



NEBRASKA RESEARCH WORK PROGRAM

FISCAL YEAR 2025
July 1, 2024 - June 30, 2025

Prepared by NDOT Research Section

Submitted April 4, 2024



Figure – Scottsbluff, Nebraska

WORK PROGRAM OVERVIEW

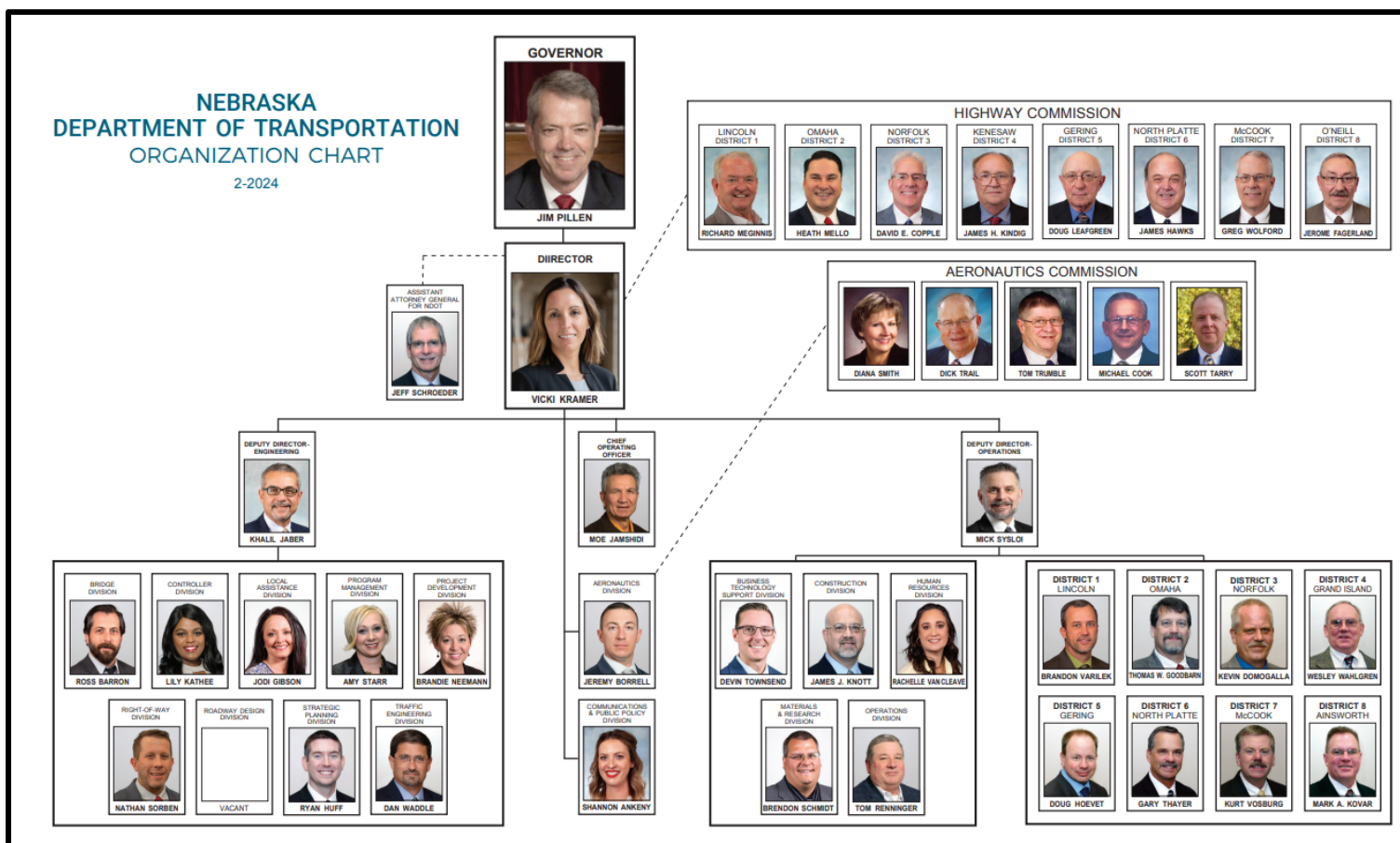
The Nebraska Department of Transportation (NDOT) Materials and Research (M&R) Division administers the research program. The research program's mission is to provide more complete knowledge of the basic characteristics of highway geometrics, traffic flow, safety, structural capabilities, economics, financing, administration, and their effectiveness within the total transportation system. The research program's primary objectives are:

-  Reduce highway construction and maintenance costs
-  Improve the quality of service to the transportation user
-  Increase the planning, operations, and administrative efficiency of various transportation modes
-  Reduce accidents and accident severity
-  Encompass the interrelationship of socioeconomic, environmental, and technological factors in the transportation systems

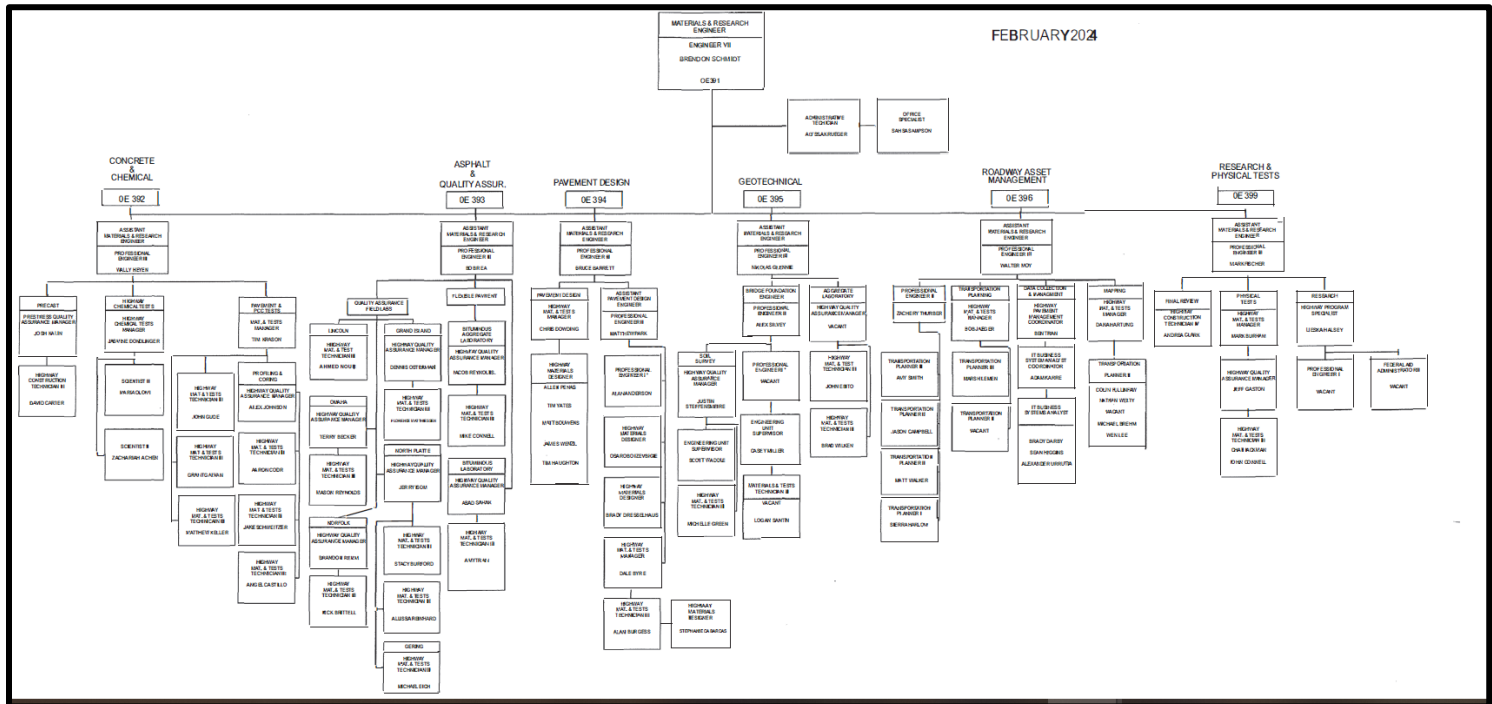
TYPICAL NDOT FEDERALLY FUNDED RESEARCH CYCLE



NEBRASKA DEPARTMENT OF TRANSPORTATION ORGANIZATION CHART



NEBRASKA DEPARTMENT OF TRANSPORTATION MATERIALS & RESEARCH DIVISION ORGANIZATION CHART



ACCOMPLISHMENTS FY-2024 TO DATE

- July to September 2023, the solicitation for Statements of Need was made to the entire State of Nebraska for FY-2025 funding
- Forty-seven (47) Statements of Needs were received.
- WebEx - Virtual meeting were hosted by each Focus group in early October; Nebraska Department of Transportation personnel, industry leaders, contractors, city and county representatives and the Statement of Need presenters;



Materials, Pavements, Maintenance and Construction



Traffic, Safety, Planning and Technology



Structures and Geotechnical



Roadway, Hydraulics and Environmental

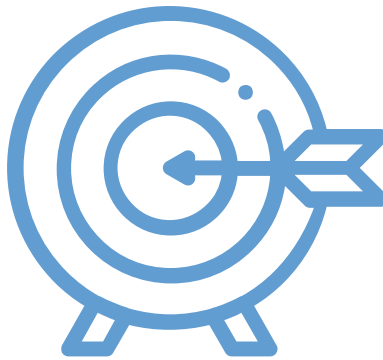
- The Nebraska Transportation Research Council (NTRC) prioritized/selected sixteen (16) Statements of Need from all focus groups.
 - October 30 through November 15th, 2023, NDOT's Research Section organized and held 16 framework review meetings placing technical experts with the researchers to develop a proposal to help accomplish the department's mission.
 - On January 29, 2024, NDOT's Research Section conducted the RAC meeting and added twelve (12) new SPR projects with a total budget of \$1,811,711.
 - NDOT expended approximately \$1.1 million so far in FY-2024 for all on-going research projects and provided financial support to TRB and NCHRP.
- Throughout the year, the Research Staff has held numerous Technical Advisory Committee meetings on active research projects.
- NDOT continues to be the lead state for the Midwest States Regional Pooled Fund Program - TPF-5(193) is in the process of closing and TPF-5(430) is in its final year of research.
- Completed 13 Projects.
- Completed projects has shared with the Nebraska Local Technical Assistance Program (LTAP) The University of Nebraska houses a complete archive of NDOT research reports in their [digital commons](#). Where all research projects are downloaded from all over the world.
- The final research reports have a new cover sheet design and a 508-compliance review by the Nebraska Transportation Center.



Figure – Courtesy of NDOT news and media

RESEARCH WORK PROGRAM GOALS FY-2025

- Establish the FY-2026 research program.
- Monitor research projects and assist Technical Advisory Committees.
- Assist with implementation of research results and added the completed projects a SharePoint site for their follow up.
- Work closely with principal investigators on:
 - Submission of quarterly reports and final reports
 - Presentations to department personnel
- Administration of the Regional Pooled Fund Program activities, which are conducted at the University of Nebraska — Midwest Roadside Safety Facility.
- Compile an Annual Work Program Report to be distributed via the research section website to the public.
- Uploading all Federal Funded research into the Transportation Research Information Services (TRIS) for new projects and Transport Research International Documentation (TRID) for all completed projects.
- Continue to collect implementation plans from the lead technical advisory committee member and ask for technology transfer from Principal Investigators. Distribute, collect, and publish evaluations on each completed project.
- Research Section will continue participation in the research program management software tool and western states consortium pooled funds.
- Start the planning process for the 2025 peer exchange.



CURRENT FUNDING OBLIGATIONS

TPF-5(193) CONTROL NO.: 00778

SUPPLEMENT NUMBER	STUDY TITLES	TOTAL STUDY BUDGET	EXPENDITURES	REMAINING BUDGET
CURRENT PROJECTS				
#128	Dynamic Testing and Evaluation of a New York State DOT Transition between Boxed Guardrail Under AASHTO MASH 2016 TL-3 Guidelines	\$236,626	\$218,024	\$18,602
#134	NYS DOT MASH 2016 Safety Hardware Evaluations - Phase 1	\$955,951	\$572,209	\$383,742
#135	MASH 2016 Safety Hardware Evaluation	\$1,033,463	\$592,314	\$441,149
#142	NDOT Generic End Terminal - Phase II	\$325,393	\$311,166	\$14,227
#144	Midwest Pooled Fund MASH Hardware Clearinghouse	\$51,206	\$11,411	\$39,795
#146	Revision to Midwest Pooled Fund Q & A Website	\$49,745	\$29,412	\$20,333
#154	MASH Testing of Single Sign Support	\$750,000	\$680,597	\$69,403
		\$3,402,384	\$2,415,133	\$987,251

1. Budget Numbers as of 3/31/2024

2. Budget shows expenses that may not be entered into FMIS

TPF-5(430) CONTROL NO.: 01010				
SUPPLEMENT NUMBER	STUDY TITLES	TOTAL STUDY BUDGET	EXPENDITURES	REMAINING BUDGET
CURRENT PROJECTS				
#1	RPFP-20-MGS-2: MGS with Reduced Embedment and Post Spacing over Low-Fill Culverts (Indiana)	\$185,912	\$92,683	\$93,229
#2	PFP-20-AGT-1: Additional Retrofit Options for Post Conflicts within AGTs (New Jersey)	\$251,429	\$111,755	\$139,674
#3	Guidelines for Flaring Thrie-Beam Approach Guardrail Transitions - Phase II	\$302,783	\$229,220	\$73,563
#4	RPFP-2--TERM-1: Further Evaluation of the End Terminals Adjacent to Curb (New Jersey)	\$257,208	\$191,784	\$65,424
#5	RPFP-20-SR-1: Development of a Short-Radius Guardrail for Intersecting Driveways or Roadways (New Jersey)	\$251,032	\$125,110	\$125,922
#9	Contingency FY20 (PF Yr 30) - Year 1	\$11,043	\$0	\$11,043
#15	RPFP-21-CABLE-1: Redesign of the High-Tension Cable Median Barrier – Phase II	\$253,893	\$198,670	\$55,223
#16	RPFP-21-CONC-2: Anchoring Temporary Barrier to Asphalt Pavement Phase II (Wisconsin)	\$224,325	\$126,622	\$97,703
#17	RPFP-21-CONC-3: MASH TL-3 Portable Barrier System (Nebraska/Wyoming)	\$148,296	\$34,198	\$114,098
#18	RPFP-21-AGT-1: Approach Guardrail Transition behind Curb and Elevated Sidewalk (Indiana)	\$146,141	\$42,782	\$103,359
#19	RPFP-21-AGT-3: Guidelines for Flaring Thrie-Beam Approach Guardrail Transitions - Phase III (Continuation)	\$121,307	\$11036	\$110,272
#20	RPFP-21-SIGN-1: Breakaway Systems for Ground-Mounted, Large Steel Sign Support Structures (New Jersey)	\$77,740	\$17,453	\$60,287
#21	RPFP-21-POLE-1: Breakaway Pole Research (Wisconsin)	\$269,455	\$86,704	\$182,751
#22	RPFP-21-CONSULT: Annual Consulting Services Support	\$61,446	\$61,445	\$1
#23	RPFP-21-MPFW: Midwest Pooled Fund Website	\$18,573	\$10,020	\$8,553
#24	RPFP-21-LS-DYNA: LS-DYNA Modeling Enhancement Support	\$43,823	\$19,633	\$24,190
#25	Contingency FY21 (PF Yr 31) - Year 2	\$1	\$0	\$1
#26	RPFP-FY2022-WISDOT-1: Reduced Grading for the MGS Long-Span Guardrail System – Phase I	\$219,891	\$0	\$219,891
PAGE SUBTOTAL		\$2,844,298	\$1,359,114	\$1,485,184

1. Budget Numbers as of 3/31/2024
2. Budget shows expenses that may not be entered into FMIS
3. Only active projects are shown. Supplements which have been completed are not shown.

TPF-5(430) CONTROL NO.: 01010				
SUPPLEMENT NUMBER	STUDY TITLES	TOTAL STUDY BUDGET	EXPENDITURES	REMAINING BUDGET
CURRENT PROJECTS - CONTINUED				
#27	FY22-IND-1-PCB: MASH 2016 TL-3 Design and Evaluation of the Indiana F-Shape PCB in Free-Standing, Asphalt Anchored Configurations, and Transitions	\$530,131	\$82,795	\$447,336
#28	RPFP-FY2022-MGS-4: Evaluation of Increased Blockout Depth with the Midwest Guardrail System	\$262,851	\$21,274	\$241,577
#29	RPFP-FY2022-MGS-5: Surface Mounted Strong-Post MGS	\$217,840	\$172	\$217,668
#30	RPFP-FY2022-AGT-3: Median Approach Guardrail Transition to Concrete Median Barrier	\$233,888	\$566	\$233,322
#31	RPFP-FY2022-WZ-2: MASH TL-3 Portable Barrier System – Phase II	\$331,619	\$353	\$331,266
#32	RPFP-FY2022-WZ-3: Midwest PCB – Anchored Median Installations	\$155,262	\$28,955	\$126,307
#33	RPFP-FY2022-CONSULT: Annual Consulting Services Support	\$65,000	\$1,579	\$63,421
#34	RPFP-FY2022-MPFW: Midwest Pooled Fund Website	\$12,111	\$973	\$11,138
#35	RPFP-FY2022-LS-DYNA: LS-DYNA Modeling Enhancement Support	\$40,000	\$0	\$40,000
#36	Contingency FY22 (PF Yr 32) - Year 3	\$46,459	\$0	\$46,459
#37	RPFP-FY2023-MGS-1: Modification and Evaluation of the MGS Long Span with Increased Span Length	\$377,870	\$281	\$377,589
#38	RPFP-FY2023-AGT-1: Guidelines for Flaring Thrie-Beam Approach Guardrail Transitions - Phase IV (Continuation)	\$310,591	\$98	\$310,493
#39	RPFP-FY2023-GET-1: Generic End Terminal – Further Development and Evaluation	\$437,226	\$6,138	\$431,088
#40	RPFP-FY2023-MWQA-1: Continued Revisions to MwRSF Pooled Fund Q & A Website	\$45,421	\$4,566	\$40,855
#41	RPFP-FY2023-AUTO-1: Coordination and Collaboration with Vehicle Manufacturers and Automotive Industry	\$56,219	\$250	\$55,969
#42	RPFP-FY2023-CONSULT: Annual Consulting Services Support	\$65,000	\$0	\$65,000
#43	RPFP-FY2023-MPFW: Midwest Pooled Fund Website	\$12,868	\$0	\$12,868
#44	RPFP-FY2023-LS-DYNA: LS-DYNA Modeling Enhancement Support	\$40,000	\$0	\$40,000
#45	Contingency FY2023 (PF Yr 33) - Year 4	\$19,805	\$0	\$19,805
#46	MASH TL-3 Evaluation of Illinois DOT's Steel Railing, Type SMX	\$319,463	\$0	\$319,463
#47	MnDOT MASH TL-3 THRIE BEAM BULLNOSE INSTALLATION MANUAL	\$110,761	\$0	\$110,761
#48	FY2023-WisDOT-Slope-1: Guidance for MGS Installed Adjacent to Steep Slopes at Variable Offsets-Phase I	\$142,639	\$0	\$142,639
PAGE SUBTOTAL		\$3,833,024	\$148,000	\$3,685,024

1. Budget Numbers as of 3/31/2024
2. Budget shows expenses that may not be entered into FMIS
3. Only active projects are shown. Supplements which have been completed are not shown.

TPF-5(430) CONTROL NO.: 01010				
SUPPLEMENT NUMBER	STUDY TITLES	TOTAL STUDY BUDGET	EXPENDITURES	REMAINING BUDGET
CURRENT PROJECTS - CONTINUED				
#49	RPFP-FY2023-WISDOT-OVERLAY-1: MASH TL-3 Evaluation Of New Jersey Shape Parapet With 3-in. Overlay	\$251,591	\$0	\$251,591
#50	FY2024-WY-1-BOX: Development and Evaluatino of Box-Beam Barrier Configuration for Shielding Fixed Objects and Bridge Ends in Medians	\$799,998	\$0	\$799,998
#51	MASH Evaluation of Florida Single Post Signs Phase II	\$750,000	\$0	\$750,000
#52	FY2024-WISC-CONC-1: Anchoring Temporary Barrier to Asphalt Phase III	\$167,436	\$0	\$167,436
#53	RPFP-FY2024-CONC-3: Grade-Separated Concrete Median Barrier	\$213,580	\$0	\$213,580
#54	RPFP-FY2024-CONC-5: Guidelines for Concrete Median Barrier Anchorage to Slabs	\$309,915	\$0	\$309,915
#55	RPFP-FY2024-MGS-1: W-Beam and Thrie Beam Splice Joint Redesign – Phase I	\$86,092	\$0	\$86,092
#56	RPFP-FY2024-MGS-3: Reduced Grading for the MGS Long-Span Guardrail System	\$322,730	\$0	\$322,730
#57	RPFP-FY2024-THRIE-1: Development of a Limited Deflection MASH TL-4 Thrie-Beam Guardrail	\$184,262	\$0	\$184,262
#58	RPFP-FY2024-GET-1: Development of a Generic End Terminal - Phase IV	\$138,529	\$0	\$138,529
#59	RPFP-FY2024-AUTO-1: LS-DYNA Investigation of Electric Vehicles and Roadside Hardware	\$142,319	\$0	\$142,319
#60	RPFP-FY2024-CONSULT: Annual Consulting Services Support	\$65,000	\$0	\$65,000
#61	RPFP-FY2024-MPFW: Midwest Pooled Fund Website	\$12,571	\$0	\$12,571
#62	RPFP-FY2024-LS-DYNA: LS-DYNA Modeling Enhancement Support	\$40,000	\$0	\$40,000
#63	RPFP-FY2024-BR-TRAINING: Implementation of MASH Bridge Railing and Deck Overhang Research	\$45,488	\$0	\$45,488
#64	RPFP-FY2024-CALTRANS-LSDYNA: LS-DYNA Simulation Consulting Support	\$30,000	\$0	\$30,000
#65	RPFP-FY2024-WISC-CONC-2: Portable Concrete Barrier Anchorage with Removeable Anchors	\$130,000	\$0	\$130,000
#66	MASH Evaluation of Forida Single Post Signs Phase II	\$750,000	\$0	\$750,000
#67	FY2024-WISC-CONC-1: Anchoring Temporary Barrier to Asphalt Phase III	\$167,436	\$0	\$167,436
PAGE SUBTOTAL		\$4,606,947	\$0	\$4,606,947
TOTAL TPF-5(430) ACTIVE PROJECTS		\$11,284,269	\$1,507,114	\$9,777,155

1. Budget Numbers as of 3/31/2024

2. Budget shows expenses that may not be entered into FMIS

3. Only active projects are shown. Supplements which have been completed are not shown.

Pooled Fund Projects and Other Contributions (100% Federally Funded)

Study Titles	Funding Type	Expenditures FY2024	Commitments for FY2025
TPF-5(347) Development of Maintenance Decision Support System	Y550	\$30,000	\$30,000
TPF-5(430) Midwest Roadside Safety Pooled Fund Program	Y550	\$65,000	\$65,000
TPF-5(437) Technology Transfer Concrete Consortium	Y550	\$12,000	\$12,000
TPF-5(438) Smart Work Zone Deployment Initiative	Y550	\$25,000	\$25,000
TPF-5(447) Traffic Control Device Consortium	Y550	\$30,000	\$30,000
TPF-5(448) Improving Specifications to Resist Frost Damage in Modern Concrete Mixes	Y550	\$20,000	\$20,000
TPF-5(451) Road Usage Charge (RUC) America	Y550	\$25,000	\$25,000
TPF-5(456) EconWorks - Improved Economic Insight	Y550	\$8,000	\$0
TPF-5(465) Consortium for Asphalt Pavement Research and Implementation (CAPRI)	Y560	\$10,000	\$10,000
TPF-5(466) National Road Research Alliance - NRRRA (Phase II)	Y550	\$75,000	\$75,000
TPF-5(467) Project Management Software for Research	Y550	\$0	\$0
TPF-5(470) Guidelines for Determining Traffic Signal Change and Clearance Intervals	Y550	\$30,000	\$30,000
TPF-5(479) Clear Roads Winter Highway Operations Phase III	Y550	\$25,000	\$25,000
TPF-5(480) Building Information Modeling (BIM) for Infrastructure	Y550	\$30,000	\$30,000
TPF-5(492) 2023 through 2025 Biennial Asset Management Conference and Training on Implementation Strategies	Y550	\$12,000	\$12,000
TPF-5(508) Concrete Bridge Engineering Institute (CBEI)	Y550	\$30,000	\$30,000
TPF-5(515) Evaluation of Low Cost Safety Improvements	Y550	\$5,000	\$5,000
TPF-5(520) Improving Traffic Detection Through New Innovative i-LST Technology Demonstration Pilot Print	Y550	\$30,000	\$30,000
TPF-5(523) Building Information Modeling (BIM) for Bridges and Structures Phase II	Y550	\$20,000	\$20,000
TPF-5(525) 2nd International Roadside Safety Conference and Peer Exchange	Y550	\$10,000	\$0
TPF-5(526) Western States Consortium	Y550	\$15,000	\$15,000
Commitment for FY2025		\$507,000	\$489,000
Transportation Research Board (TRB) Annual Transfer	Y550	\$108,600	\$109,034
National Cooperative Highway Research Program (NCHRP) Annual Transfer	Y550	\$408,858	\$410,493
Total		\$1,024,458	\$1,008,528

* Solicitations are pooled funds pending approval before turning into a full pooled fund project. Funds will not be used until the project is approved.

