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USING A COMPUTERISED MODEL TO MANAGE YOUR UNSEALED ROADS NETWORK

Darren Shepherd

IPWEAQ
2003 STATE CONFERENCE
MACKAY

SUNDAY 5 — FRIDAY 10 OCTOBER 2003
WINDMILL MOTEL & RECEPTION CENTRE

C/-MACKAY CITY COUNCIL · PO BOX 41 · MACKAY · QLD 4740
TELEPHONE: 07 4968 4598 · FACSIMILE: 07 4968 4562
EMAIL: ipweaqcon@mackay.qld.gov.au

USING A COMPUTERISED MODEL TO MANAGE YOUR UNSEALED ROADS NETWORK

Darren Shepherd, darren@shepherdservices.net

Managing Director of Shepherd Services Pty Ltd. Australia

Abstract

Believing that there was a better way of managing expenditure on unsealed roads, Darren Shepherd has developed a computer-based system to help councils to guide maintenance budgets, programs and objectives.

Key Words: Unsealed Roads, Maintenance Management, Computer System, Operational Techniques, Condition Assessment.

Introduction

Over the last four years Shepherd Services has been working with Councils developing a practical asset management system to assist councils in the management of their unsealed road networks.

The Aim of the System

To reduce the deterioration of unsealed roads to acceptable levels within financial restraints, by managing the aspects and approaches to maintenance and renewal works.

Overview of the Shepherd Services Maintenance Management System

The system is displayed in figure 1 is a simple house structure. Just like a house, the foundations of the system, the Best Practice Maintenance Operational

Techniques, is the starting point and the most critical component.

Once these operational techniques have been put in place, the adoption of

management techniques and a computer system to support the process enables the council to control a network of unsealed roads in the most economic and effective way.

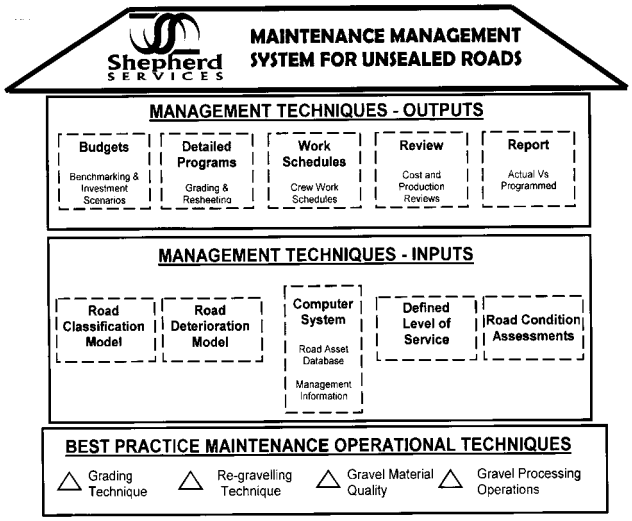


Figure 1.0 System Overview

A Comment on Best Practice Operational Techniques

The gravel surface of an unsealed road is more vulnerable to far quicker deteriorations, aspects like climate, road geometry, gravel material quality, maintenance/construction practices and seasonal traffic volumes all affect this rate of deterioration.

Therefore, the only traditional **controllable aspects** that an organisation has in offsetting the increases of deterioration are by the regular grading and resheeting of the unsealed roads with the proper techniques and more importantly with the right type of gravel materials.

- *Best Practice Grading* of the road surface ensures the removal of road defects and compaction of a uniform layer of retrieved material at a **moisture content that will maximize the stability** of the road surface.

- *Best Resheeting* of the road surface is an emphasis on **quality gravel materials**, to specification, which will ensure the decrease of gravel loss over time and also reduce the frequency of grading required.

Computer system and Management Techniques

Shepherd Services have developed a **computer system** that is used to manage unsealed roads in an easy and simple manner. The computer system performs the following tasks:

a) quantifies the work required to maintain a network of unsealed roads to a desired standard and determine how much will it cost?

b) determines current road needs and deficiencies.

c) determines when roads require maintenance within set maintenance intervention levels.

d) program works: grading, resheeting and gravel processing works.

e) review and reports on completed works: amounts, costs and production rates.

f) foster continuous improvement.

The system give Councils back the control to manage a task that in the past has been difficult to do, due to its complex nature.

Figure 2.0. Main Menu from Shepherd Services Maintenance Management System

Let's takes a closer look at some of the above components.

Quantify the Work Required to Maintain a Network of Unsealed Roads to a Desired Standard and Determine How Much will it Cost?

Step 1. Adopting A Road Classification Model.

