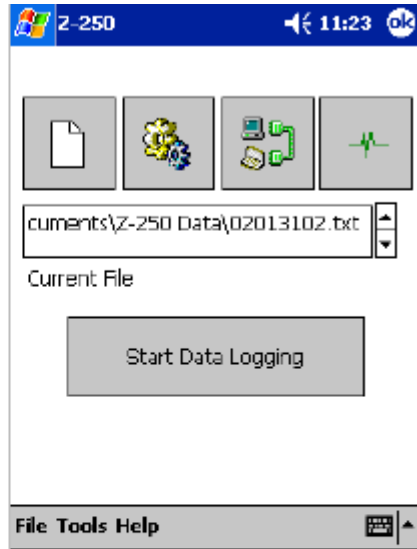
- **Pavement Roughness Data is Collected by ROMDAS Bump Integrator Unit & Profilograph.**
- **The BI unit Gives the Number of Bumps, it received from the pavement, which were, then, converted to IRI values.**
- **Profilometer gives the IRI directly on analysis through a software**

Bump Integrator Unit

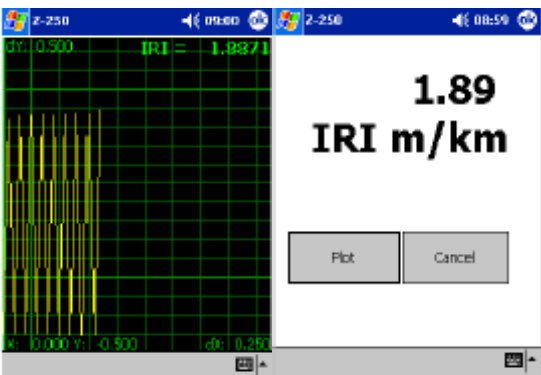


Once the software is started the screen on the right is displayed. This has four buttons which control the software setup

-  **File properties.** Defines the file name
-  **Setup.** Defines the Z-250 settings
-  **Connection.** The status of PC connection
-  **Plot.** Plot a Z-250 file and display the IRI



The name of the current file is displayed in the window. This name defaults to yymmddnn.txt, where yy is the year, mm the month, dd the day and nn the survey number. The name below is from 31 January 2002, survey number 2.



The ROMDAS Bump Integrator (BI) is illustrated below. It is installed in the rear of the vehicle but is small enough to be relatively unobtrusive.



ROMDAS BI and Mounting Plate

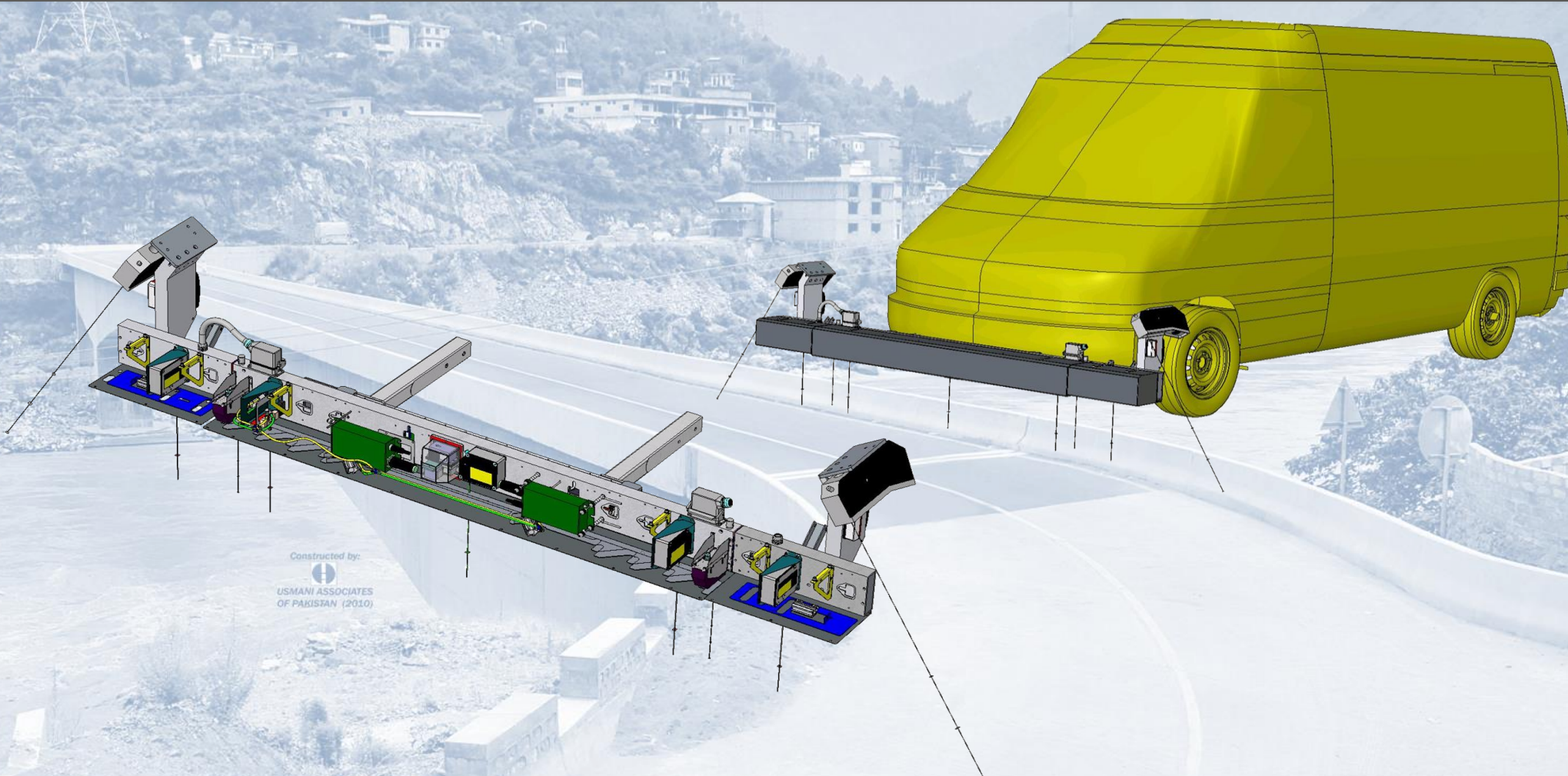
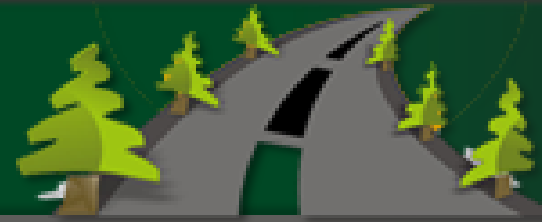