IN-PROGRESS PROJECTS					
SPR-P1(20) CONTROL NO.: 00730L					
PROJECT NUMBER	FUNDING TYPE	STUDY TITLES	TOTAL STUDY BUDGET	EXPENDITURES	REMAINING BUDGET
CURRENT ACTIVE PROJECTS					
M103	Z560	Simple for Dead Continuous for Live (SDCL) Steel Girder Bridges with UHPC and GFRP	\$132,358	\$123,651	\$8,707
M116	Z560	Effect of Antioxidant Additives and Restorations on Performance of Asphalt Binders and Mixtures – Phase I	\$445,300	\$139,614	\$305,686
M118	Z560	Computation of Peak and Low Flow Statistics and StreamStats GIS Implementation in the Elkhorn River Basin in Nebraska	\$35,000	\$35,000	\$0
BUDGET FOR IN PROGRESS SPR-P1(20) PROJECTS			\$612,658	\$263,266	\$314,392
P100	Z560	Contingencies	\$678,826	\$40,406	\$638,420
P088	Z560	Administration	\$6,000		\$6,000
P089	Z560	Research Implementation	\$50,000		\$50,000
TOTAL BUDGET FOR SPR-P1(20)			\$1,347,484	\$303,672	\$1,008,812

ALL EXPENDITURES TO-DATE FOR SPR-P1(20)	Total	Federal	State
	\$3,365,191	\$2,692,152	\$673,038

1. Budget Numbers as of 3/31/2024
2. Budget shows expenses that may not be entered into FMIS
3. Only active projects are shown. Completed projects are not shown.

IN-PROGRESS PROJECTS						
CONTROL NUMBER	PROJECT NUMBER SPR-	FUNDING TYPE	STUDY TITLES	TOTAL STUDY BUDGET	EXPENDITURES	REMAINING BUDGET
01021B	FY21(003)	Z560	Effect of Antioxidant Additives and Recycling Agents on Performance of Asphalt Binders and Mixtures – Phase II	\$167,602	\$84,211	\$83,391
01021C	FY21(004)	Z560	Approach Guardrail Transition Retrofit to Existing Concrete Parapets and Bridges	\$113,907	\$100,711	\$13,196
01034C	FY22(003)	Y560	WMA Short Term Aging	\$140,616	\$62,563	\$78,053
01034E	FY22(005)	Y560	Application of Remote Sensing and Hydrologic Modeling to Reduce Highway Flooding in the Nebraska Sandhills	\$143,166	\$111,541	\$31,625
01034H	FY22(008)	Y560	Production of Cast-in-Place UHPC for Bridge Applications	\$83,996	\$71,936	\$12,060
01034J	FY22(009)	Y560	Accelerated Bridge Construction Decision Tool	\$90,592	\$39,662	\$50,930
01046A	FY23(013)	Y560	High-Mast Tower Foundation – Phase II	\$153,428	\$70,428	\$83,000
01046B	FY23(014)	Y560	Gravel Road Performance Enhancements	\$166,064	\$82,028	\$84,036
01046C	FY23(015)	Y560	Application of Cementitious Materials and Fiber Reinforcement to Enhance Lime Stabilization for Nebraska Shale Soils	\$142,129	\$110,693	\$31,436
01046D	FY23(016)	Y560	Nebraska Balanced Mix Design – Phase II	\$141,914	\$18,468	\$123,446
01046E	FY23(017)	Y560	Development of the Nebraska Department of Transportation Winter Severity Index – Phase II	\$183,603	\$103,472	\$80,131
01046F	FY23(018)	Y560	Updating Rainfall Zones and Intensities in Nebraska for Improved Design of Non-Bridge Sized Drainage Structures: Phase I	\$120,000	\$81,780	\$38,220
01046G	FY23(019)	Y560	Minimizing Take of Threatened Rattlesnakes and Optimizing Project Review in SE Nebraska	\$62,238	\$0	\$62,238
01046H	FY23(020)	Y560	A Statewide Geographic Information System (GIS) as a Predictive Tool for Locating Deeply Buried Archeological Deposits in Nebraska: (PHASE III)	\$120,130	\$39,763	\$80,367
01046J	FY23(021)	Y560	Impacts of Stream Bed Adjustments on Local Stream Morphology at Bridge Crossings	\$134,860	\$77,949	\$56,911
01046K	FY23(022)	Y560	Air-coupled GPR and HD Imaging for High-Speed Evaluation of Concrete Bridge Decks with Asphalt Overlays	\$166,897	\$55,159	\$111,738
01046L	FY23(023)	Y560	Regression Equation Update with NET and USGS	\$74,600	\$64,600	\$10,000
01046M	FY23(024)	Y560	Repair/Preservation of Concrete Bridges Using Ultra-High-Performance Concrete	\$80,007	\$36,028	\$43,979
01046N	FY23(025)	Y560	Modeling Pedestrian and Bicyclist Crash Exposure with Location-Based Service Data	\$184,629	\$134,841	\$49,788
01057A	FY24(026)	Y560	Evaluation of Critical Shear Strength of Soils in Nebraska Based on Revised CPT	\$158,705	\$0	\$158,705
01057B	FY24(027)	Y560	The Use of Recycled Plastic in Asphalt Pavements: Feasibility Study	\$148,494	\$0	\$148,494
01057C	FY24(028)	Y560	Local Characterization of Unbound Materials (Soils/Aggregates) for AASHTOWare Pavement ME Design in Nebraska	\$159,036	\$12,011	\$147,025
01057D	FY24(029)	Y560	Assessment of Winter Maintenance Performance Objectives Using Maintenance Decision Support System	\$253,736	\$25,899	\$227,837
01057E	FY24(030)	Y560	Development and Evaluation of Crashworthy Approach Guardrail Transition with Increased Span Length between Concrete Bridge Rail and First Transition Post: Phase I	\$175,145	\$0	\$175,145
01057F	FY24(031)	Y560	Sediment Collection and Analysis of Sediment Contributing to State Storm Sewer Facilities	\$181,428	\$0	\$181,428
01057G	FY24(032)	Y560	Update of Intersection/Interchange Guidelines for Rural Expressways in Nebraska	\$179,316	\$0	\$179,316
01057H	FY24(033)	Y560	Drainage Area Limitations for NDOT Hydrologic Computations	\$114,528	\$9,425	\$105,103
01057J	FY24(034)	Y560	Ultra-High-Performance Concrete (UHPC) for Bridge Deck Overlay and Structural Deck Repair	\$152,761	\$5,500	\$147,261
01057K	FY24(035)	Y560	Framework for Quantifying Benefits to Disadvantaged Communities: Application to Nebraska's National Electric Vehicle Infrastructure (NEVI) Plan	\$179,055	\$0	\$179,055
01057L	FY24(036)	Y560	Assessment of Truck Parking Demand and Safety During Normal and Severe Weather Conditions in Nebraska	\$188,885	\$0	\$188,885
01057M	FY24(037)	Y560	Guidance for Left-Turn Flashing Yellow Arrow (FYA) Implementation in Nebraska	\$177,066	\$0	\$177,066
BUDGET FOR IN PROGRESS PROJECTS				\$4,538,533	\$1,398,667	\$3,139,866

- Budget Numbers as of 3/31/2024
- Budget shows expenses that may not be entered into FMIS
- Only active projects are shown. Completed projects are not shown.

NEW FY2025 PROJECTS						
CONTROL NUMBER	PROJECT NUMBER SPR-	FUNDING TYPE	STUDY TITLES	TOTAL STUDY BUDGET	EXPENDITURES	REMAINING BUDGET
01071A	FY25(038)	Y560	Electric Arc Furnace Slag as a Paving Material – Phase I: Physical, Chemical, Morphological and Mineralogical Characterization and Environmental Analysis	\$151,272	\$0	\$151,272
01071B	FY25(039)	Y560	Evaluation of Low-Temperature Cracking (LTC) Performance Testing Methods to Assess Nebraska Asphalt Mixtures	\$152,382	\$0	\$152,382
01071C	FY25(040)	Y560	The Utilization of Waste Plastic as a Polymer Modifier for Asphalt Binders	\$141,874	\$0	\$141,874
01071D	FY25(041)	Y560	Effect of Nighttime Lighting on Construction Workers' Safety	\$147,497	\$0	\$147,497
01071E	FY25(042)	Y560	Optimization of Energy Dissipation Using Staggered Weirs	\$136,135	\$0	\$136,135
01071F	FY25(043)	Y560	Evaluation of NDOT's Construction Stormwater Detention Measures Using Full-Scale Testing Techniques	\$199,999	\$0	\$199,999
01071G	FY25(044)	Y560	Integrated Bridge, Transportation Network, and Community Resilience Framework for Nebraska	\$200,877	\$0	\$200,877
01071H	FY25(045)	Y560	Refined Analysis of Slab Bridges for Load Rating	\$40,635	\$0	\$40,635
01071J	FY25(046)	Y560	Revised Curing Practices for NDOT Bridge Decks to Minimize Restrained Shrinkage Cracks	\$165,460	\$0	\$165,460
01071K	FY25(047)	Y560	Effect of Bridge Width on Crashes in Nebraska	\$152,230	\$0	\$152,230
01071L	FY25(048)	Y560	Development of Accurate and Reliable Average Annual Daily Traffic (AADT) Factoring Methods	\$150,732	\$0	\$150,732
01071M	FY25(049)	Y560	Crash Modification Factor and Feasibility Analysis of Lighting Rural Intersections in Nebraska	\$172,618	\$0	\$172,618
BUDGET FOR NEW PROJECTS				\$1,811,711	\$0	\$1,811,711

OTHER PROGRAM ITEMS						
CONTROL NUMBER	PROJECT NUMBER SPR-	FUNDING TYPE	STUDY TITLES	TOTAL STUDY BUDGET	EXPENDITURES	REMAINING BUDGET
RAPID RESPONSE RESEARCH						
			Rapid Response Research FY2023 Allocation	\$180,000	N/A	N/A
			Rapid Response Research FY2024 Allocation	\$35,000	N/A	N/A
			Rapid Response Research FY2025 Allocation	\$200,000	N/A	N/A
Funds Allocated for Rapid Response Research				\$415,000	N/A	N/A
01057N	RRR(001)	Y560	Low-Cement Concrete (LCC) Mixture for Bridge Decks and Rails	\$13,200	\$9,917	\$3,283
01071N	RRR(002)	Y560	Feasibility Study of Local Waste Plastic Materials in Concrete	\$75,000	\$0	\$75,000
Project Sub-Total				\$88,200	\$9,917	\$78,283
Total Available Funds for Rapid Response Research				\$326,800	N/A	N/A
PROGRAM MANAGEMENT, IMPLEMENTATION, AND COORDINATION RESOURCES						
TBD	TBD		Consultant use for Implementation and Research Coordination	\$25,000	\$0	\$25,000
TBD	TBD		2025 Peer Exchange Planning and Excecution	\$50,000	\$0	\$50,000
BUDGET FOR NEW PROJECTS AND OTHER RESOURCES				\$2,301,711	\$9,917	\$2,291,794

1. Budget Numbers as of 3/31/2024
2. Budget shows expenses that may not be entered into FMIS
3. Only active projects are shown. Completed projects are not shown.



IN PROGRESS RESEARCH PROJECTS DESCRIPTION

PROJECT NUMBER	M103
PROJECT TITLE	Simple for Dead Continuous for Live (SDCL) Steel Girder Bridges with UHPC and GFRP
PRINCIPAL INVESTIGATOR	Joshua S. Steelman – UNL
PROJECT START DATE	7/1/2019
PROJECT COMPLETION DATE	12/31/2022
TECHNICAL ADVISORY COMMITTEE	Fouad Jaber, Steve Sabra, Lynden Vanderveen, Maher Tadros-e-Construct, Douglas and David Mraz-FHWA
PROJECT TOTAL COSTS	\$132,358
PROJECT EXPENDITURES TO DATE	\$123,651
NUMBER OF EXTENSIONS GRANTED	Two (2)
PERCENTAGE OF PROJECT COMPLETE	85%
STATUS	Behind Schedule
FY-2025 BUDGET	\$8,707
FY-2025 TASKS TO BE COMPLETED	Tasks 2,5, 6, 7 & 8

Background: This research will investigate optimized construction methods for the diaphragm to provide comparable or superior constructability and structural performance, compared to existing SDCL for steel girder bridge details, when using ultra-high performance concrete (UHPC) at the girder continuity locations. Glass Fiber Reinforced Polymer (GFRP) in UHPC GFRP has been studied as a viable alternative to steel reinforcing to reduce life cycle costs for bridge structures, especially decks. The material behavior is well documented for uses in conventional concrete but has not yet been thoroughly studied for uses in UHPC. The combination of UHPC and GFRP can offer an essentially maintenance-free structural system, with negligible cracking in the UHPC, and non-corrosive glass-reinforced polymer at crossing reinforcing bridging to conventional concrete in decks. The development length of steel reinforcing is known to be much shorter than in conventional concrete (Graybeal, 2014). Lap splices on the order of 5 to 6 inches have been implemented in practice for steel in UHPC. The required development and lap splice lengths for GFRP have received only limited attention at this time. Additionally, the susceptibility of steel crossing reinforcing to corrosion at the cold joint between conventional concrete and UHPC requires that concrete surfaces be roughened before placing UHPC. This additional labor cost can potentially be avoided by using GFRP. The availability of Owens Corning as a local resource in the state of Nebraska, and the willingness on the part of their company to collaborate and donate materials and expertise, present opportunities that will be leveraged in the proposed research for the benefit of NDOT.

Objective: The primary objectives of this research are to:

1. Develop details to optimize SDCL steel girder structural design and construction for material and construction efficiency with UHPC,
2. Identify available software tools for SDCL steel girder design and rating, and/or develop an action plan for modification to existing software, as applicable, and
3. Characterize development behavior and required embedment lengths for full development of GFRP bars in UHPC.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Literature Review	\$3,977	100%
Task 2: SDCL Field Surveys	\$2,253	20%
Task 3: Parametric SDCL Scoping Study	\$12,164	100%
Task 4: GFRP in UHPC Direct Tension Tests	\$12,775	100%
Task 5: GFRP Lap Splices in UHPC Deck Joint Tests	\$10,778	91%
Task 6: Experimental SDCL Validation	\$56,522	70%
Task 7: Software Integration Study	\$18,751	62%
Task 8: Documentation and Presentation	\$15,138	85%

Deliverables: The primary benefits of this project will be reduced cost for multi-span steel girder bridges and reduced life-cycle maintenance cost (potentially maintenance free) with more resilient joint construction. Additionally, this project will further extend the benefits of UHPC by documenting GFRP development behavior. The research will support the design option to use GFRP crossing reinforcing at cold joint interfaces between conventional concrete in the deck and UHPC in longitudinal deck closure joints. GFRP will be more tolerant of any de-icing chemical penetration that may occur through road surface paving and membranes. Therefore, using GFRP crossing reinforcing could justify waiving the surface roughening currently required to enhance interlock at conventional/UHPC cold joints. Lastly, the investigations into SDCL with UHPC at continuity joints and GFRP development in UHPC can potentially improve the longevity of the structure at continuity locations.

Performance: Project is behind schedule and PI is working on draft report.

PROJECT NUMBER	M116
PROJECT TITLE	Effect of Antioxidant Additives and Restorators on Performance of Asphalt Binders and Mixtures – Phase I
PRINCIPAL INVESTIGATOR	Jamilla Teixeira UNL and Robert Rea – NDOT Materials & Research
PROJECT START DATE	7/1/2019
PROJECT COMPLETION DATE	5/31/2024
TECHNICAL ADVISORY COMMITTEE	Jasmine Dondlinger, Bruce Barrett, Matt Park, and Robert Rea
PROJECT TOTAL COSTS	\$445,300
PROJECT EXPENDITURES TO DATE	\$139,614
NUMBER OF EXTENSIONS GRANTED	Two (2)
PERCENTAGE OF PROJECT COMPLETE	97.4%
STATUS	PI is working on draft report
FY-2025 BUDGET	\$305,686
FY-2025 TASKS TO BE COMPLETED	Tasks5

Background:

The use of recycled materials, such as reclaimed asphalt pavement (RAP), recycled asphalt shingle (RAS), glass, and ground tire rubber, is a cost-effective and environmentally-friendly production method in the asphalt paving industry. The effects of recycled materials on asphalt mixtures have been investigated and reported by many researchers [1-4]. An extensive literature review reveals that the increase in stiffness, which is due to the aged asphalt binder present in RAP, is the main drawback caused by introducing RAP in asphalt mixtures [1, 5]. On the other hand, RAP in asphalt mixtures can result in an improvement in the rutting resistance of RAP blended mixtures [5-7]. The aging of an asphalt binder has a direct relationship with the stiffness and durability of asphalt mixtures [8-11].

Objective: This research aims to investigate the effect of various Ras and one antioxidant additive on performance of asphalt binders and mixtures. Testing will be performed on various blends of Ras and antioxidants containing laboratory aged materials (up to 100%). The laboratory tests will be performed to evaluate chemical properties (e.g., SARA, FTIR, elemental analysis) of the additives and binders, rheological performance (e.g., PG, Glover-Rowe) of the binders, and mechanical properties (e.g., SCB and TSR) of the mixtures. In addition, the possible correlation between chemical characteristics of the additives and rheological/mechanical properties of the binders/mixtures will be examined.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Literature Review	\$19,545	100%
Task 2: Materials Selection	\$16,002	100%
Task 3: Laboratory Tests	\$54,154	100%
Task 4: Analysis of Test Results	\$32,764	100%
Task 5: Documentation and Presentation	\$17,324	99%

Deliverables: The findings of this research study will affect Nebraska asphalt binder mixtures specifications. Test results and findings will be used to provide useful implementation guidelines of Nebraska asphalt binders and mixtures containing laboratory aged materials. This research would also bring clear benefits in sustainability of pavements by expanding their service life sustainability by expanding the use of recycling materials into our pavement engineering.

Performance PI is working on draft report.

PROJECT NUMBER	M118
PROJECT TITLE	Computation of Peak and Low Flow Statistics and StreamStats GIS Implementation in the Elkhorn River Basin in Nebraska
PRINCIPAL INVESTIGATOR	Kellan Strauch – USGS
PROJECT START DATE	9/7/2018
PROJECT COMPLETION DATE	12/31/2023
TECHNICAL ADVISORY COMMITTEE	Kirk Harvey
PROJECT TOTAL COSTS	\$35,000
PROJECT EXPENDITURES TO DATE	\$35,000
NUMBER OF EXTENSIONS GRANTED	Two (2)
PERCENTAGE OF PROJECT COMPLETE	55%
STATUS	Behind Schedule – Working Draft Report
FY-2025 BUDGET	\$0
FY-2025 TASKS TO BE COMPLETED	Tasks 1, 2, 3 & 4

Background: The project is to develop a model for the Elkhorn River Basin in Nebraska which has not been updated since the 1980's. The model is used by the department in developing flood modeling and allowing better flow and high water elevations for bridge designers.

Objective: This project will develop the Elkhorn River Basin model. Peak and low flow statistic computation will be computed using Bulletin 17C parameters for 20 streamflow gages in the Elkhorn basin. Once computed and analyzed, the information will be incorporated into the web-based StreamStats GIS based format. After testing, the data will be released for publication.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Peak flow statistic computation w/ Bulletin 17C for 20 streamflow gages in Elkhorn Basin Task 1a: Compilation of peak flow data Task 1b: Compute peak flow statistics to 2015 Task 1c: Comparison to USACE computations Task 1d: Compute peak flow statistics to 2018 Task 1e: Update peak flow statistic to 2019 (pending publication of streamflow record and updated regional skew)	\$9,500	90% 100% 100% 100% 100% 75%
Task 2: Low flow statistic computation Task 2a: Compilation of streamgage daily flow data Task 2b: Low flow statistics computation using R statistical package DV stats Task 2c: Update low flow statistic (pending publication of streamflow record)	\$7,500	90% 100% 100% 80%
Task 3: GIS implementation into StreamStats Task 3a: Acquire stream center lines for NeDNR Task 3b: LiDAR prep (burning stream center lines) Task 3c: Development of flow accumulation and flow direction grids Task 3d: Online StreamStats implementation	\$12,000	75% 100% 80% 70% 0%
Task 4: Publication Task 4a: USG Scientific Investigations report Task 4b: GIS data release (data sets and metadata)	\$6,000	50% 50% 50%

Deliverables: This project will result in the development and implementation of peak flow statistic computation, low flow statistic computation, GIS implementation into StreamStats and publication for use.

Performance: Project is Behind Schedule – Working on Draft Report.

CONTROL NUMBER	01021B
PROJECT NUMBER	FY21 (003)
PROJECT TITLE	Effect of Antioxidant Additives and Recycling Agents on Performance of Asphalt Binders and Mixtures – Phase II
PRINCIPAL INVESTIGATOR	Jamilla Teixeira – UNL and Robert Rea – NDOT Materials & Research
PROJECT START DATE	7/1/2020
PROJECT COMPLETION DATE	12/21/2024
TECHNICAL ADVISORY COMMITTEE	Robert Rea, Bruce Barrett, Jasmine Dondlinger, Kar Sia and Matthew Park
PROJECT TOTAL COSTS	\$167,602
PROJECT EXPENDITURES TO DATE	\$84,211
NUMBER OF EXTENSIONS GRANTED	Two (2)
PERCENTAGE OF PROJECT COMPLETE	99%
STATUS	On Approved Revised Schedule
FY-2025 BUDGET	\$83,391
FY-2025 TASKS TO BE COMPLETED	Tasks 5

Background: The use of recycling agents (RAs) (i.e., rejuvenators or softening agents) has gained significant attention from industry on a global scale. Its recent worldwide interest has grown as the world's population is placing a much larger focus on world climate, pollution, and ways to control the CO2 excess through reduce, reuse, and recycle. The recycling of waste materials and reducing the carbon footprint of manufactured products through the conservation of energy and reduction on the use of raw materials has become a primary focus. The use of properly engineered RA's and mix designs can effectively recover the properties of the aged asphalt binders and provide equivalent and in some cases better performing pavements. Current research has found that RAs can improve the cracking resistance, while being capable of maintaining the rutting resistance of the mixtures. However, there are some concerns about the effect of RAs on the moisture damage resistance and the long-term performance (aging) of these additives.

The idea of modifying the properties of aged binders using RAs and providing long-term age resistance through the addition of antioxidants seems to be a viable solution. Based on the test results that the PI obtained from the previous research (funded proposal number: SPR-P1(20) M116), the combination of these technologies was proved effective and can bring significant pavement life cycle cost savings, provide longer-lasting and more sustainable roadway pavements. However, the focus of this first phase of this research was to investigate if this chemistry combination would work, so it was tested on only one antioxidant, one unmodified asphalt binder and a selection of RAs.

Objective: The second phase of this research will study the effect of various RAs and antioxidant additives and their performance with modified asphalt binders and mixtures. Various tests will be performed on different combinations of RAs and antioxidants containing virgin and RAP materials to characterize physical characteristics and rheological performances of the binders as well as mechanical properties of the mixtures.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Literature Review	\$16,968	100%
Task 2: Materials Selection	\$16,801	100%
Task 3: Laboratory Tests	\$58,119	100%
Task 4: Analysis of Test Results	\$33,555	100%
Task 5: Documentation and Presentation	\$19,796	95%

Deliverables: Test results and findings will be used to provide implementation guidelines for common binder grades and mixes used in the central United States containing RAP materials. This research will also bring significant pavement life cycle cost savings, provide longer-lasting and more sustainable roadway pavements.

Performance: Project has an approved extension request, and it is up to date with the current tasks and progress.

