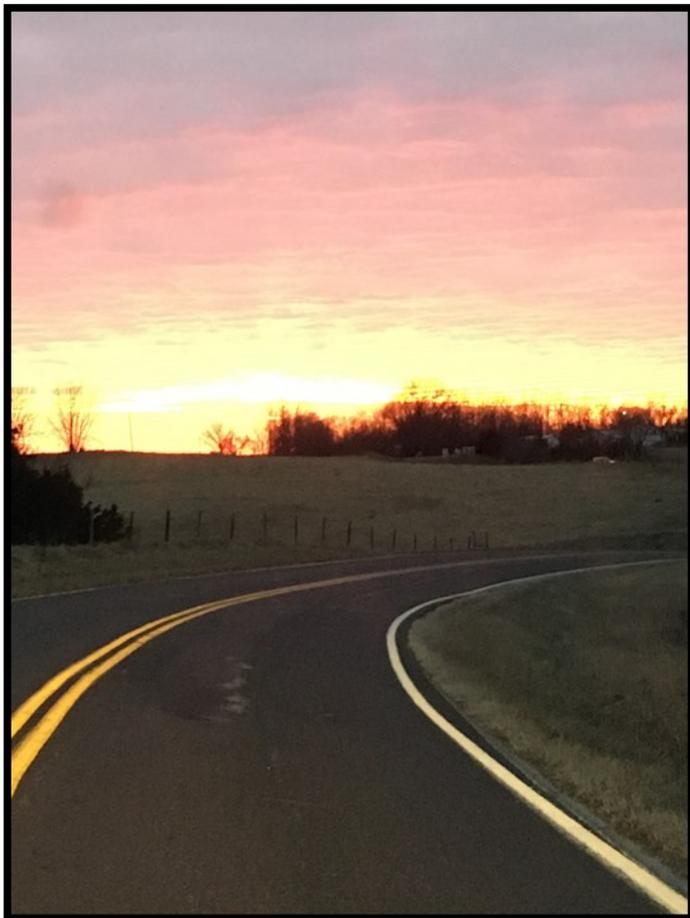


2017 Annual Report

Boone County Road and Bridge Maintenance Operations

Report prepared by:

Zachary Haverly
5551 S. Tom Bass Rd
Columbia, MO 65201



Chain of Command

Director

The Director is responsible for developing an annual work plan and budget, coordinating our superintendents in accomplishing that work plan, and managing relations and plans with other county departments.

Superintendents

We have one Superintendent who oversees maintenance of gravel roads and one who oversees maintenance of paved roads. Each is responsible for planning daily work tasks and managing the budget allocated for that work as well as evaluating and scheduling work for citizen work requests.

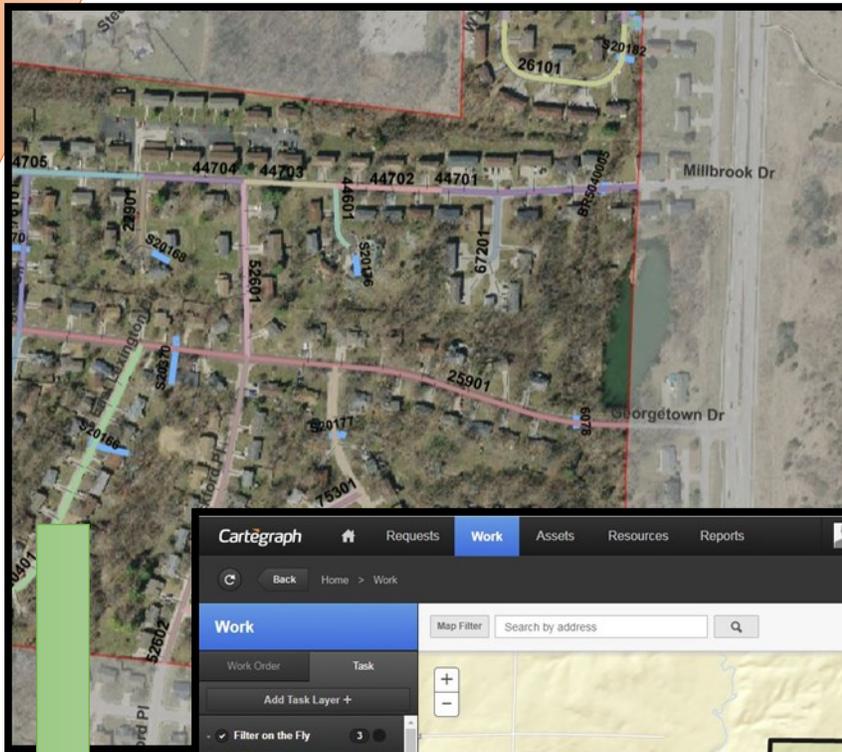
Field Supervisors

Our two Field Supervisors directly oversee the crews associated with the pavement type they are assigned—paved or gravel. They facilitate work as planned by the Superintendents and check finished work for quality assurance.

Crew Leaders

Crew Leaders direct their work crews through the daily tasks they are assigned. They are also responsible for recording their crews' daily activities in our asset management system.

Technology



This year, Boone County Road and Bridge upgraded our Asset Management System, Cartegraph. We collect data daily to describe the type of work performed, where, on what, and for how much. Prior the upgrade, we entered data into two separate systems to capture the type of work performed, where, on what, and how much it cost. Our new system, Cartegraph OMS, combines these two systems so that

we only enter our daily data once. It also provides a host of new features including customizable reports, maps, and filters as well as a mobile application allowing our superintendents, supervisors, and

crew leaders to more effectively plan, conduct, or record work in the field.

At Road and Bridge, our goal is to continually improve upon our methods and practices to bring the best value per taxpayer dollar. Enhancing our access to robust, flexible reporting and reclaiming the opportunity cost of double data entry has been a large step toward that goal.

ID	Activity	Standard Hours	Start Date	Stop Date	Not
037	Motor Grader - Blading	2	04/05/2016	04/05/2016	
037	Motor Grader - Blading	8	03/11/2016	03/11/2016	
037	Motor Grader - Blading	3	08/10/2016	08/10/2016	

Total Cost: 11099.22 Labor Hours Actual: 1107

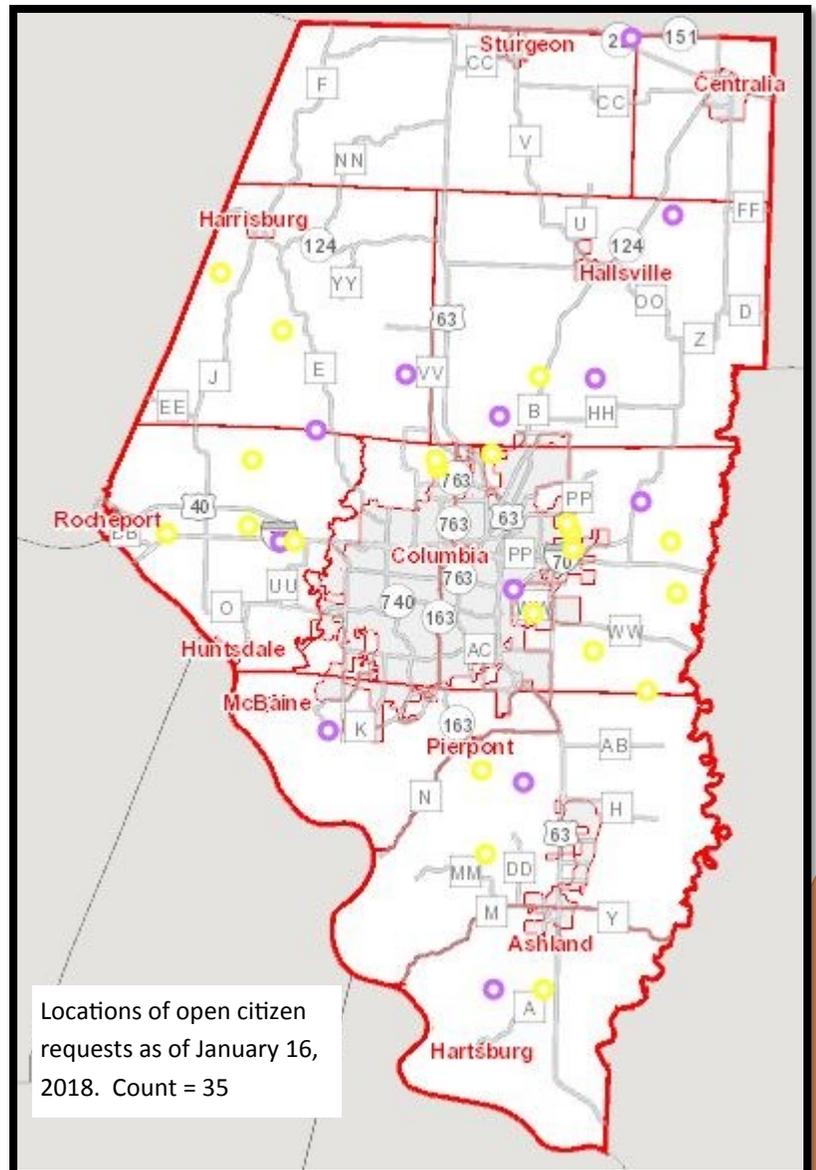
Reports: STAR Report, Cost by Surface Type and Activity, Labor Hours by Route and Activity, Cost by Route and Activity, Labor Hours by Surface Type and Activity, Activity Report

