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**NEBRASKA**

Good Life. Great Journey.

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**DEPARTMENT OF TRANSPORTATION**

# ***Nebraska Research Work Program***

**Fiscal Year 2024**

***July 1, 2023  
to  
June 30, 2024***

# NEBRASKA DEPARTMENT OF TRANSPORTATION ORGANIZATION CHART


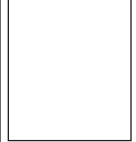






1-2023

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**JIM PILLEN**

**HIGHWAY COMMISSION**


<p>JOHNSON DISTRICT 1</p>  <p>MARY K. GERDES</p>	<p>OMAHA DISTRICT 2</p>  <p>VACANT</p>	<p>NORFOLK DISTRICT 3</p>  <p>DAVID E. COPPLE</p>	<p>KENESAW DISTRICT 4</p>  <p>JAMES H. KINDIG</p>	<p>GERING DISTRICT 5</p>  <p>DOUG LEAFGREEN</p>	<p>NORTH PLATTE DISTRICT 6</p>  <p>JAMES HAWKS</p>	<p>McCOOK DISTRICT 7</p>  <p>GREG WOLFORD</p>	<p>O'NEILL DISTRICT 8</p>  <p>JEROME FAGERLAND</p>
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**DIIRECTOR**








**VICKI KRAMER**

ASSISTANT ATTORNEY GENERAL FOR NDOT




**JEFF SCHROEDER**

**AERONAUTICS COMMISSION**

 <p>DIANA SMITH</p>	 <p>DICK TRAIL</p>	 <p>TOM TRUMBLE</p>	 <p>MICHAEL COOK</p>	 <p>SCOTT TARRY</p>
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**DEPUTY DIRECTOR-ENGINEERING**




**KHALIL JABER**


**DEPUTY DIRECTOR-OPERATIONS**



**MOE JAMSHIDI**


<p>BRIDGE DIVISION</p>  <p>ROSS BARRON</p>	<p>CONTROLLER DIVISION</p>  <p>LILY KATHEE</p>	<p>LOCAL ASSISTANCE DIVISION</p>  <p>JODI GIBSON</p>	<p>PROGRAM MANAGEMENT DIVISION</p>  <p>AMY STARR</p>	<p>PROJECT DEVELOPMENT DIVISION</p>  <p>BRANDIE NEEMANN</p>
<p>RIGHT-OF-WAY DIVISION</p>  <p>BRENDON SCHMIDT</p>	<p>ROADWAY DESIGN DIVISION</p>  <p>MICK SYSLO</p>	<p>STRATEGIC PLANNING DIVISION</p>  <p>RYAN HUFF</p>	<p>TRAFFIC ENGINEERING DIVISION</p>  <p>DAN WADDLE</p>	

**AERONAUTICS DIVISION**













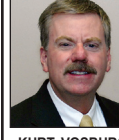

**ANN RICHART**

**COMMUNICATIONS & PUBLIC POLICY DIVISION**



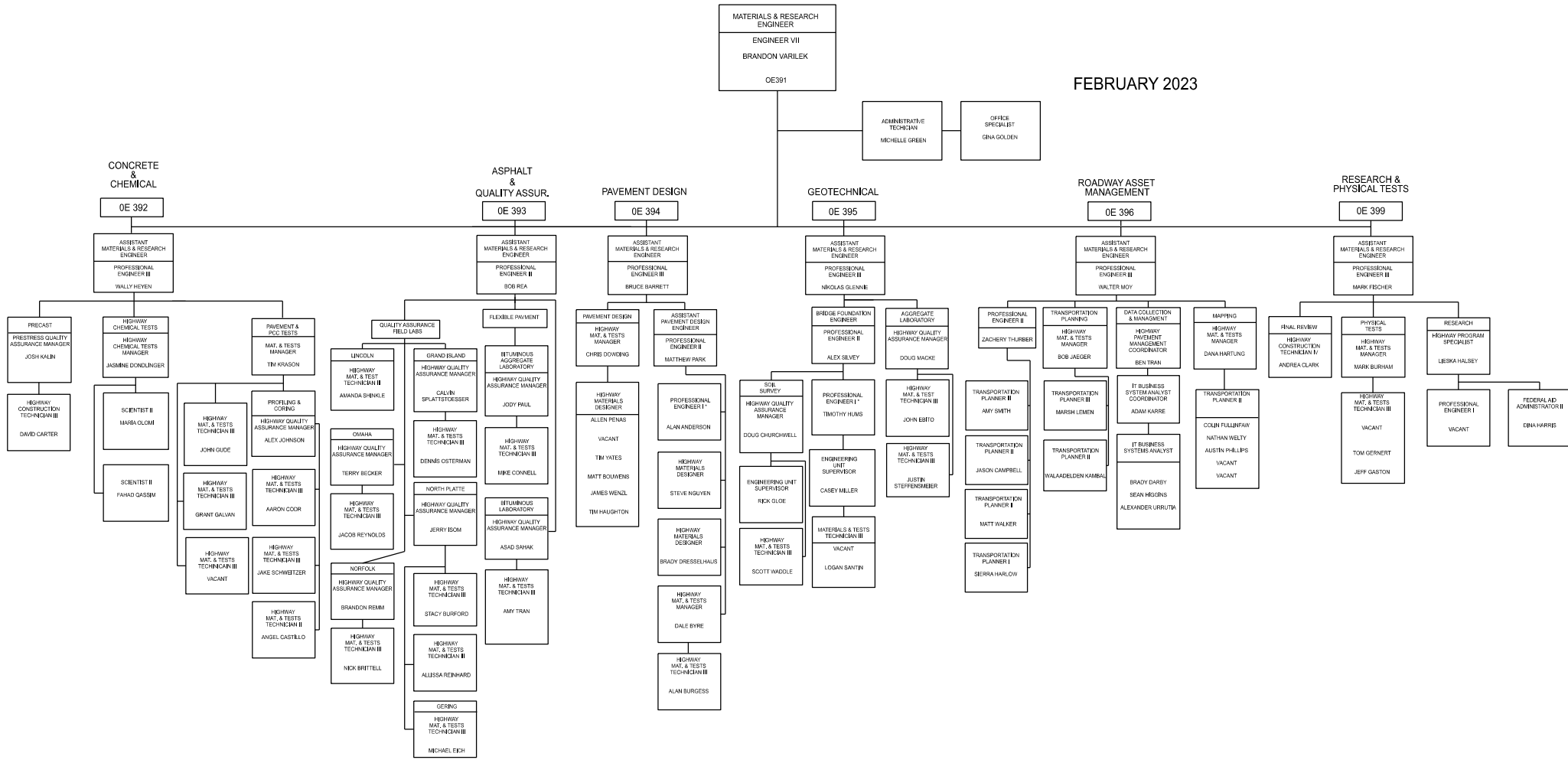
**SHANNON ANKENY**

<p>BUSINESS TECHNOLOGY SUPPORT DIVISION</p>  <p>DEVIN TOWNSEND</p>	<p>CONSTRUCTION DIVISION</p>  <p>JAMES J. KNOTT</p>	<p>HUMAN RESOURCES DIVISION</p>  <p>RACHELLE VANCLEVE</p>
<p>MATERIALS &amp; RESEARCH DIVISION</p>  <p>BRANDON VARILEK</p>	<p>OPERATIONS DIVISION</p>  <p>TOM RENNINGER</p>	

<p>DISTRICT 1 LINCOLN</p>  <p>THOMAS W. GOODBARN</p>	<p>DISTRICT 2 OMAHA</p>  <p>TIMOTHY W. WEANDER</p>	<p>DISTRICT 3 NORFOLK</p>  <p>KEVIN DOMOGALLA</p>	<p>DISTRICT 4 GRAND ISLAND</p>  <p>WESLEY WAHLGREN</p>
<p>DISTRICT 5 GERING</p>  <p>DOUG HOEVET</p>	<p>DISTRICT 6 NORTH PLATTE</p>  <p>GARY THAYER</p>	<p>DISTRICT 7 McCOOK</p>  <p>KURT VOSBURG</p>	<p>DISTRICT 8 AINSWORTH</p>  <p>MARK A. KOVAR</p>

# MATERIALS & RESEARCH DIVISION ORGANIZATIONAL CHART OE 390

FEBRUARY 2023



\* UNDER FILLED

## Research Section Mission Mission/Objective

To coordinate the departments Research Program, with the following primary objectives:



Reduce the costs of construction and maintenance.



Improve the quality of service to the highway users.



Increase the efficiency of highway planning, operations, and administration.



Reduce crashes and crash severity.



Encompass the interrelationship of socioeconomic, environmental, and technical factors into the transportation system; and implement favorable findings into departmental procedures and processes.

## Accomplishments FY-2023 to date

- ✓ In July to September 2022, the solicitation for Statements of Need was made to the entire State of Nebraska for FY-2023 funding
- ✓ Fifty-four (54) Statements of Needs were Submitted
- ✓ WebEx - Virtual meeting were hosted by each Focus group in early October; with over 132 attendees including Nebraska Department of Transportation personnel, industry leaders, 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 the Statements of Need in each focus group. NDOT Research Staff requested research proposals for twenty-two (22) Statements of Need.
- November 1<sup>st</sup> through December 3<sup>rd</sup>, 2022, NDOT's Research Section organized and held 22 framework review meetings placing technical experts with the researchers to develop a proposal to help accomplish the department's mission.
- On January 27, 2023, NDOT's Research Section conducted the RAC meeting and added twelve (12) new SPR projects with a total budget of \$2,068,155.
- NDOT expended approximately \$1,703,287 in FY-2023 for all on-going research projects and provided financial support to TRB and NCHRP.

## Typical NDOT Federally Funded Research Cycle



## *Accomplishments FY-2023 to date*

- ✓ Throughout the year, the Research Staff has held numerous Technical Advisory Committee meeting on in progress and completed research. To date NDOT hosted 63 update TAC meetings in this fiscal year.
- ✓ 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 third year for research.
- ✓ Complete and distribute the [NDOT Research Hub](#) Issue 3 via the research section website to all States, Federal Highway Administration, Nebraska Transportation Research Council Members, Research Advisory Committee Members and NDOT Divisions and Districts.
- ✓ Completed 6 Projects
- ✓ 3 Projects moved from Implementation Follow Up (RRL4) to Standard Practice (RRL5).
- ✓ 3 projects moved to Field Development (RRL4).

## *Research Work Program Goals FY-2024*

- ✓ Establish the FY-2024 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 our 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.
- ✓ 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
- ✓ Will participate in the research program management software tool pooled fund.

## TPF-5(193) CONTROL NO.: 00778

SUPPLEMENT NUMBER	STUDY TITLES	TOTAL STUDY BUDGET	EXPENDITURES	REMAINING BUDGET
<b>CURRENT PROJECTS</b>				
#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
#133	CALTRANS LS-DYNA Simulation Consulting Support	\$31,391	\$3,284	\$28,107
#134	NYS DOT MASH 2016 Safety Hardware Evaluations - Phase 1	\$955,951	\$563,863	\$392,088
#135	MASH 2016 Safety Hardware Evaluation	\$1,033,463	\$506,225	\$527,238
#142	NDOT Generic End Terminal - Phase II	\$325,393	\$298,596	\$26,797
#144	Midwest Pooled Fund MASH Hardware Clearinghouse	\$51,206	\$10,417	\$40,789
#145	NDOT Q & A Improvements	\$30,852	\$25,907	\$4,945
#146	Revision to Midwest Pooled Fund Q & A Website	\$49,745	\$26,536	\$23,209
#152	MASH 2016 Safety Hardware Evaluation - Phase 1	\$1,239,301	\$1,107,850	\$131,451
#154	MASH Testing of Single Sign Support	\$750,000	\$466,389	\$283,611
		<b>\$4,703,928</b>	<b>\$3,227,092</b>	<b>\$1,476,836</b>

1. Budget Numbers as of 4/4/2023
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**

<b>SUPPLEMENT NUMBER</b>	<b>STUDY TITLES</b>	<b>TOTAL STUDY BUDGET</b>	<b>EXPENDITURES</b>	<b>REMAINING BUDGET</b>
<b>CURRENT PROJECTS</b>				
#1	RFPF-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	RFPF-2--TERM-1: Further Evaluation of the End Terminals Adjacent to Curb (New Jersey)	\$257,208	\$191,784	\$65,424
#5	RFPF-20-SR-1: Development of a Short-Radius Guardrail for Intersecting Driveways or Roadways (New Jersey)	\$251,032	\$85,040	\$165,992
#9	Contingency FY20 (PF Yr 30) - Year 1	\$11,043	\$0	\$11,043
#15	RFPF-21-CABLE-1: Redesign of the High-Tension Cable Median Barrier – Phase II	\$253,893	\$50,292	\$203,601
#16	RFPF-21-CONC-2: Anchoring Temporary Barrier to Asphalt Pavement Phase II (Wisconsin)	\$224,325	\$89,249	\$135,076
#17	RFPF-21-CONC-3: MASH TL-3 Portable Barrier System (Nebraska/Wyoming)	\$148,296	\$26,898	\$121,398
#18	RFPF-21-AGT-1: Approach Guardrail Transition behind Curb and Elevated Sidewalk (Indiana)	\$146,141	\$6,455	\$139,686
#19	RFPF-21-AGT-3: Guidelines for Flaring Thrie-Beam Approach Guardrail Transitions - Phase III (Continuation)	\$121,307	\$0	\$121,307
#20	RFPF-21-SIGN-1: Breakaway Systems for Ground-Mounted, Large Steel Sign Support Structures (New Jersey)	\$77,740	\$14,599	\$63,141
#21	RFPF-21-POLE-1: Breakaway Pole Research (Wisconsin)	\$269,455	\$34,764	\$234,691
#22	RFPF-21-CONSULT: Annual Consulting Services Support	\$61,446	\$21,060	\$40,386
#23	RFPF-21-MPFW: Midwest Pooled Fund Website	\$18,573	\$5,383	\$13,190
#24	RFPF-21-LS-DYNA: LS-DYNA Modeling Enhancement Support	\$43,823	\$10,347	\$33,476
#25	Contingency FY21 (PF Yr 31) - Year 2	\$1	\$0	\$1
#26	RFPF-FY2022-WISDOT-1: Reduced Grading for the MGS Long-Span Guardrail System – Phase I	\$219,891	\$0	\$219,891
<b>PAGE SUBTOTAL</b>		<b>\$2,844,298</b>	<b>\$969,530</b>	<b>\$1,874,768</b>

- Budget Numbers as of 3/31/2023
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**TPF-5(430) CONTROL NO.: 01010**