A classification model separates a network of roads into different road classes as determined by an assessment of the traffic volume and road function. Various road classes reflecting different maintenance needs are used to help assign maintenance money based on relative needs. A classification system breaks up a large number of roads into more manageable amounts. The classification system that is used will be dependent on the individual council. Yet at the end of the day any logical system will work.

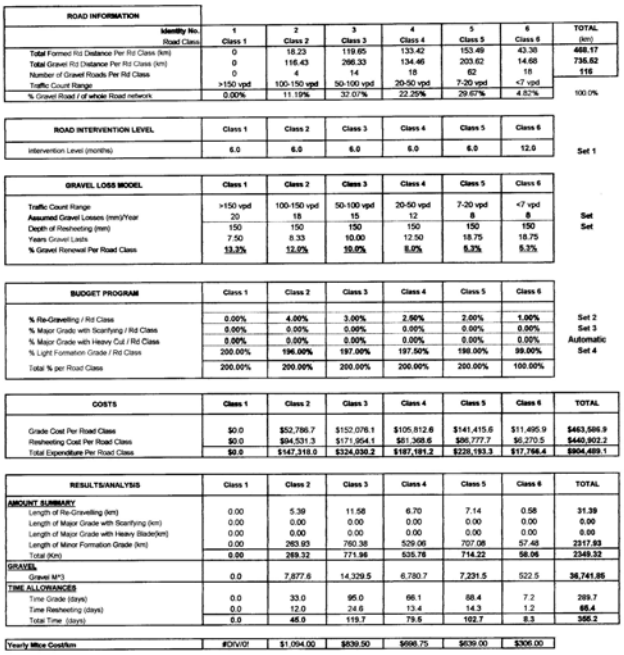
Step 2. Determine Production Rates And Costs For Operational Activities.

Determine the production rates for the different operational techniques (initially estimated until you have some real data to determine actual costs and production rates). Once these have been determined they are used to create budgets and initial programs.

Step 3. Determine Initial Benchmark Expenditure For A Network Of Unsealed Roads.

Combining the road classification, defined level of service and production rates will permit the completion of different budget scenarios for maintaining a network of unsealed roads at different levels of service (grading and resheeting frequencies).

We call this the **Benchmark Expenditure Approach**. This system allows assignment of different amounts of activities to the various road classes for different service levels, to determine expenditure and required resources.



ROAD INFORMATION							
Identity No.	1	2	3	4	5	6	TOTAL
Road Class	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	(km)
Total Formed Rd Distance Per Rd Class (km)	0	18.23	119.65	133.42	153.49	43.38	468.17
Total Gravel Rd Distance Per Rd Class (km)	0	116.43	266.33	134.46	203.62	14.68	735.52
Number of Gravel Roads Per Rd Class	0	4	14	18	62	18	116
Traffic Count Range	>150 vpd	100-150 vpd	50-100 vpd	20-50 vpd	7-20 vpd	<7 vpd	
% Gravel Road / of whole Road network	0.00%	11.19%	32.07%	22.25%	29.67%	4.82%	100.0%

ROAD INTERVENTION LEVEL	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	
Intervention Level (months)	6.0	6.0	6.0	6.0	6.0	12.0	Set 1

GRAVEL LOSS MODEL	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	
Traffic Count Range	>150 vpd	100-150 vpd	50-100 vpd	20-50 vpd	7-20 vpd	<7 vpd	
Assumed Gravel Losses (mm)/Year	20	18	15	12	8	8	Set
Depth of Resheeting (mm)	150	150	150	150	150	150	Set
Years Gravel Lasts	7.50	8.33	10.00	12.50	18.75	18.75	
% Gravel Renewal Per Road Class	13.3%	12.0%	10.0%	8.0%	5.3%	5.3%	

BUDGET PROGRAM	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	
% Re-Gravelling / Rd Class	0.00%	4.00%	3.00%	2.50%	2.00%	1.00%	Set 2
% Major Grade with Scarifying / Rd Class	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	Set 3
% Major Grade with Heavy Cut / Rd Class	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	Automatic
% Light Formation Grade / Rd Class	200.00%	196.00%	197.00%	197.50%	198.00%	99.00%	Set 4
Total % per Road Class	200.00%	200.00%	200.00%	200.00%	200.00%	100.00%	

COSTS	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	TOTAL
Grade Cost Per Road Class	$0.0	$52,786.7	$152,076.1	$105,812.6	$141,415.6	$11,495.9	$463,586.9
Resheeting Cost Per Road Class	$0.0	$94,531.3	$171,954.1	$81,368.6	$86,777.7	$6,270.5	$440,902.2
Total Expenditure Per Road Class	$0.0	$147,318.0	$324,030.2	$187,181.2	$228,193.3	$17,766.4	$904,489.1

