

Course content

- 1 Introduction
- 2 Performance
- 3 Design
- 4 Construction
- 5 Maintenance
- 6 Management**
- 7 Investigation & maintenance measure selection
- 8 Safety aspects
- 9 Rehab, improvement and upgrading



MANAGEMENT OF UNPAVED ROADS



G VAN ZYL

Gravel Road Management

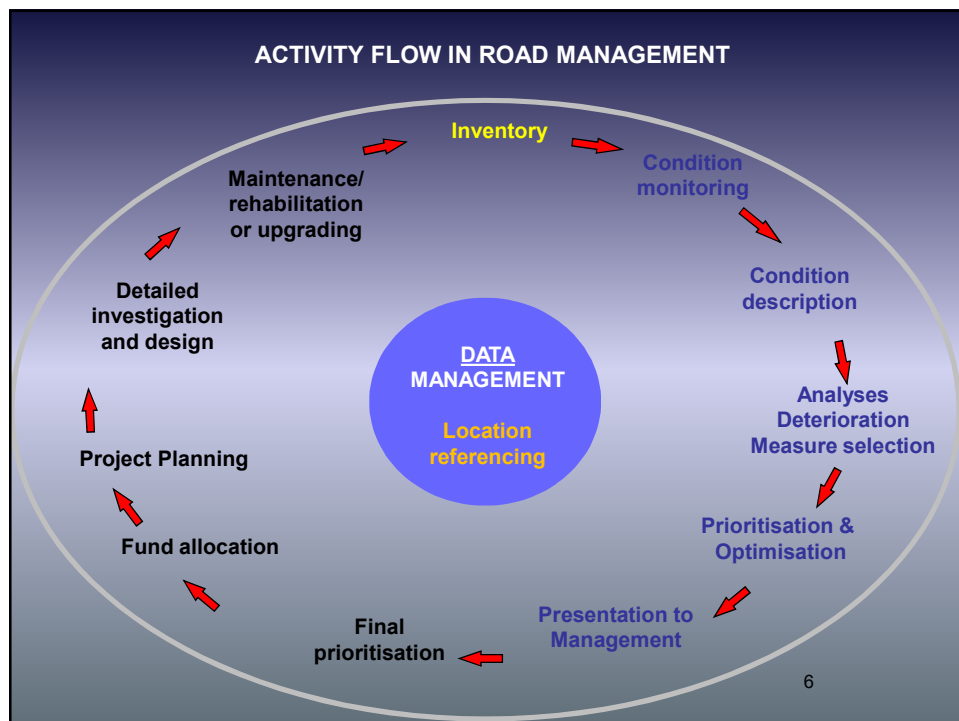
- Do you get enough money for effective maintenance?
- Are you more reactive than proactive?
- Is it difficult to budget?
- Do you have flexibility ?
- GRMS will assist with these answers!
- Let's look at what to do and assess the advantages

Gravel Road Management

- **Management Systems**
 - ☐ GRMS
 - ☐ MMS
 - ☐ Borrow Pits/MIS
 - ☐ Experiment/calibration modules
- **Performance Modeling**
- **Maintenance records**
- **Blading optimisation**
- **Cost update**

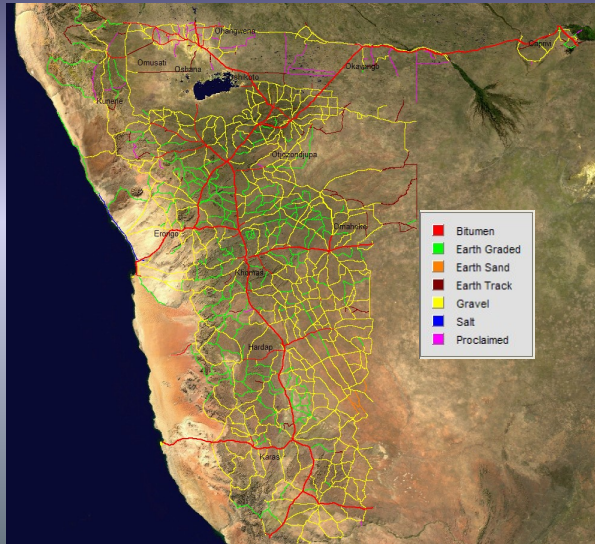
UNPAVED ROAD MANAGEMENT SYSTEM

- Unpaved road network
- Monitor condition and trends of deterioration
- Identifies and prioritises potential projects
 - Periodic maintenance measures
 - Potential surfacing/ upgrading
- Budget requirements
- Provides information
 - Reports
 - Graphs
 - Maps




Location Referencing and Inventory

- Road No
- Start & End
 - ☐ Description
 - ☐ Km
 - ☐ GPS
- Attributes
 - ☐ Category
 - ☐ Surface type
 - ☐ Geometry
 - ☐ Features
 - ☐ Etc.




UNSEALED ROAD NETWORK



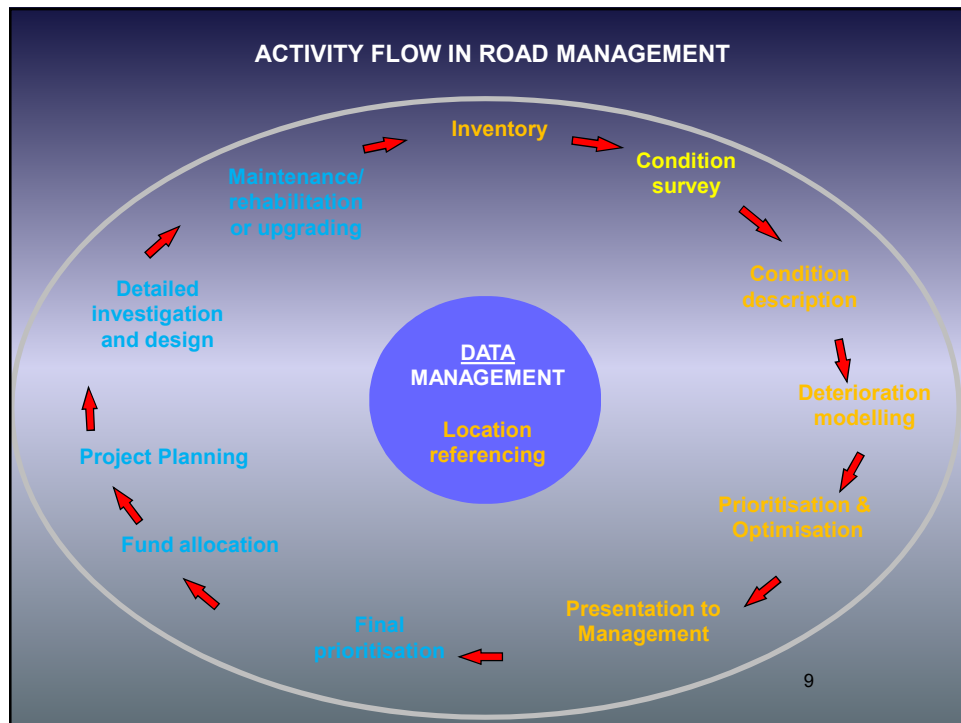
UNSEALED ROAD MANAGEMENT SYSTEM

UNSEALED ROAD ASSESSMENT (PHASE 1)

NAMIBIA ROADS AUTHORITY

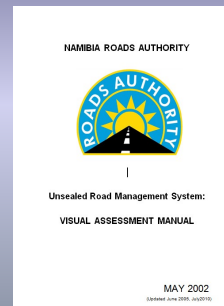


NETWORK 7		Trunk Roads	Main Roads	District Roads	Proclaimed only	Total
Bitumen		4 135.7	1 945.8	305.8		6 387.3
Gravel		435.9	8 670.8	15 637.0		24 743.7
Salt		0.0	110.5	161.4		271.9
Earth	Earth Graded	0.0	363.5	10 693.0		11 056.5
	Earth tracks	0.0	77.2	1 359.6		1 436.8
	Sand Tracks	0.0	0.0	240.8		240.8
Total		4 571.6	11 167.8	28 397.6		44 137.0
Total including Proclaimed only					1 249.5	45 386.5



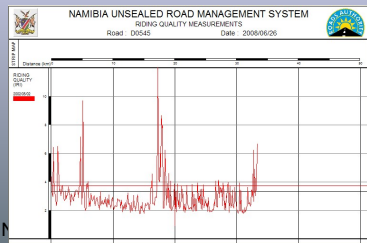
Condition Assessment

- Formalised visual assessment (TMH9: E)
- Roughness
- Material thickness and properties
- In situ strength (DCP)
- Additional information
 - ☐ Traffic
 - ☐ Climate
 - ☐ Topography

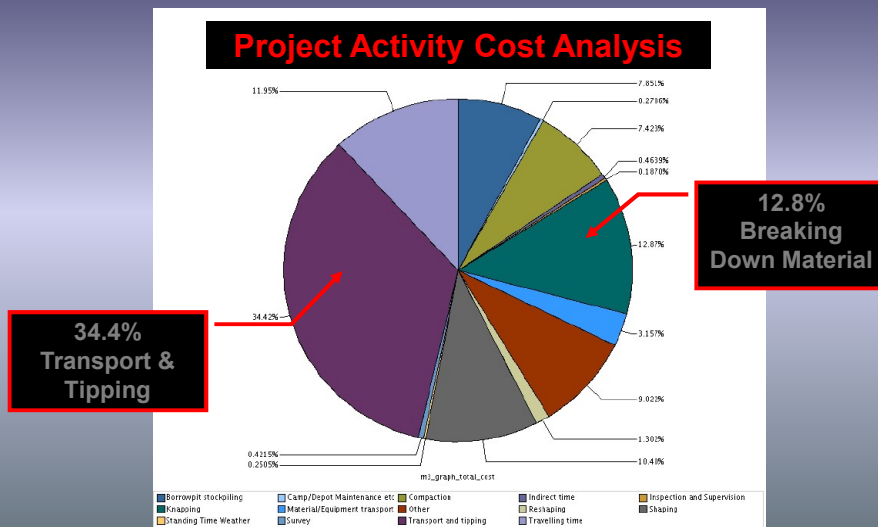


Condition assessment

- **Visual assessment**
- **Roughness**
- **Layer thickness**
- **Material properties**
- **DCP**
- **Unit costs**

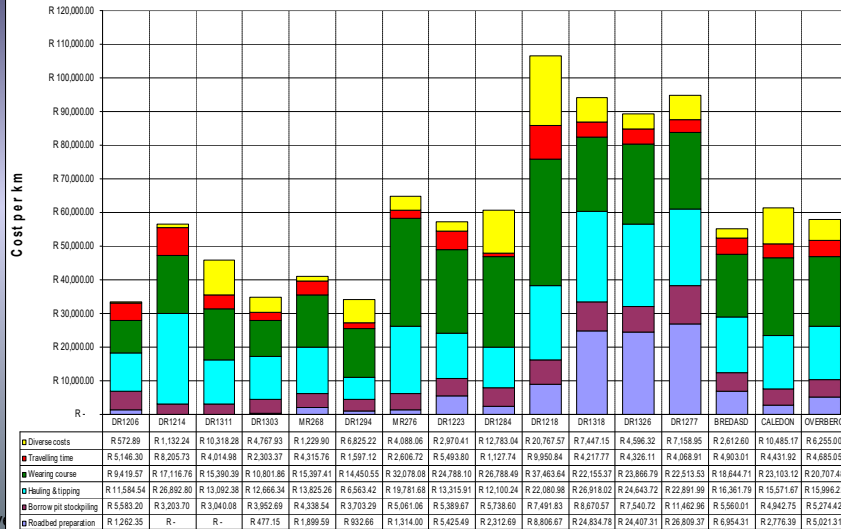
[illegible]

Project Control System



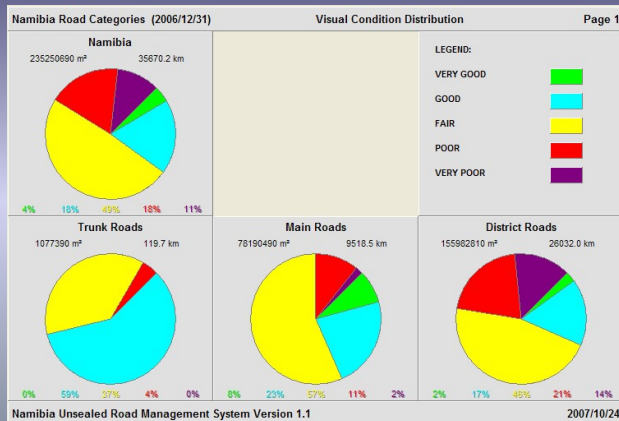
Project Control System

OVERBERG REGRAVELLING PROJECTS 2000/2001 → 2007/2008 Double



Nov

• Condition description (Network)



