NEW HAMPSHIRE
DEPARTMENT OF TRANSPORTATION
BUREAU OF MATERIALS AND RESEARCH
5 HAZEN DRIVE, PO BOX 483, CONCORD NH 03302
Telephone: 603-271-3151
Fax #: 603-271-8700
E-Mail: bureau42@dot.state.nh.us

Letter of Transmittal

To:	Date: April 18, 2017
Mr. John Butler	Highway Design

We are sending you the following:

☒ Attached ☐ Under separate cover via _____ the following items:
☐ Copy of Letter ☐ Plans ☐ Specifications ☐ Other _____

Copies	Date	Number	Description
1	4/18/17	16236	US 4 over Bunker Creek (Br. 145/116)

These are transmitted as checked below:

☐ For approval ☐ Approved as submitted ☐ Returned for corrections
☒ For your use ☐ Approved as noted ☐ Return corrected plans
☒ As requested ☐ For review and comment ☐ Resubmit copies for approval___ ea.
☐ For info only ☐ Return after use ☐ Submit copies for distribution___ ea.

Remarks:

Copy to:	Signed:
Mike Dugas – Highway Design Keith Cota – Highway Design Joe Adams – Bridge Design	E. S. Eric S. Thibodeau, P.E.
Nickie Hunter – Construction Bureau	Title: Pavement Management Chief
Brian Schutt – District 6	

S:\Pavement Management\Projects\Lee\Lee-Durham 14461\Pavement Report\Transmittal1.DOC

STATE OF NEW HAMPSHIRE
INTER-DEPARTMENT COMMUNICATION

FROM: Kevin Prince
Pavement Design Engineer

DATE: April 18, 2017
AT (OFFICE): Bureau of Materials and Research

SUBJECT: Pavement Recommendation
Bridge Rehabilitation
US 4 over Bunker Creek (Bridge No. 145/116)
Durham 16236

TO: Michael Dugas
Chief of Preliminary Design

ATTENTION: John Butler
Preliminary Design Supervisor

This memo summarizes our pavement evaluation and recommendations for the subject project. Information used in the preparation of this report included the following:

- Plans of Proposed Federal Aid Project US 4, NH Project NRS 249, dated 1933;
- Plans of Proposed Federal Aid Project US 4, NH Project No 12959, dated 2000;
- Plans of Proposed betterment Project US 4, NH Project No 1832J, dated 1974;
- Plans of Proposed betterment Project US 4, NH Project No 15944, dated 2011;
- Pavement recommendation request memo from Bridge Design dated February 28, 2017
- Preliminary Plans supplied by Highway Design, dated November 16, 2016;
- Preliminary Profile Plans supplied by Highway Design, dated October 25, 2016;
- Preliminary cross sections supplied by Highway Design, dated January 5, 2016;
- Traffic Data sheet provided by the Bureau of Traffic dated May 15, 2013;
- List of previous projects within the project area;
- Location map showing project area; and
- Pavement Data Collection vehicle data collected on May 25, 2016.

Engineering units used herein refer to the English system, unless otherwise noted, with stations and elevations in feet. For the purpose of this report, US 4 is assumed to have a west to east bearing in the up station direction. Pavement design analyses were performed using the method outlined in the NHDOT Highway Design Manual dated March 1999, which is based upon the AASHO 1972 Interim Design Guide.

Asphalt coring work was not performed and Pavement Management staff did not perform a field visit in support of this project.

Project Description

This project is located on US 4 and replaces Bridge No. 145/116 over Bunker Creek. The project begins approximately 750 feet west of Bunker Creek and proceeds 1,600 feet to approximately 850 feet east of Bunker Creek. The bridge work will replace the existing bridge and the profile will be raised as much as 4 feet in areas and lowered by 1.5 feet in other areas. Based on the provided plans, it appears that a 12-5 typical section is being proposed. Preliminary design shows full box reconstruction with 5½-inches (2½" base, 2" binder, 1" wearing) of pavement with a 2¼-inch future overlay.

The 2017 AADT is 17,000 vehicles with a projected 2037 AADT of 21,000 vehicles and an Average Daily Load (ADL) of 350 with 5.6% trucks. This project is currently

scheduled to advertise on January 8, 2019. It is understood that this project will be design-build.