RESULTS/ANALYSIS	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	TOTAL
AMOUNT SUMMARY							
Length of Re-Gravelling (km)	0.00	5.39	11.58	6.70	7.14	0.58	31.39
Length of Major Grade with Scarifying (km)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Length of Major Grade with Heavy Blade(km)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Length of Minor Formation Grade (km)	0.00	263.93	760.38	529.06	707.08	57.48	2317.93
Total (Km)	0.00	269.32	771.96	535.76	714.22	58.06	2349.32
GRAVEL							
Gravel M^3	0.0	7,877.6	14,329.5	6,780.7	7,231.5	522.5	36,741.86
TIME ALLOWANCES							
Time Grade (days)	0.0	33.0	95.0	66.1	88.4	7.2	289.7
Time Resheeting (days)	0.0	12.0	24.6	13.4	14.3	1.2	65.4
Total Time (days)	0.0	45.0	119.7	79.5	102.7	8.3	366.2
Yearly Mtce Cost/km	#DIV/0!	$1,094.00	$839.50	$698.75	$639.00	$306.00	

Figure 3. Example of an Expenditure Benchmarking

The benchmark expenditure approach considers that all roads in each road class deteriorate the same way. In real life this does not occur. Therefore, the next step is to verify this information using a visual *road condition assessment* to determine the actual road **needs** and **deficiencies.**

A **Visual Condition Assessment System** has the advantage over the electronic measurements as it tells you the quantity and severity of road defects along the road. The common defects that are picked up are corrugations, ruts, subgrade breakout, looseness, roughness, potholes and scours.

A powerful aspect of this visual defect logging system is that once the information is entered into the computer system, the system assigns particular scores to the different defect types to come up with an overall *surface condition score*.

The road surface condition score can be used in very interesting ways. For example, the score is used to **compare and prioritise road maintenance** and to **determine when a road requires maintenance** (this score is used to predetermine a level of roughness, that when reached, maintenance is engaged on roads).

Overall, the road condition assessment system is a very powerful information tool which is **very helpful** for managers, as it enables him at any time determine the needs of a road; **answer road complaints;** make sure urgent works have been completed; **avoid ligation** issues; and **program** necessary works.

Also, the information collected will enable the manager and council to **get a picture of a road or the whole road network without leaving the office**

Step 4. Fine-Tuning Of Assigned Amounts By Road Condition Assessments.

Figure 4 is a summary defect report from the system that shows the condition of roads within the network by road class. This information is used to help determine resheeting needs and also grading techniques required.

SUMMARY OF DEFECTS LOG

Rd Class	Work Area	Road Name	Date	Score/Km	CORRUGATIONS Large	Medium	Small	LOOSENESS V.Poor	Poor	Fair	ROUGHNESS V.Poor	Poor	Fair	RUTTING Large	Medium	Small	SUBGRADE Type 1	Type 2	SCOURS V.Poor	Poor	Fair
2	Dysart Township	Cotherstone - Capella Rd.	07-Dec-01	15.8									12		5.3	4.9	0.05	0.2	0		0.05
2	Dysart Township	Dysart - Clermont Rd.	07-Dec-01	5.15			0.8				1.6	6.9		1.1	5.5	1.5	1.7	0	0.1	0.3	
2	Dysart Township	Golden Mile Rd.	10-Dec-01	20.4		1.1				8.6			0.8		5.1	7.6		1.2	0		0.2
2	Mt Stuart Camp	Grass Tree Rd.	30-Jan-03	23.2		2	0.6			4.9			6.8		5.0	1.8		6.3	0		1.4
2	Lotus Creek Camp	Isaac River Rd.	07-Jan-03	3.31						2.9			3.8					0.4	0		0.9
2	Lotus Creek Camp	Lotus Ck. Rd	07-Jan-03	0.19						1.1								1.9	0		
2	Mt Stuart Camp	Mackenzie Rvr - Capella Rd	14-Nov-02	17.3			3.8			23			23		19	8.6			0		0.03
2	May Downs Camp	May Downs Rd (DMR)	20-Jan-03	63.1		8.6	9.7		3.7	5.7		3.1	18	1.8	110	8.3	0.3	8.5	0		5.6
2	Mt Stuart Camp	Mt. Stuart - Bedford Weir Rd	30-Jan-03	38.7		1.8				28			28		27			5.2	0		1.9
2	May Downs Camp	Rolfe Ck. - May Downs Rd.	07-Jan-03	0														0.5	0		
2	Lotus Creek Camp	St Lawrence to Croydon Roa	13-Jan-03	11.6		1.8	3.6		1.6	14		1.6	21		4.7	2.2		5.6	0		3.5
2	Valkyrie Camp	Valkyrie Rd.	07-Jan-03	1.97						5.6			5.6		2.1			0.7	0		
2	Middlemount Townshi	Warwick Park Rd.	07-Jan-03	0.19									1.2					2.8	0		
			Average	15.5	Tot	0	15	16	0	5.3	94	0	6.3	130	1.8	180	39	2	35	0	0.1	0