<b>SUPPLEMENT NUMBER</b>	<b>STUDY TITLES</b>	<b>TOTAL STUDY BUDGET</b>	<b>EXPENDITURES</b>	<b>REMAINING BUDGET</b>
<b>CURRENT PROJECTS - CONTINUED</b>				
#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	\$0	\$530,131
#28	RFPF-FY2022-MGS-4: Evaluation of Increased Blockout Depth with the Midwest Guardrail System	\$262,851	\$0	\$262,851
#29	RFPF-FY2022-MGS-5: Surface Mounted Strong-Post MGS	\$217,840	\$0	\$217,840
#30	RFPF-FY2022-AGT-3: Median Approach Guardrail Transition to Concrete Median Barrier	\$233,888	\$0	\$233,888
#31	RFPF-FY2022-WZ-2: MASH TL-3 Portable Barrier System – Phase II	\$331,619	\$0	\$331,619
#32	RFPF-FY2022-WZ-3: Midwest PCB – Anchored Median Installations	\$155,262	\$0	\$155,262
#33	RFPF-FY2022-CONSULT: Annual Consulting Services Support	\$65,000	\$0	\$65,000
#34	RFPF-FY2022-MPFW: Midwest Pooled Fund Website	\$12,111	\$0	\$12,111
#35	RFPF-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	RFPF-FY2023-MGS-1: Modification and Evaluation of the MGS Long Span with Increased Span Length	\$377,870	\$0	\$377,870
#38	RFPF-FY2023-AGT-1: Guidelines for Flaring Thrie-Beam Approach Guardrail Transitions - Phase IV (Continuation)	\$310,591	\$0	\$310,591
#39	RFPF-FY2023-GET-1: Generic End Terminal – Further Development and Evaluation	\$437,226	\$0	\$437,226
#40	RFPF-FY2023-MWQA-1: Continued Revisions to MwRSF Pooled Fund Q & A Website	\$45,421	\$0	\$45,421
#41	RFPF-FY2023-AUTO-1: Coordination and Collaboration with Vehicle Manufacturers and Automotive Industry	\$56,219	\$0	\$56,219
#42	RFPF-FY2023-CONSULT: Annual Consulting Services Support	\$65,000	\$0	\$65,000
#43	RFPF-FY2023-MPFW: Midwest Pooled Fund Website	\$12,868	\$0	\$12,868
#44	RFPF-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	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	\$142,639	\$0	\$142,639
<b>PAGE SUBTOTAL</b>		<b>\$3,833,024</b>	<b>\$0</b>	<b>\$3,833,024</b>
<b>TOTAL TPF-5(430) ACTIVE PROJECTS</b>		<b>\$6,677,322</b>	<b>\$969,530</b>	<b>\$5,707,792</b>

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

<b>Study Titles</b>	<b>Funding Type</b>	<b>Expenditures FY2023</b>	<b>Commitments for FY2024</b>
TPF-5(317) Evaluation of Low Cost Safety Improvements	Y550	\$5,000	\$5,000
TPF-5(347) Development of Maintenance Decision Support System	Y550	\$30,000	\$30,000
TPF-5(372) Building Information Modeling (BIM) for Bridges and Structures	Y550	\$20,000	\$20,000
TPF-5(430) Midwest Roadside Safety Pooled Fund Program	Y550	\$65,000	\$65,000
TPF-5(432) Bridge Element Detrioration for Mid-west States	Y560	\$20,000	\$0
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	\$15,000	\$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	\$4,000	\$8,000
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	Y560	\$46,000	\$0
TPF-5(470) Guidelines for Determining Traffic Signal Change and Clearance Intervals	Y560	\$30,000	\$30,000
TPF-5(479) Clear Roads Winter Highway Operations Phase III	Y560	\$25,000	\$25,000
TPF-5(480) Building Information Modeling (BIM) for Infrastructure	Y560	\$30,000	\$30,000
TPF-5(490) 2023 through 2025 Biennial Asset Management Conference and Traning on Impmentation Strategies	Y560	\$0	\$12,000
*Solicitation 1591 2nd International Roadside Safety Conference and Peer Exchange	Y560	\$0	\$5,000
*Solicitation Pending - Western States Consortium	Y560	\$0	\$15,000
*Solicitation 1572 Improving Traffic Detection Through New Innovative i-LST Technology Demonstration Pilot Print	Y550	\$0	\$30,000
<b>Commitment for FY2024</b>		<b>\$457,000</b>	<b>\$472,000</b>
Transportation Research Board (TRB) Annual Transfer	Y560	\$107,790	\$108,600
National Cooperative Highway Research Program (NCHRP) Annual Transfer	Y560	\$400,746	\$402,700
<b>Total</b>		<b>\$965,536</b>	<b>\$983,300</b>

\* 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					
M087	Z560	Design Optimization and Monitoring of Joint-less Integral and Semi-integral abutment bridges in Nebraska	\$167,687	\$163,583	\$4,104
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			\$780,345	\$426,849	\$318,496
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)			\$1,515,171	\$467,255	\$1,012,916

ALL EXPENDITURES TO-DATE FOR SPR-P1(20)	Total	Federal	State
	\$3,467,608	\$2,774,087	\$693,521

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IN-PROGRESS PROJECTS						
CONTROL NUMBER	PROJECT NUMBER SPR-	FUNDING TYPE	STUDY TITLES	TOTAL STUDY BUDGET	EXPENDITURES	REMAINING BUDGET
01021A	FY21(002)	Z560	Development of Guideline for the Use of Geosynthetics in Different Roadway Layered System in Nebraska	\$106,536	\$106,004	\$532
01021B	FY21(003)	Z560	Effect of Antioxidant Additives and Recycling Agents on Performance of Asphalt Binders and Mixtures – Phase II	\$167,602	\$77,490	\$90,112
01021C	FY21(004)	Z560	Approach Guardrail Transition Retrofit to Existing Concrete Parapets and Bridges	\$113,907	\$87,978	\$25,929
01021D	FY21(005)	Z560	UHPC Decked I-Beam for Accelerated Bridge Construction	\$104,250	\$102,211	\$2,039
01021E	FY21(006)	Z560	Rapid Concrete Bridge Repair Survey and Patch Material Evaluation	\$93,572	\$51,653	\$41,919
01021H	FY21(009)	Z560	Energy Dissipation Optimization for Circular Culverts	\$107,088	\$106,093	\$995
01021J	FY21(010)	Z560	Crashworthy Perforated Square Steel Tube (PSST) Mailbox Support	\$164,927	\$58,090	\$106,837
01021K	FY21(011)	Z560	Establishment of Wildflower Islands to Enhance Roadside Health, Ecological	\$171,275	\$154,227	\$17,048
01034A	FY22(001)	Z560	Low-Cement Concrete Mixture for Bridge Decks and Rails	\$112,394	\$73,175	\$39,219
01034B	FY22(002)	Z560	Nebraska Balanced Mix Design	\$138,937	\$35,190	\$103,747
01034C	FY22(003)	Z560	WMA Short Term Aging	\$140,616	\$19,567	\$121,049
01034D	FY22(004)	Z560	Erosion Resistant Rock Shoulder	\$142,907	\$101,784	\$41,123
01034E	FY22(005)	Z560	Application of Remote Sensing and Hydrologic Modeling to Reduce Highway Flooding in the Nebraska Sandhills	\$143,166	\$89,862	\$53,304
01034F	FY22(006)	Z560	Evaluation of NDOT's Sediment Barrier Practices Using Performance Data	\$191,099	\$0	\$191,099
01034H	FY22(008)	Z560	Production of Cast-in-Place UHPC for Bridge Applications	\$91,587	\$67,433	\$24,154
01034J	FY22(009)	Z560	Accelerated Bridge Construction Decision Tool	\$90,592	\$39,630	\$50,962
01034K	FY22(010)	Z560	Application of Steel Sheet Piles for the Abutment of Water-crossing Bridges in Nebraska	\$155,304	\$144,137	\$11,167
01034L	FY22(011)	Z560	Truck Platooning Effects on Girder Bridges - Phase II	\$120,843	\$72,039	\$48,804
01034M	FY22(012)	Z560	Inventory, Operations and Safety at Free Right-Turn Ramps	\$182,563	\$146,789	\$35,774
<b>BUDGET FOR IN PROGRESS PROJECTS</b>				<b>\$2,539,165</b>	<b>\$1,533,352</b>	<b>\$1,005,813</b>

1. Budget Numbers as of 3/31/2023

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

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FY2024 RESEARCH PROGRAM						
CONTROL NUMBER	PROJECT NUMBER SPR-	FUNDING TYPE	STUDY TITLES	TOTAL STUDY BUDGET	EXPENDITURES	REMAINING BUDGET
<b>NEW PROJECTS</b>						
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	\$0	\$159,036
01057D	FY24(029)	Y560	Assessment of Winter Maintenance Performance Objectives Using Maintenance Decision Support System	\$253,736	\$0	\$253,736
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	\$0	\$114,528
01057J	FY24(034)	Y560	Ultra-High-Performance Concrete (UHPC) for Bridge Deck Overlay and Structural Deck Repair	\$152,761	\$0	\$152,761
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
<b>BUDGET FOR NEW PROJECTS</b>				<b>\$2,068,155</b>	<b>\$0</b>	<b>\$2,068,155</b>

OTHER PROGRAM ITEMS						
CONTROL NUMBER	PROJECT NUMBER SPR-		STUDY TITLES	TOTAL STUDY BUDGET	EXPENDITURES	REMAINING BUDGET
TBD	TBD		Rapid Response Research FY2023	\$180,000	\$0	\$180,000
TBD	TBD		Rapid Response Research FY2024	\$35,000	\$0	\$35,000
<b>BUDGET FOR NEW PROJECTS</b>				<b>\$2,283,155</b>	<b>\$0</b>	<b>\$2,283,155</b>

1. Budget numbers as of 3/31/2023

# IN PROGRESS PROJECTS

<b>PROJECT NUMBER</b>	M087
<b>PROJECT TITLE</b>	Design Optimization and Monitoring of Joint-less Integral and Semi-Integral Abutment Bridges in Nebraska
<b>PRINCIPAL INVESTIGATOR</b>	Chungwook Sim, Jongwon Eun, and Seunghee Kim – UNO, Chung Song – UNL
<b>PROJECT START DATE</b>	7/1/2018
<b>PROJECT COMPLETION DATE</b>	8/31/2021
<b>TECHNICAL ADVISORY COMMITTEE</b>	Fouad Jaber, Mike Vigil, Steve Sabra, Lynden Vanderveen, and David Mraz-FHWA
<b>PROJECT TOTAL COSTS</b>	\$167,687
<b>PROJECT EXPENDITURES TO DATE</b>	\$163,583
<b>NUMBER OF EXTENSIONS GRANTED</b>	Two (2)
<b>PERCENTAGE OF PROJECT COMPLETE</b>	100%
<b>STATUS</b>	Behind Schedule - Submitted Draft Report
<b>FY-2024 BUDGET</b>	\$4,104
<b>FY-2024 TASKS TO BE COMPLETED</b>	None

**Background:** There are more than 9,000 integral abutment bridges and 4,000 semi-integral abutment bridges in the U.S., which increased dramatically in the past two decades (White 2nd, 2007). Nebraska is no exception – there are hundreds of integral and semi-integral abutment bridges in the state of Nebraska, and thus guidelines and specifications for these structures listed on the Bridge Office Policies and Procedures (BOPP, 2016). The obvious advantage of using integral abutment bridges is their reduced construction and maintenance costs by eliminating bearings and expansion joints that make the bridge “joint-less”. This also fits well with Nebraska’s “well-timed” bridge preservation practice of eliminating problems before they occur. Despite the wide acceptance in usage (more than 40 States are using integral abutment bridges) and the advantage listed above, integral and semi-integral abutment bridges are often built with specific limitations under each State’s bridge design manuals; and the design primarily relies on limited empirical data. Noticeably, small numbers of problems were reported because these bridges were built within limitations of specific skew angles, pile types, span lengths, and construction practices to name a few.

**Objective:** The research objective of this project is to monitor the integral and semi-integral abutment bridges in Nebraska to: 1) obtain data for future design and construction practices for wider applications (longer spans, increased skew angles, improve design details in connections), 2) thoroughly understand the complex long-term behavior of soil-structure interactions (interaction between deck/abutment connection, soil/pile behavior both in integral and semi-integral bridges, backfill/abutment), and 3) better maintain existing structures (repair and strengthen if needed). Our multidisciplinary team of structural and geotechnical engineers will carefully investigate the loads produced in abutments over the Nebraska integral abutment bridges, measure the load displacement of piles with fiber optic sensing, examine ratcheting effects (passive pressure increase and inward residual displacement) and voids or settlement under approach span of these structures.

**Tasks & Percent Completed:**

<b>Tasks</b>	<b>Budget by Task</b>	<b>Percent Completed</b>
Task 1: Literature Review/Field Investigation	\$13,333	100%
Task 2: Field Instrumentation/Monitoring	\$97,262	100%
Task 3: Numerical Simulation	\$42,810	100%
Task 4: Design Recommendations	\$14,282	100%

**Deliverables:** The end results of this research project will be the design and construction recommendations that can be integrated statewide or countywide for joint-less integral and semi-integral abutment bridges. The recommendations will be incorporated into the NDOT BOPP manual as well as the NDOT Standard Specifications for Highway construction, which can be used for statewide and countywide implementation. The project staff intends to work with NDOT and Nebraska counties to ensure successful adoption and implementation. It is also anticipated that these recommendations will directly influence the maximum span lengths, skew angles, design considerations, and details outlined by the FHWA Technical Advisory.

**Performance & Goals:** Project is behind schedule and PI has submitted the Draft Final Report.

<b>PROJECT NUMBER</b>	M103
<b>PROJECT TITLE</b>	Simple for Dead Continuous for Live (SDCL) Steel Girder Bridges with UHPC and GFRP
<b>PRINCIPAL INVESTIGATOR</b>	Joshua S. Steelman – UNL
<b>PROJECT START DATE</b>	7/1/2019
<b>PROJECT COMPLETION DATE</b>	12/31/2022
<b>TECHNICAL ADVISORY COMMITTEE</b>	Fouad Jaber, Steve Sabra, Lynden Vanderveen, Maher Tadros-e-Construct, Douglas Gremel - Owens Corning Infrastructure Solutions, James Priest - Owens Corning Infrastructure Solutions; Dave Hartman - Owens Corning Infrastructure Solutions; Mikhail Vorobiev - Owens Corning Infrastructure Solutions, and David Mraz-FHWA
<b>PROJECT TOTAL COSTS</b>	\$132,358
<b>PROJECT EXPENDITURES TO DATE</b>	\$123,651
<b>NUMBER OF EXTENSIONS GRANTED</b>	Two (2)
<b>PERCENTAGE OF PROJECT COMPLETE</b>	80%
<b>STATUS</b>	Behind Schedule
<b>FY-2024 BUDGET</b>	\$8,707
<b>FY-2024 TASKS TO BE COMPLETED</b>	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	10%
Task 8: Documentation and Presentation	\$15,138	62%

**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 & Goals:** Project has an approved extension request and is behind schedule.