PROJECT NUMBER	FY21 (004)
PROJECT TITLE	Midwest Guardrail System (MGS) Thrie Beam Approach Guardrail Transition (AGT) Retrofit to Existing Concrete Parapets and Bridges
PRINCIPAL INVESTIGATOR	Scott Rosenbaugh – UNL
PROJECT START DATE	7/1/2020
PROJECT COMPLETION DATE	9/30/2023
TECHNICAL ADVISORY COMMITTEE	Fouad Jaber, Ross Barron, Mike Vigil, , Austin White, David Mraz-FHWA,
PROJECT TOTAL COSTS	\$113,907
PROJECT EXPENDITURES TO DATE	\$100,711
NUMBER OF EXTENSIONS GRANTED	Two (2)
PERCENTAGE OF PROJECT COMPLETE	100%
STATUS	PI submitted draft report waiting for TAC Review
FY-2024 BUDGET	\$13,196
FY-2024 TASKS TO BE COMPLETED	Tasks completed

Background: When a roadway/bridge is resurfaced with an overlay, NDOT plans to replace the AGT adjacent to the bridge with a MASH TL-3 crashworthy design. To minimize repair costs, NDOT does not desire to replace or alter any bridge rails with adequate structural capacity and height. Bridge rails installed under NCHRP 230 or earlier standards are likely too short for current standards and need to be replaced, but bridge rails installed to NCHRP Report 350 standards should meet MASH TL-3 criteria and could remain in place. However, this creates a problem of attaching new, 31-in. tall AGTs to existing concrete bridge rails and parapets (after an overlay) that were not designed for such connections and the resulting system may not be crashworthy to current safety standards. Therefore, the development of cost effective retrofit options are desired for attaching new, 31-in. tall AGTs to existing NDOT bridge rail and parapet designs.

Objective: The objective of this project is to develop retrofit options for attachment of 31-in. tall thrie beam AGT systems to existing NDOT bridge rails and concrete parapets. The retrofits may involve the addition of connection plates to attach the thrie beam to the parapet, the addition of deflector plates to prevent vehicle snag, and/or overlapping the AGT on the parapet to prevent contact with the end of the parapet. However, the existing concrete structures are not to be modified except for the installation of anchorage hardware. The new retrofit designs will improve the overall safety of the barrier systems by ensuring its performance satisfies the Manual for Assessing Safety Hardware (MASH) Test Level 3 (TL-3) performance criteria, while preventing costly replacements of concrete structures.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Project Planning and Correspondence	\$8,763	100%
Task 2: Design and Analysis	\$23,862	100%
Task 3: Analysis of Selected Retrofit	\$33,515	100%
Task 4: Reporting and Project Deliverables	\$21,838	100%

Deliverables: Development of crashworthy retrofit options for the attachment of thrie beam AGT systems to existing NDOT bridge and concrete parapets will provide NDOT with a safe and cost-effective solution for upgrading guardrail and AGT systems without requiring difficult and costly modifications to the concrete parapets themselves or the addition of a new end buttress adjacent to the current end of the parapet. Further, the retrofit design will reduce installation times and limit the amount of lane closures and exposed workers as compared to reconstructing the concrete parapets. The availability of these retrofit attachments would also improve the long-term safety of the bridge and approach section by conforming to the safety performance criteria of MASH TL-3.

Performance & Goals: Project is up to date with the current tasks and progress and has submitted and received an extension to FHWA for approval.

CONTROL NUMBER	01034C
PROJECT NUMBER	FY22(003)
PROJECT TITLE	Asphalt Binder Laboratory Short-Term Aging – Phase II
PRINCIPAL INVESTIGATOR	Mohammad Ghashami - UNL & Robert Rea - NDOT
PROJECT START DATE	7/1/2021
PROJECT COMPLETION DATE	
TECHNICAL ADVISORY COMMITTEE	Robert Rea, Bruce Barrett, Asadullah Sahak, Matthew Park, and Nick Collins-Jebro
PROJECT TOTAL COSTS	\$140,616
PROJECT EXPENDITURES TO DATE	\$62,563
NUMBER OF EXTENSIONS GRANTED	One (1)
PERCENTAGE OF PROJECT COMPLETE	92%
STATUS	On Approved Revised Schedule
FY-2025 BUDGET	\$78,053
FY-2025 TASKS TO BE COMPLETED	Tasks 1, 3, 4, & 6

Background: While blending hot asphalt binder and aggregates in the plant, transporting, and laying the asphalt mixture, hardening of the binder can potentially occur due to the loss of volatiles and/or oxidation. This process is known as short-term aging. The PI and Co-PI proposed a research project entitled “Asphalt Binder Laboratory Short-Term Aging” to statistically investigate the effect of time, temperature, airflow rate, and asphalt binder weight on the chemical and rheological properties of different asphalt binders in the laboratory short-term aging (RTFO) process. In addition, it was attempted to find an improved RTFO aging protocol, which was applicable on both unmodified and highly modified binders. In continuation with the previous research project, finding short-term aging parameters (i.e., new/improved protocol) that can properly simulate the aging process that occurs during WMA production is vital since nearly all of the asphalt mixtures in our state are produced using WMA technology. Also, there is a need for better understanding of short-term aging of asphalt binders treated by RAs since NDOT is planning to use these chemical additives in the Nebraska asphalt mixtures in the near future.

Objective: The objective of this study is to propose a new/improved RTFO aging protocol, which is applicable on binders produced using WMA and RA technology. To meet the objective of this study, first a comprehensive chemical, rheological, and mechanical evaluation will be performed on binders extracted from plant produced WMA/RA mixtures (field short-term aging). From the same plant and project, we will collect binders and age them by varying the short-term aging parameters; time, temperature, airflow, and weight of binder poured in RTFO jar. Any discrepancies and similarities between field aged binders and lab aged binders will be identified. Then we will attempt to propose a new/improved short-term aging protocol in the lab, based on the tests results.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Literature Review	\$ 10,686	99%
Task 2: Experimental Design and Sample Collection	\$ 11,770	100%
Task 3: Laboratory Tests	\$ 64,873	99%
Task 4: Analysis of Test Results	\$ 28,956	85%
Task 5: Thermal Modeling and Analysis	\$ 9,477	100%
Task 6: Documentation and Presentation	\$ 14,854	75%

Deliverables: In this study, binders treated by WMA and RA technology will be extracted from plant produced mixtures and also the same binder that was used in the plant before mixing with aggregate will be conditioned in the laboratory by varying the aging parameters. Then the chemical, rheological, and mechanical properties of both extracted and laboratory aged binders will be compared to identify any possible discrepancies and similarities. The findings of this research will be used to improve the current AASHTO/ASTM short-term aging protocol [AASHTO T240/ASTM D2872] and address concerns which have been raised regarding the limitations of the short-term aging equipment (i.e., RTFO) and protocol in the simulation of the aging process that occurs during asphalt mixture production using WMA and RA technology. The modified protocol will ultimately improve the Nebraska quality control and assurance (QC/QA) procedure for short-term aging of asphalt binder.

Performance: Project has an approved extension request and it is up to date with the current tasks and progress.

CONTROL NUMBER	01034E
PROJECT NUMBER	FY22(005)
PROJECT TITLE	Application of Remote Sensing and Hydrologic Modeling to Reduce Highway Flooding in the Nebraska Sandhills
PRINCIPAL INVESTIGATOR	Aaron Mittelstet - UNL
PROJECT START DATE	7/1/2021
PROJECT COMPLETION DATE	12/31/2024
TECHNICAL ADVISORY COMMITTEE	Julie Ramirez, Bob Carnazzo, Cara Roesler, Kirk Harvey, Jason Dayton, Mary Schroer, Mark Kovar, Shuhai Zheng, Katie Ringland, Adele Phillips, Jamie Reinke, Ibrahim Abuzaho, Bertie Specht, Anna Allen, Jeff Hartman, Jodi Kocher-Felsburg, Holt, & Ullevig, David Mraz-FHWA
PROJECT TOTAL COSTS	\$143,166
PROJECT EXPENDITURES TO DATE	\$111,541
NUMBER OF EXTENSIONS GRANTED	One (1)
PERCENTAGE OF PROJECT COMPLETE	62%
STATUS	One approve revised scheduled
FY-2025 BUDGET	\$31,625
FY-2025 TASKS TO BE COMPLETED	Tasks 3, 4, 5, & 6

Background: Hydrologic calculations for the Nebraska Sandhills (NSH) generally assume high infiltration, no runoff, and ignore subsurface runoff (groundwater and interflow). While these assumptions allow for the solution to a complex problem, they are not accurate representations of the complex movement of water in the region. Highways in the Sandhills region are a scarce and vital link that facilitate the movement of people and goods throughout the region. Understanding the Sandhills hydrology and highway flooding is extremely difficult because stream gages and monitoring wells are sparse. The thousands of lakes in the NSH provides an opportunity to develop a detailed monitoring system of surface and ground water. Combined with available climate information (snow melt, precipitation) the higher density of groundwater and surface water elevation measurements (or estimates) from this project will lead to improved estimates of lag times between hydrologic events and water level changes. This research will help NDOT quantify the frequency, duration and depth of highway flooding in the NSH and assist NDOT in identifying the location to place culverts under the highway and where to place the highway elevation relative to the groundwater elevation.

Objective:

- 1) Identify the location, duration and frequency of highway flooding in the NSH.
- 2) Determine lag time and climatic conditions of highway flooding.
- 3) Identify frequency curves of highway flooding.
- 4) Prioritize highways based on frequency of flooding.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Determine Highways That Flood	\$ 28,512	100%
Task 2: Duration and Depth of Flooding	\$ 20,020	100%
Task 3: Conditions and Lag Time of Flooding	\$ 31,328	80%
Task 4: Prioritize Highways Based on Frequency of Flooding	\$ 31,328	50%
Task 5: Identify Most Efficient and Informed Design to Prevent Future Flooding	\$ 19,272	0%
Task 6: Write Final Report	\$ 12,706	45%

Deliverables:

- A better understanding of how to prevent overtopping of state highways in the NSH will be gained by understanding the relationship of rainfall, surface storage, and groundwater depth. Understanding the elevation needs for the roadway profile and drainage structures will help keep roads open and minimize loss to the travelling public.
- Costs can be minimized by knowing the maximum elevation of surface water and minimizing the raise in roadway profile needed to prevent overtopping. By better understanding the hydrology, the number and size of culverts can be reduced, resulting in a reduction in costs.
- Reduction in road closures due to groundwater inundation.
- More efficient and informed hydrologic and hydraulic design processes can be applied to design in the NSH.

Performance: Project has an approved extension request, and it is up to date with the current tasks and progress.

CONTROL NUMBER	01034J
PROJECT NUMBER	FY22(009)
PROJECT TITLE	Accelerated Bridge Construction (ABC) Decision Tool
PRINCIPAL INVESTIGATOR	Phil Barutha & Marc Maguire - UNL
PROJECT START DATE	7/1/2021
PROJECT COMPLETION DATE	9/30/2023
TECHNICAL ADVISORY COMMITTEE	Fouad Jaber, Ross Barron, Wayne Patras, Kyle Zillig, Mike Vigil, Kent Miller, Lynden Vanderveen, and David Mraz-FHWA
PROJECT TOTAL COSTS	\$90,592
PROJECT EXPENDITURES TO DATE	\$39,630
NUMBER OF EXTENSIONS GRANTED	One (1)
PERCENTAGE OF PROJECT COMPLETE	75%
STATUS	Behind Schedule
FY-2025 BUDGET	\$50,962
FY-2025 TASKS TO BE COMPLETED	Tasks, 4 & 5

Background: A challenge transportation asset managers face is the need to cost effectively prioritize the repair and replacement of the large inventory of deteriorating bridges while considering the increasing budgetary constraints. Accelerated bridge construction (ABC) is defined by the FHWA as bridge construction that uses innovative planning, design, materials, and construction methods in a safe and cost-effective manner to reduce the onsite construction time that occurs when building new bridges or replacing and rehabilitating existing bridges. ABC techniques have a great potential to minimize the traffic disruptions during bridge replacements and construction, promote traffic and worker safety, and improve the overall quality of the built bridges. Despite the major advances in design and construction of ABC techniques, some agencies are hesitant about using ABC techniques due to risks during construction and perceived higher initial costs. In addition, oftentimes the current decision process used to determine and prioritize the candidate bridges for this type of construction can be based solely on average annual daily traffic (AADT), where this may be prudent to evaluate based on several factors. A decision making framework incorporating important factors in determining the suitability of ABC in Nebraska will allow NDOT to find the best fit candidate bridges to maximize the benefits of Accelerated Bridge Construction.

Objective: The main objective of the study is to develop a decision making framework to help inform NDOT on the applicability of ABC methods on the various bridges within the transportation network in Nebraska. The study will obtain data specific to Nebraska and develop a decision model to compare the use of ABC as compared to traditional methods using factors weighted on importance to achieving agency objectives. Weighted factors may include direct costs, user impacts, average daily traffic, site conditions, safety, and other pertinent factors impacting construction methodology. The specific factors and weighting will be determined in coordination with NDOT during the research study.

The project will result in development of an ABC Decision Tool that will serve as a framework to allow NDOT to rigorously determine and prioritize the use of ABC on candidate bridges in need of replacement or new construction which will provide the agency with the most value. The decision tool is intended to be used early in the preliminary project development phase to evaluate design and construction methodology alternatives.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Literature Review of Current ABC Decision Processes	\$ 11,013	100%
Task 2: Investigate NDOT Internal Processes to Determine ABC	\$ 31,460	100%
Task 4: Development of Decision Process and Tool	\$ 24,304	70%
Task 5: NDOT Review and Validation of Decision Tool	\$ 15,629	0%

Deliverables: The results of this study can be used to help NDOT determine the best candidate bridges to utilize ABC early in the design and construction methodology decision making process. The decision tool can serve as a preliminary screening process to identify bridges with attributes that benefit most from the use of ABC. Early identification of good candidate bridges allows the NDOT to better implement ABC methods to maximize the benefits and minimize the costs of ABC in a budget constrained environment.

Performance Project is behind schedule.

CONTROL NUMBER	01046A
PROJECT NUMBER	FY23(013)
PROJECT TITLE	High-Mast Tower Foundation – Phase II
PRINCIPAL INVESTIGATOR	Marc Maguire - UNL
PROJECT START DATE	10/01/2022
PROJECT COMPLETION DATE	09/30/2024
TECHNICAL ADVISORY COMMITTEE	Brandon Varilek, Mick Syslo, Mark Fischer, Mark Burham, Nikolas Glennie, Ross Barron, Mike Mattison, Mark Hamilton, Karen Peterson – KDOT, and David Mraz-FHWA
PROJECT TOTAL COSTS	\$153,428
PROJECT EXPENDITURES TO DATE	\$70,428
NUMBER OF EXTENSIONS GRANTED	None
PERCENTAGE OF PROJECT COMPLETE	50%
STATUS	Behind Schedule
FY-2025 BUDGET	\$83,000
FY-2025 TASKS TO BE COMPLETED	Tasks, 3, & 4

Background: Phase I addressed a review of the research literature, design specifications, state of practice in electrical- and communication-tower embedment, and corrosion. A mastic layer is typically provided for corrosion protection. Next, the required resistance for a typical NDOT tower was computed with the developed tools. The foundation analysis and designs were conducted for sandy and clay soils typical of Nebraska with the resistance established. A finite element tool was developed for rigorous analysis, and this was combined with analysis from L-Pile, an industry standard. Finally, and significantly, site conditions and construction practices were documented. An appendix was developed that outlines project qualifications, execution methods, and construction documentation. Phase I work did not include testing. To our knowledge, no transportation structures have been directly embedded. The next step is to construct and test embedded poles in a controlled and safe location. NDOT property is suggested, but other sites may be possible. This project will:

1. Construct embedded poles
2. Statically test up to the design limit
3. Test the poles dynamically and monitor performance (low to high excitations applied with an eccentric mass oscillator (or shaker) – we will control the amplitude and loading frequency. We will monitor deformations, strains, and accelerations with our standard data acquisition and sensors. The number of cycles will approximate the years of service life.

The proposed Phase II work will employ Phase I work with a construction demonstration followed by static and dynamic testing. Tools and methods developed in Phase I are directly applicable to Phase II. Similarly, the literature review from Phase I will be considered sufficient, however, we will check for recent studies.

Objective:

1. Develop a pole design and procedures for the construction of foundations for high-mast poles.
2. Demonstrate these procedures with the installation of high-mast poles.
3. Confirm the performance with static tests to approximate the design winds.
4. Obtain damping ratios for these poles.
5. Dynamically test the pole to model long-term performance under dynamic loads.
6. Based on these findings, provide design and construction provisions to be integrated into NDOT specifications for design and construction.
7. Document the work product in a final report.
8. Share results nationally via COBS T-12 that maintains the AASHTO specifications for these structures (this is beyond the scope and is longer term)

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Literature and Specification Review	\$ 14,543	100%
Task 2: Construct Poles (this task is largely provided by NDOT)	\$ 19,453	100%
Task 3: Test Poles	\$ 82,870	0%
Task 4: Report Findings	\$ 36,561	0%

Deliverables: Research is expected to provide a design guide for structural strength I and fatigue loads. Validate the present methods for drilled shafts used by NDOT. Note that no failure or service problems have been noted in the current foundations.

Performance: Project is behind schedule.

CONTROL NUMBER	01046B
PROJECT NUMBER	FY23(014)
PROJECT TITLE	Gravel Road Performance Enhancements
PRINCIPAL INVESTIGATOR	Bora Cetin - Michigan State University
PROJECT START DATE	7/1/2022
PROJECT COMPLETION DATE	5/31/2025
TECHNICAL ADVISORY COMMITTEE	Bruce Barret, Nikolas Glennie, Brandon Varilek, Matthew Park, Terry Rogers- Martin Marietta, Mitch Doht- LTAP, Larry Legg – Lancaster County, Bruce Filipi – Saline County, Steve Riehle – Hall County, Ann Chytka - Burt County, Gary Connot – Holt & Boyd County, Chris Jacobsen – Custer County, Tim Burgeson - Harlan County, Barb Keegan – Box Butte County, Steve Baird – Scottsbluff County
PROJECT TOTAL COSTS	\$166,064
PROJECT EXPENDITURES TO DATE	\$82,028
NUMBER OF EXTENSIONS GRANTED	One (1)
PERCENTAGE OF PROJECT COMPLETE	50%
STATUS	On Approved Revised Schedule
FY-2025BUDGET	\$84,036
FY-2025 TASKS TO BE COMPLETED	Tasks, 4, 5 & 6

Background: Approximately 72,134 miles of gravel roads (39 miles state highway) exist in the 194,938-mile road network in the State of Nebraska. Two of the most common distresses for gravel roads are rutting and wash boarding. Rutting often occurs when the moisture content of gravel roads is high. These distresses are recurring across the state. The sustainability of granular roadways is very important to the rural economy since these roads provide access to rural land and enable the transportation of agricultural products. Many counties spend significant portions of their budgets on maintenance and rehabilitation of gravel roads. Opportunities exist to improve the performance of the gravel roads which would reduce the maintenance frequency and would yield significant cost savings. The proposed research project will examine several stabilization and construction methods that pose strong potential to minimize damages of gravel roads. A range of potential stabilization technologies to address these issues will be studied, including crushed rock embedment, gradation optimization, and the possible addition of angular material, and waste fines. The proposed study will conduct a comprehensive laboratory study to evaluate the efficiency of different treatment methods on improving the performance of granular road. Gravel road materials (along with the subgrades) will be collected from different locations in Nebraska that experienced significant road distresses. Data (e.g., resilient modulus, California bearing ratio (CBR), abrasion, freeze-thaw durability) will be measured and evaluated to quantify the treatment effectiveness. A primary outcome for this research is to optimize the NDOT gradation for gravel surfacing with materials that are locally sourced. In addition, this research will also develop a data-driven model to estimate the type and amount of materials to be added that would improve the performance of gravel roads via use of simple index properties

Objective:
The overall goal of this project is to develop, through rigorous laboratory tests, new guidelines for a wide range of Nebraska-specific gravel road materials and to develop a modeling tool to determine the optimized gradation to achieve a target gradation and plasticity and binding capacity, respectively, which will maximize the performance and durability of gravel roads. To accomplish this goal, the research team has established the following objectives:

1. Identify and review the current state of the practice for other state DOTs and industry (Midwest states in particular) via reports and an online survey/interview on the topic of gradation and stabilization guidelines used for gravel roads.
2. Conduct a thorough laboratory study to quantify the effects of variations in gradation and plasticity on the geomechanical characteristics of gravel road geomaterials.
3. Identify the optimum gradation and plasticity ranges that will lead to increased strength and reduced damage from freezing-thawing cycles.
4. Develop an optimized gradation modeling tool that uses laboratory index properties of aggregates to determine relative proportions of fresh aggregate, fines, and stabilizer materials to be added to achieve an optimized target gradation and plasticity.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Kickoff Meeting	\$ 0	100%
Task 2: Literature Review & Survey	\$16,540.24	100%
Task 3: Sample Collection	\$11,026.82	100%
Task 4: Laboratory Testing	\$83,362.84	60%
Task 5: Data Analysis and Development of Tool and Guideline Update	\$33,080.46	0%
Task 6: Final Report	\$22,053.64	0%

Deliverables: The maintenance of gravel roads can consume significant portions of county budgets. Improving the longevity of granular roads by optimizing the performance of surfacing materials will reduce the consumption of virgin aggregate required for surfacing, as well as the frequency of required maintenance. As a result, counties will consume fewer aggregates which are finite natural resources, thus leaving more funds to devote to other pressing social, economic, and environmental needs. The project will generate more broadly applicable stabilization techniques, which county engineers can use to achieve such improved longevity of gravel roads.

Performance: Project has an approved extension request and it is up to date with the current tasks and progress

CONTROL NUMBER	01046C
PROJECT NUMBER	FY23(015)
PROJECT TITLE	Application of Cementitious Materials and Fiber Reinforcement to Enhance Lime Stabilization for Nebraska Shale Soils
PRINCIPAL INVESTIGATOR	Jongwan Eun - UNL
PROJECT START DATE	7/1/2022
PROJECT COMPLETION DATE	12/31/2024
TECHNICAL ADVISORY COMMITTEE	Bruce Barrett, Matthew Park, Nikolas Glennie, , and Alex Silvey
PROJECT TOTAL COSTS	\$142,129
PROJECT EXPENDITURES TO DATE	\$110,693
NUMBER OF EXTENSIONS GRANTED	One (1)
PERCENTAGE OF PROJECT COMPLETE	45%
STATUS	On Approved Revised Schedule
FY-2025 BUDGET	\$31,436
FY-2025 TASKS TO BE COMPLETED	Tasks 2, 3, & 4

Background: As the previous discussion, lime and cement can be mutually complementary. Lime alone has been ineffective in stabilizing several specific soils in Nebraska. In particular, lime has not been effective at stabilizing shale soils in northeast Nebraska. However, previous studies have found that by combining lime with fly ash, cement, or fiber reinforcement they can control shrinkage and swelling as well as increase strength and stiffness. This method of combining an additive with lime enhances the performance of the stabilization. However, NDOT has not tried varying proportions of additives with lime that provisions can be written, and construction practices developed for use in the field. Thus, a systematic study is warranted to help NDOT facilitate its usage for subgrade stabilization. It is needed to identify the effectiveness of mixing cementitious materials and fiber reinforcement to enhance lime stabilization and to prepare the design practice in Nebraska.

Objective:

The objectives of this research are to 1) Identify the effectiveness of mixing cementitious materials and fiber reinforcement to enhance lime stabilization and 2) evaluate the design properties of cementitious materials and fiber reinforcement to enhance lime stabilization for weak subgrade in Nebraska. Based on the expertise of the team, the scope of work includes:

- 1) Performing extensive literature review from other DOT's cases and practices that applied to mix cementitious materials and fiber reinforcement to subgrade stabilization,
- 2) Evaluating geotechnical properties of weak subgrade soils (e.g., Pierre Shale) treated and non-treated with cementitious materials and fiber reinforcement,
- 3) Assessing environmental resistance of treated soils with freezing-thawing cycles,
- 4) Analyzing the performance of treated and non-treated subgrades through Large-Scale Track Wheel (LSTW) test [evaluating k value, CBR, resilient (Mr) modulus],
- 5) Suggesting a design practice of lime, cementitious materials, and fiber mixture. The site-specific applicability and cost-effectiveness of treated and non-treated subgrade will be identified.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: TAC Meeting and Review of Literature	\$12,795	100%
Task 2: Geotechnical characterization	\$22,157	30%
Task 3: Freezing-thawing cycle test	\$64,043	55%
Task 4: Large scale tracking wheel test	\$29,483	40%
Task 5: Design recommendation	\$12,651	0%
Task 6: Final Report and TAC Presentation	\$1,000	0%

Deliverables: The proposed research will provide mixing guidelines of lime and cementitious materials or lime and fiber reinforcement stabilization with weak soils for the roadway layers. Based on the results, the site-specific applicability of lime-cement or fiber-treated subgrades will be identified. The end results of this research project will contain a performance chart of lime, cement, or fiber stabilization with the selected sets of soil conditions, aggregate types, and the types and mixing ratio of the lime and cement or fiber stabilization.

Performance: Project has an approved extension request and it is up to date with the current tasks and progress.

