City of Ann Arbor
2023 Transportation
Asset Management Plan

A plan describing the City of Ann Arbor's transportation assets and conditions

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EXECUTIVE SUMMARY

As conduits for commerce and connections to vital services, roads and bridges are some of the most important assets in any community, and other assets like culverts, traffic signs, traffic signals, and utilities support and affect roads and bridges. The City of Ann Arbor's (Ann Arbor) roads, bridges, and support systems are also some of the most valuable and extensive public assets, all of which are paid for with taxes collected from citizens and businesses. The cost of building and maintaining these assets, their importance to society, and the investment made by taxpayers all place a high level of responsibility on local agencies to plan, build, and maintain roads, bridges, and support assets in an efficient and effective manner. This asset management plan is intended to report how Ann Arbor is meeting its obligations to maintain the public assets for which it is responsible.

This plan identifies Ann Arbor's assets and condition and how Ann Arbor maintains and plans to improve the overall condition of those assets. An asset management plan is required by Michigan Public Act 325 of 2018, and this document represents fulfillment of some of Ann Arbor's obligations towards meeting these requirements. However, this plan and its supporting documents are intended to be much more than a fulfillment of required reporting. This asset management plan helps to demonstrate Ann Arbor's responsible use of public funds by providing elected and appointed officials as well as the general public with the inventory and condition information of Ann Arbor's assets, and it gives taxpayers the information they need to make informed decisions about investing in Ann Arbor's essential transportation infrastructure.

INTRODUCTION

Asset management is defined by Public Act 325 of 2018 as “an ongoing process of maintaining, preserving, upgrading, and operating physical assets cost effectively, based on a continuous physical inventory and condition assessment and investment to achieve established performance goals”. In other words, asset management is a process that uses data to manage and track assets, like roads and bridges, in a cost-effective manner using a combination of engineering and business principles. This process is endorsed by leaders in municipal planning and transportation infrastructure, including the Michigan Municipal League, County Road Association of Michigan, the Michigan Department of Transportation (MDOT), and the Federal Highway Administration (FHWA). The City of Ann Arbor is supported in its use of asset management principles and processes by the Michigan Transportation Asset Management Council (TAMC), formed by the State of Michigan.

Asset management, in the context of this plan, ensures that public funds are spent as effectively as possible to maximize the condition of the road and bridge network. Asset management also provides a transparent decision-making process that allows the public to understand the technical and financial challenges of managing transportation infrastructure with a limited budget.

The City of Ann Arbor (Ann Arbor) has adopted an “asset management” business process to overcome the challenges presented by having limited financial, staffing, and other resources while needing to meet road users’ expectations. Ann Arbor is responsible for maintaining and operating over 312 centerline miles of roads and 16 bridge structures. It is also responsible for 151 culverts and 126 signals.

This 2023 plan identifies Ann Arbor’s transportation assets and their condition as well as the strategy that Ann Arbor uses to maintain and upgrade particular assets given Ann Arbor’s condition goals, priorities of network’s road users, and resources. An updated plan is to be released approximately every three years both to comply with Public Act 325 and to reflect changes in road conditions, finances, and priorities.

Questions regarding the use or content of this plan should be directed to Nicholas Hutchinson at 301 E. Huron Street, Ann Arbor, MI 48104 or at nhutchinson@a2gov.org. A copy of this plan can be accessed on our website at a2gov.org.

1. PAVEMENT ASSETS

Ann Arbor is responsible for 312 centerline miles of public roads. An inventory of these miles divides them into different network classes based on road purpose/use and funding priorities as identified at the state level: city major road network, which is prioritized for state-level funding, and city local road network.

Inventory of Assets

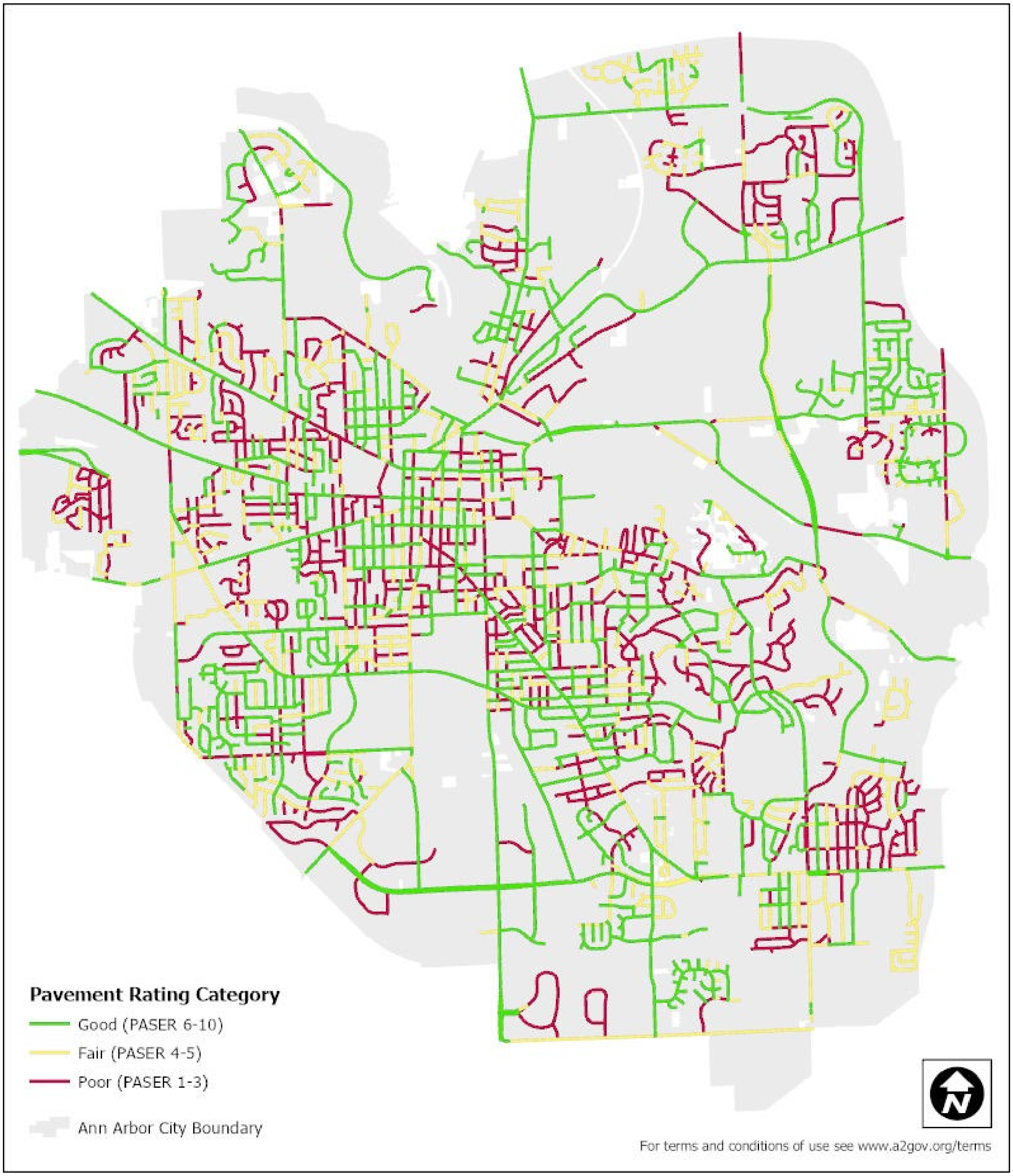

Figure 1: Map showing location or roads managed by Ann Arbor and the current condition for paved roads using Ann Arbor's definitions of Good, Fair and Poor; green for good (PASER 6-10), yellow for fair (PASER 4-5), and red for poor (PASER 1-3)

Of Ann Arbor's 312 miles of road, 110 miles are classified as city major and 202 miles are classified as city local. Ann Arbor also manages 27 miles that are classified as part of the National Highway System (NHS); the NHS is subject to special rules and regulations and has its own performance metrics dictated by the FHWA. In addition, Ann Arbor has 13 miles of unpaved roads.

More detail about these road assets can be found in Ann Arbor's Roadsoft database or by contacting the City of Ann Arbor.

Types

Ann Arbor has multiple types of pavements in its jurisdiction, including asphalt, concrete, composite, and brick; it also has unpaved roads (i.e., gravel and/or earth). Figure 2 shows a breakdown of these pavement types for all of Ann Arbor's road assets.

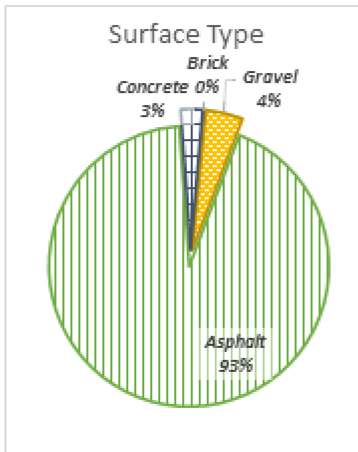

Figure 2: Pavement type by percentage maintained by Ann Arbor. Brick surfaces make up a small fraction of a percentage of Ann Arbor's total road system (<0.5%), and therefore are rounded to zero on the graph.

Condition and Goals

Paved Roads

Paved roads in Michigan are rated using the Pavement Surface Evaluation and Rating (PASER) system, which is a 1 to 10 scale with 10 being a newly constructed surface and 1 being a completely failed surface. PASER scores are grouped into TAMC definition categories of good (8-10), fair (5-7), and poor (1-4) categories. Ann Arbor collects PASER data every two years on 100 percent of its entire paved road network.

Currently, the city major network has 23% of its roads in good condition, 47% in fair condition, and 30% in poor condition, and the city local network has 20% of its roads in good condition, 31% in fair condition, and 50% in poor condition according to the TAMC definition categories (Figure 3).

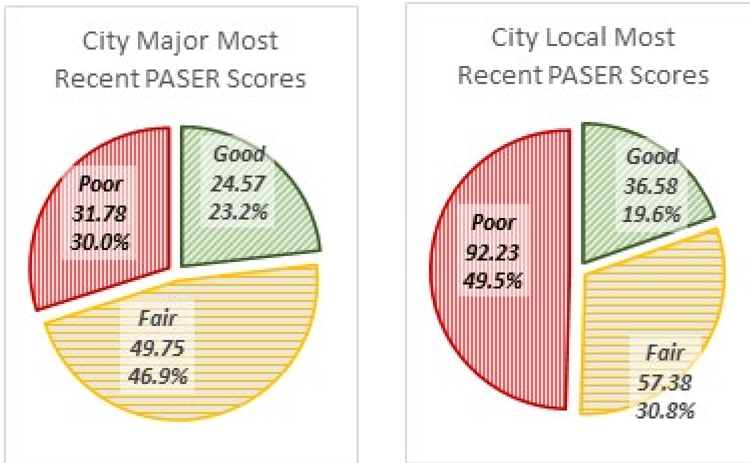

Figure 3: *Left*: Ann Arbor paved city major road network conditions by miles and percentage of good, fair, or poor, and *Right*: paved city local road network conditions by miles and percentage of good, fair, or poor. These graphs use the TAMC definitions of good/fair/poor.

Ann Arbor uses modified definitions of "good", "fair", and "poor" in the PASER system, as identified in Table 1. At the time Ann Arbor adopted the PASER system staff did not find an industry standard for PASER rating definitions of the good, fair, and poor categories. Different sources reported different definitions. Ann Arbor chose to use definitions that align pavement condition (i.e., PASER score) with the treatment types that are typically used in our community. The goals discussed for Ann Arbor in this section are based on the City of Ann Arbor definitions for "good", "fair", and "poor" pavement condition.

	TAMC Statewide Definition	**City of Ann Arbor Definition**	**Treatment Type**
Good	PASER 8-10	PASER 6-10	Crack Sealing/other minor maintenance
Fair	PASER 5-7	PASER 4-5	Capital Preventative Maintenance and/or Partial-Depth Resurfacing
Poor	PASER 1-4	PASER 1-3	Full-Depth Rehabilitation or Reconstruction

Table 1: Ann Arbor Definitions of Good, Fair, Poor PASER Ratings

Ann Arbor's network-level pavement condition strategy for paved city major roads includes the following intermediate goals to be achieved by 2026:

1. Minimum 60% of roads in good condition (PASER 6-10) by 2026
2. Maximum 20% of roads in poor condition (PASER 1-3) by 2026
3. Average PASER score of 5.80 or greater

Ann Arbor's network-level pavement condition strategy for paved city local roads includes the following intermediate goals to be achieved by 2026:

1. Minimum 45% of roads in good condition (PASER 6-10)
2. Maximum 39% of roads in poor condition (PASER 1-3)
3. Average PASER score of 5.24 or greater

Interim goals for City Local and City Major roads are identified for 2026 based on what is achievable with current financial resources, however these goals do not represent satisfactory long-term conditions for the users of the system. Following the next round of PASER data collection (Fall of 2023), additional long-term goals will be established, with the intent of continuing to improve pavement conditions into the future.

Unpaved Roads

Unpaved roads rated with the Inventory-based Rating System™ receive an IBR number ranging from 1 to 10, with a 9 or 10 (less than one year old) having good surface width, good or fair drainage, and good structural adequacy and a 1 having poor surface width, poor drainage, and poor structural adequacy. IBR numbers can be grouped in a similar fashion as the TAMC definitions into good (8-10), fair (5-7), and poor (1-4) categories. Historically the City of Ann Arbor has not collected ratings for gravel roads. Gravel roads will be rated using the IBR system during the summer or fall of 2023 and will be incorporated into future Pavement Asset Management Plans.

Modelled Trends, Gap Analysis, and Planned Projects

Modelled Trends & Gap Analysis

Ann Arbor hired OHM Advisors to model the City's road network, forecast using Roadsoft, and assist in establishing realistic goals. Ann Arbor has set goals based on what can be realistically achieved with the resources available, although the current intermediate goals do not reflect the pavement condition desired by the community. Ann Arbor will collect updated PASER ratings in 2023 and will reevaluate goals at that time. This will result in setting longer term goals to address what is needed to reach the pavement condition desire by the community.

The results of the modeled forecast are shown in figures 4 and 5 and takes into account the City's decision to issue a bond in 2022 for road improvements. The decision to issue a road bond is intended to front load investment, therefore having a more significant impact on pavement condition in the near term. Accelerating road construction in the near term will provide a small benefit to the overall improvement of the network condition in the immediate and long term.

Per the OHM report (see Appendix D of the Pavement Asset Management Plan) “The advantage to front loading the program with a bond sale is due to two primary factors. First, making a more significant investment in early years allows the City to prevent more roads from falling into the poor category which requires the more expensive major rehabilitation and/or reconstruction maintenance activities. Second, inflation and rising construction costs largely offset the debt cost over the ten years.”

Local Road Network

Paser Rating	2021/2022		Forecasted Model in 2026
6-10	36%		49%
4-5	25%		19%
1-3	39%		32%
	100%		100%
Average PASER	4.74		5.38

Major Road Network

Paser Rating	2021/2022		Forecasted Model in 2026
6-10	58%		65%
4-5	20%		17%
1-3	22%		18%
	100%		100%
Average PASER	5.67		6.07

Figure 4: Forecast good (PASER 6-10)/fair (PASER 4-5)/poor (PASER 1-3) using Ann Arbor’s definitions of good-fair-poor PASER ratings. Changes to Ann Arbor Network Condition from 2021/2022 to 2026 for the city major and local paved road networks

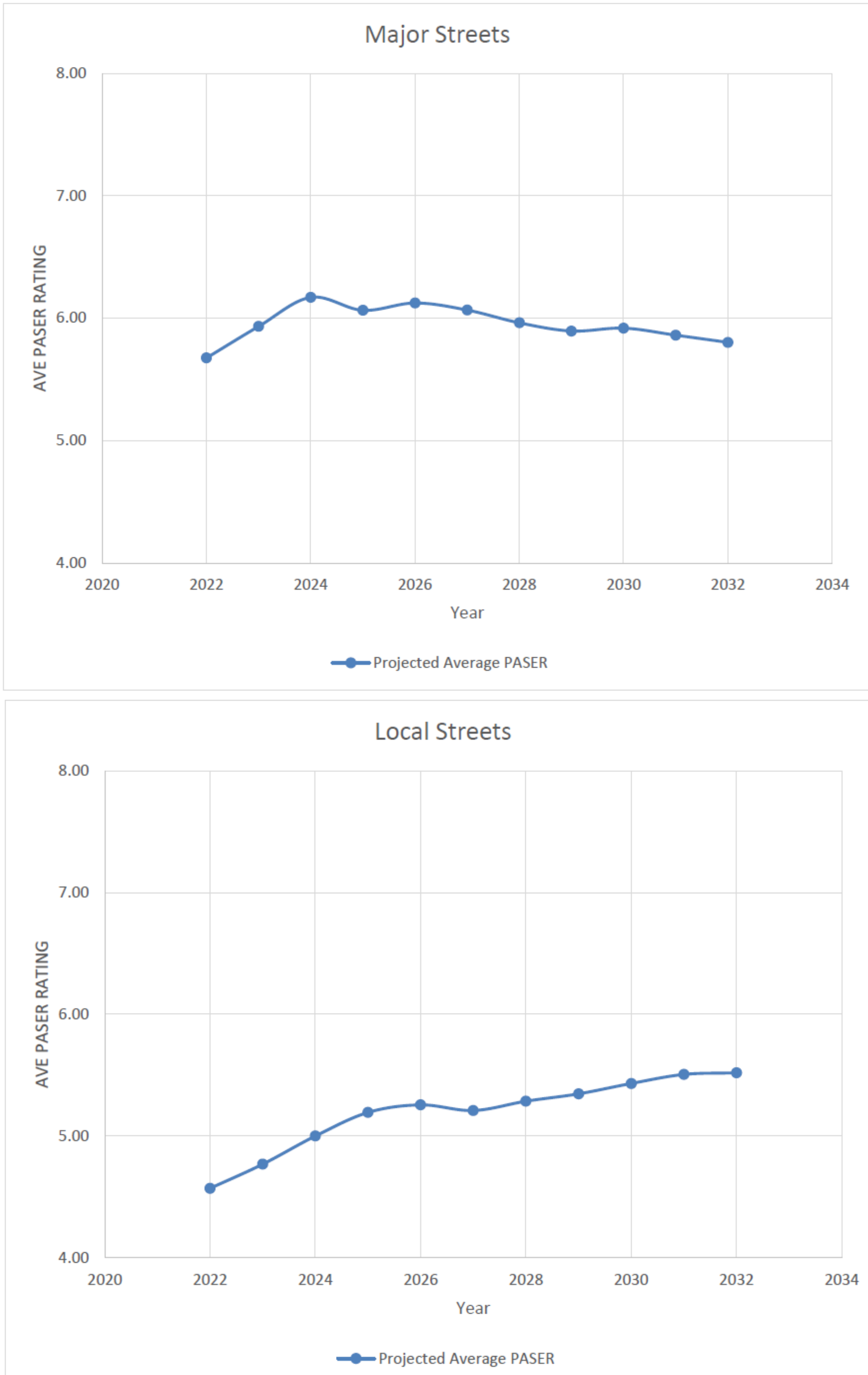

Figure 5: Forecasted Average PASER rating for Ann Arbor city major and local paved road networks.

Planned Projects

Ann Arbor's planned for the next three years are identified in Figure 6.

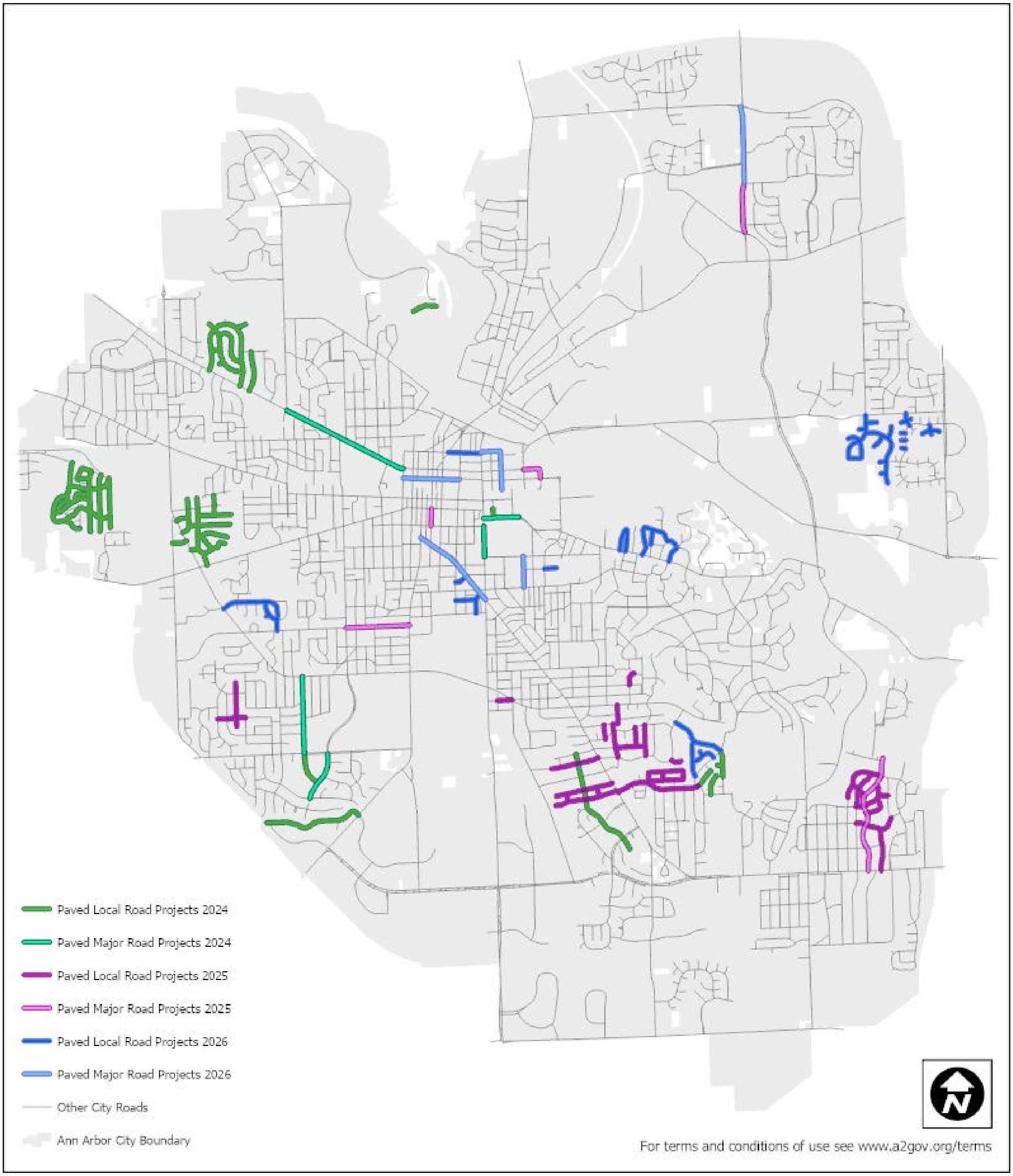

Figure 6: Map illustrating planned projects for pavement assets from 2024-2026. Does not include Capital Preventative Maintenance project locations; specific project locations are not yet identified for future years.

The total cost of the pavement design and construction aspects of the projects illustrated in Figure 6 is approximately $57,000,000. Cost estimates do not include dollars dedicated for active transportation improvements or utility improvements (water, sanitary or storm).

2. BRIDGE ASSETS

Ann Arbor is responsible for 16 bridges that provide safe service to road users across the agency network. Ann Arbor seeks to implement a cost-effective program of preventive maintenance to maximize the useful service life and safety of the local bridges under its jurisdiction.

Inventory of Assets

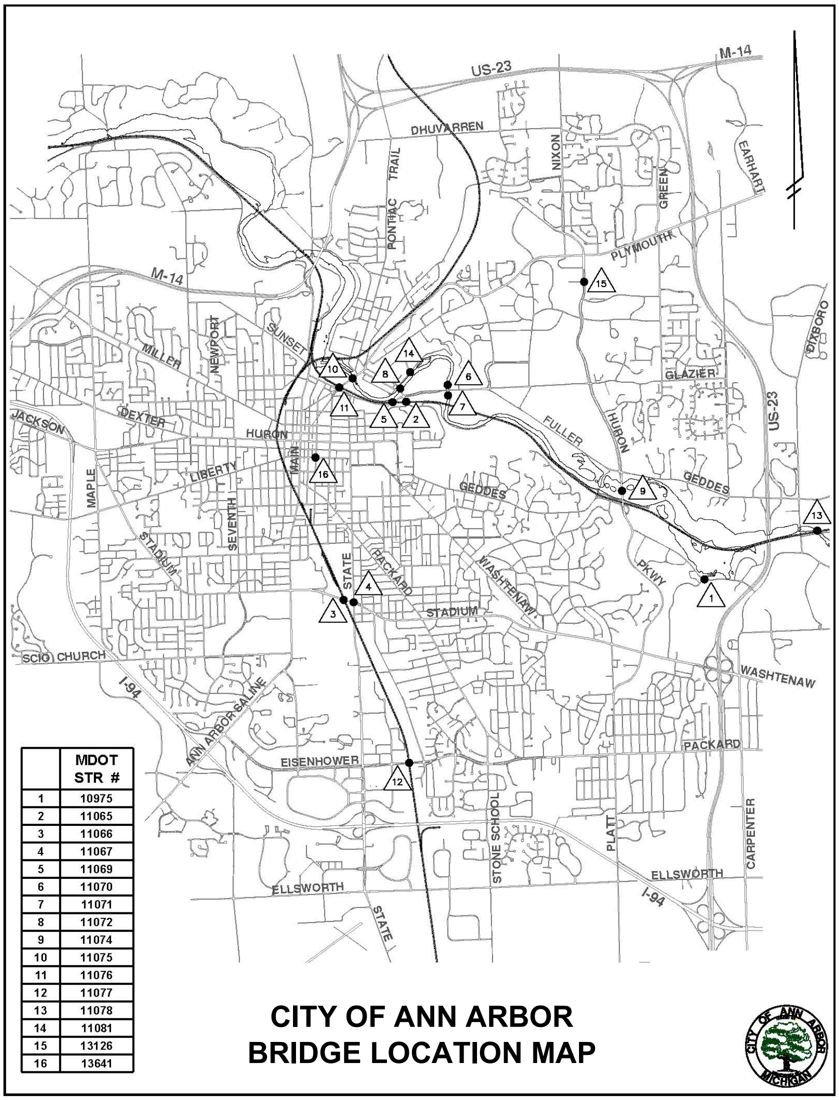

Figure 7: Map illustrating locations of Ann Arbor's bridge assets

Ann Arbor has 16 total bridges in its road and bridge network; these bridges connect various points of the road network, as illustrated in Figure 7. These bridge structures can be summarized by type, size, and condition, which are detailed in Table 2. More information about each of these structures can be found in Ann Arbor's MiBRIDGE database or by contacting the City of Ann Arbor.

Table 2: Bridge Assets by Type: Inventory, Size, and Condition								
	Total Number of Bridges	Total Deck Area (sq ft)	Condition: Structurally Deficient, Posted, Closed			2022 Condition		
Bridge Type			**Struct. Defic**	**Posted**	**Closed**	**Poor**	**Fair**	**Good**
Steel	5	126,144	0	0	0	1	3	1
Concrete	2	N/A	0	0	0	0	0	2
Pre-stressed Concrete	9	77,476	0	0	0	0	1	8
SD/Posted/Closed			**0**	**0**	**0**			
Total	**16**	**16**	**0**	**0**	**0**	**1**	**4**	**11**
Percentage (%)			**0.0%**	**0.0%**	**0.0%**	**6.25%**	**25.0%**	**68.75%**

Condition, Goals, and Trend

Bridges in Michigan are given a good, fair, or poor rating based on the National Bridge Inspection Standards (NBIS) rating scale, which was created by the Federal Highway Administration to evaluate a bridge's deficiencies and to ensure the safety of road users. The current condition of Ann Arbor's bridge network based on the NBIS is 11 (69%) are good, 4 (25%) are fair, and 1 (6%) is poor or lower (Table 1).

Bridges are designed to carry legal loads in terms of vehicles and traffic. Due to a decline in condition, a bridge may be "posted" with a restriction for what would be considered safe loads passing over the bridge. On occasion, posting a bridge may also restrict other load-capacity-related elements like speed and number of vehicles on the bridge, but this type of posting designates the bridge differently. Designating a bridge as "posted" has no influence on its condition rating. A "closed" bridge is one that is closed to all traffic. Closing a bridge is contingent upon its ability to carry a set minimum live load. Ann Arbor does not have any bridges classified as structurally deficient, posted with weight restrictions, or closed (Table 2).

The three-fold goal of Ann Arbor's asset management program is the preservation and safety of its bridge network, increase its bridge assets' useful service life by extending the time that bridges remain in good and fair condition, and reduction of future maintenance costs.

Programmed/Funded Projects, Gap Analysis, and Planned Projects

Ann Arbor receives approximately $13 million per year in funding from its Street, Bridge, and Sidewalk Millage. To achieve its goals, Ann Arbor plans to peform several projects over the life of this asset management plan:

- Rehabilitation and widening of the East Medical Center Drive bridge to better facilitate access to the Medical Center by both motorized and nonmotorized populations (approximatley $13M). This project will be funded substantially by the University of Michigan, as it is the main entrance to the univerity hospital.

- Replacement of the Waste Water Treatment Plant Drive bridge (approximately $6.6M). This project will be funded separately through Sewage Disposal Funds, as serves exclusively as access to Ann Arbor's wastewater treatment plant.
- Bridge painting and minor structural repairs on the Fuller and Maiden Lane bridges (approximately $2.4M)

By performing the above referenced preventative maintenance and replacement of bridge structures, Ann Arbor will meet its overall bridge network condition goals.

3. CULVERT ASSETS

Ann Arbors culverts are generally in good condition. Frequent inspections ensure that deficiencies are identified and corrected using both short term solutions and capital planning where necessary.

Inventory of Assets

At present, Ann Arbor tracks inventory and condition data of its culvert assets. Ann Arbor has inventoried 552 culverts and owns 151 culverts.

The City of Ann Arbor uses a culvert rating form (Figure 8) to assess each culvert on multiple criteria. Each criterion is rated as good, fair, poor or N/A, however the culvert itself is not assigned an overall good/fair/poor rating. Maintenance is scheduled to address areas of concern as they are identified, based on inspection results, to keep all culverts in acceptable condition.

Given the evaluation system Ann Arbor uses, the good/fair/poor condition of each culvert cannot be calculated. Overall, the system of the culverts is monitored and is maintained in reasonably good condition.

More detail about these culvert assets can be found in Ann Arbor's Roadsoft database and computerized maintenance management software (Cityworks) or by contacting the City of Ann Arbor.

Goals

The goal of Ann Arbor's asset management program is the preservation of its culvert network. Ann Arbor is responsible for preserving all 151 of these culverts.

Planned Projects and Investments

The City of Ann Arbor plans replacement and rehabilitation of culvert assets along the route of planned road projects or as defects are found during routine inspcetions. Ann Arbor looks for opportunities to coordinate stormwater and road projects to the extent possible through the Capital Improvements Plan (CIP) process.

Ann Arbor has a stormwater utility which funds the repairs and replacements of culvert assets.

Ann Arbor's upcoming projects and expenditures for replacement and rehabilitation of culvert assets are identified in Table 3.

Project Name/Funding Source	Estimated Cost	Scheduled
Boardwalk Area Railroad Culvert	$550,000	FY24-25
Huron River Drive Culvert	$500,000	FY24
Storm Sewer Rehabilitation, Installation, and lining (addresses pipes and culverts)	$1,000,000 annually	annually
Stormwater Sewer System Fund – culvert maintenace	$75,000+ annually	annually
Stormwater Sewer System Fund – televising pipes including culverts	$615,000+ annually	annually

Table 3: Upcoming Expenditures for Replacement and Rehabilitation of Culvert Assets

Recent culvert replacement and rehabilitation work includes the following:

- Full replacement of a 60” reinforced concrete culvert pipe (RCP) under the MDOT railroad in 2020
- Rehabilitation of a 60” RCP that included void injection and joint sealing on Scio Church Rd in 2022

Inspection | Details

Id: 217864

Location: Newport Rd

Status: Closed

Resolution:

Insp. Date: 07/20/2018 12:23 PM

Inspected By: Frieseman, Madelaine

Observations

Invert Deterioration	N/A
Joints	N/A
Section Deformation	Good
Corrosion	Good
Road Over	Good
End Section	Good
Apron	N/A
Scour Present	N/A
Scour Protection	N/A
Sediment	Fair
Invert Location	Good
Embankment	N/A
Footing Exposed	N/A

Comments

Answer

Reset

Comments

Observation:

Figure 8: Sample Culvert Inspection Form

4. SIGNAL ASSETS

Ann Arbor regularly assess the condition of its signal system and performs regularly scheduled maintenance. Thus, the condition of Ann Arbor's signals are maintained in a good condition.

Inventory of Assets

Ann Arbor has inventoried 164 traffic signals, and owns 126 traffic signals.

More detail about these traffic signal assets can be obtained by contacting the City of Ann Arbor.

Goals

The goal of Ann Arbor's asset management program is the preservation of its traffic signals. Ann Arbor is responsible for preserving all 126 of these traffic signals.

Planned Projects and Investment

Although the City of Ann Arbor does not have an active replacement or rehabilitation campaign for signal assets, Ann Arbor addresses needs as they are identified. Ann Arbor evaluates, maintains, and repairs traffic signals as needed based on inspection results, independent of road projects. Additionally, signals are often evaluated for upgrade anytime a capital project or private development touches an intersection where signals exist. Ann Arbor conducts replacements or repairs for those traffic signal assets reported as non-functional or as performing with reduced function. Ann Arbor adheres to regular maintenance and servicing policies outlined in the *Michigan Manual of Uniform Traffic Control Devices*.

Ann Arbor's average annual investment in repair and replacments for signal assets is $4 million. Signal repair and replacement is typically funded with revenues from the Michigan Transportation Fund; though few exceptions include improvements made with private developer contributions or partner contributions (e.g., University of Michigan).

Recent signal work includes the following areas:

- The signal at the intersection of Main Street and Scio Church Road was rebuilt after being damaged in a crash.
- New rectangular rapid flashing beacons were installed on Industrial Parkway (at Astor, Jewett, Rosewood, Central Academy, and TheRide offices), Main Street (at Hoover, Davis, and Mosley), and on Scio Church (at Churchill, Mershon, and Covington).
- Signal modernization was done at Huron St and Division and Huron Street and First to accommodate bicycle signal integration.
- New detection in the form of GridSmart Cameras has been installed throughout the City.
- Upgrades are ongoing to the communications (fiber optic cable) which serve the City's signals.

5. FINANCIAL RESOURCES

Public entities must balance the quality and extent of services they can provide with the tax resources provided by citizens and businesses, all while maximizing how efficiently funds are used. Below is an overview of Ann Arbor's general expenditures and financial resources currently devoted to transportation infrastructure maintenance. This financial information is not intended to be a full financial disclosure or a formal report. Full details of Ann Arbor's financial status can be found on our website at a2gov.org.

