Guidelines for Development of Pavement Improvement/Renewal Schemes

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October 9, 2013

Pavement Management System

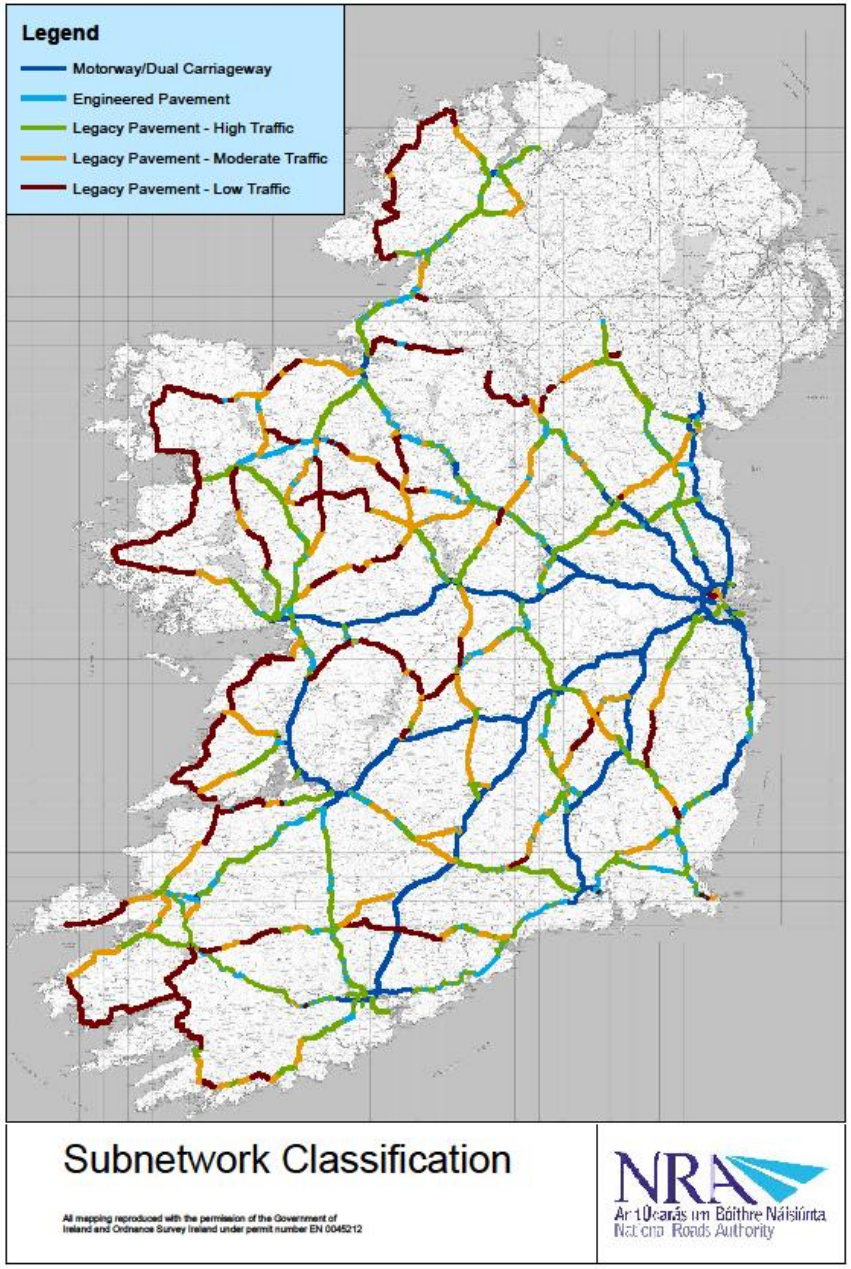
- dTIMS
- Data Repository
- Condition Data – Updated Annually
- Structure Data – Updated with Renewal
- Age – Updated with Renewal
- Surface Type – Updated with Renewal
- Traffic – Updated Annually
- Maintenance History – Updated Annually

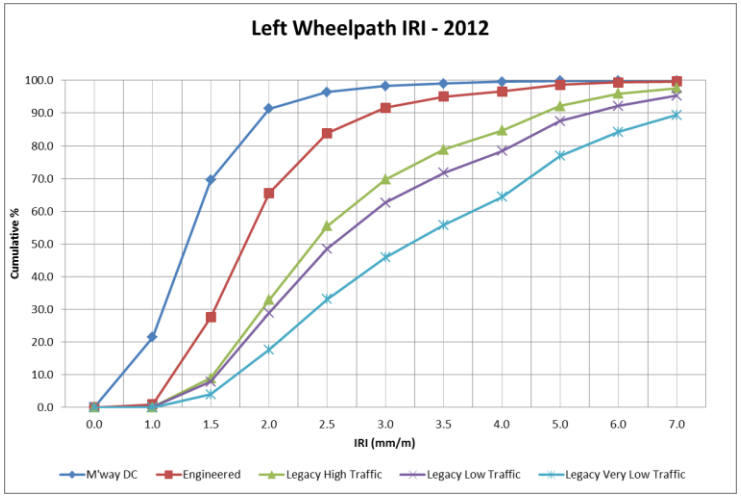
Pavement Works Programme

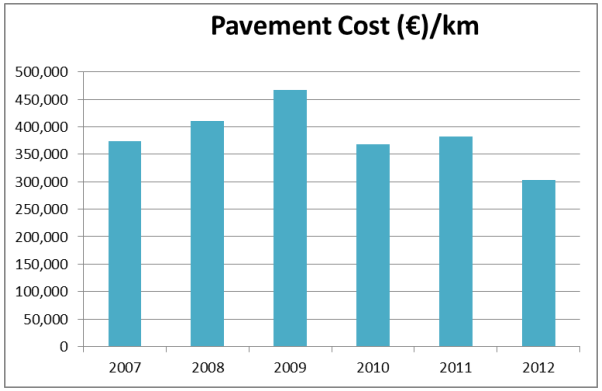
- Subnetwork Definitions
- Subnetwork Thresholds
- Percentage above Threshold (PAT)
- Prioritisation based on PATs
- 1 to 3 year programme developed
- Rutting, Ride Quality, Short Wavelength
- Cracking, Ravelling will be added

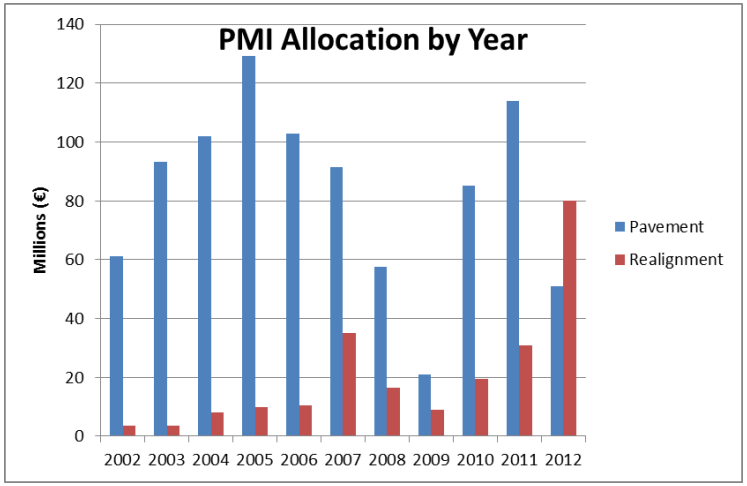
Annual Condition Report

- Description of network and subnetworks
- Current condition profile
- Changes in condition over time
- Graphic and data on pavement renewal and HD28 projects in the current year
- Changes in allocated budget over time
- Data on current pavement unit costs


Legend
Motorway/Dual Carriageway
Engineered Pavement
Legacy Pavement - High Traffic
Legacy Pavement - Moderate Traffic
Legacy Pavement - Low Traffic
Subnetwork Classification
All mapping reproduced with the permission of the Government of Ireland and Ordnance Survey Ireland under permit number EN 0045212
NRA
An tÚdarás um Bóithre Náisiúnta
National Roads Authority


Left Wheelpath IRI - 2012
Cumulative %
IRI (mm/m)
M'way DC
Engineered
Legacy High Traffic
Legacy Low Traffic
Legacy Very Low Traffic


Pavement Cost (€)/km


PMI Allocation by Year
Millions (€)
Pavement
Realignment

Network Funding

- Accurate Cost and Pavement Life data needed
- Cost by maintenance treatment type
- May vary by geographic location and/or by subnetwork type
- Life of treatment may vary by subnetwork type
- Accurate data returns needed for the system to function properly

Under Development

- Project control document to support pre-construction, construction and post-construction data recording and reporting processes for pavement surface and structural renewals

- Technical document to support pavement renewal site investigations and design

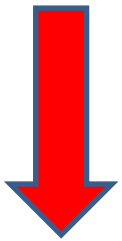
Pavement Data Management

- Project Screening
- Project Approval
- Project Commencement
- Project Closeout
- Data needed on Start/End, Maintenance Type, Surface Type, Thicknesses, Quantities, Unit Costs etc…to update, calibrate and improve PMS short-term and long-term requirements

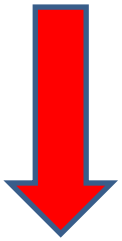
Pavement Asset Repair and Renewal Scheme Approval

- Determination of the highest-priority schemes for Pavement Renewal;
- Definition of Scheme Requirements;
- Design (Technical Guidance Document);
- Contract Document Preparation / Tender / Award;
- Scheme Construction;
- Final Account / Close out.