Citizen Requests

Boone County Road and Bridge is happy to take work requests from county residents every day. Each call is recorded in Cartegraph OMS, which automatically sends the request information to the necessary superintendent for evaluation and task assignment. Work resulting from a request is generally separate from our regularly scheduled work plan, so it may take at least a few days for a request to be completed.

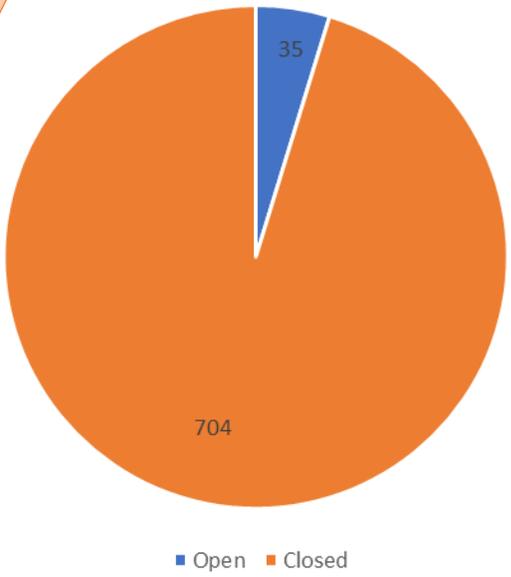
Boone County residents who submit a work request now have the option of being notified via email when their request has been recorded and when it has been completed. Callers who would like these notifications need only provide a valid email address.

County residents are also able to submit work requests through our website. The request page asks that users provide the type, location, and a short description of the issue as well as contact information. Users have the option of plotting the location of the issue on a provided map.



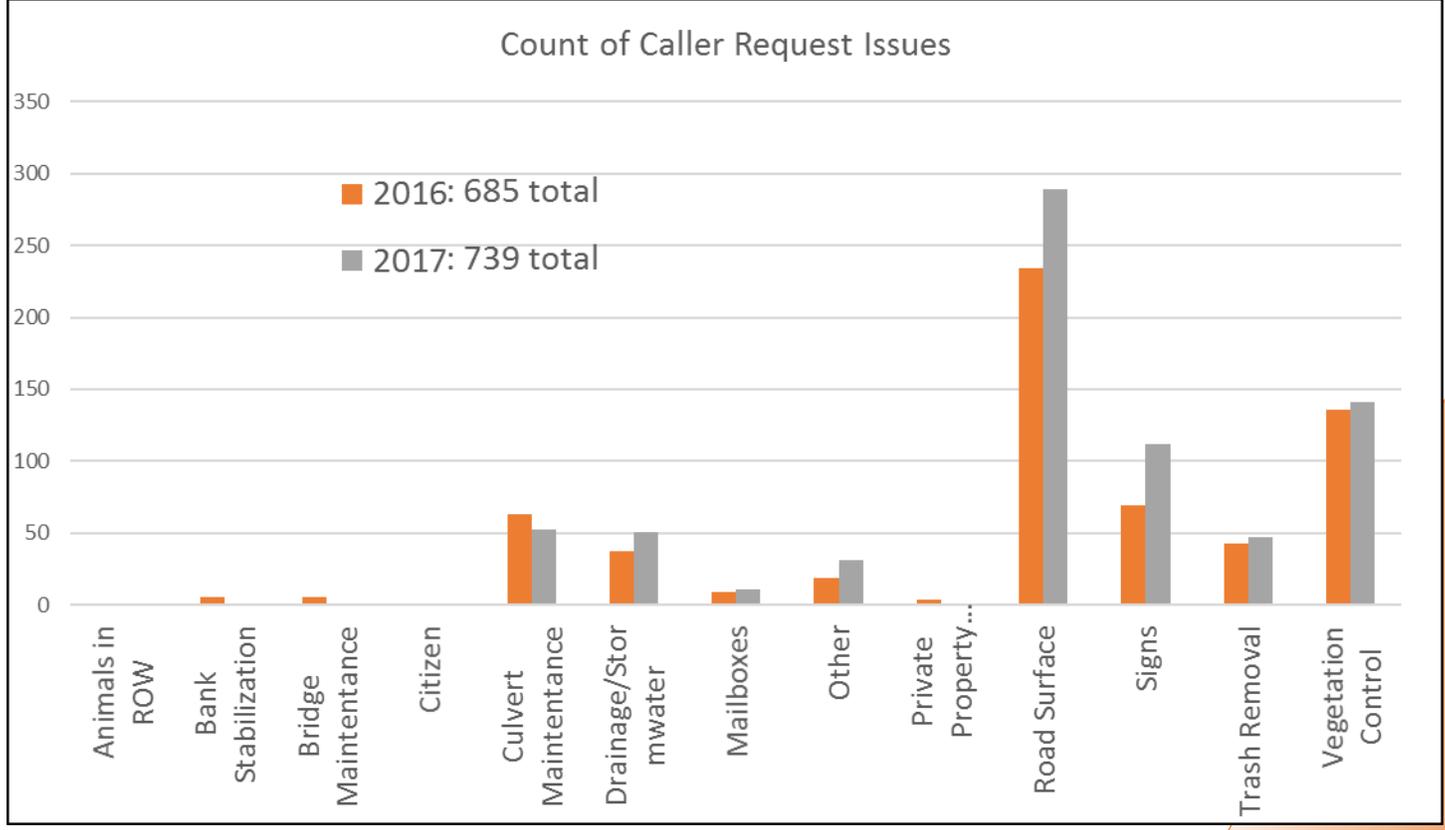
Citizen Requests

2017 Request Status



In 2017, Maintenance Operations received 739 calls from citizens who requested work be done. That call volume increased from 2016 by 18%. A count of issues cited during the calls were relatively similar to those in 2016 except for Road Surface and Signs, which increased by 23% and 62%, respectively. Only 35 requests received in 2017 had not been addressed as of December 31, 2017. Calls for which the issue resided outside of Boone County right-of-way were not counted.