Very Good



Good



Fair



Poor

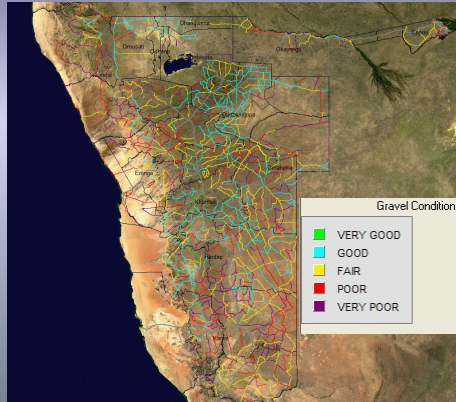


Very Poor



Condition description

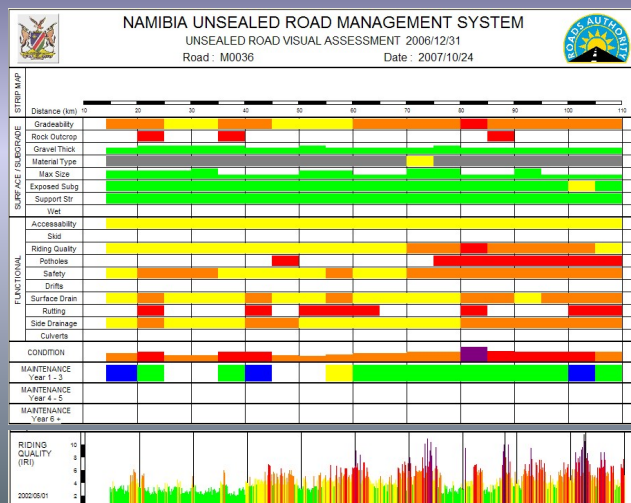
- Condition description (Network)



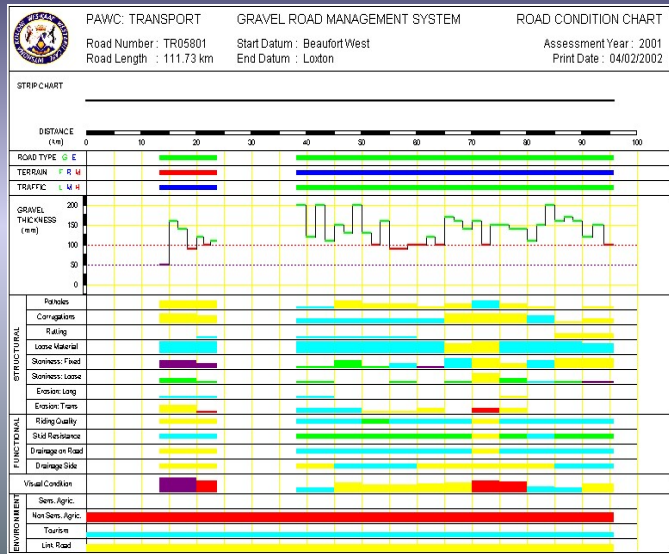
15

PROCESSES

- Condition description (per road)

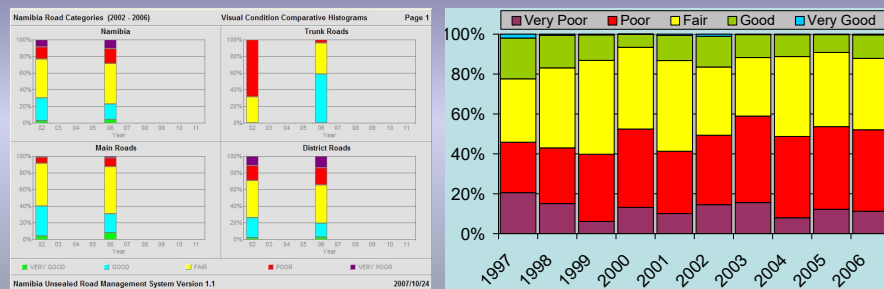


Reporting



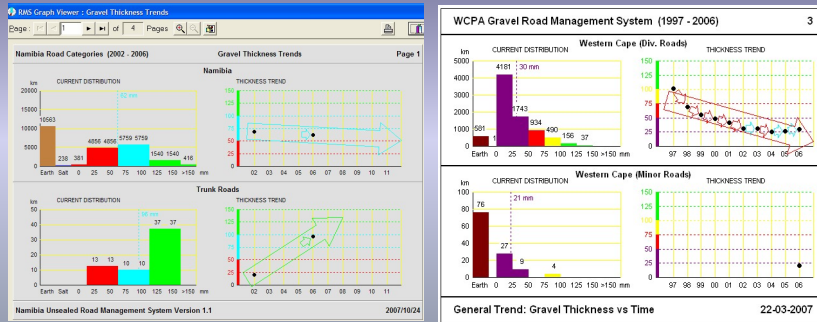
PROCESSES

- **Condition trends**



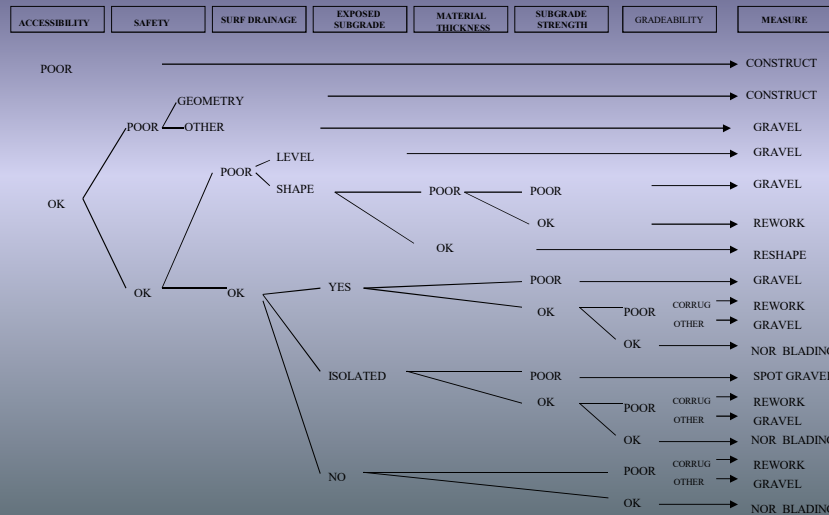
PROCESSES

• Condition trends



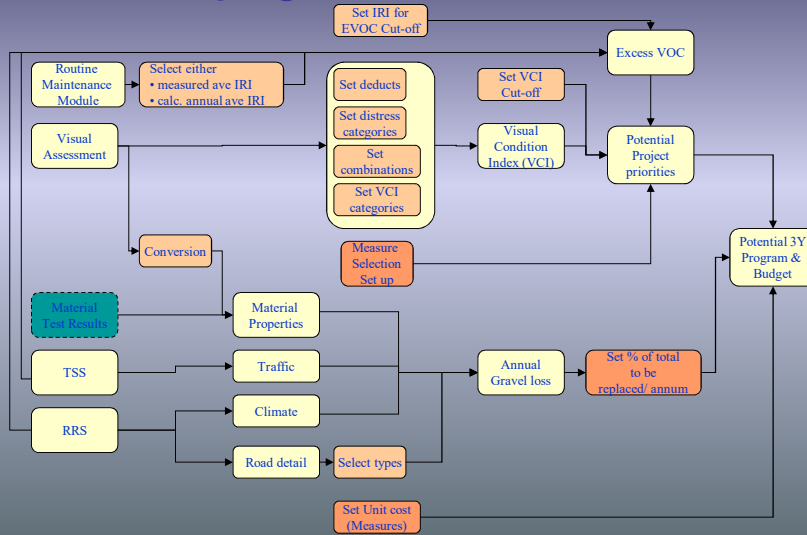
PROCESSES

• Measure Selection



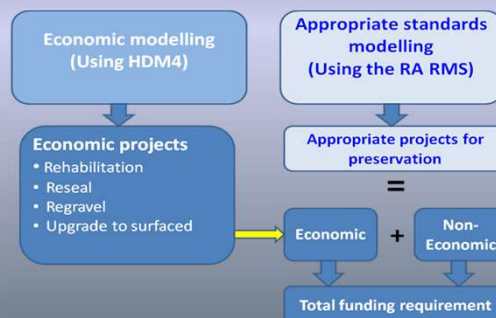
PROCESSES

• Potential programme



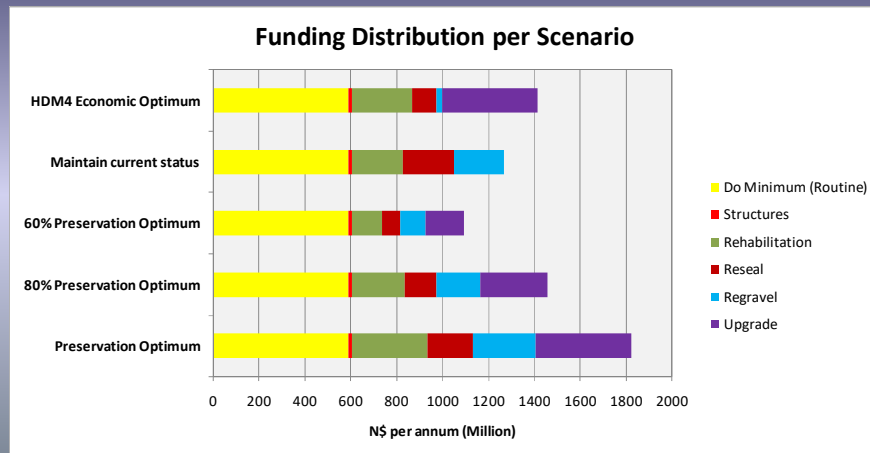
Performance Modelling

- General trends
- Individual road segments – remaining life
- HDM4 modelling



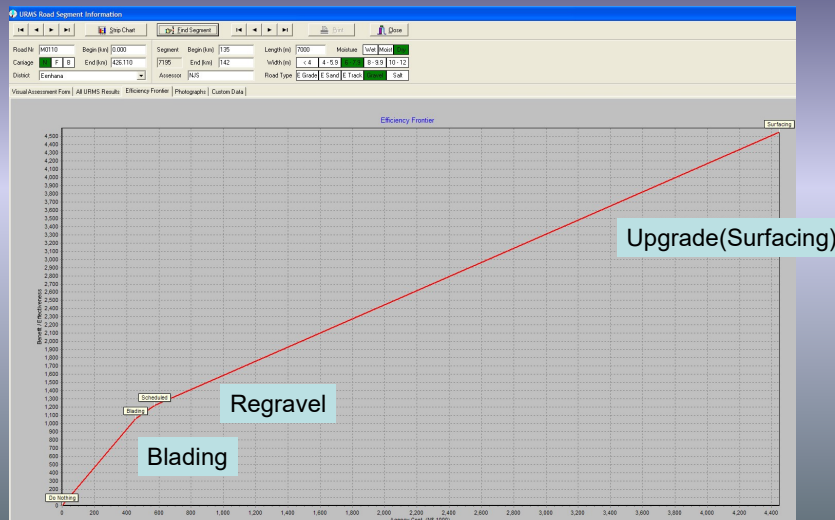
- Spreadsheet

Road network modelling



PROCESSES

• Measure Selection



PROCESSES

- **Project identification**

- ☐ Need based on accessibility, safety, maintainability
- ☐ Highest Net benefit
- ☐ Replace 100% gravel loss per year (1.67 mil m³)

UNSEALED ROAD MANAGEMENT SYSTEM														
UNSEALED ROAD ASSESSMENT (PHASE 1)														
NAMIBIA ROADS AUTHORITY														
Scheduled Maintenance Priorities										Assessment Date : 2006/12/31				
Road Number	Section Begin (km)	Section End (km)	Maintenance Region	Surface Type	Road Cat	Length (km)	Width (m)	Traffic L/H	Maint. Need VCI	Net Benefit IRR	Maintenance Year	Rec.Action	Cost (N\$000)	Gravel Replace Cum (1000m ³)
D1901	0	5	Ojivarengo	Salt	D	5.0	7.0	120/170	32	428.0	565 195	1	Revote/ SCr	450
D1901	5	10.65	Ojivarengo	Salt	D	5.7	7.0	120/170	43	76.7	458 431	1	Gravel	904
D8407	0	5	Oshulati	Gravel	D	5.0	5.0	400/50	52	86.0	270 583	1	Gravel	800
D4002	0	5	Ojivarengo	Salt	D	5.0	7.0	900/200	55	100.0	261 719	1	Gravel	800
D8407	15	20	Oshulati	Gravel	D	5.0	5.0	400/50	54	52.9	230 155	1	Gravel	800
D8407	10	15	Oshulati	Gravel	D	5.0	5.0	400/50	54	52.9	230 155	1	Gravel	800
D1999	0	1.96	Ojivarengo	Salt	D	2.0	9.0	800/80	30	325.7	216 025	1	Spot Gravel	165
D8407	20	25	Oshulati	Gravel	D	5.0	5.0	400/50	61	42.0	204 731	1	Gravel	800
D8407	25	30.25	Oshulati	Gravel	D	5.3	5.0	400/50	62	42.0	204 731	1	Gravel	840
D8405	35	40	Oshulati	Gravel	D	5.0	7.0	330/40	53	52.0	181 478	1	Revote/ SCr	450
D8405	30	35	Oshulati	Gravel	D	5.0	7.0	330/40	48	52.0	181 478	1	Gravel	800
D8405	25	30	Oshulati	Gravel	D	5.0	7.0	330/40	27	52.0	181 478	1	Gravel	800
D8405	20	25	Oshulati	Gravel	D	5.0	7.0	330/40	46	52.0	181 478	1	Gravel	800

