WYOMING DEPARTMENT OF TRANSPORTATION 2022 REVISED STATE RESEARCH CENTER WORK PROGRAM REPORT

REVISED July 2022

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WYDOT Research Center
Ethan Crockett, Research Engineer
WYDOT Materials Program
Cheyenne, WY 82009

INTRODUCTION

The Wyoming Department of Transportation 2022 Revised State Planning and Research Work Program Report (Work Program) is prepared in accordance with Federal statutes, rules and regulations, and FHWA requirements. Work Program is defined in *Title 23 C.F.R Part 420, Sec. 103 (5)* as:

> …a periodic statement of proposed work, covering no less than one year, and estimated costs that document eligible activities to be undertaken by State DOTs and/or their subrecipients with FHWA planning and research funds.

Title 23 C.F.R Part 420, Sections 111, 207 and 209 sets out that the Work Program should consist of a) a list of and description of the work and/or activities to be accomplished during the program period; b) an estimated cost for each eligible activity; c) a description of any cooperatively funded activities that are part of a national or regional pooled study, including the NCHRP contributions; and d) financial summaries that show the funding levels for each activity, which should include the Federal and state share, and any matching funds for each individual project. Further, *Subpart (c), of Title 23 of the Code of Federal Regulations, Section 420.209*, requires research programs certify that their program is in full compliance with the requirements set out in Subpart B, of Part 420.

Research performed by Principal Investigators during fiscal year 2022 will be included in this report. The Work Program shall be updated as new projects are authorized during fiscal year 2022. All proposed projects go through the WYDOT proposal process and fall under the above statutory requirements. The Research Advisory Committee (RAC) reviews each proposal to determine whether it offers a cost benefit to WYDOT, and whether the proposal is in line with the WYDOT mission statement and goals.

The selected projects by the RAC are forwarded to the WYDOT Executive Staff and FHWA for final approval on project funding using State Planning and Research Funds. All new projects must have written approval from both the Executive Staff and FHWA prior to execution.

Proposals for current/active research projects can be found on the WYDOT Research Center website. Final reports for all closed research projects from 2009 forward are archived on the WYDOT Research Center website. Research reports for projects between the years of 1969 to 2009 can be obtained by contacting the Research Center.

Title 23 C.F.R. Sec 420.209

Certificate of Compliance

I, Keith R. Fulton, P.E., Assistant Chief Engineer for the Engineering and Planning Division, do hereby certify that the State is in compliance with the requirements of *23 C.F.R. 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.

Keith Fulton (Jul 27, 2022 12:02 MDT)

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Keith R. Fulton, P.E.
Assistant Chief Engineer for Engineering and Planning

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Chapter 1. 2022 Budget Summary

This chapter sets out the proposed budget for fiscal year (FY) 2022[1].

1. State Planning & Research (SP&R) Funds (est.)	$6,284,084
REVENUE	
2. SP&R RES Funds (est.)	$1,752,935
3. LTAP Special Allocation (Fund 438)	$150,000
4. FY2021 unobligated funds (est.)	$281,423
5. Total Revenues	**$2,184,358**
EXPENSES	
6. NCHRP (est.)	$350,587
7. TRB Correlation Service (est.)	$101,231
8. Technology Transfer to U.W. Fund 438	$31,250
9. LTAP Funds RS01222	$150,000
10. Administrative Costs (est.)	$139,000
11. Pooled Funds	$289,649
12. State Research Projects (80% Federal)	$579,726
13. ICAP funds (80% Federal) (est.)	$0.00
14. Total Expenses	**$1,641,443**
TOTAL FY2022 FEDERAL FUNDS AVAILABLE	**$542,915**

LINE NUMBER EXPLANATIONS:

1. Total *estimated* 2022 SP&R funds.

REVENUE

2. Pursuant to [23 U.S.C. 505(b)(1)](), not less than 25 percent of the state planning and research (SP&R) funds must be used for research, development, and technology transfer activities. WYDOT presently obligates the minimum amount, which is made up of 100 percent Federal funds.
3. See Local Technical Assistance Program (LTAP) and Technology Transfer (T^2) Center summary for a complete financial breakdown.
4. Un-obligated Federal funds from previous fiscal year apportionments.
5. Summation of lines 2 through 4.

EXPENSES

6. The National Cooperative Highway Research Program (NCHRP) contribution is 5.5 percent of the SP&R RES Funds. This obligation is 100 percent Federal funds.

1 *The funds set out in this budget summary are a guesstimate of the funds that will be available in FY 2022.*

7. The TRB Correlation Service is a pooled fund and obligated annually using 100 percent Federal funds.
8. The University of Wyoming Technology Transfer Center's funding is contracted for and obligated annually. See Technology Transfer (T^2) Center summary for financial breakdown.
9. LTAP funding is contracted and obligated annually. See Local Technical Assistance Program (LTAP) for financial breakdown.
10. See Administrative Cost summary for financial breakdown.
11. See Transportation Pooled Fund Projects summary for financial breakdown.
12. See State Research Projects summary for financial breakdown. State research projects use 80 percent Federal funds.
13. Indirect Cost Allocation Plan (ICAP) funds (an additional 8.23 percent for projects begun prior to FY2017, and 11 percent for projects begun in FY2017 and forward) added on to each contract (80 Federal/20 state split).
14. Summation of lines 6 through 14.

TOTAL

15. Total amount available for new research (revenue, less expenses).

Chapter 2. 2022 Funding

2.1 National Cooperative Highway Research Program (NCHRP) Contribution

Identification: TPF-5(XXX)

Contacts: WYDOT Representative:
Enid White
Ethan Crockett
307-777-4182
WYDOT
Cheyenne, WY

Funding: $305,285 (est.)

Scope: Administered by the Transportation Research Board (TRB), and sponsored by the member departments (i.e., individual state departments of transportation) of the American Association of State Highway and Transportation Officials (AASHTO), in cooperation with the Federal Highway Administration (FHWA), NCHRP was created in 1962 as a means to conduct research in acute problem areas that affect highway planning, design, construction, operation, and maintenance nationwide.