CONTROL NUMBER	01046D
PROJECT NUMBER	FY23(016)
PROJECT TITLE	Nebraska Balanced Mix Design – Phase II
PRINCIPAL INVESTIGATOR	Jamilla Teixeira - UNL
PROJECT START DATE	7/1/2022
PROJECT COMPLETION DATE	5/31/2025
TECHNICAL ADVISORY COMMITTEE	Bruce Barrett; Robert Rea, Asadullah Sahak, Matthew Park, Zach Thurber, Ben Tran, Walter Moy, Marsh Lemen, and Nhung Hoang - FHWA
PROJECT TOTAL COSTS	\$141,914
PROJECT EXPENDITURES TO DATE	\$18,468
NUMBER OF EXTENSIONS GRANTED	One (1)
PERCENTAGE OF PROJECT COMPLETE	75%
STATUS	On Approved Revised Schedule
FY-2025BUDGET	\$123,446
FY-2025TASKS TO BE COMPLETED	Tasks 1, , 3, 4, & 5

Background: The research team currently is performing a research project entitled “Nebraska Balanced Mix Design - Phase I” funded by Nebraska DOT to develop BMD method for Nebraska pavements. Phase I of this research project will ultimately define the Nebraska BMD method which considers 3 main distresses: rutting, fatigue cracking, moisture damage. To be able to fully implement the outcomes of this research, the field evaluation must be conducted, and field data must be collected to establish pass/fail thresholds for future quality assurance (QA) and acceptance (QC) purposes.

Objective:
The aim of this research is to establish pass/fail thresholds for future QA/QC for the BMD mix design. To this end, several projects across the state will be selected, the condition of pavements before paving will be evaluated, and after paving will be monitored. In addition, mixes from each selected project will be collected and the BMD performance tests selected from the phase I of the BMD project will be carried out. The results of laboratory tests will be compared with field performance data to establish pass/fail thresholds.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: TAC Meeting and Review of Literature	\$ 17,494	94%
Task 2: Experimental Plan and Sample Collection	\$ 10,417	100%
Task 3: Laboratory Tests	\$ 41,593	80%
Task 4: Analysis of Test Results	\$ 50,548	50%
Task 5: Documentation and Presentation	\$ 21,863	65%

Deliverables: This study will improve the current mixture design method (i.e., Superpave) in Nebraska, where currently only volumetric characteristics are considered and the effects of additives such as recycling agents, antioxidants, polymers, and fibers cannot fully be addressed. More than that, the BMD method can be employed to design asphalt mixtures containing high RAP materials based on the fundamental properties of mixtures that can better address the main modes of distress: rutting, cracking, and moisture damage.

Performance: Project has an approved extension request and it is up to date with the current tasks and progress.

CONTROL NUMBER	01046E
PROJECT NUMBER	FY23(017)
PROJECT TITLE	Development of the Nebraska Department of Transportation Winter Severity Index – Phase II
PRINCIPAL INVESTIGATOR	Mark R. Anderson - UNL
PROJECT START DATE	7/1/2022
PROJECT COMPLETION DATE	5/31/2024
TECHNICAL ADVISORY COMMITTEE	Jessica Sherwood, Jennifer Hendrick, Mike Mattison, Tom Renninger, Kurt Vosburg, James Laughlin, and Todd Cecnle
PROJECT TOTAL COSTS	\$183,603
PROJECT EXPENDITURES TO DATE	\$103,472
NUMBER OF EXTENSIONS GRANTED	None
PERCENTAGE OF PROJECT COMPLETE	95%
STATUS	On Schedule PI working on draft report
FY-2025 BUDGET	\$80,131
FY-2025 TASKS TO BE COMPLETED	Tasks 6

Background: The Nebraska Winter Severity Index (NEWINS) was previously developed (Phase I, NDOT Report No. SPR-P1-(17)M054; Walker et al. 2018) to provide an independent, historic meteorological baseline of individual winter storm severity and overall, statewide winter seasonal severity. The NEWINS framework identified six winter storm categories based on their expected impacts to NDOT winter maintenance operations and mobility. Subsequent work assessed the NEWINS in the context of the Maintenance Decision Support System (MDSS; Anderson et al. 2020a) and with respect to weather-related vehicular crash severity (Anderson et al. 2020b). The proposed work seeks to facilitate the next phase in the expansion of NEWINS by leveraging its framework and algorithms in support of forecasting and predicting the anticipated severity of winter storms. The prediction relevant input data will be obtained from the National Centers for Environmental Information (NCEI) National Digital Forecast Database (NDFD) which is populated from National Weather Service forecasts. The NEWINS algorithms will be run on the digital forecast database in order to produce an expected, or forecasted, winter storm classification at various time increments in advance of the storm. An additional advantage of the NDFD is that NEWINS predictions are no longer restricted to NDOT district-level resolution. NEWINS can now be computed for smaller regions including although not limited to superintendent maintenance areas, specific roadway corridors (e.g., Interstate 80), and for individual counties throughout the state. Further, the NDFD could facilitate inclusion of a freezing rain parameter within the previously developed NEWINS.

Objective:
The study objectives are to expand and evaluate the NEWINS tool. This expansion intends to refine the spatial and temporal resolution of the enhanced NEWINS at the supervisor and superintendent level of a NDOT district (Figure 1). Additionally, the enhanced index will be evaluated to include freezing rain and icing events. Further, consideration of post-event weather conditions such as blowing and drifting snow and sub-freezing temperatures could also be included into NEWINS. Last, NEWINS will incorporate computer model forecast data instead of climatological data, which has been done in the past. This allows NEWINS data to be evaluated up to 72 hours before, or during an event (Figure 2). The forecasted NEWINS weather information will allow for maintenance planning and scheduling based on forecasted impacts.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: TAC Meeting and Review of Literature	\$ 10,369	100%
Task 2: Data Collection, Modeling, and Observational Products	\$ 21,233	100%
Task 3: NEWINS Capability Expansion	\$ 61,900	100%
Task 4: Case Study Analysis	\$ 37,574	100%
Task 5: Assessment Analysis	\$ 31,400	100%
Task 6: Quarterly report, final report, presentations and Write-Ups	\$ 21,127	75%

Deliverables: The project team will develop recommendations for an NDOT implementation plan. The project team anticipates that NDOT staff will need to further associate forecast NEWINS output with their own internal maintenance, personnel, and operational data in order to fully implement the potential benefits of having a forecasted winter storm severity index metric.

Performance : PI is working on draft report

CONTROL NUMBER	01046F
PROJECT NUMBER	FY23(018)
PROJECT TITLE	Updating rainfall zones and intensities in Nebraska for improved design of non-bridge sized drainage structures: Phase I -
PRINCIPAL INVESTIGATOR	Rezaul Mahmood - UNL
PROJECT START DATE	7/1/2022
PROJECT COMPLETION DATE	5/31/2024
TECHNICAL ADVISORY COMMITTEE	Julie Ramirez, Bob Carnazzo, Kirk Harvey, Jason Dayton, Anna Allen, Ibrahim Abuzaho, Bertie Specht, and Jodi Kocher - Felsburg, Holt, & Ullevig
PROJECT TOTAL COSTS	\$120,000
PROJECT EXPENDITURES TO DATE	\$81,780
NUMBER OF EXTENSIONS GRANTED	None
PERCENTAGE OF PROJECT COMPLETE	100%
STATUS	PI Submitted draft report for TAC's review
FY-2025 BUDGET	\$38,220
FY-2025 TASKS TO BE COMPLETED	Task Completed

Background:
 NDOT utilizes the Rational Method to calculate peak design discharge flows for small drainage areas (less than 640 acres) when sizing culverts and storm sewers. This method requires information about land use, watershed travel time, and precipitation data for the location of interest. NDOT's current implementation of the Rational Method simplifies the precipitation data into three rainfall zones with intensity-duration-frequency (IDF) curves determined from UNL research completed in 1988. That research developed the three rainfall zones based on the National Weather System's Technical Paper 40 (1961) by using spatial analysis of the general pattern of rainfall isohyets shown in TP-40. Climate scientists typically define a climate normal in terms of 30-year averages, meaning that the 60 years old precipitation data being utilized by NDOT to date is likely not representative of the current climatic conditions in Nebraska.

Objective: Based on the findings, the necessary updates in the current approaches will be suggested. The specific objectives of the proposed research are listed below:

1. Compare the intensities in the rainfall data from 1961 against the intensities in the current data.
2. Review and update the current rainfall zones.
3. Review and update the IDF curves.
4. Provide updated calculation method for peak flow based on updated rainfall intensities applicable to Nebraska.
5. Provide recommendations for the practitioners.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Data Collection and processing	\$ 11,519	100%
Task 2: Preparation of the updated IDF curves for the existing zones	\$ 15,674	100%
Task 3: Comparison of the updated IDF curves and the existing curves	\$ 15,612	100%
Task 4: Spatial Analysis of the collected data to create new rainfall zones	\$ 20,239	100%
Task 5: Preparation of the new IDF curves for the new zones	\$ 16,130	100%
Task 6: Dissemination and deliverables	\$ 40,825	100%

Deliverables: The project will result in updated rainfall zones and the associated IDF curves for the state of Nebraska for their use in the Rational Method to calculate peak flow. The results will clearly show the benefits of using updated rainfall information, which is expected to result in a more realistic estimation of flood peaks. A detailed guide will be provided, which will include all the specifics of the analysis and the outcomes. The copies of codes, data, and results prepared as a part of the work will be transferred to NDOT for archiving and further use. The new zones will be made available as shapefiles, and the corresponding IDF curves will be stored in an Excel file for easy interpretability and use. A demo computer program (not complete software) will be developed for demonstration purposes.

Performance : Project is up to date with the current tasks and progress.

CONTROL NUMBER	01046G
PROJECT NUMBER	FY23(019)
PROJECT TITLE	Minimizing take of threatened rattlesnakes and optimizing project review in SE Nebraska
PRINCIPAL INVESTIGATOR	Shawn Dunn – Nebraska Game and Parks
PROJECT START DATE	7/1/2022
PROJECT COMPLETION DATE	12/31/2024
TECHNICAL ADVISORY COMMITTEE	Ronald Poe and Jeff Hartman
PROJECT TOTAL COSTS	\$62,238
PROJECT EXPENDITURES TO DATE	\$0
NUMBER OF EXTENSIONS GRANTED	One (1)
PERCENTAGE OF PROJECT COMPLETE	70%
STATUS	On Approved Revised Schedule
FY-2025 BUDGET	\$62,238
FY-2025 TASKS TO BE COMPLETED	Tasks 3, 4, & 5

Background: The western massasauga (*Sistrurus tergeminus*) and the timber rattlesnake (*Crotalus horridus*) are listed threatened snake species occurring in the southeast portion of Nebraska and protected under Neb. Stat. 37-801-811. A thorough review of the massasauga’s life history can be found in Patten 2006 and Patten et al. 2016.

Recent studies (e.g., Fogell 2011) have shown these species are using green spaces in the right-of-way along several roads in Jefferson, Gage, Pawnee, and Richardson Counties which necessitates the need for added Environmental Review from Nebraska Department of Transportation (NDOT) staff and onsite surveys prior and during maintenance and construction to roadways.

- Objective:**
- a) Identify precise locations of western massasauga brumation sites;
 - b) Map travel corridors from brumation site to active (summer) sites and explore how they relate to NDOT ROW;
 - c) Develop standardized survey/search protocols.
 - d) Document materials used by snakes as basking and/or refuge locations;
 - e) Provide recommendations to avoid or minimize impacts to protected snakes for future NDOT maintenance and construction practices.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Data Collection & Supply Purchasing: initial ground surveys, mileage, LifeTags, CTT Locators, etc.	\$ 27,000	100%
Task 2: Snake surveys & Life Tag Attachment: ground surveys, snake capture and processing, mileage, etc	\$ 10,886	100%
Task 3: Geolocate snakes: continue surveying for snakes but also establish routes to track tagged snakes.	\$ 8,600	60%
Task 4: Data analysis: office work with collected data including movement, material use, standard morphometric data, mapping, etc.	\$ 3,100	50%
Task 5: Second field season: largely repeat Tasks 2 and 3 using data from first season.	\$ 11,652	15%
Task 6: Final data analysis: analyze snake movements to accomplish grant Objectives and present final products to NDOT.	\$ 1,000	0%

Deliverables: This research will result in the immediate benefits of increased knowledge of protected snake locations; thus, those data will immediately benefit project reviews, minimize the need for conservation conditions in some areas, and reduce the chances of take. Standardized protocols, recommended materials and construction practices will all be provided by Quarter 8 (see Schedule below) and can be quickly be implemented into NDOT review process.

Performance: Project has an approved extension request and it is up to date with the current tasks and progress.

CONTROL NUMBER	01046H
PROJECT NUMBER	FY23(020)
PROJECT TITLE	A Statewide Geographic Information System (GIS) as a Predictive Tool for Locating Deeply Buried Archeological Deposits in Nebraska: (PHASE III-The Sandhills Region)
PRINCIPAL INVESTIGATOR	Dave Williams - History Nebraska
PROJECT START DATE	7/1/2022
PROJECT COMPLETION DATE	12/31/2024
TECHNICAL ADVISORY COMMITTEE	Stacy Stupka, John Swigart, Katie Turner, Courtney Ziska, and Jeff Hartman,
PROJECT TOTAL COSTS	\$120,130
PROJECT EXPENDITURES TO DATE	\$ \$39,763
NUMBR OF EXTENSIONS GRANTED	One (1)
PERCENTAGE OF PROJECT COMPLETE	65%
STATUS	On Approved Revised Schedule
FY-2025 BUDGET	\$80,367
FY-2025 TASKS TO BE COMPLETED	Tasks 3, 4, 5, & 6

Background: The Sandhills cover a vast portion of central and western Nebraska and are drained by the Cedar, Calamus, North Loup, Middle Loup, Dismal, Snake, and Niobrara rivers and their tributaries. The proposed project will examine multiple localities along some of these streams to fill in the major data gap in our existing Phase I and Phase II buried sites prediction tool. While new data will always be added and the model improved, the current proposal seeks to complete acquisition of baseline data for all drainages in the entire state. Upon completion, if awarded, the project will allow to prediction tool to be operational for all of Nebraska.

Objective: The proposed project will be developed by HN as a collaborative effort with the KGS. In addition to senior project staff at HN and KGS, a graduate research assistant will be employed. The proposed project will add to the existing Phase I and Phase II GIS-based data repository of all Nebraska geoarchaeological information including: published and unpublished reports or portions of reports, bibliographies, stratigraphic profiles, radiocarbon ages, maps, notes, and photographs. These data will be linked to specific LSAs in specific stream valleys and drainage basins and in some lakeshore setting in the Sandhills. The GIS will allow us to visualize the Sandhills data in the form of maps and diagrams and reveal temporal and spatial patterns of landscape evolution in drainage basins.

The GIS will be housed at and maintained by the HN State Archeology Office. However, it will be available to transportation planners at NDOT and FHWA and also to consultants either through remote site updates or on-line. After the conclusion of the proposed project, the GIS and associated data repository will be continually updated as new information becomes available. Therefore, as time passes and data gaps are filled, the predictive capability and planning utility of the program will increase. Because the high, medium, and low site potential assignments noted above are based on correlations between known archeological site locations and a number of environmental variables, the utility of the project will improve as new archeological and environmental data become available.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Project organization and planning	\$ 3,750	100%
Task 2: Collect and digitize existing reports for Phase III geographic areas.	\$ 3,000	100%
Task 3: Field investigations at various Sandhills locations.	\$ 57,630	90%
Task 4: Refine GIS layer to add Phase III data which will also update digital repository.	\$ 26,750	50%
Task 5: Meet with TAC to provide project progress and updates.	\$ 1,000	100%
Task 6: Update Final Report and the GIS Users Guide and submit to TAC for review.	\$ 25,000	30%
Task 7: Revise and finalize Final Report and GIS Users Guide following comments by TAC.	\$ 2,000	0%
Task 8: Meet with TAC for final presentation and submission of final report	\$ 1,000	0%

Deliverables: The project will take place over the course of two years and include a significant amount of fieldwork. Phases I and II of the project resulted in the development of usable GIS Revised. 2021 layers and user's guide along with a report. Upon completion of Phase III, the GIS will have been updated and available for immediate use. The user's guide and report will also be fully updated by project completion. There are no post-project implementation efforts anticipated.

Performance: Project has an approved extension request and it is up to date with the current tasks and progress.

CONTROL NUMBER	01046J
PROJECT NUMBER	FY23(021)
PROJECT TITLE	Impacts of Stream Bed Adjustments on Local Bridge Morphology
PRINCIPAL INVESTIGATOR	David Admiraal - UNL
PROJECT START DATE	7/1/2022
PROJECT COMPLETION DATE	5/31/2025
TECHNICAL ADVISORY COMMITTEE	Kirk Harvey, Jason Dayton, Fouad Jaber, Mark Kovar, Jason Lehn, Julie Ramirez, Ross Barron, Bob Carnazzo, Anna Allen, Ibrahim Abuzaho, Bertie Specht, Jon Starr, Jodi Kocher - Felsburg, Holt, & Ullevig, and David Mraz - FHWA
PROJECT TOTAL COSTS	\$ 134,860
PROJECT EXPENDITURES TO DATE	\$77,949
NUMBER OF EXTENSIONS GRANTED	One (1)
PERCENTAGE OF PROJECT COMPLETE	70%
STATUS	On Approved Revised Schedule
FY-2025 BUDGET	\$56,911
FY-2024 TASKS TO BE COMPLETED	Tasks 1, 3, 4, 5, 6 & 7

Background: The goal of this project is to synthesize a hydrodynamic model with improved methods of representing sediment transport to better predict short-term and long-term channel migration for aggraded sand-bed rivers. Our team can rapidly and reliably collect detailed flow and topographic data and incorporating that data into the model will provide results that are more accurate and more quickly implemented than previous efforts. In addition, the model will be developed at a bridge crossing (Highway 281 over the Niobrara River) with a strongly aggraded streambed, a crossing that is of particular interest to NDOT because of the potential for abutment undermining, scour issues, and ice damage. The result of the project will be a documented strategy for rapidly collecting relevant field data associated with channel bed migration predictions, a detailed plan for incorporating that data into a hydraulic model with new modules for accurately simulating sediment transport and bedforms, and demonstrated short-term accuracy of the model at a field site that is of actual interest to NDOT. In addition, recommendations will be provided for collecting future data sets to validate the longer-term performance of the modeling approach. Along the way, channel migration concerns identified by the research team at the study site will be relayed to NDOT for possible mitigation efforts.

Objective:

The objectives of the present work include:

1. To establish a measurement method for rapidly collecting detailed topographic, bathymetric, and flow data at bridge crossings.
2. To utilize the new method to collect multiple complete data sets at a bridge crossing with dynamic streambed conditions (The Highway 281 bridges downstream of the Spencer Dam site).
3. To develop a hydraulic modeling approach for predicting short- and long-term morphologic changes at the bridge crossing and to compare predicted results with observed data.
4. To refine the modeling and data collection methods for application at any bridge crossing with a dynamic streambed.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Research Hydraulic Models and Data Collection	\$ 12,848	95%
Task 2: Collect and Process Initial Data Sets	\$ 26,883	100%
Task 3: Calibrate Hydraulic Model	\$ 12,921	90%
Task 4: Collect and Process Secondary Data Sets	\$ 22,921	95%
Task 5: Evaluate and Adjust Hydraulic Model	\$ 12,929	35%
Task 6: Collect and Process Final Data Sets	\$ 19,393	80%
Task 7: Complete Final Model Assessment	\$ 13,079	0%
Task 8: Completion of Final Report and Deliverables	\$ 14,179	0%

Deliverables: The primary outputs of this project will be two-fold: A detailed approach for collecting relevant channel and flow data at sand bed river sites with rapidly changing stream morphology and a hydraulic model that is capable of simulating stream morphology over short and long time scales. In order to relay the information that we organize and the models that we develop over the course of the project, we will provide two detailed summary guides at the end of the project: (1) a guide on the methods used to collect aerial and flow data at sand bed river sites with rapidly changing bed morphology, and (2) a guide on applying an appropriate hydraulic model to predict changes at such sites.

Performance: Project has an approved extension request and it is up to date with the current tasks and progress.

CONTROL NUMBER	01046K
PROJECT NUMBER	FY23(022)
PROJECT TITLE	Air-coupled GPR and HD Imaging for High-speed Bridge Deck Evaluation
PRINCIPAL INVESTIGATOR	Jinying Zu - UNL
PROJECT START DATE	7/1/2022
PROJECT COMPLETION DATE	12/31/2024
TECHNICAL ADVISORY COMMITTEE	Fouad Jaber, Kent Miller; Babrak Niazi, Seth Brashears, Mike Vigil, Barbara Bevins, Ross Barron, Wally Heyen, Ben Tran, and David Mraz-FHWA
PROJECT TOTAL COSTS	\$ 166,897
PROJECT EXPENDITURES TO DATE	\$55,159
NUMBER OF EXTENSIONS GRANTED	One (1)
PERCENTAGE OF PROJECT COMPLETE	40%
STATUS	On Approved Revised Schedule
FY-2025 BUDGET	\$111,738
FY-2024 TASKS TO BE COMPLETED	Tasks 2, 3, 4 & 5

Background: Asphalt overlay is increasingly applied on most Nebraska bridges. GPR is the only proven NDE technique for evaluation of bridge decks with asphalt overlays. The team has successfully developed data analysis software for ground-coupled GPR in previous projects, and determined the threshold values through correlation with VEI and HCP data. However, the need of traffic control limits wide application of the ground-coupled GPR. Air-coupled GPR and vehicle mounted HD imaging system may provide a solution for high-speed NDE of bridge decks. Because the current GPR analysis software has many limitations (proprietary, inconsistent threshold values, low spatial resolution etc.), we need to develop air-coupled GPR data analysis algorithms for evaluation of bridge decks with asphalt overlay. Data fusion analysis will be used to determine the threshold values for air-coupled GPR amplitude on bridge decks with and without asphalt overlays.

Objective:
The goal of this research project is to develop high-speed NDE technologies to evaluate bridge decks with asphalt overlays, using air coupled GPR and vehicle mounted HD imaging. Specific objectives include:

1. Develop data analysis algorithm for high-speed air-coupled GPR and establish reliable threshold values for asphalt overlaid bridge decks.
2. Fuse GPR data with high-definition surface images to improve spatial resolution.
3. Build correlation between surface defects (with HDI) and interior deterioration (with GPR), and evaluate performance of visual inspection based on HD images, which could be used as a screening tool for rapid bridge evaluation when detailed NDE may not be applied to all bridges.
4. Implement the proposed technology to Nebraska bridges and provide NDOT additional information for decision making.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: TAC Meeting and Review of Literature	\$ 10,483	100%
Task 2: Data Collection on NOBL Bridges	\$ 28,615	40%
Task 3: Air-coupled GPR and HD Data Analysis	\$ 38,538	50%
Task 4: Data Fusion Analysis	\$ 28,201	0%
Task 5: Field Demonstration	\$ 34,837	0%
Task 6: Final Report and TAC Presentation	\$ 26,222	0%

Deliverables: Air-coupled GPR data and HD images will be collected from multiple bridges scheduled for rehabilitation during the project period. Data will be collected at all construction stages: before repair (with old overlay), during the repair (after removal of asphalt overlay), and after repair (after applying new membrane and overlay). Results and findings will be communicated to NDOT as quickly as possible through technical meetings and briefs. By the end of the project, the team will submit a final technical report and the developed data analysis software package.

Performance: Project has an approved extension request and it is up to date with the current tasks and progress.