PROCESSES

- **Project Aggregation and Prioritisation**



- ☐ Minimum project length set
- ☐ Aggregates 5km segments into projects
- ☐ Selects conservative measure on project identified
- ☐ Prioritisation on IRR

UNSEALED ROAD MANAGEMENT SYSTEM														
UNSEALED ROAD ASSESSMENT (PHASE 2)														
NAMIBIA ROADS AUTHORITY														
Scheduled Maintenance Project Priorities										Assessment Date : 2006/12/31				
Road Number	Section Begin (km)	Section End (km)	Maintenance Region	Surface Type	Road Cat	Length (km)	Width (m)	Traffic L/H	Maint. Need VCI	Net Benefit IRR	Maintenance Year	Rec.Action	Cost (N\$000)	Gravel Replace Cum (1000m ³)
D1999	0	1.96	Ojivarengo	Salt	D	2.0	0.0	800/80		325.7		1	Spot Gravel	1.6
D1901	0	10.65	Ojivarengo	Salt	D	10.7	7.0	120/170		252.3		1	Gravel	7.5
D8407	0	30.25	Oshulati	Gravel	D	30.3	0.0	400/50		54.8		1	Gravel	18.9
D8405	0	79.1	Oshulati	E/Track	D	79.1	0.0	320/41		44.8		1	Gravel	46.7
D8627	0	6.13	Oshulati	Gravel	D	6.1	9.0	70/50		29.1		1	Reshape	7.5
M034	110.86	111.14	Keetmanshoop	Gravel	M	0.3	0.0	200/30		21.4		1	Spot Gravel	7.5
D1986	0	15.25	Ojivarengo	Gravel	D	15.3	3.4	30/40		16.7		1	Gravel	4.9
M0110	335	404.32	Oshulati	Gravel	M	69.3	0.0	163/25		15.3		1	Gravel	40.4
D8403	8.18	35	Oshulati	Gravel	D	26.8	0.0	110/40		14.6		1	Gravel	12.4

PROCESSES

- Identification of potential surfacing projects

- ☐ Evaluate benefits and costs of options
- ☐ Set cut-off IRR (currently 10%)
- ☐ Surfacing costs set at N\$ 1.0 mil per km
- ☐ Rank according to IRR

<div>  <div> UNSEALED ROAD MANAGEMENT SYSTEM UNSEALED ROAD ASSESSMENT (PHASE 1) NAMIBIA ROADS AUTHORITY </div>  </div>													
Potential Surfacing Priorities										Assessment Date : 2006/12/31			
Road Number	Section Begin (km)	Section End (km)	Maintenance Region	Surface Type	Road Cat	Length (km)	Width (m)	Traffic L/H	Upgrading Need VCI	IRR (%)	EMOC (N\$/km)	Drifts Small	Upgrading Cost (N\$)
D1002	0	5	Ojivavango	Salt	D	5.0	7.0	900 / 200	55	541.1	6 163 047	0	3175 902
M0044	5	15	Ojivavango	Proclaimed	M	10.0	5.0	1250 / 125	38	503.0	6 225 563	0	6351 805
D1099	0	1.96	Ojivavango	Salt	D	2.0	9.0	800 / 80	30	206.1	3 624 318	0	1244 954
M0044	15	77.21	Ojivavango	Salt	M	62.2	7.0	913 / 94	37	203.5	4 384 318	1	39514 577
D1001	0	5	Ojivavango	Salt	D	5.0	7.0	120 / 170	32	163.0	2 885 508	1	3175 902
D8405	70	79.1	Oshana	ETrack	D	9.1	5.0	600 / 100	68	153.0	3 220 223	1	5780 142

PROCESSES

- Reporting

- ☐ Text reports
- ☐ Graphs
- ☐ Maps

REPORTING



UNSEALED ROAD MANAGEMENT SYSTEM UNSEALED ROAD ASSESSMENT (PHASE 1) NAMIBIA ROADS AUTHORITY



Potential Surfacing Priorities					Assessment Date : 2006/12/31									
Road Number	Section Begin (km)	Section End (km)	Maintenance Region	Surface Type	Road Cat	Length (km)	Width (m)	Traffic L/H	Upgrading Need VCI	IBR(%)	EVOC (N\$/km)	Drifts Small	Drifts Large	Upgrading Cost (N\$)
D4002	0	5	Ogjevarongo	Salt	D	5.0	7.0	900/200	55	541.1	6163 047	0	0	3175 902
M0044	5	15	Ogjevarongo	Proclaimed	M	10.0	5.0	1250/125	38	503.0	6225 563	0	0	6351 805
D1599	0	1.96	Ogjevarongo	Salt	D	2.0	9.0	800/80	30	206.1	3 624 318	0	0	1244 954
M0044	15	77.21	Ogjevarongo	Salt	M	62.2	7.0	913/94	37	203.5	4384 318	1	0	39514 577
D1901	0	5	Ogjevarongo	Salt	D	5.0	7.0	120/170	32	163.0	2885 508	1	0	3175 902
D4405	70	79.1	Oshanaati	E Track	D	9.1	5.0	600/100	68	153.0	3 220 223	1	0	5780 142
D1901	5	10.65	Ogjevarongo	Salt	D	5.7	7.0	120/170	43	124.4	2 778 745	2	0	3388 770
D4407	0	5	Oshanaati	Gravel	D	5.0	5.0	400/50	52	86.4	1 676 959	2	0	3175 902
D4407	5	10	Oshanaati	Gravel	D	5.0	5.0	400/50	69	78.7	1 636 531	0	0	3175 902
D4407	10	30.26	Oshanaati	Gravel	D	20.3	5.0	400/50	58	76.5	1 623 656	0	1	12868 756
D4405	0	5	Oshanaati	Gravel	D	5.0	7.0	330/40	50	66.1	1 249 536	0	0	3175 902
D4405	35	40	Oshanaati	Gravel	D	5.0	7.0	330/40	53	66.1	1 249 536	0	0	3175 902
D4405	25	35	Oshanaati	Gravel	D	10.0	7.0	330/40	38	66.1	1 249 536	0	0	6351 805
D4405	20	25	Oshanaati	Gravel	D	5.0	7.0	330/40	46	66.1	1 249 536	0	0	3175 902
D4405	15	20	Oshanaati	Gravel	D	5.0	7.0	330/40	35	66.1	1 249 536	0	0	3175 902
D4405	5	15	Oshanaati	Gravel	D	10.0	7.0	330/40	50	63.7	1 233 063	0	0	6351 805
D4409	15	25	Oshanaati	Gravel	D	10.0	7.0	400/30	76	63.5	1 278 262	0	0	6351 805
D4409	5	15	Oshanaati	Gravel	D	10.0	7.0	400/30	76	63.5	1 278 262	0	0	6351 805
D4405	40	45	Oshanaati	Gravel	D	5.0	7.0	330/40	38	61.3	1 216 590	0	0	3175 902
M0120	6.36	15	Oshanaati	Gravel	M	8.6	7.0	425/15	68	59.2	1 182 985	0	0	5487 959
M0120	15	25	Oshanaati	Gravel	M	10.0	7.0	425/15	76	57.4	1 170 118	0	0	6351 805
M0110	395	400	Oshanaati	Gravel	M	5.0	7.0	250/25	32	43.0	752 028	0	0	3175 902
D4402	15	20	Oshanaati	Gravel	D	5.0	11.0	150/50	67	42.9	764 718	0	0	3175 902
M0110	385	395	Oshanaati	Gravel	M	10.0	7.0	200/25	30	35.4	569 570	0	0	6351 805
M0110	255	260	Oshanaati	Gravel	M	5.0	7.0	140/40	52	34.6	587 730	0	0	3175 902
D4611	5.51	28.26	Oshanaati	Gravel	D	22.8	9.0	215/25	71	34.6	555 303	0	0	14450 356

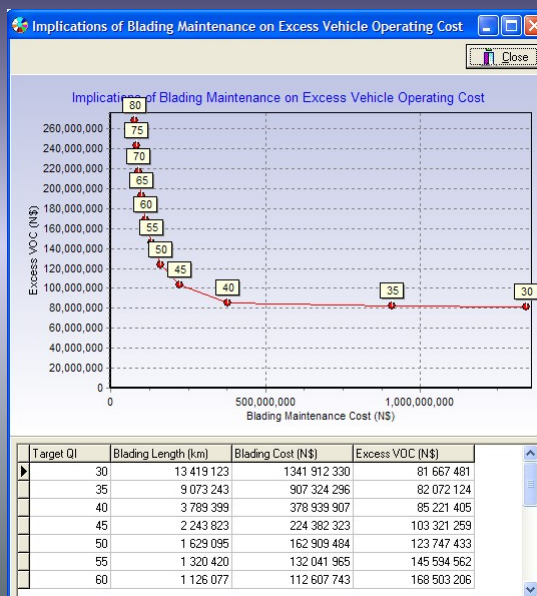
Potential Surfacing Priorities

Page 1

Printed on 2007/10/24

URMS Version 1.1 Model 1

REPORTING



URMS SUMMARY

5 –YEAR ANNUAL BUDGET REQUIREMENT		
MEASURE	Average Annual km Requirement	Annual Budget Requirement
Periodic/scheduled	4959 km	N\$ 420 mil
Upgrading (Seal)	74 km	N\$ 74 mil (10y)
Routine (Blading)		N\$ 197 mil
Routine (Ancillary)		N\$ 70 mil
TOTAL		N\$ 761 mil

Breakdown – 3-year program

	SCHEDULED MAINTENANCE REQUIREMENT (km)						
	Forming	Construct*	Spot Gravel	Gravel	Reshape	Rework	Total
Year 1	0	14	1346	1101	335	484	3280
Year 2	41	141	2427	1017	201	701	4528
Year 3	113	236	3663	759	356	1934	7061
Total	154	391	7436	2877	892	3119	14869
Average	51	130	2479	922	275	1040	4959

Experiment Modules

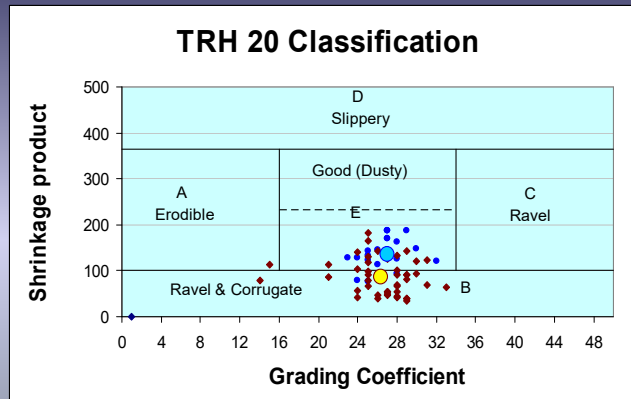
- Keep track of experiments
 - Purpose
 - Location
 - Responsibility
- Research results
- Calibration

Gravel Loss

- Function of:
 - Material properties
 - Climate
 - Traffic
 - Construction
 - Blading frequency
- Calculate remaining life
 - Minimum thickness



System: Material information availability

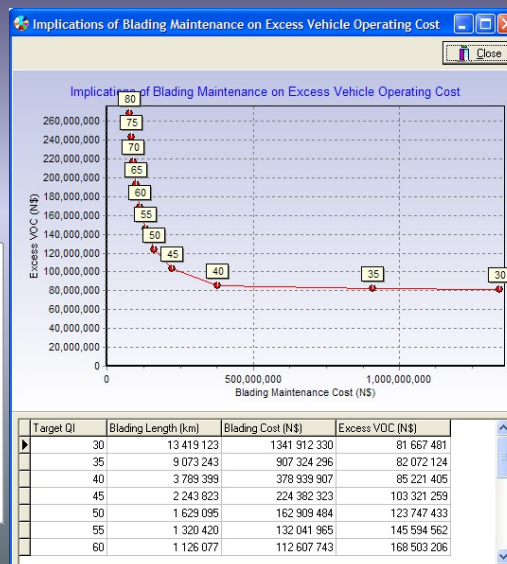
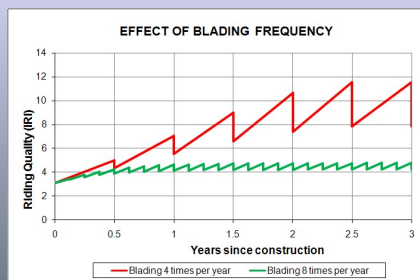


