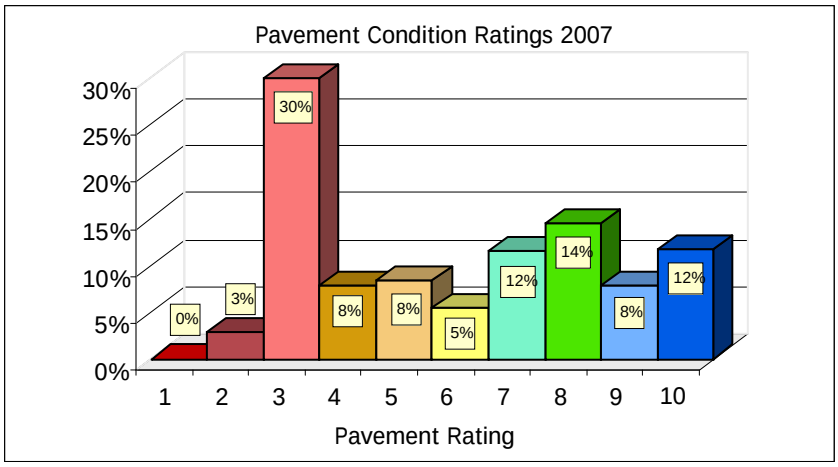
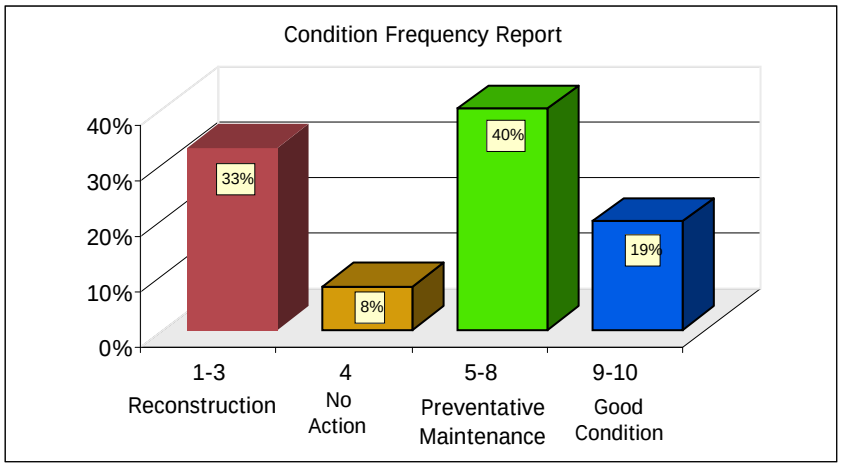
Background and Findings

The Village of Shorewood owns and maintains approximately 28 miles of roadway. Every odd year, in accordance with State Statute, the Shorewood Department of Public Works rates the Village roads according to the Wisconsin Department of Transportation PASER system. The graphic shown below is a summary of all Village maintained roads as rated in 2007, with corresponding updates for the roads reconstructed in 2008. This section also includes a Condition Frequency Map for a map corresponding to the graphic with a breakdown of roads by rating.



The graphic above indicates that one third of the Village roads are in need of reconstruction (rating 1-3). Additionally, more than one third (39%) of the Village roads are in need of preventative maintenance (rating 5-8). Only one fifth (20%) of the Village's roads are in a good enough condition that they do not require maintenance or reconstruction. This breakdown is graphically demonstrated below.



This section evaluates both the existing condition of the Village's roads and the performance of the Village's existing Street Replacement Program. A historical review of the Village's road ratings assesses the existing program and contrasts that with the improvements projected by implementing a Pavement Maintenance Program.

GENERAL

With an ever-changing climate and increasing amounts of traffic, paved roads are constantly subject to traffic wear. In order to control the deterioration of the roadway infrastructure, those roads that are in the worst shape must be identified so that immediate action can be taken. Further, those roads that are slightly deteriorated must also be identified so that preventative maintenance can be done to extend the service life of the pavement.

RATING YEAR

The ratings included in this report are as rated by the Department of Public Works Staff in 2007. Wisconsin State Statute 86.302(2) states that: "Every two years, municipalities and counties are required to submit pavement ratings to the Wisconsin Department or Transportation that represent the physical condition of roadways under their jurisdiction. Pavement rating information is due to WisDOT by December 15, odd year".

Pavement ratings were not completed again in 2008. However, the rating for the Morris Boulevard project, including adjacent roadways, was updated and included in this report.

WORK PLAN

The work plan outlines a systematic procedure used to evaluate the roads.

1. Rate all of the roads in the Village
2. Download Pavement Rating Spreadsheet
    - Download the information as provided by WisDOT.
    - Use the database to sort and analyze various aspects of the roadways
3. Recommend priority of street replacement
    - Review the existing program and amend as required based upon pavement ratings
4. Recommend methods of maintenance
    - Based upon the maintenance method associated with a particular road rating, evaluate which method is appropriate for each particular road
    - Compare the recommendations based solely upon the PASER system with those as identified by the Village of Shorewood DPW

PASER RATING SYSTEM

WisDOT requires biennial evaluation of all roads within the State. Most municipalities elect to review its roads in accordance to the Transportation Information Center's PASER Manuals. Manuals are available for asphalt, concrete and gravel roads, as well as several types of maintenance alternatives. This section includes an outline of the pavement ratings, descriptions and maintenance alternatives according to the PASER manual.

ASPHALT

Rating	Description	Type of Road	Maintenance Alternatives
10 & 9	Newly constructed or recently overlaid roads are in excellent condition and require no maintenance.	▪ New Construction ▪ Recent Overlay	None required
8	This category includes roads which have been recently sealcoated or overlaid with new road mix. It also includes recently constructed or overlaid roads which may show longitudinal or transverse cracks. All cracks are tight or sealed.	▪ Recently Sealcoated ▪ New Road Mix ▪ Widely Spaced, Sealed Cracks ▪ Occasional, Sealed Cracks ▪ Single, Transverse Crack Less than ¼ inch wide	Little or no maintenance required
7	Roads show first signs of aging, and they may have very slight raveling. Any longitudinal cracks are along paving joint. Transverse cracks may be approximately 10 feet apart. All cracks are ¼ inch or less with little or no crack erosion. Few, if any patches, all in very good condition.	▪ Transverse and longitudinal cracks. Cracks are tight and sealed ▪ Transverse cracks About 10 feet apart and well sealed ▪ Longitudinal cracks Open crack at construction joint and tight transverse cracks	Routine crack filling required
6	Roads are in sound structural condition but show definite signs of aging. Sealcoating could extend their useful life. There may be slight raveling. Transverse cracks can be frequent. Cracks may be sealed or open ¼ - ½ inch. First signs of block cracking. May have slight or moderate bleeding or polishing and patches are in good condition.	▪ Slight surface raveling Cracks are tight, closely spaced ▪ Frequent transverse cracking Well-sealed ▪ Block cracking First sign of block cracking ▪ Moderate flushing	Consider preservative treatment

Rating	Description	Type of Road	Maintenance Alternatives
5	Roads are still in good structural condition but clearly need sealcoating or overlay. They may have moderate to severe surface raveling with significant loss of aggregate. First signs of longitudinal cracks near edge. First signs or raveling along cracks. Block cracking up to 50% of surface. Extensive to severe flushing or polishing. Any patches or edge wedges are in good condition.	▪ Block cracking ▪ Moderate raveling. Raveling is extensive with block cracking. Slight crack raveling ▪ Severe flushing ▪ Wedges and patches Extensive but in good condition ▪ Aging pavement, sound structural condition No surface distortion	Preservative treatment required
4	Roads show first signs of needing strengthening by overlay or recycling. They have very severe surface raveling which should no longer be sealed. Many longitudinal and transverse cracks are raveling slightly. Over 50% of the surface may have block cracking. Patches are in fair condition. They may have rutting less than ½ inch deep or slight distortion.	▪ Severe raveling Extreme loss of aggregate ▪ Transverse cracks Open with slight crack raveling ▪ Longitudinal and block cracking Load related distress–strengthening needed ▪ Extensive block cracking Over 50% of surface, tight cracks ▪ Patch and slight rutting	Structural improvement required
3	Roads must be strengthened soon. Will require a thick overlay or recycling and very likely will require pavement patching and repair beforehand. Cracking will likely be extensive and show raveling and erosion. Surface may have severe block cracking and show first signs of alligator cracking. Patches are in fair to poor condition. There is moderate directional rutting (1 – 2 inches) and occasional potholes	▪ Many, raveled cracks Wide and raveled cracks indicated need for recycling asphalt surface ▪ Severe block cracking Open cracks with some deterioration ▪ Alligator cracking near edge. Needs repair and drainage improvement prior to rehabilitation ▪ Patches and distortion Patches are in poor condition with road settled around patch	Structural improvement required

Rating	Description	Type of Road	Maintenance Alternatives
2	Roads are very severely deteriorated and need reconstruction. These roads have more than 25% alligator cracking, severe distortion, potholes or extensive patches in poor condition.	▪ Extensive alligator cracking ▪ Patches and rutting Patches are in poor condition and there is rutting in wheel paths ▪ Severe edge distortion Water trapped at pavement edge softening subgrade	Reconstruction required
1	Roads have failed, showing severe distress and extensive loss of surface integrity.	▪ Potholes ▪ Extensive loss of surface ▪ Failed Pavement surface mostly lost	Reconstruction required

CONCRETE

Rating	Description	Type of Road	Maintenance Alternatives
10 & 9	Some traffic wear. Slight map cracking or pop-outs.	▪ New Construction ▪ Traffic wear in wheel path. ▪ Slight map cracking or pop-outs.	No maintenance required.
8	More surface wear, or slight defects showing in lanes. Pop-outs, slight surface scaling, partial loss of joint sealant, or isolated meander crack. Isolated manhole distress.	▪ Pop-outs, map cracking, or minor surface defects. ▪ Slight surface scaling. ▪ Partial loss of joint sealant. ▪ Isolated meander cracks, tight or well sealed. ▪ Isolated cracks at manholes, tight or well sealed.	Little or no maintenance required.