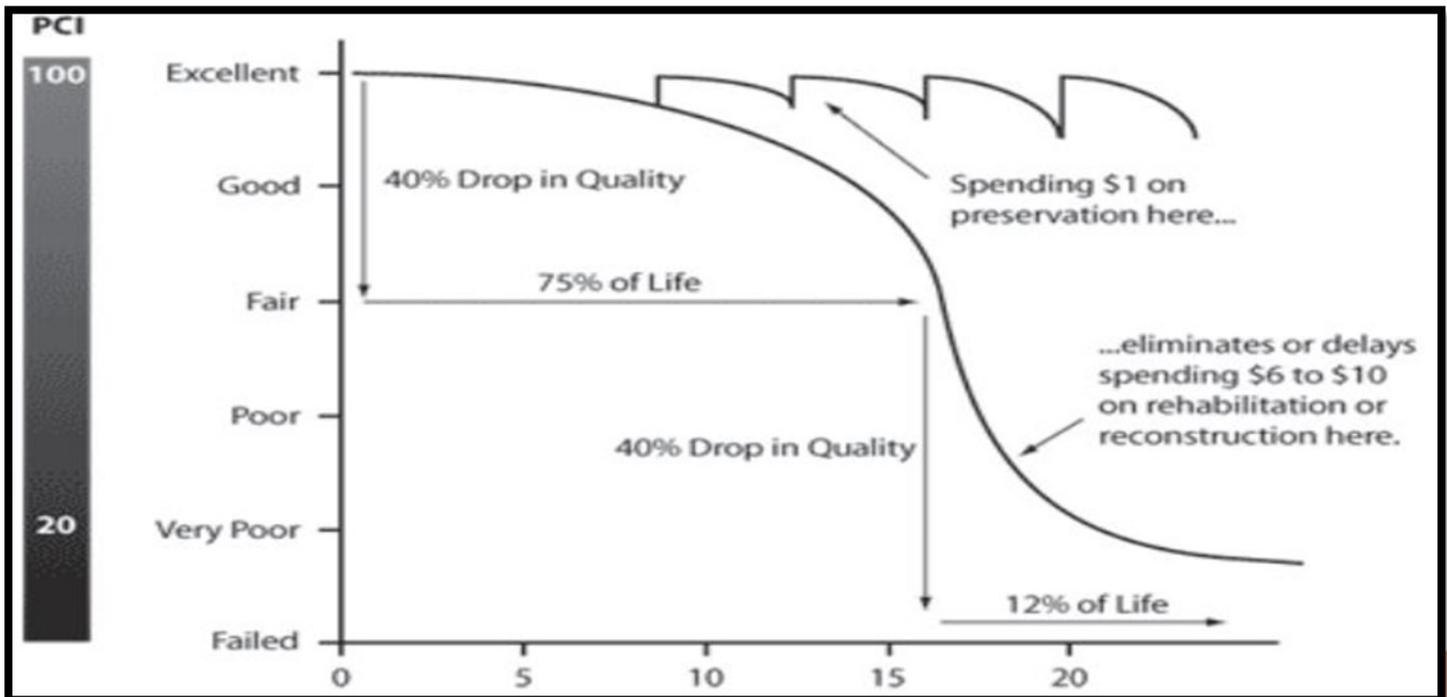
Count of Caller Request Issues



Pavement Preservation

Urban Crews

Boone County Road and Bridge collaborates with the Resource Management Department's Engineering Division to proactively maintain our 201 miles of asphalt road surface. (retired roads and roads owned but not maintained by the county were not included). Overall Condition Index (OCI) data, road history, and regular inspections are evaluated each year so as to prescribe the treatment the road needs for that point in its life cycle. The diagram below demonstrates the cost-effectiveness of proactively keeping roads in good condition rather than repairing roads in good condition.



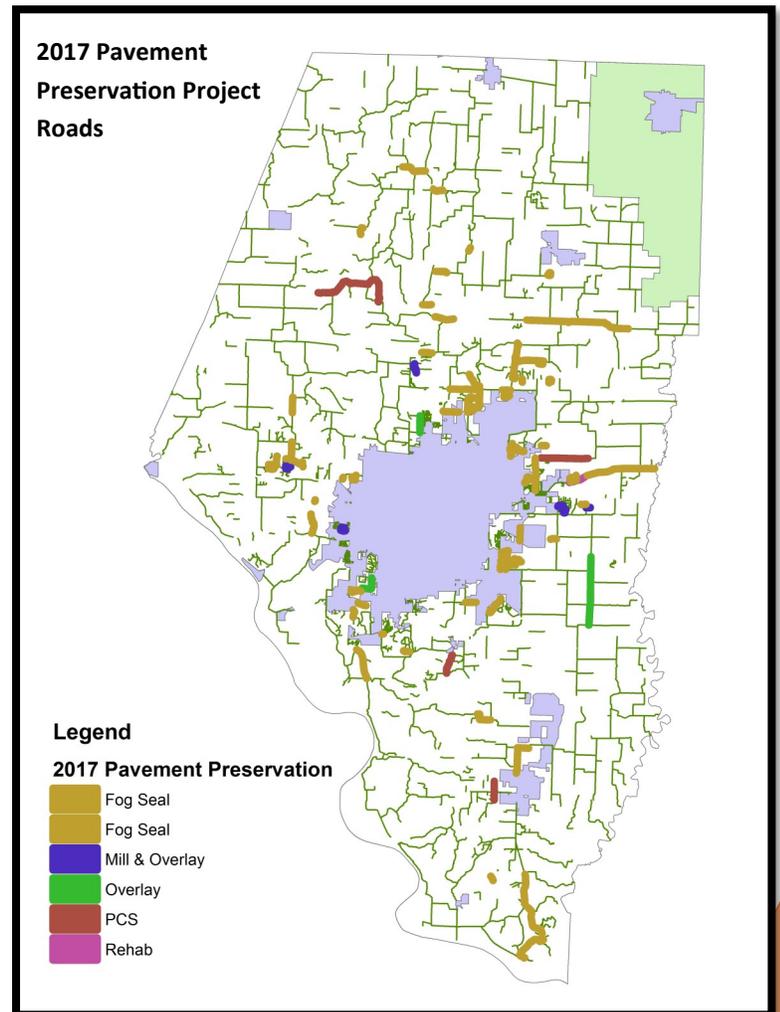
Treatment	Description
Asphalt Overlay	Application of 2" of new hot asphalt to a road in good condition
Preservation Chip Seal (PCS)	Application of oil and surface trap rock to asphalt roads in good to excellent condition, typically 3-5 years after an Asphalt Overlay
Fog Seal	Application of a surface sealant the year following a PCS treatment
Full-Depth Asphalt Reclamation	For roads in poor condition. Road surface, base, and subgrade are pulverized and mixed with water and cement to form a new road base. Asphalt overlay is then applied.
Mill and Overlay	Removes the top 2" of surface material for replacement with 2" of hot asphalt.

Pavement Preservation

Urban Crews

Each year, the Boone County Road and Bridge department prepares roads for upcoming Pavement Preservation treatments and the Engineering Division of Resource Management procures contracts with vendors to conduct the treatment. If time allows, Boone County Road and Bridge begins preparing roads for preservation treatments during the fall season before the year in which the treatments are scheduled. Preparation is then finished the in the following spring as most treatments are applied during the summer.

Approximately 65 miles of asphalt roads maintained by Boone County received a pavement preservation treatment in 2017. The table below summarizes total costs for all pavement preservation activities that occurred in 2017. Please note that the cost for Preservation Chip Seal is lower than normal as Boone County supplied some of our own material, and that the cost for preparation is not specific to the roads that received a treatment in 2017 as preparation occurs over two fiscal years.



Department	Activity	Total Miles	Total Cost	Cost per Mile
Road and Bridge	Preparation	64.8	\$525,827.20	\$8,114.62
Resource Management	Asphalt Overlay	7.9	\$1,020,692.30	\$129,201.56
Resource Management	Preservation Chip Seal	8.5	\$177,324.35	\$20,861.69
Resource Management	Onyx Surface Seal	50.4	\$714,636.55	\$14,179.30

Concrete Maintenance

Urban Crews



Boone County maintains 29.3 miles of concrete roads. Individual concrete panels maintained on these roads are inspected every two years to determine if they are in good condition, damaged, or need to be replaced in part or as a whole. Each year, the necessary concrete work is completed with in-house labor as well as with a contract through Resource Management.

In 2017, Boone County Road and Bridge also spent a significant amount of time repairing concrete curbs, gutters, and inlets (pictured left). These structures help direct water off of and away from the road, which helps keep the road in good condition. Overall, Road and Bridge spent less than half as much time repairing concrete in 2017 as in 2016.

Limestone Chip Seal

Urban Crews

The 76.5 miles of Limestone chip seal (LCS) roads in Boone County are currently resurfaced on a three-year cycle. In 2017, Public Works prepared approximately 23 miles of LCS roads for resurfacing. The project involved 1,193 hours of labor, 1,836.1 tons of asphalt, and cost a total of \$175,640.