CONTROL NUMBER	01046L
PROJECT NUMBER	FY23(023)
PROJECT TITLE	Regression Equation Update
PRINCIPAL INVESTIGATOR	Kellan R. Stauch - USGS
PROJECT START DATE	7/1/2022
PROJECT COMPLETION DATE	7/1/2025
TECHNICAL ADVISORY COMMITTEE	Kirk Harvey, Jason Dayton; Fouad Jaber, Julie Ramirez, Jamie DNR-Reinke, Ross Barron, Stefan Schaepe, Deanna Ringenberg, Brenda Densmore - USGS, Bob Carnazzo, Anna Allen, Ibrahim Abuzaho, and Bertie Specht
PROJECT TOTAL COSTS	\$ 149,200
PROJECT EXPENDITURES TO DATE	\$64,600
NUMBER OF EXTENSIONS GRANTED	One (1)
PERCENTAGE OF PROJECT COMPLETE	5%
STATUS	On Approved Revised Schedule
FY-2025 BUDGET	\$84,600
FY-2025 TASKS TO BE COMPLETED	Tasks 1, 2, & 3

Background: This project will implement StreamStats for Nebraska. StreamStats is an online mapping interface that is designed to provide a user-friendly tool that researchers, managers, and others can use to rapidly and easily compute basin characteristics, and flow statistics. These statistics describe the frequency of extreme conditions in streams and rivers and are valuable data that are routinely used by regulators, designers, builders, natural resource managers, biologists and others. Estimates of peakflow statistics are often needed to fulfill design or regulatory requirements, however, without StreamStats, flow data are generally only available for locations where there is a long-tenn stream gage. Statistical regression analyses of peak flows at stream gage locations can be used to estimate flows at locations without stream gages by relating extreme flow to basin characteristics. A wide variety of professionals, including engineers, scientists, regulators, and natural-resources managers regularly compute and use streamflow statistics, such as the l-percent annual exceedance probability flood statistic. These professionals must dedicate resources to detennine drainage area, watershed boundaries and basin characteristics upstream from a site of interest for each project they work on, because there are no publicly available web tools such as StreamStats in Nebraska. Often the methods used to estimate the flows related to these events at ungaged locations are time-consuming, resource-intensive and may generate non-reproducible results. These methods are seldom available to the public and non-hydrologists because they require considerable expe1iise and computer resources. This project would allow the public to gain access to a consistent, fast and widely accepted method of estimating a variety of useful flow statistics. Statewide regression equations for peak-flow frequencies in Nebraska have been published previously, but since the last repmi was published many years of streamflow data have been collected, analysis techniques have changed, and geospatial datasets have improved. In addition, the Nebraska Department Natural Resources (NeDNR) is cm Tenthly in the process of updating the geospatial datasets, peak streamflow statistics and regression equations for Nebraska. This project will integrate and process the Nebraska Department of Natural Resources updated geospatial datasets, peak streamflow statistics and regression equations into a free and readily available web-based application that would allow professional users and the general public to quickly and easily access streamflow statistics at gaged and ungagged locations.

Objective:
A process has been designed by the USGS national team for implementing the StreamStats tool, as has already been done in 43 other States. A national team at the U.S. Geological Survey (USGS) has developed the StreamStats user interface (Figure 1), but the web tool must be implemented on a state-by-state basis. This project will adapt StreamStats to Nebraska datasets, using the national implementation model to provide a web tool that will greatly reduce the amount of effmi, time, and cost required for a user to estimate peak-flow statistics at user-selected points. In order to develop the StreamStats web tool, several tasks ai-e required: 1.) Integrating NeDNR derived geospatial datasets into the StreamStats web interface. 2.) Review and approval of NeDNR peak streamflow statistics and regression equations. NeDNR peak streamflow statistics and regression equations will be analyzed for quality assurance to ensure that approp1iate methods and procedures were used to develop accurate streamflow regression equations. Results ofregression equations will also be compared to results calculated using StreamStats to ensure reproducibility of the solutions and identify and reconcile any possible discrepancies. 3.) Implementation and coding of regression equations into the StreamStats web tool. 4.) All data sets will be published in a pennanent publicly available repository (e.g. Sciencebase <https://www.sciencebase.gov/catalog/>) with associated complete metadata.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: StreamStats GIS development and implementation	\$ 34,800	20%
Task 2: Peak flow regression equations review and approval	\$ 29,800	0%
Task 3: Peakflow regression equation implementation into StreamStats	\$ 36,600	0%
Task 4: Analysis and publication of datasets and metadata	\$ 48,000	0%

Deliverables: Direct measurable environmental benefits such as improved water quality are expected to result from the implementation of this tool arising from the ability of managers and decision-makers to better plan for extreme flow conditions. Frequencies of peak flows are important to understanding floodplain connectivity, wetlands dynamics, geomorphology, instream habitat and the impacts of human infrastructure on the environment during flooding.

Performance: Project has an approved extension request and it is up to date with the current tasks and progress.

CONTROL NUMBER	01046M
PROJECT NUMBER	FY23(024)
PROJECT TITLE	Repair and Strengthening of Bridge Girders Using Ultra-High-Performance Concrete (UHPC)
PRINCIPAL INVESTIGATOR	George Morcous
PROJECT START DATE	7/1/2022
PROJECT COMPLETION DATE	5/31/2025
TECHNICAL ADVISORY COMMITTEE	Fouad Jaber, Wally Heyen, Wayne Patras, Kyle Zillig, Mike Vigil, Kellie Troxel, Ross Barron, Lieska Halsey, and David Mraz-FHWA
PROJECT TOTAL COSTS	\$ 80,007
PROJECT EXPENDITURES TO DATE	\$36,028
NUMBER OF EXTENSIONS GRANTED	One (1)
PERCENTAGE OF PROJECT COMPLETE	65%
STATUS	On Approved Revised Schedule
FY-2025 BUDGET	\$43,979
FY-2025 TASKS TO BE COMPLETED	Tasks 2, & 3

Background: The preliminary literature review has indicated a very limited but promising use of UHPC in the repair/preservation of concrete bridge components, such as piers, pier caps, and girder ends. Although UHPC has excellent mechanical and durability properties, there is lack of guidelines on the design approach and construction procedures for using UHPC as a repair material to encase deteriorated/damaged concrete components in particular.

Objective:
The objective of this project is to develop procedures for using UHPC in the repair/preservation of concrete bridge components including the design and construction guidelines for immediate implementation. Two demonstration projects that include the repair of deteriorated concrete bridge pier and girder end will be conducted to help bridge engineers and contractors gain the design and construction experience of using UHPC in the repair/preservation. This will also include addressing issues like surface preparation, formwork design, placing and curing methods of UHPC, and installing interface anchors between UHPC and CC. The lessons learned from these two projects will be disseminated via presentations and publications for technology transfer

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Literature Review of UHPC in Repair/Preservation	\$ 6,287	100%
Task 2: Design and Construction Guidelines	\$ 18,196	80%
Task 3: Demonstration Projects	\$ 37,630	20%
Task 4: Report, Presentation, and Technology Transfer	\$ 17,894	60%

Deliverables: Two demonstration repair/preservation projects are expected to be implemented by NDOT during the project duration. Several candidate projects were studied, and two projects were tentatively selected for demonstration and technology transfer. Figure 5 shows an example of deteriorated concrete bridge pier to be repaired using UHPC jacketing, while Figure 6 shows another example of a deteriorated concrete bridge girder end to be encased in UHPC. Constructability issues, such as traffic control, repair duration, and cost will be also evaluated in these demonstrations.

Performance: Project has an approved extension request and it is up to date with the current tasks and progress

CONTROL NUMBER	01046N
PROJECT NUMBER	FY23(025)
PROJECT TITLE	Modeling Pedestrian and Bicyclist Crash Exposure with Location-Based Service Data
PRINCIPAL INVESTIGATOR	Yunwoo Nam - UNL
PROJECT START DATE	7/1/2022
PROJECT COMPLETION DATE	5/31/2024
TECHNICAL ADVISORY COMMITTEE	Don Butler, Dan Waddle, Curtis Nosal, Craig Wacker, Claire Inbody, Roberto Partido – City of Lincoln, and Abe Anshasi- FHWA
PROJECT TOTAL COSTS	\$184,629
PROJECT EXPENDITURES TO DATE	\$134,841
NUMBER OF EXTENSIONS GRANTED	
PERCENTAGE OF PROJECT COMPLETE	100%
STATUS	PI submitted the draft report for TAC to review
FY-2025 BUDGET	\$49,788
FY-2025 TASKS TO BE COMPLETED	Tasks completed

Background: Biking and walking flows are essential components in safety analysis. Most local governments rely heavily on crash statistics to identify locations prone to pedestrian and bicyclist crashes.

However, to effectively diagnose pedestrian and bicycle safety, planners and engineers need to know the relative exposure of the pedestrians and bicyclists to risk. Not having appropriate information about the activity patterns and volume of pedestrians and bicycles at locations, it is challenging to accurately identify and predict risk levels at those locations. A variety of pedestrian and bicycle exposure measures have been suggested and tested in the literature (Alattar, Cottrill, and Beecroft, 2021; Goodspeed et al, 2021; Ryus et al, 2017; Turner et al, 2017), but these measures are inconsistent and limited, and there is no widely accepted single approach. Area-based exposure measures are usually estimated at a macro level. This approach does not adequately capture activities at facility-specific geographic scales (i.e., street segments), since data are aggregated to areawide geographic scales.

Another group of measures is based on field observation and extrapolation methods. Actual counts observed at selected locations in short periods of time are extrapolated to generate annual average daily pedestrian and bicyclist traffic estimates. This approach will not adequately display the difference in travel time (e.g., morning, afternoon, or evening), seasonal effects, days of the week, and will not cover the entire street network in a region.

One of the main challenges in developing exposure measures is the lack of walking and biking activity data available at a finer spatial resolution, such as street segments, covering the entire road network of a city. The main source of information about area-based exposure measures is survey data (such as ACS or NHTS). The units used in area-based exposure measures vary widely and the geographic scale of available travel data is limiting (only 59 records for Lincoln MSA in the 2017 NHTS). This type of data does not have facility-specific trip information. Some local entities are directly collecting pedestrian and bicyclist count data, but these counts are collected at a very limited number of locations. Therefore, there is a critical need to develop a reliable methodology to analyze pedestrian and bicyclist exposure to risk with emerging data sources.

Objective:

The motivation of the research is to enhance pedestrian and bicyclist safety with emerging active travel data. The main objective of the project is to develop a reliable methodology for measuring pedestrian and bicyclist exposure and analyzing associated risks.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Meetings with TAC and quarterly report	\$ 6,235	100%
Task 2: Review and document existing approaches	\$ 10,550	100%
Task 3: Collecting data and creating geodatabase	\$ 78,842	100%
Task 4: Data processing	\$ 17,363	100%
Task 5: Street Light data calibration	\$ 15,099	100%
Task 6: Final Report and TAC Presentation	\$ 43,900	100%
Task 7: Completion of project, final report submission and presentation	\$ 9,233	100%
Task 8: Dissemination of research outcomes	\$ 3,407	100%

Deliverables: The research will provide immediate results for the study area and a foundational platform to expand to the rest of Nebraska. The research results will include a geodatabase pedestrian crash exposure model and a geodatabase bicyclist crash exposure model. Each model will function independently from the other model. Both models will be geographically constrained to Lincoln, NE. Lincoln was chosen as a testbed for several reasons. It is a midsize city, with an extensive network of multi-use pathways, as well as on-street bicycle facilities.

Performance : Project is up to date , PI submitted the draft report for TAC's review.

CONTROL NUMBER	01057A
PROJECT NUMBER	FY24 (026)
PROJECT TITLE	Evaluation of Critical Shear Strength of Soils in Nebraska Based on Revised CPT
PRINCIPAL INVESTIGATOR	Chung R. Song - UNL
PROJECT START DATE	07/01/2023
PROJECT COMPLETION DATE	01/31/2026
TECHNICAL ADVISORY COMMITTEE	Nikolas Glennie; Bruce Barrett; Matthew Park; Alex Silvey; David Mraz - FHWA
PROJECT TOTAL COSTS	\$158,705
PROJECT EXPENDITURES TO DATE	\$0
NUMBER OF EXTENSIONS GRANTED	None
PERCENTAGE OF PROJECT COMPLETE	22%
STATUS	On Schedule
FY-2025BUDGET	\$158,705
FY-2025 TASKS TO BE COMPLETED	Tasks 2, 3, 5 & 6

Background: Multiple NDOT researches confirmed that the back-calculated strength of soils at failed slopes in Nebraska was often much lower than the measured one in the design stage (Song et al. 2017, 2020). In some cases, the strength of soils at failure slopes was only 10% to 30% of the initial strength. Further study showed that this behavior was associated with the geological/geotechnical history of the region. And it is shared by the US, Canada and several EU(European Union) countries. This shear strength is called "wet-drained-fully softened" shear strength by researchers. The laboratory testing techniques to obtain this critical strength, however, are not standardized. Furthermore, an easily applicable field testing technique does not exist to the knowledge of this researcher. This research proposes an innovative CPT based testing technique that can obtain this critical strength of soils in the field conveniently. The following figure shows that the CPT equipment with the capability of water injection can penetrate into the ground, inject water so that surrounding soils may be wet, then conduct the CPT test. Then the wet condition is obtained, the drained condition is obtained by incorporating the piezometer readings, and, the fully softened condition is obtained by taking strength parameters from the skin friction of CPT. Consequently, the "wet-undrained-fully softened" strength is obtained. This technique is much quicker for testing than the currently available laboratory technique, and therefore, the cost is more economic. This research is an innovative research, however, the UNL team has years of accumulated experience in exploring soil properties with this CPT. HPT is a recently developed device that can inject water into field soils and obtain hydraulic parameters of saturated and unsaturated soils. The team has full access to these devices so that this research can progress smoothly. HPT was developed by the CPT manufacturer, and it is a system that can be easily fitted to the existing CPT system.

Objective:

The objectives of this study are devising a method to obtain the wet-drained-fully softened shear strength of soils accurately and conveniently through following step by step procedure:

- 1) Develop a systematic wetting technique for field soils based on the revised CPT- HPT(Hydraulic Profiling Tool) equipment.
- 2) Develop a CPT testing mechanism to obtain "wet-drained-fully softened strength".
- 3) Verify the new testing method by comparing field CPT-HPT combo test results and other reference strengths.
- 4) Develop a test data reduction procedure to obtain CPT-HPT-based "wet-drained-fully softened strength", and incorporate the procedure in software so that the "wet-drained-fully softened strength" can be obtained easily by the NDOT crew.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Literature	\$ 17,128	1000%
Task 2: Development/Modification of CPT	\$ 40,206	32.39%
Task 3: Verification of the Method	\$ 49,739	4.21%
Task 4: Recommendation for Field Application	\$ 31,566	0%
Task 5: Report Findings	\$ 20,066	10%

Deliverables: This research is intended to solve a fundamental technical challenge in evaluating the critical strength of soils in Nebraska through the utilization of the devised technique. Therefore, the expected benefits are as follows;

- 1)Allow NDOT to obtain critical soil strength accurately and quickly.
- 2)Allow NDOT to selectively utilize materials invulnerable to substantial strength reduction.
- 3)Safer highways by reducing soil-related highway failure and troubles.
- 4)Reduced maintenance work and cost-saving by providing a more resilient highway system. Eventually, the structure designed based on this critical strength will require less maintenance work.

Performance: Project started July 1, 2023

CONTROL NUMBER	01057B
PROJECT NUMBER	FY24 (027)
PROJECT TITLE	The Use of Recycled Plastic in Asphalt Pavements: Feasibility Study
PRINCIPAL INVESTIGATOR	Jamilla Teixeira - UNL
PROJECT START DATE	7/1/2023
PROJECT COMPLETION DATE	01/31/2026
TECHNICAL ADVISORY COMMITTEE	Bruce Barrett; Robert Rea; Matthew Park; Nhung Hoang - FHWA
PROJECT TOTAL COSTS	\$148,494
PROJECT EXPENDITURES TO DATE	\$0
NUMBER OF EXTENSIONS GRANTED	None
PERCENTAGE OF PROJECT COMPLETE	42%
STATUS	On Schedule
FY-2025BUDGET	\$148,494
FY-2025 TASKS TO BE COMPLETED	Tasks 1, 2 & 3

Background: Recently the world’s population has been paying more attention to severe climate changes and environmental pollutions, by focusing primarily on ways to control and reduce the CO2 through reusing, and recycling a broad range of waste materials. The asphalt pavement industry has a long history of using recycled materials in asphalt mixtures to achieve engineering, economic, and environmental benefits. Besides reclaimed asphalt pavement (RAP) being recycled at a rate of approximately 94 percent, other recycled materials such as recycled asphalt shingles (RAS), recycled tire rubber (RTR), waste engine oils, steel slag, recycled glass, and many others have been and will continue to be used in some markets or applications. A recycled material that has recently gained attention for paving purposes is waste plastic residues (WPR).

The plastics industry has been actively exploring new end market opportunities for over 30 million tons of waste plastics generated yearly. One of the potential applications identified is asphalt pavements. In late 2016, media reports began suggesting the use of WPR in asphalt as an opportunity to improve the performance of asphalt pavements while eliminating the growing amount of waste plastics being landfilled or polluting the environment. However, using WPR in asphalt mixtures can be challenging due to variations in its composition and the presence of non-plastic contaminants. To ensure the quality of asphalt mixtures containing WPR, requirements are needed to specify the key properties of these materials and how they should be used to improve the overall pavement life cycle benefits while protecting the environment.

Therefore, the goal of this multi-phase study is to evaluate the feasibility of using recycled plastic in asphalt pavements by considering the effect of WPR addition on the rutting, cracking, moisture, and aging resistance of asphalt mixtures using well-established mixture performance test methods.

Objective:
The goal of this multi-phase study is to evaluate the feasibility of using recycled plastics in asphalt pavements by considering the effect of recycled plastics on the rutting, cracking, moisture damage resistance of asphalt mixtures through Balanced Mix Design (BMD) approach. More specifically, this study aims to:

- Identify waste plastics sources in Nebraska and select a few of them based on their physic o chemical properties that are considered important for use in asphalt mixtures through the dry process.
- Develop a laboratory procedure for introducing selected waste plastics that can mimic the production of recycled plastic modified mixtures at asphalt plants.
- Evaluate the performance of plastic modified asphalt mixtures prepared with various sources and types of wastes plastics in the laboratory. The main focus of this objective is on developing a mix design for plastic modified mixtures via a BMD approach.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Literature Review	\$ 14,849	65%
Task 2: Experimental Plan and Sample Collection	\$ 14,671	50%
Task 3: Laboratory Tests	\$ 48,781	90%
Task 4: Analysis of Test Results	\$ 48,432	0%
Task 5: Documentation and Presentation	\$ 21,761	5%

Deliverables: The analysis of performance testing results of various asphalt mixtures produced with different WPR contents can lead to optimum blends that meet the short- and long-term performance requirements. The results can contribute to minimizing the consumption of natural resources for construction and potentially improve the durability of asphalt pavements, resulting in significant cost savings and more sustainable asphalt pavements. The successful development and implementation of this research in our state will also provide significant environmental benefits, such as preservation of limited natural resources, reduction of energy consumption, reduction of disposed and discarded solid waste, and reduction of emissions.

Performance: Project started July 1, 2023

CONTROL NUMBER	01057C
PROJECT NUMBER	FY24 (028)
PROJECT TITLE	Local Characterization of Unbound Materials (Soils/Aggregates) for AASHTOWare Pavement ME Design in Nebraska
PRINCIPAL INVESTIGATOR	Jongwan Eun- UNL
PROJECT START DATE	7/1/2023
PROJECT COMPLETION DATE	01/31/2026
TECHNICAL ADVISORY COMMITTEE	Bruce Barrett; Brady Dresselhaus; Matthew Park; Nikolas Glennie; Nhung Hoang - FHWA
PROJECT TOTAL COSTS	\$ 159,036
PROJECT EXPENDITURES TO DATE	\$12,011
NUMBER OF EXTENSIONS GRANTED	None
PERCENTAGE OF PROJECT COMPLETE	25%
STATUS	On Schedule
FY-2025 BUDGET	\$147,025
FY-2025 TASKS TO BE COMPLETED	Tasks 2 & 3

Background: Several states have started using the AASHTOWare Pavement ME Design (Pavement ME) for road design, and recently Nebraska DOT is also taking notice. What separates the Pavement ME (ME) from other design procedures is that this empirical-mechanistic approach takes into account the material's individual response to predict the overall pavement performance. In the ME, there are three different levels of input to meet accuracy, and they require a set of material properties. However, obtaining the input parameters is a time-consuming step that oftentimes limits the application of ME. The resilient modulus (Mr) is one of the key fundamental material properties required. To contribute to implementing ME in the design of Nebraska pavements, this study aims to (1) establish a large data set of localized Mr and characteristics of unbound materials in Nebraska, (2) develop a simple method to correlate the modulus with commonly used geotechnical properties. To meet the goal, we will conduct (1) an extensive literature review of ME and other state studies, (2) laboratory testing of selected unbound materials for physical-mechanical properties and investigation of the existing correlations between Mr and soil properties, (3) evaluation and calibration of Mr for selected unbound materials and verification of the correlation to estimate Mr using soils model, and (4) finite element modeling of flexible and rigid pavement employing stress-dependent model and evaluate the sensitivity analysis varying unbound materials. Unbound and subgrade materials will be sampled from at least five different areas including problematic soils, and various testing will be conducted to determine numerous properties and characteristics including; materials classification (AASHTO and USCS), moisture-density relations, unconfined compressive strength, and resilient modulus. The resilient modulus test will be conducted according to AASHTO T 307 procedure equipped by the UNL. The resulting outcomes with statistical analyses will show the archive data set of NE unbound materials for implementing ME more optimally.

Objective:
The objectives of this research are to 1) establish an extensive data set of localized Mr and other geotechnical characteristics of unbound materials for representative NE locations, 2) develop a simple and robust method to correlate the Mr with commonly used geotechnical properties that meet for Level 2 inputs, and 3) evaluate the effect of input parameters on the performance of the typical NE pavement structures.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Extensive Review	\$14,049	100%
Task 2: Material Sampling	\$21,214	40%
Task 3: Experimental Program	\$70,193	10%
Task 4: Develop correlations of Mr with other geotechnical properties	\$28,468	0%
Task 5: Sensitivity analysis	\$16,620	0%
Task 6: Design recommendation	\$8,491	0%
Task 7: Report	\$1,000	0%

Deliverables: Based on the analyses of the data generated from this research, reliable experimental data to meet Levels 1 and 2 inputs will be prepared, and the resilient modulus models will be calibrated for local unbound pavement design. The extensive literature review (state DOT studies, national-international studies, etc.), laboratory testing, and finite element modeling simulation will provide recommended practices for roadway design in the future. Successful accomplishment of this research will provide a good level of confidence that NDOT can save costs due to more optimized pavement design. These advantages can lead to reducing long-term maintenance costs and enhancing the performance and design life of new and rehabilitated pavements.

Performance: Project started July 1, 2023

CONTROL NUMBER	01057D
PROJECT NUMBER	FY24 (029)
PROJECT TITLE	Assessment of Winter Maintenance Performance Objectives Using Maintenance Decision Support System
PRINCIPAL INVESTIGATOR	Mark Anderson- UNL
PROJECT START DATE	7/1/2023
PROJECT COMPLETION DATE	01/31/2026
TECHNICAL ADVISORY COMMITTEE	Mike Mattison; Tom Renninger; Korey Donahoo; James Laughlin; John Lutz; Ben Merchant; Helen Tran; David Mraz - FHWA
PROJECT TOTAL COSTS	\$ 253,736
PROJECT EXPENDITURES TO DATE	\$25,899
NUMBER OF EXTENSIONS GRANTED	None
PERCENTAGE OF PROJECT COMPLETE	0%
STATUS	On Schedule
FY-2025 BUDGET	\$227,837
FY-2025 TASKS TO BE COMPLETED	Tasks 1, 2, 3, 4, 5 & 6

Background: NDOT has made significant investments in winter maintenance operations including the procurement of a Maintenance Decision Support System, acquisition of dedicated weather operational expertise, and the development and refinement of a winter severity index. These resources have improved NDOT’s internal operations, coordination with its partners, and its statewide level of service; however, specific quantification of performance is necessary to maintain and improve NDOT service to its customers. Historically, NDOT has used traffic mobility data to assess performance along the Interstate 80 corridor in terms of speed recovery after a winter storm. This metric has limitations in specifically quantifying NDOT’s winter maintenance operations performance such as its responsiveness to the actions of adjacent state road closures (e.g., Wyoming) and the influence of commercial vehicle congestion when the road initially reopens. Other states have considered metrics such as friction measurements, leveraging camera images to identify time to bare pavement, road condition reports, and more. The proposed project seeks to provide strategic guidance to NDOT in the development of its own suite of performance metrics by conducting an inventory of available weather, mobility, and maintenance data that may be used to create various performance indicators. The project intends to produce sample metrics with the available data and make recommendations on best options and/or additional data needs NDOT may wish to pursue.

Objective:
The proposed project seeks to provide strategic guidance to NDOT in the development of its own suite of performance metrics by conducting an inventory of available weather, mobility, and maintenance data that may be used to create various performance indicators. The project intends to produce sample metrics with the available data and make recommendations on best options and/or additional data needs NDOT may wish to pursue.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Literature Review	\$ 11,138	0%
Task 2: NDOT Data Inventory	\$ 23,775	0%
Task 3: Data Collection and Procurement	\$ 64,715	0%
Task 4: Performance Measure Development	\$ 71,902	0%
Task 5: Performance Measure Case Study Analysis and Validation	\$ 59,200	0%
Task 6: Quarterly Reports, Presentations, and Final Report	\$ 23,006	0%

Deliverables: An assessment of winter maintenance performance objectives will allow NDOT to better understand its resource allocations during winter storms while combating challenges such as staffing shortages. Additionally, performance metrics can be an internal tool to enhance planning/scheduling activities and/or an external-facing tool to showcase how NDOT is servicing the public. Performance tracking may also assist with decisions on longer term NDOT investments such as physical equipment, maintenance assets, and service products. Overall, performance measures can provide an objective, independent baseline of NDOT winter maintenance activities and allow NDOT to identify subsequent actions to promote greater efficiency and effectiveness of its operations.

