NORTH SYDNEY COUNCIL

ASSET MANAGEMENT PLAN

ROAD PAVEMENTS 2022-2032

Document Control	Asset Management Plan

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Roads

Executive Summary

The North Sydney Local Government Area covers 10.5 square kilometres or 1049 hectares, of this total area there is approximately 152.5km of local and regional roads. Many of the roads in North Sydney were originally built from 1880 onwards. Further development and subdivisions increased significantly with the opening of the Sydney Harbour Bridge in 1932 and continued after World War 2. It was during this development period that much of the infrastructure in North Sydney was originally built. Therefore, North Sydney faces the continual challenge of maintaining a large portfolio of aging road infrastructure.

In 2019 Pavement Management Services P/L conducted a road pavement condition audit for North Sydney Council using vehicles equipped with laser profilometers and 12 high definition cameras. Pavement Management Services P/L inspected the entire road network.

Council's 152.5km road network comprises of:

- 10.0km of regional roads,
- 142.5km of local roads

Each road pavement segment was assessed in 10m intervals. A condition score was assigned to each segment.

Overall, some 68.9% by replacement cost of the portfolio is in very good to good condition (1-2). 24.3% is in fair condition (3) and 6.8% is in poor to very poor condition (4-5).

A Risk rating was assigned to each road segment. Overall 93.2% of the portfolio had a low to medium risk rating and 6.8% had a high to very high risk rating.

The total Replacement Value of the portfolio is $260,872,395. The financial values are shown in the Table below.

Table 1: Roads (Local and Regional) – Summary Table

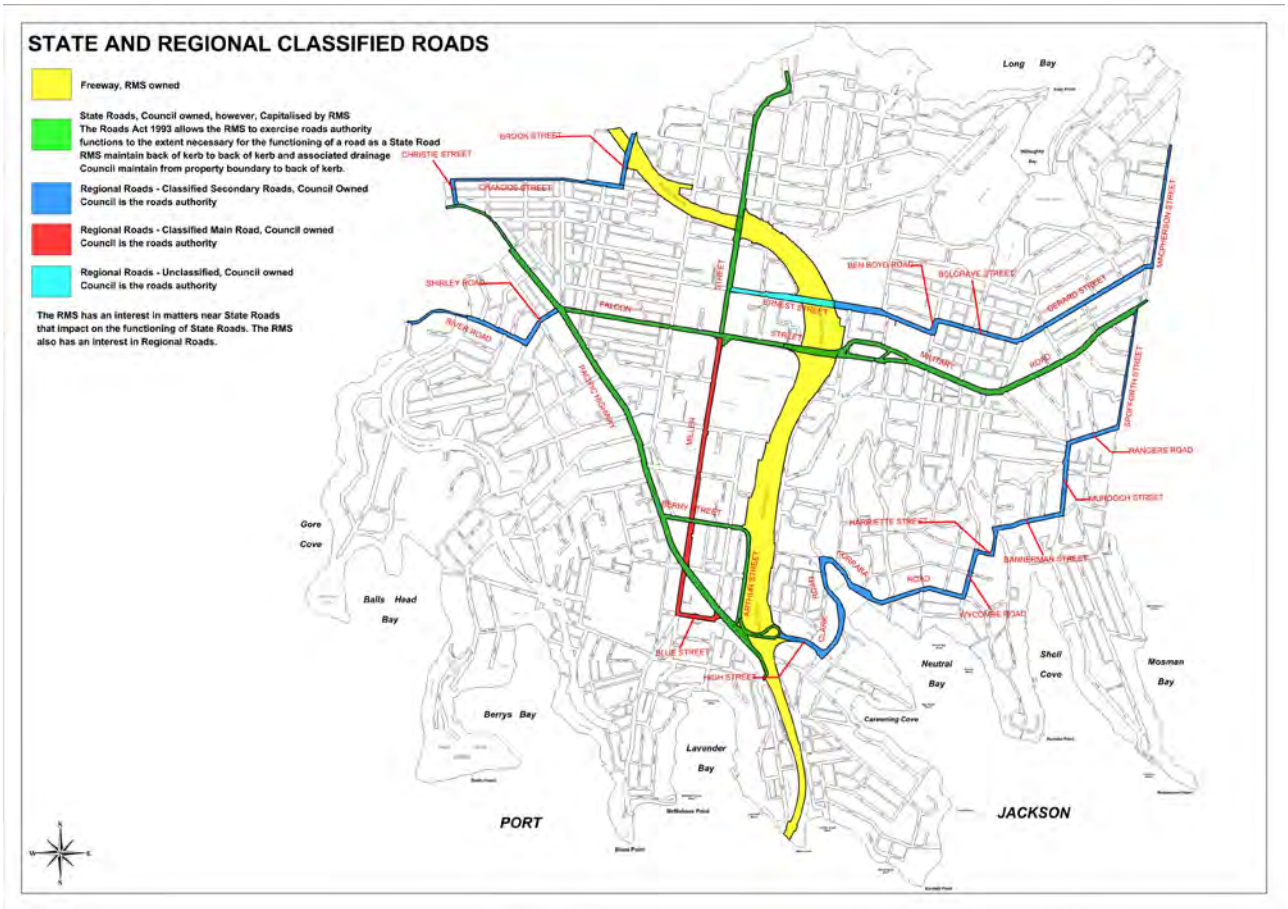
Asset Category	Length (km)	Replacement Value (2021)	Accumulated Depreciation (2021)	Fair Value (2021)	Depreciation Expense
Regional Roads	10.0	$30,465,227	$6,415,027	$24,050,201	$580,787
Local Roads	142.5	$230,407,167	$65,286,312	$165,120,855	$3,845,366
Total	**152.5**	**$260,872,395**	**$71,701,339**	**$189,171,056**	**$4,426,153**

Each Road Pavement segment comprises of the following components:

Table 2: Roads Typology (Local and Regional)

Asset Component	Area (sqm)	Replacement Value (2021)
Surface	1,201,065	$51,543,626
Structure	1,213,241	$191,111,116
Formation		$18,217,652
Total		**$260,872,395**

A map showing the road network in North Sydney is shown below. It includes Freeways and State Roads which are managed by the State Government. It also shows the Regional Roads which are managed by North Sydney Council.



Local and Regional Roads – Future Demand

There are no "green" field areas in the North Sydney LGA. Very few new roads have been constructed within the past few decades. No new assets are anticipated to be acquired. However, increasing development and population is likely to lead to increased traffic volumes resulting in increased deterioration of the road network. Traffic growth factors have been accounted for in council's Pavement Management System and will be monitored in the future.

Local and Regional Roads – Levels of Customer Service

Service levels are defined service levels in two terms, customer levels of service and technical levels of service. These are supplemented by organisational measures.

Customer Levels of Service measure how the customer receives the service and whether value to the customer is provided.

Customer levels of service measures used in the asset management plan are:

Quality	How good is the service … *what is the condition or quality of the service?*
Function	Is it suitable for its intended purpose …. *Is it the right service?*
Capacity/Use	Is the service over or under used … *do we need more or less of these assets?*

The current and expected customer service levels are detailed in the Table below.

Table 3: Local and Regional Roads – Levels of Customer Service

Service Attribute	Expectation	Performance Measure Used	Current Performance	Desired Position in 10 Years
Quality	Roads are well maintained and smooth	Percentage of residents satisfied with the maintenance of local roads and footpaths	62% (2013) 71% (2016) 73% (2020)	Improve – Customer Satisfaction Survey
	Roads that are well maintained and smooth	Percentage of businesses satisfied with the maintenance of local roads and footpaths	67% (2013) 70% (2016) 73% (2020)	Improve – Customer Satisfaction Survey
	Roads are well maintained.	Percentage of Roads in 'very good', 'good' or 'Fair' (1, 2, 3) condition and percentage "poor" or "very poor" (4, 5) Condition.	93.2% of Roads in in 'very good', 'good' or 'Fair' (1, 2, 3) condition. 6.8% of Roads in "poor" or "very poor" (4, 5) Condition.	Maintain – Condition 1-2-3 Improve and replace Condition 4-5
Function	Roads constructed to standards.	Large road projects are tested and designed.	All large road projects are tested and designed unless in an emergency.	Maintain
Capacity and Use	Number of roads required is appropriate.	Number of additional roads required	No additional roads identified as being required. Limited by available land.	Maintain

Local and Regional Roads – Levels of Technical Service

Technical Levels of Service - Supporting the customer service levels are operational or technical measures of performance. These technical measures relate to the allocation of resources to service activities to best achieve the desired customer outcomes and demonstrate effective performance.

Technical service measures are linked to the activities and annual budgets covering:

- Operations – the regular activities to provide services (e.g. cleansing, inspections, etc).
- Maintenance – the activities necessary to retain an asset as near as practicable to an appropriate service condition. Maintenance activities enable an asset to provide service for its planned life (e.g. pothole repair, minor works),
- Renewal – the activities that return the service capability of an asset up to that which it had originally (e.g. resheeting, rehabilitation),
- Upgrade/New – the activities to provide a higher level of service (e.g. road widening).

Table 4 shows the technical levels of service expected to be provided for Roads. The 'Desired' position in the table documents the position being recommended in this AM Plan.

