Road Commission of Kalamazoo County

Asset Management Plan for Bridges

Michigan Transportation Asset Management Council

CONTENTS

PURPOSE

The Road Commission of Kalamazoo County (RCKC) seeks to implement a cost-effective program of preventive maintenance to maximize the useful service life of the bridges under its jurisdiction.

The RCKC recognizes that limited funds are available for improving the bridge network. Preventive maintenance is a more effective use of these funds than the costly alternative of major rehabilitation or replacement, and we seek to identify those bridges that will benefit from a planned maintenance program.

GOAL

The goal of the RCKC is to preserve the existing bridge network, maximize the useful life of bridges, and reduce the number of structurally deficient bridges.

OBJECTIVES

The RCKC objectives in implementing the bridge asset management plan include:

- Establishing the current condition of the RCKC's bridges
- Developing a "mix of fixes" that will:
    - Program regular scheduled maintenance actions to slow deterioration of all bridges
    - Program preventive maintenance to address specific needs
    - Identify and program rehabilitation to degraded bridge elements to restore structural integrity and correct major safety defects
    - Identify and program bridges in need of replacement
- Identifying available funding sources, including:
    - Dedicated RCKC resources
    - Michigan's Local Bridge Program
    - Opportunities to obtain other funding
- Prioritizing the programmed actions within available funding limitations
- Maintaining the number of bridges rated fair/good and reducing the number of bridges classified as structurally deficient or functionally obsolete within 5 years.

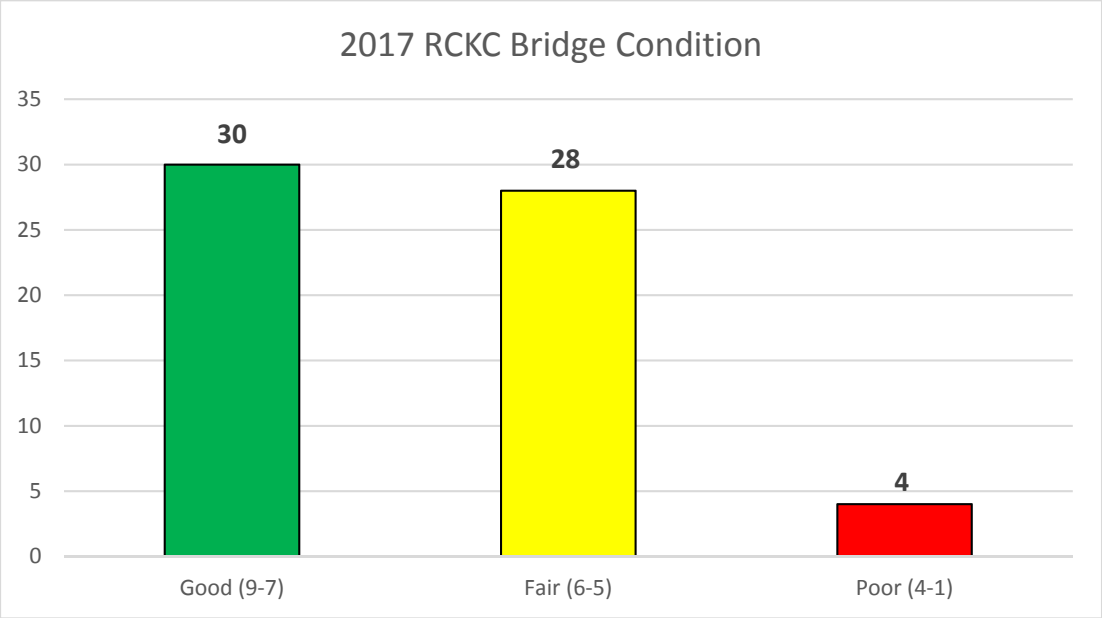
DEFINITIONS

- **Bridge** – A structure erected over a depression or obstruction that carries traffic and has an opening measured along the center of the road greater than 20 feet. Also applies when there are multiple pipes where the distance between the pipes is less than half of the smallest pipe opening.
- **Culvert** – A type of bridge constructed entirely below and independent of the road surface. Also used to describe structures whose opening measures less than 20 feet along the center of the road.
- **National Bridge Inspection Standards (NBIS)** – Federal regulations establishing requirements for inspection procedures, frequency of inspections, qualifications of personnel, inspection reports, and preparation and maintenance of bridge inventory records.
- **Structurally Deficient (SD)** – term for a bridge where significant load carrying elements are in poor condition due to deterioration and/or damage.
- **Functionally Obsolete (FO)** – term for a bridge where deck geometry, load carrying capacity, clearance (vertical or horizontal), or approach roadway alignment do not meet current standards.