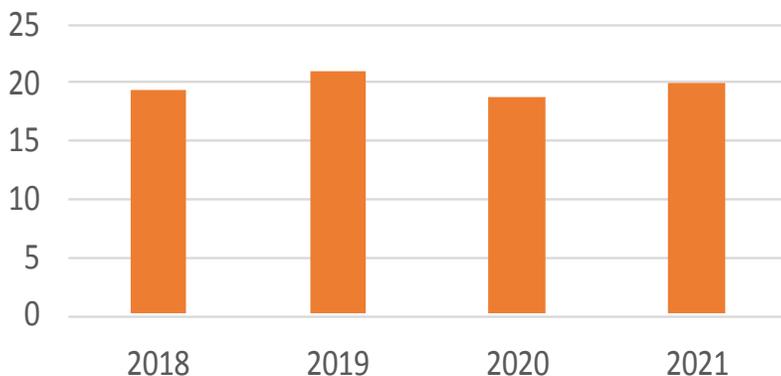
Agency	Work Type	Total Cost	Cost Per Mile
Boone County Public Works	Surface Prep	\$175,640	\$7,613.35
Contractor	LCS Application	\$480,436	\$20,825.14

Road and Bridge procured a vendor contract this year for the application of the LCS surface. The 2017 contract price was \$480,436 for the 23 miles of road surface. For 2018, we intend to return to using in-house labor and resources for LCS surface applications.

Proactive improvements to drainage along LCS roads and the availability of higher-quality materials has allowed us to adopt a four-year maintenance cycle for our LCS roads. This will reduce total miles of road per year requiring an application and balance the annual cost of that activity.



Miles of LCS Application per Year



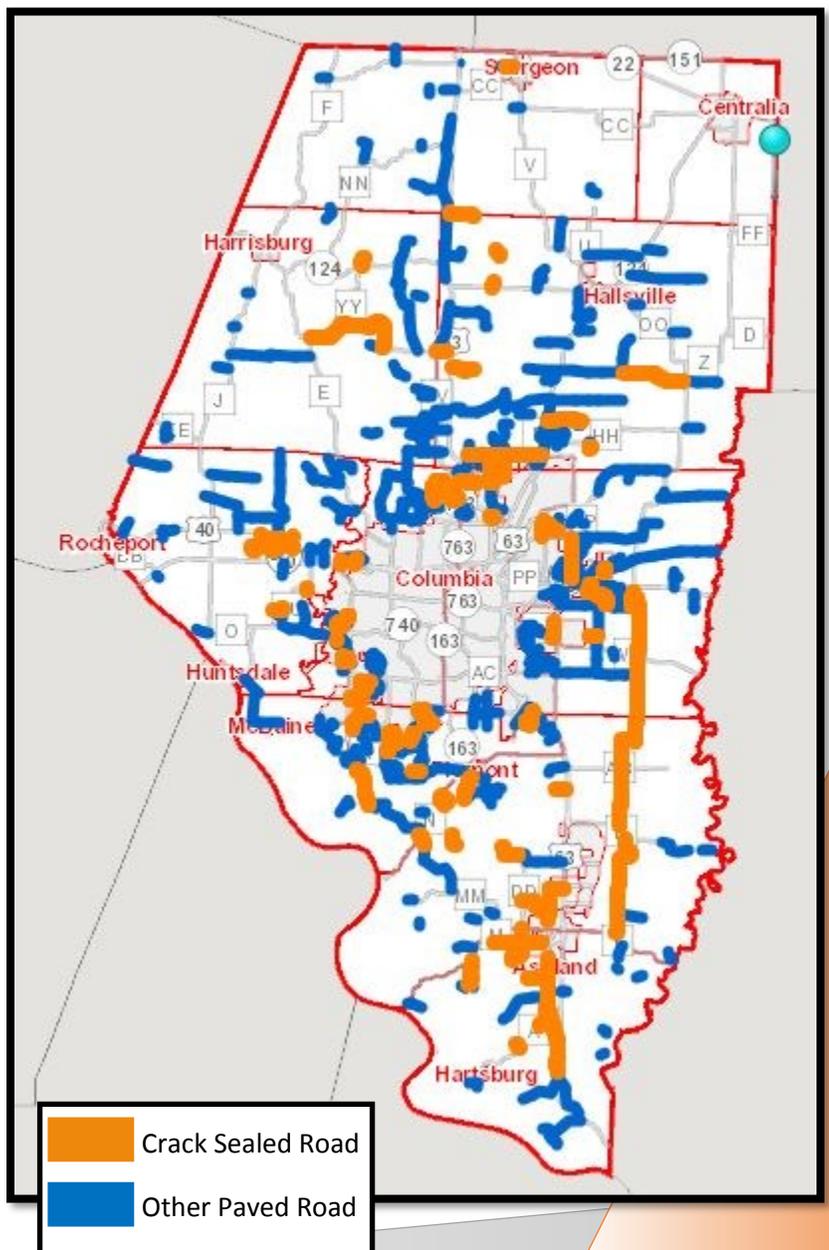
Crack Sealing

Urban Crews



Crack sealing is our most cost-effective method of preventative pavement maintenance. Cracks in the pavement surface allow moisture to penetrate into the road base, which can lead to potholes, pavement swells, and further cracking. Sealing these cracks, therefore, helps to prevent costly dig-out repairs and large, vehicle-damaging potholes.

In 2017, our crack sealing crew managed to seal surface cracks on approximately 71 miles of paved road surface. Roads maintained by Boone County Road and Bridge are generally crack sealed at least once every three years.



Sign Maintenance

Urban Crews

Our sign crew had a busy year in 2017. In addition to an additional 238 new signs installed throughout the county, our sign crew had to keep up with a spree of sign thefts in southern Boone County.

County road signs are not inexpensive. Most signs must be fabricated in our sign shop prior to being installed. If a sign post is also missing or damaged, our sign crew must travel to the site to mark a locate then return after the locate to install the sign and post. In addition to materials, labor and equipment associated with sign maintenance cost the county \$110 per hour.



Gravel Road Maintenance

Rural Crews

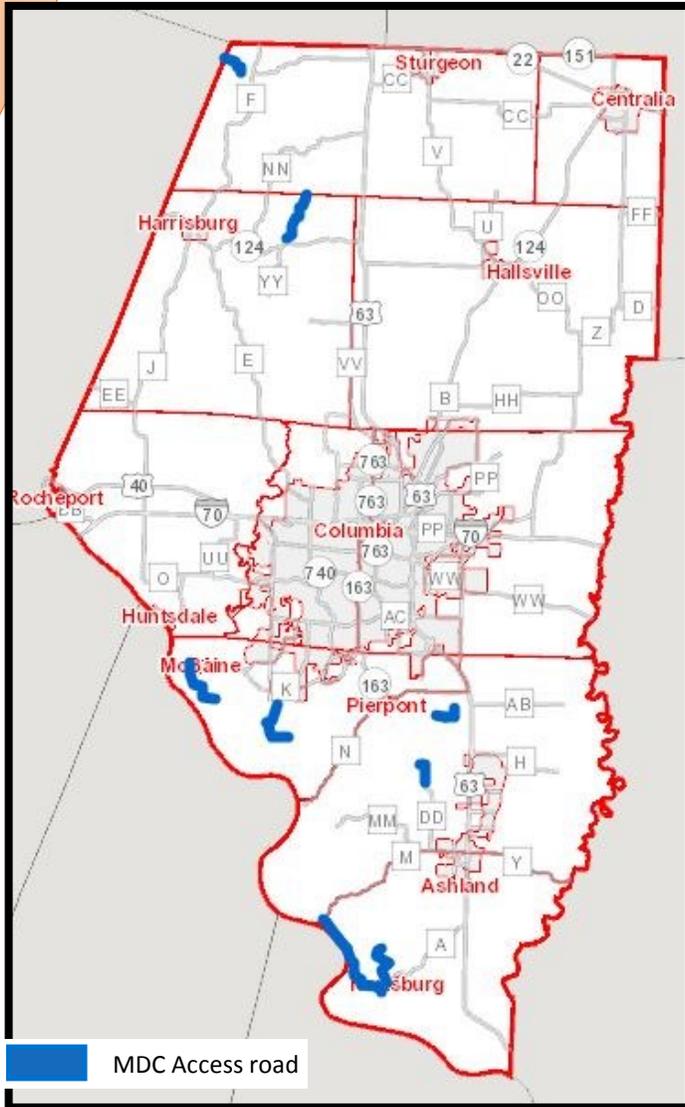


Boone County Road and Bridge department maintains 467.1 miles of gravel roads. To do so, we have divided Boone County into 8 Motor Grader Districts, each district having its own full-time motor grader and tandem axle dump truck to grade and apply rock to our roads. Actively maintaining proper crown on a gravel road facilitates drainage of water from the surface of the road to the ditches, which helps to prevent potholes. However, a gravel road also requires that a certain amount of moisture be present in the surface layer. When moisture mixes with the fine particles in the road surface, they act as a “cement” of sorts that keeps the larger aggregate bound in place. Dry conditions allow the surface particles to leave the road as dust, which can lead to washboarding and the loss of large surface aggregate to the side of the road.