Pavement Asset Management System

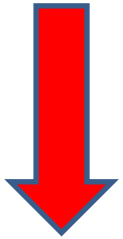


NRA Pavement Management Unit sets priorities for Pavement Renewal and requests an Asset Renewal Proposal

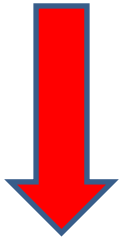


Road Authority gathers existing information to aid scheme definition and commissions any further surveys, etc. deemed necessary

Road Authority reviews the information to determine the likely causes of the pavement deterioration and develops appropriate renewal works

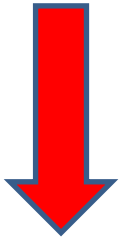


Road Authority considers appropriate method of procurement

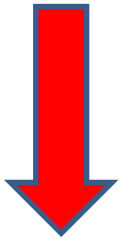


Road Authority prepares **Asset Renewal Proposal**

NRA Pavement Management Unit Approval



Road Authority prepares **Tender Documents**



NRA Regional Manager Approval

Construction stage monitoring – **notification** to NRA Regional Manager and NRA Pavement Management Unit of any **proposed scope changes**

Submission of **Final Account Report** to NRA Regional Manager and A**s-built information** (Form X) to NRA Pavement Management Unit

Approval and Sign Off by NRA Regional Manager and NRA Pavement Management Unit

Ref.	Project Name	Route No.	Category Type	NRA Allocation

Start Coordinates		End Coordinates		Length (km)	Width (m) Av.	Depth (m) Av.
Easting	Northing	Easting	Northing			

General Works Description	Foundation		Capping	
	Material	Depth (mm)	Material	Depth (mm)

Sub-base		Base		Surface	
Material	Depth (mm)	Material	Depth (mm)	Material	Depth (mm)

Total area (m2)	Cost (€)	Cost per m2 (€)	Percentage Breakdown		
			Non-BoQ	Mainline	Acc. / Off-Line Works

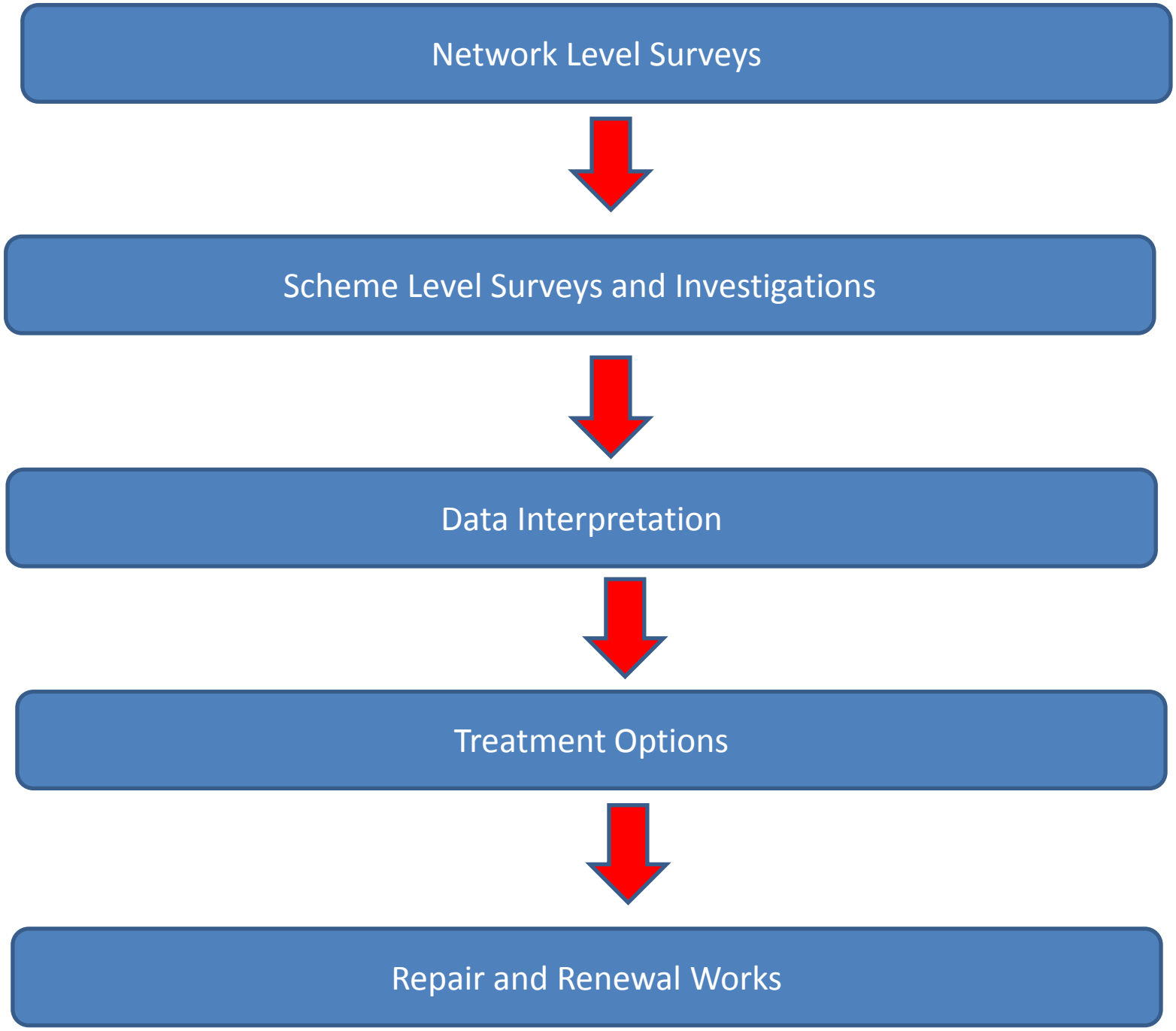
Pavement Renewal Report

- **Name and Nature of Scheme**
- Introduction
- Site and location
- Surveys and Other Information Available
  - Pavement surveys
  - Topographical surveys
  - Utility records
  - Existing plans for route improvement
  - Planned or anticipated future works on the site
  - Other

Pavement Renewal Report

- Review of Existing Pavement Condition and Causes of Deterioration
- Proposed Renewal Works (including discussion of options considered)
- Proposed procurement method and proposed phasing of Construction Works

- Appendix 1 – Drawings
- Appendix 2 – Surveys and Other Relevant Information


Network Level Surveys
Scheme Level Surveys and Investigations
Data Interpretation
Treatment Options
Repair and Renewal Works