The state departments of transportation are the sole sponsors of NCHRP. Support is voluntary and funds are drawn from the state's Federal-Aid Highway apportionment of SP&R funds. Furthermore, the funds can be spent only for the administration of problems approved on ballot by at least two-thirds of the states. Each state's allocation amounts to 5.5 percent of its SP&R apportionment and is set forth in supplementary tables issued with each year's Federal Aid Highway apportionments.

NCHRP is 100 percent federally funded, requiring no state match.

2.2 Transportation Research Board Correlation Service (TRB) Contribution

Also known as the Core Program Services for a Highway Research, Development, and Technology Program, 2022.

Identification: TPF-5(XXX)

Contacts: WYDOT Representative:
Enid White
Ethan Crockett
307-777-4182
WYDOT
Cheyenne, WY

Funding: $101,231

Scope: The Research Correlation Service of the Transportation Research Board of the National Academy of Sciences is subscribed to annually by WYDOT. Membership allows receipt of all major publications and input to various national research programs including NCHRP. In 2002, FHWA authorized the yearly payment of the TRB Correlation Service using the FHWA-administered pooled fund mechanism. Starting in FY1995, FHWA allowed the TRB correlation service charge to be paid with 100 percent Federal funding, requiring no state match.

2.3 Technology Transfer (T2) Center at the University of Wyoming

Identification: LTAP021
LTAP022
FUND 438

Contacts:

Principal Investigator:
Khaled Ksaibati
307-766-6230
University of Wyoming
Laramie, WY

Project Champion:
Enid White
Ethan Crockett
307-777-4182
WYDOT
Cheyenne, WY

Funding Summary:

Code	*Funds*	*State Portion*	*Federal Portion*	*Budgeted*
LTAP (0438)	Local Tech. Assistance		$125,000	$125,000
HPRF	(WYDOT) SP&R RES	$31,250		$31,250
SCFM	SC Fund (4 cent)	$31,250		$31,250
CCOF	Municipal & County	$31,250		$31,250
CCOF	University of Wyoming	$31,250		$31,250
Total		$125,000	$125,000	$250,000

Scope: The Local Technical Assistance Program (LTAP) is part of the Federal Highway Administration's Technology Transfer Program. LTAP creates a process using Technology Transfer Centers to transfer research findings and new technology to the local-level end-user. Technology Transfer Centers have been established in each state to provide information, advice, and training to local agencies, with Wyoming's Technology Transfer Center being established in 1985 at the University of Wyoming.

Wyoming Statute §21-17-115 states that:

> The University of Wyoming may operate a technology transfer center and provide training to Wyoming county and municipality employees regarding current trends in transportation technology.

The state portion of the funding comes from equal contributions from WYDOT (Wyo. Stat. §21-17-110(a)(i)); Wyoming counties (Wyo. Stat. §21-17-110(a)(ii)); Wyoming cities and towns (Wyo. Stat. §21-17-110(a)(iii)); and the University of Wyoming (Wyo. Stat. §21-17-110(a)(iv)), in an annual amount not less than $25,000 and a maximum of $31,250. The Federal government or other non-state contribution must equal that of the total state portion.

2.4 Local Technical Assistance Program (LTAP) at University of Wyoming

Identification: RS01222

Contacts:

Principal Investigator:
Khaled Ksaibati
307-766-6230
University of Wyoming
Laramie, WY

Project Champion:
Enid White
Ethan Crockett
307-777-4182
WYDOT
Cheyenne, WY

Funding Summary:

Code	*Funds*	*State Portion*	*Federal Portion*	*UW Match*	*Budgeted*
RS01221	Federal		$30,000		$30,000
	State Match	$7,500			$7,500
	University of Wyoming Match			$12,500	$12,500
Total		$7,500	$30,000	$12,500	$50,000

Scope: The Technology Transfer Center (T^2) is part of the Federal Highway Administration's Technology Transfer Program. The Technology Transfer Center transfers research findings and new technology to the local-level end-user. Technology Transfer Centers have been established in each state to provide information, advice, and training to local entities.

2.5 Administration of Research

Identification: RES2222

Contacts: WYDOT Representative:
Enid White, Research Manager
307-777-4182
WYDOT Research Center
Cheyenne, WY

Funding Summary:

Title	State Portion	Federal Portion	Budgeted 2022
Research Proposal Development	$1,000	$4,000	$5,000
Research Printing	$100	$400	$500
Research Office Supplies	$150	$600	$750
Vehicle Usage	$100	$400	$500
Research Library Materials	$200	$800	$1,000
RAC Administration	$9,100	$36,400	$45,500
Research Presentation	$1,000	$4,000	$5,000
Travel	$1,100	$4,400	$5,500
National RAC Meeting	$70	$280	$350
Employee Time Charges and Leave	$14,107	$56,427	$70,534
Contract Management and Misc.	$800	$3,200	$4,000
Professional Fees	$65	$260	$325
TOTAL	$27,792	$111,167	$138,959

2.6 - Pooled Fund Projects Funding Summary

	1995-2018	2019	2020	2021	2022	Total Obligations
TPF-5(193) Midwest States Regional Pooled Fund Project	$555,000			$195,000		$750,000
TPF-5(337) Avalanche Research Pooled Fund	$75,000	$75,000			$75,000	$225,000
TPF-5(391) RS05219 Comprehensive Field Load Test and Geotechnical Investigation Program		$150,000				$150,000
TPF-5(393) RS04219 Pooled Fund for the Design, Development and Testing of a Box Beam Approach Guardrail Transition and an MSG Approach Guardrail Transition to a MASH TL-4 Three Steel Tube Bridge Rail		$195,576			$190,649	$386,225
TPF-5(442) Transportation Research and Connectivity			$45,000			$45,000
TPF-5(437) Technology Transfer Concrete Consortium					$24,000	$24,000

Notes: Pooled Fund research projects are generally 100 percent Federal funds.