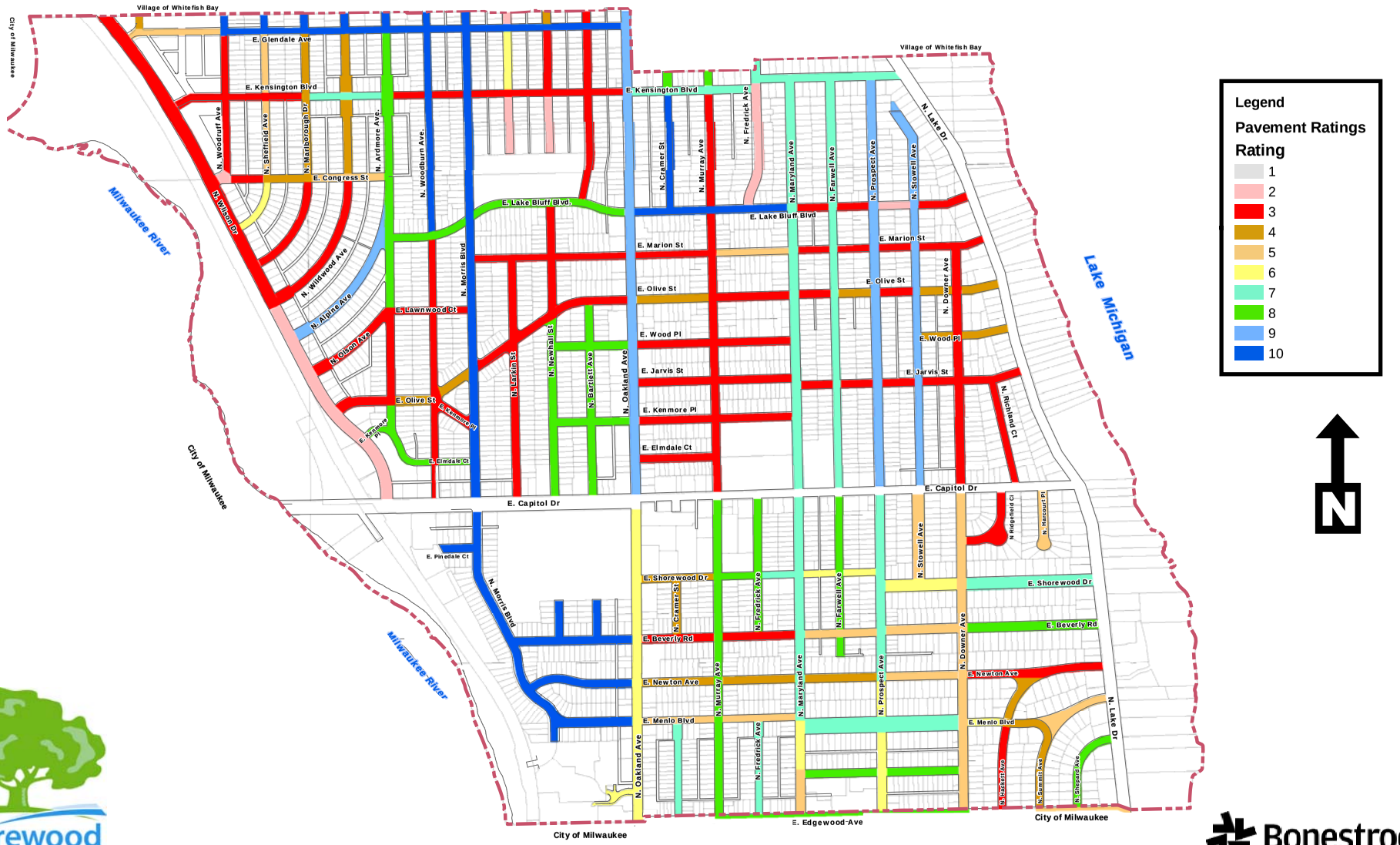
Rating	Description	Type of Road	Maintenance Alternatives
7	First signs of transverse cracking, patching or repair; more extensive pop-outs or scaling; some manhole displacement, isolated heave or settlement.	▪ More extensive surface scaling. ▪ Some open joints. ▪ Isolated transverse or longitudinal cracks, tight or well sealed. ▪ Some manhole displacement and cracking. ▪ First utility patch, in good condition. ▪ First noticeable settlement or heave area.	Seal open joints and other routine maintenance.
6	First signs of corner cracking or shallow reinforcement. More frequent transverse cracks. Open (1/4") joints and cracks. Moderate scaling.	▪ Moderate scaling in several locations. ▪ A few isolated surface spalls. ▪ Shallow reinforcement causing cracks. ▪ Several corner cracks, tight or well sealed. ▪ Open (1/4" wide) longitudinal or transverse joints and more frequent transverse cracks (some open 1/4").	Needs general joint and crack sealing. Scaled areas could be overlaid.
5	First signs of joint or crack spalling, or faulting. Multiple cracking at corners with broken pieces. Patching in fair condition.	▪ Moderate to severe polishing or scaling over 25% of the surface. ▪ High reinforcing steel causing surface spalling. ▪ Some joints and cracks have begun spalling. ▪ First signs of joint or crack faulting (1/4"). ▪ Multiple corner cracks with broken pieces. ▪ Moderate settlement or frost heave areas. ▪ Patching showing distress.	Grind to repair surface defects. Some partial depth patching or joint repairs needed.

Rating	Description	Type of Road	Maintenance Alternatives
4	Severe surface distress requires asphalt overlay or extensive surface texturing. Multiple transverse cracks with spalling and broken pieces. Corner cracking with potholes or patches. Blowups.	▪ Severe polishing, scaling, map cracking, or spalling over 50% of the area. ▪ Joints and cracks show moderate to severe spalling. ▪ Pumping and faulting of joints (1/2") with fair ride. ▪ Several slabs have multiple transverse or meander cracks with moderate spalling. ▪ Spalled area broken into several pieces. ▪ Corner cracks with missing pieces or patches. ▪ Pavement blowups.	Needs some full depth repairs, grinding, and/or asphalt overlay to correct surface defects.
3	Most joints and cracks are open (1"), spalled, or patched. D-cracking is evident. Severe (1") faulting.	▪ Most joints and cracks are open, with multiple parallel cracks, severe spalling, or faulting. ▪ D-cracking is evident. ▪ Severe faulting (1") giving poor ride. ▪ Extensive patching in fair to poor condition. ▪ Many transverse and meander cracks, open and severely spalled.	Needs extensive full depth patching plus some full slab replacement.
2	Roads are very severely deteriorated and need reconstruction.	▪ Extensive slab cracking, severely spalled and patched. ▪ Joints failed. ▪ Patching in very poor condition. ▪ Severe and extensive settlements or frost heaves.	Recycle and/or rebuild pavement.
1	Roads have failed, showing severe distress and extensive loss of surface integrity.	▪ Restricted speed. ▪ Extensive potholes. ▪ Almost total loss of pavement integrity.	Total reconstruction.

CONDITION FREQUENCY MAP

The map found on the following page is a representation of each road in the Village and its corresponding rating. A detailed table of each road and its rating can be found in the appendix.

2007 Village of Shorewood Pavement Ratings



Shorewood

Bonestroo

HISTORICAL PERFORMANCE

RECENTLY CONSTRUCTED STREETS

The Village of Shorewood operates a street replacement program which reconstructs a portion of the Village's roads on a biennial basis. The program history dates back to 1993. The table below provides a summary of project length per project year based upon Village maintenance records.

Year	Project Length (Linear Feet)	Percent of total road length
1993	3380	2.3%
1994	2642	1.8%
1995	317	0.2%
1996	3433	2.3%
1997	4807	3.2%
1998	4383	2.9%
1999	5123	3.4%
2000	3908	2.6%
2001	368	0.2%
2002	11,353	7.6%
2003	3,433	2.3%
2005	5,705	3.8%
2006	7,445	5.0%
2007	457	0.3%
2008	9,475	6.4%

Prior to 2002, the Village of Shorewood reconstructed roads at an average rate of 2.4% per year. At that rate, it would take the Village 42 years to reconstruct all of the roads within its corporate limits. After 2002, the Village implemented a new version of its Street Replacement Program which projected to reconstruct all of the roads within the corporate limits by 2034.

While the reconstruction of all of the roads within the Village will eventually be required, completing only reconstruction projects every two years places a large strain on the road budget. This strain cannot be relieved without the implementation of intermediate maintenance. Upon completion of the existing Street Replacement Program in 2034, another program would be created in its place to begin reconstructing the roads all over again in 2036.

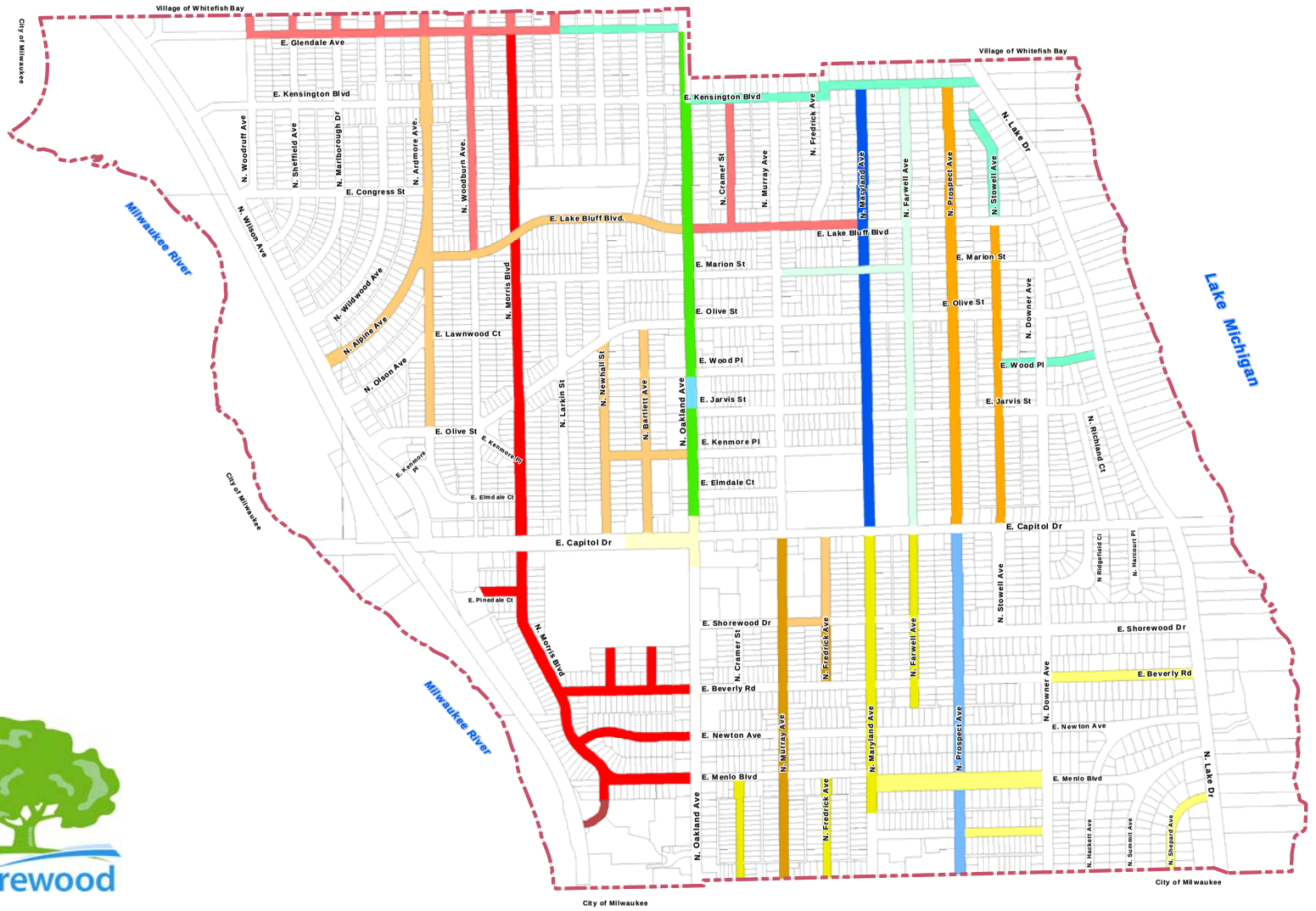
The table below shows the reconstruction projects from 1993 to date and also provides its current PASER rating. The table demonstrates how many of the "recently" reconstructed roads have begun to deteriorate, several to a rating of 6-7. Without a formal program, maintenance efforts are concentrated on those roads showing an immediate need for maintenance. While it is important to provide maintenance on an as needed basis, it is also important to provide maintenance prior to the appearance of significant deterioration. A good cracksealing program, for example, implemented within the first 3-5 years of reconstruction can significantly increase the amount of time until a more expensive maintenance strategy is required.

Road	Year Reconstructed	2007 Rating
North Morris Boulevard	2008	10
East Beverly Road (North Morris Boulevard to North Oakland Avenue)	2008	10
North Newton Avenue (North Morris Boulevard to North Oakland Avenue)	2008	10
East Menlo Boulevard (North Morris Boulevard to North Oakland Avenue)	2008	10
North Newhall Street (East Beverly Road to termini)	2008	10
North Bartlett Avenue (East Beverly Road to termini)	2008	10
East Pinedale Court	2008	10
East Glendale Avenue (North Woodruff Avenue to North Larkin Street)	2006	10
North Woodburn Avenue (East Lake Bluff Boulevard to corporate limits)	2006	10
East Lake Bluff Boulevard (North Oakland Avenue to North Maryland Avenue)	2006	10
North Cramer Street (East Lake Bluff Boulevard to East Kensington Boulevard)	2006	10
North Woodruff Avenue (East Glendale Avenue to termini)	2006	10
North Sheffield Avenue (East Glendale Avenue to termini)	2006	10
North Marlborough Drive (East Glendale Avenue to termini)	2006	10
North Ardmore Avenue (East Glendale Avenue to termini)	2006	10
North Morris Boulevard (East Glendale Avenue to termini)	2006	10
North Prospect Avenue (East Capitol Drive to East Kensington Boulevard)	2005	9
North Stowell Avenue (East Capitol Drive to East Lake Bluff Boulevard)	2005	9
North Murray Avenue (corporate limits to East Capitol Drive)	2003	8
North Frederick Avenue (East Beverly Road to East Shorewood Drive)	2003	8
North Ardmore Avenue (East Lawndale Court to East Glendale Avenue)	2002	8
North Alpine Avenue (North Wilson Avenue to North Ardmore Avenue)	2002	9
East Lake Bluff Boulevard (North Ardmore Avenue to North Oakland Avenue)	2002	8

Road	Year Reconstructed	2007 Rating
North Newhall Street (East Capitol Drive to East Olive Street)	2002	8
North Bartlett Avenue (East Capitol Drive to East Olive Street)	2002	8
East Kenmore Place (North Newhall Street to North Oakland Avenue)	2002	8
East Beverly Road (North Downer Avenue to North Lake Drive)	2000	8
East Menlo Boulevard (North Maryland Avenue to North Downer Avenue)	2000	7
East Stratford Court (North Prospect Avenue to North Downer Avenue)	2000	8
North Shepard Avenue (corporate limits to North Lake Drive)	2000	8
North Cramer Street (corporate limits to East Menlo Boulevard)	1999	7
North Frederick Avenue (corporate limits to East Menlo Boulevard)	1999	7
North Maryland Avenue (Stratford Court/Menlo alley to East Capitol Drive)	1999	7
North Farwell Avenue (termini to East Capitol Drive)	1999	8
North Farwell Avenue (East Capitol Drive to East Kensington Boulevard)	1998	7
East Glendale Avenue (North Larkin Avenue to North Oakland Avenue)	1997	10
East Kensington Boulevard (North Oakland Avenue to North Lake Drive)	1997	7
North Stowell Avenue (East Lake Bluff Boulevard to termini)	1997	9
East Wood Place (North Stowell Avenue to North Downer Avenue and North Downer Avenue to North Lake Drive)	1997	4
North Oakland Avenue (East Capitol Drive to East Jarvis Street and East Wood place to East Kensington Boulevard)	1996	9
North Oakland Avenue (East Jarvis Street to East Wood Place)	1995	9
North Prospect Avenue (corporate limits to East Menlo Boulevard and East Menlo Boulevard to East Beverly Road)	1994	6
North Prospect Avenue (East Beverly Road to East Capitol Drive)	1994	7
North Maryland Avenue (East Capitol Drive to East Marion Street and East Marion Street to East Kensington Boulevard)	1993	7

A map of the Village's previous Street Replacement Programs (1993-2008) can be found on the following page.

