

1 STATE OF NORTH CAROLINA IN THE GENERAL COURT OF JUSTICE
2 COUNTY OF WAKE SUPERIOR COURT DIVISION
3 10-CVS-019930
4

5 BRIAN CECCARELLI and LORI
6 MILLETTE, individually and
7 as class representatives,
8 Plaintiffs,

9 vs.

10 TOWN OF CARY,
11 Defendant.

12 _____

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15 The Deposition of JOSEPH E. HUMMER, Ph.D., P.E.,
16 Taken at 5050 Anthony Wayne Drive,
17 2170 Engineering Building, Second Floor,
18 Detroit, Michigan,
19 Commencing at 9:28 a.m.,
20 Wednesday, October 17, 2012,
21 Before Helen F. Benhart, CSR-2614.

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23
24
25

Job No. AMB201292

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2

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WITNESS	PAGE
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1 Detroit, Michigan
2 Wednesday, October 17, 2012
3 9:28 a.m.

4
5 JOSEPH E. HUMMER, Ph.D., P.E.,
6 was thereupon called as a witness herein, and after
7 having first been duly sworn to testify to the truth,
8 the whole truth and nothing but the truth, was
9 examined and testified as follows:

10 EXAMINATION

11 BY MR. STAM:

12 Q. My name is Paul Stam, attorney for Brian Ceccarelli
13 and Lori Millette. For your information,
14 Mr. Ceccarelli is here with me and can hear. Just for
15 my information, is anyone present other than the court
16 reporter, Ms. Martineau, and yourself?

17 A. No.

18 Q. What is your name and business address?

19 A. Name is Joseph Hummer. Business address is Department
20 of Civil and Environmental Engineering at Wayne State
21 University, Detroit, Michigan 48202.

22 Q. Do you have your resume or curriculum vitae with you?

23 A. Yes.

24 Q. I would like to have that marked as Plaintiff's
25 Deposition Exhibit 1 and just ask you if that is an

1 accurate and current resume.

2 A. Yes. The one I just printed out here we're marking as
3 Exhibit 1 is recently updated with my address change,
4 so it must be just slightly different from one that
5 you see from a few weeks ago, but in substance it is
6 the same.

7 Q. Thank you very much. You have been a professor of
8 engineering, is that correct?

9 A. Yes.

10 Q. And you have a doctorate in engineering?

11 A. Doctorate in civil engineering, yes, Purdue
12 University.

13 Q. In the course of your obtaining this doctorate and
14 undergraduate education as well, have you studied
15 physics?

16 A. Yes. I believe I had a two physics courses back
17 during my bachelor's degree days at Michigan State.

18 Q. Really? I went to Michigan State as well.

19 A. Excellent. Go Spartans.

20 Q. Go Spartans. Other than two undergraduate courses in
21 physics, have you had other courses in physics in your
22 education -- formal educational training?

23 A. I don't think so. I don't remember it.

24 Q. What is the dictionary definition of engineering?

25 MS. MARTINEAU: Objection to the form of

1 the question. We don't have a dictionary here.

2 MR. STAM: Let's see if he can answer it.
3 If he can't, I'll ask a different one.

4 MS. MARTINEAU: I think he can say what he
5 thinks the definition is, but I don't think it's --

6 MR. STAM: That's my question is.

7 BY MR. STAM:

8 Q. Dr. Hummer, you're a professor of engineering. You
9 have a doctorate in it. What do you think the
10 dictionary definition of the term engineering is?

11 MS. MARTINEAU: Same objection as to
12 dictionary. Go ahead and answer.

13 THE WITNESS: My definition of engineering
14 is the application of scientific principles to solve
15 difficult technical problems.

16 BY MR. STAM:

17 Q. Do those scientific principles include the disciplines
18 of math and physics?

19 A. Yes, and many others as well.

20 Q. What does -- in traffic engineering, what is the -- in
21 the operation of the roads, what does the yellow light
22 mean?

23 A. Yellow light is a warning that the red light is about
24 to begin.

25 Q. Is that its only purpose?

1 MS. MARTINEAU: You asked him what the
2 definition was.

3 MR. STAM: No. I asked him what does the
4 yellow light mean.

5 MS. MARTINEAU: Right, and now you're
6 asking him the purpose, so objection to the form of
7 the question. Go ahead and answer if you can.

8 BY MR. STAM:

9 Q. Does it mean anything -- I'll rephrase the question.
10 Does it mean anything other than what you just said,
11 which I believe was something to the effect that
12 yellow warns the drivers that a red light is coming?

13 A. No. That is the purpose.

14 Q. What is the purpose of having a minimum length for a
15 yellow light?

16 A. Well, there's several purposes that come to mind. One
17 purpose is, one very important thing to us in timing
18 the yellow light is uniformity, that drivers
19 approaching an intersection, approaching a signal know
20 what to expect. That is we put a high priority on
21 that and feel like that saves many lives and many
22 collisions, and a minimum yellow time ensures that
23 we're just not flashing the yellow at drivers, that
24 they will know to expect and they do expect at least a
25 certain amount of time.

1 In addition to that, there is -- needs to
2 be time for drivers to use the information that we've
3 given them to make a decision and either get their
4 vehicle stopped before they cross the stop bar or to
5 decide to proceed through the intersection in a
6 minimum time to get those drivers who are making a
7 decision to go through to indeed get through the
8 intersection.

9 Q. What information does the driver need to have in order
10 to make that decision?

11 A. Well, the driver needs a lot of information. Drivers
12 are always bringing in, integrating information from
13 their surroundings. What do they need to have at a
14 very minimum, they need to know what speed they're
15 going, they need to make a judgment of how far it is
16 from where they are to the stop bar, they need to know
17 what the surrounding traffic conditions look like,
18 they need to know what kind of movement, maneuver
19 they're making when they get to the intersection and
20 then there's probably -- if we sat here and listed it,
21 there's a hundred other things that they should use or
22 could use in helping make that decision. It's a -- as
23 drivers we're taking in information from all kinds of
24 different sources constantly.

25 Q. The term ITE I believe is Institute of Transportation

1 Engineers. Are you familiar with that?

2 A. Yes. I'm a member of that organization.

3 Q. If the driver decides to proceed toward and into the
4 intersection, according to ITE, what speed must the
5 driver go?

6 A. I don't think ITE prescribes that speed. I'm
7 searching through my mind right now to recall what --
8 and I don't remember that there's an ITE publication
9 that prescribes a certain speed.

10 Q. Are you familiar with the 1994 publication by ITE
11 entitled Determining Vehicle signal Change and
12 Clearance Intervals chaired by Beverly Thompson in the
13 report of the Institute of Transportation Engineers
14 dated August 1994?

15 MS. MARTINEAU: Is that a document you
16 provided to me, Skip?

17 MR. STAM: At the Shovlin deposition, it
18 was part of Exhibit 4, and it's referenced in the
19 attachments to the Ceccarelli affidavits, but I don't
20 think we've discussed it at previous depositions.

21 MS. MARTINEAU: Okay. Well, I just object
22 because if he -- it's not -- this is not a memory
23 test.

24 MR. STAM: Let's do this. Let me continue
25 and then maybe if you could give me your fax number we

1 could send that to you and then I could ask further
2 questions.

3 THE WITNESS: Sure. The fax is area code
4 313-577-3881.

5 MR. STAM: Do I have to put it to anybody's
6 attention or does that come right to you?

7 THE WITNESS: Put to it my attention for
8 sure. That's the department fax.

9 MR. STAM: Let me go ahead and start that
10 fax, but I'll pass on it and we'll come back to it
11 until you've had a chance to look at it. The easiest
12 thing to do is I'll just fax Exhibit 4.

13 MS. MARTINEAU: Skip, Dr. Hummer just left
14 to let his staff know to look for a fax so he'll be
15 right back.

16 MR. STAM: Okay.

17 MARKED BY THE REPORTER:

18 DEPOSITION EXHIBIT 1

19 9:37 a.m.

20 (Off the record at 9:37 a.m.)

21 (Back on the record at 9:41 a.m.)

22 MS. MARTINEAU: We're on record. Can you
23 identify what the document is, Skip, for the record.

24 MR. STAM: Yes. I'm referring to a
25 document which is Exhibit 4 to the Shovlin deposition,

1 and it's entitled Determining Vehicle signal Change
2 and Clearance Intervals dated August 1994 by the
3 Institute of Transportation Engineers, and my first
4 question is is Dr. Hummer familiar with this document.

5 THE WITNESS: I had seen it referred to in
6 the documents for this case. I looked for it. Our
7 library didn't have it, so this is the first time I've
8 seen it, but I had been aware of it.

9 BY MR. STAM:

10 Q. Okay. I'm going to ask you about Page 3, which at the
11 top says Yellow Change Interval Timing and Application
12 Procedures, and just ask if you had time to look at
13 Page 3.

14 A. Yes.

15 Q. And in particular formula one on the second column.

16 A. Yes.

17 Q. Okay. And in the second particular -- in the first
18 column, the third bullet point.

19 A. Yes. Sure.

20 Q. Okay. Let me ask my question then. What is ITE's
21 physics definition of a yellow change interval
22 according to this publication?

23 MS. MARTINEAU: Objection to the form of
24 the question.

25 THE WITNESS: Yeah. I'm not sure that ITE

1 refers to physics in this definition. ITE's an
2 organization of engineers providing information for
3 engineering, so I don't know that they're providing a
4 physics definition. The third bullet is not a
5 definition of the yellow time. It's a -- well --

6 BY MR. STAM:

7 Q. For this question I'm referring to formula one.

8 MS. MARTINEAU: He can tell you what the
9 formula he sees on that page is. Is that what you're
10 asking?

11 MR. STAM: Yes.

12 THE WITNESS: Okay. Well, formula one is
13 solving for Y, which is the length of the yellow
14 change interval in seconds. Y is equal to two terms.
15 First term is T, which is the driver
16 perception-reaction time, generally assumed to be 1.0
17 seconds, and then the second term is the vehicle
18 speed, velocity of approaching vehicle in feet per
19 second divided by an acceleration term which is two
20 times the average deceleration in feet per second
21 squared assumed from 10 to 15, so it says here added
22 to a grade correction, which is some multiplier to the
23 standard acceleration for gravity.

24 BY MR. STAM:

25 Q. And what is V? Is it the initial speed of the

1 vehicle, is it the stopped speed of the vehicle or
2 somewhere in between?

3 A. In the application of this formula, V is the speed of
4 the vehicle at the point at which they're making a
5 decision whether to stop or whether to go. Initial
6 speed, I don't know what that term refers to, and it's
7 certainly not the stopped speed. That would be zero.
8 So the formula wouldn't make any sense in that case,
9 but the application is -- V is the speed at the time
10 the vehicle in question -- the driver in question is
11 making their decision.

12 Q. Okay. And that is a critical distance away from the
13 intersection, is that correct?

14 MS. MARTINEAU: Objection to the form of
15 the question.

16 THE WITNESS: At the -- what the formula is
17 doing is -- let me back up and say this formula is
18 derived from the standard stopping distance formula
19 that engineers have used for probably over a hundred
20 years to design hundreds of billions of dollars worth
21 of roads and signals and signs and all kinds of
22 things, find that stopping distance for a vehicle
23 approaching the signal as we expect and then provide
24 enough time for a vehicle at the -- at that stopping
25 distance away from the stop bar to proceed through the

1 intersection past the stop bar during the yellow
2 before the red starts.

3 BY MR. STAM:

4 Q. Okay. At what speed -- I think you've answered this,
5 but to be clear, at what he speed --

6 A. Well, this --

7 Q. -- that it proceeds through? In other words, talking
8 now about a vehicle that is not stopping but a vehicle
9 that is going through. At what speed does that
10 vehicle go through according to this formula?

11 MS. MARTINEAU: Objection to the form of
12 the question. Vehicles can travel at a variety of
13 speeds and go through the intersection on a yellow
14 light so I'm -- objection to the form of the question.

15 MR. STAM: I do want to proceed with the
16 question, so would the court reporter read the
17 question back so the witness could remember what it
18 was without the testimony of my friend Ms. Martineau.

19 (The requested portion of the record was
20 read by the reporter at 9:47 a.m.)

21 MS. MARTINEAU: Objection to the form of
22 the question.

23 THE WITNESS: And my answer is that on
24 Page 3 here in the text below the formula, it's not
25 clear what the speed of that vehicle should be. This

1 says vehicle's velocity of approaching vehicle so
2 that's not clear. On the left side of the page down
3 toward the bottom, it does define it, and to quote
4 here, it says approach speed is defined as the higher
5 of the 85th percentile speed or the posted speed
6 limit, so that's I think what this committee was
7 intending for us to do.

8 BY MR. STAM:

9 Q. And right above the formula, three lines up, does it
10 also clarify what speed we're talking about by the
11 words at its initial speed? If you would read the
12 introductory sentence before the formula to yourself
13 and then see if you can further answer the question.

14 A. Sure. Yeah. And you're correct in that above the
15 formula it does say provides yellow time for a vehicle
16 to travel at its initial speed over the distance it
17 would take to stop at a comfortable average
18 deceleration. Again, I'm not clear from this what
19 that term initial speed means, initial speed of what,
20 initial speed where is not clear here.

21 The typical application of this formula in
22 North Carolina is to use the speed limit, and we
23 cannot, we will not without bankrupting the state
24 design for 100 percent of vehicles going any speed
25 from zero to infinity. That's just not something that

1 engineers can do. We're in the business of designing
2 roads, signals that are practical to drive and use for
3 most drivers within the budget that we have. There's
4 certainly vehicles out there that exceed the speed
5 limit. We wish they wouldn't, but sometimes they
6 choose to do that. The speed limits are often set at
7 the 85th percentile speed anyway, so ITE's verbiage
8 here about using the higher of the 85th percentile or
9 the posted speed. Often that's the same thing anyway.

10 Furthermore, drivers adjust to the
11 conditions that they are under whether those are bad
12 conditions such as wet and rainy conditions where it's
13 going to take longer to stop or good conditions where
14 drivers are driving a brand-new vehicle on a brand-new
15 piece of pavement on a nice clear day. Drivers, I
16 said before, they sort of integrate all the
17 information they have available and will adjust their
18 speed, will adjust their deceleration rates as well
19 will adjust their perception-reaction times.

20 So our choice of the speed limit as the
21 speed that drivers can go through the intersection
22 here promotes that uniformity I talked about before
23 and accommodates most drivers and most conditions and
24 allows drivers who choose to, for instance, exceed the
25 speed limit, allows them to adjust and still be able

1 to make a good decision.

2 Q. Thank you. Using that page with the formula and what
3 you mention on the bottom part of column -- the
4 left-hand column that you referred to, I understood
5 what you said. It's the speed limit or if a speed
6 survey is done the 85th percentile. Can an engineer
7 in determining the yellow change interval use a V
8 which is less than the speed limit?

9 A. I suppose so. The law, you know the law better than
10 I, but my understanding of the law is that engineers
11 have to follow the book called the Manual of Uniform
12 Traffic Control Devices MUTCD, which I'll call it that
13 from now on --

14 Q. I'll come to that later.

15 A. MUTCD specifies that -- I don't have the words right
16 in front of me, but that's for -- specifies that
17 engineers use judgment and apply engineering practice
18 and that's -- sure, there will be times when using a
19 speed below the speed limit is perfectly appropriate.
20 It's -- the MUTCD is meant to promote that uniformity
21 that I've talked about several times but also has to
22 allow for local judgment, local conditions, the
23 experiences of the responsible engineers to come into
24 play, and one great example of a place where we would
25 use lower than the speed limit is when timing for the

1 end of a protected left turn phase.

2 Q. So if an engineer uses a V which is less than the --
3 excuse me. Strike that. Start again.

4 So if an engineer uses a vehicle in the
5 formula less than the speed limit, does the driver
6 have the distance to stop?

7 A. Well, a driver who is traveling at the speed limit and
8 encounters that situation where the yellow signal is
9 timed with a V that is less, that driver could stop by
10 using a shorter perception-reaction time, reacting
11 quicker or by decelerating quicker than we had plugged
12 into the formula, and all of this presumes that this
13 driver is exactly at that stopping distance before,
14 and that's, of course, really the case. That's, you
15 know, an exact distance, a certain number of feet away
16 from the stop bar, and almost every signal cycle we'll
17 find drivers who are closer or further away but not
18 exactly at that place when the yellow signal comes on,
19 so, you know, again, it's -- you know, we never are
20 able to accommodate the 100 percent of drivers that
21 are out there, but the vast majority would be able to
22 make a good decision to either go through or get
23 stopped.

24 Q. Not talking about 100 percent of drivers but just the
25 average or the ideal driver according to North

1 Carolina DOT usages, isn't the perception-reaction
2 time 1.5 seconds?

3 A. That's not the average. That 1.5 seconds is quite
4 slow. It's well at the far side of the distribution.
5 The average, and we can pull up some literature here
6 to get more precise with that, but the average
7 perception-reaction time for a driver coming up to the
8 start of a yellow signal is something on the order of
9 .7 seconds. It's far less than one.

10 Q. All right. But you design according to 1.5 so that a
11 significant minority of drivers won't be involved in
12 crashes, is that not correct?

13 MS.MARTINEAU: Objection to the form of the
14 question.

15 THE WITNESS: But that's -- of course.
16 Everything we engineers do out on the road, highway,
17 signal design, sign design, everything is to try to
18 avoid crashes.

