City of Bothell
Pavement Management Program
State of the Streets Report

Northwest Management Systems
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City of Bothell™

Purpose

The purpose of this report is to assist policy makers in utilizing the results of the City of Bothell's Pavement Management System (PMS*)*. Specifically, this report links the PMS recommended repair program costs to Bothell's current and projected budget to improve overall maintenance and rehabilitation strategies. This report assesses the adequacy of current and projected revenues to meet the maintenance needs recommended by the PMS program. It also maximizes the return from expenditures in the following methods:

- Implementation of a multi-year road rehabilitation and maintenance program,
- Development of a preventative maintenance program; and
- Selection of the most cost effective repairs.

This report assists the City of Bothell with identifying maintenance priorities specific to the needs of the city. This study examines the overall condition of the road network and highlights options for improving the current network-level Pavement Condition Index (PCI). These options are developed by conducting speculative analyses using the City of Bothell's PMS database. By varying the budget amounts available for pavement maintenance and repair, different funding strategies are introduced which can impact the city's roads over the next six years.

Pavement Condition (2015)

The Pavement Condition Index, or PCI, is a measurement of pavement grade or condition and ranges from 0 to 100. A newly constructed road would have a PCI of 100, while a failed road would have a PCI of 25 or less. Bothell's current average Pavement Condition Index is 70, placing it in the bottom of the "Very Good" Condition Category.

Present Cost to Repair the Road Network Decision Tree

The City of Bothell's Pavement Management System (PMS) is designed to achieve an optimal network PCI in the low 80's, which is in the "Excellent Condition" category. In other words, the system will recommend maintenance treatments in an attempt to bring all of the roads in Bothell to an "Excellent Condition", with the majority of the roads falling into the low 80's PCI range.

57% of Bothell's roads have a PCI between 70 and 100, which are in the "Excellent to Very Good Condition" category. Why then, does it cost so much to repair the city's roads, and why bother improving them?

The cost to maintain and repair pavement depends on its current PCI. In the "Excellent to Very Good Category", it costs very little to apply a preventive maintenance treatment such as Crack Sealing, spot patching or slurry seals for local streets, which can extend the life of a pavement by correcting minor faults and reducing further deterioration. Treatments of this sort are applied before pavement deterioration has become severe.

31% of the city's road network falls into the "Good Condition" category. Pavements in this range show some form of distress or wear that require more than a life-extending

treatment. By this point, a well-designed pavement will have served at least 75% of its life and the quality of the pavement has dropped by about 40%. The road surface may require a 2" Mill and Fill Overlay, or on local streets a slurry seal, that may include some patching.

The remaining 12% of Bothell's road network falls into the "Fair to Poor Condition" or "Very Poor Condition" PCI ranges. These pavements are near the end of their service lives and often exhibit severe forms of distress such as potholes, extensive cracking, etc. At this stage, a roadway usually requires either a 2" Mill and Fill Overlay with patching or reconstruction depending on condition. The costs for these treatments range from about $40 per sq. yd. to $100 per sq. yd.

Decision Tree for the City of Bothell (2015)

PCI Range	Treatment	Cost Per Sq. Yd.
70 – 100*	Spot Patching, Crack Seals or Slurry Seals	$2 to $5.50
69 – 50**	Slurry or Chip Seals	$5.50 to $9
69 – 50	2" Mill and Fill Overlay or Slurry Seal with patching	$10 - $42
49 – 25	2" Mill and Fill Overlay with patching	$40 - $45
24 – 0**	Reconstruction	$90 - $100

*Spot Patching or Crack Sealing can be both applied in this Range. Slurry Seals will only be applied on Local Streets.
** Slurry Seals will be applied on Local Streets, while Chip Seals will be applied on Arterials and Collectors.
**Some local streets might be candidates for thin overlay with patching at this PCI range. Extensive sub-base and structural analysis would need to be performed on these candidates to ensure that the correct treatment is being selected

To provide more detail to street condition and respective repairs the photos below provide examples of pavement deficiencies from streets and the appropriate repair methods.
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Preventive Maintenance

Crack Seal or Slurry Seal- The Street has a PCI of 85.

This pavement is generally in good condition and would benefit from crack sealing to prevent water from entering the sub base and causing further deterioration.

