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June 23, 2020

Mr. Patrick McKenna, Director
Missouri Department of Transportation
Jefferson City, Missouri 65102

RE: SFY 2021 State Planning and Research Work
Program Missouri Project SPR-PL-00 FY (021)
and SFY FY2020 Annual Report Missouri Project
SPR-PL-00 FY (20)

Dear Mr. McKenna:

In your letter dated June 22, 2020, we received your request for the Federal Highway Administration's (FHWA) and the Federal Transit Administration (FTA) review and approval of the final version of Missouri Department of Transportation's (MoDOT) state fiscal year (SFY) 2021 State Planning and Research (SPR) Work Program and SFY 2020 Annual Report. After prior discussion and review of draft copies, we find the SFY 2021 SPR Work Program satisfactory and approve it as requested, effective July 1, 2020. The MoDOT SFY 2021 SPR Work Program year begins on July 1, 2020 and ends on June 30, 2021.

This approval includes the estimated funding amounts for the Unified Planning Work Programs (UPWPs) for Missouri's eight metropolitan planning areas. However, the UPWPs for each of the Metropolitan Planning Organizations (MPOs) continue to be subject to ONE DOT's individual review and written approval.

The SFY 2021 SPR Work Program and SFY 2020 SPR Annual Reporting data are presented in one planning work product. Please provide our Division Office the addendum that adds the actual cost to the SFY 2020 SPR Work Program by August 31, 2020 and take steps to close out the SPR-PL-00 FY (20) project within 90 days of the close of the state fiscal year 2020 work program.

If you have any questions, please contact Brad McMahon at FHWA (573) 638-2609 or Cathy Monroe at FTA (816) 329-3929.

Sincerely,

Mokhtee Ahmad
Regional Administrator
Federal Transit Administration

For: Kevin W. Ward
Division Administrator, P.E.
Federal Highway Administration

cc: Eric Curtit, MoDOT
Britni O'Connor, MoDOT
Jennifer Harper, MoDOT
Dave Ahlvers, MoDOT
Sharon Monroe, MoDOT

Missouri Department of Transportation
Patrick K. McKenna, Director

1.888.ASK MODOT (275.6636)

June 22, 2020

Mr. Kevin Ward
Division Administrator
Federal Highway Administration
3220 West Edgewood, Suite H
Jefferson City, MO 65109

Mr. Mokhtee Ahmad
Regional Administrator
Federal Transit Administration
901 Locust Street, Suite 404
Kansas City, MO 64106

Dear Messrs. Ward and Ahmad:

Attached is the Missouri Department of Transportation's fiscal year 2021 State Planning and Research Work Program. A draft copy was submitted to your office on May 28, 2020 for review by ONE DOT.

MoDOT is requesting overall approval effective July 1, 2020 of Part I-Planning and Part III-Research, Development and Technology. Part II-Metropolitan Planning is for informational purposes. The federal funds will be obligated based on the MPO's UPWP.

If there are questions regarding this SPR program, please contact Britni O'Connor at 751-6550 or me at 526-1374.

Sincerely,

Eric J.
Curtit

Digitally signed by
Eric J. Curtit
Date: 2020.06.22
10:05:15 -05'00'

Eric J. Curtit
Transportation Planning Director

Enclosure

cc: Brad McMahon - FHWA
Cathy Monroe - FTA
Jennifer Harper - CM-MODOT



Our mission is to provide a world-class transportation system that is safe, innovative, reliable and dedicated to a prosperous Missouri.

www.modot.org

State Planning and Research Program

**SPR-PL-00 FY (21)
2021 State Fiscal Year
(7/1/20 to 6/30/21)**

And

**SPR-PL-00 FY (20)
2020 State Fiscal Year
(7/1/19 to 6/30/20)**



Missouri Department
of Transportation

In Cooperation with the
U.S. Department of Transportation
Federal Highway Administration

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List of Abbreviations

AASHTO – American Association of State Highway and Transportation Officials
AEP – Annual Exceedance Probabilities
APA – American Planning Association
ARAN – Automatic Road Analyzer
ARI – Average Recurrence Intervals
ASTM – American Society for Testing and Materials
ATR – Automatic Traffic Recorder
BEAP – Bridge Engineering Assistance Program
CAP – Compliance Assessment Program
CFR – Code of Federal Regulations
CMF – Cash Modification Factor
CMS – Content Management System
CP – Cathodic Protection
CPG – Consolidated Planning Grants
DOT – Department of Transportation
EERC – Earthworks Engineering Research Center
EMTSP – Equipment Management Technical Services Program
EPG – Engineering Policy Guide
EWG – East-West Gateway Council of Governments
FARS – Fatality Analysis Reporting System
FAST Act – Fixing America’s Surface Transportation Act
FEMA – Federal Emergency Management System
FFY – Federal Fiscal Year
FHWA – Federal Highway Administration
FRP – Fiber Reinforced Polymer
FTA – Federal Transit Administration
FTZ – Foreign Trade Zone
GIS – Geographic information system
GPR – Ground-Penetrating Radar
GPS – Global Positioning System
HAL – Highway Accident Location
HMA – Hot-Mix Asphalt
HPMS – Highway Performance Monitoring System
HSM – Highway Safety Manual
HS-SCC – High Strength Self-Consolidating Concrete
HVFA – High Volume Fly Ash
IMISS – Implementing Maintenance Innovations from State to State
ITE – Institute of Transportation Engineers
ITS – Intelligent Transportation System
LED – Light Emitting Diode
LETS – Law Enforcement Technology System
LIDAR – Light Detection and Ranging
LKD – Lime Kiln Dust
LPA – Local Public Agencies
LRFD – Load and Resistance Factor Design
LRS – Linear Referencing System Network
LRTP – Long-Range Transportation Plan

LTAP – Local Technical Assistance Program
MACOG – Missouri Association of Councils of Government
MACTO – Missouri Association of County Transportation Officials
MAFC – Mid-America Freight Coalition
MAP-21 – Moving Ahead for Progress in the 21st Century
MARC – Mid-America Regional Council
MATC – Mid-America Transportation Center
MDA – Mixture Design and Analysis
MERIC – Missouri Economic Research and Information Center
MHTC – Missouri Highway Transportation Commission
MLS – Master of Library Science
MoDOT – Missouri Department of Transportation
MPO – Metropolitan Planning Organization
MUTCD – Manual on Uniform Traffic Control Devices
NCAT – National Center for Asphalt Technology
NCHRP – National Cooperative Highway Research Program
NCSC – North Central Super pave Center
NDT – Non-destructive Testing
NHI – National Highway Institute
NTKN – National Transportation Knowledge Network
NTPEP – National Transportation Product Evaluation Program
ONEDOT – Federal Highway Administration and Federal Transit Administration
OTO – Ozarks Transportation Organization
PCC – Portland Cement Concrete
PI – Principal Investigator
PIERS – Port Import Export Reporting Service
PL – Metropolitan Planning
PPG – Planning and Policy Group
QA – Quality Assurance
QC – Quality Control
RAS – Recycled Asphalt Shingles
RCA – Recycled Concrete Aggregate
RPC – Regional Planning Commission
RTAP – Rural Technical Assistance Program
RTS – Right Transportation Solutions
SASW – Spectral Analysis of Surface Waves
SCC – Self-Consolidating Concrete
SDE – Service Desk Express
SEMA – State Emergency Management System
SFY – State Fiscal Year
SHAL – Safety Handbook for Locals
SICOP – Snow and Ice Pooled Fund Cooperative Program
SPF – Safety Performance Functions
SPR – State Planning and Research
SPT – Standard Penetration Test
STARS – Missouri Statewide Traffic Accident Records System
STIP – Statewide Transportation Improvement Program
STSFA – Transportation Systems Funding Alternative
TAC – Technical Advisory Committee

TCD – Traffic Control Device
TCOAP – Thin-White Topping Concrete Overlays of existing Asphalt Pavement
TE – Transportation Enhancement
TEAP – Traffic Engineering Assistance Program
TIG – Technology Implementation Group
TKN – Transportation Knowledge Networks
TMC – Transportation Management Center
TMS – Transportation Management Systems
TRB – Transportation Research Board
TP – Transportation Planning
TPF – Transportation Pooled Funds
TSP2 – Transportation Pavement Preservation Program
TTAP –Technology Transfer Assistance Program
TTC – Temporary Traffic Control
TTCC – Technology Transfer Concrete Consortium
TTIC – Technology Transfer Intelligent Compaction
TWLT – Two-Way Left Turn
UAB – Urban Area Boundary
UPWP – Unified Planning Work Program
USGS – United States Geological Survey
UTCOAP – Ultra-Thin White Topping Concrete Overlays of existing Asphalt Pavement
VMT – Vehicle Miles of Travel

Preface

This SPR Work Program is prepared as an overview of the MoDOT activities that relate to Section 505, State Planning and Research, of Title 23, United States Code.

This report focuses on three parts. Part I (Planning) describes the state planning activities. Part II (Urban – Metropolitan planning organizations, MPO – CPG) describes the planning activities of the MPO. Part III (Research-SR) describes the technology transfer, development and research activities.

State Planning (SP) funds identify and develop methods to evaluate, prioritize and finance transportation needs.

Consolidated Planning Grant (CPG) funds are distributed to the nine metropolitan areas for their use in urban planning. The combined state and local urban planning work is coordinated into the Unified Work Program for each of the urbanized areas.

Research, Development and Technology Transfer (SR) funds are used for research, and for development and technology transfer activities necessary in connection with the planning, design, construction and maintenance of highway, public transportation and intermodal transportation systems.

The SFY 2021 SPR work program describes the proposed work activities and estimated budgets for each SFY 2021 SPR work program work element and the accomplishments for each SFY 2020 SPR work program work element. An administrative action will be completed in September 2020 for the purpose of incorporating the actual expenditure amounts for SFY 2020 work activities into the SFY 2021 SPR work program. This administrative action will be in the form of an addendum and provided to FHWA for informational purposes. It will be available for viewing on www.modot.org.

Introduction

Planning in general involves a method for accomplishing a desired objective – deciding in advance planning activities for the upcoming year. It is a continuous process aimed at maintaining the entire transportation system. Planning is the orderly and continuing assembly of information – including the history of development, the extent, dimensions, condition, use, economic and social effects, costs and future needs. It includes the analysis of this information for use by the administrators for the development and management of the transportation system in an efficient and cost-effective manner.

MoDOT's Mission:

Our mission is to provide a world-class transportation system that is safe, innovative, reliable and dedicated to a prosperous Missouri.

MoDOT's Tangible Results:

- Moving Missourians Safely
- Providing Outstanding Customer Service
- Delivering Efficient and Innovative Transportation Projects
- Operating a Reliable Transportation System
- Managing our Assets
- Stabilizing Resources and Engaging our Workforce
- Building a Prosperous Economy for All Missourians

MoDOT's Value Statements:

- Be Safe,
 - Be Accountable,
 - Be Respectful,
 - Be Inclusive,
 - Be Bold,
 - Be Better and
 - Be One Team
- So we can be a great organization

Financial Summary Sheet

As of April 30, 2020

A. Total Estimated Costs	SFY 2021	Amended SFY 2020
Part I – Planning	\$20,607,857	\$19,859,636
Part II – Metropolitan Planning	\$11,122,355	\$9,992,679
*Part III – Research, Development and Technology	\$3,689,977	\$3,591,691
TOTAL ESTIMATED COST	\$35,420,189	\$33,444,006
B. Available Federal Funds	SFY 2021	SFY 2020
Part I - State Planning		
Obligated but Not Spent	\$8,115,367	\$5,822,208
Unobligated Funds	\$28,675,207	\$29,174,012
Estimated Annual Apportionment	\$15,469,000	\$15,164,000
Less:	<u>(\$39,800)</u>	<u>(\$39,800)</u>
- Pooled Funds.....\$39,800 estimated	-	-
SUBTOTAL – STATE PLANNING	\$52,219,774	\$50,120,420
Part II - Metropolitan Planning		
Obligated but Not Spent	\$6,471,499	\$7,190,835
Unobligated Funds	\$12,392,782	\$13,652,770
Estimated FHWA PL Annual Allocation	\$5,606,000	\$5,500,000
Estimated FTA 5303 Annual Allocation	<u>\$1,914,571</u>	<u>\$1,818,340</u>
SUBTOTAL – METRO PLANNING	\$26,384,852	\$28,161,945
Part III – Research		
**Obligated but not spent	\$2,492,566	\$1,859,311
Unobligated Funds	\$10,275,526	\$9,474,535
Estimated Annual Apportionment	\$5,156,000	\$5,055,000
Less:	<u>(\$2,088,700)</u>	<u>(\$2,062,685)</u>
- NCHRP.....\$1,134,000 estimated		
- TRB Core.....\$184,700 estimated		
- Pooled Funds.....\$770,000 estimated		
SUBTOTAL – RESEARCH	\$15,835,392	\$14,326,161
TOTAL FEDERAL FUNDS AVAILABLE	\$94,440,018	\$92,608,526

* This does not include NCHRP, TRB Core and Pooled Funds.

**The majority of “Obligated but Not Spent” funds are obligated for pooled fund projects proposed project financing for SFY 2020.

C. Proposed Budget Estimates for SFY 2021

C. Proposed Budget Estimates for SFY 2021	Federal Funds	Percent	Matching Funds	Total
State Planning	\$16,486,286	80%	\$4,121,571	\$20,607,857
Metropolitan Planning (PL and 5303) (Estimated)	\$8,897,884	80%	\$2,224,471	\$11,122,355
* Research	\$3,082,634	varies	\$607,343	\$3,689,977
TOTAL SP, SR & CPG	\$28,466,804		\$6,953,385	\$35,420,189

* This does not include NCHRP, TRB Core and Pooled Funds.

D. Amended SPR Budget Estimates for SFY 2020

D. Amended SPR Budget Estimates for SFY 2020	Federal Funds	Percent	Matching Funds	Total
State Planning	\$15,887,709	80%	\$3,971,927	\$19,859,636
Metropolitan Planning (PL and 5303) (Estimated)	\$7,994,143	80%	\$1,998,536	\$9,992,679
* Research	\$2,996,904	varies	\$594,787	\$3,591,691
TOTAL SP, SR & CPG	\$26,878,756		\$6,565,250	\$33,444,006

* This does not include NCHRP, TRB Core and Pooled Funds.

Itemized Cost Budget Estimates and Actual Expenditures

Part I – Planning

Transportation Planning Activities	SFY 2021 Budget	SFY 2020 Amended Budget
• Administration	\$2,519,286	\$2,048,395
• Planning and Performance Group	\$992,646	\$1,053,546
• Statewide Programming	\$670,254	\$720,941
• Transportation Systems Management	<u>\$3,539,412</u>	<u>\$3,537,225</u>
SUBTOTAL	\$7,721,598	\$7,360,107
<i>District Transportation Planning</i>		
• CD	\$1,682,682	\$1,568,211
• KC	\$1,915,473	\$1,731,695
• NE	\$844,432	\$930,691
• NW	\$666,865	\$533,201
• SE	\$903,239	\$658,421
• SL	\$874,602	\$887,311
• SW	<u>\$603,944</u>	<u>\$853,831</u>
SUBTOTAL	\$7,491,237	\$7,163,361
<i>Other Activities</i>		
• Information Systems	\$2,146,842	\$2,428,251
• Regional Planning Commission	\$1,375,000	\$1,375,000
• Financial Services	\$1,113,820	\$1,144,480
• Bridge Division	\$196,671	\$182,380
• Design Division	\$557,689	\$201,057
• Communications	<u>\$5,000</u>	<u>\$5,000</u>
SUBTOTAL	\$5,395,022	\$5,336,168
TOTAL PART I	\$20,607,857	\$19,859,636

Note: SFY 2020 Actuals will be submitted to FHWA as an addendum September 2020.

Part II – Urban (MPO)

Metropolitan Areas	Current CPG Contract Amount	Estimated FFY 2021 Local Match	Estimated Total FFY 2021 CPG Funds with Match	FFY 2020 CPG Funds with Match
NW Arkansas	\$5,000	\$1,250	\$6,250	\$6,250
Kansas City	\$2,027,321	\$506,830	\$2,534,151	\$2,534,151
St. Louis	\$4,493,413	\$1,123,353	\$5,616,766	\$4,772,811
Springfield	\$654,352	\$163,588	\$817,940	\$698,193
Columbia	\$409,153	\$102,288	\$511,441	\$511,441
Jefferson City	\$145,844	\$36,461	\$182,305	\$182,305
Joplin	\$651,532	\$162,883	\$814,415	\$814,415
St. Joseph	\$142,833	\$35,708	\$178,541	\$178,541
Cape Girardeau	<u>\$368,436</u>	<u>\$92,109</u>	<u>\$460,545</u>	<u>\$294,571</u>
TOTAL PART II	\$8,897,884	\$2,224,471	\$11,122,355	\$9,992,679

- Note:** - The estimated total of MPO contracts (CPG agreements) in place for the SFY 2021 SPR work program is \$8,897,884
- The estimated PL amount is before post-apportionment set-asides; before penalties; before sequestration.
 - For SFY 2021 SPR, estimated total apportioned PL Funds = \$5,606,369 and Obligation limitation applied at 98%.

Part III – Research – SPR

Activity	SFY 2021 Budget	SFY 2020 Amended Budget
• Administration (SPR21ADS)	\$326,569	\$244,869
• Research (SPR21RDS)	\$2,805,908	\$2,753,908
• Development	\$0	\$95,414
• Technology Transfer (SPR21TTS)	<u>\$557,500</u>	<u>\$497,500</u>
*TOTAL PART III	\$3,689,977	\$3,591,691

* This does not include NCHRP, TRB Core and Pooled Funds.

Note: SFY 2020 Actuals will be submitted to FHWA as an addendum September 2020.

Total MoDOT SPR Work Program

	SFY 2021 Budget	SFY 2020 Amended Budget
• Part I – Planning	\$20,607,857	\$19,859,636
• Part II – Metropolitan Planning	\$11,122,355	\$9,992,679
• *Part III – Research	\$3,689,977	\$3,591,691
TOTAL MoDOT SPR WORK PROGRAM	\$35,420,189	\$33,444,006

* This does not include NCHRP, TRB Core and Pooled Funds.

Note: SFY 2020 Actuals will be submitted to FHWA as an addendum September 2020.

CFR 420.107(c) Summary

FY 2020 FHWA Research Apportionment (25%)	\$5,156,168
FY 2021 Research Budget	\$5,171,334
Pooled Funds	\$770,000
NCHRP	\$1,134,000
TRB Core	\$184,700
Part III Research (Federal Portion Only)	\$3,082,634

WORK PLANS

Core and Mandated Activities

Part I – Planning

TRANSPORTATION PLANNING ACTIVITIES

ADMINISTRATION

Purpose and Scope: Administration provides for the management of Transportation Planning's core functions. Included are items such as training, for example: NHI courses, supervisory/management training, APA training and other various training courses. Also included are such items as office supplies, equipment and travel expenses. The budget amount includes personal services and fringe benefits for employees in this unit.

This unit also includes MoDOT's participation in the Midwest Regional Rail Initiative that involves sharing of information regarding freight and passenger movements on rail and freight data update coordination, planning/economic studies and conducting MoDOT's satisfaction survey.

SFY 2021 Proposed Activities:

- Continue providing for the management of Transportation Planning's core functions including trainings and office supplies, equipment and travel expenses
- Host an annual statewide planning partner meeting to share transportation information and best practices
- Continue participating in the Midwest Regional Rail Initiative
- Attend conferences, peer exchanges, AASHTO meetings and training courses
- Conduct an economic impact analysis for the STIP
- Conduct MoDOT's report card survey
- Development of State Freight and Rail Plan

SFY 2020 Accomplishments:

- Hosted one planning partner meeting and shared information regarding transportation funding, safety initiatives and planning for the next Statewide Transportation Improvement Program and asset management planning by regional group
- Attended conferences, peer exchanges, AASHTO meetings and training courses
- Conducted an economic impact analysis for the STIP
- Began development of State Freight and Rail Plan

Financials

	<u>Amount</u>	<u>Work ID Code</u>
Projected Budget SFY 2021	\$2,519,286	SPR2140S
Amended Budget Amount SFY 2020	\$2,048,395	SPR2040S
Actual Cost SFY 2020	(See Addendum Sept. 2020)	SPR2040S

PLANNING AND PERFORMANCE GROUP

Purpose and Scope: Planning and Performance Group (PPG) includes the Planning and Policy, Strategic Planning, and Innovative Partnerships and Alternative Funding activities. The amounts include personal services and fringe benefits for employees in these units.

Planning and Policy activities include maintaining the 20-year long-range transportation plan. This plan analyzes needs for all modes of transportation and provides policy and goal direction for MoDOT as it develops the Statewide Transportation Improvement Program. Additional activities ensure MoDOT's program delivery processes are compliant with federal regulations and move as seamless as possible. Strategic Planning activities include aligning MoDOT's strategic planning process with its mission, values and tangible results. Additional activities include performance management coordination, Tracker production and innovative partnerships and alternative funding administration.

SFY 2021 Proposed Activities:

- Engage the public in discussions about additional transportation investments and needs
- Continue assisting RPCs in:
 - developing and maintaining work programs and regional transportation plans
 - providing local consultation with rural local officials
- Continue assisting MPOs in developing and maintaining the following work products
 - unified planning work programs
 - transportation improvement programs
 - long-range transportation plans
 - air quality conformity determinations
 - public involvement plans
- Attend MPOs board and technical committee meeting
- Coordinate and support MoDOT's national involvement in FAST Act/MAP-21 performance measure development, coordination and implementation
- Coordinate asset management plan development
- Administer the State Planning and Research Work Program
- Provide team facilitation for process improvement and business planning teams
- Continue to support and develop the Tracker performance management system
- Continue to coordinate and develop the Innovations Challenge program
- Conduct Transportation Planning Division's internal and external customer satisfaction surveys
- Manage OA, FHWA and AASHTO Awards coordination
- Assessment of various FHWA and USDOT credit assistance tools for initiation in Missouri
- Advising on preparation of various discretionary grant applications to USDOT and FHWA

SFY 2020 Accomplishments:

- Assisted the RPCs with:
 - developing and maintaining work programs and regional transportation plans and
 - providing local consultation with rural local officials
- Facilitated the receipt of ONE DOT approval of MPO TIPs, UPWPs and Air Quality Conformity Determination work products, and TIP and UPWP amendments
- Engaged in public discussion about additional transportation investment needs
- Continued collaborating with RPCs and MPOs and MoDOT district offices on a variety of planning issues targeted at improving federal required work products and to further enhance transportation planning efforts

- Attended MPO Board & Technical committee meetings
- Coordinated and supported MoDOT's national involvement in FAST Act/MAP-21 performance measure development, coordination and implementation
- Coordinated asset management plan development
- Updated and submitted State Planning and Research Work Program
- Supported and developed the Tracker performance management system including the production of the quarterly Tracker publications and coordination of the quarterly Tracker Review meetings
- Coordinated and further developed the Innovations Challenge program
- Managed OA, FHWA and AASHTO Awards Program
- Submitted INFRA Grant for 251 Bridges

<u>Financials</u>	<u>Amount</u>	<u>Work ID Code</u>
Projected Budget SFY 2021	\$992,646	SPR2140S
Amended Budget Amount SFY 2020	\$1,053,546	SPR2040S
Actual Cost SFY 2020	(See Addendum Sept. 2020)	SPR2040S

STATEWIDE PROGRAMMING

Purpose and Scope: The Statewide Programming unit develops the STIP and STIP-related products. This includes efforts by MoDOT Central Office personnel only. Personal services and fringe benefits for all employees within this work unit are also included in the budget amount.

SFY 2021 Proposed Activities:

- Produce and maintain the STIP in accordance with the guidelines of the Planning Framework and state and federal regulations
- Produce and maintain the Missouri Road and Bridge Program
- Produce various reports on STIP programs and projects as needed

SFY 2020 Accomplishments:

- Updated and completed the STIP
- Updated and completed the Missouri Road and Bridge Program
- Incorporated STIP revisions as needed
- Developed STIP reports as needed
- Posted Program vs. Award and AC conversion reports on the STIP web site

<u>Financials</u>	<u>Amount</u>	<u>Work ID Code</u>
Projected Budget SFY 2021	\$670,254	SPR2140S
Projected Budget Amount SFY 2020	\$720,941	SPR2040S
Actual Cost SFY 2020	(See Addendum Sept. 2020)	SPR2040S

TRANSPORTATION SYSTEM ANALYSIS

Purpose and Scope: Transportation System Analysis Group includes Mapping and Customer Service, Pavement Analysis and Application Development, Traffic Collection and Data. The group manages and

administers field acquisition, asset data, traffic data, travel way data, analysis of asset/travel way data, data query and traffic operations. The budget amount also includes personal services and fringe benefits for all employees within this work unit.