Background Information

Based on our records, the following construction and maintenance background information for this section of US 4 is offered:

- The NRS 249 project (1933) constructed US 4 throughout the length of this project. The roadway typical was two 12-foot lanes, with 0-foot shoulders. Mainline construction included 18 inches of gravel base and 4 inches of gravel surface.
- The Durham P-7779 (1967 betterment project) flattened the curve to the west of the bridge. No typical was provided.
- The Durham 13171 (2000) resurfaced US 4 throughout the length of this project as part of the Federal Resurfacing Program. Work included placing a 3.5 inch overlay consisting of 2 inches of binder and 1.5 inches of wearing course.

Outside limits (westerly) of Bunker Creek project:

- The Durham 12959 (2000) replaced the Bridge No. 133/120 over Johnson Creek and placed 10-foot shoulders on US 4. The western limit of work extended to Shearwater Street (approximately 1,200-feet west of the 16236 project). The roadway typical was two 12-foot lanes, with 10-foot shoulders. Mainline construction for the western limit (603+55 to 609+40) of work included 12 inches of sand, 12 inches of gravel, 12 inches of crushed gravel with 5½ inches of pavement (2½" base, 2" binder, and 1" wearing courses). Mainline construction for the eastern limit (609+40 to 612+65) of work was step box widening to create 10 foot shoulders with 12 inches of sand, 12 inches of gravel, 12 inches of crushed gravel. Mainline line included 5½ inches of pavement (2½" base, 2" binder, and 1" wearing courses) and the shoulders received 3 inches of pavement (2" binder, and 1" wearing courses).

Outside limits (easterly) of Bunker Creek project:

- The Durham 1832J (10968) (1974 betterment project) constructed an eastbound bypass shoulder and a westbound right turn lane at Morgan Way. No typical was provided.
- The Durham 15944 (2011) constructed a left turn lane into Morgan Way. The project limits were 700 feet west of Morgan Way to 400 feet east of Morgan Way. Mainline construction included a step box widening to the north consisting of 12 inches of gravel, 12 inches of crushed gravel with 6½-inches of pavement (2½" base. 2½" binder, and 1½" wearing courses). Mainline received a 1½-inch overlay.

This section of US 4 is currently scheduled to be resurfaced in 2019 (Paving ID 19601). The work will start at a pavement joint located near the Durham wastewater treatment plant and proceed east 2.2 miles thru the limits of this project to a pavement joint located at Mile Marker (101.0) which is just west of Back River Road. A project number for this work has not been established but the project will be Federally funded. The two projects will need to be coordinated.

It should also be noted that a section of US 4 from the Lee Traffic Circle east 8.7 miles to a pavement joint located near the Durham wastewater treatment plant is scheduled to be crack sealed in 2018 (Paving ID 18629).

Existing Conditions

Overall, the pavement is in poor condition. There are areas of wheel path rutting and cracking, longitudinal joint failure, delamination's and minor block cracking. District forces have performed some spot inlay repairs along some of the longitudinal joints. There appears to be a drainage problem outside the proposed project limits, just west of the intersection of Shearwater Street and Riverview Road.

Pavement Recommendations

General

The recommended asphalt binder grade for this project is PG 64-28. Due to the nature of the work, QC/QA Tier 2 (Item 403.11002) should be specified for all pavement work. Item 403.6 Pavement Joint Adhesive should be included for the longitudinal joints associated with all pavement layers for this project. Item 403.61 may also be included for sealing at the bridge base/curb interface. Due to the small quantity, a Material Transfer Vehicle (MTV), Item 403.4, is recommended for the wearing course only. The total 20-year ESAL for the Superpave Mix Design on this project is 2,555,000. This information should be included in the ESAL Special Provision amendment to Section 401. Copies of the applicable Division 400 Special Provisions are included in Appendix A.