Village of Shorewood
Previous Street Replacement Programs (1993 - 2008)



Legend

Year Completed

- 2008
- 2007
- 2006
- 2005
- 2003
- 2002
- 2001
- 2000
- 1999
- 1998
- 1997
- 1996
- 1995
- 1994
- 1993

(Prior to 1993 Slurry Seal Only)

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Shorewood

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Cyclical Maintenance

Portions of this information were presented to the Village in 2008 as a part of the Life Cycle Cost Analysis report contrasting the lifetime cost differences between asphalt and concrete.

This section introduces the theory of cyclical maintenance. With budget constraints, it is not feasible for the Village to simultaneously maintain all of its roads each year. Establishing a routine maintenance service associated with each pavement rating and then implementing that maintenance strategy on various roads based upon priority, average daily traffic or project location provides the long term planning required for a successful maintenance program.

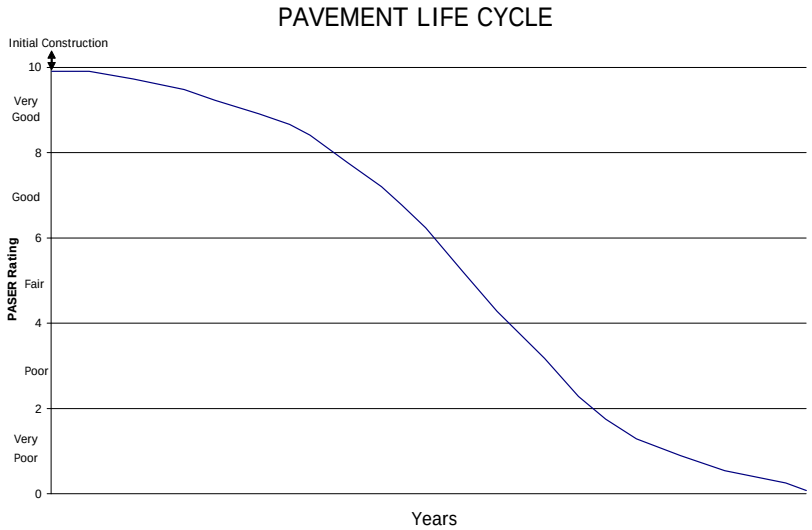
Proper maintenance management requires a valid evaluation of current conditions (Background and Findings), determination of the best method of maintenance (Maintenance Strategies) and selection of those projects that will fit within the budget (Pavement Maintenance Program).

PERPETUAL DETERIORATION

Roads are constantly subject to the effects of aging. Aging leads to pavement deterioration which can be caused by daily traffic, truck deliveries and weather conditions. In Wisconsin, roads are adversely affected by harsh freeze/thaw cycles. In the fall, tiny cracks within the pavement surface appear and by the next spring they have widened to 1-2" cracks.

The moment a reconstructed road is opened to traffic it begins to deteriorate. While a well-constructed road will not show signs of aging for several years, subsurface deterioration and surface deterioration not yet visible by the naked eye begin to affect the integrity of the newly constructed road. Due to constant and instantaneous decline, municipalities are continually juggling projects in an attempt to manage the rate of deterioration.

The rate of deterioration is directly related to time. The graph below depicts a typical deterioration cycle of a road with no maintenance.



Municipalities are constantly trying to stay ahead of pavement deterioration. With each of its roads deteriorating, roads are reconstructed or maintained in an effort to keep them from deteriorating to the point that they are no longer passable. Generally speaking, when a road becomes "bad enough" it is reconstructed. However, there are many maintenance strategies the Village can implement to extend the time between road reconstruction projects and even maintenance projects. This section proposes that the Village utilize cyclical maintenance to extend the life of its roads.

PROGRAM GOALS

The goal of cyclical maintenance is not to simultaneously upgrade all Village roadways to a "10" rating. Rather, the program focuses on arranging the maintenance schedule in a manner which creates a consistent budget over the life of the program. The most cost-effective program will have roads with various ratings, to avoid having weighted costs up-front. By increasing the amount of preventative maintenance each year in the program, the Village increases the service life of the roads and, in turn, decreases the overall cost of maintaining its roads.

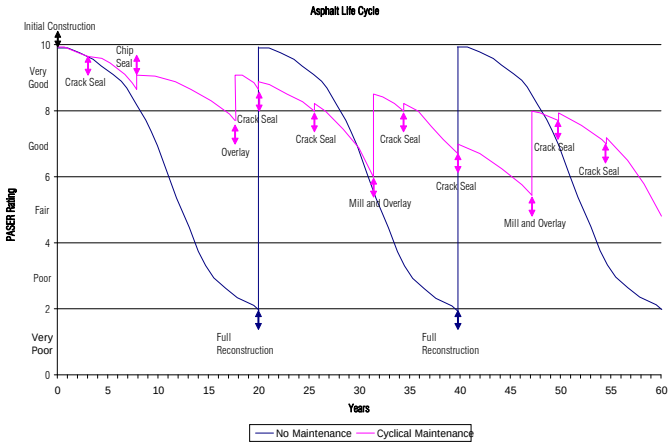
Another program goal is to extend the design life of a road. With routine maintenance, the Village can slow the rate of deterioration, thereby increasing the life of the road. A product of a longer design life is an increase in the time between reconstruction projects. Increasing the life of the road also increases the amount of time between reconstruction projects and reduces the budget expenditures on reconstruction projects. Maintenance projects are less costly than reconstruction, which also allows the Village to reduce its overall road budget.

ASPHALT

LIFE CYCLE

When an asphalt road is initially constructed, a typical road would be designed for 20 years (with proper drainage). Therefore a road left unmaintained over its lifetime would require reconstruction again in 20 years. This applies to the design life only, while the actual road surface may deteriorate at varying levels based upon traffic loading, drainage and initial construction.

With the implementation of cyclical maintenance, the design life of the road can be extended significantly. For an asphalt road, maintenance generally includes cleaning, grouting and sealing cracks as needed at 3-5 year intervals, and paving an overlay or completing a mill and overlay every 10-15 years. The performance of this routine maintenance may extend the design life of a road from 20 to 60 years.



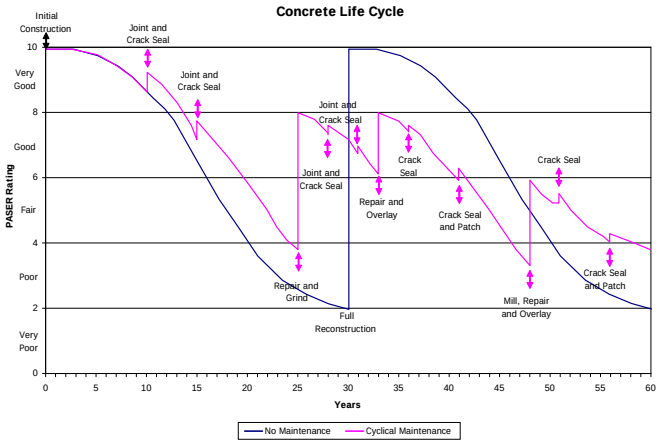
The graph represents both maintenance strategies: reconstruction only and cyclical maintenance. In a 60-year road lifetime, an asphalt road would require the initial construction, as well as two reconstructions. Cyclical maintenance reduces the annual cost of the road over the 60-year lifespan by 44%. Please refer to the Life Cycle Cost Analysis for exact calculations.

CONCRETE

LIFE CYCLE

When a concrete road is initially constructed, a typical road would be designed for 30 years (with proper drainage). Therefore a road left unmaintained over its lifetime would require reconstruction again in 30 years. This applies to the design life only, while the actual road surface may deteriorate at varying levels based upon traffic loading, drainage and initial construction.

With the implementation of cyclical maintenance, the design life of the road can be extended significantly. For a concrete road, maintenance generally includes patch repair as required, joint and crack sealing every 5-7 years, and repair and grind or repair and overlay every 10-12 years. The performance of this routine maintenance may extend the design life of a road from 30 to 60 years.



The graph represents both maintenance strategies: reconstruction only and cyclical maintenance. In a 60-year road lifetime, a concrete road would require the initial construction, as well as one reconstruction. Cyclical maintenance reduces the annual cost of the road over the 60-year lifespan by 34%. Please refer to the Life Cycle Cost Analysis for exact calculations.

TIMELINE

EFFECTIVE PROGRAM

A maintenance program must be in place for several years before there is an accurate measure of its effectiveness. Prior to the implementation of the program, roads are steadily deteriorating without maintenance. In the first year that maintenance is performed, the rate of deterioration on that particular road is slowed, but the remaining roads in the Village continue to deteriorate at the same rate.

After several years of program implementation, the number of reconstructed or maintained roads in the Village will outnumber the roads in the Village with no maintenance. At that time, there can be a true measure of the program's effectiveness. Analysis will show that roads rated 4-10

(maintenance only) will remain in that range longer before slipping into the 1-3 range (reconstruction).

Maintenance Strategies

The Village of Shorewood's existing Street Replacement Program is based upon biennial reconstruction of Village Roads. In order to plan the priority of the projects, Bonestroo generated a map of all of the Village owned roads within the Village and indicated which year the roads would be scheduled for reconstruction (see Street Replacement Program). The map represented a course of action for the Village to reconstruct roads over a 10-year period.

Without an effective maintenance program to accompany the Street Replacement Program, the Village will constantly be reconstructing its roads, with no relief from reconstruction projects or for budget constraints.

This section of the report defines types of pavement distress and failure and provides options for preventative maintenance.

GENERAL

The construction industry provides several alternatives for municipalities to use as maintenance strategies in addition to reconstruction. Typically maintenance strategies are selected based upon the type and rate of deterioration of a road. The strategy should take into account the type of pavement, the current road condition, or rating, the intended life of the maintenance and the traffic conditions.

PROGRAM

Although the program designates a maintenance strategy based upon the pavement type and rating, at the time of maintenance each road should be reevaluated to verify the prescribed maintenance is appropriate.

LIFE OF MAINTENANCE

The life span of an individual maintenance strategy is intended to slow the rate of deterioration. The applied maintenance should prolong the life of the road until it is time to apply the next maintenance strategy. There is no single strategy, including reconstruction, which will prevent deterioration or that will not require maintenance. By utilizing cyclical maintenance, a municipality can predict the deterioration of a roadway and apply maintenance strategies according to a prescribed schedule. The result is a road that increases its road rating or maintains its existing rating for a longer period of time.

MAINTENANCE ALTERNATIVES

The following are possible maintenance and repair alternatives along with costs associated with the improvement. Please note that all cost estimates have been obtained via the WisDOT – Average Unit Price List and will vary depending upon project size and location. Each project should be individually evaluated before determining the maintenance budget.

ASPHALT

CRACK SEALING

- **Description** – First step: clean and rout (as needed) cracks. Second Step: fill with sealing compound. There should be no water in the crack at the time of sealing. Process will close

the cracks and prevent water from entering aggregate base. The process also prevents damage from freeze-thaw cycles. Generally used to repair cracks up to 3 inches in depth.
- **Cost** – Estimated at $0.60 per linear foot of joint/crack sealed, but the amount of material required will fluctuate based upon the width and depth of the cracks.

CHIP SEAL

- **Description** – Chip sealing is a form of emulsified asphalt surface treatment. An emulsion (mix of asphalt and water) is sprayed onto the pavement surface. A layer of gravel is spread over the surface and compacted.
- **Cost** – Estimated at $40.00 per cubic yard of application depending on the quantity applied. Unit prices can vary significantly for small amounts.