2.6.1 - TPF-5(193) Midwest States Pooled Fund Crash Test Program

Contacts:	Lead Agency Contact: Jodi Gibson Nebraska Department of Roads 402-479-3687	Lead Contact: Bill Wilson WYDOT Cheyenne, WY

Period of Study:	Start Date: July 1, 2012 Estimated Completion: Unknown Cleared by FHWA

Scope: To crash test highway roadside appurtenances to assure that they meet criteria established nationally. At this time there are 19 states tied to this pooled fund.

Status: Information gained from the various projects within this pooled fund has proven beneficial to WYDOT. All quarterly reports for this project can be found on the Pooled Fund website. WTDOT's commitment for this project expires in September of 2022.

2.6.2 - TPF-5(497) Avalanche Research Pool

*This pooled fund has been reassigned from TPF-5-(337)

Contacts:	Lead Agency Contact: David Reeves Colorado DOT 303-757-9518	Lead Contact: Brenden Cronin WYDOT Jackson, WY

Period of Study: Additional funding Approved: June of 2022

Estimated Completion: Unknown

Scope: The study's mission is to support collaborative research efforts in the field of avalanche hazard assessment and mitigation, with the goal of improving the safety, efficiency, and quality of control efforts, along with providing better information gathering and analysis techniques and seamless integration of new technologies to further these goals. The participation of many transportation related agencies in this study will also further cooperation in this industry, leading to improved future development of beneficial technologies and improved sharing of information and avalanche data, greatly furthering the safety, efficiency, and quality of the work done in this field for all relevant agencies.

Status: The TARP met three times in 2022 for planning the next group of research projects. The annual meeting was held in Washington DC on May 17, 2022. The next proposed project revolves around LIDAR Phase 2 and CDOT is working on the procurement to get the project under contract. All reports for this project can be found on the Pooled Fund website.

2.6.3 - TPF-5(391). RS05219 Comprehensive Field Load Test and Geotechnical Investigation Program for Development of LRFD Recommendations of Driven Piles on Intermediate Geomaterials

Contacts:	Lead Agency Contact: Kam Ng University of Wyoming Laramie, WY 307-766-4388	Lead Contact: Todd Sullivan WYDOT Cheyenne, WY

Period of Study:	Proposal Approved: January 9, 2019 Estimated Completion: December 31, 2023

Scope: The overall goal of the proposed research project is to develop Load and Resistance Factor Design (LRFD) recommendations for driven piles on Intermediate Geomaterials (IGM).

Status: The TARP holds quarterly meetings with all parties. The research project will have several direct benefits to state DOTs, deep foundations industries, and other relevant stakeholders. Bridges are being selected in the various states. All reports for this project can be found on the Pooled Fund website. It outlines the work for each of the states involved in this project.

2.6.4 - TPF-5(393) RS04219 Pooled Fund for the Design, Development and Testing of a Box Beam Approach Guardrail Transition and an MSG Approach Guardrail Transition to a MASH TL-4 Three Steel Tube Bridge Rail

Contacts:	Lead Agency Contact:	Lead Contact:
	Roger Bligh	Bill Wilson
	Texas A&M	WYDOT
	College Station, TX	Cheyenne, WY
	979-845-4377	

Period of Study: Proposal Approved: February 14, 2019

Estimated Completion: December 14, 2023

Scope: Wyoming Department of Transportation (WYDOT) formulated a strategy for meeting the MASH compliance timeline and implementing standards and policies that offer to improve roadside safety in Wyoming. While many of WYDOT's roadside safety devices are considered MASH compliant, some barrier systems have yet to be updated to MASH. The compliance date for transitions, which is the roadside safety hardware category that is the focus of the proposed project, is December 31, 2019. This research is needed to provide crashworthy transitions systems for connection of common barrier types that are MASH compliant.

Status: The progress report for this project can be found on the Pooled Fund website.

2.6.5 - TPF-5(442) Pooled Fund for the Transportation Research and Connectivity Project

Contacts:	Lead Agency Contact: Michael Molina Oklahoma Transportation Library 405-420-1003	Lead Contact: Enid White WYDOT Cheyenne, WY
Period of Study:	Proposal Approved: August 12, 2019 Estimated Completion: February 28, 2023	

Scope: The project is set up to support coordinated development of transportation libraries as well as research organizations without dedicated libraries, the following objectives will be undertaken. These objectives will be accomplished through member activities and partnerships with professional groups such as the Transportation Research Board (TRB) Library and Information Science for Transportation Committee (LIST), the Special Libraries Association (SLA) Transportation Division, and the National Transportation Knowledge Network (NTKN). Completed projects will be stored permanently at the NTKN and the National Transportation Library (NTL) for public use and will be completed within the three-year span of the pooled fund study.

Status: Numerous meetings have been conducted regarding digitization, toolkits, Section 508 compliance, and the direction of the project. The progress report for this project can be found on the Pooled Fund website.

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

Contacts:	Lead Agency Contact: Iowa Department of Transportation	Lead Contact: Whitney Wise Wesley Bybee Greg Milburn WYDOT Cheyenne, WY

Period of Study: Proposal Approved: January 2022

Estimated Completion: February 28, 2024

Scope: The goals of the Technology Transfer Concrete Consortium are to identify needed research priorities by region; provide a forum for technology exchange between participants; develop and fund technology transfer materials; provide on-going communication of research needs faced by state agencies to the FHWA, industry, and CP Tech Center; Provide technical leadership for concrete related national initiatives to advance state-of-the-art construction and material practices.

Status: The spring 2022 meeting was held in Nashville, TN, on April 4-6. The winter newsletter can be found at https://mailchi.mp/d5400af87b6d/winter-2021-2022-nc2-news. There are 34 member states at this time.