Table 4: Local and Regional Roads – Technical Levels of Service

Service Attribute	Service Activity Objective	Activity Measure Process	Current Performance	Desired for Optimum Lifecycle Cost
Operations	Streets are clean	Street sweeping frequency	Street sweeping frequency carried out by OSE in accordance with defined service levels	Maintain
Maintenance	Roads are safe for user's needs	Regular Maintenance Inspections	Maintenance Inspections carried out in accordance with Mtce Mgmt System	Maintenance Inspections carried out in accordance with Mtce Mgmt System
Renewal	Roads are well maintained.	Percentage of Roads in 'very good', 'good' or 'Fair' (1, 2, 3) condition and percentage "poor" or "very poor" (4, 5) Condition.	93.2% of Roads in in 'very good', 'good' or 'Fair' (1, 2, 3) condition. 6.8% of Roads in "poor" or "very poor" (4, 5) Condition.	Maintain – Condition 1-2-3 Improve and replace Condition 4-5
Upgrade/New	Satisfactory provision of roads.	New roads provided as required.	No additional roads identified as being required. Limited by available land.	Maintain

Local and Regional Roads – Condition

The condition of Council's Road Pavement network was surveyed in 2019 by Consultants, Pavement Management Services Pty Ltd. The following condition criteria was used.

Table 5: Local and Regional Roads Condition Survey Criteria

Grade	Condition	Description	Response
0	**Not Rated**		
1	**Very Good**	Structural: Sound physical condition. Insignificant deterioration. Asset likely to perform adequately without gravel resheeting work for typically 12 years or more. (Austroads Guide to Pavement Technology Part 6: Unsealed Pavements 2009 8.3 Resheeting (Wear Course Replacement) Serviceability: No or insignificant surface defects apparent. Very good driveability. Routine maintenance only required.	No immediate action required. Routine patrol grading to be maintained. Maintain standard programmed condition assessment.

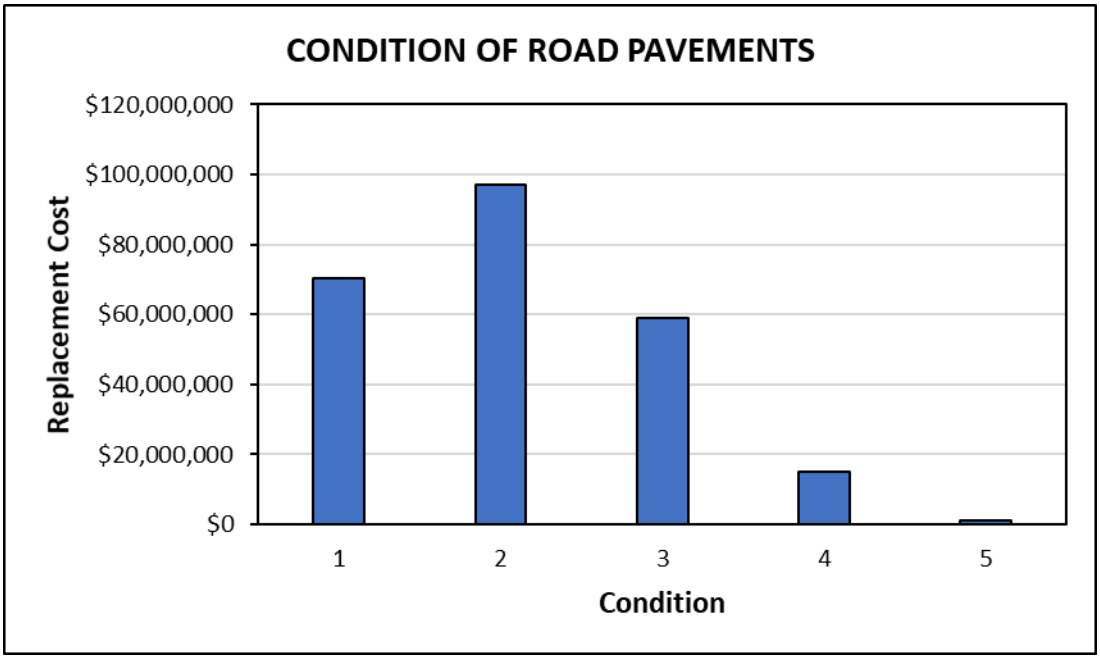
Grade	Condition	Description	Response
2	**Good**	Structural: Acceptable physical condition; minor deterioration/ minor defects evident. Serviceability: Minor increase in pavement roughness counts. Some minor surface defects apparent. Driveability still good. Negligible short-term failure risk but potential for deterioration in medium-term (Typically 10 years plus). Only routine patrol grading required.	No immediate action required other than routine maintenance and patrol grading. Maintain standard programmed condition assessment.
3	**Fair**	Structural: Moderate to significant localised deterioration evident: Minor components or isolated sections of the asset need replacement or repair now but not affecting short term overall structural integrity. Serviceability: Moderate increase of pavement roughness but asset still functions safely at adequate level of service. Failure unlikely within the short term but further deterioration likely and major replacement likely within next 5 to 10 years. Significant maintenance grading and reshaping required but asset is still serviceable.	Take action as appropriate to address defects and if necessary, major maintenance grading and shape correction. Monitor with programmed condition assessment for rehabilitation and/or renewal in medium term.
4	**Poor**	Structural: Serious deterioration and significant defects evident affecting structural integrity. Serviceability: Significant increase in pavement roughness. Substantial work required in short-term to keep asset serviceable. Failure likely in short to medium term. Poor driveability. Likely need to carry out gravel resheeting within the next 1 to 2 years. No immediate risk to health or safety but works required within 1 to 2 years to ensure asset remains safe.	Take immediate action as appropriate to address the defects. Immediately undertake risk assessment and further investigate options. Schedule appropriate action – rehabilitation or renewal in short term.
5	**Very Poor**	Structural: Failed or failure imminent. Immediate need to replace most or all of asset. Serviceability: Large increase in pavement roughness and surface defects. Increase in road user costs and a deterioration in the safe performance of the asset. Very poor drivability. Major work including reshaping and gravel resheeting required urgently.	Take immediate action as appropriate to address the defects. Immediately undertake risk assessment and further investigate options. Schedule appropriate action – immediate rehabilitation or renewal.

The Table below shows the Replacement Cost for each of the condition scores of Road Pavement assets. In practice road pavements in condition 3 or below are often resheeted/replaced in conjunction with condition 4 and 5 assets as it is practical to do. Also, Regional Roads have high traffic volumes with high percentages of heavy vehicles. Intervention/treatment on Regional Roads is generally undertaken prior to reaching condition 4 where funds permit.

Table 6: Local and Regional Roads Condition Survey Results – Overall

CONDITION OF ROAD PAVEMENT - OVERALL		
Condition	**Replacement Cost**	**% Condition (based on cost)**
1 (Very Good)	$70,189,232	28.9%
2 (Good)	$97,025,369	40.0%
3 (Fair)	$59,075,604	24.3%
4 (poor)	$15,180,351	6.3%
5 (Very Poor)	$1,184,186	0.5%
Total	**$242,654,743**	**100.0%**

The Graph below shows the condition of Road Pavement assets over the entire network in terms of replacement cost.



Local and Regional Roads – Review of Useful Lives

The Table below compares the Useful Lives of North Sydney's road assets with detailed studies in South Australia, Queensland, as well as recommendations in the IPWEA 2017 Practice Note – "Useful Life of Infrastructure" which workshopped and reviewed all the reports. Given the local conditions, maintaining condition, population density, and traffic volumes the useful lives of road assets in North Sydney has been reviewed and adjusted.

USEFUL LIVES - ROADS							
Road Class	**Component A = Asphalt C=Concrete**	**NSC Previous (years)**	**South Aust. 2014 Tonkin Report**	**QLD 2013 RAV Project Recommended (years)**	**NSW OLG 2015 data Group 2&3 Cnls**	**IPWEA 2017 Practice Note Recommended (years)**	**NSC Adopted (years)**
Regional	Surface (A)	20	15 to 40 (24 Avg)	20 to 50	21 to 30 (25 Avg)	12 to 25	18
Collector		30					22
Local		40	15 to 35 (26 Avg)			15 to 30	24
Lanes		40					30
Regional	Structure (A)	70	45 to 100 (67 Avg)	20 to 100	92 to 104 (98 Avg)	50 to 100	60
Collector		90					72
Local		150	55 to 150 (83 Avg)				88
Lanes		150					100
All	Structure (C)	120		50 to 100			100
All	Formation	200		100 to 1000			200

Based on a useful lives as reviewed in the Table above, the forecast Depreciation is as follows:

Capital funding to maintain a renewal ratio of 1	
	Annual Depreciation
Local and Regional Roads	**$4,426,153**

A budget of $4,426,153 is required on average over the long term to maintain the condition of Council's Road Pavement network, noting that fluctuations in renewal requirements in the medium term.

Local and Regional Roads – Funding Strategy

The Asset Renewal Funding Ratio is the most important indicator. It compares funding with depreciation. An Asset Renewal Funding Ratio of 1 or greater sustained over the long term indicates the optimal renewal and replacement of assets.

The forecast for Depreciation (or Long Term Average Annual Asset Consumption) is $4,426,153. Therefore, an annual average capital renewal funding of $4,426,153 (2021 dollars) will achieve an Asset Renewal Funding Ratio of 1.