Performance: Project started July 1, 2023.

CONTROL NUMBER	01057E
PROJECT NUMBER	FY24 (030)
PROJECT TITLE	Development and Evaluation of Crashworthy Approach Guardrail Transition with Increased Span Length between Concrete Bridge Rail and First Transition Post: Phase I
PRINCIPAL INVESTIGATOR	Tewodros Yosef- UNL
PROJECT START DATE	7/1/2023
PROJECT COMPLETION DATE	01/31/2026
TECHNICAL ADVISORY COMMITTEE	Nathan Sorben; Austin White; Abe Anshasi - FHWA; David Mraz - FHWA
PROJECT TOTAL COSTS	\$175,145
PROJECT EXPENDITURES TO DATE	\$0
NUMBER OF EXTENSIONS GRANTED	None
PERCENTAGE OF PROJECT COMPLETE	5%
STATUS	On Schedule
FY-2025BUDGET	\$175,145
FY-2025TASKS TO BE COMPLETED	Tasks 1, 2, 3 & 4

Background: The Midwest Roadside Safety Facility (MwRSF) has recently conducted multiple research projects to develop crashworthy retrofits or design alterations for Approach Guardrail Transitions (AGTs) when the site conditions prevent the as-tested design configuration from being implemented. These research projects have mainly focused on issues that obstruct AGT posts from being properly installed (i.e., wing walls, drainage structures, utilities, and reduced grading). Most of these obstructions are located near the bridge railing end at the AGT’s downstream region, where the posts are spaced closely together. Designing a new MASH crashworthy AGT that incorporates a large span length between the bridge rail end and the first transition post would avoid these obstructions and prevent the need for design retrofits. In 2020, a MASH TL-3 crashworthy AGT was created by the MwRSF for a steel-tube bridge rail for the Illinois and Ohio DOTs. This AGT had a 9-ft span length between the first bridge rail post and the adjacent transition post, which was designed to extend over ground obstructions near the bridge end. This AGT design used two HSS6x6x1/4 transition rail elements to match the specific steel-tube bridge rail configuration. However, a similar AGT could be developed using strong rail elements to prevent large deflections.

Objective:
The objective of this project is to develop and evaluate the standard 34-in. tall NDOT thrie beam MASH AGT system with increased span length between the concrete buttress end and the first transition post to accommodate a wide range of obstructions that prevent proper installation of posts, including bridge abutments and wing walls, as well as drainage and utility structures. The research and development effort will identify various critical obstructions near bridge ends through a survey of the NDOT district engineers and seek feedback on the desired maximum span length for the AGT. The project will develop numerous design concepts by exploring various mechanisms, such as surrogate post (i.e.,continuous horizontal beam, cantilever beam, and grade-mounted post), and stiffening and increasing moment capacity of AGT rail elements to mitigate large deflections, vehicle instabilities, pocketing, and snag associated with the increased span length. Evaluation of the 34-in. tall NDOT AGT with increased span length designs will include dynamic analysis of impacts near the upstream W-to-thrie beam stiffness transitions and the downstream thrie beam to rigid buttress transition using LS-DYNA finite element analysis computer program. The AGT system would be designed to meet the MASH TL-3 impact safety requirements. Full-scale testing may be recommended to evaluate the new AGT system in a follow-on phase of the research.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Project Planning and Correspondence	\$ 14,815	20%
Task 2: Concept Development	\$ 30,976	0%
Task 3: Engineering Analysis and Optimization of Selected Designs	\$ 84,051	0%
Task 4: Reporting and Project Deliverables	\$ 45,303	0%

Deliverables: Development and evaluation of the 34-in. tall NDOT thrie-beam AGT system with increased span length between the concrete bridge end and the first transition post would provide NDOT with crashworthy and cost-effective solutions for avoiding installation issues adjacent to the bridge end where various obstructions (i.e., drains, foundations, utilities, etc.) could prevent proper post placement. The new AGT system would be developed to satisfy MASH TL-3 performance criteria while accommodating a wide range of obstructions by providing increased span length. Additionally, developing the AGT system with an increased span length will provide roadside designers with crashworthy solutions for non-ideal installation sites and reduce the costs associated with relocations of the previously-noted obstructions.

Performance: Project started July 1, 2023.

CONTROL NUMBER	01057F
PROJECT NUMBER	FY24 (031)
PROJECT TITLE	Sediment Collection and Analysis of Sediment Contributing to State Storm Sewer Facilities
PRINCIPAL INVESTIGATOR	Bruce Dvorak- UNL
PROJECT START DATE	7/1/2023
PROJECT COMPLETION DATE	01/31/2026
TECHNICAL ADVISORY COMMITTEE	Julie Ramirez; Jodi Kocher; Anna Allen; Ron Poe; Brian D Anderson; Jason Jurgens; Chi Zhang; Isabella Fleege; Kyle Hall; David Mraz - FHWA; Tim Zach - LTU; Trevor Hansen - LTU; Mike Middendorf - LTU; Justin.Zetterman@fremontne.gov
PROJECT TOTAL COSTS	\$181,428
PROJECT EXPENDITURES TO DATE	\$0
NUMBER OF EXTENSIONS GRANTED	None
PERCENTAGE OF PROJECT COMPLETE	20%
STATUS	On Schedule
FY-2025BUDGET	\$181,428
FY-2025TASKS TO BE COMPLETED	Tasks 1, 2, 3, 4, 5 & 6

Background: NDOT would like to implement SAFL Baffles and possibly other mechanical sediment trapping devices in future projects to address MS4 regulations. These devices require preliminary determination of runoff sediment characteristics including particle size distributions and concentrations. The required data are available in some other states but not in Nebraska. Using data obtained in other states will be inaccurate and will likely result in over- or under-design of the sediment trapping devices. Proper design of the trapping devices will optimize cost and efficiency of the devices. Measuring sediment size distributions and concentrations at multiple drainage sites in Nebraska municipalities is needed to provide defensible characterization of runoff sediment. Modeling of the sediment size distributions and concentrations is needed to extend measured results to similar drainages.

Objective: The overarching goal of this project is to establish reasonable estimates of particle size distributions and concentrations of sediment washed from roadways into storm sewers in Nebraska MS4 municipalities. These data are needed for proper sizing and maintenance scheduling of SAFL Baffles. To meet this goal, the following objectives have been identified:

- Objective 1. Develop a thorough understanding of existing roadway sediment runoff data including concentrations and sediment distributions.
- Objective 2. Establish a rigorous and defensible methodology for collecting roadway runoff sediment data that is representative of MS4 communities in Nebraska.
- Objective 3. Collect a complete set of roadway sediment runoff data for a two-year period that includes multiple seasons.
- Objective 4. Produce a model and guidelines for extending the data to represent MS4 communities throughout Nebraska.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Literature Review	\$ 13,385	30%
Task 2: Sampling Site Preparation	\$ 69,147	50%
Task 4: Data Collection and Processing	\$ 47,508	0%
Task 6: Develop Model / Guidelines	\$ 36,419	0%
Task 8: Provide Final Recommendations	\$ 14,986	0%

Deliverables: This research is straight forward and the results will be directly utilized by NDOT in its MS4 program. The research will allow for inlet and manhole sump structure designs that are tailored specifically to Nebraska data. The data may also be utilized in design of other MS4 treatment methods by using the sediment concentration and particle size distributions to calculate expected sediment loads, potential settlement timing, and clogging potential on filtering systems.

Performance: Project started July 1, 2023.

CONTROL NUMBER	01057G
PROJECT NUMBER	FY24 (032)
PROJECT TITLE	Update of Intersection/Interchange Guidelines for Rural Expressways in Nebraska
PRINCIPAL INVESTIGATOR	Aemal Khattak - UNL
PROJECT START DATE	7/1/2023
PROJECT COMPLETION DATE	01/31/2026
TECHNICAL ADVISORY COMMITTEE	Dan Waddle; Alan Swanson; Harrison Redepenning; Matt Neeman; Nathan Sorben; Don Butler; Kyle Christensen; Alison Koch - FHWA; Nhung Hoang - FHWA
PROJECT TOTAL COSTS	\$179,316
PROJECT EXPENDITURES TO DATE	\$0
NUMBER OF EXTENSIONS GRANTED	None
PERCENTAGE OF PROJECT COMPLETE	18%
STATUS	On Schedule
FY-2025 BUDGET	\$179,316
FY-2025 TASKS TO BE COMPLETED	Tasks 1, 2, 3, 4 & 5

Background: Update of Intersection/Interchange Guidelines for Rural Expressways in Nebraska

NDOT staff frequently deals with the decision to change an existing two-way STOP-controlled expressway intersection to either a signalized intersection or an interchange. Current guidelines for such decisions are in the "Interchange vs. at-grade intersection on rural expressways" report No. TRP-02-25-91, May 1992. This report deals with conversion of two-way STOP-controlled intersections to either a signalized intersection or a full diamond interchange with STOP-controlled off ramps. The report is dated and NDOT staff needs guidance on additional options (e.g., roundabouts, RCUT) besides the two mentioned in the report. This research is proposed to update the guidance in the report using the latest cost components (e.g., crash costs) and newer methodology that incorporates additional options besides the original two (signalized intersection and full diamond interchange). The proposed research would consist of updated methodology for three major components: 1) Assessment of operational efficiency and associated costs based on current state-of-art method adjusted to Nebraska conditions, 2) Safety and associated cost estimations based on recent crash data, and 3) Construction cost assessment based on recent market values and practices. The original research relied on the Highway Capacity Software (HCS). The proposed research will also utilize calibrated and validated microsimulation models for Nebraska conditions to assess in-depth operational impacts. The research will update and supplement existing guidelines.

Objective:

The proposed research has the following objectives.

- Assess the operational and safety performance and associated costs of different alternative design options available for reconfiguring rural two-way stop-controlled expressway intersections based on the current state-of-the-art method adjusted to Nebraska conditions.
- Assess the construction and maintenance cost of different options that are available for intersections/interchanges based on recent market values and practices.
- Develop rural expressway intersection reconfiguration guidelines based on benefit/cost analysis of the alternative design options.

This research will focus on the following intersection options: two-way stopped-controlled (TWSC) intersections, signalized intersections, diamond interchange, DDI, RCUT, and roundabouts. The analyses will include both four-legged and three-legged facilities, as appropriate. As part of the operational analyses, this research will develop 1) deterministic models (e.g., HCS) to assess the operational impacts of at-grade intersections and interchanges and 2) microsimulation models calibrated and validated for Nebraska conditions to assess in-depth operational impacts of location-specific facilities. Note that these models will be accessible to NDOT, if they wish to use them.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: TAC Meeting and Review of Literature	\$ 30,745	80%
Task 2: Data Collection	\$ 36,068	20%
Task 3: Operational Analysis and Associated Cost Estimation	\$ 21,963	0%
Task 4: Safety Analysis and Associated Cost Estimation	\$ 24,270	0%
Task 5: Construction and Maintenance and Associated Cost Estimation	\$ 24,270	0%
Task 6: Benefit/Cost Analysis and Establish Guidelines	\$ 19,872	0%
Task 7: Final Report and TAC Presentation	\$ 22,127	0%

Deliverables: The proposed research project will not only update existing guidelines utilizing the latest information available but also include new options for dealing with rural expressway intersections controlled by two-way stop signs. This will enable NDOT staff to make more informed decisions well into the future and improve expressway intersection operation and safety in Nebraska. The eventual benefits will be efficient operation and improved expressway intersection safety in Nebraska.

Performance: Project started July 1, 2023.

CONTROL NUMBER	01057H
PROJECT NUMBER	FY24 (033)
PROJECT TITLE	Drainage Area Limitations for NDOT Hydrologic Computations
PRINCIPAL INVESTIGATOR	Rollin H. Hotchkiss - Brigham Young University (BYU)
PROJECT START DATE	7/1/2023
PROJECT COMPLETION DATE	01/31/2026
TECHNICAL ADVISORY COMMITTEE	Julie Ramirez; Jodi Kocher - FH; Anna Allen; Kyle Hall; Jason Dayton; Kirk Harvey; Chi Zhang; Isabella Fleege; Alison Koch - FHWA; David Mraz - FHWA; Matt McConville - HDR Inc
PROJECT TOTAL COSTS	\$114,528
PROJECT EXPENDITURES TO DATE	\$9,425
NUMBR OF EXTENSIONS GRANTED	None
PERCENTAGE OF PROJECT COMPLETE	30%
STATUS	On Schedule
FY-2025 BUDGET	\$105,103
FY-2025 TASKS TO BE COMPLETED	Tasks 2, 3, 4, 5, 6, 7 & 8

Background: There is a lack of performance-based guidance on drainage area-based use of hydrologic methods to predict peak discharge. Specifically, a lack of guidance when using SCS curve number-based methods leaves designers with less confidence about the applicability decisions.

- Objective:** The objectives of this study are to
- Compare estimates of peak discharge using SCS curve number methods to those from smaller gaged watersheds to determine a logical lower and upper limit for drainage area applicability.
 - Apply recently developed hydrologic methods that provide long-term simulations for gaged and ungaged areas and apply flood frequency estimates derived therefrom to those from gage records and curve number results.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Continue the literature review of both traditional and next gen methods for calculating peak discharge	\$ 8,000	100%
Task 2: Assemble all available streamflow records from smaller drainage areas from the U.S. Geological Survey and cooperative agencies that collect streamflow data.	\$ 10,000	80%
Task 3: Perform standard flow frequency analyses for all streamflow records	\$ 10,000	60%
Task 4: Calculate peak flow estimates using the Rational Method (drainage areas less than 1 square mile), SCS curve number methods, and the National Water Model for all selected gaged watersheds.	\$ 15,000	40%
Task 5: Calculate flow frequency for several ungaged areas using the same three methods and regression equations.	\$ 19,000	0%
Task 6: Analyze all results to determine drainage area limitations and guidelines.	\$ 32,000	0%
Task 7: Meet with the TAC members throughout the life of the project.	-	-
Task 8: Produce a final report and technical brief and provide training for project implementation to NDOT designers	\$ 20,000	0%

Deliverables:

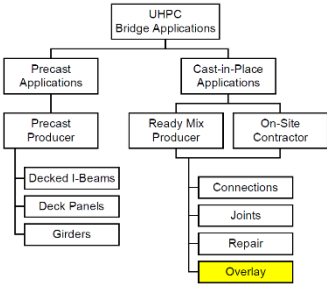
- Achieving the study objectives will
- Provide designers better guidance on the application of available hydrologic methods for calculating peak discharge, which will provide additional consistency and uniformity when sizing hydraulic structures.
 - Increase skill levels using more sophisticated computational approaches such as the Watershed Modeling System (WMS).
 - Allow designers to consider new methods for predicting peak discharge.
 - Share results at Transportation Research Board and/or National Hydraulic Engineering Conference
 - Lead the way in considering the power of recent and ongoing hydrologic research

Performance: Project started July 1, 2023.

CONTROL NUMBER	01057J
PROJECT NUMBER	FY24 (034)
PROJECT TITLE	Ultra-High-Performance Concrete (UHPC) for Bridge Deck Overlay and Structural Deck Repair
PRINCIPAL INVESTIGATOR	Jiong Hu - UNL
PROJECT START DATE	7/1/2023
PROJECT COMPLETION DATE	01/31/2026
TECHNICAL ADVISORY COMMITTEE	Ross Barron; Fouad Jaber; Wally Heyen; Kyle Zillig; Kent Miller, Lieska Halsey; David Mraz - FHWA
PROJECT TOTAL COSTS	\$ 152,761
PROJECT EXPENDITURES TO DATE	\$5,500
NUMBER OF EXTENSIONS GRANTED	None
PERCENTAGE OF PROJECT COMPLETE	30%
STATUS	On Schedule
FY-2025 BUDGET	\$147,261
FY-2025 TASKS TO BE COMPLETED	Tasks 1, 2 & 3

Background: Recently developed NDOT non-proprietary UHPC mixture for precast and cast-in-place applications does not meet the specific requirements for deck overlay (e.g., interface bond with existing deck, high thixotropy, workability retention, sloped construction, and increased fiber content). As shown in Figure 2, the current project will, therefore, primarily focus on bridge Deck overlay and Structural deck repair, which completes the NDOT roadmap for promoting the use of UHPC in bridge applications.

Objective:
The objective of this project is to develop an NDOT UHPC mixture specific for overlay and structural deck repair applications using local materials, evaluate its fresh, mechanical, and durability properties using laboratory testing and mockup specimens, and implement it in demonstration projects.



Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Literature Review	\$ 10,574	80%
Task 2: Mixture Development	\$ 28,899	80%
Task 3: Performance Evaluation	\$ 68,843	5%
Task 4: Mockup and Demonstration	\$ 34,554	0%
Task 5: Document and Presentation	\$ 9,891	0%

Deliverables: Through bridge deck overlay and structural deck repair, UHPC is expected to improve the long-term performance of NDOT bridge decks and have a lower life-cycle cost than conventional materials due to their durability and structural performance. It is expected to extend the service life of the overlay beyond the 75-year service life of the bridge structure. This project will be a key component of the NDOT Roadmap of UHPC. The success of this project will provide the necessary knowledge for UHPC as an overlay or structural repair material for bridge decks, which will greatly encourage producers and contractors to adopt this innovative approach.

Performance: Project started July 1, 2023.

CONTROL NUMBER	01057K
PROJECT NUMBER	FY24 (035)
PROJECT TITLE	Framework for Quantifying Benefits to Disadvantaged Communities: Application to Nebraska's National Electric Vehicle Infrastructure (NEVI) Plan
PRINCIPAL INVESTIGATOR	Li Zhao - UNL
PROJECT START DATE	7/1/2023
PROJECT COMPLETION DATE	01/31/2026
TECHNICAL ADVISORY COMMITTEE	Ryan Huff; Curtis Nosal; Walter Moy; Harrison Redepenning; Kimberly Baker; Amy Starr; Felicia Beltran - FHWA; Justin Luther - FHWA
PROJECT TOTAL COSTS	\$ 179,055
PROJECT EXPENDITURES TO DATE	\$0
NUMBER OF EXTENSIONS GRANTED	None
PERCENTAGE OF PROJECT COMPLETE	12%
STATUS	On Schedule
FY-2025 BUDGET	\$ 179,055
FY-2025 TASKS TO BE COMPLETED	Tasks 2, 3 & 4

Background: The Bipartisan Infrastructure Law (BIL) created the National Electric Vehicle Infrastructure (NEVI) Formula Program that will give NDOT access to \$30.2 million over the five-year span (2022 - 2026) of the program to strategically install Electric Vehicle Supply Equipment (EVSE) around the State. The Formula Program is subject to the Justice40 directive which states that 40% of the overall benefits from Federal covered programs need to be distributed to disadvantaged communities (DACs). Under the Justice40 directive, each agency is required to establish a methodology for calculating the benefits that (1) flow from each applicable covered program, and (2) accrue in DACs from each covered program. The NEVI Formula Program is one of many Justice40-covered programs as announced by the White House on August 18, 2022. The Justice40 directive does not require NDOT to place 40% of the EVSE in the DACs, and it would not be appropriate to do so given where the DACs are in the State. Thus, quantifying the 40% or higher benefits to DACs is not a straightforward task. To date, the Joint Office (Energy and Transportation) has not provided NDOT and other State DOTs specific guidance on how to measure benefits to DACs. This project proposes to assist NDOT in developing a set of indices (e.g., EVSE accessibility index) that can be used to compare EVSE deployment benefits to DACs and non-DACs. A crucial element of the proposed project is the method/procedure to easily collect the necessary data for calculating the indices. The indices developed from this project can be used and applied by NDOT to other Justice40-covered programs.

Objective: This project aims to assist NDOT in complying with Justice40 initiative by providing a tool that can be used to quantify benefits to DACs from the selected locations for installing EV charging stations. The primary work is the development of a set of practical metrics that consider transportation, energy, economic, environmental, and health of communities. There are three measurable objectives that drive this project.

(1) Develop a set of metrics based on data to analyze the impact of an EV charging station on transportation accessibility, energy efficiency, economic growth, and environmental and health improvements.

(2) Develop a framework that provides an aggregate measure of benefits from the various metrics developed in Objective 1. The aggregate measure considers the relative importance of a benefit to a particular DAC based on its type.

(3) Develop a scenario planning tool to allow NDOT to examine different deployment strategies, such as evaluating the effect of choosing one location versus another and the effect of installing a station earlier or later than another.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Literature Search	\$16,651	100%
Task 2: Community Engagement Survey	\$29,431	45%
Task 3: Data Collection and Synthesis	\$33,276	30%
Task 4: Metric Determination and Calculation	\$29,653	10%
Task 5: Benefit Measure Modeling	\$26,354	0%
Task 6: Scenario Planning Tool Development	\$26,615	0%
Task 7: Final report and Presentation	\$17,075	0%

Deliverables:

This project will provide the following key benefits to the stakeholders in Nebraska and beyond.

- A set of practical equity metrics that can be incorporated into any project funded by a covered program.
- A scenario planning tool to support decision making by allowing agencies to investigate various scenarios and their tradeoffs..
- Ensure compliance with the Justice40 directive and support the implementation of Nebraska NEVI Program (as an application) and other Justice40-covered programs.

Performance: Project started July 1, 2023.

CONTROL NUMBER	01057L
PROJECT NUMBER	FY24 (036)
PROJECT TITLE	Assessment of Truck Parking Demand and Safety During Normal and Severe Weather Conditions in Nebraska
PRINCIPAL INVESTIGATOR	Nathan Huynh - UNL
PROJECT START DATE	7/1/2023
PROJECT COMPLETION DATE	01/31/2026
TECHNICAL ADVISORY COMMITTEE	Ryan Huff; Jarrod Walker; Walter Moy; Don Butler; Jarrod Walker; Justin Luther - FHWA
PROJECT TOTAL COSTS	\$ 188,885
PROJECT EXPENDITURES TO DATE	\$0
NUMBER OF EXTENSIONS GRANTED	None
PERCENTAGE OF PROJECT COMPLETE	25%
STATUS	On Schedule
FY-2025 BUDGET	\$188,885
FY-2025 TASKS TO BE COMPLETED	Tasks 2, 3 & 4

Background: MAP-21 included a provision requiring truck drivers to use an Electronic Logging Device to record their compliance with Hours-of-Service (HOS) requirements. This mandate, effective as of December 2017, requires commercial drivers to stop and rest after 11 hours of driving. Around the same time this mandate became effective, NDOT completed its first State Freight Plan. Through the planning process and discussions with the trucking industry and other stakeholders, the topic surrounding the availability of safe and convenient truck parking came to the fore, with truck drivers, motor carriers, and safety officials in Nebraska expressing concerns and seriousness of this issue. Commercial drivers seeking to comply with HOS regulations often park illegally, creating unsafe conditions for motorists and other commercial drivers. The extent of the problem in Nebraska is unknown and evidence is often anecdotal. For these reasons, the State Freight Plan recommended that NDOT develop an asset-based approach to understand how truck parking deficiencies affect safety and operations on its highway network. To assess truck parking at the state level, this project proposes to develop a method to scan the entire State using satellite imagery to (1) determine truck parking lot occupancy, and (2) identify locations where trucks have parked illegally. In collecting this information over 10 years, trends and projections can be made to inform policy and provide factual data to guide discussions with NDOT’s freight partners.

Objective:
 To accomplish the goals stated above, the project team will work in consultation with the Technical Advisory Committee (TAC) to accomplish the following research objectives.

1. Use publicly available sources to create a complete inventory of public and private truck parking facilities along I-80 in Nebraska and the number of available parking spaces at each facility.
2. Analyze 2022 year-long truck GPS data from the American Truck Research Institute (ATRI), supplemented with satellite imagery data, to determine actual truck parking demand at all public and private facilities along I-80 in Nebraska and identify truck parking hotspots.
3. Objective 2 will provide NDOT with very accurate information regarding truck parking demand and utilization at each facility. However, the information will be limited to the year 2022. To provide NDOT with the ability to estimate the occupancy of truck parking areas in future years, a model will be developed to provide this information.
4. Identify undesignated truck parking clusters in inclement weather to determine where best to provide emergency parking.
5. Conduct an exploratory analysis of crashes that were likely due to truck parking shortages.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Conduct Literature Review	\$14,910	100%
Task 2: Obtain and Process Truck GPS Data and Crash Data	\$66,214	45%
Task 3: Determine Truck Parking Supply and Demand	\$27,994	40%
Task 4: Develop a Model to Estimate the Occupancy of Truck Parking Areas	\$25,139	0%
Task 5: Identify Undesignated Truck Parking Clusters in Inclement Weather	\$20,663	0%
Task 6: Determine the Number of Crashes Associated with Truck Parking Shortages	\$18,155	0%
Task 7: Prepare Final Report and Presentation	\$15,811	0%

Deliverables: The primary benefit of this project to NDOT is having factual data about truck parking supply and demand in Nebraska. The secondary benefit is understanding the extent of crashes that were most likely due to truck parking shortages. These data can be incorporated into the next update of the State Freight Plan and provide a basis for meaningful dialogues with the trucking industry and related stakeholders. This project could potentially lead to more truck parking facilities across the state due to the business opportunities identified in this project for the private sector. Should that take place, it will make travel through the State safer for truck drivers and other travelers, reduce unnecessary travel and fuel consumption by trucks searching for a parking spot, and improve the efficiency of commercial vehicle operations. The providing lists the benefits of providing more truck parking by stakeholders (MnDOT, 2019)

Performance: Project started July 1, 2023.