Z-250 With Data Logger



ROMDAS BI Installed in Vehicle With Protective Cover Off

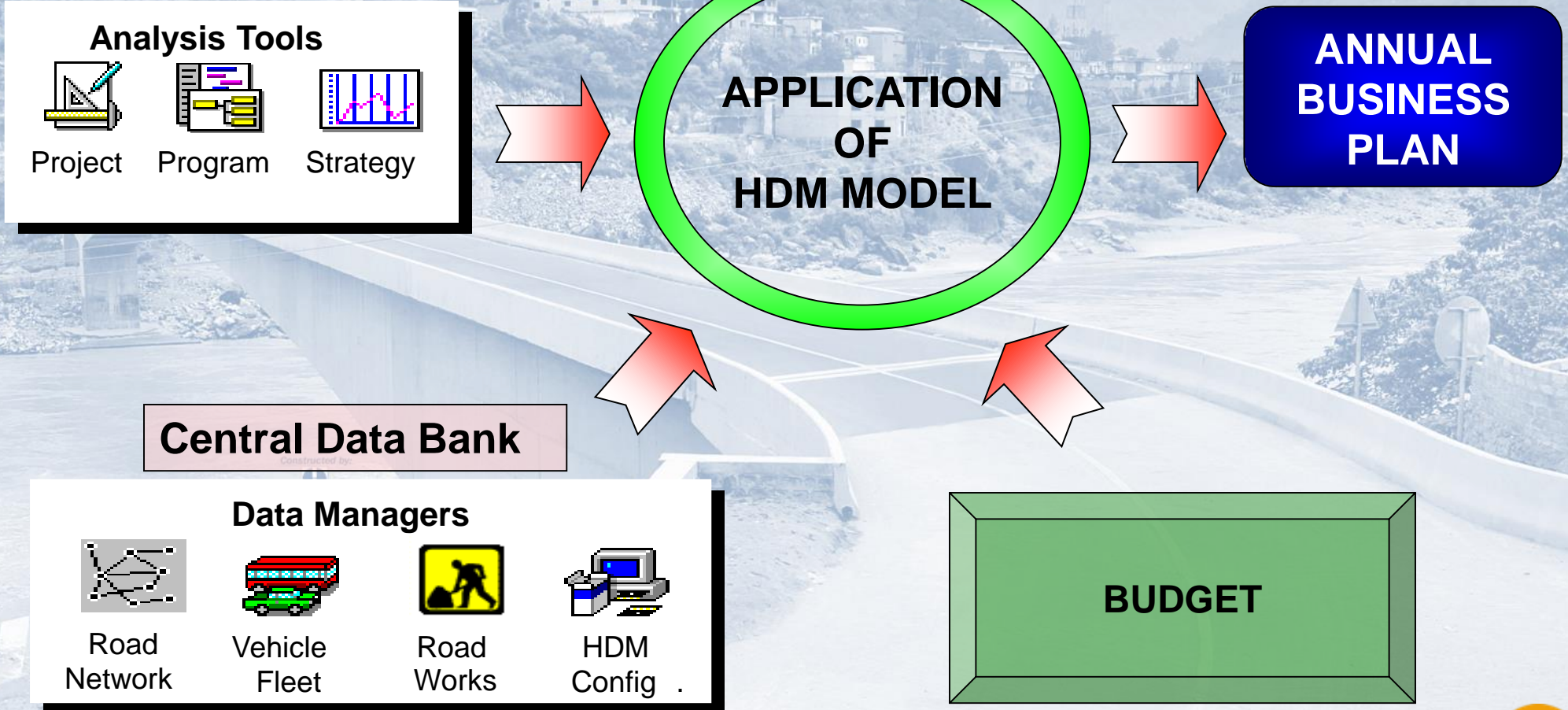
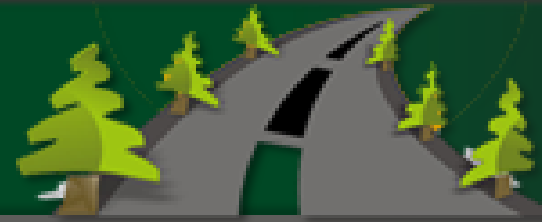
Profilograph



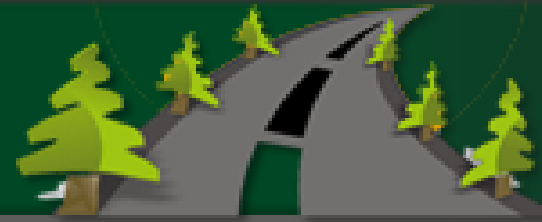
**Front bar with 13 roughness lasers (16 kHz)
and 2 texture lasers (64 kHz)**