19 BY MR. STAM:

20 Q. So -- and you're aware that NCDOT bases its decisions
21 on 11.2 seconds per second for deceleration?

22 MS. MARTINEAU: Objection to the form of
23 the question. Are you talking about NCDOT's yellow
24 time formula?

25 BY MR. STAM:

1 Q. Go ahead and answer the question, Dr. Hummer.

2 MS. MARTINEAU: Same objection. Go ahead.

3 THE WITNESS: My understanding is again we
4 could pull up a document here to see that, but the
5 current NCDOT practice is to use 11.2 feet per second
6 squared deceleration rate in the yellow time formula.

7 BY MR. STAM:

8 Q. Okay. If the speed limit is 45 miles an hour,
9 according to ITE and the laws of motion as you
10 understand it, can a driver decelerate, say, quickly
11 from 45 miles an hour down to 10 miles an hour and
12 still proceed through or does he have to proceed at 45
13 miles an hour for the other initial speed to get
14 through the intersection?

15 MS. MARTINEAU: Objection to the form of
16 the question as to -- well, just objection to the form
17 of the question. Answer if you can.

18 THE WITNESS: Yeah. That's a hypothetical.
19 There's so many things I'd need to know about the
20 specifics there before answering that. There's too
21 many other things going on. I can't answer that.

22 BY MR. STAM:

23 Q. All right. Let's hypothesize zero grade, clear day,
24 90-degree intersection, ordinary care, ordinary
25 driver, no obstructions. If the speed limit is 45

1 miles per hour according to the ITE formula, for a
2 driver who wants to proceed through the intersection,
3 is the driver to proceed through at 45 miles an hour
4 or something equivalent to it or can the driver, say,
5 decelerate to 10 miles an hour and still proceed
6 through the intersection?

7 MS. MARTINEAU: Same objection. Do you
8 want to give him in your hypothetical where the driver
9 is when he first makes a decision to proceed through
10 the intersection? Because I think that's -- we don't
11 know that.

12 BY MR. STAM:

13 Q. Dr. Hummer, if you would see if you could answer the
14 question.

15 A. I really can't. Is the driver 500 feet away or 50
16 feet away, and --

17 Q. All right. Let's suppose the driver is 294 feet,
18 which according to the calculations of the plaintiff
19 is -- and using the laws of physics is the critical
20 distance, so let's, in addition to the other
21 assumptions that I stated in the previous question,
22 state that the driver's at a -- 294 feet away from the
23 entry to the intersection. Does the driver then have
24 to proceed at the speed limit or the initial speed to
25 get through or could the driver decelerate to, say, 10

1 miles an hour and still make it through?

2 MS. MARTINEAU: Objection to the form of
3 the question. Is this a straight through? Is he
4 going straight?

5 MR. STAM: Yes. Well, actually the answer
6 to that question doesn't matter. I mean, that factor
7 doesn't matter, so let's leave that to the side.

8 BY MR. STAM:

9 Q. Can you answer that question, Dr. Hummer?

10 MS. MARTINEAU: Well, same objection.

11 THE WITNESS: If I'm understanding
12 correctly, the answer is that that driver at 294 feet
13 away with the amount of yellow that the ITE formula
14 recommends as applied in North Carolina, that driver
15 would have to proceed -- keep proceeding at 45 miles
16 an hour or higher to be able to cross the stop bar
17 before the yellow ends.

18 BY MR. STAM:

19 Q. On that piece of paper, could we mark that as Exhibit
20 2 to your deposition, please.

21 A. I was going to add to my answer, though, if I could.

22 Q. Oh, please, please.

23 A. That a driver at 45 miles per hour at the 294 foot
24 distance, when the yellow occurs, that driver starts
25 to decelerate from 45 to 10, as you mentioned, we

1 would hope, we would expect that that driver would
2 just come to a stop if they -- and we don't know why
3 they're decelerating there, but if they're -- you
4 know, something in the road, something -- you know,
5 some extraordinary condition there that they come to a
6 stop and that the 294 feet, if I am understanding this
7 correctly, would have given them enough time to come
8 to a stop if they need to and that they could always,
9 like we said earlier, adjust, react quicker,
10 decelerate at a greater rate than the formula allows
11 for as well, so -- okay. That's my answer.

12 Q. All right. Some drivers think that a yellow light
13 means proceed with caution and that caution means slow
14 down, and my question is this: If a driver going at
15 the speed limit within the critical distance, let's
16 say at or closer than 294 feet going 45 miles an hour,
17 the posted speed limit, all the other assumptions I
18 gave previously, clear day, no other interruptions,
19 90-degree angle, no grade, if that driver decides to
20 be cautious and, therefore, slow down to some speed
21 below 45 miles per hour, whether it's 10 miles an hour
22 or 20 or 30, will that driver have enough distance to
23 clear the intersection if the driver slows down?

24 MS. MARTINEAU: I just want to object not
25 to the question but to the -- to your statements

1 before your question. Go ahead and answer.

2 THE WITNESS: Yeah. First response is
3 that, of course, we hope all drivers are cautious at
4 all times going through all intersections, and drivers
5 that slow down as you described certainly are not the
6 only cautious ones out there and don't have a sort of
7 corner on that market.

8 Second response is that if drivers have
9 that perception that that's what the yellow means,
10 then we need to do better in our driver education
11 because that's certainly not what we intended, and my
12 observation in almost 30 years in this business is
13 that's not how most drivers behave out on the roads.
14 They may profess that in some survey, but what they
15 actually do out on the roads in response to yellow
16 signals is quite different.

17 The other response I have is that, as I
18 said before, yes, the ITE yellow time formula is
19 designed get a driver across the stop bar during the
20 yellow who was at the stopping distance when the
21 yellow first came on, and drivers at that constant
22 speed of the speed limit and anybody who drives -- was
23 at that speed limit and then slows down and still
24 tries to make it through the yellow will not do so.
25 That's easy to show, fortunately, I think a pretty

1 rare condition.

2 Q. And in my previous question I misused one word so I'm
3 going to correct it. I don't think it will make a
4 difference to your answer, but please tell me if it
5 did. I think what I said in the question is would
6 they have enough distance to clear the intersection
7 when what I should have said and meant to say was
8 would they have enough distance to enter the
9 intersection. If I change that term in my question,
10 does it change your answer?

11 A. No. Thank you for that. I guess I was hearing you to
12 say enter the intersection anyway. Cross the stop bar
13 is the key thing for the purpose of the yellow
14 calculation, so no problem there.

15 Q. All right. When you drive personally, Dr. Hummer, do
16 you ever have to tap your brakes for cars emerging or
17 egressing from business entrances in front of you or
18 to accommodate the movement of cars in front of you?

19 A. Of course.

20 Q. As the driver such as you must be cautious and slow
21 down for these type of obstacles, in the case of
22 entering an intersection, will these kinds of real
23 life actions violate ITE's mandate for the use of its
24 yellow change interval formula?

25 A. Well, no. Like I said before, we can't design for the

1 100 percent case. There's no formula that will do
2 that and be practical on the roads would provide for
3 that uniformity that we talked about and have the
4 other facts which I'd like to get into of the bad
5 effects of longer yellow times, to keep yellow times
6 practical and somewhat uniform.

7 Q. I'm going to ask about that also. We'll give you a
8 chance, but --

9 MS. MARTINEAU: Let him finish his question
10 if you would. Finish his answer.

11 BY MR. STAM:

12 Q. You can finish, but I'm not sure you have to go off on
13 that subject to answer this question because I will
14 ask you about that.

15 A. Right. So in the case you mentioned, my professional
16 opinion is that's rare. Most drivers are not going to
17 do that, and, again, we're talking about the slimmest
18 of probabilities already with the driver going exactly
19 the speed limit at exactly 294 feet away and then who
20 chooses to decelerate at exactly 11.2 feet per second
21 squared.

22 Most drivers adjust to the conditions
23 around them, and, you know, seeing somebody coming out
24 from a driveway, seeing somebody about to merge into
25 their lane will already be off the accelerator and may

1 already be on the brake well before that person gets
2 into their lane, and so in that situation, they're
3 going to adjust and make the best decision they can
4 make for themselves at that time, and in all
5 likelihood they're going to have enough yellow to make
6 a good decision, so, you know, it works for the huge
7 vast majority of drivers in most times in most
8 circumstances.

9 Q. Are you implying or stating that the DOT's
10 specifications do not work for its own ideal driver as
11 set out in the specifications?

12 A. No. A driver that has exactly 1.5 seconds
13 perception-reaction time and 11.2 seconds feet per
14 second squared deceleration rate driving exactly at
15 the speed limit at exactly that distance away from the
16 stop bar will be able to make a good decision and, for
17 that matter, at any other distance away from the
18 intersection will be able to make a good decision, so,
19 no. The formula works the way it was supposed to.

20 Q. Okay. Dr. Hummer, this is a multiple-choice question
21 with four possible -- I'd like to suggest four
22 possible answers or you can come up with a fifth or
23 sixth, so let me ask the entire question.

24 Using the DOT's assumptions for the ideal
25 driver, that is the one who perceives and reacts in

1 1.5 seconds and decelerates at 11.2 feet per second
2 squared, what is the length of the yellow change
3 interval, four possibilities or a fifth, whatever, is
4 it 50 percent of the time it takes a driver to stop,
5 100 percent of the time it takes a driver to stop, 150
6 percent of the time it takes a driver to stop or
7 something else?

8 MS. MARTINEAU: Objection to the form of
9 the question as to ideal -- DOT's assumptions for
10 ideal driver.

11 THE WITNESS: And the question doesn't make
12 any sense to me. The yellow time formula provides
13 time for a driver at that stopping distance away from
14 the intersection to go through the intersection so --

15 MS. MARTINEAU: Or the stop --

16 THE WITNESS: Or to pass -- yeah, pass the
17 stop bar. So I don't understand the way the question
18 was phrased. The yellow time formula is not trying to
19 do what you describe if I heard it right.

20 BY MR. STAM:

21 Q. All right. I'll take that answer to my question.

22 Do you know who Denos Gazis is?

23 A. He's the author of the classic paper in 1959. I don't
24 know that I ever met him or heard him speak.

25 Q. Well, my question is are you -- obviously you're

1 familiar with his 1959 paper, The Problem of the Amber
2 Signal Light in Traffic Flow?

3 A. Yes.

4 Q. What is a dilemma zone?

5 A. A dilemma zone is a space on the roadway on an
6 approach to an intersection where a driver in that
7 space has no chance to get stopped before crossing the
8 stop bar at the onset of a yellow and has no chance to
9 proceed past the stop bar before the yellow ends and
10 that is to stop or proceed according to their
11 capabilities.

12 Q. If you still have it handy, I think it's Exhibit 2,
13 the Shovlin deposition, it's the ITE 1994 paper,
14 Page 3. You still have that handy?

15 A. Oh, yeah. Yeah, sure.

16 Q. If you could look in the first column and the third
17 bullet point, but it's actually a square, I don't know
18 if you call that a bullet point, is that what is being
19 described in that third bullet point? And I'll just
20 read it for the record. When approaching an
21 intersection, a driver's faced with one of several
22 situations when the yellow change interval appears,
23 and then the third alternate is the driver can neither
24 stop comfortably nor proceed into and clear the
25 intersection before the appearance of a conflicting

1 green indication. Is that what is referred to as a
2 dilemma zone?

3 A. That's maybe just slightly different from what I
4 described, but generally speaking, that's a dilemma
5 zone. My definition of it did not include the clear
6 the intersection part before the appearance of a
7 conflicting green, but in North Carolina we use an
8 all-red indication after the yellow to take care of
9 clearing the intersection, so with that slight
10 difference, generally that's a dilemma zone, sure.

11 Q. What is an indecision zone?

12 A. That's not a standard term in traffic engineering as
13 far as I know.

14 Q. I may come back to that.

15 According to the ITE formula, what would
16 cause a dilemma zone?

17 A. If we apply the ITE formula to time the yellow signal,
18 a driver who was exceeding the speed limit could
19 potentially be in a dilemma zone. A driver who was
20 not able to decelerate at at least the assumed rate,
21 11.2 feet per second squared, in North Carolina could
22 be in a dilemma zone. A driver who didn't react
23 within the 1.5 seconds could be in a dilemma zone,
24 but --

25 Q. Are those -- I'm thinking of the word. Ors and ands.

1 In other words, are those four different
2 possibilities, each of which could cause it, or are
3 you saying all four of those would have to occur to
4 create a dilemma zone?

5 A. No. That's each of those -- any of those individually
6 could create a dilemma zone. Of course, a combination
7 of those could create a dilemma zone as well.

8 Q. For example, a driver of a vehicle who is not
9 exceeding the speed limit at any point could find him
10 or herself in a dilemma zone through no fault of his
11 or her own?

12 MS. MARTINEAU: Objection to the form of
13 the question. You can answer.

14 THE WITNESS: Yeah. No, I would not
15 characterize it that way at all. The 1.5 second
16 perception-reaction time is quite generous, as I
17 mentioned before, really over twice the average,
18 generally speaking, and it's really quite slow.
19 That's got to be a driver that's not paying attention,
20 attention diverted for some reason, so a driver who's
21 not able to decelerate at 11.2 feet per second
22 squared, we have to question whether that vehicle
23 should be on the road.

24 Most drivers and vehicles are able to
25 decelerate at something like 20 feet per second

1 squared on dry pavement and at least 13, 14, 15 or so
2 feet per second squared or on wet pavement without any
3 harmful effects, and in an emergency situation,
4 drivers can decelerate at something like 30 feet per
5 second squared. So 11.2 is really pretty poor
6 performance by that driver and vehicle, and, of
7 course, exceeding the speed limit is illegal so I
8 don't -- I don't agree with your characterization
9 there.

10 BY MR. STAM:

11 Q. Well, let me ask it this way. If a driver suppose
12 approaching an intersection at 45 miles per hour, no
13 grade, clear day, no wet pavement, if this driver
14 never exceeds the posted speed limit, does have a
15 perception-reaction time of 1.5 seconds, is able to
16 decelerate at 11.2 feet per second, with that driver,
17 is there a dilemma zone according to the ITE formula?

18 A. No. No. The ITE formula makes sure that that driver
19 has a good decision to make. Drivers can always make
20 bad decisions, and many do, unfortunately. Again, you
21 know, it's -- we can't find a way to prevent that,
22 unfortunately, with our current technology and current
23 budgets, but that driver at least has a decision to
24 make to either stop or proceed, and most of the time
25 drivers like that will make the correct decision and

1 the results at most of the intersections are good. It
2 works.

3 Q. Now, I just want to be clear because you answered two
4 different ways I think, but I don't want to put words
5 in your mouth. At the end you said most of the time
6 and so let's be clear. Let me be clear. If I'm not
7 clear on this, let me know.

8 Intersection's coming up, 45 miles an hour.
9 This driver does perceive and react in 1.5 seconds per
10 second. This driver is able and does decelerate at
11 11.2 feet per second per second. Can this driver that
12 I hypothesize in this question be caught in a dilemma
13 zone which Gazis describes and which is also described
14 as a third bullet point on the first column of Page 3
15 of Exhibit 2, the ITE paper, if that driver --

16 MS. MARTINEAU: And you're saying that
17 they're at the stopping distance when they first see
18 the yellow light?

19 MR. STAM: Just inside it, right.

20 THE WITNESS: Just inside. There is no
21 dilemma zone for that driver. That driver has a
22 decision to make, and if they're just inside the
23 stopping distance, then they will have enough yellow
24 to proceed through the intersection. They should
25 choose to proceed.

1 BY MR. STAM:

2 Q. All right. Suppose that that driver is going to turn
3 left at that intersection. All the other assumptions
4 are the same as in my last question. Can that driver
5 be caught in a dilemma zone? The driver never exceeds
6 the speed limit, perceives and reacts in 1.5 seconds
7 or less, decelerates at 11.2 seconds per second or
8 faster -- or, excuse me. The faster's not the right
9 word. Decelerates at 11.2 seconds per second. Can
10 that driver be caught in a dilemma zone described by
11 Gazis and also -- and/or in the third bullet point of
12 the first column Plaintiff's Exhibit 2?

13 A. Well, North Carolina practice is not to design yellow
14 times for -- at the end of a protected left turn phase
15 for a driver going the speed limit. The practice is
16 typically to use a speed of 20 miles an hour and
17 sometimes to use a higher speed depending on the
18 conditions. We could talk about those conditions.

19 There's many that a good traffic engineer
20 should look at before making that decision, but
21 typically 20 miles an hour, so the supposition that,
22 you know, we would have a driver approaching it at 45,
23 well, drivers don't approach the end of a protected
24 left turn at 45 miles an hour. That's -- you know, we
25 have a long history, much practice and experience and

1 data that say 20 or so is appropriate for that
2 condition and so our timing of the yellow signal at
3 the end of a protected left turn phase is typically
4 based on that 20 miles an hour speed.

5 Q. Measured where?

6 A. Let me finish. A driver going 45 would have a dilemma
7 zone. That's not something we're, by our standard
8 engineering practice, are designing for. A driver
9 driving 20 will not have a dilemma zone and will use
10 the yellow long enough to eliminate that.

11 Q. Let me repeat my question. Where is the 20 miles per
12 hour measured?

13 MS. MARTINEAU: That's a different -- you
14 haven't asked that question yet, but object to the
15 form of the question. Go ahead and answer.

16 THE WITNESS: The 20 miles an hour would be
17 at the stopping distance. That's going to be
18 typically 100, maybe 200 feet upstream of the stop
19 bar.

20 BY MR. STAM:

21 Q. Does the driver know that?

22 A. Sure. Most drivers have gained the experience, have
23 been through protected left turn phases and made many
24 left turns as they drive through the years, gain
25 experience. This is part of learning to drive. We

1 count on that.