Overlay & Reconstruction

Overlay – This Street has a PCI of 64

This pavement is in good condition with a few areas of alligator cracking that should be structurally patched before it is resurfaced with a 2" Mill and Fill overlay.

Overlay – This Street has a PCI of 42

This pavement is in very poor condition with areas of alligator cracking that should be structurally patched before it is resurfaced with a 2 inch Mill and Fill overlay with patching.

Reconstruction – The Street has a PCI of 17

Reconstruction – The Street has a PCI of 17 (Close Up View)

This pavement is in very poor condition with severe alligator cracking, potholes, and areas of settlement. This street should be rubblized, regraded, and reconstructed with new sub base material and asphalt pavement.

Future Expenditures for Pavement Maintenance

It is estimated that the City of Bothell will spend $1.3 million a year or $26 Million on pavement rehabilitation and reconstruction during the next twenty years (2016 - 2035), assuming current funding levels.

Impacts of Projected Funding Levels

With the existing budget over the next twenty-year period, the condition of the network deteriorates, with the average PCI decreasing from 70 to 44. The amount of "deferred" maintenance increases from $15.2 million to $127.9 million.

Deferred maintenance consists of pavement maintenance that is needed, but which cannot be allocated due to lack of funding. Shrinking budgets have forced many Puget Sound Area cities and counties to defer much-needed road maintenance. By deferring maintenance, not only does the frequency of citizens' complaints about the condition of the network increase, but the cost to repair these roads rises as well.

Budget Needs

Based on the principle that it costs less to maintain roads in the “Excellent to Very Good Condition” than to repair those that are in the “Fair to Poor Condition”, the City of Bothell’ Pavement Management System strives to develop a maintenance strategy that will first improve the overall condition of the network to an optimal PCI level. This PCI level is dependent upon the City’s maintenance and rehabilitation policies as delineated

in the predetermined preventative maintenance and rehabilitation decision trees. These decision trees systematically assign a specific treatment dependent on the PCI and types of distress found on the pavement. For Bothell, this optimum PCI level is in the 80's. Although the average PCI for the city is 70, which is in the bottom of the “Very Good Condition“ category, a portion of the network suffers from load-related distresses.

The first step in developing a cost-effective Maintenance and Rehabilitation (M&R) strategy is to determine, assuming unlimited revenues, the M&R "needs" of Bothell’s road network. Using the PMS analysis module, maintenance needs over the next twenty years were estimated at over $107 million if Bothell follows the strategy recommended by the PMS program to increase the average network PCI to 80. If however, no maintenance is applied over the next twenty years, already distressed roads will continue to deteriorate, and the network PCI will drop to 30. The results of the budget needs analysis are summarized in the table below.

Table 2 - Summary of Results from Budget Needs Analysis ($ Millions)

Year	2016 -2020	2021-2025	2026 - 2030	2031 -2035
PCI w/ Treatment	70 80 82 82 83	82 82 82 82 81	82 81 82 82 81	81 81 81 80 80
PCI w/out Treatment	70 68 66 64 62	60 58 56 54 52	49 47 44 42 40	38 36 34 32 30
Budget Needs ($) for each of a five year period.	$43.3	$22.6	$19.9	$21.6

Table 2 (above) shows the level of expenditures required to raise Bothell’ pavement condition to an optimal network PCI of 80 and eliminate the current maintenance backlog. The results of the budget needs analysis represent the ideal funding strategy recommended by the City of Bothell’s PMS. Of the $107 million in M&R needs shown, $10 million is earmarked for preventative maintenance or life-extending treatments, while $97 million is allocated for light and heavy rehabilitation and reconstruction treatments.

Budget Scenarios

Having determined the maintenance needs of the city's road network, the next step in developing a cost-effective maintenance and rehabilitation strategy is to conduct a what-if analysis. Using the PMS budget analysis module, the impacts of various budget "scenarios" can be evaluated. The program projects the effects of the different scenarios on pavement condition (PCI) and deferred maintenance (backlog). By examining the effects on these indicators, the advantages and disadvantages of different funding levels and maintenance strategies become clear. The following scenarios were run for the purposes of this report:

Scenario 1 ($107 million over 20 years) All Streets Program - ***Bring PCI to 80 in 20 years*** - The budget for each year is identified in the budget needs analysis. This scenario will allow the city to reasonably improve the condition of the network to a PCI

of 80, assuming that existing repair and renovation practices as described in the maintenance and rehabilitation decision trees are utilized.