Year	Blading	Rock Application	Cost per Mile
2014	\$974,629.83	\$1,545,352.58	\$5,394.95
2015	\$744,467.29	\$2,099,121.66	\$6,087.75
2016	\$947,507.01	\$1,697,805.67	\$5,663.27
2017	\$730,578.36	\$1,493,614.65	\$4,761.71

Conservation Area Access

Rural Crews



The County Aid Road Trust (CART) is one of a few methods by which the state funds road maintenance. In this case, a trust disperses funds to counties and other entities within the state that are responsible for maintaining public road rights-of-way. The Missouri Department of Conservation (MDC) uses their portion of CART funding by reimbursing counties for money spent on roads that serve as access to conservation areas. There are 11 such roads in Boone County totaling 14.55 miles.

In 2017, Boone County Road and Bridge received \$24,392.42 from MDC for the maintenance of conservation area access roads. As of January 2018, we do not know that MDC will continue the CART reimbursement program for their 2018 fiscal year.

Conservation Area	Road	Length (mi)	Reimbursement Amount
Eagle Bluff CA	Star School Rd	1.8	\$3,420.00
Hart Creek CA	Jemerson Creek Rd	1.0	\$1,900.00
Hart Creek CA	Hart Creek Rd	0.9	\$288.80
Hartsburg Access	River Rd	4.5	\$8,550.00
Lick Creek CA	Oak Grove School Rd	1.5	\$2,850.00

Conservation Area	Road	Length (mi)	Remimbursement Amount
Providence Access	Old Plank Rd	1.2	\$2,280.00
Providence Access	West Dothage Rd	0.7	\$1,229.68
Rudolph Bennit CA	Thornhill Rd	1.1	\$1,783.94
Three Creeks CA	Deer Park Rd	1.1	\$2,090.00
Three Creeks CA	Myers Ln	0.75	\$0.00

Drainage Improvements

Rural Crews

To preserve and enhance drainage for Boone County roads, Boone County Road and Bridge regularly cleans and re-shapes roadside ditches, installs new culverts, and replaced failed culverts.

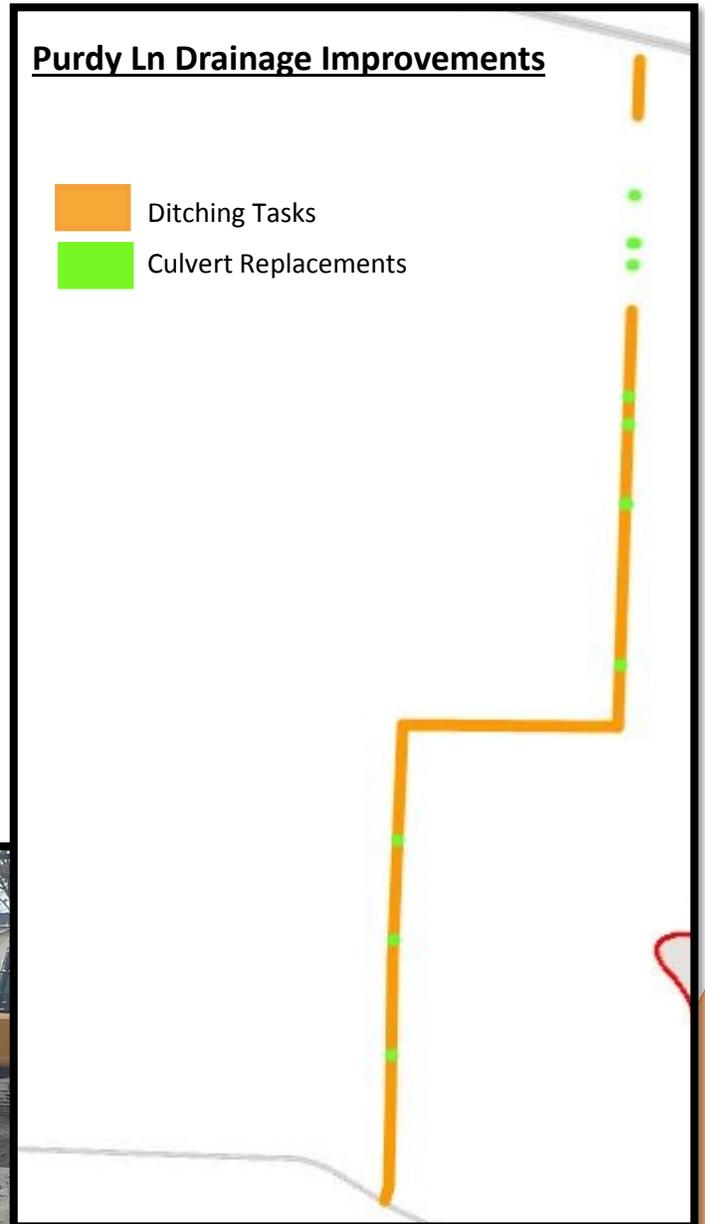
In 2017, we replaced or installed 281 culverts and maintained at least 64 miles of ditches for a total cost of \$692,692 and 8,085.05 labor hours. A particularly large drainage improvement project occurred on Purdy Ln, where we replaced 10 cross-road culverts and maintained 2.7 miles of ditches. The project cost a total of \$39,462 and 345 labor hours.

Year	Count of Culverts Installed	Total Length of Installed Culverts
2016	121	6,158 ft
2017	281	8,673 ft



Purdy Ln Drainage Improvements

-  Ditching Tasks
-  Culvert Replacements



Magnesium Chloride

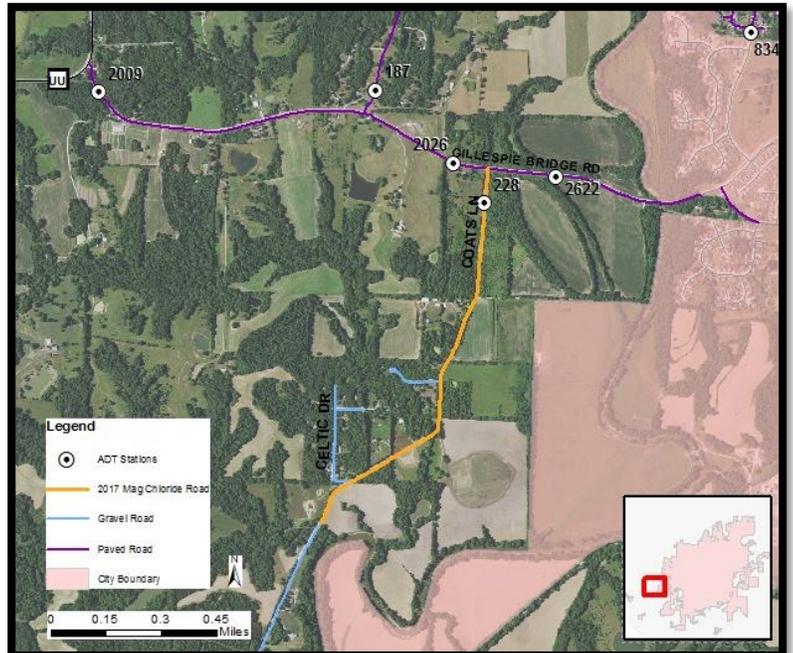
Rural Crews

Magnesium Chloride is a chemical treatment applied to gravel roads to reduce the amount of dust on a road. Gravel roads in Boone County can receive a magnesium chloride treatment through two different methods:

First, citizens may purchase a magnesium chloride treatment through the county's contracted vendor, Scotwood Industries. Citizens who are interested in purchasing a treatment from Scotwood Industries are encouraged to contact them directly. Orders are generally due by May 1 of each year for applications to be carried out during the summer.