The cost to fully replace assets in condition 4 and 5 as well as the cost to replace the condition 3 assets which will become condition 4 over the next 10 is $56,457,341. This is an average annual cost of $5,645,734 which is greater than the $4,426,153 Depreciation Expense and is greater than the average annual forecast budget of $3,979,720. With further investigation and detailed design it is hoped that alternate and lesser cost solutions may be possible to maintain road pavement assets at an optimal level.

Local and Regional Roads – Capital works

Replacement of Local and Regional Roads is assumed to be a Capital works project.

The ranking criteria used to determine priority of identified renewal and replacement proposals is detailed in Table 7. A priority for action of 1 to 5 has been assigned to each Local and Regional Roads Assets requiring capital works.

Local and Regional Roads – Managing the Risks

There are risks associated with providing and maintaining Local and Regional Roads are primarily as follows:

- Damage to infrastructure as a result of major storm events
- Decreasing frequency of renewal resulting in deterioration of overall network

The following risk response table was used to identify roads requiring action within the next 10 years.

Table 7: Local and Regional Roads – Risk Response Table

Level of Risk		Category	Action Required	Time frame for repairs, upgrade or replacement
VH	Very High Risk	5	Immediate corrective action	1 Years
H	High Risk	4	Prioritised action required	1-4 Years
M	Medium Risk	3	Planned action required	4-10 Years
L	Low Risk	2	Manage by routine procedures	Inspections 1-2 years
New	No Risk	1	None	None

Consideration has been given to each road section, whether to replace the road section or perform maintenance on it.

Road sections that have a **Very High or High** risk rating were considered to need replacement within the 1-4 year forecast period.

Road sections segment with a **Medium** risk rating were also considered needing replacement within the 4-10 year forecast period.

Examples of road pavements in poor condition in the North Sydney LGA

Examples of road pavements in poor condition in the North Sydney LGA	
	
	
	

Council will endeavour to manage these risks within available funding by prioritising road pavement renewal works based on the Road Pavement Condition Audit prepared by Consultants, Pavement Management Services Pty Ltd.

Table 8: Local and Regional Roads – Capital renewal Priorities based on Condition and Risk Rating

Risk Matrix – Local and Regional Roads – Overall (Condition and Risk Rating)					
Likelihood of Road failing (L) Refer to Table 5. Condition Criteria	Local and Regional Roads – Overall - Cost of Roads ($)				
	Road Hierarchy	Lane	Local Road	Collector	State/ Regional Road
	Priority	d	c	b	a
Condition 1 – Very Good (28.9%)	5	$15,279,104	$40,801,600	$21,595,160	$10,731,021
Condition 2 - Good (40.0%)	4	$12,777,932	$37,872,818	$31,295,120	$15,079,499
Condition 3 – Fair (24.3%)	3	$12,513,382	$27,654,883	$14,533,230	$4,374,109
Condition 4 – Poor (6.3%)	2	$5,243,191	$7,005,475	$2,651,086	$280,599
Condition 5 – Very Poor (0.5%)	1	$143,204	$936,053	$104,929	

(Note: Also Refer to Table 6)

Note: This table is based on data in the current register.

Note: Councils receive funding for Regional Roads based on the Transport for NSW assessment score.

Note: The priority in which works are done could vary depending on associated works such as Streetscape projects or drainage projects etc. Some roads may deteriorate faster than anticipated in a change in the order in which works are done, for example, due to increased traffic loads from increased development. In addition, Utility Authorities regularly upgrade their services in North Sydney. Whilst these service trenches are "permanently" restored to make the road safe the overall condition of the road is reduced. Roads with numerous patches have reduced Useful Life and require renewal sooner than planned.

Note: The PARMMS Road Manager software was used to produce the required future works program. The methodology used is detailed in Appendix B.

It should be noted that roads may also be replaced based on other criteria including:

- Damage
- Utility Authority Restorations
- Roads replaced in association with other projects such as kerb and gutter or drainage works
- Streetscape projects

Local and Regional Roads – Maintenance

Operations include regular activities to provide services such as public health, safety and amenity, e.g. cleaning and street sweeping.

Routine maintenance is the regular on-going work that is necessary to keep assets operating, including instances where portions of the asset fail and need immediate repair to make the asset operational again, e.g. pothole repairs.

Maintenance includes all actions necessary for retaining an asset as near as practicable to an appropriate service condition including regular ongoing day-to-day work necessary to keep assets operating.

Future operations and maintenance expenditure is forecast to trend in line with the value of the asset stock. The quantity of road pavement stock is not forecast to increase. North Sydney has a detailed Maintenance Management System. The inspection and response levels are described in Appendix A.

Local and Regional Roads – Prioritised Expenditure Forecast

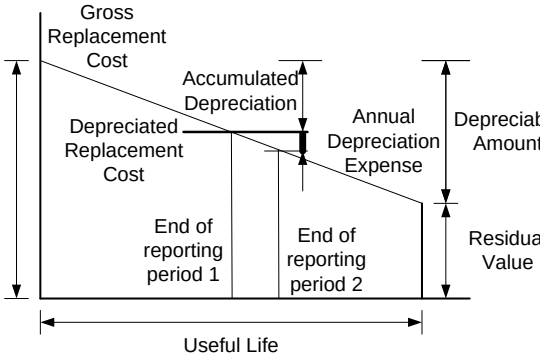
Table 9: Local and Regional Roads – Prioritised Expenditure Forecast – 10 years FY2023-FY2032

Year		Priority	Capital Costs	Maintenance Costs	Total Cost
1	2022/23	1b to 2d	$3,626,300	$166,101	$3,792,401
2	2023/24	2b to 2d	$4,130,900	$166,101	$4,297,001
3	2024/25	2b to 2d	$4,005,000	$166,101	$4,171,101
4-10	2025/32	2b to 3d	$28,035,000	$1,162,706	$29,197,706
Works Identified	2025/32	3b to 3d	$16,660,141		$16,660,141
Grand Total			**$56,457,341**	**$1,661,009**	**$58,118,350**

In summary the current value of Road Pavement assets is detailed in the Table below.

Table 10: Roads – Valuation

Asset Category	Length (km)	Replacement Value (2021)	Accumulated Depreciation (2021)	Fair Value (2021)	Depreciation Expense
Regional Roads	10.0	$30,465,227	$6,415,027	$24,050,201	$580,787
Local Roads	142.5	$230,407,167	$65,286,312	$165,120,855	$3,845,366
Total	**152.5**	**$260,872,395**	**$71,701,339**	**$189,171,056**	**$4,426,153**



Local and Regional Roads – Valuation Forecast

Asset values are forecast to remain steady. It is forecast that no additional assets are expected to be added to the asset stock from new construction and acquisition by Council or from assets constructed by land developers or other assets donated to Council.

Local and Regional Roads – Key Assumptions – Financial Forecast

Key assumptions made in this asset management plan are listed in the Table below.

Table: 11. Key Assumptions made in AM Plan and Risks of Change

Key Assumptions	Risks of Change to Assumptions
Use of Pavement Management System for renewal Requirements	Low risk (reviewed every 4 years with condition survey). Results of Pavement Management System verified by field checks.
Rate of deterioration	Low risk

Local and Regional Roads – Creation / Acquisition / Upgrade Program

New works are those that create a new asset that did not previously exist, or works which will upgrade or improve an existing asset beyond its existing capacity. They may result from growth, social or environmental needs. Assets may also be acquired at no cost. No new assets are currently identified.

Local and Regional Roads – Disposal Plan

No Road Assets have been identified for disposal.

Local and Regional Roads – Forecast reliability and confidence

The estimated confidence level and reliability of data used in this AMP is considered to be reliable as the data is based on a detailed condition report on Roads.

Local and Regional Roads – Improvement Plan

The improvement plan is shown in the table below.

Task No	Task	Responsibility	Resources Required	Timeline
1	Review Useful Lives	EPS	Staff Time	2024

Local and Regional Roads – Monitoring and Review Procedures

This Asset Management Plan will be reviewed during annual budget planning processes and amended to show any material changes in service levels and/or resources available to provide those services as a result of budget decisions.

The Asset Management Plan has a life of 4 years and is due for complete revision and updating within 1 year of each Council election.

Local and Regional Roads – Renewal and Replacement Program

Renewal and replacement expenditure is major work which does not increase the asset's design capacity but restores, rehabilitates, replaces or renews an existing asset to its original service potential. Work over and above restoring an asset to original service potential is considered to be an upgrade/expansion or new work expenditure resulting in additional future operations and maintenance costs.

Road assets requiring renewal/replacement have been identified following a Condition Audit completed by Consultants, Pavement Management Service P/L.

Local and Regional Roads – Funding Scenarios

The Long Term Financial Plan includes three scenarios, all of which maintain current services levels but propose differing levels of capital expenditure on the renewal of Council's ageing infrastructure assets.

In summary:

- Pessimistic Scenario - This Scenario results in a decline in operating results and deficits in the later years.
- Optimistic Scenario - This Scenario results in improvements in operating results for the life of the plan.
- Planned Scenario - This Scenario results modest surplus operating results for the life of the plan.

