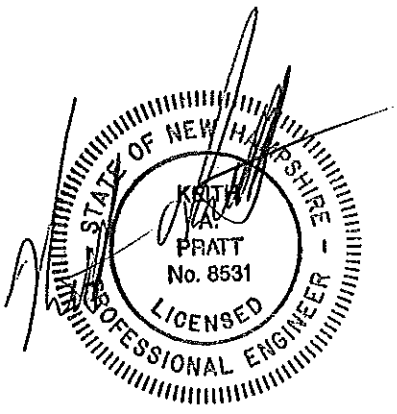
Technical Memorandum

January 7, 2015

Tolend Road Peer Review
Dover, New Hampshire
UE Job #1876



UNDERWOOD
engineers

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1.0 Purpose/Background

1.1 Purpose

This report summarizes investigations of pavement failure along 16,425 feet of Tolend Road (the study area) between the Barrington town line and Columbus Avenue (STA 101+25 to STA 265+50).

1.2 Background

Tolend Road Reconstruction plans and specification were issued by CMA Engineers (Portsmouth, NH) in September 2012. Improvements to the study area were constructed by American Excavating (Derry, NH) during the 2013 construction season. Base course pavement (binder) was installed by Brox Industries, LLC, a subcontractor to American. Wearing course pavement was scheduled to be installed in 2014, but is now scheduled for 2015. Binder pavement installation occurred in 10 phases on the following dates (starting from the Barrington line to Columbus):

6/20/2013 – Phase IIB (358 T)
6/19/2013 – Phase IIA (1,480 T)
5/9/2013 – Phase I (1,028 T)
7/18/2013 – Phase IIIA (1,030 T)
7/19/2013 – Phase IIIB (551 T)
8/6/2013 – Phase IV (664 T)
10/17/2013 – Phase VII (1,111 T)
8/29/2013 – Phase V (1,082 T)
9/26/2013 – Phase VI (1,207 T)
11/6/2013 – Phase VIII (1,045 T)

A total of 9,556 tons of base course pavement was placed in the study area. See attached work plan showing pavement phasing areas.

In January 2014, pavement cracking was observed. In July 2014, CMA completed an inventory of the cracking. A draft Change Order was prepared to mitigate the cracking prior to placement of the wearing course.

