GILMORE & ASSOCIATES, INC.
ENGINEERING & CONSULTING SERVICES

ROADWAY CONDITION EVALUATION

FOR

CALN TOWNSHIP
CHESTER COUNTY, PENNSYLVANIA

File No. 23-07086

January 4, 2024

Prepared For:

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BUILDING ON A FOUNDATION OF EXCELLENCE

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APPENDIX

1.0 PROJECT OBJECTIVE AND SCOPE OF SERVICES

Gilmore & Associates, Inc. (G&A) has been retained by Caln Township to evaluate the condition of the Township's roads to aid prioritization of future roadway improvement projects. The scope included Township-owned roads and excluded state roads, private roads, and roads currently under construction. To facilitate this study, G&A has utilized a Pavement Condition Index (PCI) to quantify the general condition of each road as summarized in this report. To obtain data for the condition assessment, G&A traveled along each road and recorded observations of roadway conditions between November 1 and November 30, 2023. Based on our observations, each road was assigned a value on a scale of 1 to 10. In addition to the overall condition index value, comments are provided which describe the observed distress types and general observations. Based on the results of our evaluations, recommendations have been provided regarding general maintenance, repairs, and reconstruction of applicable roads. The findings and recommendations in this report reflect the conditions observed on the dates the roadways were evaluated, and therefore may not be representative of current roadway conditions.

2.0 GENERAL PAVEMENT CONSTRUCTION

Public roadways are generally constructed with multiple layers utilizing different materials at select thicknesses. Layer materials and thicknesses are dependent on the traffic volumes, subgrade conditions, and any municipal pavement design standards/specifications that may have been required during the design phase of the roadway. Most roads are constructed using a combination of some or all of the layers listed below. At a minimum, roads usually consist of bituminous wearing and base courses, underlain by aggregate subbase material. Please review *Detail 1: Typical Flexible Pavement Cross-Section*, as it illustrates the layers in standard pavement construction. As our evaluation was performed visually from the surface, layers below the surface course and pavement subgrades were not assessed during this study. Subsurface courses may be evaluated in future studies using drilling/coring methods if desired. Roadway coring can be especially useful to determine the need for full or partial depth replacement, and associated repair costs for failing roadways.

2.1 Wearing Course

The wearing course or surface course is the top layer of the pavement. The wearing course is usually bituminous concrete (also known as asphalt pavement) which is a blend of mineral aggregate, bitumen, and air voids. The aggregate maximum diameter of the wearing course is 9.5 millimeters. The most common types of wearing course are Hot Mix Asphalt (HMA) and Warm Mix Asphalt (WMA) and the thickness usually ranges from 1.5 to 3 inches. In many cases, the wearing course is re-applied as an overlay to repair roadways.

2.2 Binder Course

The binder course is placed below the wearing course and is also made of bituminous concrete (also known as asphalt pavement). The maximum diameter of aggregate in the binder course is 19.5 millimeters and the layer thickness usually ranges between 3 to 9 inches.

2.3 Base Course

The base course is placed below the binder course (and wearing course) and is also made of bituminous concrete. The maximum diameter of aggregate in the base course is 19.5 to 25 millimeters and the layer thickness is usually 4 inches or greater.

2.4 Subbase Course

The subbase course is placed below the bituminous courses and is composed of a crushed stone aggregate. In Pennsylvania, the most common subbase aggregate is 2A modified stone. The 2A modified stone has a maximum diameter of 1.5 inches. Depending on the type of road, the subbase course is usually 6 inches or greater.

2.5 Subgrade

The bottom of the pavement is underlain by the subgrade or the underlying soil. Prior to the placement of the subbase material, the subgrade soils are graded and compacted. Ideally, the subgrade soils are inspected by a geotechnical engineer to confirm stability and that the material is suitable before subbase material placement. Subgrade soils should be free of over-sized materials, organics, ash, and other deleterious materials. Moisture-sensitive, fine-grained soils, are generally not considered suitable for the pavement subgrade. In some instances, soil reinforcement such as geotextile fabrics or chemical stabilization can be used as a remediation measure. Pavement failure can occur if the subgrade soils are unsuitable, resulting in potholes, rutting, or other pavement distresses. In addition, drainage performance at the subgrade can be essential to the long-term performance of pavement sections.

2.6 Sealant

In an effort to prevent water from entering the pavement along the curb lines, inlets, and other abutment areas, all pavement joints should be sealed with a rubberized emulsion. Joint seals will also prevent weeds and silt accumulations from occurring in these areas. In some cases, sealants are used to temporarily stabilize cracked asphalt or patched locations following utility work.

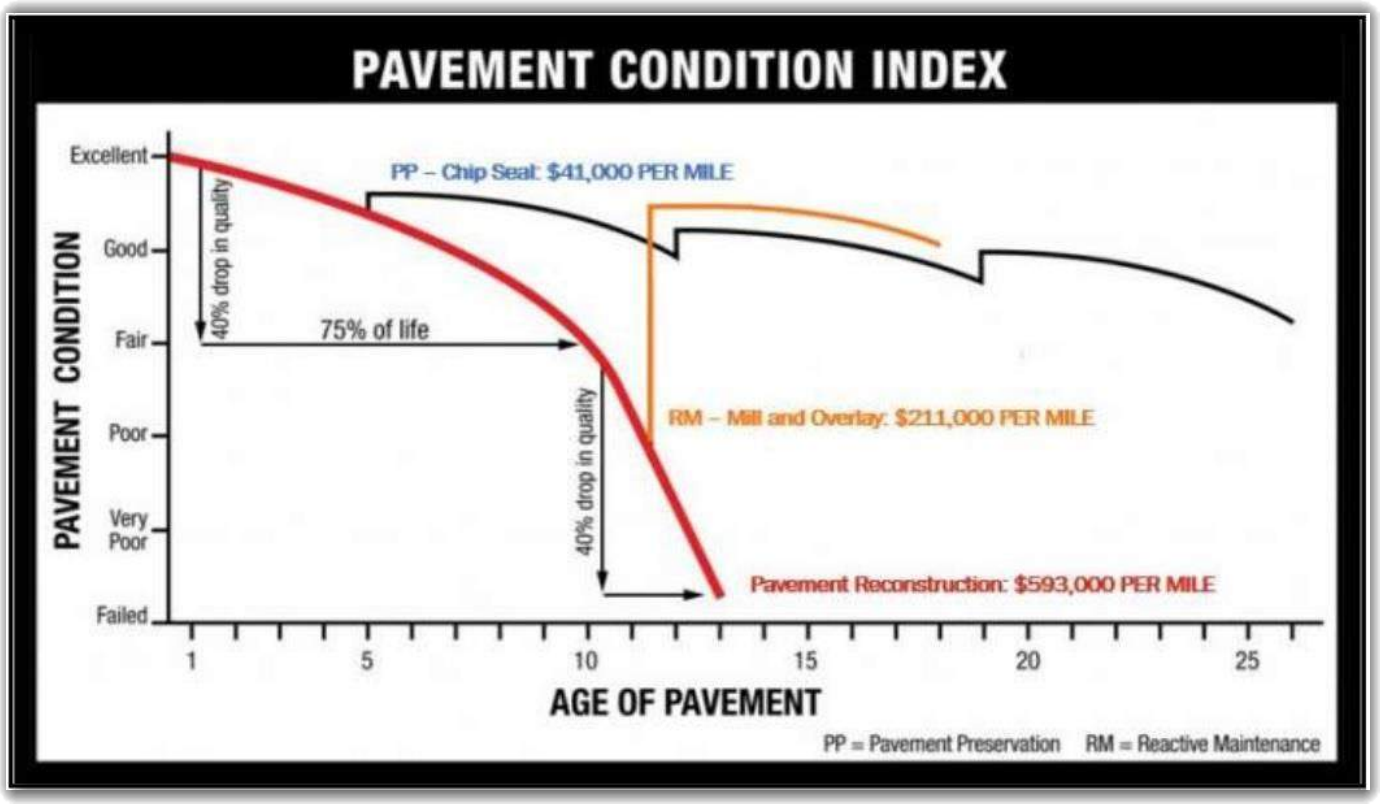
Detail 1: Typical Pavement Cross-Section