Shrinkage product (Sp) = % linear shrinkage x % passing 0,425 mm sieve

Grading coefficient (Gc)
= $([\% \text{ passing } 26,5 \text{ mm} - \% \text{ passing } 2,0 \text{ mm}] \times \% \text{ passing } 4,75 \text{ mm}) / 100$

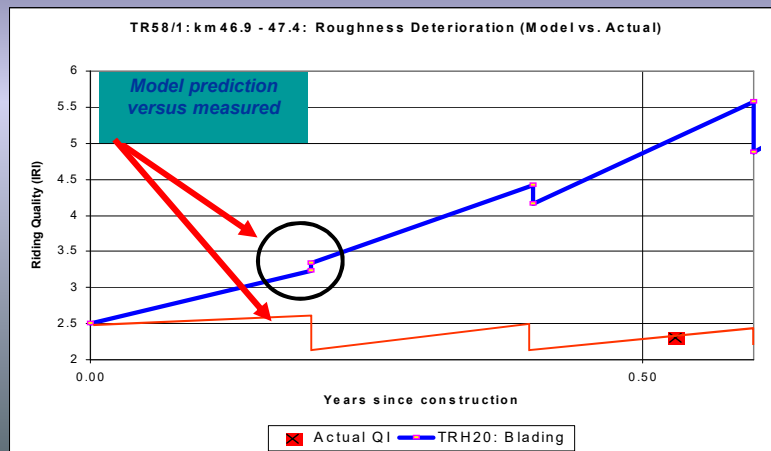
Roughness deterioration

- Impact of different strategies

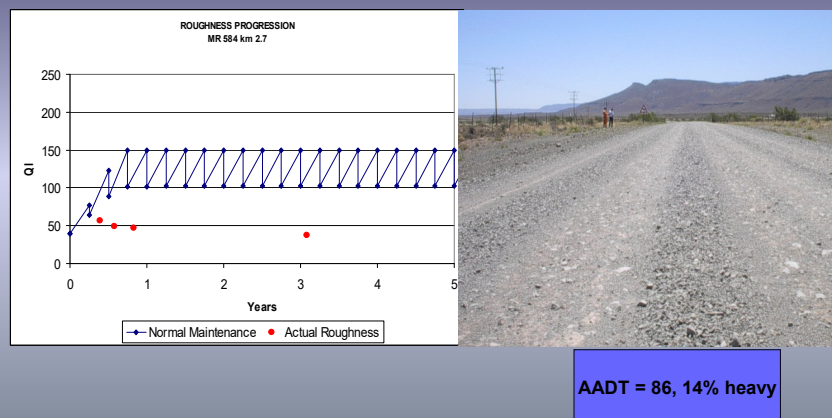


OBSERVATIONS AND IMPLICATIONS

- No deterioration after blading at low roughness levels



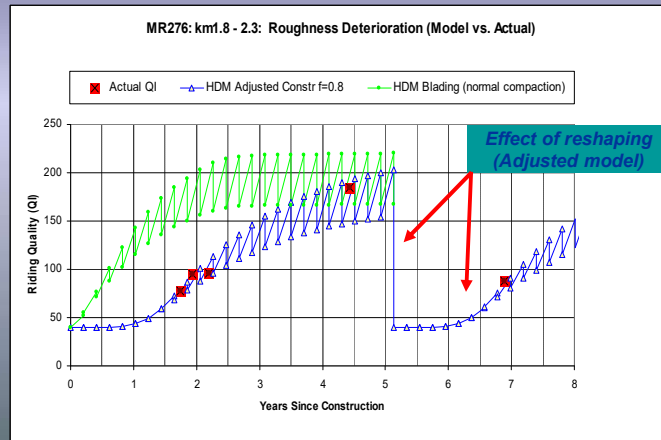
Effect of regular light blading



Slide 40

CONCLUSIONS ON RESHAPING

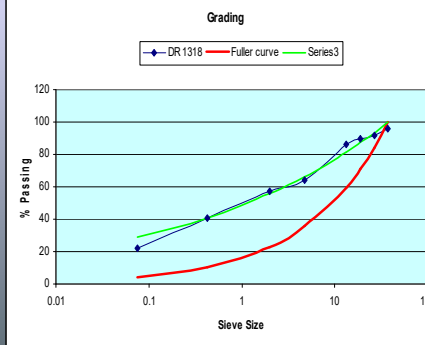
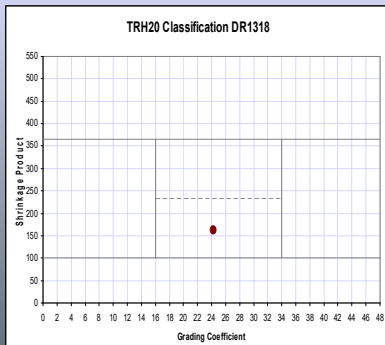
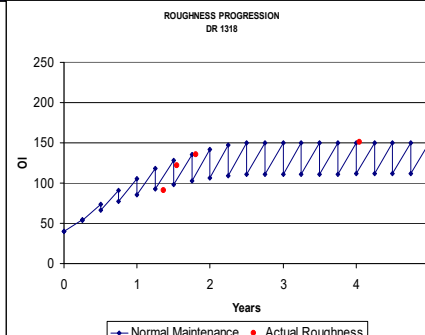
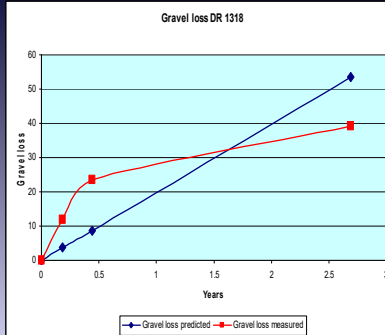
- Reshaping more economic than continuous blading at high roughness levels

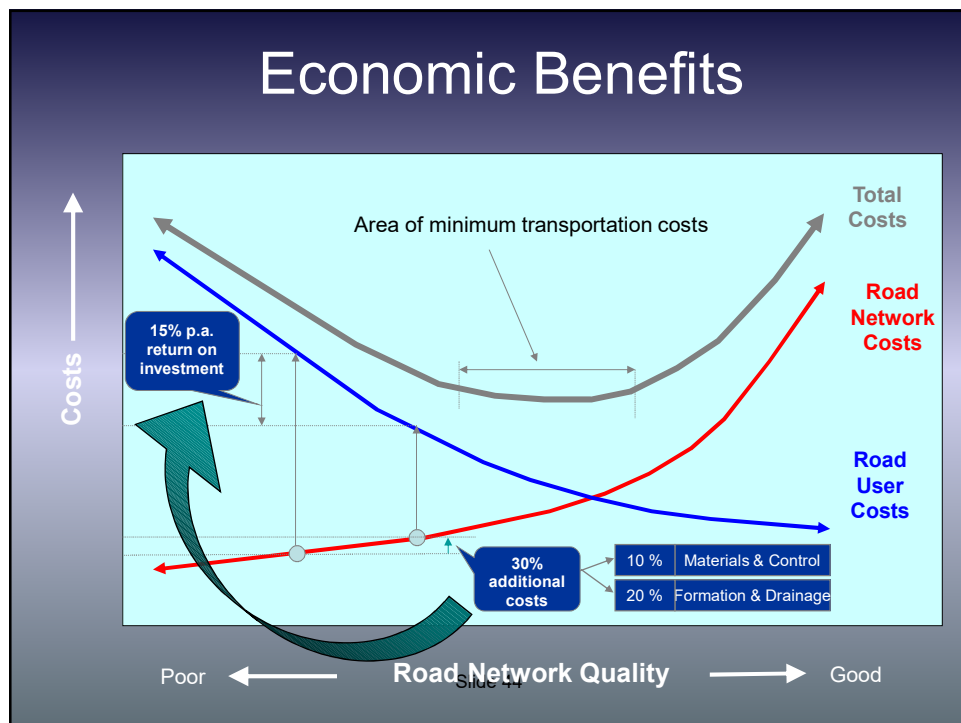
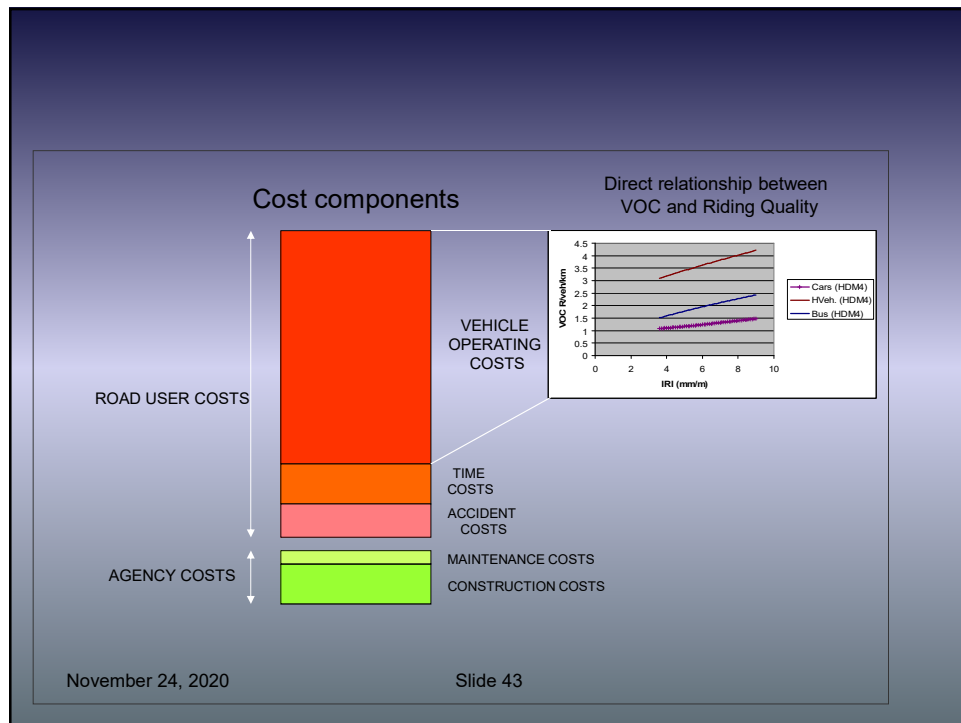


AADT = 323, 19% heavy (2001)



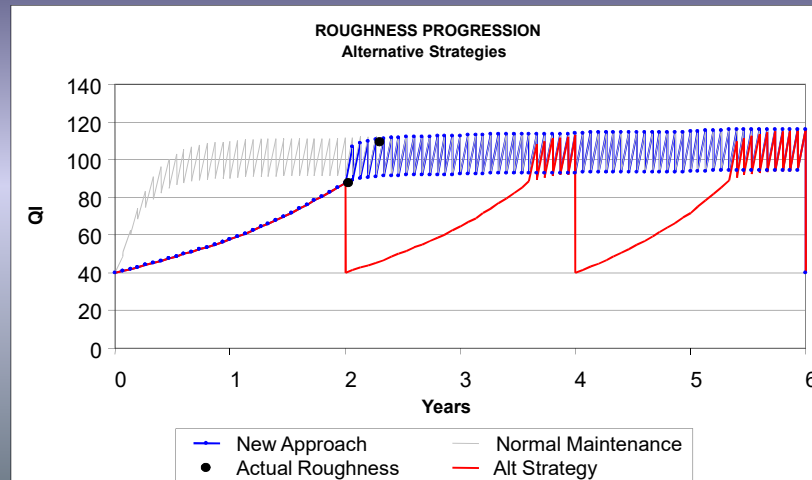
AADT > 500 (2007)