Case Study: N21 Lantern Lodge, Adare, Co. Limerick

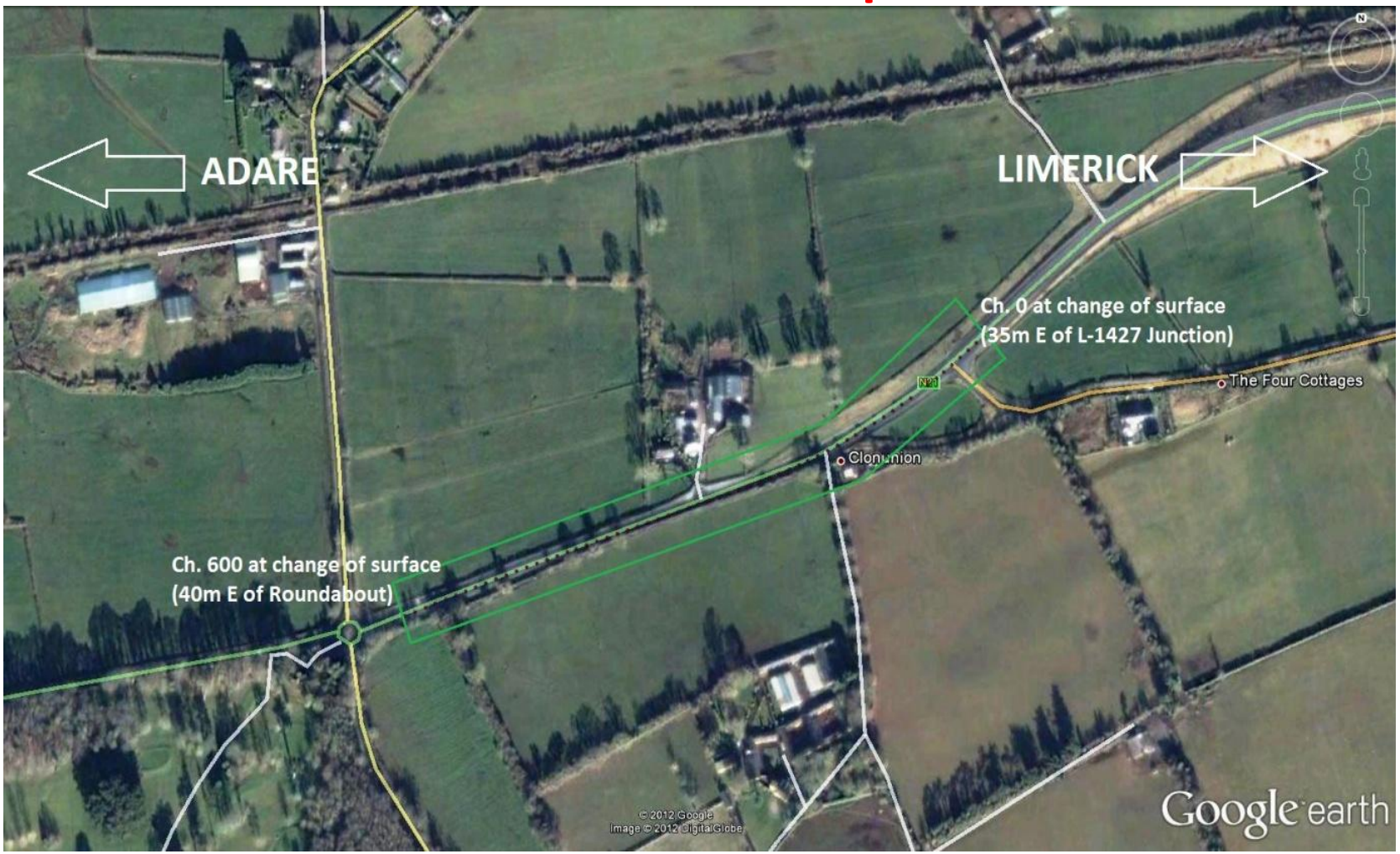
August 2012

Introduction

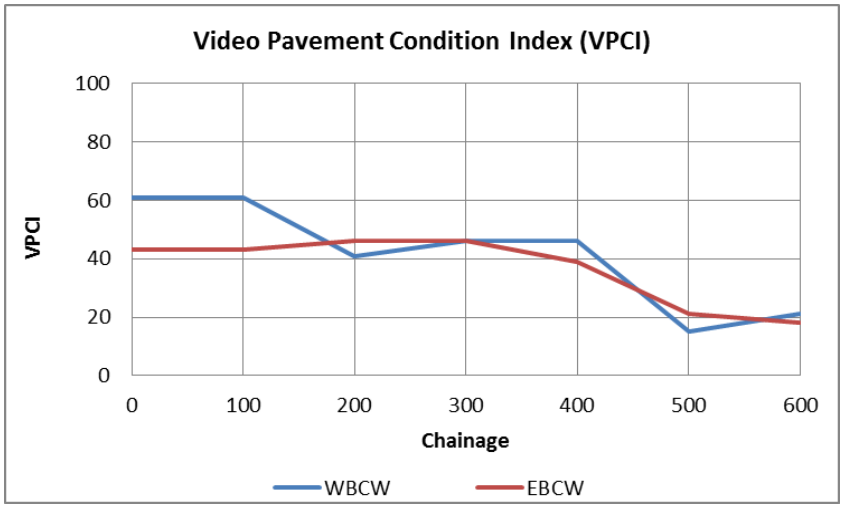
- Objective: Establish and assign in detail the maintenance and repair requirements for this section of the N21 based on the condition parameters collected

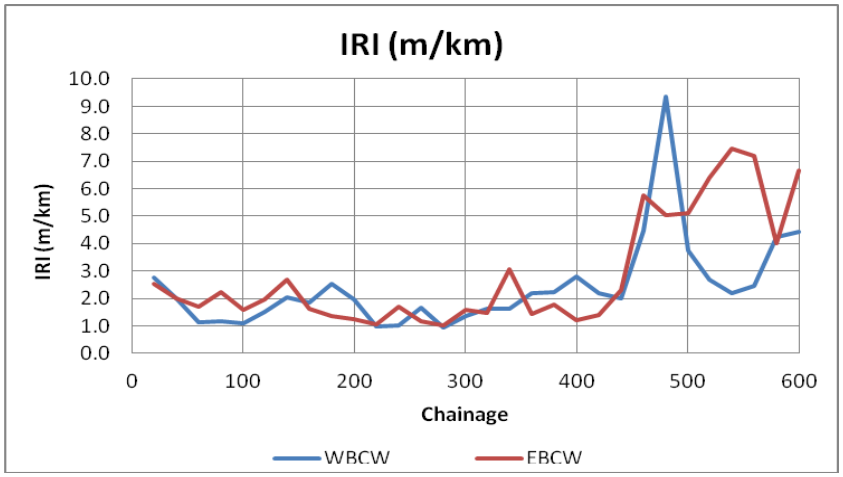
- Data Collection:
  1. 3 dimensional Spatial Co-ordinates (GPS)
  2. Longitudinal profile (IRI, 3m LPV), Transverse profile (Rut Depth and Crossfall) and Surface Texture (MPD) from the RSP
  3. Cracking data using laser crack measurement system (LCMS)
  4. Skid resistance data in terms of SCRIM
  5. Structural evaluation data using FWD
  6. Pavement structure including ground penetrating radar (GPR)
  7. Pavement-Oriented Digital Video and Visual condition

Site Description



Visual Condition (VPCI) & Long. Profile (IRI)



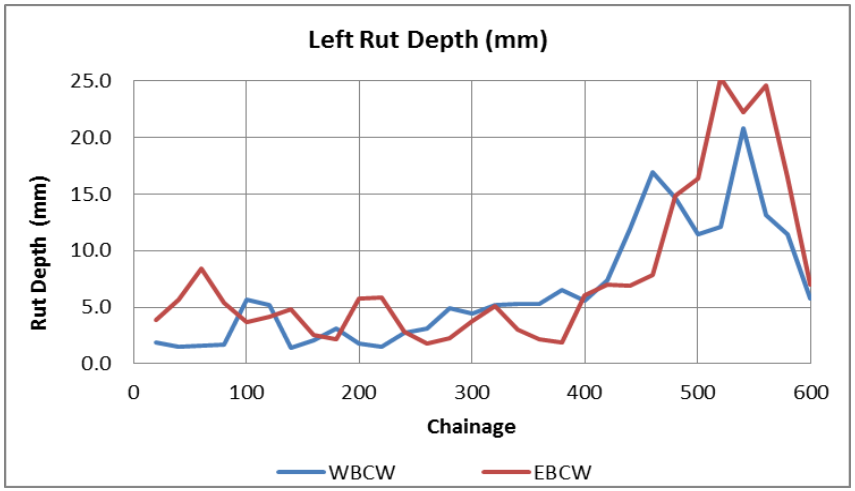


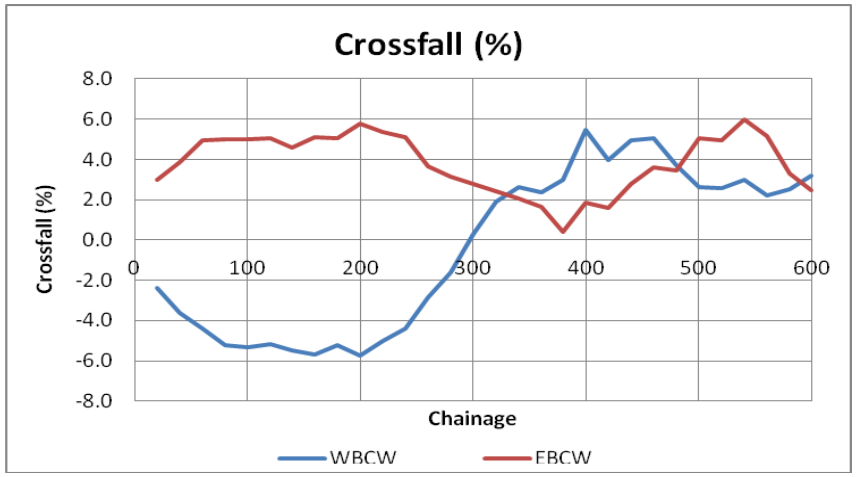
Name	No. Of Occurrences	Average Quantity	Average Deduct
Ravelling	17	32	20
Rutting	15	11	42
Bleeding	14	52	29
Patching	11	5	15
Other Cracking	10	1	7
Alligator Cracking	4	4	24
Depressions	5	3	17
Edge Breakup	4	1	12
Potholes	3	2	11
Disintegration	0	0	0

Chainage	VPCI	PCI Rating	Std. Dev of VPCI	% Structural	% Surface
0 to 400	46	Poor	7	33%	63%
400 to 600	19	Failed	3	46%	25%

Lane	Chainage		Percentage of 20m Segments		
	From	To	Avg. IRI > 3.2m/km	Avg. IRI > 4m/km	Avg. IRI > 6m/km
WBCW	0	440	0%	0%	0%
	440	600	63%	50%	13%
EBCW	0	440	0%	0%	0%
	440	600	89%	89%	44%