3.0 PAVEMENT DETERIORATION

Pavement deterioration and aging occurs over time due to a variety of factors. The most common type of fatigue is cracking. As pavement surfaces oxidize over time, they become brittle and can crack from repeated traffic loads. Once cracks have formed, water may enter into the pavement sections and cause additional deterioration. The deterioration can become more severe over time if the necessary repairs are neglected, especially in the winter due to freeze-thaw cycles. In general, as pavement conditions continue to deteriorate over time, the repair costs increase as well. Ideally, a preventative maintenance plan should be followed to preserve pavement starting at the early stages of its life-cycle. Preventative measures may include chip sealing, crack sealing, patching, overlays, and other methods outlined in the Recommendations section of this report.

The graph below, *Graph 1: Pavement Condition Index vs Maintenance Plans* (per the U.S. Army Corps of Engineers), is an example of how pavements deteriorate over time given the chosen maintenance plan. The graph shows how a pavement preservation plan can increase the pavement condition over the life-cycle versus a reactive plan. A reactive plan is performed after the pavement condition has become poor or worse. The reactive plan usually requires significantly higher costs as compared to a preservation plan.

Graph 1: Pavement Condition Index vs Maintenance Plan



Source: Modified from U.S. Army Corp. of Engineers

4.0 GENERAL OBSERVATIONS OF TOWNSHIP ROADS

Based on information provided to G&A from the Township, the older roads typically have pavement sections consisting of 1 to 2 inches of wearing course, underlain by 2 to 3 inches of binder course, underlain by varying thicknesses of crushed aggregate base course. The roads observed during our study had a range of distress characteristics, and overall conditions ranging from “failed” to “excellent”.

5.0 TYPES OF PAVEMENT DISTRESS

The pavement distress types described below are the primary pavement distresses that can be expected for asphalt pavement roads; many of these types of distresses were observed during our field condition assessment for roadways within the Township. In some cases, the observed distresses were confined to localized sections of the road, and in other cases were more widespread along the roadway surface. The descriptions of the distresses outlined below should be reviewed in conjunction with the Pavement Condition Index, comments, and photos (where applicable) to gain a better understanding of the condition of each roadway. For instance, a roadway in a poorer condition may have visible distress along the entire spans of road, while a roadway in a better condition may have distress in only localized areas. The distresses outlined below were used to determine our recommendations outlined in the Road Evaluation Results Section of this report.

The primary distresses noted in our assessment are summarized in the table below. Pictures for each distress were taken from field assessment.

Table 1: Types of Pavement Distresses

DISTRESS	DESCRIPTION	
Block Cracking	Interconnected cracking into rectangular or block-like pieces that can range in size from 1 to 100 square feet; generally caused from a poor binder choice in the mix design or aging in the asphalt binder	
Fatigue/Alligator Cracking	Series of interconnected cracks that appear to resemble the back of an alligator that are caused by tensile stresses	
Longitudinal & Transverse Cracking	Cracking that occurs parallel (Longitudinal) and perpendicular (Transverse) to the centerline of the pavement that is caused by poorly constructed joints, thermal contraction and expansion, shrinkage in pavement layers, underlying cracking, wearing course fatigue	
Potholes	Deep divots, pockmarks, and or holes in the pavement that are caused from snow and rain seeping into the cracks of the pavement, then freezing and thawing, creating voids in the pavement layers, and the weight of heavy vehicles causes cracked pieces to fall into the voids	

DISTRESS	DESCRIPTION	
Raveling	Disintegration of the asphalt binder and aggregate particles at the pavement surface caused from dust coatings bonding to the binder rather than the aggregate, poorly-graded aggregate particles, inadequate compaction during construction	
Rutting	Depressions, permanent deformation, and or consolidation in the pavement surface spanning parallel with the road, typically shown by the wheel path engraved on the road	
Shoulder Drop-Off	Drop in elevation between travel lanes, paved shoulders, and unpaved shoulders; caused from resurfacing roadways without raising the height of the shoulder or the abutting ground	
Shoving	Plastic movement creating a wave-like pattern across the surface, usually occurs at areas where asphalt abuts a rigid object; possible causes include mix contamination, poor mix design, lack of aeration of liquid asphalt emulsions, weak subgrades, or improper rolling during construction	

6.0 ROAD CONDITION RANKING SYSTEM

The Township informed G&A that all roads are to be included in our assessment with the exception of PennDOT-owned roads, privately-owned roads, and roads currently under construction or recently constructed roads. G&A produced a map of the Township roadways titled *Road Program Update Map*, dated October 2023, which was used for this evaluation. Upon review of the map, the pavement surface for each subject road was visually assessed and pavement distresses were noted as outlined in *Table 1: Types of Pavement Distresses*. The field assessment included visual observations of the pavement surface conditions and did not include any physical testing, core sampling, or subgrade evaluations. The map has been updated and includes the condition rating for the roads evaluated in our assessment.

Each roadway condition was subjectively rated based on the visual appearances of the surface and the ride quality at the time of the survey. The visual appearance was checked for pavement distresses that could lead to a pavement failure, and or any other failure conditions that may affect the performance and function of the road. The visual observations were documented and used to determine the roadway condition rating for each roadway. The condition rating was based on a 1 to 10 scale, with a 1 signifying a completely failed roadway section and a 10 indicating a near perfect condition. In instances where the conditions varied throughout the length of the roadway, a rating value was assigned based on an

interpretation of the conditions with consideration to the total road area. Segments were used in some cases to help identify specific areas rather than averaging a rating for the entire length of the road.

The rating for each roadway evaluated in the field study is in general conformance with the roadway rating system set forth in *Table 2: Roadway Condition Rating System*. For a full summary of the documented road conditions and assessment rating, refer to the Roadway Condition Summary Table in the Appendix attached to the end of this report.