SFY 2021 Proposed Activities:

- Administer and continue to improve the HPMS program
- Analyze transportation data and provide timely and accurate information to MoDOT's customers
- Provide analysis, custom queries and reports using TMS data
- Maintain and publish the official Missouri State Highway Map
- Maintain and update state, county, and city maps and develop specialty maps as requested
- Conduct monthly TMS application update testing, provide support and TMS data restoration as required by our route update process
- Provide pavement data, analysis and projections for transportation decision-making
- Verify, maintain, and update MoDOT's linear referencing system for all public roads
- Monitor pavement data to evaluate current and past best practices in pavement management
- Calculate and provide statewide travel data
- Collect, manage, and report data on all public roads in an effort to support the strategic and performance-based goals in the SHSP and HSIP
- Maintain roadway data and its attributes

SFY 2020 Accomplishments:

- Administered HPMS program
- Analyzed and provided transportation data to customers and transportation decision makers
- Provided data for the development of the MoDOT Asset Management Plan
- Conducted monthly TMS application update testing, provided support and TMS data restoration
- Created state, county, city, and/or specialty maps as needed
- Published the official Missouri State Highway Map
- Provided analysis, custom queries and reports using TMS data
- Continued development of data zone applications
- Maintained MoDOT's linear referencing system and continually worked with counties to verify local roads
- Processed portable and permanent counts in accordance with the traffic monitoring guide for HPMS submittal
- Calculated and provided statewide travel data and reports
- Collected pavement data of Missouri's roadways
- Maintained an inventory of roadway lane data and its attributes
- Collected, managed, and reported data on all public roads

<u>Financials</u>	<u>Amount</u>	<u>Work ID Code</u>
Projected Budget SFY 2021	\$3,539,412	SPR2140S
Amended Budget Amount SFY 2020	\$3,537,225	SPR2040S
Actual Cost SFY 2020	(See Addendum Sept. 2020)	SPR2040S

DISTRICT TRANSPORTATION PLANNING

This program supports the department's district planning staff in efforts to provide comprehensive, cooperative and continuing transportation planning assistance and direction to the district staff, MPOs and RPCs. It includes the district staff efforts and activities with the MPOs, RPCs, local government officials and federal transportation agencies that support the long-range planning process and programming of transportation needs and pre-scoping activities.

<i>District Transportation Planning</i>	<i>SFY 2021 Budget</i>	<i>Amended SFY 2020 Budget</i>
• CD	\$1,682,682	\$1,568,211
• KC	\$1,915,473	\$1,731,695
• NE	\$844,432	\$930,691
• NW	\$666,865	\$533,201
• SE	\$903,239	\$658,421
• SL	\$874,602	\$887,311
• SW	\$603,944	\$853,831
SUBTOTAL	\$7,491,237	\$7,163,361

Note: SFY 2020 Actuals will be submitted in the September 2020 Addendum.

OTHER ACTIVITIES**INFORMATION SYSTEMS**

Purpose and Scope: MoDOT is directing a portion of the SPR funds for support, maintenance and modernization of the Transportation Management System.

SFY 2021 Proposed Activities:

- Maintain and modernize the Transportation Management System
 - Repair, maintenance and fix of current system including the following key areas of TMS that provide critical support to MoDOT users and customers: Bridge, Adopt A Highway, Outdoor Advertising, Statewide Transportation Improvement Program, Traffic & Congestion, Pavement Tools, Intelligent Transportation System and Safety System.

SFY 2020 Accomplishments:

- Provided TMS Core Maintenance Support

Financials

Projected Budget SFY 2021

Amount**\$2,146,842****Work ID Code**

SPR21ISS

Amended Budget Amount SFY 2020

\$2,428,251

SPR20ISS

Actual Cost SFY 2020

(See Addendum Sept. 2020)

SPR20ISS

REGIONAL PLANNING COMMISSIONS

Purpose and Scope: MoDOT is directing a portion of the SPR funds to regional planning agencies for transportation planning activities. These funds provide sources of funding for the Missouri RPC to carry out comprehensive and continuing transportation planning processes in cooperation with state and local planning partners. State Planning and Research funds that are allocated to RPCs assist with producing regional transportation plans, work programs involving transportation planning activities, citizen involvement processes, and other rural transportation planning efforts. Seventeen RPCs will receive federal SPR funding at approximately \$65,000 each. Budget and actual amounts include local match.

SFY 2021 Proposed Activities:

- Cooperate and collaborate with MoDOT on transportation planning processes
- Attend MACOG meetings held monthly in Jefferson City to discuss various issues with RPCs
- Participate in RPCs' transportation advisory committee meetings held in the respective regions throughout the state
- RPCs work with MoDOT and districts with developing work programs involving transportation planning activities
- Participate in FAST Act/ MAP-21 conference calls

SFY 2020 Accomplishments:

- Attended MACOG meetings held monthly in Jefferson City to discuss various issues with RPCs
- Participated in RPCs technical committee meetings held in the respective regions throughout the state
- Worked with RPCs and districts with developing work programs involving transportation planning activities
- Attended Statewide Planning Partner meeting hosted by MoDOT

<u>Financials</u>	<u>Amount</u>	<u>Work ID Code</u>
Projected Budget SFY 2021	\$1,375,000	SPR2127S
Budget Amount SFY 2020	\$1,375,000	SPR2027S
Actual Cost SFY 2020	(See Addendum Sept. 2020)	SPR2027S

FINANCIAL SERVICES

Purpose and Scope: These activities support MoDOT's budget, finance, funds management and infrastructure bank activities. In addition, funds will be managed to achieve a balanced budget and provide coordination of STIP and federal-aid projects. The budget amount also includes personal services and fringe benefits for employees within this work unit.

SFY 2021 Proposed Activities:

- Provide activities to support MoDOT's budget, finance, funds management and infrastructure bank activities
 - Provide coordination of STIP and federal-aid projects
 - Prepare financial models to support department long-term plans and short-term cash needs
 - Provide information on innovative sources of funding for the department's transportation projects

SFY 2020 Accomplishments:

- Provided activities to support MoDOT's budget, finance, funds management and infrastructure bank activities

<u>Financials</u>	<u>Amount</u>	<u>Work ID Code</u>
Projected Budget SFY 2021	\$1,113,820	SPR2193S
Amended Budget Amount SFY 2020	\$1,144,480	SPR2093S
Actual Cost SFY 2020	(See Addendum Sept. 2020)	SPR2093S

BRIDGE DIVISION

Purpose and Scope: MoDOT is directing a portion of the SPR funds for Bridge Division staff spending all or a portion of their time working on projects prior to them being included in the STIP.

SFY 2021 Proposed Activities:

- Prepare projects to be included in the STIP

SFY 2020 Accomplishments:

- Prepared projects to be included in the STIP

<u>Financials</u>	<u>Amount</u>	<u>Work ID Code</u>
Projected Budget SFY 2021	\$196,671	SPR21BRS
Amended Budget Amount SFY 2020	\$182,380	SPR20BRS
Actual Cost SFY 2020	(See Addendum Sept. 2020)	SPR20BRS

DESIGN DIVISION

Purpose and Scope: MoDOT is directing a portion of the SPR funds for Design Division staff spending all or a portion of their time working on projects prior to them being included in the STIP.

SFY 2021 Proposed Activities:

- Prepare projects to be included in the STIP
- Assist consultant with federal grant applications and safety benefit cost ratio

SFY 2020 Accomplishments:

- Prepared projects to be included in the STIP

<u>Financials</u>	<u>Amount</u>	<u>Work ID Code</u>
Projected Budget SFY 2021	\$557,689	SPR2195S
Amended Budget Amount SFY 2020	\$201,057	SPR2095S
Actual Cost SFY 2020	(See Addendum Sept. 2020)	SPR2095S

COMMUNICATIONS

Purpose and Scope: The Division will direct the Customer Satisfaction Survey. This study evaluates MoDOT customer satisfaction through use of a customer survey.

SFY 2021 Proposed Activities:

- Administer MoDOT Customer Satisfaction Survey
 - During each month of the quarter, approximately 200 people who contacted MoDOT's customer service center in the previous month are contacted by Heartland Research, LLC via telephone or a provided email address to take a short survey regarding their experience.
 - The survey data and all comments are provided to MoDOT in a detailed report each month. On the last month of the quarter, information is also provided on the results by quarter.
 - The data is reported in MoDOT's Statewide Tracker.

SFY 2020 Accomplishments:

- Administered MoDOT Customer Satisfaction Survey

<u>Financials</u>	<u>Amount</u>	<u>Work ID Code</u>
Projected Budget SFY 2021	\$5,000	SPR21CRS
Projected Budget Amount SFY 2020	\$5,000	SPR20CRS
Actual Cost SFY 2020	(See Addendum Sept. 2020)	SPR20CRS

Part II – Urban Transportation Planning

TRANSPORTATION PLANNING IN METROPOLITAN AREAS – CONSOLIDATED PLANNING GRANT (CPG)

The U.S Department of Transportation's Consolidated Planning Grant Program (CPG) allows the States and Metropolitan Planning Organizations (MPOs) to merge FTA metropolitan or statewide planning funds with FHWA Planning (PL) funds to provide States support for both highway and transit planning activities to single consolidated grants. This CPG program fosters a cooperative effort between the Federal agencies and the participating States to streamline the delivery of their planning programs providing the flexibility in the use of planning funds. Beginning July 1, 2003, MoDOT elected to have FHWA PL Funds and FTA Section 5303 Metropolitan Transportation Planning Funds consolidated. As of June 2016, the designated lead agency for administering the CPG funds was changed from FTA to FHWA.

CPG funds provide the principal source of funding for Missouri MPOs to carry out a comprehensive and continuing transportation planning process in cooperation with local, state and federal transportation agencies. This process is a prerequisite for receiving federal-aid funding for transportation improvements in metropolitan areas. FAST Act reaffirmed the leading role of the MPOs in the transportation improvement decision-making process, particularly in the large urbanized areas of more than 200,000 populations.

CPG funds, which are all allocated to MPOs, assist MPOs with producing long-range multimodal transportation plans, transportation improvement programs, planning work programs, studies, citizen involvement processes and other urban transportation planning requirements and goals

Under CPG, the FTA and FHWA continue to distribute metropolitan planning and Statewide planning funds according to each agency's statutory formulas that the MoDOT distributes to MPOs by formulas that meet the legislative factors for each category of funds in 23 U.S.C. 104(f)(4) and 49 U.S.C. 5305(d)(2). MoDOT's distribution formula has been developed in consultation with the MPOs, and approved by FTA and FHWA for their respective programs.

The following chart shows the estimated amount of CPG funds (FHWA PL and FTA Section 5303) available for Missouri's MPOs to carry out the metropolitan transportation planning work activities to be budgeted for in each MPO's annual Unified Planning Work Program (UPWP). The MPOs will include the below listed CPG amounts or similar amounts in their UPWPs to complete activities necessary to carry out metropolitan transportation planning. Each MPO's UPWP is approved by the MPO's Policy Board and the FHWA/FTA (ONEDOT). Planning grant agreements based on approved UPWPs are executed between the MPOs and MoDOT to allow the pass through of Federal planning funds and 5303 Transit funds to the MPOs. SFY 2021 5303 allocation amount used 2010 census urbanized area populations.

Table 1: Total CPG Funds Available to MPOs for SFY 2021 UPWP Work Activities

Metropolitan Areas (Fiscal Year)	MPO Balances as of May 2020 (with FY 2020 allocation)	Estimated FFY21 PL Allocation	Estimated FFY21 5303 Allocation Amounts	Estimated Total CPG Funds	Current CPG Contract Amount
NW Arkansas 07/01 - 06/30	\$2,875	\$5,000	\$0	\$7,875	\$5,000
Kansas City 01/01 - 12/31	\$3,069,525	\$1,515,518	\$531,446	\$5,116,489	\$2,027,321
St. Louis 07/01 - 06/30	\$10,773,975	\$2,685,406	\$1,004,061	\$14,463,442	\$4,493,413
Springfield 07/01 - 06/30	\$1,120,389	\$482,670	\$154,592	\$1,757,651	\$654,352
Columbia 10/01 - 09/30	\$860,052	\$224,400	\$70,454	\$1,154,906	\$409,153
Jefferson City 11/01 - 10/31	\$554,619	\$131,830	\$33,058	\$719,507	\$145,844
Joplin 11/01 - 10/31	\$1,149,835	\$165,721	\$46,749	\$1,362,304	\$651,532
St. Joseph 01/01 - 12/31	\$750,801	\$160,175	\$44,509	\$955,484	\$142,833
Cape Girardeau 07/01 - 6/30	<u>\$778,586</u>	<u>\$123,523</u>	<u>\$29,702</u>	<u>\$931,811</u>	<u>\$368,436</u>
TOTAL PART II	\$19,060,656	\$5,494,242	\$1,914,571	\$26,469,469	\$8,897,884

* The MPOs balance is adjusted to include the actual SFY 2020 CPG allocation and equals the unobligated prior year (SFY 2020 and older) CPG allocated amounts. The MPOs balance column updates with payments of invoices and the allocation of CPG funds. The balance reported is a snapshot for the SPR work program update. The estimated total of MPOs' contracts (CPG agreements) that will be in place for the SFY 2021 SPR work program is \$8,897,884.

MPOs annually program consolidated federal planning fund amounts in approved UPWPs to complete activities necessary to implement the metropolitan transportation planning process. MPO's UPWPs identify the available amounts of FHWA PL and FTA Section 5303 funds separately as funding sources but are not requested to identify SFY the separate amounts on each work activity or in the financial summary. Each MPO's UPWP is approved by the MPO's Policy Board and the FHWA/FTA (ONE DOT). CPG agreements, based on approved UPWPs, are executed between the MPOs and MoDOT to allow the pass through of Federal planning funds to the MPOs. MPOs have up to five years to spend CPG balances.

MoDOT allows MARC, OTO and EWG (Kansas City, Springfield and St. Louis, respectively) to use the value of MoDOT's state-funded only metropolitan planning activities to leverage the CPG funds (FHWA PL and FTA Section 5303). These MoDOT District planning activities include data collection, data analysis and data sharing that supports and enhances the overall planning process within each metropolitan planning area. Activities include such work items as traffic counts, signal timing, analysis of planning and/or traffic studies and analysis of traffic volumes and safety concerns. These work items support a more informed, better decision-making process for the MPOs and can be demonstrated to be directly attributable to the MPOs planning work elements. MPOs are able to utilize 80 percent of the value of MoDOT eligible metropolitan planning work as a credit to help provide the MPOs required 20 percent match for the Federal planning funds.

The estimated values of the MoDOT state-funded metropolitan planning work activities based on the most current fiscal year are as follows:

Kansas City MPO	\$258,619
St. Louis MPO	\$318,849
Springfield MPO	\$23,724

Part III – Research

ADMINISTRATION

Purpose and Scope: Provide general administration funds for the development and monitoring of research programs that benefit the Missouri Department of Transportation. This includes distributing available information concerning past, current and proposed research work related to highways and transportation to supporting agencies; evaluation and development of proposed research studies; and, implementation and dissemination of research results.

<u>Financials</u>	<u>Amount</u>	<u>Work ID Code</u>
Projected Budget SFY 2021	\$326,569	SPR21ADS
Budget Amount SFY 2020	\$244,869	SPR20ADS
Actual Cost SFY 2020	(See Addendum Sept. 2020)	SPR20ADS

RESEARCH

Purpose and Scope: Research at MoDOT primarily expands and advances our knowledge in all areas of transportation, so we may provide the best, total-transportation system for Missourians. The research program responds to our customer needs, provides information and technology for management policy decisions and undertakes research and development issues that have high possibilities of being implemented. It also includes contingency funds for contract research studies approved after the start of the fiscal year.

<u>Financials</u>	<u>Amount</u>	<u>Work ID Code</u>
Projected Budget SFY 2021	\$2,805,908	SPR21RDS
Amended Budget Amount SFY 2020	\$2,753,908	SPR20RDS
Actual Cost SFY 2020	(See Addendum Sept. 2020)	SPR20RDS

DEVELOPMENT

Purpose and Scope: Development studies find and implement products that have the most positive effect on MoDOT's operations. Development takes a product, process or method produced as a result of research and evaluates it for eventual implementation. Implementation applies the research, best practices and new product results within the department. The development and implementation process provides cost savings in material or time, safety issues or improved life-cycle costs. This function is no longer being done out of the research section. The salary for the third research employee was rolled into the SPR21ADS Work ID Code.

<u>Financials</u>	<u>Amount</u>	<u>Work ID Code</u>
Projected Budget SFY 2021	\$0	SPR21DVS
Budget Amount SFY 2020	\$95,414	SPR20DVS
Actual Cost SFY 2020	(See Addendum Sept. 2020)	SPR20DVS

TECHNOLOGY TRANSFER

Purpose and Scope: Technology transfer provides mechanisms to coordinate the transfer of research results and information with MoDOT divisions and districts as well as with outside organizations. The Local Technical Assistance Program provides transportation information and training opportunities to local transportation agencies. Funding is provided to match other funds to support the BEAP and the TEAP. These programs offer assistance to local entities for bridge design and traffic studies. In addition, technology transfer provides direction and support to department personnel to maintain an understanding of new methodologies and technologies.

<u>Financials</u>	<u>Amount</u>	<u>Work ID Code</u>
Projected Budget SFY 2021	\$557,500	SPR21TTS
Budget Amount SFY 2020	\$497,500	SPR20TTS
Actual Cost SFY 2020	(See Addendum Sept. 2020)	SPR20TTS

Certification Statement

I, Jen Harper, Research Director, of the State of Missouri, do hereby certify that the State is in compliance with all requirements of 23 U.S. Code 505 and its implementing regulations with respect to the research, development, and technology transfer program, and contemplate no changes in statutes, regulations, or administrative procedures which would affect such compliance.



 Research Director



 Date

Part III Research Summary

Project No.	Project Name	SFY2021 Budget
TA206601	Research Administration	\$326,569
TR21CONT	Research Contingencies	\$388,327
TR201313	Secretary of State Library MOU	\$5,300
TR201610	AASHTO Technical Service Program	\$165,000
TR201807	Understanding and Improving Heterogeneous, Modern Recycled Asphalt Mixes	\$52,650
TR201809	Assessment and Repair of Corroded Steel H-Piles	\$20,595
TR201811	Support for Balanced Asphalt Mixture Design Specification Development in Missouri	\$1,826
TR201813	Leader-Follower TMA System	\$357,449
TR201814	Leader-Follower TMA System Misc. Expenses	\$36,844
TR201904	Compacted Concrete Pavement-SE District	\$30,504
TR201909	HFST Before and After Safety Analysis	\$95,262
TR201910	Developing Implementation Strategies for Risk Based Inspection (RBI)	\$0
TR201911	Inlaid Pavement Marking Evaluation	\$27,150
TR202001	Library Support Contract (2020-2021)	\$100,000
TR202002	Snow and Ice Treatment Products Evaluation	\$51,466
TR202003	Evaluating Performance of Concrete Overlays	\$32,202
TR202004	Traffic Disruption-free Bridge Inspection Initiative with Robotic Systems	\$19,528
TR202005	Evaluation of Alternatives to Calcined Bauxite for HFST	\$77,055
TR202006	Transportation Infrastructure Asset Monitoring through the IIOT	\$19,634
TR202007	Geotechnical Asset Management of NW and NE	\$58,939
TR202008	Wireless Crack Sensing	\$12,266
TR202009	Optimizing WZ Zipper Merge Operations Using Driving Simulations	\$60,748
TR202010	Missouri Systemic Countermeasures to Improve Pedestrian Safety	\$78,266
TR202011	Assessment and Repair of Prestressed Bridge Girders Subjected to Over-Height Truck Impacts (OHTI)	\$50,000
TR202012	Evaluation of MO Bridge Inventory for Effective Service Life	\$120,000
TR202013	The Effect of Rubber Fills on the Performance of Infrastructure Phase 1	\$50,000
TR202014	Impact Factor for Winter Severity Indices	\$100,000
TR202015	Using Thermal Integrity Profiling for Detecting Defects in Drilled Shafts	\$70,000
TR202016	Monitoring an Active Landslide on Route 465 Near Branson	\$75,000
TR202017	Scour Analysis at Missouri Bridges	\$80,000
TR202019	Fiber-Reinforced Concrete with Adapted Rheology for Bridge Construction and Rehabilitation	\$75,000
TR202020	Evaluation of Recycled Components in SMA Mixes	\$100,000
TR202021	Consultant Support for IC and PMTP Projects in 2020-2021	\$111,670
TR202023	Predictive Deep Learning for Flash Flood Management	\$53,227
TR202024	Perform. of Wicking Geotextile (H2Ri) to Mitigate Pavement Pumping	\$20,000
TR202025	MCTI Administration	\$75,000
TR202101	Enhanced Camber Calculations for Prestressed Concrete Bridge Girders	\$30,000

TR202102	Safety Evaluation of Flashing Yellow Left-Turn Arrows in Missouri	\$45,000
TR202103	Lightweight Deflectometer (LWD) for Acceptance of Unbound Materials	\$40,000
TR202105	Airport Design/Build Bid Documents	\$20,000
TTAPT001	Local Technical Transfer Assistance Program (LTAP)	\$300,000
TR202018	FY20 009 MoSTIC LTAP Safety Circuit Rider 2020	\$55,291
TR202106	MoSTIC LTAP Safety Circuit Rider 2021	\$4,709
TT200701	National Highway Institute (NHI)	\$40,000
TTAPT001	BEAP and TEAP	\$157,500
	Total	\$3,689,977

Pooled Funds

TPF-5(255)	Highway Safety Manual	\$0
TPF-5(305)	ME Design	\$0
TPF-5(316) / TPF(447)	Traffic Control Device (TCD) Consortium	\$25,000
TPF-5(317)	Evaluation of Low-Cost Safety Improvements	\$5,000
TPF-5(319)	Transportation Management Center Pooled Fund Study	\$25,000
TPF-5(334)	Enhancement to the Intelligent Construction Data Management (Veta) and Implementation	\$0
TPF-5(341) / solic. 1531	National Road Research Alliance (NRRRA)	\$150,000
TPF-5(343)	Roadside Safety Research for MASH Implementation	\$50,000
TPF-5(353)	Clear Roads Phase II	\$25,000
TPF-5(357)	Connecting the DOTs: Implementing ShakeCast Across Multiple State Departments of Transportation for Rapid Post-Earthquake Response	\$0
TPF-5(375)	MnROAD/MCAT Joint Study Phase II	\$0
TPF-5(396)	Mid-America Freight Coalition (MAFC) Phase 3	\$37,000
TPF-5(430)	Midwest Roadside Safety Pooled Fund Program	\$65,000
TPF-5(435)	Aurora Program (FY20-FY24)	\$25,000
TPF-5(437)	Technology Transfer Concrete Consortium (FY20-FY24)	\$8,000
TPF-5(438)	Smart WZ (FY20-FY24)	\$50,000
TPF-5(441)	No Boundaries Transportation Maintenance Innovations	\$10,000
TPF-5(442)	Transportation Research and Connectivity (librarian toolkit / knowledge networking / information condition / analysis of resources / digitization efforts / ADA support)	\$25,000
TPF-5(443)	Continuous Asphalt Mixture Compaction Assessment using Density Profiling System (DPS)	\$25,000
TPF-5(448)	Integrating Construction Practices and Weather Into Freeze Thaw Specifications	\$20,000
Solicitation 1481	Full-Scale Accelerated Load Testing of RCC Pavements	\$40,000
Solicitation 1499	Determining the in-place strength of concrete using piezoelectric based sensors	\$25,000
Solicitation 1507	Flood-frequency analysis in the Midwest: Addressing potential nonstationary annual peak-flow records	\$55,600

Solicitation 1527	Hydrologic and Hydraulic Software Enhancements (SMS, WMS, Hydraulic Toolbox, and HY-8)	\$20,000
Solicitation 1530	Research Project Tracking System	\$3,500
Solicitation 1533	Consortium for Asphalt Pavement Research and Implementation (CAPRI)	\$14,000
	Pooled Fund Contingency	\$66,900
	Total Pooled Funds	\$770,000
	TRB Core Subscription estimate	\$184,700
	NCHRP FY2021 estimate	\$1,134,000
	Total	\$2,088,700

Administration – SPR21ADS

Estimated Cost - \$326,569

TAyy6601 - Research Administration

Project Type: Contracts Other

MoDOT Contact: Jen Harper

Total Contract Amount: \$326,569

Contract Period: 7/1/1966 to 6/30/2021

Funding: SPR 80%, State 20%

Project Description and Objectives:

Research administration is a funding source for the administration of research activities. This includes office support such as phone, supplies, and office equipment. The type of project is "contract other" because project work will include contract management. The purpose of this item is to provide funds for the development and monitoring of a program designed to meet the research needs of the Missouri Department of Transportation.