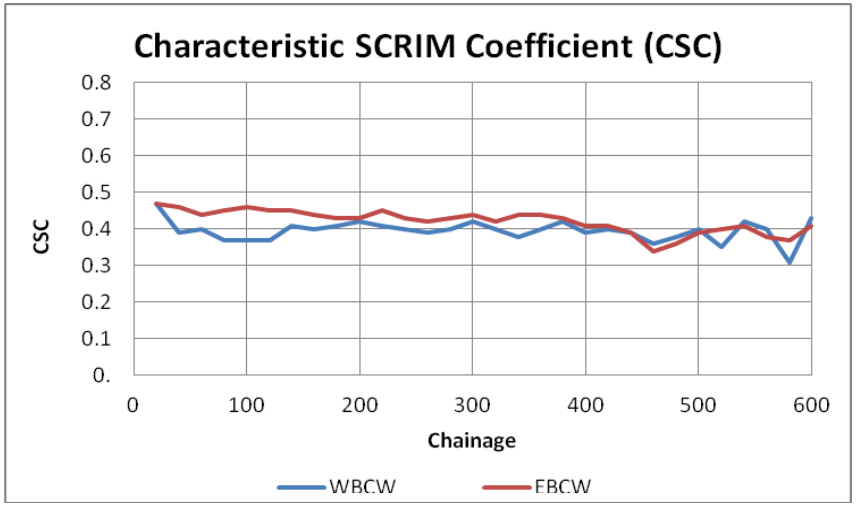
Transverse Profile (Rut Depth & Crossfall)

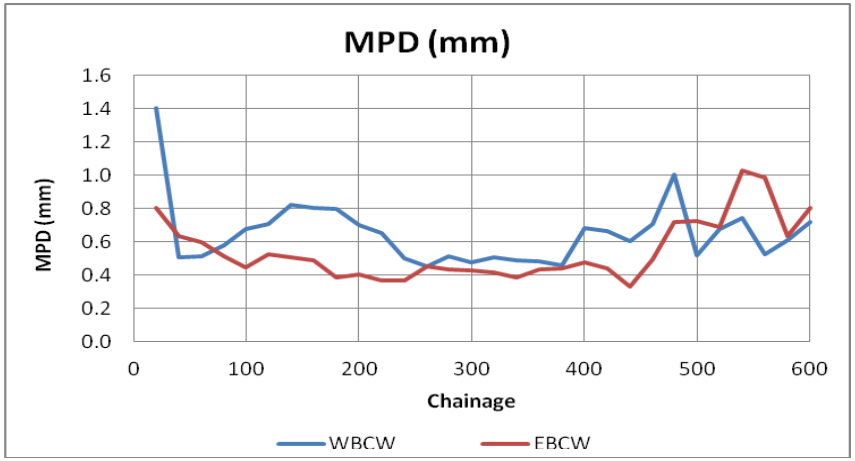




Lane	Chainage		Percentage of 20m Segments		
	From	To	Left Rut > 6mm	Left Rut > 9mm	Left Rut > 15mm
WBCW	0	400	5%	0%	0%
	400	600	90%	80%	10%
EBCW	0	400	5%	0%	0%
	400	600	100%	60%	30%

Skid Resistance & Surface Texture

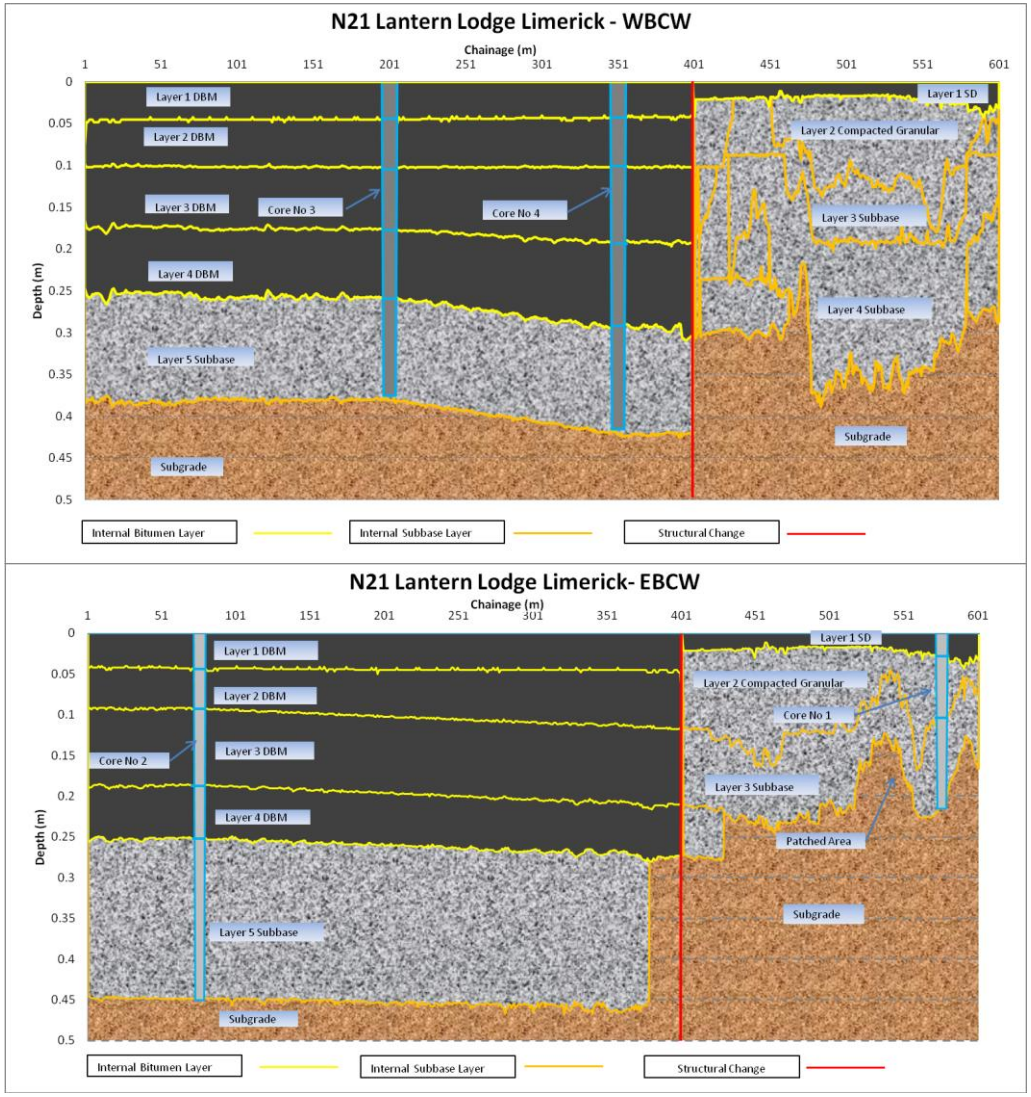




Lane	Ch. from	Ch. to	Site Category	IL	CSC	Points below IL
WBCW	0	20	Q	0.45	0.47	-0.02
WBCW	20	50	Q	0.45	0.40	0.05*
WBCW	50	150	C	0.40	0.38	0.02*
WBCW	150	250	C	0.40	0.41	-0.01
WBCW	250	350	C	0.40	0.40	0.00*
WBCW	350	450	C	0.40	0.39	0.01*
WBCW	450	550	C	0.40	0.39	0.01*
WBCW	550	600	C	0.40	0.37	0.03*
EBCW	0	20	C	0.40	0.47	-0.07
EBCW	20	50	Q	0.45	0.45	0.00*
EBCW	50	100	Q	0.45	0.45	0.00*
EBCW	100	150	Q	0.45	0.44	0.01*
EBCW	150	250	C	0.40	0.43	-0.03
EBCW	250	350	C	0.40	0.43	-0.03
EBCW	350	450	C	0.40	0.41	-0.01
EBCW	450	550	C	0.40	0.38	0.02*
EBCW	550	600	C	0.40	0.38	0.02*

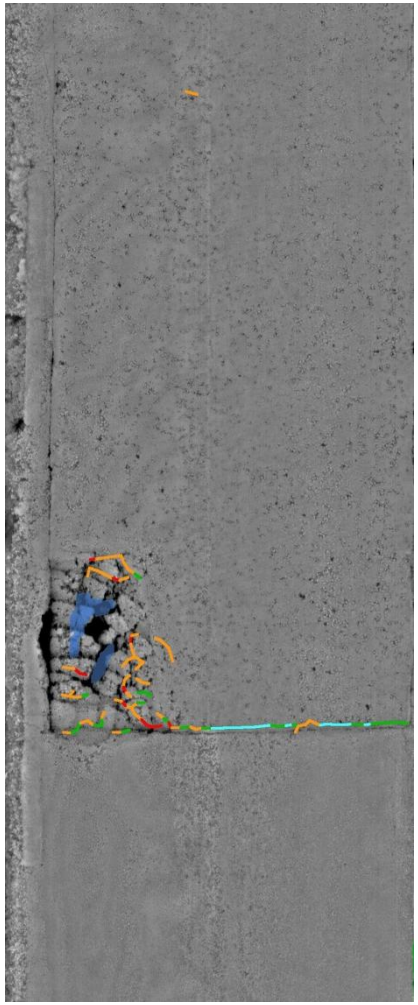
Lane	Ch.		MPD (mm)	Percentage of 20m Segments		
	From	To		MPD < 1.5 mm	MPD ≤ 1.0 mm	MPD ≤ 0.7 mm
WBCW	0	600	0.7	100%	97%	83%
EBCW	0	600	0.5	100%	100%	87%