Table 2: Roadway Condition Rating System

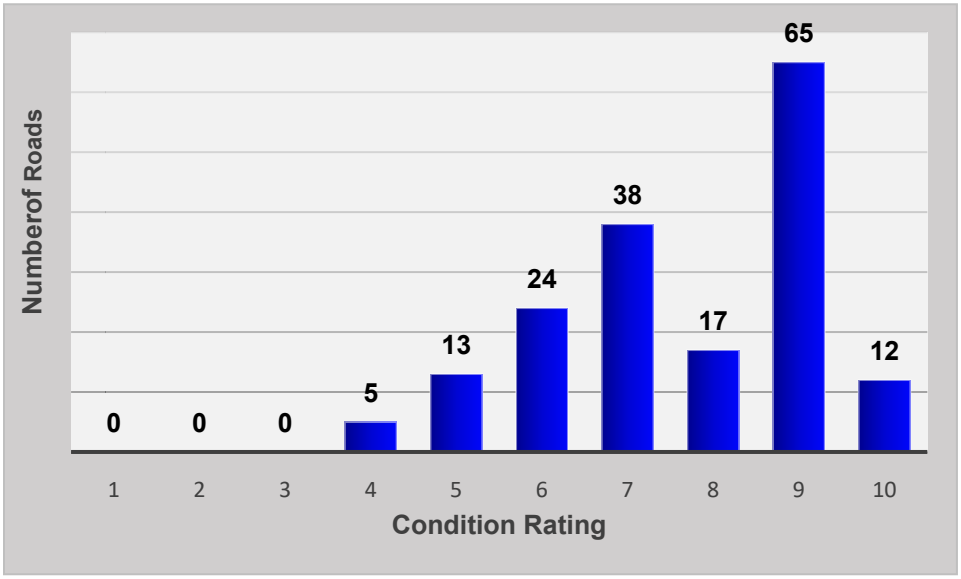
RATING	DESCRIPTION OF ROADWAY CONDITION	EXAMPLE
10	Roadway is in near perfect condition and has recently been re-paved.	Fifteenth Avenue (North of Reed Street) 
9	Roadway is in very good overall condition with some minor wearing/cracking observed.	Albermarle Court 
7-8	Roadway is in good condition but showed signs of wearing, oxidation, and more cracking.	Elmwood Lane 
5-6	Roadway is in poor to fair condition and showed significant wear, oxidization, and widespread cracking.	Grand View Lane 
1-4	Roadway has failed.	Ridge View Drive 

7.0 ROAD EVALUATION RESULTS

Based on the results of our assessment, the overall condition of the Township-owned road system is "good", with over 75% of the roadways scoring a 7 or higher and no Township-owned streets scoring lower than a 4. The graph below titled *Graph 2: Caln Township Roadway Conditions*, summarizes the quantity of roads that earned each rating. The results suggest that the conditions of the Township's roads are generally good; however, select roadways and roadway segments will require more significant repairs beyond a simple seal coating. Roadways that are only in need of general maintenance repairs such as seal coats or sealing localized distresses with minor patching represent approximately 75% to 90% of the Township roads currently in operation. Roadways in need of more intensive repairs, including pavement reconstruction and milling and overlaying represent approximately 10% to 25% of the Township roads.

The roadways that have scored a 5 or 6 are approaching a failure state, and should be prioritized for repairs. Five roads, including Fifteenth Street (south of Reed Street), Longview Drive, Louanna Avenue, North Humpton Road, and Ridge View Drive scored a rating of 4, which is considered a failure state (meaning that the roadways have deteriorated to the point were more significant and costly repairs are required). Repair of these roadways, which may require complete reconstruction of the pavement section, is recommended to be a top priority. Of the five roads receiving a failure score, North Humpton Road is in the worst condition. Repairs may include a partial or full replacement of the existing pavement structure as deemed necessary to bring the roadway back to a good or very good condition. For a tabulation of individual roadway ratings and distresses, please review the *Caln Township – Roadway Condition Summary in the Appendix of this report.*

Graph 2: Caln Township Roadway Conditions



8.0 TREATMENT OPTIONS AND COST

Applicable treatment options will depend on the severity of the roadway deterioration. Generally, the quality of the repair and the cost of the repair are directly related. To aid the Township, G&A has compiled relative cost estimates in the following section of the report. We note that the presented costs are approximate and are based on information obtained from general research. The prices are subject to fluctuations based on economic drivers, local contractor and material supplier availability and experience, project size, and additional factors.

8.1 Cold Patch

Cold patch can be used for repairing individual potholes and cracks with larger widths. Cold patch material, also known as cold asphalt mix (CMA), is an asphalt mix comprised of aggregate, bitumen emulsion, and water. The benefits of cold patch include its simple application process, as it does not require heat, and it is inexpensive. A 50-pound bag of cold patch costs about $20 and covers about a 0.5- to 1.0-square foot of surface area depending on the thickness applied. An additional benefit to cold patch is that it can be applied during any time of the year, including during either extremely hot or cold temperatures.

The application process requires potholes and cracks to be clear of any loose debris. The Township may wish to coat the inside of the pothole or crack with an asphalt bonding agent before filling it. Potholes and cracks greater than 2 inches in thickness should be filled and compacted with an aggregate subbase before placing cold patch. Once the cold patch is placed, it should be compacted with a plate tamper. Cold patch should be given 3 to 4 hours to cure before receiving any traffic loads.

Figure 1: Cold Patch Repair

Source: https://www.homedepot.com/p/SAKRETE-50-lb-U-S-Cold-Patch-Pothole-Repair-60450007/100672929

Using cold patch as a treatment option should only be considered for small, localized repairs due to its limitations. Although it is cost-efficient and easily applied, cold patch treatment is generally used for short-term and emergency fixes due to its lack of long-term durability. Cold patch repairs are considered unsuitable for high-traffic areas and heavy vehicle loads, and therefore should only be used as a temporary repair until more intensive repairs can be completed.

8.2 Crack Sealant

Minor cracks in the roadways can be sealed individually using a crack sealant. Crack sealing can be performed during the Spring, Summer, and Fall seasons of the year. The application process involves using an asphalt tar kettle or "tar buggy" to seal cracks in pavement areas. Tar buggies are also used to seal the joints between the existing pavement and new asphalt patches placed within the pavement section.

Figure 2: 850-gallon Asphalt Tar Kettle

Source: https://www.crssupply.com/search-results/ase-phoenix-series-asphalt-kettles/

G&A is aware the Township currently owns and uses a tar buggy for sealing pavement cracks. We recommend that the Township continue to use the tar buggy to seal cracks between 0.25 to 1.00 inches using a PennDOT approved rubberized joint and crack sealant. Any cracks wider than an inch should be filled using a 4.75 millimeter wearing course mix. If no additional repairs are made to the roadway surface within 3 to 5 years, the crack sealant must be reapplied in order to continue to protect the pavement section.

Rubberized crack sealer (material) costs approximately $0.35 to $1.00 per linear foot for depending on the width and thickness of the crack, the material used, and how it is applied.

8.3 Surface Treatment

Surface treatments are ideal for roadway conditions that drop to a score of 8 but may also be used for pavement preservation with roadway condition scores as low as 5 depending on the Township's preferences. Surface treatments are preferably used to cover large areas and repair minor cracking and restore skid resistances to worn surfaces. Overall, to utilize a surface treatment the roadway condition needs to be generally good aside from some minor cracking and wear, as the surface treatment is not suitable for repairing other types of more significant pavement distresses and does not add any structural capacity to the roadway.

Figure 3: Slurry Seal Application

Source: https://www.boxley.com/asphalt/slurry-seal-micro-surfacing/

There are three main methods for surface treatment – slurry seal, micro-surfacing, and chip seal.

Slurry seal is a treatment method that uses a mixture of polymer asphalt emulsion, crushed aggregate, water, and additives. Slurry seal involves mixing the emulsion and aggregates to create a "slurry" and the slurry is added to top or seal the roadway. Once the slurry is placed, the seal requires about 4 to 6 hours to cure before the road can be opened to traffic. Slurry seal applications are used to seal cracks, restore

flexibility, restore the black color in the pavement, and help preserve the underlying roadway courses. Roadways selected for cyclical micro-surfacing would typically be treated every 5 to 7 years. Slurry seals are ideal for residential streets and the average cost to apply slurry seal is approximately $2.50 to $2.70 per square yard.