Boone County Road and Bridge will prepare each road segment for the application by reestablishing a proper crown and, if necessary, hauling more gravel to the road.

Boone County Road and Bridge also applies magnesium chloride to a few select roads each year. Those roads and the cost data associated with their treatment are presented in the table to the right.



Road	Miles Treated	Application Rate (g/ yd ³)	Total Cost	Cost per Mile
Akeman Bridge Rd	1.15	0.214	\$4,623.78	\$4,202.68
Calvin Dr	1.46	0.194	\$7,315.24	\$5,010.44
Coats Ln	1.01	0.144	\$4,567.90	\$4,522.67
Ellis School Rd	0.95	0.214	\$4,346.22	\$4,574.97
Kircher Rd	1.48	0.148	\$3,810.97	\$2,574.98
Log Providence	0.38	0.263	\$2,626.18	\$6,911.00
Mexico Gravel Rd	0.84	0.087	\$1,666.21	\$1,983.58
Oakland Gravel Rd	0.43	0.251	\$3,334.49	\$7,754.63
Old Rocheport Rd	0.51	0.169	\$1,925.44	\$3,775.37
Robbie Forbis Rd	1.52	0.251	\$7,398.62	\$4,867.51
Rocheport Gravel Rd	1.21	0.077	\$5,953.24	\$4,920.03
Sugar Creek Dr	0.95	0.098	\$2,656.32	\$2,796.13
Wilhite Rd	4.53	0.179	\$26,716.60	\$5,897.70

SWI
Scotwood Industries, Inc
12980 Metcalf Ave. Suite 240
Overland Park, KS 66213
1-800-844-2022
Scotwoodindustries.com

Bridge Maintenance

Rural Crews



Boone County Road and Bridge maintains 127 bridges and 66 low water crossings (LWCs). Bridges are inspected by the Missouri Department of Transportation (MODOT) every two years, and these inspections inform each year's bridge maintenance activities.

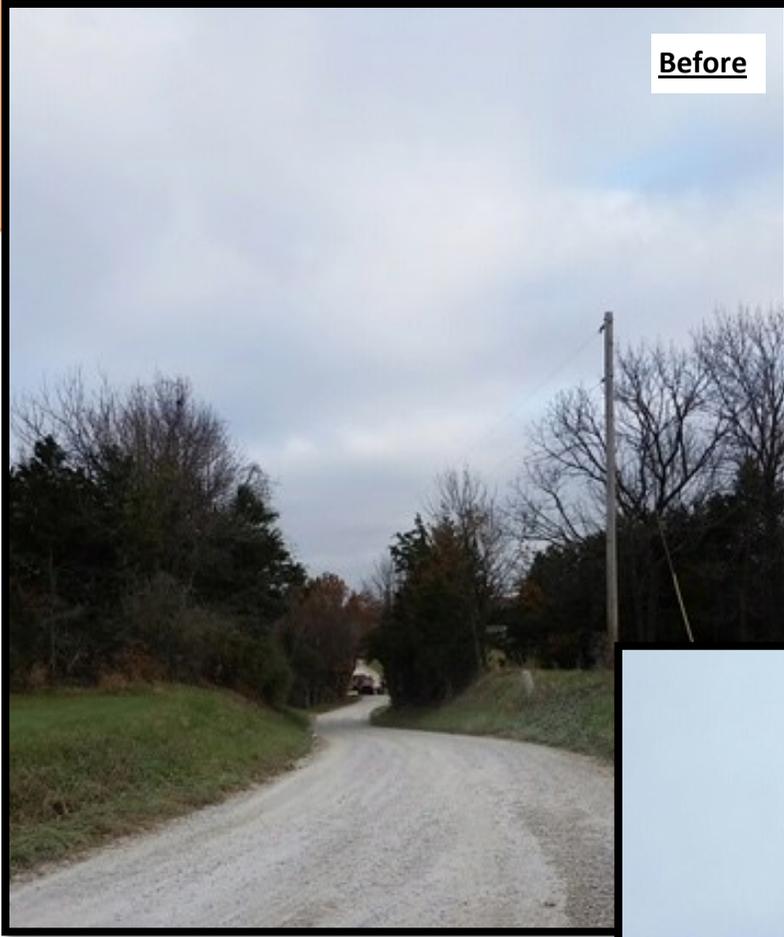
Small bridge repairs to the bridge decks, wing walls, or abutments and LWC repairs are completed by Road and Bridge. For larger, more costly bridge treatments, the Boone County Resource Management department obtains contracts with local vendors to complete the needed work.

In 2017, a total of 54 bridges and LWCs were repaired or replaced through the joined efforts of Road and Bridge and Resource Management.

Department	Activity	Count	Total Cost	Cost per Structure
Road and Bridge	Bridge Maintenance	33	\$40,501.91	\$1,227.33
Road and Bridge	LWC Repair	4	\$66,922.18	\$16,730.55
Resource Management	Hydro-demolition	2	\$168,868.00	\$84,343.00
Resource Management	Trenchless Rehabilitation	8	\$197,850.00	\$24,731.25
Resource Management	Replace Culvert with	3	\$105,328.79	\$35,109.60
Resource Management	Replace Bridge Structure	4	\$954,799.73	\$238,699.93

Vegetation Control

Before



Tall vegetation along a roadway can be problematic for a number of reasons. Trees in the county right-of-way cast shade on the road, which inhibits the evaporation of water off of the road and results in a muddy road for a longer period of time. Trees can also fall onto the road and block traffic, or while standing can reduce line-of-sight around curves or slopes. Both of these present significant safety issues, so Boone County Road and Bridge actively maintains and trims back vegetation present in the county right-of-way.

After

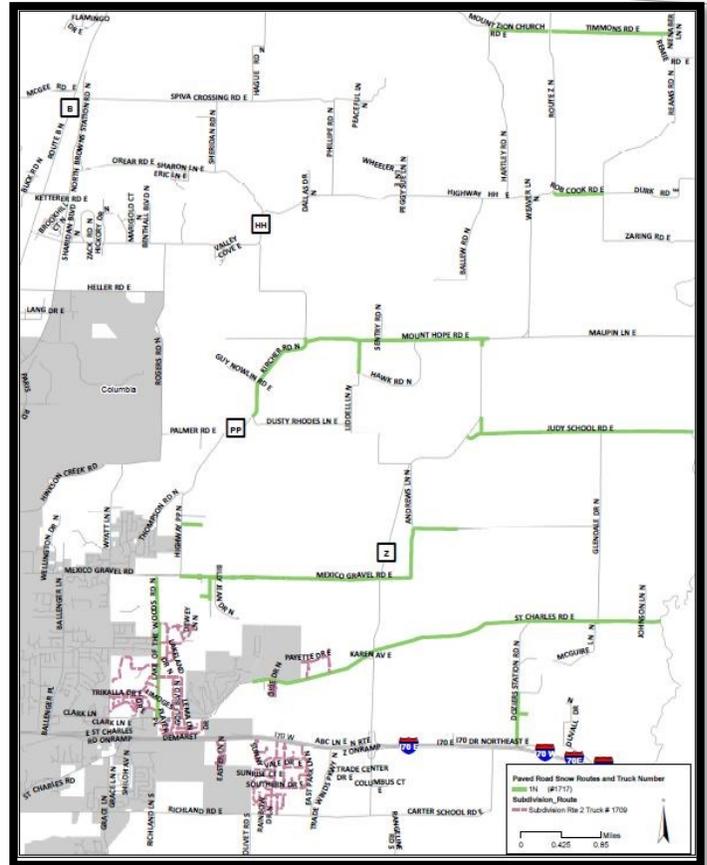


Late in 2017, one such project occurred on James Sapp Rd (pictured above and right). Cedar trees and other small deciduous hardwood species had grown up along the road. They were reducing line-of-sight and casting lots of shade on the road. So, as part of a larger ditching project, Boone County Road and Bridge removed every tree within 15 feet of the centerline of the road. As you can see, the James Sapp Rd is now much safer for daily drivers. James Sapp Rd should also dry out more quickly after heavy rains this summer.