2.7 – Research Projects

2.7.1 – RS03217 Development of an Ultra Accelerated Test to Evaluate ASR Potential in Concrete

Contacts: Principal Investigators:
Jennifer Tanner
University of Wyoming
1000 East University Ave.
Laramie, WY

Project Champion:
Whitney Wise
Greg Milburn
WYDOT
Cheyenne, WY

Period of Study: Proposal Approved: October 19, 2016
Original Estimated Completion: March 31, 2022
Revised Estimated August 31, 2022

Funding Summary:

Fiscal Year	Total Contract, Amendment and/or revision Amount	ICAP (11% above Total Contract Amount)	**Total Funds** (Total Contract Amount, state match, and ICAP Funding)	Breakdown of the Total Funds	
				Total Federal SP&R (80% of total contract amount)	Total State Match (20% of total contract amount)
2017	$142,880	$15,717	**$158,597**	$126,878	$31,719
2019	$70,509	$7,756	**$78,265**	$62,612	$15,653
Total	$213,389	$23,473	**$236,862**	$189,490	$47,372

Scope: A proposed test could potentially replace the yearlong concrete prism test with a weeklong test for evaluation of combinations of coarse and fine aggregates. The primary goal of this project is cost savings by producing durable concrete with an extended service life.

Status: Due to issues with COVID and travel for students, this project was extended to August 31, 2022. Principle Investigator is finalizing the final report.

2.7.2 – RS08217 Implementation of SHRP2 Results within the Wyoming Connected Vehicle Variable Speed Limit System – SHRP2 Implementation Assistance Program (Round 4)

Contacts: Principal Investigators:
Mohamed Ahmed
Rhonda Young
University of Wyoming
Laramie, WY

Project Champion:
Vince Garcia
WYDOT
Cheyenne, WY

Period of Study: Proposal Approved: June 25, 2017
Estimated Completion: December 31, 2021

Funding Summary:

Fiscal Year	Total Contract, Amendment and/or revision Amount	ICAP (11% above Total Contract Amount)	**Total Funds** (SP&R Funds, state match, and SHRP2 Funding)	Breakdown of the Total Funds		
				SHRP2	SP&R Funds	State Match
2017	$364,162	$4,757	**$368,919**	$320,920	$34,594	$8,648

Scope: The primary objective of the second phase is to model driver's responses to various adverse weather and road conditions.

Status: This project has been finalized. The final report was completed in January of 2022.

2.7.3 – RS02218 Revegetation Success and Weed Resilience of Wyoming Right-of-Way

Contacts: Principal Investigators:
Kristina Hufford
University of Wyoming
Laramie, WY

Project Champion:
Scott Gamo
WYDOT
Cheyenne, WY

Period of Study: Proposal Approved: October 18, 2017
Estimated Completion: August 13, 2022

Funding Summary:

Fiscal Year	Total Contract, Amendment and/or revision Amount	ICAP (11% above Total Contract Amount)	**Total Funds** (Total Contract Amount, state match, and ICAP Funding)	Breakdown of the Total Funds	
				Total Federal SP&R (80% of total contract amount)	Total State Match (20% of total contract amount)
2018	$151,270	$16,640	**$167,910**	$134,328	$33,582

Scope: The objectives of this proposal are to evaluate different reclamation seed mixes over the years to determine the rate of reseeding success and better define combinations of species and site variables that contribute to successful revegetation outcomes. The proposal will also compare sites and seed mixes for resilience to invasion by high impact species, such as cheatgrass. Data will contribute to recommendations to maximize seeding success and minimize weeds, and will assist future evaluations of other vegetation factors, such as minimizing traffic/wildlife conflicts.

Status: This project was extended to November of 2022 due to COVID issues and travel. This project is 75 percent complete and there has been a delay in the student analysis and final report writing. Data collection has been completed over the past 3 summers with information sampling completed summer 2018, main vegetation and soil sampling completed summer 2019, and additional data collection summer 2020. Initial exploratory analyses have been completed and the student has determined analysis direction and is in the process of completing. Initial outlines and some wording of thesis content has begun.

2.7.4 – RS4218 Human Machine Interface (HMI) for Connected Vehicle: Requirements, Development and Assessment

Contacts: Principal Investigators: Mohamed Ahmed, University of Wyoming, Laramie, WY

Project Champion: Vince Garcia, WYDOT, Cheyenne, WY

Period of Study: Proposal Approved: January 23, 2018
Estimated Completion: October 31, 2021

Funding Summary:

Fiscal Year	Total Contract, Amendment and/or revision Amount	ICAP (11% above Total Contract Amount)	**Total Funds** (Total Contract Amount, state match, and ICAP Funding)	Breakdown of the Total Funds	
				Total Federal SP&R (80% of total contract amount)	Total State Match (20% of total contract amount)
2018	$228,820	$25,170	**$253,990**	$203,192	$50,798

Scope: Develop a HMI that is effective in delivering critical information while minimizing distraction risks that might be posed by the system.

Status: The project was completed in March of 2022.

2.7.5 – RS2219 Developing a Prototype System for Establishing Passing and No-Passing Zones of Two Lane Highways

Contacts: Principal Investigators:
Ahmed Farid
Khaled Ksaibati
Suresh Muknahallipatna
Victor Bershinsky
University of Wyoming
Laramie, WY

Project Champion:
Jeffery Mellor
Ryan Shields
WYDOT
Cheyenne, WY

Period of Study: Proposal Approved: October 31, 2018
Estimated Completion: January 31, 2022

Funding Summary:

Fiscal Year	Total Contract, Amendment and/or revision Amount	ICAP (11% above Total Contract Amount)	**Total Funds** (Total Contract Amount, state match, and ICAP Funding)	Breakdown of the Total Funds	
				Total Federal SP&R (80% of total contract amount)	Total State Match (20% of total contract amount)
2019	$171,899	$18,910	**$190,809**	$152,647	$38,162
2020	$15,972	$1,757	**$17,729**	$14,183	$3,546
Total	$187,871	$20,667	**$208,538**	$166,830	$41,708

Scope: The purpose of this study is to develop a quick and functional prototype of the two-vehicle method for measuring the passing sight distance (PSD) on Wyoming's two-lane highway.

Status: This project is 45 percent complete. The first apparatus, Prototype 1 was delivered to the WYDOT traffic department in the fall 2020, while Prototype 2 was expected to be delivered in late 2021. Prototype 1 has been updated multiple times to fulfill the needs of the traffic department. Prototype 1 will be retracted, upgraded with the advanced ITS features and delivered once more to WYDOT by January 31, 2022.