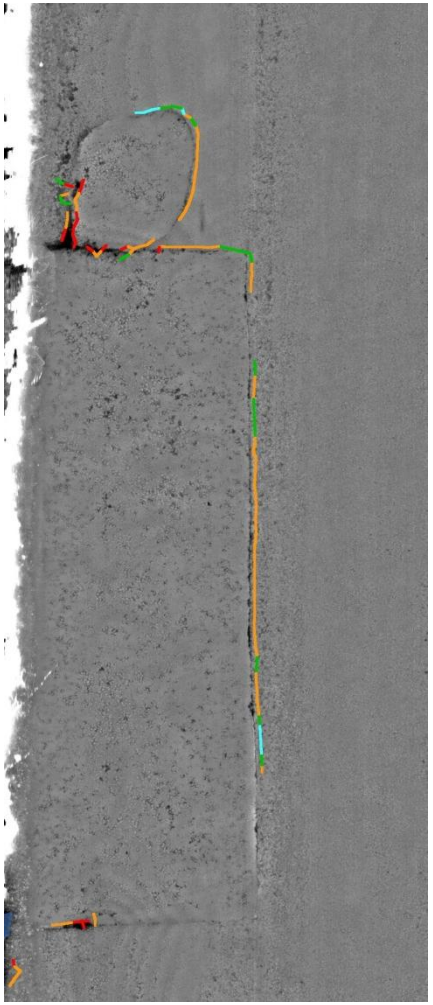
Pavement Structure (GPR & Coring)



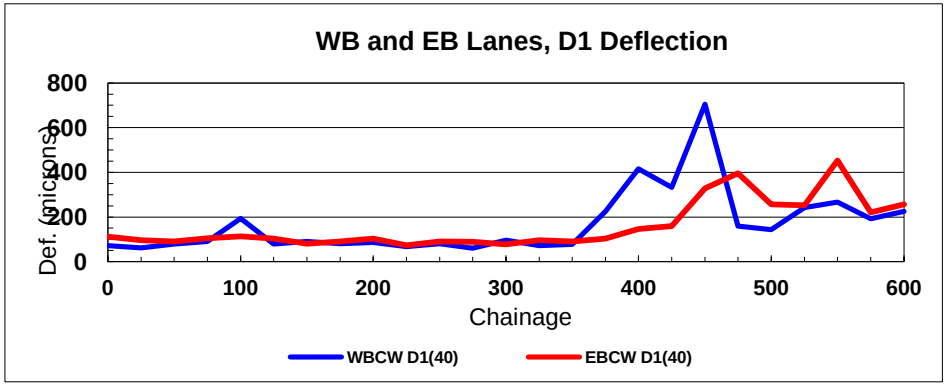
Lane	Chainage (m)		Average Depth (mm)	
	From	To	Bituminous Material	Sub-base (Granular) Material
WBCW	0	250	258	125
WBCW	250	400	289	125
WBCW	400	600	23	296
EBCW	0	250	256	199
EBCW	250	400	269	180
EBCW	400	600	29	174

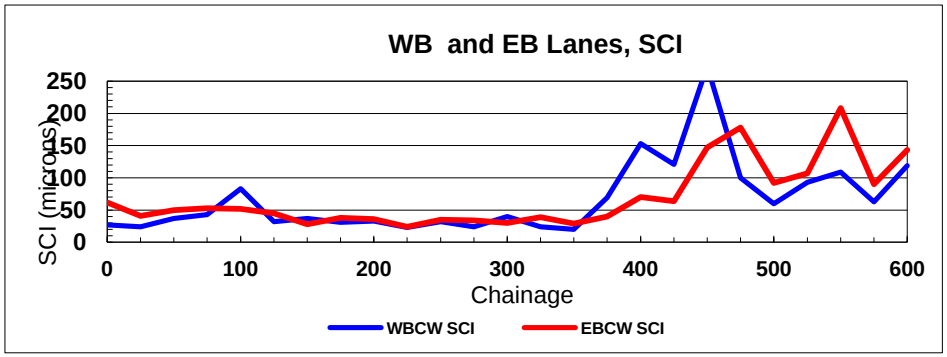
LCMS Crack Detection

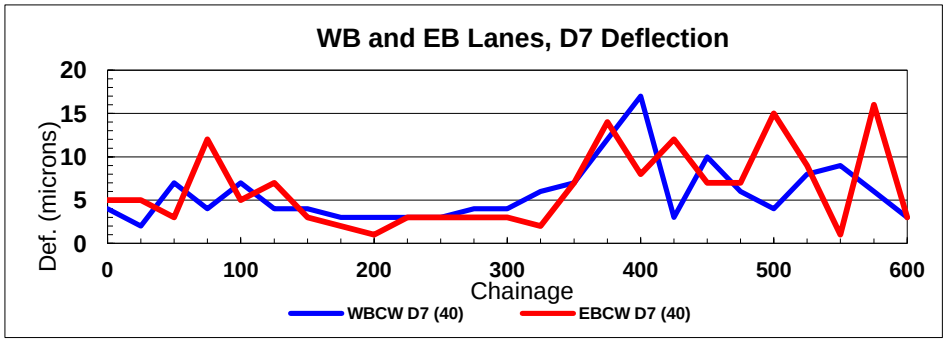




FWD Structural Evaluation





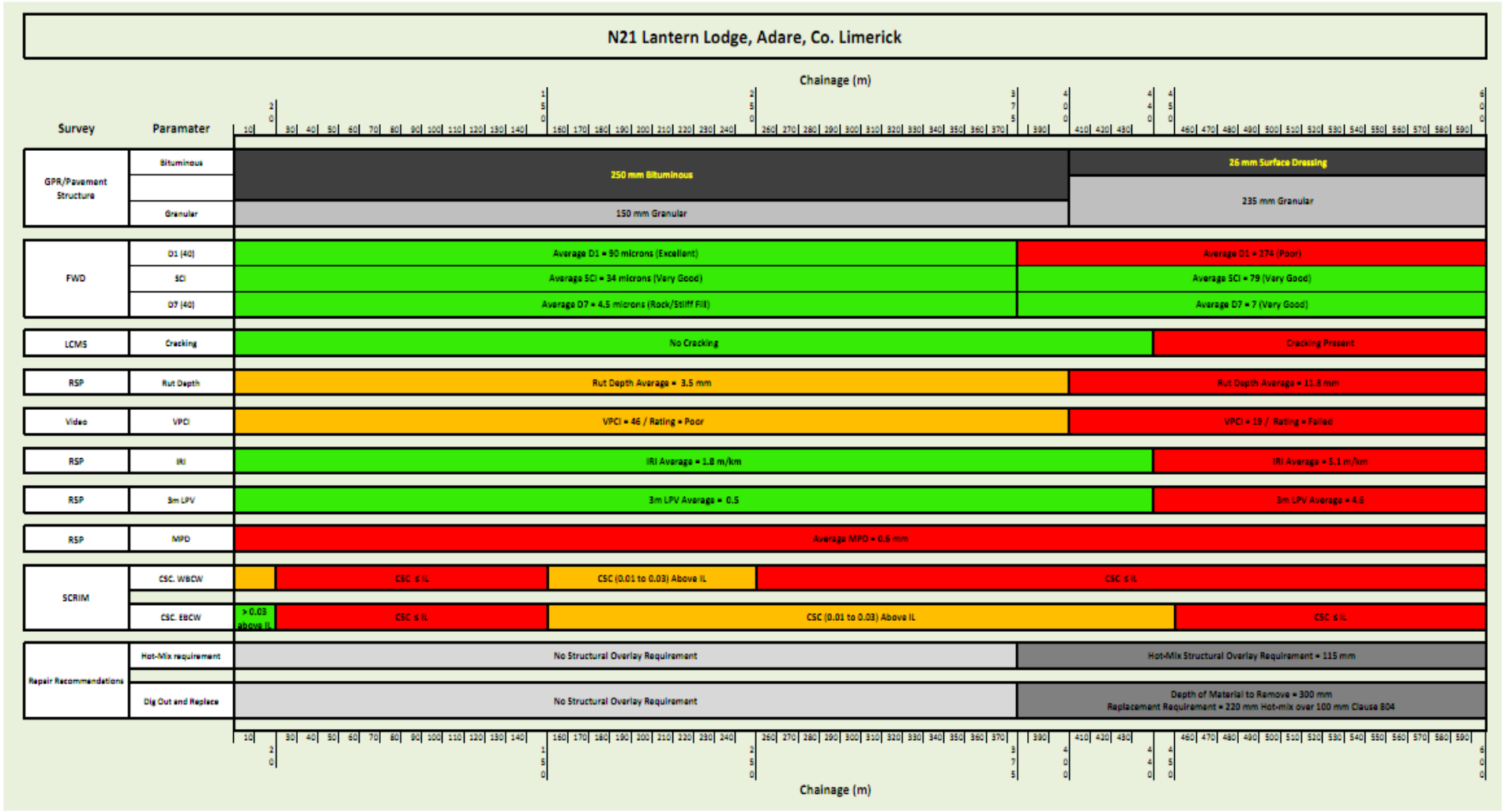


Lane	Chainage	Description	Avg. D1	Avg. SCI	Avg. D7
WBCW	0 to 375	Excellent	86	34	4
WBCW	375 to 600	Poor	291	116	8
EBCW	0 to 375	Excellent	94	43	5
EBCW	375 to 600	Poor	257	114	9