HDM-4 MODEL

PRIORITIZATION CYCLE

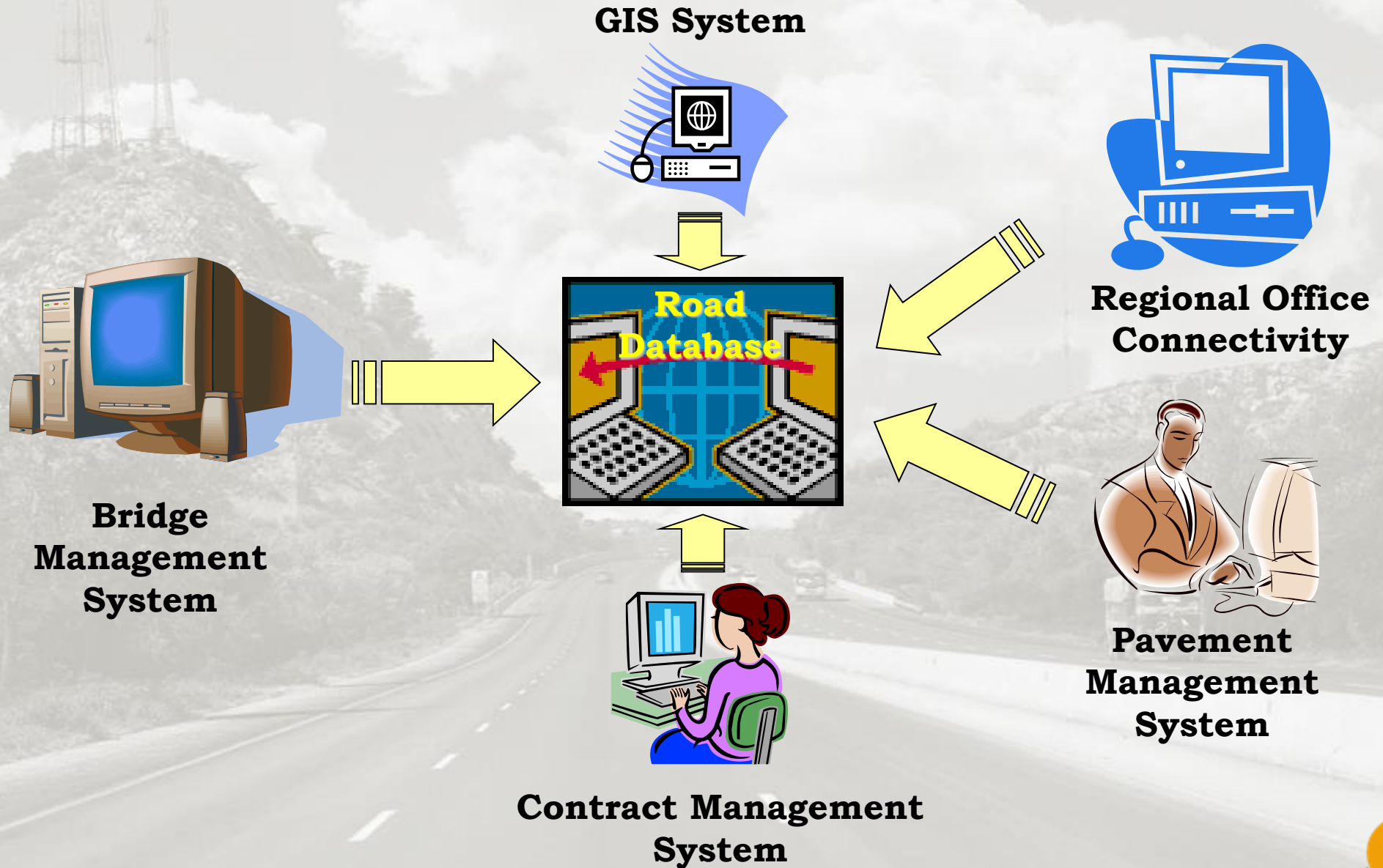


HDM-4 ANALYTICAL FRAMEWORK



- **Based on the concept of life cycle analysis**
- **Predicts the following over the life cycle of a road pavement;**
 - ❖ **Road deterioration**
 - ❖ **Road user effects (RUC)**
 - ❖ **Road works effects (RAC)**
 - ❖ **Socio-economic and environmental effects**
- **Analysis period typically 15 to 40 years**