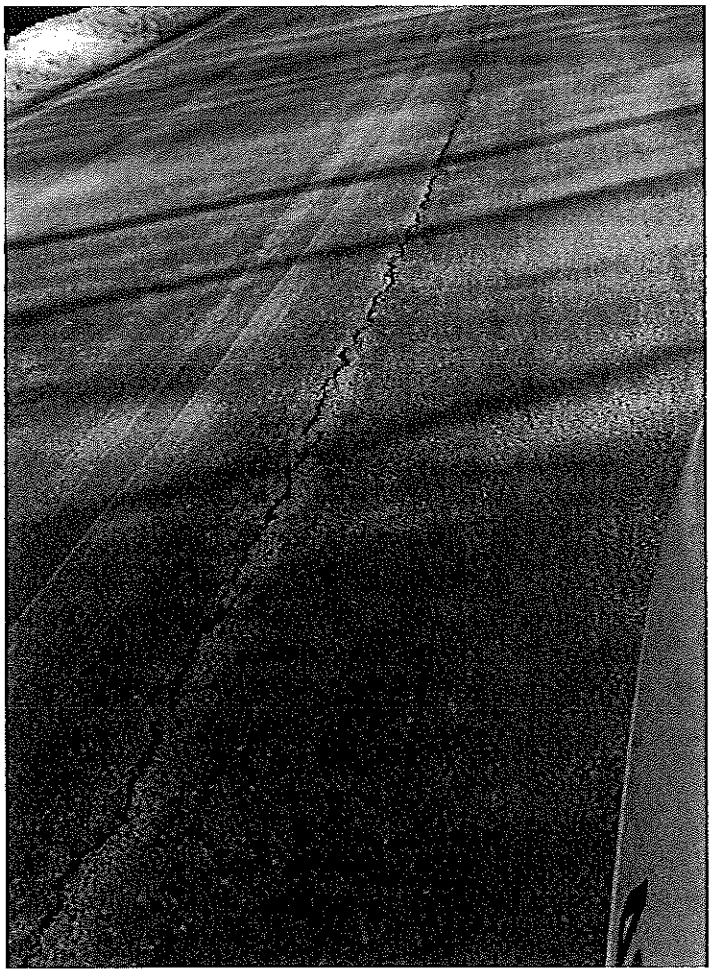


Photo 1. Cracking observed in January 2014

The City of Dover requested this peer review to determine if any additional measures are necessary prior to placing the final wearing course.

The base course pavement installed was based on a mix design submitted by Brox (through American Excavating) for a 75 gyrations, 19.0 mm "Superpave" (Appendix C and D).

1.3 Previous Investigations

Due to the observed pavement cracking, pavement cores were taken and tested by CMA and the Contractor during the summer of 2014 (Appendix E). Pavement thickness varied between 2.88 inches and 3.95 inches. The average thickness was 3.28 inches from the tests taken. Asphalt content, percent fines and compaction were also measured. A summary table is shown below and the complete tabulation created by CMA is provided in Appendix E.

Table 1: Pavement core data taken during the summer of 2014 (CMA).

Parameter	Min	Max	Average	Spec
Thickness	2.9"	4.0"	3.3"	3.5"
Compaction	93.0%	97.2%	95.0%	92%
Percent Fines	3.5%	5.0%	4.2%	3.4% +/- 1%
Asphalt Content	4.6%	4.9%	4.7%	4.7% +/- 0.4%

The Cardno samples taken on August 1, 2014 were not included in the data presented in Table 1 because they were considered duplicates of those taken by Brox (Contractor). Additionally, they did not identify the standard method used for the analysis. However, the Cardno samples had similar results for fines and thicknesses, but had shown higher asphalt content (5.1% vs. 4.7%).

2.0 Summary of Investigations

Underwood Engineers, Inc. (UE) was contracted by the City of Dover to conduct an independent review of the design and construction. The following investigations were completed:

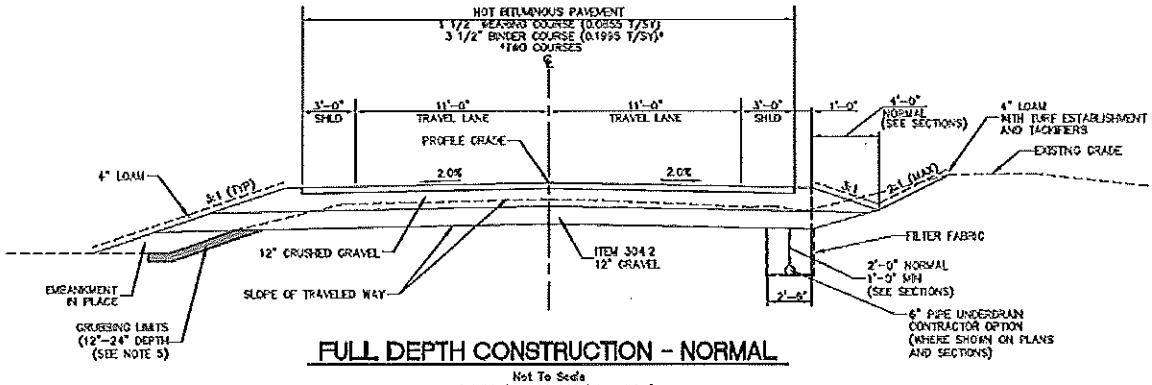
- Review of the contract documents (plans and specifications).
- Review of the engineering field reports
- Inventory of pavement conditions in 6 discrete 100 foot areas as follows (randomly selected):
  - Area #1 – STA 117+00 to 118+00 (Phase IIA)
  - Area #2 – STA 128+00 to 129+00 (Phase IIA)
  - Area #3 – STA 152+50 to 153+50 (Phase I)
  - Area #4 – STA 163+50 to 164+50 (Phase IIIA)
  - Area #5 – STA 191+00 to 192+00 (Phase IV and VII)
  - Area #6 – STA 228+00 to 229+00 (Phase VI)
- Observed and logged 3 test pits of the gravels and subgrade.