Design Period	AADT	% Heavy Goods Vehicles	Std. Axles per Vehicle	Cum. No. of Std. Axles
20 years	15,131	6.2%	1.8	9.14 msa

Lane	Chainage	Hot-mix Overlay Requirement
WBCW	0 to 375	No Overlay Required*
WBCW	375 to 600	115 mm
EBCW	0 to 375	No Overlay Required*
EBCW	375 to 600	115 mm
* Structural Requirement Only		

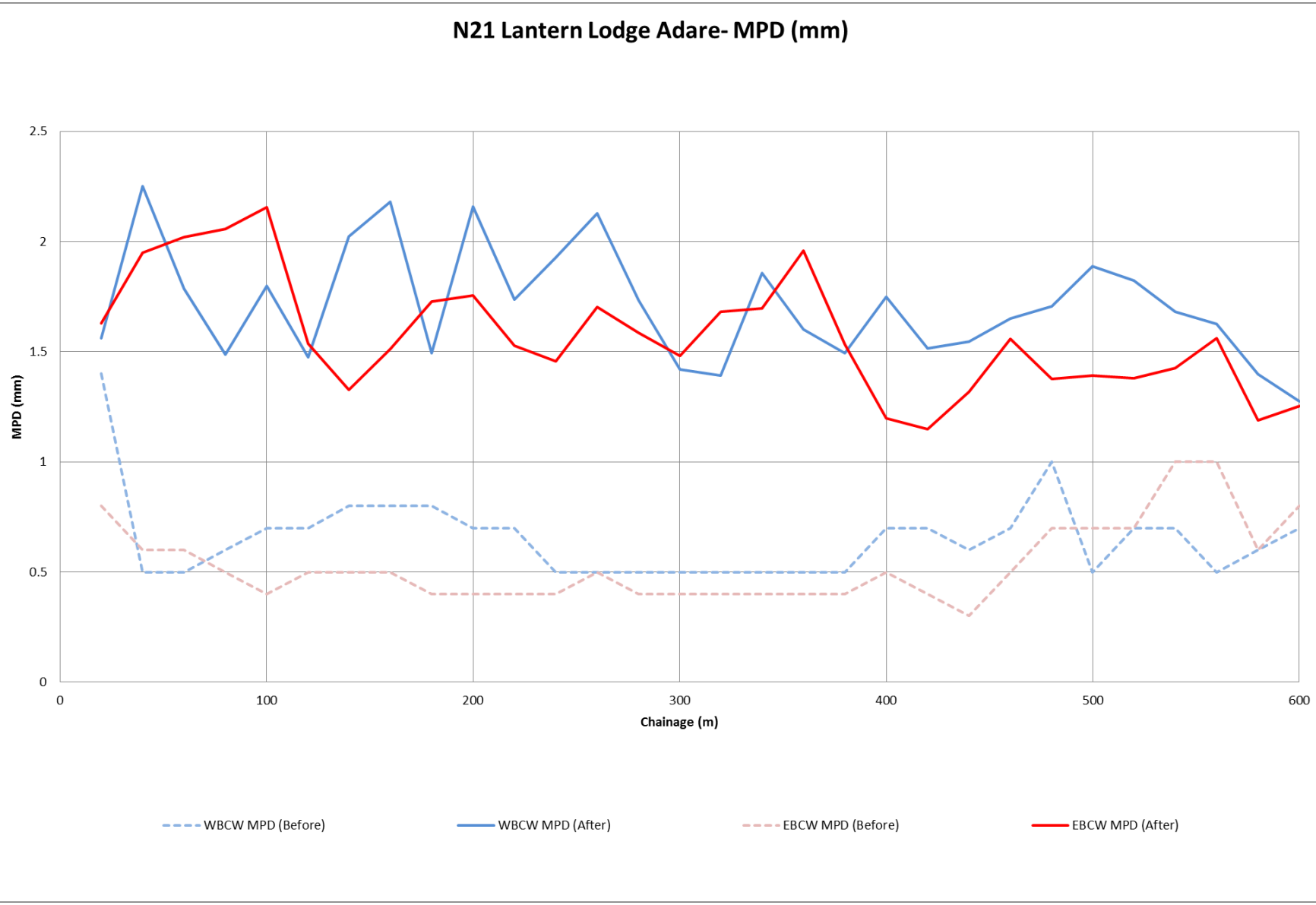
Strip Map

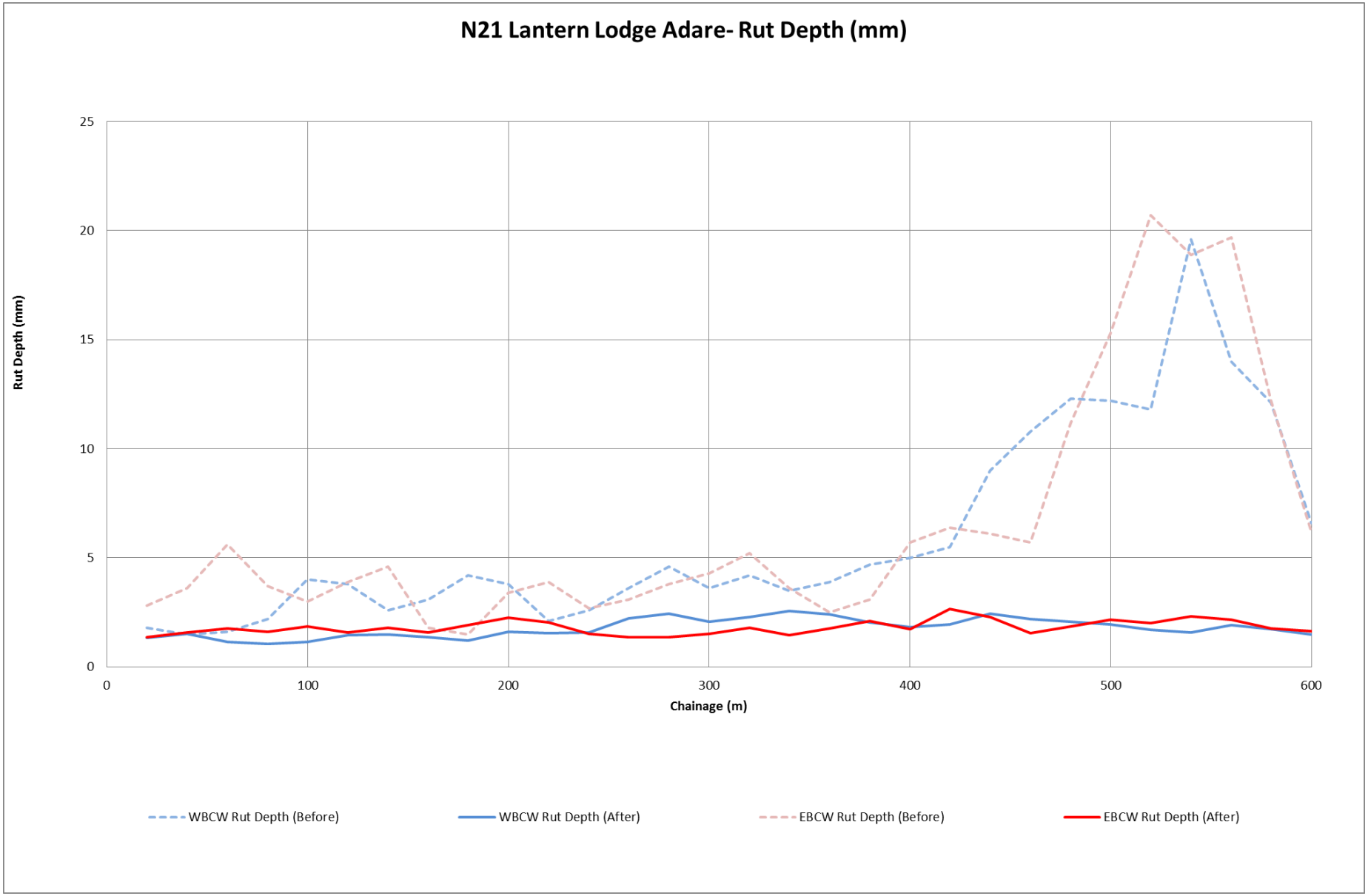

N21 Lantern Lodge, Adare, Co. Limerick
Chainage (m)
Survey
Paramater
GPR/Pavement Structure
Bituminous
Granular
250 mm Bituminous
150 mm Granular
26 mm Surface Dressing
235 mm Granular
FWD
D1 (40)
SCI
D7 (40)
Average D1 = 90 microns (Excellent)
Average SCI = 34 microns (Very Good)
Average D7 = 4.5 microns (Rock/Stiff Fill)
Average D1 = 274 (Poor)
Average SCI = 79 (Very Good)
Average D7 = 7 (Very Good)
LCMS
Cracking
No Cracking
Cracking Present
RSP
Rut Depth
Rut Depth Average = 3.5 mm
Rut Depth Average = 11.8 mm
Video
VPCI
VPCI = 46 / Rating = Poor
VPCI = 19 / Rating = Failed
RSP
IRI
IRI Average = 1.8 m/km
IRI Average = 5.1 m/km
RSP
3m LPV
3m LPV Average = 0.5
3m LPV Average = 4.6
RSP
MPD
Average MPD = 0.6 mm
SCRIM
CSC. WBCW
CSC. EBCW
CSC ≤ IL
CSC (0.01 to 0.03) Above IL
> 0.03 above IL
Repair Recommendations
Hot-Mix requirement