SCRATCH COAT

- **Description** – Less invasive than milling or pulverizing, a metal or stiff rubber strike off is used to "scratch" the top of the asphalt to create an even surface. An emulsion or overlay is paved on top.
- **Cost** – Estimated at $5 per square yard depending on the amount of material required to build the surface.

MILLING

- **Description** – Process by which the pavement surface is scraped off. The milled pavement may be used as the aggregate in the overlay, or removed. Milling must be accompanied by a chipseal or overlay, depending upon the depth milled and surface condition.
- **Cost** – Estimated at $8.00 per square yard including a 2-inch overlay of asphalt depending on the quantity of milling required.

PULVERIZING

- **Description** – Pulverizing is a process by which the surface is broken down and ground into additional base material. The end result is an increased base depth to which an additional layer of pavement can be applied.
- **Cost** – Estimated at $7.50 per square yard including a 2-inch overlay of asphalt depending on the quantity of pulverizing required.

ASPHALT OVERLAY

- **Description** – Process by which an additional layer of asphalt is added to the road surface. Depth of overlay required depends upon the existing condition of the road surface.
- **Cost** – Estimated at $6.50 per square yard for a 2-inch overlay.

HAND PATCHING

- **Description** – Localized repair. The existing pavement may be sawcut and removed, milled or pulverized. The void is filled by hand with asphalt and compacted in place.
- **Cost** – Estimated at $4.00 per square yard based on a thickness of 2 inches.

RECONSTRUCTION

- **Description** – Complete removal of the existing pavement surface and aggregate base, if required. Paving of new road surface in accordance with the approved cross section. If required, drainage improvements and utility replacement/repair should be completed prior to reconstruction.
- **Cost** – Varies dependent upon the scope of reconstruction including pavement and base removal, curb and gutter replacement or repair, sidewalk and any alignment adjustments required. An individual cost estimate should be prepared for each project.

CONCRETE

JOINT AND CRACK SEAL

- **Description** – First step: clean and rout (as needed) cracks. Second Step: fill with sealing compound. There should be no water in the crack at the time of sealing. Process will close the cracks and prevent water from entering aggregate base. The process also prevents damage from freeze-thaw cycles. Generally used to repair cracks up to 3 inches in depth.
- **Cost** – Estimated at $0.60 per linear foot of joint/crack sealed, but the amount of material required will fluctuate based upon the width and depth of the cracks.

CRACK/JOINT REPAIR

PARTIAL DEPTH

- **Description** – First step: remove damaged concrete, typically by milling. Step two: apply bonding grout and place new concrete to the same grade and alignment. Step three: reestablish joints, either by tooling or sawing, or placing compression materials as required.
- **Cost** – Estimated at $9.50 per linear foot of joint and $14.75 per linear foot of crack repair, but the depth of removal and replacement of concrete will cause the price to vary significantly.

FULL DEPTH

- **Description** – First step: saw cut and remove full depth of concrete slab to the base course, to include damaged concrete and sufficient buffer. Step two: apply bonding grout and place and cure new concrete to the same grade and alignment. Step three: reestablish joints, either by tooling or sawing, or placing compression materials as required.
- **Cost** – Estimated at $200 per square yard of repair, but the existing cross section will cause the price to vary significantly.

REPAIR AND OVERLAY

- **Description** – Localized repair of concrete (partial depth or full depth), method similar to that of the crack/joint repair. Once completed, a bonding agent would be applied to the surface and the road overlayed with asphalt.
- **Cost** – Repair costs as outlined above. Asphalt overlay estimated at $6.50 per square yard for a 2-inch overlay.

GRIND, REPAIR AND OVERLAY

- **Description** – First step: localized repair of concrete (partial depth or full depth), method similar to that of the crack/joint repair. Second step: diamond grinding of concrete surface to remove the top several inches of concrete. Third step: application of a bonding agent and paving of an asphalt overlay.
- **Cost** – Repair costs as outlined above. Grinding estimated at $3.50 per square yard. Asphalt overlay estimated at $6.50 per square yard for a 2-inch overlay.

RECONSTRUCTION

- **Description** – Complete removal of the existing pavement surface and aggregate base, if required. Paving of new road surface in accordance with the approved cross section. If required, drainage improvements and utility replacement/repair should be completed prior to reconstruction.
- **Cost** – Varies dependent upon the scope of reconstruction including pavement and base removal, curb and gutter replacement or repair, sidewalk and any alignment adjustments required. An individual cost estimate should be prepared for each project.

All prices vary depending on the classification of road. Namely, the maintenance and reconstruction of major arterials is generally more costly that the maintenance and reconstruction of local neighborhood roads.

ASPHALT ON CONCRETE

The maintenance for roads consisting of asphalt on concrete is dependent upon the road's original construction. If the road was originally constructed with a concrete base and asphalt surface, the road is typically maintained as if it was an asphalt road, with localized concrete base repair when required. If the road was originally constructed as a concrete road and an asphalt overlay has since been applied as a form of maintenance, the road is typically approaching a reconstruction. However, continued maintenance including crack sealing, patching and mill, repair and overlay will continue to prolong the life of the road.

MILL, REPAIR AND OVERLAY

- **Description** – Generally completed on a concrete road that had previously been maintained via a grind, repair and overlay. The asphalt surface is milled off and removed, localized concrete repair completed as necessary, with a reapplication of an asphalt overlay.
- **Cost** – Repair costs as outlined above. Mill and overlay estimated at $8.00 per square yard for a 2-inch overlay of asphalt depending on the quantity of milling required.

All prices vary depending on the classification of road. Namely, the maintenance and reconstruction of major arterials is generally more costly that the maintenance and reconstruction of local neighborhood roads.

MAINTENANCE SCHEDULE

ASPHALT

In conjunction with PASER ratings, the following table was created to manage the type of maintenance required on Village Roads:

ROAD RATING	TYPICAL MAINTENANCE
1	Reconstruction
2	Reconstruction
3	Reconstruction
4	No Maintenance
5	Mill/Pulverize and Overlay
6	Mill/Pulverize and Overlay
7	Chip Seal
8	Chip Seal
9	Crack seal within 3-5 years of reconstruction
10	No maintenance required

As outlined in the maintenance section of this report, roads rated at a 9 or 10 are in good condition and not in need of maintenance. However, roads should be crack sealed within the first three to five years after reconstruction. Roads rated 9 that are deteriorating at a slow rate may be recommended for a crack seal.

Roads rated at a 7 or 8 are beginning to show signs of wear and could benefit from localized patching and an overall sealcoat or chipseal. Roads rated at a 5 or 6 may show signs of some localized cracking and the life of the road would be prolonged with an overlay, or scratchcoat and overlay in cases of heavier cracking. Roads rated at a 4 show signs of structural damage and are beyond benefit of an overlay. However, roads rated at a 4 have not yet deteriorated to the point that they require complete reconstruction. These roads are best left to decline until such time that reconstruction is warranted. Roads rated at a 1-3 have already depreciated to the point that a complete reconstruction is required.

CONCRETE

In conjunction with PASER ratings, the following table was created to manage the type of maintenance required on Village Roads:

ROAD RATING	TYPICAL MAINTENANCE
1	Reconstruction
2	Reconstruction
3	Grind, repair and overlay or mill, repair and overlay
4	Crack Seal and Patch
5	Repair and Overlay
6	Repair and Overlay
7	Joint and Crack Seal
8	Joint and Crack Seal
9	Joint and Crack Seal within 3-5 years of Reconstruction
10	No maintenance required

Please note that the recommended maintenance is also dependent upon the age of the road. In the case of roads rated 3-4, the grind, repair and overlay or mill, repair and overlay will depend upon whether the road was previously overlayed. The cyclical maintenance graph and individual pavement evaluation will be utilized to determine the proper method of maintenance.

As outlined in the maintenance section of this report, roads rated at a 9 or 10 are in good condition and not in need of maintenance. However, roads should be joint and cracksealed within the first three to five years after reconstruction. Roads rated 9 that are deteriorating at a slow rate may be recommended for a crack seal.

Roads rated at a 5 or 6 are beginning to show signs of wear and could benefit from localized repair and overlay. Roads rated at a 4 benefit from crack seal and patching. Depending upon the type and rate of deterioration, the life of roads rated 3 may be prolonged by a repair and grind or repair, grind and overlay. Roads rated at a 1-2 have already depreciated to the point that a complete reconstruction is required.

ASPHALT ON CONCRETE

In conjunction with PASER ratings, the following table was created to manage the type of maintenance required on Village Roads:

ROAD RATING	TYPICAL MAINTENANCE
1	Reconstruction
2	Reconstruction
3	Reconstruction
4	Mill, Repair and Overlay
5	Crack Seal and Patch
6	Repair and Overlay
7	Crack Seal
8	Crack Seal
9	No maintenance required
10	No maintenance required

Asphalt on concrete construction typically follows the maintenance strategy of a concrete road, as the asphalt overlay itself is a form of maintenance. For roads constructed or reconstructed as asphalt on concrete, the table above prescribes a method of maintenance. As with asphalt and concrete roads, asphalt on concrete roads rated 9 or 10 are in good condition and do not require maintenance. Roads rated 6 or 7 benefit from crack sealing. Roads rated 6 should have the concrete base repaired and an asphalt overlay installed. Roads rated 5 may require asphalt crack sealing and localized patching. As the road deteriorates to a rating of 4, the road will benefit from a mill, repair and overlay. Roads deteriorating to a 1-3 should be reconstructed.

Overall Executive Summary

WHAT IS PAVEMENT MANAGEMENT?

An effective pavement management plan evaluates existing road conditions and formulates a plan to address and improve deteriorating infrastructure. Pavement management recognizes that a municipality is never "done" maintaining its roads and therefore must implement a long term strategy to anticipate road improvements and budget accordingly. By planning improvements and maintenance activities comprehensively, the Village of Shorewood can maximize the useful life of existing pavements and ultimately reduce the concentration on reconstruction and focus on maintenance.

The 2009 Village of Shorewood Pavement Management Program incorporates three capital management plans: the Village's existing Street Replacement Program; a companion Pavement Maintenance Program; and a new alley maintenance program which includes both reconstruction and maintenance components (illustrations follow).

BACKGROUND

The Village of Shorewood owns and maintains approximately 28 miles of roadway. Based upon 2007 pavement conditions, over one third of these streets are currently in need of reconstruction.

In 2005, the Department of Public Works and Bonestroo developed a biennial Street Replacement Program with the goal of reconstructing each of the residential streets within the corporate limits over a 30-year period. While the program provides an excellent basis for the planning of pavement reconstruction and accompanying utility infrastructure management, it does not account for the continuous deterioration of roadways. Without an effective pavement maintenance program to accompany the Street Replacement Program, the Village will constantly be reconstructing its roads with no relief from reconstruction projects or the expenditures which accompany them.

The 2007 WISLR pavement ratings were used to produce the report as they were the most current ratings available when the Pavement Management Plan was developed. The information provides a baseline for evaluating the Village's roads.

PAVEMENT MAINTENANCE PROGRAM

The Street Replacement Program is the foundation of the Village's management program. The previously adopted program is proposed to continue through 2030 with reconstruction projects implemented in even-numbered years.

The Pavement Maintenance Program will supplement the existing reconstruction program. The proposed program outlines activities in the years 2011-2021. For budgetary purposes, the Village will complete maintenance projects on a biennial bases, opposite reconstruction projects.

The Alley Maintenance Program proposes a similar strategy for the public alleys in the Village and incorporates both reconstruction and maintenance activities. The alley program is designed to run concurrently with the Pavement Maintenance Program. It is scheduled for the odd year and structured on a biennial basis for ten years.