Micro-surfacing is a treatment method that uses a mixture polymer asphalt emulsion, crushed aggregate, water, and chemical additives. Micro-surfacing involves topping the roadway with additional wearing course(s), typically applied in a 3/8-inch coat. Micro-surfacing is similar to a slurry seal treatment with the exception of its curing method. In contrast to the slurry seal method, which relies on the evaporation of the water in the asphalt emulsion to harden or cure, the asphalt emulsion in the micro-surfacing material contains chemical additives which allows it to cure without relying on evaporation. Micro-surfacing cures more quickly (about 1 to 2 hours after placement) than slurry seal and is ideal for streets that experience a significant amount of shade and/or traffic. Roadways selected for cyclical micro-surfacing would typically be treated every 5 to 7 years. The average cost to apply micro-surfacing is approximately $2.75 to $4.05 per square yard.

Figure 4: Micro-Surfacing Application

Source: https://www.duncor.ca/pavement-preservation-micro-surfacing/

Figure 5: Chip Seal Application

Source: https://ergonasphalt.com/treatments/chipSeal

Chip seal is the cheapest and most common treatment method. The general treatment method is a two-step process that involves applying a layer of asphalt emulsion followed by applying a layer of small crushed rocks or “chips”. The asphalt emulsion generally consists of asphalter, water, a surfactant also known as the “emulsifying agent”, a polymer, and sometimes a “rejuvenator” agent. The asphalt emulsion serves as a “hardener” and improves the adhesion of the crushed rock to the pavement surface. The “rejuvenator” agent softens the pavement surface and creates a better bond. In most cases, the street is swept/cleaned prior to applying the asphalt emulsion and swept again about 1 week after the chips area applied in effort to remove any loose aggregate. Chip seals can be used as a wearing course or as a binder course topped with slurry seal or micro-surfacing. Roadways selected for cyclical chip seal would typically be treated every 3 to 5 years. The average cost to apply chip seal is approximately $1.50 per square yard.

Table 3 outlines the cost per mile and typical life span of each type of surface treatment.

Table 3: Surface Treatment Costs & Life Span[1]

Surface Treatment	Cost Per Mile[2]	Life Span
Chip Seal	$21,120	3-5 Years
Slurry Seal	$35,200 - $38,016	5-7 Years
Micro-Surfacing	$38,720 - $56,600	7-10 Years

[1]Pricing should be considered a basic range (or average) which can be higher or lower depending on the actual roadway conditions and the preferred application thicknesses, and may also vary with market/economic conditions and contractor availability
[2]Assumes 24-foot-wide roadway, Cost assumes 2023 averages

8.4 Pavement Overlay

Roadways rated poor to fair with a score of 5 to 6, showing significant distresses, should be repaired by installing a new wearing course over the roadway surface. The new wearing course increases the structural integrity of the pavement while also sealing the surface from water. If the existing roadway grading will accommodate it, the new wearing course can be placed over the existing surface layer after the placement of a pavement fabric, or the existing surface layer can be milled and removed and the new wearing course can be constructed as a replacement. The milling thickness of the existing wearing course is typically around 1.5 inches and is performed to remove the cracked surface layer. Prior to the placement of the new wearing course, base repairs should be completed as deemed necessary.

Figure 6: Pavement Fabric Application

Source: https://www.roadfabrics.com/paving-fabrics/

Compared to the mill and overlay approach, overlaying the existing wearing course with a pavement fabric and a new wearing course allows for a longer life span. The pavement fabric creates a barrier to prevent water infiltration into the existing wearing course and it also prevents reflective cracking in the new wearing course. The pavement fabric overlay option is ideal for roadways that are considered to be in generally good condition but where the pavement structure may be thinner than desired based on current standards. G&A understands that several roads in the Township have already been overlaid with pavement fabric and a wearing course overlay. G&A encourages the Township to continue repairing roads using this method.

Table 4 outlines the cost per mile and life span of each overlay option.

Table 4: Pavement Overlay Costs & Life Span[1]

Pavement Overlay	Cost Per Mile[2]	Life Span
Mill & Overlay	$253,000 - $381,000	10-15 Years
Pavement Fabric & Overlay	$200,000 - $241,000	15-20 Years

[1]Pricing should be considered a basic range which can be higher or lower depending on the actual roadway conditions and the preferred application thicknesses, and may also vary with market/economic conditions and contractor availability

[2]Assumes 24-foot-wide roadway, Cost assumes 2023 averages

8.5 Pavement Reconstruction

Once a roadway reaches a condition score of 4 or less, the pavement section is at the end of its lifespan and a new pavement section should be reconstructed. Typically, reconstruction involves removing the existing pavement section and the subbase material, and installing a new subbase, base/binder course, and wearing course. Compared to the repair methods previously discussed, the costs to complete this work are significantly higher.

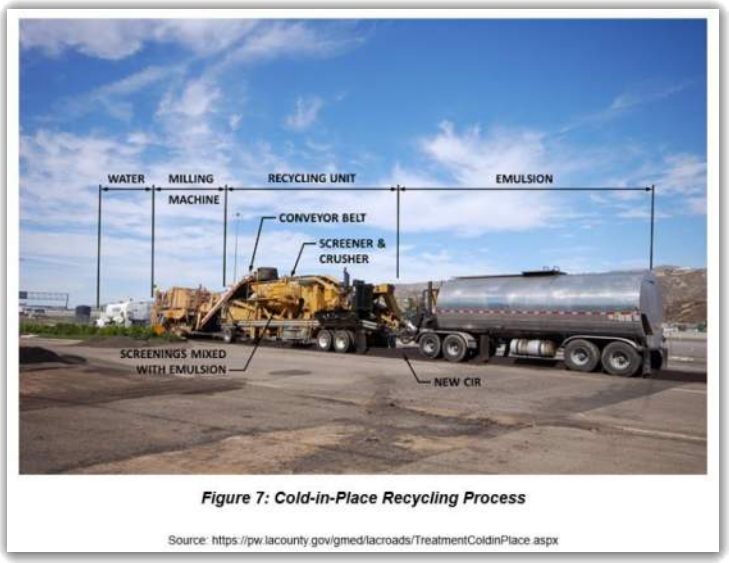


Figure 7: Cold-in-Place Recycling Process

Source: https://pw.lacounty.gov/gmed/lacroads/TreatmentColdinPlace.aspx

As an alternative option to completely removing and replacing the existing roadway, there are methods that involve recycling the existing pavement sections. The two recycling methods are Cold-in-Place Recycling (CIR) and Full Depth Reclamation (FDR).

The CIR construction requires milling the existing pavement section and simultaneously combining asphalt emulsion to bind the mixture together, and then replacing the mixture back into the roadway to be finish graded and compacted to form a new base course for the pavement section.

Prior to the beginning of construction activities, a mix design must be confirmed to determine the application rate for the asphalt emulsion. The equipment is typically linked together to form a “train”, which makes this process less ideal for highly developed areas and areas with sharp turns. Due to the relatively short time between mixing the millings and emulsion to their placement time, only light traffic should be allowed on the roadway for at least one week to let the mixture cure. Once the new base course has been given sufficient time to cure, a new binder and wearing course are installed per the design specifications. The CIR method is limited in that the underlying soil subgrade must be suitable.

Figure 8: Full Depth Reclamation Construction

Source: https://journal.kai.re.kr/articles/xml/eqxO/

The FDR process is similar to that of the CIR except that it not only recycles the pavement

millings, but it also recycles the subbase material and, if suitable, the subgrade material as well. FDR construction involves milling the material to be recycled and mixing it with an additive. The additive used will be specific to the condition and the mix designed will be determined prior to construction. The PennDOT approved additives include asphalt, cement, magnesium chloride, and calcium chloride. Select PennDOT aggregate mixtures may be used as an additive for roadways with lower traffic volumes.