<b>PROJECT NUMBER</b>	M116
<b>PROJECT TITLE</b>	Effect of Antioxidant Additives and Restorators on Performance of Asphalt Binders and Mixtures – Phase I
<b>PRINCIPAL INVESTIGATOR</b>	Hamzeh Haghshenas – UNL and Robert Rea – NDOT Materials & Research
<b>PROJECT START DATE</b>	7/1/2019
<b>PROJECT COMPLETION DATE</b>	5/31/2024
<b>TECHNICAL ADVISORY COMMITTEE</b>	Brandon Varilek, , Jody Paul, Jasmine Dondlinger, Bruce Barrett, Matt Park, and Robert Rea
<b>PROJECT TOTAL COSTS</b>	\$445,300
<b>PROJECT EXPENDITURES TO DATE</b>	\$139,614
<b>NUMBER OF EXTENSIONS GRANTED</b>	Two (2)
<b>PERCENTAGE OF PROJECT COMPLETE</b>	97.4%
<b>STATUS</b>	On Approved Revised Schedule
<b>FY-2024 BUDGET</b>	\$305,686
<b>FY-2024 TASKS TO BE COMPLETED</b>	Tasks, 3, 4 & 5

**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:**

<b>Tasks</b>	<b>Budget by Task</b>	<b>Percent Completed</b>
Task 1: Literature Review	\$19,545	100%
Task 2: Materials Selection	\$16,002	100%
Task 3: Laboratory Tests	\$54,154	98%
Task 4: Analysis of Test Results	\$32,764	97%
Task 5: Documentation and Presentation	\$17,324	92%

**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 & Goals:** Project has an approved extension request and is up to date on revised tasks and schedule.



<b>PROJECT NUMBER</b>	M118
<b>PROJECT TITLE</b>	Computation of Peak and Low Flow Statistics and StreamStats GIS Implementation in the Elkhorn River Basin in Nebraska
<b>PRINCIPAL INVESTIGATOR</b>	Kellan Strauch – USGS
<b>PROJECT START DATE</b>	9/7/2018
<b>PROJECT COMPLETION DATE</b>	12/31/2023
<b>TECHNICAL ADVISORY COMMITTEE</b>	Kirk Harvey
<b>PROJECT TOTAL COSTS</b>	\$35,000
<b>PROJECT EXPENDITURES TO DATE</b>	\$35,000
<b>NUMBER OF EXTENSIONS GRANTED</b>	Two (2)
<b>PERCENTAGE OF PROJECT COMPLETE</b>	55%
<b>STATUS</b>	Behind Schedule – Working Draft Report
<b>FY-2023 2024 BUDGET</b>	\$0
<b>FY-2023 2024 TASKS TO BE COMPLETED</b>	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	\$9,500	90%
Task 1a: Compilation of peak flow data		100%
Task 1b: Compute peak flow statistics to 2015		100%
Task 1c: Comparison to USACE computations		100%
Task 1d: Compute peak flow statistics to 2018		100%
Task 1e: Update peak flow statistic to 2019 (pending publication of streamflow record and updated regional skew)		75%
Task 2: Low flow statistic computation	\$7,500	90%
Task 2a: Compilation of streamgage daily flow data		100%
Task 2b: Low flow statistics computation using R statistical package DV stats		100%
Task 2c: Update low flow statistic (pending publication of streamflow record)		80%
Task 3: GIS implementation into StreamStats	\$12,000	75%
Task 3a: Acquire stream center lines for NeDNR		100%
Task 3b: LiDAR prep (burning stream center lines)		80%
Task 3c: Development of flow accumulation and flow direction grids		70%
Task 3d: Online StreamStats implementation		0%
Task 4: Publication	\$6,000	50%
Task 4a: USG Scientific Investigations report		50%
Task 4b: GIS data release (data sets and metadata)		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 & Goals:** Project is Behind Schedule – Working on Draft Report.

<b>CONTROL NUMBER</b>	01021A
<b>PROJECT NUMBER</b>	FY21 (002)
<b>PROJECT TITLE</b>	Development of Guideline for the Use of Geosynthetics in Different Pavement Layered System in Nebraska
<b>PRINCIPAL INVESTIGATOR</b>	Jongwan Eun & Seunghee Kim – UNL
<b>PROJECT START DATE</b>	7/1/2020
<b>PROJECT COMPLETION DATE</b>	3/31/2023
<b>TECHNICAL ADVISORY COMMITTEE</b>	Nikolas Glennie; Bruce Barrett; Brandon Varilek, Kar SiaJesse De Los Santos. Matthew Park, and Ray Trujillo
<b>PROJECT TOTAL COSTS</b>	\$106,536
<b>PROJECT EXPENDITURES TO DATE</b>	\$106,004
<b>NUMBER OF EXTENSIONS GRANTED</b>	One (1)
<b>PERCENTAGE OF PROJECT COMPLETE</b>	85%
<b>STATUS</b>	Behind Schedule
<b>FY-2024 BUDGET</b>	\$532
<b>FY-2024 TASKS TO BE COMPLETED</b>	Tasks 3, 4 & 5

**Background:** Geosynthetics reinforcement such as geogrid, geotextile, etc. has been used as a viable alternative to stabilize the subgrade of roadway pavement construction in regions with soft and/or problematic subgrade (foundation) soils. Geosynthetics are typically marketed either as having the ability to lengthen the pavement design life through controlling the damage of the pavement or as a cost-saver to reduce the aggregate base thickness while maintaining the same level of design-equivalent single axle loads as with traditional pavement systems.

**Objective:** The proposed research will pursue the two primary goals:

- (1) Evaluate the design properties of geosynthetic reinforced roadway pavement including base, subbase, subgrade in Nebraska; and
- (2) Suggest a design guideline of geosynthetic reinforced roadway pavement.

**Tasks & Percent Completed:**

<b>Tasks</b>	<b>Budget by Task</b>	<b>Percent Completed</b>
Task 1: Extensive Review of Geosynthetic-Reinforced Roadway Pavement	\$17,810	100%
Task 2: Experimental Characterization of Geosynthetic Reinforced Pavement with Pullout and Direct Shear Tests Task 2.a Fundamental laboratory test, we will characterize and evaluate the fundamental properties of geosynthetics, and soils chosen for this study Task 2.b Pullout resistance will be evaluated in the different directions of the geosynthetics, such as the machine and cross-machine direction, by using a large pullout testing device (ASTM D6706). Task 2.c Large-size direct shear test (ASTM D5321) will be conducted to evaluate the shear resistance at the soil-geosynthetic interface	\$32,400	100%
Task 3: Large-scale Track Wheel (LSTW) Tests to Evaluate Geosynthetic Reinforced Pavement	\$25,986	70%
Task 4: Numerical Study of Geosynthetic-Reinforced Roadway System	\$23,193	90%
Task 5: Suggestion of Design Recommendation	\$7,147	80%
Task 6: Final Report	-	0%

**Deliverables:**

- (1) It is anticipated that the in-depth review of current practices of geosynthetic reinforced payment in Nebraska and other states will identify an opportunity for improvements in the design and construction with less cost and still superb performance.
- (2) The proposed project will provide precise input parameters of the soil-geosynthetic and aggregate-geosynthetic interactions, in accordance with the common design practice of Nebraska.
- (3) Via the unprecedented large-scale experimental study and in-depth numerical simulations, the proposed project will lead to the improvement of design practices and the introduction of economically viable roadway pavement strategies. In doing so, it will contribute to effectively preventing the issue of deterioration with less cost tailored to the local soil properties in Nebraska.
- (4) Subsequently, the proposed project will greatly help reduce the cost, time, and efforts for maintaining the existing roadways.

**Performance & Goals:** Project has an approved extension request and is up to date on revised tasks and is behind schedule.

<b>CONTROL NUMBER</b>	01021B
<b>PROJECT NUMBER</b>	FY21 (003)
<b>PROJECT TITLE</b>	Effect of Antioxidant Additives and Recycling Agents on Performance of Asphalt Binders and Mixtures – Phase II
<b>PRINCIPAL INVESTIGATOR</b>	Hamzeh Haghshenas & Jiong Hu – UNL and Robert Rea – NDOT Materials & Research
<b>PROJECT START DATE</b>	7/1/2020
<b>PROJECT COMPLETION DATE</b>	5/31/2024
<b>TECHNICAL ADVISORY COMMITTEE</b>	Robert Rea, Brandon Varilek, Bruce Barrett, Jasmine Dondlinger, Kar Sia and Matthew Park
<b>PROJECT TOTAL COSTS</b>	\$167,602
<b>PROJECT EXPENDITURES TO DATE</b>	\$77,490
<b>NUMBER OF EXTENSIONS GRANTED</b>	One (1)
<b>PERCENTAGE OF PROJECT COMPLETE</b>	80%
<b>STATUS</b>	On Approved Revised Schedule
<b>FY-2024 BUDGET</b>	\$90,112
<b>FY-2024 TASKS TO BE COMPLETED</b>	Tasks 1, 3, 4 & 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:**

<b>Tasks</b>	<b>Budget by Task</b>	<b>Percent Completed</b>
Task 1: Literature Review	\$16,968	95%
Task 2: Materials Selection	\$16,801	100%
Task 3: Laboratory Tests	\$58,119	85%
Task 4: Analysis of Test Results	\$33,555	70%
Task 5: Documentation and Presentation	\$19,796	50%

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

<b>CONTROL NUMBER</b>	01021C
<b>PROJECT NUMBER</b>	FY21 (004)
<b>PROJECT TITLE</b>	Midwest Guardrail System (MGS) Thrie Beam Approach Guardrail Transition (AGT) Retrofit to Existing Concrete Parapets and Bridges
<b>PRINCIPAL INVESTIGATOR</b>	Scott Rosenbaugh – UNL
<b>PROJECT START DATE</b>	7/1/2020
<b>PROJECT COMPLETION DATE</b>	9/30/2023
<b>TECHNICAL ADVISORY COMMITTEE</b>	Fouad Jaber, Ross Barron, Mike Vigil, Phil TenHulzen, Austin White, Abdul Sidiqi, David Mraz-FHWA, and Andrew Heuerman-FHWA
<b>PROJECT TOTAL COSTS</b>	\$113,907
<b>PROJECT EXPENDITURES TO DATE</b>	\$87,978
<b>NUMBER OF EXTENSIONS GRANTED</b>	Two (2)
<b>PERCENTAGE OF PROJECT COMPLETE</b>	75%
<b>STATUS</b>	On Approved Revised Schedule
<b>FY-2024 BUDGET</b>	\$25,929
<b>FY-2024 TASKS TO BE COMPLETED</b>	Tasks 1, 2, 3 & 4

**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 a. General project planning and documentation b. TAC meetings	\$8,763	95%
Task 2: Design and Analysis a. Review of existing bridge rails, parapets, and end buttresses b. Concept development of retrofit options c. Selection of desired retrofit	\$23,862	90%
Task 3: Analysis of Selected Retrofit a. LS-DYNA computer simulation b. Structural design of attachment hardware c. Selection of CIPs d. Development of CAD details	\$33,515	80%
Task 4: Reporting and Project Deliverables a. Summary report to document research effort, including conceptual design, selection of desired retrofit, computer simulation, CAD details, and implementation guidance b. Report editing (internal and sponsor review) c. Technical Brief for NDOR d. PowerPoint presentation of research results following project completion e. Project closing (printing, dissemination, accounting)	\$21,838	0%

**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.

<b>CONTROL NUMBER</b>	01021D
<b>PROJECT NUMBER</b>	FY21 (005)
<b>PROJECT TITLE</b>	UHPC Decked I-Beam for Accelerated Bridge Construction
<b>PRINCIPAL INVESTIGATOR</b>	George Morcous – UNL & Maher Tadros – e.Construct.US
<b>PROJECT START DATE</b>	7/1/2020
<b>PROJECT COMPLETION DATE</b>	11/30/2022
<b>TECHNICAL ADVISORY COMMITTEE</b>	Fouad Jaber, Ross Barron, Wally Heyen, Kent Miller, Mike Vigil, Mark Lafferty-Concrete Industries, Todd Culp-Core Slab and David Mraz–FHWA
<b>PROJECT TOTAL COSTS</b>	\$104,250
<b>PROJECT EXPENDITURES TO DATE</b>	\$102,211
<b>NUMBER OF EXTENSIONS GRANTED</b>	One (1)
<b>PERCENTAGE OF PROJECT COMPLETE</b>	99%
<b>STATUS</b>	On Approved Revised Schedule
<b>FY-2024 BUDGET</b>	\$2,039
<b>FY-2024 TASKS TO BE COMPLETED</b>	Tasks

**Background:** Ultra-High Performance Concrete (UHPC) is an excellent material for bridge construction due to its exceptional durability and superior mechanical properties. Several Departments of Transportations (DOTs), including NDOT, have limited the use of UHPC in bridge construction to joints and connections between bridge components due to the relatively high materials cost of commercially UHPC products. Recently, NDOT has sponsored a research project to develop a non-proprietary UHPC using local materials to reduce materials cost and ensure its availability to local contractors and precast producers. The project was completed successfully and an economical UHPC mix that satisfied all workability, durability, and strength requirements was developed and tested. The cost of the raw materials for this mix was about \$700 per cubic yards which is about 30 percent of the cost of pre-bagged commercial UHPC materials. Therefore, it is economically feasible at this time to expand the use of UHPC to bridge components, such as deck slabs and girders, to have a service life of over 150 years. Some researchers (Voo and Foster 2010) estimate the theoretical service life to be about 340 years. Its use will clearly minimize bridge maintenance costs and traffic disruptions.

**Objective:** The objective of this project is to develop a UHPC superstructure system for bridges in Nebraska that is optimized with respect to structural efficiency, constructability, and economy. Few highway bridges have already been built using UHPC superstructure in France, Korea, Malaysia, USA, and Canada. These bridges had different superstructure systems including pi-girders, bulb-tee girders, tub girders, box girders, decked I-beams, and waffle slabs. These systems will be reviewed and evaluated to determine the system(s) that meet NDOT needs.

The research team will work with NDOT bridge engineers and local bridge producers and contractors in this project. This will include conducting necessary materials testing, structural testing, and formwork design; and addressing issues related to girder shipping and handling, longitudinal joints, differential camber and camber growth, railing connections, cross slope/skewed bridges, and multi span continuity.