2 As I said before, the driver's integrating
3 information from all kind of sources including looking
4 at the lengths of yellows, and, in fact, you know, I
5 said several times before we count on that with the
6 business of trying to be uniform and give drivers what
7 they expect. Well, drivers have an expectation
8 because they've been through many somewhat similar
9 intersections before and are -- have this sort of
10 embedded after, you know, just a short bit of
11 experience, so, yeah, I think that generally drivers
12 are aware of this and we, traffic engineers, work hard
13 to create that awareness.

14 Q. All right. Are you familiar with the intersection
15 where Lori Millette was cited?

16 MS. MARTINEAU: Do you know which one that
17 is?

18 MR. STAM: Kildaire Farm turning left --
19 going north turning left on Cary Parkway.

20 MS. MARTINEAU: Is it okay, Paul, if I get
21 that traffic signal plan out so he can take a look at
22 it?

23 MR. STAM: Sure, but it actually would be
24 any left turning intersection with a zero grade,
25 90-degree angle.

1 THE WITNESS: And I used to live just down
2 the street from that anyway, down Cary Parkway, about
3 a mile from there. I lived they're for ten years so
4 I'm --

5 BY MR. STAM:

6 Q. What years were those?

7 A. -- very aware of that. I lived there 1992 to 2001 I
8 think in the Kildaire Farm subdivision, so I'm very
9 familiar with --

10 Q. You're familiar with that intersection?

11 A. Yes.

12 Q. We'll probably get into this in more detail later, but
13 suppose Lori Millette has been driving that for years
14 and it's been a four-second yellow change interval and
15 then they decide to make it a three-second interval.
16 You're relying on the yellow change interval. If
17 you're relying on drivers to know what speed they can
18 go differently than the posted speed limit, you see
19 how this might affect drivers?

20 A. A change -- any kind of change out on the road -- a
21 change in the yellow time is a difficult thing. We
22 don't like to do that. We have to do that sometimes.
23 There's, you know, good reasons I'm sure to make that
24 change and other changes. We -- engineers, we weigh
25 the cost of the change, and there will be some, and

1 surprise drivers and such against the benefit from the
2 change, which I'm sure there were many.

3 I would add, too, in addition to relying on
4 the driver's prior experience about how long the
5 yellow is -- well, I think I did say before, too, that
6 there's many other clues that drivers are using and
7 integrating as they make their decisions. One of the
8 big ones is, and applies to that intersection, is the
9 turns are tight. The left turn at that place, at many
10 of our intersections, allows a turning speed of
11 something like 15 to 20 miles an hour.

12 That's very clear in our professional
13 literature, in the design manual that we all use to
14 design the roads, that's the policy on geometric
15 design of highways by an organization called AASHTO,
16 A-A-S-H-T-O, that the speed for a left turn, designed
17 speed, which is on the high side, is going to be
18 something on the order of 15 to 20 miles per hour and
19 could be less if the turn is even tighter, so, you
20 know -- and drivers know this and experience --
21 drivers with experience at that intersection know
22 that, too.

23 Q. Is that the speed approaching the intersection or the
24 approach -- the speed within the intersection?

25 A. That is the speed within the intersection, but

1 there's --

2 Q. Not the approach speed?

3 A. Well, the drivers are in the process -- they're going
4 to need to go 15 to 20 miles an hour on the high side
5 within the turn. Often during the left turn phase
6 they're following other drivers who are going 15 to 20
7 at the most within the turn, and so it doesn't -- and
8 we're only talking about, as I said before, 100, maybe
9 200 feet in front of the stop bar anyway, so, no,
10 we're not designing for somebody to go 45 miles per
11 hour 100 to 200 feet before the stop bar and then hit
12 the brakes really hard to get to 15 to 20 miles an
13 hour to make the turn just past the stop bar.
14 That's -- most drivers will make a much smoother
15 deceleration, will kind of cruise in through that left
16 turn.

17 Let's not forget as well that all the
18 drivers at that place, at all left turn lanes had to
19 shift over from the through lane to the left turn lane
20 before they're making their turn anyway and had to
21 slow down to do that, and sometimes, depending on the
22 intersection and the shape of the taper, that's a
23 relatively -- that movement has to be made relatively
24 slowly, too, so it's just not plausible for drivers to
25 be going 40 through the sort of stopping distance that

1 we're talking about here, 40, 45, whatever, and then
2 slowing down to 15 or 20 during the turn. That
3 just -- that's not what we design for.

4 Q. To be clear, my understanding is there's really two
5 speed limits. One is the posted speed limit, for
6 example, 45 miles an hour, but every driver has -- is
7 forbidden to drive without due care and caution though
8 as to cause accidents, but my question is really
9 different than that. I think you're assuming that all
10 these left turning vehicles are in a cue lined up
11 right there.

12 If a driver has a clear, unimpeded path of
13 the intersection, the signal is green, shows a green
14 arrow are left turning drivers allowed to go the speed
15 limit approaching the intersection so long as they
16 exercise due care and caution within the intersection?

17 A. You know, I guess legally, sure, the speed limit is
18 45, and as long as they stay below 45, I don't think
19 the police department will be able to give them a
20 ticket. That's just not plausible. Again, does it
21 ever happen? Can somebody in a race car take that
22 turn at 45 that we've designed for 20 or less?
23 Probably. Should we set the yellow time for that,
24 that -- again, I really wanted to get into at some
25 point here the negative effects of extending yellow

1 times, but, you know, without extending the yellow,
2 should we be designing for that diver who is sort of
3 ripping into that turn at quite high speed? I don't
4 think so.

5 Q. I understand you want to talk about that. Let me ask
6 you at this point what are the negative effects of --
7 that you see of having yellow change intervals that
8 are, quote, too long, end quote?

9 A. Right. Yeah. Thanks. There are actually two major
10 ones that I could think of, and one is the lack of
11 uniformity, and the MUTCD could not be clearer on this
12 point. It's the reason the whole manual exists. It's
13 a -- the central pillar in the whole highway system is
14 as much uniformity as possible worldwide, nationwide,
15 statewide as much as we can manage because our driver
16 population is so diverse and people are -- we're
17 driving -- trying to accommodate people who have never
18 seen this place for the first time, the uniformity's
19 there, and if we start to allow some places to have
20 yellow times that are more than twice other places,
21 we'll lose that and drivers will not know what to
22 expect, and crashes occur because of that, that lack
23 of uniformity. It's just a central thing to the
24 way -- the standard engineering practice.

25 The second point is with a long yellow,

1 that we lose capacity at the intersection. The
2 reference that we use to calculate that is called the
3 highway capacity manual. It's a standard reference
4 across the U.S. and in many other countries.

5 The equation for capacity at a signalized
6 intersection has only three terms. One of those terms
7 is called effective green time, and that's the part of
8 the signal phase that drivers actually use. Effective
9 green time is the actual green time plus the actual
10 yellow time plus the all-red time. In other words,
11 the full phase minus the loss time. Loss time is time
12 that's wasted. Nobody's going through the
13 intersection. Well, the longer the yellow, the higher
14 the loss time.

15 The highway capacity manual instructs us
16 that loss time at the end of a phase equals the yellow
17 plus the all-red minus two seconds. The longer the
18 yellow --

19 Q. Is it two seconds how long it takes the green people
20 to get going?

21 A. No. That's at the beginning of the phase. That's
22 another bit of loss time called beginning loss time.

23 Q. Please continue. I'm sorry.

24 A. There's two bits of loss time. There's some at the
25 beginning, there's some at the end. Longer yellow

1 means longer ending loss time at the end of the phase,
2 and that's on every phase. So, for instance, at Cary
3 Parkway and Kildaire Farm Road, that signal has
4 basically four phases. If we extend the yellow let's
5 say two seconds each of those phases, that's eight
6 more seconds of wasted time for everybody at the
7 intersection, loss capacity, and then that compounds,
8 of course, over all of the cycles throughout an hour
9 or peak hour and what have you.

10 That loss of capacity is -- not only wastes
11 gas and adds to the carbon emissions and all that bad
12 stuff, but it has a safety effect as well. The cues
13 grow longer at the intersection which leads to more
14 rear-end collisions at the back of the cue. Drivers
15 react to the long cues by starting to cut through
16 neighborhoods, and believe me, in my time as a
17 resident of Kildaire Farm, we worried a lot about
18 drivers cutting through our neighborhoods already at
19 that intersection, and we sure didn't want to lose
20 capacity out there and have even more cut-through
21 traffic. There's all kinds of ways that that loss of
22 capacity turns out, you know, not only to lose
23 efficiency, waste money, waste gas, et cetera, but
24 also has a safety effect as well in lots of different
25 ways, so we engineers struggle hard with this. It's

1 not an easy solution to try to keep that bounded and
2 to try to keep the yellow reasonable and avoid those
3 very nasty negative effects.

4 Q. Let's talk about that. Before I do that, is there a
5 third reason besides lack of uniformity and capacity?

6 A. Those are the two that occur to me here. I can look
7 back at my notes perhaps, but those are the two that
8 occur to me.

9 Q. Let me ask about the effective green at that
10 particular intersection of Cary Parkway and Kildaire
11 Farm that you're familiar with. In a given hour, I
12 would guess the cars approaching from each side get,
13 therefore, somewhat less than 30 minutes of effective
14 green. I don't know how much less than 30 seconds it
15 would be, but subtracting all the whatever you called
16 it, the down time, the two seconds --

17 A. Right, loss time.

18 Q. Loss time. So it would be something less than 30
19 minutes out of every hour. Could you give a ballpark
20 thought? I mean, would it be like 29 minutes of every
21 hour or --

22 A. Roughly speaking, at an intersection like that with
23 typical times, about 10 percent of the time is already
24 lost in that loss time. The remaining 90 percent of
25 the time is split up with maybe -- let me -- I don't

1 like to do math on the fly here, but perhaps --

2 Q. It's an estimate. I'm not looking for --

3 A. Sure. Thirty percent of the time for the east and
4 west through, 30 percent of the time for the north and
5 south through, 15 percent of the time for the north
6 and south left turn, 15 percent of the time for the
7 east and west left turn. I think that adds up to 100
8 percent.

9 Q. Okay. So let's take the driver going east and west
10 that would be affected by my next question. They
11 would have effective green light to go through that
12 intersection of about how much per hour? Something
13 less than 30 minutes but --

14 A. Oh, yeah. Thirty percent of 60 minutes, that's again
15 math on the fly here, but I think that's something
16 like 18 minutes.

17 Q. Okay. So they have 18 minutes of effective green
18 time. Now, Lori Millette's light after a time period
19 of being four seconds allowed for the yellow change
20 interval went to three seconds, and another exhibit
21 you'll see later shows the dramatic results of that.
22 If it were four seconds instead of three seconds, how
23 much would that reduce from the effective time in any
24 given hour for east-west traffic? They had 18 minutes
25 before. If we added back a second for Lori Millette's

1 left turn, in an hour, how many -- well, we could
2 calculate it. In an hour, how many left turn yellow
3 change intervals in Lori Millette's direction are
4 there in an hour?

5 MS. MARTINEAU: Object to the form of the
6 question. What about the all-red?

7 MR. STAM: Well, that doesn't change this
8 question.

9 THE WITNESS: Yeah. Let me --

10 BY MR. STAM:

11 Q. Because you could always -- if you had added a second
12 back for yellow, you could always reduce a second for
13 the all-red and it would amount to the same -- as far
14 as safety is concerned, it would amount to the same
15 thing.

16 MS. MARTINEAU: Objection to the form of
17 the question.

18 BY MR. STAM:

19 Q. My question is if you had four seconds instead of
20 three seconds for cars traveling as Lori Millette's
21 was traveling, how many -- how much time would that
22 detract from the effective green for east-west
23 traffic?

24 A. Well, that's -- if we were only worried about that
25 phase, the left turn for the north and south street,

1 one second taken away -- well, let's put it this way.
2 One extra second of -- added to the north and south
3 left turn takes away that time from everybody else. A
4 typical signal cycle at a place like this is maybe 120
5 seconds. I don't know what it is exactly at this
6 place, but just roughly, so, you know, that's -- one
7 divided by 120 is in the neighborhood of one percent
8 loss of capacity, but, you know, almost always when
9 we're making changes like this, we're also making that
10 same change to the east-west left turn and another one
11 percent there, but --

12 Q. I know, but I'm asking for the east-west driver who
13 has 18 minutes of effective green light every hour.
14 How much effective green time would the east-west
15 driver have per hour if we added one second to Lori
16 Millette's yellow change interval?

17 A. Well, my back-of-the-envelope estimate there would be
18 a one percent loss in capacity for that one second
19 change.

20 Q. Let me do the math here. I can take -- 18 minutes
21 times 60 would give me 11 -- and you tell me if I'm
22 right on this -- 1,140 seconds.

23 MS. MARTINEAU: We don't have a calculator
24 here, Skip.

25 BY MR. STAM:

1 Q. All right. One percent of 1,140 would be 11 and a
2 half seconds, so if -- and you just tell me if this
3 sounds right. Instead of 18 minutes of effective
4 time, the east-west traffic would have 17 minutes and
5 49 seconds.

6 MS. MARTINEAU: We're not going to do math.

7 I mean --

8 BY MR. STAM:

9 Q. Does that sound right, Dr. Hummer?

10 A. Well, for this very rare hypothetical that you're
11 proposing here, sure, that's about right.

12 Q. I mean, east-west traffic would lose eleven seconds --
13 11 and a half seconds per hour. Does that sound about
14 right?

15 A. For that rare hypothetical you're proposing there,
16 sure.

17 Q. It wasn't a hypothetical because they did raise it --
18 lower it from four seconds to three seconds at a point
19 in time, did they not?

20 A. They -- my understanding is that they did, but that --
21 almost always in concert with that they would be
22 changing the phasing -- changing the timing of other
23 phases as well.

24 Q. Which would mean that the north-south traffic would
25 also go from 18 minutes per hour effective green time

1 to 17 minutes and 48 and a half seconds of effective
2 green time?

3 A. Well, right. Everybody around the intersection loses
4 that one percent capacity, not just the east-west
5 through movement, and the -- you know, almost always
6 we'd be changing the yellow time for the east-west
7 left turn as well, that phase, and take away another
8 second there.

9 One thing I want to add here at this point
10 is that the effective capacity loss is not linear.
11 That is to say if we lose one percent of capacity, the
12 effect on delay could actually be much more than one
13 percent, 5 percent, 10 percent, who knows. The curve
14 is not linear. The effects of even a small change in
15 capacity at the wrong time in the wrong place can be
16 quite large in effect to the driver driving through
17 there.

18 Q. For sound engineering in this field, does traffic
19 capacity or safety issues have priority?

20 A. Safety is the number one goal of all transportation
21 agencies.

22 Q. Do you believe that sound physics creates dilemma
23 zones as described by Denos Gazis?

24 MS. MARTINEAU: Do you want to point out
25 what you're talking about so he can look at --

1 BY MR. STAM:

2 Q. Do you believe that sound engineering practices create
3 dilemma zones as described by Denos Gazis in his 1959
4 paper?

5 MS. MARTINEAU: Do you want him to look at
6 that paper? We don't have it in front of us.

7 MR. STAM: He's already told us what it --
8 I'll ask it a different way.

9 BY MR. STAM:

10 Q. Do you believe sound engineering practices create
11 dilemma zones as described in Plaintiff's Exhibit
12 Number 2, Page 3, left column, bullet point number
13 three?

14 A. No. No. Sound engineering practices eliminate
15 dilemma zones as described there. If we apply sound
16 engineering practices, apply the yellow time equation
17 as I've discussed, that all drivers will have the
18 opportunity to make a good decision to get stopped or
19 proceed through.

20 Q. If the judge decides that current engineering
21 practices in North Carolina in fact do create dilemma
22 zones as described in Plaintiff's Exhibit Number 2,
23 Page 3, first column, third bullet point, would you
24 agree that those engineering practices are not sound
25 engineering practices?

1 MS. MARTINEAU: Objection to the form of
2 the question.

3 THE WITNESS: Well, I -- who am I to argue
4 with the judge? We engineers obey the law. If the
5 judge's decision becomes law, we'll adjust to that and
6 obey the law and do what's legally required.

7 BY MR. STAM:

8 Q. According to engineering standards of care, are
9 engineers in traffic signal design responsible to
10 accommodate the requirements of physics and for a
11 range of reasonable driver behavior?

12 MS. MARTINEAU: Objection to the form of
13 the question. Go ahead and answer.

14 THE WITNESS: Well, we certainly can't
15 violate the laws of physics. That doesn't work on
16 earth gravity anyway, and we have to do -- we want
17 to -- we integrate in what we know about human factors
18 and vehicle performance and a whole range of other
19 aspects as well in putting together these kinds of
20 decisions and applying these practices.

21 BY MR. STAM:

22 Q. In the literature on this subject, are you familiar
23 with the term critical distance?

24 A. I've seen it, not a term I would use -- not a term I
25 have used often, but I have seen the term, sure.

1 Q. Is it related to safe stopping distance?

2 MS. MARTINEAU: Objection to the form of
3 the question.

4 THE WITNESS: Yeah, and it -- I think so.
5 Again, the term safe stopping distance, I've seen it
6 out there. I'm not in total agreement with that,
7 either, but I've seen it. I think it is related
8 generally, sure.

9 BY MR. STAM:

10 Q. All right. Does the ITE formula for yellow time for
11 the yellow change interval also embed the formula to
12 compute the critical distance?