Figure 4. Condition Summary Report

Once you have set your network budget, then individual road programs can be completed using this system.

Program Works Within Budget Restraints

Step 1. Assign Works Based On Needs

The Shepherd Services Maintenance Management System has a simple and easy way to complete detailed roadwork programs for unsealed roads. For example, the form in figure 5 comes from the computer system; it shows how different types of works for individual roads can be programmed.

Assigned works are based on recent road condition assessment reports.

In the amount column you can assign the lengths for different operational activities to be completed. Also, for the resheeting exercise, the gravel pit to be used so that a gravel pit-processing schedule can be produced later.

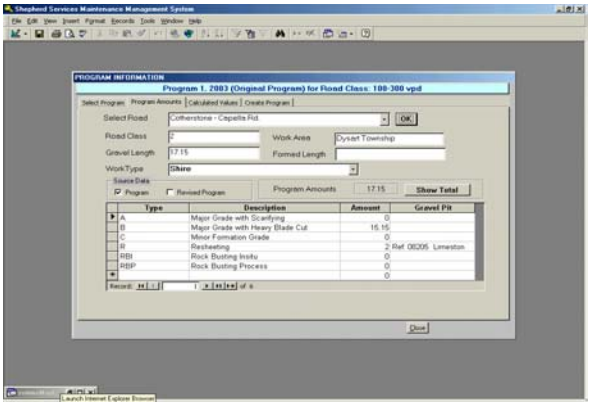


Figure 5. Program Works Form

This system also allows the revision of programs and the completion of different programs from main roads and other shire works like flood damage.

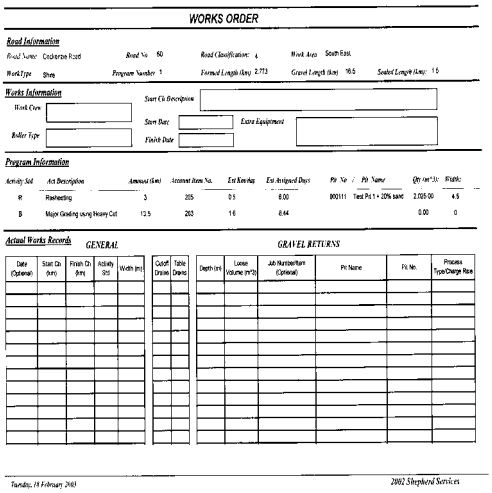
Step 2. Review Program Within Budget Restraints

From here the computer system will specify for the selection of roads that have programmed works, the cost and time to complete each road. Also, once you are satisfied with the program then a detailed report can be produced either sorted by work area or road class, which tells you the total cost of assigned works so that it can be checked against your budget restraints.

Step 3. Produced Work Order for Workforce

Then once you are satisfied with what you have programmed you can print off works orders. This work order doubles up as a form to record actual works completed (this saves confusion).

This form in figure 6 displays what road and works are required to be completed. Once the works have been completed then the "Work Information' and 'Actual Works Records" sections are filled in and handed back to the office



WORKS ORDER

Road Information

Road Name: Cockatoo Road Road No: 60 Road Classification: 4 Work Area: South East

Work Type: Shire Program Number: 1 Formed Length (km): 2.773 Gravel Length (km): 10.5 Sealed Length (km): 1.6

Works Information

Work Crew Start Ch Description

Roller Type Start Date Extra Equipment

Finish Date

Program Information

Activity Std	Act Description	Amount (Km)	Account Item No.	Est Km/day	Est Assigned Days	Pit No / Pit Name	Qty (m^3):	Width:
R	Resheeting	3	205	0.5	6.00	990111 Test Pit 1 + 20% sand	2,025.00	4.5
B	Major Grading using Heavy Cut	12.5	203	1.6	8.44		0.00	0

Actual Works Records

GENERAL

Date (Optional)	Start Ch (km)	Finish Ch (km)	Activity Std	Width (m)	Cutoff Drains	Table Drains

GRAVEL RETURNS

Depth (cm)	Loose Volume (m^3)	Job Number/Item (Optional)	Pit Name	Pit No.	Process Type/Change Rate

Tuesday, 19 February 2002 2002 Shepherd Services

Figure 6. Works Order

Step 4. Determine Work Schedules

From a summary program report (for example, the time to complete grading and resheeting activities) you can then produce crew work schedules. The prioritising of works is completed using the condition scores that are produced by the computer system. These scores can be sorted from highest need to lowest by individual roads or work areas.