Proposed Activities for SFY 2021:

The salary and expenses of the Research Director, Research Engineer, and Research Analyst will be charged against this item.

SFY 2020 Accomplishments:

The Research Section had 42 active contract research projects and a total of 4 projects were completed at the end of the third quarter. The Research Section also published 9 reports as of June 18, 2020.

Financials

Projected Budget SFY 2021

Amount

\$326,569

Budget Amount SFY 2020

\$244,869

Actual Cost SFY 2020

(See Addendum Sept. 2020)

Prior to SFY 2020 Actual Cost

N/A

Research – SPR21RDS

Estimated Cost - \$2,805,908

TRyyCONT - Research Contingencies

Project Type: Contracts Other

MoDOT Contact: Jen Harper

Total Contract Amount: \$388,327

Contract Period: 7/1/2018 to 6/30/2021

Contract Investigator: N/A

Funding: SPR 80%, State 20%

Project Description and Objectives:

Research and development contingencies are funds for unanticipated costs on current or new activities. These funds are for proposed research projects that are in the initiation stage and for unanticipated projects during the year. The type of project is "Contract Other" because project funded work will include contract management and contract expenditures.

Proposed Activities for SFY 2021:

In addition to funds for unanticipated costs on current or ongoing activities, funds have been included for studies that may be initiated during State Fiscal Year 2021. These include administrative and other eligible costs.

SFY 2020 Accomplishments:

20 new projects were approved for funding in Fiscal Year 2020.

TR201909 HFST Before and After Safety Analysis

TR202005 Evaluation of Alternatives to Calcined Bauxite for HFST

TR202006 Transportation Infrastructure Asset Monitoring through the Industrial Internet-of-Things

TR202007 Geotechnical Asset Management of NW and NE

TR202008 Wireless Crack Sensing

TR202009 Optimizing Work Zone Zipper Merge Operations Using Driving Simulations

TR202010 Missouri Systemic Countermeasures to Improve Pedestrian Safety

TR202012 Evaluation of MO Bridge Inventory for Effective Service Life

TR202013 The Effect of Rubber Fills on the Performance of Infrastructure Phase 1

TR202014 Impact Factor for Winter Severity Indices

TR202015 Using Thermal Integrity Profiling for Detecting Defects in Drilled Shafts

TR202016 Monitoring an Active Landslide on Route 465 Near Branson

TR202017 Scour Analysis at Missouri Bridges

TR202018 FY20 009 MoSTIC LTAP Safety Circuit Rider 2020

TR202019 Fiber-Reinforced Concrete with Adapted Rheology for Bridge Construction and Rehabilitation

TR202020 Evaluation of Recycled Components in SMA Mixes

TR202021 Consultant Support for IC and PMTP Projects in 2020-2021

TR202022 Performance Prediction for Recycled Asphalt Mixtures in Missouri

TR202023 Predictive Deep Learning for Flash Flood Management

TR202024 Performance of Wicking Geotextile (H2Ri) to Mitigate Pavement Pumping - Phase 2

TR202025 MCTI Administration

Financials**Amount**

Projected Budget SFY 2021	\$388,327
Budget Amount SFY 2020	\$881,812
Adjusted Budget Amount SFY 2020	\$0
Actual Cost SFY 2020	(See Addendum Sept. 2020)
Prior to SFY 2020 Actual Cost	N/A

TR201313 - Secretary of State Library MOU**Project Type:** Contract Research**MoDOT Contact:** Jen Harper**Total Contract Amount:** N/A**Contract Period:** 7/1/2013 to 6/30/2021**Contract Investigator:** Waheedah Bilal**Funding:** SPR 80%, State 20%**Project Description and Objectives:**

MoDOT has established a library to serve employees, researchers and industry partners. This library contains materials (hardcopy and electronic) that are catalogued according to current national bibliographic standards. MoDOT and the Secretary of State Library have executed a Memorandum of Understanding that outlines the responsibilities of each organization. MoDOT and the Secretary of State Library agree to maintain the MoDOT library collection at the Missouri State Library. The library holdings will be included in the state library's integrated online library catalog. The bibliographic records in the MoDOT library collection will be included in the statewide MOBIUS catalog to facilitate resource sharing.

Proposed Activities for SFY 2021:

It is expected that the SFY 2021 invoice will be received and sent for payment during the first quarter.

SFY 2020 Accomplishments:

The 2020 MOU was executed by MoDOT on August 23, 2019. The invoice for the amount of \$5,343.50 was processed on August 26, 2019. The MOU for SFY 2021 is currently in the process of being executed.

Financials**Amount**

Projected Budget SFY 2021	\$5,300
Budget Amount SFY 2020	\$5,344
Actual Cost SFY 2020	(See Addendum Sept. 2020)
Prior to SFY 2020 Actual Cost	N/A

TR201522 - MoDOT Customer Satisfaction Tracking Survey-Completed**Project Type:** Contract Research**MoDOT Contact:** Jen Harper**Total Contract Amount:** \$152,948**Contract Period:** 3/4/2015 to 1/31/2020**Contract Investigator:** Lance Gentry

Funding: SPR 80%, State 20%

Project Description and Objectives:

This study evaluates MoDOT customer satisfaction through use of a customer survey. This survey will be conducted quarterly to evaluate MoDOT's overall satisfaction. The Right Transportation Survey (RTS) will be conducted once under this contract.

Proposed Activities for SFY 2021:

This project was determined not to be eligible for SPR Part B funds under new guidance from FHWA. The next contract will be administered through another division with their own funding.

SFY 2020 Accomplishments:

A quarterly report was provided for the Customer Relations Tracker measure reflecting the three months of each quarter. In addition, during each month, approximately 200 people who contacted MoDOT the previous month were surveyed by phone about their experience along with online surveys being distributed to those who provided an email address. A summary report was provided to MoDOT each month.

Financials

	<u>Amount</u>
Projected Budget SFY 2021	\$0
Budget Amount SFY 2020	\$13,087
Actual Cost SFY 2020	(See Addendum Sept. 2020)
Prior to SFY 2020 Actual Cost	\$139,861

TR201609 - MEPDG Local Calibration-Completed

Project Type: Contract Research

MoDOT Contact: Jen Harper

Total Contract Amount: \$254,950

Contract Period: 3/2/2016 to 3/30/2019

Contract Investigator: Chetana Rao

Funding: SPR 80%, State 20%

Project Description and Objectives:

The Missouri Department of Transportation (MoDOT) has always relied on sound engineering for designing new and rehabilitated pavements. The current design approach is the Mechanistic-Empirical Pavement Design Guide (MEPDG), developed under a series of National Cooperative Highway Research Projects (NCHRP). The MEPDG utilizes existing state-of-the-practice mechanistic-based pavement analysis and distress prediction algorithms.

Enough time has elapsed to perform a second local calibration cycle. During this interim period, more performance data has been collected from the original field test sections. In addition, newer models have been introduced to the AASHTO Pavements ME Design Guide software that requires a first local calibration. Greater emphasis will be placed on the rehabilitation models.

Objectives:

- Perform a second local calibration of distress prediction models for existing field test sections.
- Supplement existing test sections with additional rehabilitation pavement sections.

- Perform a first local calibration of newer prediction models in the AASHTO Pavement ME Design Program
- Update the materials database library with contemporary pavement materials properties, including reclaimed materials.
- Fully document the local calibration work, including clear guidance for changing calibration coefficients. Update the user manual. Provide recommendations and precise details of any suggested /incorporated changes.

Proposed Activities for SFY 2021:

This project was completed in FY20.

SFY 2020 Accomplishments:

The rest of the data files were received during the second quarter along with the draft report. The technical advisory panel reviewed the data and final report for acceptance and reviewed the final report. A new draft was sent on March 9, 2020 but needed another full review due to the amount of requested changes. Comments and questions were sent to the researchers on April 20, 2020. The final report was received and accepted on May 26, 2020 and the final invoice posted in June. This project is completed.

Financials

	<u>Amount</u>
Projected Budget SFY 2021	\$0
Budget Amount SFY 2020	\$73,690
Adjusted Budget Amount SFY 2020	\$46,976
Actual Cost SFY 2020	(See Addendum Sept. 2020)
Prior to SFY 2020 Actual Cost	\$207,974

TR201610 - AASHTO Technical Service Program FY20 & FY21

Project Type: Contract Research

MoDOT Contact: Jen Harper

Total Contract Amount: \$330,000

Contract Period: 7/1/2019 to 06/30/2021

Contract Investigator: FHWA

Funding: SPR 100%

Project Description and Objectives:

Each year, the Standing Committee on Highways and the board of directors of American Association of State Highway and Transportation Officials (AASHTO) approves the listing of Technical Service Programs. The type of project is "Contract Other" because the project is to participate in the Technical Service Programs. The purpose of this item is to support continued participation in various AASHTO Technical Service Programs.

Proposed Activities for SFY 2021:

MoDOT's Construction and Materials Division is expected to participate in the following AASHTO Technical Service Programs for Fiscal Year 2021:

- National Transportation Product Evaluation Program (NTPEP), \$20,000.
- AASHTO Innovation Initiative (AII), formerly Technology Implementation Group (TIG), \$6,000.
- Transportation Curriculum Coordination Council (TC3), \$20,000

- Technical Service Program to Develop AASHTO Materials Standards (DAMS), \$10,000.
- Technical Service Program AASHTO Resource (formerly AMRL), \$20,000.

The total amount for SFY2021 for Construction and Materials is \$76,000. Other MoDOT Divisions are participating in various Technical Service Programs that total up to \$89,000 making the total MoDOT TSP commitment \$165,000.

SFY 2020 Accomplishments:

The Construction Materials Division initially approved the funding of four AASHTO Technical Services Programs. These are the NTPEP program (\$20,000), AASHTO Innovation Initiative (\$6,000), Transportation Curriculum Coordination Council (\$20,000) and Technical Service Program to Develop AASHTO Materials Standards (DAMS), \$10,000. In the fall it was found the Construction and Materials was paying for the TSP AASHTO Resource (formerly AMRL) with state funding. After approval from FHWA this \$20,000 was added into this project with funding taken from the Contingency “Project”. The total of \$76,000 was processed for Construction and Materials this state fiscal year. It was found that multimodal is not going to be using SPR funds since they are being reimbursed by FRA. SPR Part B funds for the Technical Service Programs that the other Divisions participate in were also paid in July; these totaled amount for the other divisions is \$89,000.

Financials

	<u>Amount</u>
Projected Budget SFY 2021	\$165,000
Budget Amount SFY 2020	\$155,000
Adjusted Budget Amount SFY 2020	\$165,000
Actual Cost SFY 2020	(See Addendum Sept. 2020)
Prior to SFY 2020 Actual Cost	N/A

TR201720 - Rejuvenating Asphalt Products-Completed

Project Type: Contract Research

MoDOT Contact: Jen Harper

Total Contract Amount: \$283,759

Contract Period: 8/11/17 to 1/31/2020

Contract Investigator: Jay Bledsoe

Funding: SPR 80%, State 20%

Project Description and Objectives:

The objective of this investigation is to provide recommendations for creating a performance-based specification for rejuvenating and surface sealing products that extend asphalt pavement life. The product evaluation will consider the effectiveness of softening the existing asphalt binder, improving the existing rheological properties (less brittle), and decreasing the permeability of the pavement. The product comparisons will outline the pros and cons to include, but not limited to: the testing results, cure time necessary before opening roadway to traffic, daily production rate, material cost, material location, other economical limitations, application rate utilized and blotting materials utilized, if applicable. A field application study will be performed and evaluated by a third-party researcher to provide a report of each product's performance.

Proposed Activities for SFY 2021:

This project was completed in State Fiscal Year 2020,

SFY 2020 Accomplishments:

The final work to be completed in State Fiscal Year 2020 included the reduction of data from the final field data collection activities. A budget modification was made due to additional site visits being needed due to weather. Coronavirus caused issues as people (ARA and MoDOT) adjusted to working remotely. Issues are technical in nature, mostly related to internet access. This delayed delivery of the final report several weeks. The final report was received on May 4, 2020. Due to verbal agreements with the contractors regarding not publishing friction data and lack of data in other areas of the research it was determined, and agreed upon with FHWA, to keep the final report as an internal document. This project is complete.

Financials**Amount**

Projected Budget SFY 2021	\$0
Budget Amount SFY 2020	\$25,610
Adjusted Budget Amount SFY 2020	\$64,617
Actual Cost SFY 2020	(See Addendum Sept. 2020)
Prior to SFY 2020 Actual Cost	\$219,142

TR201724 – MoDOT Report Card Survey-Completed

Project Type: Contract Research

MoDOT Contact: Jen Harper

Total Contract Amount: \$142,010

Contract Period: 4/20/2017 to 12/31/2021

Contract Investigator: Lance Gentry

Funding: SPR 80%, State 20%

Project Description and Objectives:

This project is a statewide evaluation of satisfaction from a general population survey of Missouri adults. Results are reported to MHTC and the Missouri Department of Transportation (MoDOT). Provide a statewide evaluation of satisfaction levels with MoDOT performance from a general population telephone survey of Missouri adults. The survey will be conducted every other year in May in years 2017, 2019, and 2021. MoDOT expects this review to result in reports summarizing the data received by using specified methodology. The results are reported in the July MoDOT Tracker.

Proposed Activities for SFY 2021:

This project was determined to no longer be eligible for SPR Part B funds under new guidance from FHWA. The last report card survey in this contract will be administered and paid by Transportation Planning.

SFY 2020 Accomplishments:

Data collection was completed on July 31, 2019. The raw data and unweighted topline results were provided to MoDOT on August 1. Heartland provided a final report to MoDOT on September 23, 2019. Heartland also provided unweighted results by district to MoDOT on September 21, 2019. The final report was submitted in October 2019. The findings were presented to the Commission in January and then published on the website.

Financials**Amount**

Projected Budget SFY 2021	\$0
Budget Amount SFY 2020	\$32,155

Actual Cost SFY 2020
Prior to SFY 2020 Actual Cost

(See Addendum Sept. 2020)
\$109,855

TR201806 - Performance-Based Specifications of Fiber-Reinforced Concrete to Enhance Performance and Reduce Steel-Reinforcement in Structural Members-Completed

Project Type: Contract Research
MoDOT Contact: Jen Harper
Total Contract Amount: \$89,999
Contract Period: 12/1/2017 to 5/1/2020
Contract Investigator: Kamal Khayat
Funding: SPR 80%, State 20%

Project Description and Objectives:

The project aims at evaluating the combined effect of calcium oxide-based EA (CaO-based), LWA, and fiber content under different moist-curing regimes on restrained shrinkage, mechanical properties, frost durability, transport properties, and corrosion resistance of Eco high-performance concrete (Eco-HPC) targeted for bridge applications (Eco-Bridge-Crete). It has also been recognized that the FR-SWC can be produced using EA and various types of fibers. Proper use of fibers was shown to increase flexural strength and flexural toughness in monolith beams cast using FRC vs. those cast using regular concrete. As such, the incorporation of fibers can replace a portion of the steel reinforcement bars and obtaining same flexural strength, and even associated improve in toughness and crack resistance for the enhancement of resilience.

Proposed Activities for SFY 2021:

This project was completed in State Fiscal Year 2020.

SFY 2020 Accomplishments:

The final testing was completed during the first few quarters of the state fiscal year. Work began on the final report around January. The draft report was submitted on March 11th. MoDOT reviewed the report and sent back comments on April 29, 2020. The final report was received on May 26, 2020 and the final invoice was paid in June. This project is completed.

Financials

	<u>Amount</u>
Projected Budget SFY 2021	\$0
Budget Amount SFY 2020	\$4,796
Actual Cost SFY 2020	(See Addendum Sept. 2020)
Prior to SFY 2020 Actual Cost	\$85,203

TR201807 - Understanding and Improving Heterogeneous, Modern Recycled Asphalt Mixes

Project Type: Contract Research
MoDOT Contact: Jen Harper
Total Contract Amount: \$543,534
Contract Period: 3/1/2018 to 2/28/2021
Contract Investigator: Bill Butler
Funding: SPR 80%, State 20%

Project Description and Objectives:

The research goal will be to focus on high-type mixes (MoDOT Sec. 403 mixes), although findings will provide useful insight for all asphalt mixes used in Missouri. A comprehensive suite of binder and mixture tests will be carried out in order to link mix designs and materials to eventual field performance (rutting, cracking, and moisture damage predictions). This project will allow us to evaluate the potential performance of modern crumb rubber mixes, RAP and RAS mixtures, and rejuvenators in Missouri.

Proposed Activities for SFY 2021:

The project was scheduled to be completed in State Fiscal Year 2020. Due to some delays in the exchange of data between the two universities and then delay due to lab closures with COVID-19 a no-cost extension was granted through February 28, 2021. The work still to be completed is the extraction and recover of the binder from the final field cores and lab samples. Once that is completed work will begin on the final results and reporting.

SFY 2020 Accomplishments:

Six sections were selected for running performance tests on the field cores. Three sets of the field cores were from cracked sections, and the other field cores were extracted from good performing sections. The field cores were cut and prepared for DC(T), SCB (i_Fit) and Hamburg tests. Field performance data for the sections such as IRI, condition (PASER) and rut depth were extracted from the MoDOT TMS system. The S&T team finished extraction and recovery testing for the second field core batch during the second quarter and began work on the third and final set the third quarter. As expected, a wide range of binder properties is noted for these sections with different recycling types and amounts, different age, location and field performance. A contract extension was granted, and the new end date is February 28, 2021.

Financials

	<u>Amount</u>
Projected Budget SFY 2021	\$52,650
Budget Amount SFY 2020	\$164,691
Adjusted Budget Amount SFY 2020	\$112,041
Actual Cost SFY 2020	(See Addendum Sept. 2020)
Prior to SFY 2020 Actual Cost	\$378,843

TR201809 – Assessment and Repair of Corroded Steel H-Piles-Time Extension

Project Type: Contract Research

MoDOT Contact: Jen Harper

Total Contract Amount: \$227,498

Contract Period: 12/1/2017 to 12/1/2020

Contract Investigator: Mohamed ElGawady

Funding: SPR 80%, State 20%

Project Description and Objectives:

The overarching objective of this research is to develop efficient, accelerated, and sustainable techniques for repairing H-piles to restore their initial axial capacities. The corrosion will be simulated by milling the flanges and/or webs of the H-piles. For a severely corroded pile, the reduced section dimensions will be accompanied by a void in the web and/or cuts in the flanges. The piles will be repaired using pultruded fiber reinforced polymer (FRP) sections, ultra-high-performance concrete (UHPC) sections, and FRP wrapping.

Proposed Activities for SFY 2021:

This project was scheduled to be completed in all but possibly the final invoice during State Fiscal Year 2020. However the lab closure due to COVID-19 has delayed the project. The new date for the draft report is due September 1st and the final report November 1st.

SFY 2020 Accomplishments:

Most of the testing was completed in SFY 2020. These tests included compression and bending tests and optimization of the shape of the UHPC thin plate repair. Durability testing was being carried out when the lab closures occurred due to COVID-19. Students were allowed minimal access in order to check on the salinity of the water in the environmental tanks, but all other work was halted. A time extension was executed, and the new end date is December 1, 2020.

Financials

	<u>Amount</u>
Projected Budget SFY 2021	\$20,595
Budget Amount SFY 2020	\$100,000
Adjusted Budget Amount SFY 2020	\$108,974
Actual Cost SFY 2020	(See Addendum Sept. 2020)
Prior to SFY 2020 Actual Cost	\$97,929

TR201811 - Support for Balanced Asphalt Mixture Design Specification Development in Missouri

Project Type: Contract Research

MoDOT Contact: Jen Harper

Total Contract Amount: \$283,609

Contract Period: 5/18/2017 to 6/30/2020

Contract Investigator: Bill Butler

Funding: SPR 80%, State 20%

Project Description and Objectives:

The project is being developed to mix performance tests to supplement volumetric mix design and the PG binder specification, and there is currently a national movement to rectify that shortcoming. Advances in fundamental and torture-type asphalt mixture tests, particularly those related to crack control, have become more prevalent in the past decade. However, states are just now beginning to implement these new tests into specifications for asphalt mixture design, control, and acceptance. The first step in this path usually involves the introduction of tests for the mixture design stage.

Proposed Activities for SFY 2021:

It is anticipated all but the final invoice will occur in State Fiscal Year 2020.

SFY 2020 Accomplishments:

Field coring for six sections was carried out during the summer of 2019. From MoDOT's TMS database, performance data of IRI, Rut, and Condition (PASER) were extracted for the sections cored. The research team worked with MoDOT and industry on current balanced mix design specifications and what changes should be made. The draft final report was submitted on June 8, 2020. The research team reviewed the report and will submit comments back to the research team by the end of June.

Financials

	<u>Amount</u>
Projected Budget SFY 2021	\$1,826
Budget Amount SFY 2020	\$24,476

Adjusted Budget Amount SFY 2020	\$22,650
Actual Cost SFY 2020	(See Addendum Sept. 2020)
Prior to SFY 2020 Actual Cost	\$259,133

TR201813 - Leader-Follower TMA System

Project Type: Contract Research
MoDOT Contact: Jen Harper
Total Contract Amount: \$549,921
Contract Period: 3/5/2018 to 3/16/2020
Contract Investigator: Jay Rhoades
Funding: SPR 80%, State 20%

Project Description and Objectives:

MoDOT's mobile and slow-moving operations, such as striping, sweeping, bridge flushing and pothole patching, are critical for efficient and safe operation of the highway transportation system. MoDOT's slow moving operations have been crashed into over 80 times since 2013 resulting in many injuries to MoDOT employees. The objective of this RFP is to provide a NCHRP 350 Level 3 compliant Leader-Follower TMA System capable of operating a driverless rear advanced warning truck in mobile highway operations as described in Traffic Application TA-35a. The system shall consist of a Lead Truck (LT) and a Rear Advanced Warning Truck called the Follow Truck (FT). The goal is to avoid operator injury by eliminating the need for a human operator in the FT.

Proposed Activities for SFY 2021:

It was anticipated a majority of the 250-hour testing in a live mobile work zone would take place in State Fiscal Year 2020. However, issues with the equipment in early fall caused the testing to be pushed into spring. This spring before testing could begin COVID-19 hit which required Social Distancing measures from employees so two employees could not be in the lead truck as required. Once the social distancing restrictions are lifted a new timeline will be determined.

SFY 2020 Accomplishments:

The Kratos Team collaborated with the GPS supplier to update and validate a technical solution to resolve reported GPS denied anomalies. September 16-20 the Kratos team provided on-site support. They upgraded the radio detection and ranging and LIDAR systems to improve obstacle detection performance. They also upgraded the hardware and software for the GPS denied issues. Testing took place during the early part of the quarter while the weather allowed striping to occur. It was anticipated that the rest of the 250 hours testing would begin again during spring striping season. However due to COVID-19 the testing was postponed. The department policy on social distancing requires that only one person is in a truck unless absolutely necessary. For the Leader-Follower system it requires two people in the lead vehicle. Once the social distancing requirements are lifted a new timeline will be developed.

Financials

	<u>Amount</u>
Projected Budget SFY 2021	\$357,449
Budget Amount SFY 2020	\$357,449
Adjusted Budget Amount SFY 2020	\$0
Actual Cost SFY 2020	(See Addendum Sept. 2020)
Prior to SFY 2020 Actual Cost	\$192,472

TR201814 - Leader-Follower TMA System Misc. Expenses**Project Type:** Contract Research**MoDOT Contact:** Jen Harper**Total Contract Amount:** \$50,000**Contract Period:** 3/5/2018 to 3/16/2020**Contract Investigator:** N/A**Funding:** SPR 80%, State 20%**Project Description and Objectives:**

This project is set up for the miscellaneous expenses for the Leader-Follower truck project that are not part of the contract. Items such as shipping of the trucks to the contractor would fall under this project number.

Proposed Activities for SFY 2021:

It is unclear if additional miscellaneous expenses will be required for State Fiscal Year 2021.

SFY 2020 Accomplishments:

No miscellaneous expenses have occurred at the time this report was written.