Dig Out and Replace
No Structural Overlay Requirement
Hot-Mix Structural Overlay Requirement = 115 mm
Depth of Material to Remove = 300 mm
Replacement Requirement = 220 mm Hot-mix over 100 mm Clause 804

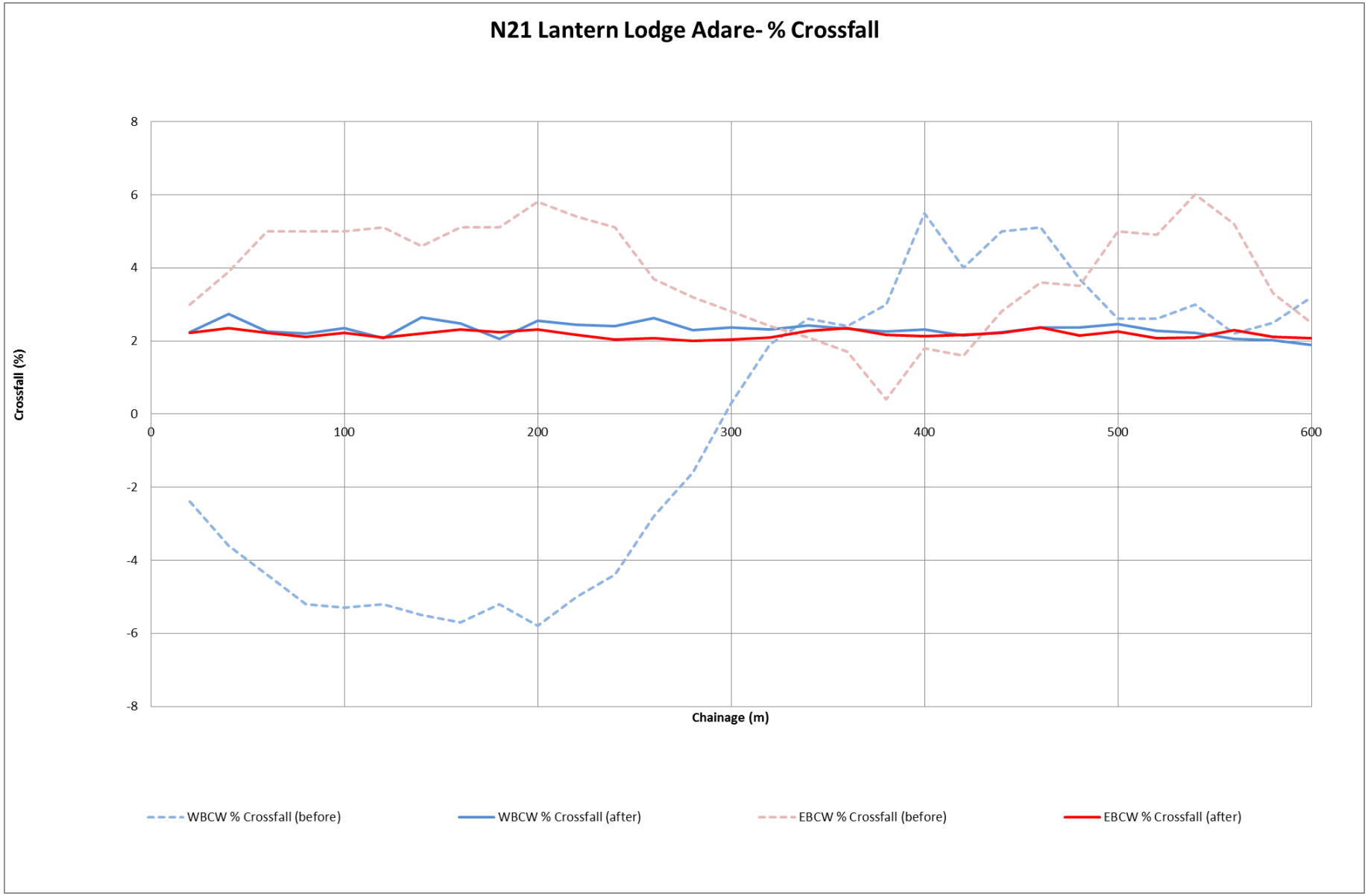
Recommendations

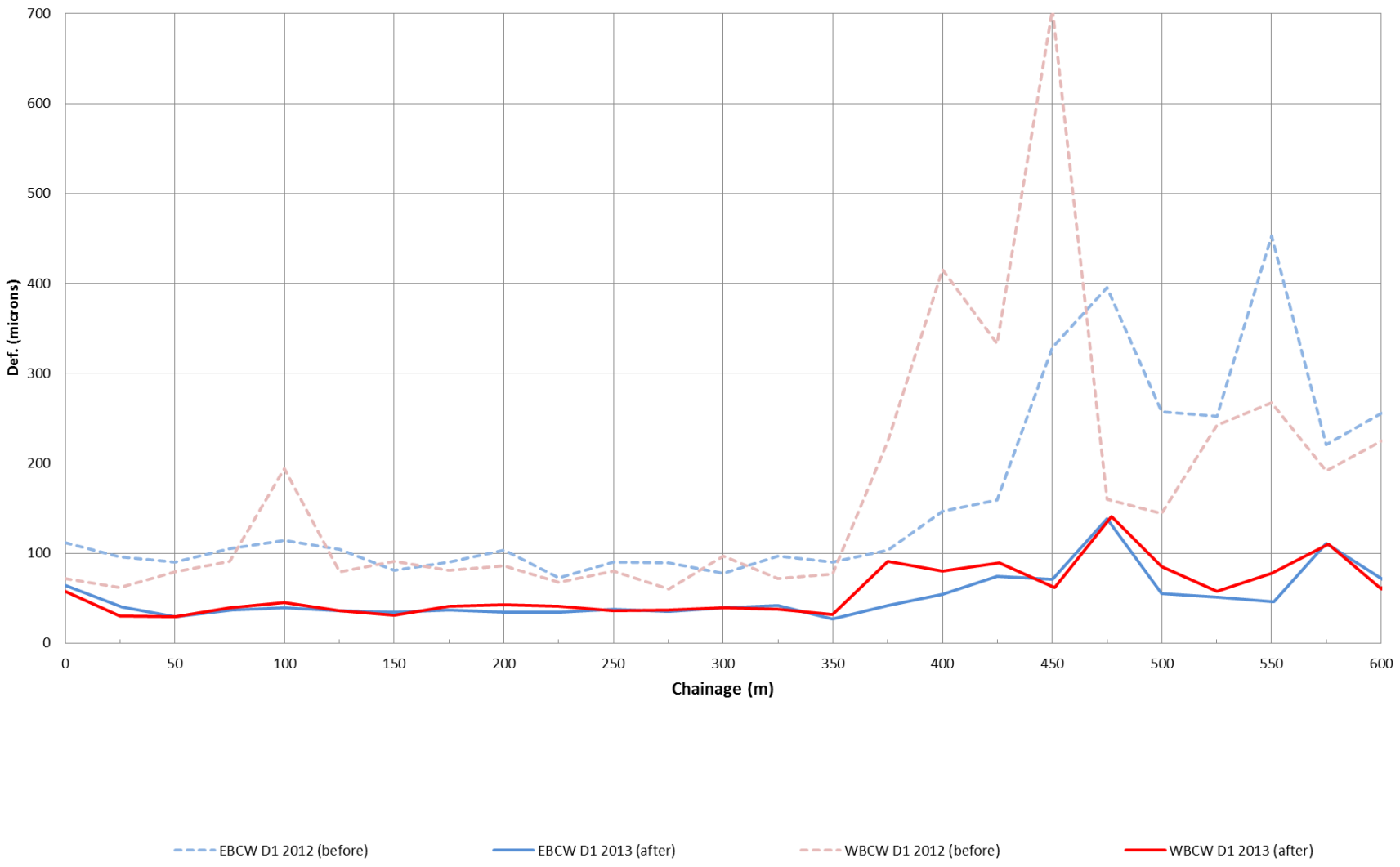
- Ch. 0 to 375
  - Very good condition from a structural viewpoint as indicated by the FWD and GPR
  - Requires surface restoration based on the results of the RSP, LCMS, SCRIM and visual condition surveys.
  - Reshape using Clause 907 Regulation Course to provide adequate profile and crossfall.
  - Overlay with a final surface course of Clause 910 Hot Rolled Asphalt 45mm thickness

- Ch. 375 to 600
  - Overall poor condition from a structural viewpoint as indicated FWD and GPR
  - Overall poor condition from a shape and non-structural defects viewpoint based on the results of the RSP, LCMS, SCRIM and visual condition surveys.
  - Structural repair recommended for which two options are recommended based on a design life of 20 years:
    - Design Option 1: Structural Overlay – 115mm Hot-mix Minimum
    - Design Option 2: Structural Inlay – Remove 300mm and Replace with 220mm Hot-Mix over 100mm Cl. 804 Granular material.