#### **Tasks & Percent Completed:**

<b>Tasks</b>	<b>Budget by Task</b>	<b>Percent Completed</b>
Task 1: Review Existing UHPC Superstructure Systems	\$7,480	100%
Task 2: Evaluate System Alternatives	\$9,967	100%
Task 3: Develop Final Design and Detailing	\$19,954	100%
Task 4: Fabricate and Test Full-Scale Specimen(s)	\$46,782	100%
Task 5: Prepare Project Documentation and Technology Transfer	\$14,068	100%

**Deliverables:** The research team currently has a PCI funded research project on nation-wide implementation of UHPC precast/prestressed components in buildings and bridges. This project will supplement the team efforts to develop and implement UHPC superstructure system, which is a great benefit to the state of Nebraska, in particular, and bridge community at large. The use of precast UHPC superstructure system saves construction time of deck forming, reinforcing, casting, and curing, which leads to accelerated bridge construction. It also enhances construction safety, and minimizes traffic disruptions, which is highly needed on interstate highway projects. This project will be conducted by UNL researchers with unpaid consulting services by e.construct.

**Performance & Goals:** Project is up to date with the current tasks and progress. Waiting for final report.

<b>CONTROL NUMBER</b>	01021E
<b>PROJECT NUMBER</b>	FY21 (006)
<b>PROJECT TITLE</b>	Rapid Concrete Bridge Repair Survey and Patch Material Evaluation
<b>PRINCIPAL INVESTIGATOR</b>	Marc Maguire & Jiong Hu – UNL
<b>PROJECT START DATE</b>	7/1/2020
<b>PROJECT COMPLETION DATE</b>	5/31/2023
<b>TECHNICAL ADVISORY COMMITTEE</b>	Wally Heyen, Ross Barron, Fouad Jaber, Mike Vigil, Logan Sia, Brandon Varilek, Nikolas Glennie, Lieska Halsey and David Mraz-FHWA
<b>PROJECT TOTAL COSTS</b>	\$93,572
<b>PROJECT EXPENDITURES TO DATE</b>	\$51,653
<b>NUMBER OF EXTENSIONS GRANTED</b>	One (1)
<b>PERCENTAGE OF PROJECT COMPLETE</b>	80%
<b>STATUS</b>	On Approved Revised Schedule
<b>FY-2024 BUDGET</b>	\$41,919
<b>FY-2024 TASKS TO BE COMPLETED</b>	Tasks, 3, 4 & 5

**Background:** Tracking the heat of hydration (HoH) of Portland cement concrete has become a widely used and viable technique to characterize cement mixtures hydration behavior for cement producers, practicing engineers, and contractors (ASTM C1679). The Nebraska Department of Transportation (NDOT) is interested in gaining background knowledge on the HoH generated from local cements at different ambient temperatures. This information will be primarily beneficial for troubleshooting field concrete setting issues thereby improving support for Portland cement concrete contractors and ultimately improving project quality. Isothermal calorimetry (IC) has become the method of choice for characterizing cement set and hydration behavior due to its reliability and relatively easy data collection.

**Objective:** The general objective of this research is to identify the HoH of locally available cements. The specific objectives are to identify HoH in (1) different ambient curing temperatures, (2) different water-to-cement ratios (w/c), (3) different manufacturers. The HoH and Thermal Power Curves developed will be able to identify critical conditions for set times across the NDOT construction situation. Furthermore, this research will enable additional future research into the behavior of various mineral and chemical admixtures used by NDOT contractors to allow even more specific and continuous contractor support and enhance contractor and Portland cement concrete performance.

**Tasks & Percent Completed:**

Tasks	Budget by Task	Percent Completed
Task 1: Literature Review and Survey Development	\$14,040	100%
Task 2: Compiling Paper Data Identify Lab Testing	\$12,390	100%
Task 3: Site Visits	\$14,700	90%
Task 4: Lab Testing and Data Analysis of Collected Data	\$28,737	50%
Task 5: Reporting	\$23,705	50%

**Deliverables:** This project will allow NDOT to identify the HoH generation curve and the various metrics associated with different w/c and ambient temperatures. By better understanding the HoH of locally available cements, NDOT will be able to better anticipate early or late setting problems and provide guidance to concrete contractors in different conditions, using different mixtures. Ultimately, this will streamline the construction process, ideally providing better quality final concretes and reduce construction headaches for NDOT and its contractors. Future phases of this project will provide guidance on the combination of various admixtures under different conditions to provide additional information.

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

<b>CONTROL NUMBER</b>	01021H
<b>PROJECT NUMBER</b>	FY21 (009)
<b>PROJECT TITLE</b>	Energy Dissipation Optimization for Circular Culverts
<b>PRINCIPAL INVESTIGATOR</b>	David Admiraal – UNL
<b>PROJECT START DATE</b>	7/1/2020
<b>PROJECT COMPLETION DATE</b>	12/31/2022
<b>TECHNICAL ADVISORY COMMITTEE</b>	Julie Ramirez, Austin White, Jason Dayton, Kirk Harvey, Bob Carnazzo, Bertie Specht, Anna Allen, Ibrahim Abuzaho, Jodi Kocher (Felsberg, Holt, and Ullevig) and Ben Fischer (Felsberg, Holt, and Ullevig)
<b>PROJECT TOTAL COSTS</b>	\$107,088
<b>PROJECT EXPENDITURES TO DATE</b>	\$106,093
<b>NUMBER OF EXTENSIONS GRANTED</b>	One (1)
<b>PERCENTAGE OF PROJECT COMPLETE</b>	95%
<b>STATUS</b>	Behind Schedule
<b>FY-2024 BUDGET</b>	\$995
<b>FY-2024 TASKS TO BE COMPLETED</b>	Tasks 4, 8 & 9

**Background:** In 2004, NDOT research examined the use of weir energy dissipators for rectangular culverts. The method has proven valuable and effective for minimizing velocities and decreasing cost and has been included in FHWA's Hydraulic Engineering Circular No. 14: Hydraulic Design of Energy Dissipators for Culverts and Channels. NDOT has already installed similar dissipators (including weir and staggered weir wall dissipators) downstream of circular culverts, but there is no formal design procedure for this application. Although NDOT Roadway Hydraulics has developed methods of analysis for the new application, they do not have any guidance on the validity of the analysis method because no specific research has been conducted. The current method of analysis does not account for energy losses associated with the transition from a round pipe to a concrete box cross section. These additional losses may reduce the necessary size of the dissipation structure. As part of the proposed research, we would like to develop and validate a formal design procedure and simultaneously optimize design details of the resulting dissipator geometry.

**Objective:** The overarching objective of this research is: to develop and improve energy-dissipation designs for circular culverts in order to mitigate downstream erosion, lessen sedimentation and blockage by debris, minimize the footprint of the energy dissipation structure, and reduce installation cost.

**Tasks & Percent to be completed:**

Tasks	Budget by Task	Percent Completed
Task 1: Literature Review and Existing Structures	\$11,230	100%
Task 1a: Literature Review		
Task 1b: Visit existing dissipation structures		
Task 1c: Document dissipation alternatives		
Task 2: TAC 1 - Select Alternatives	\$0	100%
Task 3: Construct and Test Energy Dissipation Alternative 1	\$42,455	100%
Task 3a: Build Alternative 1		
Task 3b: Test Alternative 1		
Task 4: Analyze data for Alternative 1	\$14,358	90%
Task 5: TAC 2 - Report results of Alternative 1	\$0	100%
Task 6: Build and Test Alternative 2	\$23,858	100%
Task 6a: Build Alternative 2		
Task 6b: Test Alternative 2		
Task 7: TAC 3 – Design implementation meeting	\$0	100%
Task 8: Analyze data for Alternative 2	\$11,273	90%
Task 9: TAC 4 - Present Experimental Results to NDOT	\$0	60%
Task 10: Complete Report and Technical Brief. TAC 5 - Final Presentation	\$3,913	0%

**Deliverables:**

1. Documented design detail for all currently used dissipation structure types.
2. Possible extension of the design to include non-traditional applications such as sites with incomplete hydraulic jumps at the outlet.
3. Reduced cost of installation resulting from improved understanding of geometric limitations of the structures.
4. Decreased maintenance for new designs due to reduced sedimentation and clogging.
5. Smaller footprints for completed structures, leading to lessened right-of-way requirements, reduced environmental impacts, and expedited project delivery.
6. Improved effectiveness of the energy dissipation structures will lead to reduced downstream erosion impacts. Reduced erosion will lead to reduced sedimentation in downstream water bodies and wetlands.
7. Quantification of energy losses will include the transition from a circular pipe to a rectangular box structure, potentially resulting in size reductions of energy dissipation structure designs.

**Performance & Goals:** Project has an approved revised schedule and is behind schedule.

<b>CONTROL NUMBER</b>	01021J
<b>PROJECT NUMBER</b>	FY21(010)
<b>PROJECT TITLE</b>	Crashworthy Perforated Square Steel Tube (PSST) Mailbox Support
<b>PRINCIPAL INVESTIGATOR</b>	Robert Bielenberg, Scott Rosenbaugh, Ron Faller, and Cody Stolle – UNL
<b>PROJECT START DATE</b>	7/1/2020
<b>PROJECT COMPLETION DATE</b>	5/31/2023
<b>TECHNICAL ADVISORY COMMITTEE</b>	Matt Neeman, Phil TenHulzen, Austin White, Nathan Sorben, and John Lutz
<b>PROJECT TOTAL COSTS</b>	\$164,927
<b>PROJECT EXPENDITURES TO DATE</b>	\$58,090
<b>NUMBER OF EXTENSIONS GRANTED</b>	One (1)
<b>PERCENTAGE OF PROJECT COMPLETE</b>	35.3%
<b>STATUS</b>	On Approved Revised Schedule
<b>FY-2024 BUDGET</b>	\$106,837
<b>FY-2024 TASKS TO BE COMPLETED</b>	Tasks 1, 2, 3 & 4

**Background:** NDOT desires that the mailbox support be updated to meet MASH 2016 TL-3 safety performance criteria. Very few mailbox supports have been evaluated according to MASH TL-3 specifications. The Texas A&M Transportation Institute (TTI) evaluated locking architectural mailboxes on thin-wall, steel-tube supports to MASH TL-3 (TTI Report No. 9-1002-12-9). A single-mailbox mount was tested and was successful. Two multiple-mailbox (combined standard and locking architectural mailboxes) mounts were tested and both configurations failed to meet MASH TL-3. The mailbox support for multiple mailboxes was subsequently redesigned and resulted in successful MASH TL-3 tests. Due to the limited number of tested mailbox supports, NDOT desired to design and evaluate a MASH TL-3 mailbox support.

**Objective:** The objective of this research project is to develop a non-proprietary mailbox support using PSST support posts that is MASH TL-3 crashworthy. The design should consider single and multiple mailbox configurations. The design may start with the previous NDOT mailbox support or could be developed independently depending on NDOT's preference. The Phase I objective will be to design and evaluate the mailbox support utilizing bogie testing.

**Tasks & Percent Completed:**

Tasks	Budget by Task	Percent Completed
Task 1: Project Planning and Correspondence a. General project planning and documentation b. Literature search of previous crashworthy mailbox supports and PSST sign supports c. TAC meeting	\$17,343	65.6%
Task 2: Design and Analysis a. Review of previous crashworthy mailbox supports and mailbox connections b. Establish design criteria based on NDOT's needs c. Development of PSST mailbox support concepts d. Preparation of 3D CAD details e. Sponsor comments on proposed concepts f. Recommendation of a proposed design	\$43,383	51.9%
Task 3: Dynamic Component Testing a. Construction of test article – procure mailbox hardware and assembly of mailbox system at MwRSF's Outdoor Testing Facility b. Document material certifications, specifications, and certificates of compliance c. Conduct 6 dynamic component tests on proposed mailbox supports with MwRSF bogie representative of a small car d. Data analysis – Transducer and video analysis for each crash test e. System removal – Removal and disposal of system components	\$82,280	24.6%
Task 4: Reporting and Project Deliverables a. Compile summary report to document research effort, including literature review, concept development, dynamic component tests, and recommendations for further testing b. Report editing (internal and sponsor review) c. Prepare Technical Brief for NDOR d. PowerPoint presentation of research results following project completion e. Project closing (printing, dissemination and accounting).	\$21,921	18.6%

**Deliverables:** Development of a PSST mailbox support that meets MASH TL-3 requirements will provide NDOT with a crashworthy solution for mailboxes adjacent to state roadways. Additionally, the adoption of a design using PSST similar to current NDOT sign supports will reduce and simplify the state inventory.

**Performance & Goals:** Project has an approved revised schedule and is up to date with the current tasks and progress.



<b>CONTROL NUMBER</b>	01021K
<b>PROJECT NUMBER</b>	FY21 (011)
<b>PROJECT TITLE</b>	Establishment of Wildflower Islands to Enhance Roadside Health, Ecological Value, and Aesthetics - Phase II
<b>PRINCIPAL INVESTIGATOR</b>	John Guretzky, Tom Weissling and Judy Wu-Smart – UNL
<b>PROJECT START DATE</b>	7/1/2020
<b>PROJECT COMPLETION DATE</b>	3/31/2023
<b>TECHNICAL ADVISORY COMMITTEE</b>	Ron Poe and Jeff Hartman
<b>PROJECT TOTAL COSTS</b>	\$171,275
<b>PROJECT EXPENDITURES TO DATE</b>	\$154,227
<b>NUMBER OF EXTENSIONS GRANTED</b>	One (1)
<b>PERCENTAGE OF PROJECT COMPLETE</b>	94%
<b>STATUS</b>	On Approved Revised Schedule
<b>FY-2024 BUDGET</b>	\$17,048
<b>FY-2024 TASKS TO BE COMPLETED</b>	Tasks 9

**Background:** A previous study completed by the University of Nebraska-Lincoln (UNL) in collaboration with NDOT has shown that wildflowers compose less than 10% of the botanical composition of highway roadsides 10 years following seeding. More recently in 2016, UNL/NDOT launched a new project to test the use of wildflower islands as a means of increasing the establishment and persistence of wildflowers on roadsides (phase I). These islands varied in size and consisted of segregated stands of diverse mixtures of wildflowers within grass-dominated roadsides. From this two-year study, we demonstrated that islands promoted higher bee abundance and richness than conventionally seeded plots following current NDOT practices.

**Objective:**

1. Continue to assess the plant community within wildflower islands from phase I to determine the role of island or patch size on longevity of wildflower plots,
2. On newly-seeded roadsides, we will repeat wildflower establishment in varying island sizes or strips (i.e., drill passes) but reduce the number of wildflower species in the seed mixture and introduce mowing regimes to better manage volunteer weeds and assess plant community responses to mowing, and
3. Assess attractiveness of wildflower mixtures on pollinators and other beneficial insects from Phase I and Phase II sites to evaluate the ecological impact of wildflower plots.