Financials

	<u>Amount</u>
Projected Budget SFY 2021	\$36,844
Budget Amount SFY 2020	\$16,664
Adjusted Budget Amount SFY 2020	\$0
Actual Cost SFY 2020	(See Addendum Sept. 2020)
Prior to SFY 2020 Actual Cost	\$13,156

TR201901 – Work Zone Inspection Training using Enhanced Visualization Technology-Completed**Project Type:** Contract Research**MoDOT Contact:** Jen Harper**Total Contract Amount:** \$106,265**Contract Period:** 9/1/2018 to 2/29/2020**Contract Investigator:** Praveen Edara**Funding:** SPR 80%, State 20%**Project Description and Objectives:**

MoDOT engineers inspect all work zones in one or more districts each year. This annual exercise is demanding as each work zone is inspected and rated based on several factors. A rating value is assigned for each factor based on discrepancies and deficiencies. The inspection team, typically consisting of 4 to 5 personnel, compiles the ratings for all work zones operational in the district, prepares a summary, and presents the findings to the district management. Personnel on the inspection team need to be familiar with the inspection worksheet and the different evaluation categories. They need to also be familiar with the typical applications (TA) for different facilities and work activities. This project will develop a work zone inspection training module for MoDOT engineers. The module will consist of two steps. The first step is a learning routine which will be founded on the historical knowledge gained by MoDOT staff from inspections dating back at least 10 years. The second step is an immersive routine that will place the personnel in a virtual work zone and observe their performance and provide feedback.

Proposed Activities for SFY 2021:

This project was completed in State Fiscal Year 2020.

SFY 2020 Accomplishments:

Work on the flagger scenario was near completion during the first quarter. There were some delays in getting feedback on the videos, so a no-cost time extension was given. The draft report was submitted November 19, 2019. The technical advisory team reviewed the report and comments were sent back to the researchers on December 30th. The final deliverables were submitted on March 12, 2020. The final invoice was processed on April 22, 2020. This project is completed. FHWA's Accelerated Market Readiness Program invited the research team to submit a full proposal in partnership with MoDOT on extending the scenarios to 10. The full proposal was submitted in September and is currently in review.

Financials**Amount**

Projected Budget SFY 2021	\$0
Budget Amount SFY 2020	\$38,172
Actual Cost SFY 2020	(See Addendum Sept. 2020)
Prior to SFY 2020 Actual Cost	\$68,093

TR201902 – IC-IR Consultant Contract-Phase 3-Completed

Project Type: Contract Research

MoDOT Contact: Jen Harper

Total Contract Amount: \$199,852

Contract Period: 7/1/2018 to 1/31/2020

Contract Investigator: George Chang

Funding: SPR 80%, State 20%

Project Description and Objectives:

This project provides consultant support for approximately 25 MoDOT projects for the 2019 construction season. The consultant has developed and lead contractor Intelligent Compaction (IC) and Infrared (IR) training for MoDOT projects in previous years. This current research project will provide training, data and field support for each of the IC-IR MoDOT Asphalt Projects constructed in 2019.

Proposed Activities for SFY 2021:

This project was completed in State Fiscal Year 2020.

SFY 2020 Accomplishments:

The project team continued supporting IC-IR projects either remotely or onsite during the 2019 construction season. On August 26, 2019 the research team came to Missouri to demonstrate new Voegle RoadScan and HAMM technology. The technology was used on a MoDOT project in the Northeast District for a week. The final IC-IR feedback meeting and executive briefing was held on December 18th and 19th, 2019. On December 18, MoDOT and the research team met with MoDOT construction staff, contractors, and suppliers on the past progress of IC-IR and the steps moving forward. On December 19, the research team and MoDOT Construction and Materials met with the MoDOT Deputy Director/Chief Engineer and Assistant Chief Engineer to brief them on the current status and discuss possible future implementation. The project team submitted the final report at the end of January. MoDOT reviewed the report and sent back comments a few weeks later. The final report was published on MoDOT's website. The company names were redacted for the published version.

Financials

	<u>Amount</u>
Projected Budget SFY 2021	\$0
Budget Amount SFY 2020	\$112,182
Actual Cost SFY 2020	(See Addendum Sept. 2020)
Prior to SFY 2020 Actual Cost	\$87,670

TR201904 – Compacted Concrete Pavement-SE District**Project Type:** Contract Research**MoDOT Contact:** Jen Harper**Total Contract Amount:** \$125,000**Contract Period:** 9/28/2018 to 12/31/2021**Contract Investigator:** Kamal Khayat**Funding:** SPR 80%, State 20%**Project Description and Objectives:**

In order to assess the construction issues and characterize the long-term performance of Compacted Concrete Pavement (CCP), three CCP test sections made with and without fiber will be part of a larger project constructed in Scott County, Missouri. The test section pavement will be designed and tested. The project objective is to determine the performance of designed CCP mixtures given special design features and durability of surface texture through field implementation and detailed laboratory testing. The primary performance characteristics include mechanical properties, drying shrinkage, durability, optimum joint spacing, and enhancement of joint load transfer gained from fiber-reinforcement of the pavement.

Proposed Activities for SFY 2021:

State Fiscal Year 2021 will be devoted to finishing the testing of the samples and monitoring readings from the test site. Assuming the delays due to COVID-19 travel restrictions and testing do not affect the overall timeline of the project; work will begin in the fall of CY2021 to develop the final deliverables.

SFY 2020 Accomplishments:

During the first quarter of State Fiscal Year 2020, samples extracted from the compacted concrete pavement (CCP) were tested, and in-situ deformation of concrete cells using various embedded sensors were analyzed. The cells were designed with different panel sizes and were cast with and without structural synthetic macro fibers. The date of 3/16/2020 was arranged by the team of Missouri S&T, MoDOT and MnDOT to conduct the truck loading test, FWD, and curling and warping measurement in Scott City, MO. However, the operation was postponed due to the unprecedented situation of coronavirus and the associated travel restrictions.

Financials

	<u>Amount</u>
Projected Budget SFY 2022	\$15,000
Projected Budget SFY 2021	\$30,504
Budget Amount SFY 2020	\$82,365
Adjusted Budget Amount SFY 2020	\$61,861
Actual Cost SFY 2020	(See Addendum Sept. 2020)
Prior to SFY 2020 Actual Cost	\$17,635

TR201905 – Use of H2Ri to Mitigate Pumping in Concrete Pavement Shoulder - Completed**Project Type:** Contract Research**MoDOT Contact:** Jen Harper**Total Contract Amount:** \$37,403**Contract Period:** 9/28/2018 to 1/31/2020**Contract Investigator:** Xiong Zhang**Funding:** SPR 80%, State 20%**Project Description and Objectives:**

Pumping is one of the major factors contributing toward concrete pavement slab failures. It is believed that drainage issues are the major cause of severe pumping and failure of PCC slabs because water and fine materials are observed to be ejected out through the joints. In recent years, a new type of wicking fabric (H2Ri) was developed by TenCate Geosynthetics to remove the excess water in the pavement structure and potentially maintain good pavement performance and longevity. By installing a layer of wicking fabric horizontally beneath the road shoulder, the excess water in the pavement structure can be absorbed from the soils, transported along the wicking fabric to the slope, and vaporized to the surrounding atmosphere which has much higher suction. A full depth shoulder replacement project at Milepost 115.9 on I-44 will be used as a field test section to test the effectiveness of the H2Ri wicking fabric in mitigating pumping of concrete shoulders. Three test sections will be constructed and instrumented. Laboratory testing will also be conducted as part of the project.

Proposed Activities for SFY 2021:

This project was completed in State Fiscal Year 2020. A follow-up project was developed to continue field monitoring for an additional two years. This work will be done in contract TR202024.

SFY 2020 Accomplishments:

A last site visit took place in early fall. The final report was submitted in early November but was not written well enough to be accepted. The report was sent back to the PI to be edited. The draft report was resubmitted in late January and reviewed by the technical advisory group. Comments and edits were incorporated into the final report, which was delivered and subsequently published on March 1st. The final invoice was received on April 30, 2020 and posted May 1, 2020. This project is completed. The researcher is working with MoDOT to set up a second phase of the project for 2 years of monitoring. This project is TR202024.

Financials

	<u>Amount</u>
Projected Budget SFY 2021	\$0
Budget Amount SFY 2020	\$37,403
Adjusted Budget Amount SFY 2020	\$31,098
Actual Cost SFY 2020	(See Addendum Sept. 2020)
Prior to SFY 2020 Actual Cost	\$6,305

TR201908 – Highway Safety Manual Training-Completed**Project Type:** Contract Research**MoDOT Contact:** Jen Harper**Total Contract Amount:** \$100,000**Contract Period:** 1/1/2019 to 5/31/2019**Contract Investigator:** Carlos Sun

Funding: SPR 80%, State 20%

Project Description and Objectives:

Missouri has been one of the 12 lead states in improving transportation safety analysis nationwide and promoting the use of the national Highway Safety Manual (HSM). The research team previously completed multiple research projects with MoDOT to develop calibration factors specific to Missouri. The goal of this project is to produce a training framework so that HSM training can be provided to a wide range of users on a regular basis. This framework involves two main components: 1) practitioner-friendly material that is relevant to Missouri and 2) a system to train trainers. This project seeks to produce training materials that can be used with a wide variety of delivery methods such as in person workshops, remotely delivered workshops, and online modules. Missouri examples will be used in all training modules. The data will be obtained from MoDOT Transportation Management Systems (TMS), MoDOT districts, and aerial photographs.

Proposed Activities for SFY 2021:

It is anticipated this project will be completed in State Fiscal Year 2020.

SFY 2020 Accomplishments:

The PIs continued to develop the training framework and methodology during the first quarter of SFY 2020. Various tools (e.g., Camtasia, Panopto) were explored for the online training module. Two separate trainings were developed. The overview training is utilizing online learning technologies, while the advanced training is focused mostly on in person delivery. Learning technology tools were designed into the training modules. A no-cost time extension was requested and approved in October. The draft report, training materials, and video were submitted at the end of February. The technical advisory panel reviewed the deliverables and provided feedback to the research team. The final versions were delivered April 25, 2020 and were accepted. The final invoice was paid in June.

Financials

	<u>Amount</u>
Projected Budget SFY 2021	\$0
Budget Amount SFY 2020	\$46,729
Actual Cost SFY 2020	(See Addendum Sept. 2020)
Prior to SFY 2020 Actual Cost	\$53,271

TR201909 – HFST Before and After Safety Analysis

Project Type: Contract Research

MoDOT Contact: Brent Schulte

Total Contract Amount: \$100,000

Contract Period: 11/1/2019 to 3/4/2021

Contract Investigator: Jay Bledsoe

Funding: SPR 80%, State 20%

Project Description and Objectives:

MoDOT has been using HFST to improve or restore surface friction since 2013 in different locations such as wet crash locations, sharp curves and variable elevations. The objective of this study is to review and evaluate the effectiveness of existing and future High Friction Surface Treatment applications used in Missouri. The contractor will evaluate HFST projects in terms of performance, durability and impact on safety.

Proposed Activities for SFY 2021:

Final processing of data will take place in the first 4 months of State Fiscal Year 2021. The draft of the final report is due on November 15, 2020 and the final report is due January 4, 2021.

SFY 2020 Accomplishments:

The project RFP was posted on July 31, 2019. The project was awarded to Applied Research Associates and, the contract was executed on October 30, 2019. The research team developed databases to collect before and after data for the crash analysis. To make sure the locations were accurate, video was reviewed for all sections and coordinates established where possible. With internet issues and a slowdown of the ARAN video due to the number of people working remotely, this was an issue, however ARA does not anticipate it will have an impact on the final delivery dates or budget.

Financials

	<u>Amount</u>
Projected Budget SFY 2021	\$95,262
Budget Amount SFY 2020	\$4,738
Actual Cost SFY 2020	(See Addendum Sept. 2020)
Prior to SFY 2020 Actual Cost	\$0

TR201911 – Inlaid Pavement Marking Evaluation

Project Type: Contract Research

MoDOT Contact: Jen Harper

Total Contract Amount: \$120,000

Contract Period: 3/15/2019 to 6/30/2020

Contract Investigator: Carmine Dwyer and Jay Bledsoe

Funding: SPR 80%, State 20%

Project Description and Objectives:

Over the past three decades, MoDOT has tried multiple strategies to provide and improve wet nighttime guidance on its major routes, culminating in the current use of ASTM Type III glass beads on all lines on MoDOT's major roadways. Before the implementation of the Type III bead system, MoDOT's St. Louis District began experimenting with inlaid pavement markers (IPMs); however, to date, a complete evaluation of their effectiveness and life cycle cost has not been performed. Before moving forward with further implementation plans for IPMs, the performance and effectiveness of these devices needs to be determined in order to establish a statewide direction for the use of these devices. The objective of this study is to determine the benefits of IPMs on Missouri roadways considering our current wet reflective pavement marking system. It is believed IPMs will provide added benefit in certain locations; however, there is a question regarding the accuracy of national crash modification factors (CMFs) as they apply to Missouri's roadways. It is assumed these CMFs were established based on IPM applications with standard pavement markings.

Proposed Activities for SFY 2021:

This project should be completed in State Fiscal Year 2020 except possibly the final invoice.

SFY 2020 Accomplishments:

Identifying the exact locations (beginning and end points) and the installation dates of the IPM sections for this study took longer than expected, but with the use of videos recorded for many of the sections, the final list of sections was defined and agreed upon during the first quarter of the state fiscal year.

The naive before/after crash analysis for CMF development was completed, and a draft report was submitted on October 8. The report also included a recommendation to proceed with the full Empirical Bayes (EB) methodology for CMF development. The technical review committee reviewed the report; no edits were requested; and approval was given to proceed with the EB analysis. ARA's analysis of the IPM count data files from the Mobile Retroreflector Unit (MRU) survey was completed during the third quarter. The next phase of the IPM performance analysis requires viewing and comparing the markers from night-time videos previously recorded, which are difficult to access while employees are working remotely. Therefore, work on the IPM performance assessment was delayed. The research team is still hoping to complete the reporting during State Fiscal Year 2020.

Financials

	<u>Amount</u>
Projected Budget SFY 2021	\$27,150
Budget Amount SFY 2020	\$109,739
Adjusted Budget Amount SFY 2020	\$82,589
Actual Cost SFY 2020	(See Addendum Sept. 2020)
Prior to SFY 2020 Actual Cost	\$10,261

TR201912 – Predictive Deep Learning for Flood Evacuation Planning and Routing - Completed

Project Type: Contract Research

MoDOT Contact: Jen Harper

Total Contract Amount: \$86,548

Contract Period: 2/8/2019 to 12/31/2019

Contract Investigator: Suzi Long

Funding: SPR 80%, State 20%

Project Description and Objectives:

Although Departments of Transportation have detailed safety and disaster planning response documents in place, these plans have limited effectiveness for flash flood scenarios resulting from higher than average rainfalls or other unexpected conditions impacting roadways and roadway infrastructure along river basins. The lack of real-time rate of water rise information can prevent effective evacuation or detour routing before rising flood waters overtop impacted routes. This proposed research uses deep learning methods, along with geospatial data from the USGS National Map and other public geospatial data sources, to develop forecasting tools capable of assessing water level rate of change in high risk flood areas. These tools build on existing models developed by the USGS, FEMA, and others and are used to determine evacuation routing and detours to mitigate the potential for loss of life during flash floods. The project scope includes analysis of publicly available flood data along a river basin as part of a pilot project in Missouri.

Proposed Activities for SFY 2021:

This project was completed in State Fiscal Year 2020.

SFY 2020 Accomplishments:

The draft report was received November 12, 2019. The technical advisory team reviewed the report and sent back comments at the end of December. The Final report was received on December 31, 2019. The final invoice was paid on Feb 24, 2020. This project is completed.

Financials

	<u>Amount</u>
Projected Budget SFY 2021	\$0

Budget Amount SFY 2020	\$36,501
Actual Cost SFY 2020	(See Addendum Sept. 2020)
Prior to SFY 2020 Actual Cost	\$50,047

TR201918 – Flood Inundation Maps to Support Flood Warning for Dardenne Creek-Completed

Project Type: Contract Research

MoDOT Contact: Jen Harper

Total Contract Amount: \$20,000

Contract Period: 5/1/2019 to 5/31/2020

Contract Investigator: USGS

Funding: SPR 80%, State 20%

Project Description and Objectives:

The proposed work will address the lack of flood warning information along Dardenne Creek in St. Charles County, Missouri. Existing USGS stream gage locations at Highway K near O’Fallon, Missouri, and Main Street at Old Town St. Peters, Missouri, can serve as NWS forecast points and developed flood-inundation maps could provide corresponding information on the areas of inundation at various water levels that can be used in providing flood warning, flood prevention and future mitigation, and rescue efforts. The flood-inundation maps will be tied to real-time data from the USGS stream flow gages, flood forecast information, and delivered to the public via the Internet. The maps will be created by the USGS and will depict the approximate area that would be inundated at selected water levels in increments of 1 to 2 feet referenced to both Dardenne Creek stream gages, ranging from the NWS defined “Action Stage” near the top of the bank to the maximum observed water level at the estimated annual exceedance probability of 0.2 percent (e.g. 500-year flood).

Proposed Activities for SFY 2021:

This project was completed in State Fiscal Year 2020.

SFY 2020 Accomplishments:

USGS updated the current hydraulic model to include 2019 conditions by adding six bridges, removing one bridge from the model that no longer exists, and obtaining updated bridge cross section geometry at all bridge openings and at the location of the removed bridge. USGS incorporated flood plain land use changes into the model by modifying and refining the roughness coefficients at all cross sections. This was done to calibrate the model to the two USGS stream gage readings. USGS has also developed flood-inundation maps depicting backwater flooding in Dardenne Creek from the Mississippi River. USGS used the new models to generate flood-inundation maps at 2 ft intervals along Dardenne Creek at 6 Mississippi River backwater conditions ranging from no effect from the Mississippi up to major flood stage on the Mississippi. Map results are presented using dual slider bars to control both the Dardenne Creek and Mississippi River water levels. USGS hosted a webinar on June 15, 2020 to present the results and the tool.

Financials

	<u>Amount</u>
Projected Budget SFY 2021	\$0
Budget Amount SFY 2020	\$0
Actual Cost SFY 2020	(See Addendum Sept. 2020)
Prior to SFY 2020 Actual Cost	\$20,000

TR201919 – Field Implementation of Compacted Concrete Pavement - Mexico, MO-Completed**Project Type:** Contract Research**MoDOT Contact:** Jen Harper**Total Contract Amount:** \$30,000**Contract Period:** 6/1/2019 to 5/30/2020**Contract Investigator:** Missouri S&T**Funding:** SPR 80%, State 20%**Project Description and Objectives:**

The city of Mexico, Missouri received an Accelerated Innovation Deployment grant from FHWA to use Compacted Concrete Pavement on a city street. Part of the grant proposal was to evaluate some of the concrete properties in order to compare them with traditional pavement methods. This work was initially going to be part of a field implementation project with Dr. Kamal Khayat but due to delays in the letting of the Mexico, MO project the initial implementation project was closed out.

Proposed Activities for SFY 2021:

This project was completed in State Fiscal Year 2020.

SFY 2020 Accomplishments:

The CCP paving took place on July 23, 2019 after several delays. Field samples were prepared at the time of paving plus a section of slab was cut approximately 10 days after paving to be used to make additional samples. Laboratory tests were done on cast in field samples prepared during paving as well as saw-cut and cored samples. Tests include compressive strength and modulus of elasticity of cylinders and flexural strength of prisms. Other tests include freeze-thaw durability, de-icing salt scaling, hardened air-void system, bulk/surface resistivity, and drying shrinkage. The draft report was submitted on March 2nd. Comments were sent back to the PI on March 25, 2020. The final version was submitted on April 29, 2020. The final invoice was paid on May 20, 2020.

Financials

	<u>Amount</u>
Projected Budget SFY 2021	\$0
Budget Amount SFY 2020	\$30,000
Actual Cost SFY 2020	(See Addendum Sept. 2020)
Prior to SFY 2020 Actual Cost	\$0

TR202001 - Library Support Contract (2020-2021)**Project Type:** Contract Research**MoDOT Contact:** Jen Harper**Total Contract Amount:** \$225,640**Contract Period:** 7/1/2019 to 6/30/2021**Contract Investigator:** Henry Brown**Funding:** SPR 80%, State 20%**Project Description and Objectives:**

The demand for information services has increased as more MoDOT users are realizing the timely, diverse and high-quality information they receive using the services of the current librarian. The major objective of this project is to provide library, research and reference support services for MoDOT. University of Missouri-Columbia will provide the services of a Master of Library Science (MLS)

librarian who will work 40 hours per week and will be located at the Secretary of State's State Library and MoDOT in Jefferson City.

Proposed Activities for SFY 2021:

The librarian will continue to provide reference and research support services to MoDOT employees. Other services include circulation, cataloging, collection management (which includes digital repositories) & maintenance, marketing & outreach in addition to website content creation. Ongoing activities include coordinating and collaborating with the Missouri State Library.

SFY 2020 Accomplishments:

For 2019 Q1-Q3 the librarian answered a total of 64 reference questions and conducted 8 literature searches. A total 8,208 print and electronic library items were circulated or accessed. Forty-five new items were added to the library collection. Four contract Research Reports were posted to the Innovation Library. The Pooled Fund TPF-5(442) Transportation Research and Connectivity Pooled Fund Study kicked off in April. The MoDOT librarian is serving on the technical panel and will be the contact for Missouri. The first two items being discussed are digitization and 508 compliance. The latter of which is a hot topic for the MoDOT Research Section.

Financials

	<u>Amount</u>
Projected Budget SFY 2022	\$24,631
Projected Budget SFY 2021	\$100,000
Budget Amount SFY 2020	\$100,000
Adjusted Budget Amount SFY 2020	\$101,009
Actual Cost SFY 2020	(See Addendum Sept. 2020)
Prior to SFY 2020 Actual Cost	\$0

TR202002 – Snow and Ice Treatment Products Evaluation

Project Type: Contract Research

MoDOT Contact: Ryan Martin

Total Contract Amount: \$99,461

Contract Period: 8/16/19 to 11/30/2020

Contract Investigator: Dr. Jenny Liu

Funding: SPR 80%, State 20%

Project Description and Objectives:

The Missouri Department of Transportation (MoDOT) Maintenance Division employs various tools to reduce the impact of snow and ice on State travel ways. Rock salt (sodium chloride) has been used for decades as the primary snow and ice treatment solution, as both a spread solid and sprayed brine solution, to treat the pavement before and during inclement weather. In addition, abrasives such as sand or cinders are sometimes utilized in an attempt to provide a level of skid resistance in situations when temperatures render chloride treatment less effective. Both treatments have been deployed on state routes for many a winter and are considered the standard. MoDOT would like an evaluation of chemical treatments, including those being chloride-based and agriculture-based, in addition to viable alternatives on the market. The evaluation will address the cost effectiveness of the treatments, the impacts to varied pavement structures and the overall performance of the treatments.

Proposed Activities for SFY 2021:

Assuming the labs are open towards the end of State Fiscal Year 2020, the first quarter will be devoted to finishing lab testing of the delivered products and analyzing the results. The original schedule called for the draft final report to be delivered on August 31, 2020 with the final version on October 31, 2020. Due to the lab closure with COVID-19 most likely a no-cost time extension will be required.

SFY 2020 Accomplishments:

The task order was executed on August 20, 2019. A kick-off meeting that included the research team and MoDOT personnel was held September 4, 2019, where the schedule, scope and other project details were reviewed. A complete products list of MoDOT's planned or in-use snow and ice treatment products to review and evaluate for the project was identified and finalized by MoDOT personnel and the research team. Task 4, which is product trials, have been greatly affected by the COVID-19 pandemic. MoDOT Maintenance Division collected identified de-icing/anti-icing products and will deliver them as soon as possible, but lab access was restrained due to efforts to minimize spread of the virus. Once access to labs is restored and products delivered, Task 4 laboratory tests will commence, and data analyzed thereafter. Depending on how long lab access is restricted, a no-cost extension will likely be required for completion of project deliverables.