Table 12: Funding Scenarios – Local and Regional Roads – North Sydney Councils 10 Year Plan

Scenario	Capital Funding Level required per annum	10 Year Plan $ Total
Scenario 1.	$3,979,720/year	$39,797,200
Scenario 2.	$3,979,720/year	$39,797,200
Scenario 3.	$3,979,720/year	$39,797,200

Note: *These Scenarios are based on the 10-year Long Term Financial Plan.*

Local and Regional Roads – Service and Risk Tradeoffs

The decisions made in adopting this AM Plan are based on the objective to achieve the optimum benefits from the available resources.

Service trade-off

If this funding Scenario is adopted, then the Level of Service will be maintained.

Risk trade-off

If this funding Scenario is adopted, then it there is less risk of a sudden failure of a road asset.

Local and Regional Roads – Renewal and Replacement Program – FY2023-FY2032 (10 Year Plan)

Council's projected 10 year Capital Renewal Program is shown in the Tables below. It is based on the funding required to replace road assets identified following a Condition Audit completed by Consultants, Pavement Management Service P/L.

It should be noted that roads may also be replaced based on other criteria including:

- Damage
- Utility Authority Restorations
- Roads replaced in association with other projects such as kerb and gutter or drainage works
- Streetscape projects

Project priorities may also be subject to change due to accelerated deterioration, sudden failure or finalization of detailed designs and project costings.

Table13: Local and Regional Roads – Renewal and Replacement Program – FY2023-FY2032 (10 Year Plan)

Priority Projects 2022/23 (Year 1)

Replace Year	Priority	Location	Risk Rating/ Category	Condition	Capital Cost
2022/23	1b	Spruson St, Neutral Bay (PSID 514)	Very High (5)	Very Poor	$668,884
2022/23	1b	Spruson St, Neutral Bay (PSID 515)	Very High (5)	Very Poor	$177,428
2022/23	1b	Ben Boyd Rd, Neutral Bay (PSID 84)	Very High (5)	Very Poor	$704,784
2022/23	2c	Phillips St, Neutral Bay (PSID 443)	High (4)	Poor	$197,077
2022/23	2d	Phillips La, Neutral Bay (PSID 902)	High (4)	Poor	$114,296
2022/23	2d	Ixion La, Cammeray (PSID 707)	High (4)	Poor	$57,353
2022/23	Regional Roads Rehabilitation (priority subject to TfNSW funding assessment). Includes TfNSW REPAIR grant and Block Grant (Supplementary)				$634,000
2022/23	Heavy Patching Budget (Local & Regional Roads)				$864,600
2022/23	Contingency				$207,878
				Total	**$3,626,300**

Note: *These Cost estimates do not include inflation / building escalations costs which can vary between 3-8% each year.*

Projects based on Pavement Management System using data provided by Pavement Management Services. Road pavements have been grouped into projects to improve economy of scale to provide better value for Council.

Table 14: Local and Regional Roads – Renewal and Replacement Program

Priority Projects 2023/24 (Year 2)

Replace Year	Priority	Location	Risk Rating/ Category	Condition	Capital Cost
2023/24	2b	Henry Lawson Ave, Mcmahons Point (PSID 275)	High (4)	Poor	$264,272
2023/24	2b	Carr St, Waverton (PSID 146)	High (4)	Poor	$469,778
2023/24	2b	Grosvenor St, Neutral Bay (PSID 258)	High (4)	Poor	$399,055
2022/23	2c	Hardie St, Neutral Bay (PSID 688)	High (4)	Poor	$97,171
2022/23	2c	Highview La, Neutral Bay (PSID 692)	High (4)	Poor	$56,724
2022/23	2c	Marks St (Westbound), Cammeray (PSID 724)	High (4)	Poor	$94,445
2023/24	2c	Harriott St, Waverton (PSID 267)	High (4)	Poor	$286,589
2023/24	2c	Carr St, Waverton (PSID 144)	High (4)	Poor	$207,045
2023/24	2c	Oxley St, Crows Nest (PSID 427)	High (4)	Poor	$139,839
2023/24	2d	Alexander La, Crows Nest (PSID 810)	High (4)	Poor	$30,463
2023/24	2d	Waverton La, Waverton (PSID 560)	High (4)	Poor	$136,623
2023/24	2d	Young La, Cremorne (PSID 611)	High (4)	Poor	$77,133
2023/24	2d	Belgrave La, Cremorne (PSID 65)	High (4)	Poor	$55,863

Replace Year	Priority	Location	Risk Rating/ Category	Condition	Capital Cost
2023/24	Regional Roads Rehabilitation (priority subject to TfNSW funding assessment). Includes TfNSW REPAIR grant and Block Grant (Supplementary)				$634,000
2023/24	Heavy Patching Budget (Local & Regional Roads)				$881,900
2023/24	Contingency				$300,000
				Total	**$4,130,900**

Note: *These Cost estimates do not include inflation / building escalations costs which can vary between 3-8% each year.*

Projects based on Pavement Management System using data provided by Pavement Management Services. Road pavements have been grouped into projects to improve economy of scale to provide better value for Council.

Table 15: **Local and Regional Roads – Renewal and Replacement Program**

Priority Projects 2024/25 (Year 3)

Replace Year	Priority	Location	Risk Rating/ Category	Condition	Capital Cost
2024/25	2b	Newlands St, Wollstonecraft (PSID 417)	High (4)	Poor	$283,877
2024/25	2c	Reed St, Cremorne (PSID 464)	High (4)	Poor	$249,293
2023/24	2c	Kyngdon St, Cammeray (PSID 327)	High (4)	Poor	$98,713
2024/25	2c	Reed St, Cremorne (PSID 463)	High (4)	Poor	$304,842
2024/25	2c	Fifth Ave, Cremorne (PSID 234)	High (4)	Poor	$272,909
2024/25	2d	Sinclair St, Wollstonecraft (PSID 901)	High (4)	Poor	$32,746
2024/25	2d	Morton La, Wollstonecraft (PSID 403)	High (4)	Poor	$108,688
2024/25	2d	Macarthur Ave, Crows Nest (PSID 723)	High (4)	Poor	$122,429
2024/25	2d	Colin St, Cammeray (PSID 171)	High (4)	Poor	$227,041
2024/25	2d	Wilson St, Cammeray (PSID 588)	High (4)	Poor	$296,425
2024/25	2d	Cairo St, Cammeray (PSID 132)	High (4)	Poor	$264,328
2024/25	2d	Greens Dr, Cammeray (PSID 685)	High (4)	Poor	$181,611
2024/25	2d	Spofforth La, Cremorne (PSID 775)	High (4)	Poor	$28,498
2024/25	Regional Roads Rehabilitation (priority subject to TfNSW funding assessment). Includes TfNSW REPAIR grant and Block Grant (Supplementary)				$634,000
2024/25	Heavy Patching Budget (Local & Regional Roads)				$899,600
				Total	**$4,005,000**

Note: *These Cost estimates do not include inflation / building escalations costs which can vary between 3-8% each year.*

Projects based on Pavement Management System using data provided by Pavement Management Services. Road pavements have been grouped into projects to improve economy of scale to provide better value for Council.

Table 16: Local and Regional Roads – Renewal and Replacement Program

Priority Projects 2025/32 (Years 4-10)

Replace Year	Priority	Location	Risk Rating/ Category	Condition	Capital Cost
2025/32	2b	Crows Nest Rd, Waverton (PSID 184)	High (4)	Poor	$471,478
2025/32	2b	Grosvenor St, Neutral Bay (PSID 259)	High (4)	Poor	$446,746
2025/32	2b	Alfred St North (Southbound), North Sydney (PSID 617)	High (4)	Poor	$239,177
2025/32	2b	Willoughby Rd, Crows Nest (PSID 586)	High (4)	Poor	$771,383
2025/32	2b	Brightmore St, Cremorne (PSID 115)	High (4)	Poor	$671,465
2025/32	2b	Florence St, Cremorne (PSID 239)	High (4)	Poor	$536,117
2025/32	2b	Gillies St, Wollstonecraft (PSID 246)	High (4)	Poor	$765,980
2025/32	2b	Shirley Rd, Wollstonecraft (PSID 498)	High (4)	Poor	$520,718
2025/32	2b	Ernest St, Crows Nest (PSID 216)	High (4)	Poor	$664,345
2025/32	2b	Amherst St, Cammeray (PSID 24)	High (4)	Poor	$1,164,610
2025/32	2b	Bellevue St, Cammeray (PSID 70)	High (4)	Poor	$500,114
2025/32	2b	Lavender St, Lavender Bay (PSID 332)	High (4)	Poor	$341,224
2025/32	2b	Walker St, North Sydney (PSID 544)	High (4)	Poor	$502,429
2025/32	2b	Olympic Dr, Milsons Point (PSID 752)	High (4)	Poor	$826,007
2025/32	2b	Ben Boyd Rd, Neutral Bay (PSID 85)	High (4)	Poor	$796,057
2025/32	3c	Montague Rd, Cremorne (PSID 399)	Medium (3)	Fair	$677,288
2025/32	3c	Balls Head Rd, Waverton (PSID 50)	Medium (3)	Fair	$473,833
2025/32	3c	Balls Head Rd, Waverton (PSID 51)	Medium (3)	Fair	$488,609
2025/32	3c	Balls Head Dr, Waverton (PSID 45)	Medium (3)	Fair	$294,822
2025/32	3c	Ada St, Cremorne (PSID 3)	Medium (3)	Fair	$268,010
2025/32	3c	Spencer Rd, Cremorne (PSID 512)	Medium (3)	Fair	$408,600
2025/32	3c	Carabella St, Kirribilli (PSID 137)	Medium (3)	Fair	$445,013
2025/32	3c	Elamang Ave, Kirribilli (PSID 207)	Medium (3)	Fair	$340,937
2025/32	3c	Iredale Ave, Cremorne (PSID 302)	Medium (3)	Fair	$201,992
2025/32	3c	Blue St, North Sydney (PSID 102)	Medium (3)	Fair	$159,003
2025/32	3c	William St, North Sydney (PSID 575)	Medium (3)	Fair	$191,617
2025/32	3c	Milray Ave, Wollstonecraft (PSID 387)	Medium (3)	Fair	$514,887
2025/32	3c	Northcliff St, Milsons Point (PSID 746)	Medium (3)	Fair	$178,964
2025/32	3c	Donnelly Rd (Westbound), Cammeray (PSID 957)	Medium (3)	Fair	$16,869
2025/32	3c	Hollowforth Ave, Neutral Bay (PSID 285)	Medium (3)	Fair	$180,375
2025/32	3c	Tiley St, Cammeray (PSID 865)	Medium (3)	Fair	$51,427
2025/32	3c	Spofforth St (Northbound), Cremorne (PSID 513)	Medium (3)	Fair	$143,338
2025/32	3c	Kareela Rd, Cremorne Point (PSID 857)	Medium (3)	Fair	$108,173
2025/32	3c	Chandos St, Crows Nest (PSID 155)	Medium (3)	Fair	$316,796
2025/32	3c	Ellalong Rd, Cremorne (PSID 209)	Medium (3)	Fair	$452,723
2025/32	3c	Hodgson Ave, Cremorne Point (PSID 281)	Medium (3)	Fair	$322,046
2025/32	3c	Macpherson St (Northbound), Cremorne	Medium (3)	Fair	$320,995