2.7.6 – RS3219 Connected-Autonomous Traffic Signal Control Algorithms for Trucks and Fleet Trucks

Contacts:	Principal Investigators:	Project Champion:
	Milan Zlatkovic	Christina Spindler
	Mohamed Ahmed	WYDOT
	University of Wyoming	Cheyenne, WY
	Laramie, WY	

	Proposal Approved: October 31, 2018
Period of Study:	Estimated Completion: October 31, 2021

Funding Summary:

Fiscal Year	Total Contract, Amendment and/or revision Amount	ICAP (11% above Total Contract Amount)	Other Funds MPC ($60,000 and WYDOT state funds ($42,000)	**Total Funds** (Total Contract Amount, state match, and ICAP Funding)	Breakdown of the Total Funds	
					Total Federal SP&R (80% of total contract amount)	Total State Match (20% of total contract amount)
2019	$148,866	$16,375	$102,000	**$267,241**	$132,193	$33,048

Scope: The goal of this study is to develop and test special traffic signal control algorithms for connected vehicles, with a focus on truck and fleet vehicles. The work on the project has been divided into seven main tasks.

Status: This project was completed in March of 2022.

2.7.7 – RS7219 Characterization of Blowover Risk in the Wyoming Highway System

Contacts:	Principal Investigators: Noriaki Ohara Rhonda Young University of Wyoming Laramie, WY	Project Champion: Kathy Ahlenius Clifford Spoonemore WYDOT Cheyenne, WY

Period of Study: Proposal Approved: January 31, 2019
Estimated Completion: December 31, 2021

Funding Summary:

Fiscal Year	Total Contract, Amendment and/or revision Amount	ICAP (11% above Total Contract Amount)	**Total Funds** (Total Contract Amount, state match, and ICAP Funding)	Breakdown of the Total Funds	
				Total Federal SP&R (80% of total contract amount)	Total State Match (20% of total contract amount)
2019	$119,762	$13,174	**$132,936**	$106,349	$26,587

Scope: The purpose of this study is to assist WYDOT to better understand how wind, vehicle speed, load weights, and road geometry factor into rollover crashes, and to improve operations practices related to weather responsive road management.

Status: This project is 70 percent complete. The manuscript on the methodology development on the blowover risk evaluation is close to submission to a journal. The blowover model has been further modified to incorporate the effects of local terrain on the crosswind magnitude. The statewide model implementation based on the winds from the Weather Research and Forecasting (WRF) model output has been initiated. Works to improve the operational risk assessment based on the existing Road Weather Information System (RWIS) stations for the statewide application are ongoing.

2.7.8 – RS02220 A Feasibility Study for Establishing a Regional Road Track Pavement Testing Facility in Wyoming

Contacts:	Principal Investigators:	Project Champion:
	Marwan Hafex	Greg Milburn
	Khaled Ksaibati	Keith Fulton
	University of Wyoming	WYDOT
	Laramie, WY	Cheyenne, WY

Period of Study: Proposal Approved: January 30, 2020
Estimated Completion: January 31, 2022

Funding Summary:

Fiscal Year	Total Contract, Amendment and/or revision Amount	ICAP (11% above Total Contract Amount)	Other Funds MPC	**Total Funds** (Total Contract Amount, state match, and ICAP Funding)	Breakdown of the Total Funds	
					Total Federal SP&R (80% of total contract amount)	Total State Match (20% of total contract amount)
2020	$102,002	$11,220	$68,628	**$181,850**	$90,578	$22,644

Scope: This project is set up to evaluate the effectiveness of constructing a state of the art pavement testing facility in Wyoming to conduct research studies for the dry freeze region.

Status: This project is 65 percent complete. A technical paper has been published in the CivilEng Journal. The review has been expanded to include accelerated pavement testing (APT) applications in pavement research using full-scale experiments. A text data mining was conducted to investigate the current trends of APT research along the three APT conference proceedings. The appropriate location of the proposed road track facility in Wyoming was investigated along I-80 segments between Laramie and Cheyenne.

2.7.9 – RS03220 Characterization of Soil and Rock for Transportation Infrastructure Using Seismic Methods in Wyoming

Contacts:

Principal Investigators:
Shawn Griffiths
University of Wyoming
Laramie, WY

Project Champion:
Kirk Hood
James Dahill
WYDOT
Cheyenne, WY

Period of Study: Proposal Approved: January 6, 2020
Estimated Completion: January 31, 2022

Funding Summary:

Fiscal Year	Total Contract, Amendment and/or revision Amount	ICAP (11% above Total Contract Amount)	**Total Funds** (Total Contract Amount, state match, and ICAP Funding)	Breakdown of the Total Funds	
				Total Federal SP&R (80% of total contract amount)	Total State Match (20% of total contract amount)
2020	$171,668	$18,883	**$190,551**	$152,441	$38,110

Scope: This project is set up to perform refraction and surface wave testing at nine (9) sites in Wyoming.

Status: This project is 60 percent complete. Data collection has been completed, data analysis is almost complete, and data correlation has just begun. Shear wave velocities have been measured at nine sites. Correlation of velocities to borehole and pile driving records has begun.

2.7.10 – RS04220 Impacts of Cooperative Automated Transportation (CAT) on Wyoming Highway Infrastructure

Contacts:

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Period of Study: Proposal Approved: January 6, 2020
Estimated Completion: August 31, 2023

Funding Summary:

Fiscal Year	Total Contract, Amendment and/or revision Amount	ICAP (11% above Total Contract Amount)	**Total Funds** (Total Contract Amount, state match, and ICAP Funding)	Breakdown of the Total Funds	
				Total Federal SP&R (80% of total contract amount)	Total State Match (20% of total contract amount)
2020	$149,809	$16,479	**$166,288**	$133,030	$33,258

Scope: This project is set up to conduct a synthesis of the research and practice needs, and challenges for the state-wide deployment of Automated Transportation in Wyoming. It will provide WYDOT with recommendations on the regulation and policy development, infrastructure design and operations, upgrades of traffic management strategies, upgrades of regional transportation planning models, and cybersecurity of data management, which will support WYDOT in safely and efficiently integrating CAT into the road network in Wyoming.