Financials

	<u>Amount</u>
Projected Budget SFY 2021	\$51,466
Budget Amount SFY 2020	\$60,000
Adjusted Budget Amount SFY 2020	\$47,995
Actual Cost SFY 2020	(See Addendum Sept. 2020)
Prior to SFY 2020 Actual Cost	\$0

TR202003 – Evaluating Performance of Concrete Overlays

Project Type: Contract Research

MoDOT Contact: Brent Schulte

Total Contract Amount: \$99,999

Contract Period: 8/12/19 to 10/31/2020

Contract Investigator: Applied Pavement Technology

Funding: SPR 80%, State 20%

Project Description and Objectives:

Concrete overlays are used to maintain or rehabilitate, increase the structural capacity and re-establish a smooth profile for existing roadways consisting of concrete, asphalt, or composite pavement structures. MoDOT currently uses bonded and unbonded concrete overlays to maintain or rehabilitate existing pavements. The objective of this study is to review and evaluate the performance of unbonded and bonded overlays that have been constructed in Missouri during the past 20 years. Existing data consisting of design and construction information, smoothness data, and video media will be compiled and analyzed to provide a thorough synthesis of concrete overlays used for Missouri's infrastructure.

Proposed Activities for SFY 2021:

Originally the draft of the final report was due on June 30, 2020. With delays getting the contractor project data initially, the project is running several months behind. A no-cost extension will be issued early in State Fiscal Year 2021 once it is known if there will be any additional delays due to COVID-19.

SFY 2020 Accomplishments:

The task order was executed on August 20, 2019. The kick-off meeting was held with the contractor and MoDOT personnel on August 29, 2019. A list of projects was supplied to the contractor. APTech reviewed two datasets from MoDOT containing construction and materials test data, and pavement distress data. APTech has reviewed electronic plans for the 47 concrete overlay projects, extracted pertinent project data from the plans and created an Excel database. APTech performed a series of video surveys to review the surficial condition of the concrete overlay projects and created a unified pavement distress database in Excel. APTech's response to the coronavirus outbreak has been to order all of its employees to work from home. This is not expected to have any impact on the work being performed on this project, however, as all remaining work activities can be completed in the office and via remote conferencing measures as needed. Due to delays in the MoDOT providing initial data a no-cost time extension will be granted once any impacts due to COVID-19 are known.

Financials

	<u>Amount</u>
Projected Budget SFY 2021	\$32,202
Budget Amount SFY 2020	\$60,000
Adjusted Budget Amount SFY 2020	\$67,797
Actual Cost SFY 2020	(See Addendum Sept. 2020)
Prior to SFY 2020 Actual Cost	\$0

TR202005 –Evaluation of Alternatives to Calcined Bauxite for HFST

Project Type: Contract Research

MoDOT Contact: Brent Schulte

Total Contract Amount: \$99,984

Contract Period: 11/22/2019 to 4/2/2021

Contract Investigator: Dr. Magdy Abdelrahman and Dr. John Myers

Funding: SPR 80%, State 20%

Project Description and Objectives:

Maintaining the appropriate amount of pavement friction is critical for safe driving. High friction surface treatment (HFST) can enhance the ability of a road surface to provide pavement friction to vehicles in critical braking or cornering maneuvers. MoDOT has used HFST since 2013 to restore pavement surface friction where traffic has worn down pavement surface aggregates and also to improve wet crash locations. Although several aggregates have been evaluated, only calcined bauxite aggregate has met the threshold for performance necessary to be called a HFST. Currently, calcined bauxite is the primary aggregate used for HFST in Missouri. Calcined bauxite has very limited sources, which makes it more expensive than locally available aggregates. The objective of this study is to identify and compare alternatives to calcined bauxite through testing and laboratory evaluation.

Proposed Activities for SFY 2021:

With the lab closure at Missouri S&T most of the evaluation of materials will take place in State Fiscal Year 2021. These include measuring the basic aggregate properties, measuring the friction characteristics of aggregate coupons, conducting abrasion and polishing tests and conducting accelerated friction testing. The draft of the final report is due on December 3, 2020 and the final report on February 3, 2021.

SFY 2020 Accomplishments:

The RFP was posted on August 29, 2019. A research team from Missouri S&T was awarded the project. The task order was executed on November 18th and the kick-off meeting was held on November 25th.

Sources of materials were identified prior to collection and experts in the area of HFST were contacted to collect information about material selection, testing, field data, etc. Test equipment and testing arrangements were made with the University of Idaho. Laboratory evaluation of materials started March 2020 but were quickly put on hold because of the S&T lab closure due to COVID-19. Per MoDOT's request, the team will communicate to finalize the selection of aggregate sources. The PI will monitor the lab closure situation and communicate with MoDOT if there is a need to adjust the project schedule.

Financials

	<u>Amount</u>
Projected Budget SFY 2021	\$77,055
Budget Amount SFY 2020	\$22,929
Actual Cost SFY 2020	(See Addendum Sept. 2020)
Prior to SFY 2020 Actual Cost	\$0

TR202006 –Transportation Infrastructure Asset Monitoring through the Industrial Internet-of-Things

Project Type: Contract Research

MoDOT Contact: Ryan Martin

Total Contract Amount: \$60,000

Contract Period: 10/1/19 to 7/31/2020

Contract Investigator: AECOM Technical Services, Inc.

Funding: SPR 80%, State 20%

Project Description and Objectives:

With MoDOT managed assets being so numerous and at different stages in their life-cycles, having a means of monitoring critical infrastructure assets would be highly valued. Being able to access life-cycle data for different types of construction (bridges or pavement) could aid in better understanding of proactive and cost saving maintenance schedules along with determining life-cycle cost analyses for various assets. The Industrial Internet-of-Things (IIoT) is the name given to interconnected computing devices, sensors, instruments and other technology that collects data or information at a prescribed interval of time and transmits that information over existing communications infrastructure. This project consists of two independent phases. Phase 1 investigates what sensors and capabilities are currently market ready and how they could benefit the Department. If the results from Phase 1 address Department needs and demonstrate intrinsic value, Phase 2 will further explore the findings of Phase 1 and begin implementation through installation, monitoring of assets and analysis of data.

Proposed Activities for SFY 2021:

The final report will be received in July. Final billing will take place at the beginning of State Fiscal Year 2021. Per the RFP, MoDOT will have 90 days to determine if it will proceed with phase 2 which would be implementation of IIOT as pilot demonstrations.

SFY 2020 Accomplishments:

The contract was executed on September 30, 2019. A kick-off meeting was held on October 17, 2019. Vendors and literature related to the topic were compiled and reviewed. The PI attended two conferences to meet with engineers, developers and vendors to investigate trends in IIoT. A survey was distributed in February 2020 through AASHTO RAC and among other contacts with state DOTs. Some minor delays occurred due to the COVID-19 pandemic, which resulted in the modification of the regular working environments. The draft report should be received at the end of this state fiscal year but after submittal of this report.

Financials

Projected Budget SFY 2021	<u>Amount</u> \$19,634
Budget Amount SFY 2020	\$40,366
Actual Cost SFY 2020	(See Addendum Sept. 2020)
Prior to SFY 2020 Actual Cost	\$0

TR202007 –Geotechnical Asset Management of NW and NE**Project Type:** Contract Research**MoDOT Contact:** Brent Schulte**Total Contract Amount:** \$99,886**Contract Period:** 9/26/19 to 2/1/21**Contract Investigator:** Aine Mines**Funding:** SPR 80%, State 20%**Project Description and Objectives:**

The goal of Geotechnical Asset Management is to align asset design, operation and maintenance decisions with the goals and objectives of an agency. Geotechnical Asset Management of Missouri's rock slopes, engineered embankments, retaining walls, subgrades and sinkholes can be a vital tool for MoDOT to successfully operate its transportation system. The objective of this project is to create a Geotechnical Asset Management (GAM) program along with condition and risk assessment of MoDOT's Northwest and Northeast Districts. The preferred (GAM) program developed in this project would be a mobile application or a cloud-based program that could be executed from a smart phone or tablet while in the field.

Proposed Activities for SFY 2021:

Travel for the field work that was planned for late April/early May will most likely take place first quarter of State Fiscal Year 2021. The draft final report is due in November but will most likely need to be pushed back. Issues with the licensing of ARCGIS and travel delays will most likely require both a time and cost extension.

SFY 2020 Accomplishments:

The contract was executed on September 30, 2019. The kick-off meeting with the project team was held November 5, 2019. A project meeting was held December 11, 2019, and asset rating categories were discussed with the group and largely finalized, along with the method for deriving asset condition from those rating categories and a level of risk assessment. The apps were shared with the technical committee for review, and their feedback was discussed in a February teleconference. The researchers also created a map in Collector App to use as a reference during field work. They had planned on doing the field work in late April/early May. At this point, that plan is on hold until the travel guidance changes. At this time, they remain optimistic that they can complete the project with the scheduled contract time frame. Currently, the technical committee is working to determine how many licensed users MoDOT will need to collect detailed site ratings and manage the GAM database in the future. This could be an issue and require rework on the project.

Financials

Projected Budget SFY 2021	<u>Amount</u> \$58,939
Budget Amount SFY 2020	\$40,947

Actual Cost SFY 2020
Prior to SFY 2020 Actual Cost

(See Addendum Sept. 2020)
\$0

TR202008 – Wireless Crack Sensing

Project Type: Contract Research

MoDOT Contact: Jen Harper

Total Contract Amount: \$50,000

Contract Period: 7/22/19 to 12/31/2020

Contract Investigator: Chenglin Wu

Funding: SPR 80%, State 20%

Project Description and Objectives:

This project will develop and deploy a wireless crack sensing system that can measure and monitor cracks in bridge structures. This system will contain the sensing unit, wireless data transmitting system, as well as a data processing unit. The sensing unit(s) will be connected to a wireless transmitting system to broadcast the signal wirelessly. The wireless transmitting system utilizes a blue-tooth technology that can enable the sensing unit to broadcast electronic signals in terms of electrical resistance. These signals will be received by a cell-phone device that can convert the electrical resistance information into the measured strains. The data processing unit will convert the strains into crack displacement and when the measured crack displacement exceeds a predetermined warning threshold, warning messages will be sent to designated terminal devices through a mobile application software. The preliminary installation will be conducted to evaluate the accuracy of the developed system. After initial data collection, the sensing system will be revised and re-deployed in a final field testing.

Proposed Activities for SFY 2021:

It is anticipated that the field test of the sensor will take place in early State Fiscal Year 2021. While the current task order calls for the draft report to be due on September 30, 2020 this will not allow enough time to monitor the current sensor system. A time extension will most likely be required.

SFY 2020 Accomplishments:

The task order was executed on July 22, 2019. The team successfully demonstrated the feasibility of the proposed sensing mechanism. The prototype sensor was developed and, a site ready sensor package was prepared for field testing. The team has met with MoDOT engineers and planned for a field test of the sensor in the Spring. A date was set for safety training and then field deployment but unfortunately, it had to be postponed due to COVID-19. It is unknown at this time when it will be rescheduled. There has been an issue with billing of the project. Missouri S&T's Office of Sponsored Programs has been working with the researcher's office to fix the billing issue.

Financials

Projected Budget SFY 2021

Amount

\$12,266

Budget Amount SFY 2020

\$37,734

Actual Cost SFY 2020

(See Addendum Sept. 2020)

Prior to SFY 2020 Actual Cost

\$0

TR202009 –Optimizing Work Zone Zipper Merge Operations Using Driving Simulations

Project Type: Contract Research

MoDOT Contact: Ryan Martin
Total Contract Amount: \$90,000
Contract Period: 11/1/19 to 12/31/20
Contract Investigator: Carlos Sun
Funding: SPR 80%, State 20%

Project Description and Objectives:

The zipper merge concept can reduce time lost in the queue prior to a work zone, driver frustration and accidents that commonly occur when less efficient merging techniques are employed. Even with these benefits, the zipper merge is not always the most ideal merging operation for all scenarios. Travelways with higher speeds, irregular lane setups, large variations in observed traffic speeds, and other situations might not be prime zipper merge candidates. This project will utilize a driving simulator study to help to identify the most appropriate travelway situations for implementing the zipper merge along with the most effective signage and sign packages to help the traveling public properly navigate the closure of lanes prior to a work zone.

Proposed Activities for SFY 2021:

The initial timeline for the project was to have the simulations trials completed by the end of the first quarter of the State Fiscal Year 2021. With the lab closures due to COVID-19 the project will need to be extended. Once the MU labs fully reopen a new timeline will be determined.

SFY 2020 Accomplishments:

The task order was executed on November 5, 2019. A kick-off meeting was held on November 8, 2019 with MoDOT technical advisory committee members and the UMC research team. The zipper merge simulator scenarios were narrowed as follows: 2 to 1 lane closure, pre vs. post education, prevailing speeds of 65 vs. 45 mph, 2 signage options (e.g. dynamic vs. static), and low vs. medium volume levels. The Institutional Review Board human subject experimental request was submitted and revised. The PI reports that details of human subject trial scenarios are currently being developed and that the campus Institutional Review Board has approved the zipper merge human subject experiment as a minimal risk study. With the University of Missouri Columbia campus being recently locked down due to the COVID-19 pandemic, continued development of the simulator trials is being continued off campus, although any testing and development using the physical simulator on campus has been stopped. In-house alpha testing and eventual human subject trials are delayed until the campus can be reopened. A no-cost extension will be submitted once the campus reopens and a new schedule is determined.

Financials

	<u>Amount</u>
Projected Budget SFY 2021	\$60,748
Budget Amount SFY 2020	\$29,252
Actual Cost SFY 2020	(See Addendum Sept. 2020)
Prior to SFY 2020 Actual Cost	\$0

TR202010 – Missouri Systemic Countermeasures to Improve Pedestrian Safety

Project Type: Contract Research
MoDOT Contact: Ryan Martin
Total Contract Amount: \$79,916
Contract Period: 11/25/19 to 12/31/20
Contract Investigator: Jalil Kianfar
Funding: SPR 80%, State 20%

Project Description and Objectives:

Pedestrian safety on and around Missouri's travelways is of the utmost importance to MoDOT and our county, city and other local partners. Improving awareness in the driving public and visibility for pedestrians at uncontrolled crossings is not a one-size-fits-all approach, and many variables contribute to making one or more safety measures more ideal than another proven option when addressing pedestrian crossings. This project will focus on providing an easy to use tool for local and state selection of better pedestrian safety countermeasures. Long-term measures of success would be implementation of more and better pedestrian improvements, followed by annual decreases in pedestrian related crashes and pedestrian fatalities.

Proposed Activities for SFY 2021:

Work should be finishing up during the first quarter of State Fiscal Year 2021. The draft final report is due on September 30th and the final version on November 30, 2020.

SFY 2020 Accomplishments:

The project was awarded, and the contract was finalized on December 18, 2019. A kick-off meeting was held on December 20, 2019. The PI worked with the technical advisory committee to generate a list of approved countermeasures. They also established a representative database of risk factors and pedestrian crashes. The research team has received crash data and reports from MoDOT, as was requested. During the last quarter of the state fiscal year the project was moving at a slower pace due to the impacts from the COVID-19 pandemic.

Financials

	<u>Amount</u>
Projected Budget SFY 2021	\$78,266
Budget Amount SFY 2020	\$1,650
Actual Cost SFY 2020	(See Addendum Sept. 2020)
Prior to SFY 2020 Actual Cost	\$0

TR202012 – Evaluation of MO Bridge Inventory for Effective Service Life

Project Type: Contract Research

MoDOT Contact: Jen Harper

Total Contract Amount: \$193,280

Contract Period: 4/2/20 to 9/1/2021

Contract Investigator: Glenn Washer and John Myers

Funding: SPR 80%, State 20%

Project Description and Objectives:

The Missouri National Bridge Inventory data for the past 27 years is available for downloading in a text format from FHWA's website. By using data mining techniques to retrieve and organize this data, information can be derived for the deterioration of different bridge systems that have been used over the years. Developing deterioration curves for the various rated items on bridges and culverts is desired for use by MoDOT for their data driven asset management plan. Knowing approximately how many years each part of a bridge (deck, superstructure, substructure) or a culvert will be at a particular NBI rating can lead to more informed programming decisions within the asset management plan. MoDOT is interested in the trends in deterioration for different types of bridges on the MoDOT system based on some of the following criteria: structure type, era of construction, span length, material type, traffic volume, and

environmental exposure. The research team will also provide recommendations of which types of bridges have been cost effective.

Proposed Activities for SFY 2021:

A majority of the work on the project will take place during State Fiscal Year 2021. Some of the data reduction has already been completed as part of the Risk Based Inspection Pooled Fund project. Development of the deterioration curves and providing recommendations will take place in the second half of the fiscal year. The draft final report is due on May 15, 2021 and the final report on July 15, 2021.

SFY 2020 Accomplishments:

RFPs were due on January 9, 2020. The research team of Glenn Washer from MU and John Myers from Missouri S&T was awarded the project. This is the first MCTI project being awarded. Due to this fact, contracting took slightly longer than anticipated and the task order was finally executed on April 16, 2020. Very little work was completed before the lab closures. A kick-off meeting was held on Tuesday June 9th.

Financials

	<u>Amount</u>
Projected Budget SFY 2022	\$73,280
Projected Budget SFY 2021	\$120,000
Budget Amount SFY 2020	\$0
Actual Cost SFY 2020	(See Addendum Sept. 2020)
Prior to SFY 2020 Actual Cost	\$0

TR202013 – The Effect of Rubber Fills on the Performance of Infrastructure Phase 1

Project Type: Contract Research

MoDOT Contact: Jen Harper

Total Contract Amount: \$170,066

Contract Period: 10/15/19 to 12/31/21

Contract Investigator: Dr. Mohamed Elgawady

Funding: SPR 80%, State 20%

Project Description and Objectives:

This project investigates using large chips of scrap tires having various shapes and sizes as tire derived aggregate (TDA) in different infrastructure applications including subgrade fill and the core of embankment fills as well as backfill material for retaining walls and bridge abutments. The TDA possesses unique engineering properties of being durable, lightweight, allowing drainage, and having cohesive abilities. Due to its lightweight, using TDA backfill will reduce the lateral pressures on retaining walls and bridge abutments which can reduce the design forces and hence lighter structural elements can be used. The lightweight backfill will also reduce the settlement of underlying soils and increase the global stability of the structural elements which may allow using a spread footing rather than deep foundations leading to significant savings in the construction costs. The drainage capabilities of the TDA can eliminate the need for a clean granular backfill.

Proposed Activities for SFY 2021:

Much of the work done during State Fiscal Year 2021 will be the field testing and developing the shear parameters. Work on the short term and long-term compressibility will also take place towards the end of the year. The draft final report is not due until State Fiscal Year 2022.

SFY 2020 Accomplishments:

The literature review has been completed. This past quarter the PI visited the TDA manufacturer and arranged for the delivery of the required TDA. Several design setups were reviewed from the literature and a test setup was designed. The research team also worked with the MoDOT librarian to contact different DOTs across the nation to collect any available data. All lab work was stopped due to the closure of the University due to COVID-19. The research team believes they will be able to make up time lost throughout the project.

Financials

	<u>Amount</u>
Projected Budget SFY 2022	\$54,629
Projected Budget SFY 2021	\$50,000
Budget Amount SFY 2020	\$65,437
Actual Cost SFY 2020	(See Addendum Sept. 2020)
Prior to SFY 2020 Actual Cost	\$0

TR202014 – Impact Factor for Winter Severity Indices

Project Type: Contract Research

MoDOT Contact: Ryan Martin

Total Contract Amount: \$139,966

Contract Period: 4/15/2020 to 7/30/2021

Contract Investigator: Richard Bennett

Funding: SPR 80%, State 20%

Project Description and Objectives:

Winter severity indices have been utilized for several years by a variety of groups and organizations who deal with winter weather. These indices take into account weather attributes such as total snow and/or ice accumulation, snow and ice rates, persistence of cold weather and other variables, and quantify those attributes by event or events to give a historical perspective of the weather being evaluated. This index can then be used to compare response costs to weather events of varying intensities. Unfortunately, the intensity of the weather event alone doesn't give the full picture of the challenges of responding to that event. The true "total" cost of [responding to] a winter event is affected by a combination of the severity, timing and location of the winter event, along with its effect on the surface transportation system and area traffic. The purpose of this research project is to determine those impacts, quantify them, and develop a factor that can be applied to a winter severity index value to take into account the timing, location and underlying effects of those winter events and to normalize the events for reporting purposes.

Proposed Activities for SFY 2021:

A majority of the work will take place in State Fiscal Year 2021 with only delivery of the final report and final billing scheduled to take place in SFY 2022. The first few months will be devoted to a literature review before the research team moves into identifying measures and factors for analysis. The second half of the state fiscal year will be spent establishing a baseline standard, data evaluations, and impact calculations. The draft final report is due April 30, 2021 with the final report due July 1, 2021.

SFY 2020 Accomplishments:

The project was awarded on March 19, 2020 and the contract was executed on April 15, 2020. A kick-off meeting was held on May 15, 2020. Work was just beginning on the project during this fiscal year.

<u>Financials</u>	<u>Amount</u>
Projected Budget SFY 2022	\$39,966
Projected Budget SFY 2021	\$100,000
Budget Amount SFY 2020	\$0
Actual Cost SFY 2020	(See Addendum Sept. 2020)
Prior to SFY 2020 Actual Cost	\$0

TR202015 – Using Thermal Integrity Profiling for Detecting Defects in Drilled Shafts

Project Type: Contract Research
MoDOT Contact: Brent Schulte
Total Contract Amount: \$149,985
Contract Period: 4/1/2020 to 12/31/2021
Contract Investigator: Andy Boeckman
Funding: SPR 80%, State 20%

Project Description and Objectives:

Drilled shafts are deep foundations used to support structures with large axial and lateral loads and are constructed by excavating cylindrical shafts into the ground and filling them with concrete. The construction of the drilled shafts relies heavily on good practices from the contractor, engineer and inspector to produce a quality foundation element. Most installation methods involve blind concreting, so it is difficult to be certain of an intact concrete mass of the intended dimensions. The objective of this project is to evaluate the effectiveness, accuracy and cost of using Thermal Integrity Profiling versus Cross-Hole Sonic Logging for detecting defects in drilled shafts used in deep foundation construction for MoDOT. MoDOT also wants to evaluate the use of optical fiber-based TIP or other materials/techniques as opposed to the conventional thermal wire-based TIP for detecting defects in drilled shafts. This project will include both laboratory and field investigation.

Proposed Activities for SFY 2021:

It is anticipated that the literature search and laboratory preparation will take place in the first quarter of State Fiscal Year 2021. The research team is prepared if a bridge is identified with construction taking place in the fall of 2020 but most likely the identified bridge will be built the following spring or summer. The timeline of the project is to allow for a 2021 construction season project but if it occurs this fall the timeline will be moved up.

SFY 2020 Accomplishments:

RFPs were due on January 28, 2020. The research team from Dan Brown and Associates was selected to perform the research. The contract was executed on March 25, 2020. The project start date was April 1, 2020. A kick-off meeting was held on April 14, 2020 with the research team and folks from MoDOT's research, geotechnical and bridge offices. The research team sent a memo on May 8th with the characteristics that would be beneficial in the selected bridge site as well as characteristics that might make the research more challenging. The hope is the list will help narrow down possible projects for the TIP research.

<u>Financials</u>	<u>Amount</u>
Projected Budget SFY 2022	\$76,740
Projected Budget SFY 2021	\$70,000
Budget Amount SFY 2020	\$3,245

Actual Cost SFY 2020
Prior to SFY 2020 Actual Cost

(See Addendum Sept. 2020)
\$0

TR202016 – Monitoring an Active Landslide on Route 465 Near Branson

Project Type: Contract Research
MoDOT Contact: Brent Schulte
Total Contract Amount: \$149,992
Contract Period: 4/8/2020 to 3/1/2022
Contract Investigator: Landslide Technologies
Funding: SPR 80%, State 20%

Project Description and Objectives:

Slope movements, including types of landslides and extremely slow soil creep occur throughout the United States and along many state highway systems. Successful prediction of the risk and consequences of landslides depends on knowing the geometry of the slide surface and slip surfaces, as well as the material and hydrological properties. Early warnings against the instability and failures of slopes can help the Missouri Department of Transportation (MoDOT) effectively manage the potential mitigation of the landslide and maintenance of the effected highway. The objective of this project is to monitor a slow-moving landslide on Route 465 near Branson, Missouri using remote sensing techniques. The landslide will be monitored for a minimum of 12 months. The results of this study will provide MoDOT with better understandings and methods to predict and lessen the effects of landslides around the state. Preliminary recommendations and guidelines will be established for use in other slope movements along Missouri's highway systems.

Proposed Activities for SFY 2021:

A large portion of the work on site will take place in the first quarter of State Fiscal Year 2021. The goal is to get the monitoring set up in time to get a full 4 seasons of monitoring in prior to the draft final report which is due November 24, 2021. Assuming travel is not still restricted due to COVID-19 the project should remain on this schedule.