	EVEN YEAR	ODD YEAR
Street Replacement Program	$2,000,000.00	--
Pavement Maintenance Program	--	$220,000.00
Alley Maintenance Program	--	$127,500.00
TOTAL	$2,000,000.00	$347,500.00

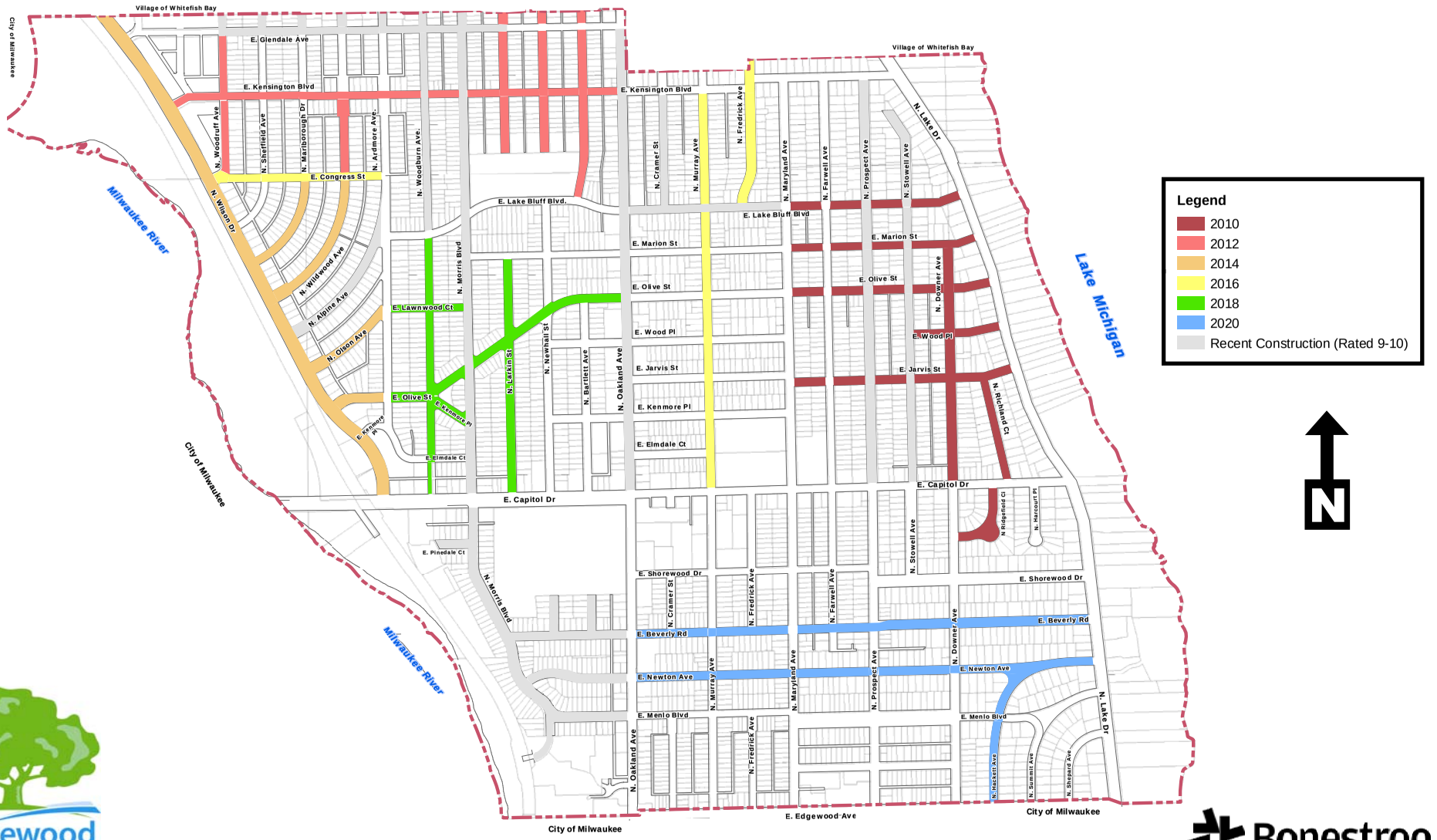
PLAN IMPLEMENTATION AND EVALUATION

While the Pavement Management Plan provides yearly dates associated with the projects outlined in the Street Replacement Program and Pavement Maintenance Program, the Plan is intended to be a long-term strategy. Specific projects may be moved from one year to the next, but either reconstruction or maintenance activities should be completed on an annual basis.

The Pavement Management Plan should be reviewed on a regular and periodic basis to ensure the goals, objectives and long term project plans are current and applicable. The plan should be evaluated in terms of pavement condition ratings, financial implications and comparison to the ideal rate of deterioration.

The ultimate goal of cyclical maintenance – whether on streets or alleys – is to extend the time between reconstruction projects. As maintenance activities are generally less expensive than reconstruction, over time the annual road budget will decrease. A comprehensive program such as this is a cost-effective way for the Village to address its pavement infrastructure.

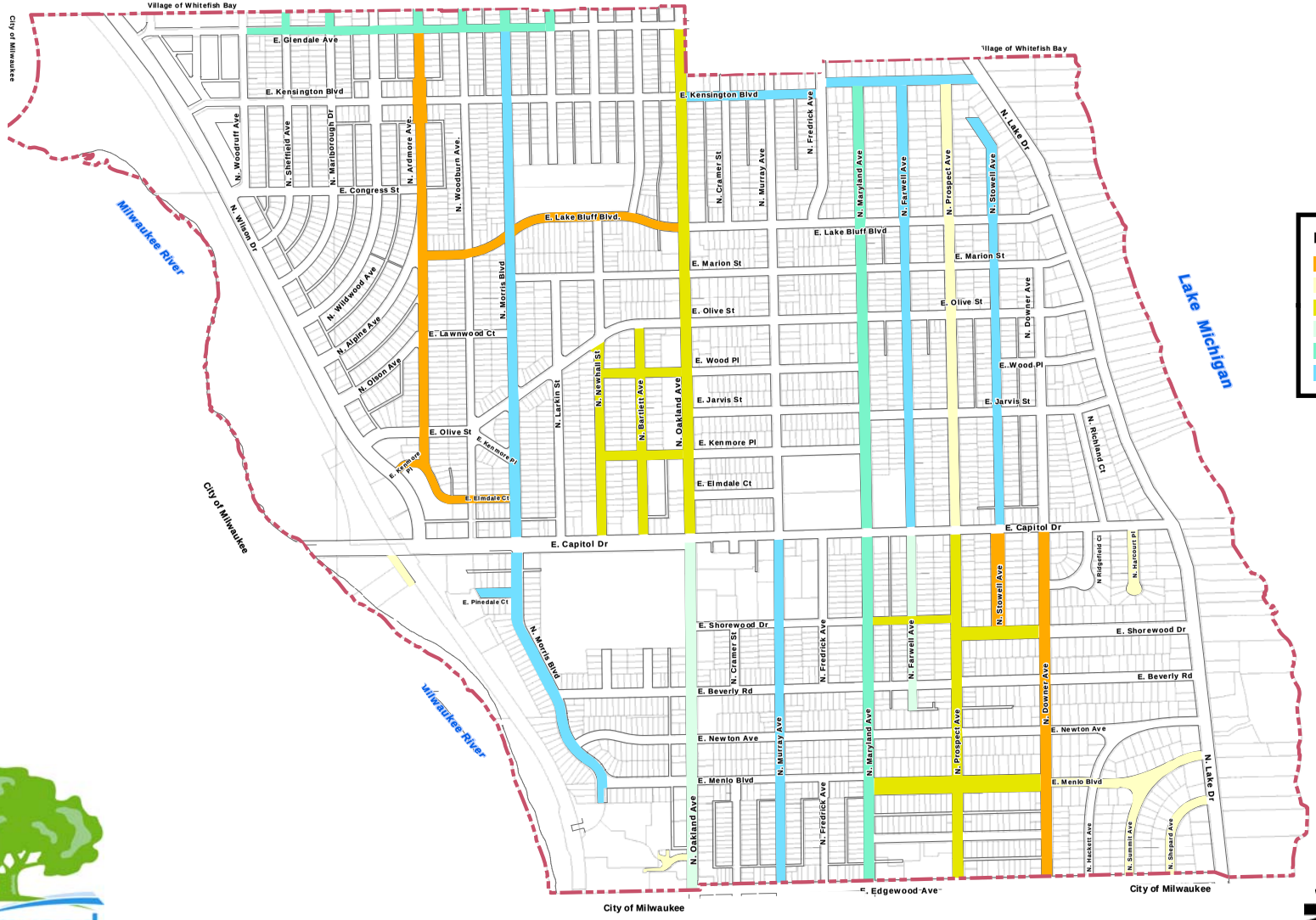
Street Replacement Program (2010 - 2020)



Shorewood

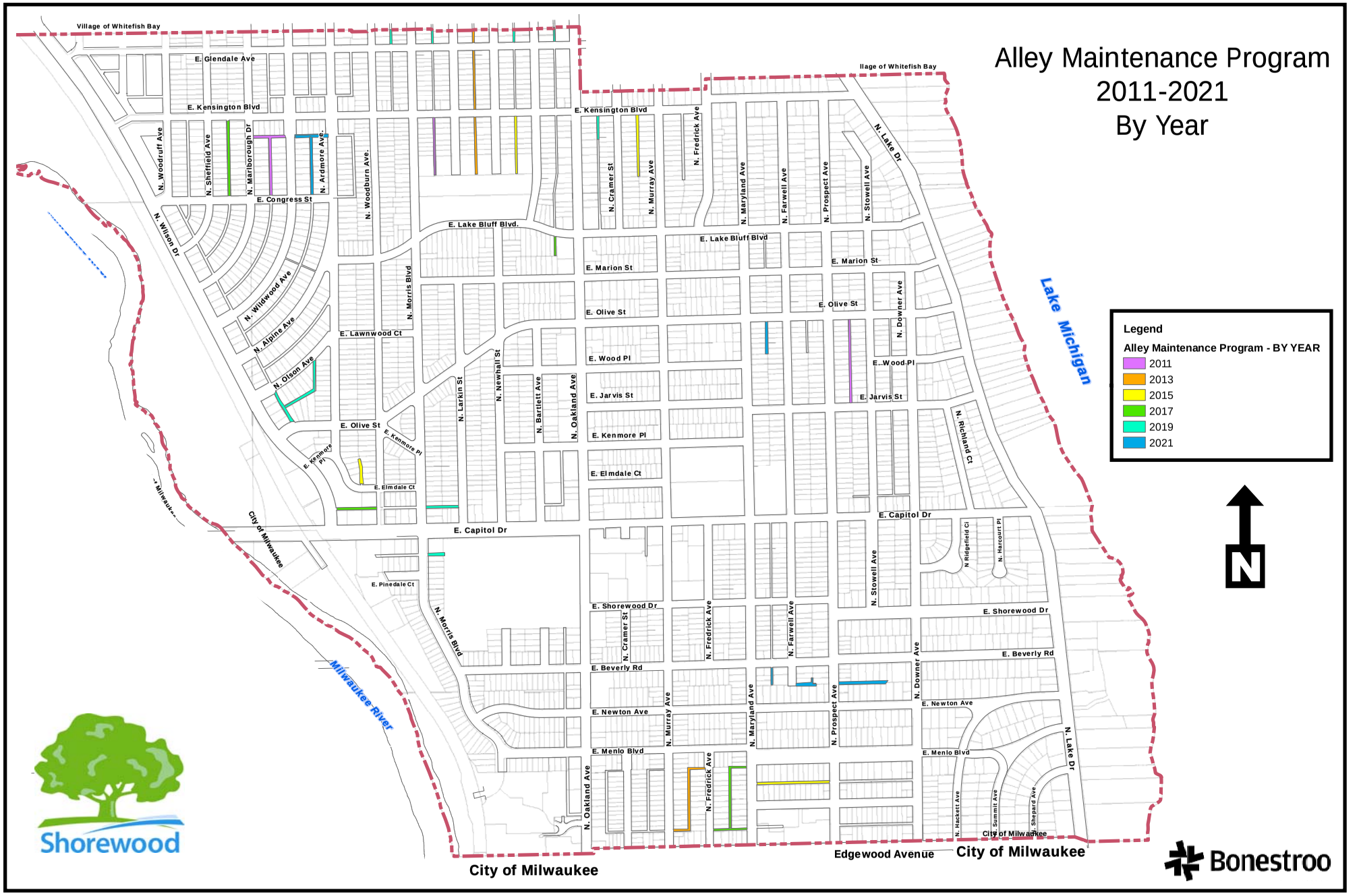
Bonestroo

Pavement Maintenance Program (2011 - 2021)
By Year



Shorewood

Bonestroo


Alley Maintenance Program
2011-2021
By Year
Legend
Alley Maintenance Program - BY YEAR
2011
2013
2015
2017
2019
2021
Lake Michigan
Milwaukee River
Village of Whitefish Bay
E. Glendale Ave
E. Kensington Blvd
N. Woodruff Ave
N. Sherfield Ave
N. Marlborough Dr
N. Ardmore Ave.
E. Congress St
N. Wilson Dr
N. Woodburn Ave.
N. Wildwood Ave
N. Alpine Ave
N. Olson Ave
E. Lawnwood Ct
N. Morris Blvd
E. Olive St
E. Kenmore Pl
E. Elmdale Ct
E. Capitol Dr
E. Pinedale Ct
City of Milwaukee
E. Lake Bluff Blvd.
N. Larkin St
N. Newhall St
N. Bartlett Ave
N. Oakland Ave
N. Cramer St
N. Murray Ave
N. Fredrick Ave
E. Marion St
E. Wood Pl
E. Jarvis St
E. Kenmore Pl
E. Elmdale Ct
E. Shorewood Dr
E. Beverly Rd
E. Newton Ave
E. Menlo Blvd
N. Maryland Ave
N. Farwell Ave
N. Prospect Ave
N. Stowell Ave
N. Lake Dr
N. Downer Ave
N. Richland Ct
N Ridgefield Ct
N. Harcourt Pl
N. Hackett Ave
N. Summit Ave
N. Shepard Ave
Edgewood Avenue
City of Milwaukee
Shorewood
Bonestroo

Plan Performance

The life cycle graph presented in the Cyclical Maintenance section reviews how pavement deteriorates over time. This graph can be applied to the proposed Street Replacement Program and Pavement Maintenance Program to determine how the program will affect the pavement condition ratings.