Status: This project is 45 percent complete. The Principle Investigator has reviewed and synthesized existing national and state level regulations and legislation related to automated vehicles (AVs) and connected automated vehicles (CAV); participated in the Wyoming AV working group to gain feedback from stakeholders on the review carried out on statewide legislations and regulations, and the recommendations provided for the Wyoming draft bill on AV; reviewed and synthesized the AV/CAV/Truck platooning activities in the state; reviewed the literature regarding the impacts of CAT on the design and maintenance of roadway infrastructure and traffic control devices; prepared a draft on an on-line survey questionnaire to collect Wyoming residents' perception of CAT and autonomous driving; and has sent off the application of the institutional review board (IRB) to administer the survey.

2.7.11 – RS05220 Automated Real Time Weather Detection System Using Artificial Intelligence

Contacts: Principal Investigators:
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Period of Study: Proposal Approved: January 6, 2020
Estimated Completion: January 31, 2023

Funding Summary:

Fiscal Year	Total Contract, Amendment and/or revision Amount	ICAP (11% above Total Contract Amount)	**Total Funds** (Total Contract Amount, state match, and ICAP Funding)	Breakdown of the Total Funds	
				Total Federal SP&R (80% of total contract amount)	Total State Match (20% of total contract amount)
2020	$239,328	$23,326	**$262,654**	$210,123	$52,531

Scope: The study will help in facilitating and improving maintenance operations and enhancing the safety and convenience of highway travel. One of the major benefits of the proposed study is that it will not require any additional camera installations and hence could be an affordable source of collecting accurate weather information in real-time. Furthermore, the weather detection system will be able to provide weather conditions throughout the year, including winter and summer, since it will consider seven levels of weather conditions: clear, light rain, heavy rain, light snow, heavy snow, light fog, and thick fog.

Status: This project is 45 percent complete. A literature review has been conducted; data images from webcams have been acquired for February 2019 to May 2019; images of weather and surface conditions in snowy weather of I-80 and I-25 have been extracted and annotated; additional data from the webcams have been requested from WYDOT; and a research paper has been submitted to TRB for the annual meeting in 2021.

2.7.12 – RS06220 Enhancing Crash Data Reporting to Highway Safety Partners in Wyoming Utilizing Big Data Analysis and Survey

Contacts:

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Period of Study: Proposal Approved: January 6, 2020
Estimated Completion: January 31, 2023

Funding Summary:

Fiscal Year	Total Contract, Amendment and/or revision Amount	ICAP (11% above Total Contract Amount)	**Total Funds** (Total Contract Amount, state match, and ICAP Funding)	Breakdown of the Total Funds	
				Total Federal SP&R (80% of total contract amount)	Total State Match (20% of total contract amount)
2020	$117,879	$12,967	**$130,846**	$104,677	$26,169

Scope: The purpose of this research project is to assess the data needs of the Wyoming Department of Transportation's safety partners, identify gaps in crash reporting and recommend appropriate guidelines to present traffic safety data.

Status: This project was completed in March of 2022.

2.7.13 – RS07220 A Proposal for Extending the Field Testing and Long Term Monitoring of Selected High Mast Lighting Towers for 18 Months

Contacts:

Principal Investigators:	Project Champion:
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Period of Study: Proposal Approved: January 30, 2020
Estimated Completion: December 31, 2022

Funding Summary:

Fiscal Year	Total Contract, Amendment and/or revision Amount	ICAP (11% above Total Contract Amount)	**Total Funds** (Total Contract Amount, state match, and ICAP Funding)	Breakdown of the Total Funds	
				Total Federal SP&R (80% of total contract amount)	Total State Match (20% of total contract amount)
2020	$68,553	$7,541	**$76,094**	$60,875	$15,219

Scope: This project is to continue to monitor four (4) high-mast light towers (HMLT) at locations already instrumented in order to determine the cause of severe fatigue damage in the pole-to-base plate weld observed in the three (3) HMLTs at the Wagonhound Rest Area. The outcome of this research is intended to determine what accelerated the fatigue failure of the HMLTs enabling WYDOT to take corrective action on existing and future HMLT installations in order to ensure the public safety.

Status: Progress report has not been received.

2.7.14 – RS08220 Automating the Implementation of the Updated Grade Severity Rating System (GSRS) for Wyoming Mountain Passes

Contacts: Principal Investigators:
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Project Champion:
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Period of Study: Proposal Approved: January 30, 2020
Estimated Completion: May 31, 2022

Funding Summary:

Fiscal Year	Total Contract, Amendment and/or revision Amount	ICAP (11% above Total Contract Amount)	Other Funds MPC	**Total Funds** (Total Contract Amount, state match, and ICAP Funding)	Breakdown of the Total Funds	
					Total Federal SP&R (80% of total contract amount)	Total State Match (20% of total contract amount)
2020	$79,565	$8,752	$73,000	**$161,317**	$70,654	$17,663

Scope: This study is aimed at achieving three objectives. The first objective is to validate the grade severity rating system (GSRS) model for trucks that have only drum brakes installed. The second objective is to make the updated GSRS fully implementable by incorporating horizontal curves into the formulation of weight specific speed (WSS) signs. The final objective is to develop a program that simplifies the implementation of the GSRS and formulation of WSS signs.

Status: This project is 75 percent complete. An object-oriented software with a Graphical User Interface based on the updated GSRS and incorporating horizontal curves was developed to automate the formulation of WSS signs. The software was tested on segments selected from US-16. Truck tests (Hill-descent and Validation tests) were conducted on selected segments on US-16 and data points required to validate the model for a truck semitrailer equipped with only drum-brakes were obtained.