Both CIR and FDR methods will increase the height of the roadways, which will require subgrade material to be removed and properly disposed of where the increases in height are undesirable, such as along curb lines, adjoining roadways, or roadways with manholes, storm sewer grates, or any other surface utilities.

Table 5 outlines the cost per mile of each reconstruction option.

Table 5: Pavement Reconstruction Costs[1]

Reconstruction	Cost Per Mile[2]
Removal & Replacement[3,4]	$568,000
Cold-in-Place Recycling[3]	$318,000
Full Depth Reclamation[3,5]	$270,000

[1]Pricing should be considered a basic average which can be higher or lower depending on the actual roadway conditions and the preferred application thicknesses, and may also vary with market/economic conditions and contractor availability
[2]Assumes 24-foot-wide roadway, Cost assumes 2023 averages
[3]Replaced pavement section assumes 1.5" of 9.5mm Wearing Course and 3" of 19mm Binder Course
[4]Includes subbase replacement
[5]Cement additive used for cost analysis

9.0 ROADWAY RECOMMENDATIONS

The rating conditions for each road were determined by the physical conditions observed during the field assessment and our professional judgement based on research and past experience. Roadway conditions within the same rating value may vary; therefore, we recommend evaluating each road individually when determining a specific roadway repair strategy. Based on the results of our assessment, G&A offers the Township the following recommendations in an effort to aid the roadway repair process.

9.1 Failed Roadways (Score of 4 or less)

The five roads that received a score of 4 or less– Fifteenth Street (south of Reed Street), Longview Drive, Louanna Avenue, North Humpton Road, and Ridge View Drive – are considered to be at their failure point. We recommend these roadways be repaired as soon as possible to avoid further deterioration and to improve the use of the roadways by Township residents. These roads will require pavement reconstruction and therefore will be the most expensive to repair. North Humpton Road is in the worst condition with multiple severe potholes.

Based on the cost to obtain materials, schedule the work, mobilize the equipment and other construction costs, the Township may wish to consider performing the repairs to all five roads concurrently. The lengths of the five roads are relatively short (0.02, 0.51, 0.26, 0.11, and 0.25 miles, respectively); therefore, it may be feasible to perform the work under a single contract.

9.2 Poor to Fair Roadways (Scores of 5 & 6)

Roads receiving a score of 5 are in poor condition. The severity and spans of the distresses vary. Deer Drive is near failure as detrimental cracking was observed through the majority of the roadway span. Other roads, such as Dogwood Lane, showed localized severe distresses while other areas of the roadway were in good condition.

We recommend the Township evaluate roads with a rating of 5 individually to determine which roads should receive a full pavement reconstruction or a pavement fabric overlay/mill and overlay. To make this determination, field studies such as pavement cores may be necessary. In some instances, the Township may elect to perform mill and overlays on sections of roadways. Careful consideration should be made as these roadways are near failure and delaying repair work could be the difference between a pavement overlay repair versus full pavement reconstruction.

Roads receiving a rating of 6 are considered to be in fair condition and generally immediate repairs are not required to prevent roadway failure. To prevent further degradation of the fair rated road locations, the Township may want consider placing surface treatment in the next maintenance cycle. For localized distress areas, placement of cold patch, crack sealant, and sectional patching may also be viable options to prevent localized distresses from growing into larger repair efforts. We recommend that roadways with higher traffic volumes and longer extents, such as Barley Sheaf Road and Fisherville Road, be prioritized for surface treatment.

The Township may wish to consider full depth repairs on roads with 5 and 6 scores if they are located adjacent to failed roads. Full depth repairs may be economically favorable if the work can be performed concurrently with the repairs made to nearby failed roads.

9.3 Good to Near Perfect Roadways (Scores of 7-10)

Although roads receiving a rating of 7 or 8 could benefit from surface treatments, funding limitations typically result in significant maintenance be deferred to a later time for roads that are still in good condition. This is an acceptable practice, provided that roads do ultimately receive necessary maintenance before they deteriorate to a condition that would require even more costly repairs. To extend the life of the roadway, the Township may consider cold patching, crack sealing, or sectional patching any localized distresses. It is important that the Township continue to monitor the condition of the roads receiving a score of 7 or greater. Up-keep by repairing localized distresses as they arise will extend the roadway life span. Highly traveled roads that extend greater distances, such as G.O. Carlson Boulevard (8 & 9 scores) and Municipal Drive (9 score), may be considered for surface treatment as a preventative measure.

9.4 Additional Considerations

During our field assessment, G&A observed many roads with unsupported edges. Although not considered a distress, in many cases the unsupported edges can lead to shoulder drop-off distresses. Shoulder drop-off distresses are commonly found in areas where the top of pavement grade is a few inches higher than the abutting subgrade, at corners of intersections where drivers make the turns short, in areas that have space for vehicles to pull off the roadway, and areas in neighborhoods where vehicles park off the side of the road. We recommend that – in conjunction with each road restoration project – shoulder drop-off areas be filled and compacted up to grade to prevent potential or minimize vehicle and roadway damage. The Township can prevent future shoulder drop-offs from occurring by installing guardrails, curbs, and or placing large boulders or rocks in these areas to make them undrivable.

10.0 LIMITATIONS

The conclusions and recommendations contained in this report are based upon the visual field observations, the information collected, and the information received from the Client, as stated in this report and provided as of the time of issue of this report. The conclusions and recommendations presented in this report are unique to the specific roadways at the times of the field assessment. This assessment was limited to visual observations of the roadway surfaces and no additional evaluations including physical testing, core sampling, or subgrade evaluations were performed.

We appreciate the opportunity to be of service to you. If you have any questions, or if we can be of further assistance, please contact us at 215-345-4330.

Respectfully submitted,

Anthony J. Carta, P.E.
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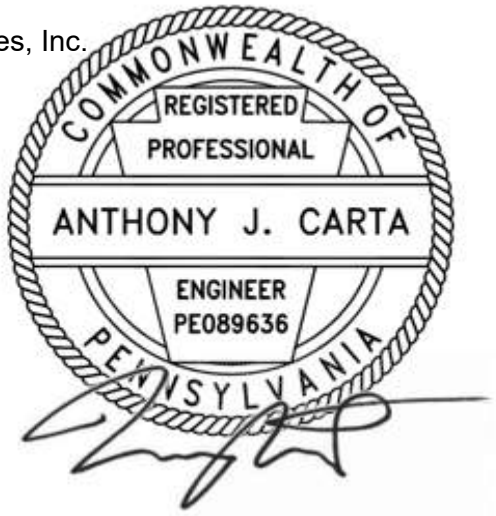
AJC/TGW/sl



Legend

Roadway Condition Rating

- 9-10
- 7-8
- 6
- 5
- 1-4
- Exclude (Private/Under Construction, Etc.)
- Exclude (State)

ROAD PROGRAM UPDATE MAP

CALN TOWNSHIP, CHESTER COUNTY, PA

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JOB NO: 23-07086 | DATE: DECEMBER 2023 | 0 450 900 1,800 Ft