This section projects the state of the Village roads upon completion of the program. While this projection allows the report to evaluate the performance of the individual and combined program, the Village should update this document at a minimum of every 5 years to evaluate the program performance based upon historical results.

GENERAL

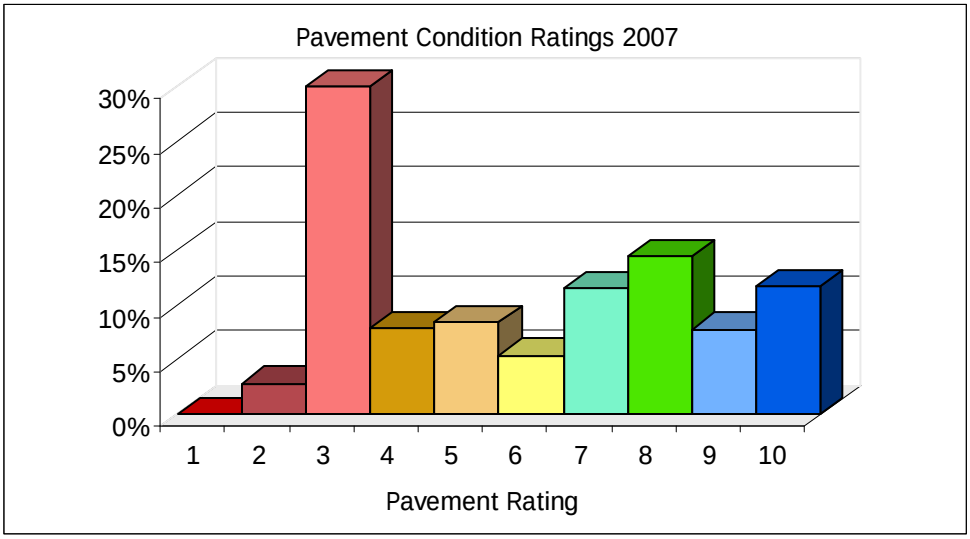
This section evaluates both the Street Replacement Program and the combined Street Replacement Program and Pavement maintenance program in three ways: pavement condition ratings upon completion of the program, financial burden and as compared to the ideal.

All three analyses reveal that the combined program is more effective than reconstruction alone. The combined program reduces the percentage of roads in the 1-3 rating that require reconstruction more significantly than the Street Replacement Program, maintains those roads requiring routine maintenance, elevates the roads rated 9-10 requiring no maintenance, produces a decreased backlog of project costs and meets or exceeds the ideal graph more often.

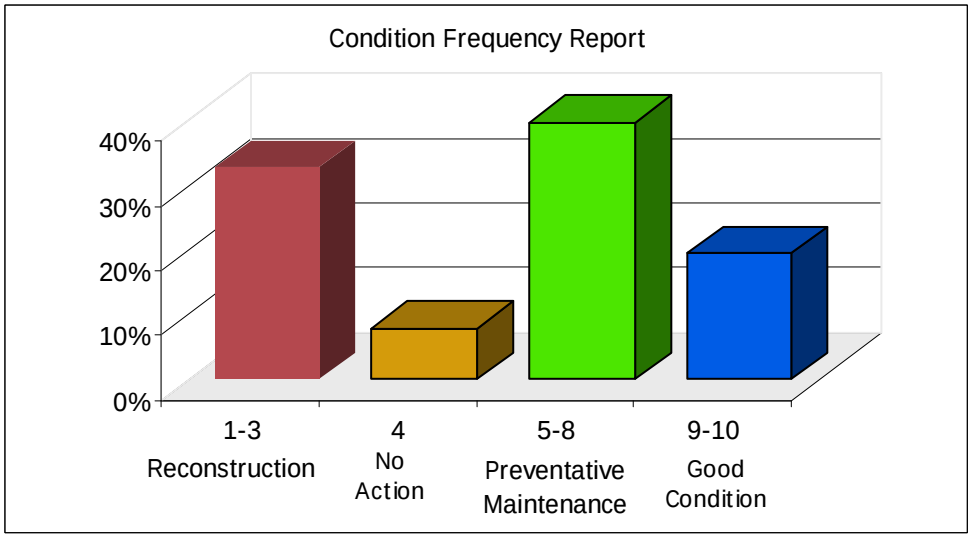
ROAD PERFORMANCE DURING PROGRAM

CONDITION BEFORE PROGRAM

As described in the Background and Findings section, the 2007 pavement ratings for the Village are broken down as follows:

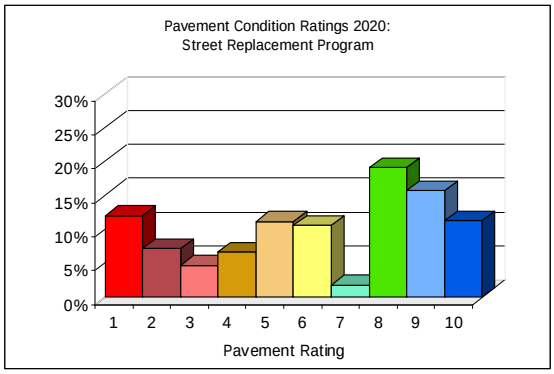


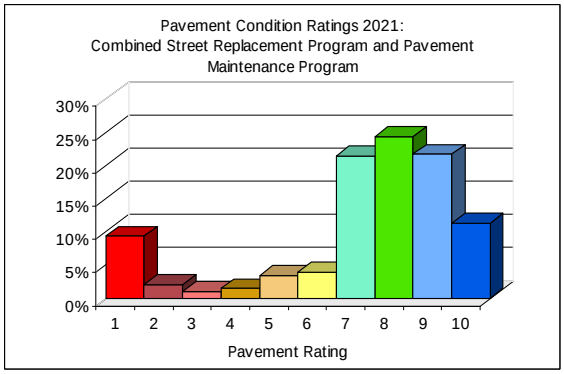
The Maintenance Strategies section of this report outlines how each pavement rating translates to a specific maintenance strategy. This is graphically displayed as follows:



CONDITION AFTER PROGRAM

While evaluating the existing Street Replacement Program against the proposed, combined Street Replacement Program and Pavement Maintenance Program, the projected pavement ratings in 10 years are as follows:





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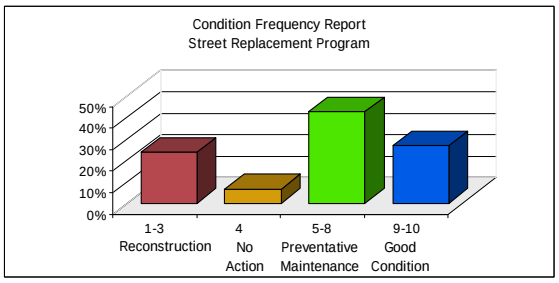
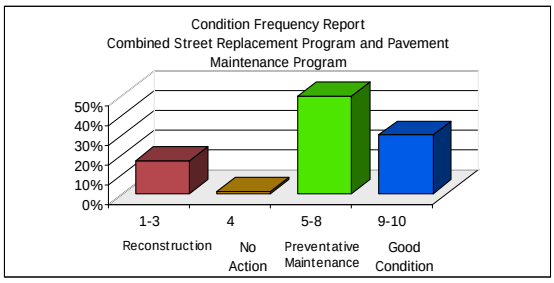




EVALUATION

In examining the Condition Frequency Report, it appears as though the Street Replacement Program is an effective pavement management system. Overall the percentage of roads requiring reconstruction decreases, the percentage of roads in good condition increases and the percentage of roads requiring no action or preventative maintenance is stable. The Pavement Maintenance Program goes one step further than the Street Replacement Program in improving the Village's roads. As with the Street Replacement Program, the percentage of roads requiring reconstruction decreases. In addition, the roads requiring only preventative maintenance and those roads in good condition both increase, indicating that the combination of a street replacement program and pavement maintenance program is more effective pavement management system than the replacement program alone.

However, in examining the Street Replacement Program pavement condition ratings breakdown, the Village roads are deteriorating. In 2007, no Village roads were rated 1 and only 3% were rated 2. In 2020, 12% of Villages roads are rated 1 and 7% are rated 2. A slide of ratings also occurs in those roads requiring preventative maintenance. The Village roads rated 8 increases from 14% to 18%, but those rated 7 decrease dramatically from 12% to 2%, increasing those roads rated 6 from 5% to 11% and those roads rated 5 from 8% to 11%. Although those roads in good condition increased, only those roads rated 10 were stable, decreasing only 1% over the life of the program. The percentage of roads rated 9 doubles from 8% to 16%. Beyond the 10 year project timeframe these roads will continue to deteriorate and slide from good condition down the ratings scale.

Although the Pavement Maintenance Program completes only routine maintenance, the roads requiring reconstruction decreased by nearly one third, from 33% to 12%. The Street Replacement Program alone only reduced those roads from 33% to 24%, indicating that the addition of a pavement maintenance program can effectively reduce the percentage of Village roads requiring reconstruction.

The reduction is a result of slowing the rate of deterioration to the point that less roads decline to a 1-3 rating over the 10-year timeframe. Although it appears as though the roads requiring preventative maintenance and in good condition increase, it is actually the effect of those roads maintaining an elevated rating. The Street Replacement Program improves low rated roads and the Pavement Maintenance program keeps them there.

Even with the combined program, the Village roads do continue to deteriorate with supplemental maintenance. In examining the Pavement Condition Ratings, the most significant increase is in those roads rated 1, going from 0% to 9%. The roads rated 3 decrease from 30% to 1%.

The largest impact of the combined program can be seen in the retention of the elevated rating of those roads rated 7-10. Roads rated 2 and 4-6 are slightly reduced yet stable, indicating the Pavement Maintenance Program is adequately addressing the Village's needs. With continued maintenance, the Village should be able to reduce the length of the projects in the Street Replacement Program or increase the time between reconstruction projects.

IDEAL DISTRIBUTION

As previously discussed, the goal of the program is not to simultaneously improve each road in the Village to a 9 or 10 rating. Doing so will only place a larger strain on the pavement maintenance program, as all of the roads rated 9 or 10 deteriorate at relatively the same rate. Given the rate of deterioration, if all of the roads were rated 9 or 10, they would also all

deteriorate to 2 or 3 at the same rate. That rate would be faster than the budget would allow for maintenance or reconstruction. Eventually rather than all of the roads being rated 9 or 10 requiring no maintenance, all of the roads would be rated 2 or 3 requiring reconstruction.

Ideally, the distribution of roads would have approximately one third (33%) rated a 9 or 10 requiring no maintenance. Since the roads require no maintenance, they are not a burden on the annual road budget. This also allows the Village to focus on the remaining two thirds of its roads.

The ideal distribution would include approximately one half (50%) of the Village roads in the 5-8 rating range, or the range requiring routine maintenance. Slowing the rate of pavement deterioration allows the Village to keep the majority of its roads in this rating range. By preventing pavements from deteriorating to a 4 or below, the Village can manage the amount of reconstruction needs. Routine maintenance is also less expensive than reconstruction, allowing the Village to maintain a lower annual budget.

The remaining roads, mathematically 17%, would be rated 1-4. Roads rated 1-3 require reconstruction. With the Street Replacement Program, the Village is reconstructing 5-7% of its roads every two years. Essentially every two years 5-7% of the roads in the 1-4 range would move to the 9-10 range. This movement allows for the roads in the 5-8 rating to deteriorate and be addressed with reconstruction.

VARIATIONS

In comparing the existing conditions and plan performance against an ideal standard, it is important to understand when pavement conditions are truly better than the ideal.

INDIVIDUAL RATINGS

Generally speaking, it is good if the percentage of roads rated 9-10 is higher than the ideal graph. Likewise it is also good if the percentage of roads rated 1-3 is lower than the ideal graph. However, when comparing against the ideal, the graph must be examined as a whole. There must be a balance in order for the program to be successful.