- **Local Bridge Program** – Program overseen by the Michigan Department of Transportation (MDOT) that allocates a limited amount of Federal and State funds each year to local agencies (cities, villages and road commissions) in Michigan for bridge construction projects. If a project is chosen for funding, the program typically covers 95% of the construction costs with the local agency responsible for all remaining costs.
- **Structure Rating** – a calculated number based on the condition of bridge elements as determined by NBIS inspections
    - Failed – NBIS rating of 0, bridge is closed
    - Poor/Critical – NBIS rating of 1-4, bridge has significant deterioration and could have weight restrictions, closure of bridge could be imminent
    - Fair – NBIS rating of 5-6, bridge is sound but signs of deterioration are apparent
    - Good – NBIS rating of 7-9, bridge has minor to no problems

PERFORMANCE MEASURES

Several metrics will be used to assess the effectiveness of the preservation plan. RCKC will monitor and report the annual change in the number of bridges rated fair/good (5 or higher) and the annual change in the number of structurally deficient and functionally obsolete bridges. A tracking graph will be used to monitor progress toward an objective of maintaining the number of the county's bridges rated fair/good and reducing the number classified as structurally deficient or functionally obsolete.



Progress Tracking

The preservation plan is intended to extend the period of time that bridges remain in good and fair condition, thereby increasing their useful service life and reducing future maintenance costs. RCKC has been implementing some preventive maintenance and scheduled maintenance measures in the past, however has not specifically tracked their effects on bridge condition. Moving forward, RCKC will evaluate past inspection records and condition ratings and establish a baseline of past performance by determining the average period of time that a bridge remains in good or fair condition. The performance

measures will be the increased average amount of time a bridge is rated good or fair after implementation of the preservation strategy when compared to the baseline time before implementation.

BRIDGE ASSETS

RCKC is responsible for 62 bridges. Detailed inventory data and condition ratings for each bridge are contained in Appendix A-1. The bridge inventory data was obtained from MDOT's online bridge management and inspection system (MiBRIDGE). There is potential for the number of bridges to increase as RCKC replaces stream crossings the Department of Environmental Quality (DEQ) has identified as undersized and would result in the new crossing exceeding the 20 foot threshold for bridge designation.

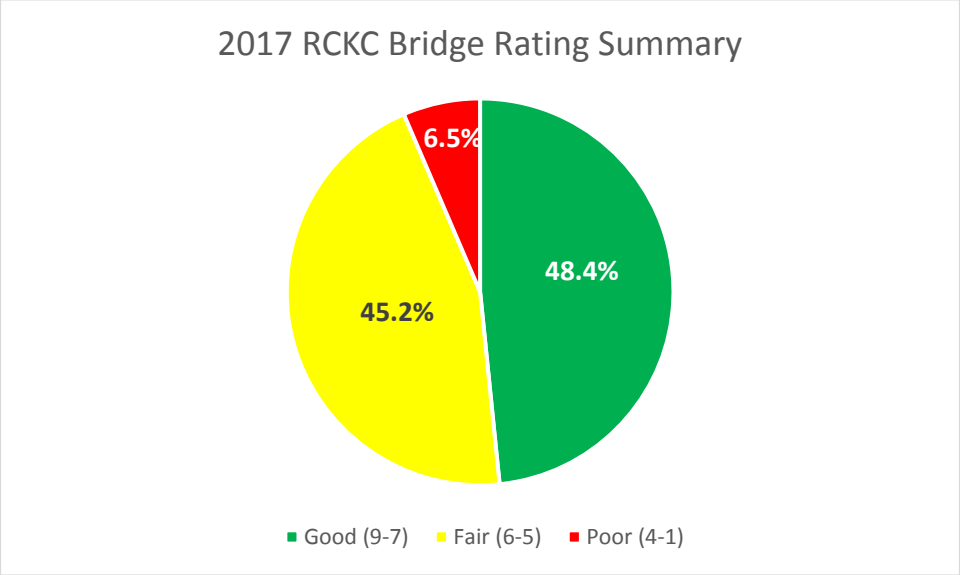
A summary and distribution of the bridge population is presented in the following table:

Bridge Type	Number of Bridges					2017 Condition		
	Total	Structurally Deficient	Functionally Obsolete	Weight Restricted	Closed*	Poor	Fair	Good
Concrete								
Other	1	1		1		1		
Culverts	9						1	8
Steel								
Multi-girder	2	2		2		2		
Multi-girder, galv	4							4
Culverts, Arch	2						2	
Culverts, Multiple	11	1				1	10	
Railroad	1		1				1	
Continuous, multi-girder, galv	1							1
Pre-stressed concrete								
Multi-girder	3		1				2	1
Box beam	17		1	1			4	13
Spread box beam	1							1
Timber								
slab	3			2			2	1
slab, composite	2			1			2	
Culvert	5	1		1			4	1
Total SD/FO/PSTD		**5**	**3**	**8**	**0**			
Total	**62**					**4**	**28**	**30**
Percentage (%)		**8.06%**	**4.84%**	**12.90%**		**6.45%**	**45.16%**	**48.39%**

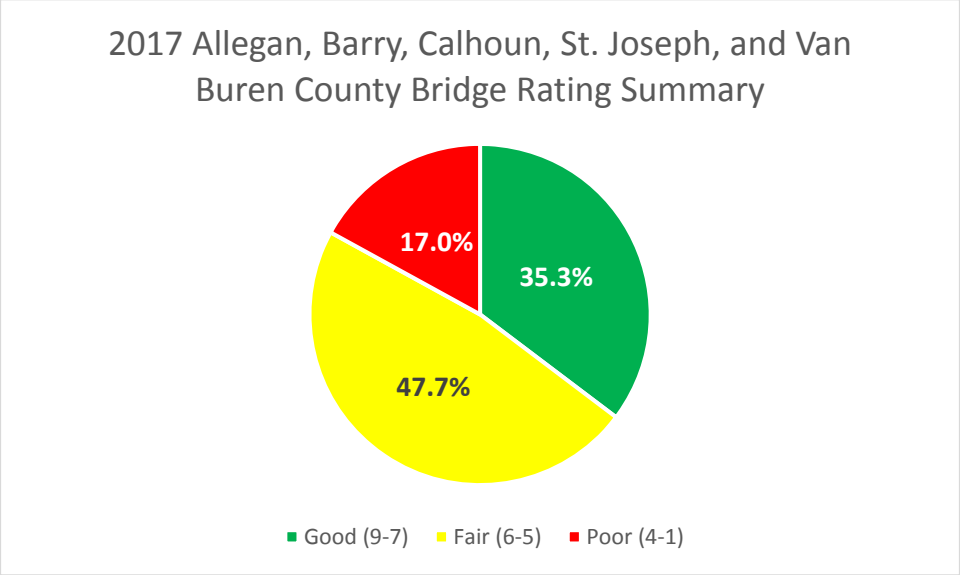
*Once a bridge has been closed for more than 3 years it is no longer included in the bridge inventory.

CONDITION ANALYSIS

As detailed in the previous table, RCKC is responsible for 62 bridges of various designs and materials. As the material type often determines the type of maintenance activities that are appropriate for a bridge, it is useful to note that RCKC's inventory consist of 10 concrete, 21 steel, 21 pre-stressed concrete, and 10 timber bridges. The distribution of overall bridge condition is: 4 (6.5%) are poor; 28 (45.2%) are fair; and 30 (48.4%) are good. The RCKC bridge inventory includes 5 (8.1%) structurally deficient bridges, 4 are on local roads, and 3 (4.8%) functionally obsolete bridges, of which 1 is on a local road.