Anticipated Revenues & Expenses

Ann Arbor receives funding from the following sources:

- **State funds** – One of Ann Arbor's principal sources of transportation funding is the Michigan Transportation Fund (MTF). This fund is supported by vehicle registration fees and the state's per-gallon gas tax. Allocations from the MTF are distributed to state and local governmental units based on a legislated formula, which includes factors such as population, miles of certified roads, and vehicle registration fees for vehicles registered in the agency's jurisdiction. Ann Arbor also receives revenue from the Michigan Department of Transportation to maintain (e.g. plow, patch, mow) the state trunklines within its jurisdictional boundary. Revenue from these maintenance contracts are received on a time and materials basis as resources are expended to maintain the State's roads. Examples of state grants also include local bridge grants, economic development funds, and metro funds.
- **Federal and state grants for individual projects** – These are typically competitive funding applications that are targeted at a specific project type to accomplish a specific purpose. These may include safety enhancement projects, economic development projects, or other targeted funding. Examples of federal funds include Surface Transportation Program (STP) funds, bridge

funds, Congestion Mitigation Air Quality (CMAQ) grants, and Highway Safety Improvement Program (HSIP) grants. Ann Arbor regularly utilizes CMAQ funding, and applies for, and typically receives, HSIP funding on an annual basis.

- **Local tax millages** – Many local agencies in Michigan use local tax millages to supplement their road-funding budget. These taxes can provide for additional construction and maintenance for new or existing roads that are also funded using MTF or MDOT funds. Ann Arbor's Street, Bridge and Sidewalk Millage is a five-year millage that provides 2.125 mils of revenue annually. The intent of this millage is to provide funding for the repair and maintenance of the City's network of streets, bridges, and sidewalks. The Washtenaw County Road Commission Road Millage also provides funding for pavement and non-motorized projects, the City's portion of which totals to approximately $2.6M per year.
- **Interest** – Interest from invested funds.
- **Other** – Other revenues can be gained through salvage sales, property rentals, land and building sales, sundry refunds, equipment disposition or installation, private sources, and financing. In addition, the University of Michigan often participates in cost-sharing on a project-by-project basis.

Ann Arbor is required to report transportation fund expenditures to the State of Michigan using a prescribed format with predefined expenditure categories. The definitions of these categories according to Public Act 51 of 1951 may differ from common pavement management nomenclature and practice. For the purposes of reporting under PA 51, the expenditure categories are:

- **Construction/Capacity Improvement Funds** – According to PA 51 of 1951, this financial classification of projects includes, "new construction of highways, roads, streets, or bridges, a project that increases the capacity of a highway facility to accommodate that part of traffic having neither an origin nor destination within the local area, widening of a lane width or more, or adding turn lanes of more than 1/2 mile in length."[1]
- **Preservation and Structural Improvement Funds** – Preservation and structural improvements are "activit[ies] undertaken to preserve the integrity of the existing roadway system."[2] Preservation includes items such as a reconstruction of an existing road or bridge, or adding structure to an existing road.
- **Routine and Preventive Maintenance Funds** – Routine maintenance activities are "actions performed on a regular or controllable basis or in response to uncontrollable events upon a highway, road, street, or bridge".[3] Preventive maintenance activities are "planned strategy[ies] of cost-effective treatments to an existing roadway system and its appurtenances that preserve assets by retarding deterioration and maintaining functional condition without significantly increasing structural capacity".[4]

[1] Public Act 51 of 1951, 247.660c Definitions
[2] Public Act 51 of 1951, 247.660c Definitions
[3] Public Act 51 of 1951, 247.660c Definitions
[4] Public Act 51 of 1951, 247.660c Definitions

- **Winter Maintenance Funds** – Expenditures for snow and ice control.
- **Trunkline Maintenance Funds** – Expenditures spent under Ann Arbor's maintenance agreement with MDOT for maintenance it performs on MDOT trunkline routes.
- **Administrative Funds** – There are specific items that can and cannot be included in administrative expenditures as specified in PA 51 of 1951. The law also states that the amount of MTF revenues that are spent on administrative expenditures is limited to 10 percent of the annual MTF funds that are received.
- **Other Funds** – Expenditures for equipment, capital outlay, debt principal payment, interest expense, contributions to adjacent governmental units, principal, interest and bank fees, and miscellaneous for cities and villages.

Table 4 details the revenues and expenditures for Ann Arbor.

Table 4: Annual Fiscal-Year Revenues & Expenditures per Fiscal Year

REVENUES			**EXPENDITURES**		
Item	**Estimated $**	**Percent of Total**	**Item**	**Estimated $**	**Percent of Total**
State funds	$15,000,000	46%	Preservation & structural improvement (PSI)	$20,000,000	62%
Federal funds	$ 2,000,000	6%	Routine maintenance	$ 940,000	3%
Local Tax Millages*	$15,500,000	48%	Winter maintenance	$ 1,250,000	4%
Investment Income**	$ -	0%	Other ACT 51 eligible expenditures	$ 6,110,000	19%
			Trunkline maintenance	$ 200,000	1%
			Administrative	$ 4,000,000	12%
TOTAL	$ 32,500,000		**TOTAL**	$ 32,500,000	

*Street, Bridge, & Sidewalk Millage and Washtenaw County Road Commission Millage

** Averaged zero over the last three years

6. RISK OF FAILURE ANALYSIS

Transportation infrastructure is designed to be resilient. The system of interconnecting roads and bridges maintained by Ann Arbor provides road users with multiple alternate options in the event of an unplanned disruption of one part of the system. There are, however, key links in the transportation system that may cause significant inconvenience to users if they are unexpectedly closed to traffic. Key transportation links include:

- **Geographic divides:** Areas where a geographic feature (river, lake, hilly terrain, or limited access road) limits crossing points of the feature; bridge failures, in particular, can create loss of access to entire regions of the state
- **Emergency alternate routes for high-volume roads and bridges:** Roads and bridges that are routinely used as alternate routes for high-volume assets are included in an emergency response plan
- **Limited access areas:** Roads and bridges that serve remote or limited access areas that result in long detours if closed
- **Main access to key commercial districts:** Areas with a large concentration of businesses or where large-size business will be significantly impacted if a road is unavailable

Our road and bridge network includes the key links as shown in Table 5 and Figure 9.

Name	Limit1	Limit2	Reason
Jackson Rd EB	Wagner Rd	Lakeview Dr	High Volume; Freeway Xchange; Limited residential access
Jackson Rd WB	Wagner Rd	Lakeview Dr	High Volume; Freeway Xchange; Limited residential access

Jackson Ave	Lakeview Dr	W Huron St	High Volume; Freeway Xchange
W Huron St	Jackson Ave	E Huron St	High Volume; Commercial Area
E Huron St	W Huron St	Washtenaw Ave	High Volume; Commercial Area
Washtenaw Ave	E Huron St	E Stadium Blvd	High Volume
Washtenaw Ave	E Stadium Blvd	City Limit/Yost Blvd	High Volume; Freeway Xchange
N Main St	M-14	Huron St	High Volume; Freeway Xchange; Commercial Area
Ann Arbor Saline Rd	S Main St	City Limit/I-94	High Volume; Freeway Xchange
Broadway St	Beakes St/N Division St	Swift St	High Volume; River and Rail Divide
Plymouth Rd	Broadway St	US-23	High Volume; Commercial area
E Stadium Blvd	S Main St	S Industrial Hwy	Rail Divide; High Volume
Huron Pkwy	Fuller Rd/Geddes Rd	Geddes Ave	River and rail divide
E Eisenhower Pkwy	S State St	S Industrial Hwy	Rail Divide; Commercial area; Volume
S State St	E Eisenhower Pkwy	E Ellsworth Rd	Volume; Freeway divide; Commercial area
Glen/Fuller St	E Huron St	Beal Ave	Volume; Hospital access; River and rail divides; Bridges
Huron Pkwy/Platt Rd	Washtenaw Ave	E Ellsworth Rd	Volume; Freeway divide
Packard Rd	E Eisenhower Pkwy	US-23	Volume; Freeway divide
Stone School Rd	Packard St	E Ellsworth Rd	Volume; Freeway divide
S State St	W Huron St	E Eisenhower Pkwy	Volume; Rail divide; Commercial Area
Scio Church Rd	S Maple Rd	S Main St	Volume; Freeway divide
Barton Dr	Whitmore Lake Rd	Pontiac Trail	Freeway divide
Depot St	N Main St	Glen/Fuller St	Volume; Hospital and Train access
Maiden Lane	Plymouth Rd	Medical Center Dr	River and rail divide; Hospital access
Geddes Rd	Huron Pkwy	US-23	Volume; Freeway divide
Liberty St	City Limit	W Stadium Blvd	Freeway divide; Residential access; Volume
Miller Ave	City Limit	N Maple	Volume; Freeway divide
Newport Rd	City Limit	Miller Ave	Freeway divide; Residential access; Volume

Table 5: Ann Arbor's Key Transportation Links

Although the listing provides various areas that could be considered "key links", the Ann Arbor road network has a significant level of redundancy and a well-connected grid network that avoids mobility and circulation challenges in the event of a failure on any particular route. This duplication within the system ensures that alternate routes are available and avoids catastrophic disruptions to the system.

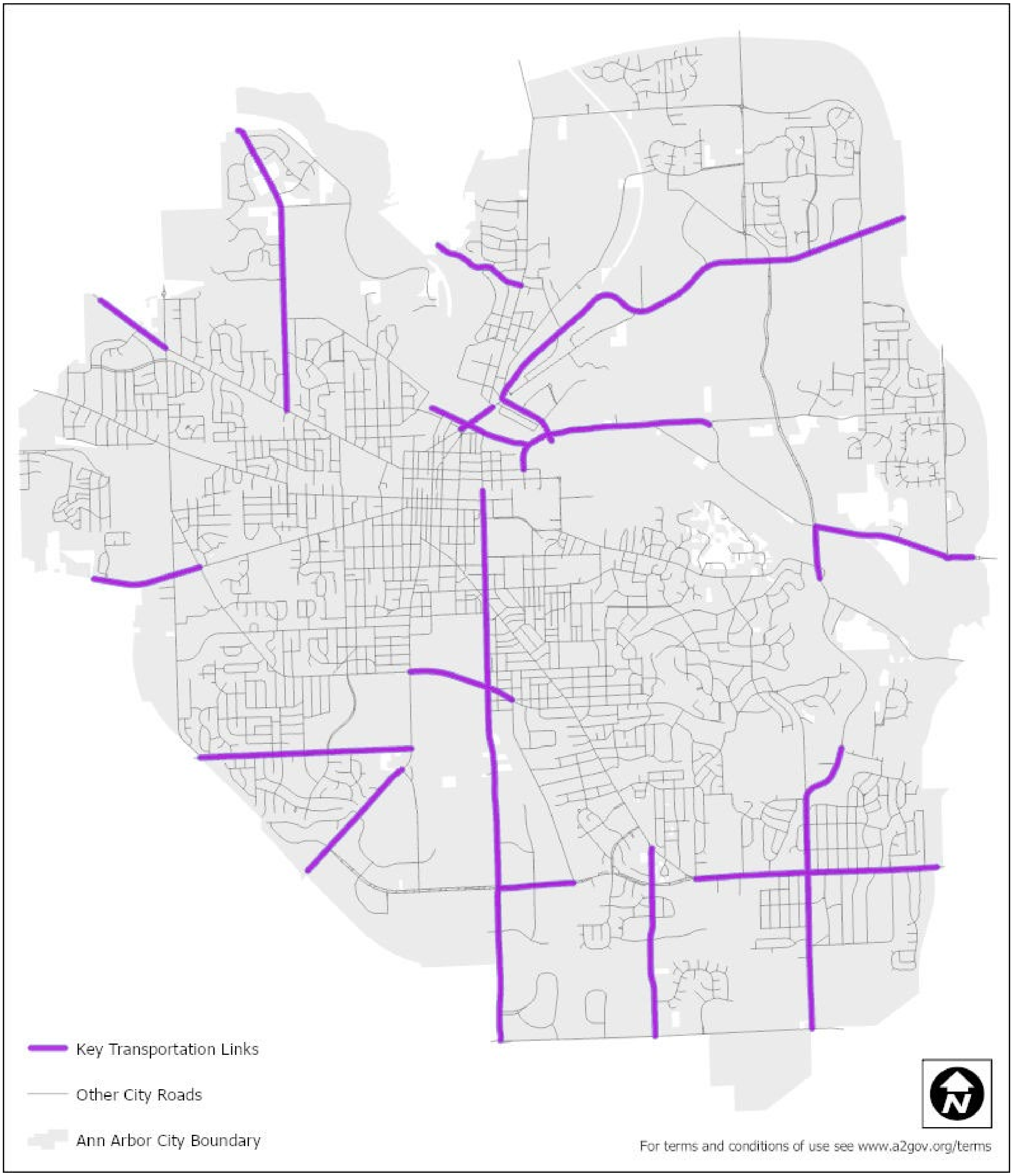

Figure 9: Key transportation links in Ann Arbor's road and bridge network

7. COORDINATION WITH OTHER ENTITIES

An asset management plan provides a significant value for infrastructure owners because it serves as a platform to engage other infrastructure owners using the same shared right of way space. Ann Arbor communicates with both public and private infrastructure owners to coordinate work.

Coordinated Planning for City Assets

Ann Arbor maintains drinking water, sanitary, and stormwater assets in addition to transportation assets. Ann Arbor follows an asset management process for all of its assets by coordinating the upgrade, maintenance, and operation of all major assets.

All major infrastructure projects for public service assets are planned for and coordinated through the Capital Improvements Program (CIP). Priority projects are identified through coordinated planning efforts across multiple asset groups that collectively share the right-of-way space. This includes, but is not limited to, street construction, underground utility projects (stormwater, sanitary and water), active transportation such as sidewalk and bike infrastructure, and other transportation projects within the right of way.

Each asset group identifies project needs, scores each one based on defined metrics, and the Ann Arbor staff programs projects with heavy consideration to coordinating work within a shared space. Over 70 staff across the City of Ann Arbor are involved in the CIP process, plus representatives from other entities such as the Ann Arbor Housing Commission, the Downtown Development Authority, the University of Michigan, and the Ann Arbor Area Transit Authority.

Broad participation in the CIP process enables open communication about upcoming projects and provides the opportunity to maximize efficiency and minimize community disruption by addressing the complete needs in a specific area at one time. In particular, sub-surface utility plans are coordinated with the transportation infrastructure plans to maximize value and minimize service disruptions and cost to the public.

Ann Arbor takes advantage of coordinated infrastructure work to reduce cost and maximize value using the following guiding principles:

- Roads which are in poor condition that have a subsurface infrastructure project planned will be rehabilitated full-width using transportation funds.
- Subsurface infrastructure projects which will cause damage to pavements in good to fair condition will be delayed as long as possible, or will consider methods that do not require excessive pavement cuts. If the underground utility project must move forward on a pavement in good or fair condition, the road will be rehabilitated using utility funds.

In addition to the CIP process, project needs are identified and planned for through Ann Arbor's asset management plans and comprehensive planning documents, which includes:

- Drinking water distribution system asset management plan
- Sanitary collection system asset management plan
- Sanitary sewer system asset management plan
- Stormwater asset management plan
- Vision Zero Transportation Plan

External Coordination and Other Tools

Ann Arbor's CIP provides a six-year plan of upcoming infrastructure work and is publicly available on a2gov.org/CIP and a2gov.org/a2CIPmap. Private utilities and others managing infrastructure in the area are encouraged to access plan materials to be aware of upcoming projects in the City of Ann Arbor right-of-way.

The City of Ann Arbor continues to improve communication channels with public entities such as DTE Energy (the local electric and gas provider) who also perform work in the right-of-way space. The City currently holds routine meetings with DTE representatives and is working towards and approach to exchange project plans in advance.

Ann Arbor's Street Cut Moratorium is one tool we are using to encourage coordinated work. This policy discourages new street cuts for a period of time after the road is treated, unless cutting the street is deemed necessary for emergency work.

8. PROOF OF ACCEPTANCE

PUBLIC ACT 325

CERTIFICATION OF TRANSPORTATION ASSET MANAGEMENT PLAN

Certification Year: 2023

Local Road-owning Agency Name: City of Ann Arbor

Beginning October 2019 and on a three-year cycle thereafter, certification must be made for compliance to Public Act 325. A local road-owning agency with 100 certified miles or more must certify that it has developed an asset management plan for the road, bridge, culvert, and traffic signal assets. Signing this form certifies that the hitherto referred agency meets with minimum requirements as outlined by Public Act 325 and agency-defined goals and objectives.

This form must be signed by the City Administrator and chief financial officer of the local road-owning agency.

Signature		Signature	
Printed Name		Printed Name	
Title	Date	Title	Date

Due every three years based on agency submission schedule

Submittal Date: _______________________________

See attached council resolution in Appendix F.

A. PAVEMENT ASSET MANAGEMENT PLAN

An attached pavement asset management plan follows.

City of Ann Arbor
2023 Pavement
Asset Management Plan

A plan describing the City of Ann Arbor’s roadway assets and conditions

Prepared by:
Nicholas Hutchinson
City Engineer
nhutchinson@a2gov.org

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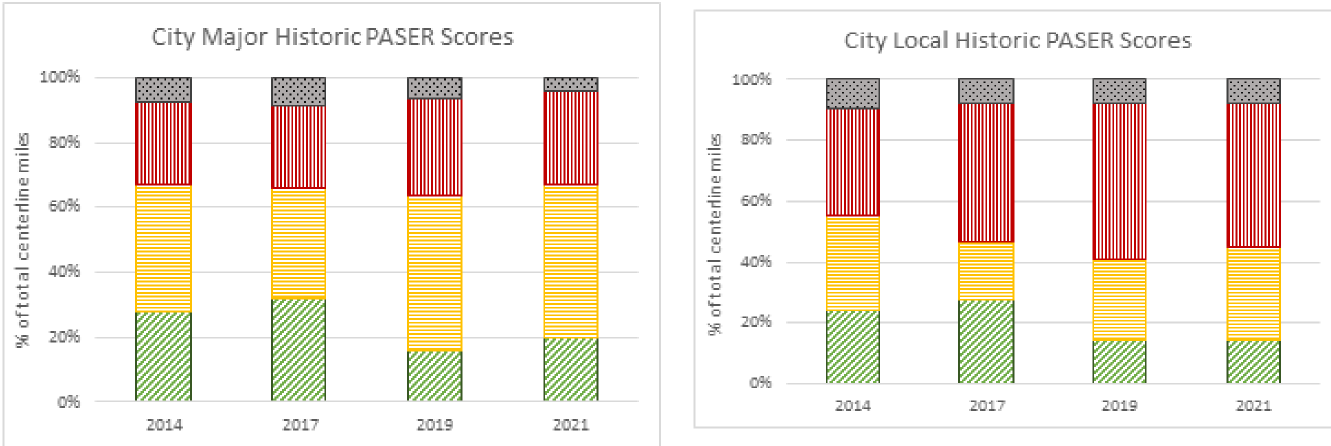
EXECUTIVE SUMMARY

As conduits for commerce and connections to vital services, roads are among the most important assets in any community along with other assets like bridges, culverts, traffic signs, traffic signals, and utilities that support and affect roads. The City of Ann Arbor's (Ann Arbor) roads, other transportation assets, and support systems are also some of the most valuable and extensive public assets; all of which are paid for with taxes collected from citizens and businesses. The cost of building and maintaining roads, their importance to society, and the investment made by taxpayers all place a high level of responsibility on local agencies to plan, build, and maintain the road network in an efficient and effective manner. This asset management plan is intended to report on how Ann Arbor is meeting its obligations to maintain the public assets for which it is responsible.

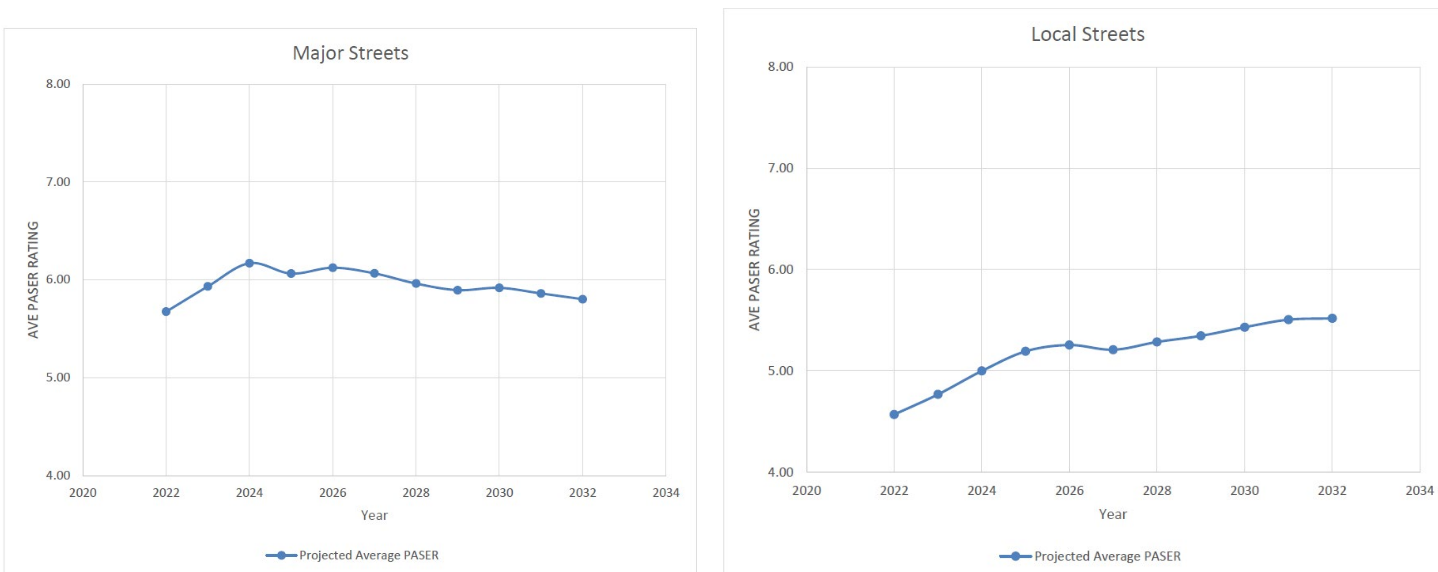
This plan overviews Ann Arbor's road assets, and explains how Ann Arbor works to maintain and improve the overall condition of those assets. These explanations can help answer the following questions:

- What kinds of road assets Ann Arbor has in its jurisdiction, who owns them, and options for maintaining these assets.
- What tools and processes Ann Arbor uses to track and manage road assets and funds.
- What condition Ann Arbor's road assets are in compared to statewide averages.
- Why some road assets are in better condition than others, and the path to maintaining and improving road asset conditions through proper planning and maintenance.
- How agency transportation assets are funded and where those funds come from.
- How funds are used, and the costs incurred during Ann Arbor's road assets' normal life cycle.
- What condition Ann Arbor can expect its road assets if those assets continue to be funded at the current funding levels
- How changes in funding levels can affect the overall condition of all of Ann Arbor's road assets.

Ann Arbor owns and/or manages 312 centerline miles of roads. This road network can be divided into the city major network, the city local network, the unpaved road network, and the National Highway System (NHS) network based on the different factors these roads have that influence asset management decisions. A summary of Ann Arbor historical and current network conditions, projected trends, and goals for city major network and city local network can be seen in the figures below:



Historical Ann Arbor paved city major and local road networks condition trends



Forecasted Average PASER rating for Ann Arbor city major and local paved road networks.

An asset management plan is required by Michigan Public Act 325 of 2018, and this document represents fulfillment of some of Ann Arbor's obligations towards meeting these requirements. This asset management plan also helps demonstrate Ann Arbor's responsible use of public funds by providing elected officials and the general public with inventory and condition information of Ann Arbor's road assets, and gives taxpayers the information they need to make informed decisions about investing in its essential transportation infrastructure.

INTRODUCTION

Asset management is defined by Public Act 325 of 2018 as “an ongoing process of maintaining, preserving, upgrading, and operating physical assets cost effectively, based on a continuous physical inventory and condition assessment and investment to achieve established performance goals”. In other words, asset management is a process that uses data to manage and track assets, like roads and bridges, in a cost-effective manner using a combination of engineering and business principles. This process is endorsed by leaders in municipal planning and transportation infrastructure, including the Michigan Municipal League, County Road Association of Michigan, the Michigan Department of Transportation (MDOT), and the Federal Highway Administration (FHWA). Ann Arbor is supported in its use of asset management principles and processes by the Michigan Transportation Asset Management Council (TAMC), formed by the State of Michigan.

Asset management, in the context of this plan, ensures that public funds are spent as effectively as possible to maximize the condition of the road network. Asset management also provides a transparent decision-making process that allows the public to understand the technical and financial challenges of managing road infrastructure with a limited budget.

The City of Ann Arbor (Ann Arbor) has adopted an “asset management” business process to overcome the challenges presented by having limited financial, staffing, and other resources while needing to meet road users’ expectations. Ann Arbor is responsible for maintaining and operating over 312 centerline miles of roads.

This plan outlines how Ann Arbor determines its strategy to maintain and upgrade road asset condition - given agency goals, priorities of its road users, and resources provided. An updated plan is to be released approximately every three years to reflect changes in road conditions, finances, and priorities.

Questions regarding the use or content of this plan should be directed to Nicholas Hutchinson at 301 E. Huron Street, Ann Arbor, MI 48104 or at nhutchinson@a2gov.org. Key terms used in this plan are defined in Ann Arbor’s comprehensive transportation asset management plan (also known as the “compliance plan”) used for compliance with PA 325 of 2018.

Knowing the basic features of the asset classes themselves is a crucial starting point to understanding the rationale behind an asset management approach. The following primer provides an introduction to pavements.

Pavement Primer

Roads come in two basic forms—paved and unpaved. Paved roads have hard surfaces. These hard surfaces can be constructed from asphalt, concrete, composite (asphalt and concrete), sealcoat, and brick and block materials. On the other hand, unpaved roads have no hard surfaces. Examples of these surfaces are gravel and unimproved earth.

The decision to pave with a particular material, as well as the decision to leave a road unpaved, allows road-owning agencies to tailor a road to a particular purpose, environment, and budget. Thus, selecting a pavement type or leaving a road unpaved depends upon purpose, materials available, and budget. Each choice represents a trade-off between budget and costs for construction and maintenance.

Maintenance enables the road to fulfill its particular purpose. To achieve the maximum service for a pavement or an unpaved road, continual monitoring of a road's pavement condition is essential for choosing the right time to apply the right fix in the right place.

Here is a brief overview of the different types of pavements, how condition is assessed, and treatment options that can lengthen a road's service life.

Surfacing

Pavement type is influenced by several different factors, such as cost of construction, cost of maintenance, frequency of maintenance, and type of maintenance. These factors can have benefits affecting asset life and road user experience.

Paved Surfacing

Typical benefits and tradeoffs for hard surface types used in Ann Arbor include:

- **Concrete pavement:** Concrete pavement, which is sometimes called a rigid pavement, is durable and lasts a long time when properly constructed and maintained. Concrete pavement can have longer service periods between maintenance activities, which can help reduce maintenance-related traffic disruptions. However, concrete pavements have a high initial cost and can be challenging to rehabilitate and maintain at the end of their service life. A typical concrete pavement design life will provide service for 30 years before major rehabilitation is necessary.

- **Hot-mix asphalt pavement (HMA):** HMA pavement, sometimes known as asphalt or flexible pavement, is currently less expensive to construct than concrete pavement (this is, in some part, due to the closer link between HMA material costs and oil prices that HMA pavements have in comparison with other pavement types). However, they require frequent maintenance activities to maximize their service life. A typical HMA pavement design life will provide service for 18 years before major rehabilitation is necessary. The vast majority of local-agency-owned pavements are HMA pavements.

- **Composite pavements:** Composite pavement is a combination of concrete and asphalt layers. Typically, composite pavements are old concrete pavements exhibiting ride-related issues that were overlaid by several inches of HMA in order to gain more service life from the pavement before it would need reconstruction. Converting a concrete pavement to a composite pavement is typically used as a "holding pattern" treatment to maintain the road in usable condition until reconstruction funds become available.

Unpaved Surfacing

Typical benefits and trade-offs for non-hard surfacing include:

- **Gravel:** Gravel is a low-cost, easy-to-maintain road surface made from layers of soil and aggregate (gravel). However, there are several potential drawbacks such as dust, mud, and ride smoothness when maintenance is delayed, or if traffic volume exceeds design expectations. Gravel roads require frequent low-cost maintenance activities. Gravel can be cost-effective for lower-volume, lower-speed roads. In the right conditions, a properly constructed and maintained gravel road can provide a service life comparable to an HMA pavement, and can be significantly less expensive than the other pavement types.

Pavement Condition

Besides traffic congestion, pavement condition is what road users typically notice most about the quality of the roads that they regularly use—the better the pavement condition, the more satisfied users are with the service provided by the roadwork performed by road-owning agencies. Pavement condition is also a major factor in determining the most cost-effective treatment—that is, routine maintenance, capital preventive maintenance, or structural improvement—for a given section of pavement. As pavements age, they transition between "windows" of opportunity when a specific type of treatment can be applied to improve quality and extend service life. Routine maintenance is day-to-day, regularly-scheduled, low-cost activity applied to "good" roads to prevent water or debris intrusion. Capital preventive maintenance (CPM) is a planned set of cost-effective treatments for "fair" roads that corrects pavement defects, slows further deterioration, and maintains the functional condition without increasing structural capacity. Ann Arbor uses pavement condition and age to anticipate when a specific section of pavement will be a potential candidate for preventive maintenance. More detail on this topic is included in the *Pavement Treatment* section of this primer.

Pavement condition data is also important because it allows road owners to evaluate the benefits of preventive maintenance projects. This data helps road owners to identify the most cost-effective use of road construction and maintenance dollars. Further, historic pavement condition data can enable road owners to predict future road conditions based on budget constraints and to determine if a road network's condition will improve, stay the same, or degrade at the current or planned investment level. This analysis can help determine how much additional funding is necessary to meet a network's condition improvement goals.

Paved Road Condition Rating System

Ann Arbor is committed to monitoring the condition of its road network and using pavement condition data to drive cost-effective decision-making and preservation of valuable road assets. Ann Arbor uses the Pavement Surface Evaluation and Rating (PASER) system to assess its paved roads. PASER was developed by the University of Wisconsin Transportation Information Center to provide a simple, efficient, and consistent method for evaluating road condition through visual inspection. The widely used PASER system has specific criteria for assessing asphalt, concrete, sealcoat, and brick-and-block pavements. Information regarding the PASER system and PASER manuals may be found on the TAMC website at: http://www.michigan.gov/tamc/0,7308,7-356-82158_82627---,00.html.

The TAMC has adopted the PASER system for measuring statewide pavement conditions in Michigan for asphalt, concrete, composite, sealcoat, and brick-and-block paved roads. Broad use of the PASER system means that data collected at Ann Arbor is consistent with data collected statewide. PASER data is collected using trained inspectors in a slow-moving vehicle using GPS-enabled data collection software provided to road-owning agencies at no cost to them. The method does not require extensive training or specialized equipment; and data can be collected rapidly, which minimizes the expense for collecting and maintaining this data.

The PASER system rates surface condition using a 1-10 scale, where 10 is a brand-new road with no defects that can be treated with routine maintenance; 5 is a road with distresses but is structurally sound that can be treated with preventive maintenance; and 1 is a road with extensive surface and structural distresses that requires total reconstruction.

Roads with lower PASER scores generally require costlier treatments to restore their quality than roads with higher PASER scores. The cost-effectiveness of treatments generally decreases as the PASER number decreases. In other words, as a road deteriorates, it costs more dollars per mile to fix it, and the dollars spent are less efficient in increasing the road’s service life. Nationwide experience and asset management principles tell us that a road that has deteriorated to a PASER 4 or less will cost more to improve and the dollars spent are less efficient. Understanding this cost principle helps to draw meaning from the current PASER condition assessment.

The TAMC has developed statewide definitions of road condition by creating three simplified condition categories—“good”, “fair”, and “poor”—that represent bin ranges of PASER scores having similar contexts regarding maintenance and/or reconstruction. The definitions of these rating conditions are:

- “Good” roads, according to the TAMC, have PASER scores of 8, 9, or 10. Roads in this category have very few, if any, defects and only require minimal maintenance; they may be kept in this category longer using CPM. These roads may include those that have been recently seal coated or newly constructed. Figure 1 illustrates an example of a road in this category.

- “Fair” roads, according to the TAMC, have PASER scores of 5, 6, or 7. Roads in this category still show good structural support, but their surface is starting to deteriorate. Figure 1 illustrates two road examples in this category. CPM can be cost-effective for maintaining the road’s “fair” condition or even raising it to “good” condition, before the structural integrity of the pavement has been severely impacted. CPM treatments can be likened to shingles on a roof of a house: while the shingles add no structural value, they protect the house from structural damage by maintaining the protective function of a roof covering.

- “Poor” roads, according to the TAMC, have PASER scores of 1, 2, 3, or 4. These roads exhibit evidence that the underlying structure is failing, such as alligator cracking and rutting. These roads must be rehabilitated with treatments like a heavy overlay, crush and shape, or total reconstruction. Figure 1 illustrates a road in this category.

The TAMC’s good, fair, and poor categories are based solely on the definitions above. Therefore, caution should be exercised when comparing other condition assessments with these categories because other condition assessments may have “good”, “fair”, or “poor” designations similar to the TAMC condition categories but may not share the same definition. Often, other condition assessment systems define the “good”, “fair”, and “poor” categories differently, thus rendering the data of little use for cross-system comparison. The TAMC’s definitions provide a statewide standard for all of Michigan’s road-owning agencies to use for comparison purposes.

Figure 1: *Top image, right*– PASER 8 road that is considered “good” by the TAMC exhibit only minor defects. *Second image, right*– PASER 5 road that is considered “fair” by the TAMC. Exhibiting structural soundness but could benefit from CPM. *Third image, right*– PASER 6 road that is considered “fair” by the TAMC. *Bottom image, right*– PASER 2 road that is considered “poor” by the TAMC exhibiting significant structural distress.

PASER data is collected 100 percent every two years on all federal-aid-eligible roads in Michigan. The TAMC dictates and funds the required training and the format for this collection, and it shares the data regionally and statewide. In addition, Ann Arbor collects 100 percent of its paved non-federal-aid-eligible network every two years.

Unpaved Road Condition Rating System (IBR System™)

The condition of unpaved roads can change rapidly, which makes it difficult to obtain a consistent surface condition rating over the course of weeks or even days. The PASER system works well on most paved roads, which have a relatively stable surface condition over several months, but it is difficult to adapt to unpaved roads. To address the need for a reliable condition assessment system for unpaved roads, the TAMC adopted the Inventory Based Rating (IBR) System™, and Ann Arbor is also planning to use the IBR System™ for rating its unpaved roads. Information about the IBR System™ can be found at http://ctt.mtu.edu/inventory-based-rating-system.

Figure 2: *Top*– Road with IBR number of 1 road that has poor surface width, poor drainage adequacy, and poor structural adequacy. *Middle*– Road IBR number of 7 that has fair surface width, fair drainage adequacy, and fair structural adequacy. *Bottom*– Road with IBR number of 9 road that has good surface width, good drainage adequacy, and good structural adequacy.

The IBR System™ gathers reliable condition assessment data for unpaved road by evaluating three features—surface width, drainage adequacy, and structural adequacy—in comparison to a baseline, or generally considered “good”, road. These three assessments come together to generate an overall 1-10 IBR number. A high IBR number reflects a road with wide surface width, good drainage, and a well-designed and well-constructed base, whereas a low IBR number reflects a narrow road with no ditches and little gravel. A good, fair, or poor assessment of each feature is not an endorsement or indictment of a road’s suitability for use but simply provides context on how these road elements compare to a baseline condition, and provides some indication of a road’s capabilities to support different traffic volumes and types in all weather.