Alternative Strategies

Frequent reshaping

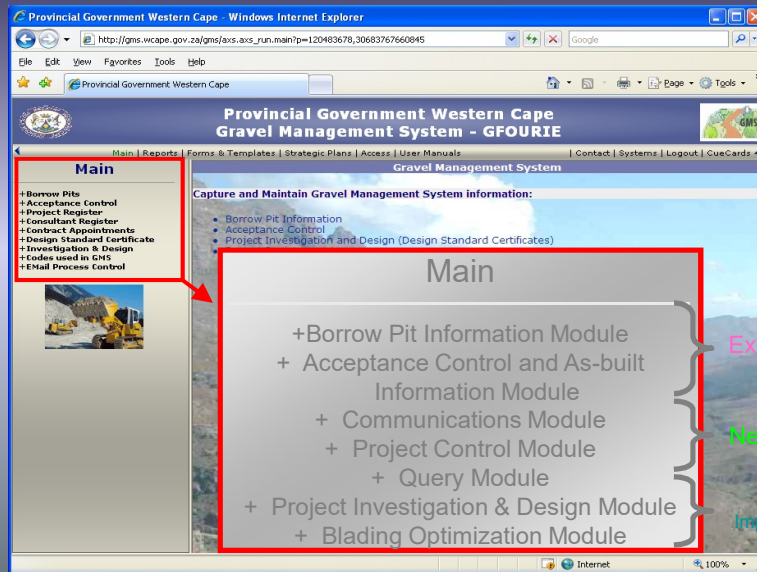


November 24, 2020

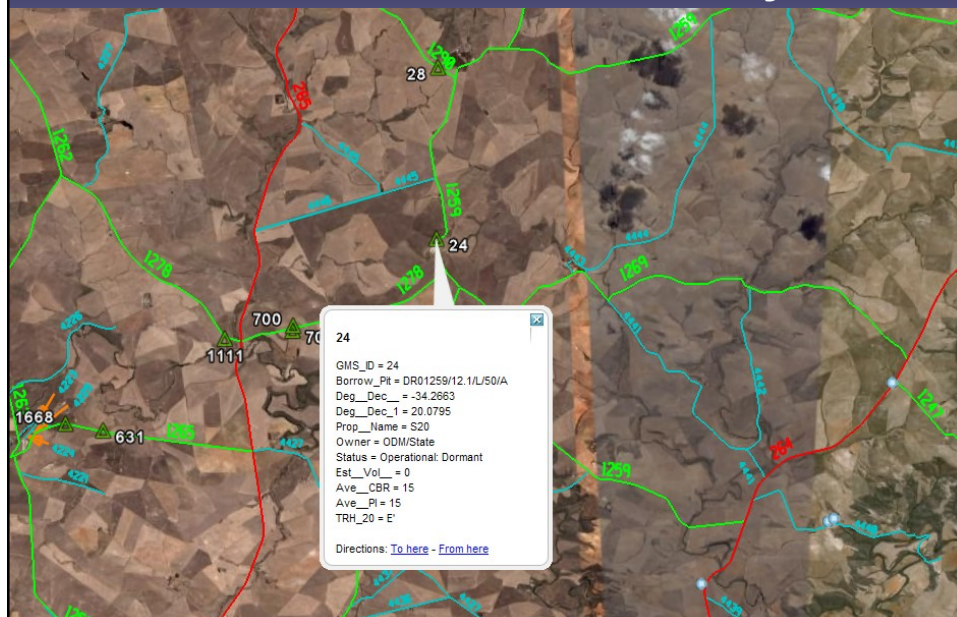
Slide 45

Borrow pit/ Materials Information Systems

Main Modules of GMS



WCPA Materials Information System



Maintenance Recording

ROADS AUTHORITY

SECTION : ROAD MANAGEMENT SYSTEM

FORM FOR RECORDING CONSTRUCTION , RESEAL AND GRAVELLING WORK

Region : _____ District : _____ Type of Construction : _____ Date of Capture: _____

Consulting Firm: _____ Recorded By: _____

RoadNo	CarriageWay	BeginKM	EndKM	LayerCategory	YearConstructed	LayerThickness	Layer Pri. Code	Layer Sec. Code	Layer Ter. Code	Main Act. Taken	Surf. Type	After	Remarks

Field Name	Explanation	Size
RoadNo	Road Number e.g. D0212, T0106, M0052 etc	5 characters
CarriageWay	Should be S, F or B (which stands for Single, Forward and Backward)	1 character
BeginKM	Start km position of layer	Float
EndKM	End km position of layer	Float
LayerCategory	Layer Category (1 - 4) as explained next to this table	Integer
YearConstructed	Year Layer was constructed	Integer
LayerThickness	Thickness of Layer in mm	Float
Layer_Pri_Code	Primary Layer Code - See tables	4 characters
Layer_Sec_Code	Secondary Layer Code - See tables	8 characters
Layer_Ter_Code	Tertiary Layer Code - See tables	4 characters
Main_Act_Taken	Main Action Taken as explained below	
Surf_Type_After	Surfacing Type After Action as explained on the right	
Remarks	Any remark(s) regarding this layer	80 characters

Layer Categories
1 - Surfacing
2 - Base Layer
3 - Sub Base Layer
4 - Selected Layer

Surfacing Type
1 - Bitumen
2 - Earth Graded
3 - Earth Sand
4 - Earth Track
5 - Gravel
6 - Soil
7 - Proclaimed Only

NOTES

USE LATEST ROAD LOGS FROM THE ROAD REFERENCE

FILL THE FORM AND SEND IT WHENEVER A PROJECT ON AN UNSEAL ROAD IS COMPLETED OR AT AN INTERVAL NOT EXCEEDING THREE MONTHS

SEND THE FORM OR FAX TO THE RMS SECTION, FOR ATTENTION RMS MANAGER, ON FAX: 061 - 2847149 AND SENIOR ENGINEER MAINTENANCE ON FAX

MAIN ACTIONS TAKEN

1 - Construct	8 - Reseal
2 - Rehabilitation	9 - Resurfacing
3 - Form	10 - Feasibility Study
4 - Reseal	11 - Preliminary Design
5 - Reshape	12 - Detailed Design
6 - Spot gravel	
7 - Gravel Regravel	

Note: If layers are imported, indicate layer category and thickness

Signatories:

Compiled by: _____

Date: _____

Received by: _____

Date: _____

Short codes – Layer Maint History

Primary Description (Alpha Numeric and Numeric)	Secondary description (Alpha Numeric and Numeric - for gravelling or re-gravelling)	Tertiary description: (Alpha numeric and Numeric - Defines modification)
"G" - Granular (According to current G classification i.e. G1 - G10)	Provision is made to record the material quality using the TRH20 classification (WA,WB,WC,WD,WE1 and WE2) - in case of wearing courses	"M" - Indicates that the pavement layer type as indicated, does not conform to all the specifications (Existing rule sets for Namibia as discussed in Appendix A apply)
"C" - Cemented (According to current TRH14/COLTO class i.e. C1 - C5)	Defines the maximum aggregate size e.g. >53, 53, 37, 26, 19, 16, 13, 9, 6, 4, 2	"A" - Defines treatment of granular layers other than bituminous products or conventional stabilising agents e.g. polymers, enzymes etc.
"BC" - Hot mix bitumen treated BTB continuously graded	Recording "N" in the secondary description would indicate "no information on maximum size available"	"H" - Conventional hot bitumen (Penetration grades, Medium cutback)
"BS" - Hot mix bitumen treated BTB Semi gap graded		"P1 to P2" - Hot polymer modified (Refer TG1 for numeric character)
"ET1 to ET4" - Emulsion treated material based on UCS and ITS (Refer TG2)		"R" - Bitumen rubber
"FB1 to FB4" - Foam Treated material based on UCS and ITS (Refer TG2) Note: Maximum size and binder type are defined separately if data is available		"E" - Conventional bitumen emulsion
"PCJ" - Jointed Concrete		"L1 to L2" - Polymer modified emulsion (latex) (Refer TG1 for numeric character)
"PCC" - Continuously Reinforced Concrete		"T" - Tar (Although not commonly used, information still exists in the database)
"PCR" - Rolled Concrete		"C" - Portland cement
"MW" - Waterbound Macadam		"L" - Lime
"MP" - Penetration Macadam		"dr" - Dry Compaction
"DR" - Dump Rock		"mm" - Mechanically modified (includes crushing, rock busting, adding of fines etc.)
"BR" - Bed Rock		"N" - Modified but no information on modification type
"N" - No Information		

A gravel wearing, mechanically modified and "dry compacted" could be described as G6-WB/37-mm/dr

Maintenance Management Systems

- Blading optimisation

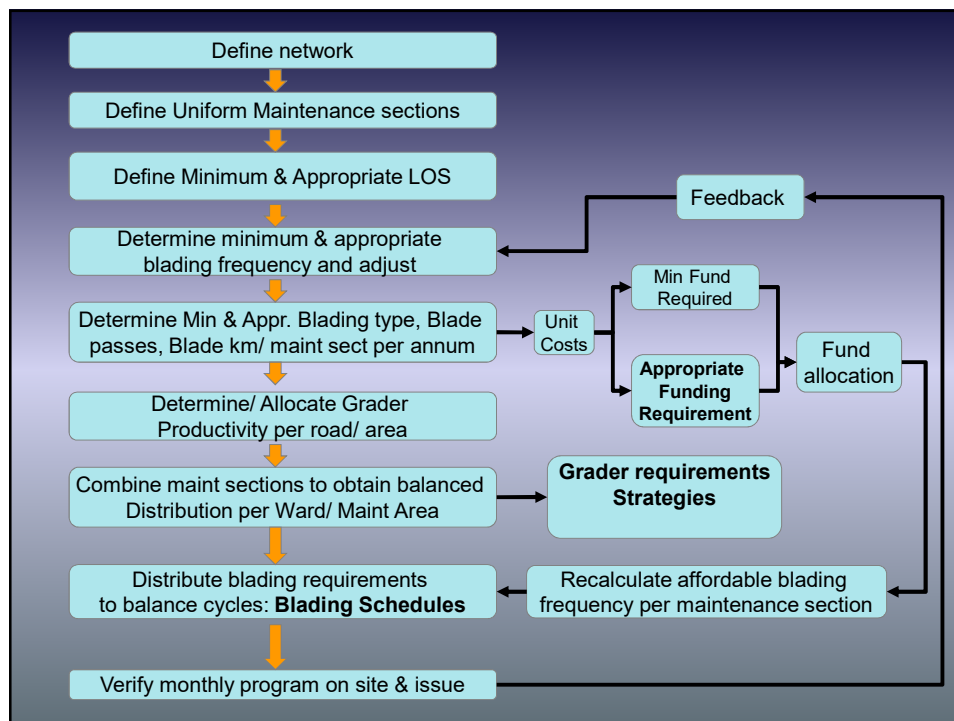
Blading optimisation



Factors influencing blading program

- **Funding**
- **Organisational policy (uitslaap), depots**
- **Effectiveness (Grader availability, working hours)**
- **Road condition, material and maintainability**
- **User requirements**
- **Methodology and operator abilities**
- **Emergencies**

Slide 53

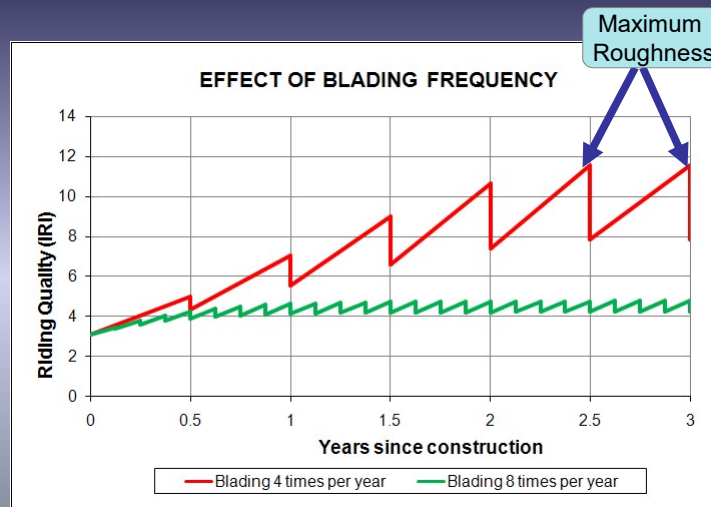


Levels of Serviceability

Level of Serviceability	Required standards		
	Max Roughness ^a	Dustiness ^b	Impassability
5	15	5	Frequently
4	11	3	< 5 days/yr
3	9	3	Never
2	8	3	Never
1	6	1	Never

a International Roughness Index (IRI) in m/km
b See Jones and Paige-Green (2000)

Slide 55



Levels of Serviceability (Implications)

Provincial Road Category	Level of Serviceability	Required standards	
		Max Roughness (IRI)	Average target Roughness
	5	15	13
	4	11	10
	3	9	8
	2	8	7
	1	6	5.5

Slide 57

Levels of Serviceability (Strategic level adjustment)

RIFSA Classification	Traffic (AADT)	Level of Serviceability	Required standards		Minimum Standards
			Max Roughness (IRI)	Appropriate Roughness (IRI)	Minimum Standard Allowed
(6) Non motorised Access	0	5	15	13	1 Blade/year
(5) Access roads	<50	4	11	10	2 Blades/year
(4) District collector	50 - 100	3	9	8	9
(3) District distributor	<150	2	8	7	8
	>150	1	6	5.5	6
(2) Regional distributor		1	6	5.5	6
(1) Primary distributor		1	6	5.5	6
Refer TRH20 (Appendix B) Refer RIFSA Guidelines 2008					

Slide 58

TRH20

Target IRI	Traffic ADT <50			ADT =100			ADT = 200		
	Wet	Mod	Dry	Wet	Mod	Dry	Wet	Mod	Dry
4	8	9	12	10	12	18	18	28	50
5	4	5	6	5	6	9	7	10	18
6	3	4	5	4	5	7	5	7	12
7	3	3	4	3	4	6	4	6	9
8	2	2	3	2	3	4	3	4	7
9	1	1	1	1	1	1	2	2	4
12							1	1	1