CALN TOWNSHIP - ROADWAY CONDITION SUMMARY

Road Name	Road Length (miles)	Condition Rating	Distress #1	Distress #2	Distress #3	Distress #4	Comments
Acorn St.	0.07	9					Edge cracking; unsupported edge; slight weathering
Adams St.	0.22	9	L&T Cracking				Minor cracking observed
Albermarle Ct.	0.05	9					Slight weathering
Allison Dr.	0.05	8	L&T Cracking				<5% of the road contains patches
Alydar Rd.	0.51	9	L&T Cracking				<5% of the road contains patches; weathering; depressions
Ambrose Ave.	0.05	10					Recently re-paved, unsupported edge
Andrew Rd.	0.08	6	L&T Cracking	Alligator Cracking			<5% of the road contains patches; depressions; weathering
Atkins Ave.	0.27	10					Unsupported edges
Avebury Stone Cir.	0.16	9					<5% of the road contains patches; weathering
Ayerwood Dr.	0.25	9					<1% of the road contains patches
Baker Ln.	0.19	7	L&T Cracking				<5% of the road contains patches
Balmoral Rd.	0.22	9					Slight weathering
Barclay St.	0.13	9	L&T Cracking				Minor cracking observed
Barley Sheaf Rd.	1.38	6	L&T Cracking	Shoulder Drop-Off	Alligator Cracking	Block Cracking	Roadway also suffers from edge cracking and has unsupported edges
Beaver Run Rd. (North)	0.22	7	L&T Cracking	Alligator Cracking			<5% of the road contains patches
Beaver Run Rd. (South)	0.30	5	L&T Cracking	Alligator Cracking	Rutting		Depressions and weathering observed; patching observed throughout road
Beufort Ct.	0.04	9					Minor weathering; recently paved
Broad St.	0.05	9					Minor weathering; recently paved
Bungalow Glade	0.16	6	L&T Cracking	Block Cracking			Observed edge cracking; unsupported edges; <5% of the road contains patches
Caln Meetinghouse Rd.	0.75	9					Recently re-paved
Caranel Cir.	0.08	6	L&T Cracking			`	<5% of the road contains patches; weathering
Carlson Wy.	0.21	5	L&T Cracking	Alligator Cracking			Road suffers from weathering and depressions; patches observed throughout road; road was re-paved 10-15 years ago and was built in 1982
Clothier St.	0.17	9	L&T Cracking				
Corey Ln.	0.05	7	L&T Cracking				<5% of the road contains patches
Country Edge Cir.	0.06	8	L&T Cracking				Depressions, patches, and minor weathering observed
Courtney Ln.	0.11	9	L&T Cracking				Minor weathering observed
Crest Dr.	0.27	7	L&T Cracking				<5% of the road contains patches; edge cracking; weathering
Dana Dr.	0.09	7	L&T Cracking	Block Cracking			Roadway sufferes from weathering
Deer Dr.	0.21	5	L&T Cracking	Alligator Cracking	Block Cracking		
Deerfield Dr.	0.12	9	L&T Cracking				Minor depressions observed
Devonshire Rd.	0.14	9					Minor weathering; recently paved
Dogwood Ln.	0.4	5	L&T Cracking	Alligator Cracking			<5% of the road contains patches; edge cracking; unsupported edge on north side of Scott Drive
Doral Ct	0.07	9	L&T Cracking				<5% of the road contains patches
Dupont St.	0.13	9	L&T Cracking				
East Summit Ave.	0.17	6	L&T Cracking	Potholes	Alligator Cracking		Edge cracking
Edge Ln.	0.35	9	L&T Cracking				<5% of the road contains patches
Edgemont Ave.	0.15	6	L&T Cracking				Edge cracking and depressions observed
Ehlen Ave.	0.70	7	Block Cracking				The road has unsupported edges; the intersection with Parkside Avenue shows alligator cracking and a pothole on the inside curve
Eighteenth Ave	0.07	7	Block Cracking	L&T Cracking			Road suffers from weathering
Eliot Rd.	0.12	6	L&T Cracking	Alligator Cracking			<5% of the road contains patching; weathering
Elizabeth Ct.	0.07	5	L&T Cracking	Alligator Cracking			
Elmwood Ln.	0.14	8	L&T Cracking				Edge cracking; depressions
Essex St.	0.21	9	L&T Cracking				
FD 38 Access Rd.	0.08	6	L&T Cracking	Alligator Cracking			

Condition Rating Descriptions			
10	Roadway is in near perfect condition; recently re-paved	6	Roadway is in fair condition
9	Roadway is in very good condition	5	Roadway is in poor condition
7-8	Roadway is in good condition	1-4	Roadway has failed

CALN TOWNSHIP - ROADWAY CONDITION SUMMARY

Road Name	Road Length (miles)	Condition Rating	Distress #1	Distress #2	Distress #3	Distress #4	Comments
Fifteenth Ave. (North)	0.25	10					Recently re-paved, unsupported edge
Fifteenth Ave. (South of Reed St.)	0.02	4	Alligator Cracking	L&T Cracking	Ravelling		Weathering
First Ave.	0.04	10					Unsupported edges
Fisherville Rd. (Rt. 30 to King's Grant Blvd.)	0.54	7	L&T Cracking	Raveling			<5% of the road contains patches; depressions; edge cracking; unsupported edges
Fisherville Rd. (East of King's Grant Blvd.)	1.37	6	L&T Cracking	Raveling	Shoving		Most of the roadway is in good condition; unsupported edges; select areas distresses, depressions, edge cracking, were observed
Fitzwilliam Ct.	0.06	9					Slight Weathering
Fourteenth Ave.	0.27	9	L&T Cracking				Edge cracking; unsupported edge
Fox Ave.	0.15	7	L&T Cracking				Edge cracking, depressions
Fox Farm Ln	0.24	9					Recently re-paved
Fulton Ave.	0.08	7	L&T Cracking				<5% of the road contains patches
Fynamore Ln.	0.2	9	L&T Cracking				
G.O. Carlson Blvd. (East)	0.80	9					Minor depression observed
G.O. Carlson Blvd. (West)	1.47	8	L&T Cracking	Rutting			<5% of the road contains patches
Gallagherville Rd.	0.28	9					Recently re-paved
Garden View Dr.	0.53	7	L&T Cracking				Edge cracking and depressions observed; <5% of the road contains patches
GL Eggleston Blvd.	0.31	9					<5% of the road contains patches
Glen Ridge Dr.	0.36	7	L&T Cracking	Block Cracking	Alligator Cracking		Transverse cracking is starting to become alligator cracks; patches have been made in some areas
Glen View Ln.	0.10	6	L&T Cracking	Block Cracking	Alligator Cracking		Cracking was observed through the entire road span; approximately 15% of the road contains patches
Grandview Rd.	0.12	7	L&T Cracking	Block Cracking			Weathering; edge cracking; unsupported edges
Granger Ln.	0.12	9					Weathering
Greenleaf Ct.	0.10	8	L&T Cracking				Patching and weathering observed throughout the road
Greenwood Cr.	0.29	7	L&T Cracking	Block Cracking	Potholes		<5% of the road contains patches; edge cracking; pothole around manhole
Hartley Ave.	0.28	10					Unsupported edges
Harvest Dr.	0.10	9	L&T Cracking				
Hazelwood Ave.	0.52	8	L&T Cracking				Edge cracking; unsupported edges
Heather Ct.	0.07	9	L&T Cracking				Minor cracking and some patching
Hidden Creek Dr.	0.68	7	L&T Cracking				Alligator cracking observed at intersection of Willow Glen Circle; roadway contains patches
Hillcrest Dr.	0.33	6	Block cracking	L&T Cracking	Alligator Cracking		Cracking is moderately severe and some cracks had recently been patched
Homestead Ln.	0.12	7	L&T Cracking				<5% of the road contains patches; patches in need of repair
Honeymead Rd.	0.55	9	L&T Cracking				Weathering
Horseshoe Drive	0.08	8	L&T Cracking				Minor depressions observed
Humpton Rd.	0.82	5	L&T Cracking	Potholes			Unsupported edge
Hurley Rd.	0.04	7	L&T Cracking				Edge cracking; unsupported edge
Ingleside Dr.	0.36	9	L&T Cracking	Raveling			<5% of the road contains patches
James Buchanan Dr.	0.17	9					<5% of the road contains patches
Jason Ln.	0.12	9	L&T Cracking				
Jennifer Dr.	0.27	7	L&T Cracking				<5% of the road contains patches; depressions; weathering
Jewell Ave.	0.18	7	Rutting	Shoulder Drop-Off	L&T Cracking		<5% of the road contains patches; edge cracking; weather; unsupported edge; most of the roadway is in good condition with the exception of the south end
Johnson Ave	0.16	7	L&T Cracking				Edge cracking
Jonathan Dr.	0.31	7	Potholes	L&T Cracking			Edge cracking; weathering; depressions
Joseph Ct.	0.19	7	L&T Cracking				<5% of the road contains patches; edges of roadways are cracking; depressions observed around inlets
Katherine Ln.	0.21	6	L&T Cracking				<5% of the road contains patches; depressions; weathering