Figure 2 illustrates the range over which features may be assessed. The top example in Figure 2 shows an unpaved road with a narrow surface width, little or no drainage, and very little gravel thickness. Using the IBR System™, these assessments would yield an IBR number of “1” for this road. The middle example in Figure 2 shows a road with fair surface width, fair drainage adequacy, and fair structural adequacy. These assessments would yield an IBR number of “7” for this road. The bottom example in Figure 2 shows a road with good surface width, good drainage adequacy, and good structural adequacy. These assessments would yield an IBR number of “9” for this road.

Unpaved roads are constructed and used differently throughout Michigan. A narrow, unpaved road with no ditches and very little gravel (low IBR number) may be perfectly acceptable in a short, terminal end of the road network; for example, on a road segment that ends at a lake or serves a limited number of unoccupied private properties. However, high-volume unpaved roads that serve agricultural or other industrial activities with heavy trucks and equipment will require wide surface width, good drainage, and a well-designed and well-constructed base structure (high IBR number). Where the unpaved road is and how it is used determines how the road must be constructed and maintained: just because a road has a low IBR number does not necessarily mean that it needs to be upgraded.

Historically, the City of Ann Arbor has not collected ratings for gravel roads. Gravel roads will be rated using the IBR system during the Summer or Fall of 2023 and will be incorporated into future Pavement Asset Management Plans.

Pavement Treatments

Selection of repair treatments for roads aims to balance costs, benefits, and road life expectancy. All pavements are damaged by water, traffic weight, freeze/thaw cycles, and sunlight. Each of the following treatments and strategies—reconstruction, structural improvements, capital preventive maintenance, and others used by Ann Arbor—counters at least one of these pavement-damaging forces.

Reconstruction

Pavement reconstruction treats failing or failed pavements by completely removing the old pavement and base and constructing an entirely new road (Figure 3). Every pavement has to eventually be reconstructed and it is usually done as a last resort after more cost-effective treatments are done, or if the road requires significant changes to road geometry, base, or buried utilities. Compared to the other treatments, which are all improvements of the existing road, reconstruction is the most extensive rehabilitation of the roadway and therefore, also the most expensive per mile and most disruptive to regular traffic patterns. Reconstructed pavement will subsequently require one or more of the previous maintenance treatments to maximize service life and performance. A reconstructed road lasts approximately 15 years and costs $1,000,000 per lane mile. The following descriptions outline the main reconstruction treatments used by Ann Arbor.

Figure 3: Examples of reconstruction treatments—(left) reconstructing a road and (right) road prepared for full-depth repair.

Full-depth Concrete Repair

A full-depth concrete repair removes sections of damaged concrete pavement and replaces it with new concrete of the same dimensions (Figure 3). It is usually performed on isolated deteriorated joint locations or entire slabs that are much further deteriorated than adjacent slabs. The purpose is to restore the riding surface, delay water infiltration, restore load transfer from one slab to the next, and eliminate the need to perform costly temporary patching. This repair lasts approximately twelve years and typically costs $300,000 per mile. Concrete roads are a small percentage of Ann Arbor's road network, therefore this treatment is used very infrequently.

Ditching (for Unpaved Roads)

Water needs to drain away from any roadway to delay softening of the pavement structure, and proper drainage is critical for unpaved roads where there is no hard surface on top to stop water infiltration into the road surface and base. To improve drainage, new ditches are dug or old ones are cleaned out. Unpaved roads are re-ditched sporadically, as needed in Ann Arbor at a cost of $10,000 per mile.

Gravel Overlay (for Unpaved Roads)

Unpaved roads will exhibit gravel loss over time due to traffic, wind, and rain. Gravel on an unpaved road provides a wear surface and contributes to the structure of the entire road. Unpaved roads are overlaid with new gravel sporadically, as needed in Ann Arbor. The cost for this maintenance is listed below with Maintenance Grading and Post Storm Inspections.

Structural Improvement

Roads requiring structural improvements exhibit alligator cracking and rutting and rated poor in the TAMC scale. Road rutting is evidence that the underlying structure is beginning to fail and it must be rehabilitated with a structural treatment. Examples of structural improvement treatments include HMA overlay with or without milling, and crush and shape (Figure 4). The following descriptions outline the main structural improvement treatments used by Ann Arbor.

Figure 4: Examples of structural improvement treatments—(from left) HMA overlay on an unmilled pavement, milling asphalt pavement, and pulverization of a road during a crush-and-shape project.

Hot-mix Asphalt (HMA) Overlay with Milling

An HMA overlay is a layer of new asphalt (liquid asphalt and stones) placed on an existing pavement (Figure 4). Depending on the overlay thickness, this treatment can add significant structural strength. This treatment also creates a new wearing surface for traffic and seals the pavement from water, debris, and sunlight damage. The top layer of severely damaged pavement is removed by milling, a technique that helps prevent structural problems from being quickly reflected up to the new surface. Milling is also done to keep roads at the same height of curb and gutter that is not being raised or reinstalled in the project. An HMA overlay with milling lasts approximately five to ten years and costs $100,000 per lane mile. .

Capital Preventive Maintenance

Capital preventive maintenance (CPM) addresses pavement problems of fair-rated roads before the structural integrity of the pavement has been severely impacted. CPM is a planned set of cost-effective treatments applied to an existing roadway that slows further deterioration and that maintains or improves the functional condition of the system without significantly increasing the structural capacity. Examples of such treatments used in Ann Arbor include crack seal, cape seal, slurry seal, and microsurface (Figure 5). The purpose of the following CPM treatments is to protect the pavement structure, slow the rate of deterioration, and/or correct pavement surface deficiencies. The following descriptions outline the main CPM treatments used by Ann Arbor.

Figure 5: Examples of capital preventive maintenance treatments—(from left) crack seal, fog seal, chip seal, and slurry seal/microsurface.

Crack Seal

Water that infiltrates the pavement surface softens the pavement structure and allows traffic loads to cause more damage to the pavement than in normal dry conditions. Crack sealing helps prevent water infiltration by sealing cracks in the pavement with asphalt sealant (Figure 5). Ann Arbor seals pavement cracks early in the life of the pavement to keep it functioning as strong as it can and for as long as it can. Crack sealing lasts approximately two years and costs $4,500 per lane mile. Even though it does not last very long compared to other treatments, it does not cost very much compared to other treatments. This makes it a very cost-effective treatment when Ann Arbor looks at what crack filling costs per year of the treatment's life.

Cape Seal

A chip seal, also known as a sealcoat, is a two-part treatment that starts with liquid asphalt sprayed onto the old pavement surface followed by a single layer of small stone chips spread onto the wet liquid asphalt layer (Figure 5). The liquid asphalt seals the pavement from water and debris and holds the stone chips in place, providing a new wearing surface for traffic that can correct friction problems and helping to prevent further surface deterioration. Chip seals are best applied to pavements that are not exhibiting problems with strength, and their purpose is to help preserve that strength. Ann Arbor does not use chip seal alone within the urban environment, rather an additional microsurfacing treatment is added over the chip seal to create a cape seal, which reduces complaints about the loose stones. The unit cost of the cape seal treatment is approximately $150,000 per lane mile, which includes patching of the underlying pavement. This treatment is expected to last five to seven years.

Maintenance Grading and Post Storm Inspection (for Unpaved Roads)

Maintenance grading and post storm inspection involves regrading and adding gravel to unpaved roads to remove isolated potholes, washboarding, and ruts then restoring the compacted crust layer (Figure 6). Crust on an unpaved road is a very tightly compacted surface that sheds water with ease but takes time to be created, so destroying a crusted surface with maintenance grading requires a plan to restore the crust. Maintenance grading and post storm inspections often needs to be performed up to 12 times per year and costs $870 per mile.

Dust Control (for Unpaved Roads)

Dust control involves spraying chloride or other chemicals on a gravel surface to reduce dust loss, aggregate loss, and maintenance (Figure 6). This is a relatively short-term fix that helps create a crusted surface. Chlorides work by attracting moisture from the air and existing gravel. This fix is not effective if the surface is too dry or heavy rain is imminent, so timing is very important. Dust control is done four times per year and each application costs $820 per mile.

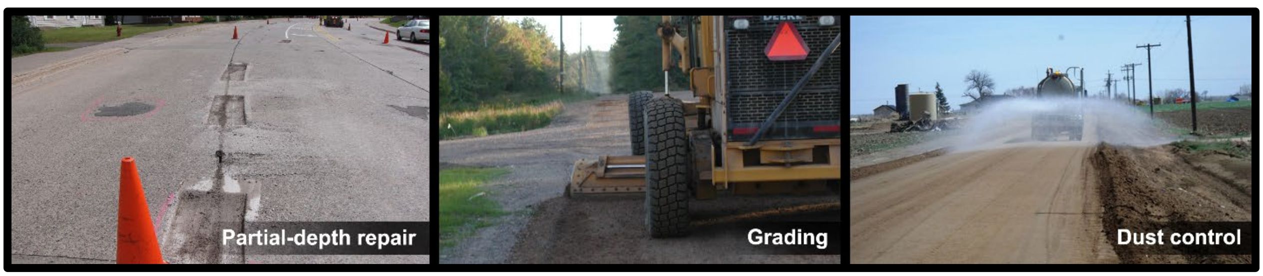


Figure 6: Examples of capital preventive maintenance treatments, cont'd—(from left) concrete road prepared for partial-depth repair, gravel road undergoing maintenance grading, and gravel road receiving dust control application (dust control photo courtesy of Weld County, Colorado, weldgov.com).

Innovative Treatments

Innovative treatments are those newer, unique, non-standard treatments that provide ways of treating pavements using established engineering principles in new and cost-effective ways. Ann Arbor strives to be innovative with its pavement treatments by looking for ways to prevent pavement damage and save taxpayer dollars.

Ann Arbor has occasionally used Stress Absorbing Membrane Interlayers (SAMI) in its resurfacing projects. SAMI treatments typically consist of a chip seal (with or without fibers), which is applied to a milled HMA surface and then covered with another course or two of HMA. This treatment is used on a case-by-case basis typically on thick pavement sections where not all the HMA is being removed in an effort to reduce reflective cracking. The cost for a typical SAMI treatment is $40,000 per lane mile and is expected to extend the life of the pavement an extra three to five years.

Maintenance

Maintenance is the most cost-effective strategy for managing road infrastructure and prevents good and fair roads from reaching the poor category, which require costly rehabilitation and reconstruction treatments to create a year of service life. It is most effective to spend money on routine maintenance and CPM treatments, first; then, when all maintenance project candidates are treated, reconstruction and rehabilitation can be performed as money is available. This strategy is called a “mix-of-fixes” approach to managing pavements.

1. PAVEMENT ASSETS

Building a mile of new road can cost over $1 million due to the large volume of materials and equipment that are necessary. The high cost of constructing road assets underlines the critical nature of properly managing and maintaining the investments made in this vital infrastructure. The specific needs of every mile of road within an agency's overall road network is a complex assessment, especially when considering rapidly changing conditions and the varying requisites of road users; understanding each road-mile's needs is an essential duty of the road-owning agency.

In Michigan, many different governmental units (or agencies) own and maintain roads, so it can be difficult for the public to understand who is responsible for items such as planning and funding construction projects, repairs, traffic control, safety, and winter maintenance for any given road. MDOT is responsible for state trunkline roads, which are typically named with "M", "I", or "US" designations regardless of their geographic location in Michigan. Cities and villages are typically responsible for all public roads within their geographic boundary with the exception of the previously mentioned state trunkline roads managed by MDOT. County road commissions (or departments) are typically responsible for all public roads within the county's geographic boundary, with the exception of those managed by cities, villages, and MDOT.

In cases where non-trunkline roads fall along jurisdictional borders, local and intergovernmental agreements dictate ownership and maintenance responsibility. Quite frequently, roads owned by one agency may be maintained by another agency because of geographic features that make it more cost effective for a neighboring agency to maintain the road instead of the actual road owner. Other times, road-owning agencies may mutually agree to coordinate maintenance activities in order to create economies of scale and take advantage of those efficiencies.

Ann Arbor is responsible for a total of 312 centerline miles of public roads, as shown in Figure 7.

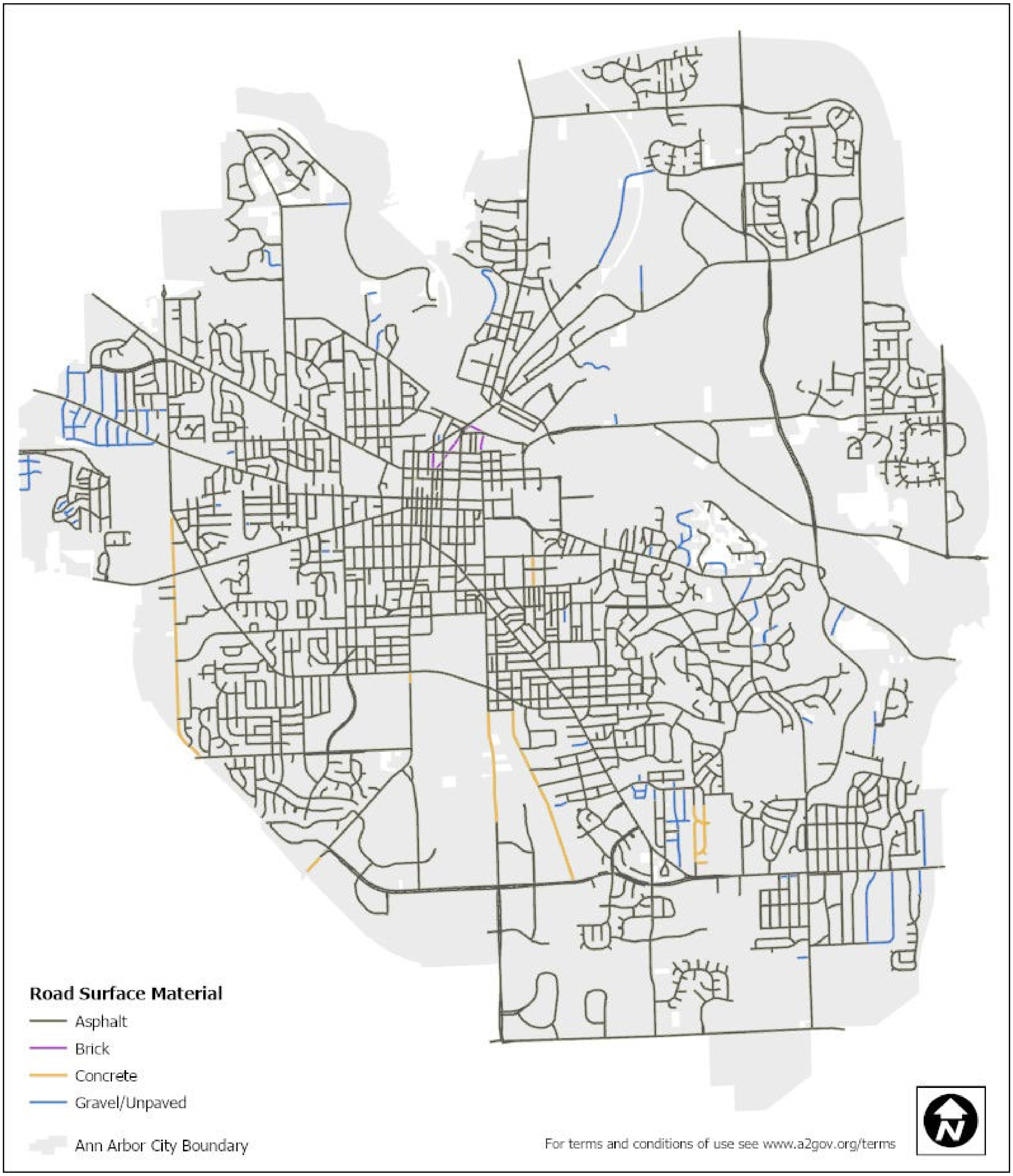


Figure 7: Map showing location of Ann Arbor's paved roads (asphalt, brick and concrete surfaces) as well as the location of Ann Arbor's unpaved roads

Inventory

Michigan Public Act 51 of 1951 (PA 51), which defines how funds from the Michigan Transportation Fund (MTF) are distributed to and spent by road-owning agencies, classifies roads owned by Ann Arbor as either city major or city local roads. State statute prioritizes expenditures on the city major road network, as shown in Figure 8 below.

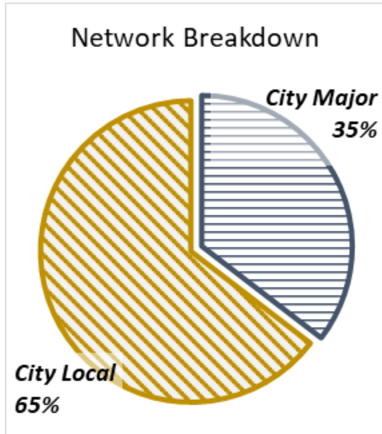


Figure 8: Percentage of city major and city local roads for Ann Arbor.

Ann Arbor manages 27 miles of roads that are part of the National Highway System (NHS)—in other words, those roads that are critical to the nation's economy, defense, and mobility—and monitors and maintains their condition. The NHS is subject to special rules and regulations and has its own performance metrics dictated by the FHWA. While most NHS roads in Michigan are managed by MDOT, Ann Arbor manages a percentage of those roads located in its jurisdiction, as shown in Figure 9.

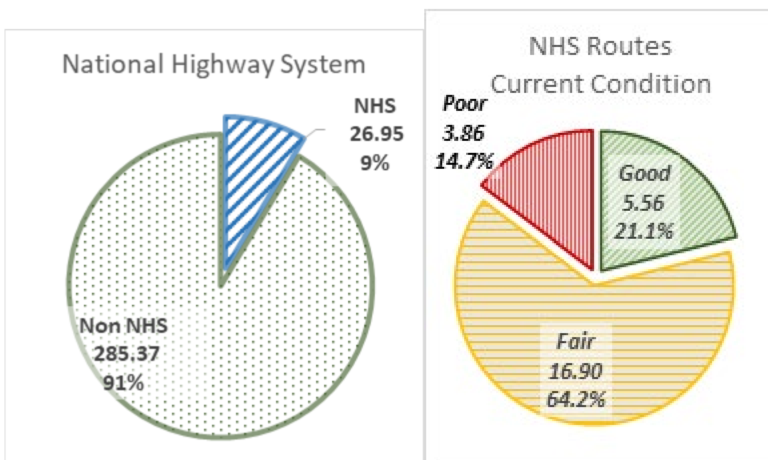


Figure 9: Miles of roads managed by Ann Arbor that are part of the National Highway System and condition.

Ann Arbor also owns and manages 13 miles of unpaved roads.

Types

Ann Arbor has multiple types of pavements in its jurisdiction, including: asphalt, concrete, brick, and composite pavement; it also has unpaved roads (i.e., gravel). Factors influencing pavement type include cost of construction, cost of maintenance, frequency of maintenance, type of maintenance, asset life, and road user experience. More information on pavement types is available in the Introduction's Pavement Primer.

Figure 10 illustrates the percentage of various pavement types that Ann Arbor has in its network..

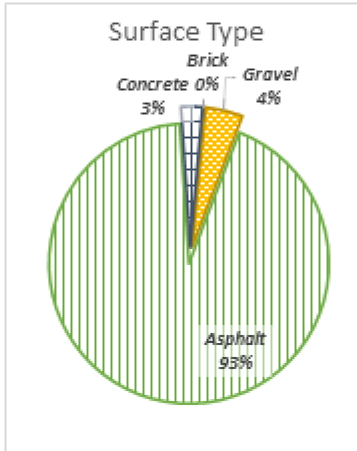


Figure 10: Pavement type by percentage maintained by Ann Arbor. Brick surfaces make up a small fraction of a percentage of Ann Arbor's total road system (<0.5%), and therefore are rounded to zero on the graph above.

Locations

Locations and sizes of each asset can be found in Ann Arbor's Roadsoft database. For more detail, please refer to the agency contact listed in the *Introduction* of this pavement asset management plan.

Condition

The road characteristic that road users most readily notice is pavement condition. Pavement condition is a major factor in determining the most cost-effective treatment—that is, routine maintenance, capital preventive maintenance, or structural improvement—for a given section of pavement. Ann Arbor uses pavement condition and age to anticipate when a specific section of pavement will be a potential candidate for preventive maintenance. Pavement condition data enables Ann Arbor to evaluate the benefits of preventive maintenance projects and to identify the most cost-effective use of road construction and maintenance dollars. Historic pavement condition data can be used to predict future road conditions based on budget constraints and to determine if a road network's condition will improve, stay the same, or degrade at the current or planned investment level. This analysis helps to determine how much additional funding is necessary to meet a network's condition improvement goals. More detail on this topic is included in the Introduction's *Pavement Primer*.

Paved Roads

Ann Arbor is committed to monitoring the condition of its road network and using pavement condition data to drive cost-effective decision-making and preservation of valuable road assets. Ann Arbor uses the Pavement Surface Evaluation and Rating (PASER) system, which has been adopted by the TAMC for measuring statewide pavement conditions, to assess its paved roads. The PASER system provides a simple, efficient, and consistent method for evaluating road condition through visual inspection. More information regarding the PASER system can be found in the Introduction's Pavement Primer.

Ann Arbor collects 100 percent of its PASER data on its entire paved road network every two years.

Ann Arbor's 2021 paved city major road network has 23 percent of roads in the TAMC good condition category, 47 percent in fair, and 30 percent in poor (Figure 11A). The paved city local road network has 20 percent in good, 31 percent in fair, and 50 percent in poor (Figure 11B).

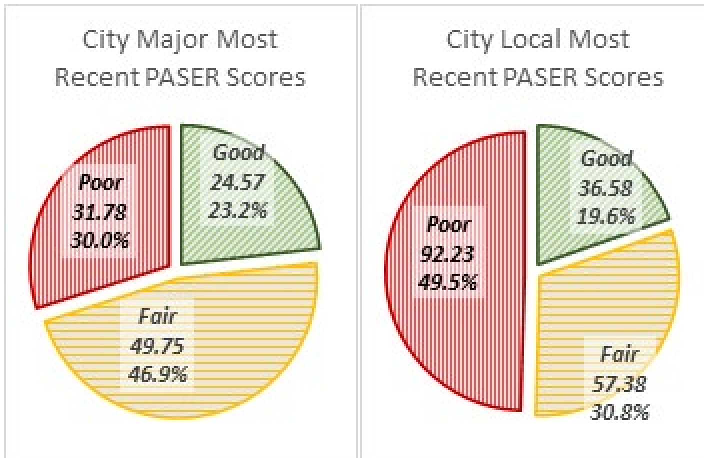


Figure 11: (A) Left: Ann Arbor paved city major road network conditions by miles and percentage of good, fair, or poor, and (B) Right: paved city local road network conditions by miles and percentage of good, fair, or poor. Ratings shown use TAMC definitions.

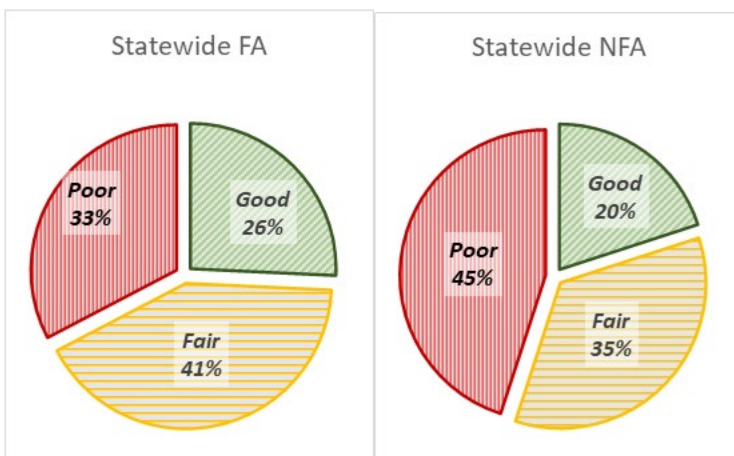


Figure 12: (A) Left: Statewide paved city major road network conditions by percentage of good, fair, or poor, and (B) Right: paved city local road network conditions by percentage of good, fair, or poor

In comparison, the statewide paved city major road network has 26 percent of roads in the TAMC good condition category, 41 percent in fair, and 33 percent in poor (Figure 12A). The statewide paved city local road network has 20 percent in the good condition category, 35 percent in fair, and 45 percent in poor

(Figure 12B). Other road condition graphs can be viewed on the TAMC pavement condition dashboard at: http://www.mcgi.state.mi.us/mitrp/Data/PaserDashboard.aspx.

Comparing Figure 11 and Figure 12 shows that Ann Arbor's paved city major and local road networks are in similar condition to similarly-classified roads in the rest of the state. Over the past decade or so, there has been a heavy focus on improving the condition of Ann Arbor's major road network. This effort has put the major road network in relatively good condition, but to some degree at the expense of the local network. Ann Arbor plans to focus more heavily on improving the local network, which makes up roughly two thirds of the entire network, in coming years.

Figure 13 and Figure 14 show the number of miles for Ann Arbor's roads with PASER scores expressed in TAMC definition categories for the paved city major road network (Figure 13) and the paved city local road network (Figure 14). The TAMC definitions of good-fair-poor pavement condition considers road miles on the transition line between good and fair (PASER 8) and the transition line between fair and poor (PASER 5) as representing parts of the road network where there is a risk of losing the opportunity to apply less expensive treatments that gain significant improvements in service life.

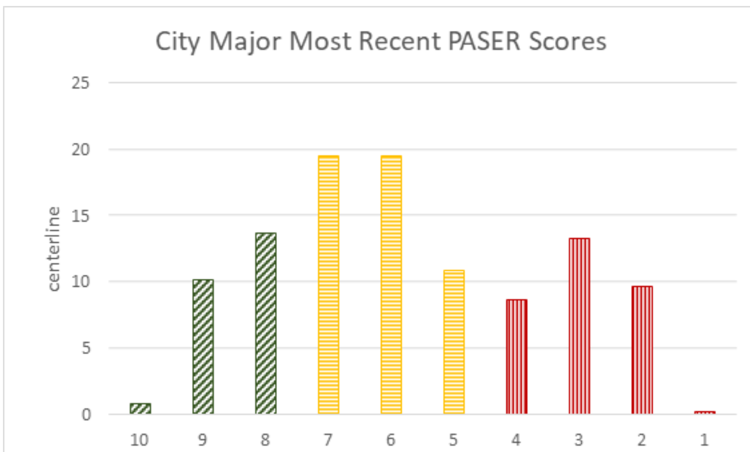


Figure 13: Ann Arbor paved city major road network conditions. Bar graph colors correspond to good/fair/poor TAMC designations.

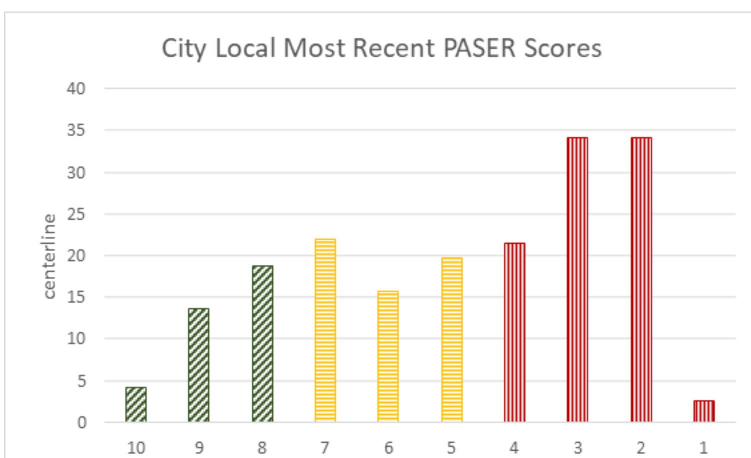


Figure 14: Ann Arbor paved city local network condition by PASER rating. Bar graph colors correspond to good/fair/poor TAMC designations.

Figure 15 provides a map illustrating the geographic location of paved roads and their respective PASER condition. An online version of the most recent PASER data is located at https://www.mcgi.state.mi.us/tamcMap/. Ann Arbor also maintains a public-facing dashboard for its own system, which can be found at www.a2gov.org/a2streets.

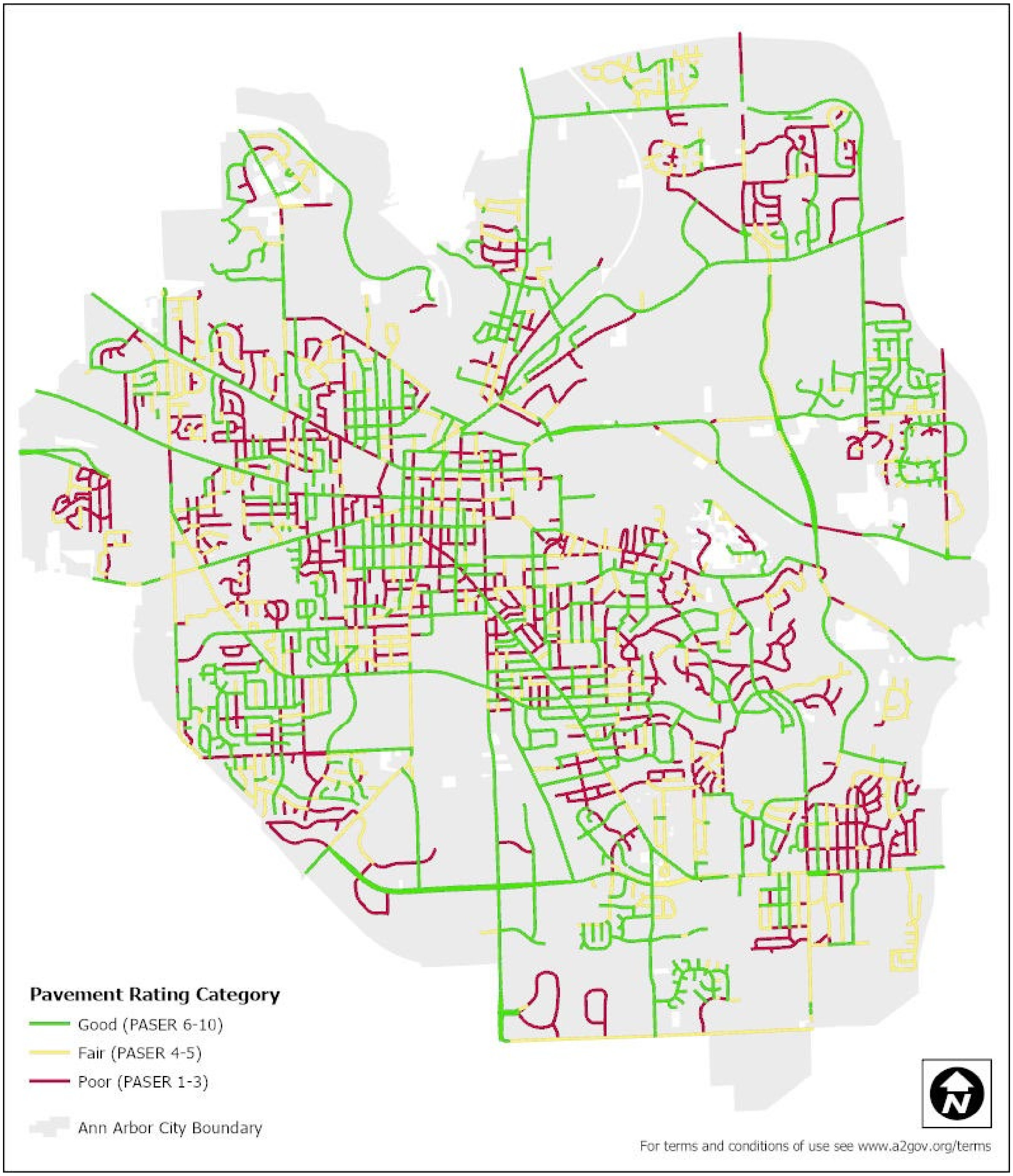


Figure 15: Map of the current paved road condition using the City of Ann Arbor's definitions of Good, Fair and Poor. See 'Goals' section of this report for more information. Good (PASER 6-10) are shown in green, fair (PASER 4-5) are shown in yellow, and poor (PASER 1-3) are shown in red. Only Roads owned by Ann Arbor are shown.

The distribution of Ann Arbor roads along the PASER spectrum shows a mix of good, fair and poor pavement condition. Ann Arbor would like to see more roads in the good and fair categories, and progress is being made towards those goals (for more detail see the "Goals" section of this report). Pavement condition improvement is not moving as quickly as the community would prefer; however, what is possible with the resources available is being achieved. Risks to achieving these goals are headlined by the dramatic increase in construction costs experienced in recent years. Ann Arbor recently issued a Road Bond to accelerate road construction in the near term, which will have a small benefit to the overall improvement of the network condition in the immediate and long term.

In recent years the overall quality of Ann Arbor's paved city major roads have been staying fairly consistent, as can be observed in Figure 16. Although the percentage of roads in good and fair condition has shifted slightly, there haven't been any major swings in the data over the past several years. The cumulative percent of good and fair condition roads vs. poor condition roads is very similar from 2014 to 2021 with a very small overall increase in good and fair conditions. The city has implemented pavement asset management best practices, such as using a mix of fixes approach, to try to make greater progress in pavement condition improvement.

Comparing Ann Arbor's paved city major road condition trends illustrated in Figure 16 with overall statewide condition trends for similarly-classified roads, which are illustrated in Figure 17, shows a similar trend locally as in the rest of the state.

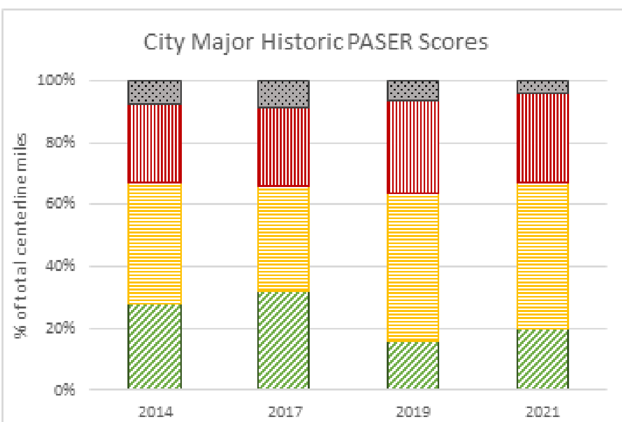


Figure 16: Historical Ann Arbor paved city major road network condition trend

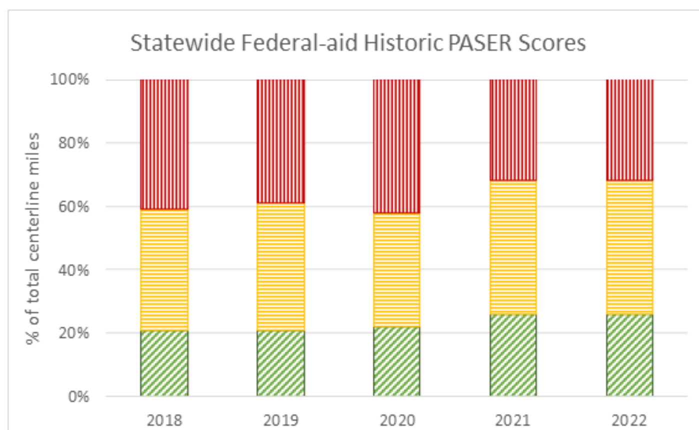


Figure 17: Historical statewide city major road network condition trend

Historically, the overall quality of Ann Arbor's paved city local roads have been decreasing more than the paved city major road network because they lack an adequate source of state and federal funding and therefore must be supported locally. Figure 18 illustrates the condition of the paved city local road network in Ann Arbor while Figure 19 illustrates these conditions statewide.