- Performed gradations of the gravel and subgrade from the test pits.
- Obtained 9 cores of the base course pavement.
- Performed pavement extraction test and gradation of select pavement cores (2).
- Performed borings in 31 locations to estimate structure thickness (pavement and gravel)
- Engineering evaluation of pavement structure.

3.0 Review of Design and 2013 Construction

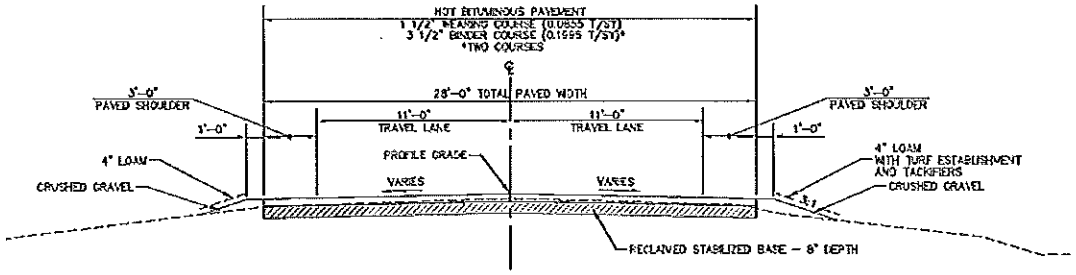
3.1 Design Documents

The Contract Documents called for a 'boxed out' reconstructed road section from Barrington to STA 248+00 (14,675 feet) and reclaim beyond STA 248+00 (1,750 feet). The standard details from the construction drawings are shown below:



FULL DEPTH CONSTRUCTION - NORMAL

Not To Scale
STA 101+75 TO 245+00 (TOLEND RD)
STA 266+50 TO 268+50 (WITH SIDEWALK- SEE DETAIL)
STA 274+00 TO 278+00 (TOLEND RD)
STA 500+15 TO 505+00 (WATSON RD)



8" RECLAIM - NORMAL

Not to Scale
STATION 248+00 TO 262+00

The cross-sections identified a standard 2% crown, except where transitions occurred or where superelevation was designed into the roadway. The longitudinal slope (road

profile) was designed as 0.3% for much of the roadway near the Barrington end of the project. Maximum longitudinal slopes were 6%.

The roadway was raised in much of the project area especially near the Barrington end. Underdrains were incorporated into the design in certain areas. A total of 2,300 feet of underdrain was specified in the Contract and they were reportedly installed per design.

3.2 Shop Drawings

UE reviewed the following approved shop drawings from the project:

- Crushed Stone Fine Gradation (304.4) – Note, this material was approved as a substitute for 304.3 (crushed gravel) (approved 3/29/13)
- Crushed Stone Coarse Gradation (304.5) – Note, this material was approved as a substitute for 304.2 (gravel) (approved 3/29/13)
- HMA Superpave 75 gyration (19.0 mm) – binder pavement (approved 5/13/13)
- HMA Superpave 75 gyration (12.5 mm) – wearing coarse pavement (approved 5/13/13)
- Crushed stone fine gradation resubmittal (304.4) – this material was approved on August 8, 2013.

3.3 Field Reports

During construction in 2013, daily field reports were prepared by CMA between the dates of March 29, 2013 and December 16, 2013. The field reports provide a summary of day to day activities performed by the Contractor and their Subcontractors. Notes and observations by field personnel are also included. The following is a summary of key points and activities based on UE's review of the CMA reports.