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CALN TOWNSHIP - ROADWAY CONDITION SUMMARY

Road Name	Road Length (miles)	Condition Rating	Distress #1	Distress #2	Distress #3	Distress #4	Comments
King's Grant Blvd.	0.03	9					Weathering
Kingsway Dr.	0.40	9					Recently re-paved
Kingswood Ln.	0.17	8	L&T Cracking				<5% of the road contains patches
Larson Dr.	0.20	5	L&T Cracking	Alligator Cracking			Depressions, patching, and weathering observed throughout the entire road
Links Way	0.02	8	L&T Cracking				<5% of the road contains patches
Lisa Dr.	0.08	9	L&T Cracking				
Lloyd Av.	0.71	7	L&T Cracking				Patches and depressions observed; unsupported edges; cracking along edges
Longview Dr.	0.51	4	L&T Cracking	Shoulder Drop-Off	Alligator Cracking	Raveling	Roadway suffers from weathering; unsupported edges
Loomis Ave.	0.27	10					Unsupported edges
Louanna Ave.	0.26	4	Alligator Cracking				<5% of the road contains patches; observed depressions, edge cracking, and unsupported edge
Lynn Blvd.	0.22	9					<5% of the road contains patches
Magnolia Ct.	0.13	5	L&T Cracking	Alligator Cracking	Block Cracking		Patching and depressions observed throughout the roadway
Maple Ave.	0.09	6	L&T Cracking	Alligator Cracking	Rutting		Roadway suffers from weathering; unsupported edges
Marion Dr.	0.07	9	L&T Cracking				<5% of the road contains patches
Marshall Cir.	0.38	9	L&T Cracking				
Marshall Dr.	0.10	8	L&T Cracking				<5% of the road contains patches
Meadow Dr.	0.27	8	L&T Cracking				<5% of the road contains patches, slight weathering
Melissa Dr.	0.03	6	L&T Cracking				<5% of the road contains patches; weathering
Miller Ave.	0.33	9					<5% of the road contains patches
Millwood Lane	0.31	7	L&T Cracking	Alligator Cracking			<5% of the road contains patches; edge cracking
Moore Rd.	0.60	8					<5% of the road contains patches; edge cracking; unsupported edges
Morgan Dr.	0.42	5	L&T Cracking	Alligator Cracking	Potholes		Road suffers from weathering; depressions; <5% of the road contains patches
Municipal Dr.	0.76	9	L&T Cracking				Minor depressions observed; unsupported edge; <5% of the road contains patches
Norma Dr.	0.43	9	L&T Cracking				<5% of the road contains patches
North Bailey Rd. (North)	0.48	6	Potholes	Raveling			Unsupported edges; edge cracking, depressions
North Bailey Rd. (South)	0.64	7	L&T Cracking	Shoving			Unsupported edge; depressions observed throughout road; <5% of the road contains patches
North Barley Sheaf Rd.	0.59	6	L&T Cracking	Alligator Cracking			Minor depressions observed; <5% of the road contains patches
North Humpton Rd.	0.11	4	L&T Cracking	Alligator Cracking	Potholes		Severe cracking; patching observed throughout roadway; unsupported edge; this road is the worst in the Township
North Longview Drive	0.08	7	L&T Cracking				Roadway suffers from weathering
Northumberland Rd.	0.23	9					Minor weathering; recently paved
Norton Ave.	0.27	10					Unsupported edges
Norwood Ave.	0.38	6	Block Cracking	L&T Cracking			Observed depressions, edge cracking, and unsupoorted edges
Oak Ln.	0.10	5	Alligator Cracking	L&T Cracking			Edge cracking and unsupported edge
Oak St.	0.41	9					Recently re-paved west of 14th Street; unsupported edge
Oakmont Dr.	0.13	9	L&T Cracking				Minor depressions observed and <5% of the road contains patches
Old Horseshoe Pike	0.07	7	L&T Cracking				Segment of roadway is unpaved with only gravel
Olive St.	0.20	9					Recently re-paved with the exception of a small portion on the east end; unsupported edge
Osborne Rd.	0.27	7	L&T Cracking				<5% of the road contains patches
Park Dr.	0.34	8	L&T Cracking				Section from Meadow Drive to G.O. Carlson shows signs of alligator cracking and L&T cracking
Parkside Ave.	0.09	6	L&T Cracking	Alligator Cracking			
Parkside Dr.	0.21	6	L&T Cracking	Rutting			Edges are unsupported
Paul Nelms Dr.	0.37	10					Appears to have been recently re-paved
Pierce Ln.	0.09	9					Minor weathering, recently re-paved