According to statistics from the Transportation Asset Management Council (TAMC), the condition of bridges maintained by counties adjacent to Kalamazoo (Allegan, Barry, Calhoun, St. Joseph, and Van Buren), currently 17.0% are poor, 47.7% are fair, and 35.3% are good, indicating that RCKC's bridge condition is comparatively in better condition than in the surrounding counties.



Some of the severely degraded, structurally deficient, and functionally obsolete bridges will require replacement or major rehabilitation. Due to the restricted flow associated with multiple steel culverts and the lack of a natural bottom, when required to be replaced, all of the crossings of this type will have to be replaced with a different type of bridge. Many of the remaining bridges require one-time preventive maintenance actions to repair defects and restore the structure to a higher condition rating. A scheduled maintenance plan will group similar maintenance actions for groups of bridges of similar material and type, by location.

RCKC's objective in formulating this preservation plan is to maintain the number of the agency's bridges in fair to good condition and reduce the number classified as structurally deficient over the next 5 years.

RISK MANAGEMENT

The RCKC recognizes that 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 or missing expansion joints, etc.

RCKC assess these risks by administering biennial (and more frequently if conditions warrant) inspections of its bridges in accordance with NBIS and MDOT requirements. The inspector documents the condition of RCKC's bridges on the MDOT Bridge Safety Inspection Report and evaluates them in order to identify new defects and monitor advancing deterioration. The inspector identifies items needing follow-up, special inspection actions and recommends bridge-by-bridge maintenance activities on MDOT's Bridge Inspection Report. Both of these reports are provided to us and entered into MiBridge by the inspector.

Items identified in the inspection reports that would qualify as preventive or responsive to specific bridge conditions are prioritized to correct critical structural safety and traffic issues first, then to address other needs based on the operational importance of each bridge and the long-term preservation of the network. The inspection results are used to modify and update the Operations and Maintenance Plan.

PRESERVATION STRATEGY

RCKC's asset management plan employs a "mix of fixes" strategy made up of replacement, rehabilitation, preventive maintenance, and scheduled maintenance. The aim of this plan is to address the structures of critical concern by targeting poor rated elements, and to improve the overall condition of the bridge network to good or fair condition.

- **Replacement** - complete structure replacement. Last resort when preventive maintenance and rehabilitation are no longer cost effective. Replacement is not considered a preservation activity.
- **Rehabilitation** – provide complete, or nearly complete restoration of bridge elements or components. 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** - extend the service life of fair and good structures.
  - Cyclical – performed on a pre-determined interval with the aim of preserving the existing bridge component. These activities are not always going to improve the bridge component, but delay deterioration.
  - Condition Based – performed as needed based on items identified through the bridge inspection process. These activities will restore bridge components to a state of good repair.
- **Scheduled Maintenance** – maintain the existing serviceability and reduce the deterioration rate. These activities sustain the current bridge condition longer whether the current condition is good, fair or poor.

The replacement, rehabilitation, and preventive maintenance projects are generally eligible for funding under the Local Bridge Program, and the RCKC will submit requests for funding annually in an effort to maximize our budget.

RCKC's scheduled maintenance program will be an integral part of the asset management plan, and is intended to extend the service life of the bridges by preserving them in their current condition for a longer period of time. Scheduled maintenance is proactive and not necessarily condition driven.

The "mix of fixes" strategy combines long-term reconstruction or replacement fixes, medium-term rehabilitation fixes, and short-term preventive maintenance fixes with a regular program of scheduled maintenance.

IMPLEMENTATION OF THE STRATEGY

RCKC's implementation of the preservation plan strategy begins with an annual review of the inspection reports and work recommendations documented in MiBridge for all of the bridges. The preservation actions are selected in accordance with criteria contained in the table below. These criteria are based on MDOT's Project Scoping Manual, which is intended to address MDOT's trunk line bridges. RCKC has modified the selection criteria to more closely align with our specific bridge network.