Note: Only valid for specific material properties and climatic conditions

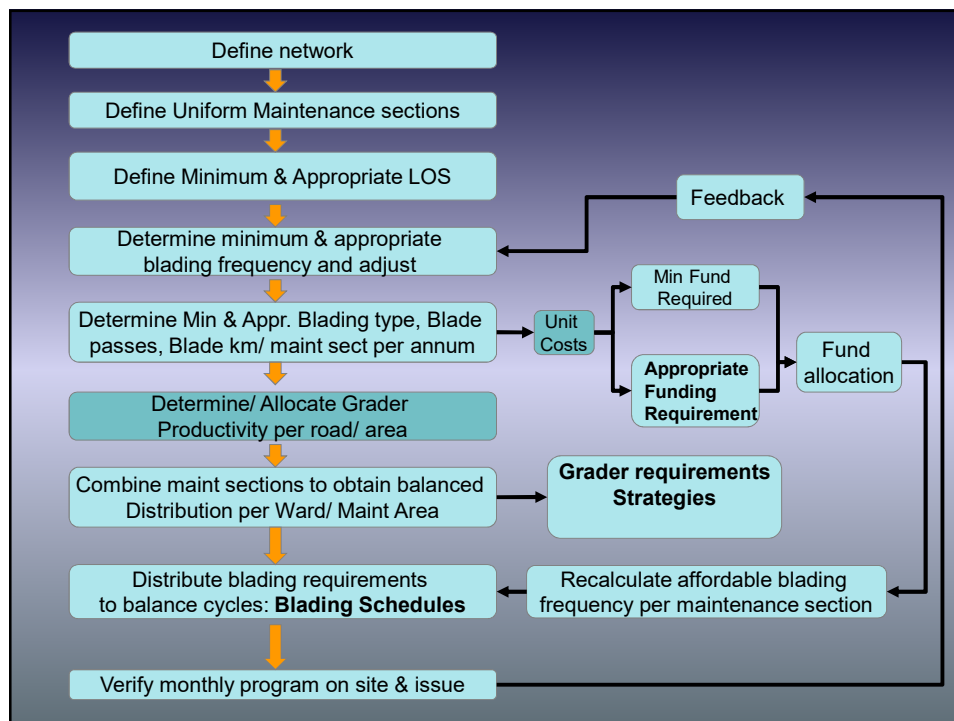


Table 6 Productivity (Blade km per day)

Maintenance measure	Easy Conditions	Moderate	Difficult conditions
Light blading	65	45	25
Hard rain blading	30	25	20
Hard blading with water bowser	20	15	10

Note:

Difficult conditions could include

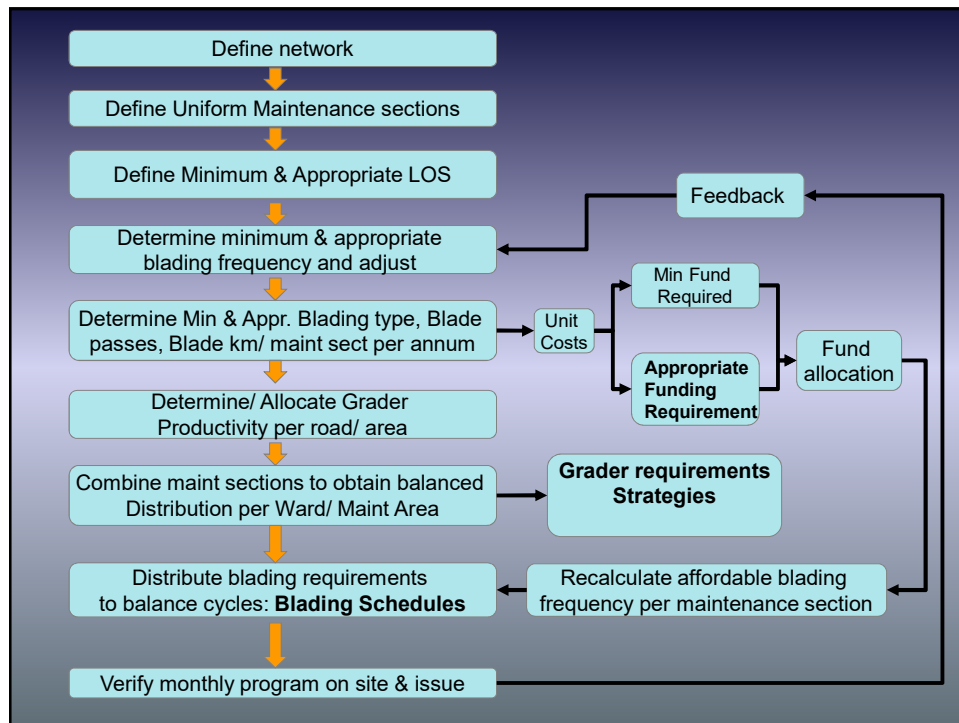
- Only 4 working hours due to travel policy/ distance to depot
- Steep grades
- High traffic volumes resulting in shorter blading sections and additional time to accommodate traffic
- Hard material
- Poor condition
- Long haulage for water bowser

Easy conditions include

- Moist fine material
- Flat areas
- Close to base (long potential working hours)
- Low traffic volumes

Table 11 Equipment costs

Equipment	Cost per hour (including operator)	Cost per day	Cost per blade km (15 blade km per day)	Cost per blade km (20 blade km per day)	Cost per blade km (25 blade km per day)	Cost per blade km (50 blade km per day)
Production (km/day)			15	20	25	50
Maintenance grader	R 353.80	R 2 830.40	R 188.69	R 141.52	R 113.22	R 56.61
Water bowser	R 326.68	R 2 613.44	R 174.23	R 130.67	R 104.54	
			R 362.92	R 272.19	R 217.75	
Vibratory roller (12 ton)	R 871.00	R 6 968.00	R 464.53	R 348.40	R 278.72	



Monthly program issued to operator

EDEN DISTRIKSMUNISIPALITEIT: DEPARTEMENT TEGNIESE DIENSTE
MAANDBEPLANNING: JULIE 2008

WYK: Odn Wes

Bertus Hartzenberg

Hoeveelheid werkdade vir operateur in maand:
Beplande lem km vir maand:

16
320

SIKLUS	PAD NOMMER	PAD NAAM	KILOMETER AFSTAND		LEM KM	TAAKBESKRYWING	OPMERKING	AFGEHANDEL
			VAN	TOT				
1	DR01649	Paardebont	0.00	3.42	14	Ligte droë skraap		
1	DR01649	Paardebont	3.42	20.00	66	Ligte droë skraap		
1	DR01649	Paardebont	20.00	42.60	90	Ligte droë skraap		
1	DR01656	Safransrivier	0.00	12.36	49	Ligte droë skraap		
1	DR01677	Zeeoogst/Wynands	0.00	11.18	45	Ligte droë skraap		
1	DR01693	Steenondegat	0.00	12.37	47	Ligte droë skraap		
	DR01655	Mount Hope	0.00	4.00	16	Ligte droë skraap		
	DR01655	Mount Hope	4.00	11.50	30	Ligte droë skraap		

Totale Beplande Lem km vir die maand: 357

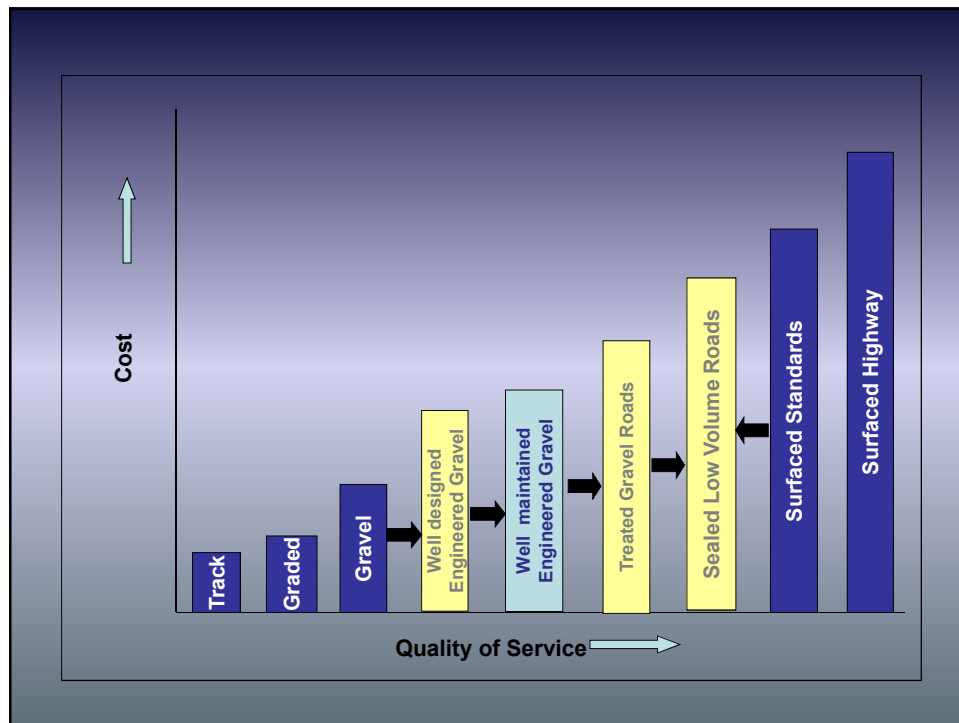
Nota: Operateur moet in opmerking kolom die skraaptoestande beskryf Bv Nat, Baie droog, Stofgate ens.

Operateur moet datum waarop seksie afgehandel is in afgehandel kolom skryf.

Die Vorm moet aan die einde van elke maand ingehandig word by die supt.

Operateurs inligting:

Datum		TAAKBESKRYWING	Addisionele inligting rondom staantyd, soos reën, werktuig break, operateur siek ens.
Van	Tot		
1-Jul-08		Padskraaper operateurs vergadering	
23-Jul-08		Spanbesoek met Gert, Alvin, Maevia, Reginald	
28-Jul-08	31-Jul-08	Nof 4 kursus	

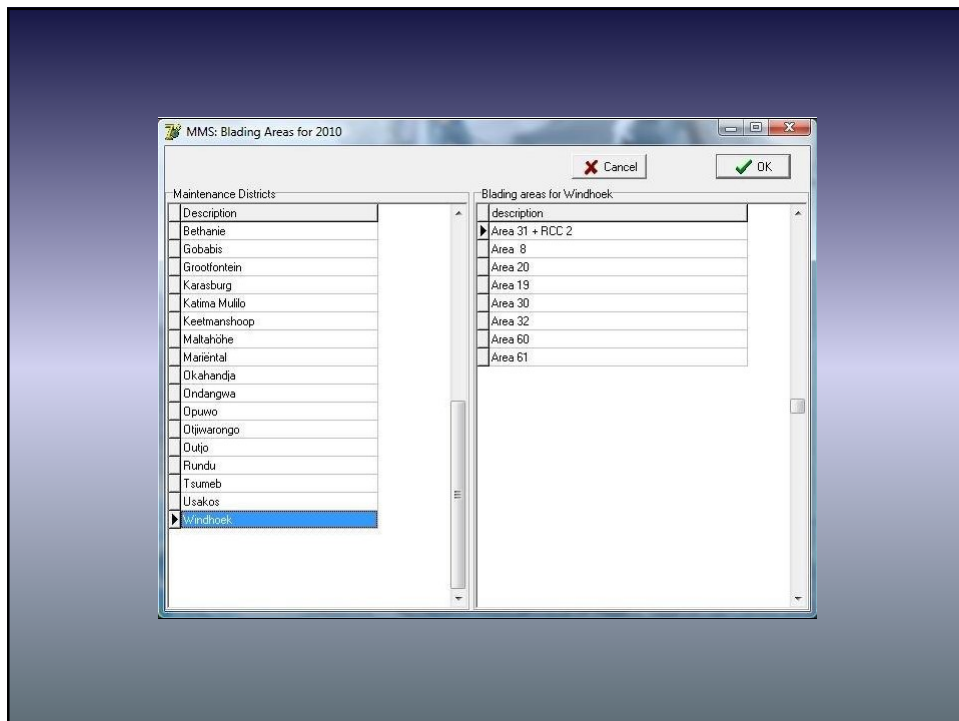
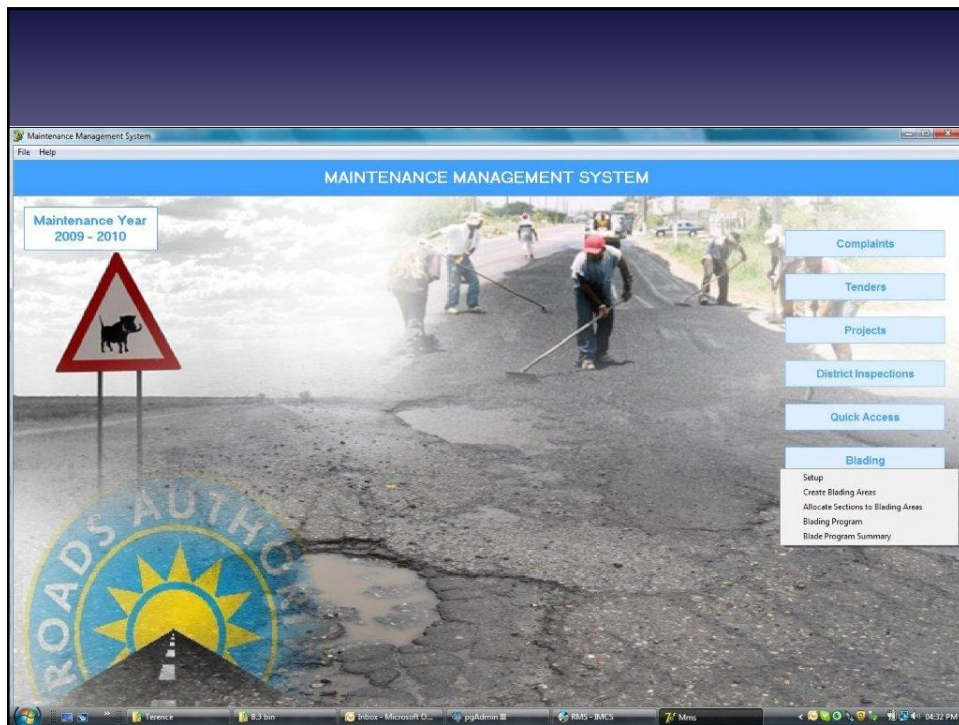