<u>Gravel Placement & Grading</u>

- Grade controls were provided by the Contractor
  1.) Although results of field checks are not reported consistently, profiles and cross slopes were checked by CMA field representatives.
- Gravel was typically placed in three lifts as noted below:
  1.) 12" sub-base, stone coarse gradation
  2.) 6" base, stone fine gradation
  3.) 6" base, stone fine gradation, shim lift was placed in advance of paving
- Certain gravel issues were noted (and subsequently corrected), including:
  1.) Some segregation of materials was reported in aggregate base coarse (7/17/13), prior to Phase III paving.

2.) Flat areas of pavement were reported on July 30, 2013 in Phase II asphalt that was constructed on June 19, 2013.

Pavement Notes

1.) Pavement depth estimates are included in field reports. Reported depths, calculated from tons of asphalt installed, and pavement lengths and widths varied from 3.1" to 3.5".
2.) It appears that pavement was generally placed in one 4.5 inch loose lift and compacted to the depths reported.
3.) In place density (compactions) testing of gravel were generally completed in advance of paving operations and were found to be satisfactory.
4.) Phase IIIA and Phase IIIB paving was placed when ambient air temperature was above 90 degrees.

3.4 Construction Quality Assurance and Quality Control (QA/QC)

Construction QA/QC performed in 2013 was provided by CMA for review (some of which is in Appendix E). A summary is as follows:

Gravels:

- Additional gradations of the crushed stone fine material were performed from gravel stockpiles on three occasions to confirm the shop drawings (4/15/13, 8/6/13, and 4/24/14). The testing was acceptable.
- Additional gradations of the crushed stone course material were performed from gravel stockpiles on two occasions to confirm shop drawings (4/12/13 and 4/24/14). The testing was acceptable.
- No in-situ gravel gradation testing was completed or reported to UE.
- Many in place density tests were completed prior to pavement operations. Of the 144 in-place density tests taken, they were all reported to be acceptable.

Reclaim:

- Reclaim materials were tested on five different occasions (phase VIII), four of which were from stockpile materials and one that was in-situ. Three of the stockpiled tests failed and one passed. The in-situ test passed. The test report did not report the location of the in-situ samples, just the sample number (13-981).
- Several compaction tests were completed on November 1st, 2013, which were acceptable.

Pavement:

- Phase I pavement was tested in place on May 9, 2013 and was found acceptable for asphalt content, gradation, density, and percent voids.

- Phase IIA pavement was tested in place on June 19, 2014 and was also found acceptable.
- No additional pavement testing was completed in 2013 or reported to UE.

4.0 Peer Review Data Collection

The following work was completed by UE as part of the independent review. All the data presented below was collected and evaluated in October and November of 2014.

4.1 Subsurface Borings and Test Pits

Pavement cores (October 3, 2014) and test pits (October 6, 2014) were completed by UE. A summary of the location and method for the investigations are summarized below. For each of the pavement cores taken, 6" diameter samples were retained (Appendix G). The test pits were located at the edge of the pavement to observe the pavement and gravels thickness. Gravel samples were retained form each of the test pits (Appendix F).

Table 2. Pavement Cores and Test Pits Completed by UE (October 2014).

ID No.	Method	Phase	Approx STA.	Offset	Pavement Thickness
B1core	Pavement Core	IIA	117+30	9'RT	3.3"
TP#1	Test Pit	IIA	128+35	13'RT	Table 3
B2core	Pavement Core	IIA	128+45	8.5'RT	3.0"
B3core	Pavement Core	I	152+96	C.L.	2.8"
B4core	Pavement Core	IIIA	159+50	3'RT	2.4"
TP#2	Test Pit	IIIA	159+80	15.5'RT	Table 3
B5core	Pavement Core	IIIA	164+12	C.L.	2.9"
B6core	Pavement Core	IIIA	164+12	9'RT	3.3"
B8core	Pavement Core	IV	190+22	9'LT	3.9"
TP#3	Test Pit	IV	191+23	13'RT	Table 3
B7core	Pavement Core	VII	191+29	7'RT	2.6"
B9core	Pavement Core	VI	228+60	C.L.	2.8"