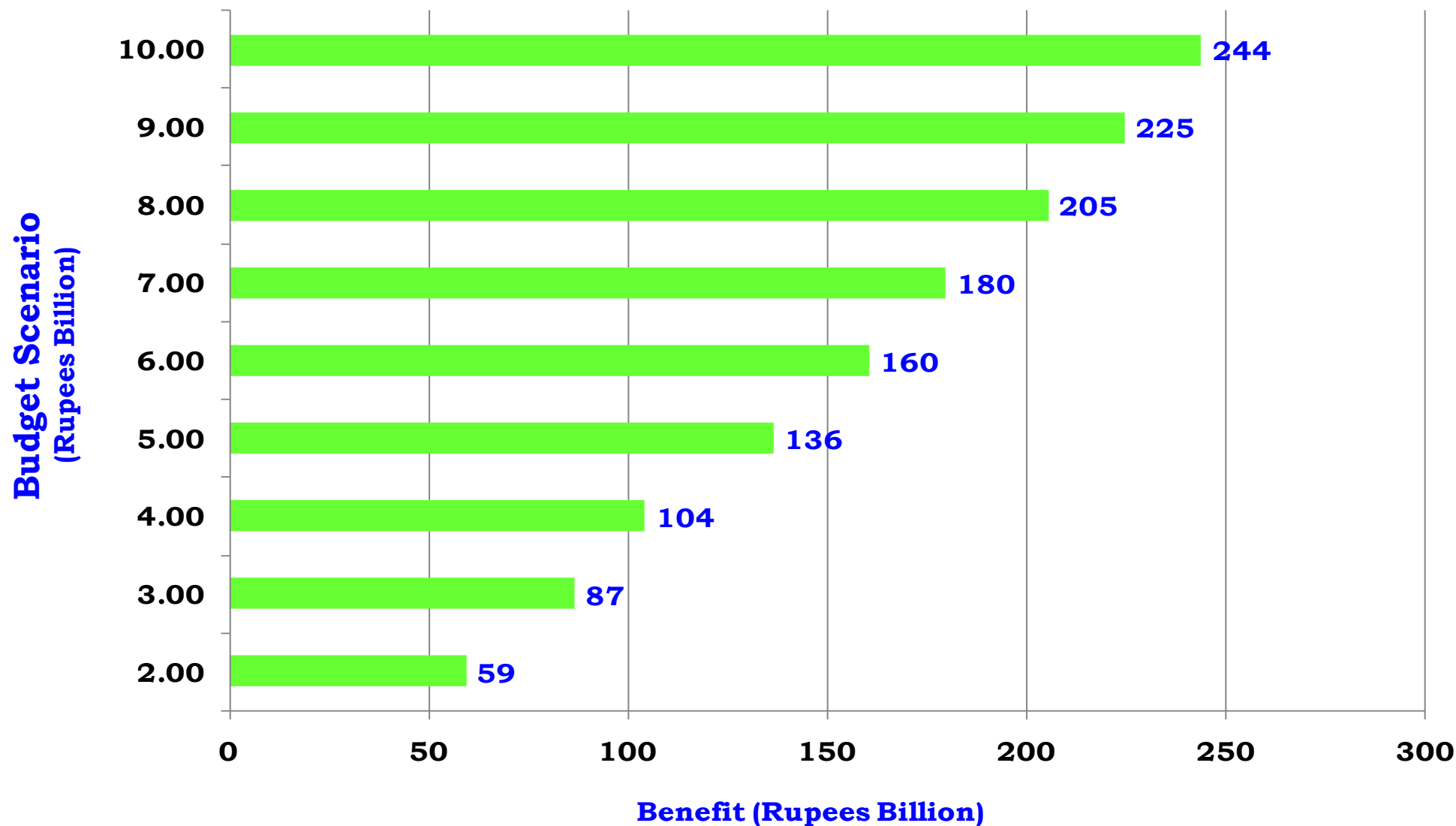
NHA - RAMS DATABASE

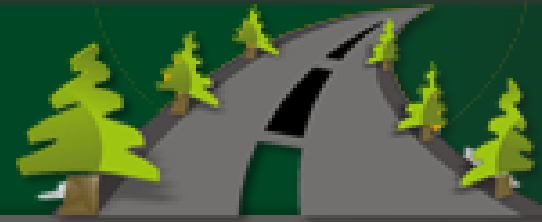


Investment Vs Benefits



BENEFITS OF MAINTENANCE INVESTMENT





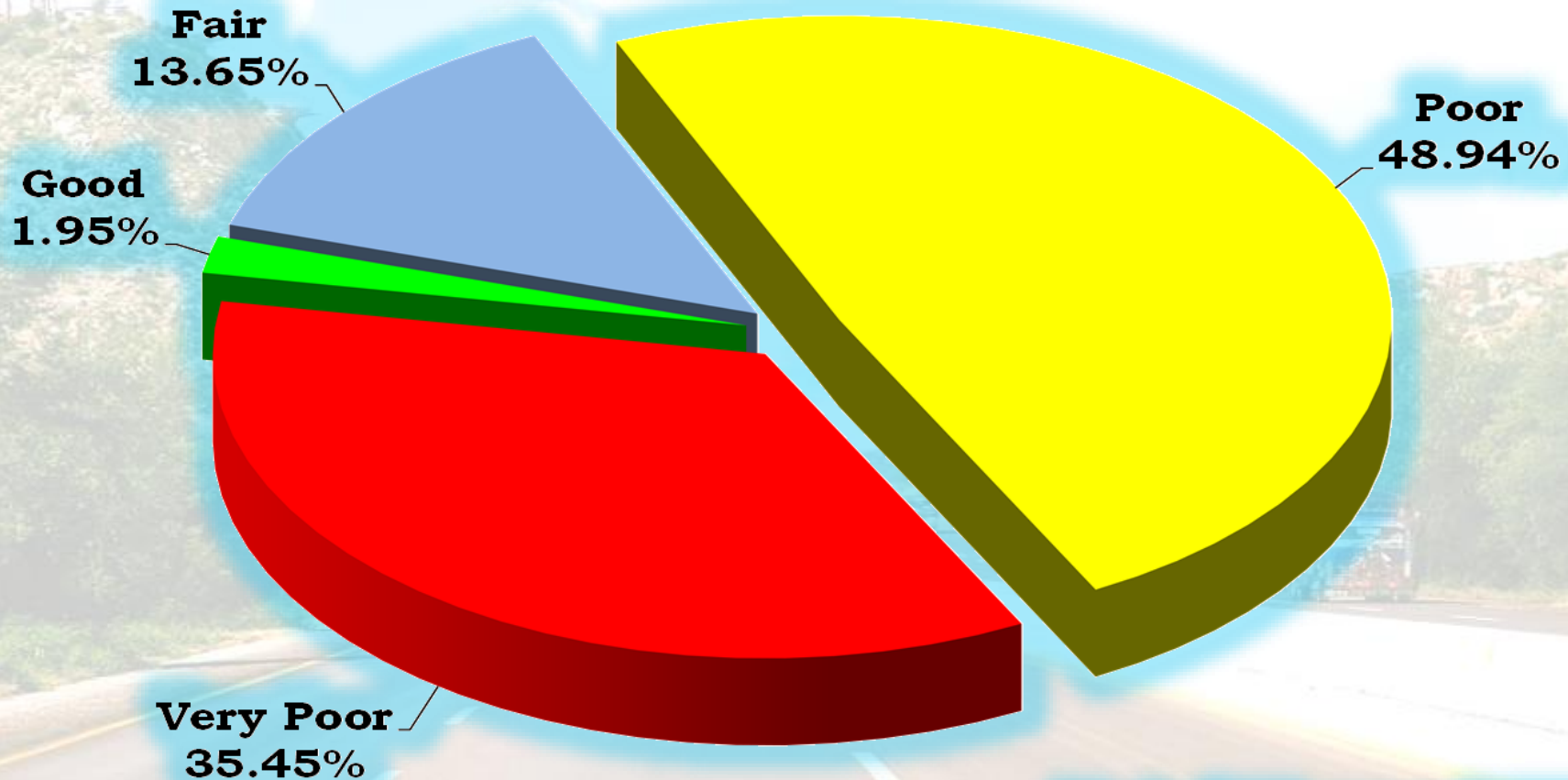
**NATIONAL HIGHWAY NETWORK
CONDITION SURVEY