Comparing Ann Arbor's paved city local road condition trends illustrated in Figure 18 with overall statewide condition trends for all paved city local roads illustrated in Figure 19 indicates a similar trend locally as in the rest of the state. The current condition of Ann Arbor's local road network is comparable to the statewide average, although Ann Arbor started with a higher quality network, comparatively, several years ago. While the statewide has shown improvement to pavement quality over time, the condition of the Ann Arbor local network has decreased over time. The city's recent decision to issue a road bond is intended to front load investment to have a more significant impact on pavement condition in the near term. Also, more resources focused toward the local network in coming years will improve the condition of that network.

The percentage of Ann Arbor's Local streets in Poor condition continues to exceed that of the Major street system, indicative of the far greater mileage of Local streets to be repaired and maintained and the historically lower investment in this portion of the system.

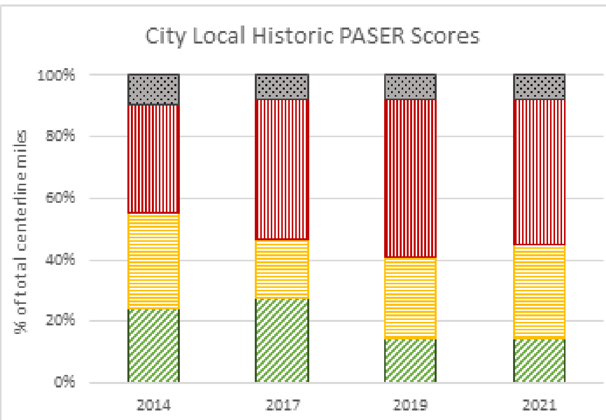


Figure 18: Historical Ann Arbor paved city local road network condition trend

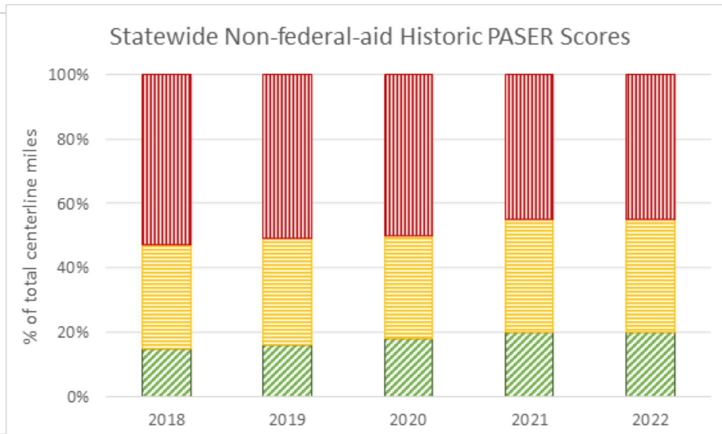


Figure 19: Historical statewide city local road network condition trend

Unpaved Roads

The condition of unpaved roads can be rapidly changing, which makes it difficult to obtain a consistent surface condition rating over the course of weeks or even days. The TAMC adopted the Inventory Based Rating (IBR) System™ for rating unpaved roads. More information regarding the IBR System™ can be found in the Introduction's Pavement Primer. Historically the City of Ann Arbor has not collected ratings for gravel roads. However, Ann Arbor plans to rate its gravel roads for the first time using the IBR system during the summer or fall of 2023. This data will be incorporated into future Pavement Asset Management Plans.

Ann Arbor's gravel roads consist almost entirely of single-family residential areas. Often, they are found between "gaps" in the paved network, and in some cases in larger neighborhoods that are mostly or entirely unpaved.

Goals

Goals help set expectations to how pavement conditions will change in the future. Pavement condition changes are influenced by water infiltration, soil conditions, sunlight exposure, traffic loading, and repair work performed. Ann Arbor is not able to control any of these factors fully due to seasonal weather changes, traffic pattern changes, and its limited budget. In spite of the uncontrollable variables, it is still important to set realistic network condition goals that efficiently use budget resources to build and maintain roads meeting taxpayer expectations. An assessment of the progress toward these goals is provided in the *1. Pavement Assets*: *Gap Analysis* section of this plan.

Ann Arbor uses modified definitions of "good", "fair", and "poor" in the PASER system, as identified in the Table 1. Ann Arbor feels these definitions better group pavement condition (i.e., PASER score) with the treatment types that are typically used in our community. The Goals discussed for Ann Arbor in this section are based on the City of Ann Arbor definitions for "good", "fair", and "poor" pavement condition.

	TAMC Statewide Definition	**City of Ann Arbor Definition**	**Treatment Type**
Good	PASER 8-10	PASER 6-10	Crack Sealing/other minor maintenance
Fair	PASER 5-7	PASER 4-5	Capital Preventative Maintenance and/or Partial-Depth Resurfacing
Poor	PASER 1-4	PASER 1-3	Full-Depth Rehabilitation or Reconstruction

Table 1: Ann Arbor Definitions of Good, Fair, Poor PASER Ratings

Goals for Paved City Major and Local Roads

The overall goal for Ann Arbor's paved city major and local road network is to maintain or improve road conditions network-wide at 2021 levels

Ann Arbor's network-level pavement condition strategy for paved city major roads includes the following intermediate goals to be achieved by 2026:

1. Minimum 60% of roads in good condition (PASER 6-10) by 2026
2. Maximum 20% of roads in poor condition (PASER 1-3) by 2026
3. Average PASER score of 5.80 or greater

Ann Arbor's network-level pavement condition strategy for paved city local roads includes the following intermediate goals to be achieved by 2026:

4. Minimum 45% of roads in good condition (PASER 6-10)
5. Maximum 39% of roads in poor condition (PASER 1-3)
6. Average PASER score of 5.24 or greater

Interim goals for City Local and City Major roads are identified for 2026 based on what is achievable with current financial resources, however these goals do not represent satisfactory long-term conditions for the users of the system. Following the next round of PASER data collection (Fall of 2023), additional long-term goals will be established, with the intent of continuing to improve pavement conditions into the future.

Goals for Unpaved Roads

The City of Ann Arbor will collect baseline condition ratings for gravel roads for the first time during the summer or fall of 2023. This data will be incorporated into future Pavement Asset Management Plans and will be used to identify future goals.

Modelled Trends

Roads age and deteriorate just like any other asset. All pavements are damaged by water, traffic weight, freeze/thaw cycles, sunlight, and traffic weight. To offset natural deterioration and normal wear-and-tear on the road, Ann Arbor must complete treatment projects that either protect and/or add life to its pavements. The year-end condition of the whole network depends upon changes or preservation of individual road section condition that preservation treatments have affected.

Ann Arbor uses many types of repair treatments for its roads, each selected to balance costs, benefits, and road life expectancy. When agency trends are modelled, any gap between goals and accomplishable work becomes evident. Financial resources influence how much work can be accomplished across the network within agency budget and what treatments and strategies can be afforded; a full discussion of Ann Arbor's financial resources can be found in the *5. Financial Resources* section.

Treatments and strategies that counter pavement-damaging forces include reconstruction, structural improvement, capital preventive maintenance, innovative treatments, and maintenance. For a complete discussion on the pavement treatment tools, refer to the *1. Introduction*'s *Pavement Primer*.

Correlating with each PASER score range are specific types of treatments best performed either to protect the pavement (CPM) or to add strength back into the pavement (structural improvement). Table 2 provides a comprehensive list of potential treatment types; the treatments most common in Ann Arbor are detailed in the *1. Introduction*'s *Pavement Primer*. MDOT provides guidance regarding when a specific pavement may be a candidate for a particular treatment. These identified PASER scores "trigger" the timing of projects appropriately to direct the right pavement fix at the right time, thereby providing the best chance for a successful project. The information provided in Table 2 is a guide for identifying potential projects; however, this table should not be the sole criteria for pavement treatment selection. Other information such as future development, traffic volume, utility projects, and budget play a role in project selection. This table should not be a substitute for engineering judgement.

Table 2: Service Life Extension (in Years) for Pavement Types Gained by Fix Type[1]				
	Life Extension (in years)*			
Fix Type	**Flexible**	**Composite**	**Rigid**	**PASER**
HMA crack treatment	1-3	1-3	N/A	6-7
Overband crack filling	1-2	1-2	N/A	6-7
One course non-structural HMA overlay	5-7	4-7	N/A	4-5****
Mill and one course non-structural HMA overlay	5-7	4-7	N/A	3-5
Single course chip seal	3-6	N/A	N/A	5-7†
Double chip seal	4-7	3-6	N/A	5-7†
Single course microsurface	3-5	**	N/A	5-6
Multiple course microsurface	4-6	**	N/A	4-6****
Ultra-thin HMA overlay	3-6	3-6	N/A	4-6****
Paver placed surface seal	4-6	**	N/A	5-7
Full-depth concrete repair	N/A	N/A	3-10	4-5***
Concrete joint resealing	N/A	N/A	1-3	5-8
Concrete spall repair	N/A	N/A	1-3	5-7
Concrete crack sealing	N/A	N/A	1-3	4-7
Diamond grinding	N/A	N/A	3-5	4-6
Dowel bar retrofit	N/A	N/A	2-3	3-5***
Longitudinal HMA wedge/scratch coat with surface treatment	3-7	N/A	N/A	3-5****
Flexible patching	**	**	N/A	N/A
Mastic joint repair	1-3	1-3	N/A	4-7
Cape seal	4-7	4-7	N/A	4-7
Flexible interlayer "A"	4-7	4-7	N/A	4-7
Flexible interlayer "B" (SAMI)	4-7	4-7	N/A	3-7
Flexible interlayer "C"	4-7	4-7	N/A	3-7
Fiber reinforced flexible membrane	4-7	4-7	N/A	3-7
Fog seal	**	**	N/A	7-10
GSB 88	**	**	N/A	7-10
Mastic surface treatment	**	**	N/A	7-10
Scrub seal	**	**	N/A	4-8
* The time range is the expected life extending benefit given to the pavement, not the anticipated longevity of the treatment.				
** Data is not available to quantify the life extension.				
*** The concrete slabs must be in fair to good condition.				
**** Can be used on a pavement with a PASER equal to 3 when the sole reason for rating is rutting or severe raveling of the surface asphalt layer.				
† For PASER 4 or less providing structural soundness exists and that additional pre-treatment will be required for example, wedging, bar seals, spot double chip seals, injection spray patching or other pre-treatments.				
[1] Part of Appendix D-1 from *MDOT Local Agency Programs Guidelines for Geometrics on Local Agency Projects* 2017 Edition Approved Preventive Maintenance Treatments				

In addition to these triggers and the considerations already mentioned for project selection, the City of Ann Arbor has a well-developed Capital Improvements Program to guide staff through a systematic approach to planning upcoming pavement condition improvement projects.

Capital Improvements Program

The City of Ann Arbor plans for and selects road projects through the Capital Improvements Plan (CIP) process. The CIP is a six-year schedule of public service expenditures, that is updated annually. It is a planning tool for large, physical improvements that are permanent in nature, including the basic facilities, services, and installations needed for a community to function. More information about the CIP process is available at a2gov.org/CIP and an interactive map of the currently planned CIP projects is available at a2gov.org/a2CIPmap.

Staff identify capital projects based on comprehensive planning efforts, maintenance history, inspections, risk of failure, regulatory compliance needs, and long-term asset management planning. Within the Street Construction asset group, CIP projects are planned consistent with the needs identified in this Pavement Asset Management Plan. Pavement-related projects are also planned for within the Other Transportation asset group, and in coordination with the Utility asset groups (Sanitary, Stormwater and Water). The CIP process provides a thorough analysis of our system needs and includes checks and balances to ensure that underground utilities needs are addressed in advance of, or in coordination with, surface-level pavement condition improvements. This systematic approach helps us to avoid cutting into newer pavement to address utility needs.

Each capital project is scored and prioritized based on defined metrics, as shown in Figure 20 and 21. Substantial weight is placed on the value of advancing the goals of Pavement Asset Management Plan and consideration is given to existing pavement condition. This scoring process helps staff determine a priority ranked listing of projects which is considered in the project programming process in addition to coordination with other projects and availability of funding.

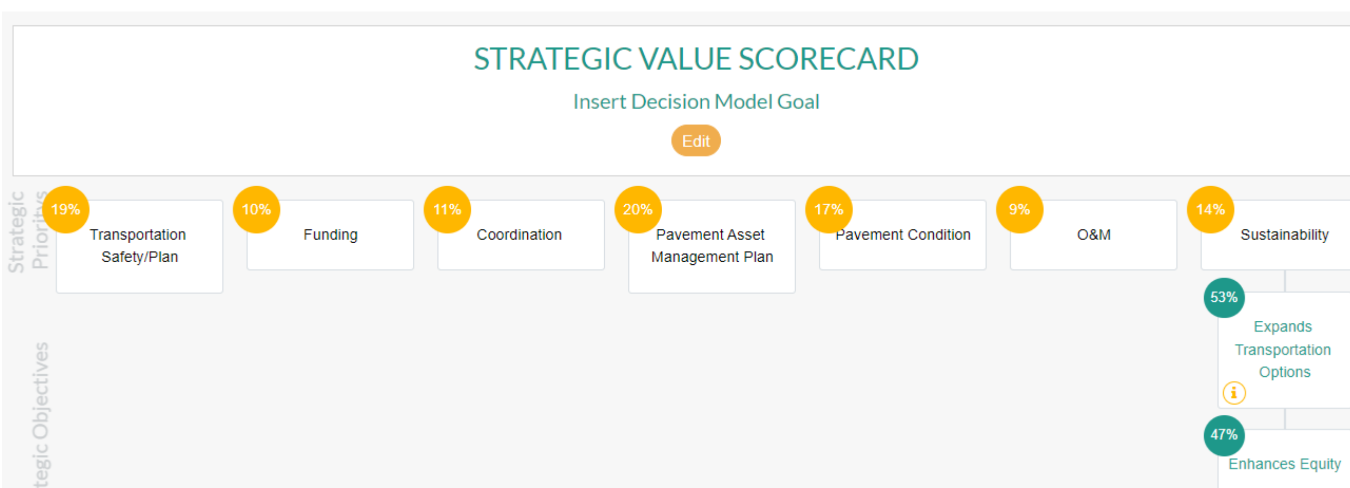


Figure 20: The Street Construction asset group Strategic Value Scorecard shows the prioritization criteria and weights. Each street construction is evaluated based on these criteria to help determine when the project needs to be completed.

City of Ann Arbor CIP 2022 - Street Construction

Priority	Objective			
Transportation Safety/ Plan		Includes minor improvements that may improve transportation safety	Includes project elements that have a significant positive impact to transportation safety OR implements a Tier 2 improvement in the transportation plan	Project is being driven by a transportation safety need OR implements a Tier 1 improvement in the transportation plan
Funding		Funding is identified from unstable/unreliable sources (i.e. General Fund, Special Assessments, Competitive Grants that are not yet awarded)	Funding available from standard City funding sources (i.e. Act 51, Street Millage, County Millage).	Has anticipated substantial project funding (>33%) from outside non-loan sources (i.e. STP, U of M, Developers, Grants, etc.)
Coordination		A project that has minimal interaction with other asset groups	A project that is coordinated with other asset groups resulting Modest in cost savings and minimizes disruption to the public OR has partnership with external agencies that minimize disruption to the public AND/OR provides opportunity to increase consistency across jurisdictional boundary	A project that is coordinated with other asset groups resulting in Significant cost savings and minimizes disruption to the public OR has partnership with external agencies that minimize disruption to the public AND/OR provides opportunity to increase consistency across jurisdictional boundary
Pavement Asset Management Plan		No significant contribution to the plan	Modestly aligns with plan (utility driven projects that require higher treatment level than what the plan specifies)	Significantly aligns with plan (matches recommended annual investment level)
Pavement Condition		PASER score 9+	PASER score 5	PASER score 1
O&M		Creates a net increase (i.e. adds facilities) in O&M	Makes a modest contribution to O&M cost reduction (i.e. nonstructural improvements)	Makes a significant contribution to O&M cost reduction (i.e. structural improvements)
Sustainability	**Expands Transportation Options**	Maintains or improves existing active transportation and/or transit features	Adds active transportation and/or transit features	Prioritizes active transportation and transit
	Enhances Equity	Project occurs in a neighborhood with a low percentage of households in poverty (less than 5%)	Project occurs in a neighborhood with a moderate percentage of households in poverty (5- less than 10%)	Project occurs in a neighborhood with a high percentage of households in poverty (greater than 10%) https://headwaterseconomics.org/tools/neighborhoods-at-risk/

Figure 21: Detailed definitions of the Street Construction asset group prioritization metrics provide guidance for staff evaluators to determine where along the continuum each project scores.

Roadsoft Pavement Condition Forecast of Future Trends

Ann Arbor uses Roadsoft, an asset management software suite, to manage road- and bridge-related infrastructure. Roadsoft is developed by Michigan Technological University and is available for Michigan local agencies at no cost to them. Roadsoft uses pavement condition data to drive network-level deterioration models that forecast future road conditions based on planned construction and maintenance work.

Paved City Major Roads

The network-level Strategy Comprehensive Report on the paved city major road networks is shown in Appendix D as part of the OHM report. The Strategy Comprehensive Report includes the treatments and the average treatment volume of future projects that should be scheduled to achieve the City's defined goals. See Appendix A of this plan for details on planned projects.

Results from the Roadsoft network condition model for the city major roads are shown in Appendix D. The Roadsoft network analysis of Ann Arbor's planned projects from its currently-available budget does allow Ann Arbor to reach its pavement condition goals given the projects planned through 2026; for more information see the Goals section of this report.

Paved City Local Road

The network-level Strategy Comprehensive Report on the paved city local road networks is shown in Appendix D as part of the OHM report. The Strategy Comprehensive Report includes the treatments and the average treatment volume of future projects that should be scheduled to achieve the City's defined goals. See Appendix A of this plan for details on planned projects.

Results from the Roadsoft network condition model for the city local roads are shown in Appendix D. The Roadsoft network analysis of Ann Arbor's planned projects from its currently-available budget does allow Ann Arbor to reach its pavement condition goals given the projects planned for 2026; for more information see the Goals section of this report.

Because Ann Arbor's local street pavement condition has shown a decrease in overall condition over the past several years, Ann Arbor has planned investments focusing on improving pavement condition for the local system, which makes up two-thirds of the entire network. Fortunately, Ann Arbor's Street Millage provides flexibility in its ability to direct funding toward the major and/or local street network. During this period of focus on restoring the local street pavement condition, the major street network will likely experiencea slight decrease in overall condition.

Planned Projects

Ann Arbor plans major construction projects several years in advance. A multi-year planning threshold is required due to the time necessary to plan, design, and finance construction and maintenance projects on the paved city major road network. This includes planning and programming requirements from state and federal agencies that must be met prior to starting a project and can include studies on environmental and archeological impacts, review of construction and design documents and plans, documentation of rights-of-way ownership, planning and permitting for stormwater discharges, and other regulatory and administrative requirements.

Per PA 499 of 2002 (later amended by PA 199 of 2007), road projects for the upcoming three years are required to be reported annually to the TAMC. Planned projects represent the best estimate of future activity; however, changes in design, funding, and permitting may require Ann Arbor to alter initial plans. Project planning information is used to predict the future condition of the road networks that Ann Arbor maintains. The *1. Pavement Assets*: *Modelled Trends* section of this plan provides a detailed analysis of the impact of the proposed projects on their respective road networks.

For 2024-2026, Ann Arbor plans to do the following projects:

Paved City Major Projects

Ann Arbor is currently planning the construction and maintenance projects listed in Appendix A for the paved city major road network. The locations of these projects are shown in Figure 22. The total cost of pavement design and construction aspects of these projects is approximately $30,000,000. Cost estimates do not include dollars dedicated for active transportation improvements or utility improvements (water, sanitary or storm).

Paved City Local Projects

Ann Arbor is currently planning the construction and maintenance projects listed in Appendix B for the paved city local road network. The locations of these projects are shown in Figure 22. The total cost of pavement design and construction aspects of these projects is approximately $27,000,000 . Cost estimates do not include dollars dedicated for active transportation improvements or utility improvements (water, sanitary or storm).

Unpaved Road Projects

Ann Arbor is not currently planning any specific construction projects for the unpaved road network. The City of Ann Arbor does not have an established asset management plan for our gravel roads

General maintenance is performed with an average annual budget of $179,000 per year. The City is completing a stormwater study that will provide guidance and recommendations for areas where ditches do not currently exist. The City is also completing a gravel road condition assessment in fall 2023. Once the condition data has been collected needs will be reevaluated.

More detailed information on these projects can be found in Appendix A and B.

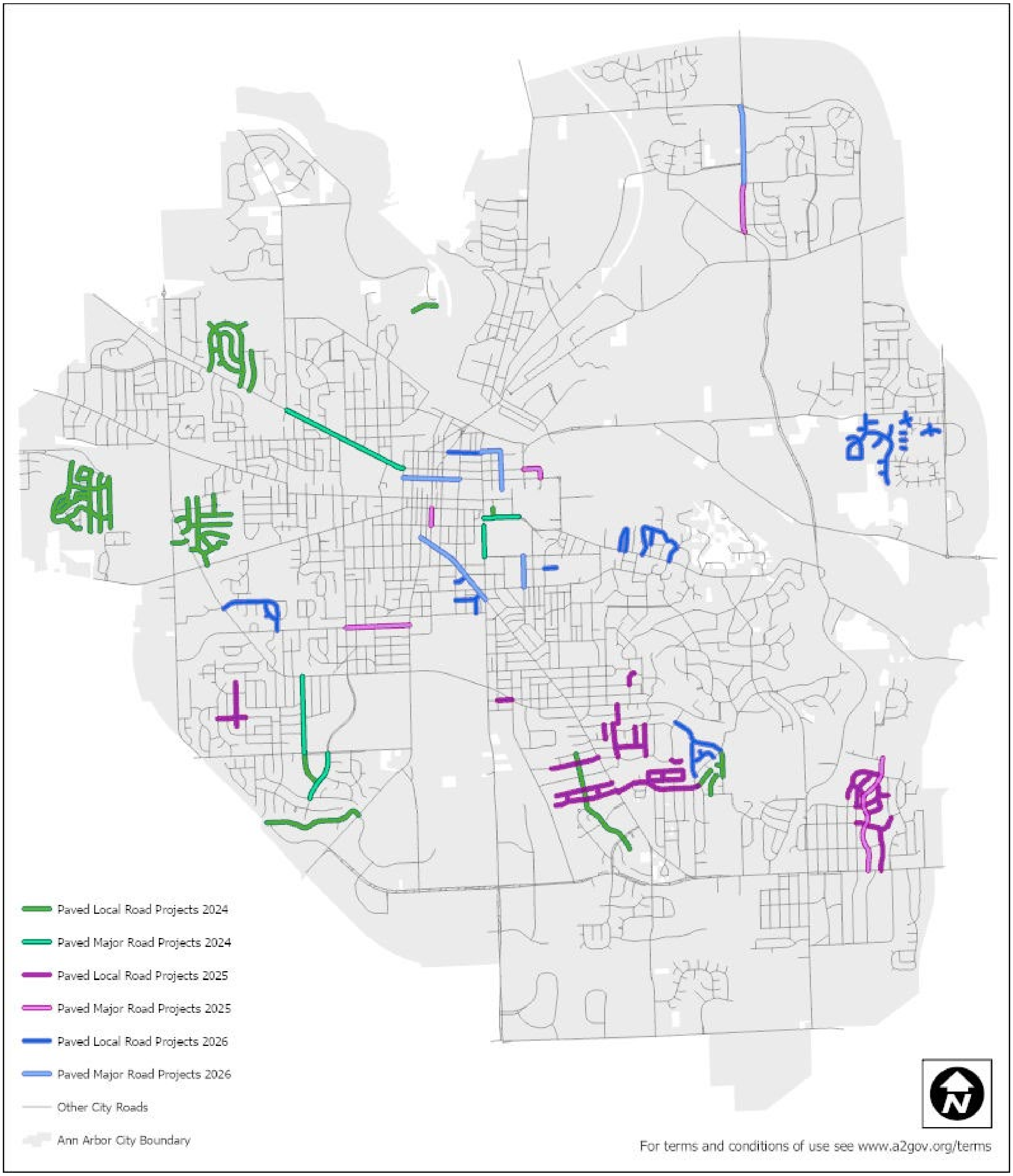


Figure 22: Map showing paved city local and major road projects planned for 2024-2026. Does not include Capital Preventative Maintenance project locations; specific project locations are not yet identified for future years.

Gap Analysis

Ann Arbor has set goals based on what can be realistically achieved with the resources available. The current intermediate goals do not reflect the pavement condition desired by the community. Ann Arbor will collect updated PASER ratings in 2023 and will reevaluate goals at that time. This will result in setting longer term goals to address what is needed to reach the pavement condition desire by the community. The *1. Pavement Assets*: *Goals* section of this plan provides further detail about the goals and the *1. Pavement Assets*: *Modelled Trends* section provides further detail on the current budget. Ann Arbor believes that the overall condition of this network can be maintained or improved with additional funding for construction and maintenance.

Roadsoft Pavement Condition Forecast for the Paved City Network

Ann Arbor hired OHM Advisors to model the City's road network, forecast using Roadsoft, and assist in establishing realistic goals.The summary report from OHM is included in Appendix D.

OHM analyzed the Roadsoft model and determined the projected network distribution for the paved city major and local road networks, which are shown in Figure 23 and 24 below.

Local Road Network

Paser Rating	2021/2022	Forecasted Model in 2026
6-10	36%	49%
4-5	25%	19%
1-3	39%	32%
	100%	100%
Average PASER	4.74	5.38

Major Road Network

Paser Rating	2021/2022	Forecasted Model in 2026
6-10	58%	65%
4-5	20%	17%
1-3	22%	18%
	100%	100%
Average PASER	5.67	6.07

Figure 23: Forecast good (PASER 6-10)/fair (PASER 4-5)/poor (PASER 1-3) using Ann Arbor's definitions of good-fair-poor PASER ratings. Changes to Ann Arbor Network Condition from 2021/2022 to 2026 for the city major and local paved road networks.

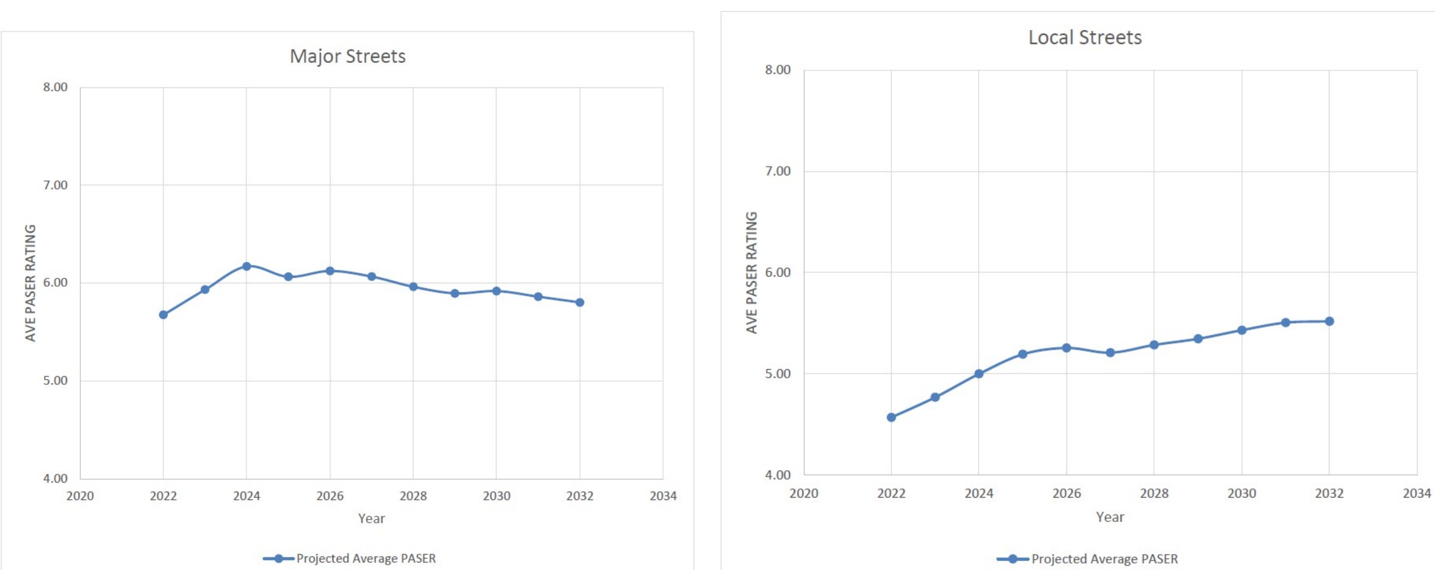


Figure 24: Forecasted Average PASER rating for Ann Arbor city major and local paved road networks.

2. FINANCIAL RESOURCES

Public entities must balance the quality and extent of services they can provide with the tax resources provided by citizens and businesses, all while maximizing how efficiently funds are used. Ann Arbor will overview its general expenditures and financial resources currently devoted to pavement maintenance and construction. This financial information is not intended to be a full financial disclosure or a formal report. Michigan agencies are required to submit an Act 51 Report to the Michigan Department of Transportation each year; this is a full financial report that outlines revenues and expenditures. This report can be obtained on our website at a2gov.org.

Ann Arbor has an average annual budget for pavement asset management of $21 million.

Many local agencies in Michigan use local tax millages to supplement their road-funding budget. These taxes can provide for additional construction and maintenance for new or existing roads that are also funded using MTF or MDOT funds. Ann Arbor has a Street, Bridge and Sidewalk Millage, which provides 2.125 mils of revenue. The intent of this millage is to provide funding for the repair and maintenance of the City's network of streets, bridges, and sidewalks.

City Major Network

Ann Arbor has historically (over the past three years) spent approximately $9 million annually on pavement-related projects. Over the next three years, Ann Arbor plans to spend approximately $10 million on city major-network projects consisting of, but not limited to, reconstruction, overlay, culvert replacement, and preventive maintenance. Spending on projects depends on revenue from Michigan Transportation Fund (MTF), bonds, millages, and federal/state programs, and can sometimes vary considerably from year to year.

City Local Network

Ann Arbor has historically (over the past three years) spent $12,015,162 annually on pavement-related projects, although this figure is skewed due to recent road bond issue. Over the next three years, Ann Arbor plans to spend an average of $9.5 million annually on city local-network projects consisting primarily of, but not limited to, rehabilitations and capital preventive maintenance. Spending on projects depends on revenue from Michigan Transportation Fund (MTF), bonds, millages, and federal/state programs.

General Sources of Funding for Lifecycle Costs

Responsibility for management of the City's pavement assets is shared among different areas of the City. Allocating of responsibilities and funds occurs principally as follows:

a. Act 51 monies have traditionally been administered by the City's Public Works Unit for a broad range of street maintenance functions. These include snow plowing, street sweeping, maintenance of pedestrian facilities, patching potholes, and maintaining signs, signals, streetlights, and pedestrian crossings. This Unit also responds to other street related repair requests generated by citizens through the City's A2FixIt web application. The City's Engineering Unit utilizes Act 51 monies to maintain the street pavement marking system and to perform targeted capital preventive maintenance functions.

b. Since 1984, voters of the City have approved a street millage, monies from which have traditionally been utilized for street resurfacing and reconstruction projects. These funds are managed by the City's Engineering Unit under the direction of the City Engineer/Street Administrator.

c. In 2013, an Annual Capital Preventive Maintenance fund was carved out from within street millage and Act 51 funds to foster greater consideration of capital preventive maintenance treatment alternatives which go beyond the level of routine maintenance, but which stop short of rehabilitation or reconstruction.

d. In 2017, and again in 2019, Washtenaw County passed a Roads and Non-Motorized millage. The City receives approximately two million dollars in revenue annually from this millage and allocates approximately $500,000 of those funds to non-motorized improvements. Note that this funding is currently only programmed through 2024, pending renewal of the millage.

e. The City actively seeks grants and other outside funds from sources such as STP-Urban funds, CMAQ funds, TAP funds, and other sources. These funds are sought primarily to acquire monies for significant reconstruction projects on major roads or to address safety projects.

3. RISK OF FAILURE ANALYSIS

Transportation infrastructure is designed to be resilient. The system of interconnecting roads and bridges maintained by Ann Arbor provides road users with multiple alternate options in the event of an unplanned disruption of one part of the system. There are, however, key links in the transportation system that may cause significant inconvenience to users if they are unexpectedly closed to traffic. Figure 25 illustrates the key transportation links in Ann Arbor's road network, including those that meet the following types of situations:

- **Geographic divides:** Areas where a geographic feature (river, lake, mountain or limited access road) limits crossing points of the feature
- **Emergency alternate routes for high-volume roads:** Roads which are routinely used as alternate routes for high volume roads or roads that are included in an emergency response plan
- **Limited access areas:** Roads that serve remote or limited access areas that result in long detours if closed
- **Main access to key commercial districts:** Areas where large number or large size business will be significantly impacted if a road is unavailable.

Our road network includes the key links as shown in Table 3.

Name	Limit1	Limit2	Reason
Jackson Rd EB	Wagner Rd	Lakeview Dr	High Volume; Freeway Xchange; Limited residential access
Jackson Rd WB	Wagner Rd	Lakeview Dr	High Volume; Freeway Xchange; Limited residential access
Jackson Ave	Lakeview Dr	W Huron St	High Volume; Freeway Xchange

W Huron St	Jackson Ave	E Huron St	High Volume; Commercial Area
E Huron St	W Huron St	Washtenaw Ave	High Volume; Commercial Area
Washtenaw Ave	E Huron St	E Stadium Blvd	High Volume
Washtenaw Ave	E Stadium Blvd	City Limit/Yost Blvd	High Volume; Freeway Xchange
N Main St	M-14	Huron St	High Volume; Freeway Xchange; Commercial Area
Ann Arbor Saline Rd	S Main St	City Limit/I-94	High Volume; Freeway Xchange
Broadway St	Beakes St/N Division St	Swift St	High Volume; River and Rail Divide
Plymouth Rd	Broadway St	US-23	High Volume; Commercial area
E Stadium Blvd	S Main St	S Industrial Hwy	Rail Divide; High Volume
Huron Pkwy	Fuller Rd/Geddes Rd	Geddes Ave	River and rail divide
E Eisenhower Pkwy	S State St	S Industrial Hwy	Rail Divide; Commercial area; Volume
S State St	E Eisenhower Pkwy	E Ellsworth Rd	Volume; Freeway divide; Commercial area
Glen/Fuller St	E Huron St	Beal Ave	Volume; Hospital access; River and rail divides; Bridges
Huron Pkwy/Platt Rd	Washtenaw Ave	E Ellsworth Rd	Volume; Freeway divide
Packard Rd	E Eisenhower Pkwy	US-23	Volume; Freeway divide
Stone School Rd	Packard St	E Ellsworth Rd	Volume; Freeway divide
S State St	W Huron St	E Eisenhower Pkwy	Volume; Rail divide; Commercial Area
Scio Church Rd	S Maple Rd	S Main St	Volume; Freeway divide
Barton Dr	Whitmore Lake Rd	Pontiac Trail	Freeway divide
Depot St	N Main St	Glen/Fuller St	Volume; Hospital and Train access
Maiden Lane	Plymouth Rd	Medical Center Dr	River and rail divide; Hospital access
Geddes Rd	Huron Pkwy	US-23	Volume; Freeway divide
Liberty St	City Limit	W Stadium Blvd	Freeway divide; Residential access; Volume
Miller Ave	City Limit	N Maple	Volume; Freeway divide
Newport Rd	City Limit	Miller Ave	Freeway divide; Residential access; Volume

Table 3: Ann Arbor's Key Transportation Links

Although the listing provides various areas that could be considered "key links", the Ann Arbor road network has a significant level of redundancy and a well-connected grid network that avoids mobility and circulation challenges in the event of a failure on any particular route. This duplication within the system ensures that alternate routes are available and avoids catastrophic disruptions to the system.