Scenario 2 ($60 million over 20 years) Staff recommended - The staff-recommended program would increase spending to $3,000,000 per year and focus those funds primarily on arterial pavements. Remaining funds would go toward local streets.

Scenario 3 ($53.38 million over 20 years) Arterials Only Program - This scenario explores the impact of spending pavement dollars only on Arterials and maintaining these roads at a PCI of 80.

Scenario 4 ($26 million over 20 years) Current Budget – This scenario explores the impact of the current budget.

Discussion and Recommendations

Figure 1 (below) illustrates the change in PCI over time for the different budget scenarios. Note that Scenario 1, which represents the ideal funding strategy, ultimately achieves a PCI of 80 after six years. By comparison, Bothell' projected current budget, Scenario 3 results in a drop in PCI to 57.

Figure 1 Pavement Condition Index per Scenario by Year

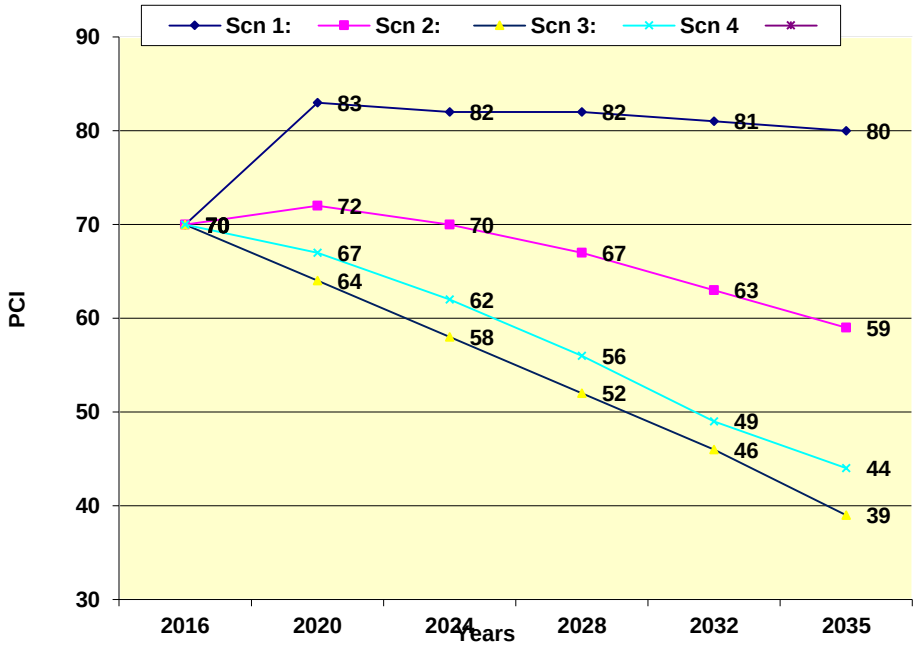
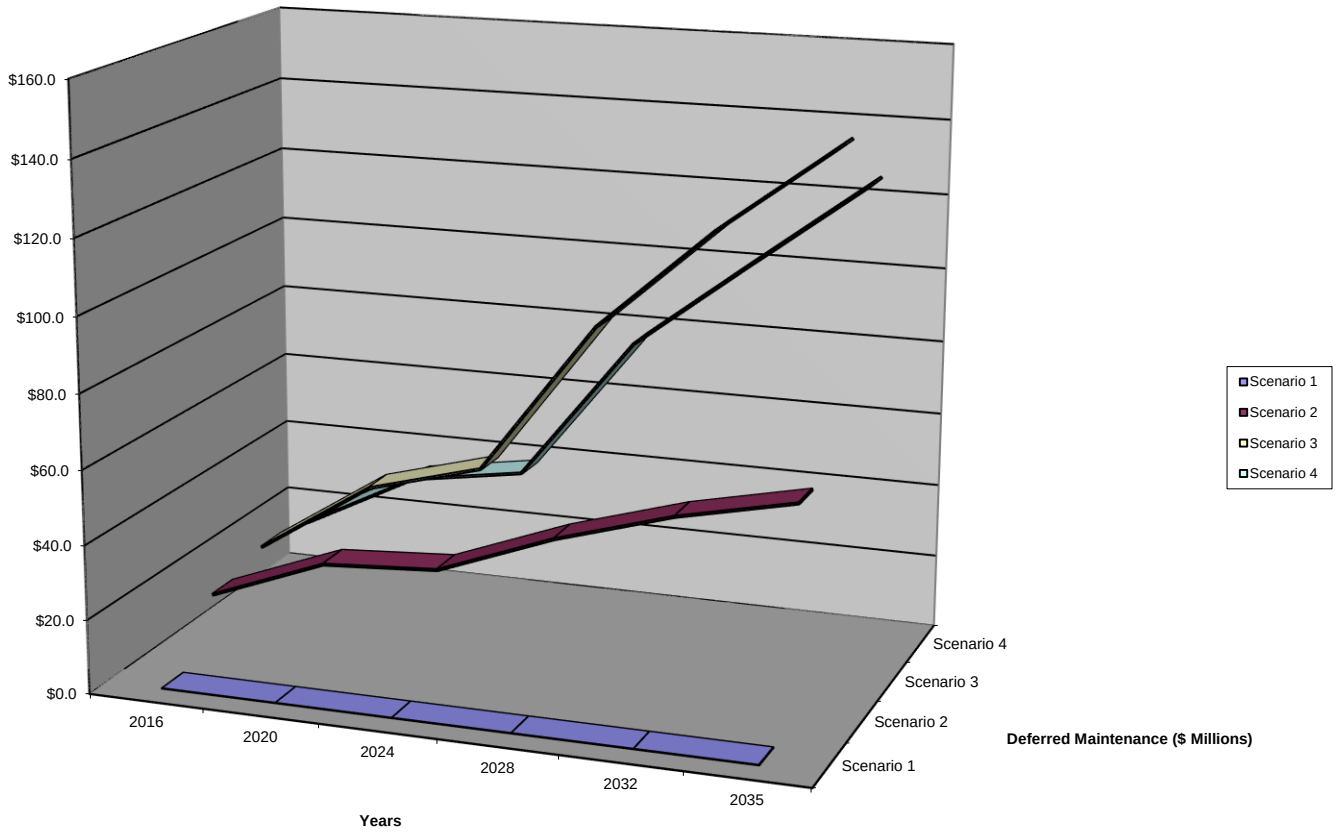