Mainline Recommendations

The recommended treatment consists of full box reconstruction consisting of 12-inches of sand, 12-inches of crushed stone (course), and 12-inches of crushed stone (fine) with 7-inches of pavement consisting of 5½-inches of binder and 1½-inches of wearing course pavement. The binder course should be placed in two equal lifts. It is recommended that the above pavement section be constructed full width including any turn lanes and shoulders. A pavement design was completed for this project; see Appendix B.

If it is anticipated that this will be a multiple season project and traffic will be maintained on binder for a winter shutdown, then both lifts of binder should be placed with the final lift of binder being a "winter" binder and the following note should be included in the Prosecution of Work (POW).

- If traffic will be maintained on binder pavement for a winter shutdown, the Department reserves the right to require the use of "winter" binder. Winter binder has a finer gradation and slightly higher asphalt cement (AC) content.

It is recommended that the easterly project limit be extended approximately 365 feet to match into an existing pavement joint located east of Morgan Way.

Additional Recommendations

The 16236 project is located approximately 1,200 feet east of the limits of the 12959 project (Johnson Creek). At present, the gap between the two projects was constructed by the NRS 249 project (1933) that constructed 22 inches of gravel. The pavement within this section is in poor condition and the 22 inch gravel structural box is insufficient to carry current day traffic loadings. Also, there is 1,100 feet of roadway located within the 12959 project that received a step box widening only. Consideration should be given to extending the 16236 project westerly 1,200 feet to tie into the Johnson Creek project and to extend another 1,100 feet to reconstruct the step box widened area. There seems to be areas that have drainage/underdrain issues west of Shearwater Street. If the project is extended, it is recommended that QC/QA Tier 1 (Item 403.11001) be specified and an MTV should be

required for all paving courses. An estimate was completed to fill this gap and also the step box widening area, see Appendix C. It is estimated that the cost of extending the work 3,300 feet would be approximately $900,000. It may be possible to fund this work from the Tier 2 Rehabilitation program. US 4 is part of the National Highway System (NHS) and it would be advantageous to reconstruct these sections to place more of the US 4 corridor in preservation mode.

Please contact the undersigned if you have any questions or if you require additional information.

Sincerely,

Kevin P. Prince, P.E.
Pavement Design Engineer

Eric S. Thibodeau, P.E.
Pavement Management Chief

cc. Joe Adams, Bridge Design
Keith Cota, Highway Design
Nickie Hunter, Construction Bureau
Brian Schutt, District 6

APPENDIX A

SECTION 401 SPECIAL PROVISIONS

01/10/13

SSD: 1/11/1999, 04/09/09

DURHAM
16236

April 18, 2017

S P E C I A L P R O V I S I O N

AMENDMENT TO SECTION 401 -- PLANT MIX PAVEMENTS - GENERAL

Items 403.XXXX - Hot Bituminous Pavement, _____

Add to 2.5.1:

2.5.1.1 The 20-year ESAL for the SUPERPAVE Mix Design on this project has been estimated to be 2,555,000.

4/23/09

SSD: 10/21/97, 2/9/98; Reviewed 6/10

DURHAM
16236

April 18, 2017

S P E C I A L P R O V I S I O N

AMENDMENT TO SECTION 401 -- PLANT MIX PAVEMENTS - GENERAL

Amend the second sentence of 2.2 to read:

On this project the grade of bituminous material to be used shall be PG 64-28.

APPENDIX B

AASHO 1972 DESIGN ANALYSES

FLEXIBLE PAVEMENT DESIGN

PROJECT: **Durham**
STATE NUMBER: **16236**
MEAN YEAR ADL: 350
REGION FACTOR: 2.0
DESIGN PERIOD: 20 years
TERMINAL SERVICE: 2.5

DESCRIPTION:
AASHO 1972 Interim Design Guide Analysis
FULL BOX RECONSTRUCTION

COMPILED BY: KPP
CHECKED BY: EST

COURSE	DEPTH	SN/in	SN LAYER	SN CUMULATIVE	SOIL SUPPORT FACTOR	REQ'D SN
Wearing Course Pavement	1.50	0.38	0.57	**0.57**		
Binder Course Pavement (2 lifts)	5.50	0.38	2.09	2.66	7.50	**2.75**
Crushed Stone (fine)	12.00	0.14	1.68	**4.34**	7.50	2.75
Crushed Stone (course)	12.00	0.14	1.68	**6.02**	5.50	3.64
Sand	12.00	0.05	0.60	**6.62**	4.50	4.17