2.7.15 – RS09220 Improving Design and Construction of Transportation Infrastructure through Bedrock Characterization

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Project Champion:
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Period of Study: Proposal Approved: January 30, 2020
Estimated Completion: June 30, 2022

Funding Summary:

Fiscal Year	Total Contract, Amendment and/or revision Amount	ICAP (11% above Total Contract Amount)	Other Funds MPC	**Total Funds** (Total Contract Amount, state match, and ICAP Funding)	Breakdown of the Total Funds	
					Total Federal SP&R (80% of total contract amount)	Total State Match (20% of total contract amount)
2020	$75,000	$8,250	$50,000	**$133,250**	$66,600	$16,650

Scope: The overall goal of the proposed research project is to understand the strength and deformation behaviors of Wyoming bedrocks in order to improve the design and construction of transportation infrastructure.

Status: This project is 40 percent complete. The Principle Investigator has begun the assessment of the rock database and inventory; geotechnical investigation and sampling; some laboratory rock testing; and data analysis.

2.7.16 – RS02221 Reducing Shrinkage in Concrete Bridge Decks using Single and Double Ring Test Methods

Contacts: Principal Investigators:
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Project Champion:
Whitney Wise
Greg Milburn
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Period of Study: Proposal Approved: March 20, 2021
Estimated Completion: September 30, 2022

Funding Summary:

Fiscal Year	Total Contract, Amendment and/or revision Amount	ICAP (11% above Total Contract Amount)	**Total Funds** (Total Contract Amount, state match, and ICAP Funding)	Breakdown of the Total Funds	
				Total Federal SP&R (80% of total contract amount)	Total State Match (20% of total contract amount)
2021	$116,306	$12,794	**$129,100**	$103,280	$25,820

Scope: The overall goal of the proposed research project is to set forth the terms and conditions by which the Principle Investigator shall evaluate critical factors relating to early age shrinkage and to review multiple methods to reduce the factor that contributes to early degradation.

Status: This project is 6 percent complete. The Principle investigator has begun constructing the test specimens and single ring shrinkage test apparatus.

2.7.17 – RS04221 Rapid Safety Assessment Tool for Non-Conventional Roadway Designs and Emerging Technologies: Innovative Artificial Intelligence Application

Contacts: Principal Investigators:
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Project Champion:
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Cheyenne, WY

Period of Study: Proposal Approved: May 20, 2021
Estimated Completion: August 31, 2023

Funding Summary:

Fiscal Year	Total Contract, Amendment and/or revision Amount	ICAP (11% above Total Contract Amount)	**Total Funds** (Total Contract Amount, state match, and ICAP Funding)	Breakdown of the Total Funds	
				Total Federal SP&R (80% of total contract amount)	Total State Match (20% of total contract amount)
2021	$175,115	$19,263	**$194,378**	$155,502	$38,876

Scope: The overall goal of the proposed research project is to set forth the terms and conditions by which the Principle Investigator shall research a proactive road safety assessment for non-conventional designs and emerging technologies for Wyoming utilizing traffic conflict analysis.

Status: No progress reports have been received on this project.

2.7.18 – RS05221 Managing Pavement Friction of Wyoming's Roads Considering Safety

Contacts: Principal Investigators:
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Project Champion:
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Period of Study: Proposal Approved: March 20, 2021
Estimated Completion: June 30, 2023

Funding Summary:

Fiscal Year	Total Contract, Amendment and/or revision Amount	ICAP (11% above Total Contract Amount)	**Total Funds** (Total Contract Amount, state match, and ICAP Funding)	Breakdown of the Total Funds	
				Total Federal SP&R (80% of total contract amount)	Total State Match (20% of total contract amount)
2021	$154,025	$16,943	**$170,968**	$136,774	$34,194

Scope: The objective of this project is to improve road safety when maintaining Wyoming's roadway pavement surfaces to ensure adequate skid resistance.

Status: This project is 10 percent complete. The Principle Investigator has been communicating with WYDOT regarding the roadway inventory data and pavement surface friction data needed.

2.7.19 – RS06221 Developing Pavement Marking Management plans for Accommodating Advanced Vehicle Technologies in Wyoming

Contacts: Principal Investigators:
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Project Champion:
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Period of Study: Proposal Approved: March 20, 2021
Estimated Completion: June 30, 2023

Funding Summary:

Fiscal Year	Total Contract, Amendment and/or revision Amount	ICAP (11% above Total Contract Amount)	**Total Funds** (Total Contract Amount, state match, and ICAP Funding)	Breakdown of the Total Funds	
				Total Federal SP&R (80% of total contract amount)	Total State Match (20% of total contract amount)
2021	$115,582	$12,714	**$128,296**	$102,637	$25,659

Scope: The objectives of this study are to develop strategic long-term pavement marking management plans for Wyoming.

Status: A kickoff meeting was held and the advisory group from WYDOT was established. Surveys are being prepared to be disseminated to professionals in Departments of Transportation in North Dakota, South Dakota, Nebraska, Michigan, Colorado, Utah, Idaho, Minnesota, Montana, and Missouri.

2.7.20 – RS07221 Integrating Human Behavior toward the Development of Safer Cooperative Automated Transportation: Implementation of SHRP2 Naturalistic Driving Study

Contacts:	Principal Investigators:	Project Champion:
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	Md Nasim Khan	WYDOT
	University of Wyoming	Cheyenne, WY
	Laramie, WY	

Period of Study: Proposal Approved: August 2, 2021
Estimated Completion: May 2, 2023

Funding Summary:

Fiscal Year	Total Contract, Amendment and/or revision Amount	ICAP (11% above Total Contract Amount)	**Total Funds** (Total Contract Amount, state match, and ICAP Funding)	Breakdown of the Total Funds	
				Total Federal SP&R (80% of total contract amount)	Total State Match (20% of total contract amount)
2021	$177,917	$19,571	**$197,488**	$157,990	$39,498

Scope: The purpose of this project is to utilize the SHRP2 NDS data to understand the complex nature of human behavior, incorporate the behavior for the development of Cooperative Automated Transportation (CAT) and investigate the CAT capacity at different levels of Market Penetration Rates (MPR).