13 A. I'll phrase it this way. I think I said this earlier.
14 The ITE yellow time formula as shown here on Page 3 of
15 Exhibit 2 starts from the stopping distance formula
16 that we all use for a wide variety of applications and
17 then use that stopping distance in the way described
18 before, so, sure, this formula starts from the
19 stopping distance formula.

20 Q. In that same formula does changing V in the equation
21 change the length of the critical distance?

22 A. In the stopping distance formula, sure, yes.

23 Q. That same formula and the laws of physics, at what
24 specific location on the road would the traffic
25 engineer measure the V?

1 MS. MARTINEAU: Objection to the form of
2 the question.

3 BY MR. STAM:

4 Q. Where would the -- where must the traffic engineer
5 measure the V? And we sort of touched on that an hour
6 ago. I want to make sure we're still on the same
7 page.

8 A. Right. That's -- the speed is most important at
9 the -- at that stopping distance at that place that we
10 are trying to calculate. It's a bit of a circular
11 process here, is going to do the initial speed study
12 we have to sort of guess where that's going to be,
13 collect our data, then do the calculation of what the
14 actual stopping distance turns out to be. It's
15 difficult to get that exactly right as with any
16 iteration of the process in the first time, but
17 generally speaking we're trying to get the speed at or
18 as near as we can to that stopping distance.

19 MR. STAM: If you'll give me just a moment,
20 I may be able to edit my remaining questions, although
21 they're quite a few. Can you give me a minute here?

22 MS. MARTINEAU: Do you want to go off the
23 record for a few minutes?

24 MR. STAM: Let's take five minutes.

25 MS. MARTINEAU: Okay.

1 (Off the record at 10:52 a.m.)

2 (Back on the record at 10:59 a.m.)

3 MARKED BY THE REPORTER:

4 DEPOSITION EXHIBIT 2

5 10:59 a.m.

6 MR. STAM: Back on the record.

7 BY MR. STAM:

8 Q. Dr. Hummer, suppose the speed limit's 45 miles per
9 hour but a traffic engineer plugs a value for V of 35
10 miles an hour into the ITE yellow change interval
11 formula. Will the resulting yellow change interval
12 allow all drivers traveling greater than 35 miles per
13 hour stop safely using DOT assumptions about
14 perception-reaction time and decelerations?

15 MS. MARTINEAU: Objection to the form of
16 the question. Go ahead and answer.

17 THE WITNESS: No. And let's be clear.
18 That formula didn't allow all drivers to do that
19 beforehand. The formula allowed all drivers to make a
20 decision beforehand, and the formula as you described
21 with that change in speed would create a dilemma zone
22 for those particular drivers with those particular
23 assumptions, but I really must add, as I said before,
24 that drivers adjust, and in my opinion, most drivers
25 going a slightly faster speed than we put into the

1 formula finding themselves in or near that dilemma
2 zone would decelerate faster, would proceed faster,
3 would find a way still to make a good decision and not
4 have to proceed through the -- past the stop bar on
5 red.

6 BY MR. STAM:

7 Q. Okay. Here I'm referring to Walnut Street and Meeting
8 Place, and I wonder if you're familiar with that
9 intersection, the turn into Crossroads Shopping
10 Center.

11 A. I am familiar with that one, yes.

12 MR. STAM: And if you want to bring up,
13 Ms. Martineau, the signal plan for that, that's fine.

14 MS. MARTINEAU: Sure. Hold on.

15 THE WITNESS: We're looking at it.

16 BY MR. STAM:

17 Q. If this road had a 45 miles per hour speed limit, a
18 driver is going to turn left at Meeting Place to turn
19 into the shopping center and is far from the
20 intersection, say two to 300 feet long -- two to 300
21 feet away, the left turn lane is long, over 300 feet,
22 there's no cue waiting to turn left, the arrow is
23 green, can that left turn lane accommodate a 45 miles
24 per hour driver up until the point the driver needs to
25 slow down to proceed safely?

1 A. That driver's probably going to have to slow down to
2 make the move over into the left turn lane. If I
3 recall correctly, that left turn lane is a finite
4 distance, and the driver would have to make a maneuver
5 through the taper there to get into the left turn
6 lane, so some slowing there. The turn is a relatively
7 sharp one. The speed in the turn in this place is
8 probably on average no more than 20 miles an hour,
9 probably average less than that.

10 Q. Does your signal plan show how long the left turn lane
11 is?

12 A. I don't think so. This particular drawing there's a
13 break mark here so we have -- actually I think it's --
14 we could determine from the scale drawing here the
15 length of the full dual left turn lanes. The length
16 of the taper because of the -- where they had a break
17 doesn't look like it could be determined here. We
18 could get -- I think we could scale off and get the
19 length of the full left turn lanes anyway.

20 Q. Well, if there's no cue -- how -- at what point on
21 that signal plan does the driver have to reduce speed
22 to 20 miles per hour?

23 MS. MARTINEAU: Objection to the form of
24 the question.

25 THE WITNESS: The driver's going to have to

1 get speed reduced, and, you know, my estimate would be
2 something less than 20 miles an hour on average in the
3 turn and so I don't know precisely, but some distance
4 before entering the turn the driver's going to need to
5 get slowed down on average past 20, so I don't know
6 what the distance is there, but it will be some
7 distance before the stop bar.

8 BY MR. STAM:

9 Q. We'll come to another exhibit called determination of
10 yellow change and red clearance intervals which is
11 part of the signal design section, transportation,
12 mobility and safety division, DOT, and it says in a
13 note, I'm sure you've seen this, for most left turns
14 assume a speed of 20 miles an hour -- 30 miles per
15 hour, and I'm just trying to ask you as a designated
16 witness -- expert witness for the town, where is that
17 speed to be measured?

18 MS. MARTINEAU: Objection to the form of
19 the question, as if it's to be measured.

20 THE WITNESS: Yeah. And it's difficult to
21 say and it would be difficult for the town engineers
22 to do that as well. It's some distance prior to the
23 stop bar. We -- to do a speed study, we would
24 probably want to go out there and watch it for a
25 while, watch the traffic for a while and try to see

1 where that location is. It's not -- I don't think
2 there's an easy formula application to do this. I
3 should add, too, in this particular place, in this
4 particular case of approach to a protected left turn,
5 that this is a very difficult speed study to perform.
6 There's not -- our current equipment, our current
7 technology is really unsuited to the job of even
8 performing a speed study at this place. Most of the
9 tubes, loops, electromagnetic counting equipment and
10 such that we have doesn't accurately measure speeds
11 below 15 miles an hour so --

12 BY MR. STAM:

13 Q. And is that why the --

14 A. Let me finish, please. This is a, you know, very
15 difficult study to perform, and that is why in most
16 places we're relying on the judgment of the engineer,
17 the engineer's consultant who's very familiar with the
18 area and has made field visits and watched, and their
19 judgment of the speed is probably the best information
20 we have.

21 Q. Looking at that signal plan for Walnut Street and
22 Meeting Place, we've gotten out of scale and it looks
23 like -- on the map itself it looks like in excess of
24 20 feet. Would you take the scale and see if you can
25 estimate the minimum length of that left turn lane?

1 A. Sure. Hang on a second. If I scale it correctly, the
2 full width, dual left turn lane, this is southbound
3 Walnut heading toward Meeting Street, looks to be
4 about 215 feet, and then again it doesn't include the
5 taper which is pretty impossible to measure with this
6 drawing because of the break point.

7 Q. Okay. There are two left turn lanes there, is that
8 correct?

9 A. Yes. It's a dual left turn lane.

10 Q. So you have one left turn lane that goes back even
11 farther, then it doubles at 215 feet, is that about
12 right?

13 A. What I can confirm from this drawing is that the full
14 dual left turn lane configuration is about 215 feet
15 long. I don't know what happens upstream of that.

16 Q. A different question. A road has a 45 miles per hour
17 speed limit, zero grade, perpendicular cross traffic.
18 A driver wants to turn -- intends to turn left but is
19 still far from the intersection, say two or 300 feet.
20 The left turn lane is short, say 100 feet, but there's
21 no cue waiting to turn left. The arrow is green. Can
22 this driver who is still in a common lane travel at 45
23 miles of hour switch to the left turn lane when the
24 left turn lane starts?

25 MS. MARTINEAU: Objection to the form of

1 the question.

2 THE WITNESS: Yeah. I'm sorry. I need
3 that question repeated. I didn't understand it.

4 BY MR. STAM:

5 Q. The road has a 45 miles per hour speed limit sign for
6 the approaching driver, zero grade, perpendicular
7 intersection. The driver intends to turn left but is
8 still far from the intersection, and by that I mean at
9 least two to 300 feet, but the left turn lane is
10 short, say just 100 feet before the intersection but
11 there's no cue waiting to turn left. The arrow is
12 green. Can this driver who is still in the common
13 lane travel at 45 miles an hour then switch to the
14 left turn lane when the left turn lane starts?

15 A. I doubt it. A left turn lane only 100 feet long, that
16 implies a short little taper, and that driver's
17 probably going to have to slow down a good bit just to
18 get themselves into the left turn lane before starting
19 to turn, so that doesn't sound like that they could be
20 traveling 45 at the place you're talking about. You
21 know, again, there's so many factors that work here in
22 real intersections. We can't sit here and second
23 guess what people see out in the field and actually
24 observe, but my guess in that instance you're
25 mentioning, there is no -- they're going to have to

1 slow down a good bit to get into that left turn lane
2 before making their maneuver.

3 Q. Assume the left lane is a center road lane. You know
4 what I mean? Like you have five lanes and the one in
5 the middle -- there's no taper. There's no taper,
6 just a center lane.

7 A. Well, in that case, the pavement markings direct when
8 the driver should enter that lane. There's a -- the
9 pavement markings turn from a yellow -- with a solid
10 yellow with a yellow dashed line beside it, then
11 there's either a gap or the pavement markings turn to
12 a white dash line and then the pavement marking turns
13 to a white solid line.

14 The driver's supposed to maneuver into the
15 left turn lane at either the gap or the white -- I
16 should say that's a white skip line. Either during
17 the gap or the right skip line, so, you know, again,
18 drivers can do all kinds of things. We can't
19 accommodate the 100 percent driver. No, we can't do
20 that. A driver who's performing as intended, as
21 designed, as legal enters that left turn lane either
22 in the skip or the gap, and so that's similar to the
23 situation where there's a curbed median, actually.

24 The reason we do that is that two-way left
25 turn lane almost always exists to accommodate left

1 turns going in the opposite direction into some kind
2 of driveway or side street or something and so it's
3 not like there's an infinitely long left turning
4 deceleration space or cuing space. It doesn't work
5 that way. The two-way left turn lane almost always is
6 accommodating some other use.

7 Q. Assuming that the driver is not violating some other
8 law, is it legal for a driver to travel 45 miles an
9 hour if the posted speed limit is 45 miles an hour no
10 matter which lane the driver is in?

11 A. I don't know. I'd want to consult the lawyer on that.
12 I'm not sure.

13 Q. Do you know any approach to any intersection in North
14 Carolina where the North Carolina DOT posts a
15 different speed limit for a left turning driver as
16 opposed to the through driver?

17 A. I can't think of one. There are a lot of intersection
18 geometries out there. There's a lot of places where
19 left turn drivers are physically separated from the
20 through drivers, and I wouldn't dismiss the
21 possibility of that, but I don't know of one, no.

22 Q. I don't think you've answered this, but maybe an hour
23 ago you did. A 45 mile per hour zero grade road using
24 DOT's assumptions about perception-reaction time,
25 deceleration rate, about how far back from the

1 intersection is the critical distance or the safe
2 stopping distance?

3 A. With a 45 --

4 Q. 45 miles per hour.

5 A. -- speed limit? I believe that -- with DOT's
6 assumptions, I believe that number was 294 feet. In
7 fact, if you hang on for just a minute, I've got that
8 calculation in my file. Hang on just a moment. I
9 don't have to guess. I've got that. Yeah. Right,
10 294 feet.

11 Q. That same route are drivers allowed to go the speed
12 limit 294 feet back from the intersection?

13 MS. MARTINEAU: What road are we talking
14 about?

15 MR. STAM: Well, actually it doesn't
16 matter.

17 BY MR. STAM:

18 Q. Are they allowed to go to the speed limit 294 feet
19 away from an intersection?

20 A. Of course.

21 Q. Okay. A hypothetical for your opinion. Two drivers
22 are traveling side by side approaching an intersection
23 at the speed limit of 45 miles per hour, zero grade,
24 perpendicular intersection. One intends to turn left,
25 the other intends to travel straight through. At the

1 exact same moment, they're side by side, they pass --
2 they're 294 feet from the intersection. Or let's say
3 they're 293 feet from the intersection. Both proceed
4 toward and enter the intersection. The light turns
5 yellow. Both drivers still have their foot on the
6 accelerator. Eventually the left turning driver will
7 slow down to about 23 miles an hour before entering
8 the intersection. The straight through driver will
9 proceed through at a constant rate of 45. Which
10 driver takes the longer amount of time to reach the
11 intersection entry point, the left turning driver or
12 the straight through driver?

13 A. The left turning driver.

14 Q. Did you know that DOT current engineering practice is
15 to give the turning driver less time, not more time?

16 MS. MARTINEAU: For what?

17 THE WITNESS: Yeah.

18 MR. STAM: To traverse the critical
19 distance or the safe stopping distance.

20 THE WITNESS: Well, and that's -- DOT's
21 current practice, as we said, is to -- for an end of a
22 protected left turn phase is to assume a speed of 20
23 to 30 miles an hour, usually 20, for the reasons we
24 talked about, the turning driver's going to have to
25 slow down to likely below 20 or 15 or so during the

1 turn, and the hypothetical that you're posing there is
2 unlikely, that that left turning driver has probably
3 already started to slow down, should be already off
4 the accelerator preparing to get -- make their turn
5 and has hopefully looked up and seen that the green
6 arrow has been on for a while and that noticing that
7 would hopefully reduce their perception-reaction time
8 a good bit and so that --

9 BY MR. STAM:

10 Q. After the --

11 MS. MARTINEAU: Let him finish. Let him
12 finish.

13 THE WITNESS: The situation that you're
14 describing there is -- it seems to me to be a
15 vanishingly remove possibility.

16 BY MR. STAM:

17 Q. Of course, this is after the perception-reaction time
18 question, and I think this is the point. If the left
19 turning driver is decelerating at a rate sufficient to
20 make a safe left turn and the through driver is either
21 accelerating or maintaining the speed at the speed
22 limit, is it not true that the left turning driver
23 will need more time to enter the intersection than the
24 through driver?

25 A. Of course that's correct, but that's -- the left

1 turning driver decelerating means that they should
2 stop. That the correct decision for them would be
3 that they're decelerating anyway, go ahead and get
4 stopped, and I'm sure relative to their stopping
5 distance at that slower speed, that they can decide to
6 get stopped and go ahead and get stopped. So even
7 with the very slow 1.5 second perception-reaction
8 time, that since they're decelerating anyway, they can
9 get themselves stopped.

10 Q. At this point I would like to authenticate or
11 introduce some exhibits, and I think Ms. Martineau has
12 them there.

13 MS. MARTINEAU: I should. I'm not sure if
14 I have them in the order you gave them to me the other
15 day. So go ahead and identify them and I'll grab
16 them.

17 MR. STAM: Can we go off the record for a
18 minute?

19 MS. MARTINEAU: Sure.

20 (Off the record at 11:21 a.m.)

21 (Back on the record at 11:27 a.m.)

22 MARKED BY THE REPORTER:

23 DEPOSITION EXHIBITS 3-12

24 11:27 a.m.

25 BY MR. STAM:

1 Q. I show you what's marked, Dr. Hummer, as Plaintiff's
2 Deposition Exhibit 3 and ask if you're familiar with
3 that.

4 A. Yes, I am.

5 Q. Did you help prepare it?

6 A. No.

7 Q. And with some change in detail, does it express the
8 same basic formula as the ITE formula one determining
9 yellow change interval length using the kinematic
10 model that was in Exhibit 2?

11 A. Yes, it's basically the same.

12 Q. But it has -- if you would, look at Page 1, middle
13 column.

14 A. Okay.

15 Q. Does it also add the red interval formula?

16 A. Yes, yes. That's what it does.

17 Q. On both sides of the equation?

18 A. Yes.

19 Q. Yellow interval and an all-red interval. And do you
20 note that the term V is used in both terms of the
21 equation, once for the yellow term -- yellow change
22 interval and once for the red clearance?

23 A. That's correct.

24 Q. When the same -- is the meaning of the variables in
25 the first term of that equation -- is the meaning of

1 that variable V in the first part of that equation the
2 same as its meaning in the second part of the
3 equation? In other words, where it's V over 2a plus
4 2Gg, it has a certain meaning, whereas W plus L over V
5 has a certain meaning?

6 MS. MARTINEAU: Do you mean does the value
7 need to be the same?

8 MR. STAM: That's my question to the
9 witness, is what is the meaning of V in that equation,
10 is it the same meaning where it is used in two
11 different places?

12 MS. MARTINEAU: Objection to the form of
13 the question. You can answer.

14 THE WITNESS: Yeah. It's the same V, and
15 the assumption here is that the speed stays constant
16 throughout the interest area of this formula.

17 BY MR. STAM:

18 Q. Okay. Would you go to Page 22.

19 A. Okay.

20 Q. Third column, you see an equation there?

21 A. That's equation four?

22 Q. Is that equation four? Yes, equation four. Are you
23 familiar with that equation?

24 A. Not as much as the previous one. I read this paper,
25 but I'd have to confess, I was paying more attention

1 to the information on the yellow than on the red, so
2 familiar with it but didn't concentrate on it.