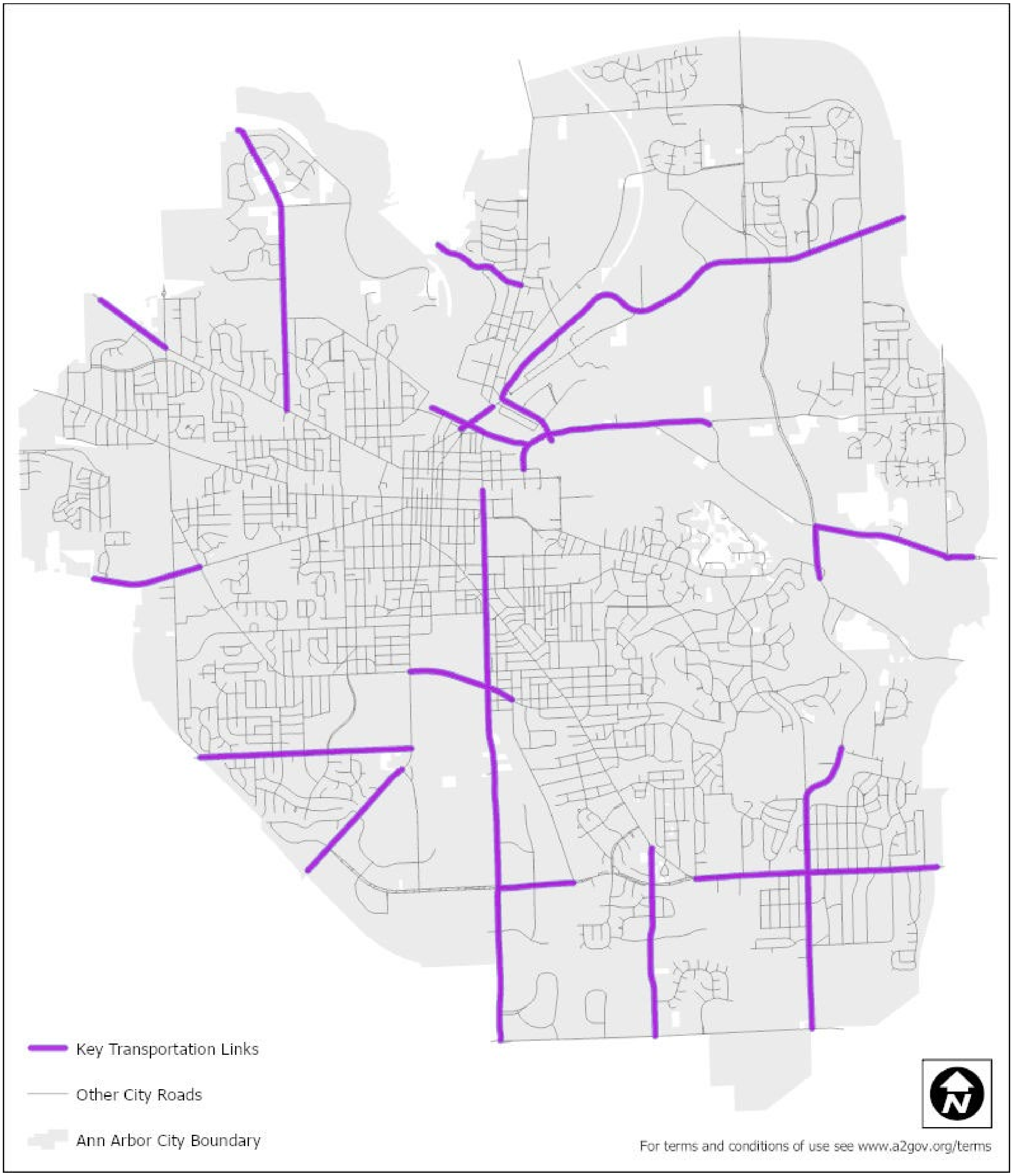


Figure 25: Key transportation links in Ann Arbor's road network

4. COORDINATION WITH OTHER ENTITIES

An asset management plan provides a significant value for infrastructure owners because it serves as a platform to engage other infrastructure owners using the same shared right of way space. Ann Arbor communicates with both public and private infrastructure owners to coordinate work.

Coordinated Planning for City Assets

Ann Arbor maintains drinking water, sanitary and stormwater assets in addition to transportation assets. Ann Arbor follows an asset management process for all of its assets by coordinating the upgrade, maintenance, and operation of all major assets.

All major infrastructure projects for public service assets are planned for and coordinated through the Capital Improvements Program (CIP). Priority projects are identified through coordinated planning efforts across multiple asset groups that collectively share the right-of-way space. This includes, but is not limited to, street construction, underground utility projects (stormwater, sanitary and water), active transportation such as sidewalk and bike infrastructure, and other transportation projects within the right of way.

Each asset group identifies project needs, scores each one based on defined metrics, and the Ann Arbor staff programs projects with heavy consideration to coordinating work within a shared space. Over 70 staff across the City of Ann Arbor are involved in the CIP process, plus representatives from other entities such as the Ann Arbor Housing Commission, the Downtown Development Authority, the University of Michigan, and the Ann Arbor Area Transit Authority.

Broad participation in the CIP process enables open communication about upcoming projects and provides the opportunity to maximize efficiency and minimize community disruption by addressing the complete needs in a specific area at one time. In particular, sub-surface utility plans are coordinated with the transportation infrastructure plans to maximize value and minimize service disruptions and cost to the public.

Ann Arbor takes advantage of coordinated infrastructure work to reduce cost and maximize value using the following guiding principles:

- Roads which are in poor condition that have a subsurface infrastructure project planned will be rehabilitated full-width using transportation funds.
- Subsurface infrastructure projects which will cause damage to pavements in good to fair condition will be delayed as long as possible, or will consider methods that do not require excessive pavement cuts. If the underground utility project must move forward on a pavement in good or fair condition, the road will be rehabilitated using utility funds.

In addition to the CIP process, project needs are identified and planned for through Ann Arbor's asset management plans and comprehensive planning documents, which includes:

- Drinking water distribution system asset management plan
- Sanitary collection system asset management plan
- Sanitary sewer system asset management plan
- Stormwater asset management plan
- Vision Zero Transportation Plan

External Coordination and Other Tools

Ann Arbor's CIP provides a six-year plan of upcoming infrastructure work and is publicly available on a2gov.org/CIP and a2gov.org/a2CIPmap. Private utilities and others managing infrastructure in the area are encouraged to access plan materials to be aware of upcoming projects in the City of Ann Arbor right-of-way.

The City of Ann Arbor continues to improve communication channels with public entities such as DTE Energy (the local electric and gas provider) who also perform work in the right-of-way space. The City currently holds routine meetings with DTE representatives and is working towards and approach to exchange project plans in advance.

Ann Arbor's Street Cut Moratorium is one tool we are using to encourage coordinated work. This policy discourages new street cuts for a period of time after the road is treated, unless cutting the street is deemed necessary for emergency work.

APPENDIX A: 2024-206 PAVED CITY MAJOR ROAD PLANNED PROJECTS

2024 Projects
Greenview (Stadium to Scio Church) Resurfacing
Miller (First to Newport) Rehabilitation
N. University (State to Fletcher) and Thayer (N. University to Washington) Resurfacing
Seventh (Scio Church to Delaware) and Greenview (Scio Church to Seventh) Road Improvements
State St (William to S University) Resurfacing
Capital Preventative Maintenance Program FY2024[1]
2025 Projects
Fourth Ave Transit Enhancements (Liberty to William)(DDA)
Nixon (Huron Pkwy to S of Bluett) Phase 1 Road Improvements
Pauline (7th to Main) Resurfacing
Zina Pitcher/Catherine - Ann to Glen
Capital Preventative Maintenance Program FY2025
2026 Projects
Ann (First St to Division St) Resurfacing
E University (Hill to S University) Pavement Resurfacing
Ingalls and Kingsley (Huron to Detroit) Resurfacing
Nixon (Bluett to Dhu Varren) Phase 2 Road Improvements
Packard (Main to State) Resurfacing
Capital Preventative Maintenance Program FY2026

[1] Dollars are allocated for an annual capital preventative maintenance program. Specific project locations are not yet identified for future years.

APPENDIX B: 2024-2026 PAVED CITY LOCAL ROAD PLANNED PROJECTS

2024 Projects
Creal Cres, Creal Ct., Argyle Cres, Helen St Water Main Replacement
Hatcher Cres., Saunders Cres., & Cooley Ave Water Main Replacement
Huron View (Main west to Limits of Dual Mains) Water Main Consolidation
Yorkshire, Independence, Medford, Medford Ct Water Main Replacement
Northbrook
Page Ave
Yost
Pittsfield Village Street Improvements
Pittsfield (Washtenaw to Packard)
Whitewood (Packard to Oakwood)
Oakwood (Fernwood to Pinecrest)
Richard (Pittsfield to Edgewood)
Edgewood (Fernwood to Pittsfield (N))
Carolyn (Edgewood to end of HMA)
Jeanne (Parkwood to Pittsfield)
Fernwood (Edgewood to Parkwood)
Parkwood (Olde Hickory to Pittsfield)
Local Street Resurfacing Calendar 2024 - candidate streets provided below:
Parklake (Jackson to Lakeview)
McCotter (Parklake to Lakewood)
Lake Park (McCotter to end of ROW)
Lakewood (Park Lake to Gralake)
Andrea (Lakewood to 90-deg turn)
Andrea (90-deg turn to Gralake)
Sunnywood (Dolph to Hazelwood)
Sunnywood (Hazelwood to Mason)
Sunnywood (Mason to Highlake)
Dolph Dr/Central Ave (Sunnywood to Hazelwood)
Lakeview Dr (Parklake to Highlake)
Hilltop (Gralake to Gralake)
Gralake (Jackson to end of ROW)
Mason (Jackson to end of ROW)
Highlake (Jackson to end of ROW)
Burwood (Jackson to Liberty)
Collingwood (Jackson to Stadium)
Pleasant (Jackson to Charlton)
Shelby (Stadium to Collingwood)

Charlton (Burwood to end of ROW)
Fair (Collingwood to Burwood)
Fair (Burwood to end of ROW)
Winewood (Burwood to end of ROW)
Thaler (Stadium to Burwood)
Carolina (Winewood to Thaler)
Garden (Thaler to end of ROW)
Winewood (Stadium to Maple)
Wines (Miller to Hillridge)
Capital Preventative Maintenance Program FY2024
2025 Projects
Glastonbury and Weldon (Covington to Waverly) Water Main Replacement
Harding (Morton to Wallingford) Water Main Construction
Local Street Resurfacing Calendar 2025 - candidate streets provided below:
Victoria (Camelot to Ridge)
Gladstone (Camelot to Ridge)
Powell (Camelot to Ridge)
Ridge (Victoria to Powell)
Camelot (Victoria to Powell)
Independence (Packard to Manchester)
Kensington (Packard to end of ROW)
Marlborough (Packard to end of ROW)
Warner (Kensington to Marlborough)
Tremmel (Kensington to Marlborough)
Rosewood (Packard to W of Tremmel)
Ferdon (South to Crestland)
Ferdon (Stadium to South)
Anderson (Ferdon to Carhart)
Steer (South to Brockman)
Devolson (Brockman to Anderson)
Carhart (Winchell to Crestland)
Frieze (Ferdon to Brockman)
Amelia (Crestland to end of ROW)
Henry (White to Stadium)
Capital Preventative Maintenance Program FY2025
2026 Projects
Arbordale St, Sherwood St, and Sherwood Ct Water Main Replacement
Needham, Medford, Buckingham Water Main Replacement
Local Street Resurfacing Calendar 2026 - candidate streets provided below:

Green (Glazier to Narrow Gauge)
Narrow Gauge (Green to Watershed)
Watershed (Green to Narrow Gauge)
Watershed (Green to end)
Stanton (Green to end)
Ridgeline (Green to end)
Fox Hunt (Green to end)
Barclay Ct (Fox Hunt to end)
Cherrystone (Fox Hunt to end)
Burns (Fox Hunt to end)
Penberton Ct (Fox Hunt to west end)
Tremont Pl (Glazier to Tremont Ln)
Tremont Ln (west end to east end)
Waldenwood (3 courts extending west)
Wellington Cross (Waldenwoods to N, W, E ends)
Forest Ct (Forest Ave to east end)
Cross (Division to Packard)
Mary St (Packard to Hoover)
Benjamin (Division to Mary)
Ridgeway (Geddes Ave to Geddes Ave)
Highland Rd (Geddes Ave to Lenawee)
Concord (Highland to Lafayette)
Awixa (Highland to Geddes Ave)
Capital Preventative Maintenance Program FY2026

APPENDIX C

A Quick Check of Your Highway Network Health

By Larry Galehouse, Director, National Center for Pavement Preservation and

Jim Sorenson, Team Leader, FHWA Office of Asset Management

Historically, many highway agency managers and administrators have tended to view their highway systems as simply a collection of projects. By viewing the network in this manner, there is a certain comfort derived from the ability to match pavement actions with their physical/functional needs. However, by only focusing on projects, opportunities for strategically managing entire road networks and asset needs are overlooked. While the "bottom up" approach is analytically possible, managing networks this way can be a daunting prospect. Instead, road agency administrators have tackled the network problem from the "top down" by allocating budgets and resources based on historical estimates of need. Implicit in this approach, is a belief that the allocated resources will be wisely used and prove adequate to achieve desirable network service levels.

Using a quick checkup tool, road agency managers and administrators can assess the needs of their network and other highway assets and determine the adequacy of their resource allocation effort. A quick checkup is readily available and can be usefully applied with minimum calculations.

It is essential to know whether present and planned program actions (reconstruction, rehabilitation, and preservation) will produce a net improvement in the condition of the network. However, before the effects of any planned actions on the highway network can be analyzed, some basic concepts should be considered.

Assume every lane-mile segment of road in the network was rated by the number of years remaining until the end of life (terminal condition). Remember that terminal condition does not mean a failed road. Rather, it is the level of deterioration that management has set as a minimum operating condition for that road or network. Consider the rated result of the current network condition as shown in Figure 1.

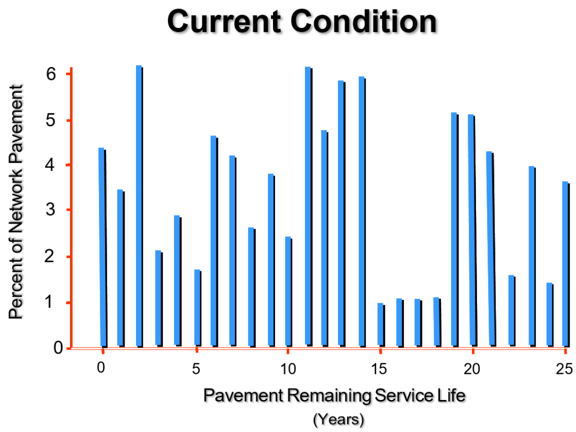


Figure 1 – Current Condition

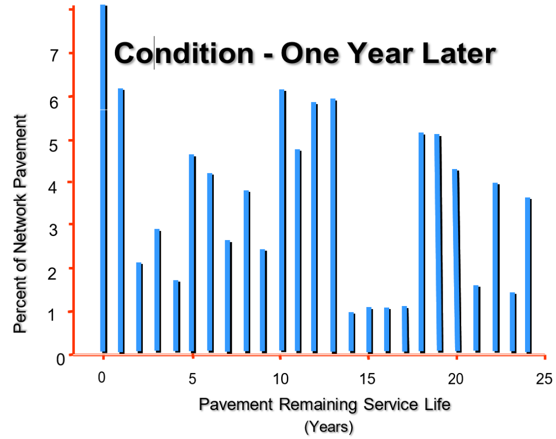


Figure 2 – Condition 1-Year Later

If no improvements are made for one year, then the number of years remaining until the end of life will decrease by one year for each road segment, except for those stacked at zero. The zero- stack will increase significantly because it maintains its previous balance and also becomes the recipient of those roads having previously been stacked with one year remaining. Thus, the entire network will age one year to the condition shown in Figure 2, with the net lane-miles in the zero stack raised from 4% to 8% of the network.

Some highway agencies still subscribe to the old practice of assigning their highest priorities to the reconstruction or rehabilitation of the worst roads. This practice of "worst first", i.e., continually addressing only those roads in the zero-stack, is a proven death spiral strategy because reconstruction and rehabilitation are the most expensive ways to maintain or restore serviceability. Rarely does sufficient funding exist to sustain such a strategy.

The measurable loss of pavement life can be thought of as the network's total lane-miles multiplied by 1 year, i.e., lane-mile-years. Consider the following quantitative illustration. Suppose your agency's highway network consisted of 4,356 lane-miles. Figure 3 shows that without intervention, it will lose 4,356 lane-mile-years per year.

Agency Highway Network = 4,356 lane miles

Each year the network will lose

4,356 lane-mile-years

Figure 3 – Network Lane Miles

To offset this amount of deterioration over the entire network, the agency would need to annually perform a quantity of work equal to the total number of lane-mile-years lost just to maintain the status quo. Performing work which produces fewer than 4,356 lane-mile-years would lessen the natural decline of the overall network, but still fall short of maintaining the status quo. However, if the agency produces more than 4,356 lane-mile-years, it will improve the network.

In the following example, an agency can easily identify the effect of an annual program consisting of reconstruction, rehabilitation, and preservation projects on its network. This assessment involves knowing the only two components for reconstruction and rehabilitation projects: lane-miles and design life of each project fix. Figure 4 displays the agency's programmed activities for reconstruction and Figure 5 displays it for rehabilitation.

Reconstruction Evaluation

Projects this Year = 2

Project	Design Life	Lane Miles	Lane Mile Years	Lane Mile Cost	Total Cost
No. 1	25 yrs	22	550	$463,425	$10,195,350
No. 2	30 yrs	18	540	$556,110	$10,009,980
	Total	=	**1,090**		$20,205,330

Figure 4 - Reconstruction

Rehabilitation Evaluation

Projects this Year = 3

Project	Design Life	Lane Miles	Lane Mile Years	Lane Mile Cost	Total Cost
No. 10	18 yrs	22	396	$263,268	$5,791,896
No. 11	15 yrs	28	420	$219,390	$6,142,920
No. 12	12 yrs	32	384	$115,848	$3,707,136
	Total	=	**1,200**		$15,641,952

Figure 5 – Rehabilitation

When evaluating pavement preservation treatments in this analysis, it is appropriate to think in terms of "extended life" rather than design life. The term design life, as used in the reconstruction and rehabilitation tables, relates better to the new pavement's structural adequacy to handle repetitive loadings and environmental factors. This is not the goal of pavement preservation. Each type of treatment/repair has unique benefits that should be targeted to the specific mode of pavement deterioration. This means that life extension depends on factors such as type and severity of distress, traffic volume, environment, etc. Figure 6 exhibits the agency's programmed activities for preservation.

Preservation Evaluation

Project	Life Extension	Lane Miles	Lane Mile Years	Lane Mile Cost	Total Cost
No. 101	2 yrs	12	24	$2,562	$30,744
No. 102	3 yrs	22	66	$7,743	$170,346
No. 103	5 yrs	26	130	$13,980	$363,480
No. 104	7 yrs	16	112	$29,750	$476,000
No. 105	10 yrs	8	80	$54,410	$435,280
	Total	=	**412**		$1,475,850

Figure 6 – Preservation

To satisfy the needs of its highway network, the agency must accomplish 4,356 lane-mile-years of work per year. The agency's program will derive 1,090 lane-mile-years from reconstruction, 1,200 lane-mile-years from rehabilitation, and 412 lane-mile-years from pavement preservation, for a total of 2,702 lane-mile-years. Thus, these programmed activities fall short of the minimum required to maintain the status quo, and hence would contribute to a net loss in network pavement condition of 1,653 lane-mile-years. The agency's programmed tally is shown in Figure 7.

Network Trend

Programmed Activity	Lane-Mile-Years	Total Cost
Reconstruction	1,090	$20,205,330
Rehabilitation	1,200	$15,641,952
Preservation	412	$1,475,850
Total	**2,702**	**$37,323,132**
Network Needs (Loss)	(-) 4,356	
Deficit =	**- 1,654**	

Figure 7 – Programmed Tally

This exercise can be performed for any pavement network to benchmark its current trend. Using this approach, it is possible to see how various long-term strategies could be devised and evaluated against a policy objective related to total-network condition.

Once the pavement network is benchmarked, an opportunity exists to correct any shortcomings in the programmed tally. A decision must first be made whether to improve the network condition or just to maintain the status quo. This is a management decision and system goal.

Continuing with the previous example, a strategy will be proposed to prevent further network deterioration until additional funding is secured.

The first step is to modify the reconstruction and rehabilitation (R&R) programs. An agonizing decision must be made about which projects to defer, eliminate, or phase differently with multi- year activity. In Figure 8, reductions are made in the R&R programs to recover funds for less costly treatments in the pavement preservation program. The result of this decision recovered slightly over $6 million.

Program Modification

Programmed Activity	**Lane-Mile-Years**	**Cost Savings**
Reconstruction ***31 lane miles*** ~~(40 lane miles)~~	***820*** ~~(1,090)~~	**$5,004,990**
Rehabilitation ***77 lane miles*** ~~(82 lane miles)~~	***1,125*** ~~(1,200)~~	**$1,096,950**
Pavement Preservation (84 lane-miles)	(412)	**0**
Total =	***2,357*** **(2,702)**	**$6,101,940**

Figure 8 – Revised R & R Programs

Modifying the reconstruction and rehabilitation programs has reduced the number of lane-mile- years added to the network from 2,702 to 2,357 lane-mile-years. However, using less costly treatments elsewhere in the network to address roads in better condition will increase the number of lane-mile-years added to the network. A palette of pavement preservation treatments, or mix of fixes, is available to address the network needs at a much lower cost than traditional methods.

Preservation treatments are only suitable if the right treatment is used on the right road at the right time. In Figure 9, the added treatments used include concrete joint resealing, thin hot-mix asphalt (HMA) overlay (≤ 1.5”), microsurfacing, chip seal, and crack seal. By knowing the cost per lane-mile and the treatment life-extension, it is possible to create a new strategy (costing $36,781,144) that satisfies the network need. In this example, the agency saved in excess of $500,000 from traditional methods (costing $37,323,132), while erasing the 1,653 lane-mile-year deficit produced by the initial program tally. Network Strategy

Programmed Activity		Lane Mile Years	Total Cost
Reconstruction	(31 lane-miles)	820	$15,200,340
Rehabilitation	(77 lane-miles)	1,125	$14,545,002
Pavement Preservation	(84 lane-miles)	412	$1,475,850
Concrete Resealing	(4 years x 31 lane-miles)	124	$979,600
Thin HMA Overlay	(10 years x 16 lane-miles)	160	$870,560
Microsurfacing	(7 years x 44 lane-miles)	308	$1,309,000
Chip Seal	(5 years x 79 lane-miles)	395	$1,104,420
Crack Seal	(2 years x 506 lane-miles)	1,012	$1,296,372
	Total =	4,356	$36,781,144

Figure 9 – New Program Tally

In a real-world situation, the highway agency would program its budget to achieve the greatest impact on its network condition. Funds allocated for reconstruction and rehabilitation projects must be viewed as investments in the infrastructure. Conversely, funds directed for preservation projects must be regarded as protecting and preserving past infrastructure investments.

Integrating reconstruction, rehabilitation, and preservation in the proper proportions will substantially improve network conditions for the taxpayer while safeguarding the highway investment.

APPENDIX D: OHM REPORT AND SUPPLEMENTAL MATERIALS INCLUDING ROADSOFT NETWORK-LEVEL MODEL OUTPUTS

June 15, 2022

City of Ann Arbor
Mr. Nicholas Hutchinson, City Engineer
301 E. Huron Street
Ann Arbor, MI 48104

RE: Pavement Surface Evaluation and Rating (PASER)
Pavement Condition Forecasting

Dear Mr. Hutchinson:

OHM analyzed projected pavement condition forecasts with two distinct budget scenarios. A 'No Bond' alternative applied budgets provided by the City annually. The second 'Bond' option front loaded the program with bonded improvements, paid back over time with program dollars. The 'Bond' scenario was shown to have an advantage in both the immediate and long-term condition of the City's road network. The City elected to leverage a bond sale to take advantage of this impact. The annual allocations with the bond sale revenue included are follows:

Table 1: Budget Scenarios

Annual Budgets Front Loaded with Bonded Improvements			
Year	Majors		Locals
2022	$ 9,340,000		$ 8,000,000
2023	$ 9,340,000		$ 8,000,000
2024	$ 6,840,000		$ 10,500,000
2025	$ 4,840,000		$ 7,500,000
2026	$ 4,840,000		$ 7,500,000
2027	$ 4,840,000		$ 7,500,000
2028	$ 4,840,000		$ 7,500,000
2029	$ 4,840,000		$ 7,500,000
2030	$ 4,840,000		$ 7,500,000
2031	$ 4,840,000		$ 7,500,000
Total	$ 59,400,000		$ 79,000,000

The model runs with the budgets above indicate the city could expect the following road distribution per centerline mile after construction year 2026 depending on project selection and inflationary increases.

OHM Advisors®
355 SOUTH ZEEB ROAD, SUITE A
ANN ARBOR, MICHIGAN 48103
T 734.522.6711
F 734.522.6427
OHM-Advisors.com

Table 2: Projected Network Distribution

Local Road Network

Paser Rating	2021/2022		Forecasted Model in 2026
6-10	36%		49%
4-5	25%		19%
1-3	39%		32%
	100%		100%
Average PASER	4.74		5.38

Major Road Network

Paser Rating	2021/2022		Forecasted Model in 2026
6-10	58%		65%
4-5	20%		17%
1-3	22%		18%
	100%		100%
Average PASER	5.67		6.07

In addition to the rating distribution, average PASER rating projections are a useful tool to evaluate the effectiveness of a strategy. The modeled projections for the two scenarios for both the major and local system are provided below in Figures 1 and 2.

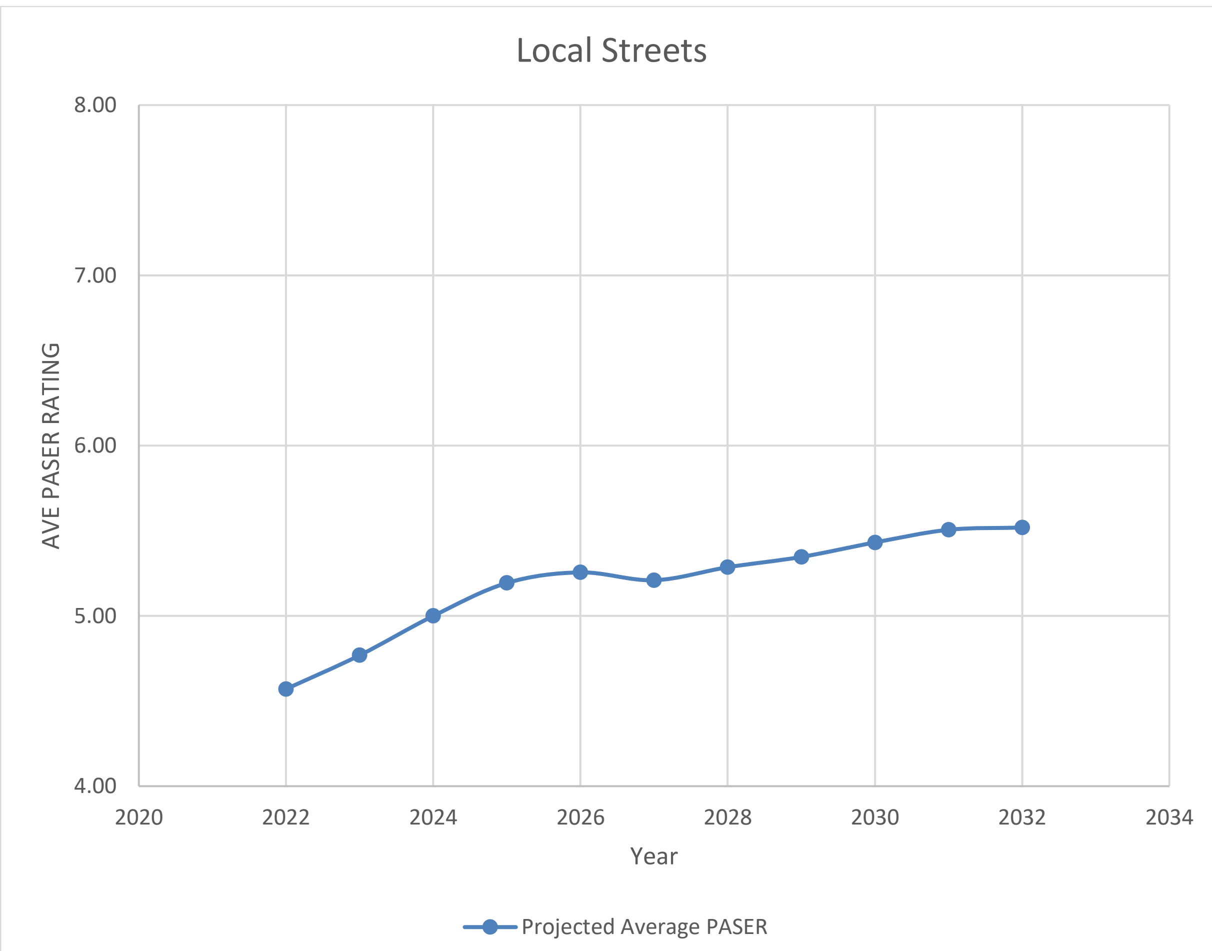


Figure 1. Local Road Projections

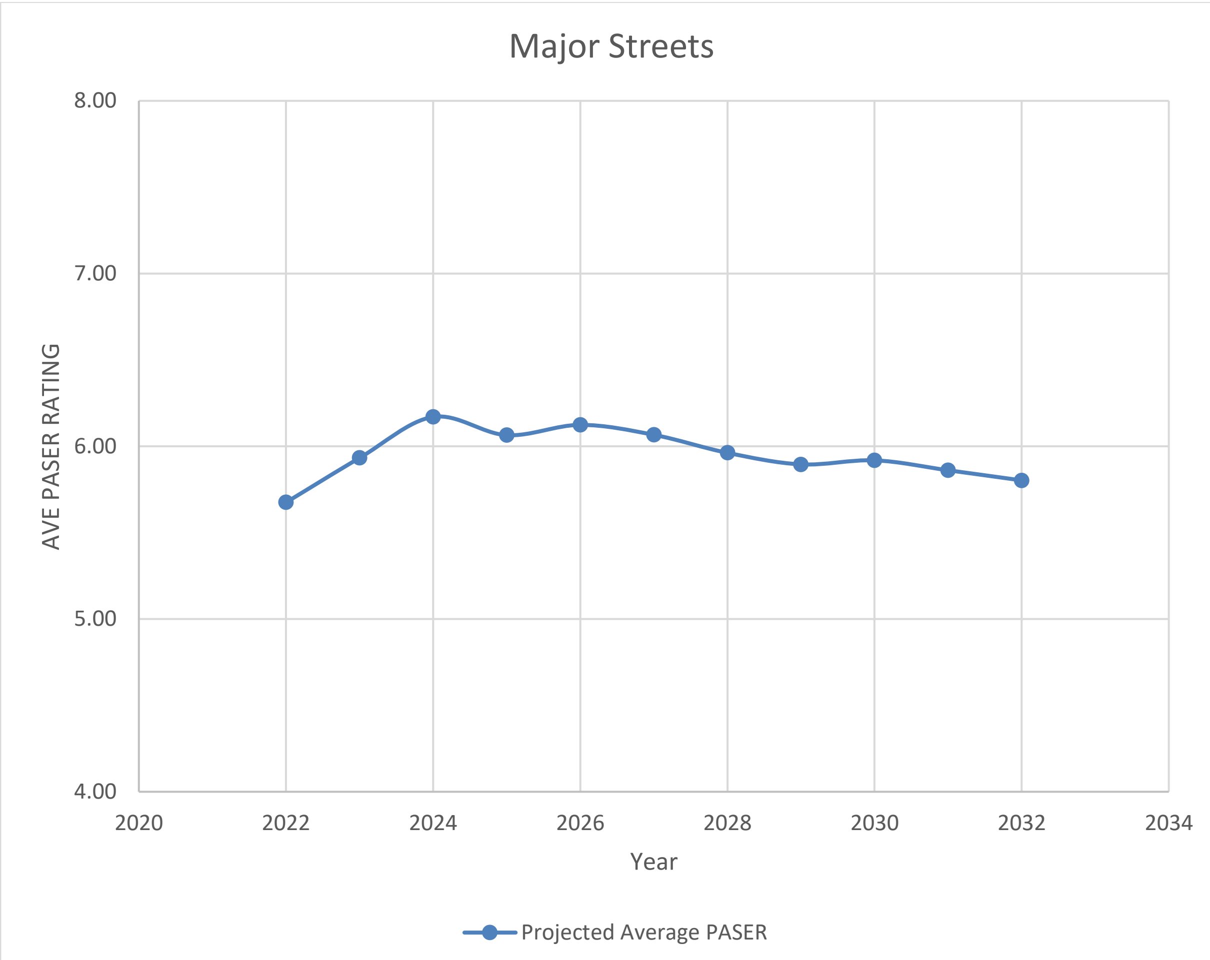


Figure 2. Major Road Projections

The advantage to front loading the program with a bond sale is due to two primary factors. First, making a more significant investment in early years allows the City to prevent more roads from falling into the poor category which requires the more expensive major rehabilitation and/or reconstruction maintenance activities. Second, inflation and rising construction costs largely offset the debt cost over the ten years.

We recommend the City consider setting goals that incorporate three previously discussed performance metrics:

1. Average PASER Rating
2. %Good, %Fair, %Poor Thresholds to be Achieved or not Exceeded
3. Measured Improvement Over Existing Conditions

We further recommend the City consider establishing different performance metrics for the major and local networks that incorporate the above components. We recommend the City consider setting goals with the following format. Example metrics are provided, however final numbers should be established with input from staff, elected officials, and other stakeholders

Major Roads – By 2026
Minimum 60% of Roads in Good (PASER 6-10) condition (2% increase from 2021)
Maximum 20% of Roads in Poor (PASER 1-3) condition (2% decrease from 2021)

Average PASER of 5.8 (0.13 increase from 2021)

Local Roads – By 2026
Minimum 45% of Roads in Good (PASER 6-10) condition (9% increase from 2021)
Maximum 39% of Roads in Poor (PASER 1-3) condition (no increase from 2021)
Average PASER of 5.24 (0.5 increase from 2021)

Finally, we recommend these goals be reevaluated following the 2023 PASER rating data collection.

Sincerely,
OHM Advisors

Marcus J McNamara

cc: Dave Dykman, City of Ann Arbor

October 3, 2022

City of Ann Arbor
Mr. Nicholas Hutchinson, City Engineer
301 E. Huron Street
Ann Arbor, MI 48104

RE: Pavement Surface Evaluation and Rating (PASER)
Pavement Condition Forecasting – Supplemental Information

Dear Mr. Hutchinson:

The following graphs are provided as supplemental information associated with the Pavement Condition Forecasting report dated June 15, 2022. These graphs provide the modeled condition projections for both budget scenarios as outlined in Table 1.