Two of the cores B5core and B8core were submitted to Advanced Asphalt Technologies (Sterling, VA) for testing. Each core was analyzed for asphalt content, gradation, air voids and Performance Grade (PG) on Recovered Binder. The asphalt content were within the required specification. However, the quantity of fines exceeded the specification in both samples. Based on the PG Grading, the stiffness (brittleness) of the mix was found to be higher than anticipated. This could have been caused by higher temperatures or poor quality reclaimed asphalt product (RAP) used in the mix design. See Jo Daniel's report (Appendix A) for a more detailed discussion on the results.

A summary of the test pits completed on October 6, 2014 is provided below (See Appendix F). A piezometer was installed in each of the test pits to record water levels.

Table 3. Test Pit Data from UE tests pits (October 6, 2014).

	Test Pit #1 STA 128+35	Test Pit #2 STA 159+80	Test Pit #3 STA 191+23	Spec
Phase	IIa	IIIa	IV	
Pavement Thickness (see note)	3"	3"	3"	3.5"
Gravel Top Layer				
Thickness	12"	9"	16"	12"
Gradation (see note)	Pass	Fail	Fail	(304.4)
Gravel Bottom Layer				
Thickness	11"	11"	0"	12"
Gradation (see note)	Pass	Fail	N/A	(304.5)
Water Observed	None	None	None	

Note: The pavement thickness was measured at the edge and may not be representative. With one exception, the failures of gradation were due to excessive fines passing the #200 sieve. The specification was 5.0 and the samples ranged from 5.8 to 6.8.

Due to the variations in gravel thicknesses observed in the test pits, additional borings were completed on October 23rd and October 24th, 2014. A total of 31 additional borings were completed in the traveled lane; half of which were in the eastbound lane and the other half in the westbound lane (See Appendix I). From this round of investigations and the test pits, the gravel thicknesses ranged from 16" to 28", averaging about 22.3" +/-2" (excluding reclaim area). The pavement thickness ranged from 2.4" to 4.5" with an average of 3.4" (excluding reclaim area and B-1). To confirm the overall measured thickness of pavement, yield calculations of the pavement placed in each section as calculated. The overall average of the entire section was 3.4" confirming the measured average. The reclaimed section (Phase VIII) had reclaimed product that averaged 12.5" (ranged of 9" to 16") and pavement of 4". The gravel thickness in the boxed out section was specified to be 24" and the reclaim thickness was specified to be 8".

To evaluate the pavement structure, the borings completed on October 23rd/24th, the test pits completed on October 6th, and the cores completed on October 3rd were tabulated by each phase as shown in Table 4. Yield calculations were used for the evaluation by Jo Daniel because they are believed to represent the pavement thicknesses in each phase more appropriately.

Table 4. Boring and Test Pit Data summaries (October 2014).

Phase	HMA (Measured)		HMA	Gravel	
	Average Thick (in)	Range	Calculated Thick (in)	Average Thick (+/- 2")	Range
IIB	4.0	One sample	4.0	26.0	One sample
IIA	3.5	3.0 to 4.0	3.3	23.7	18.0 to 28.0
I	3.5	2.8 to 4.5	3.5	22.0	21.0 to 24.0
IIIA	3.1	2.4 to 3.5	3.2	22.4	20.0 to 24.0
IIIB	No samples		3.8	No samples	
IV	3.6	3.5 to 3.9	3.6	19.3	16.0 to 21.0
VII	3.2	2.6 to 3.5	3.4	22.3	21.0 to 24.0
V	4.0	4.0 to 4.0	3.5	20.0	18.0 to 22.0
VI	3.6	2.8 to 4.0	3.4	23.3	20.0 to 26.0
VIII	4.0	4.0 to 4.0	3.4	12.5	9.0 to 16.0

Note: The core taken at 101+80 (B-1) was not included because it appears to be located in Barrington. Pavement thicknesses from the test pits were neglected because they were measured at the edge and not considered representative.