3 Q. Looking at the introduction to it, it said how to
4 calculate an all-red clearance interval. Would that
5 be an important equation for traffic safety?

6 A. Sure. Yeah. All-red is important to traffic safety,
7 sure.

8 Q. I would like to go to what's been marked for
9 identification as Plaintiff's Exhibit 4.

10 A. Okay.

11 Q. Are you familiar with this document? What is it?

12 A. I actually wrote a chapter in this one so I'm very
13 familiar with it. It's the Traffic Engineering
14 Handbook, sixth edition, from ITE.

15 MS. MARTINEAU: It's excerpts of it.

16 THE WITNESS: Excerpts.

17 BY MR. STAM:

18 Q. Excerpts, yes. And I can't tell -- what chapter did
19 you write?

20 A. I wrote the chapter on how to conduct traffic
21 engineering studies. I don't remember which chapter
22 number that was, but it's not part of these excerpts.

23 Q. It's not part of these excerpts?

24 A. Right.

25 Q. But you're -- are you familiar with the entire

1 handbook?

2 A. Well, yeah. I can't say I've read the whole thing,
3 but --

4 Q. Are you familiar with these two pages that are
5 excerpted here?

6 A. Yes.

7 Q. I'm sorry. I don't have a page number. I don't know
8 why I don't, but --

9 A. You included here Page 412 and 413.

10 Q. Okay. Thank you. Looking at Page 412 toward the
11 bottom -- well, the middle is -- well, it's toward the
12 bottom. The second full paragraph from the bottom
13 that says as can be seen, would you read that for the
14 record. It's just two sentences.

15 A. It's says as it can be seen from the formula above,
16 slower speeds result in higher values of yellow
17 clearance time. When calculating the needed time,
18 consideration should be given to the values for the
19 15th percentile speed, particularly at wider
20 intersections.

21 Q. Is the first sentence of that paragraph correct?

22 A. I don't believe so. I think that the first sentence
23 is -- there's an error in there, and I think that what
24 they're talking about is the all-red time.

25 Q. Instead of the yellow change clearance?

1 A. Instead of the yellow. That's my interpretation, yep.

2 Q. Do you know if this has ever been corrected?

3 A. I don't know.

4 Q. Would you look at what's been marked for
5 identification as Exhibit 5.

6 A. Sure.

7 Q. And I'll represent to you this is prepared by my
8 client, Mr. Ceccarelli. Is it -- do you have any
9 comment on it?

10 MS. MARTINEAU: Well, ask him a question.

11 MR. STAM: That is a question?

12 MS. MARTINEAU: Well, objection to the form
13 of the question. That's not a question.

14 THE WITNESS: I have no comment on it.

15 BY MR. STAM:

16 Q. Do you agree with it? I could take them one by one if
17 you prefer.

18 A. Yeah. I'm -- I guess I'm okay with equation one and
19 two and four as they are. How to go from equation two
20 to equation three, I -- basically my comment was that
21 I would have liked to see more explanation here of
22 how to get from -- I guess it was from equation three
23 to equation four, to remove the changes and get to
24 constants. I felt like it -- you know, for me to
25 fully understand what he's trying to say here, I'd

1 want more explanation.

2 Q. Okay. Are there any terms there you don't understand?

3 And I could suggest -- maybe we could -- I mean, you
4 know what the -- A is acceleration.

5 A. Correct.

6 Q. B is -- I'll proceed. We'll save that for later.

7 Show you what's been marked as Deposition Exhibit 6.

8 A. Okay.

9 Q. Have you seen this before today or --

10 A. Yes. Ms. Martineau showed it to me yesterday.

11 Q. Are these equations correct as far as you know in your
12 opinion?

13 A. They look to be, yes.

14 Q. I show you what's been marked as Plaintiff's
15 Exhibit 7.

16 A. Okay.

17 Q. And I note at the very bottom the critical distance is
18 294 feet long, which is the exact answer you gave
19 previously. Does this equation -- do these equations
20 appear correct to you?

21 A. Again, my discomfort is with the term critical
22 distance. I refer to this as the stopping distance,
23 but that aside, the equation and plugging in these
24 numbers, it appears to be correct.

25 Q. So the stopping distance -- so you would say the

1 stopping distance is 294 feet long?

2 A. I would have called this stopping distance, yes.

3 That's my usual term.

4 Q. Where the speed limit is 45 miles per hour?

5 A. That would be my usual usage, yes.

6 Q. I show you what's marked for identification Exhibit 8,
7 11 pages, excerpts from the Manual on Uniform Traffic
8 Control Devices.

9 A. Okay.

10 Q. The very last page attached, probably should be the
11 very first page because it says Page 1, I'd ask if you
12 would go to that page.

13 A. Yes.

14 Q. If you would look at the middle of the page under
15 guidance, to be effective, a traffic control device
16 should meet five basic requirements, do you see that?

17 A. I do.

18 Q. Can you tell me how a yellow change interval conveys a
19 clear simple meaning?

20 A. Sure. That as I think it was your -- one of your
21 first questions. The yellow change interval says that
22 the green has ended and the red is about to begin.
23 That's in my mind a clear and simple meaning.

24 Q. And can you tell us E, looking at E, how the yellow
25 change interval, the light -- actually I mean the

1 light, not the interval, how it gives adequate time
2 for proper response?

3 A. Sure. That's -- as we talked about before, if we use
4 standard engineering practice and apply the ITE
5 equation with the typical values in place for
6 perception-reaction and deceleration, then a driver
7 operating at those parameters will be able to make a
8 good decision and either get stopped before passing
9 the stop bar or proceed past the stop bar before the
10 yellow ends while using their constant speed, so the
11 adequate time for proper response to me is if the --
12 if we apply the formula, drivers have a chance to make
13 a good decision.

14 Q. All right. This is a multiple-choice question.

15 MS. MARTINEAU: I object to your
16 multiple-choice question, but go ahead.

17 MR. STAM: We'll place the laughter by
18 Ms. Martineau in the record.

19 MS. MARTINEAU: Sure.

20 MR. STAM: And counter laughter by Mr.
21 Stam.

22 BY MR. STAM:

23 Q. This is a-multiple choice question. Does the yellow
24 light give adequate time for proper response to the
25 average driver, all drivers, 85 percent of all drivers

1 or some other way that you would answer?

2 MS. MARTINEAU: Object to the form of the
3 question. Go ahead and answer.

4 THE WITNESS: I'll pick D, and my answer
5 would be that it gives adequate time for proper
6 response to almost all drivers, and as I said several
7 times before, there's just no way we can accommodate
8 with current technology every single driver on every
9 single road in every single position doing every
10 single thing, but almost all drivers would have
11 adequate time for proper response if we follow our
12 standard engineering practice.

13 BY MR. STAM:

14 Q. Dr. Hummer, could you quantify almost all? Again it's
15 a multiple-choice question. Which would be closer to?
16 Would it be 99.9 percent of all drivers, 99 percent,
17 98 percent, 90 percent or some other figure?

18 MS. MARTINEAU: Object to the form of the
19 question. Go ahead and answer.

20 THE WITNESS: Some other figure, something
21 higher than 99.9 percent. I'm basing that on the fact
22 that most drivers don't end up violating red signals,
23 and as I said, even where we have provided adequate
24 time for proper response, some drivers will do things
25 that lead them to violate anyway, but most drivers

1 don't violate, and that's our best evidence to say
2 that we're providing adequate time for proper
3 response, so something far greater than 99.9 percent.

4 BY MR. STAM:

5 Q. All right. Does the ITE yellow change interval
6 formula consider the air brake lag time for trucks and
7 school buses?

8 A. Well, the formula allows a chance for engineers to
9 plug in a deceleration rate. The NCDOT and other
10 agencies, NITE, make suggestions as to what a typical
11 deceleration rate should be. If you follow that
12 typical deceleration rate, then there's a greater
13 chance for a truck or a bus to not be able to
14 decelerate at that typical rate, but in a place where
15 we know that there's a lot of trucks and buses, expect
16 a lot of trucks and buses, expect a lot of trucks and
17 buses, expect a lot of trucks and buses to be
18 operating at the speed limit coming through the
19 intersection at a time, that they could be around the
20 stopping distance here, then an engineer has a chance
21 to plug in his or her own value into the equation.

22 You know, keeping in mind that we're trying
23 to also achieve uniformity. There still is a chance,
24 and all of our main documents allow engineers a chance
25 to customize for individual intersections, and a large

1 number of trucks and buses would be one of those
2 things that, you know, could lead us to customize.

3 Q. Do you know what the lag time is for air brakes to
4 engage after the action by the driver on the brake?

5 A. I don't have that here, no.

6 Q. Do you know whether it's approximately three-quarters
7 of a second?

8 A. I'd have to look that up. I don't know offhand.

9 Q. Let's take the intersection where Lori Millette turned
10 left, and you're familiar with this intersection,
11 Kildaire going north, left on Cary Parkway. If a
12 driver used 1.5 seconds to perceive and the driver
13 happened to be a school bus driver or a truck driver,
14 does that driver get extra time to get through or
15 isn't it the same yellow change interval no matter who
16 the driver is?

17 A. Of course it's the same yellow change interval
18 regardless of who the driver is, but traffic engineers
19 are also conscious of a couple other things regarding
20 trucks and buses, and one of those is that they are
21 driven by professionals with many years of experience
22 and additional driver certification. Another thing
23 we're conscious of is that those professional drivers
24 are hopefully driving somewhat slower than the speed
25 limit and especially that they've looked up and seen

1 that the light has been green for a while, applying
2 that experience and, you know, starting to slow down
3 before they even get close to being at their stopping
4 distance, you know.

5 For instance, truck drivers are routinely
6 asked to survey the road 10 or 12 seconds ahead of
7 where they are, and auto drivers I'm sure don't do
8 that, which leads to the third point, is that truck
9 and bus drivers sit up higher. They've got a better
10 view of the road. There's much less chance that their
11 view will be blocked by a vehicle ahead or if there's
12 a curve in the road their view would be blocked by a
13 sign or a hedge or something, so all of those things
14 together go to my point that I made some time ago,
15 that all drivers use all the information that they
16 have available to them and make these adjustments.

17 The formula is a good one and it covers, as
18 I said, almost all drivers almost all times, and then
19 the times that it doesn't, such as a truck or a bus
20 being in sort of the wrong place, that we expect some
21 of these other things to kick in and a truck or a bus
22 driver to make a good decision for themselves as well.

23 Q. If you go to the next preceding page which appears to
24 be Page 512, and I'm looking at the very end of that
25 page, the standard and guidance, the duration of the

1 flashing yellow interval and the duration of the
2 steady yellow change interval and then below that the
3 guidance of about three to six seconds. Other than a
4 minimum of three seconds and a maximum of six seconds,
5 does this manual have any objective criteria other
6 than engineering judgment or engineering practices?

7 A. Well, my response is that I think their word here is
8 determined and used in engineering practice. That is
9 pretty objective as well. That's --

10 Q. Is there -- in your engineering judgment --

11 MS. MARTINEAU: Let him finish if you
12 would.

13 MR. STAM: I'm sorry. It's a little hard
14 for me to know when he's finished if --

15 MS. MARTINEAU: Oh, I know.

16 MR. STAM: -- he stops talking. I'm not
17 intending to interrupt, I'm really not. I don't like
18 interruptions.

19 THE WITNESS: And I'm trying to compose my
20 thoughts as quickly as I can, too. Sorry about that.
21 But where was I going with that, actually? What I was
22 wanting to say was that the engineering practice in
23 this case is very clear.

24 Almost all traffic engineers would identify
25 that ITE formula and its application with

1 perception-reaction times and deceleration rates,
2 somewhat like we're talking about here, as the
3 standard practice. There is -- in our profession,
4 there's very few times when we actually have such
5 widespread agreements on what we should do and what we
6 should use.

7 There's certainly agencies out there that
8 use, for instance, a constant yellow time, but even
9 those agencies would recognize that the ITE formula is
10 something they should look at and consider before they
11 choose their constant yellow, so in our profession of
12 50 different state DOTs and hundreds of different
13 local transportation agencies, it's hard to get this
14 kind of lock step like we have in the case of the
15 yellow time formula so that in this case, you know,
16 the practice I would argue is pretty objective and
17 clear.

18 BY MR. STAM:

19 Q. Do you -- is there a difference between engineering
20 judgment and engineering practice as used on this page
21 toward the bottom?

22 A. Sure, there's a difference. I'm going to apply my
23 words to it and somewhere in the MUTCD here there may
24 be better definitions and I would certainly defer to
25 those, but my understanding of engineering judgment is

1 a chance for the local engineer to apply all of the
2 knowledge they have about a particular site or
3 particular group of drivers and then make their
4 designs and decisions, engineering practice being more
5 of a particular methodology, a particular formula, a
6 particular algorithm on the way to doing something, so
7 my interpretation, the judgment would be a little bit
8 more localized.

9 Q. Okay. I understand. If the judge should decide that
10 the engineering practices for yellow change intervals,
11 whether it's a steady or a flashing yellow, is
12 contrary to the laws of physics, and I preface that by
13 saying if the judge should so decide, would you agree
14 that it would not be a sound engineering practice or
15 sound engineering judgment to oppose the laws of
16 physics?

17 MR. MARTINEAU: Objection to the form of
18 the question.

19 THE WITNESS: Well, I just -- I don't think
20 we can oppose the laws of physics. You know, as long
21 as we're on earth and dealing with humans and machines
22 and, you know, we're not Star Trekkers, some alternate
23 universe, we can't oppose the laws of physics, so if a
24 judge makes a ruling, we will abide by the law and
25 adjust to that.

1 Let me add here, though, that such a
2 ruling -- no, no. Let me stop there. No. We don't
3 oppose the laws of physics. They apply to us just as
4 well as everybody else on earth.

5 BY MR. STAM:

6 Q. If you would look at Exhibit 9, five pages.

7 A. Sure.

8 Q. This purports to be the same chart over time as a
9 document of the signals in geometric section. Are you
10 familiar with any or all of these iterations of the
11 determination of yellow change and red clearance
12 intervals?

13 A. Well, I reviewed this yesterday. I probably have seen
14 these documents before. Which ones I don't remember.
15 I don't remember quite what the contexts were. I've
16 been doing this kind of work for many years, 20 years,
17 22 years as an engineering professor in North Carolina
18 so I probably saw these before but really reviewed
19 them again for the first time yesterday.

20 Q. Would you be able to speak to the reasons for the
21 changes over time?

22 A. Just generally. These are NCDOT documents, and an
23 NCDOT person would certainly be more qualified than I
24 to talk about that. I think generally speaking there
25 has been movement in our profession toward using

1 the -- what's now the standard practice, the ITE
2 formula, more and more.

3 I think years ago, probably when traffic
4 signals first developed and when yellow first
5 appeared, that the practice was a constant yellow
6 time, and the movement I think through the years,
7 especially let's say up until the mid 2000s decade,
8 was to go more and more toward the application of the
9 ITE formula of course first developed by Gazis in
10 1959.

11 I think the Task Force, 2004, and it
12 resulted eventually in the document that we use as
13 Exhibit 3, that came from maybe a bit of a let's kind
14 of hold the line here, that if we apply the ITE
15 formula, especially on roads with quite high speeds,
16 above 55 mile an hour speeds, we'd get to these
17 excessive yellow times, and I talked about that
18 before, the negative effects that those have.

19 So maybe in the last, oh, let's say five,
20 six, seven years there's been sort of a stabilizing of
21 the practice, but the -- what I would say generally is
22 the practice was going from more use of the constant
23 yellow to more use of the ITE formula with a chance to
24 customize for individual intersections.

25 Q. Would you take a look at Plaintiff's Exhibit 10.

1 A. Sure. Yes.

2 Q. And if you would, take a look at the first page.

3 Well, no. I'm sorry. If you would look -- go back to
4 the fourth page where it begins a document entitled
5 Calculation of Yellow Change and All-Red Clearance
6 Intervals: The North Carolina Experience, do you see
7 that?

8 A. Yes.

9 Q. It appears to me that this document is sort of a
10 working draft or a preliminary version of Exhibit 3.

11 A. I think so. My interpretation would be, and I was not
12 involved in drafting either of these documents so I do
13 not know for sure, but my interpretation is that this
14 Exhibit 10 document is sort of the longer report form
15 that was intended for North Carolina audiences, and
16 then Exhibit 3 was a publication in the ITE journal,
17 which is the journal of the organization, ITE, and
18 goes to a national and international audience and was
19 intended really to tell the rest of the world what the
20 North Carolina task force had done and had come up
21 with, but certainly the shorter version published in
22 the ITE journal seems to be closely based on this
23 longer what I'm calling a report.

24 Q. And my understanding from Greg Fuller who testified
25 Monday is that Steven Click, who is the corresponding

1 author, was actually employed by DOT at time of -- at
2 the time he prepared the report or was somehow
3 involved with the task force. Do you know Mr. Click
4 or Dr. Click?

5 A. I do, yeah. He attended NC State during my time
6 there. I was on his dissertation committee. I know
7 him well. I think that Mr. Fuller is right about
8 that, that Steven was at NCDOT during the days that
9 the task force met and was involved with that task
10 force, yes.

11 Q. If you turn to Page 7 of his -- of that document, I
12 just would like you to comment on the final paragraph,
13 which is not in Exhibit 3, but the paragraph that
14 begins initially the speed subcommittee. Do you see
15 that paragraph?