Table 1: Budge Scenarios

Annual Budgets with No Bonded Improvements				Annual Budgets Front Loaded with Bonded Improvements		
Year	Majors	Locals		Year	Majors	Locals
2022	$ 8,000,000	$ 6,000,000		2022	$ 9,340,000	$ 8,000,000
2023	$ 8,000,000	$ 6,000,000		2023	$ 9,340,000	$ 8,000,000
2024	$ 5,500,000	$ 8,500,000		2024	$ 6,840,000	$ 10,500,000
2025	$ 5,500,000	$ 8,500,000		2025	$ 4,840,000	$ 7,500,000
2026	$ 5,500,000	$ 8,500,000		2026	$ 4,840,000	$ 7,500,000
2027	$ 5,500,000	$ 8,500,000		2027	$ 4,840,000	$ 7,500,000
2028	$ 5,500,000	$ 8,500,000		2028	$ 4,840,000	$ 7,500,000
2029	$ 5,500,000	$ 8,500,000		2029	$ 4,840,000	$ 7,500,000
2030	$ 5,500,000	$ 8,500,000		2030	$ 4,840,000	$ 7,500,000
2031	$ 5,500,000	$ 8,500,000		2031	$ 4,840,000	$ 7,500,000
Total	$ 60,000,000	$ 80,000,000		Total	$ 59,400,000	$ 79,000,000

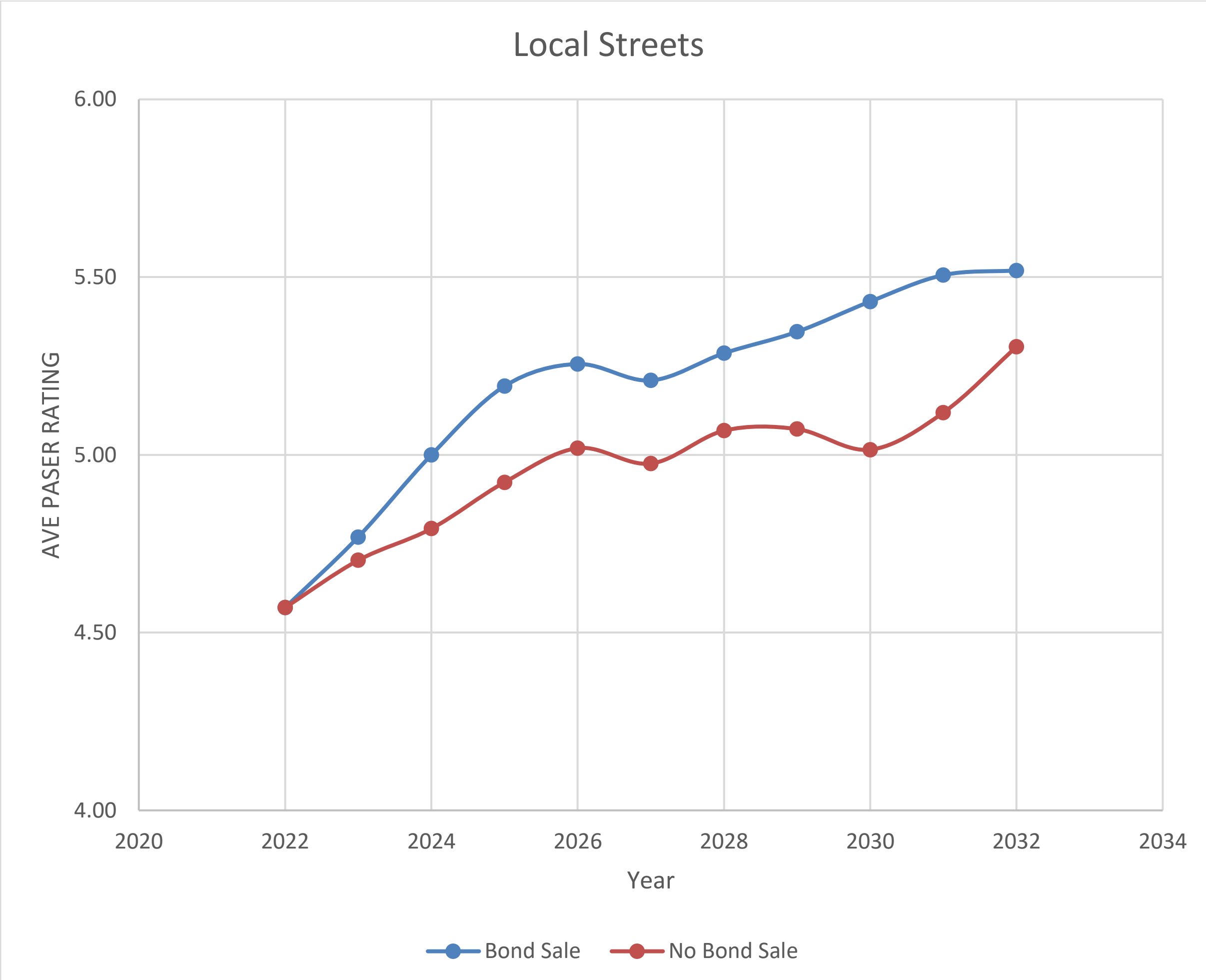


Figure 1. Local Road Projections

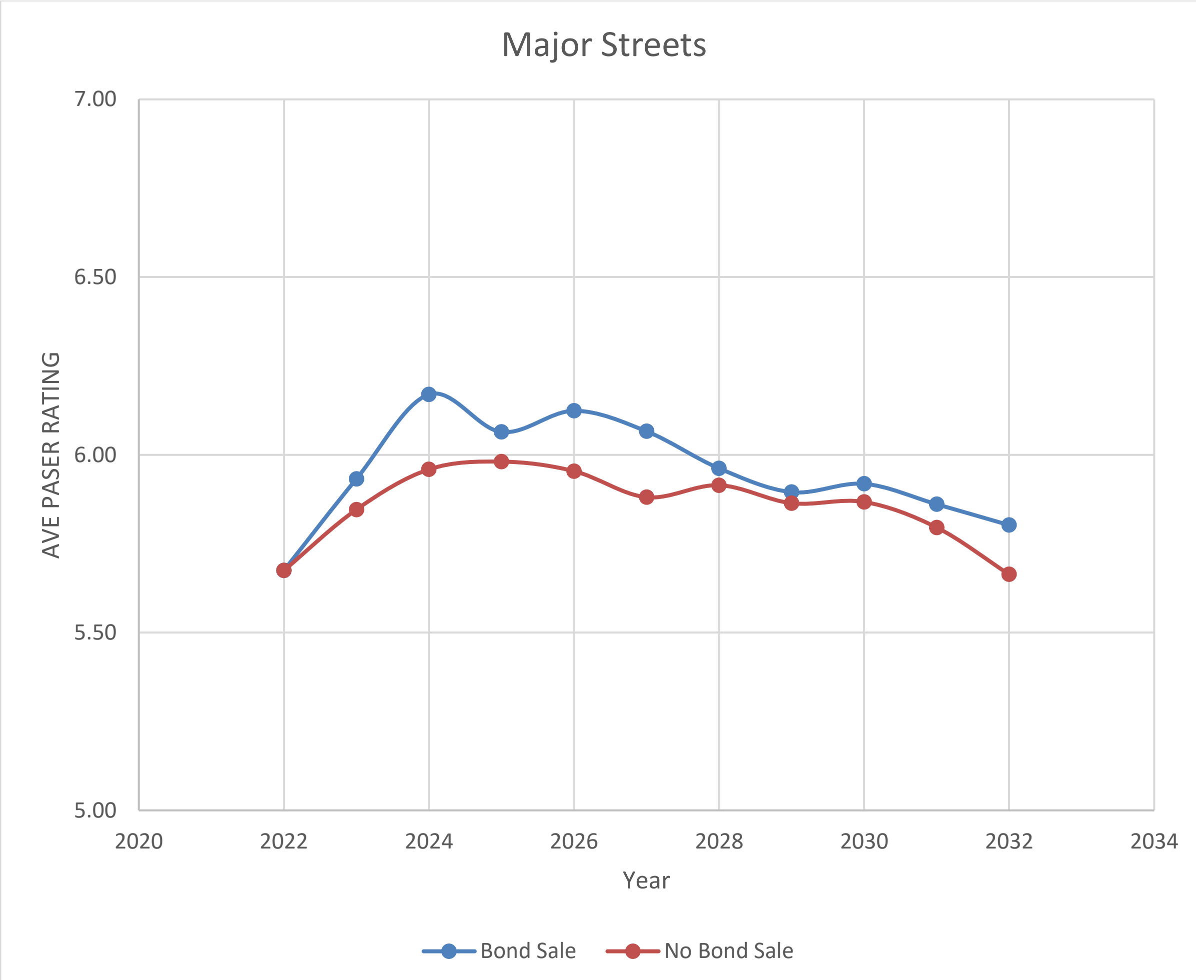


Figure 2. Major Road Projections

Strategy Comprehensive Report

Major_Bond_Final

Base Year	2022
Percent Inflation	3
Number of Years	10
Optimized	Yes
Current Filter	2020 Filter for Model Majors

Subtype	Treatment	Trigger	Reset	Cost/Ln Mile	Budget	Lane Miles	Year
Asphalt-Standard	RH (SI) Rehabilitation Major (Remove & Replace full depth)	2 - 3	10	$880,000.00			
					$2,000,000	2.273	2022
					$2,000,000	2.207	2023
					$2,000,000	2.142	2024
					$2,000,000	2.080	2025
					$2,000,000	2.019	2026
					$2,000,000	1.960	2027
					$2,000,000	1.903	2028
					$2,000,000	1.848	2029
					$2,000,000	1.794	2030
					$2,000,000	1.742	2031
	RH (SI) Resurfacing Major - Mill & replace > 2" & < total)	3 - 4	9	$633,600.00			
					$3,340,000	5.271	2022
					$3,340,000	5.118	2023
					$840,000	1.250	2024
					$432,177	0.606	2026
					$840,000	1.144	2027
					$840,000	1.110	2028
					$840,000	1.078	2029
					$840,000	1.047	2030
					$840,000	1.016	2031

PM (CPM) Cape Seal Major	5 - 6	8	$149,600.00			
				$1,000,000	6.684	2022
				$1,000,000	6.490	2023
				$1,000,000	6.301	2024
				$1,000,000	6.117	2025
				$1,000,000	5.939	2026
				$1,000,000	5.766	2027
				$1,000,000	5.598	2028
				$1,000,000	5.435	2029
				$1,000,000	5.277	2030
				$1,000,000	5.123	2031
PM (CPM) Microsurface, Single Course - Major	6 - 6	8	$92,400.00			
				$1,000,000	10.823	2022
				$1,000,000	10.507	2023
				$1,000,000	10.201	2024
				$1,000,000	9.904	2025
				$1,000,000	9.616	2026
				$1,000,000	9.336	2027
				$1,000,000	9.064	2028
				$1,000,000	8.800	2029
				$1,000,000	8.543	2030
				$1,000,000	8.295	2031
PM (CPM) Mill & Fill Major - < = 2" Thick	5 - 5	9	$290,400.00			
				$2,000,000	6.887	2022
				$2,000,000	6.686	2023
				$2,000,000	6.492	2024
				$840,000	2.647	2025
				$407,823	1.248	2026

Strategy Comprehensive Report

Local_Bond_Final

Base Year	2022
Percent Inflation	3
Number of Years	10
Optimized	Yes
Current Filter	2020 Filter For Model Local

Subtype	Treatment	Trigger	Reset	Cost/Ln Mile	Budget	Lane Miles	Year
Asphalt-Standard	RC (SI) Reconstruction (Local)	1 - 2	10	$1,122,177.30			
					$120,634	0.108	2027
					$6,914,135	5.982	2028
					$6,862,621	5.764	2029
					$6,814,792	5.558	2030
					$6,750,844	5.345	2031
	RH (SI) Rehabilitation Local (Remove & Replace full depth)	2 - 3	10	$748,000.00			
					$2,000,002	2.674	2022
					$1,999,985	2.596	2023
					$1,999,992	2.520	2024
	RH (SI) Resurfacing Local - Mill & replace > 2" & < total)	3 - 4	9	$532,147.44			
					$4,531,448	8.515	2024
					$5,078,092	9.265	2025
					$6,153,144	10.899	2026
					$6,886,725	11.843	2027
	PM (CPM) Cape Seal Local	5 - 6	8	$132,000.00			
					$1,999,998	15.152	2022
					$1,999,999	14.710	2023
					$468,626	3.346	2024
	PM (CPM) Crack Seal	7 - 7	8	$5,104.00			
					$248,692	48.725	2022
					$163,155	31.035	2023
					$313,248	57.850	2024
					$421,910	75.648	2025
					$440,771	76.728	2026
					$487,626	82.412	2027
					$575,772	94.475	2028
					$635,737	101.276	2029
					$684,053	105.799	2030
					$748,268	112.360	2031

Strategy Comprehensive Report

	PM (CPM) Microsurface, Single Course - Local	6 - 6	8	$88,000.00			
					$2,000,002	22.727	2022
					$1,999,999	22.065	2023
					$1,058,227	11.335	2024
	PM (CPM) Mill & Fill Local - < = 2" Thick	4 - 5	9	$369,600.00			
					$1,749,280	4.733	2022
					$1,815,958	4.770	2023
					$1,999,989	5.101	2024
					$2,000,014	4.952	2025
					$906,105	2.178	2026
Concrete-Standard	RH (SI) Full Depth / Overlay	2 - 3	10	$65,714.00			
					$20,503	0.312	2023
					$128,467	1.898	2024
					$4,290	0.058	2027
					$9,142	0.120	2028
					$970	0.012	2030
	PM (CPM) Crack Sealing	7 - 7	9	$8,800.00			
					$2,042	0.232	2022
					$399	0.044	2023
					$786	0.077	2027
					$967	0.092	2028
					$1,602	0.148	2029
					$167	0.015	2030
					$896	0.078	2031

B. BRIDGE ASSET MANAGEMENT PLAN

An attached bridge asset management plan follows.

City of Ann Arbor
2023 Bridge
Asset Management Plan

E. Stadium Boulevard Bridges – November 2012

A plan describing the City of Ann Arbor's Bridge transportation assets and conditions

Prepared by:
Francisca Chan, P.E.
Project Manager
City of Ann Arbor – Public Services Area
Engineering

e-mail: fchan@a2gov.org
Phone: (734) 794-6410 ext. 43701

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EXECUTIVE SUMMARY

As conduits for commerce and connections to vital services, bridges are critical assets in our community, along with roads, culverts, traffic signs, traffic signals, and utilities that support and affect the road network. The cost of building and maintaining Ann Arbor's bridges, their importance to society, and the investment made by taxpayers all place a high level of responsibility on local agencies to plan, build, and maintain the road and bridge network in an efficient and effective manner. This asset management plan is intended to describe how Ann Arbor is meeting its obligations to maintain the city's bridges.

Ann Arbor owns and/or manages 16 bridges. This plan provides an overview of Ann Arbor's bridge assets and conditions and explains how the City of Ann Arbor works to maintain and improve the overall condition of those assets. It includes:

- What kinds of bridge assets Ann Arbor has in its jurisdiction and the different options for maintaining them.
- What tools and processes Ann Arbor uses to track and manage bridge assets and funds.
- What condition Ann Arbor's bridge assets are in compared to statewide averages.
- Why some bridge assets are in better condition than others and the path to maintaining and improving bridge conditions through proper planning and maintenance.
- How agency bridge assets are funded and the source of these funds.
- How funds are used, and the costs incurred during Ann Arbor's bridge assets' normal life cycle.
- The condition of Ann Arbor's bridges if current funding levels continue.
- How changes in funding levels can affect the overall condition of Ann Arbor's bridge assets.

An asset management plan is required by Michigan Public Act 325 of 2018, and this document represents fulfillment of some of Ann Arbor's obligations towards meeting these requirements. This asset management plan also helps demonstrate Ann Arbor's responsible use of public funds by providing elected and appointed officials as well as the general public with inventory and condition information of Ann Arbor's bridge assets and gives taxpayers the information they need to make informed decisions about investing in essential transportation infrastructure.

INTRODUCTION

Asset management is defined by Public Act 325 of 2018 as "an ongoing process of maintaining, preserving, upgrading, and operating physical assets cost effectively, based on a continuous physical inventory and condition assessment and investment to achieve established performance goals". This process is endorsed by leaders in municipal planning and transportation infrastructure, including the Michigan Municipal League, County Road Association of Michigan, the Michigan Department of Transportation (MDOT), and the Federal Highway Administration (FHWA). The City of Ann Arbor is supported in its use of asset management principles and processes by the Michigan Transportation Asset Management Council (TAMC), formed by the State of Michigan.

Asset management, in the context of this plan, ensures that public funds are spent as effectively as possible to maximize the condition of the bridges in Ann Arbor. Proper asset management should also provide for transparent decision-making, which allows the public to understand the technical and financial challenges of managing infrastructure with limited resources.

The City of Ann Arbor has adopted an "asset management" process for its 16 bridges to help overcome the challenges presented by limited funds, staffing, and other resources while meeting stringent safety standards and bridge users' expectations.

This 2023 plan outlines how Ann Arbor determines its strategy to maintain and upgrade bridge conditions given agency goals, priorities of users, and resources provided. An updated plan is to be released every three (3) years to reflect changes in bridge conditions, finances, and priorities.

Questions regarding the use or content of this plan should be directed to **Francisca Chan, P.E., Project Manager**, City of Ann Arbor – Engineering, via e-mail fchan@a2gov.org or phone (734) 794-6410 extension 43701. A copy of this plan can be accessed on our website at www.a2gov.org/engineering.

Key terms used in this plan are defined in Ann Arbor's comprehensive transportation asset management plan (also known as the "compliance plan") used for compliance with PA 325 or 2018.

Knowing the basic features of an asset class is a crucial starting point to understanding the rationale behind an asset management approach. The following primer provides an introduction to bridges.

Bridge Primer

Bridge Types

Bridges are structures that span 20 feet or more. These bridges can extend across one or multiple spans.

If culverts are placed side by side to form a span of 20 feet or more (for example, three 6-foot culverts with one-foot between each culvert), then this culvert system would be defined as a bridge. (Note: The Compliance Plan Appendix C contains a primer on culverts not defined as bridges.)

Bridge types are classified based on two features: design and material.

The most common bridge design is the **girder system** (Figure 1). With this design, the bridge deck transfers vehicle loads to girders (or beams) that, in turn, transfer the load to the piers or abutments (see Figure 6).

A similar design that lacks girders (or beams) is a **slab bridge** (Figure 2, and see Figure 6). A slab bridge transfers the vehicle load directly to the abutments and, if necessary, piers.

Truss bridges were once quite common and consist of a support structure that is created when structural members are connected at joints to form interconnected triangles (Figure 4). Structural members may consist of steel tubes or angles connected at joints with gusset plates.

Another common bridge design in Michigan is the three-sided pre-cast box or arch bridge (Figure 4).

Michigan is also home to several unique bridge designs.

Adding another layer of complexity to bridge typing is the primary construction materials used (Figure 5). Bridges are generally constructed from concrete, steel, pre-stressed concrete, or timber. Some historical bridges or bridge components in Michigan may be constructed from stone or masonry.

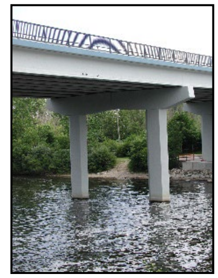

Figure 1: Girder bridge

Figure 2: Slab bridge

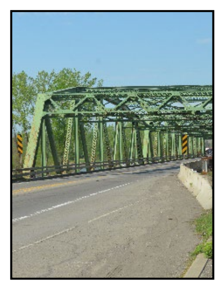

Figure 3: Truss bridge

Figure 4: Three-sided box bridge

Figure 5: Examples of common bridge construction materials used in Michigan

Bridge Condition

Michigan inspectors rate bridge condition on a 0-9 scale known as the National Bridge Inventory (NBI) rating scale (see Table for a summary of the NBI Rating scale). Elements of the bridge's superstructure, deck, and substructure receive a 9 if they are in excellent condition down to a 0 if they are in failed condition. A complete guide for Michigan bridge condition rating according to the NBI can be found in the MDOT Bridge Field Services' *Bridge Safety Inspection NBI Rating Guidelines* (https://www.michigan.gov/documents/mdot/BIR_Ratings_Guide_Combined_2017-10-30_606610_7.pdf).

Table 1: Summary of the NBI Rating Scale

NBI Rating	General Condition
9-7	Like new/good
6-5	Fair
4-3	Poor/serious
2-0	Critical/failed

Bridge Treatments

Replacement

Replacement work is typically performed when a bridge is in poor condition (NBI rating of 4 or less) and will improve the bridge to good condition (NBI rating of 7 or more). The Local Bridge Program, a part of MDOT's Local Agency Program, defines bridge replacement as full replacement, which removes the entire bridge (superstructure, deck, and substructure) before re-building a bridge at the same location (Figure 6). The decision to perform a total replacement over rehabilitation (see below) should be made based on a life-cycle cost analysis. Generally, replacement is selected if rehabilitation costs more than two-thirds of the cost of replacement. Replacement is generally the most expensive of the treatment options.

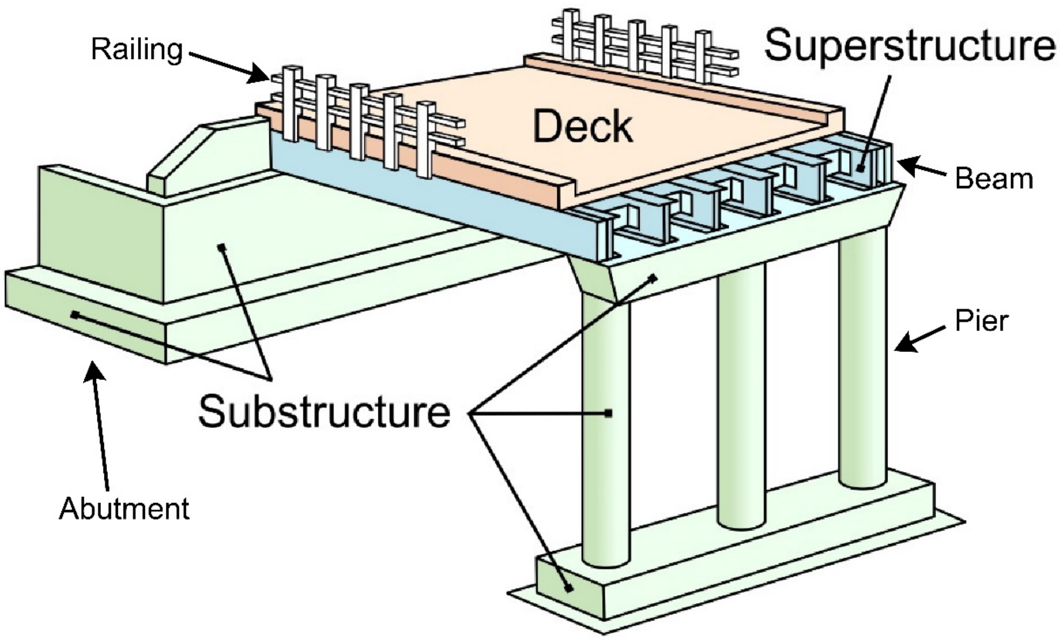

Figure 6: Diagram of basic elements of a bridge

Rehabilitation

Rehabilitation involves repairs that improve the existing condition and extend the service life of the structure and the riding surface. Most often, rehabilitation options are associated with bridges that have degraded beyond what can be fixed with preventive maintenance. Rehabilitation is typically performed on poor-rated elements (NBI rating of 4 or less) to improve them to fair or good condition (NBI rating of 5 or more). Rehabilitation can include superstructure replacement (removal and replacement of beams and deck) or deck replacement. While typically more expensive than general maintenance, rehabilitation treatments may be more cost-effective than replacing the entire structure.

- **Railing retrofit/replacement:** A railing retrofit or replacement either reinforces the existing railing or replaces it entirely (Figure 6). This rehabilitation is driven by a need for safety improvements on poor-rated railings or barriers (NBI rating less than 5).
- **Beam repair:** Beam repair corrects damage that has reduced beam strength (Figure 6). In the case of steel beams, it is performed if there is 25 percent or more of section loss in an area of the beam that affects load-carrying capacity. In the case of concrete beams, this is performed if there is 50 percent or more spalling (i.e., loss of material) at the ends of beams.
- **Substructure concrete patching and repair:** Patching and repairing the substructure is essential to keep a bridge in service. These rehabilitation efforts are performed when the abutments or piers are fair or poor (NBI rating of 5 or 4), or if spalling and delamination affect less than 30 percent of the bridge surface.

Preventive Maintenance

The Federal Highway Administration's (FHWA) *Bridge Preservation Guide* (2018) defines preventive maintenance as "a strategy of extending service life by applying cost-effective treatments to bridge elements…[that] retard future deterioration and avoid large expenses in bridge rehabilitation or replacements."

Preventive maintenance work is typically done on bridges rated fair (NBI rating of 5 or 6) in order to slow the rate of deterioration and keep them from falling into poor condition.

- **Concrete deck overlay:** A concrete deck overlay involves removing and replacing the driving surface. Typically, this is done when the deck surface is poor (NBI rating is less than 5) and the underneath portion of the deck is at least fair (NBI rating greater than 4). A shallow or deep concrete overlay may be performed depending on the condition of the bottom of the deck. The MDOT *Bridge Deck Preservation* matrices provide more detail on concrete deck overlays (see https://www.michigan.gov/mdot/0,4616,7-151-9625_24768_24773---,00.html).

- **Deck repairs:** Deck repairs include three common techniques: HMA overlay with or without waterproof membranes, concrete patching, deck sealing, crack sealing, and joint repair/replacement. An HMA overlay with an underlying waterproof membrane can be placed on bridge decks with a surface rating of fair or lower (NBI of 5 or less) and with deficiencies that cover between 15 and 30 percent of the deck surface and deck bottom. An HMA overlay without a waterproof membrane should be used on a bridge deck with a deck surface and deck bottom rating of serious condition or lower (NBI rating of 3 or less) and with deficiencies that cover greater than 30 percent of the deck surface and bottom; this is considered a temporary holdover to improve ride quality when a bridge deck is scheduled to undergo major rehabilitation within five years. All HMA overlays need to be accompanied by an updated load rating. Patching of the concrete on a bridge deck is done in response to an inspector's work recommendation or when the deck surface is in good, satisfactory, or fair condition (NBI rating of 7, 6, or 5) with minor delamination and spalling. To preserve a good bridge deck in good condition, a deck sealer can be used.

  Deck sealing should only be done when the bridge deck has surface rating of fair or better (NBI of 5 or more). Concrete sealers should only be used when the top and bottom surfaces of the deck are free from major deficiencies, cracks, and spalling. An epoxy overlay may be used when between 2 and 5 percent of the deck surface has delaminations and spalls, but these deficiencies must be repaired prior to the overlay. An epoxy overlay may also be used to repair an existing epoxy overlay. Concrete crack sealing is an option to maintain concrete in otherwise good condition that has visible cracks with the potential of reaching the steel reinforcement. Crack sealing may be performed on concrete with a surface rating of good, satisfactory, or fair (NBIS rating of 7, 6, or 5) with minor surface spalling and delamination; it may also be performed in response to a work recommendation by an inspector who has determined that the frequency and size of the cracks require sealing.

- **Steel bearing repair/replacement:** Rather than sitting directly on the piers, a bridge superstructure is separated from the piers by bearings. Bearings allow for a certain degree of movement due to temperature changes or other forces. Repairing or replacing the bearings is considered preventive maintenance. Girders and a deck in at least fair condition (NBI of 5 or higher) and bearings in poor condition (NBI rating of 4 or less) identifies candidates for this maintenance activity.

- **Painting:** Re-painting a bridge structure can either be done in totality or in part. Total re-painting is done in response to an inspector's work recommendation or when the paint condition is in serious condition (NBI rating of 3 or less). Partial re-painting can either consist of zone re-painting, which is a preventive maintenance technique, or spot re-painting, which is scheduled maintenance (see below). Zone re-painting is done when less than 15 percent of the paint in a smaller area, or zone, has failed while the rest of the bridge is in good or fair condition. It is also done if the paint condition is fair or poor (NBI rating of 5 or 4).

- **Channel improvements:** Occasionally, it is necessary to make improvements to the waterway that flows underneath the bridge. Such channel improvements are driven by an inspector's work recommendation based on a hydraulic analysis or to remove vegetation, debris, or sediment from the channel and banks (Figure 6).

- **Scour countermeasures:** An inspector's work recommendations or a hydraulic analysis may require scour countermeasures (see the *Risk Management* section of this plan for more information on scour). This is done when a structure is categorized as scour critical and is not scheduled for replacement or when NBI comments in abutment and pier ratings indicate the presence of scour holes.

- **Approach repaving:** A bridge's approach is the transition area between the roadway leading up to and away from the bridge and the bridge deck. Repaving the approach areas is performed in response to an inspector's work recommendation, when the pavement surface is in poor condition (NBI rating of 4 or less), or when the bridge deck is replaced or rehabilitated (e.g., concrete overlay).

- **Guardrail repair/replacement:** A guardrail is a safety feature on many roads and bridges that prevents or minimizes the effects of lane departure incidents. Keeping bridge guardrails in good condition is important. Repair or replacement of bridge guardrail should be done when a guardrail is missing or damaged, or when it needs a safety improvement.

Scheduled Maintenance

Scheduled maintenance activities are those activities or treatments that are regularly scheduled and intend to maintain serviceability while reducing the rate of deterioration.

- **Superstructure washing:** Washing the superstructure, or the main structure supporting the bridge, typically occurs in response to an inspector's work recommendation or when salt-contaminated dirt and debris collected on the superstructure is causing corrosion or deterioration by trapping moisture.

- **Drainage system cleanout/repair:** Keeping a bridge's drainage system clean and in good working order allows the bridge to shed water effectively. An inspector's work recommendation may indicate drainage system cleanout/repair. Signs that a drainage system needs cleaning or repair include clogs and broken, deteriorated, or damaged drainage elements.

- **Spot painting:** Spot painting is a form of partial bridge painting. This scheduled maintenance technique involves painting a small portion of a bridge. Generally, this is done in response to an inspector’s work recommendation and is used for zinc-based paint systems only.
- **Slope repair/reinforcement:** The terrain on either side of the bridge that slopes down toward the channel is called the slope. At times, it is necessary to repair the slope. Situations that call for slope repair include when the slope is degraded, when the slope has significant areas of distress or failure, when the slope has settled, or if the slope is in fair or poor condition (NBI rating of 5 or less). Other times, it is necessary to reinforce the slope. Reinforcement can be added by installing Riprap, which is a side-slope covering made of stones. Riprap protects the stability of side slopes of channel banks when erosion threatens the surface.
- **Vegetation control and debris removal:** Keeping the area around a bridge structure free of vegetation and debris safeguards the bridge structure from these potentially damaging forces. Removing or restricting vegetation around bridges prevents damage to the structure. Vegetation control is done in response to an inspector’s work recommendation or when vegetation traps moisture on structural elements or is growing from joints or cracks. Debris in the water channel or in the bridge can also cause damage to the structure. Removing this debris is typically done in response to an inspector’s work recommendation or when vegetation, debris, or sediment accumulates on the structure or channel.
- **Miscellaneous repairs:** These are uncategorized repairs in response to an inspector’s work recommendation.

1. BRIDGE ASSETS

Ann Arbor is working to implement an asset management program for its bridges. This program balances reconstruction, rehabilitation, preventive maintenance, scheduled maintenance, or new construction, with Ann Arbor's bridge funding to maximize the useful service life and to ensure the safety of the city's bridges.

Like most agencies, the City of Ann Arbor has limited funds for improving the bridge network. Since preservation strategies like preventive maintenance are generally a more effective use of funds than costly alternative management strategies like major rehabilitation or replacement, Ann Arbor is identifying those bridges that will benefit from a planned maintenance program while addressing those bridges that pose usability and/or safety concerns.

The three-fold goal of Ann Arbor's asset management program is the preservation and safety of its bridge network, increase its bridge assets' useful service life by extending the time that bridges remain in good and fair condition, and reduction of future maintenance costs. To quantify this goal, Ann Arbor specifically aims to have to have 100% of the city's bridges in fair to good condition and to have none of them classified as structurally deficient over this 3-year plan.

Thus, Ann Arbor's asset management plan objectives are:

- To continue to track the current condition of the city's bridges
- To develop a "mix of fixes" that will:
    - Program scheduled maintenance actions to impede deterioration of bridges in good condition
    - Implement selective corrective repairs or rehabilitation for degraded bridge elements in order to maintain and/or restore functionality
    - Identify and program those eligible bridges in need of replacement

- To identify available funding sources, such as:
    - Dedicated city resources
    - Obtaining funding through Michigan's Local Bridge Program
    - Opportunities to obtain other funding from outside sources such as the University of Michigan where their interests and the City's bridge system intersect
- To prioritize the programmed actions within available funding limitations
- To raise the condition of all city-owned vehicular bridges within the City's control to a condition of good or fair by the end of City of Ann Arbor Fiscal Year 2026

Inventory

Ann Arbor is responsible for 16 local bridges. Table 2 summarizes Ann Arbor's bridge assets by type, sizes by bridge type, and condition by bridge type. Additional inventory data, condition ratings, and proposed preventive maintenance actions for each bridge are contained in Appendix 1. The bridge inventory data was obtained from MDOT MiBRIDGE and other sources, and the 2022 condition data and maintenance actions are taken from the inspector's summary report.

Types

Of Ann Arbor's 16 structures for which it either owns or is responsible to report, 2 are concrete structures that meet the definition of a bridge, 5 are steel bridges, and 9 are pre-stressed concrete bridges. The City does not own any public, vehicular, timber bridges that have federally-mandated reporting requirements. Of the two concrete structures mentioned above, one is a pre-cast underground parking structure that meets the definition of a bridge; and, another is a cast-in-place concrete tunnel under a public roadway that meets the definition of a bridge. This tunnel is owned by the University of Michigan.

Locations and Sizes

Figure 7 illustrates the locations of bridge assets owned by Ann Arbor. Details about the locations and sizes of each individual asset can be found in Ann Arbor's MiBRIDGE database. For more information, please refer to the agency contact listed in the *Introduction* of this bridge asset management plan.