Results after implementation (Eden DM)

- Well defined monthly programs
- Major reduction in complaints
- Positive feedback from communities/ RU
- Ability to adjust blading programs with reduced/ increased funding
- Ability to manage emergency work

Note: Process verified with other authorities –
TRH20

- Emphasis now on training (DVD)



MMS: Allocate sections to blading areas for 2009 - 2010

Maintenance Districts and Blading Areas		Sections not allocated in Windhoek						Sections allocated to Area 51					
		Road Number	Begin km	End km	Length (km)	Begin Description	End Description	Road Number	Begin km	End km	Length (km)	Begin Description	End Description
Bethanie		D1228	0.00	26.71	26.710	M0033	D1249						
Gobabis		D1230	69.05	75.34	7.290	Hardap - Khomas Regions	M0045						
Grootfontein		D1232	0.00	13.91	13.910	T0105	Khomas - Hardap	D1261	10.61	41.58	30.970	END OF GRAVEL SECTION	D1274
Karasburg		D1249	0.00	45.85	45.850	M0033	D1228	D1261	41.58	48.91	7.330	D1274	Hardap - Khomas f
Katima Mulilo		D1274	8.84	23.23	14.390	Hardap - Khomas Regions	D1261	D1261	54.23	70.45	16.220	Hardap - Khomas Regions	D1275
Keetmanshoop		D1282	10.53	19.78	9.250	D1236	Hardap - Khoma	D1261	70.45	93.25	22.800	D1275	D1265
Mariental		D1305	0.00	2.39	2.390	M0049	END OF EARTH	D1261	93.25	98.78	5.530	D1265	Hardap - Khomas f
Okahandja		D1305	38.53	41.88	3.350	END OF PROCLAMATION	D1982						
Ondangwa		D1427	0.00	9.99	9.990	T0105	END OF ROAD						
Opuwo		D1448	0.00	18.55	18.550	M0033	D1219						
Otiwarongo		D1448	18.55	20.00	1.450	D1219	END OF GRAVE						
Oujo		D1501	0.00	1.68	1.680	T0601	END OF ROAD						
Rundu		D1504	2.76	4.42	1.660	END OF BITUMEN SECTION	END OF GRAVE						
Tsumeb		D1980	13.60	39.89	26.290	Erongo - Khomas Regions	D1982						
Usakos		M0031	408.17	413.84	5.670	Hardap - Khomas Regions	M0036						
Windhoek		M0036	145.17	157.51	11.240	Erongo - Khomas Regions	M0049						
Area 31 + RCC 2		M0036	157.51	195.83	38.320	M0045	Erongo - Khoma						
Area 8		M0036	194.93	221.32	26.390	Erongo - Khomas Regions	D1275						
Area 20		M0036	221.32	230.60	9.280	D1275	M0031						
Area 19		M0036	230.60	234.75	4.150	M0031	Hardap - Khoma						
Area 30		M0045	45.25	70.44	25.190	Hardap - Khomas Regions	D1223						
Area 32		M0045	70.44	93.11	22.670	D1223	D1230						
Area 60		M0045	93.11	98.16	5.050	D1230	Hardap - Khoma						

23 sections - 316.82 km 7 records selected

5 sections - 82.83 km 0 records selected

MMS: Maintenance Setup

Initial Gravel Section Setup

Maintenance District	Blading Area	Maintenance Type	Unit	Cost per Unit	Units per day
Gobabis	Area 20	Heavy Blading	km	180.00	15
Grootfontein	Area 20	Light Blading	km	120.00	45
Karasburg	Area 20	Road Reserve Blading	km	200.00	10
Katima Mulilo	Area 30	Blading Day Work	hour	150.00	8
Keetmanshoop	Area 30	Heavy Blading	km	180.00	15
Mariental	Area 30	Light Blading	km	120.00	45
Okahandja	Area 30	Road Reserve Blading	km	200.00	10
Ondangwa	Area 31 + RCC 2	Blading Day Work	hour	150.00	8
Opuwo	Area 31 + RCC 2	Heavy Blading	km	180.00	15
Otiwarongo	Area 31 + RCC 2	Light Blading	km	120.00	45
Oujo	Area 31 + RCC 2	Road Reserve Blading	km	200.00	10
Rundu	Area 32	Blading Day Work	hour	150.00	8
Tsumeb	Area 32	Heavy Blading	km	180.00	15
Usakos	Area 32	Light Blading	km	120.00	45
Windhoek	Area 32	Road Reserve Blading	km	200.00	10
	Area 60	Blading Day Work	hour	150.00	8

Planning per blading segment

BladingProgramCapture.jpg - Picasa Photo Viewer

MMS Blading program for 2010 - 2011

Maintenance Areas and Blading Areas

Blading program for Area 8

Calculate totals

Road Length: 317.140
Blade km per year: 10 582.560

Blade days required: 235.2
Available days per year: 220
Graders req: 1.07

Export

Road Nr	Begin Km	End Km	Length (km)	Light Blading Passes	Additional Light Passes	Light Cycles	Light Blading km	Light Blade km/day	Light Blading Days Required	Length (km)	Heavy Blading Passes	Additional Heavy Passes	Heavy Cycles	Heavy Blading km	Heavy Blade km/day	Heavy Blading Days Required	Length (km)
D1601	0.00	40.52	40.52	48.52	0	12	1 944.96	45	43.2	40.52	0	0	0	0.00	15	0.0	40.52
D1603	0.00	3.88	3.88	3.88	4	0	93.12	45	2.1	3.88	0	0	0	0.00	15	0.0	3.88
D1670	0.00	56.19	56.19	56.19	4	0	2 697.12	45	59.9	56.19	0	0	0	0.00	15	0.0	56.19
D1681	0.00	40.77	40.77	40.77	4	0	1 956.96	45	43.5	40.77	0	0	0	0.00	15	0.0	40.77
D1702	0.00	24.14	24.14	24.14	4	0	1 729.36	45	38.5	24.14	0	0	0	0.00	15	0.0	24.14
D1735	0.00	43.98	43.98	43.98	4	0	2 211.04	45	48.9	43.98	0	0	0	0.00	15	0.0	43.98
M0113	0.00	57.66	57.66	57.66	5	0	5 189.40	45	115.3	57.66	0	0	0	0.00	15	0.0	57.66

Comments

Copy to new year

7 sections

MMS Blading program for 2010

Maintenance Districts and Blading Areas

Calculate totals

Road Length: 82 050
Blade km per year: 5 041.170

Blade days required: 103.1
Available days per year: 220
Graders required: 0.47
Annual Cost (R\$): 556 752.00

Export

Road Nr	Begin Km	End Km	Length (km)	Begin Description	End Description	Traffic Light	Traffic Heavy	Width (m)	LOS	Impossibility	Cycles per year	Light Blading Passes	Additional Light Passes	Light Cycles	Light Blading km	Light Blade km/day	Light Blading Days Required	Heavy Blading Passes	Additional Heavy Passes	Heavy Cycles	Heavy Blading km	Heavy Blade km/day	Heavy Blading Days Required	Reserve Blading Passes
D1163	10.61	41.50	30.89	END DP	D1274	40	5	7.0	ND		15	3	1	14	1734.32	45	38.5	1	1	1	61.94	15	4.1	3
D1203	41.58	46.91	5.33	D1274	Hardap	40	5	7.0	ND		15	3	1	14	416.48	45	9.1	1	1	4	98.64	15	3.9	3
D1261	54.23	70.45	16.22	Hardap	D1275	40	5	7.0	ND		15	3	1	14	908.32	45	20.2	1	1	1	32.44	15	2.2	3
D1261	70.45	93.25	22.80	D1275	D1265	40	5	7.0	ND		15	4	0	14	3276.80	45	28.4	0	0	0	0.00	15	0.0	3
D1261	93.25	98.70	5.45	D1265	Hardap	20	5	7.0	ND		21	4	0	14	309.60	45	6.9	0	0	0	7.00	15	0.0	3

MMS Blading program for 2010

Maintenance Districts and Blading Areas

Calculate totals

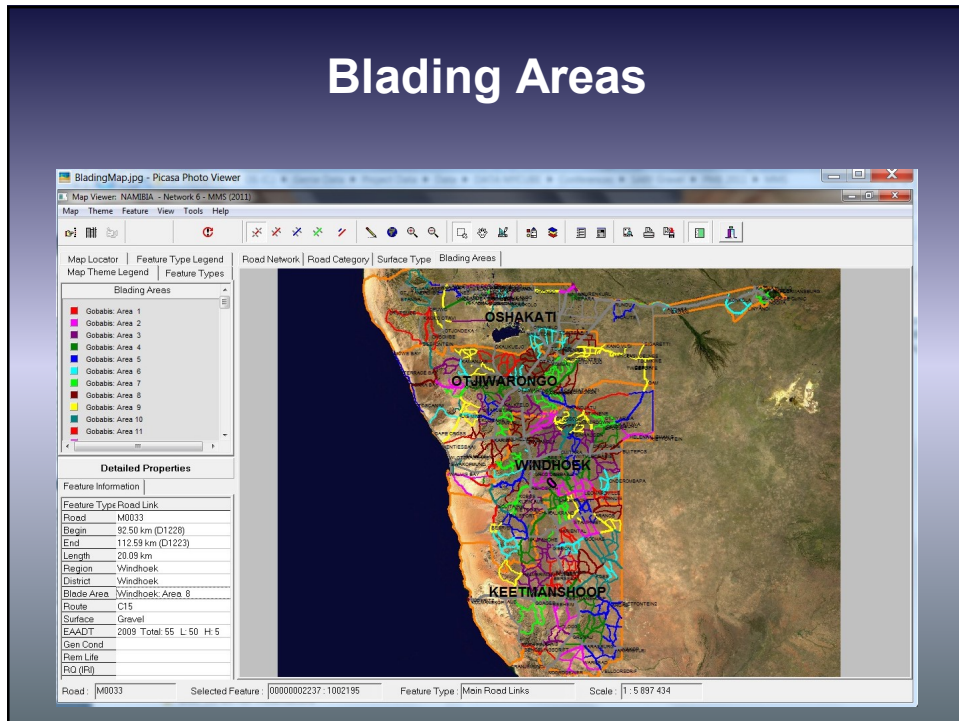
Road Length: 82 050
Blade km per year: 5 041.170

Blade days required: 103.1
Available days per year: 220
Graders required: 0.47
Annual Cost (R\$): 556 752.00