16 A. I do, yes.

17 Q. Would you read that to yourself and then tell me
18 whether you agree with it, disagree with it or any
19 other comment on it.

20 MS. MARTINEAU: Objection to the form of
21 the question.

22 THE WITNESS: Okay. I've read it. Could
23 you restate your question, please.

24 BY MR. STAM:

25 Q. Do you agree with it, disagree or have other comments?

1 MS. MARTINEAU: Same objection.

2 THE WITNESS: Well, I'm glad that a
3 subcommittee was looking at different options. That's
4 what committees should do. That's what the whole task
5 force was supposed to do, I thought was to look at all
6 the available options for yellow and all-red timing
7 and make recommendations on what the best practice
8 was, so I'm glad they were looking at different
9 options.

10 I guess this is the second sentence here
11 talking about the difficulty of quantifying all the
12 variables, and that's I think I've been trying to say
13 that several ways throughout my deposition here, is
14 that there's so many factors that go into the
15 determination of the speed that we're, you know, best
16 to leave the formula as it is, make a recommendation
17 of sort of a default value, 20 miles an hour, leave
18 some discretion for local engineers to change that to
19 25 or 30 if they think that that's more appropriate
20 but not try to what I would call over engineer and
21 come up with some formula that's -- that we really
22 don't understand, that we really don't have enough
23 data to back it up.

24 Which reminds me, of course, you know,
25 another difficulty here is that we don't do anything

1 out there in the way of changing practices or signs or
2 signals without empirical evidence, without running a
3 test and seeing how it goes in the field, and I think
4 that's sort of implied in the last paragraph here,
5 too, is, you know, it's difficult to quantify all
6 these variables.

7 I said before it's difficult to collect the
8 speed, difficult to quantify all those variables
9 because the experiment would be really difficult the
10 research would be really difficult, and we don't put
11 anything in the field without testing it first,
12 without the empirical evidence, so I think they're
13 kind of hinting at that in this response as well, so
14 I --

15 BY MR. STAM:

16 Q. Looking at the second to the last line there, they're
17 going to come up with a single speed, quote,
18 determined when the vehicle was negotiating the left
19 turn. Do you see that?

20 A. I do.

21 Q. So for the situation of the North Carolina DOT ideal
22 driver turning left, have you ever done the math or
23 could the math be done that shows the difference in
24 location between where a driver must slow down in
25 order to stop and the location where a driver must

1 slow down to a comfortable intersection entry speed?

2 MS. MARTINEAU: Objection to the form of
3 the question.

4 THE WITNESS: You know, I've done some
5 stopping distance calculations if -- that's what I
6 think you were asking.

7 BY MR. STAM:

8 Q. Well, that wasn't what I was asking, but I do
9 appreciate the answer. The V in the equation, if they
10 do it when the vehicle V is negotiating the left turn
11 as in the second to last line of that page, will
12 obviously be different than the V in the initial speed
13 as in Exhibit 2, the 1994 ITE paper. Is that correct?

14 MS. MARTINEAU: Objection to the form of
15 the question.

16 THE WITNESS: Well, no, not obviously.
17 There's lots of cases, I'm sure majority of the cases
18 where drivers kind of cruise through the left turn bay
19 and into their left turn at a constant speed, and
20 especially when they're cued, but even drivers who
21 know that they've got time enough to make their turn
22 and want to make a comfortable deceleration and just
23 kind of cruise through the bay in their turn, so, no,
24 I don't think that's obvious.

25 I think the -- I think the committee's

1 expressing here that they -- that we really don't
2 know, that it's a very complex procedure. It's
3 different at all kinds of intersections. It's
4 difficult to collect the data. It would be difficult
5 to put an equation together that would apply in a lot
6 of places, and when we don't know, let's pick a value,
7 and, again, 20 miles an hour is on the high side for
8 the turn. Most drivers, you know, our data are very
9 clear about this, the data in the paper here are
10 clear, that, you know, most drivers are turning --
11 making a left turn at a speed lower than 20.

12 BY MR. STAM:

13 Q. But for the driver who doesn't see the yellow light
14 right at the stop bar but sees it at some point back
15 from the stop bar at some point, where is the critical
16 distance for the safe stopping distance for that
17 driver who may be going 30 miles an hour at some
18 distance back?

19 A. Well, again, I'm not using the critical point. That's
20 not my terminology. The stopping distance depends on
21 speed, so, you know, where -- a driver approaching an
22 intersection at the speed limit, let's say 45 miles an
23 hour, makes a left turn at a speed on an average of 15
24 miles an hour, so they've got to get slowed down
25 somewhere on the approach to the intersection between

1 45 and 15. It's complex. We don't know what that
2 profile looks like. We don't know where they do.

3 I've given you several reasons to think
4 that most drivers do most of their deceleration before
5 they get into the left turn bay and that the choice of
6 20 miles an hour as our standard practice is
7 appropriate for most of those drivers most of those
8 times, and, you know, I've also agreed that there's --
9 there will be other drivers that will not do what most
10 do, and that's always the case for us. We can't
11 design for the 100 percent.

12 Q. Look at Exhibit 11.

13 A. Sure. Okay.

14 Q. It's four pages, and I'm looking at Page 2, the second
15 page, which is labeled Kildaire Farm Road and Cary
16 Parkway.

17 A. Okay.

18 Q. I'll represent to you where this comes from, that
19 Mr. Ceccarelli got the Excel spreadsheet directly from
20 the town of Cary, that he pushed a couple of buttons
21 on his computer which generated this graph. I
22 wouldn't know how to do it myself, but that's what it
23 appears to be, is a graph of over time the number of
24 citations per month at a particular intersection,
25 northbound turning left on Kildaire Farm Road. Do you

1 see that graph there?

2 A. I see the graph, yeah.

3 Q. And later on we'll look at the signal plans which tell
4 when the plans were approved, but those plans don't
5 show when they go into effect. As a professor of
6 engineering, if you had seen this graph, what would
7 your immediate -- what would your impulsive immediate
8 nonscientific reaction be to looking at that graph?

9 A. That something changed in November, December of 2009.
10 Yeah. Something changed on the road, in the signs, in
11 the signal. Something changed.

12 Q. Before that time there were about two -- well, let's
13 say about an average of 75 violators per month which
14 would mean about two to three a day.

15 MS. MARTINEAU: Are you purporting that
16 that's what this graph shows?

17 MR. STAM: Well, the witness can --

18 MS. MARTINEAU: Because he I mean, he's --

19 BY MR. STAM:

20 Q. Looks to me about 75 a month. Does that look like it
21 to you, Dr. Hummer?

22 A. Yeah. I just have no idea where these numbers came
23 from. You're representing something to me. I have no
24 way to check or verify or --

25 Q. If I'm right, that the numbers came direct from the

1 town of Cary, your answer is totally dependent on if
2 that is true or false?

3 A. Well, and --

4 Q. If it's false, then your -- we'll strike your answer,
5 but --

6 MS. MARTINEAU: Well, no. He doesn't have
7 any foundation for the graph, so all I'm asking you to
8 do is just say, you know, I purport this is what this
9 graph is showing and then ask --

10 MR. STAM: That's what I've done.

11 BY MR. STAM:

12 Q. And, Dr. Hummer, the town of Cary that's retained you
13 as an expert witness in this case, have they not
14 provided you the data for the citations for the
15 intersections in question?

16 MS. MARTINEAU: What data? You mean the
17 number of tickets at the intersections?

18 MR. STAM: Number of citations per
19 intersection per month over time.

20 THE WITNESS: Yeah. I haven't seen those
21 data.

22 Q. Okay. You may find this interesting. Mr. Ceccarelli,
23 after he got a citation, went to the Cary office, saw
24 the Excel spreadsheet on the walls and said, a-ha,
25 engineering error, and my question to you is as a

1 professor of engineering, when you teach students to
2 look for anomalies or things to discover engineering
3 errors, is spikes in graphs something you would look
4 at?

5 MS. MARTINEAU: Objection to the form, move
6 to strike the part of the question that wasn't a
7 question. You may answer.

8 THE WITNESS: I would never jump to the
9 conclusion that there's any kind of error here. You
10 know, first reaction to the graph is that something
11 changed. We're looking at one dimension here. We're
12 not seeing what happened around the rest of the
13 intersection. We're not seeing what happened to
14 collisions. We're not seeing what happened to cues,
15 to congestion, to speeds, to -- you know, there's many
16 dimensions to the performance of an intersection, and
17 before jumping to any kind of conclusion that there
18 was any kind of error here, you'd want to see much
19 more of the complete picture to see what goes on here.

20 BY MR. STAM:

21 Q. Assuming solely for the purpose of a hypothesis that
22 the only thing changed was the time of the yellow
23 change interval went from four seconds to three
24 seconds around December of 2009, and then around July
25 to August of 2010 the town of Cary just cut the camera

1 off, just turned it off. If that -- in those two
2 assumptions are correct, that there was no change in
3 the physical characteristics of the intersection or
4 the abilities of the drivers and only a change in the
5 time, would that change your opinion?

6 A. Well, if that was true, but that's almost never true,
7 and I would go into this doubting that that would be
8 true. It's not usual practice for agencies to go in
9 and change a yellow time in isolation. Almost always
10 that's done with some other package of improvements.
11 What I happen to know about this intersection is that
12 flashing yellow arrow was installed at some point in
13 that time frame. I don't know if it was exactly
14 November and December of '09, but sometime in the late
15 part of that decade.

16 Were other changes made, that's -- seems to
17 me highly unlikely that that's the only thing that
18 changed as a person who's made a big part of my career
19 on research. I have to say that that's a vanishingly
20 small possibility. We go around looking for times
21 when agencies only change one thing so that we can
22 measure them, and we have a hard time finding those.
23 This would be a rare and special case indeed if that
24 were the case. It might be. I don't know, but I
25 doubt it. Almost always it's -- a change in yellow is

1 made as part of the package.

2 Q. I mean, you would not, for example, think that maybe
3 in December of 2009 all the drivers around Cary
4 suddenly got a death wish to start running red lights,
5 that driver behavior suddenly changed?

6 A. I agree with you with that, and I've written about
7 that before and I've said that many times in class,
8 that our driver population and practices tends to be
9 one of the most stable things that we deal with,
10 and -- but I've also said that's by design. That's
11 because we try to promote uniformity and get those
12 messages out there.

13 We have succeeded to a large extent and
14 that's what you see, and I agree with you that one of
15 the last things we would suppose is that the driver
16 population or its behavior changed drastically. I
17 agree with that, but let's, you know, bring that back
18 and say that's by design, that's what we intend, that
19 just doesn't happen.

20 Q. I'd like to look at the first page of that exhibit
21 which is Cary Town Boulevard and Convention Drive.

22 A. Okay.

23 Q. Which again I'll represent to you is a graph of data
24 from the town of Cary and that at a certain point
25 around March of 2010, the town of Cary increased the

1 yellow change interval from four seconds to 4.5
2 seconds, which seems like a very small change, just a
3 half a second, but does it appear to you that the
4 number of violations go down significantly when they
5 corrected their -- and I assume it was a correction or
6 they wouldn't have done it, when they corrected their
7 yellow change interval by only a half a second?

8 MS. MARTINEAU: Objection to the form of
9 the question. He can look at the graph and the graph
10 shows what the graph shows. You purported it to be
11 what it is.

12 THE WITNESS: A lot of this, if it is what
13 you say it is, then, again, I -- my reaction is that
14 something changed, and, again, my instinct is based on
15 my many years of experience here in the profession and
16 as a researcher, is that almost always that change was
17 not in isolation, that there were other things
18 happening at this time, and, you know, that's what
19 makes a good research project or a paper that's
20 capable of being published in the peer review
21 literature in engineering is that we are able to
22 eliminate all those other causes and get down to, you
23 know, just one thing or one thing we're sure of that
24 changed, and, you know, these data not coming from a
25 peer review paper, I'm kind of doubtful that that's

1 the case. What I go into it thinking about here is I
2 look at these data.

3 BY MR. STAM:

4 Q. Assuming only for purposes of discussion what our --
5 Plaintiff's contention is, is that the previous
6 traffic signal plan assumed the speed limit of 35
7 miles per hour when the actual speed limit was 45
8 miles an hour and Mr. -- actually the town prepared a
9 plan to change it before Mr. Ceccarelli got his
10 citation, but then it wasn't actually approved by DOT
11 and put on the ground until after he got his citation.
12 So just for purpose of discussion, the only change was
13 the town of Cary recognized that the signal plan was
14 incorrect by having the wrong value for V in the
15 equation, using 35 miles an hour instead of 45, when
16 in fact there was no change of the actual speed limit
17 but they just discovered a mistake.

18 So if the judge should find that that was
19 the only thing that changed at the point when it went
20 way down in March of 2010, and, indeed, the judge has
21 limited our class to those before that time it was
22 corrected, would that graph not show you that the
23 number of violations goes up or down much more than
24 linearly? I think you mentioned this when we were
25 talking about the green time, that a one-second change

1 could be much more than a -- geometric instead of
2 linear. Do you understand what I'm saying,
3 Dr. Hummer?

4 A. That part, yes.

5 Q. Okay. So, for example -- for these first two pages,
6 it seems like for Kildaire Farm Road and Cary Parkway
7 that a mere one-second change out of four raises the
8 number of violators six, seven, eight times, and in
9 Mr. Ceccarelli's case, the first page, a mere half a
10 second reduction or increase in this yellow change
11 interval drastically decreases the number of
12 violators.

13 MS. MARTINEAU: Do you have a question?

14 BY MR. STAM:

15 Q. The question is do you agree that that's a geometric
16 result rather than a linear result?

17 MS. MARTINEAU: Objection to the form of
18 the question, misrepresented facts. Go ahead. I'm
19 just putting my objection.

20 BY MR. STAM:

21 Q. Mr. Ceccarelli says I may not have used the right
22 words.

23 MS. MARTINEAU: Objection to the form of
24 the question, misrepresenting --

25 BY MR. STAM:

1 Q. Dr. Hummer --

2 MS. MARTINEAU: Wait. Let me put my
3 objection in. Objection to the form of the question,
4 misrepresenting facts not in evidence. Go ahead.

5 MR. STAM: The question was objectionable,
6 I agree with you, but I would like to know Dr.
7 Hummer's answer to my objectionable question.

8 MS. MARTINEAU: If there was a question. I
9 didn't really see a question in there, Skip, but go
10 ahead.

11 THE WITNESS: What I see in this graph is a
12 change in the case of the -- Page 1, Cary Town
13 Boulevard and Convention Drive, it looks like the
14 change happened around February or March of 2010. The
15 shape of the change does not appear to be linear.
16 What particular shape it is, who's to say.

17 One thing I would want to point out is that
18 we don't know what happened after December of 2010 or
19 what would have happened if the cameras would have
20 stayed on, and drivers adjust, and it's quite
21 possible, and it happens in all kinds of cases that we
22 see in traffic engineering, that the agency changes
23 something on the road, the drivers react to it not
24 well for the first few weeks, months, and then a
25 gradual return to the -- what you might say typical

1 levels.

2 BY MR. STAM:

3 Q. In that duration --

4 A. Sorry. I'm grabbing some water. I've got something
5 else. We've got a term for that. That's called the
6 feedback mechanism. That's a term I think that's out
7 of psychology or human factors, one of the other
8 sciences that we use, and it is the process of drivers
9 adjusting to what changes out there and then returning
10 back to their level, so, unfortunately, in this case
11 we don't get to see whether drivers would have, you
12 know, reverted back to that level that we were seeing
13 before, maybe they would have, maybe they wouldn't,
14 but we don't get to see that.

15 Q. Are you talking about Page 1 or Page 2?

16 A. Page 1.

17 Q. That one never got turned off, but are you referring
18 to the phenomena that's noted on the document,
19 determination of yellow change and red clearance
20 intervals? It's in a couple of the exhibits you've
21 already talked about. It's that one -- for example,
22 Exhibit 9, which is five pages of the most current
23 version. It's also in Exhibit 3, that inset formula.
24 In the second to last note it says that consider
25 adding a note to the plan to direct field forces to

1 reduce the time incrementally.

2 MS. MARTINEAU: Where are you looking at?

3 BY MR. STAM:

4 Q. Do you know which exhibit I'm looking at?

5 A. Exhibit 9 which is the NCDOT five-page --

6 Q. I would be looking at the last page of that.

7 A. Okay.

8 MS. MARTINEAU: What's the date of that one
9 you're looking at?

10 MR. STAM: July of '09.

11 MS. MARTINEAU: Okay.

12 BY MR. STAM:

13 Q. And in the second column under notes, do you see the
14 second to last note?

15 A. Yes.

16 Q. If you could just scan that for a sec.

17 A. Right. Yeah. Exactly. That's -- the idea is when we
18 make a change to anything, yellow time, red time,
19 green time, signing, geometry, almost any kind of
20 change on the highway, drivers almost universally act
21 badly toward it. They don't like change.

22 That's the theme here. We try to keep
23 things uniform. When we change, we try to monitor
24 that, and if it's a large change and it's reaction is
25 very bad, we try to make -- you know, kind of break

1 that up and -- I like their word here, is to reduce
2 the time incrementally. That is a little bit at a
3 time to try to ease the transition there. That's
4 standard good practice.

5 Q. Using that principle, would you go back to Exhibit 11,
6 the second page which is the graph of citations at
7 Kildaire Farm Road and Cary Parkway.