FOR AMP 2014-15
RESULTS**

Road Roughness Survey for AMP 2014-15

ROUGHNESS



National Highway Network

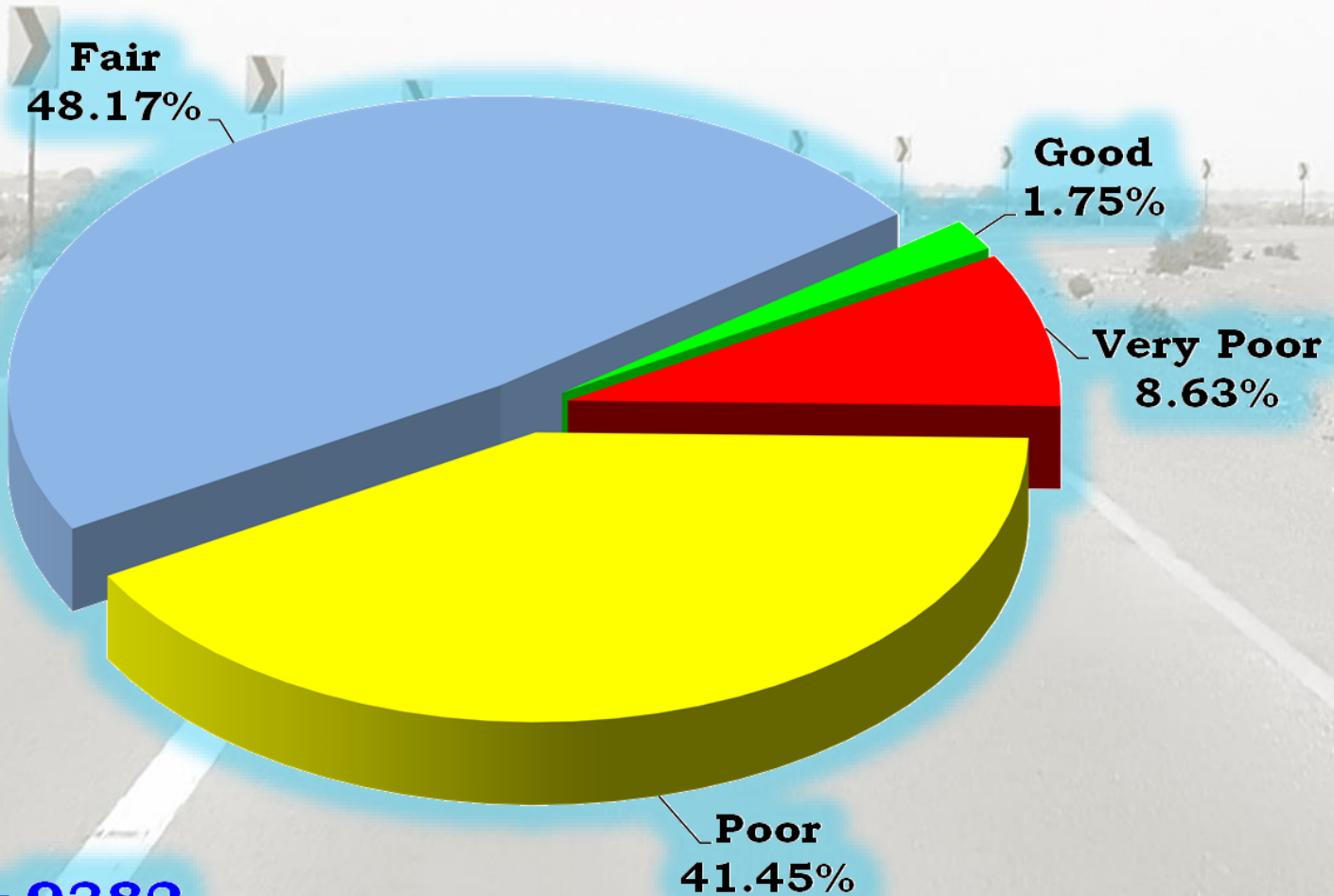


Total Kms = 9382

Road Condition & Roughness Surveys for AMP 2014-15

REMAINING SERVICE LIFE (RSL)