Step 5. Determine Gravel Processing Schedule

Also, the computer system will print out gravel **production schedules** for your **gravel pit operations,** from the programmed resheeting works. This will enable you to be able to schedule when and how much gravel should be processed for your gravel pits and thus maximise the amounts that are processed.

Review And Report On Works Completed And Foster Continuous Improvement?

Once the works are completed the actual works records are entered into the computer system along with expenditure and time it took to complete the works. Figure 7 shows an example of one of the reports that can be produced by the system after this information has been entered.

Detailed Actuals with Production Rates

Actual Amounts					Km/Day				Cost/km				Gravel Qty
Road Name	A	B	C	R	A	B	C	R	A	B	C	R	R
Notch Point Rd.		3.36		1.20									
Palms Rd.		1.95		.49		2.20		.41		$798.5		$17,599.5	516.7
Barbour's Rd.		.60		.25		2.32		.52		$785.9		$12,167.8	612.2
Brown's Rd.			.28	.40		2.40		1.00		$1,188.6		$7,764.9	504.0
Cape Palmerston Rd.	2.70		.45	2.35			.00	.85			$141.9	$8,846.8	250.0
Garnham's Rd.			1.28		.96		.59	1.18	$2,008.4		$3,252.0	$9,743.4	604.3
Gillinbin Cr. Rd.		4.56		.33			3.12				$513.8		
Hindles's Rd.		.84		.40		3.31		.22		$705.8		$25,933.7	1325.3
Landel's Rd.		1.23		.25		2.24		.53		$1,254.8		$12,242.5	650.0
Loadsman's Rd.			.20	.47		.86		.00		$2,425.2		$7,283.5	560.0
Manion Settlement - Notch Pt. Rd.			.96				.83	.58			$1,305.0	$15,921.3	851.1
Manion Settlement Rd.		2.68	3.19	1.50			2.04				$804.8		
McLeod's Rd.		2.06		.40		1.05	1.60	.78		$2,010.9	$1,201.2	$9,911.0	546.7
Rasmussen's Rd.		.43	.70	.40		2.06		.00		$1,018.0		$5,680.4	600.0
Upper Flaggy Rock Rd.			.57	2.10		1.34	.00	.39		$717.1	$0.7	$11,305.8	700.0
Walter Jackson's Rd.			.35	.50			1.14	.84			$5,710.6	$5,771.4	486.7
Camerons Rd.		1.37		.40			.83	.50			$2,473.2	$10,993.4	602.0
Carmila West Rd.		2.05		1.20		2.74		.40		$1,348.1		$12,052.4	650.0
Gibberland Rd.	6.80			.00		1.58		.68		$1,360.3		$11,265.5	546.7

Figure 7. Detailed Actuals with Production Rates

Activity Standards Production Rates Review: $/km, Km/day for the different activities of grading and resheeting.

This report is used to check your target production rates. Also, this information enables continual review of these rates, which will lead to better predictions on how much and how long it will take to complete different assigned works.

The process of developing programs and reviewing them during the year, with also good communications between the workforce and management enables a council to continue to obtain improvements both in operations and in the performance of the unsealed road network year after year.

This system has been implemented at both the Fitzroy and Broadsound Shire Councils. Current implementations are occurring at the Calliope, Nebo and Belyando Shire Councils.

Author Biography

Darren Shepherd is the Managing Director of the company Shepherd Services Pty Ltd and developer of the SSMMS computer system used to manage unsealed road networks, which was Nominated for the IPWEAQ Excellence Award 2002 and also was displayed in a recent article in the National Australia's Road Management and Construction Magazine called "ROADS".

Darren has an academic and professional background in civil engineering and has worked for Local Councils facilitating the management of unsealed roads for the last 8 years. Darren has a strong background in information technology and project management as well.

Darren holds a Degree in Civil Engineering, is a Registered Professional Engineer of Queensland and is an active Member of the Institute of Public Works Engineering Australia Central Queensland Branch.

Postal Address: Darren Shepherd, PO BOX 315, Gracemere QLD 4702.

E-mail: darren@shepherdservices.net

Web: http://www.shepherdservices.net/