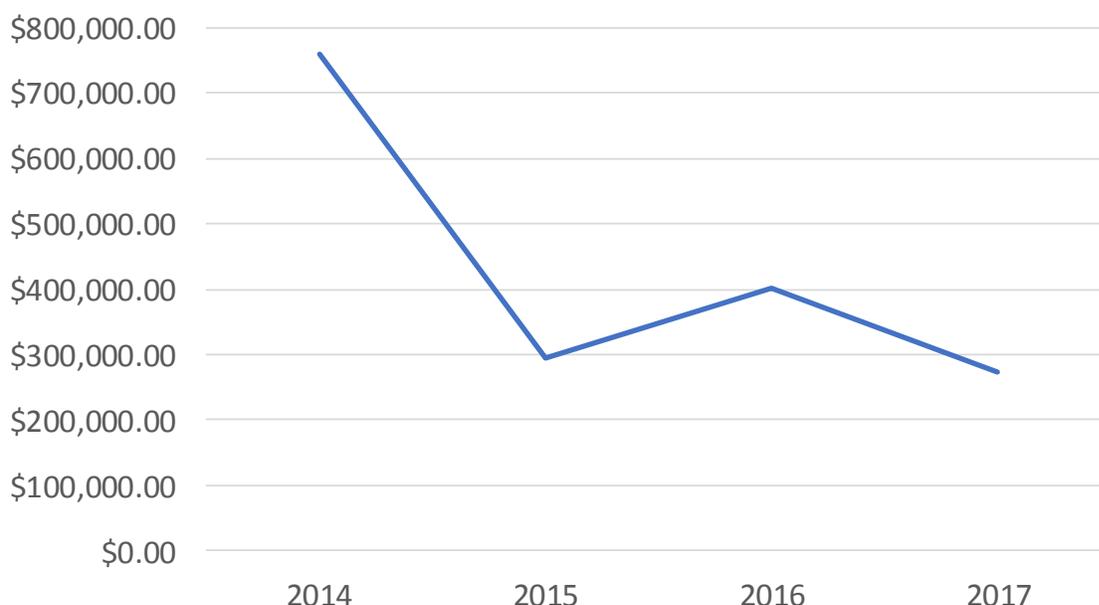
Snow and Ice

Boone County Road and Bridge is proud of the snow and ice control procedures and practices we have developed over the last several years. Every October, our snow and ice committee meets to discuss any changes to snow routes, update our snow route maps, and then have our crews drive each of their routes to refresh themselves or to introduce the route to new employees. During a snow event, our drivers apply 200lbs of salt per lane mile to all of our paved roads and motor graders stir up gravel road surfaces to provide additional traction.

Crews are divided into day and night shifts. Every hour of snow operations costs the county \$2,770.08 per hour during the day shift and \$882.84 per hour during the night shift. To cover our snow routes in salt at 200 lbs per lane mile, it costs the county \$3,975.62 per round of coverage.

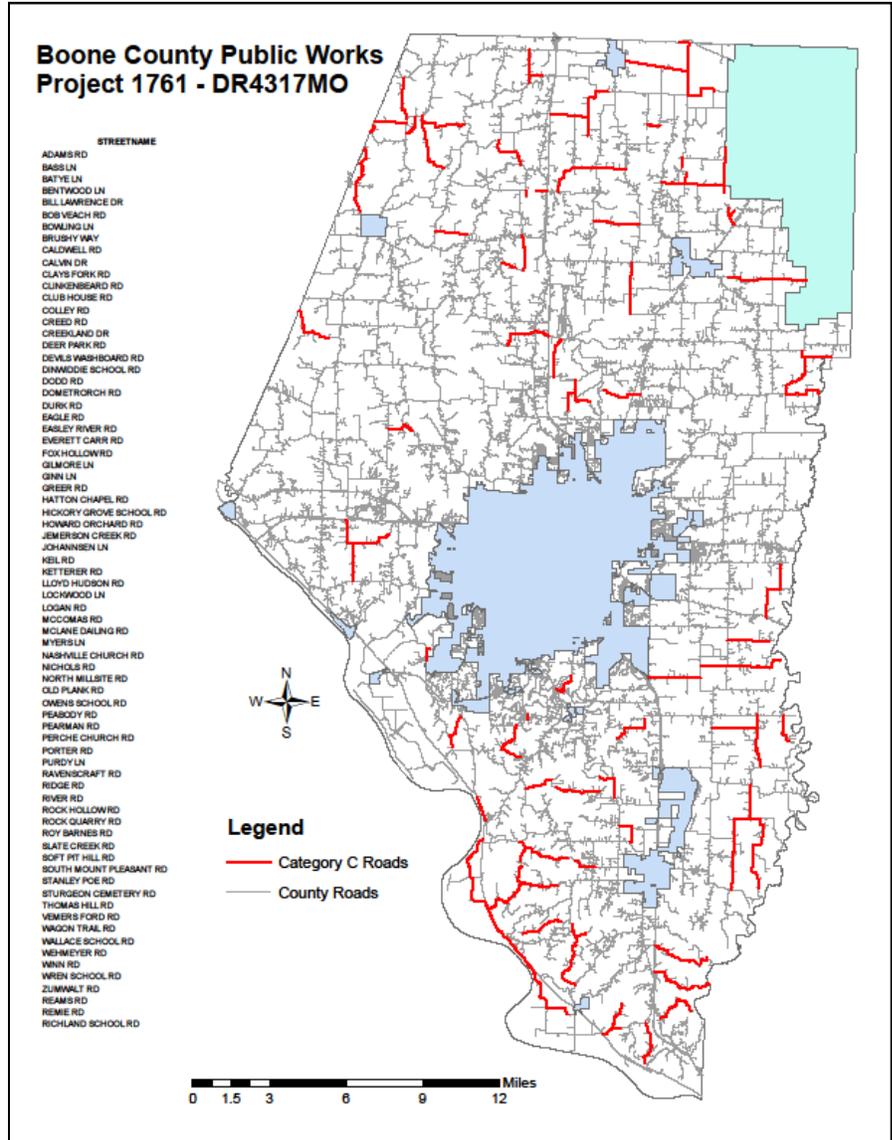


Annual Cost of Snow Removal



Storm Response

April 28, 2017 through May 5, 2017, Boone County received upwards of 8 inches of rain. The flooding that ensued caused more than \$100,000 in damage to county roads and rights-of-way. The Boone County Office of Emergency Management (OEM) applied for reimbursement through the Federal Emergency Management Agency's (FEMA) public assistance program. As a result, Boone County became part of federal disaster DR-4317 and therefore eligible for public assistance. Boone County Road and Bridge, Facilities Maintenance, and OEM worked together to gather and submit the necessary forms and information. Our efforts resulted in federal and state reimbursements in the amount of \$128,172.53.