8 A. Sure.

9 Q. Lori Millette.

10 A. Sure.

11 Q. Going from four seconds to three seconds and knowing
12 that 1.5 of that is perception change, you're really
13 going from 2.5 seconds to stop or to proceed through
14 to 1.5 seconds to stop or proceed through, is that
15 correct?

16 MS. MARTINEAU: Objection to the form of
17 the question.

18 THE WITNESS: I don't know what that --
19 where that 2.5 and 1.5 came from.

20 BY MR. STAM:

21 Q. It would be four seconds minus 1.5 is
22 perception-reaction time equals 2.5 stop or proceed
23 time.

24 MS. MARTINEAU: Objection to the form of
25 the question.

1 BY MR. STAM:

2 Q. And then for three seconds, minus 1.5 would leave you
3 1.5 seconds to actually stop or to continue proceeding
4 safely into the intersection.

5 MS. MARTINEAU: Same objection.

6 THE WITNESS: Yeah. That's a -- not the
7 way the formula's intended to be applied, but okay.

8 BY MR. STAM:

9 Q. I may have misstated it, but you understand the point
10 I'm trying to make? That to go from four seconds to
11 three seconds is not a 25 percent decrease in your
12 time to brake or time to enter the intersection if
13 you're not braking. Instead, it's almost a 40 percent
14 reduction from 2.5 to 1.5.

15 MS. MARTINEAU: Objection to the form of
16 the question. Just because that's the value of
17 deceleration, he's already testified that's not what
18 most people -- you know, 11.2 is not most people's --
19 excuse me. 1.5 is not most people's -- it doesn't
20 take most people 1.5 seconds to make a decision
21 whether they're going to stop or go.

22 BY MR. STAM:

23 Q. Are you able to answer the question, Dr. Hummer?

24 A. I'm still not particularly understanding the question.
25 Let me try to answer it this way. Three seconds is

1 plenty, standard engineering practice. They meet the
2 practice. They did what they should have done there.
3 Previously they had four seconds, don't know why,
4 not -- maybe the four seconds was there from some
5 previous practice, not sure why that was there, but
6 the change to three seconds, three was still meeting
7 the standard practice. It was adequate. It would
8 have worked, provided enough time for the vast
9 majority of drivers to make a good decision.

10 Q. Well, Dr. Hummer, looking at your Exhibit 9 again,
11 five pages, up until March of '02, wouldn't the yellow
12 change interval in seconds be at least 4.7 seconds?

13 MS. MARTINEAU: For through or for left
14 turns?

15 MR. STAM: For -- well, I don't think this
16 one has a separate -- wait. I'm sorry. Sorry. I
17 withdraw that. Go back to -- well, for either one.

18 MS. MARTINEAU: Objection to the form of
19 the question. I think you need to restate it.

20 MR. STAM: I mean, look. It has -- for
21 anything -- if you look at the first sheet, for any
22 speed less than 40 miles an hour, yellow interval
23 change in seconds, 4.0.

24 MS. MARTINEAU: What sheet are you looking
25 at?

1 MR. STAM: That's true on sheets one, two,
2 three, so even if you're saying it's 20 miles an hour,
3 until you got to '05, the minimum was four seconds.

4 THE WITNESS: Again, these are NCDOT sheets
5 and the question is better directed toward an NCDOT
6 person, but let me take a stab at it. The first sheet
7 in Exhibit 9 from October of 1999 does not seem to
8 say -- well, I take that back. On the right side,
9 even though the first sheet, the last paragraph says
10 for most left turn lanes assume the speed of 20 miles
11 an hour for high-speed locations with turning angles
12 greater than 90 degrees, higher speed may be used, so
13 it's unclear from this first sheet what NCDOT
14 personnel are supposed to do with it, but the note
15 directing people to use 20 miles an hour implies that
16 they should be plugging that into the ITE formula and
17 using what comes out of that formula at that time.

18 The second page of this exhibit has that
19 same note to assume a speed of 20 miles an hour, and
20 the second page is from May of 2001. The third page
21 from March of 2002 has a note at the bottom of the
22 left column. It says for separate left-turn phases
23 use 4.0 seconds, and it appears to be the first time
24 that that appeared, but actually it appeared on the
25 second sheet as well, but on this third page from

1 March of '02, they also have the note about 20 miles
2 per hour.

3 So those first three sheets I'm going to
4 conclude are unclear and giving sort of contradictory
5 advice, but the 20 mile per hour note on there shows
6 that -- or implies use the formula with 20 miles an
7 hour.

8 BY MR. STAM:

9 Q. Let me go back to Exhibit 11 and sheet two, and
10 hopefully this will be my last question if I'm able to
11 express it so you can answer it. You see which one
12 I'm talking about, Kildaire Park Road and Cary
13 Parkway?

14 A. I've got it.

15 Q. From that graph, would you hypothesize, I won't say
16 conclude because you might want to do further
17 investigation, would you hypothesize that the town of
18 Cary followed the advice or the notes on that
19 determination of yellow change interval to make the
20 change from four seconds to three seconds gradually in
21 increments of two-tenths of a second per week?

22 MS. MARTINEAU: Objection to the form of
23 the question. He has a lack of foundation. Answer if
24 you know.

25 THE WITNESS: Yeah. I don't know what else

1 was going on out there at that time. I would need to
2 know a lot of other things about that intersection.
3 Where I sit right here, the people that know the most
4 about that intersection and how it's operating are the
5 town traffic engineers, and I'm going to defer to them
6 to make the best judgment they can about how to make
7 that change. There's certainly, you know, a custom in
8 our profession, and that note that you pointed out,
9 there's reasons to think about making changes
10 incrementally certainly, but I'm in no position to
11 second guess that from here. They know better. They
12 know their intersection. They know their drivers.
13 They know what they're trying to accomplish, so that's
14 got to be left up to the locals.

15 BY MR. STAM:

16 Q. One follow-up question on that and then I'll go to my
17 next exhibit. Citations for red light of violations
18 in Cary punish drivers with a \$50 penalty. Do you
19 think that drivers should be punished for engineering
20 changes?

21 MS. MARTINEAU: Objection to the form of
22 the question. They get violations for running red
23 lights.

24 THE WITNESS: Yeah. That's -- that is my
25 answer. They get violations for running red signals.

1 They get violations for disobeying the law.

2 BY MR. STAM:

3 Q. On that sheet were the drivers who entered that
4 intersection after the change any more culpable than
5 the drivers who entered that intersection before the
6 change?

7 A. Both sets of drivers violated the law.

8 Q. Go to Exhibit 12.

9 A. Okay.

10 Q. Are you familiar with that document?

11 A. No. This is another one I just saw yesterday.

12 Q. We may be finished. If you'd just give us about two
13 minutes, I think I'm about finished unless I consult
14 and have one more question.

15 MS. MARTINEAU: Do you want to go --

16 MR. STAM: I'm sorry. We are finished. We
17 are finished.

18 MS. MARTINEAU: All right. I'd like to
19 take a break. I do have a couple of questions. Do
20 you want to take five minutes?

21 MR. STAM: Sure. Just un-mute when you're
22 ready to go.

23 MS. MARTINEAU: Okay.

24 (Recess taken at 12:33 p.m.)

25 (Back on the record at 12:54 p.m.)

EXAMINATION

1
2 BY MS. MARTINEAU:

3 Q. Dr. Hummer, as you know, my name is Elizabeth
4 Martineau. You've been designated by me on behalf of
5 the town of Cary to serve as an expert witness in this
6 case. I know we -- Mr. Stam attached a copy of your
7 current CV to this deposition, but would you please
8 talk about your education and experience with traffic
9 signal design.

10 A. Sure. Yes. Education, bachelor's and master's
11 degrees in civil engineering from Michigan State
12 University with a course in project work in traffic
13 signals, Ph.D. from Purdue in civil engineering with a
14 course in project work and traffic signals, and my
15 dissertation was on leading versus lagging left turn
16 indication at traffic signals, so dissertation on
17 really almost this topic, and then two and a half
18 years as an assistant professor of civil engineering
19 at UNC Charlotte teaching and doing research in
20 several areas of transportation operations and safety
21 and design, many of them related to traffic signals,
22 and then 20 years as a professor at NC state, again
23 with research and teaching in many areas of operations
24 and safety and design related to traffic signals.

25 Q. Okay. Are you a licensed engineer?

1 A. Yes.

2 Q. Where are you licensed?

3 A. Professional engineer in North Carolina.

4 Q. Do you know in North Carolina whether traffic signal
5 plans can be signed and sealed by someone other than a
6 professional North Carolina licensed engineer in North
7 Carolina?

8 A. No. They have to be sealed by a North Carolina PE.

9 Q. I wanted to ask you -- you talked -- let's first look
10 at, if you would, the excerpts of the Manual of
11 Uniform Traffic Control Devices that have been
12 identified by Mr. Stam as Exhibit 8, and if you
13 would -- are you familiar with the Manual of Uniform
14 Traffic Control Devices, the 2009 version?

15 A. Yes.

16 Q. All right. Do you use the Manual of Uniform Traffic
17 Control Devices in your role as a professor teaching
18 traffic signal engineering to students?

19 A. Often, yeah, teaching and research.

20 Q. Okay. And there are -- if you look at Page 485, there
21 are -- there's headings called guidance and standard
22 and option. Do you see that?

23 A. Yes.

24 Q. What is the difference between what MUTCD means by
25 standard versus guidance versus option?

1 A. Standard is the sort of highest level, the things that
2 we must do. Basically the law requires us to do those
3 things. Guidance is the next level down from that.
4 Guidance is a should whereas standard is a shall. A
5 should is a very strong bit of information. If -- as
6 an engineer, if we're not following the guidance, we
7 better have a darn good reason. We better have done a
8 study and have some data and have some justification
9 ready report for the file. If we violate something
10 that's a guidance and a collision happens because of
11 that violation, we're very vulnerable to a lawsuit and
12 being held liable for that, so guidance is quite
13 strong. Support is the -- or option, or the next
14 lower level, option is to allow us to do something,
15 and it's a good idea to have documentation if we don't
16 follow an option but probably not going to result in a
17 successful lawsuit, not going to be liable, and, of
18 course, support is just other information that we
19 should be aware of, so it's a hierarchy of strength.

20 Q. Okay. And for what is the Manual of Uniform Traffic
21 Control Devices, what is the standard for determining
22 the yellow duration or the yellow change interval
23 according to the MUTCD 2009 edition?

24 A. Well, the key sentence there on page 485 is the
25 duration of the yellow change interval shall be

1 determined using engineering practice.

2 Q. And is there also then a guidance for determining the
3 duration of yellow change intervals on the 2009 MUTCD?

4 A. Back a few pages, flipping through here, Page 489,
5 toward the top of Page 489 provides the guidance that
6 yellow change intervals should have a minimum duration
7 of three seconds and a maximum duration of six
8 seconds.

9 Q. Okay. If you would turn your attention to the last
10 page of Exhibit 8 that says 2009 edition, Part 1,
11 general.

12 A. Yes.

13 Q. Okay. You were asked questions regarding under
14 Section 1A.02, principles of traffic control devices,
15 guidance. What is your understanding of how the
16 yellow duration or the yellow change interval should
17 meet Guidance D, command respect from road users?

18 A. Yeah. That's a really important one for us that we
19 should not skip over. The command respect really gets
20 to the business of lengthening the yellow and the
21 almost universal concern among traffic engineers that
22 if we provide too long a yellow, that drivers will
23 start to treat the yellow as if it was green and then
24 we'll be in a tough spot of trying to convey when we
25 really mean it, when the drivers really should pay

1 attention to a yellow.

2 Lengthening the yellow has an excellent
3 chance of eroding that respect that we currently now
4 have for the yellow time, and so D there under
5 guidance is a very important one that we all as
6 engineers have in mind and try to maintain that
7 respect.

8 Q. And are you familiar with your -- well, in your past
9 role of teaching -- when did you stop -- when did you
10 change from NC State to Wayne State University?

11 A. I moved here the start of fall semester, which was the
12 middle of August of 2012.

13 Q. So when was the last time you were teaching North
14 Carolina students traffic signal engineering?

15 A. I taught them during the summer of 2012.

16 Q. Okay. And are you familiar with the general standard
17 practice of traffic signal engineering in North
18 Carolina?

19 A. Yes.

20 Q. And how are you familiar with that?

21 A. As a teacher and as a researcher. I've never put my
22 PE stamp on a set of signal plans, but I have taught
23 this material for upwards of 23 years and not only to
24 our students at NC State but also in short courses in,
25 for instance, the PE review class where people go to

1 review for the exam to become a PE. For many years I
2 taught the material on signal timing, and yellow time
3 and all-red time is a standard question on the PE
4 exam. So I would teach, you know, not only our
5 graduate and undergraduate students but professional
6 engineers or PE wannabes on how to do these things,
7 research-wise as well as a number of projects having
8 to do with signals, signal timing, signal operation,
9 red light running cameras and other aspects of
10 signals.

11 Q. You also indicated you were a member of the -- of ITE.
12 What does ITE stand for again?

13 A. It's the Institute of Transportation Engineers.

14 Q. What is that?

15 A. It's an organization of about 15,000 members worldwide
16 that try to promote the profession, conduct research,
17 publish documents that we all need, establish
18 standards and recommended practices. It's really our
19 professional organization.

20 Q. Are you familiar with the recommended practice ITE has
21 promulgated for the calculation to determine yellow
22 change intervals?

23 A. Sure. Yeah. We looked at that before most
24 prominently in the traffic engineering handbook.
25 That's an ITE publication.

1 Q. Okay. Is there -- from your experience as a North
2 Carolina professional licensed engineer as well as
3 your role as an educator of engineers and your role as
4 a member of ITE, is there much or any disagreement
5 regarding what the formula should be for determining
6 the length of yellow times?

7 A. There's no disagreement that I know of. There are --
8 there have been a series of research projects through
9 the years to look at the values that we enter into the
10 equation, the deceleration rates, the
11 perception-reaction times. That research continues.
12 It's good to have that. We keep trying to come up
13 with the best recommendations for those values, but as
14 far as the formula goes, I know of no disagreement out
15 there.

16 This is -- and I think I said this before.
17 In my world, in the traffic engineering profession,
18 this is about as close to universal agreement as
19 anything that we do. It's along the lines of that,
20 you know, stop signs should be red kind of thing.
21 It's -- you know, almost all of us agree on it.

22 Q. Can you take a look at the document that shows the
23 North Carolina DOT -- the one that shows the
24 calculations, NCDOT calculations. Let's see. It's
25 exhibit -- let me --

1 A. This one?

2 Q. Yes. Take a look at Plaintiff's Exhibit 9. And you
3 testified that this is an NCDOT internal document as
4 far as you know, is that right?

5 A. Yes.

6 Q. And are you also familiar with NCDOT's recommended
7 practice of using 1.5 seconds for perception-reaction
8 time?

9 A. Yes.

10 Q. And is 1.5 seconds a more forgiving or lenient time
11 than the recommended ITE of 1.0 seconds?

12 A. Yeah. Recommended ITE and other agencies. Many use
13 one, so the 1.5 seconds perception-reaction time is
14 more lenient.

15 Q. Are you familiar with the perception-reaction time
16 that professional engineers -- excuse me, professional
17 traffic signal engineers use currently in North
18 Carolina currently?

19 A. I think it's the 1.5 seconds.

20 Q. Does that meet engineering practices as far as --
21 well, does that meet engineering practices, using 1.5
22 seconds as a perception-reaction time?

23 A. Yes. Yes, it does.

24 Q. Is there anything controversy in the engineering
25 community of traffic signal engineers of using a 1.5

1 perception-reaction time?

2 A. If anything, there's maybe a feeling out there that
3 it's overly generous. I don't have any data on this,
4 but I would guess that, you know, most agencies
5 actually use the 1.0, so, again, it's on the lenient
6 side.

7 Q. Sure. But for North Carolina, it's your understanding
8 that 1.5 is a general accepted practice that traffic
9 signal engineers use when determining
10 perception-reaction time?

11 A. Yes.

12 Q. Okay. Now, are you -- we talked a little bit about
13 the North Carolina section of ITE Task Force, and you
14 were not a member of that task force, correct?

15 A. I was not.

16 Q. Were you aware that they -- that such a task force was
17 looking at the practices of North Carolina traffic
18 signal engineers in determining yellow and red times?

19 A. Yes, I was aware of the task force, yes.

20 Q. Do you know whether or not when the task force came
21 out with its report and later when Steven Click wrote
22 his ITE publication, what did the publication
23 recommend regarding the length -- excuse me, regarding
24 how to determine the length of yellow change intervals
25 for dedicated left turns?

1 A. To use the standards ITE equation and to use a speed
2 of 20 miles an hour in most circumstances but to
3 recommend that engineers could use a speed higher than
4 that up to 30 miles an hour if they felt that that was
5 more appropriate.

6 Q. Okay. And Mr. Stam showed you on Exhibit 9 some
7 earlier editions of the change in clearance interval
8 published -- or change in clearance interval with a
9 document from the signals and geometric section of
10 North Carolina DOT, and some versions, for example,
11 the 5-01 version, indicates use a four-second yellow
12 change interval for protected left turns. Do you see
13 that?

14 A. I do.

15 Q. And then after the task force came out with its
16 recommendation that you just discussed, do you know
17 when that recommendation came out?

18 A. It was somewhere around the 2004, five time frame.

19 Q. If you take a look at the change in clearance interval
20 7-05 version from NCDOT signals and geometric session
21 on the notes, does the 7-05 document continue to say
22 that the minimum left turn yellow duration for
23 dedicated left turns should be at least four seconds?