Replace Year	Priority	Location	Risk Rating/ Category	Condition	Capital Cost
		(PSID 349)			
2025/32	3c	Barry St, Neutral Bay (PSID 845)	Medium (3)	Fair	$45,499
2025/32	3c	Brothers Ave, Cammeray (PSID 117)	Medium (3)	Fair	$100,469
2025/32	3c	Dumbarton St, Mcmahons Point (PSID 193)	Medium (3)	Fair	$196,390
2025/32	3c	Earle St, Cremorne (PSID 194)	Medium (3)	Fair	$285,473
2025/32	3c	Balls Head Dr, Waverton (PSID 47)	Medium (3)	Fair	$326,516
2025/32	Regional Roads Rehabilitation (priority subject to TfNSW funding assessment). Includes TfNSW REPAIR grant and Block Grant (Supplementary)				$4,438,000
2025/32	Heavy Patching Budget (Local & Regional Roads)				$6,822,364
2025/32	Contingency				$46,122
				Total	**$28,035,000**

Note: *These Cost estimates do not include inflation / building escalations costs which can vary between 3-8% each year.*

Projects based on Pavement Management System using data provided by Pavement Management Services. Road pavements have been grouped into projects to improve economy of scale to provide better value for Council.

Table 17: Local and Regional Roads – Renewal and Replacement Program

Works Identified – Years 2025 - 32 (Years 4 - 10)

Replace Year	Priority	Location	Risk Rating / Category	Condition	Capital Cost
2025/32	3c	Wyong Rd (North-Westbound), Cremorne (PSID 606)	Medium (3)	Fair	$138,088
2025/32	3c	Edward St, North Sydney (PSID 203)	Medium (3)	Fair	$298,258
2025/32	3c	King St, Wollstonecraft (PSID 314)	Medium (3)	Fair	$446,421
2025/32	3c	Russell St, Wollstonecraft (PSID 483)	Medium (3)	Fair	$475,887
2025/32	3c	Vernon St, Cammeray (PSID 539)	Medium (3)	Fair	$336,975
2025/32	3c	Woolcott St, Waverton (PSID 596)	Medium (3)	Fair	$215,548
2025/32	3c	Hazelbank Rd, Wollstonecraft (PSID 273)	Medium (3)	Fair	$555,849
2025/32	3c	Balls Head Dr, Waverton (PSID 48)	Medium (3)	Fair	$374,319
2025/32	3c	Vale St, Cammeray (PSID 538)	Medium (3)	Fair	$453,848
2025/32	3c	Carlow St, North Sydney (PSID 140)	Medium (3)	Fair	$522,716
2025/32	3d	Chandos La, Crows Nest (PSID 151)	Medium (3)	Fair	$108,230
2025/32	3d	Willoughby La, CROWS NEST (PSID 578)	Medium (3)	Fair	$33,184
2025/32	3d	Honda Rd, Neutral Bay (PSID 291)	Medium (3)	Fair	$129,302
2025/32	3d	Arthur La, Lavender Bay (PSID 622)	Medium (3)	Fair	$70,701
2025/32	3d	Arthur St, Lavender Bay (PSID 33)	Medium (3)	Fair	$201,551
2025/32	3d	Denos La, Cremorne (PSID 960)	Medium (3)	Fair	$178,638
2025/32	3d	Rose Ave, Neutral Bay (PSID 771)	Medium (3)	Fair	$76,004
2025/32	3d	Wyagdon St, Neutral Bay (PSID 798)	Medium (3)	Fair	$168,741
2025/32	3d	Willoughby La, Crows Nest (PSID 581)	Medium (3)	Fair	$64,434

Replace Year	Priority	Location	Risk Rating / Category	Condition	Capital Cost
2025/32	3d	Chapel La, Crows Nest (PSID 647)	Medium (3)	Fair	$57,031
2025/32	3d	Willoughby La, Crows Nest (PSID 580)	Medium (3)	Fair	$73,533
2025/32	3d	Zig Zag La, Crows Nest (PSID 808)	Medium (3)	Fair	$42,567
2025/32	3d	Cooper La, Neutral Bay (PSID 172)	Medium (3)	Fair	$48,720
2025/32	3d	Shirley Rd, Wollstonecraft (PSID 503)	Medium (3)	Fair	$177,219
2025/32	3d	Como La, Cremorne (PSID 659)	Medium (3)	Fair	$36,103
2025/32	3d	Elliott St, North Sydney (PSID 677)	Medium (3)	Fair	$123,343
2025/32	3d	Newlands La, Wollstonecraft (PSID 415)	Medium (3)	Fair	$164,694
2025/32	3d	Belmont La, Wollstonecraft (PSID 627)	Medium (3)	Fair	$16,185
2025/32	3d	Lambert St, Cammeray (PSID 713)	Medium (3)	Fair	$103,052
2025/32	3d	Ben Boyd La, Cremorne (PSID 75)	Medium (3)	Fair	$46,279
2025/32	3d	Bray La, North Sydney (PSID 983)	Medium (3)	Fair	$12,823
2025/32	3d	Langley Ave, Cremorne (PSID 329)	Medium (3)	Fair	$198,507
2025/32	3d	Langley Ave, Cremorne (PSID 714)	Medium (3)	Fair	$119,985
2025/32	3d	Education La, Cremorne (PSID 202)	Medium (3)	Fair	$120,633
2025/32	3d	Edwin La, Cammeray (PSID 674)	Medium (3)	Fair	$26,418
2025/32	3d	Shellbank Pde, Cremorne (PSID 773)	Medium (3)	Fair	$97,881
2025/32	3d	Holdsworth Rd, Neutral Bay (PSID 695)	Medium (3)	Fair	$50,111
2025/32	3d	Robertson La, Kirribilli (PSID 903)	Medium (3)	Fair	$13,129
2025/32	3d	Doohat Ave, North Sydney (PSID 191)	Medium (3)	Fair	$198,421
2025/32	3c	Mchatton St, Waverton (PSID 356)	Medium (3)	Fair	$502,610
2025/32	3c	Oxley St, Crows Nest (PSID 428)	Medium (3)	Fair	$131,764
2025/32	3b	Shirley Rd, Wollstonecraft (PSID 499)	Medium (3)	Fair	$790,429
2025/32	3d	Boyd La, Neutral Bay (PSID 635)	Medium (3)	Fair	$34,986
2025/32	3c	Victoria Pl, Mcmahons Point (PSID 785)	Medium (3)	Fair	$84,139
2025/32	3c	Pine St, Cammeray (PSID 844)	Medium (3)	Fair	$266,371
2025/32	3c	Berry St, North Sydney (PSID 96)	Medium (3)	Fair	$385,855
2025/32	3b	Blues Point Rd, Mcmahons Point (PSID 105)	Medium (3)	Fair	$385,223
2025/32	3b	Blues Point Rd, Mcmahons Point (PSID 106)	Medium (3)	Fair	$463,935
2025/32	3d	Boronia St, Wollstonecraft (PSID 109)	Medium (3)	Fair	$360,722
2025/32	3c	Boyle St, Cremorne (PSID 110)	Medium (3)	Fair	$313,734
2025/32	3b	Amherst St, Cammeray (PSID 23)	Medium (3)	Fair	$566,314
2025/32	3c	Grasmere Rd, Cremorne (PSID 254)	Medium (3)	Fair	$348,383
2025/32	3c	Balls Head Dr, Waverton (PSID 46)	Medium (3)	Fair	$439,353
2025/32	3d	Rialto Ave, Cremorne Point (PSID 467)	Medium (3)	Fair	$103,927
2025/32	3b	Yeo St, Neutral Bay (PSID 609)	Medium (3)	Fair	$501,429
2025/32	3b	Ben Boyd Rd, Neutral Bay (PSID 83)	Medium (3)	Fair	$688,774
2025/32	3d	Ben Boyd Rd, Neutral Bay (PSID 830)	Medium (3)	Fair	$49,970
2025/32	3b	Ernest St, Crows Nest (PSID 217)	Medium (3)	Fair	$604,018
2025/32	3d	Ancrum St, Waverton (PSID 26)	Medium (3)	Fair	$97,273
2025/32	3c	Hazelbank Rd, Wollstonecraft (PSID 274)	Medium (3)	Fair	$318,361