SFY 2020 Accomplishments:

The contract was executed on April 9, 2020. The Kick-off meeting took place via webinar on Friday April 24th. The research team has worked with MoDOT's Geotechnical section to determine which methods of monitoring are appropriate and what type of access is available on site. Work has begun to coordinate travel arrangements assuming travel restrictions are beginning to lift.

Financials

	<u>Amount</u>
Projected Budget SFY 2022	\$60,575
Projected Budget SFY 2021	\$75,000
Budget Amount SFY 2020	\$14,417
Actual Cost SFY 2020	(See Addendum Sept. 2020)
Prior to SFY 2020 Actual Cost	\$0

TR202017 – Scour Analysis at Missouri Bridges

Project Type: Contract Research
MoDOT Contact: Jen Harper

Total Contract Amount: \$199,996
Contract Period: 4/1/2020 to 6/30/2022
Contract Investigator: Amanda Cox
Funding: SPR 80%, State 20%

Project Description and Objectives:

In the late 1990s MoDOT had a consultant perform a scour analysis on a number of bridges that had a high potential of being “scour critical” using Water-Surface PROfile (WSPRO) modeling to determine the hydraulic data. MoDOT would like to have a sampling of these bridges re-studied to evaluate the validity of the original scour analysis. The main objectives of the project are as follows: provide a methodology used to determine soil/rock sampling locations and depths, and the soil sampling and testing methods used; do a comparison of the scour analysis results using HEC-RAS (1D) hydraulic modeling data to results using SMS/SHR-2D hydraulic modeling data using the sampling methodology employed for this study; do a comparison of the scour analysis developed in the second objective to the current analysis method of using a single soil sample from the stream bed, and to the existing scour analysis results developed using WSPRO hydraulic model data; and do a risk assessment, due to scour, for the bridges studied by the project.

Proposed Activities for SFY 2021:

This project will be active throughout State Fiscal Year 2021 and 2022. It is scheduled to finish at the end of the fiscal year but might have billing continue into the first part of State Fiscal Year 2023.

SFY 2020 Accomplishments:

Originally the winning team selected was from Southern Illinois University and USGS; however, MoDOT and the legal staff at SIU were unable to reach a contract. The team that was second, St. Louis University, was then selected to perform the research. The contract was signed on April 7, 2020. A kick-off meeting was held Tuesday April 21st. MoDOT’s bridge division provided a list of the bridges that had the original scour analysis with the bridges removed that have been since been replaced.

Financials

	<u>Amount</u>
Projected Budget SFY 2022	\$119,996
Projected Budget SFY 2021	\$80,000
Budget Amount SFY 2020	\$0
Actual Cost SFY 2020	(See Addendum Sept. 2020)
Prior to SFY 2020 Actual Cost	\$0

TR202020 – Evaluation of Recycled Components in Stone Matrix Asphalt Mixes

Project Type: Contract Research
MoDOT Contact: Ryan Martin
Total Contract Amount: \$320,000 estimated
Contract Period: TBD
Contract Investigator: TBD
Funding: SPR 80%, State 20%

Project Description and Objectives:

Stone matrix asphalt (SMA), also called stone mastic asphalt, is a durable, rut-resisting wearing course employing a gap-graded aggregate structure and thick modified asphalt binder, typically with higher asphalt content and fibers. It has improved deformation resistance and durability due to the stone-on-stone

structure of the mix. Recycled asphalt pavement (RAP), also called reclaimed asphalt pavement, is previously laid pavement that has been removed and reprocessed. When properly crushed and screened, RAP consists of high-quality, well-graded aggregates coated by asphalt cement. Recycled (or reclaimed) asphalt shingles (RAS) is the reprocessed byproduct of tear-off sheets of roofing shingles. These reclaimed products, along with other alternatives like select plastic wastes, processed tire rubber, and other viable recycled material sources can potentially provide a “win-win” in identifying an end-use for a waste stream and reducing material costs for pavement. MoDOT has employed the use of RAP and RAS in conventional hot mix asphalt pavements for some time now, along with using the two in SMAs, albeit in limited quantity. This project aims to focus in on the optimal contents for various recyclable materials to be used in SMA mixes.

Proposed Activities for SFY 2021:

MoDOT will notify the selected research team on July 3, 2020 as well as notifying the non-selected teams. The first quarter will be devoted to getting the project under contract and conducting the kick-off meeting. A majority of the work will take place in State Fiscal Year 2021 and 2022 with mostly reporting and final billing taking place in State Fiscal year 2023.

SFY 2020 Accomplishments:

The RFP was posted on April 10, 2020. Due to the university staff and consultants working from home an extended timeline was given for submission of proposals. The proposal due date is June 12, 2020.

Financials

	<u>Amount</u>
Projected Budget SFY 2023	\$70,000
Projected Budget SFY 2022	\$150,000
Projected Budget SFY 2021	\$100,000
Budget Amount SFY 2020	\$0
Actual Cost SFY 2020	(See Addendum Sept. 2020)
Prior to SFY 2020 Actual Cost	\$0

TR202021 – Consultant Support for Intelligent Compaction and Paver-Mounted Thermal Profiling Projects in 2020-2021

Project Type: Contract Research

MoDOT Contact: Jen Harper

Total Contract Amount: \$283,660

Contract Period: 3/16/20 to 4/29/22

Contract Investigator: George Chang

Funding: SPR 80%, State 20%

Project Description and Objectives:

This project provides consultant support for MoDOT projects for the 2020 and 2021 construction seasons. The consultant has developed and led contractor Intelligent Compaction (IC) and Paver-Mounted Thermal Profiling (PMTP) training and project support for MoDOT projects in previous years. This current research project will provide training, data and field support as needed for each of the IC-PMTP MoDOT asphalt projects constructed in 2020 and 2021. This project will also begin the process of addressing the Quality Assurance (QA) testing required by FHWA.

Proposed Activities for SFY 2021:

Work for State Fiscal Year 2021 will include the research team continuing to support contractors utilizing IC-PMTP equipment on specified projects. During the 2020 construction season work will also begin on the quality assurance aspect of the project. The quality assurance aspects of the project will be the first in the nation. MoDOT and the research team are working closely with FHWA to develop a procedure that will satisfy federal QA testing requirements.

SFY 2020 Accomplishments:

The contract was signed on March 4, 2020. The first workshop for MoDOT and contractor training took place virtually on April 16, 2020 due to the restrictions in place for social distancing. In past years the training was held a little earlier in the year but the new VETA 6.0 version was not available any sooner and it has many added features. It was decided to hold off the training until it was available. The research team started support of projects in the spring construction season.

Financials

	<u>Amount</u>
Projected Budget SFY 2022	\$119,711
Projected Budget SFY 2021	\$111,670
Budget Amount SFY 2020	\$52,279
Actual Cost SFY 2020	(See Addendum Sept. 2020)
Prior to SFY 2020 Actual Cost	\$0

TR202023 – Predictive Deep Learning for Flash Flood Management

Project Type: Contract Research

MoDOT Contact: Jen Harper

Total Contract Amount: \$72,680

Contract Period: 3/10/2020 to 12/31/20

Contract Investigator: Missouri S&T

Funding: SPR 80%, State 20%

Project Description and Objectives:

Unlike normal flooding events, flash floods are very rapid events that are almost always associated with inclement weather. Alert systems are in place that provide broad early warning, but do not provide detailed updates on particular crossings where flash flooding is either occurring or soon to occur and so have limited effectiveness for flash flood scenarios resulting from heavy localized rainfalls or other unexpected conditions impacting roadways and roadway infrastructure located in drainage basins. The lack of real-time rate of water rise information and coordinated reporting for these small-time scale events can prevent effective warning detour routing before rising flood waters overtop impacted routes. For these announcements detours to be effective, they must be in place at a speed comparable to the events and must consider similar flash flooding events along alternate routes. This research extends previous research in disaster restoration and flood prediction by the research team. This proposed research uses deep learning techniques to integrate geospatial data and information into flood modeling and management protocols.

Proposed Activities for SFY 2021:

A majority of the work will take place the first quarter of State Fiscal Year 2021. The draft final report is due October 31, 2020 and the final report December 31, 2020. It is unknown at this time if the lab/campus closures at Missouri S&T will cause a delay in the project timeline.

SFY 2020 Accomplishments:

This project is a continuation of work done with Missouri S&T and flooding in the St. Louis region. The MoDOT project provides matching funds for the Regional UTC. This past quarter was spent putting together the documents to get the contract executed. The contract was finally executed on March 25, 2020 and has a start date of April 10th.

Financials

	<u>Amount</u>
Projected Budget SFY 2021	\$53,227
Budget Amount SFY 2020	\$19,453
Actual Cost SFY 2020	(See Addendum Sept. 2020)
Prior to SFY 2020 Actual Cost	\$0

TR202024 – Performance of Wicking Geotextile (H2Ri) to Mitigate Pavement Pumping - Phase 2

Project Type: Contract Research

MoDOT Contact: Ryan Martin

Total Contract Amount: \$49,916

Contract Period: 4/1/2020 to 3/30/2022

Contract Investigator: Xiong Zhang

Funding: SPR 80%, State 20%

Project Description and Objectives:

Pumping is one of the major factors contributing toward pavement failures. In a recently completed project, three field test sections were established in a full depth shoulder replacement project at Milepost 117.2 on I-44 in September 2018 to assess the effectiveness of the H2Ri wicking fabric in mitigating pumping of concrete shoulders. The main objective of this project is to maintain the data collection system at the I44 test sections and continue to monitor the long-term performance of the H2Ri wicking fabric at the test site for another two years from April 1, 2020 to March 30, 2022.

Proposed Activities for SFY 2021:

A majority of the work that will take place during State Fiscal Year 2021 is regular site visits to download the project data. No other placements or field work are scheduled to take place.

SFY 2020 Accomplishments:

The researcher developed the dates and budget for the project and contracting was ready in early spring. This is the first Missouri S&T project to be run through MCTI however and there have been delays in getting the task order executed. The task order was executed on May 26, 2020.

Financials

	<u>Amount</u>
Projected Budget SFY 2022	\$29,916
Projected Budget SFY 2021	\$20,000
Budget Amount SFY 2020	\$0
Actual Cost SFY 2020	(See Addendum Sept. 2020)
Prior to SFY 2020 Actual Cost	\$0

TR202025 – MCTI Administration

Project Type: Contract Research

MoDOT Contact: Jen Harper
Total Contract Amount: \$225,000
Contract Period: 11/18/2019 to 6/30/2023
Contract Investigator: Bill Buttlar
Funding: SPR 80%, State 20%

Project Description and Objectives:

MCTI is a partnership between MoDOT and the 4 University Campuses: Columbia, KC, St. Louis, and Missouri S&T. MoDOT and the University of Missouri System (UMS) have a long-standing, collegial relationship in working on transportation problems together, leading to local and national impact. This relationship includes MoDOT funding of sponsored research projects, MoDOT projects serving as center matching funds, access to field demonstration projects and test sections, educational programs, scholarships, and internships. However, the administration of research funding to universities is a significant burden on MoDOT, along with the transfer of technology across Missouri and beyond. In addition, the lack of streamlined, highly coordinated research efforts have, at times, led to MoDOT research dollars flowing out of Missouri, and to redundancies with other national efforts. Following the practice of other states, this center is a collaboration to move transportation research forward in Missouri. This administrative funding will help MoDOT with some of the administrative duties such as tracking project process and report editing and 508 compliance.

Proposed Activities for SFY 2021:

Work will continue to progress the center forward but will also include hiring a publications person at least on a part time basis. The website will begin being populated so that project tracking will be available both for the MCTI cabinet as well as MoDOT research staff.

SFY 2020 Accomplishments:

Administrative duties this fiscal year comprised of getting the center up and running, getting the website populated, and working with the various campuses to get the funding coding in place. MoDOT's portion on the administrative costs is \$75,000 of up to a total of \$300,000 per year. The rest will come from F&A (facilities and administration) funding that the universities charge on all projects.

<u>Financials</u>	<u>Amount</u>
Projected Budget SFY 2022	\$75,000
Projected Budget SFY 2021	\$75,000
Budget Amount SFY 2020	\$75,000
Actual Cost SFY 2020	(See Addendum Sept. 2020)
Prior to SFY 2020 Actual Cost	\$0

TR202101– Enhanced Camber Calculations for Prestressed Concrete Bridge Girders

Project Type: Contract Research
MoDOT Contact: Ryan Martin
Total Contract Amount: \$80,000 estimated
Contract Period: TBD
Contract Investigator: TBD
Funding: SPR 80%, State 20%

Project Description and Objectives:

Like many State Departments of Transportation, MoDOT has been utilizing prestressed concrete I-girders in bridge construction for quite some time. Similarly, like other DOTs, MoDOT has observed issues of late with increased occurrences of negative camber in completed prestressed concrete bridges. Positive bridge camber in prestressed concrete I-girders is a critical design component in the ride, appearance, maintenance requirements and overall life of a concrete superstructure bridge. There are a variety of components that go into the final camber of prestressed concrete girders, including the initial calculation, casting and release, shipping and eventual loading with the deck components. MoDOT is actively exploring new ways to improve the efficiency, constructability and overall performance of bridge replacements and new construction. An enhanced girder camber calculation, taking into account many different factors and lessons learned over the years, will be a primary deliverable from this project.

Proposed Activities for SFY 2021:

Proposals are due on the project July 28, 2020. It is anticipated an award will be made early second quarter. Most of the work will take place in State Fiscal Year 2021. The draft final report is due in the first quarter of Fiscal Year 2022.

SFY 2020 Accomplishments:

The RFP was posted May 26, 2020 and proposals are not due until next fiscal year.

Financials

	<u>Amount</u>
Projected Budget SFY 2022	\$50,000
Projected Budget SFY 2021	\$30,000
Budget Amount SFY 2020	\$0
Actual Cost SFY 2020	(See Addendum Sept. 2020)
Prior to SFY 2020 Actual Cost	\$0

TR202102 – Safety Evaluation of Flashing Yellow Left-Turn Arrows in Missouri

Project Type: Contract Research

MoDOT Contact: Ryan Martin

Total Contract Amount: \$90,000 estimated

Contract Period: TBD

Contract Investigator: TBD

Funding: SPR 80%, State 20%

Project Description and Objectives:

The Missouri Department of Transportation (MoDOT) has been utilizing flashing yellow arrows for left turns on state routes since 2006 after receiving interim approval from FHWA. MoDOT has been installing these signal indications at new signalized intersections where a permissive left turn is needed and updating current locations with a circular green ball for permissive movements to the flashing yellow arrow across the state. For various reasons, there have been questions whether the change to the flashing yellow arrow for left turns has actually led to an increase in crashes over recent years. Given that there is sufficient crash data at this point, this project will provide a valuable Missouri-focused study on the before and after safety of flashing yellow left-turn arrows for left turns.

Proposed Activities for SFY 2021:

It is anticipated the RFP will go out in the first quarter of State Fiscal Year 2021 with an award made early second quarter.

SFY 2020 Accomplishments:

This project is currently in the development stage during State Fiscal Year 2020.

Financials

	<u>Amount</u>
Projected Budget SFY 2022	\$45,000
Projected Budget SFY 2021	\$45,000
Budget Amount SFY 2020	\$0
Actual Cost SFY 2020	(See Addendum Sept. 2020)
Prior to SFY 2020 Actual Cost	\$0

TR202103 – Lightweight Deflectometer (LWD) for Acceptance of Unbound Materials

Project Type: Contract Research

MoDOT Contact: Brent Schulte

Total Contract Amount: \$100,000 estimated

Contract Period: TBD

Contract Investigator: TBD

Funding: SPR 80%, State 20%

Project Description and Objectives:

There is a desire by MoDOT to move away from the Nuclear Density Gage (NDG) as the primary device for evaluating compacted materials. MoDOT has recently participated in a pooled fund project with Maryland DOT and the University of Maryland that studied this issue and produced draft standards for use of the LWD. This project will develop a procedure and standards for using a LWD for acceptance of unbound materials. It is intended to build on the findings from the pooled fund study to tailor the results for Missouri; not duplicate the previous work.

Proposed Activities for SFY 2021:

It is anticipated the RFP will go out in the first quarter of State Fiscal Year 2021 with an award made early second quarter.

SFY 2020 Accomplishments:

This project is currently in the development stage during State Fiscal Year 2020.

Financials

	<u>Amount</u>
Projected Budget SFY 2022	\$60,000
Projected Budget SFY 2021	\$40,000
Budget Amount SFY 2020	\$0
Actual Cost SFY 2020	(See Addendum Sept. 2020)
Prior to SFY 2020 Actual Cost	\$0

TR202105 – Airport Design/Build Bid Documents

Project Type: Contract Research

MoDOT Contact: Brent Schulte

Total Contract Amount: \$150,000 estimated

Contract Period: TBD

Contract Investigator: TBD

Funding: SPR 80%, State 20%

Project Description and Objectives:

The FAA recently gave the approval for local airports to do Design/Build projects. MoDOT's Aviation Section sees this as an opportunity to help smaller airports with the hanger projects that they occasionally do. Unfortunately, since these are small airports, they have little experience doing those types of bid documents. The first airport that has tried the Design/Build process did not have a positive experience because their solicitation documents were not written well. This project will be to develop guidelines/generic bid package for these airports so they can release bid documents that lead to successful Design/Build projects.

Proposed Activities for SFY 2021:

It is anticipated the RFP will go out in the first quarter of State Fiscal Year 2021 with an award made early second quarter.

SFY 2020 Accomplishments:

This project is currently in the development stage during State Fiscal Year 2020.

Financials

	<u>Amount</u>
Projected Budget SFY 2022	\$130,000
Projected Budget SFY 2021	\$20,000
Budget Amount SFY 2020	\$0
Actual Cost SFY 2020	(See Addendum Sept. 2020)
Prior to SFY 2020 Actual Cost	\$0

MoDOT Lead Pooled Fund Studies

TR201910 / TPF-5(388) – Developing Implementation Strategies for Risk Based Inspection (RBI)

Project Type: Pooled Funds

MoDOT Contact: Jen Harper

MoDOT/Total Commitment: \$100,000/\$400,000

Contract Period: 11/1/2018 to 12/31/2021

Contract Investigator: Glenn Washer – University of Missouri-Columbia

Funding: SPR 100%

Project Description and Objectives:

The research envisions developing a handbook for implementation of RBI practices that will provide a resource to participating states, presenting examples and case studies that define suitable attributes and characteristic for RBI. Workshops and training will be provided to participating states to assist with implementation of RBI, and tools will be developed to assist with future implementation of the RBI technology. Analysis of the bridge inventory to evaluate risk-based strategies will provide data for better asset management.

Proposed Activities for SFY 2021:

During the first quarter of State Fiscal Year 2021 a task order extension will be administered to address the budget increase required due to the additional states (the task order was executed prior to the last few states joining) and the time requirements. This fiscal year work will move towards developing the handbook for risk-based inspection. The final reporting will take place in early State Fiscal Year 2022.

SFY 2020 Accomplishments:

During State Fiscal Year 2021 the Alabama DOT joined the pooled fund. Analysis of data from the Reliability Assessment Panel (RAP) meetings in Wisconsin, Pennsylvania, Missouri, Idaho, Illinois, and Washington took place early in the fiscal year. The data collected through the RAP meetings were entered into flow charts to characterize the RAP data collection steps, levels of detail, and level of importance (screening, high, moderate and low) for damage modes and attributes. Also, searches for the definitions and interpretations of the condition rating (CR) and condition state (CS) of defects from every state inspection manual are in progress to supplement the RAP meeting data. The analysis of the NBI data was completed for all of the participating states. The process of linking damage mode attributes to bridge inspection manuals was completed for Illinois, Missouri, Washington, Wisconsin, and Pennsylvania. Data regarding Consequence Factors were compiled for Idaho, Illinois, Missouri, Washington, and Wisconsin.

Financials

	<u>Amount</u>
Projected Budget SFY 2021 – SFY 2022	\$0
Budget Amount SFY 2020	\$32,757
Actual Cost SFY 2020	(See Addendum Sept. 2020)
Prior to SFY 2020 Actual Cost	\$67,243

TR202004 / TPF-5(395) – Traffic Disruption-free Bridge Inspection Initiative with Robotic Systems

Project Type: Pooled Funds

MoDOT Contact: Jen Harper

MoDOT/Total Commitment: \$125,000/\$575,000

Contract Period: 8/01/2019 to 7/31/2024

Contract Investigator: Dr. Genda Chen – Missouri University of Science and Technology

Funding: SPR 100%

Project Description and Objectives:

The INSPIRE University Transportation Center (<https://inspire-utc.mst.edu>) at Missouri University of Science and Technology was awarded in December of 2016 by the U.S. Department of Transportation. The center is focused on the development of advanced technologies to aid in bridge inspection and maintenance. Specifically, structural crawlers and unmanned aerial vehicles (UAVs) will provide a mobile platform for in-depth inspection of elevated bridges. Microwave and hyperspectral images will be developed to qualitatively or quantitatively assess concrete delamination and steel corrosion of reinforced concrete (RC) bridges.

The goals of this pooled-fund initiative are to engage closely with several state departments of transportation (DOTs) in the early stage of technology development at the INSPIRE University Transportation Center, and leverage the center resources to develop case studies, protocols, and guidelines that can be adopted by state DOTs for bridge inspection without adversely impacting traffic. The initiative involves the integration, field demonstration and documentation of a robotic system of structural crawlers, UAVs, NDE devices, sensors, and data analytics. Depending on the interest of participating DOTs, the objectives of this initiative include, but are not limited to:

- Development of inspection protocols for various types of bridges with the robotic system integrated into current practice.
- Comparison and correlation of bridge deck inspections from above and underneath decks to understand the reliability of traffic disruption-free bridge inspection from underneath.
- Design and technical guidelines of measurement devices on a robotic platform for the detection of surface and internal damage/deterioration in structural members, and for the change in lateral support of foundations.
- Data fusion and analytics of measurements taken from various imaging and sensing systems for consistency and reliability.

Proposed Activities for SFY 2021:

The research team will begin to develop the list of bridges to survey in each of the pooled fund member states. The next two years will be focused on correlation of top and bottom deck inspections, NDE and sensing integration into visual inspection, and case studies with the chosen bridge inventory. Protocol and guidelines will be modified throughout the project.

SFY 2020 Accomplishments:

The start date for the project was August 1, 2019. The participating states are Missouri, California, Georgia, New York, Texas, Virginia, and Wisconsin. The project team had an in-person kick-off meeting on August 7, 2019 at the International Conference on Structural Health Monitoring of Intelligent Infrastructure. The fabrication of the second prototype of a BIRDS for combined flying and traversing capabilities began. The finite element model of the hybrid unmanned vehicle was established to optimize the structural design of the vehicle and understand the aerodynamic stability as the vehicle approaches a bridge girder. This understanding can help develop an effective and practical navigation strategy of the BIRDS in application, providing foundation for workforce training in vehicle operation. Two finalists were selected to fill the associate research professor and research engineer positions. The associate research professor is specialized in robotics and system integration. The research engineer is specialized in civil engineering with some construction and inspection experience. Offer letters have been prepared but must be approved by the S&T administrator before they can be sent out due to the new hire freeze policy associated with the COVID-19 outbreak

Financials

	<u>Amount</u>
Projected Budget SFY 2022 – SFY 2025	\$0
Projected Budget SFY 2021	\$19,528
Budget Amount SFY 2020	\$100,000
Adjusted Budget Amount SFY 2020	\$105,472
Actual Cost SFY 2020	(See Addendum Sept. 2020)
Prior to SFY 2020 Actual Cost	\$0

TR202011 / Solicitation 1520 – Assessment and Repair of Prestressed Bridge Girders Subjected to Over-Height Truck Impacts (OHTI)

Project Type: Pooled Funds

MoDOT Contact: Jen Harper

MoDOT/Total Commitment: \$135,000/\$675,000 to begin

Contract Period: TBD

Contract Investigator: Dr. Mohamed Elgawady – Missouri University of Science and Technology

Funding: SPR 100%

Project Description and Objectives:

Based on bridge failure incidents that occurred between 1967 and 2006, vessel and vehicle impacts are the second highest cause of bridge failure. This project will include a comprehensive experimental and analytical program to assess the damage to bridge girders due to over-height truck impact. The remaining carrying capacity of the damaged bridge girders will be determined, which will allow stakeholders (e.g., DOT engineers) to prioritize girder repairs. Then, different repair measures will be investigated. The carrying capacity of the repaired girders will be determined as well. The remaining carrying capacities of both the damaged and repaired girders will be determined using analytical and finite element models. The anticipated testing includes testing fourteen full-scale prestressed girders under impact load. Standard detailing and design provisions for the proposed repair techniques will be developed.