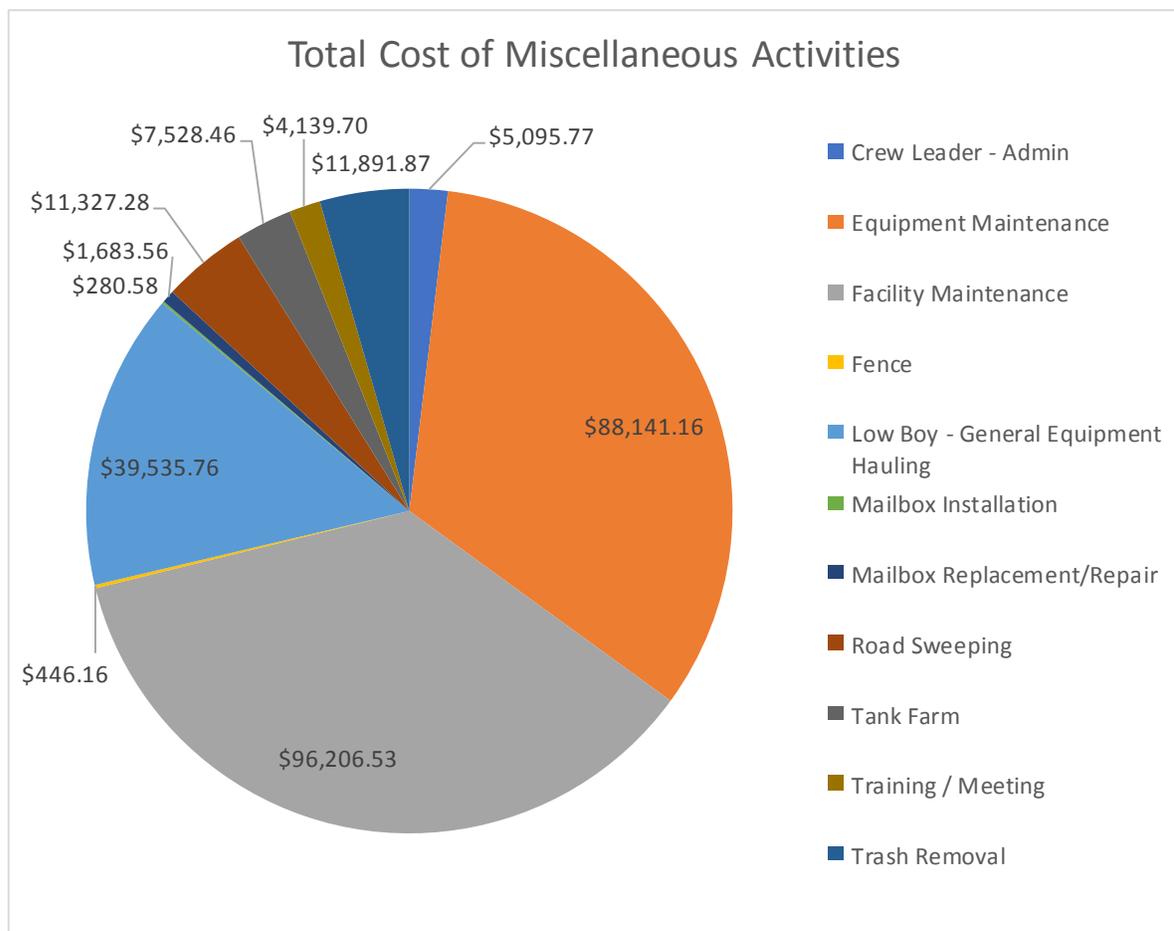


Department	Damages	Total Cost	Amount Reimbursed
Road and Bridge	Road Surfaces	\$79,185.00	\$79,185.00
Road and Bridge	ROW Vegetation	\$26,120.38	\$26,120.38
Road and Bridge	Jemerson Creek Rd culvert	\$8,678.94	\$8,678.94
Facilities Maintenance	Hinkson Creek Bridge	\$528.94	\$528.94
Facilities Maintenance	MKT Trail	\$11,475.15	\$11,475.15
Both	Administrative Costs	\$2,184.12	\$2,184.12

Miscellaneous Tasks

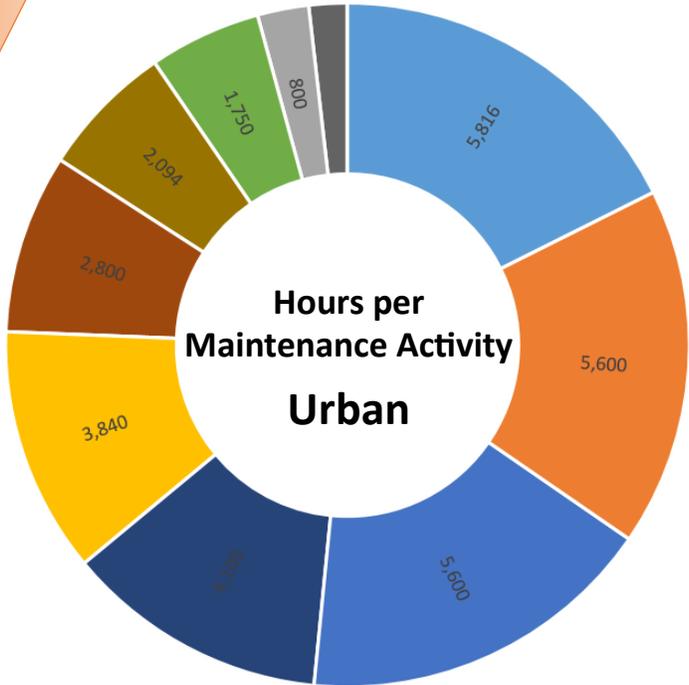
In addition to the pavement repairs, gravel road maintenance, and other activities directly related to road and bridge maintenance, Boone County Road and Bridge conducts activities that, although are necessary to complete normal work, generally go unnoticed. Such activities include equipment maintenance (that does not involve repairs), facility maintenance, equipment hauling, training, and a few more similar tasks that keep us operating at our optimal efficiency. These tasks cost the department a total of \$266,276.83 and constituted 4.22% of our total budgetary spending in 2017 .

At \$96,206.53, our cost for Facility Maintenance was disproportionately large. The extra expenses incurred for this category of work were a result of moving our equipment and excess materials from a satellite facility on Oakland Gravel Rd to our northern facility on Highway 124. The move cost the department \$31,250.67 and 379 labor hours.

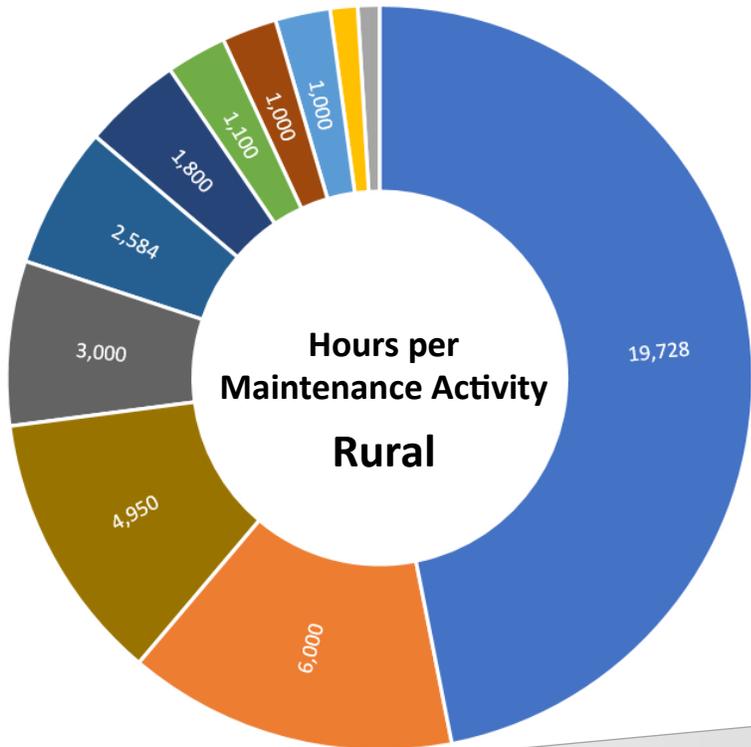


2018 Work Plan

Rural Crews



- Concrete Panel Replacement
- Asphalt Preparation
- Drainage and Culvert Improvements
- Tree Trimming
- Mowing/Brush
- Signs
- Snow and Ice
- LCS Preparation
- LCS Application
- Miscellaneous



- Gravel Road Maintenance
- Drainage and Culvert Improvement
- Tree Trimming
- Mowing/Brush
- Bridge Maintenance
- Magnesium Chloride Application
- Chip Seal Application
- Low Water Crossings
- Projects
- Snow and Ice
- Miscellaneous