National Highway Network

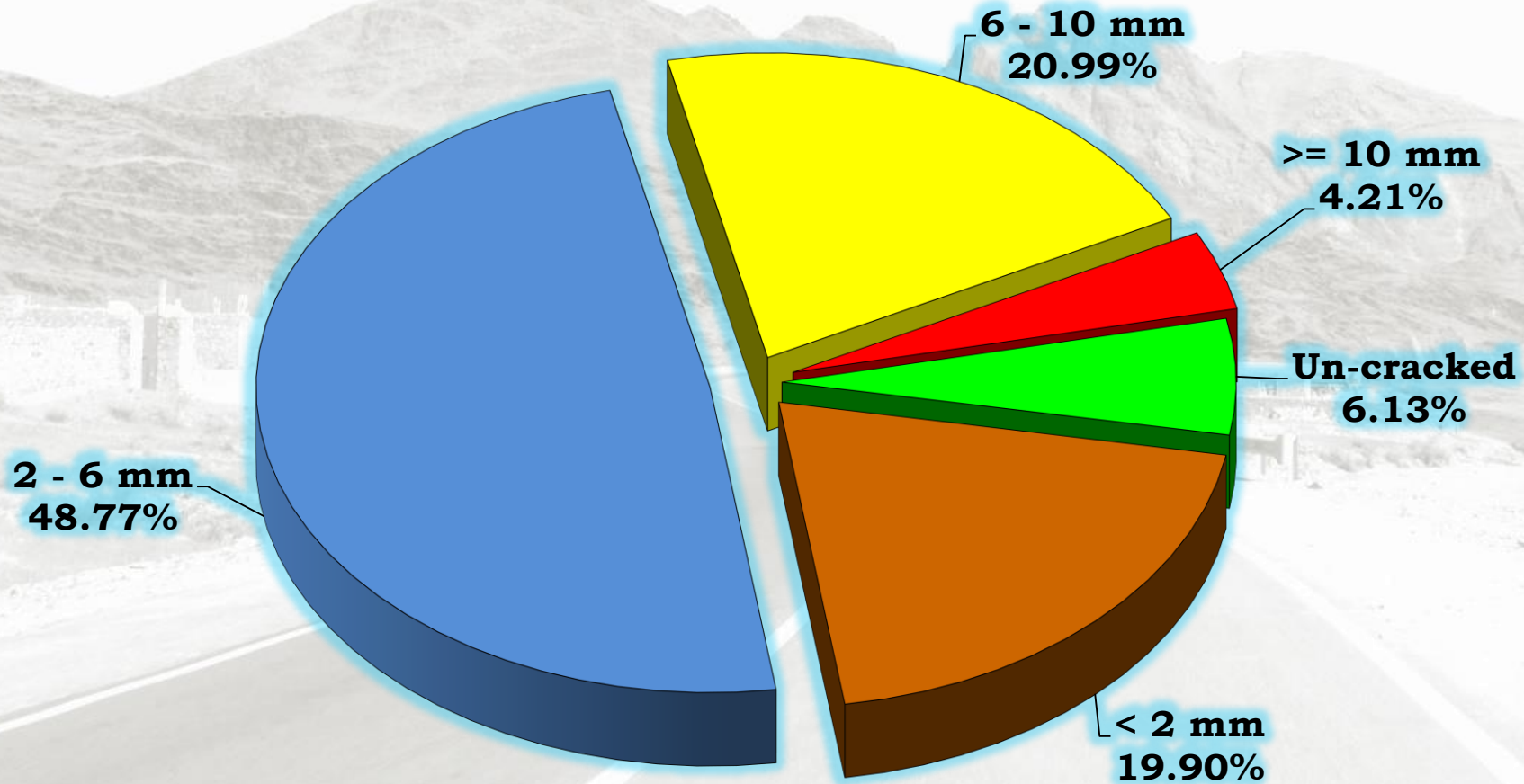


Total Kms = 9382

Road Condition Survey for AMP 2014-15

CRACKING (Structural) (width)