FOR FUTURE OVERLAYS

HBP (REQ'D SN-ACTUAL SN) 2.75 - 2.66 = 0.09
HBP (SN/in) / 0.38

FUTURE OVERLAYS REQUIRED: 1/4 inches

NOTE: Specify additional sand where recommended by Bureau of Materials and Research to meet frost requirements

REMARKS:
Conclusions:
1. Base Courses: 12" sand, 12" Cr Stone (course), and 12" Cr Stone (fine).
2. Pavement Thickness: 5-1/2" Binder and 1-1/2" Wearing Course
3. Future Overlays: 0"

APPENDIX C

COST ESTIMATE

New Hampshire DOT Department of Transportation	Material & Research	PROJECT	Durham		
		PROJECT NO.	16236	ROUTE	US 4
	CALCULATION SHEET	CALCULATED BY	KPP	DATE	03/28/17
		CHECKED BY	EST	DATE	04/18/17
	SUBJECT	Estimate		SHEET	1 OF 1

COST OF EXTENDING PROJECT TO TIE INTO THE JOHNSON CREEK PROJECT

Assumptions

1,200 Ft gap | 12/10 Typical | Full box 12/12/12 | 7" of pavement

ITEM 304.1 - Sand

1,200	Ft	X	1	Ft	X	44	Ft	=	52,800	CF	=	1,956	CY	@	18.00	$ 35,200
11.2 CY/100LF					11.2	X	12	=	134	CY				@	18.00	$ 2,419
																$ 37,619

ITEM 304.5 - Crushed Stone (Course)

1,200	Ft	X	1	Ft	X	44	Ft	=	52,800	CF	=	1,956	CY	@	23.00	$ 44,978
33.4 CY/100LF					33.4	X	12	=	401	CY				@	23.00	$ 9,218
																$ 54,196

ITEM 304.4 - Crushed Stone (Fine)

1,200	Ft	X	1	Ft	X	44	Ft	=	52,800	CF	=	1,956	CY	@	26.00	$ 50,844
70.4 CY/100LF					70.4	X	12	=	845	CY				@	26.00	$ 21,965
																$ 72,809

ITEM 403.11002 - Hot Bituminous Pavement

1,200	Ft	X	44	Ft	/	9	X	0.399	Tons/SY	=	2,340.8	Tons	@	68.00	$ 159,174

SUB-TOTAL: $ 323,799

COST OF EXTENDING INTO THE STEP BOX WIDENING AREA OF THE JOHNSON CREEK PROJECT

Assumptions

1,100 Ft gap | 12/10 Typical | Full box 12/12/12 | 7" of pavement

ITEM 304.1 - Sand

1,100	Ft	X	1	Ft	X	44	Ft	=	48,400	CF	=	1,793	CY	@	18.00	$ 32,267
11.2 CY/100LF					11.2	X	11	=	123	CY				@	18.00	$ 2,218
																$ 34,484

ITEM 304.5 - Crushed Stone (Course)

1,100	Ft	X	1	Ft	X	44	Ft	=	48,400	CF	=	1,793	CY	@	23.00	$ 41,230
33.4 CY/100LF					33.4	X	11	=	367	CY				@	23.00	$ 8,450
																$ 49,680

ITEM 304.4 - Crushed Stone (Fine)

1,100	Ft	X	1	Ft	X	44	Ft	=	48,400	CF	=	1,793	CY	@	26.00	$ 46,607
70.4 CY/100LF					70.4	X	11	=	774	CY				@	26.00	$ 20,134
																$ 66,742

ITEM 403.11002 - Hot Bituminous Pavement

1,100	Ft	X	44	Ft	/	9	X	0.399	Tons/SY	=	2,145.7	Tons	@	68.00	$ 145,910

SUB-TOTAL: $ 296,816

TOTAL (Both Sections): $ 620,615

GRAND-TOTAL (w/40% Fixed Cost Multiplier): $ 868,861