CONTROL NUMBER	01057M
PROJECT NUMBER	FY24 (037)
PROJECT TITLE	Guidance for Left-Turn Flashing Yellow Arrow (FYA) Implementation in Nebraska
PRINCIPAL INVESTIGATOR	Aemal Khattak - UNL
PROJECT START DATE	7/1/2023
PROJECT COMPLETION DATE	01/31/2026
TECHNICAL ADVISORY COMMITTEE	Alan Swanson; Don Butler; Bryan Guy - City of Omaha; Nicholas Gordon - City of Omaha; Garret Schram - City of Omaha; Andy Jenkins - City of Lincoln; MyungWoo Lee - City of Lincoln; Abe Anshasi - FHWA; Alison Koch; Dan Fuchs - Iteris
PROJECT TOTAL COSTS	\$ 177,066
PROJECT EXPENDITURES TO DATE	\$0
NUMBER OF EXTENSIONS GRANTED	None
PERCENTAGE OF PROJECT COMPLETE	35%
STATUS	On Schedule
FY-2025 BUDGET	\$177,066
FY-2025 TASKS TO BE COMPLETED	Tasks 2 , 3 & 4

Background: In recent years, various municipalities in Nebraska have transitioned to the use of the flashing yellow arrow (FYA) for permissive left-turns in accordance with MUTCD guidelines. A preliminary study conducted by the University of Nebraska Lincoln and City of Lincoln (S 27th & J-St, S 33rd & Pioneer, S 84th & Firethorn, Wedgewood & O-St) during 2019-2020 provided some evidence that the new protocols are working well. The FYA provides safety benefits while providing more flexibility and versatility in field operation (e.g., phasing sequences, modes, and displays). However, the best practice of FYA arrangement (e.g., phasing, signing) remain unclear. Inappropriate combinations of the FYA display mode may lessen the effectiveness of the FYA application. This study will examine before-after safety of a sample of signalized intersections where changes from solid green ball to FYA installations were made for left turns. Cross-sectional field study on FYA operations will be conducted to evaluate the effectiveness of the left-turn FYA indication at signalized intersections. Specially focus on the investigation if signal display arrangement (e.g., lead/lag phasing, supplemental signing, varying time-of-day operations) had a significant effect. Guidelines on optimal implementation of the FYA considering different traffic conditions (e.g., turning movement, intersection geometry, driver comprehension, etc.) will be developed for transportation agencies.

Objective:
This study will investigate the effect on safety and traffic operation of upgrading the permissive left-turn indication from CG to FYA at signalized intersections in Nebraska. Guidelines will be developed to provide NDOT and city traffic engineers with knowledge for safer and more efficient application of left-turn FYA signal configuration and arrangement in Nebraska. Specifically, the objective of this project will be to:

1. Develop an evaluation framework for the effectiveness of the left-turn FYA indication at signalized intersections to assess both safety and operational performance and investigate if the display arrangement (e.g., supplemental sign, lead/lag phasing) has a significant effect.
2. Identify significant factors (e.g., geometric, speed, volume, signal design) that cause an increase in crashes at a particular location after conversion to left-turn FYA to assess the suitability of lead/lag phasing and develop safety improving mitigation measures for existing locations with lead/lag phasing that may be experiencing higher than expected crashes, while retaining the lead/lag operation.
3. Develop a guideline for efficient utilization and implementation of left-turn FYA indication at signalized intersections for comparing efficiency (e.g., delay reduction) and safety of left-turn FYA given different left-turn FYA settings.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Literature Search and TAC Meeting	\$ 18,985	100%
Task 2: Crash Data Analysis	\$ 33,167	50%
Task 3: Data Collection and Field Study	\$ 26,844	75%
Task 4: Cross-sectional analysis with/without FYA supplemental signs	\$ 27,042	5%
Task 5: Lead/Lag and Safety Improving Measures	\$ 24,056	0%
Task 6: Guideline Development	\$ 23,036	0%
Task 7: Final Report and Presentation to NDOT	\$ 23,937	0%

Deliverables:

1. Identify the efficacy of the left turn FYA indication at intersections under different types of protocols.
2. Provide guidance for the appropriate implementation of left-turn FYA displays (e.g., supplemental sign, lead/lag phasing) and safety improving measures for locations with lead/lag phasing experiencing higher than expected crashes.
3. Development and consistent usage of the FYA guidelines for Nebraska.

Performance: Project started July 1, 2023.

CONTROL NUMBER	01057P
PROJECT NUMBER	RRR (001)
PROJECT TITLE	LOW-CEMENT CONCRETE (LCC) MIXTURE FOR BRIDGE DECKS AND RAILS
PRINCIPAL INVESTIGATOR	Wally Heyen (NDOT and Lieska Halsey (NDOT)
PROJECT START DATE	07/28/2023
PROJECT COMPLETION DATE	03/31/2025
TECHNICAL ADVISORY COMMITTEE	Ross Barron; Fouad Jaber; Wally Heyen; Kyle Zillig; Kent Miller, Kyle Zillig; Kellie Troxel, Lieska Halsey; David Mraz - FHWA
PROJECT TOTAL COSTS	\$13,200
PROJECT EXPENDITURES TO DATE	\$9,917
NUMBER OF EXTENSIONS GRANTED	None
PERCENTAGE OF PROJECT COMPLETE	50%
STATUS	On Schedule
FY-2025 BUDGET	\$3,283
FY-2025 TASKS TO BE COMPLETED	Task 2,3 and 4

Background: The Materials and Research PCC Engineer is proposing to perform mixes UNL completed under project number FY22(001) using a ready mixed to confirm the mechanical and durability properties. As well as, introducing E5 Internal Cure and E5 Liquid Fly Ash for the of placement improving workability, longer window for finishing, minimal bleed rate, consistence air entrainment and enhancing cement/paste reduction.

- Objective:**
- To evaluate LCC concrete mixes for mechanical properties and durability characteristics that are compatible with NDOT requirements for a good performance mix design from a ready-mix concrete.
 - To ensure workability and constructability so that the mixes can be easily used in engineering applications.
 - To evaluate the use of E5 Internal Cure and E5 Liquid Fly Ash by validating the benefits of the admixture by improving workability, longer window for finishing, minimal bleed rate, consistence air entrainment and enhancing cement/paste reduction.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Evaluate Mechanical and Durability Properties from 8 cubic yards of concrete	\$ 9,917	100%
Task 2: Additional testing for Durability testing to evaluate curing	\$ 0	50%
Task 3: Data Analysis and Presentation	\$ 0	0%
Task 4: Report and Documentation	\$ 0	0%

Deliverables: Improving and proving a more sustainable 47BD mix design by reducing cement content in bridge deck mixes will reduce the concrete cost, improve durability due to less shrinkage cracking and will reduce carbon footprint, which are significant economic and environmental advantages.

Performance: Project started July 28, 2023



NEW FY25 RESEARCH PROJECT DESCRIPTIONS

CONTROL NUMBER	01071A
PROJECT NUMBER	SPR-FY25(038)
PROJECT TITLE	Electric Arc Furnace Slag as a Paving Material – Phase I: Physical, Chemical, Morphological and Mineralogical Characterization and Environmental Analysis
PRINCIPAL INVESTIGATOR	Jamilla Teixeira – UNL
PROJECT START DATE	7/1/2024
PROJECT COMPLETION DATE	5/31/2026
TECHNICAL ADVISORY COMMITTEE	To Be Determined
PROJECT TOTAL COSTS	\$151,272
PROJECT EXPENDITURES TO DATE	\$0
NUMBER OF EXTENSIONS GRANTED	None
PERCENTAGE OF PROJECT COMPLETE	0%
STATUS	New Project
FY-2025 BUDGET	\$75,636
FY-2025 TASKS TO BE COMPLETED	Tasks 1, 2, 3, 4 & 5

Background: NDOT is interested in exploring the utilization of Electric Arc Furnace Slag (EAF) as an alternative for soil stabilization. This research initiative holds the potential to diminish the necessity for commercial stabilizing agents like hydrated lime or Portland cement, consequently contributing to a reduction in CO2 emissions and offering a sustainable solution for pavement construction in Nebraska. The application of slags for soil stabilization has become a prominent topic within the pavement community. It presents an opportunity to enhance pavement performance, leading to longer-lasting roads by improving soil engineering properties. Simultaneously, it addresses the growing accumulation of materials in landfills while reducing carbon emissions.

- Objective:** The primary objectives of this research are to:
1. Conduct a bibliometric analysis aimed at identifying key national and international studies, alongside research institutions, focusing on the utilization of slag specifically for pavement applications.
 2. Gather and synthesize technical reports and U.S. state agency specifications, with a specific emphasis on delineating the prerequisites necessary for employing slag as a material for pavement applications. Characterize development behavior and required embedment lengths for full development of GFRP bars in UHPC.
 3. Identify the main sources of slags in Nebraska and characterize them in terms of physical, chemical, mechanical, mineralogical, and morphological characteristics that are considered important for stabilization of soils.
 4. Verify if the addition of slags can pose environmental concerns due to leaching of hazardous heavy metals in comparison with traditional stabilizing materials.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Literature Review	\$5,749	0%
Task 2: Sample Collection and Preparation	\$6,296	0%
Task 3: Experimental Plan (Slag Characterization & Environmental Analysis)	\$68,860	0%
Task 4: Examination of Feasibility and Potential Implementation	\$36,094	0%
Task 5: Documentation and Presentation	\$34,276	0%

Deliverables: This study will enrich the state-specific soil stabilization strategies and pavement sustainable solutions. A successfully accomplished research will show if the EAF slag is technically and environmentally suitable for paving application. With the success of this initial stage laboratory-based research, the research team plan to move to a second phase focused on soil-slag mechanical characterization and field evaluation. A procedure manual for using EAF/caster slags will be prepared and delivered to NDOT at the end of multi-phase study. Those results will be suggested to be incorporated into the NDOT Standard Specifications for Highway Construction, which can be used for statewide and countywide implementation.

Performance : Project will start July 1, 2024.

CONTROL NUMBER	01071B
PROJECT NUMBER	SPR-FY25(039)
PROJECT TITLE	Evaluation of Low-Temperature Cracking (LTC) Performance Testing Methods to Assess Nebraska Asphalt Mixtures
PRINCIPAL INVESTIGATOR	Chun-Hsing Ho – UNL
PROJECT START DATE	7/1/2024
PROJECT COMPLETION DATE	5/31/2026
TECHNICAL ADVISORY COMMITTEE	To Be Determined
PROJECT TOTAL COSTS	\$152,382
PROJECT EXPENDITURES TO DATE	\$0
NUMBER OF EXTENSIONS GRANTED	None
PERCENTAGE OF PROJECT COMPLETE	0%
STATUS	New Project
FY-2025 BUDGET	\$76,191
FY-2025 TASKS TO BE COMPLETED	Tasks 1, 2, 3, 4 & 5

Background: NDOT has embarked on the development of balanced mix design (BMD) method with the two previous NDOT-funded research projects, Phase I (SPR-FY22 (002)) and Phase II (SPR-FY23(016) that considers 2 main distresses: rutting and mid-temperature cracking. Although the research outcomes show that the proposed BMD methods are practically efficient and implementable, they are limited and do not assess low temperature cracking resistance of asphalt mixtures, which is considered as one of the main concerns in cold climate states like Nebraska. Based on the NCHRP 20-07(406) report, there are three states (Iowa, Minnesota, and Missouri) in the mid-US regions that require a thermal cracking test in their mix design specifications [1]. The report further indicated that among state DOTs and asphalt contractors, the most commonly used thermal cracking tests were the Semi-Circular Bend Test (SCB), the Disc-Shaped Compact Tension Test (DCT), the Indirect Tensile (IDT) Creep Compliance and Strength Test, the Thermal Stress Restrained Specimen Test (TSRST), the Illinois Flexibility Index Test (I-FIT) and Bending Beam Rheometer (BBR) test (Figure 1).

- Objective:** The primary objectives of this research are to:
1. Conduct LTC tests on the different binders and mixtures collected from Nebraska field projects to verify the sensitivity and reproducibility of suggested tests from literature. The selected mixtures will include various binder PG grade, source and content, aggregate types (virgin and RAP) and nominal maximum aggregate size.
 2. Verify the LTC sensitivity to mixture volumetrics. Plant collected mixtures will be lab compacted at different levels of air voids to verify LTC test susceptibility to this mixture parameter.
 3. Compare results from the two scales (binder & mixture) of material testing with results obtained from samples collected from NDOT paving projects approved by NDOT TAC members.
 4. Establish preliminary pass/fail thresholds based on the obtained results and comparison with literature for future QC and acceptance purposes.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Literature Review	\$45,507	0%
Task 2: Experimental Plan	\$19,462	0%
Task 3: Lab Test	\$31,803	0%
Task 4: Data Analysis	\$54,509	0%
Task 5: Documentation and Final Report	\$1,100	0%

Deliverables: This study will contribute to the implementation of Nebraska Balanced Mix Design (BMD). Currently, only volumetric characteristics are considered in the design of Nebraska asphalt mixtures, and the effects of new materials such as recycling agents, antioxidants, polymers, waste plastics, and/or high RAP materials cannot be fully addressed. Furthermore, the addition of an NDOT project with a focus on LTC (Low Temperature Cracking) is a critical need that will allow the determination of the most suitable LTC test method to be incorporated into the Nebraska BMD approach. In this way, fundamental properties of mixtures can better address the effects of low temperature, such as thermal cracking and mixture interactions during freeze-thaw conditions.

Performance : Project will start July 1, 2024.

CONTROL NUMBER	01071C
PROJECT NUMBER	SPR-FY25(040)
PROJECT TITLE	The Utilization of Waste Plastic as a Polymer Modifier for Asphalt Binders
PRINCIPAL INVESTIGATOR	Jamilla Teixeira – UNL
PROJECT START DATE	7/1/2024
PROJECT COMPLETION DATE	5/31/2026
TECHNICAL ADVISORY COMMITTEE	To Be Determined
PROJECT TOTAL COSTS	\$141,874
PROJECT EXPENDITURES TO DATE	\$0
NUMBER OF EXTENSIONS GRANTED	None
PERCENTAGE OF PROJECT COMPLETE	0%
STATUS	New Project
FY-2025 BUDGET	\$70,937
FY-2025 TASKS TO BE COMPLETED	Tasks 1, 2, 3, 4 & 5

Background: Polymer-modified asphalt (PMA) has shown great promise in improving the performance of flexible asphalt pavements at low, intermediate, and high temperatures by increasing pavement resistance to permanent deformation, thermal cracking, and fatigue cracking. Recently, waste plastics (WPs) have been explored for making PMAs and incorporating them in asphalt binder through wet processes due to WP abundance and their ability to act as bonding enhancers. NDOT is interested in exploring the use of WP as an alternative sustainable material for binder modification. This research effort can contribute to reducing, reusing, and recycling waste plastic materials while providing enhanced binders and asphalt mixtures.

Objective: The primary objectives of this research are to:

1. Evaluate the effect of PE WP size on asphalt’s storage stability. We will vary the WP sizes from millimeter (mm) to micrometer (mm) and nanometer (nm) ranges. We will determine the storage stability of the modified asphalt binder using a globally established separation tube test (also called the cigar tube test).
2. Determine the distribution and aggregation behavior of WPs (of different composition and size) in the asphalt binder. We will use time-resolved dynamic light scattering technique that provide time-dependent measurement and information about particle aggregation behavior in a liquid dispersion media (here the binder).
3. Verify the rheological properties of single and hybrid PMAs with and without the use of surfactants subjected to short- and long-term aging. We will test the WP/Surf incorporated PMAs using dynamic shear rheometer and bending beam rheometer.
4. Compare the results from hybrid PMA with commercial highly polymer modified base binders used in Nebraska.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Literature Review	\$11,838	0%
Task 2: Waste Sampling and Characterization	\$17,669	0%
Task 3: PMA Laboratory Tests (Blends and Tests)	\$42,816	0%
Task 4: Analysis of Test Results	\$38,403	0%
Task 5: Documentation and Presentation	\$31,149	0%

Deliverables: This research is expected to develop a stable polymer modified asphalt (PMA) with improved storage stability and rheological properties compared to the commercial PMAs that are currently in use. The project targets the production of PMAs using waste plastics – that will reduce the overall cost of productions for PMAs and will provide long-term stability to the asphalt pavement. The research project will also develop information about WPs characteristics that will provide the best performing and highly stable PMA without increasing the cost of the PMA production and application. The micro- and nanoscale WPs are also expected to enhance the durability and crack-resistance or prevention of crack-initiation of the asphalt pavements through bridging between aggregates.

Performance : Project will start July 1, 2024.

CONTROL NUMBER	01071D
PROJECT NUMBER	SPR-FY25(041)
PROJECT TITLE	Effect of Nighttime Lighting on Construction Workers' Safety
PRINCIPAL INVESTIGATOR	Chun-Hsing Ho – UNL
PROJECT START DATE	7/1/2024
PROJECT COMPLETION DATE	5/31/2026
TECHNICAL ADVISORY COMMITTEE	To Be Determined
PROJECT TOTAL COSTS	\$147,497
PROJECT EXPENDITURES TO DATE	\$0
NUMBER OF EXTENSIONS GRANTED	None
PERCENTAGE OF PROJECT COMPLETE	0%
STATUS	New Project
FY-2025 BUDGET	\$73,749
FY-2025 TASKS TO BE COMPLETED	Tasks 1, 2, 3, 4, 5 & 6

Background: Current roadway lighting is designed specifically to provide illumination for vehicles and pedestrians in support of residential street and highway operations. However, the illumination levels are usually less than 20% of what is required for work operations [1] and do not take nighttime construction operations into consideration. Many state Departments of Transportation (DOT) use some form of nighttime work zone lighting based on the Federal Highway Administration's Nighttime Lighting Guidelines [2] and NCHRP's Illumination Guidelines [3] to conduct construction and maintenance activities on or near the travel portion of the road system. However, in the past 10 years, light emitting diode (LED) technology has evolved and the illuminance of lighting sources has been increased; the resources for nighttime lighting design from the two national guidelines have been outdated and need improvements and updates. More recently, Indiana DOT [4] and Virginia DOT [5] have conducted research projects about the glare assessment based on the lighting system's parameters and luminance levels of lighting sources, but their demonstration settings were performed in a controlled environment and no real field test was used to assess the effectiveness of the proposed lighting set-ups. The geometry and characteristics of construction operations and highway profiles vary by place, so lighting arrangements should be conducted in a practical way that would be suitable for the structure of highways in Nebraska. Therefore, this proposal is prepared to provide NDOT, construction organizations (e.g., Associated General Contractors of America, AGC Nebraska Chapter), and contractors with a list of recommendation of nighttime lighting arrangements for construction operations at night as well as to supplement informed knowledge about construction lighting setups and update guidelines to the NDOT "Standard Specifications for Highway Construction".

Objective: The primary objectives of this research are to evaluate the effect of lighting on work zone safety, taking the perspectives of construction workers and motorists into consideration for nighttime lighting arrangements, including:

- the effect of lighting (i.e., glare/luminance/visibility) on the visual performance of construction workers.
- the effect of orientation and placement of light towers on the perception of construction workers and motorists..
- the identification of unsafe conditions due to inadequate lighting arrangements at nighttime work zones.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Literature Review	\$24,557	0%
Task 2: Survey	\$18,087	0%
Task 3: Experimental Plan and Prototyping	\$28,613	0%
Task 4: Data Analysis	\$69,636	0%
Task 5: Field Test and Assessment	\$5,504	0%
Task 6: Documentation and Final Report	\$1,100	0%

Deliverables: This study will contribute to the state-of-the-practice nighttime lighting guidelines by conducting a series of field prototyping on glare and luminance assessments through a variety of lighting arrangements. The proposed project is prepared based on glare and luminance assessments from the perspectives of construction workers and motorists in nighttime work zones. We will evaluate factors influencing the safety of nighttime construction work zones such as orientation of lights, placement of light towers, type of lights, etc. and provide a list of recommended arrangement of lighting systems for future nighttime construction planning. Specifically, the project will focus on the effect of glare/luminance/visibility on the perception of motorists, the visual performance of construction workers, the interference of construction workers and equipment/vehicles, and the identification of unsafe conditions at nighttime work zones on I-80. The implementation of an NDOT project with a focus on lighting arrangements is a vital addition to be incorporated into NDOT's daily construction operations, roadway design, and traffic control measures.

Performance : Project will start July 1, 2024.

CONTROL NUMBER	01071E
PROJECT NUMBER	SPR-FY25(042)
PROJECT TITLE	Optimization of Energy Dissipation Using Staggered Weirs
PRINCIPAL INVESTIGATOR	David Admiraal – UNL
PROJECT START DATE	7/1/2024
PROJECT COMPLETION DATE	5/31/2026
TECHNICAL ADVISORY COMMITTEE	To Be Determined
PROJECT TOTAL COSTS	\$136,135
PROJECT EXPENDITURES TO DATE	\$0
NUMBER OF EXTENSIONS GRANTED	None
PERCENTAGE OF PROJECT COMPLETE	0%
STATUS	New Project
FY-2025 BUDGET	\$68,068
FY-2025 TASKS TO BE COMPLETED	Tasks 1, 2, 3, 4, 5, 6, 7, 8, 9 & 10

Background: Energy dissipation at culvert outlets is necessary for preventing excessive scour that can result in damage to the outlet structure, adjacent roadway, or downstream channel. Energy dissipation basins have long been used for this purpose because of their simple design and effectiveness, but these basins take a lot of space and result in stagnant water pools. Improvements to dissipation structures can help reduce the size of these basins, which results in reduced project cost and helps eliminate stagnant pools.

Objective: The objective of the proposed research is to optimize the staggered weir so that it maximizes flow energy dissipation to minimize downstream erosion. In the research process, we will both:

1. optimize the geometry of the staggered weir to improve its effectiveness and
2. extend its range of applicability by modifying the testing system so that we can investigate a much wider set of inlet Froude numbers and inflow conditions.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Literature and Design Process Review	\$6,386	0%
Task 2: Model Revisions	\$41,437	0%
Task 3: TAC 1-Data Collection Strategy	\$0	0%
Task 4: Test Data One (Variable Geometry Data)	\$47,639	0%
Task 5: TAC 2-Review Variable Geometry Data	\$0	0%
Task 6: Test Data Two (Follow-up Tests)	\$6,514	0%
Task 7: TAC 3-Review Follow-up Data	\$0	0%
Task 8: Design Integration	\$11,715	0%
Task 9: Report Preparation	\$13,072	0%
Task 10: Final Presentation, Draft Revisions, and Reporting	\$9,372	0%

Deliverables: There will be three primary outputs of this project: (1) A thorough description of the test procedure to determine the optimal staggered-weir geometry and the result, (2) a detailed dataset for the optimal staggered-weir geometry, and (3) integration of test results into spreadsheets and/or software for simplified design of staggered-weir dissipation structures.

Performance : Project will start July 1, 2024.

CONTROL NUMBER	01071F
PROJECT NUMBER	SPR-FY25(043)
PROJECT TITLE	Evaluation of NDOT's Construction Stormwater Detention Measures Using Full-Scale Testing Techniques
PRINCIPAL INVESTIGATOR	Michael A. Perez – Auburn University
PROJECT START DATE	7/1/2024
PROJECT COMPLETION DATE	5/31/2026
TECHNICAL ADVISORY COMMITTEE	To Be Determined
PROJECT TOTAL COSTS	\$199,999
PROJECT EXPENDITURES TO DATE	\$0
NUMBER OF EXTENSIONS GRANTED	None
PERCENTAGE OF PROJECT COMPLETE	0%
STATUS	New Project
FY-2025 BUDGET	\$100,000
FY-2025 TASKS TO BE COMPLETED	Tasks 1, 2, 3, 4, 5, 6 & 7

Background: Earthmoving activities associated with highway construction create increased risk of downstream pollution from stormwater runoff. Rainfall dislodges sediment and runoff mobilizes soil particles and other pollutants that can cause significant risk to receiving water bodies. Excessive sediment in waterways can harm aquatic life by increasing turbidity, reducing fish habitats, as well as increasing the risk of flooding by reducing the flow capacity of rivers and streams. The cost of sediment in surface waters is drastic, with the cost of sediment pollution being estimated at \$16 billion in 1998, including the physical, biological, and chemical damages caused by unmanaged or improperly managed stormwater discharges.