Replace Year	Priority	Location	Risk Rating / Category	Condition	Capital Cost
2025/32	3d	Kareela La, Cremorne Point (PSID 310)	Medium (3)	Fair	$311,095
2025/32	3d	Lloyd Ave, Cremorne (PSID 341)	Medium (3)	Fair	$172,393
2025/32	3b	Mclaren St, North Sydney (PSID 358)	Medium (3)	Fair	$602,741
2025/32	3d	Old La, Cremorne (PSID 425)	Medium (3)	Fair	$101,021
2025/32	Contingency				$1,459,993
				Total	**$16,660,141**

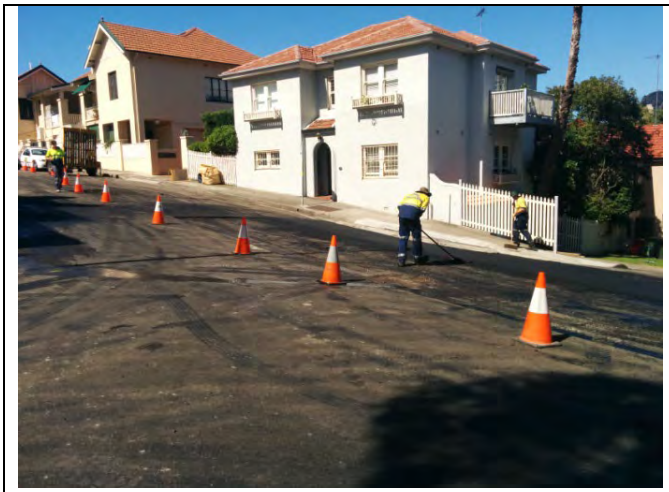
Note: *These Cost estimates do not include inflation / building escalations costs which can vary between 3-8% each year.*

Projects based on Pavement Management System using data provided by Pavement Management Services. Road pavements have been grouped into projects to improve economy of scale to provide better value for Council.

Local and Regional Roads Renewal Program

Mitchell Street, McMahons Point, before and after

Miller Street, North Sydney, before and after



High and Hipwood Streets, Kirribilli

	
Folly Point, Cammeray, before and after	

	
Montpellier St, Neutral Bay, before and after	

Local and Regional Roads – Performance Measures

The effectiveness of the asset management plan can be measured in the following ways:

- The degree to which the required projected expenditures identified in this asset management plan are incorporated into the long term financial plan,
- The degree to which 1-5 year detailed works programs, budgets, business plans and corporate structures take into account the 'global' works program trends provided by the asset management plan,
- The degree to which the existing and projected service levels and service consequences (what we cannot do), risks and residual risks are incorporated into the Strategic Plan and associated plans,
- The Asset Renewal Funding Ratio achieving the target of 1.0.

Local and Regional Roads – References

- IPWEA, 2006, 'International Infrastructure Management Manual', Institute of Public Works Engineering Australasia, Sydney, www.ipwea.org/IIMM
- IPWEA, 2008, 'NAMS.PLUS Asset Management', Institute of Public Works Engineering Australasia, Sydney, www.ipwea.org/namsplus.
- IPWEA, 2015, 2nd edn., 'Australian Infrastructure Financial Management Manual', Institute of Public Works Engineering Australasia, Sydney, www.ipwea.org/AIFMM.
- IPWEA, 2015, 3rd edn., 'International Infrastructure Management Manual', Institute of Public Works Engineering Australasia, Sydney, www.ipwea.org/IIMM
- IPWEA, 2012 LTFP Practice Note 6 PN Long Term Financial Plan, Institute of Public Works Engineering Australasia, Sydney

APPENDICES

Appendix A: Maintenance Management System

Defect Management Inspection - Roads

Inspection areas have been defined in accordance with the identified key factors of:

- Road pavement where failure is most disruptive and expensive to the community/users.
- Traffic (both vehicular and pedestrian) flows, eg. pedestrian use areas; retail/commercial areas; schools; hospitals; major collector roads; primary or sole access to significant population areas;

Inspection frequencies are based on these areas as defined by the reference maps and the resources currently available to undertake the inspections.

Red – 2 times per year; **Blue** – Annual; **Other** – Once every 2 years;

The results of inspections will be downloaded into the MMDS database.

There are 5 categories in which a defect may be placed. Not all categories may be applicable to every inspection area and/or type of asset:

Cat 5		Will be **made safe** no later than 2 working days after allocation of defect to work crew. Defect may then be re-categorised as Cat 4 or Cat 3.
Cat 4		Will be repaired no later than 10 working days after allocation of defect to work crew.
Cat 3		Will be placed on Zone Maintenance Program. This program operates on an 8 week cycle, however, depending on workload and reactive maintenance requests, Cat 3 defects may miss a cycle or more before repairs are able to be undertaken.
Cat 2		Deferred maintenance. Defect may be repaired if close-by to Cat 4 or Cat 3 defect that is being repaired. Otherwise will be re-inspected on next area inspection.
Cat 1		As new. Surface displaying no defects. May have aesthetic aspects such as gum, stains, services mark-up, etc.

Intervention Matrix

ROADS	RED	BLUE	OTHER
USED BY PEDESTRIANS	**28**	**24**	**21**
> 100mm or > 10sqm and > 30mm	**23**	**19**	**16**
30 – 100mm or 5-10sqm and > 30mm	**20**	**16**	**13**
< 30mm	**18**	**14**	**11**
AESTHETIC	**10**	**6**	**3**

Scoring example: 28 = High Use Area score 10 and Defect of Slippery or Loose Underfoot score 18

The focus of road inspections will be the areas of road pavement used by pedestrians and the traffic lanes. Parking lanes will be inspected if visible at the time of inspection.

If defects appear at intervals at of approximately every 2.0m of road pavement, then the area of the defect recorded shall be the width by the distance from the first to the last identified defect.

NORTH SYDNEY COUNCIL - GUIDE FOR ROAD DEFECT RATING

AN EXPLANATION OF THE DEFECT INSPECTION SYSTEM

AREA OF INSPECTION		SCORE
RED	**ROAD PAVEMENT WHERE FAILURE IS MOST DISRUPTIVE AND EXPENSIVE TO THE COMMUNITY/USERS. HIGH TRAFFIC FLOWS. EG. HIGH PEDESTRIAN USE AREAS; RETAIL/COMMERCIAL AREAS; SCHOOLS; HOSPITALS; MAJOR COLLECTOR ROADS; PRIMARY OR SOLE ACCESS TO SIGNIFICANT POPULATION AREAS;** **INSPECTIONS - 2 PER YEAR**	**10**
BLUE	**ROAD PAVEMENT WHERE FAILURE IS LIKELY TO BE LESS DISRUPTIVE BUT STILL SIGNIFICANT TO THE COMMUNITY/USERS. MEDIUM TRAFFIC FLOWS. EG. MEDIUM PEDESTRIAN USE AREAS; SIDE STREETS NEAR RETAIL/COMMERCIAL AREAS, SCHOOLS and HOSPITALS; ALTERNATE ROUTES TO MAJOR COLLECTOR ROADS and ACCESS TO SIGNIFICANT POPULATION AREAS** **INSPECTIONS - ANNUAL**	**6**
WHITE	**ALL OTHER AREAS IN LGA EXCLUDING PARKS; RESERVES and PLAZAS** **INSPECTION - EVERY 2 YEARS** **NOTE:** IN THESE AREAS ONLY DEFECTS GREATER THAN ABOUT 30mm WILL HAVE DETAILS RECORDED.	**3**

PAVEMENT TYPE	
CONCRETE	PAVING - UNIPAVERS & OTHER TYPES OF PAVERS
ASPHALT	STENCILLED/COLOURED ASPHALT

DEFECT – MAY BE **HEIGHT or WIDTH**	
AREA OF ROAD PAVEMENT USED BY PEDESTRIANS	**18**
DEFECT GREATER THAN ABOUT 100mm HEIGHT or WIDTH	**13**
DEFECT AREA GREATER THAN 10 sqm and HEIGHT or WIDTH GREATER THAN 30mm	**13**
DEFECT BETWEEN ABOUT 30mm AND ABOUT 100mm HEIGHT or WIDTH	**10**
DEFECT AREA 5 to 10 sqm and HEIGHT or WIDTH GREATER THAN 30mm	**10**
LESS THAN ABOUT 30MM	**8**
AESTHETIC ISSUES - STAINS, SERVICES MARK-UP; etc	**0**