It should be noted that the SW Cole report on the 31 borings originally reported the accuracy of the measurements to be "*1 to 2 +/- inches more likely in favor of underestimation*". As a result of discussions with the City and CMA, a clarification was requested to confirm the measurements and tolerances reported. Following the request for clarification, SW Cole revised the report (December 4, 2014) to report only the tolerance of "1 to 2 +/- inches."

CMA has reported that certain field documentation exists that may explain the gravel depths found in certain areas. CMA provided the following regarding two locations:

> *At TP -3, measured gravel (crushed stone) thickness was 16". We determined that this location was at a transition area where west-east construction was temporarily suspended (due to a property owner issue), and "leap frogged" to the east. The gravel layer was tapered at the time of construction suspension. When the skipped section was ultimately constructed weeks later, the tapered gravel was encountered, and construction completed. The "tapered" gravel was not to the fully specified fully depth for a limited length. TP-3 happened to be in that limited section, and was not representative.*
>
> *At SW Coles B-2, 18" of gravel (crushed stone) was reported (subject to the measurement methodologies discussed). The location was in a long fill section, where the fill was essentially the entire 24" gravel section. We note that for the gravel thicknesses to be 6" low (18" vs 24") there would need to be a dip in the road, or an anomalous "bump" in the subgrade that was not noted in our QA. We checked the finished road grade in early December, and it is as specified; and there is no "dip" in the road. Based on this, we believe the measurement was in error, or there was an anomalous "bump" in the graded subgrade, which we think is very unlikely.*

UE has reported the values presented in SW Cole's revised report, but notes that the average gravel depth is 22.3 inches +/- 2" or 20.3 inches to 24.3 inches.

4.2 Section Evaluation (Area #1 through Area #6)

To assess the road, random 100 foot sections were evaluated in detail (see Figures 1 and 2). The following information was collected in the field (See Appendix J):

- Determined the as-constructed crown (cross-slope)
- Measured the as-constructed paved width
- Measured the pavement variations in cross slopes
- Documented pavement cracking

In general, the following was noted:

- The crowns (cross-slope) varied from a minimum of 0.21% to a maximum of 2.61%.
- The pavement width in Area #1 and #2 ranged from 24.5 feet to 24.8 feet.
- The pavement width in Area #3, #4, and #5 varied from 27.1 feet to 28. 2 feet.
- The pavement width in Area #6 varied from 27.3 feet to 30.8 feet. Pavement width is wider at west approach to Willow Street.
- Pavement variations in cross-slope were measured by using a 10' straight edge as described in Section 401.3.17.3.4.1 of NHDOT Standard Specifications. Variations ranged from 0" to 2". Much of the variation appears to be either in the wheel path and/or the centerline of the road.
- Variations in excess of 3/16" were consistently observed. The variations in pavement seemed worst (3/4" or greater) in Area #1 (Phase IIA) and Area #3 (Phase I paving).
- In lane cracking was more significant in Area #2 (Phase IIA) and Area #4 (Phase IIIA).

4.3 Truck Traffic

This section of Tolend Road (between Green Hill and Columbus) has a significant number of truck traffic. Specific counts were not available, but the Town reports most of the trucks are loaded gravel trucks and garbage trucks. Truck traffic may impact cracking of the road, particularly during seasonal freeze-thaw cycles.