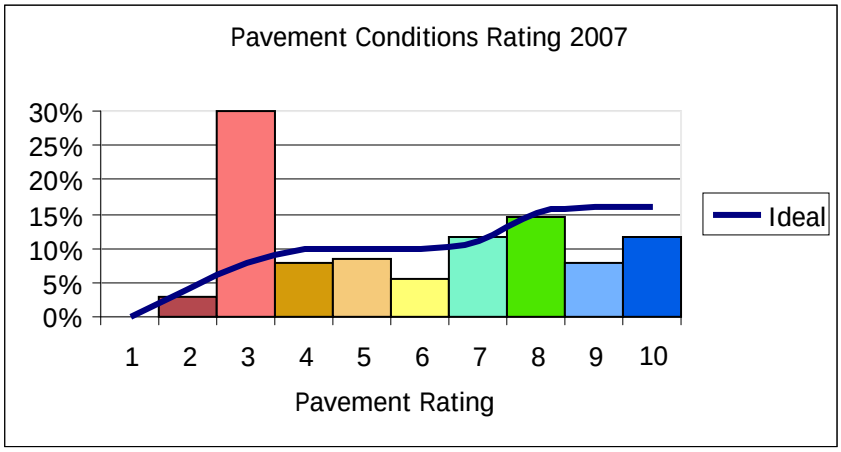
TRENDS

It is also important to evaluate the contrast between the slope of the ideal graph and the pavement conditions. As shown on the graph, the percentage of roads rated 9-10 requiring no maintenance is stable, as is the percentage of roads rated 5-8 requiring routine maintenance. The percentage of roads rated 1-3 is decreasing to 0% at rating 1. The rate of deterioration from those roads requiring no maintenance to those requiring routine maintenance is steeper than the rate of deterioration from routine maintenance to reconstruct. In practice, this translates to concentrating less funds on roads rated 9-10 to keep them at that rating, rather than trying to maintain roads rated 5-8 in that range.

The goal of the program is to decrease the rate of deterioration overall to slow the percentage of roads that require maintenance from falling into the category of reconstruction.

EXISTING CONDITIONS

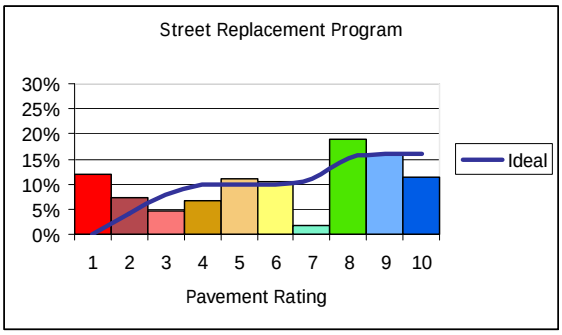
In order to accurately evaluate the projected performance of the Village's Pavement Management Plan, it must first review the existing conditions. The pavement ratings may be found on the next page with the ideal line for rating distribution.

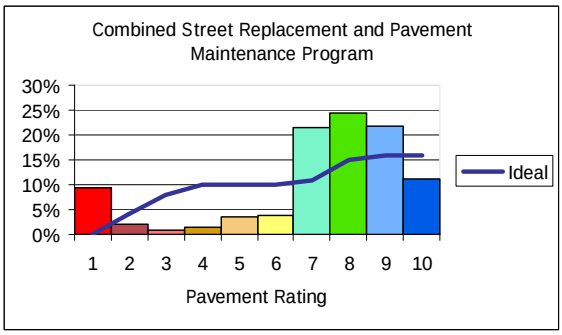


The most noticeable deviation from the ideal graph is those roads rated 3. The Village has more roads rated 3 than any other rating. Addressing those roads should be a priority of any program. Aside from roads rated 3, the remaining roads in the Village perform close to the ideal curvature. As would be expected by the larger overage in roads rated 3, the distribution of those rated 4-6 and 9-10 is less than ideal. The Village should aim to increase the percentage of roads rated 9-10 and maintain those rated 4-6.

AFTER PROGRAM

Both the Street Replacement Program alone and the combined programs can also be compared against the ideal graph:





EVALUATION

Both programs show marked improvement over the existing conditions.

STREET REPLACEMENT PROGRAM	COMBINED PROGRAM
▪ Percentage of roads rated 1 and 2 exceed ideal conditions	▪ Percentage of roads rated 1 exceeds ideal conditions
▪ Gap between roads rated 8-10 and 1-6 which could potentially lead to a budget imbalance to continue a significant amount of reconstruction.	▪ Overall, the combined program performs better, as it reduces the percentage of roads that exceed the ideal for roads rated 1-6
▪ Percentage of roads requiring no maintenance is deteriorating from 10 to 8 at increasing rate rather than being stable	▪ Although the percentage of roads in each rating does not match the shape of the ideal curve, the pavement conditions are better than the ideal in all but the rating 1, 2 and 10 categories
	▪ General trend of decreasing percentages from 8 to 3 which exceeds ideal conditions.
	▪ Over time, excess in roads rated 7-9 should distribute over roads rated 3-6, moving closer to ideal conditions. Discrepancy due to initiation of pavement maintenance program.

WHAT TO DO TO IMPROVE:

Continue combined program. As the Village continues to reconstruct low rated roads and maintain higher rated roads, the percentage of roads rated 1-3 will continue to decrease and eventually stabilize. The maintenance program will keep the roads in the 5-8 rating category longer. Over time, the reconstruction cost will deteriorate and the Village can focus more effort on maintenance.

The evaluation of the combined program is based upon rating projections without concrete rating history, as the Village has not previously had a formal maintenance program. The Village should regularly update this document to verify that the program results follow the ideal curvature.

NEEDS/EXPENDITURES/BACKLOG

One way to evaluate the performance of a pavement management plan is in terms of the financial implications.

NEEDS

As established in the Maintenance Strategies section, each road in the Village has an associated rating with a recommended maintenance application and a corresponding cost. Based upon the Condition Frequency Report, the current state of roads in the Village equates to a combined reconstruction and maintenance cost of $11,497,861.56. If the Village was not limited by financial constraints and decided to simultaneously maintain all of its roads in one year, this dollar amount would equate to the Village "needs". This assumes that all roads simultaneously undergo reconstruction or maintenance as outlined in the Maintenance Schedule portion of the Maintenance Strategies section.

The distribution of the roads in the Village and corresponding cost can be summarized in the following table:

RATING	LENGTH	PERCENTAGE	COST/LFT	TOTAL COST
1	0	0%	$145 - $175	$0
2	4,278	3%	$145 - $175	$739,140.00
3	44,624	30%	$107 - $175	$ 7,753,440.00
4	11,722	8%	$0 - $97.35	$ 1,012,680.00
5	12,514	8%	$6.50 - $74.84	$ 909,245.36
6	8,080	5%	$24.15 - $114.75	$ 585,576.00
7	17,167	12%	$0.60 - $16.32	$ 235,390.40
8	21,596	14%	$1.76 - $18.19	$ 262,389.80
9	11,620	8%	$0	$0
10	17,425	12%	$0	$0
	149,026	100%		$11,497,861.56

Table 1: Village "needs" as rated in 2007

EXPENDITURES

The actual amount that the Village spends over the 10-year life of the program is the program "expenditure". This assumes that the Village maintains the existing budget consistently over the life of the program. For the purposes of this report, the Village expenditure for the Street Replacement Program is assumed to be $2 million each biennium, or $12 million total over the 10-year program. At an average of $220,000 per year, the total for the Pavement Maintenance Program is $1,401,290.12 over the 10-year program. The total Village expenditure is $13,401,290.12.

	STREET REPLACEMENT PROGRAM	PAVEMENT MAINTENANCE PROGRAM
2010	$2,000,000	
2011		$223,055.62
2012	$2,000,000	
2013		$220,933.20
2014	$2,000,000	
2015		$240,889.00
2016	$2,000,000	
2017		$220,060.00
2018	$2,000,000	
2019		$265,191.90
2020	$2,000,000	
2021		$231,160.40
SUBTOTAL	$12,000,000	$1,401,290.12
TOTAL	$13,401,290.12	

BACKLOG

At the end of the program a "backlog" is created. This backlog is the financial impact of not reconstructing or maintaining all of the Village's roads.

The calculation of the program backlog is more complicated than simply subtracting the program expenditures from the program needs. The backlog accounts for deterioration. The program estimates that over a 10-year period of time, the Village roads will deteriorate according to the graphs shown in the Cyclical Maintenance section. Even those roads reconstructed during the program are subject to deterioration.

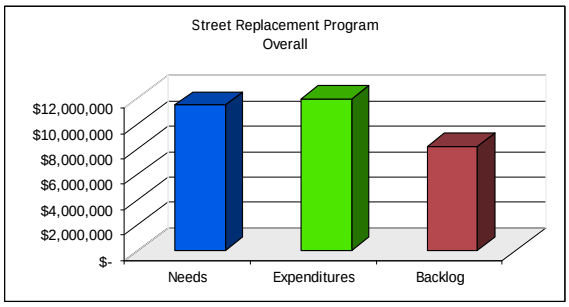
The backlog is calculated to allow for the continual deterioration of roads rather than "freezing" time, therefore the backlog is higher than the difference between the needs and expenditures due to deterioration. Deterioration introduces emerging projects and a more comprehensive improvement strategy when a need is not met and left to deteriorate.

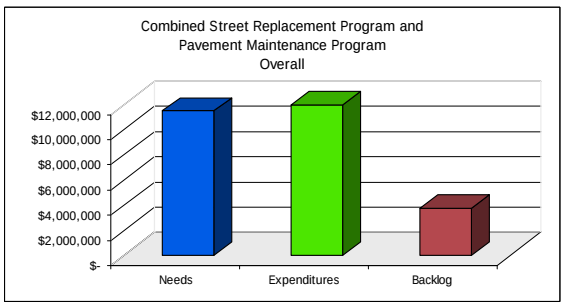
The costs shown in the graph are all based upon 2008 dollars and do not account for inflation or increases in material and labor costs.

RATING	LENGTH	PERCENTAGE	COST/LFT	TOTAL COST
1	17,950	12%	$145 - $175	$3,114,310.00
2	10,720	7%	$145 - $175	$1,766,680.00
3	6,972	5%	$107 - $175	$1,092,105.00
4	9,877	7%	$0 - $97.35	$22,540.00
5	16,583	11%	$6.50 - $74.84	$781,473.60
6	15,735	10%	$24.15 - $114.75	$1,053,927.50
7	2,642	2%	$0.60 - $16.32	$36,820.00
8	28,411	19%	$1.76 - $18.19	$395,049
9	23,342	16%	$0	$0
10	16,794	11%	$0	$0
	149,026	100%		$8,262,904.90

OVERALL

In 2008, the cost associated with reconstruction or maintaining all of the roads in the Village is $13.4 million. As graphically displayed below, the program needs exceed the program expenditures.



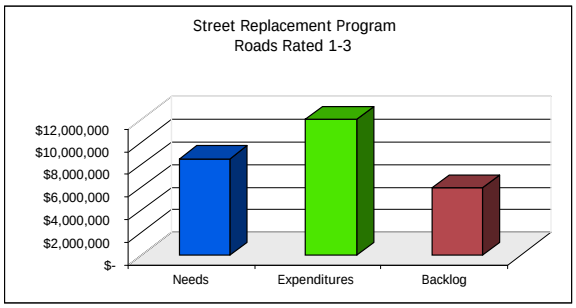


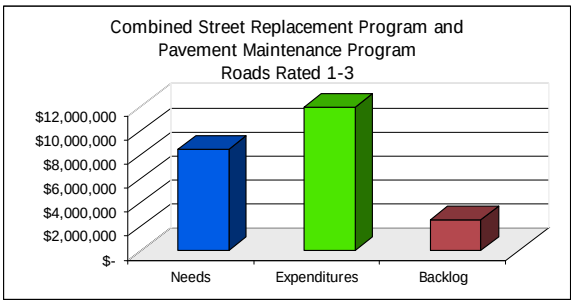
From 2010-2021, the Village will spend approximately $12 million in reconstruction projects and $1.4 million in maintenance projects. At the end of the program in 2021, the Village will reduce

its backlog to under $3.7 million. The backlog is slightly less than half of the backlog from reconstruction alone, $8.3 million.

ROADS RATED 1-3

Currently the Village's Street Replacement Program addresses the lowest rated roads, generally those rated 1-3. Therefore the expenditures for the program can be isolated to roads rated 1-3. In 2008, the cost of the needs for reconstruction is approximately $8.5 million. With a $12 million expenditure over 10 years, the Village is still left with more than a $6 million backlog of reconstruction costs. This indicates that although the Village has dedicated a significant amount of resources to reconstruction, the Village roads are deteriorating more quickly than the Village is reconstructing them.