Status: This project is 40 percent complete. The VISSIM simulation model for mileposts 323-329 has been calibrated; microsimulation scenarios have been developed; CV and three types of AV vehicles in microsimulation have been developed; NDS information has been requested; and papers have been presented to the 2022 TRB annual meeting.

2.7.21 – RS08221 Developing a Collision Warning and Collision Avoidance System for WYDOT Snowplows

Contacts:	Principal Investigators:	Project Champion:
	Muhammad Tahmidul Hag	Clifford Spoonemore
	Khaled Ksaibati	WYDOT
	University of Wyoming	Cheyenne, WY
	Laramie, WY	

Period of Study: Proposal Approved: November 15, 2021
Estimated Completion: May 15, 2024

Funding Summary:

Fiscal Year	Total Contract, Amendment and/or revision Amount	ICAP (11% above Total Contract Amount)	Other Funds MPC	**Total Funds** (Total Contract Amount, state match, and ICAP Funding)	Breakdown of the Total Funds	
					Total Federal SP&R (80% of total contract amount)	Total State Match (20% of total contract amount)
2021	$170,046	$18,705	$89,210	**$277,961**	$151,001	$37,750

Scope: The main goal of this study is to develop a collision warning and collision avoidance system for WYDOT snowplow trucks and other maintenance vehicles, and to maximize the capability of preventing crashes in order to minimize the severity of crashes.

Status: No progress reports have been received on this project.

2.7.22 – RS09221 Evaluation of the WYDOT Research Center 2021

Contacts:	Principal Investigators: Omar Albatayneh Khaled Ksaibati University of Wyoming Laramie, WY	Project Champion: Ethan Crockett WYDOT Cheyenne, WY

Period of Study: Proposal Approved: November 11, 2021
Estimated Completion: October 15, 2023

Funding Summary:

Fiscal Year	Total Contract, Amendment and/or revision Amount	ICAP (11% above Total Contract Amount)	**Total Funds** (Total Contract Amount, state match, and ICAP Funding)	Breakdown of the Total Funds	
				Total Federal SP&R (80% of total contract amount)	Total State Match (20% of total contract amount)
2021	$68,228	$7,505	**$75,733**	$60,586	$15,147

Scope: The main goal of this study is to evaluate the performance of the WYDOT Research Center based on the research studies that were concluded since 2017.

Status: No progress reports have been received on this project.

2.7.23 – RS02222 Utilization of Transportation Structures by Bats in Wyoming: A comprehensive investigation

Contacts:	Principal Investigators:	Project Champion:
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Period of Study: Proposal Approved: March 14, 2022
Estimated Completion: March 14, 2025

Funding Summary:

Fiscal Year	Total Contract, Amendment and/or revision Amount	ICAP (11% above Total Contract Amount)	Other Funds University of Wyoming, Wyoming Game and Fish, Wyoming Governor's Big Game License Coalition Grant	**Total Funds** (Total Contract Amount, state match, and ICAP Funding)	Breakdown of the Total Funds	
					Total Federal SP&R (80% of total contract amount)	Total State Match (20% of total contract amount)
2022	$34,539	$3,799	$102,663	**$38,338**	$30,670	$7,668

Scope: The purpose of this study is to collect bat use data on bridges to aid WYDOT and agency partners in determining what bridge types are attractive to bats and to develop means of mitigation to minimize impacts to bridge maintenance and reconstruction timelines.

Status: No progress reports have been received on this project.

2.7.24 – RS03222 Wyoming Transportation Asset Management Plan (TAMP)

Contacts:	Principal Investigators:	Project Champion:
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Period of Study: Proposal Approved: March 14, 2022
Estimated Completion: March 14, 2025

Funding Summary:

Fiscal Year	Total Contract, Amendment and/or revision Amount	ICAP (11% above Total Contract Amount)	Other Funds	**Total Funds** (Total Contract Amount, state match, and ICAP Funding)	Breakdown of the Total Funds	
					Total Federal SP&R (80% of total contract amount)	Total State Match (20% of total contract amount)
2022	$179,877	$19,786		**$199,663**	$159,730	$39,933

Scope: The project will only consider pavement and bridge assets to investigate the supportive techniques of central funding allocation and district practices at the network level.

Status: No progress reports have been received on this project.

2.7.25 – RS04222 Assessment of Motorcycle Safety in Wyoming: Fatal and Sever Crashes, Contributing Factors, and Potential Countermeasures

Contacts: Principal Investigators:
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Project Champion:
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Period of Study: Proposal Approved: March 14, 2022
Estimated Completion: March 14, 2023

Funding Summary:

Fiscal Year	Total Contract, Amendment and/or revision Amount	ICAP (11% above Total Contract Amount)	Other Funds	**Total Funds** (Total Contract Amount, state match, and ICAP Funding)	Breakdown of the Total Funds	
					Total Federal SP&R (80% of total contract amount)	Total State Match (20% of total contract amount)
2022	$50,510	$5,556		**$56,066**	$44,853	$11,213

Scope: The goal of this study is to assess the characteristics of motorcycle safety in Wyoming with the focus on fatal and severe injury crashes, and provide a set of recommendations with a potential to reduce the frequency and severity of motorcycle-related crashes.

Status: No progress reports have been received on this project.

2.7.26 – RS05222 Evaluation and Forecasting of Winter Road Conditions Associated with Blowing Snow for the Wyoming Highway System

Contacts: Principal Investigators:
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Period of Study: Proposal Approved: Contract has not been completed yet
Estimated Completion: Unknown

Funding Summary:

Fiscal Year	Total Contract, Amendment and/or revision Amount	ICAP (11% above Total Contract Amount)	Other Funds	**Total Funds** (Total Contract Amount, state match, and ICAP Funding)	Breakdown of the Total Funds	
					Total Federal SP&R (80% of total contract amount)	Total State Match (20% of total contract amount)
2022	$136,063	$14,967		**$151,030**	$120,824	$30,206

Scope: The goal of this study is to quantify low visibility and low traction road safety conditions due to blowing snow associated with analyzing the wind field, road geometry, quantity of mobile snow, and the location of snow fences.

Status: No progress reports have been received on this project.