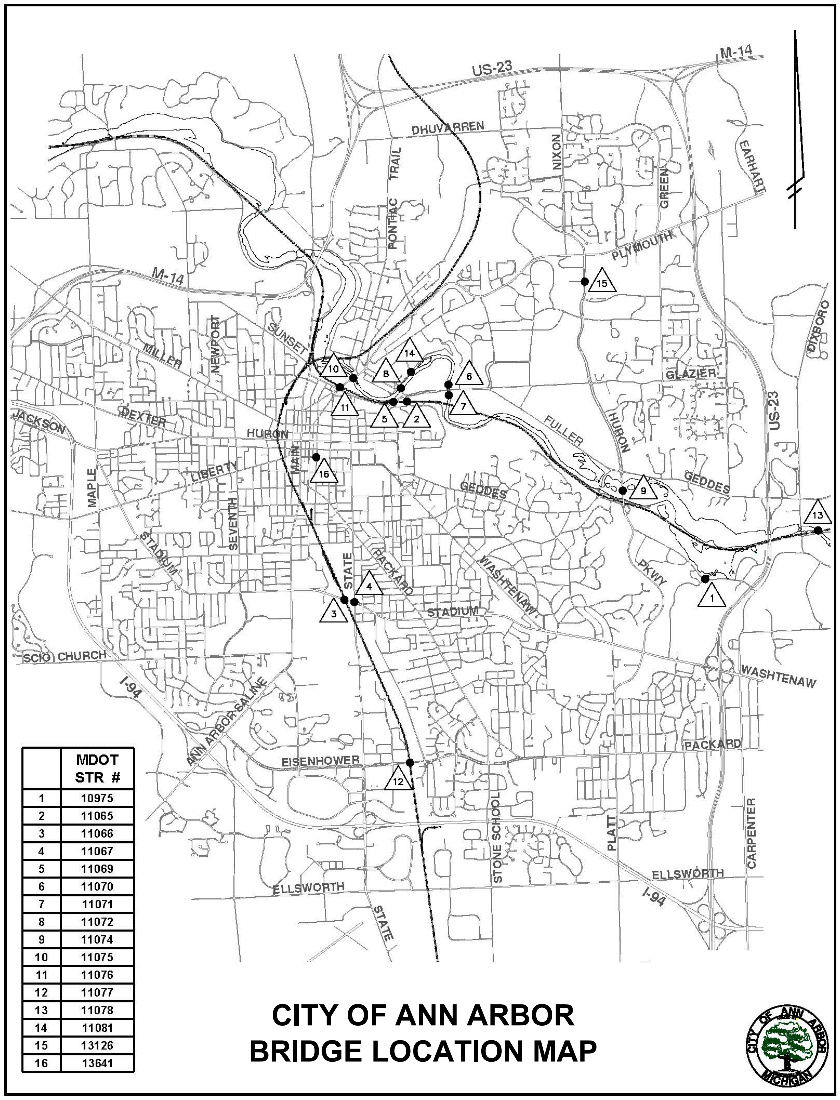

Figure 7: Map illustrating locations of the City of Ann Arbor's Public Roadway bridge assets

Condition

Ann Arbor evaluates its bridges according to the National Bridge Inspection Standards rating scale, with a rating of 9 to 7 being like new to good condition, a rating of 6 and 5 being fair condition, and a rating of 4 or lower being poor or serious/critical condition. The current condition of Ann Arbor's bridge network is 11 (69%) are good, 4 (25%) are fair, and 1 (6%) is poor or lower.

Another layer of classification of Ann Arbor's bridge inventory classifies zero (0) bridges as either structurally deficient, posted with weight restrictions, or closed. Structurally deficient bridges are those with a deck, superstructure, substructure, and/or culvert rated as "poor" according to the NBI rating scale, with a load-carrying capacity significantly below design standards, or with a waterway that regularly overtops the bridge during floods. Posted bridges are those that have declined in condition to a point where a restriction is necessary for what would be considered safe for vehicular or traffic loads passing over the bridge; designating a bridge as "posted" has no influence on its condition rating. Closed bridges are those that are closed to all traffic; closing a bridge is contingent upon its ability to carry a set minimum live load.

Table 2: Bridge Assets by Type: Inventory, Size, and Condition

Bridge Type	Total Number of Bridges	Total Deck Area (sq ft)	Condition: Structurally Deficient, Posted, Closed			2022 Condition		
			Struct. Defic	Posted	Closed	Poor	Fair	Good
Steel	5	126,144	0	0	0	1	3	1
Concrete	2	N/A	0	0	0	0	0	2
Pre-stressed Concrete	9	77,476	0	0	0	0	1	8
SD/Posted/Closed			**0**	**0**	**0**			
Total	**16**	**16**	**0**	**0**	**0**	**1**	**4**	**11**
Percentage (%)			**0.0%**	**0.0%**	**0.0%**	**6.25%**	**25.0%**	**68.75%**

Statewide, MDOT's 2022 statistics for local agency bridges show that 11% are poor and 89% are good/fair, indicating that the Ann Arbor has a lesser percentage of poor bridges compared to the statewide average for local agencies. Correspondingly, Ann Arbor has 93.75% of its bridges in fair/good condition versus the statewide average of 89% for local agency bridges. Statewide, 8% of local agency bridge deck area classifies as structurally deficient compared to 0% of Ann Arbor's bridge deck area.

Goals

The goal of Ann Arbor's asset management program is the preservation and safety of its bridge network; it also aims to extend the time that bridges remain in good and fair condition, thereby increasing their useful service life and reducing future maintenance costs.

Specifically, this goal translates into long-range goals of having 100% of its bridges rated fair/good condition by the end of City Fiscal Year 2025.

Several metrics will be used to assess the effectiveness of this asset management program. Ann Arbor will monitor and report the annual change in the number of its bridges rated fair/good (5 or higher) and the annual change in the number of its bridges classified as structurally deficient.

Prioritization, Programmed/Funded Projects, and Planned Projects

Prioritization

Ann Arbor's asset management program aims to address the structures of critical concern by targeting elements rated as being in poor condition and to improve and maintain the overall condition of the bridge network to good or fair condition by using a 'mix-of-fixes' strategy. Therefore, Ann Arbor prioritizes bridges for projects by evaluating five factors and weighting them as follows: condition – 30%, load capacity – 30%, traffic volume/roadway classification – 25%, safety – 15%, and length of Detour route/Impact to Major Stakeholders – 10%. There are several components within each factor that are used to arrive at its score. Each project under consideration is scored, and its total score is then compared with other proposed project to establish a priority order.

Ann Arbor annually reviews the current condition of each of its bridges using the NBIS inspection data contained in the *MDOT Bridge Safety Inspection Report* and the inspector's work recommendations contained in MDOT's *Bridge Inspection Report*. The inspection inventory and condition data and treatment recommendations are provided in Appendix 1. The management and preservation actions are selected in accordance with criteria contained in the *Summary of Preservation Criteria* table (below) and adapted to Ann Arbor's specific bridge network.

Table 3: Summary of Preservation Criteria

Preservation Action	Bridge Selection Criteria	Expected Service Life
Replacement		
Total Replacement	• NBI rating of 3 or less [1] [2] • *OR* Cost of rehabilitation exceeds cost of replacement [1] • *OR* Bridge is scour critical with no counter-measures available [1]	70 years
Superstructure Replacement	• NBI rating of 4 or less for the superstructure [1] [2] • *OR* Cost of superstructure and deck rehabilitation exceeds cost of replacement [1]	40 years [1]
Deck Replacement Epoxy Coated Steel Black Steel	• Use guidelines in MDOT's Bridge Deck Preservation Matrix [3] [4] • NBI rating of 4 or less for the deck surface and deck bottom [1] [2] • Deck bottom has more than 25% total area with deficiencies [1] • *OR* Replacement cost of deck is competitive with rehabilitation [1]	60+ years [3] [4]
Rehabilitation		
Substructure Replacement (Full or Partial)	• NBI rating of 4 or less for abutments, piers, or pier cap [1] [2] • Has open vertical cracks, signs of differential settlement, or active movement [1] • Pontis rating of 3 or 5 for more than 30 percent of the substructure [1] [5] • *OR* Bridge is scour critical with no counter-measures available	40 years [1*]
Steel Beam Repair	• More than 25% section loss in an area of the beam that affects load carrying capacity [1] • *OR* To correct impact damage that impairs beam strength [1]	40 years [1*]

Table 3: Summary of Preservation Criteria		
Preservation Action	**Bridge Selection Criteria**	**Expected Service Life**
Prestressed Concrete Beam Repair	• More than 5% spalling at ends of prestressed I-beams [1] • *OR* Impact damage that impairs beam strength or exposes prestressing strands [1]	40 years [1*]
Substructure Concrete Patching and Repair	• NBI rating of 5 or 4 for abutments or piers, and surface has less than 30% area spalled and delaminated [1] [2] • *OR* Pontis rating of 3 or 4 for the column or pile extension, pier wall, and/or abutment wall and surface has between 2% and 30% area with deficiencies [1] [5] • *OR* In response to inspector's work recommendation for substructure patching [1]	
Abutment Repair/Replacement	• NBI rating of 4 or less for the abutment [1] [2] • *OR* Has open vertical cracks, signs of differential settlement, or active movement	
Railing/Barrier Replacement	• NBI rating greater than 5 for the deck [1] [2] • NBI rating less than 5 for the railing with more than 30% total area having deficiencies [1] [2] • *OR* Pontis rating is 4 for railing [1] [5] • *OR* Safety improvement is needed [1]	
Culvert Repair/Replacement	• NBI rating of 4 or less for culvert or drainage outlet structure • *OR* Has open vertical cracks, signs of deformation, movement, or differential settlement	
Preventive Maintenance		
Shallow Concrete Deck Overlay	• NBI rating is 5 or less for deck surface, and deck surface has more than 15% area with deficiencies [1] [2] • NBI rating of 4 or 5 for deck bottom, and deck bottom has between 5% and 30% area with deficiencies [1] [2] • *OR* In response to inspector's work recommendation [1]	12 years
Deep Concrete Deck Overlay	• NBI rating of 5 or less for deck surface, and deck surface has more than 15% area with deficiencies [1] [2] • NBI deck bottom rating is 5 or 6, and deck bottom has less than 10% area with deficiencies [1] [2] • *OR* In response to inspector's work recommendation [1]	25 years
HMA Overlay with Waterproofing Membrane	• NBI rating of 5 or less for deck surface, and both deck surface and bottom have between 15% and 30% area with deficiencies [1] [2] • *OR* Bridge is in poor condition and will be replaced in the near future and the most cost-effective fix is HMA overlay [1]	
HMA Overlay Cap without Membrane	• Note: All HMA caps should have membranes unless scheduled for replacement within five years. • NBI rating of 3 or less for deck surface and deck bottom, and deck surface and deck bottom have more than 30% area with deficiencies. Temporary holdover to improve ride quality for a bridge in the five-year plan for rehab/replacement. [1] [2]	3 years
Concrete Deck Patching	• NBI rating of 5, 6, or 7 for deck surface, and deck surface has between 2% and 5% area with delamination and spalling [1] [2] • *OR* In response to inspector's work recommendation [1]	5 years

Table 3: Summary of Preservation Criteria		
Preservation Action	**Bridge Selection Criteria**	**Expected Service Life**
Steel Bearing Repair/Replacement	• NBI rating of 5 or more for superstructure and deck, and NBI rating 4 or less for bearing [2]	
Deck Joint Replacement	• Always include when doing deep or shallow concrete overlays [1] • NBI rating of 4 or less for joints [1] [2] • *OR* Joint leaking heavily [1] • *OR* In response to inspector's work recommendation for replacement [1]	
Pin and Hanger Replacement	• NBI rating of 4 or less for superstructure for pins and hangers [1] [2] • Pontis rating of 1, 2, or 3 for a frozen or deformed pin and hanger [1] [5] • *OR* Presence of excessive section loss, severe pack rust, or out-of-plane distortion [1]	15 years
Zone Repainting	• NBI rating of 5 or 4 for paint condition, and paint has 3% to 15% total area failing [1] [2] • *OR* During routine maintenance on beam ends or pins and hangers [1] • *OR* less than 15% of existing paint area has failed and remainder of paint system is in good or fair condition [1]	10 years
Complete Repainting	• NBI rating of 3 or less for paint condition [1] [2] • *OR* Painted steel beams that have greater than 15% of the existing paint area failing [1]	
Partial Repainting	• See Zone or Spot Painting	
Channel Improvements	• Removal of vegetation, debris, or sediment from channel and banks to improve channel flow • *OR* in response to inspector's work recommendation	
Scour Countermeasures	• Pontis scour rating of 2 or 3 and is not scheduled for replacement [1] [5] • OR NBI comments in abutment and pier ratings indicate presence of scour holes [1] [2]	

Approach Repaving	• Approach pavement relief joints should be included in all projects that contain a significant amount of concrete roadway (in excess of 1000' adjacent to the structure). The purpose is to alleviate the effects of pavement growth that may cause distress to the structure. Signs of pavement growth include:
	  ○ Abutment spalling under bearings [1]
	  ○ Beam end contact [1]
	  ○ Closed expansion joints and/or pin and hangers [1]
	  ○ Damaged railing and deck fascia at joints [1]
	  ○ Cracking in deck at reference line (45 degree angle) [1]	

Guard Rail Repair/Replacement	• Guard rail missing or damaged [2*] • *OR* Safety improvement is needed [2*]	
Scheduled Maintenance		
Superstructure Washing	• When salt contaminated dirt and debris collected on superstructure is causing corrosion or deterioration by trapping moisture [1] • *OR* Expansion or construction joints are to be replaced and the steel is not to be repainted [1]	2 years

Table 3: Summary of Preservation Criteria		
Preservation Action	**Bridge Selection Criteria**	**Expected Service Life**
	• *OR* Prior to a detailed replacement [1] • *OR* In response to inspector's work recommendation [1]	
Drainage System Clean-Out/Repair	• When drainage system is clogged with debris [1] • *OR* Drainage elements are broken, deteriorated, or damaged [1] • *OR* NBI rating comments for drainage system indicate need for cleaning or repair [1] [2]	2 years
Spot Repainting	• For zinc-based paint systems only. Do not spot paint with lead-based paints. • Less than 5% of paint area has failed in isolated areas [1] • *OR* In response to inspector's work recommendation [1]	5 years
Slope Paving Repair	• NBI rating is 5 or less for slope protection [1] [2] • *OR* Slope is degraded or sloughed • *OR* Slope paving has significant areas of distress, failure, or has settled [1]	
Riprap Installation	• To protect surface when erosion threatens the stability of side slopes of channel banks	
Vegetation Control	• When vegetation traps moisture on structural elements [1] • *OR* Vegetation is growing from joints or cracks [1] • *OR* In response to inspector's work recommendation for brush cut [1]	1 year
Debris Removal	• When vegetation, debris, or sediment accumulates on the structure or in the channel • *OR* In response to inspectors work recommendation	1 year
Deck Joint Repair	• Do not repair compression joint seals, assembly joint seals, steel armor expansions joints, and block out expansion joints; these should always be replaced. [1] • NBI rating is 5 for joint [1] [2] • *OR* In response to inspector's work recommendation for repair [1]	
Concrete Sealing	• Top surface of pier or abutments are below deck joints and, when contaminated with salt, salt can collect on the surface [1] • *OR* Surface of the concrete has heavy salt exposure. Horizontal surfaces of substructure elements are directly below expansion joints [1]	
Concrete Crack Sealing	• Concrete is in good or fair condition, and cracks extend to the depth of the steel reinforcement [1] • *OR* NBI rating of 5, 6, or 7 for deck surface, and deck surface has between 2% and 5% area with deficiencies [1] [2] • *OR* Unsealed cracks exist that are narrow and/or less than 1/8" wide and spaced more than 8' apart [1] • *OR* In response to inspector's work recommendation [1]	5 years
Minor Concrete Patching	• Repair minor delaminations and spalling that cover less than 30% of the concrete substructure [1] • *OR* NBI rating of 5 or 4 for abutments or piers, and comments indicate that their surface has less than 30% spalling or delamination [1] [2]	

Table 3: Summary of Preservation Criteria		
Preservation Action	**Bridge Selection Criteria**	**Expected Service Life**
	• *OR* Pontis rating of 3 or 4 for the column or pile extension, pier wall and/or abutment wall, and surface has between 2% and 30% area with deficiencies [1] [5] • *OR* In response to inspector's work recommendation [1]	
HMA Surface Repair/Replacement	• HMA surface is in poor condition • *OR* In response to inspector's work recommendation	
Seal HMA Cracks/Joints	• HMA surface is in good or fair condition, and cracks extend to the surface of the underlying slab or sub course • *OR* In response to inspector's work recommendation	
Timber Repair	• NBI rating of 4 or less for substructure for timber members • *OR* To repair extensive rot, checking, or insect infestation	
Miscellaneous Repair	• Uncategorized repairs in response to inspector's work recommendation	

This table was produced by TransSystems and includes information from the following sources:

[1] MDOT, *Project Scoping Manual*, MDOT, 2019.

[2] MDOT, *MDOT NBI Rating Guidelines*, MDOT, 2017.

[3] MDOT, *Bridge Deck Preservation Matrix - Decks with Uncoated "Black" Rebar*, MDOT, 2017.

[4] MDOT, *Bridge Deck Preservation Matrix - Decks with Epoxy Coated Rebar*, 2017.

[5] MDOT, *Pontis Bridge Inspection Manual*, MDOT, 2009.

* From source with interpretation added.

In terms of management and preservation actions, Ann Arbor's asset management program uses a 'mix-of-fixes' strategy that is made up of replacement, rehabilitation, preventive maintenance and/or scheduled maintenance.

Replacement involves substantial changes to the existing structure, such as bridge deck replacement, superstructure replacement, or complete structure replacement, and is intended to improve critical or closed bridges to a good condition rating.

Rehabilitation is undertaken to extend the service life of existing bridges. The work will restore deficient bridges to a condition of structural or functional adequacy, and may include upgrading geometric features. Rehabilitation actions are intended to improve the poor or fair condition bridges to fair or good condition.

Preventive maintenance work will improve and extend the service life of fair bridges, and will be performed with the understanding that future rehabilitation or replacement projects will contain appropriate safety and geometric enhancements. Preventive maintenance projects are directed at limited bridge elements that are rated in fair condition with the intent of improving these elements to a good rating. Most preventive maintenance projects will be one-time actions in response to a condition state need. Routine maintenance will be performed by the Ann Arbor's in-house maintenance team and/or contracted out.

Ann Arbor's **scheduled maintenance** program is an integral part of the preservation plan, and is intended to extend the service life of fair and good structures by preserving the bridges in their current condition for a longer period of time. Scheduled maintenance is proactive and not necessarily condition driven. In-house maintenance crews will perform much of this work.

One of the severely degraded and structurally deficient bridges requires replacement or major rehabilitation. Several of the remaining bridges require one-time preventive maintenance actions to repair defects and restore the structure to a higher condition rating. Most bridges are included in a scheduled maintenance plan with appropriate maintenance actions programmed for groups of bridges of similar material and type, bundled by location.

The replacement, rehabilitation, and preventive maintenance projects may be generally eligible for funding under the local bridge program and any requests for funding may be submitted with Ann Arbor's annual applications.

To achieve its goals, a primary objective of Ann Arbor's asset management program is improvement of bridges rated poor (4 or lower) to a rating of fair (5) or higher and/or preservation of bridges currently rated fair (5) or higher in their current condition within a five (5) year time period through management and/or preservation activities. The primary work activities that will be used to meet this improvement objective include a combination of replacement, rehabilitation, preventive maintenance, and scheduled maintenance. The work has been prioritized by considering each individual bridge's needs, its importance, the present costs of improvements, and the impact of deferral (i.e., cost increase due to increased degradation). Additionally, Ann Arbor's asset management program incorporates preservation of bridges currently rated fair (5) or higher in their current condition in order to extend their useful service life. The primary work activities used to meet this preservation objective include some combination of scheduled and preventive maintenance. A bridge-by-bridge preservation plan is presented in the Appendix 1.

Programmed/Funded Projects

Ann Arbor receives approximately $13 million per year in funding from its Street, Bridge, and Sidewalk Millage. To achieve its goals, Ann Arbor plans to peform several projects over the life of this asset management plan:

- Rehabilitation and widening of the East Medical Center Drive bridge to better facilitate access to the Medical Center by both motorized and nonmotorized populations (approximatley $13M). This project will be funded substantially by the University of Michigan, as it is the main entrance to the univerity hospital.
- Replacement of the Waste Water Treatment Plant Drive bridge (approximately $6.6M). This project will be funded separately through Sewage Disposal Funds, as serves exclusively as access to Ann Arbor's wastewater treatment plant.
- Bridge painting and minor structural repairs on the Fuller and Maiden Lane bridges (approximately $2.4M)

By performing the above referenced preventive maintenance and replacement of bridge structures, Ann Arbor will meet its overall bridge network condition goals.

By performing the aforementioned projects, Ann Arbor will meet its overall bridge network condition goals.

Ann Arbor computes the estimated cost of each typical management and/or preservation action using unit the suggested planning level costs contained prices in the latest *Bridge Repair Cost Estimate* spreadsheet contained in MDOT's *Local Bridge Program Call for Projects*. The cost of items of varying complexity, such as maintenance of traffic, staged construction, scour counter-measures, and so forth, are estimated on a bridge-by-bridge basis. The cost estimates are reviewed and updated periodically when better information becomes available. A summary of the programmed/funded projects and investments can be found in Table 4, the Cost Projection table, below.

Planned Projects

Ann Arbor does not have any identified additional priority projects that remain unfunded.

Table 4: Planned Projects and Revenue Needs

Strategy	2023	2024	2025	2026	Total
New					
11078	$0	$0	$2,400,000	$4,200,000	$6,600,000
Subtotal	$0	$0	$2,400,000	$4,200,000	$6,600,000
Rehabilitation					
11065	$300,000	$10,300,000	$2,000,000	$0	$12,600,000
Subtotal	$300,000	$10,300,000	$2,000,000	$0	$12,600,000
Preventive Maintenance					
11069	$0	$0	$0	$1,200,000	$1,200,000
11072	$0	$0	$0	$1,200,000	$1,200,000
Subtotal	$0	$0	$0	$2,400,000	$2,400,000
Grand Total	$300,000	$10,300,000	$4,400,000	$6,600,000	$21,600,000

Notes:

The funding to be used for Structure 11078 (the Waste Water Treatment Plant Drive bridge over the Huron River, will come exclusively from the Sewage Disposal Fund as this bridge exclusively serves the Waste Water Treatment Plant.

The funding to be used for Structure 11065 (E. Medical Center Drive over the Wolverine Line) is expected to be funded primarily from University of Michigan Hospital funding sources as they are the primary user of this structure and the planned improvements are being coordinated with other improvements on and within the hospital campus.

The funding required for the other bridges listed in the Table 4 will come from City of Ann Arbor funding sources (the Street Resurfacing Millage and the City's Weight and Gas Tax Revenue that it receives from the State of Michigan.

Gap Analysis

When Ann Arbor compares its funding and its programmed/funded projects with all of its prioritized projects as shown in Table 4, Ann Arbor believes it should be able to achieve all of its asset management goals for the period of this plan. If circumstances develop that create a situation whereby the City of Ann Arbor is unable to complete a planned project, we will continue to monitor the bridge assets and take any necessary steps within its budget to prevent or mitigate a condition decline or a need to post or close the structure.

2. FINANCIAL RESOURCES

Anticipated Revenues

Ann Arbor has programmed projects and has identified expected funding streams for the purpose(s) of various performing the necessary work types for selected bridges. This funding is intended for use in the identified years.

Anticipated Expenses

Scheduled maintenance activities and minor repairs that are not affiliated with any applications, grants, or other funded projects will be performed by Ann Arbor’s in-house maintenance forces and funded through the annual operating budget.

3. RISK MANAGEMENT

Ann Arbor recognizes the potential risks associated with bridges generally fall into several categories:

- Personal injury and property damage resulting from a bridge collapse or partial failure;
- Loss of access to a region or individual properties resulting from bridge closures, restricted load postings, or extended outages for rehabilitation and repair activities; and
- Delays, congestion, and inconvenience due to serviceability issues, such as poor-quality riding surface, loose expansion joints, or missing expansion joints.

Ann Arbor addresses these risks by implementing regular bridge inspections and a preservation strategy consisting of preventive maintenance.

Ann Arbor administers the biennial inspection of its bridges in accordance with NBIS and MDOT requirements. The inspection reports document the condition of Ann Arbor's bridges and evaluates them in order to identify new defects and monitor advancing deterioration. The summary inspection report in Appendix 1 identifies items needing follow-up, special inspection actions, and recommended bridge-by-bridge maintenance activities.

Bridges that are considered "scour critical" pose a risk to Ann Arbor's road and bridge network. Scour is the depletion of sediment from around the foundation elements of a bridge commonly caused by fast-moving water. According to MDOT's *Michigan Structure Inventory and Appraisal Coding Guide*, a scour critical bridge is one that has unstable abutment(s) and/or pier(s) due to observed or potential (based on an evaluation study) scour. Bridges receiving a scour rating of 3 or less are considered scour critical.

Ann Arbor does not have any scour critical bridges.

Similiarly, Ann Arbor does not have any bridges that require weight postings or are closed.

The preservation strategy identifies actions in the operations and maintenance plan that are preventive or are responsive to specific bridge conditions. The actions are prioritized to correct critical structural safety and traffic issues first, and then to address other needs based on the operational importance of each bridge and the long-term preservation of the network. The inspection results serve as a basis for modifying and updating the operations and maintenance plan annually.

Appendix 1: City of Ann Arbor 2021/2022 Bridge Inspection Report Executive Summary and

General Recommendations

- The City of Ann Arbor's bridge network is generally in good to fair condition.
- The Waste Water Treatment Plant Drive Bridge is currently scheduled to be replaced in 2025 in order to improve accessibility and redundancy to the plant. It is expected that the existing bridge will remain in place to continue to carry the existing trunkline sanitary sewers that feed the plant. The existing bridge is not expected to continue to carry vehicular traffic.
- E. Medical Center Drive bridge will be rehabilitated and widened in 2024 to better facilitate access to the Medical Center by both motorized and nonmotorized populations. The City is currently working with the University of Michigan on the design of the project.
- The Fuller and Maiden Lane bridges are scheduled for bridge painting and minor repairs in 2026.
- The above described work is expected to restore the condition of all City-owned roadway bridges to a condition of "Good" by City FY 25.
- Continue to perform the present inspection program in order to properly assess the condition of each bridge and its structural elements.

Bridge-by-bridge Preservation Plan

11065 **E. Medical Center Drive over the Wolverine Line**
Year Constructed: 1982 **Reconstructed:** N/A **General Condition:** Poor

Description: Three span bridge constructed in 1982 with twelve, rolled, steel, wide flange beams with welded coverplates and a composite, reinforced, concrete deck. The bridge length is 160'-0" from reference line to reference line with an out-to-out width of 70'-11¼" and an approximate skew of 36º to the left. The bridge carries a four-lane road and is located immediately south of the University of Michigan Medical Center. This bridge is located on the roadway that is the primary access into the Medical Center.

Recommendation: This structure requires rehabilitation in order to keep it in a high functioning condition and increase its rating to good. The major items of the proposed rehabilitation include; remove and replace the deck and deck joints; perform beam end repairs; repair/replace rusted end diaphragms; replace the pier cap at the north pier (Pier 2) and south Pier (Pier 1); perform substructure repairs; re-paint the structural steel; remove vegetation overgrowth from all quadrants of the bridge; complete replace deck; perform guardrail upgrades to meet current safety standards; remove and hot-dip galvanize and paint the existing steel tube railings.

This structure is anticipated to be rehabilitated and widened to five lanes in summer of 2024.

11066 **E. Stadium Boulevard over the Ann Arbor Railroad**
Year Constructed: 2012 **Reconstructed:** N/A **General Condition:** Good

Description: Single span bridge constructed in 2012 with eighteen adjacent pre-stressed concrete box beams and a composite reinforced concrete deck. The bridge length is 118'-4" from reference line to reference line with an out-to-out width of 77'-1" and an approximate skew of almost 20º to the right. The bridge carries a four-lane road along a major thoroughfare within the City.
E. Stadium Boulevard is a National Highway System Route.

Recommendation: The inspection of the East Stadium Boulevard Bridge found the structure to be in good condition with no major items of repair needed at this time. There are minor repairs that could be performed to improve the lifespan of the structure. Recommendations listed below are prioritized with low, medium, and high priority:

- Clean Expansion Joints (Medium)
- Place shallow concrete overlay on bridge deck (Medium)

The existing expansion joints should routinely be cleaned as part of the maintenance of the bridge.

The bridge deck surface has continued to crack since a second healer/sealer was applied in 2017. New cracks have formed, and sealed cracks have continued to grow and are no longer sealed. A shallow concrete overlay has a service life of 20-25 years, longer than an epoxy overlay or healer/sealer. Due to the young age of the bridge, a repair option with a longer service life is recommended.

11067 **E. Stadium Boulevard over S. State Street**
Year Constructed: 2012 **Reconstructed:** N/A **General Condition:** Good

Description: Single span bridge constructed in 2012 with eighteen adjacent pre-stressed concrete box beams and a composite reinforced concrete deck. The bridge length is 74'-5" from reference line to reference line with an out-to-out width of 77'-1" and an approximate skew of 42º to the right. The bridge carries a four-lane road along a major thoroughfare within the City.
E. Stadium Boulevard is a National Highway System Route.

Recommendation: The inspection of the East Stadium Boulevard Bridge found the structure to be in good condition with no major items of repair needed at this time. There are minor repairs that could be performed to improve the lifespan of the structure. Recommendations listed below are prioritized with low, medium, and high priority:

- Clean Expansion Joints (Medium)
- Place shallow concrete overlay on bridge deck (Medium)

The existing expansion joints should routinely be cleaned as part of the maintenance of the bridge.

The bridge deck surface has continued to crack since a second healer/sealer was applied in 2017. New cracks have formed, and sealed cracks have continued to grow and are no longer sealed. A shallow concrete overlay has a service life of 20-25 years, longer than an epoxy overlay or healer/sealer. Due to the young age of the bridge, a repair option with a longer service life is recommended.

11069 **Fuller Road over the Wolverine Line**
Year Constructed: 1982 **Reconstructed:** N/A **General Condition:** Good

Description: Three span bridge constructed in 1982 with ten, rolled, steel, wide flange beams with welded coverplates and a composite, reinforced, concrete deck. The bridge length is 261'-0" from reference line to reference line with an out-to-out width of 81'-5" and an approximate skew of 60º to the right. The bridge was rehabilitated in 2015 with a shallow concrete deck overlay; deck joint replacement; pin and hangar and end diaphragm replacement; zone painting; clearing existing vegetation from all four quadrants of the bridge; railing end wall and backwall repairs; and, guardrail upgrades at the SW quadrant.

Recommendation: The inspection of the Fuller Road Bridge found the structure to be in good condition. There are some repairs that should be completed in order to improve safety and the lifespan of the structure. Recommendations listed below are prioritized with low, medium, or high priority:

- Remove and replace the bridge railings to satisfy AASHTO standards (Low)

- Paint remaining portions of steel beams (Medium)

From our field inspection and the existing traffic counts, it is evident that this roadway is heavily traveled by both vehicular and pedestrian traffic. It is our opinion that the safety of this structure could be improved by replacing the substandard railing. The railing replacement can be postponed until the deck and/or sidewalks are replaced as part of a future project.

11070 **Fuller Road (WB) over the Huron River**
Year Constructed: 1994 **Reconstructed:** N/A **General Condition:** Good

Description: Three span bridge constructed in 1994 with 13 adjacent 27" pre-stressed, concrete, box beams with a 6" composite concrete deck. The box beams are transversely post-tensioned. The bridge length is 168'-0" from reference line to reference line with an out-to-out width of 40'-10½". The bridge substructure is pile supported.

Recommendation: At this time, no repairs are needed or recommended. The only advised action is to clear the vegetation between the bridges and adjacent to the structures which will remove a source of moisture adjacent to the bridges.

11071 **Fuller Road (EB) over the Huron River**
Year Constructed: 1993 **Reconstructed:** N/A **General Condition:** Good

Description: Three span bridge constructed in 1993 with 13 adjacent 27" pre-stressed, concrete, box beams with a 6" composite concrete deck. The box beams are transversely post-tensioned. The bridge length is 168'-0" from reference line to reference line with an out-to-out width of 40'-10½". The bridge sub-structure is pile supported.

Recommendation: At this time, no repairs are needed or recommended. The only advised action is to clear the vegetation between the bridges and adjacent to the structures which will remove a source of moisture adjacent to the bridges.

11072 **Maiden Lane over the Huron River**
Year Constructed: 1982 **Reconstructed:** N/A **General Condition:** Fair

Description: Three span bridge constructed in 1982 with nine, rolled, steel, wide flange beams with a composite, reinforced, concrete deck. The bridge length is 209'-0" from reference line to reference line with an out-to-out width of 70'-11¼" and an approximate skew of 15º to the right. The bridge was rehabilitated in 2015 with a shallow concrete deck overlay; deck joint replacement; zone painting; clearing existing vegetation from all four quadrants of the bridge; railing end wall repairs; and, guardrail upgrades at the NW and SE quadrants.

Recommendation: The inspection of the Maiden Lane Bridge found the structure to be in fair condition. Recommendations listed below are prioritized with low, medium, or high priority:

- Complete painting of structural steel (Medium)
- Repair spalled sidewalk curb at southeast expansion joint device (Low)
- Replace damaged guardrail post in the northeast quadrant (Low)

11074 **Huron Parkway over the Huron River, Geddes Avenue, and the Wolverine Line**
Year Constructed: 1968 **Reconstructed:** 2000 **General Condition:** Fair

Description: Seven span bridge constructed in 1968 with eight, continuous, variable depth, steel plate girders with a composite, reinforced, concrete deck. The bridge length is 1,018'-6.75" from reference line to reference line with an out-to-out width of 75'-1½". The bridge was rehabilitated in 2000 and 2007.

The 2000 rehabilitation included replacement of the east deck, sidewalk, and railing; the west deck was overlaid with a cantilevered sidewalk added and railing replacements, beam end repairs, diaphragm replacement under expansion joints, partial painting, expansion joint replacement, slope paving repairs, tree removal, and rip-rap placement.

The 2007 rehabilitation included cleaning and coating of the structural steel, bolted beam repairs to areas with section loss, and placing a strip seal at the center longitudinal open joint between the east and west decks.

Recommendation: At this time, no repairs are needed or recommended. The only advised action is the installation of low clearance signs in Span 1 over Geddes Avenue and Span 7 over the trail path.

11075 **Broadway Bridge over the Huron River**
Year Constructed: 2004 **Reconstructed:** N/A **General Condition:** Good

Description: Three span bridge constructed in 2004 with nine, 39", pre-stressed concrete box beams in a spread configuration with a composite, reinforced, concrete deck. The bridge length is 166'-8" from reference line to reference line with an out-to-out width of approximately 73'-0". The bridge substructure is pile supported.
Broadway is a National Highway System route.

Recommendation: The inspection of the Broadway Bridge found the structure to be in good condition with no major items of repair. There are minor repairs that could be performed to improve the lifespan of the structure. Recommendations listed below are prioritized with low, medium, high priority:

- Remove vegetation near structure (Medium)
- Clean expansion joints (Medium)
- Place riprap along banks and at abutments (Medium)
- Patch concrete beam ends (Low)
- Remove and replace the concrete parapet railings to satisfy MDOT standards (Low)

Remove vegetation and trees growing in the riprap adjacent to the bridge in the southwest quadrant which will remove a source of moisture from along the bridge. The existing expansion joints should routinely be cleaned as part of the maintenance of the bridge. Riprap is missing along portions of the northwest bank approaching the bridge and at abutments where geotextile fabric is exposed. Since the walkway along the abutment has sheet piling protection, the riprap is not needed to prevent scour at the bridge. Riprap should be placed to protect the bank and to keep the geotextile fabric in place. From our field inspection and existing traffic counts, it is evident that this roadway is heavily traveled by both vehicular and pedestrian traffic. Safety on this structure could be improved by replacing the substandard railings. The replacement of the railings can be postponed until the deck and/or sidewalks are replaced as part of a future project.

Repairs to the concrete box beam ends are not warranted at this time. The minor deterioration of the beam ends should be monitored during future inspections. The minor cracks and spall do not appear to be a result of field conditions.

11076 **Broadway Bridge over Depot Street and the Wolverine Line**
Year Constructed: 2004 **Reconstructed:** N/A **General Condition:** Good

Description: Four span bridge constructed in 2004 with nine, 39", pre-stressed concrete box beams in a spread configuration with a composite, reinforced, concrete deck. The bridge length is 316'-6" from reference line to reference line with an out-to-out width of approximately 73'-0". The Abutment "B" and Pier Nos. 2 and 3 are pile supported.
Broadway is a National Highway System route.