**Tasks & Percent Completed:**

Tasks	Budget by Task	Percent Completed
Task 1: Implement project	\$ 14,450	100%
Task 2: Line up contractors and collect data	\$ 34,936.00	100%
Task 3: Literature search and insect identification	\$24,851.00	100%
Task 4: Analyze data	\$19,588.00	100%
Task 5: Compile 2020 results	\$9,150.00	100%
Task 6: Data collection and treatment application	\$22,237.00	100%
Task 7: Insect collection and identification	\$9,559.00	100%
Task 8: Data analysis	\$20,269.00	100%
Task 9: Task 9 and 10 – final report	\$16,234.00	85%

**Deliverables:** Current methods of establishing wildflowers in roadside stands are expensive (wildflower seeds account for as much as 30% of seed mixture costs) and commonly unsuccessful. Based on phase I results, we believe there are cost-saving modifications that could be made to the seeding mixture to promote better establishment and longevity of wildflower islands. Deliverables of phase II include refinements to seeding methods, improved maintenance practices, and changes in seeding mixtures that would replace poor-performing species with native plant species that consistently grow well on roadsides and have other ecologically favorable traits (i.e. long bloom periods, positive responses to mowing, attractive to many insects). The proposed research for phase II surveys will include information about which plants are used by insects throughout the season to further demonstrate the ecological value of roadside habitats. Insect and vegetation surveys will be completed at phase I sites and newly-seeded phase II sites to provide more information about establishment and longevity of wildflower islands on roadsides. Additionally, wildflower islands will be evaluated to inform which wildflower mixtures and seeding methods are most favorable for beneficial insects. NDOT has recently become involved with the nationwide Candidate Conservation Agreement with Assurances (CCA) efforts to promote monarch butterflies utilizing resources on energy and transportation lands illustrating the importance of pollinators to our state. Phase II of this project would align with these interests and priorities. Results generated from this project will improve our understanding of how to most efficiently and cost-effectively establish pollinator-friendly forage and wildlife habitat on roadsides and will inform other state and federal agencies interested in similar projects.

**Performance & Goals:** Project has an approved revised schedule and is up to date with the current tasks and progress.

<b>CONTROL NUMBER</b>	01034A
<b>PROJECT NUMBER</b>	FY22(001)
<b>PROJECT TITLE</b>	Low-Cement Concrete Mixture for Bridge Decks and Rails
<b>PRINCIPAL INVESTIGATOR</b>	George Morcoux and Jiong Hu - UNL
<b>PROJECT START DATE</b>	7/1/2021
<b>PROJECT COMPLETION DATE</b>	5/31/2023
<b>TECHNICAL ADVISORY COMMITTEE</b>	Fouad Jaber, Wally Heyen, Ross Barron, Noah Pitts, Wayne Patras, Scott Fischer, Brandon Varilek, Lieska Halsey, Mike Willman-GCP Applied Technologies, Kevin Piper-Simon, Mark Deetz-Lyman Richey Corporation, and David Mraz-FHWA
<b>PROJECT TOTAL COSTS</b>	\$112,394
<b>PROJECT EXPENDITURES TO DATE</b>	\$73,175
<b>NUMBER OF EXTENSIONS GRANTED</b>	One (1)
<b>PERCENTAGE OF PROJECT COMPLETE</b>	80%
<b>STATUS</b>	On Approved Revised Schedule
<b>FY-2024 BUDGET</b>	\$39,219
<b>FY-2024 TASKS TO BE COMPLETED</b>	Tasks 3, 4, & 5

**Background:** Early-age cracking of concrete bridge decks and rails accelerates the penetration of water and chemicals into the concrete, which leads to reinforcement corrosion, delamination, and eventually spalling. This common deterioration problem results in shorter service life, road closures, and costly repairs/replacements. The early-age cracking of concrete decks and rails is primarily attributed to the drying shrinkage of restrained concrete immediately after construction. Concrete mixture design and curing procedure are key factors in reducing drying shrinkage and, consequently, early-age cracking.

**Objective:** The main objective of this research project is to achieve a cement content reduction in NDOT bridge deck and rail concrete mixture through aggregate particle packing optimization and evaluate the overall performance of the new mixture. The Modified Toufar Model will be used in optimizing particle packing and the combined aggregate void content test will be used to experimentally justify optimized aggregate gradations. Locally available aggregates from both East and West Nebraska will be considered. The experimental program of this study consists of three Phases: Phase 1 focuses on obtaining optimized aggregate blends to reduce cement content by half or full sack, while meeting strength and workability requirements for bridge decks and rails. Phase 2 focuses on the evaluation of the overall performance of concrete with reduced cement content with respect to mechanical, viscoelastic, and durability properties. This will include, but not limited to, air content, setting time, modulus of rupture, modulus of elasticity, bond strength, surface and bulk resistivity, free shrinkage, restrained shrinkage, and freeze/thaw resistance. Phase 3 focuses on demonstrating the use of the developed mixture in the construction of a bridge deck slab and/or rail. This could be accomplished in an actual bridge project or full-scale laboratory specimen, where concrete pumpability, consolidation, and curing procedures are evaluated.

**Tasks & Percent Completed:**

<b>Tasks</b>	<b>Budget by Task</b>	<b>Percent Completed</b>
Task 1: Literature Review	\$ 7,565	100%
Task 2: Mix Development	\$ 21,0147	100%
Task 3: Performance Evaluation	\$ 45,795	80%
Task 4: Demonstration	\$ 22,716	0%
Task 5: Report and Presentation	\$ 15,270	85%

**Deliverables:** This study will result in the following benefits: Alternative concrete mixture for bridge decks and rails that is less susceptible to early-age shrinkage cracking, which could increase the service life of bridge decks/rail and reduce road closures/detours associated with repair and replacement activities; and the use of less cement in bridge deck mixes will reduce the concrete cost and its carbon footprint, which are significant economic and environmental advantages.

**Performance & Goals:** Project has an approved revised schedule and is up to date with the current tasks and progress.

<b>CONTROL NUMBER</b>	01034B
<b>PROJECT NUMBER</b>	FY22(002)
<b>PROJECT TITLE</b>	Nebraska Balanced Mix Design – Phase I
<b>PRINCIPAL INVESTIGATOR</b>	Hamzeh F. Haghshenas and Mahdiah Khademati - UNL & Robert Rea - NDOT
<b>PROJECT START DATE</b>	7/1/2021
<b>PROJECT COMPLETION DATE</b>	5/31/2023
<b>TECHNICAL ADVISORY COMMITTEE</b>	Robert Rea, Brandon Varilek, Bruce Barrett, Matthew Park, Asadullah Sahak, Jody Paul, Zach Thurber, Marsh Lemen, Ben Tran, Walter Moy, and Gregg Leber-Constructors
<b>PROJECT TOTAL COSTS</b>	\$138,937
<b>PROJECT EXPENDITURES TO DATE</b>	\$35,190
<b>NUMBER OF EXTENSIONS GRANTED</b>	None
<b>PERCENTAGE OF PROJECT COMPLETE</b>	86%
<b>STATUS</b>	On Schedule
<b>FY-2024 BUDGET</b>	\$103,747
<b>FY-2024 TASKS TO BE COMPLETED</b>	Tasks 3, 4 & 5

**Background:** Typically, asphalt mixtures are designed under the Superpave system, in which the proportioning of the aggregates and asphalt binder is based on the aggregate quality characteristics and mixture volumetric properties such as air voids, voids in the mineral aggregate, and voids filled with asphalt. Mixtures designed with high amount of asphalt can be susceptible to rutting, while those with low asphalt content are prone to cracking, raveling, or other durability related pavement distresses. One of the largest shortcomings of current design procedures is the lack of long-term materials aging protocol. Therefore, performance tests should be included as part of the mixture design procedure to ensure the desirable field pavement performance. Many performance tests have been proposed for the evaluation of the rutting resistance (e.g., Hamburg Wheel Track Tester, Gyrotory Stability, IDEAL Rutting Test, and High-Temp Indirect Tensile Test), cracking resistance (e.g., Semi-circular Bending Test and IDELA Cracking Test, and moisture susceptibility (e.g., Indirect Tensile Strength, Hamburg Wheel Track Tester) of the asphalt mixtures. In Balanced Mix Design (BMD), two or more mechanical tests are coupled to quantify the mixture resistance against different forms of distress.

**Objective:** The aim of this research is to establish benchmarks for the current and future mixture designs and criteria to address rutting, cracking, and moisture damage resistance in more detail, especially with a focus on high recycled mixtures and major binder modifications through the use of recycling agents and antioxidants. To this end, the BMD performance tests in high-, and mid-temperature used in different states will be considered and some of them will be carried out on various Nebraska mixtures collected from the field projects. In addition, moisture performance tests will be included in the Nebraska BMD. Long-term aging protocols will be applied to the mixtures to address cracking resistance more accurately. The field evaluation will be conducted on pavement sections and field data will be collected to establish pass/fail thresholds for future quality assurance and acceptance purposes. Then the mixtures containing recycled materials, recycling agents, and antioxidant will be designed and evaluated based on the established pass/fail thresholds.

**Tasks & Percent Completed:**

<b>Tasks</b>	<b>Budget by Task</b>	<b>Percent Completed</b>
Task 1: Literature Review	\$ 17,570	100%
Task 2: Experimental Plan and Sample Collection	\$ 11,687	100%
Task 3: Laboratory Tests	\$ 43,290	90%
Task 4: Analysis of Test Results	\$ 47,440	80%
Task 5: Documentation and Presentation	\$ 18,950	60%

**Deliverables:** The results of this study will provide significant insights to the current and future mixture designs and criteria by addressing major pavement distresses like rutting, cracking, and moisture damage. A special focus will be given to high recycled mixtures modified by additives like recycling agents and antioxidants. The successful development and implementation of BMD in our state will provide safer, more efficient, trustworthy, and comfortable means for the transportation construction industry. It also can lead to significant cost reduction and provide longer lasting and more sustainable asphalt pavements.

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

<b>CONTROL NUMBER</b>	01034C
<b>PROJECT NUMBER</b>	FY22(003)
<b>PROJECT TITLE</b>	Asphalt Binder Laboratory Short-Term Aging – Phase II
<b>PRINCIPAL INVESTIGATOR</b>	Hamzeh Haghshenas and Mohammad Ghashami - UNL & Robert Rea - NDOT
<b>PROJECT START DATE</b>	7/1/2021
<b>PROJECT COMPLETION DATE</b>	5/31/2023
<b>TECHNICAL ADVISORY COMMITTEE</b>	Robert Rea, Brandon Varilek, Bruce Barrett, Asadullah Sahak, Matthew Park, and Nick Collins-Jebro
<b>PROJECT TOTAL COSTS</b>	\$140,616
<b>PROJECT EXPENDITURES TO DATE</b>	\$19,567
<b>NUMBER OF EXTENSIONS GRANTED</b>	None
<b>PERCENTAGE OF PROJECT COMPLETE</b>	70%
<b>STATUS</b>	Behind Schedule
<b>FY-2024 BUDGET</b>	\$121,049
<b>FY-2024 TASKS TO BE COMPLETED</b>	Tasks 1, 3, 4, 5 & 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	97%
Task 2: Experimental Design and Sample Collection	\$ 11,770	100%
Task 3: Laboratory Tests	\$ 64,873	55%
Task 4: Analysis of Test Results	\$ 28,956	55%
Task 5: Thermal Modeling and Analysis	\$ 9,477	70%
Task 6: Documentation and Presentation	\$ 14,854	45%

**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 & Goals:** Project is behind schedule.

<b>CONTROL NUMBER</b>	01034D
<b>PROJECT NUMBER</b>	FY22(004)
<b>PROJECT TITLE</b>	Erosion Resistant Rock Shoulder
<b>PRINCIPAL INVESTIGATOR</b>	Chung Song & Richard Wood - UNL
<b>PROJECT START DATE</b>	7/1/2021
<b>PROJECT COMPLETION DATE</b>	5/31/2023
<b>TECHNICAL ADVISORY COMMITTEE</b>	Bruce Barrett, Brandon Varilek, Nikolas Glennie, Matthew Park, and Terry Rogers-Martin Marietta
<b>PROJECT TOTAL COSTS</b>	\$142,907
<b>PROJECT EXPENDITURES TO DATE</b>	\$101,784
<b>NUMBER OF EXTENSIONS GRANTED</b>	None
<b>PERCENTAGE OF PROJECT COMPLETE</b>	71%
<b>STATUS</b>	On Schedule
<b>FY-2024 BUDGET</b>	\$41,123
<b>FY-2024 TASKS TO BE COMPLETED</b>	Tasks 4 & 5

**Background:** With the advent of climate change, weather patterns are becoming more unpredictable, and consequently, severe drought and flooding are unavoidable. For highway structures, this new weather pattern created new problems in the pavement system. Techniques to evaluate erosion resistance of these materials are not well developed so far. Consequently, the improved design of erosion resistant aggregate and combinations of soil and aggregate are needed. NDOT currently utilizes the gradation of crushed rock surface course and soils, however, materials with this gradation are not always readily available or perform as intended. This study combines dedicated testing methods and hydrodynamics analysis technique to test, evaluate and obtain the erosion resistant shouldering materials which outperform the current design recommendation.

**Objective:**

- 1) Obtain an experimental quantity called “erosion coefficient” for various conditions -three different gradations times five different binding agents. The binding agents include No agent (control), Lignon, Nebraska Soybean-based soap-stock, POSS, Loessy binding soils. These will be characterized using the University of Nebraska-Lincoln Erosion Test Bed (UNLETB) and a Jet Erosion Test (JET). The test will be conducted at the same density as the field crushed rock surface course.
  - a. UNLETB is a large erosion testing bed. It will test combined specimen of crushed rock surface course and binding agents. JET is a small erosion testing apparatus, and it will test binding agents only.
  - b. Expected products are numerical values of erosion coefficient for different samples.
- 2) Perform a numerical verification of the experimental results using a Hydro-dynamics analytical platform.
  - a. For erosion coefficient obtained in objective 1, Flow3D, a computational fluid dynamics software, will be calibrated to predict the erosion performance of the above 15 different conditions. Ultimately, the calibrated parameters, Flow3D, and HEC-RAS(Hydrological Software) will be used to predict field erosion conditions such as field geometry of shoulder, flow depth, and flow velocity.
  - b. Expected products are calibrated erosion parameters for field conditions (geometry, flow depth, and flow velocity).
- 3) Obtain a simplified field erosion equation for different gradations of crushed rock surface courses with multiple different binding agents.
  - a. In addition to the Flow3D based calibrated erosion parameters, hand calculation enabled erosion parameters will be provided by statistical analysis.
  - b. Expected products are mono grams.
- 4) Provide an optimized design chart so that NDOT may obtain a conservative gradation of crushed rock surface course (with and without binding agents) from multiple available choices.
  - a. Combining output from objectives 1 to 3, a flow chart that can lead engineers to obtain proper crushed rock surface course will be obtained.
  - b. Expected products are both in the form of graphical design chart and a computer-based design procedure.