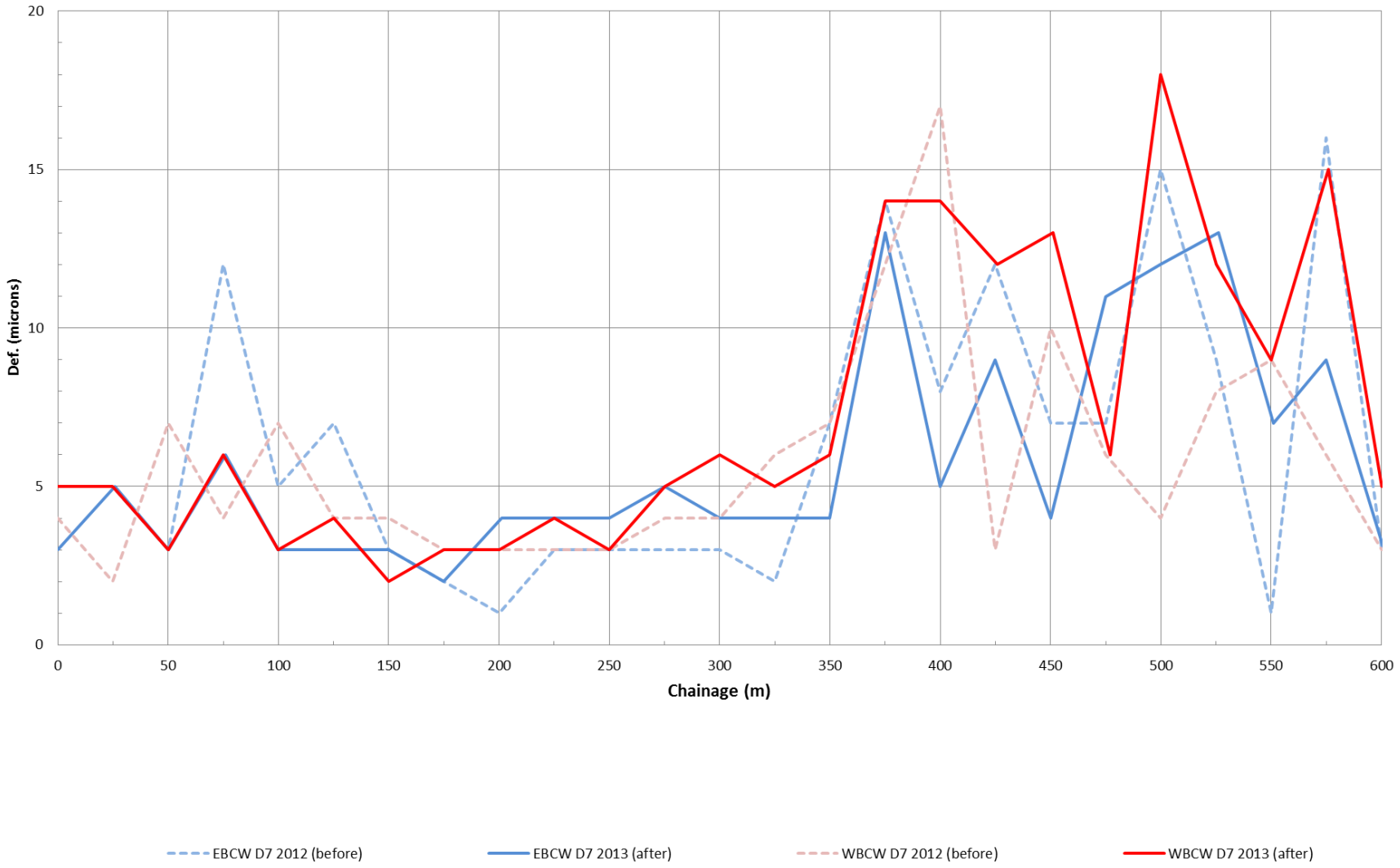

N21 Lantern Lodge Adare- MPD (mm)
MPD (mm)
2.5
2
1.5
1
0.5
0
0
100
200
300
400
500
600
Chainage (m)
WBCW MPD (Before)
WBCW MPD (After)
EBCW MPD (Before)
EBCW MPD (After)


N21 Lantern Lodge Adare- Rut Depth (mm)
Rut Depth (mm)
25
20
15
10
5
0
0
100
200
300
400
500
600
Chainage (m)
WBCW Rut Depth (Before)
WBCW Rut Depth (After)
EBCW Rut Depth (Before)
EBCW Rut Depth (After)

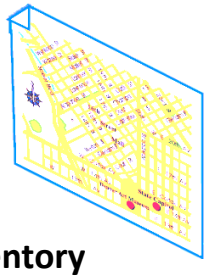

N21 Lantern Lodge Adare- % Crossfall
Crossfall (%)
8
6
4
2
0
-2
-4
-6
-8
0
100
200
300
400
500
600
Chainage (m)
WBCW % Crossfall (before)
WBCW % Crossfall (after)
EBCW % Crossfall (before)
EBCW % Crossfall (after)


N21 Lantern Lodge Adare - D1 Deflections
Def. (microns)
700
600
500
400
300
200
100
0
0
50
100
150
200
250
300
350
400
450
500
550
600
Chainage (m)
EBCW D1 2012 (before)
EBCW D1 2013 (after)
WBCW D1 2012 (before)
WBCW D1 2013 (after)

N21 Lantern Lodge Adare - D7 Deflections

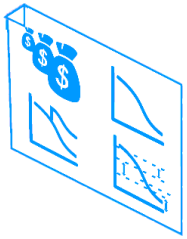


What is the NRA-PMS idea?



Inventory

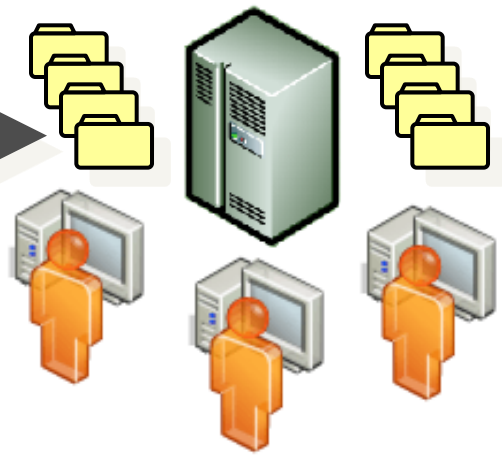
- Netdata
- Pavement
- Traffic
- Condition
- Others



Models and requirements

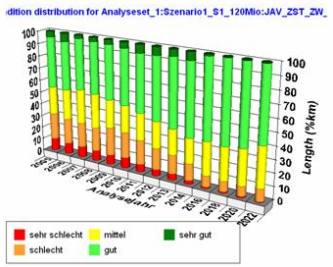
- Performance prediction
- Treatments
- Requirements (framework conditions)
- Time frame and intervals

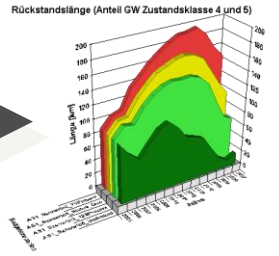
INPUT

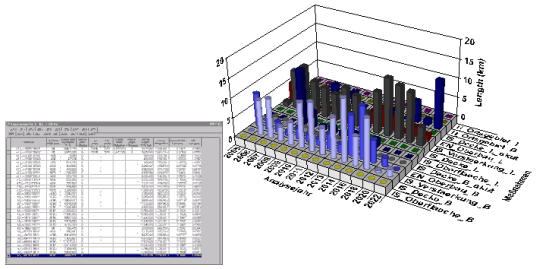


OUTPUT

Basics for strategic decisions







Basics for recommended construction program

Overall Summary

- Data Scope
- Data Completeness
- Data Quality

Annual and multi-annual programmes,reporting based on Pavement Management System Output

Reliability of Output closely linked to Quality of Data Inputs