HAZARD TYPE (REFER TO ROAD DEFECT REFERENCE SHEETS)	
TRIP - LIFTING/DROPPING OF SECTION TO ADJACENT SECTION	RUTTING - DEFORMATION IN ONE OR BOTH WHEEL PATHS
DELAMINATION - PEELING OR LIFTING OF PAVEMENT SURFACE	POT HOLE - TYPICALLY BOWL SHAPED AND BREAKING EDGES
CRACKING - ROAD PAVEMENT FRACTURES (SEE REF DIAGRAM)	UNEVEN SURFACE - LOWER OR ABOVE SURROUNDING AREA
SERVICE ACCESS COVER - BELOW OR ABOVE SURROUNDING PAVEMENT or PAVEMENT BREAKING UP AROUND IT	
PAVEMENT SURFACE - SLIPPERY or LOOSE UNDER FOOT eg. SAND, LEAVES, SEEDS or OIL ON SURFACE	

OTHER ASPECTS	
AREA HAS KERB & GUTTER (K&G) FAILURE THAT HAS CONTRIBUTED TO ROAD PAVEMENT FAILURE AND NEEDS ATTENTION PRIOR TO ROAD PAVEMENT REPAIR	PRESENCE OF PARTICULAR ASPECT/S NOTED PRIOR TO DEPARTURE FROM PSID. REFERRED TO RELEVANT NSC SECTION VIA EMAIL
AREA HAS DROP OFF ALONG EDGE OF ROAD PAVEMENT > 50MM - NO K&G	
AREA HAS OBSTRUCTIONS DUE TO OVERHANGING TREE or VEGETATION	

Appendix B: Capital Renewal Works Program Modelling

The PARMMS® Road Manager software is used to produce the required future works programs. This system is detailed below.

Pavement Treatments

The appropriate and applicable preventive, corrective and rehabilitation maintenance options considered are shown in the following Table.

Table: Selected Treatments

TREATMENT	DESCRIPTION OF TREATMENT
Routine	Routine maintenance involves work such as pothole repairs and clearing of drainage that is carried out during a patrol of the road network.
Do Nothing	No treatment is necessary at this time.
Crack Sealing	Sealing of cracks to waterproof the pavement surface and reduce the ingress of moisture into the pavement to extend the useful pavement life. This routine maintenance activity is not currently undertaken by NSC.
Pothole Patching	Repair of potholes to provide a safe pavement surface and reduce the moisture ingress into the pavement.
Heavy Patching	Repair of pavement affected by structural cracking to restore localised failures and reduce ingress of moisture leading to more significant failures.
Mill & Resheet	The existing pavement is profiled to allow the pavement to remain at the existing level after the treatment and therefore the existing drainage capacity of the pavement is retained. This treatment utilises a minimum 50mm of AC and is used where there is minimal structural distress and the pavement is sound.
Full Depth Asphalt	The existing pavement is profiled to allow the pavement to remain at the existing level after the treatment and therefore the existing drainage capacity of the pavement is retained. This treatment utilises a minimum 150mm of AC and is used where there is extensive distress and the pavement requires strengthening.

These pavement treatments are to be triggered based on the intervention levels described below.

Intervention Levels

To allow investigation as to what treatment would be applicable once the pavement has reached a determined serviceability level, intervention levels are specified indicating the minimum condition under which work would be undertaken. These levels are set out for each of the classes based on North Sydney's road network as shown in the Table below. The intervention levels for the appropriate pavement condition are compared to the average current condition to assist in the interpretation of these levels.

Pavement Condition	Class 6 Regional	Class 7 Collector	Class 8 Local	Class 9 Lanes
Roughness (counts/km)	100	150	N/A	N/A
Rut Depth (mm)	6	12	18	18
Environmental Cracking (%)	5	10	20	20
Fatigue Cracking (%)	2	5	10	15
Potholes (%)	5	5	5	5
Ravelling (%)	10	25	35	50

Treatment Selection

The treatment selection processes used in this analysis, via the Road Manager software is a two-phase analysis. The first phase is a broad classification of the pavement treatment needs based solely on the condition data and is referred to as "Classification"; the second is a more detailed "Resolution" of the required treatment based on both pavement condition and the attributes of the pavement.

Classification

In this process the current condition of the pavement is used to determine an appropriate level of treatment. For example, less than 5% of cracking on a class 6 regional road may be acceptable and this condition would be ignored for the current year. If there is between 5% and 10% cracking it is recommended for "heavy patching". For over 10% the reason for the distress would be determined and the pavement would be redesigned according to the NAASRA road design manual. This is the "redesign" action of the resolution phase.

On occasions sections will satisfy more than one condition in the classification decision matrix. When this occurs the process selects the highest classification treatment group to be used in the resolution phase. The priorities from highest to lowest are listed in the following Table, with highest priority being reconstruction.

Table: Classification Priorities

Classification Treatment	Priority
Reconstruction	1
Redesign	2
Resurface	3
Pothole Patching	4
Heavy Patching	5
Crack Sealing	6
No Treatment	7

The following notes outline each of the classification priorities shown in above Table and how they are used to determine where road sections will be sent in the resolution matrix.

- **Roughness** – there is a minimum level for class 6 and 7 roads above which sections will be sent to the '*redesign*' area of the resolution phase. Class 8 and 9 roads do not consider roughness due to the low speed environment. A second intervention level has been set where a high roughness results in sections being sent to the '*reconstruction*' area of the resolution phase.

- **Rut depth** – there is a lower intervention level based on class above which sections will be sent to the '*redesign*' area of the resolution phase.

- **Environmental cracking** – there is a lower intervention level based on class above which sections will be sent to the '*crack sealing'* area of the resolution phase. When the cracking is greater than the upper intervention level the section will be sent to the '*redesign'* area of the resolution phase.

- **Fatigue cracking** – there is a lower intervention level based on class above which sections will be sent to the '*heavy patching'* area of the resolution phase. When the cracking is greater than the upper intervention level the section will be sent to the '*redesign'* area of the resolution phase to investigate the cause of the structural cracking.

- **Potholes** - there is a minimum level based on class above which sections will be sent to the '*pothole patching'* area of the resolution matrix. When the potholes are greater than the upper intervention level the section will be sent to the '*redesign'* area of the resolution matrix.

- **Ravelling** - there is a lower intervention level based on class above which sections will be sent to either the '*rejuvenation'*, or '*resurface*' area of the resolution phase.

If a section has no characteristics exceeding the minimum intervention levels, the section will be sent to the '*no treatment'* area of the resolution matrix.

Resolution

This phase uses a series of decision trees in order to obtain a treatment suitable for routine maintenance, resurfacing or rehabilitation of each pavement section. The treatment can be based on a combination of both the condition and attributes of the pavement, such as: roughness, rut depth, NAASRA class, surface type, kerb height, overlay requirement, curvature function, geographical conditions, skid resistance parameters and surface life. The careful process of combining the desired factors allows the system to define the treatment selection process, with the process being flexible and tailored to the client's practices and pavement conditions, creating an expert system.

The following notes outline the operation of various areas of the resolution matrix in determining what, if any, treatment will be applied to a given section. The resolution matrix is read from left to right with a particular treatment being applied only if all criteria in the particular row are satisfied.

- **No Treatment -** When sections are assigned the Treatment Classification of '*no treatment'* no treatment is applied.
- **Crack Sealing -** When sections are sent to crack sealing this treatment is applied to the areas affected by environmental cracking.
- **Pothole Patching -** When sections are sent to pothole patching this treatment is applied to the areas affected by potholes.
- **Heavy Patching -** When sections are sent to heavy patching this treatment is applied to the areas affected by structural cracking.
- **Resurface -** When sections are sent resurface and asphalt overlay treatment is applied based on the total area of the section.
- **Redesign -** Sections sent to the treatment classification '*redesign*' are divided into a range of characteristics as outlined in the Resolution Matrix, Appendix A.
- **Reconstruction -** When sections are sent to reconstruction this treatment is applied based on a depth of 200mm of asphalt material.

Works Effects

Post resolution adjustment, or the resetting of condition data after a treatment, is required so that decisions for future years can be made on the basis of defensible data. The adjustment modifies the condition of the pavement so that it reflects the predicted condition after performing a certain treatment. The following Table shows the works effects models used for all years in the analysis, for each treatment.

Table: Works Effects Models, Reset Values

Treatment	Roughness Reset, Min Value	Potholes	Environmental Cracking	Fatigue Cracking	Rutting	Surface Age*	Structural Capacity
Crack Sealing	N/A	N/A	0	N/A	N/A	No	No
Pothole Patching	+1, N/A	0	N/A	N/A	N/A	No	No
Heavy Patching	+2, N/A	0	N/A	0	N/A	No	No
Mill & Resheet	-60, 70	0	0	0	0	Yes	No
Full Depth Asphalt	-150, 70	0	0	0	0	Yes	Yes

* Ravelling condition is also reset to zero where indicated by "Yes"

Risk Scenarios

Each pavement condition is examined through five scenarios. These include DO NOTHING, ROUTINE and three USER DEFINED risk scenarios.

The three USER DEFINED risk scenarios are based on the statistical risk of failure. For example, if we want to be 100% sure our decision is correct then we will have to use a safety factor to ensure all failure contingencies are met. If it is possible to accept a 25% failure (i.e. expect to be correct 75% of the time) then it is possible to accept a lower safety factor, and if we are considered to be correct 50% of the time we need not use a safety factor at all.