**Tasks & Percent Completed:**

Tasks	Budget by Task	Percent Completed
Task 1: Literature Study	\$ 6,829	100%
Task 2: Fabrication of UNL Erosion Testing Bed (UNLETB)	\$ 18,694	100%
Task 3: Verification of Testing Technique by Analytical Method	\$ 17,217	100%
Task 4: Testing and Recommendations for crushed rock surface course materials	\$ 42,348	72.8%
Task 5: Reporting	\$ 57,819	44.21%

**Deliverables:**

- 1) Allow flexibility in selecting crushed rock surface course – multiple available gradation and multiple available rock quarries will reduce supply chain issues.
- 2) Safer highway by reducing drop-offs and associated lane departure crashes.
- 3) Reduced maintenance work and cost saving by providing more resilient highway shoulder.
- 4) Reduced amount of dislodged rocks relieving stress to District Maintenance Operations.

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

<b>CONTROL NUMBER</b>	01034E
<b>PROJECT NUMBER</b>	FY22(005)
<b>PROJECT TITLE</b>	Application of Remote Sensing and Hydrologic Modeling to Reduce Highway Flooding in the Nebraska Sandhills
<b>PRINCIPAL INVESTIGATOR</b>	Aaron Mittelstet - UNL
<b>PROJECT START DATE</b>	7/1/2021
<b>PROJECT COMPLETION DATE</b>	5/31/2023
<b>TECHNICAL ADVISORY COMMITTEE</b>	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, and Dillon Dittmer-FHWA
<b>PROJECT TOTAL COSTS</b>	\$143,166
<b>PROJECT EXPENDITURES TO DATE</b>	\$89,862
<b>NUMBER OF EXTENSIONS GRANTED</b>	None
<b>PERCENTAGE OF PROJECT COMPLETE</b>	54%
<b>STATUS</b>	Behind Schedule
<b>FY-2024 BUDGET</b>	\$53,304
<b>FY-2024 TASKS TO BE COMPLETED</b>	Tasks 2, 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	60%
Task 3: Conditions and Lag Time of Flooding	\$ 31,328	55%
Task 4: Prioritize Highways Based on Frequency of Flooding	\$ 31,328	20%
Task 5: Identify Most Efficient and Informed Design to Prevent Future Flooding	\$ 19,272	0%
Task 6: Write Final Report	\$ 12,706	40%

**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 & Goals:** Project is behind schedule.

<b>CONTROL NUMBER</b>	01034F
<b>PROJECT NUMBER</b>	FY22(006)
<b>PROJECT TITLE</b>	Evaluation of NDOT's Sediment Barrier Practices Using Performance Data
<b>PRINCIPAL INVESTIGATOR</b>	Mike Perez and Wesley Donald - Auburn University & Blake Whitman - Middle Tennessee State University
<b>PROJECT START DATE</b>	7/1/2021
<b>PROJECT COMPLETION DATE</b>	5/31/2023
<b>TECHNICAL ADVISORY COMMITTEE</b>	Ron Poe and Brian Anderson
<b>PROJECT TOTAL COSTS</b>	\$191,099
<b>PROJECT EXPENDITURES TO DATE</b>	\$0
<b>NUMBER OF EXTENSIONS GRANTED</b>	None
<b>PERCENTAGE OF PROJECT COMPLETE</b>	75%
<b>STATUS</b>	On Schedule
<b>FY-2024 BUDGET</b>	\$191,099
<b>FY-2024 TASKS TO BE COMPLETED</b>	Tasks 2, 5, 6, & 7

**Background:** Construction activities involve heavy earthmoving activities that typically disturb several acres of land. Due to the nature of construction activity, sediment is the predominant pollutant of concern during the clearing and grading stages, which typically exposes large un-vegetated and un-stabilized land areas to erosive elements. Sediment runoff rates from construction sites can be 10 to 20 times higher than those of agricultural lands and 1,000 to 2,000 times greater than those of forested lands. Construction sites have measured erosion rates of approximately 20 to 200 tons per acre (45 to 450 metric tons per ha) per year. In addition to environmental implications, sedimentation can cause vast economic problems. The loss of aquatic habitat and diminished water quality is often difficult to quantify, however some impacts (i.e., cost of dredging and disposing of accumulated sediment) are easier to assess. Furthermore, the cost of eroded soil replacement comes at a high price. Stormwater management has become an increasingly important aspect of construction activities in the state of Nebraska. The National Pollutant Discharge Elimination System Permit for Storm Water Discharges from Construction Sites (NPDES Permit) requires the Nebraska Department of Transportation (NDOT) to develop a stormwater pollution prevention plan (SWPPP) for all construction activities that are covered by the permit. The SWPPP includes the design, installation, and maintenance of erosion and sediment control practices to minimize downstream impact from stormwater discharges. Currently, NDOT has specifications, standard drawings, and guidance for the design of erosion and sediment control practices. Opportunities exist to better understand the performance of standard NDOT erosion and sediment control practices, improve the design and performance of practices, and to develop additional design manual guidance for the proper selection and design of practices.

**Objective:**

- 1) Determine a methodology and modeling process to evaluate the performance of various buffer configuration (i.e., length, vegetation type, soil, etc.) typically encountered along NDOT highway construction sites.
- 2) Conduct large-scale laboratory experiments to determine the performance of sediment barrier practices used by NDOT using estimated soils losses and stormwater runoff volumes associated with NDOT highway construction projects that can be used to supplement buffers that are not able to meet the minimum 50 ft requirement.

**Tasks & Percent Completed:**

<b>Tasks</b>	<b>Budget by Task</b>	<b>Percent Completed</b>
Task 1: Kickoff Meeting	\$ 2,850	100%
Task 2: Literature Review	\$ 16,150	90%
Task 3: Develop Methodology for Determining Buffer Efficiency	\$ 30,400	100%
Task 4: Develop Large-Scale Testing Methodology	\$ 7,600	100%
Task 5: Conduct Large-Scale Sediment Barrier Testing	\$ 106,399	65%
Task 6: Data Analysis	\$ 17,100	35%
Task 7: Final Report	\$ 10,600	0%

**Deliverables:** The proposed project is expected to improve regulatory compliance and further demonstrate NDOT's commitment to environmentally friendly construction practices. Ultimately, the scientifically attained data generated through this research effort will provide designers, contractors, and NDOT inspectors with a comprehensive performance review of NDOT's sediment barrier practices and effective implementable strategies to improve their performance. In addition, recommendations for updates to current erosion and sediment control design tools that will allow NDOT designers to incorporate effective and innovative erosion and sediment control technologies into their stormwater management plans. Enhanced practices will protect water quality downstream of construction activities, reduce regulatory compliance issues, improve overall public perception, and save Nebraska taxpayer dollars. Erosion and sediment control research performed at the AU-ESCTF has led to immediate implementation through updated standard drawings and specification updates by the Alabama DOT.

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

<b>CONTROL NUMBER</b>	01034H
<b>PROJECT NUMBER</b>	FY22(008)
<b>PROJECT TITLE</b>	Production of Cast-in-Place UHPC for Bridge Applications
<b>PRINCIPAL INVESTIGATOR</b>	Jiong Hu & George Morcous - UNL
<b>PROJECT START DATE</b>	7/1/2021
<b>PROJECT COMPLETION DATE</b>	5/31/2023
<b>TECHNICAL ADVISORY COMMITTEE</b>	Fouad Jaber, Ross Barron, Wally Heyen, Wayne Patras, Kyle Zillig, Lieska Halsey, Lynden Vanderveen, Dale Burkhead-Simon, and David Mraz-FHWA
<b>PROJECT TOTAL COSTS</b>	\$91,587
<b>PROJECT EXPENDITURES TO DATE</b>	\$67,433
<b>NUMBER OF EXTENSIONS GRANTED</b>	None
<b>PERCENTAGE OF PROJECT COMPLETE</b>	85%
<b>STATUS</b>	On Schedule
<b>FY-2024 BUDGET</b>	\$24,154
<b>FY-2024 TASKS TO BE COMPLETED</b>	Tasks 1, 4 & 5

**Background:** Ultra-high performance concrete (UHPC) is a new class of concrete that has mechanical and durability properties that far exceed those of conventional concrete. The use of UHPC will result in significant improvements in the structural capacity and durability of bridge components. Due to its superior characteristics, UHPC has drawn substantial interest in the bridge community at both federal and state levels. Besides the bridge deck connections applications in multiple states, Federal Highway Administration (FHWA) Every Day Counts (EDC-6) program “UHPC for Bridge Preservation and Repair” emphasizes the use of UHPC for bridge applications due to its excellent mechanical and durability properties. The research team has already developed a non-proprietary mix using local materials through a recent completed NDOT project (SPR-P1(18) M072) entitled “Feasibility Study of Development of Ultra-High Performance Concrete (UHPC) for Highway Bridge Applications in Nebraska” with a unit cost at approximately \$740/CY. While the development of non-proprietary UHPC mixes could greatly encourage the usage of UHPC, the lack of training and experience in batching and handling the material hinders its widespread use. FHWA and multiple state agencies have recently developed guidelines for the use of UHPC. However, most of these documents are focused on either the design of UHPC components or precast UHPC production. There is a lack of detailed guidelines on cast-in-place (CIP) UHPC production and handling, especially when non-proprietary mixes are used. Due to the large amount of fine powders and the very low water-to-cement ratio in UHPC, the proportioning and batching of UHPC is very different from conventional concrete. Also, while it is generally known that UHPC is very flowable, it is often challenging to achieve the desired workability while maintaining stability and too high flowability could lead to fiber segregation. On the other hand, the viscous nature of UHPC could lead to a lack of flow and consolidation. Another peculiarity of UHPC is the rapid workability loss due to the high content of high-range water-reducing (HRWR) admixture. The self-consolidation properties of UHPC cannot easily stand for an extended period of time, resulting in issues of concrete transportation and placement. A preliminary study from the investigators shows that guidelines need to be developed to better control the workability and stability of UHPC in both static and dynamic conditions.

**Objective:**

- 1) Provide technical training for producers, contractors, and NDOT engineers required for batching, mixing, transporting, placing, and testing cast-in-place UHPC with both non-proprietary and proprietary mixes (pre-bagged),
- 2) Develop guidelines for UHPC production and controlling, and maintaining the workability of UHPC production in on-site conditions, and
- 3) Develop special provisions for cast-in-place UHPC production and quality control.

**Tasks & Percent Completed:**

Tasks	Budget by Task	Percent Completed
Task 1: State-of-the-Practice of CIP UHPC Production	\$ 16,730	95%
Task 2: UHPC Production and Testing Guidelines Development	\$ 20,164	100%
Task 3: Training Material Development and Contractors Training	\$ 22,665	100%
Task 4: UHPC Field Production Demonstration	\$ 11,724	20%
Task 5: Special Provision, Report and Presentation	\$ 12,714	75%

**Deliverables:**

1. Address the challenges associated with UHPC production and on-site construction. The lack of experience and best practice guidelines often causes concerns for producers and contractors.
2. Provide the necessary knowledge and technical support for UHPC production and construction. The success of this project will greatly encourage producers and contractors to adopt this innovative material in cast-in-place bridge applications.

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



<b>CONTROL NUMBER</b>	01034J
<b>PROJECT NUMBER</b>	FY22(009)
<b>PROJECT TITLE</b>	Accelerated Bridge Construction (ABC) Decision Tool
<b>PRINCIPAL INVESTIGATOR</b>	Phil Barutha & Marc Maguire - UNL
<b>PROJECT START DATE</b>	7/1/2021
<b>PROJECT COMPLETION DATE</b>	5/31/2023
<b>TECHNICAL ADVISORY COMMITTEE</b>	Fouad Jaber, Ross Barron, Wayne Patras, Kyle Zillig, Mike Vigil, Kent Miller, Lynden Vanderveen, and David Mraz-FHWA
<b>PROJECT TOTAL COSTS</b>	\$90,592
<b>PROJECT EXPENDITURES TO DATE</b>	\$39,630
<b>NUMBER OF EXTENSIONS GRANTED</b>	None
<b>PERCENTAGE OF PROJECT COMPLETE</b>	70%
<b>STATUS</b>	Behind Schedule
<b>FY-2024 BUDGET</b>	\$50,962
<b>FY-2024 TASKS TO BE COMPLETED</b>	Tasks 3, 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 3: Obtain Feedback from Nebraska Contractors	\$ 8,186	50%
Task 4: Development of Decision Process and Tool	\$ 24,304	50%
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 & Goals:** Project is behind schedule.

<b>CONTROL NUMBER</b>	01034K
<b>PROJECT NUMBER</b>	FY22(010)
<b>PROJECT TITLE</b>	Application of Steel Sheet-Piles for the Abutment of Water-Crossing Bridges in Nebraska
<b>PRINCIPAL INVESTIGATOR</b>	Seunghye Kim, Jongwan Eun, Chung Song, and Chungwook Sim - UNL
<b>PROJECT START DATE</b>	7/1/2021
<b>PROJECT COMPLETION DATE</b>	5/31/2023
<b>TECHNICAL ADVISORY COMMITTEE</b>	Fouad Jaber, Ross Barron, Wayne Patras, Noah Pitts, Jake Blessen, Matt Eames, Jason Dayton, Kellie Troxel, Nikolas Glennie, Alex Silvey, Mark Mainelli-Mainelli Wagner and Associates, Jesse Sire-JEO, and David Mraz-FHWA
<b>PROJECT TOTAL COSTS</b>	\$155,304
<b>PROJECT EXPENDITURES TO DATE</b>	\$144,137
<b>NUMBER OF EXTENSIONS GRANTED</b>	None
<b>PERCENTAGE OF PROJECT COMPLETE</b>	90%
<b>STATUS</b>	On Schedule
<b>FY-2024 BUDGET</b>	\$11,167
<b>FY-2024 TASKS TO BE COMPLETED</b>	Tasks 3, 4, & 5

**Background:** Sheet piles are recommended to be installed for most water-crossing bridges, along with load-bearing piles, to avoid the scouring problem and protect backfill soils in Nebraska. A specific design procedure related to the axially loaded sheet piling does not exist in most parts of the US. Accordingly, the research team perceived a lack of data and experience in the design and analysis of vertical and lateral load resistance of the axially loaded sheet piling. For example, there is insufficient confidence in the estimate of bending and lateral stresses induced by the axial loading and lateral soil pressure, respectively. There is also uncertainty on how lateral load could be transferred from the superstructure to the sheet pile during a seasonal temperature variation. In terms of the side frictional resistance, it is unknown how the skin frictional resistance of the sheet pile could be mobilized in the different passive and active zones. Moreover, the side frictional resistance could be noticeably different between the dry and submerged soil conditions. For the end bearing resistance, the soil plugging effect may improve the end bearing capacity. Those uncertainties may result in a too conservative design, and thus, an unnecessary increase in the construction cost.