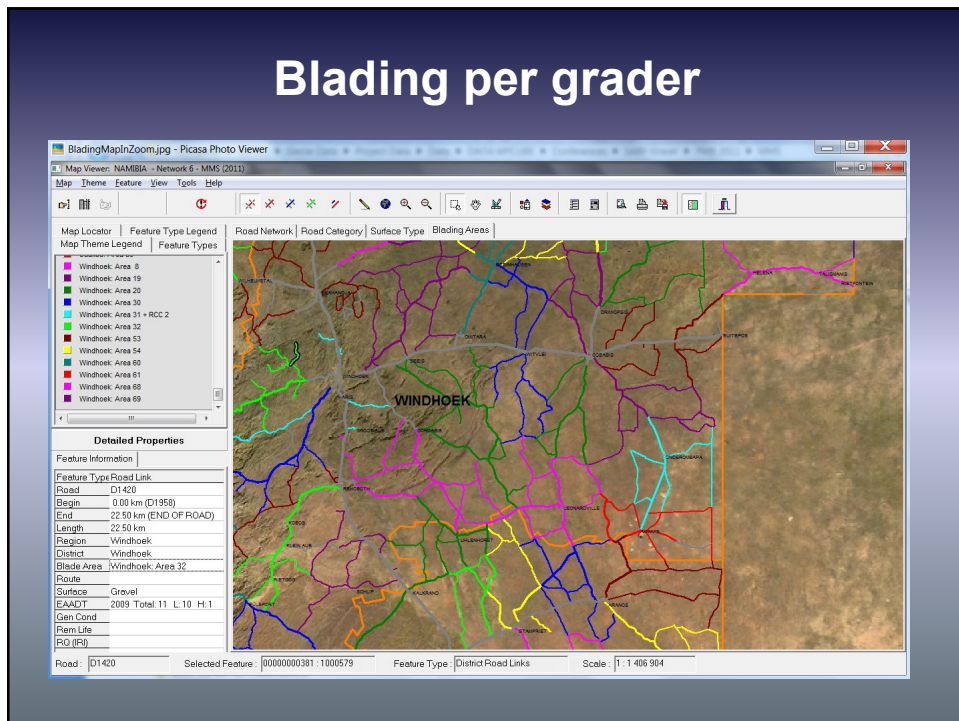
Export

Road Nr	Begin Km	End Km	Length (km)	Light Cycles	Light Blading km	Light Blade km/day	Light Blading Days Required	Heavy Blading Passes	Additional Heavy Passes	Heavy Cycles	Heavy Blading km	Heavy Blade km/day	Heavy Blading Days Required	Reserve Blading Passes	Reserve Cycles	Reserve Blading km	Reserve Blade km/day	Reserve Blading Days Required	Daywork Length (km)	Daywork Cycles	Daywork Hours	Annual Grading Cost
D1163	10.61	41.50	30.89	14	1734.32	45	38.5	1	1	1	61.94	15	4.1	3	1	52.91	10	3.291	5	2	24	240 068.00
D1203	41.58	46.91	5.33	14	416.48	45	9.1	1	1	4	98.64	15	3.9	3	1	21.99	10	2.199	2	2	24	71 410.00
D1261	54.23	70.45	16.22	14	908.32	45	20.2	1	1	1	32.44	15	2.2	3	1	46.66	10	4.666	3	2	36	135 863.00
D1261	70.45	93.25	22.80	14	3276.80	45	28.4	0	0	0	0.00	15	0.0	3	1	68.4	10	6.84	2	2	18	172 286.00
D1261	93.25	98.70	5.45	14	309.60	45	6.9	0	0	0	7.00	15	0.0	3	1	16.59	10	1.659	2	2	18	45 076.00

Blading Areas



Blading per grader



ANNUAL COST UPDATE

Annual Update of Costs



GOVERNMENT OF THE REPUBLIC OF NAMIBIA

ROADS AUTHORITY

Report on Roadworks Costs
For the
Road Maintenance Activities as defined in the Road Management System

November 24

Standardised way to calculate costs

74 Rehab (M)

Gravel layers to 95% incl 1km freehaul	m ³	0.15	23.62	3.54
Reworking insitu	m ³	0.15	14.04	2.11
Stabilisation	m ³	0.15	7.48	1.12
Stab Agent	t	0.01	1 270.79	9.53
Crushed stone base 88%	m ³	0.15	163.35	24.50
Overhaul ?	m ³ km	12.50	1.65	20.63
Gravel shoulders	m ³	0.15	26.08	3.91
Borrow materials				1.46
Finishing RR				0.89
Side drainage				8.03
Add D Seal				25.50
Total				101.22

75 Rehab (H)

Gravel layers to 93% incl 1km freehaul	m ³	0.15	20.25	3.04
Gravel layers to 95% incl 1km freehaul	m ³	0.15	23.62	3.54
Reworking insitu	m ³	0.15	14.04	2.11
Extra over for adding material	m ³	0.05	17.00	0.85
Stabilisation	m ³	0.15	7.48	1.12
Stab Agent	t	0.01	1 270.79	9.53
Crushed stone base 88%	m ³	0.15	163.35	24.50
Overhaul ?	m ³ km	25.00	1.65	41.25
Gravel shoulders	m ³	0.30	26.08	7.82
Borrow materials				1.46
Finishing RR				0.89
Side drainage				8.03
Add D Seal				25.50
Total				129.65

Novembe

Unit Cost of Works

Remedial Action			Basic Unit Cost	Additional Costs as a Fraction of the Basic Unit Cost												Project Unit Cost		
No.	Action Type	Remedial Action Description		Unit	Pretreat-ment	1300 Establish-ment	1400 Engineer's Site Estab.	1500 Traffic	5600 Road Signs	5700 Road Markings	6100 Testing Materials	Esca-lation	Mat. Test	Prof fees	Super- vision		Head Office Overheads	VAT
Surfaced Roads																		
		Crack sealing	m ²	36.36	0.000	0.010	0.000	0.005	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.025	0.150	42.10
		Patching	m ²	301.00	0.000	0.010	0.000	0.005	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.025	0.150	350.45
		Edge breaks	m ²	268.00	0.000	0.010	0.000	0.005	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.025	0.150	319.19
		Single seal with shape correction	m ²	40.76	0.100	0.010	0.000	0.005	0.000	0.010	0.001	0.000	0.010	0.000	0.000	0.025	0.150	53.44
		Double seal with shape correction	m ²	62.54	0.100	0.010	0.000	0.005	0.000	0.010	0.001	0.000	0.010	0.000	0.000	0.025	0.150	83.07
1	Asphalt (AC)	Asphalt Concrete	m ²	32.85	0.100	0.010	0.000	0.005	0.000	0.010	0.001	0.000	0.010	0.000	0.000	0.025	0.150	43.07
2	REJ + AC	Rejuvenator + Asphalt Concrete	m ²	37.03	0.100	0.010	0.000	0.005	0.000	0.010	0.001	0.000	0.010	0.000	0.000	0.025	0.150	46.55
3	13.2+6.7	13.2 + 6.7mm Double Seal	m ²	25.50	0.100	0.010	0.000	0.005	0.000	0.010	0.001	0.000	0.010	0.000	0.000	0.025	0.150	33.43
4	Cape Seal	Cape Seal	m ²	25.50	0.100	0.010	0.000	0.005	0.000	0.010	0.001	0.000	0.010	0.000	0.000	0.025	0.150	33.43
5	13.2mm	13.2mm Single Seal	m ²	12.36	0.100	0.010	0.000	0.005	0.000	0.010	0.001	0.000	0.010	0.000	0.000	0.025	0.150	16.20
6	9.5mm	9.5mm Single Seal	m ²	9.89	0.100	0.010	0.000	0.005	0.000	0.010	0.001	0.000	0.010	0.000	0.000	0.025	0.150	12.97
7	REJ + Cape	Rejuvenator + Cape Seal	m ²	29.68	0.100	0.010	0.000	0.005	0.000	0.010	0.001	0.000	0.010	0.000	0.000	0.025	0.150	36.91
8	CS + Mod13	Coarse Slurry + Modified 13.2mm	m ²	25.25	0.100	0.010	0.000	0.005	0.000	0.010	0.001	0.000	0.010	0.000	0.000	0.025	0.150	33.10
9	Slurry (CS)	Coarse Slurry	m ²	10.08	0.100	0.010	0.000	0.005	0.000	0.010	0.001	0.000	0.010	0.000	0.000	0.025	0.150	13.21
11	REJ	Rejuvenator	m ²	4.18	0.100	0.010	0.000	0.005	0.000	0.000	0.001	0.000	0.010	0.000	0.000	0.025	0.150	5.44
13	Z - seal	Sand Seal / Grit Seal	m ²	6.02	0.100	0.010	0.000	0.005	0.000	0.010	0.001	0.000	0.010	0.000	0.000	0.025	0.150	7.89
15	REJ + 13.2	Rejuvenator + 13.2mm Single Seal	m ²	16.54	0.100	0.010	0.000	0.005	0.000	0.010	0.001	0.000	0.010	0.000	0.000	0.025	0.150	21.68
16	REJ + 9.5	Rejuvenator + 9.5mm Single Seal	m ²	14.07	0.100	0.010	0.000	0.005	0.000	0.010	0.001	0.000	0.010	0.000	0.000	0.025	0.150	16.45
18	REJ + FS	Rejuvenator + Fine Slurry	m ²	12.87	0.100	0.010	0.000	0.005	0.000	0.010	0.001	0.000	0.010	0.000	0.000	0.025	0.150	16.87
19	REJ + CS	Rejuvenator + Coarse Slurry	m ²	14.25	0.100	0.010	0.000	0.005	0.000	0.010	0.001	0.000	0.010	0.000	0.000	0.025	0.150	18.69
20	Mod 13.2	Mod Binder 13.2mm Single Seal	m ²	15.17	0.100	0.010	0.000	0.005	0.000	0.010	0.001	0.000	0.010	0.000	0.000	0.025	0.150	19.89
26	REJ + Mod13	REJ + Mod Binder 13.2mm Seal	m ²	19.35	0.100	0.010	0.000	0.005	0.000	0.010	0.001	0.000	0.010	0.000	0.000	0.025	0.150	25.37
33	FS + 13.2	Fine Slurry + 13.2mm Seal	m ²	17.94	0.100	0.010	0.000	0.005	0.000	0.010	0.001	0.000	0.010	0.000	0.000	0.025	0.150	23.52
43	FS + Mod13	Fine Slurry + Mod Binder 13.2mm	m ²	23.86	0.100	0.010	0.000	0.005	0.000	0.010	0.001	0.000	0.010	0.000	0.000	0.025	0.150	31.28
53	REJ+FS+13.2	REJ + Fine Slurry + 13.2mm Seal	m ²	25.23	0.100	0.010	0.000	0.005	0.000	0.010	0.001	0.000	0.010	0.000	0.000	0.025	0.150	33.08
54	REJ+FS+9.5	REJ + Fine Slurry + 9.5mm Seal	m ²	22.76	0.100	0.010	0.000	0.005	0.000	0.010	0.001	0.000	0.010	0.000	0.000	0.025	0.150	29.84
63	REJ+FS+Mod13	REJ + Fine Slurry + Mod 13.2mm	m ²	28.04	0.100	0.010	0.000	0.005	0.000	0.010	0.001	0.000	0.010	0.000	0.000	0.025	0.150	36.76
70	Mix+Replace	Mill and Replace with Asphalt	m ²	46.35	0.300	0.100	0.050	0.070	0.010	0.010	0.025	0.150	0.050	0.075	0.100	0.075	100.16	
71	Rehab (HS)	Rehabilitate (Hold Action: Seal)	m ²	22.47	0.300	0.100	0.050	0.070	0.010	0.010	0.025	0.150	0.050	0.075	0.100	0.075	49.52	
72	Rehab (HA)	Rehabilitate (Hold Action: Asph)	m ²	38.12	0.300	0.100	0.050	0.070	0.010	0.010	0.025	0.150	0.050	0.075	0.100	0.075	82.53	
73	Rehab (L)	Rehabilitate (Light)	m ²	63.71	0.100	0.100	0.050	0.070	0.010	0.010	0.025	0.150	0.050	0.075	0.100	0.075	125.19	
74	Rehab (M)	Rehabilitate (Medium)	m ²	101.22	0.100	0.100	0.050	0.070	0.010	0.010	0.025	0.150	0.050	0.075	0.100	0.075	196.90	
75	Rehab (H)	Rehabilitate (Heavy)	m ²	129.64	0.100	0.100	0.050	0.070	0.010	0.010	0.025	0.150	0.050	0.075	0.100	0.075	254.74	
Unsurfaced Roads																		
		Blinding	bl.km	74.00	0.000	0.010	0.000	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.025	0.150	89.06
		Forming	km	52 427.00	0.000	0.010	0.000	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.025	0.150	62 388.13
		Reshaping	km	61 772.00	0.000	0.010	0.000	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.025	0.150	73 508.68
		Spot graveling	m ²	105.00	0.000	0.010	0.000	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.025	0.150	124.95
		Regraveling	km	105 386.00	0.000	0.050	0.000	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.025	0.150	129 637.06
		Upgrading (Low)	m ²	102.68	0.000	0.050	0.050	0.030	0.000	0.000	0.000	0.000	0.010	0.000	0.000	0.025	0.150	135.02
		Upgrading (Medium)	m ²	219.90	0.050	0.100	0.050	0.070	0.010	0.000	0.025	0.150	0.050	0.075	0.100	0.075	418.91	
		Upgrading (High)	m ²	284.82	0.100	0.100	0.050	0.070	0.010	0.000	0.025	0.150	0.050	0.075	0.100	0.075	556.62	