Recommendation: The inspection of the Broadway Bridge found the structure to be in good condition with no major items of repair. There are minor repairs that could be performed to improve the lifespan of the structure. Recommendations listed below are prioritized with low, medium, and high priority:

- Clean Expansion Joints (Medium)
- Repair concrete beam ends (Low)
- Remove and replace the concrete parapet railings to satisfy MDOT standards (Low)

The existing expansion joints should routinely be cleaned as part of the maintenance of the bridge. Repairs to the concrete box beam ends are not warranted at this time. The minor deterioration of the beam ends should be monitored during future inspections. The minor cracks and spalls do not appear to be a result of field conditions. From our field inspection and existing traffic counts, it is evident that this roadway is heavily traveled by both vehicular and pedestrian traffic. Safety on this structure could be improved by replacing the substandard railings. The replacement of the railings can be postponed until the deck and/or sidewalks are replaced as part of a future project.

11077 **Eisenhower Parkway over the Ann Arbor Railroad**
Year Constructed: 1974 **Reconstructed:** N/A **General Condition:** Good

Description: Three span bridge constructed in 1974. The original structure consisted of a dual structure on shared substructure units separated by an open joint along the bridge centerline. The superstructure is comprised of twelve, 36", pre-stressed, concrete, I-beams with a composite, reinforced concrete deck. The bridge length is 132'-5¼" from reference line to reference line with an out-to-out width of 78'-5".
Eisenhower Parkway is a National Highway System route.

The bridge was rehabilitated in 2005. The raised median and open joint was removed and a continuous bridge deck was constructed. The deck joints were removed and replaced and a shallow overlay was performed. Substructure repairs were performed as well as guard rail upgrades and other miscellaneous improvements.

Recommendation: The inspection of the Eisenhower Parkway Bridge found the structure to be in fair condition with no major items of repair. There are minor repairs that could be performed to improve the lifespan of the structure. Recommendations listed below are prioritized with low, medium, high priority:

- Repair concrete spalls in approach slabs and sleeper slabs (Low)
- Repair joint in east abutment (Medium)
- Perform concrete I-beam end repairs (Medium)
- Perform substructure repairs on the piers (Medium)
- Replace the bearing pads at the piers (Medium)
- Repair slope paving areas at abutments (Low)

There are vertical, diagonal, and longitudinal cracks in the beam ends at the piers, extending from the bearing pads toward the ends of the concrete I-beam. Some beam ends have spalled concrete with exposed reinforcement while other beam ends are patched. It is likely that the beam end deterioration occurred prior to the 2005 structure rehabilitation work when there was an open joint along the center of the bridge and a raised median which created curb lines for the water to rest in. Some beam ends were repaired in 2005 and should be repaired again when new expansion joints are placed in the bridge deck. The lengths of the cracks should be monitored over future inspection cycles to determine any growth in length. It appears at this time that the growth has slowed or stopped. There is also one location where a piece of wood is located between two beam ends on the west pier (Pier 1). This should be removed since it may constrict the expansion movement between the beams and may trap moisture. The center joint in the east abutment should be replaced to prevent further loss of fill and undermining of the approach slab. The existing substructure deterioration areas are too small to justify substructure patching at this time. These repairs can be postponed or completed with the beam end repair work noted above.

11078 **Waste Water Treatment Plant Drive bridge over the Huron River**
Year Constructed: 1934 **Reconstructed:** N/A **General Condition:** Fair

Description: Two span bridge constructed in 1934 with three, rolled steel, wide flange, beams and composite reinforced concrete deck. The bridge length is 117'-1" from reference line to reference line with an out-to-out width of 18'-6". The substructure is pile supported based on the information contained in the original design drawings.

The bridge was rehabilitated in 1985 and 2000. In 1985 the expansion joint device and guard rails were replaced and the beams were painted. In 2000, the bridge deck was overlaid , the bridge railings and guardrails were replaced, the expansion joint was replaced, and the substructure was patched.

In Summer 2016 the following repairs were performed on the structure; clearing and tree removal in all quadrants of the structure; two diaphragms were replaced over the piers; substructure repairs above and below the water line were made using a Porta-dam system to control the river flows; placement of scour counter-measures at the east abutment and upstream end of the pier; cleaning the expansion joint; removal of timber debris at upstream end of the pier; spot painting of the steel beams; and crack injection at the abutments and pier.

Recommendation: At this time, no repairs are needed or recommended. The only advised action is the installation of narrow/ one-lane bridge signs at each approach. We understand the City is planning to construct a parallel vehicle structure to replace the current bridge that will serve as the access road to the treatment plant. Minor repairs to this structure (including the installation of scour countermeasures as recommended in the 2019 underwater report) may be included with that future project.

Due to the very narrow clear width of the bridge deck (16.1 feet), it is not possible to replace the bridge deck while maintaining traffic to the treatment plant.

Because of these factors, it is recommended that a replacement bridge be constructed in the next 5-10 years to provide uninterrupted access in and out of the treatment plant. A new structure could be constructed south of the existing structure, along a new alignment. After this bridge is constructed, the existing structure could have the concrete deck and railings removed, the beams, beam bearings and utility diaphragms rehabilitated, and an open grating or some other light-weight pedestrian only deck placed to maintain pedestrian access to the existing utility pipes. The WWTP should begin the process of determining ROW needs and other factors related to the design and construction of a replacement structure soon to maintain access to the plant in the future.

Beyond the deck condition and geometric constraints, the existing structural steel has surface rust which is the beginning sign of paint system failure. Each bay and fascia convey utilities across the structure. The beams are difficult to access for painting due to the utilities.

11081 **Island Drive over Traver Creek**
Year Constructed: 1962 **Reconstructed:** N/A **General Condition:** Fair

Description: Single span bridge constructed in 1962 with fourteen, 12", side-by-side box beams with a bituminous wearing surface. The bridge length is 24'-0" from reference line to reference line with an out-to-out width of 42'-3½". The existing substructure consists of full-height reinforced concrete abutments supported on spread footings. The channel between the abutments is lined with a cast-in-place concrete slab.

Recommendation: At this time, no repairs are needed or recommended. The only advised action is to clear the channel debris at the upstream side of the structure.

10975 **E. Huron River Drive over Mallett's Creek**
Year Constructed: 1979 **Reconstructed:** N/A **General Condition:** Good

Description: Single span bridge constructed in 1979 with 6, pre-stressed, concrete, I-beams with a 9" thick cast-in-place concrete deck. The bridge length is 50.0' with an out-to-out width of 41'-7". The existing substructure consists of full height curtain wall abutments on spread footings.

The bridge was rehabilitated in 2017. As part of the bridge work the existing concrete deck was patched, the existing railings were removed and replaced solid parapet wall type barrier with MDOT Standard 2-tube railings attached to the parapet wall. An epoxy overlay was placed on the bridge deck. Scour counter-measures were placed along the east abutment.

Recommendation: The following recommendations are prioritized as High, Medium or Low and should be implemented soon:

- Remove the buildup of dirt on the south shoulder (High)
- Remove channel drift lodged under utility supports on the south side (High)
- Pave the approach shoulders or otherwise reduce/eliminate the flow of water and dirt onto the bridge deck (High)
- Trim the brush behind all guardrail approaches to increase visibility (High)
- Cut down trees adjacent to abutments (Medium)
- Clean out deck expansion joint device (Medium)

- Place riprap around west abutment (Medium)

13126 **U of M Tunnel under Huron Parkway**

Year Constructed: 2001 **Reconstructed:** N/A **General Condition:** Good

Description: The tunnel is a reinforced concrete, double-barrel. Tunnel. The tunnel is approximately 29’-0” wide by approximately 17’-0” tall and is 362’-0” long. The tunnel has two sections, the first is a 21’-6” wide by 17’-0” tall section that conveys pedestrians between two University of Michigan buildings. The second is a 7’-6” wide by 17’-0” section that enclose utilities that run between the buildings.

The University of Michigan owns and operates the tunnel.

Recommendation: The University of Michigan Tunnel is in good condition with no major items in need of repair. There are minor repairs that could be performed to improve the lifespan of the structure. Recommendations listed below are prioritized with low, medium, high priority:

- Repair the torn portions of the end joints of the tunnel (Low)

13641 **South Fifth Avenue over below grade parking structure**

Year Constructed: 2011 **Reconstructed:** N/A **General Condition:** Good

Description: A portion of the parking structure is located under the roadways and sidewalks of S. Fifth Avenue and Library Lane. The “bridge” portion of the structure is three spans totaling approximately 188’-6” long by approximately 63’-6” wide along S. Fifth Avenue. The “bridge” portion under Library Lane is approximately 17 spans totaling approximately 530’ long by 63’-6” and is located along Library Lane between S. Fifth Avenue and S. Division Street. The “bridge deck” consists of a post-tensioned concrete slab. The “bridge” substructure primarily consists of four columns per span supporting post-tensioned beams. The parking structure is four levels high.

Recommendation: The South Fifth Avenue over the below grade Parking structure is in good condition with no items of repair.

C. CULVERT ASSET MANAGEMENT PLAN SUPPLEMENT

Culvert Primer

Culverts are structures that lie underneath roads, enabling water to flow from one side of the roadway to the other (Figure C-1 and Figure C-2). The important distinguishing factor between a culvert and a bridge is the size. Culverts are considered anything under 20 feet while bridges, according to the Federal Highway Administration, are 20 feet or more. While similar in function to storm sewers, culverts differ from storm sewers in that culverts are open on both ends, are constructed as straight-line conduits, and lack intermediate drainage structures like manholes and catch basins. Culverts are critical to the service life of a road because of the important role they play in keeping the pavement layers well drained and free from the forces of water building up on one side of the roadway.

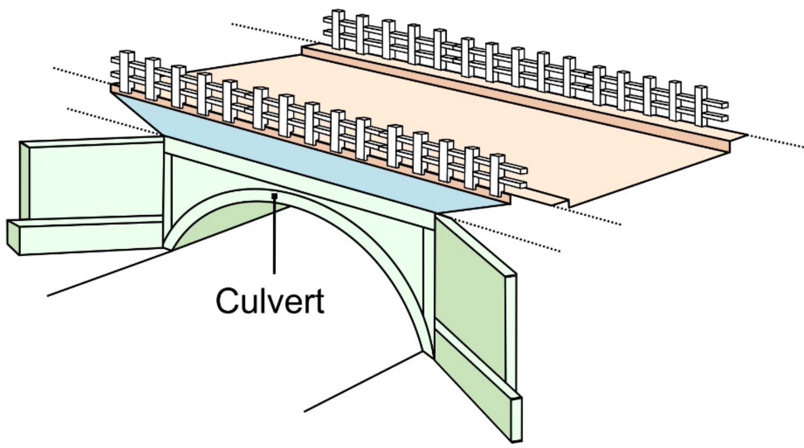

Figure C-1: Diagram of a culvert structure

Figure C-2: Examples of culverts. Culverts allow water to pass under the roadway (left), they are straight-line conduits with no intermediate drainage structures (middle), and they come in various materials (left: metal; middle and right: concrete) and shapes (left: arch; middle: round; right: box).

Culvert Types

Michigan conducted its first pilot data collection on local agency culverts in the state in 2018. Of almost 50,000 culverts inventoried as part of the state-wide pilot project, the material type used for constructing culverts ranged from (in order of predominance) corrugated steel, concrete, plastic, aluminum, and masonry/tile, to timber materials. The shapes of the culverts were (in order of predominance) circular, pipe arch, arch, rectangular, horizontal ellipse, or box. The diameter for the majority of culverts ranged from less than 12 inches to 24 inches; a portion, however, ranged from 30 inches to more than 48 inches.

Culvert Condition

Several culvert condition assessment practices exist. The FHWA has an evaluation method in its 1986 *Culvert Inspection Manual*. In conjunction with descriptions and details in the Ohio Department of Transportation's 2017 *Culvert Inspection Manual* and Wisconsin DOT's *Bridge Inspection Field Manual*, the FHWA method served as the method for evaluating Michigan culverts in the pilot. In 2018, Michigan local agencies participated in a culvert pilot data collection, gathering inventory and condition data; full detail on the condition assessment system used in the data collection can be found in Appendix G of the final report (https://www.michigan.gov/documents/tamc/TAMC_2018_Culvert_Pilot_Report_Complete_634795_7.pdf).

The Michigan culvert pilot data collection used a 1 through 10 rating system, where 10 is considered a new culvert with no deterioration or distress and 1 is considered total failure. Each of the different culvert material types requires the assessment of features unique to that material type, including structural deterioration, invert deterioration, section deformation, blockage(s) and scour. Corrugated metal pipe, concrete pipe, plastic pipe, and masonry culverts require an additional assessment of joints and seams. Slab abutment culverts require an additional assessment of the concrete abutment and the masonry abutment. Assessment of timber culverts only relied on blockage(s) and scour. The assessments come together to generate condition rating categories of good (rated as 10, 9, or 8), fair (rated as 7 or 6), poor (rated as 5 or 4), or failed (rated as 3, 2, or 1).

Culvert Treatments

The *MDOT Drainage Manual* addresses culvert design and treatments. Of most importance to the longevity of culverts is regular cleaning to prevent clogs. More extensive treatments may include re-positioning the pipe to improve its grade and lining a culvert to achieve more service life after structural deterioration has begun.

D. TRAFFIC SIGNALS ASSET MANAGEMENT PLAN SUPPLEMENT

Traffic Signals Primer

Types

Electronic traffic control devices come in a large array of configurations, which include case signs (e.g., keep right/left, no right/left turn, reversible lanes), controllers, detection (e.g., cameras, push buttons), flashing beacons, interconnects (e.g., DSL, fire station, phone line, radio), pedestrian heads (e.g., hand-man), and traffic signals. This asset management plan is only concerned with traffic signals (Figure D-1) as a functioning unit and does not consider other electronic traffic control devices.

Figure D-1: Example of traffic signals

Condition

Traffic signal assessment considers the functioning of basic tests on a pass/fail basis. These tests include battery backup testing, components testing, conflict monitor testing, radio testing, and underground detection.

Treatments

Traffic signals are maintained in accordance with the *Michigan Manual on Uniform Traffic Control Devices*. Maintenance of traffic signals includes regular maintenance of all components, cleaning and servicing to prevent undue failures, immediate maintenance in the case of emergency calls, and provision of stand-by equipment. Timing changes are restricted to authorized personnel only.

E. GLOSSARY & ACRONYMS

Glossary

Alligator cracking: Cracking of the surface layer of an asphalt pavement that creates a pattern of interconnected cracks resembling alligator hide. This is often due to overloading a pavement, sub-base failure, or poor drainage.[5]

Asset management: A process that uses data to manage and track road assets in a cost-effective manner using a combination of engineering and business principles. Public Act 325 of 2018 provides a legal definition: "an ongoing process of maintaining, preserving, upgrading, and operating physical assets cost effectively, based on a continuous physical inventory and condition assessment and investment to achieve established performance goals".[6]

Biennial inspection: Inspection of an agency's bridges every other year, which happens in accordance with National Bridge Inspection Standards and Michigan Department of Transportation requirements.

Bridge inspection program: A program implemented by a local agency to inspect the bridges within its jurisdiction systematically in order to ensure proper functioning and structural soundness.

Capital preventative maintenance: Also known as CPM, a planned set of cost-effective treatments to address of fair-rated infrastructure before the structural integrity of the system has been severely impacted. These treatments aim to slow deterioration and to maintain or improve the functional condition of the system without significantly increasing the structural capacity. Light capital preventive maintenance is a set of treatments designed to seal isolated areas of the pavement from water, such as crack and joint sealing, to protect and restore pavement surface from oxidation with limited surface thickness material, such as fog seal; generally, application of a light CPM treatment does not provide a corresponding increase in a segment's PASER score. Heavy capital preventive maintenance is a set of surface treatments designed to protect pavement from water intrusion or environmental weathering without adding significant structural strength, such as slurry seal, chip seal, or thin (less than 1.5-inch) overlays for bituminous surfaces or patching or partial-depth (less than 1/3 of pavement depth) repair for concrete surfaces.

Cape seal: An asphalt pavement treatment method consisting of, first spraying liquid asphalt onto the old pavement surface and, then a single layer of small stone chips spread onto the wet asphalt layer, followed by an additional layer of sprayed liquid asphalt.

City major: A road classification, defined in Michigan Public Act 51, that encompasses the generally more important roads in a city or village. City major roads are designated by a municipality's governing body and are subject to approval by the State Transportation Commission. These roads do not include roads under the jurisdiction of a county road commission or trunkline highways.

City minor: A road classification, defined in Michigan Public Act 51, that encompasses the generally less important roads in a city or village. These roads include all city or village roads that are not city major road and do not include roads under the jurisdiction of a county road commission.

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[5] https://en.wikipedia.org/wiki/Crocodile_cracking
[6] Inventory-based Rating System for Gravel Roads: Training Manual

Composite pavement: A pavement consisting of concrete and asphalt layers. Typically, composite pavements are old concrete pavements that were overlaid with HMA in order to gain more service life.

Concrete joint resealing: Resealing the joints of a concrete pavement with a flexible sealant to prevent moisture and debris from entering the joints. When debris becomes lodged inside a joint, it inhibits proper movement of the pavement and leads to joint deterioration and spalling.

Concrete pavement: Also known as rigid pavement, a pavement made from portland cement concrete. Concrete pavement has an average service life of 30 years and typically does not require as much periodic maintenance as HMA.

Cost per lane mile: Associated cost of construction, measured on a per lane, per mile basis. Also see *lane-mile segment*.

CPM: See *Capital preventive maintenance*.

Crack seal: A pavement treatment method for both asphalt and concrete pavements that fills cracks with asphalt materials, which seals out water and debris and slows down the deterioration of the pavement. Crack seal may encompass the term “crack filling”.

Crust: A very tightly compacted surface on an unpaved road that sheds water with ease but takes time to be created.

Culvert: A pipe or structure used under a roadway that allows cross-road drainage while allowing traffic to pass without being impeded; culverts span up to 20 feet.[7]

Dust control: A gravel road surface treatment method that involves spraying chloride or other chemicals on the gravel surface to reduce dust loss, aggregate loss, and maintenance. This is a relatively short-term fix that helps create a crusted surface.

Expansion joint: Joints in a bridge that allow for slight expansion and contraction changes in response to temperature. Expansion joints prevent the build up of excessive pressure, which can cause structural damage to the bridge.

Federal Highway Administration: Also known as FHWA, this is an agency within the U.S. Department of Transportation that supports state and local governments in the design, construction, and maintenance of the nation’s highway system.[8]

Federal-aid network: Portion of road network that is comprised of federal-aid routes. According to Title 23 of the United States Code, federal-aid-eligible roads are “highways on the federal-aid highways systems and all other public roads not classified as local roads or rural minor collectors”.[9] Roads that are part of the federal-aid network are eligible for federal gas-tax monies.

FHWA: See *Federal Highway Administration*.

Flexible pavement: See *hot-mix asphalt pavement*.

Full-depth concrete repair: A concrete pavement treatment method that involves removing sections of damaged concrete pavement and replacing it with new concrete of the same dimensions in order to restore

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[7] Adapted from Inventory-based Rating System for Gravel Roads: Training Manual
[8] Federal Highway Administration webpage https://www.fhwa.dot.gov/
[9] Inventory-based Rating System for Gravel Roads: Training Manual

the riding surface, delay water infiltration, restore load transfer from one slab to the next, and eliminate the need to perform costly temporary patching.

Geographic divides: Areas where a geographic feature (e.g., river, lake, mountain) limits crossing points of the feature.

Grants: Competitive funding gained through an application process and targeted at a specific project type to accomplish a specific purpose. Grants can be provided both on the federal and state level and often make up part of the funds that a transportation agency receives.

Gravel surfacing: A low-cost, easy-to-maintain road surface made from aggregate and fines.

Heavy capital preventive maintenance: See *Capital preventive maintenance*.

HMA: See *hot-mix asphalt pavement*.

Hot-mix asphalt overlay: Also known as HMA overlay, this a surface treatment that involves layering new asphalt over an existing pavement, either asphalt or concrete. It creates a new wearing surface for traffic and to seal the pavement from water, debris, and sunlight damage, and it often adds significant structural strength.

Hot-mix asphalt pavement: Also known as HMA pavement, this type of asphalt creates a flexible pavement composed of aggregates, asphalt binder, and air voids. HMA is heated for placement and compaction at high temperatures. HMA is less expensive to construct than concrete pavement, however it requires frequent maintenance activities and generally lasts 18 years before major rehabilitation is necessary. HMA makes up the vast majority of local-agency-owned pavements.

IBR: See *IBR element*, *IBR number*, and/or *Inventory-based Rating System™*.

IBR element: A feature used in the IBR System™ for assessing the condition of roads. The system relies on assessing three elements: surface width, drainage adequacy, and structural adequacy.[10]

IBR number: The 1-10 rating determined from assessments of the weighted IBR elements. The weighting relates each element to the intensity road work needed to improve or enhance the IBR element category.[11]

Interstate highway system: The road system owned and operated by each state consisting of routes that cross between states, make travel easier and faster. The interstate roads are denoted by the prefix "I" or "U.S." and then a number, where odd routes run north-south and even routes run east-west. Examples are I-75 or U.S. 2.[12]

Inventory-based Rating System™: Also known as the IBR System™, a rating system designed to assess the capabilities of gravel and unpaved roads to support intended traffic volumes and types year round. It assesses roads based on how three IBR elements, or features—surface width, drainage adequacy, and structural adequacy—compare to a baseline, or "good", road.[13]

Investment Reporting Tool: Also known as IRT, a web-based system used to manage the process for submitting required items to the Michigan Transportation Asset Management Council. Required items

[10] Inventory-based Rating System for Gravel Roads: Training Manual
[11] Inventory-based Rating System for Gravel Roads: Training Manual
[12] https://www.fhwa.dot.gov/interstate/faq.cfm#question3
[13] Adapted from Inventory-based Rating System for Gravel Roads: Training Manual

include planned and completed maintenance and construction activity for roads and bridges and comprehensive asset management plans.

IRT: See *Investment Reporting Tool*.

Jurisdiction: Administrative power of an entity to make decisions for something. In Michigan, the three levels of jurisdiction classification for transportation assets are state highways, county roads, and city and village streets. State highways are under the jurisdiction of the Michigan Department of Transportation, county roads are under the jurisdiction of the road commission for the county in which the roads are located, and city and village streets are under the jurisdiction of the municipality in which the roads are located.

Jurisdictional borders: Borders between two road-owning-agency jurisdictions, or where the roads owned by one agency turn into roads owned by another agency. Examples of jurisdictional borders are township or county lines.

Lane-mile segment: A segment of road that is measured by multiplying the centerline miles of a roadway by the number of lanes present.

Lane-mile-years: A network's total lane-miles multiplied by one year; a method to quantify the measurable loss of pavement life.

Light capital preventive maintenance: See *Capital preventive maintenance*.

Limited access areas: Areas—typically remote areas—serviced by few or seasonal roads that require long detours routes if servicing roads are closed.

Main access to key commercial districts: Areas where large number or large size business will be significantly impacted if a road is unavailable.

Maintenance grading: A surface treatment method for unpaved roads that involves re-grading the road to remove isolated potholes, washboarding, and ruts, and then restoring the compacted crust layer.

MDOT: See *Michigan Department of Transportation*.

MDOT's Local Bridge Program Call for Projects: A call for project proposals for replacement, rehabilitation, and/or preventive maintenance of local bridges that, if granted, receives bridge funding from the Michigan Department of Transportation. The Call for Projects is made by the Local Bridge Program.

MGF: See *Michigan Geographic Framework*.

Michigan Department of Transportation: Also known as MDOT, this is the state of Michigan's department of transportation, which oversees roads and bridges owned by the state or federal government in Michigan.

Michigan Geographic Framework: Also known as MGF, this is the state of Michigan's official digital base map that contains location and road information necessary to conduct state business. The Michigan Department of Transportation uses the MGF to link transportation assets to a physical location.

Michigan Public Act 51 of 1951: Also known as PA 51, this is a Michigan legislative act that served as the foundation for establishing a road funding structure by creating transportation funding distribution methods and means. It has been amended many times.[14]

Michigan Public Act 325 of 2018: Also known as PA 325, this legislation modified PA 51 of 1951 in regards to asset management in Michigan, specifically 1) re-designating the TAMC under Michigan Infrastructure Council (MIC); 2) promoting and overseeing the implementation of recommendations from the regional infrastructure asset management pilot program; 3) requiring local road three-year asset management plans beginning October 1, 2020; 4) adding asset classes that impact system performance, safety or risk management, including culverts and signals; 5) allowing MDOT to withhold funds if no asset management plan submitted; and 6) prohibiting shifting finds from a country primary to a county local, or from a city major to a city minor if no progress toward achieving the condition goals described in its asset plan.[15]

Michigan Public Act 499 of 2002: Also known as PA 499, this legislation requires road projects for the upcoming three years to be reported to the TAMC.

Michigan Transportation Asset Management Council: Also known as the TAMC, a council comprised of professionals from county road commissions, cities, a county commissioner, a township official, regional and metropolitan planning organizations, and state transportation department personnel. The council reports directly to the Michigan Infrastructure Council.[16] The TAMC provides resources and support to Michigan's road-owning agencies, and serves as a liaison in data collection requirements between agencies and the state.

Michigan Transportation Fund: Also known as MTF, this is a source of transportation funding supported by vehicle registration fees and the state's per-gallon gas tax.

Microsurface treatment: An asphalt pavement treatment method that involves applying modified liquid asphalt, small stones, water, and portland cement for the purpose of protecting a pavement from damage caused by water and sunlight.

Mill and hot-mix asphalt overlay: Also known as a mill and HMA overlay, this is a surface treatment that involves the removal of the top layer of pavement by milling and the replacement of the removed layer with a new HMA layer.

Mix-of-fixes: A strategy of maintaining roads and bridges that includes generally prioritizes the spending of money on routine maintenance and capital preventive maintenance treatments to impede deterioration and then, as money is available, performing reconstruction and rehabilitation.

MTF: See *Michigan Transportation Fund*.

National Bridge Inspection Standards: Also known as NBIS, standards created by the Federal Highway Administration to locate and evaluate existing bridge deficiencies in the federal-aid highway system to ensure the safety of the traveling public. The standards define the proper safety for inspection and evaluation of all highway bridges.[17]

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[14] Inventory-based Rating System for Gravel Roads: Training Manual
[15] Inventory-based Rating System for Gravel Roads: Training Manual
[16] Inventory-based Rating System for Gravel Roads: Training Manual
[17] https://www.fhwa.dot.gov/bridge/nbis/

National Center for Pavement Preservation: Also known as the NCPP, a center that offers education, research, and outreach in current and innovative pavement preservation practices. This collaborative effort of government, industry, and academia entities was established at Michigan State University.

National Functional Class: Also known as NFC, a federal grouping system for public roads that classifies roads according to the type of service that the road is intended to provide.

National highway system: Also known as NHS, this is a network of roads that includes the interstate highway system and other major roads managed by state and local agencies that serve major airports, marine, rail, pipelines, truck terminals, railway stations, military bases, and other strategic facilities.

NBIS: See *National Bridge Inspection Standards*.

NCPP: See *National Center for Pavement Preservation*.

NCPP Quick Check: A system created by the National Center for Pavement Preservation that works under the premise that a one-mile road segment loses one year of life each year that it is not treated with a maintenance, rehabilitation, or reconstruction project.

NFC: See *National Functional Class*.

Non-trunkline: A local road intended to be used over short distances but not recommended for long-distance travel.

Other funds: Expenditures for equipment, capital outlay, debt principal payment, interest expense, contributions to adjacent governmental units, principal, interest and bank fees, and miscellaneous for cities and villages.

PA: See *Michigan Public Act 51*, *Michigan Public Act 325*, and/or *Michigan Public Act 499*.

PASER: See *Pavement Surface Evaluation and Rating system*.

Pavement reconstruction: A complete removal of the old pavement and base and construction of an entirely new road. This is the most expensive rehabilitation of the roadway and also the most disruptive to traffic patterns.

Pavement Surface Evaluation and Rating system: Also known as the PASER system, the PASER system rates surface condition on a 1-10 scale, where 10 is a brand new road with no defects, 5 is a road with distress but that is structurally sound and requires only preventative maintenance, and 1 is a road with extensive surface and structural distresses that is in need of total reconstruction. This system provides a simple, efficient, and consistent method for evaluating the condition of paved roads.[18]

Pothole: A defect in a road that produces a localized depression.[19]

Preventive maintenance: Planned treatments to an existing asset to prevent deterioration and maintain functional condition. This can be a more effective use of funds than the costly alternative of major rehabilitation or replacement.

Proactive preventive maintenance: Also known as PPM, a method of performing capital preventive maintenance treatments very early in a pavement's life, often before it exhibits signs of pavement defect.

[18] Adapted from Inventory-based Rating System for Gravel Roads: Training Manual
[19] Inventory-based Rating System for Gravel Roads: Training Manual

Public Act 51: See *Michigan Public Act 51 of 1951*

Public Act 325: See *Michigan Public Act 325 of 2018*

Public Act 499: See *Michigan Public Act 499 of 2002*

Reconstruction and rehabilitation programs: Programs intended to reconstruct and rehabilitate a road.

Restricted load postings: A restriction enacted on a bridge structure when is incapable of transporting a state's legal vehicle loads.

Rights-of-way ownership: The owning of the right-of-way, which is the land over which a road or bridge travels. In order to build a road, road agencies must own the right-of-way or get permission to build on it.

Rigid pavement: See *concrete pavement*.

Road infrastructure: An agency's road network and assets necessary to make it function, such as traffic signage and ditches.

Road: The area consisting of the roadway (i.e., the travelled way or the portion of the road on which vehicles are intended to drive), shoulders, ditches, and areas of the right of way containing signage.[20]

Roadsoft: An asset management software suite that enables agencies to manage road and bridge related infrastructure. The software provides tools for collecting, storing, and analyzing data associated with transportation infrastructure. Built on an optimum combination of database engine and GIS mapping tools, Roadsoft provides a quick, smooth user experience and almost unlimited data handling capabilities.[21]

Ruts/rutting: Deformation of a road that usually forms as a permanent depression concentrated under the wheel path parallel to the direction of travel.[22]

Scheduled maintenance: Low-cost, day-to-day activities applied to bridges on a scheduled basis that mitigates deterioration.[23]

Sealcoat pavement: A gravel road that has been sealed with a thin asphalt binder coating that has stone chips spread on top.

Service life: Time from when a road or treatment is first constructed to when it reaches a point where the distresses present change from age-related to structural-related (also known as the critical distress point).[24]

Slurry seal: An asphalt pavement treatment method that involves applying liquid asphalt, small stones, water, and portland cement in a very thin layer with the purpose of protecting an existing pavement from being damaged by water and sunlight.

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[20] Inventory-based Rating System for Gravel Roads: Training Manual
[21] Inventory-based Rating System for Gravel Roads: Training Manual
[22] Paving Class Glossary
[23] Inventory-based Rating System for Gravel Roads: Training Manual
[24] Inventory-based Rating System for Gravel Roads: Training Manual

Structural improvement: Pavement treatment that adds strength to the pavement. Roads requiring structural improvement exhibit alligator cracking and rutting and are considered poor by the TAMC definitions for condition.

Subsurface infrastructure: Infrastructure maintained by local agencies that reside underground, for example, drinking water distribution systems, wastewater collection systems, and storm sewer systems.

TAMC: See *Michigan Transportation Asset Management Council*.

TAMC pavement condition dashboard: Website for viewing graphs of pavement and bridge conditions, traffic and miles travelled, safety statistics, maintenance activities, and financial data for Michigan's cities and villages, counties, and regions, as well as the state of Michigan.

TAMC's good/fair/poor condition classes: Classification of road conditions defined by the Michigan Transportation Asset Management Council based on bin ranges of PASER scores and similarities in defects and treatment options. Good roads have PASER scores of 8, 9, or 10, have very few defects, and require minimal maintenance. Fair roads have PASER scores of 5, 6, or 7, have good structural support but a deteriorating surface, and can be maintained with CPM treatments. Poor roads have PASER scores of 1, 2, 3, or 4, exhibit evidence that the underlying structure is failing, such as alligator cracking and rutting. These roads must be rehabilitated with treatments like heavy overlay, crush and shape, or total reconstruction.

Tax millages: Local tax implemented to supplement an agency's budget, such as road funding.

Thin hot-mix asphalt overlay: Application of a thin layer of hot-mix asphalt on an existing road to re-seal the road and protect it from damage caused by water. This also improves the ride quality and provides a smoother, uniform appearance that improves visibility of pavement markings.[25]

Transportation infrastructure: All of the elements that work together to make the surface transportation system function including roads, bridges, culverts, traffic signals, and signage.

Trigger: When a PASER score gives insight to the preferred timeline of a project for applying the correct treatment at the correct time.

Trunkline abbreviations: The prefixes *M-*, *I-*, and *US* indicate roads in Michigan that are part of the state trunkline system, the Interstate system, and the US Highway system. These roads consist of anything from 10-lane urban freeways to two-lane rural highways and even one non-motorized highway; they cover 9,668 centerline miles. Most of the roads are maintained by MDOT.

Trunkline bridges: Bridge present on a trunkline road, which typically connects cities or other strategic places and is the recommended rout for long-distance travel.[26]

Trunkline maintenance funds: Expenditures under a maintenance agreement with MDOT for maintenance activities performed on MDOT trunkline routes.

Trunkline: Major road that typically connects cities or other strategic places and is the recommended route for long-distance travel.[27]

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[25] [second sentence] http://www.kentcountyroads.net/road-work/road-treatments/ultra-thin-overlay
[26] https://en.wikipedia.org/wiki/Trunk_road
[27] https://en.wikipedia.org/wiki/Trunk_road

Washboarding: Ripples in the road surface that are perpendicular to the direction of travel.[28]

Wedge/patch sealcoat treatment: An asphalt pavement treatment method that involves correcting the damage frequently found at the edge of a pavement by installing a narrow, 2- to 6-foot-wide wedge along the entire outside edge of a lane and layering with HMA. This extends the life of an HMA pavement or chip seal overlay by adding strength to significantly settled areas of the pavement.

Worst-first strategy: Asset management strategy that treats only the problems, often addressing the worst problems first, and ignoring preventive maintenance. This strategy is the opposite of the "mix of fixes" strategy. An example of a worst-first approach would be purchasing a new automobile, never changing the oil, and waiting till the engine fails to address any deterioration of the car.

List of Acronyms

CIP: Capital Improvements Plan

CMAQ: Congestion Mitigation Air Quality grant

CPM: capital preventive maintenance

FHWA: Federal Highway Administration

HMA: hot-mix asphalt

HSIP: Highway Safety Improvement Program grant

I: trunkline abbreviation for routes on the Interstate system

IBR: Inventory-based Rating

M: trunkline abbreviation for Michigan state highways

MDOT: Michigan Department of Transportation

MTF: Michigan Transportation Fund

NBIS: National Bridge Inspection Standards

NCPP: National Center for Pavement Preservation

NHS: National Highway System

PA 51: Michigan Public Act 51 of 1951

PASER: Pavement Surface Evaluation and Rating

R&R: reconstruction and rehabilitation programs

TAMC: (Michigan) Transportation Asset Management Council

US: trunkline abbreviation for routes on the US Highway system

[28] Inventory-based Rating System for Gravel Roads: Training Manual

APPENDIX F: CERTIFIED RESOLUTION FROM CITY COUNCIL’S ACCEPTANCE OF THE TRANSPORTATION ASSET MANAGEMENT PLAN/COMPLIANCE PLAN