Proposed Activities for SFY 2021:

The project will hopefully have enough states committed that a contract can be executed early in Fiscal Year 2021. Soon after the contract is signed a kick-off meeting will be held with the participating states. Often pooled-fund kick-off meetings take place in person however with COVID related travel restrictions it most likely will be virtual. Much of the first year of the project will be devoted to determining the designs of the girders to be tested and setting up the testing plan.

SFY 2020 Accomplishments:

The first half of State Fiscal Year 2020 was spent finding interested states so that a draft work plan could be developed. The pooled fund solicitation was posted on February 5, 2020. A 100% SPR fund waiver was requested and approved by FHWA. States have begun making commitments on the website. A total of 5 states are needed in order to move it from solicitation to a project.

Financials

	<u>Amount</u>
Projected Budget SFY 2022	\$85,000
Projected Budget SFY 2021	\$50,000
Budget Amount SFY 2020	\$0
Actual Cost SFY 2020	(See Addendum Sept. 2020)
Prior to SFY 2020 Actual Cost	\$0

TR202019 / Solicitation 1523 – Fiber-Reinforced Concrete with Adapted Rheology for Bridge Construction and Rehabilitation

Project Type: Pooled Funds

MoDOT Contact: Jen Harper

MoDOT/Total Commitment: \$200,000/\$1,200,000 to start

Contract Period: TBD

Contract Investigator: Dr. Kamal Khayat – Missouri University of Science and Technology

Funding: SPR 100%

Project Description and Objectives:

Research carried out in the RE-CAST UTC at Missouri S&T in collaboration with Rutgers University and the University of Oklahoma, MoDOT, NJ DOT, and ODOT has demonstrated the viability of using

crack-free fiber-reinforced concrete to extend the service life of infrastructure elements. The proposed project is a logical continuation of the project with MoDOT and RE-CAST UTC to conduct an implementation phase involving a pooled fund to further investigate the field performance of crack-free fiber-reinforced concrete with adapted rheology. Some of the deliverables include guidelines for construction and rehabilitation of various bridge elements with FR-SWC as well as lifecycle cost assessments.

Proposed Activities for SFY 2021:

The Project will hopefully have enough states committed that a contract can be executed early in State Fiscal Year 2021. Soon after the contract is signed a kick-off meeting will be held with the participating states. Often pooled-fund kick-off meetings take place in person however with COVID related travel restrictions it most likely will be virtual.

SFY 2020 Accomplishments:

The second quarter of State Fiscal Year 2020 was spent developing a draft scope of work. The pooled fund solicitation was posted on February 18, 2020. A 100% SPR fund waiver was requested and approved by FHWA. A total of 6 states are needed in order to move it from solicitation to a project. The researcher made a presentation to the Transportation Concrete Consortium in early spring in hopes of finding interested states.

Financials

	<u>Amount</u>
Projected Budget SFY 2022	\$125,000
Projected Budget SFY 2021	\$75,000
Adjusted Budget Amount SFY 2020	\$0
Actual Cost SFY 2020	(See Addendum Sept. 2020)
Prior to SFY 2020 Actual Cost	\$0

Pooled Fund Studies

(Pooled Fund Project contributions are not taken out of the RDS funding category)

TPF-5(255)-Highway Safety Manual

Project Type: Pooled Funds

MoDOT Contact: Jen Harper

MoDOT Total Commitment: \$200,000

Contract Period: 1/19/2012 to 12/31/2020

Contract Investigator: FHWA

Funding: SPR 100%

Project Description and Objectives:

The Highway Safety Manual (HSM), 1st Edition, was published by AASHTO in 2010. The HSM provides the best factual information and tools in a useful form to facilitate roadway planning, design, operations, and maintenance decisions based on precise consideration of their safety consequences. The AASHTO Standing Committee on Highway Traffic Safety has established a goal to institutionalize the AASHTO Highway Safety Manual (HSM) and its associated analytical tools to make data-driven decisions, advance the science of safety, and to ultimately reduce fatalities and serious injuries. The

objectives of the study are to advance ongoing efforts by lead states to implement the HSM, and to expand implementation to all states.

<u>Financials</u>	<u>Amount</u>
Committed Funds SFY 2021	\$0
Committed Funds SFY 2020	\$20,000
Transferred Funds SFY 2020	\$20,000

TPF-5(305)-Regional and National Implementation and Coordination of ME Design

Project Type: Pooled Funds
MoDOT Contact: Jen Harper
MoDOT Total Commitment: \$50,000
Contract Period: 1/1/15 to 12/30/19
Contract Investigator: Iowa DOT
Funding: SPR 100%

Project Description and Objectives:

The focus of this pooled fund project will be to provide peer exchanges and the AASHTO National Users Group meeting. The meetings are to support State DOT and Canadian province implementation of ME Design procedures by (1) sharing information between, (2) identifying issues at the local/regional level with regard to implementation, (3) identifying needs or areas that still need to be researched relative to the MEPDG, and (4) organizing implementation efforts on a regional and National basis. The four peer exchanges will be limited to participation by governmental agencies, while the AASHTO Users group meeting will be open to industry representatives, academics, consultants, and others interested in ME Design.

<u>Financials</u>	<u>Amount</u>
Committed Funds SFY 2021	\$0
Committed Funds SFY 2020	\$0
Transferred Funds SFY 2020	\$0

TPF-5(316)/TPF-5(447)-Traffic Control Device (TCD) Consortium (Traffic)

Project Type: Pooled Funds
MoDOT Contact: Jen Harper
MoDOT Total Commitment TPF-5(316): \$125,000
MoDOT Total Commitment TPF-5(447): \$25,000
Contract Period: 1/14/2015 to 1/14/2021
Contract Investigator: FHWA
Funding: SPR 100%

Project Description and Objectives:

The Traffic Control Device Consortium will focus on systematic evaluation of novel TCDs, employing a consistent process that addresses human factors and operations issues for each TCD idea and by providing local and state agencies a quicker response to new technologies with the right assessment skills and tools that will enable consistent TCD idea identification and evaluation. TCD Consortium efforts will address

TCD issues identified by local and state jurisdictions, industry, and organizations and will aid in the compliance to the MUTCD rule-making process and incorporation of novel TCDs into the MUTCD. This project is a continuation of TPF-5(065) and TPF-5(316).

<u>Financials</u>	<u>Amount</u>
Committed Funds SFY 2021	\$25,000
Committed Funds SFY 2020	\$25,000
Transferred Funds SFY 2020	\$25,000

TPF-5(317)-Low Cost Safety Improvements

Project Type: Pooled Funds
MoDOT Contact: Jen Harper
MoDOT Total Commitment: \$30,000
Contract Period: 2/10/2015 to 2/9/2021
Contract Investigator: FHWA
Funding: SPR 100%

Project Description and Objectives:

The Evaluation of Low-Cost Safety Improvements Pooled Fund Study will encompass safety-effectiveness evaluations of priority strategies from the NCHRP Report 500 Guidebooks, Guidance for Implementation of the AASHTO Strategic Highway Safety Plan. A target of 24 strategies totaling \$6M over three years is planned, but this will vary depending on the level of support. The data for the study will be gathered from those states that implement the strategies throughout the US. The data will be collected, and evaluation studies performed. This project is a continuation of TPF-5(099).

<u>Financials</u>	<u>Amount</u>
Committed Funds SFY 2021	\$5,000
Committed Funds SFY 2020	\$5,000
Transferred Funds SFY 2020	\$5,000

TPF-5(319)-Transportation Management Center Pooled Fund Study

Project Type: Pooled Funds
MoDOT Contact: Jen Harper
MoDOT Total Commitment: \$150,000
Contract Period: 4/17/2015 to 4/16/2021
Contract Investigator: FHWA
Funding: SPR 100%

Project Description and Objectives:

The Transportation Management Center (TMC) Pooled Fund Study (PFS) serves as a forum to identify and address issues that are common among agencies that manage and operate TMCs and provides an opportunity for agencies to collectively take on those key issues and challenges. The goal of the TMC PFS is to assemble regional, state, and local transportation management agencies and the Federal Highway Administration (FHWA) to (1) identify human-centered and operational issues; (2) suggest approaches to addressing identified issues; (3) initiate and monitor projects intended to address identified issues; (4) provide guidance and recommendations and disseminate results; (5) provide leadership and

coordinate with others with TMC interests; and (6) promote and facilitate technology transfer related to TMC issues nationally. This project is a continuation of TPF-2(207).

<u>Financials</u>	<u>Amount</u>
Committed Funds SFY 2021	\$25,000
Committed Funds SFY 2020	\$25,000
Transferred Funds SFY 2020	\$25,000

TPF-5(334) - Enhancement to the Intelligent Construction Data Management System (Veda) and Implementation

Project Type: Pooled Funds
MoDOT Contact: Jen Harper
MoDOT Total Commitment: \$125,000
Contract Period: 1/19/2016 to 6/30/2020
Contract Investigator: Minnesota DOT
Funding: SPR 100%

Project Description and Objectives:

MnDOT, in collaboration with local contractors and suppliers, is moving forward with full implementation of geo-spatial technologies such as intelligent compaction and thermal profiling (infrared imaging) as quality control tools on grading, reclamation, and asphalt paving projects. Currently, only 10 to 15 percent of the MnDOT 2014 bituminous paving contracts will utilize these technologies due to lack of needed enhancements to the ICDM-Veda for use in contract administration. The pooled fund offers participating states to be a part of development of a software interface that will provide intelligent construction data collection systems (i.e., geospatial systems such as intelligent compaction, paver-mounted thermal profiling [infrared radar technology], ground penetrating radar (GPR), and pavement smoothness/profile, etc.) gather large quantities of data each day of production activities. This pooled fund is closing, and the work is being rolled into the new NRRA pooled fund which is solicitation 1531.

<u>Financials</u>	<u>Amount</u>
Committed Funds SFY 2021	\$0
Committed Funds SFY 2020	\$25,000
Transferred Funds SFY 2020	\$25,000

TPF-5(341)/ new solicitation 1531-National Road Research Alliance

Project Type: Pooled Funds
MoDOT Contact: Jen Harper
MoDOT Total Commitment: \$750,000
MoDOT Commitment to new solicitation: \$150,000
Contract Period: 4/19/2016 to 6/30/2020
Contract Investigator: Minnesota
Funding: SPR 100%

Project Description and Objectives:

The need for the National Road Research Alliance (NRRA) has grown over the last several years. It is based on a number of successful efforts the Minnesota Department of Transportation (MnDOT) has

achieved utilizing the MnROAD research facility. These efforts include a number of local and national research studies, pool fund research projects, local-national-international partnerships, academic and industry involvement, Transportation Engineering and Road Research Alliance (TERRA) pooled fund, and MnROAD's 2014 Peer exchange.

Primary objectives of the National Road Research Alliance (NRRA) are:

- Conduct structured construction, field testing and evaluation using the MnROAD cold weather facility;
- Evaluate pavement materials, equipment and methods under real-world conditions;
- Establish industry standards and develop performance measure for improving pavement performance;
- Develop and/or revise specifications and recommendations;
- Studying and promoting innovative techniques and technologies that will save agencies money, improve safety and increase efficiency;
- Supporting technology transfer by developing practical field guides, best practices, and training curriculum to promote the results of research projects

<u>Financials</u>	<u>Amount</u>
Committed Funds SFY 2021	\$150,000
Committed Funds SFY 2020	\$150,000
Transferred Funds SFY 2020	\$150,000

TPF-5(343)-Roadside Safety Research for MASH Implementation

Project Type: Pooled Funds

MoDOT Contact: Jen Harper

MoDOT Total Commitment: \$200,000

Contract Period: 1/1/2016 to 12/31/2020

Contract Investigator: Washington

Funding: SPR 100%

Project Description and Objectives:

The Roadside Safety Research for MASH Implementation program is designed to conduct research on roadside safety priorities for research projects aligned with the MASH implementation completion schedule. The compliance dates for MASH roadside safety hardware are:

- December 31, 2017: W-beam barriers and cast-in-place concrete barriers;
- June 30, 2018: W-beam terminals;
- December 31, 2018: Cable barriers, cable barrier terminals, crash cushions;
- December 31, 2019: Bridge rails, transitions, all other longitudinal barriers (including portable barriers installed permanently), all other terminals, sign supports, and other breakaway hardware;
- Also, temporary work zone devices, including portable barriers, manufactured after December 31, 2019, must have been successfully tested to the 2015 edition of MASH.

<u>Financials</u>	<u>Amount</u>
Committed Funds SFY 2021	\$50,000
Committed Funds SFY 2020	\$50,000
Transferred Funds SFY 2020	\$50,000

TPF-5(353)-Clear Roads Phase II**Project Type:** Pooled Funds**MoDOT Contact:** Jen Harper**MoDOT Total Commitment:** \$125,000**Contract Period:** 1/1/2017 to 12/30/2021**Contract Investigator:** Minnesota DOT**Funding:** SPR 100%**Project Description and Objectives:**

The Clear Roads pooled fund project will maintain its focus on advancing winter highway operations nationally but will include a more pronounced emphasis on state agency needs, technology transfer and implementation. State departments of transportation are aggressively pursuing new technologies, practices, tools, and programs to improve winter highway operations and safety while maintaining fiscal responsibility. This pooled fund is needed to evaluate these new tools and practices in both lab and field settings, to develop industry standards and performance measures, to provide technology transfer and cost benefit analysis, and to support winter highway safety.

Financials**Amount**

Committed Funds SFY 2021

\$25,000

Committed Funds SFY 2020

\$25,000

Transferred Funds SFY 2020

\$25,000

TPF-5(357)-Connecting the DOTs: Implementing ShakeCast Across Multiple State Departments of Transportation for Rapid Post-Earthquake Response**Project Type:** Pooled Funds**MoDOT Contact:** Jen Harper**MoDOT Total Commitment:** \$60,000**Contract Period:** 1/1/2017 to 6/30/2020**Contract Investigator:** California DOT**Funding:** SPR 100%**Project Description and Objectives:**

When an earthquake occurs, the U. S. Geological Survey (USGS) ShakeMap portrays the extent of potentially damaging shaking. In turn, the ShakeCast system, a freely-available, post-earthquake situational awareness application, automatically retrieves earthquake shaking data from USGS ShakeMap, analyzes shaking intensity data against users' facilities (e.g., bridges, buildings, roads), sends notifications of potential impacts, and generates maps and other web-based products for emergency managers and responders. ShakeCast is particularly suitable for earthquake planning and response purposes by Departments of Transportation (DOTs), in part since it can utilize State's existing NBI databases to implement shaking-based inspection priority and impact assessments. This collaborative effort will bring participating DOTs into full ShakeCast operation for post-earthquake assessment of state and local bridge inventories. The project will provide a mechanism to actively engage representatives from state DOTs with the common interests in implementing and expanding the application of ShakeCast technologies to improve emergency response capabilities.

Financials**Amount**

Committed Funds SFY 2021

\$0

Committed Funds SFY 2020	\$15,000
Transferred Funds SFY 2020	\$15,000

TPF-5(375) - MnROAD/NCAT Joint Study – Phase II

Project Type: Pooled Funds

MoDOT Contact: Jen Harper

MoDOT Total Commitment: \$150,000

Contract Period: 6/1/2012 to 9/30/2020

Contract Investigator: Minnesota DOT

Funding: SPR 100%

Project Description and Objectives:

MnROAD and NCAT are seeking organizations to join the partnership for the second phase of research efforts. Main objectives include:

1. Determining the life cycle cost of various pavement preservation alternatives in a highly controlled experiment that will provide state Departments of Transportation (DOTs) with the financial foundation to begin to build a decision tree for their own maintenance program
2. Develop quality assurance QA field testing protocols to correlate construction practices with long term performance of pavement preservation techniques.
3. Technology transfer - Answering practical questions posed by research sponsors through formal (i.e., reports & technical papers) & informal (e.g., one-on-one responses to sponsor inquiries) technology transfer on how these life extending benefits can be best utilized in each state.

Financials

	<u>Amount</u>
Committed Funds SFY 2021	\$0
Committed Funds SFY 2020	\$0
Transferred Funds SFY 2020	\$0

TPF-5(396)-Mid-America Freight Coalition-III

Project Type: Pooled Funds

MoDOT Contact: Jen Harper

MoDOT Total Commitment: \$111,000

Contract Period:

Contract Investigator: Wisconsin DOT

Funding: SPR 100%

Project Description and Objectives:

The industries and farms of the Mississippi Valley region can compete in the marketplace only if their products can move reliably, safely and at reasonable cost to market. Growing congestion threatens the sustainability of this freight movement. The people of the region are dependent upon farms and industries for their livelihoods and their economic quality of life depends on the flow of goods to our markets. The Mississippi Valley Freight Coalition (MVFC) was created to protect and support the economic wellbeing of the industries, farms and people of the region by keeping the products of those industries, farms and

people flowing to markets reliably, safely, and efficiently. This project is a continuation of Pooled Fund TPF-5(156).

<u>Financials</u>	<u>Amount</u>
Committed Funds SFY 2021	\$37,000
Committed Funds SFY 2020	\$37,000
Transferred Funds SFY 2020	\$37,000

TPF-5(420)-National Cooperative Highway Research Program (NCHRP) FY 2020 & TPF-5(421)-National Cooperative Highway Research Program (NCHRP) FY 2021

Project Type: Pooled Funds
MoDOT Contact: Bill Stone
MoDOT Total Commitment: \$2,284,357
Contract Period: 7/1/2019 to 6/30/2021
Contract Investigator: NCHRP
Funding: SPR 100%

Project Description and Objectives:

FHWA has a longstanding association with the American Association of State Highway and Transportation Officials (AASHTO) and the National Academy of Sciences for conducting the National Cooperative Highway Research Program (NCHRP) under the Transportation Research Board (TRB). Each year contributions to the NCHRP are requested from the states. The NCHRP meets the criteria for use of federal-aid funds and is authorized to use 100% State Planning and Research Funds for the contribution.

<u>Financials</u>	<u>Amount</u>
Committed Funds SFY 2021 (estimated)	\$1,134,000
Committed Funds SFY 2020	\$1,134,357
Transferred Funds SFY 2020	\$1,134,357

TPF-5(430) -Midwest States Pooled Fund Crash Test Program

Project Type: Pooled Funds
MoDOT Contact: Jen Harper
MoDOT Total Commitment: \$130,000
Contract Period: TBD
Contract Investigator: Nebraska DOT
Funding: SPR 100%

Project Description and Objectives:

This project is continuation of work done under project SPR-3(017) and SPR-5(193), in which MoDOT has been a participant since 1991. The study has proved to be successful to this point and will remain active under the new project number. The purpose of the project is to crash test highway roadside appurtenances to assure they meet criteria established nationally. For more information, please refer to the Midwest Roadside Safety website: www.mwrsf.unl.edu

<u>Financials</u>	<u>Amount</u>
Committed Funds SFY 2021	\$65,000
Committed Funds SFY 2020	\$65,000
Transferred Funds SFY 2020	\$65,000

TPF-5(435)-Aurora Program (FY20-FY24)

Project Type: Pooled Funds
MoDOT Contact: Jen Harper
MoDOT Total Commitment: \$50,000
Contract Period: 1/1/2020 to 12/31/24
Contract Investigator: Iowa DOT
Funding: SPR 100%

Project Description and Objectives:

The Aurora Program is a consortium of public agencies focused on collaborative research, evaluation, and deployment of technologies for detailed road weather monitoring and forecasting. Members seek to implement advanced road weather information systems (RWIS) that fully integrate state-of-the-art roadway and weather forecasting technologies with coordinated, multi-agency weather monitoring infrastructures; ultimately lessening adverse impacts of inclement weather.

<u>Financials</u>	<u>Amount</u>
Committed Funds SFY 2021	\$25,000
Committed Funds SFY 2020	\$25,000
Transferred Funds SFY 2020	\$25,000

TPF-5(437) -Technology Transfer Concrete Consortium (TTCC)

Project Type: Pooled Funds
MoDOT Contact: Jen Harper
MoDOT Commitment: \$16,000
Contract Period: 1/1/2020 to 12/31/2025
Contract Investigator: Iowa State
Funding: SPR 100%

Project Description and Objectives:

Increasingly, state DOTs are challenged to design and build longer life concrete pavements that result in higher levels of user satisfaction. In order to foster new technologies and practices, experts from state DOTs, FHWA, academia and industry must collaborate to identify and examine new concrete pavement research initiatives. The Technology Transfer Concrete Consortium (TTCC) is to establish a pooled fund for state representatives to continue collaborative efforts begun in TPF-5(066) Materials and Construction Optimization and then TPF-5(313) with the current project name. TTCC will provide new developments in concrete paving leading to implementation of new technologies and longer life pavements through the use of innovative testing, technology transfer, and construction optimization technologies and practices.

<u>Financials</u>	<u>Amount</u>
Committed Funds SFY 2021	\$8,000
Committed Funds SFY 2020	\$8,000

Transferred Funds SFY 2020

\$8,000

TPF-5(438) -Smart Work Zone Deployment Initiatives (SWZDI)-FY20-FY24**Project Type:** Pooled Funds**MoDOT Contact:** Jen Harper**MoDOT Commitment:** \$100,000**Contract Period:** 10/1/2019 to 9/30/2024**Contract Investigator:** Iowa DOT**Funding:** SPR 100%**Project Description and Objectives:**

The Midwest Smart Work Zone Deployment Initiative (MwSWZDI) was initiated in 1999 as a Pooled Fund Study intended to coordinate and promote research related to safety and mobility in highway work zones. The Iowa DOT has been the lead state since 2004. The previous pooled fund number was TPF-5(295). The program is an ongoing cooperative effort between State Departments of Transportation, universities, and industry. Commercial products are provided by private vendors for evaluation, although this is not the only focus of contracted projects. State DOTs provide funds, prioritize products with respect to the anticipated benefits to their construction and maintenance activities, and cooperate with researchers to identify test sites and conduct the evaluations.

Financials

Committed Funds SFY 2021

Committed Funds SFY 2020

Transferred Funds SFY 2020

Amount

\$50,000

\$50,000

\$50,000

TPF-5(441) -No Boundaries Roadway Maintenance Practices**Project Type:** Pooled Funds**MoDOT Contact:** Jen Harper**MoDOT Total Commitment:** \$20,000**Contract Period:** TBD**Contract Investigator:** Colorado DOT**Funding:** SPR 100%**Project Description and Objectives:**

Through this pooled fund project, the Colorado Department of Transportation will work with other State Departments of Transportation (DOTs) to facilitate the implementation of promising non-snow and ice maintenance innovations and technologies. This project provides a forum for State DOTs to share their maintenance innovations with each other, support technology transfer activities and develop marketing and deployment plans for the implementation of selected innovations. Resources will be provided for implementing the innovations that includes travel, training and other technology transfer activities. This project is a continuation of the previous project initiated and led by the Missouri DOT TPF-5(239) and then Ohio under TPF-5(330). It is anticipated that this consortium will become the national forum for state involvement in the technical exchange needed for collaboration and new initiatives and be a forum for advancing the application and benefit of research technologies. Workshops will continue to be provided for the states participating in the pooled fund project.

<u>Financials</u>	<u>Amount</u>
Committed Funds SFY 2021	\$10,000
Committed Funds SFY 2020	\$10,000
Transferred Funds SFY 2020	\$10,000

TPF-5(442) - Transportation Research and Connectivity (librarian toolkit / knowledge networking / information condition / analysis of resources / digitization efforts / ADA support)

Project Type: Pooled Funds

MoDOT Contact: Jen Harper

MoDOT Total Commitment: \$50,000

Contract Period: TBD

Contract Investigator: Oklahoma DOT

Funding: anticipated SPR 100%

Project Description and Objectives:

With the number of transportation librarians shrinking nationwide and the number of complex issues facing transportation researchers only increasing, several solutions will be developed in the proposed study to remedy the aforementioned problems. To increase professionalism and standardization among non-library information managers, a toolkit will be developed that will offer guidance on best practices and be scalable to the research organization's size and abilities. Separately, a white paper on the changing nature of transportation libraries in the 21st century will be produced. This document will provide a roadmap for transportation organizations to follow with respect to current conditions of transportation information infrastructure. It will identify recurring problems, recommend solutions, and help organizations adapt to the rapid change that is occurring across the research landscape.