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Road Name	Road Length (miles)	Condition Rating	Distress #1	Distress #2	Distress #3	Distress #4	Comments
Pippen Ln.	0.22	9					<5% of the roads contain patches; weathering
Quarry St.	0.15	7	L&T Cracking				Edge cracking
Raye Rd.	0.19	9	L&T Cracking				<5% of the road contains patches
Ridge View Dr.	0.25	4	L&T Cracking	Raveling	Alligator Cracking	Potholes	Unsupported edge; edge cracking; depressions; weathering
Schoolhouse Ln.	0.13	7	L&T Cracking	Alligator Cracking			
Scott Dr.	0.26	5	L&T Cracking	Block Cracking			<5% of the road contains patches; edge cracking; unsupported edge; weathering
Second Ave.	0.10	9					<5% of the road contains patches
Seltzer Ave.	0.27	10					Unsupported edges
Seventeenth Ave.	0.29	10					Recently re-paved, unsupported edge
Shelburne Rd.	0.35	9	L&T Cracking				Weathering
Sherry Ln	0.07	6	L&T Cracking	Block Cracking			<5% of the road contains patches; depressions; weathering
Silbury Hill	0.64	8					<5% of the road contains patches; weathering
Sixteenth Ave.	0.21	9					Recently re-paved; unsupported edge; joint crack observed down the centerline; patched area at intersection of Oak Street
Skyline Dr.	0.04	5	Potholes	L&T Cracking	Alligator Cracking		<5% of the road contains patches; weathering
South Bailey Rd.	0.46	6	L&T Cracking				Edge cracking; unsupported edges; weathering
South Caln Rd.	0.45	7	L&T Cracking	Alligator Cracking			<5% of the road contains patches; edge cracking; unsupported edge
South Llyod Ave.	0.40	7	L&T Cracking				<5% of the road contains patches; water main replacement on-going during survey
Stirling St.	0.29	8	L&T Cracking				<5% of the road contains patches
Stockley Ln.	0.14	9	L&T Cracking				Weathering
Stonebridge Ln	0.44	8	L&T Cracking				<1% of the road contains patches; minor depressions around inlets
Stouffs Rd.	0.07	7	L&T Cracking				Edge cracking; unsupported edges
Suzanne Dr.	0.03	6	L&T Cracking	Alligator Cracking	Ravelling		Road suffers from weathering
Sylvan Dr.	0.40	9	L&T Cracking				
Third Ave.	0.10	9					Unsupported edges
Thornridge Dr.	0.59	8	L&T Cracking				Patches have depressions
Toth Ave.	0.28	7	L&T Cracking	Potholes			<5% of the road contains patches
Township Dr.	0.04	7	L&T Cracking	Alligator Cracking			Slightly weathered; one small area with bad alligator cracking
Turnberry Dr.	0.27	7	L&T Cracking				Depressions observed throughout the roadway
Tyning Ln.	0.17	9	L&T Cracking				Weathering; depressions
Walnut St.	0.41	9					<5% of the road contains patches
Warren Ave.	0.17	9					Recently re-paved
Watson Ave.	0.15	10					Recently re-paved
Wayne Ave.	0.21	9					Recently re-paved
Wedgewood Road	0.56	6	L&T Cracking	Alligator Cracking			
West Bondsville Rd.	0.14	10					Recently re-paved; unsupported edge
West Embreeville Rd.	0.23	5	L&T Cracking	Potholes			Edge cracking; unsupported edges; depressions
West Summit Ave.	0.21	6	L&T Cracking	Potholes	Alligator Cracking		Edge cracking
Westerham Rd.	0.44	9	L&T Cracking				<5% of the road contains patches; weathering
Whissell Dr.	0.18	9	L&T Cracking				<5% of the road contains patches
Williams Way	0.29	9	L&T Cracking				<5% of the road contains patches
Willow Glen Cir.	0.10	9	L&T Cracking				Minor weathering observed
Windsor Ln.	0.36	9	L&T Cracking				<5% of the road contains patches
Woodruff Rd.	0.27	9	L&T Cracking				Slight weathering
Woodview Dr.	0.08	7	L&T Cracking	Alligator Cracking	Raveling		Weathering; edge cracking
Zinn Rd.	0.18	7	L&T Cracking	Alligator Cracking			Depressions observed

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REPRESENTATIVE
PHOTO INDEX

Acorn Street – Slight Weathering, 9 Score

Balmoral Road – Slight Weathering, 9 Score

Bungalow Glade – Block Cracking, 6 Score

Dogwood Lane – Alligator Cracking, 5 Score

Fisherville Road – Transverse Crack, 6 Score

Fitzwilliam Court – Slight Weathering, 9 Score

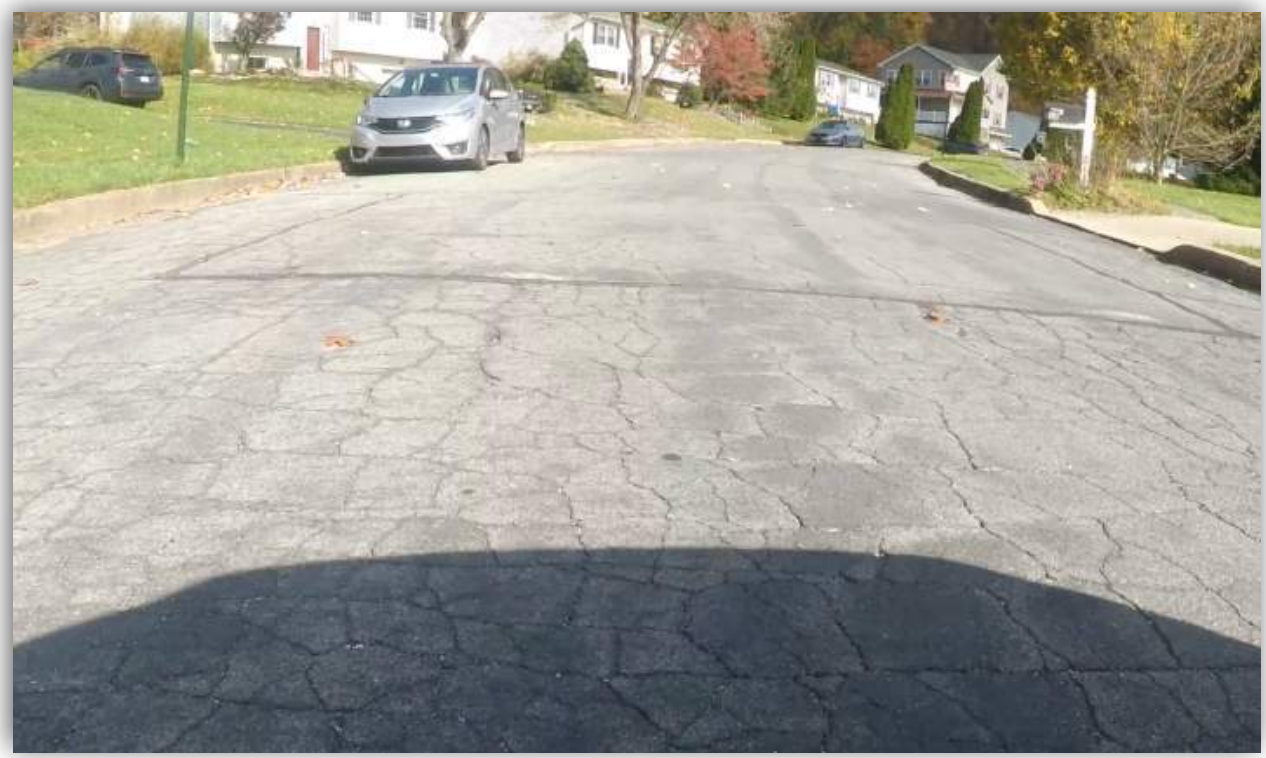
Fox Avenue – Depression around Inlet, 7 Score

Glen Ridge Drive – L&T Cracking, 7 Score

Grandview Road – Edge Cracking, 7 Score

Greenwood Circle – Pothole around Manhole, 7 Score

Heather Court – Slight Weathering, 9 Score



Hillcrest Drive – Block Cracking, 6 Score

Jennifer Drive – Transverse Cracking, 7 Score

Jewell Avenue – Rutting and Cracking at South End, 7 Score

Kingswood Lane – Longitudinal Cracking, 8 Score

Maple Avenue – Depression & Raveling, 6 Score

Meadow Drive – Slight Weathering, 8 Score

North Bailey Road (North) – Potholes & Raveling, 6 Score

Norwood Avenue – Cracking, 6 Score

Oak Street – 9 Score

Park Drive – 8 Score

Seventeenth Street – 10 Score

Sixteenth Street – Crack down the Centerline, 9 Score

South Caln Road – Longitudinal Cracking along Centerline, 7 Score

Schoolhouse Lane – Alligator Cracking in Small Area, 7 Score

Woodview Drive – Alligator Cracking & Raveling, 7 Score