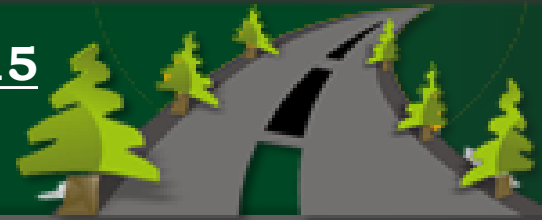
National Highway Network



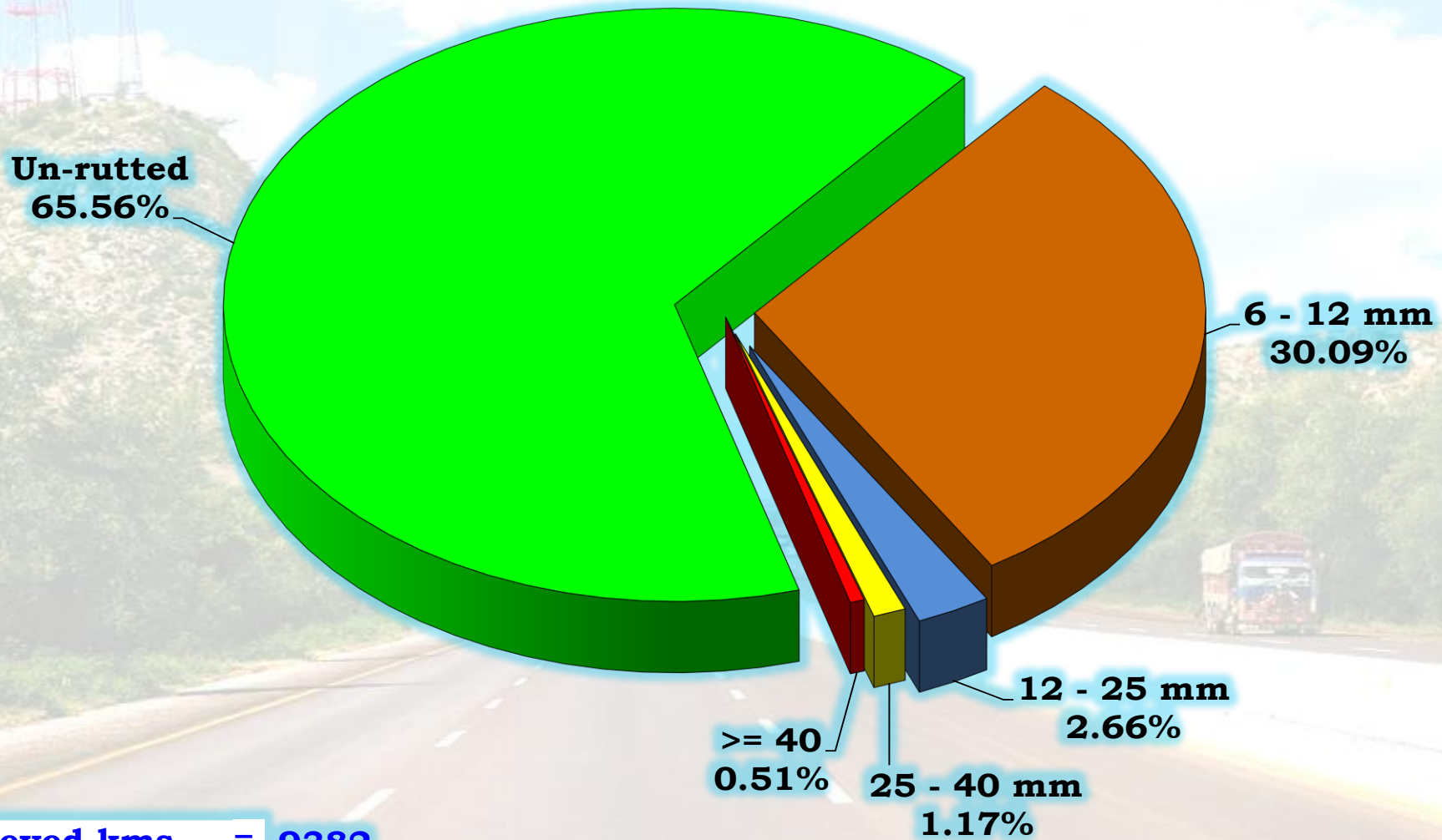
Surveyed kms. = 9382

Road Condition Survey for AMP 2014-15

RUTTING (depth)