5.0 Relevant Conclusions

Conclusions regarding the design, shop drawing review, construction, and QA/QC performed during 2013 are summarized below:

Roadway Design

- There are no apparent design flaws that may have contributed to the pavement cracking. The roadway was designed with 24" of gravel and 5" of pavement to be constructed in three lifts (2 course of binder and a single wearing course). Underdrains and geotextile fabric were included in the specification for installation in the field where deemed appropriate.
- The reclaim section of road (STA 248+00 to STA 265+50) is not structurally equivalent to the boxed out section of the rest of the road. Although pavement conditions in this section do not appear any different than the other sections.

Roadway Gravel

- The use of crushed stone (coarse and fine) as approved by the shop drawing process, in lieu of the specified gravel and crushed gravel, is likely a better structural material for the road structure.
- Grain size analyses were completed on certain stockpiled materials prior to placement and were found to be acceptable. No in-situ gravel testing was completed (after placement).
- Gravel compaction efforts were reported to be acceptable.

Roadway Pavement

- The asphalt mix design used on the project (75 gyration), is not typically used for roads such as Tolend Road. It has a lower asphalt content (4.7%) than the 50 gyration mix design (5.5%) and is less flexible.
- The binder course was installed primarily with a loose lift of 4.5" and compacted to depths of less than 3.5", generally. This may not exceed acceptable practices, but it is a thicker lift than specified. CMA did report "stretching of the mat as it was rolled.
- Phase IIIA and Phase IIB pavement areas, which appear to have significant cracking, were placed on high temperature days (over 90 degrees). Pavement temperatures were not provided so it is not known if adjustments in mix temperature were made. It also cannot be determined whether this had an impact on the quality of the HMA.

QA/QC

- QA/QC completed in 2013 included gravel gradations, gravel compaction testing and pavement cores. The amount of QA/QC during construction is not inconsistent with similar municipal type projects.
- In 2013, the only pavement testing was completed on Phase I and Phase IIA pavement.

- Subsequent testing completed by CMA and American in 2014 found that the pavement was within target values for asphalt content and density. The fines were found to be on the high end of the specification. In fact, approximately 46% of 2013 test data (including Cardno data) exceeded the required specification limit of 4.4%. Note, both samples analyzed by UE in the Fall of 2014 (Advanced Asphalt Technologies) exceeded the specification.

A summary of the investigative work completed by UE (October and November 2014) is as follows:

Gravel

- The average gravel thickness was 22.3 inches, but based on the method used by SW Cole to measure it, the tolerance of the data is +/- 2 inches. Phases IV and V has the lowest average gravel thickness of about 19" and 20" (+/- 2"). Given the tolerance of the measurements, it cannot be stated that the gravel does not meet the required thickness in most of the phases. However, it does appear the gravel thickness is generally below the specified thicknesses.
- Of the five gravel samples taken from the test pits, three do not meet the required specification primarily due to too many fines.
- It is noted that the gravel thickness (and related tolerance) as well as elevated fines may not have contributed directly to the cracking that occurred in the winter of 2013/14 because the cracking reportedly occurred during the winter when the ground was frozen.

Pavement

- The asphalt content and density were within target values and meet specification. The air voids on one sample (centerline) were above target; however this is not unusual at a construction (centerline) joint.
- The percent fines of the asphalt exceeded specification.
- The measured asphalt binder thickness varies between 2.4" to 4.5" (average = 3.4). Phase IIIA and VII had the thinnest overall measured pavement thickness at 3.1" and 3.2" respectively. Yield calculations identified the same overall average thickness, but phase thicknesses ranged between 3.2" and 4.0".
- The asphalt mix is considered brittle and is likely contributing to the cracking (see Jo Daniel report in Appendix A).

Section (Area #1 - #6) Evaluation

- The pavement crown (cross-slope) does not adhere to project specifications in most of the sections. It can be corrected with the wearing course, but will require additional mix.
- Variations greater than 3/16" in any ten foot length may be considered unacceptable for final wearing courses. This is consistent with the requirements of NHDOT specifications for 'ride smoothness" (Section 401.3.17.3.4.1). Variations in binder pavement cross slopes do not meet this standard, but can be corrected with the final wearing course.