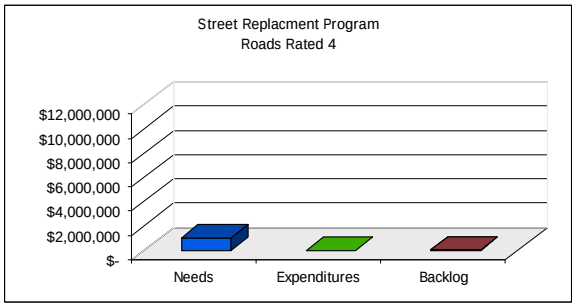


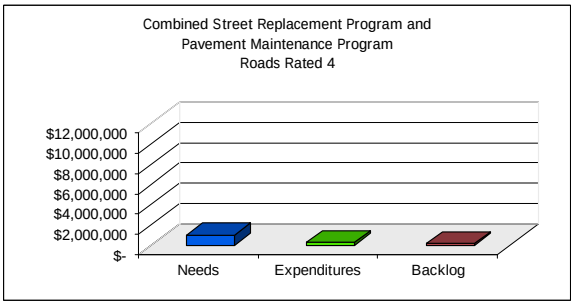


With the addition of the Pavement Maintenance Program and maintenance expenditures at higher ratings, the backlog of projects rated 1-3 is reduced from $6 million to just under $3.2 million without any additional reconstruction expenditures.

ROADS RATED 4

Asphalt roads rated 4 require no action and concrete roads rated 4 undergo minor repair. The Village does not traditionally maintain roads rated 4, resulting in a $0 expenditure. In 2008, the cost associated with roads rated 4 is $1 million. At the end of the program in 2020 the backlog will be approximately $22,500. The backlog reduction is due to roads rated 4 being reconstructed, or deteriorating to 3 or lower over the course of the program.

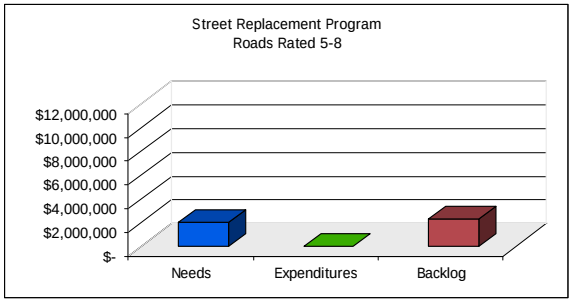


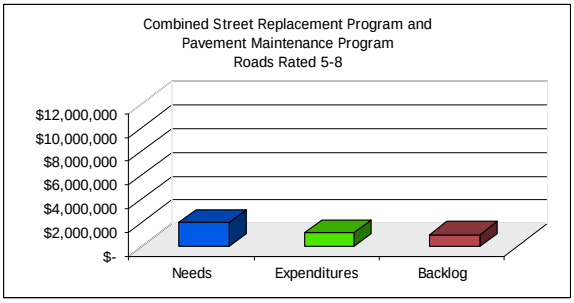


In the combined program, $282,000 is spent on roads rated 4. In 2021 the backlog is under $80,000 as compared to $22,540 with the Street Replacement Program alone. Although this appears to indicate a poor performance of the Pavement Maintenance Program, it is more accurately a combination of roads rated 4 deteriorating to 1-3 and rating retention of those roads rated 5-8 attributed to routine maintenance.

ROADS RATED 5-8

In 2008, the cost associated with preventative maintenance is almost $2 million. The Village does not currently complete a significant amount of preventative maintenance, shown as a $0 expenditure for the Street Replacement Program. At the end of the program in 2020 the backlog will be approximately $2.3 million. Although the backlog only increased $300,000 over 10 years, this is not an indication that no preventative maintenance is required. It is also a sign that the Village roads are deteriorating beyond the point which preventative maintenance is a viable option.





In the combined program, the majority of the Village's maintenance program expenditure, $1.12 million, is spent on preventative maintenance. With the implementation of the Pavement Maintenance Program, the backlog of projects is reduced more than half from $2.3 million to less than $1.0 million. The reduction in cost for the backlog of projects is one indication that the maintenance program is an efficient way for the Village to reduce road budget costs. The efficiency is also evident in the increased percentage of roads rated 5-8, indicating the road maintenance program is successfully 1maintaining a higher rating.

ROADS RATED 9-10

Roads rated 9-10 require no maintenance. The need, expenditure and backlog for this classification are $0.

PROGRAM ACCOMPLISHMENTS

The deterioration outlined in the backlog section is displayed as broken down by maintenance strategy in the following graphs:

ROADS RATED 1-3

ASPHALT

- Reconstruction

CONCRETE

- Reconstruction (1-2)
- Repair and grind or mill, repair and overlay (3)

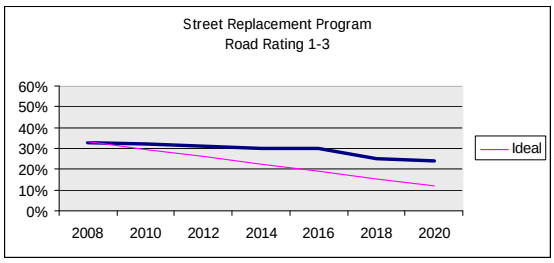
EVALUATION

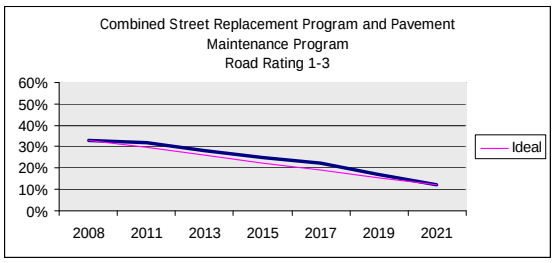
The graphs below demonstrate the percentage of Village roads requiring reconstruction or major repair over the life of the 10-year program. Even with deterioration, the Street Replacement Program is able to reduce the percentage of roads in the Village requiring reconstruction or major repair. This is an indication that the program is performing as it is intended.

Similar to the Street Replacement Program, the combined program reduces the percentage of roads in the Village requiring reconstruction or major repair. The combination of programs effectively reduces the percentage more quickly and efficiently than the Street Replacement Program alone.

IDEAL

Both programs follow the overall trend of the ideal graph, to decrease the percentage of roads rated 1-3. The Street Replacement Program alone does not reduce the roads requiring reconstruction as quickly as ideal. However, the combined program is near exactly the ideal.





ROADS RATED 4

ASPHALT

- No Maintenance (road beyond routine maintenance, but not yet requiring reconstruction)

CONCRETE

- Crack seal and patch

EVALUATION

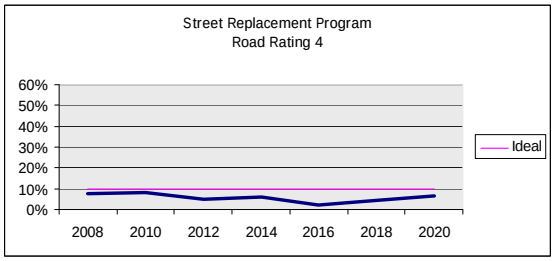
The graphs below demonstrate the percentage of Village roads requiring minor or no maintenance over the life of the 10-year program. Although the percentage of roads in the Village requiring minor or no maintenance decreases throughout the 10-year Street Replacement Program, at the end of the program the percentage of roads is nearly identical. This is not an indication that the program is performing poorly, rather an indication that the percentage of

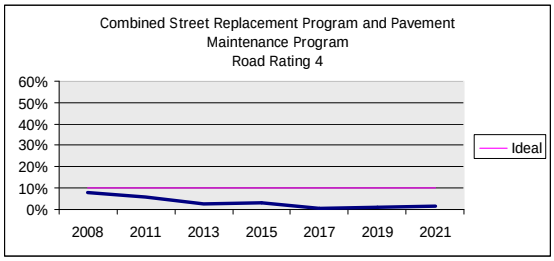
roads that will require reconstruction or major repair in the near future is the same in the beginning as at the end of the program. The Village will need to continue to reconstruct roads at the same or an increased rate to keep up with deterioration.

The Street Replacement Program alone reduces the percentage of roads rated 4, but at program end there is no change. The combination of programs also reduces the percentage of roads rated 4, but maintains the reduction over the entire life of the program.

IDEAL

Both programs have a lower percentage of roads than ideal, which can be a good thing since roads deteriorating beyond a 4 require reconstruction. In fact, the combined program reduces roads rated 4 to nearly zero, which provides a buffer of time during which roads rated 5-8 may deteriorate to and beyond the 4 rating prior to a need for reconstruction. The graphs do show that the Village is effectively reducing the rate of deterioration, which is more important than maintaining roads at a 4 rating.





ROADS RATED 5-8

ASPHALT

- Mill/pulverize and overlay (5-6)
- Chip seal (7-8)

CONCRETE

- Repair and overlay (5-6)
- Joint and crack seal (7-8)

EVALUATION

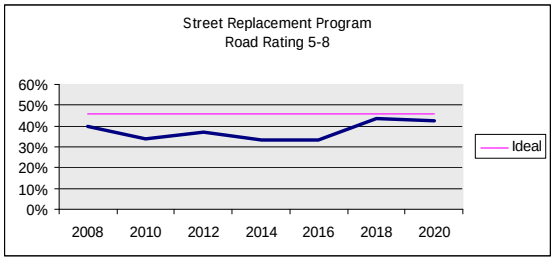
The graphs below demonstrate the percentage of Village roads requiring routine maintenance over the life of the 10-year program. The percentage of roads in the Street Replacement Program requiring routine maintenance decreases slightly over time, but at program end is slightly higher than it was in the beginning of the program. This indicates that while reconstruction addresses the lower rated roads, not having a routine maintenance program in the Village results in an increase of roads requiring maintenance.

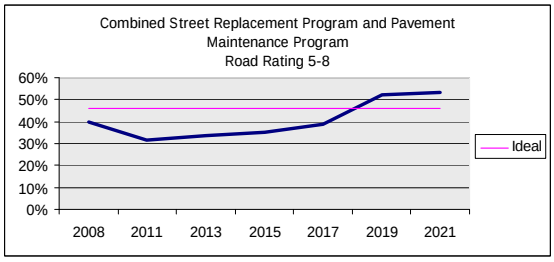
Roads rated 5-8 in the Village also account for over 40% of the Village's roads. Without maintenance, as those roads continue to deteriorate, they pose a large budget issue for the Village in the future. At some point all of those roads will require reconstruction. If the Village does not implement a maintenance program, those roads may all requiring reconstruction at the same time. As demonstrated in the graphs for roads rated 1-3 and 4, the Village is not significantly decreasing the number of roads that require major maintenance. Therefore as the roads rated 5-8 continue to deteriorate, the roads rated 1-4 will begin to increase rapidly.

The Street Replacement Program alone maintained the percentage of roads rated 5-8. The combination of programs not only maintains, but also increases the percentage of roads rated 5-8 by over 50%.

IDEAL

The Street Replacement Program alone never reaches the ideal percentage of roads rated 5-8. By the end of the 10-year combined program, the percentage of roads rated 5-8 not only meets, but exceeds the ideal percentage. The percentage in the combined program also levels off by 2021, which meets the intent of the ideal graph to maintain a high percentage of roads rated 5-8.





ROADS RATED 9-10

ASPHALT

- No maintenance required

CONCRETE

- No maintenance required

EVALUATION

The graphs below demonstrate the percentage of Village roads in good condition requiring no maintenance over the life of the 10-year program. The percentage of roads requiring no maintenance in the Street Replacement Program increases significantly over the first eight years, but endures a decline in the last two years. This indicates that while the reconstruction succeeds in bringing roads of low rating to become roads of high rating, the reconstruction is not able to keep up with the rate of deterioration.

The overall shape of the graph for the Street Replacement Program alone and the combined programs are nearly identical, indicating similar program performance. However, the increase in percentage of Village roads rated 9-10 in the first 8 years of the program increase significantly more than that of the Street Replacement Program alone. The percentage of roads rated 9-10 at the end of the combined programs is also higher than that of the reconstruction program alone.

IDEAL

The Street Replacement Program follows the ideal increase in roads rated 9-10 nearly identically, but falls off in the last four years. While the percentage at the completion of the program is less than 5% lower than the ideal, it shows a trend that the roads being brought up to a 9-10 rating through reconstruction or maintenance are decreasing to a lower rating quicker than the Street Replacement Program can reconstruct roads. In contrast, the combined program mirrors the slope, but is at a much higher percentage of roads rated 9-10 than the ideal. The decrease

within the last 4 years is not of a major concern, as the percentage levels off to nearly exactly what is ideal.