In addition to those general challenges, there are additional research needs perceived by engineers in Nebraska. First, the load transfer from the superstructure to the substructure could be substantially different depending on the connection design that is a unique design of Nebraska DOT compared to other states. The main difference with other states is that Nebraska is no longer using back walls behind the deck for semi-integral abutment bridges. If there is a back wall element, there will be a joint created at the end of the deck before the approach span starts. Nebraska moved from this design and has details which combines the deck, girder, and approach span and creates the joint far away from the end of the deck at the approach span. Due to the difference in details at the end of the deck, the total horizontal force created by temperature loading from the superstructure, which should interact with the lateral soil loads that will create a moment, will differ from other cases. Second, the tie-rod anchor may be avoided depending on the soil condition and bridge design. With that, the reduction or elimination of the anchor will bring the cost and time saving for the construction. Lastly, there is a research need that investigates the feasible length of the superstructure that is compatible with the concept of the axially loaded sheet pile abutment system of a short-span bridge for general geologic conditions and construction practices in Nebraska.

**Objective:** The overall goal of this study is to investigate the anticipated performance of steel sheet-pile bridge abutment to encourage its wider applications to not only new construction but also repair/replacement of existing water-crossing bridges in Nebraska. To achieve this goal, we set several objectives as follows:

- Suggest an improved analysis method that incorporates the combined effect of axial and lateral loads that are imposed on the sheet pile walls and considers the following aspects:
  - Skin frictional resistance in active/passive zones for either dry or submerged soil conditions, Soil plugging effects, Different cross-sections of the sheet piles, Design configurations (cantilever vs. anchored walls), Effect of seasonal temperature variations.
- Elucidate the moment generated by the forces between the horizontal movement of the superstructure of semi-integrals in Nebraska vs. loads caused by the soil behind (e.g., active/passive pressures, the friction of backfill on superstructure end or the shearing resistance of backfill, which could play a role if the bridge has skew and lateral bearings are not provided).
- Assess the feasibility of avoiding the tie-rod anchoring for various design parameters.
- Suggest a range of superstructure length and skew angle that can be supported by the axially loaded sheet pile abutment system.
- Provide the research summary and design recommendations that can be used by engineers and contractors for the water-crossing bridges in Nebraska.

**Tasks & Percent Completed:**

Tasks	Budget by Task	Percent Completed
Task 1: Review on the Sheet Pile Bridge Abutment Systems	\$ 14,460	100%
Task 2: Experimental Studies to Obtain Design Parameters	\$ 81,354	100%
Task 3: Numerical Studies to Investigate the Performance of Sheet Pile Bridge Abutment Systems	\$ 44,677	85%
Task 4: Summary and Design Recommendations	\$ 7,846	20%
Task 5: Final Report	\$ 6,967	0%

**Deliverables:** Experimental and numerical modeling data and improved analysis for the axially loaded sheet pile abutment systems, including the anchored design, will be provided; A better understanding of the earth pressure development, the mobilization of skin friction resistance, end-bearing capacity, and load transfer will be provided; Design recommendations to improve the performance of sheet pile abutment systems will be provided; and Based on those outcomes, the research findings can help reduce the construction time and cost for both new and repair/replacement of water-crossing bridges in Nebraska.

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

<b>CONTROL NUMBER</b>	01034L
<b>PROJECT NUMBER</b>	FY22(011)
<b>PROJECT TITLE</b>	Truck Platooning Effects on Girder Bridges, Phase II
<b>PRINCIPAL INVESTIGATOR</b>	Joshua Steelman, Jay Puckett, and Daniel Linzell - UNL
<b>PROJECT START DATE</b>	7/1/2021
<b>PROJECT COMPLETION DATE</b>	5/31/2023
<b>TECHNICAL ADVISORY COMMITTEE</b>	Fouad Jaber, Ross Barron, Kyle Zillig, Kpandji Lakmon, Emilie Hudon-Olsson and David Mraz-FHWA
<b>PROJECT TOTAL COSTS</b>	\$120,843
<b>PROJECT EXPENDITURES TO DATE</b>	\$72,039
<b>NUMBER OF EXTENSIONS GRANTED</b>	None
<b>PERCENTAGE OF PROJECT COMPLETE</b>	75%
<b>STATUS</b>	On Schedule
<b>FY-2024 BUDGET</b>	\$48,804
<b>FY-2024 TASKS TO BE COMPLETED</b>	Tasks 3, 4, 5 & 6

**Background:** Connected and Automated Driving System (C/ADS)-equipped vehicles are expected to become increasingly common in the United States and elsewhere globally. Truck platooning with CV technologies places trucks much closer than current design codes anticipate. Truck platooning is expected to be deployed imminently, according to the anticipated timeline provided in Trimble. The density of truck traffic and the implications for structural safety and serviceability should be considered as part of a platooning policy to avoid compromising bridge service lives. Platoons of heavy trucks will be economically advantageous for freight operators in the near future, but information currently available is insufficient for bridge owners to establish platoon operation limitations and guidelines ensuring safe and serviceable loading demands in girder bridge structures in terms of vehicle weights, live load uncertainties, and headways.

**Objective:**

1. Calibrate appropriate live load factors for use with platoons to address the Service III limit state for concrete girder bridges.
2. Calibrate appropriate live load factors for use with platoons to address the Service II limit state for steel girder bridges.
3. Propose a framework for characterization of uncertainty from individual contributions within live load effects.
4. Facilitate adoption of platoon permitting with illustrative examples.
5. Approximately assess the significance of platoon-induced fatigue with respect to service life.

**Tasks & Percent Completed:**

Tasks	Budget by Task	Percent Completed
Task 1: Service III Evaluation for Prestressed Concrete Girders	\$ 26,703	100%
Task 2: Service II Evaluation for Composite Steel Girders	\$ 27,362	100%
Task 3: Operationalize Uncertainty Calibration	\$ 8,711	50%
Task 4: Illustrative Examples	\$ 18,983	10%
Task 5: Fatigue Platoon vs Design Comparison	\$ 6,894	30%
Task 6: Correspondence and Documentation	\$ 32,190	35%

**Deliverables:** This research will enable NDOT to strategically and responsibly incentivize platoon operations along the I-80 corridor by optimizing freight transport efficiency. Additional truck traffic will provide economic benefits from direct sale of vehicle fuel, as well as secondary economic benefits to mechanics and technicians who provide vehicle maintenance and smart vehicle control services. Providing a smart corridor for platoons also positions Nebraska for future benefits if a transportation tax is imposed on a vehicle-miles-traveled basis rather than a direct fuel tax. The results of this research will enable platooning operations to increase vehicle weights without compromising service lives of bridges from overloads and repeated cycles of inelastic behavior. This research will build upon a framework developed in the first phase of the research and thereby capitalize on investments previously allocated by NDOT.

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

<b>CONTROL NUMBER</b>	01034M
<b>PROJECT NUMBER</b>	FY22(012)
<b>PROJECT TITLE</b>	Inventory, Operations, and Safety at Free Right-Turn Ramps
<b>PRINCIPAL INVESTIGATOR</b>	Aemal Khattak - UNL
<b>PROJECT START DATE</b>	7/1/2021
<b>PROJECT COMPLETION DATE</b>	5/31/2023
<b>TECHNICAL ADVISORY COMMITTEE</b>	Alan Swanson, Scott Milliken, Kris Fornoff, Kyle Christensen, and Abe Anshasi-FHWA
<b>PROJECT TOTAL COSTS</b>	\$182,563
<b>PROJECT EXPENDITURES TO DATE</b>	\$146,789
<b>NUMBER OF EXTENSIONS GRANTED</b>	None
<b>PERCENTAGE OF PROJECT COMPLETE</b>	79%
<b>STATUS</b>	On Schedule
<b>FY-2024 BUDGET</b>	\$35,464
<b>FY-2024 TASKS TO BE COMPLETED</b>	Tasks 5 & 6

**Background:** Research on right turns at rural intersections on the state highway system was initiated by the Nebraska Department of Transportation (NDOT) during the 1990's (McCoy et al., 1995) and again during the 2016-2018 period (Khattak and Kang, 2018). In the former study, the authors developed guidelines for the establishment of FRT ramps on rural two-lane highways in Nebraska based on a benefit-cost analysis. They recommended that design-year right-turn AADTs ranging from 440 to 825 vehicles per day (depending on truck percentage) warranted a FRT ramp at unsignalized intersections on rural two-lane highways. Acceleration lanes improved vehicle merge operations and while right-turning traffic moved efficiently, there were no discernable safety improvements from FRT ramps.

In the latter study, the authors looked at safety and economic benefits of rural intersections with offset right-turn lanes (ORTL) compared to rural intersections with no right-turn lanes and those with traditional right-turn lanes. They also investigated drivers' stopping behavior on the minor approaches at ORTLs. Results showed ORTLs had the lowest crash rates; however, the difference was statistically not significant. The cost-benefit analysis indicated that compared to intersections with no right-turn lanes, ORTL intersections had an annual reduction of 0.202 crashes per million entering vehicles, which translated to \$22,662 savings in crash costs per year. When compared with intersections having no right-turn lanes, a traditional right-turn lane reduced 0.0758 crashes per million entering vehicles annually or \$8,504 savings in crash costs per year. Driver stopping behavior assessment showed that number of through lanes, width of right-turn lane and width of the ORTL offset were statistically associated with driver's stopping position on the minor approach and overall drivers were taking advantage of the ORTLs improved sight distance. In this study, free right-turn (FRT) ramps were excluded due to their uniqueness (compared to traditional right-turn lanes and ORTLs) for a later study.

NDOT has several FRT ramps across the state highway system. The intersection minor approaches stop-controlled and varying driver warning devices may be in place at these locations. There are concerns about the safety and operations of FRT ramps and therefore, there is a need to review the operations and safety of these locations.

**Objective:**

- Create a statewide inventory of rural free right turn ramp intersections and provide to NDOT in an appropriate format.
- Using NDOT 10-year crash data, conduct statistical safety analyses of rural FRT intersections extending ¼-mile in each direction from the intersection.
- Study vehicular operations at rural intersections with and without FRT ramps. This will include a comparison of recorded vehicular speeds and conflict analysis.
- Develop guidelines for operations and safety tradeoffs to assist with NDOT projects on maintaining similar locations, removing or reconstructing ramps and traffic warning/control signage.

**Tasks & Percent Completed:**

Tasks	Budget by Task	Percent Completed
Task 1: TAC Meeting and Review of Literature	\$ 27,493	100%
Task 2: Inventory of Rural FRT Ramp Intersections	\$ 21,456	100%
Task 3: Safety Analysis of Rural FRT Ramp Intersections	\$ 32,654	100%
Task 4: Study of Vehicle Interactions and Comparison	\$ 42,421	100%
Task 5: Operations and Safety Tradeoffs Analysis	\$ 19,090	50%
Task 6: Final Report and TAC Presentation	\$ 39,450	25%

**Deliverables:** The research will assist NDOT Traffic Engineering, District staff, and Roadway Design Divisions with making more informed decisions when dealing with rural intersections with free right turn ramps. The research will also lead to improved public safety on Nebraska highways.

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

# NEW PROJECTS FY 2024

<b>CONTROL NUMBER</b>	01057A
<b>PROJECT NUMBER</b>	FY24 (026)
<b>PROJECT TITLE</b>	Evaluation of Critical Shear Strength of Soils in Nebraska Based on Revised CPT
<b>PRINCIPAL INVESTIGATOR</b>	Chung R. Song - UNL
<b>PROJECT START DATE</b>	07/01/2023
<b>PROJECT COMPLETION DATE</b>	05/31/2025
<b>TECHNICAL ADVISORY COMMITTEE</b>	To be Determine
<b>PROJECT TOTAL COSTS</b>	\$158,705
<b>PROJECT EXPENDITURES TO DATE</b>	\$0
<b>NUMBER OF EXTENSIONS GRANTED</b>	None
<b>PERCENTAGE OF PROJECT COMPLETE</b>	0%
<b>STATUS</b>	New Project
<b>FY-2024 BUDGET</b>	\$ 97,647
<b>FY-2024 TASKS TO BE COMPLETED</b>	Tasks 1, 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. Additionally, the CPT platform of UNL and NDOT are the same, therefore, technology transfer for findings in this research will be unquestionably smooth.

**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	0%
Task 2: Development/Modification of CPT	\$ 40,206	0%
Task 3: Verification of the Method	\$ 49,739	0%
Task 4: Recommendation for Field Application	\$ 31,566	0%
Task 5: Report Findings	\$ 20,066	0%

**Deliverables:** This research is intended to solve a fundamental technical challenge in evaluating the critical strength of soils in Nebraska through the utilization of a newly 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 need much less maintenance work.

**Performance & Goals:** Project will start July 1, 2023

<b>CONTROL NUMBER</b>	01057B
<b>PROJECT NUMBER</b>	FY24 (027)
<b>PROJECT TITLE</b>	The Use of Recycled Plastic in Asphalt Pavements: Feasibility Study
<b>PRINCIPAL INVESTIGATOR</b>	Jamilla Teixeira - UNL
<b>PROJECT START DATE</b>	7/1/2023
<b>PROJECT COMPLETION DATE</b>	5/31/2025
<b>TECHNICAL ADVISORY COMMITTEE</b>	To be Determined
<b>PROJECT TOTAL COSTS</b>	\$148,494
<b>PROJECT EXPENDITURES TO DATE</b>	\$0
<b>NUMBER OF EXTENSIONS GRANTED</b>	None
<b>PERCENTAGE OF PROJECT COMPLETE</b>	0%
<b>STATUS</b>	New Project
<b>FY-2024 BUDGET</b>	\$ 71,325
<b>FY-2024 TASKS TO BE COMPLETED</b>	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 physical and 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 waste 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	0%
Task 2: Experimental Plan and Sample Collection	\$ 14,671	0%
Task 3: Laboratory Tests	\$ 48,781	0%
Task 4: Analysis of Test Results	\$ 48,432	0%
Task 5: Documentation and Presentation	\$ 21,761	0%

**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 & Goals:** Project will start July 1, 2023

<b>CONTROL NUMBER</b>	01057C
<b>PROJECT NUMBER</b>	FY24 (028)
<b>PROJECT TITLE</b>	Local Characterization of Unbound Materials (Soils/Aggregates) for AASHTOWare Pavement ME Design in Nebraska
<b>PRINCIPAL INVESTIGATOR</b>	Jongwan Eun- UNL
<b>PROJECT START DATE</b>	7/1/2023
<b>PROJECT COMPLETION DATE</b>	5/31/2025
<b>TECHNICAL ADVISORY COMMITTEE</b>	To be Determine
<b>PROJECT TOTAL COSTS</b>	\$ 159,036
<b>PROJECT EXPENDITURES TO DATE</b>	\$0
<b>NUMBER OF EXTENSIONS GRANTED</b>	None
<b>PERCENTAGE OF PROJECT COMPLETE</b>	0%
<b>STATUS</b>	New Project
<b>FY-2024 BUDGET</b>	\$63,341
<b>FY-2024 TASKS TO BE COMPLETED</b>	Tasks 1, 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	0%
Task 2: Material Sampling	\$21,214	0%
Task 3: Experimental Program	\$70,193	0%
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 & Goals:** Project will start July 1, 2023



<b>CONTROL NUMBER</b>	01057D
<b>PROJECT NUMBER</b>	FY24 (029)
<b>PROJECT TITLE</b>	Assessment of Winter Maintenance Performance Objectives Using Maintenance Decision Support System
<b>PRINCIPAL INVESTIGATOR</b>	Mark Anderson- UNL
<b>PROJECT START DATE</b>	7/1/2023
<b>PROJECT COMPLETION DATE</b>	5/31/2025
<b>TECHNICAL ADVISORY COMMITTEE</b>	To be Determined
<b>PROJECT TOTAL COSTS</b>	\$ 253,736
<b>PROJECT EXPENDITURES TO DATE</b>	\$0
<b>NUMBER OF EXTENSIONS GRANTED</b>	None
<b>PERCENTAGE OF PROJECT COMPLETE</b>	0%
<b>STATUS</b>	New Project
<b>FY-2024 BUDGET</b>	\$ 138,186
<b>FY-2024 TASKS TO BE COMPLETED</b>	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:**

<b>Tasks</b>	<b>Budget by Task</b>	<b>Percent Completed</b>
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 & Goals:** Project will start July 1, 2023.