<u>Financials</u>	<u>Amount</u>
Committed Funds SFY 2021	\$25,000
Committed Funds SFY 2020	\$25,000
Transferred Funds SFY 2020	\$25,000

TPF-5(443)- Continuous Asphalt Mixture Compaction Assessment using Density Profiling System (DPS)

Project Type: Pooled Funds

MoDOT Contact: Jen Harper

MoDOT Total Commitment: \$50,000

Contract Period: TBD

Contract Investigator: Minnesota DOT

Funding: SPR 100%

Project Description and Objectives:

The Aurora Program is a consortium of public agencies focused on collaborative research, evaluation, and deployment of technologies for detailed road weather monitoring and forecasting. Members seek to implement advanced road weather information systems (RWIS) that fully integrate state-of-the-art roadway and weather forecasting technologies with coordinated, multi-agency weather monitoring infrastructures; ultimately lessening adverse impacts of inclement weather.

<u>Financials</u>	<u>Amount</u>
Committed Funds SFY 2021	\$25,000
Committed Funds SFY 2020	\$25,000
Transferred Funds SFY 2020	\$25,000

TPF-5(448) – Integrating Construction Practices and Weather Into Freeze Thaw Specifications

Project Type: Pooled Funds
MoDOT Contact: Jen Harper
MoDOT Total Commitment: \$40,000
Contract Period: 10/1/2019 to 9/30/2024
Contract Investigator: Oklahoma DOT
Funding: SPR 100%

Project Description and Objectives:

It has been suggested that the freeze-thaw behavior of concrete can be related to the rate at which the concrete absorbs water and reaches a critical degree of saturation. After the critical degree of saturation is reached and frozen the sample begins to crack and the stiffness degrades rapidly. This mechanism was suggested by Fagerlund and then expanded by research completed under pooled fund – TPF-5-297. Despite these advancements, there is still more work that is needed. The ultimate goal of this work is to build on previous research efforts to produce improved specifications and advance existing test methods; while, improve the underlying understanding of freeze thaw damage. This work will specifically focus on construction practices and the impact of weather.

<u>Financials</u>	<u>Amount</u>
Committed Funds SFY 2021	\$20,000
Committed Funds SFY 2020	\$20,000
Transferred Funds SFY 2020	\$20,000

TPF-5(450)-TRB Research Subscription FY 2020 & FY 2021

Project Type: Pooled Funds
MoDOT Contact: Jen Harper
MoDOT Total Commitment: \$365,312
Contract Period: 7/1/2019 to 6/30/2021
Contract Investigator: TRB
Funding: SPR 100%

Project Description and Objectives:

This is a subscription for support of core technical activities with the Transportation Research Board (TRB). The subscription is an agreement between MoDOT and the Transportation Research Board for the Research Correlation Service. The Research Correlation Service comprises a bundle of core services whose aim is to promote innovation through the coordination of research and dissemination of research results. The type of project is "Contract Other" because MoDOT purchases the services. The activities supported by this subscription include the collection of available information concerning past, current, and proposed research related to transportation. Sources including federal, state, and other governmental agencies, colleges and universities, research and planning organizations, transport operators and industry, as well as the TRB Annual Meeting and conference programs.

<u>Financials</u>	<u>Amount</u>
Committed Funds SFY 2021 (estimated)	\$184,700
Committed Funds SFY 2020	\$180,612
Transferred Funds SFY 2020	\$180,612

Solicitation 1481- Full-Scale Accelerated Load Testing of RCC Pavements

Project Type: Pooled Funds
MoDOT Contact: Jen Harper
MoDOT Total Commitment: \$40,000
Contract Period: TBD
Contract Investigator: Louisiana DOT
Funding: SPR 100%

Project Description and Objectives:

There has been a resurgent interest in design and construction of RCC pavements because their rapid construction process, enhanced surface characteristics, ability to open to traffic early, improved RCC pavement construction equipment, and overall cost effectiveness of RCC. Given these benefits, the RCC Pavement Council in conjunction with LTRC has undertaken an initiative to explore specific aspects of Roller Compacted Concrete (RCC) pavement under load using the Pavement Research Facility (PRF) located in Port Allen, LA. For this research, the Accelerated Transportation Loading and Simulation (ATLaS) device can apply a maximum dual tire wheel load of 30,000 lb. with a tire pressure of 150 psi at a rate of up to 6 mph. The loading carriage applies the dual tire wheel load in two directions (bidirectional) with a productivity of approximately 15,000 load cycles/day. LTRC will set aside up to four test lanes for the RCC full-scale testing program. Each lane is capable of accommodating three test sites. The effective site length is approximately 50 feet. Within a typical lane, there are also three areas in each lane designated for material sampling of the constructed section.

<u>Financials</u>	<u>Amount</u>
Committed Funds SFY 2021	\$40,000
Committed Funds SFY 2020	\$0
Transferred Funds SFY 2020	\$0

Solicitation 1499- Determining the in-place strength of concrete using piezoelectric based sensors

Project Type: Pooled Funds
MoDOT Contact: Jen Harper
MoDOT Total Commitment: \$25,000
Contract Period: TBD
Contract Investigator: Indiana DOT
Funding: SPR 100%

Project Description and Objectives:

Fast-paced construction schedules often expose concrete pavement and/or structures to undergo substantial loading conditions even at its early age, which causes pre-mature failure or a significant reduction in the life span of pavement and bridges. The current methods for determining traffic opening times can be inefficient and expensive, causing construction delays and cost overruns. To address this

critical need an in-situ nondestructive sensing method was developed that enables an accurate and efficient understanding of early age properties of concrete using electromechanical impedance (EMI) method coupled with piezoelectric sensors.

<u>Financials</u>	<u>Amount</u>
Committed Funds SFY 2021	\$25,000
Committed Funds SFY 2020	\$0
Transferred Funds SFY 2020	\$0

Solicitation 1507- Flood-frequency analysis in the Midwest: Addressing potential nonstationary annual peak-flow records

Project Type: Pooled Funds
MoDOT Contact: Jen Harper
MoDOT Total Commitment: \$55,600
Contract Period: TBD
Contract Investigator: South Dakota DOT
Funding: SPR 100%

Project Description and Objectives:

Peak-flow frequency analysis is essential for flood insurance studies, floodplain management, and the design of transportation infrastructure. In recent decades, better understanding of long-term hydroclimatic persistence, as well as concerns about potential climate change and land-use change have caused the stationarity assumption, underpinning for flood-frequency analysis, to be reexamined. The federal guidelines of Bulletin 17B (Interagency Advisory Committee on Water Data, 1982) and the recent updates in Bulletin 17C (England et al., 2018) recognize that the conventional assumptions for performing flood frequency analyses (e.g., the annual time series is a representative time sample of random homogeneous events and that the stochastic processes that generate floods are stationary or invariant in time) are violated in some cases. The overall goal of this study is to evaluate the combined effects of multidecadal climatic persistence (including hydroclimatic shifts), gradual climate change, and land-use change on peak-flow frequency analyses in the multi-state region in the Midwest. This study is intended to provide a framework for addressing potential nonstationary issues in statewide flood-frequency updates that commonly are conducted by the USGS in cooperation with state DOTs throughout the nation on an ongoing basis.

<u>Financials</u>	<u>Amount</u>
Committed Funds SFY 2021	\$55,600
Committed Funds SFY 2020	\$0
Transferred Funds SFY 2020	\$0

Solicitation 1527- Hydrologic and Hydraulic Software Enhancements (SMS, WMS, Hydraulic Toolbox, and HY-8)

Project Type: Pooled Funds
MoDOT Contact: Jen Harper
MoDOT Total Commitment: \$20,000
Contract Period: TBD

Contract Investigator: FHWA**Funding:** SPR 100%**Project Description and Objectives:**

The Federal Highway Administration (FHWA) sponsors ongoing development of four computer programs that perform both routine and complex hydrologic and hydraulic analyses of watersheds, river and stream systems, and transportation infrastructure. These programs incorporate procedures and equations documented in FHWA Hydraulic Design Series (HDS) documents, Hydraulic Engineering Circulars (HEC), technical briefs, and research reports. The continual evolution of the national hydraulic engineering state of practice necessitates ongoing development of and upgrades to these tools. The four computer programs are: Surface-water Modeling System (SMS), Watershed Modeling System (WMS), Hydraulic Toolbox, and HY-8 Culvert Hydraulic Analysis Program.

Financials

	<u>Amount</u>
Committed Funds SFY 2021	\$20,000
Committed Funds SFY 2020	\$0
Transferred Funds SFY 2020	\$0

Solicitation 1530- Research Project Tracking System**Project Type:** Pooled Funds**MoDOT Contact:** Jen Harper**MoDOT Total Commitment:** \$20,000**Contract Period:** TBD**Contract Investigator:** Kentucky**Funding:** SPR 100%**Project Description and Objectives:**

Each state in the U.S. has a transportation research program, typically managed by designated staff in the state DOT (or equivalent agency). While these programs vary substantially in size, complexity, staffing level, and resource availability, there are certain needs that are generally common to all programs. One of these needs is a tracking system for active and completed research projects. The tracking system can be used for numerous functions. The objective of the project is to develop common functional requirements, a software solution and maintenance of the software solution for a Research Program Tracking System to be used by multiple DOTs.

Financials

	<u>Amount</u>
Committed Funds SFY 2021	\$3,500
Committed Funds SFY 2020	\$0
Transferred Funds SFY 2020	\$0

Solicitation 1533- Consortium for Asphalt Pavement Research and Implementation (CAPRI)**Project Type:** Pooled Funds**MoDOT Contact:** Jen Harper**MoDOT Total Commitment:** \$14,000**Contract Period:** TBD**Contract Investigator:** Alabama DOT

Funding: SPR 100%

Project Description and Objectives:

As owners and operators of the nation's surface transportation infrastructure, state departments of transportation (DOTs) are striving to design and build longer lasting and more cost-effective asphalt pavements that meet a higher level of sustainability, safety and user satisfaction for the public. To achieve this goal, state DOTs continue to adopt innovative technologies and optimized practices for designing, constructing, and preserving asphalt pavements. The adopted innovative technologies and practices are often developed from the collaborative research efforts supported by the state DOTs, Federal Highway Administration (FHWA), and industry. To continue fostering the development of new technologies and practices, this pooled fund study will identify and address national priority research and implementation needs for asphalt pavements that state DOTs face today and in the future. CAPRI will operate as a voluntary consortium of flexible pavement stakeholders that is open to all state, local, and federal highway agencies, industry associations, individual companies, academic institutions and research organizations. The Alabama DOT will serve as the lead state and the National Center for Asphalt Technology (NCAT) at Auburn University will handle administrative duties for the project. Each participating entity may appoint one voting representative to CAPRI.

<u>Financials</u>	<u>Amount</u>
Committed Funds SFY 2021	\$14,000
Committed Funds SFY 2020	\$0
Transferred Funds SFY 2020	\$0

N/A- Transportation Pooled Fund Contingency

Project Type: Pooled Funds

MoDOT Contact: Jen Harper

MoDOT Total Commitment SFY21: \$66,900

Contract Period: TBD

Contract Investigator: N/A

Funding: anticipated SPR 100%

Project Description and Objectives:

At the time of this document, state DOTs are just now working on the upcoming 2021 pooled fund solicitations. It is anticipated that Missouri DOT staff will request to enter into several other pooled fund projects in State Fiscal Year 2021. This Contingency project is to account for those requests over the next 13 months.

<u>Financials</u>	<u>Amount</u>
Committed Funds SFY 2021	\$66,900
Committed Funds SFY 2020	\$0
Transferred Funds SFY 2020	\$125,000

Development – SPR21DVS

Estimated Cost - \$0

TDyy0701 - Product testing in general

Project Type: New Products

MoDOT Contact: Brent Schulte

Contract Period: 7/1/208 to 6/30/2021

Funding: SPR 80%, State 20%

Project Description and Objectives:

Previously, sales persons have been able to contact many divisions, districts, and offices of MoDOT resulting in multiple evaluations, duplicated efforts, and potentially contradictory results. By setting a single point of contact, MoDOT can simplify applications, eliminate duplicate work, and improve evaluations of products. This project establishes a centralized application, a review method, and a database for all products submitted to MoDOT. Safety, cost, and minimum qualifications can be checked before resources are spent evaluating a product. If a product is selected for evaluation, then work is coordinated for better, faster, and less expensive testing. This project includes education to help personnel understand procedures and direct sales persons to the Coordinator.

Proposed Activities for SFY 2021:

The new products functions are being moved to the Construction and Materials Field Office. Research will help if there are any innovative products that need a research component.

SFY 2020 Accomplishments:

The new products system continued to be split between specification compliant and non-compliant products.

Financials

Projected Budget SFY 2021

Budget Amount SFY 2020

Actual Cost SFY 2020

Prior to SFY 2020 Actual Cost

Amount

\$0

\$95,414

(See Addendum Sept. 2020)

N/A

Technology Transfer – SPR21TTS

Estimated Cost - \$557,500

LTAP = \$300,000

MoSTIC = \$60,000

NHI = \$40,000

BEAP = \$120,000

TEAP = \$37,500

TTAP - LTAP Program

Project Type: Contracts Other

MoDOT Contact: Jen Harper

Contract Investigator: Missouri S&T

Funding: SPR 100%

TTAP Number	Calendar Year	SPR Work Program Timeline	Contract \$
TTAP-T001(34)	2019	7/1/19 through 12/31/19	\$206,017
TTAP-T001(35)	2020	1/1/20 through 12/31/20	\$300,000
TTAP-T001(36)	2021	1/1/21 through 6/30/21	\$100,000

Project Description and Objectives:

The Local Technical Assistance Program (LTAP) was established by the Federal Highway Administration (FHWA) in 1982 in response to a recognized need for funding and technical support to the 38,000 communities that maintain local roads and bridges. The Missouri LTAP center is located at Missouri University of Science and Technology. The center enables local counties, parishes, townships, cities and towns to improve their roads and bridges by supplying them with a variety of training programs; new and existing technology updates; and personalized technical assistance. Through these core services, the LTAP center provides access to training and information that may not otherwise be accessible.

Accomplishments

CY 2019:

There was a joint Advisory Committee and Ambassadors meeting on November 15, 2019 to go over the 2020 work plan before issuing the next task order. In the third quarter of calendar year 2019, LTAP conducted 25 classes with 1,256 attendees. The number of classes is up from the 16 classes and the number of attendees is more than the number of attendees (1,001) compared to the same quarter of calendar year 2018. For the fourth quarter of calendar year 2019, LTAP conducted 55 classes with 2,633 attendees. The number of classes is up from the 48 classes and the number of attendees is less than the number of attendees (4,093) compared to the same quarter of calendar year 2018.

CY 2020:

The Task Order was executed by the Commission on January 7, 2020. For the first quarter of calendar year 2020, LTAP conducted 14 classes with 317 attendees. The number of classes is down from the 24 classes and the number of attendees is less than the number of attendees (449) compared to the same quarter of calendar year 2019. Seven additional classes were scheduled for March but were canceled due to the COVID-19 pandemic. At this time all in person classes are cancelled and it is unsure when they will begin taking place again. The LTAP program continues to be asked to increase their class curriculum. The top classes that were scheduled the most during the quarter were “Pavement Evaluation & Rating” and “ADA in the Right of Way”.

Proposed Activities**CY 2020**

- Will be seeking to expand our LTAP contact list by developing partnerships with various organizations. Also continue to look for partnerships through the Local Public Agency LPA efforts with MoDOT.
- Provide technology transfer materials.
- Provide increased information services - Continue to review and update the webpage to increase the services provided online and the links available.
- Conduct and arrange seminars & workshop training sessions.
- Continue offering “Show Me” Roads Scholar Program Level I courses; will be offering more Level II classes.
- Develop more Level II courses.
- Pursue additional funding sources that will allow the program to be expanded. This would allow us to further promote LTAP and our training and services.
- Continue to assist the MoDOT Local Public Agency efforts through training and other administrative opportunities.
- Evaluate program effectiveness.
- Create efficiencies in providing tech transfer materials and training by sharing resources and cost sharing with the Rural Technical Assistance Program (RTAP) on such deliverables as e-newsletters, arranging training and providing materials.

CY 2021

MoDOT will go out for a Request for Proposal for the Calendar Year 2021 contract.

Financials

	<u>Amount</u>
Projected Budget SFY 2021	\$300,000
Budget Amount SFY 2020	\$300,000
Actual Cost SFY 2020	(See Addendum Sept. 2020)
Prior to SFY 2020 Actual Cost	N/A

TR202018 – FY20 009 MoSTIC LTAP Safety Circuit Rider 2020

Project Type: Contract Research

MoDOT Contact: Jen Harper

Total Contract Amount: \$60,000

Contract Period: 1/1/2020 to 12/31/2020

Contract Investigator: Gidget Koestner

Funding: SPR 80%, State 20%

Project Description and Objectives:

The Missouri Department of Transportation (MoDOT) and the Missouri Local Technical Assistance Program (LTAP) hired a Safety Circuit Rider on contract under the Missouri LTAP Center. This position will provide part-time engineering services and advice as a local field liaison. The target audience would include road and bridge agencies and street departments with limited or no in-house transportation safety engineering resources to conduct these activities on their own. The approach would include travel to local agencies, promoting and facilitating specific low-cost, easy to-implement strategies for safety and infrastructure improvements as well as providing guidance to apply for additional funding where warranted. The position will coordinate with other road safety activities provided by, or funded by, MoDOT and/or Missouri LTAP to benefit local agencies while avoiding duplication of effort.

Proposed Activities for SFY 2021:

Work during State Fiscal Year 2021 will be the same as 2020. MoSTIC funds were requested again for the calendar 2021 year. This will allow continuous funding until this position is called out in the Blueprint and safety funds can be utilized.

SFY 2020 Accomplishments:

Gidget Koestner, P.E. was hired as the state's Safety Circuit Rider under the Missouri LTAP Center and started the beginning of January. Koestner presented to local public agencies on roadside safety and cost-effective countermeasures at an equipment challenges and skills building event, the Greater Games 2020, held in Bolivar, MO on February 27. She attended the pilot Road Safety Champion training in Missoula, MT on March 3-4. She obtained access to MoDOT's Crash Data Zone and had a video meeting with Ray Shank regarding the Data Zone's available attributes as well as other potential MoDOT resources. Throughout March and April, she assessed data for local roadway crashes to identify key LPAs to target in coordination with MoDOT. Additionally, she studied the implementation of key components of the Focus on Reducing Rural Roadway Departures (FoRRRwD) initiative for local agencies in Missouri.

Financials

	<u>Amount</u>
Projected Budget SFY 2021	\$55,291
Budget Amount SFY 2020	\$4,709
Actual Cost SFY 2020	(See Addendum Sept. 2020)
Prior to SFY 2020 Actual Cost	\$0

TR20106 –MoSTIC LTAP Safety Circuit Rider 2021

Project Type: Contract Research

MoDOT Contact: Jen Harper

Total Contract Amount: \$60,000

Contract Period: 1/1/2020 to 12/31/2020

Contract Investigator: Gidget Koestner

Funding: SPR 80%, State 20%

Project Description and Objectives:

The Missouri Department of Transportation (MoDOT) and the Missouri Local Technical Assistance Program (LTAP) hired a Safety Circuit Rider on contract under the Missouri LTAP Center. This position will provide part-time engineering services and advice as a local field liaison. The target audience would

include road and bridge agencies and street departments with limited or no in-house transportation safety engineering resources to conduct these activities on their own. The approach would include travel to local agencies, promoting and facilitating specific low-cost, easy to-implement strategies for safety and infrastructure improvements as well as providing guidance to apply for additional funding where warranted. The position will coordinate with other road safety activities provided by, or funded by, MoDOT and/or Missouri LTAP to benefit local agencies while avoiding duplication of effort.

Proposed Activities for SFY 2021:

Work will begin during calendar year 2021. For calendar year 2022 it is anticipated the project will be funded through the Blueprint and Safety funds.

SFY 2020 Accomplishments:

This will start in SFY 2021.

Financials

	<u>Amount</u>
Projected Budget SFY 2022	\$55,291
Projected Budget SFY 2021	\$4,709
Budget Amount SFY 2020	\$0
Actual Cost SFY 2020	(See Addendum Sept. 2020)
Prior to SFY 2020 Actual Cost	\$0

TT200701 - NHI National Highway Institute Training SFY 2020 & SFY 2021

Project Type: Contracts Other

MoDOT Contact: Jen Harper

Total Contract Amount: \$80,000

Contract Period: 7/1/2018 to 6/30/2021

Contract Investigator: Sherron Motts

Funding: SPR 80%, State 20%

Project Description and Objectives:

The National Highway Institute (NHI) as part of FHWA is a source for training the transportation community. NHI provides a catalog of available courses that MODOT can purchase and host. Construction and Materials provides research funding in the amount up to \$40,000. The type of project is "Contract Other" because MoDOT purchases the classes. NHI training courses provide direction and support to department personnel. Courses are scheduled and provided for department personnel to maintain an understanding of new methodologies and technologies. Training is also provided to meet employee needs and enhance their abilities to support the department's functions.

Proposed Activities for SFY 2021:

Provide opportunity for training of department personnel through NHI courses. Other training opportunities may be offered that support department functions, including on-site classes and workshops necessary to maintain our goal.

SFY 2020 Accomplishments:

There were several classes scheduled for the spring of 2020. Unfortunately, when COVID-19 hit they were cancelled. A reschedule date has not been determined at the time of this report. Most likely they will not take place until next fiscal year.

Financials**Amount**

Projected Budget SFY 2021	\$40,000
Budget Amount SFY 2020	\$40,000
Adjusted Amount SFY 2020	\$0
Actual Cost SFY 2020	(See Addendum Sept. 2020)
Prior to SFY 2020 Actual Cost	N/A

BEAP Program 2020 and 2021**Project Type:** Contracts Other**MoDOT Contact:** Bill Stone**Total Contract Amount:** \$240,000**Contract Period:** 7/1/2018 to 6/30/2021**Funding:** SPR 80%, State 20%**Problem, Background, and Significance:**

The BEAP program has been in existence for a number of years. It provides an avenue for local agencies without engineering expertise to get some engineering assistance, through approved consultants, to deal with problems on their bridges. The Bridge Division administers the BEAP program. The type of project is "Contract Other" because the project work will include contract management. The objective of this program is to provide engineering technical assistance to various local agencies to deal with operational problems on their bridges. This assistance results in reports that are provided to the local agencies providing them with options for addressing these issues. Implementation by the local agency of the recommendations from these reports will result in improvements to the functionality and safety of their bridges.

Proposed Activities for SFY 2021:

Provide opportunity for local agencies to get technical assistance for bridge engineering problems. It is estimated that the available funds will allow for around 30 BEAP projects. The total number of projects per year will vary depending on the scope and final cost of individual projects.

SFY 2020 Accomplishments:

As of 4/29/20, the funding allocation for SFY20 has allowed for 26 BEAP studies to be completed. These studies involved 28 local agency bridges that had some type of operational problem. Currently, 17 of these studies have been completed. It is anticipated that four additional studies may be started before the end of the fiscal year.

Financials**Amount**

Projected Budget SFY 2021	\$120,000
Budget Amount SFY 2020	\$120,000
Actual Cost SFY 2020	(See Addendum Sept. 2020)
Prior to SFY 2020 Actual Cost	N/A

TEAP Programs 2020 and 2021**Project Type:** Contracts Other**MoDOT Contact:** Bill Stone**Total Contract Amount SPR:** \$60,000

Total Contract Amount Local Agency Match: \$15,000

Total Contract Amount: \$75,000

Contract Period: 7/1/2017 to 6/30/2020

Funding: SPR 80%, State 20%

Problem, Background, and Significance:

The TEAP program has been in existence for a number of years. It provides an avenue for local agencies without engineering expertise to get some engineering assistance, through approved consultants, to deal with problems on their roadways. The Design Division administers the TEAP program. The type of project is "Contract Other" because the project work will include contract management. The objective of this program is to provide engineering technical assistance to various local agencies to deal with operational problems on their bridges and roadways. This assistance results in reports that are provided to the local agencies providing them with options for addressing these issues. Implementation by the local agency of the recommendations from these reports will result in improvements to the functionality and safety of their roadways.

Proposed Activities for SFY 2021:

Provide opportunity for local agencies to get technical assistance for traffic engineering problems. The total number of projects per year will vary depending on the scope and final cost of individual projects. The TEAP program is managed by MoDOT's Design Division's LPA group.

SFY 2020 Accomplishments:

The funding allocation for SFY2020 allowed for 11 TEAP studies to provide technical assistance for local agency roadways. The eleven projects were from a combination of technical transfer funding and highway safety funding.

Financials

Projected Budget SFY 2021

Amount

\$37,500

Budget Amount SFY 2020

\$37,500

Actual Cost SFY 2020

(See Addendum Sept. 2020)

Prior to SFY 2020 Actual Cost

N/A