Figure 2 illustrates the change in deferred maintenance over time for the different budget scenarios. Note that Scenario 1 has no backlog of maintenance.

Figure 2 Deferred Maintenance per Scenario by Year



Figures 1 and 2 illustrate that Bothell's projected budget as outlined in Scenario 4 is insufficient to preserve the network at its current condition. In addition, the increase in deferred maintenance will result in higher costs to repair the streets in the future.

Summary

In summary, the City of Bothell has a substantial investment in their roadway network. Overall, 57% of the City's network is in the "Excellent to Very Good Condition" category. However, the remaining 37% of the streets require a significant amount of money to bring them into the "Excellent to Very Good Condition" category. With Bothell' projected budget of $26 million for the next twenty years, the average PCI of the network is expected to decrease, with a steadily increasing deferred maintenance backlog. The high maintenance backlog will result in increased future costs because revenue intensive treatments (reconstruction) will unfortunately be necessary when less expensive feasible treatments (crack, slurry or chip seals or overlays) could have prevented further deterioration.

Recommendations

It is recommended that the City of Bothell increase the funds available for street maintenance and implement more rigorous preventative maintenance strategies. The PMS results show that total expenditures of $26 million over the next twenty years will result in the City dropping an overall PCI from the current 70 to 44. This is the current Budget Option. The result of this scenario will be a decreasing PCI and an increasing deferred maintenance cost. This is not an ideal scenario. As an alternative to the Current funding option, the City may wish to adopt the Staff Recommended program. This option will improve the overall PCI over the current funding alternative and slow the increase of deferred maintenance over twenty years. The staff proposal also allows for the adoption of preventative maintenance by the City. This is necessary in order to balance repairing good roads with poor ones. This will begin the process of spending pavement repair dollars in a more cost effective manner.