<b>CONTROL NUMBER</b>	01057E
<b>PROJECT NUMBER</b>	FY24 (030)
<b>PROJECT TITLE</b>	Development and Evaluation of Crashworthy Approach Guardrail Transition with Increased Span Length between Concrete Bridge Rail and First Transition Post: Phase I
<b>PRINCIPAL INVESTIGATOR</b>	Tewodros Yosef- UNL
<b>PROJECT START DATE</b>	7/1/2023
<b>PROJECT COMPLETION DATE</b>	5/31/2025
<b>TECHNICAL ADVISORY COMMITTEE</b>	To be Determined
<b>PROJECT TOTAL COSTS</b>	\$175,145
<b>PROJECT EXPENDITURES TO DATE</b>	\$0
<b>NUMBER OF EXTENSIONS GRANTED</b>	None
<b>PERCENTAGE OF PROJECT COMPLETE</b>	0%
<b>STATUS</b>	New Project
<b>FY-2024 BUDGET</b>	\$ 87,815
<b>FY-2024 TASKS TO BE COMPLETED</b>	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	0%
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 & Goals:** Project will start July 1, 2023.

<b>CONTROL NUMBER</b>	01057F
<b>PROJECT NUMBER</b>	FY24 (031)
<b>PROJECT TITLE</b>	Sediment Collection and Analysis of Sediment Contributing to State Storm Sewer Facilities
<b>PRINCIPAL INVESTIGATOR</b>	Bruce Devorak- UNL
<b>PROJECT START DATE</b>	7/1/2023
<b>PROJECT COMPLETION DATE</b>	5/31/2025
<b>TECHNICAL ADVISORY COMMITTEE</b>	To be Determined
<b>PROJECT TOTAL COSTS</b>	\$181,428
<b>PROJECT EXPENDITURES TO DATE</b>	\$0
<b>NUMBER OF EXTENSIONS GRANTED</b>	None
<b>PERCENTAGE OF PROJECT COMPLETE</b>	0%
<b>STATUS</b>	New Project
<b>FY-2024 BUDGET</b>	\$ 126,970
<b>FY-2024 TASKS TO BE COMPLETED</b>	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:**

<b>Tasks</b>	<b>Budget by Task</b>	<b>Percent Completed</b>
Task 1: Literature Review	\$ 13,385	0%
Task 2: Sampling Site Preparation	\$ 69,147	0%
Task 3: TAC 1 meeting – November 2023	-	-
Task 4: Data Collection and Processing	\$ 47,508	0%
Task 5: TAC 2 meeting – May 2024	-	-
Task 6: Develop Model / Guidelines	\$ 36,419	0%
Task 7: TAC 3 meeting – November 2024	-	-
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 & Goals:** Project will start July 1, 2023.

<b>CONTROL NUMBER</b>	01057G
<b>PROJECT NUMBER</b>	FY24 (032)
<b>PROJECT TITLE</b>	Update of Intersection/Interchange Guidelines for Rural Expressways in Nebraska
<b>PRINCIPAL INVESTIGATOR</b>	Aemal Khattak - UNL
<b>PROJECT START DATE</b>	7/1/2023
<b>PROJECT COMPLETION DATE</b>	5/31/2025
<b>TECHNICAL ADVISORY COMMITTEE</b>	To be Determined
<b>PROJECT TOTAL COSTS</b>	\$179,316
<b>PROJECT EXPENDITURES TO DATE</b>	\$0
<b>NUMBER OF EXTENSIONS GRANTED</b>	None
<b>PERCENTAGE OF PROJECT COMPLETE</b>	0%
<b>STATUS</b>	New Project
<b>FY-2024 BUDGET</b>	\$ 95,711
<b>FY-2024 TASKS TO BE COMPLETED</b>	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	0%
Task 2: Data Collection	\$ 36,068	0%
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 & Goals:** Project will start July 1, 2023.

<b>CONTROL NUMBER</b>	01057H
<b>PROJECT NUMBER</b>	FY24 (033)
<b>PROJECT TITLE</b>	Drainage Area Limitations for NDOT Hydrologic Computations
<b>PRINCIPAL INVESTIGATOR</b>	Rollin H. Hotchkiss - Brigham Young University (BYU)
<b>PROJECT START DATE</b>	7/1/2023
<b>PROJECT COMPLETION DATE</b>	5/31/2025
<b>TECHNICAL ADVISORY COMMITTEE</b>	To be Determined
<b>PROJECT TOTAL COSTS</b>	\$114,528
<b>PROJECT EXPENDITURES TO DATE</b>	\$0
<b>NUMBR OF EXTENSIONS GRANTED</b>	None
<b>PERCENTAGE OF PROJECT COMPLETE</b>	0%
<b>STATUS</b>	New Project
<b>FY-2024 BUDGET</b>	\$56,420
<b>FY-2024 TASKS TO BE COMPLETED</b>	Tasks 1, 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:**

<b>Tasks</b>	<b>Budget by Task</b>	<b>Percent Completed</b>
Task 1: Continue the literature review of both traditional and next gen methods for calculating peak discharge	\$ 8,000	0%
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	0%
Task 3: Perform standard flow frequency analyses for all streamflow records	\$ 10,000	0%
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	0%
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

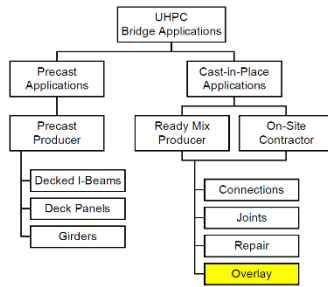
**Performance & Goals:** Project will start July 1, 2023.

<b>CONTROL NUMBER</b>	01057J
<b>PROJECT NUMBER</b>	FY24 (034)
<b>PROJECT TITLE</b>	Ultra-High-Performance Concrete (UHPC) for Bridge Deck Overlay and Structural Deck Repair
<b>PRINCIPAL INVESTIGATOR</b>	Jiong Hu - UNL
<b>PROJECT START DATE</b>	7/1/2023
<b>PROJECT COMPLETION DATE</b>	5/31/2025
<b>TECHNICAL ADVISORY COMMITTEE</b>	To be Determined
<b>PROJECT TOTAL COSTS</b>	\$ 152,761
<b>PROJECT EXPENDITURES TO DATE</b>	\$0
<b>NUMBER OF EXTENSIONS GRANTED</b>	None
<b>PERCENTAGE OF PROJECT COMPLETE</b>	0%
<b>STATUS</b>	New Project
<b>FY-2024 BUDGET</b>	\$ 73,895
<b>FY-2024 TASKS TO BE COMPLETED</b>	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	0%
Task 2: Mixture Development	\$ 28,899	0%
Task 3: Performance Evaluation	\$ 68,843	0%
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 & Goals:** Project will start July 1, 2023.

<b>CONTROL NUMBER</b>	01057K
<b>PROJECT NUMBER</b>	FY24 (035)
<b>PROJECT TITLE</b>	Framework for Quantifying Benefits to Disadvantaged Communities: Application to Nebraska's National Electric Vehicle Infrastructure (NEVI) Plan
<b>PRINCIPAL INVESTIGATOR</b>	Li Zhao - UNL
<b>PROJECT START DATE</b>	7/1/2023
<b>PROJECT COMPLETION DATE</b>	5/31/2025
<b>TECHNICAL ADVISORY COMMITTEE</b>	To be Determined
<b>PROJECT TOTAL COSTS</b>	\$ 179,055
<b>PROJECT EXPENDITURES TO DATE</b>	\$0
<b>NUMBER OF EXTENSIONS GRANTED</b>	None
<b>PERCENTAGE OF PROJECT COMPLETE</b>	0%
<b>STATUS</b>	New Project
<b>FY-2024 BUDGET</b>	\$ 102,969
<b>FY-2024 TASKS TO BE COMPLETED</b>	Tasks 1, 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	0%
Task 2: Community Engagement Survey	\$29,431	0%
Task 3: Data Collection and Synthesis	\$33,276	0%
Task 4: Metric Determination and Calculation	\$29,653	0%
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 & Goals:** Project will start July 1, 2023.

<b>CONTROL NUMBER</b>	01057L
<b>PROJECT NUMBER</b>	FY24 (036)
<b>PROJECT TITLE</b>	Assessment of Truck Parking Demand and Safety During Normal and Severe Weather Conditions in Nebraska
<b>PRINCIPAL INVESTIGATOR</b>	Nathan Huynh - UNL
<b>PROJECT START DATE</b>	7/1/2023
<b>PROJECT COMPLETION DATE</b>	5/31/2025
<b>TECHNICAL ADVISORY COMMITTEE</b>	To be Determined
<b>PROJECT TOTAL COSTS</b>	\$ 188,885
<b>PROJECT EXPENDITURES TO DATE</b>	\$0
<b>NUMBER OF EXTENSIONS GRANTED</b>	None
<b>PERCENTAGE OF PROJECT COMPLETE</b>	0%
<b>STATUS</b>	New Project
<b>FY-2024 BUDGET</b>	\$ 112,634
<b>FY-2024 TASKS TO BE COMPLETED</b>	Tasks 1, 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	0%
Task 2: Obtain and Process Truck GPS Data and Crash Data	\$66,214	0%
Task 3: Determine Truck Parking Supply and Demand	\$27,994	0%
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 & Goals:** Project will start July 1, 2023.



<b>CONTROL NUMBER</b>	01057M
<b>PROJECT NUMBER</b>	FY24 (037)
<b>PROJECT TITLE</b>	Guidance for Left-Turn Flashing Yellow Arrow (FYA) Implementation in Nebraska
<b>PRINCIPAL INVESTIGATOR</b>	Aemal Khattak - UNL
<b>PROJECT START DATE</b>	7/1/2023
<b>PROJECT COMPLETION DATE</b>	5/31/2025
<b>TECHNICAL ADVISORY COMMITTEE</b>	To be Determined
<b>PROJECT TOTAL COSTS</b>	\$ 177,066
<b>PROJECT EXPENDITURES TO DATE</b>	\$0
<b>NUMBER OF EXTENSIONS GRANTED</b>	None
<b>PERCENTAGE OF PROJECT COMPLETE</b>	0%
<b>STATUS</b>	New Project
<b>FY-2024 BUDGET</b>	\$ 85,806
<b>FY-2024 TASKS TO BE COMPLETED</b>	Tasks 1, 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	0%
Task 2: Crash Data Analysis	\$ 33,167	0%
Task 3: Data Collection and Field Study	\$ 26,844	0%
Task 4: Cross-sectional analysis with/without FYA supplemental signs	\$ 27,042	0%
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:** The insights gained from this research will improve the safety and efficiency of operations at signalized intersections in Nebraska. There are three main benefits from this project.

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.

In summary, the results of this project may be used by Nebraska transportation agencies to make informed decisions on future installations of the FYA indication and improve existing FYA signalized intersections that may be experiencing higher than expected crashes.

**Performance & Goals:** Project will start July 1, 2023.

# COMPLETED PROJECTS

<b>Project Number</b>	<b>Federally Funded Projects Completed and Published</b>	<b>Focus Area</b>	<b>Completed</b>
FY21(001)	<b>An Investigation of Water Obstructions and Related Weather Conditions for Nebraska Roadways</b> <a href="#">Research Report</a> <a href="#">NDOT Recommendations Based of Completed Research</a>	Operations/ Hydraulics	2022
FY21(008)	<b>Estimating System and Traveler Costs Due to Lane Closures During Construction and Maintenance Operations</b> <a href="#">Research Report</a> <a href="#">NDOT Recommendations Based of Completed Research</a>	Traffic	2022
FY21(007)	<b>Intelligent Work Zone Using Automatic Queue Detection Systems</b> <a href="#">Research Report</a> <a href="#">NDOT Recommendations Based of Completed Research</a>	Traffic	2022
M102	<b>Phased Construction Bridges: Monitoring and Analysis for Traffic-Induced Vibration</b> <a href="#">Research Report</a> <a href="#">NDOT Recommendations Based of Completed Research</a>	Structures	2022
M104	<b>Data-Driven Prioritization and Empirical Predictions for Bridge Scour in Nebraska</b> <a href="#">Research Report</a> NDOT Recommendations Based of Completed Research- Pending	Structures	2022
M107	<b>Outdoor Laboratory and Testbed for Bridge Health</b> <a href="#">Research Report</a> NDOT Recommendations Based of Completed Research- Pending	Structures	2022
<b>Projects moved to Field Development (RRL4)</b>			
	<a href="#">Settlement and Bumps at Bridge Approach</a>	Geotechnical	2022
	<a href="#">Cast-in-Place and Precast Concrete Approach Slabs</a>	Structures	2022
	<b>Development of High-Performance Rapid Patching Materials for Pavement Repair – Recommendations Pending</b>	Materials	2022
<b>Projects moved from Implementation Follow Up (RRL4) to Standard Practice (RRL5)</b>			
	<a href="#">Completed Follow Up Implementation</a> <b>Cone Penetration Test (CPT) Based Pile Design</b> <a href="#">NDOT Evaluation Based of Completed Research</a>	Geotechnical	2022
	<a href="#">Completed Follow Up Implementation</a> <b>Nebraska Specific Slope Design Manual</b> <a href="#">NDOT Implementation Based of Completed Research</a>	Geotechnical	2022
	<a href="#">Completed Follow Up Implementation</a> <b>Nebraska Rail Crossing Safety Research</b> <a href="#">NDOT Implementation Based of Completed Research</a>	Transit	2022