Summary of Preservation Criteria

Preservation Action	Bridge Selection Criteria	Expected Service Life
Replacement - $600,000 to $5,000,000 estimated cost		
Total Replacement	- NBI Rating of 3 or less - *OR* when cost of rehabilitation exceeds cost of replacement - *OR* when bridge is scour critical with no counter-measures available	70 years
Superstructure Replacement	- NBI Rating for superstructure of 4 or less - *OR* when cost of rehabilitating superstructure and deck exceeds replacement cost	40 years
Deck Replacement	Use guidelines in MDOT's *Bridge Deck Preservation Matrix* - NBI Rating of 4 or for deck surface and deck bottom	

• Epoxy Coated Steel • Black Steel	- *OR* when deck replacement cost is competitive with rehabilitation	70 years 40 years
Substructure Replacement (Full or Partial)	- NBI Rating of 4 or less for abutments, piers, or pier cap - *OR* existence of open vertical cracks, signs of differential settlement, or presence of active movement - *OR* bridge is scour critical with no counter-measures available	40 years
Rehabilitation - $100,000 to $1,000,000 estimated cost		
Concrete Deck Overlays • Deep • Shallow • HMA/Membrane • HMA Cap	Guidelines in MDOT's *Bridge Deck Preservation Matrix* NBI Deck Rating <5 for surface and >5 for bottom NBI Deck Rating <5 for surface and >4 for bottom NBI Deck Rating <5 for surface and >4 for bottom NBI Deck Rating <5 for surface and <4 for bottom	 25 years 12 years 8 years 3 years
Railing Retrofit/Replacement	- NBI Deck Rating greater than 5 - *OR* Railing/Barrier rated less than 5 - *OR* Safety Improvement is needed	
Steel Beam Repairs	- More than 25% section loss is present in an area of the beam that affects load carrying capacity - *OR* in order to correct impact damage that impairs beam strength	
Prestressed Concrete Beam Repairs	- Repair ends of prestressed I-beams when more than 5% spalling is present - *OR* repair areas to correct impact damage that impairs beam strength or exposes prestressing strands	
Repair/Replace Culvert	- NBI Rating of 4 or less for culvert or drainage outlet structure - *OR* existence of open vertical cracks, signs of deformation, movement, or differential settlement	
Repair/Replace Retaining Wall	- NBI Rating of 4 or less for retaining wall - *OR* existence of open vertical cracks, signs of differential settlement, or presence of active movement	
Pin and Hanger Replacement	- NBI Rating for elements is 4 or lower; presence of excessive section loss, severe pack rust, or out-of-plane distortion	
Substructure Concrete Patching and Repair	- NBI Rating for abutments or piers is 5 or 4 and less than 30% of the surface is spalled and delaminated - *OR* in response to inspector's work recommendation for substructure patching	
Preventive Maintenance - $10,000 to $100,000 estimated cost		
Repair/Replace Deck Joint	- Include when doing deep or shallow overlays - *OR* NBI Rating for joint is 4 or lower - *OR* joint is leaking heavily	

Repair/Replace Steel Bearing	- NBI Rating for girders and deck is 5 or higher and rating for bearings is 4 or lower	
Complete Painting	- NBI Rating for paint condition is 3 or lower - *OR* in response to inspector's work recommendation for complete painting	15 years
Zone Painting	- NBI Rating for paint condition is 5 or 4 - *OR* less than 15% of existing paint area has failed and remainder of paint system is in good or fair condition	10 years
HMA Overlay Cap without Membrane	- NBI Rating of 3 or less for deck surface and deck bottom; temporary holdover to improve rideability for a bridge in the 5-year plan for rehab/replacement	3 years
Concrete Deck Patching	- Deck Surface Rating of 5, 6, or 7 with minor delamination and spalling - *OR* in response to inspector's work recommendation	5 years
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	- Structure is categorized as scour critical and is not scheduled for replacement; NBI comments in abutment and pier ratings indicate presence of scour holes	
Scheduled Maintenance - $500 to $10,000 estimated cost		
Superstructure Washing	- When salt contaminated dirt and debris collected on superstructure is causing corrosion or deterioration by trapping moisture - *OR* in response to inspector's work recommendation	2 years
Vegetation Control	- When vegetation traps moisture on structural elements or is growing from joints or cracks - *OR* in response to inspector's work recommendation for brush cut	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
Joint clean out	- Clean debris from all joints	1 year
Drainage System Clean-Out/Repair	- When drainage system is clogged with debris or drainage elements are broken, deteriorated, or damaged	2 years
Seal Concrete Cracks/Joints	- Concrete is in good or fair condition, and cracks extend to the depth of the reinforcement - *OR* in response to inspector's work recommendation	5 years
Repair/Replace HMA Surface	- 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	
Minor Concrete Patching	- Repair minor delaminations and spalling - *OR* in response to inspector's work recommendation	
Timber Repairs	- NBI Rating of 4 or less for timber members - *OR* to repair extensive rot, checking, or insect infestation	
Repair/Replace Guard Rail	- Guard rail missing or damaged - *OR* safety improvement is needed	
Repave Approaches	- HMA is in poor condition - *OR* in response to inspector's work recommendation	
Repair Slopes	- NBI Rating is 5 or lower - *OR* when slope is degraded or sloughed - *OR* slope paving has significant areas of distress, failure, or has settled	
Install Riprap	To protect surface when erosion threatens the stability of side slopes of channel banks	
Miscellaneous Repairs	Uncategorized repairs in response to inspector's work recommendation	