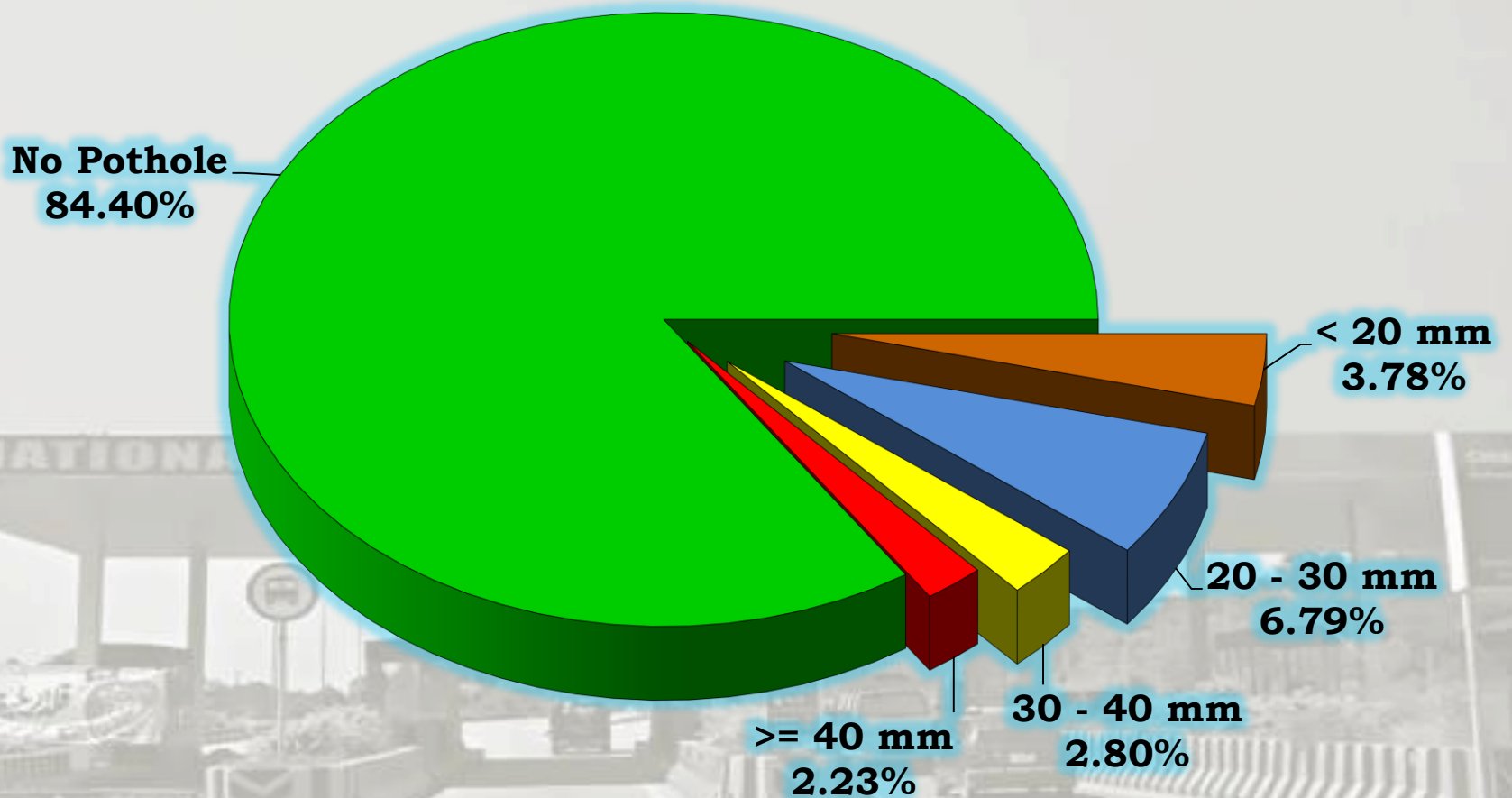
National Highway Network



Surveyed kms. = 9382

POTHOLES (depth)

National Highway Network



Surveyed kms. = 9382



ANNUAL MAINTENANCE PLAN F.Y. 2014-15



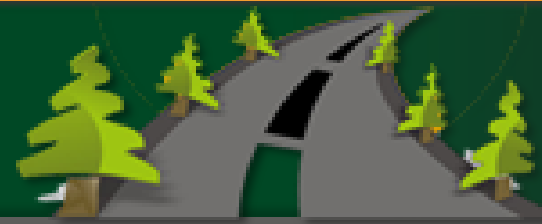
Financial Executive Summary of AMP 2014-15



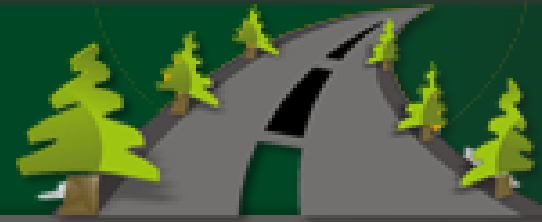
Amounts: Rs. in million

Sr. No.	MAINTENANCE ACTIVITY	Punjab North	Punjab South	Sindh North	Sindh South	Khyber Pakhtunkhwa	Balochistan North	Balochistan South	Northern Areas	Gilgit-Baltistan	M' way (M-1)	M' ways (M-2 & M-3)	Total
1	Rehabilitation	1,062.13	-	-	-	183.83	-	-	-	-	-	-	1,245.96
2	Periodic Maintenance (Structural Overlay)	2,426.34	2,749.26	1,702.62	740.88	671.76	531.52	653.00	642.47	-	-	-	10,117.86
3	Periodic Maintenance (Functional Overlay)	354.81	227.08	-	127.73	859.18	1,070.16	354.81	212.88	-	403.39	201.69	3,811.73
4	Routine Maintenance	251.76	576.34	254.22	381.83	476.15	598.45	162.60	313.92	155.66	143.27	44.70	3,358.90
5	Highway Safety	145.00	135.00	95.00	95.00	70.00	170.00	130.00	45.00	25.00	60.00	30.00	1,000.00
TOTAL - A (sum of Sr. No. 1 to 5)		4,240.04	3,687.67	2,051.85	1,345.44	2,260.92	2,370.13	1,300.41	1,214.28	180.66	606.65	276.39	19,534.45
6	i	Corridor Management (incl. Trauma centres)											50.00
	ii	Toll Plazas & Weigh Stations											200.00
	iii	Administrative expenses (services)											1475.00
	iv	Logistic expenses / Survey Equipments											100.00
	v	Afforestation along national highways											30.00
	vi	Emergency maintenance allocation											300.00
	vii	Special Maintenance											900.00
	viii	Preventive Maintenance											100.00
	ix	Hill Slope Stability Program & Road Protection Works											50.00
	x	Consultancy (Survey, Design, Monitoring, Revenue Surveys, etc.)											80.00
	xi	Geometrics Improvement (Land)											100.00
	xii	Bridge / Culvert Structural Maintenance											322.00
	xiii	Promotion of sports and cultural activities											20.00
	xiv	HRTC (Counterpart fund)											99.00
TOTAL - B (sum of Sr. No. 6)													3,826.00
GRAND TOTAL – C = A+B (AMP 2014-15) - sum of 1-6		4,240.04	3,687.67	2,051.85	1,345.44	2,260.92	2,370.13	1,300.41	1,214.28	180.66	606.65	276.39	23,360.45
Note: All the schemes/expenditures will only be approved by Member (Planning) / Chairman NHA for Serial No. 6 allocations.													
Ongoing Works of F.Y. 2012-13 & F.Y. 2013-14 Financed under AMP 2014-15 (details are attached at Chapter 6) – D												12,289.65	
TOTAL (C + D)												35,650.10	

Maintenance Requirements



Unconstrained demand of NHN for <u>FY 2014-15</u>	Rs. 60 Billion
Current Financial Resources available	Rs. 24 Billion
Backlog of Current Year	Rs. 36 Billion
No. of Km (<u>Poor to Very Poor</u>)	3,486 Km
Current Cost of Rehabilitation of <u>3,486</u> Km	Rs. 209.16 Billion
With just Periodic Intervention as per AMP	1,100 Km
Next 5 years annual requirement (<u>Maintenance Only</u>)	Rs. 30.00 Billion



Thank you