Objective: The objective of this proposed research is to evaluate NDOT's standard silt trap and sediment trap used to facilitate impoundment and capture sediment. This study is divided into three primary objectives:

1. Develop a full-scale testing methodology that allows for the performance comparison of construction stormwater detention practices,
2. Evaluate construction stormwater detention practices and modified installations through full-scale testing at the AU-SRF that mimics conditions found on a NDOT highway construction project, and
3. Develop implementable design guidance and comparisons on the use of detention practices on construction projects, including performance, costs, installation, maintenance requirements, etc.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Kickoff Meeting	\$1,000	0%
Task 2: Literature Review	\$16,000	0%
Task 3: Design Experimental Detention Measures/Develop Testing Methodology	\$12,000	0%
Task 4: Construction of Experimental Detention Measures	\$40,000	0%
Task 5: Conduct Full-Scale Testing	\$103,000	0%
Task 6: Data Analysis	\$12,000	0%
Task 7: Final Report	\$15,999	0%

Deliverables: This study is expected to provide immediate implementable results for NDOT. A complete report containing an executive summary and complete record of the project, including methods, data collection and analysis will be provided. In addition, a technology transfer brief will be created to summarize key findings. Design recommendations for evaluated stormwater detention practices will be developed for NDOT implementation consideration. This guidance will include clear specifications, drawings, and language for stormwater detention practices that may be considered for future stormwater management plans.

Performance : Project will start July 1, 2024.

CONTROL NUMBER	01071G
PROJECT NUMBER	SPR-FY25(044)
PROJECT TITLE	Integrated Bridge, Transportation Network, and Community Resilience Framework for Nebraska
PRINCIPAL INVESTIGATOR	Christine Wittich – UNL
PROJECT START DATE	7/1/2024
PROJECT COMPLETION DATE	5/31/2026
TECHNICAL ADVISORY COMMITTEE	To Be Determined
PROJECT TOTAL COSTS	\$200,877
PROJECT EXPENDITURES TO DATE	\$0
NUMBER OF EXTENSIONS GRANTED	None
PERCENTAGE OF PROJECT COMPLETE	0%
STATUS	New Project
FY-2025 BUDGET	\$100,439
FY-2025 TASKS TO BE COMPLETED	Tasks 1, 2, 3, 4 & 5

Background: Climate-related disasters, such as flooding, routinely damage infrastructure, weaken economies, and significantly impact communities within the country and within Nebraska. Since 1980, 338 climate-related disasters in the United States have incurred damage exceeding \$1 billion (NOAA 2022). The average number of billion-dollar disasters per year has more than doubled from 7.7 events to 17.8 events over the past 5 years and is expected to continue to increase. The State of Nebraska Long-Term Recovery and Resilience Plan specifically identifies efficient assessment, restoration, and revitalization of infrastructure systems as a priority, and the state transportation network is critical to state climate resilience. NDOT's Long-Range Transportation Plan (LRTP) identified "secure and resilient transportation" as one of its six overarching goals to achieve by 2040. Climate-related disasters, such as flooding, can have initially catastrophic impacts, such as structural collapse, critical route closures, and casualties; however, the impacts can also cascade due to the interdependencies of modern communities. Given the anticipated increased frequency of major flood events combined with the potentially devastating impacts, it is critical for the state of Nebraska and the Department of Transportation to increase resilience to future hazards.

Objective: Given the critical need to evaluate and quantify resilience considering the integrated Nebraska transportation network and broader community, the following technical objectives guide the proposed work:

1. Develop a framework for quantifying resilience considering an integrated state transportation and community model.
2. Validate the developed resilience framework using the floods of 2019.
3. Demonstrate the use of the resilience framework for prioritization and planning for future hazards.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Literature Review and Survey	\$29,624	0%
Task 2: Development of Resilience Model	\$47,008	0%
Task 3: Validation of Resilience Model	\$48,276	0%
Task 4: Case Study Demonstration	\$37,235	0%
Task 5: Final Reporting	\$38,734	0%

Deliverables: The primary outcomes of this project will be: 1) a validated flood resilience model which can be used by NDOT for prioritizing maintenance and recovery planning; and, 2) prioritization of potential resilience improvement projects. The implementation of the latter is straightforward, where NDOT can elect to implement the considered projects with known improvements to transportation resilience. Implementation of the resilience model is a focus of the project's third objective. The resilience model will be developed in Python, such that the state-of-the-art IN-CORE platform can be leveraged. The PIs will work with the TAC to demonstrate the model's usage within ongoing scenario-planning efforts or other current and future projects that may benefit from resilience quantification, which will be documented in detail in the final technical report.

Performance : Project will start July 1, 2024.

CONTROL NUMBER	01071H
PROJECT NUMBER	SPR-FY25(045)
PROJECT TITLE	Refined Analysis of Slab Bridges for Load Rating
PRINCIPAL INVESTIGATOR	Marc Maguire – UNL
PROJECT START DATE	7/1/2024
PROJECT COMPLETION DATE	5/31/2026
TECHNICAL ADVISORY COMMITTEE	To Be Determined
PROJECT TOTAL COSTS	\$40,635
PROJECT EXPENDITURES TO DATE	\$0
NUMBER OF EXTENSIONS GRANTED	None
PERCENTAGE OF PROJECT COMPLETE	0%
STATUS	New Project
FY-2025 BUDGET	\$20,318
FY-2025 TASKS TO BE COMPLETED	Tasks 1, 2 & 3

Background: NDOT has approximately 100 slab bridges in its inventory that were originally built as early as the 1930's. Material strengths were relatively low, e.g., $f_y = 33$ ksi, and $f_c = 3000$ psi or less. These structures often fail to pass load rating procedures and Superload (NDOT's) automated Routing and Rating System that uses LARS/Superload and LFR employing a beamline approach. Beamline analysis requires a distribution width E (the lane's width to support one or two lanes of trucks). The load demands are inversely proportional to E , i.e., a refined finite element analysis (FEA) might increase E by 20%, so the load demands decrease by 20%. Better analysis can potentially economize bridge operations and allow vehicles to cross these structures safely. The process might allow increasing or removing the posting sign for any posted structures.

Objective: Provide a method for computing refined effective widths for load rating slab bridges. The primary objectives of this research are to:

1. Develop a finite element application that analyzes slab bridges to determine the response, specifically longitudinal bending moments.
2. Use the response to compute and report effective widths.
3. Validate the application with static checks and comparisons with LRFD and LFD equations.
4. Write output graphics and reports that aid the validation of computations and permit checking.
5. Document where the results may be entered into AASHTOWare BrR to create bridge/structure alternatives
6. Demonstrate using the bridge alternative for different operational use cases.
7. Create a short video on the use of the application
8. Provide a webinar to NDOT for engineers interested in using this application

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Application Development	\$27,422	0%
Task 2: Implementation	\$6,419	0%
Task 3: Final Report	\$6,794	0%

Deliverables: This study will enrich the state-specific load rating strategies for slab bridges and help develop better load rating solutions. Comsol has a tool to develop the user interface. The finite element tool and application development are tightly integrated and are unique to the industry. The Comsol tool is then used to compile the interface and the interface to Comsol runtime modules. (similar to almost all Windows applications that use Microsoft's runtime DLLs.) The runtime can be embedded into an executable application file (.exe), or the application can address a runtime downloaded separately. The end user does not have to purchase a Comsol license, and Comsol has no claim on these applications, royalties, etc. NDOT can share this application with their consultants, and others as they wish.

Performance : Project will start July 1, 2024.

CONTROL NUMBER	01071J
PROJECT NUMBER	SPR-FY25(046)
PROJECT TITLE	Revised Curing Practices for NDOT Bridge Decks to Minimize Restrained Shrinkage Cracks
PRINCIPAL INVESTIGATOR	Jiong Hu – UNL
PROJECT START DATE	7/1/2024
PROJECT COMPLETION DATE	5/31/2026
TECHNICAL ADVISORY COMMITTEE	To Be Determined
PROJECT TOTAL COSTS	\$165,460
PROJECT EXPENDITURES TO DATE	\$0
NUMBER OF EXTENSIONS GRANTED	None
PERCENTAGE OF PROJECT COMPLETE	0%
STATUS	New Project
FY-2025 BUDGET	\$82,730
FY-2025 TASKS TO BE COMPLETED	Tasks 1, 2, 3, 4, 5 & 6

Background: Due to their high cement content and low water-to-cement ratio, cast-in-place concrete bridge decks are particularly susceptible to early-age cracking. This is often exacerbated by the shrinkage of the concrete when constrained by supporting girders. Such cracks can lead to significant issues, such as rebar corrosion and delamination, posing a primary concern for the Nebraska Department of Transportation (NDOT). Recognizing this challenge, recent and ongoing research initiatives at NDOT, including projects SPR-FY22(001)1 and SPR-P1 (19) M0832, as well as ongoing studies at NDOT Materials & Research (M&R), have identified promising strategies to mitigate this issue. These strategies include internal curing, reduction in cementitious material content, and the use of innovative admixtures (e.g., E5® Internal Cure admixture), all aimed at reducing shrinkage-related cracking in bridge decks. The previous projects exemplifies a successful approach for reducing free and restrained shrinkage strains in concrete bridge decks by reducing cementitious material content by 50, 100, and 150 lbs per cubic yard and optimizing aggregate gradation. This approach is expected to significantly lower the likelihood of shrinkage cracking in concrete bridge decks. Despite the progress in reducing concrete shrinkage, there remains a gap in understanding regarding the feasibility of shortened curing durations when using lower-shrinkage mixtures.

Objective: The proposed study seeks to establish revised NDOT bridge deck curing practices based on evaluating the effects of varying curing durations on the shrinkage and crack potential of different concrete mixtures, particularly in the context of typical bridge girder restraints. This research is intended to guide the development of more effective and efficient curing protocols, aligning them with the specific characteristics of various concrete mixtures used in bridge construction. The study's specific objectives are as follows:

1. Review existing curing practices and criteria for concrete shrinkage for bridge deck applications, drawing insights from other Departments of Transportation (DOTs).
2. Conduct an in-depth evaluation of early and long-term concrete shrinkage under various curing methods and practices.
3. Numerically and experimentally assess the cracking potential of newly developed low shrinkage mixtures under different curing conditions when subjected to typical bridge deck restraints.
4. Revise NDOT guidelines for bridge-deck curing practices when adopting lower-shrinkage mixtures.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Literature Review	\$8,158	0%
Task 2: Concrete Shrinkage Evaluation	\$40,185	0%
Task 3: Analytical Investigation	\$17,219	0%
Task 4: Cracking Potential Assessment	\$74,749	0%
Task 5: Guideline Development	\$7,014	0%
Task 6: Documentation and Presentation	\$18,135	0%

Deliverables: The proposed study has great potential to be implemented by NDOT. If the revised curing practices demonstrate feasibility through various laboratory tests, analytical investigations, and mockup trials, NDOT may opt for a field demonstration project. This project would validate bridge decks' performance against premature cracking, utilizing the newly revised curing protocol. Such a practical application will be pivotal in confirming the effectiveness of these updated practices in real-world scenarios.

Performance : Project will start July 1, 2024.

CONTROL NUMBER	01071K
PROJECT NUMBER	SPR-FY25(047)
PROJECT TITLE	Effect of Bridge Width on Crashes in Nebraska
PRINCIPAL INVESTIGATOR	Aemal Khattak – UNL
PROJECT START DATE	7/1/2024
PROJECT COMPLETION DATE	5/31/2026
TECHNICAL ADVISORY COMMITTEE	To Be Determined
PROJECT TOTAL COSTS	\$152,230
PROJECT EXPENDITURES TO DATE	\$0
NUMBER OF EXTENSIONS GRANTED	None
PERCENTAGE OF PROJECT COMPLETE	0%
STATUS	New Project
FY-2025 BUDGET	\$76,115
FY-2025 TASKS TO BE COMPLETED	Tasks 1, 2, 3, 4, 5 & 6

Background: Bridges and bridge approaches sometimes are changed to accommodate increased traffic volume, lane expansion, maintaining adequate clearance, non-motorized accommodation, or for construction and maintenance cost optimization. Such changes may alter the relationship between bridge and approach widths and may impact the safety of the travelling public. The Nebraska Department of Transportation (NDOT) “Bridge Office Policies and Procedures,” initially published in January 2000 and revised in December 2016, serves as the reference and design guideline for NDOT bridge engineers, designers, detailers, and consultants working with the NDOT bridge office. However, NDOT staff lacks comprehensive guidelines regarding the impact of bridge and approach widths on crash frequencies and severities. A comprehensive research-based study is required to determine how bridge widths should be designed in relation to approach widths, while considering crash prevention and ensuring motorists have unrestricted mobility between bridge lanes.

Objective: The primary objectives of this research are to:

1. Investigate crash frequencies and severity across various bridge width intervals, such as 1-20 ft, 20-24 ft, 24-30 ft etc. Particular emphasis will be placed on assessing how safety is impacted when bridge widths exceed 30 ft. Gather and synthesize technical reports and U.S. state agency specifications, with a specific emphasis on delineating the prerequisites necessary for employing slag as a material for pavement applications. Characterize development behavior and required embedment lengths for full development of GFRP bars in UHPC.
2. Examine variations in crash frequencies and severity based on relative bridge-roadway width intervals. This will involve studying the effects of different relative bridge-roadway width ranges, including 9 ft or narrower, 7-8 ft narrower, and so forth, up to 1-2 ft wider, 3-4 ft wider, etc., on crashes.
3. Perform a multivariate analysis on crash frequency and severity in relation to bridge width intervals and other relevant factors including but not limited to as bi-directional travel vs divided multilane travel, posted speed limits, traffic volume, bridge type and inside shoulder width, crash temporal aspects, work zone conditions, road surface conditions and bridge safety countermeasures.
4. Perform a multivariate analysis on crash frequency and severity in relation to bridge-roadway relative width (difference in bridge and approach roadway width) intervals and other relevant factors, including, but not limited to, posted speed limits, bridge type and geometric aspects, crash temporal aspects, road surface conditions, work zone conditions, bridge safety countermeasures, lane configuration, and traffic volume.
5. Forecast future crash frequency and severity resulting from various bridge widths across Nebraska’s highway system bridges by developing robust statistical models for predicting both crashes and their severity. Additionally, this will involve estimating separate models for work zones on bridges.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: TAC Meeting & Literature Review	\$17,421	0%
Task 2: Data Collection	\$24,008	0%
Task 3: Data Aggregation, Processing & Exploration	\$24,805	0%
Task 4: Multivariate Analysis	\$26,292	0%
Task 5: Predictive Analysis (Statistical Modelling)	\$30,112	0%
Task 6: Final Report and TAC Presentation	\$29,592	0%

Deliverables: The research will be implemented and utilized through collaboration with NDOT Traffic Engineering, Highway Safety, and the Roadway Design Divisions. The research team can provide NDOT with comprehensive guidelines for conducting safety and operational studies related to bridge width decisions. Additionally, we will actively share our findings through presentations and publications at local, regional, and national forums to disseminate the valuable insights gained from this research.

Performance : Project will start July 1, 2024.

CONTROL NUMBER	01071L
PROJECT NUMBER	SPR-FY25(048)
PROJECT TITLE	Development of Accurate and Reliable Average Annual Daily Traffic (AADT) Factoring Methods
PRINCIPAL INVESTIGATOR	Li Zhao – UNL
PROJECT START DATE	7/1/2024
PROJECT COMPLETION DATE	5/31/2026
TECHNICAL ADVISORY COMMITTEE	To Be Determined
PROJECT TOTAL COSTS	\$150,732
PROJECT EXPENDITURES TO DATE	\$0
NUMBER OF EXTENSIONS GRANTED	None
PERCENTAGE OF PROJECT COMPLETE	0%
STATUS	New Project
FY-2025 BUDGET	\$75,366
FY-2025 TASKS TO BE COMPLETED	Tasks 1, 2, 3, 4 & 5

Background: According to the Federal Highway Administration (FHWA), “Annual Average Daily Traffic (AADT) estimates, with as little bias as possible, the mean traffic volume across all days for a year for a given location along a roadway”. AADT provides crucial information about road activity in terms of vehicular volume (i.e., vehicles per day) on specific road segments. As such, it plays a pivotal role in supporting highway agency activities that include planning, design, maintenance, operations, safety, environmental analysis, finance, engineering economics, and performance management. Moreover, AADT serves as a key parameter for the allocation of funds to state Departments of Transportation (DOTs). Nebraska DOT (NDOT) is required to collect and report AADTs to the FHWA annually as part of the Highway Performance Monitoring System program, as well as make these data publicly available. This is because AADTs are used by a wide range of stakeholders in Nebraska, including NDOT divisions, city traffic engineers, and private consultants. Therefore, providing accurate AADTs is imperative, while using inaccurate AADTs in one or more of the mentioned studies would result in direct economic losses for the state.

Objective: The primary objective of this project is to determine the most appropriate temporal adjustment factor for estimating AADT on the Nebraska highway systems. To accomplish this, the team will undertake a rigorous and comprehensive evaluation of the current AADT factor compared to alternative factors. The specific goals are to identify the most effective temporal adjustment factors among various options such as month of the year, week of the year, day of the week, and their combinations. It should be noted that the scope of this research is limited to NDOT-managed highway systems excluding interstates and local functional roads. In other words, the AADT factoring study in this project is limited to FHWA functional classes 2 to 6.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Literature Review	\$27,606	0%
Task 2: Preliminary Data Study	\$30,460	0%
Task 3: Adjust Factor Calculation	\$42,968	0%
Task 4: Spreadsheet Tool Development	\$25,787	0%
Task 5: Final Report and Presentation	\$23,911	0%

Deliverables: If NDOT’s current AADT estimation method needs to be updated, this project will create a tool to facilitate implementation. The tool will be developed using Microsoft Excel and Visual Basic for Applications (VBA). Input from the NDOT traffic analysis team will be sought to ensure that the tool aligns with their usage needs and preferences. It is expected that the NDOT traffic analysis team will be able to use the developed tool immediately upon the completion of this research project. The project team is committed to offering ongoing support for the tool beyond project completion.

Performance : Project will start July 1, 2024.

CONTROL NUMBER	01071M
PROJECT NUMBER	SPR-FY25(049)
PROJECT TITLE	Crash Modification Factor and Feasibility Analysis of Lighting Rural Intersections in Nebraska
PRINCIPAL INVESTIGATOR	Aemal Khattak – UNL
PROJECT START DATE	7/1/2024
PROJECT COMPLETION DATE	5/31/2026
TECHNICAL ADVISORY COMMITTEE	To Be Determined
PROJECT TOTAL COSTS	\$172,618
PROJECT EXPENDITURES TO DATE	\$0
NUMBER OF EXTENSIONS GRANTED	None
PERCENTAGE OF PROJECT COMPLETE	0%
STATUS	New Project
FY-2025 BUDGET	\$86,309
FY-2025 TASKS TO BE COMPLETED	Tasks 1, 2, 3, 4, 5,6 & 7

Background: Intersection lighting is an important countermeasure intended to enhance safety for drivers during nighttime. According to the National Highway Transportation Safety Administration (NHTSA), nighttime driving conditions account for more than 40% of fatalities, although only 27% of crashes occur at night (NHTSA, 2012). Federal Highway Administration (FHWA) reported that the number of fatal crashes occurring in daylight is about the same as those that occur in darkness. However, the nighttime fatality rate is three times greater than the daytime rate because only 25% of vehicle miles traveled (VMT) occur at night (FHWA, 2023). FHWA and other studies reported that installing lights at the intersection may reduce accidents by around 30% to 40% (FHWA, 2023; Bruneau and Morin, 2005).

Objective: The primary objectives of this research are to:

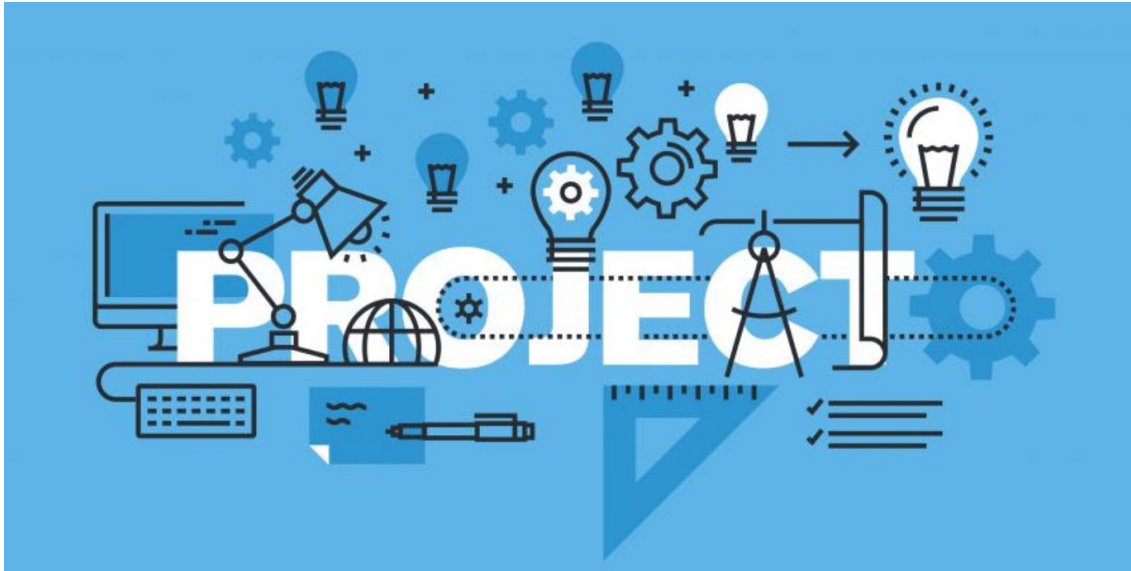
1. Document current intersection lighting practices and CMFs nationwide.
2. Develop Nebraska-based CMF for lighting rural intersections.
3. Conduct Nebraska-based benefit-cost trade-off analysis for lighting rural intersections.
4. Develop guidelines for best practices of rural intersection lighting.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Literature Review	\$18,072	0%
Task 2: Nationwide Intersection Lighting Practices and Reported CMFs	\$21,982	0%
Task 3: Data Collection	\$26,083	0%
Task 4: Nebraska Rural Intersection and Driver Behavior	\$27,645	0%
Task 5: Determination of Nebraska-based CMF	\$27,343	0%
Task 6: Feasibility Analysis and Guidelines	\$24,160	0%
Task 7: Final Report	\$27,333	0%

Deliverables: intersections. The guidelines will aid in finding best practices for lighting rural intersections with respect to types of intersections (i.e., 3-legged, 4-legged), traffic conditions (i.e., AADT, truck percentage), and illumination configuration. The research team can offer software tools/models to NDOT to conduct benefit-cost analysis. The results of this project will be added to the FHWA's CMF Clearinghouse and submitted for consideration to include in future editions of the HSM. Implementation and utilization of the research will be via NDOT Traffic Engineering, District staff, and Roadway Design Divisions. The research team will make presentations and publications of the research results at various local, regional, and national forums.

Performance : Project will start July 1, 2024.



COMPLETED PUBLISHED PROJECTS

Project Number	Research Title
FY21 (002)	<u>Development of Guideline for the Use of Geosynthetics in Different Pavement Layered System in Nebraska</u>
FY21 (005)	<u>UHPC Decked I-Beam for Accelerated Bridge Construction</u>
FY21 (006)	<u>Rapid Concrete Used in Bridge Concrete Repair</u>
FY21 (009)	<u>Energy Dissipation Optimization for Circular Culverts</u>
FY21 (010)	<u>Crashworthy Perforated Square Steel Tube (PSST) Mailbox Support</u>
FY21 (011)	<u>Establishment of Wildflower Islands to Enhance Roadside Health, Ecological Value, and Aesthetics - Phase II</u>
FY22(001)	<u>Low-Cement Concrete Mixture for Bridge Decks and Rails</u>
FY22(002)	<u>Nebraska Balanced Mix Design – Phase I</u>
FY22(004)	<u>Erosion Resistant Rock Shoulder</u>
FY22(006)	<u>Evaluation of NDOT's Sediment Barrier Practices Using Performance Data</u>
FY22(010)	<u>Application of Steel Sheet-Piles for the Abutment of Water-Crossing Bridges in Nebraska</u>
FY22(011)	<u>Truck Platooning Effects on Girder Bridges - Phase II</u>
FY22(012)	<u>Inventory, Operations, and Safety at Free Right-Turn Ramps</u>



CONTACT

Materials & Research Headquarters

1400 Nebraska Parkway, Lincoln, NE 68509

Email: ndot.research@nebraska.gov

Phone: 402-479-4697

Website: [NDOT Research](https://ndotresearch.com)

Subscribe to NDOT Research Updates:

<https://public.govdelivery.com/accounts/NEDOR/subscribers/qualify>

NEBRASKA

Good Life. Great Journey.

DEPARTMENT OF TRANSPORTATION