COST ESTIMATE

RCKC computes the estimated cost of each typical preservation action using unit prices in the latest Bridge Repair Cost Estimate spreadsheet provided by MDOT's Local Bridge Program during the annual call for projects. The cost of items of varying complexity, such as maintenance of traffic, staged construction, scour counter-measures, and so forth, are computed on a bridge-by-bridge basis. The cost estimates are reviewed and updated annually.

OPERATIONS AND MAINTENANCE PLAN—ANNUAL ACTIVITIES/5-YEAR PLAN

A primary objective of RCKC's asset management plan is maintaining the number of bridges in fair to good condition and reducing the number of structural deficient bridges over the next 5 years through a program 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 (cost increase due to increased degradation) of deferral. The 5 year program incorporates annual scheduled maintenance activities designed to preserve bridges currently rated fair (5) or higher with the objective of extending their useful service life.

PROJECT PRIORITIZATION CRITERIA

RCKC follows the MDOT prioritization formula that evaluates five factors and weights them as follows: condition – 30%, load capacity –25%, traffic –20%, safety –15%, and detour –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 projects to establish a priority order.

FIVE-YEAR ANNUAL COST PROJECTION

Preservation Activity	2018	2019	2020	2021	2022	Total
Replacement						
36th Street over Dorrance Creek	$885,000					
C Avenue over Augusta Creek		$1,005,000				
Bridge TBD				$940,000		
Bridge TBD					$940,000	
Subtotal	**$885,000**	**$1,005,000**		**$940,000**	**$940,000**	**$3,770,000**
Preventive Maintenance						
29th Street over Portage River			$109,000			
9th Street over Amtrak Railroad			$74,000			
Portage Road over Gourdneck Creek			$53,000			
35th Street over Kalamazoo River			$100,000			
Subtotal			**$400,000**			
Scheduled Maintenance						
	$5,000	$5,000	$5,000	$5,000	$5,000	$25,000
ANNUAL TOTAL	**$890,000**	**$1,010,000**	**$405,000**	**$945,000**	**$945,000**	**$4,195,000**

IDENTIFY FUNDING SOURCES

The replacement of bridges in 2018 and 2019 have been programmed and funded using RCKC funds. RCKC has received MDOT Local Bridge Program funds for the preventive maintenance projects in the 2020 funding year. $940,000 has been allocated for bridge projects in 2021 and 2022. While these amounts are currently shown for bridge replacements, the funds can also be used for rehabilitation and preventive maintenance as needed and depending on award of MDOT Local Bridge Program funds. Historically the Local Bridge Program has been underfunded. For funding year 2020, $48 million was available for the entire state of Michigan with $6.6 million allocated to the Southwest Region which encompasses 9 counties including Kalamazoo. The local agencies in the Southwest Region had 66 applications totaling $45 million in bridge work for 2020. Since the amount of money available from the Local Bridge Program is limited and highly competitive, alternative funding sources for bridge construction need to be identified especially for bridges that are located on the RCKC local road system. Per RCKC policy, townships are responsible for 50% of the cost for bridge construction projects. It may become necessary in the future to consider utilizing sources similarly used for road funding, such as special assessments, millages, or private sources in order to improve the condition of our bridge network.