- The pavement variations were worst in Area #1 (Phase IIA) and Area #3 (Phase I).
- In lane cracking was most significant in Area #2 (Phase IIA) and Area #4 (Phase IIIA).
- Additional pavement thickness is recommended to compensate for the brittle pavement mix and to mitigate the pavement cracking. See report in Appendix A.

General Comment

The above results do not identify one single issue that appears to be cause of the pavement cracking observed. All of the identified issues in combination are likely a factor. Most of the QA/QC results, with some exceptions (i.e., fines in pavement and gravel), are within project specifications. However, the brittle pavement coupled with thin base course pavement, installation means and methods, and heavy truck traffic are all likely contributing to the pavement cracking. It is also possible that some of the subgrade material (or gravels) may have moved and/or settled causing some of the pavement variations and cracking, but this is less likely.

6.0 Recommendations

Based on our review, we recommend the following:

Fall 2014 through winter 2015

- If not done so already put the Contractor on notice that the pavement is considered defective in accordance with the appropriate section of the contract documents.
- Provide temporary mitigation of cracking by completing crack sealing prior to winter. This will reduce water migration.
- Make efforts to reduce truck traffic on Tolend Road until the mitigation efforts are complete and final structural pavement overlays are installed.

Spring/summer 2015.

- Prior to completing repairs in the spring, complete an additional assessment/observation of the road using the six (6) discrete areas as a baseline to see if additional issues have manifested themselves, including:
  - Review cracking inventory to see if additional cracking develops.
  - Measure variations and cross slopes to see if there is additional movement.
- Complete the following repairs in the spring/summer of 2015:
  - Based on assessment above, perform additional crack sealing (or other appropriate repairs) where necessary
  - Apply a fabric to the areas with cracking including the center line consistent with the recommendations outlined in the draft Change Order #7. However, the quantities need to be confirmed (especially for the mat) as additional fabric material may be required.

- Correct the crown and rutting by shimming. This will provide additional pavement thickness, but cannot be counted in the recommended overlay thickness because of its variability.
- Install the wearing course using a 50 gyration mix design (12.5 mm).
- Place the final wearing course at the following minimum thicknesses (rounded) after the rutting and crown has been corrected.
  - Phase IIB 1.75"
  - Phase IIA 2.00"
  - Phase I 2.00"
  - Phase IIIA 2.50"
  - Phase IIIB 2.00"
  - Phase IV 2.00"
  - Phase VII 2.00"
  - Phase V 2.00"
  - Phase VI 1.75"
  - Phase VIII 1.75"
- The amount of additional pavement needed is approximately 5,500 tons 1,200 tons of which is additional pavement beyond 5". This does not include the mix necessary to shim the road to correct the rutting and the crown.
- Install additional gravel backing

- Request extended warranty from the contractor.
- Although repairs for the gravel thickness are not recommended, it is noted that, even with the tolerances reported, there may be less gravel than specified in two phases.
- Coordinate with property owners of adjacent driveways where road is being raised more than the anticipated 1.5". Additional pavement thickness may require adjustments to driveways to accommodate grades and drainage.
- A sink hole was observed at the underdrain patch at the Barrington Town line that requires correction (~STA 100+50 12 feet RT).
- It is recommended QA/QC for repairs include (minimum):
  - Shop drawing approval of a new mix design
  - Shop drawing approval of crack sealing and fabric.
  - Field testing of mix as it being placed (temperature, yield calculations, etc.)
  - Confirmation of virgin asphalt and RAP source
  - Visit batch plant during pavement operations to confirm adherence to approved shop drawing.
  - It may also be appropriate to complete additional material testing of mix after placement for every 2,000 tons if batch operations appear to warrant it.

Figure 1 and 2 – Work Plan