The risk scenarios used in the analysis for North Sydney Council are 5, 15 and 25%.

The ROUTINE scenario is when the system adopts a strategy of only crack sealing, pothole and heavy patching until such time as the pavement reaches terminal roughness and public objection would dominate. At this point reconstruction is necessary.

The DO NOTHING scenario adopts a strategy of no treatments on the pavement section until reconstruction is required. This is a viable option when the pavement is in a poor condition thus making it more cost effective to allow deterioration to the terminal point, and then reconstructing.

Data Synchronisation

The PARMMS® Road Manager system is capable of accepting input data on a cyclical basis, where treatments are applied on an annual basis reflecting the work undertaken in that year. As a result, there will be age discrepancies between the data sets for different pavement sections with some being based on measured data and others on predicted data.

Because the pavement section's data maybe collected once every five years, the information necessary to compute the pavement sections maintenance strategy is out of synchronisation with the starting year of the analysis. Thus there is a preliminary activity to bring this condition into synchronisation before the optimum redesign treatment can be identified.

The PARMMS® Road Manager system will deteriorate the condition for each pavement section in accordance with the deterioration models and the time interval between the pavement sections condition date and the analysis start date.

After the pavement condition has been deteriorated using the appropriate deterioration models, all conditions are in synchronisation with the analysis start date. At this point further analysis and decisions identify the optimum redesign treatment for the applicable scenario and study period.

Model Calibration

The deterioration models have previously been calibrated based on Long Term Pavement Performance (LTPP) site data previously collected across the North Sydney and Sydney road networks. The following environmental factor and rainfall figures are also used;

- Environmental Factor: 1.0% (deterioration in roughness per annum associated with the temperature and rainfall environment of the NSC network)

- Mean Monthly Precipitation: 100mm

Traffic

Traffic count data has been provided for 43% of the road network over a period of 19 years with close to half this data less than 5 years old. Where traffic count data is not available, traffic data was interpolated using traffic data from adjacent road segments or surrounding roads by representatives of NSC in order to provide 100% coverage of the network.

Classification Matrix

ROUGHNESS (NRM)	NAASRA CLASS 6	NAASRA CLASS 7	NAASRA CLASS 8	NAASRA CLASS 9
0 - 100	No Treatment	No Treatment	No Treatment	No Treatment
100 - 150	Redesign	No Treatment	No Treatment	No Treatment
150 - 200	Redesign	Redesign	No Treatment	No Treatment
200 - 350	Redesign	Redesign	Redesign	No Treatment
350 - 400	Redesign	Redesign	Redesign	Redesign
> 400	Reconstruction	Reconstruction	Reconstruction	Reconstruction

RUT DEPTH (mm)	NAASRA CLASS 6	NAASRA CLASS 7	NAASRA CLASS 8	NAASRA CLASS 9
0 - 6	No Treatment	No Treatment	No Treatment	No Treatment
6 - 12	Redesign	No Treatment	No Treatment	No Treatment
12 - 18	Redesign	Redesign	No Treatment	No Treatment
18 - 24	Redesign	Redesign	Redesign	No Treatment
> 24	Redesign	Redesign	Redesign 1	Redesign

ENVIRONMENTAL CRACKING (%)	NAASRA CLASS 6	NAASRA CLASS 7	NAASRA CLASS 8	NAASRA CLASS 9
0 - 5	No Treatment	No Treatment	No Treatment	No Treatment
5 - 10	Heavy Patching	No Treatment	No Treatment	No Treatment
10 - 20	Heavy Patching	Heavy Patching	No Treatment	No Treatment
20 - 30	Redesign	Redesign	Heavy Patching	Heavy Patching
> 30	Redesign	Redesign	Redesign	Redesign

STRUCTURAL CRACKING (%)	NAASRA CLASS 6	NAASRA CLASS 7	NAASRA CLASS 8	NAASRA CLASS 9
0 - 2	No Treatment	No Treatment	No Treatment	No Treatment
2 - 5	Heavy Patching	No Treatment	No Treatment	No Treatment
5 - 10	Heavy Patching	Heavy Patching	No Treatment	No Treatment
10 - 15	Heavy Patching	Heavy Patching	Heavy Patching	No Treatment
15 - 20	Heavy Patching	Heavy Patching	Heavy Patching	Heavy Patching
20 - 30	Redesign	Redesign	Heavy Patching	Heavy Patching
30 - 50	Redesign	Redesign	Heavy Patching	Heavy Patching
> 50	Redesign	Redesign	Redesign	Redesign

POTHOLES & POTHOLE PATCHING (%)	NAASRA CLASS 6	NAASRA CLASS 7	NAASRA CLASS 8	NAASRA CLASS 9
0 - 5	No Treatment	No Treatment	No Treatment	No Treatment
5 - 8	Pothole Patching	Pothole Patching	Pothole Patching	Pothole Patching
8 - 13	Heavy Patching	Heavy Patching	Heavy Patching	Pothole Patching
13 - 15	Redesign	Redesign	Heavy Patching	Pothole Patching
15 - 20	Redesign	Redesign	Redesign	Heavy Patching
> 20	Redesign	Redesign	Redesign	Redesign

RAVELLING (%)	NAASRA CLASS 6	NAASRA CLASS 7	NAASRA CLASS 8	NAASRA CLASS 9
0 - 10	No Treatment	No Treatment	No Treatment	No Treatment
10 - 25	Resurface	No Treatment	No Treatment	No Treatment
25 - 35	Resurface	Resurface	No Treatment	No Treatment
35 - 50	Resurface	Resurface	Resurface	No Treatment
50 - 75	Redesign	Resurface	Resurface	Resurface
80 - 100	Redesign	Redesign	Resurface	Resurface

Resolution Matrix

NAASRA Class	Treatment Classification	Surface Type	Minimum Age	Structural Cracking	Treatment Number	Treatment
6	No Treatment				2	No Treatment
	Crack Sealing				5	Crack Sealing
	Heavy Patching				7	Heavy Patching
	Pothole Patching				6	Pothole Repair
	Resurfacing	Asphalt	≤ Min		2	No Treatment
			> Min		9	Mill & Resheet
		Concrete			2	No Treatment
		Pavers			2	No Treatment
	Redesign	Asphalt	≤ Min		2	No Treatment
			> Min	≤ 20	9	Mill & Resheet
				> 20	11	Full Depth Asphalt
		Concrete		< 50	2	No Treatment
				> 50	18	Reconstruction Concrete
		Pavers			2	No Treatment
	Reconstruction	Asphalt			17	Reconstruction Asphalt
		Concrete			18	Reconstruction Concrete
		Pavers			2	No Treatment

NAASRA Class	Treatment Classification	Surface Type	Minimum Age	Structural Cracking	Treatment Number	Treatment
7	No Treatment				2	No Treatment
	Crack Sealing				5	Crack Sealing
	Heavy Patching				7	Heavy Patching
	Pothole Patching				6	Pothole Repair
	Resurfacing	Asphalt	≤ Min		2	No Treatment
			> Min		9	Mill & Resheet
		Concrete			2	No Treatment
		Pavers			2	No Treatment
	Redesign	Asphalt	≤ Min		2	No Treatment
			> Min	≤ 25	9	Mill & Resheet
				> 25	11	Full Depth Asphalt
		Concrete		< 50	2	No Treatment
				> 50	18	Reconstruction Concrete
		Pavers			2	No Treatment
	Reconstruction	Asphalt			17	Reconstruction Asphalt
		Concrete			18	Reconstruction Concrete
		Pavers			2	No Treatment

NAASRA Class	Treatment Classification	Surface Type	Minimum Age	Structural Cracking	Treatment Number	Treatment
8	No Treatment				2	No Treatment
	Crack Sealing				5	Crack Sealing
	Heavy Patching				7	Heavy Patching
	Pothole Patching				6	Pothole Repair
	Resurfacing	Asphalt	≤ Min		2	No Treatment
			> Min		9	Mill & Resheet
		Concrete			2	No Treatment
		Pavers			2	No Treatment
	Redesign	Asphalt	≤ Min		2	No Treatment
			> Min	≤ 40	9	Mill & Resheet
				> 40	11	Full Depth Asphalt
		Concrete		< 50	2	No Treatment
				> 50	18	Reconstruction Concrete
		Pavers			2	No Treatment
	Reconstruction	Asphalt			17	Reconstruction Asphalt
		Concrete			18	Reconstruction Concrete
		Pavers			2	No Treatment

NAASRA Class	Treatment Classification	Surface Type	Minimum Age	Structural Cracking	Treatment Number	Treatment
9	No Treatment				2	No Treatment
	Crack Sealing				5	Crack Sealing
	Heavy Patching				7	Heavy Patching
	Pothole Patching				6	Pothole Repair
	Resurfacing	Asphalt	≤ Min		2	No Treatment
			> Min		9	Mill & Resheet
		Concrete			2	No Treatment
		Pavers			2	No Treatment
	Redesign	Asphalt	≤ Min		2	No Treatment
			> Min	≤ 50	9	Mill & Resheet
				> 50	11	Full Depth Asphalt
		Concrete		< 50	2	No Treatment
				> 50	18	Reconstruction Concrete
		Pavers			2	No Treatment
	Reconstruction	Asphalt			17	Reconstruction Asphalt
		Concrete			18	Reconstruction Concrete
		Pavers			2	No Treatment