24 A. No. I think that -- I don't see that in this -- on
25 this page, no.

1 Q. And would that be consistent then with the
2 recommendation from the North Carolina section of ITE?

3 A. Right. Right. That's -- and what I said before, what
4 I thought was generally the trend in the profession to
5 go away from the sort of, you know, more constant
6 value to applying the formula with the typical speed
7 of 20, so, yep, that's consistent with the task force.

8 Q. Okay. And is it -- are you familiar with prior to
9 2005 what the traffic signal engineering practice in
10 North Carolina was for using as a speed value when
11 determining -- when plugging in the equation and
12 determining the length of yellow turn intervals for
13 protected left turns?

14 A. I think most everybody used 20 miles an hour even back
15 then as well, and the prior pages had that note in
16 there that we've looked at before, but my recollection
17 is that that was the typical value prior to 2005.

18 Q. Okay. And is the -- is the 7-05 document that has the
19 yellow change interval equation and also indicates for
20 left turns without a separate phase -- excuse me.
21 Where it says for most left turns assume a speed of 20
22 miles to 30 miles an hour, is that -- does that meet
23 engineering practices in North Carolina for July of
24 2005 for traffic signal engineers?

25 A. Yes.

1 Q. Is that a standard practice for North Carolina?

2 A. Yes.

3 Q. Are you aware of other jurisdictions that use an
4 assumed speed lower than the speed limit for
5 calculating the length of yellow times for dedicated
6 left turns?

7 A. I think there's some that use 15 miles per hour,
8 actually.

9 Q. Now, do traffic signal engineers typically design for
10 trucks and buses with air brakes?

11 A. Well -- in an approach to a yellow signal?

12 Q. Yes.

13 A. No. They usually don't.

14 Q. Is that common practice in North Carolina among
15 traffic signal engineers?

16 A. Right. Right. It's common practice not to design --
17 I mean, like I said before, they're on our mind, we're
18 thinking about them. They're an important part of the
19 vehicle population, but they don't appear directly in
20 the equation. We have other ways that we believe that
21 they adjust successfully and manage not to go through
22 red signals.

23 Q. Is the braking distance for tractor-trailers or buses
24 calculated in your experience in the equation for
25 determining yellow change intervals that engineers who

1 are members of ITE use?

2 A. No.

3 Q. And is that practice good or is that practice the
4 standard of -- is that practice a standard practice
5 among North Carolina traffic signal engineers?

6 A. Yes.

7 Q. Now, earlier Mr. Stam asked you a question about if an
8 engineer calculates a yellow time that creates a
9 dilemma zone as Mr. Stam defined that, would that be a
10 good engineering practice, and I have a couple of
11 follow-up questions for you.

12 What again is your definition or what is
13 the definition that we saw in the materials today for
14 dilemma zone?

15 A. It is a place on the road within which a driver does
16 not have a good option for reacting to the start of a
17 yellow signal, cannot proceed through the intersection
18 at a constant speed without running the red light and
19 cannot get stopped before the stop bar at the
20 perception-reaction time and the deceleration rate
21 that we use.

22 Q. Okay. And for some drivers, even using good
23 engineering practices, some drivers just based on
24 their characteristics of driving could be caught in
25 the a dilemma zone, is that correct?

1 A. Some drivers based on their characteristics, sure,
2 yeah, they could be in a dilemma zone.

3 Q. If such a driver was in a dilemma zone, that does not
4 mean that the traffic signal design engineer had a bad
5 design?

6 A. No. No. Very well, very likely could be the result
7 of bad driving.

8 Q. As far as the -- if we take a look at the most current
9 yellow change interval calculation that is the last
10 page of Exhibit 9, change in clearance intervals,
11 signal design section of the Transportation Mobility
12 and Safety Division, NCDOT, that formula is what?

13 A. That formula in the upper left of that page is the --
14 what we've been calling the ITE standard formula first
15 term perception-reaction time and second term speed
16 and deceleration rate and a grade correction.

17 Q. And what is that -- can you explain -- and you did a
18 little bit, but can you explain what that formula is
19 designed to do?

20 A. Sure. Sure. That formula is designed to eliminate
21 the dilemma zone for drivers driving at the speeds and
22 making -- and the other characteristics that are
23 plugged into the formula so, in other words, a driver
24 driving at the speed in the formula with the
25 perception-reaction time in the formula with the

1 deceleration rate in the formula will be able to make
2 a decision to either stop before crossing the stop bar
3 or to be able to proceed through the intersection at
4 that constant speed without entering on a red signal.
5 The formula's designed to allow every driver operating
6 within the parameters here to be able to make a
7 correct decision.

8 Q. Okay. And does -- is there any math error in that
9 formula?

10 A. Error?

11 Q. Yes.

12 A. On that -- no.

13 Q. So, for example, if a traffic signal engineer was
14 determining a yellow change interval using the formula
15 in North Carolina on a roadway with a speed limit of
16 30 miles an hour, would that formula allow a driver --
17 or is that formula designed to allow a driver who at
18 the stopping distance of the constant deceleration
19 rate used by North Carolina engineers of 11.2 seconds
20 and using perception-reaction time of 1.5 seconds, is
21 the yellow change interval formula designed to allow
22 that driver at 30 miles an hour either enough time to
23 continue traveling at 30 and enter the intersection
24 before the light turns red or enough distance to stop
25 before entering the intersection?

1 A. Yes.

2 Q. Okay. So for North Carolina traffic signal engineers
3 designing -- or determining or designing yellow times
4 for left turns, is the purpose of using 20 miles an
5 hour to allow a driver who is traveling at 20 miles an
6 hour at the stopping distance either the appropriate
7 time if he continues to travel 20 to enter the
8 intersection or the proper distance if he decelerates
9 at the assumed deceleration speed of 11.2 seconds or
10 more to stop?

11 A. Exactly.

12 Q. Okay. And so for -- now, it's possible that a --
13 correct, that a driver who is turning left might be
14 going at a speed less than 20 miles an hour, let's say
15 17 miles an hour?

16 A. Most of them do, sure.

17 Q. Okay. That driver then would certainly have the
18 distance to stop before entering the intersection at
19 the designed stopping speed of the yellow change
20 interval if they use 20 miles an hour, correct?

21 A. That is correct. If they were at the calculated
22 stopping distance when the light turned yellow, they
23 would have enough distance to get stopped before the
24 stop bar.

25 Q. And for those drivers who drove faster than 20 miles

1 an hour, let's say 23 miles an hour, at the designed
2 stopping distance using 20, when that driver hits the
3 designed stopping distance and the light turns yellow,
4 that driver could proceed through the intersection
5 before the light turned red, correct?

6 A. Yes. Yes. Maintaining that speed, they would have
7 enough time to get through before the light turned
8 red.

9 Q. And if a driver who had some special car that was able
10 to maneuver a 90-degree left-hand turn going 45 miles
11 an hour, if such a vehicle and driver existed and that
12 driver was at the calculated stopping distance, based
13 on the yellow change interval formula used by North
14 Carolina traffic signal engineers, that driver, while
15 not having enough time -- excuse me, not having enough
16 distance to stop, could clearly continue through the
17 intersection before the lights turned red?

18 A. Yes.

19 Q. So is it your opinion based on a reasonable degree of
20 engineering certainty that the yellow change interval
21 used by North Carolina traffic signal engineers, the
22 formula shown on seven point -- excuse me, the formula
23 shown on the last page of Exhibit 9 does what traffic
24 signal engineers intend it to do?

25 A. Yes.

1 Q. And does that yellow change interval formula meet the
2 standards of practice for engineering -- traffic
3 signal engineering in North Carolina?

4 A. Yes.

5 Q. Now, you were asked a question earlier about -- I
6 think it's the last exhibit, Exhibit 12. Is 12 the
7 exhibit, do you know, Dr. Hummer, that talks about
8 that -- or maybe -- do you recall the exhibit,
9 Dr. Hummer, that talks about having increment changes
10 or implementing increment changes? That might be
11 Exhibit 9. But, in any event, do you recall
12 testifying about whether or not it was proper to make
13 an incremental change when changing the length of
14 either the yellow change interval or the red change
15 interval?

16 A. I remember that, yep.

17 Q. And is it your opinion that it would be a -- that it
18 would be a good -- strike that.

19 Do you have an opinion of whether or not
20 changing a yellow time interval one second either up
21 or down would require an incremental change in order
22 to meet good engineering practice?

23 A. Certainly doesn't require it, no, no. And I do see
24 here it's on -- is this on --

25 Q. Sure. It's on exhibit --

1 A. Fifth page of Exhibit 9.

2 Q. Okay. Yeah. So what -- go ahead, if you would read
3 again what it says on the fifth page of Exhibit 9.

4 A. Consider adding a note to the plan to direct field
5 forces to reduce the time incrementally. Let me read
6 the whole sentence. If approach is high speed and
7 existing times are significantly higher than the
8 calculated times, use the calculated values to
9 consider adding a note to the plan to direct field
10 forces to reduce the time incrementally.

11 Q. Significantly higher, is there an agreed-upon
12 engineering practice of what significantly higher
13 means in order to require incremental determination or
14 is that just engineering judgment?

15 A. That's going to be judgment. That's going to be based
16 on lots of local factors.

17 Q. If the evidence in this case was that the change in
18 the yellow times for any of the intersections in
19 question in this lawsuit was not done incrementally,
20 would that -- and it was as much as one second, would
21 that violate good engineering practice in your
22 opinion?

23 A. No. No. That -- I said before that needs to be a
24 judgment of the local engineers who know far better
25 and know the details of that intersection.

1 MR. STAM: I want to mark as Exhibit 13 an
2 NCDOT traffic signal plan with an engineering sign and
3 seal date of 10/26/09 for Walnut and Meeting Street.

4 MARKED BY THE REPORTER:

5 DEPOSITION EXHIBIT 13

6 1:26 p.m.

7 BY MS. MARTINEAU:

8 Q. It's Exhibit 13, and I will --

9 MS. MARTINEAU: I know, Skip, you don't
10 have a copy of this, but I will tell you that I --
11 there's some of my writing on there. It says -- I
12 wrote on there Walnut and Meeting, 10/2990, S Walnut,
13 L Meeting, August 1, 2010, and I did that based upon
14 the order just so I could identify the correct sheet.

15 MR. STAM: Okay.

16 BY MS. MARTINEAU:

17 Q. Dr. Hummer, do you see what I've marked as Exhibit 13?

18 A. Yes.

19 Q. Do you recognize Exhibit 13?

20 A. Sure. Yes. It is the signal plan for Walnut and
21 Meeting Street at the date you indicated.

22 Q. Okay. And have you -- have you looked at the yellow
23 time for going south on Walnut making a left on
24 Meeting Street?

25 A. Yes.

1 Q. Okay. Could you -- do you have -- could you take a
2 pen and just draw or, you know, follow -- so you could
3 identify what direction we're talking about.

4 A. Sure. I'm doing it now.

5 Q. Okay. And what phase is that?

6 A. That is -- hang on a minute. Let me make sure of
7 this. That is Phase 5.

8 Q. Okay. So do you see where in the upper left-hand
9 corner it says phasing diagram?

10 A. Yes.

11 Q. Can you circle -- or there is a circle. Is that
12 the -- there's already a circle on there. Is that the
13 correct phase that we're talking about?

14 A. Yes, that's it.

15 Q. Okay. And then from that can you determine what the
16 timing chart has for Phase 5 for yellow time?

17 A. Yes. The timing chart for Phase 5 yellow time says
18 3.2 seconds.

19 Q. Okay. Is three point -- okay. Can you look -- do you
20 know whether or not these plans were signed by a
21 professional North Carolina licensed engineer?

22 A. Yes, they appear to be signed by an NC PE.

23 Q. Do you know -- do you have an opinion -- well, you're
24 familiar, right, with the requirements of the Manual
25 of Uniform Traffic Control Devices, correct?

1 A. Yes.

2 Q. And does the yellow time for Phase 5 south on Walnut
3 going left on Meeting of a value of -- where is the
4 value?

5 A. 3.2.

6 Q. 3.2. Is that value in accordance with the Manual of
7 Uniform Traffic Control Devices?

8 A. Yes. It conforms with engineering practice, which is
9 to say it uses the ITE formula with appropriate values
10 and, therefore, meets MUTCD. It's also between three
11 seconds and six seconds.

12 MS. MARTINEAU: I'm going to be marking
13 Exhibit 14. This is the clearance time calculation,
14 Skip, for Walnut and Meeting for this plan.

15 MR. STAM: I don't think I have that but --

16 MS. MARTINEAU: It was part of Lisa Moon's
17 exhibits.

18 MR. STAM: For one of them, but, yeah. I
19 mean, I'll just get a copy.

20 MS. MARTINEAU: Okay. Sorry about that.

21 MR. STAM: No problem.

22 MARKED BY THE REPORTER:

23 DEPOSITION EXHIBIT 14

24 1:29 p.m.

25 BY MS. MARTINEAU:

1 Q. Do you recognize Exhibit 14?

2 A. Yes, I've seen that before.

3 Q. What is Exhibit 14?

4 A. It is the clearance time calculation for Walnut and
5 Meeting as of the time that we're talking about here.

6 Q. Are you familiar with the form?

7 A. Yeah. Yeah, seen it before.

8 Q. Okay. And is this form consistent with how North
9 Carolina engineers, you know, use computer calculation
10 forms to compute yellow and red times?

11 A. Yeah, yeah, it is that.

12 Q. Okay. And if you would circle on this the movement
13 we're concerned about, which again is south on Walnut
14 making a left onto Meeting Street.

15 A. Okay.

16 Q. Does that form indicate what the North Carolina
17 engineer used as far as the speed for the left turn
18 movement?

19 A. Yes. It shows a speed of 25 miles an hour.

20 Q. And is that speed using an assumed speed of 20 -- or
21 using a value speed of 25 miles an hour for a left
22 turn, does that meet the standard of care for North
23 Carolina traffic signal engineers?

24 A. Yes.

25 Q. And moving down, what is the grade?

1 A. They use zero percent.

2 Q. Okay. And, again, do they -- is it -- does it show on
3 Exhibit 14 what perception-reaction time they used?

4 A. Yes, it does. That's 1.5 seconds.

5 Q. Will you circle that. And is using 1.5 seconds the
6 standard of the industry in North Carolina for traffic
7 signal engineers?

8 A. Yes.

9 Q. Okay. How about deceleration rate? Does it use
10 deceleration rate?

11 A. Yes.

12 Q. What's the deceleration rate used?

13 A. 11.2 feet per second squared.

14 Q. Is that the correct deceleration -- excuse me. Does
15 that 11.2 -- is that the standard deceleration rate
16 used by traffic signal engineers in North Carolina
17 when determining yellow and red times?

18 A. Yes.

19 Q. And is -- what does the sheet show that was the result
20 of that formula?

21 A. It's shows the result to be yellow time of 3.2.

22 Q. Is that 3.2 seconds what is shown on Exhibit 13 for
23 the left turn yellow time in question?

24 A. Yes.

25 Q. Okay. So is it -- do you have an opinion whether or

1 not the engineer who determined the left turn yellow
2 time Phase 4 going south on Walnut, left onto Meeting
3 on Exhibit 13 met general engineering practices when
4 determining that time?

5 A. Yes, they did meet those practices.

6 Q. Okay.

7 MS. MARTINEAU: I'd like to next mark as
8 exhibit -- did I take your exhibits? I sure did.
9 Here they are. Okay. I stole the court reporter's
10 exhibits. Sorry about that. I'm going to mark here
11 as exhibit -- I'm marking as Exhibit 15 a signal plan.
12 It's a two-page document, and I don't know why it's a
13 two-page document, and it's dated -- the engineering
14 date is 6/7/06.

15 MARKED BY THE REPORTER:

16 DEPOSITION EXHIBIT 15

17 1:34 p.m.

18 BY MS. MARTINEAU:

19 Q. Dr. Hummer, are you familiar with this document?

20 A. Yes, I am.

21 Q. And, again, this document has some handwritten notes
22 on it. I'll purport these are my handwritten notes
23 just so I could identify what signal plan I wanted to
24 ask you about and what direction I wanted to ask you
25 about. What is Exhibit 15?

1 A. It is the signal plan for Maynard and Kildaire as of
2 June th of 2006.

3 Q. Have you reviewed this signal plan in particular with
4 the yellow time for westbound Maynard taking a left on
5 Kildaire Farm?

6 A. Yes.

7 Q. Can you take your pen and draw on Exhibit 15 what that
8 movement is.

9 A. There we go.

10 Q. And what phase is that movement?

11 A. That is Phase 7.

12 Q. Okay. Can you go ahead and circle on Exhibit 15 -- or
13 what exhibit is this? Yeah, 15. Go ahead and on the
14 timing chart if you could find the yellow time in
15 question, what is the duration of the yellow time
16 shown on 15?

17 A. That's 3.0 seconds.

18 Q. Is 3.0 seconds yellow time for Phase 7 on Exhibit 15
19 in accordance with the Manual of Uniform Traffic
20 Control Devices?

21 A. Yes.

22 Q. Is that your opinion -- professional opinion as a
23 North Carolina licensed traffic signal engineer?

24 A. Yes.

25 Q. I'm going to show you what I am marking as Exhibit 16.

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MARKED BY THE REPORTER:

DEPOSITION EXHIBIT 16

1:35 p.m.

BY MS. MARTINEAU:

Q. Are you familiar, Dr. Hummer, with Exhibit 16?

A. Yes.

Q. And what's Exhibit 16?

A. That's the clearance time calculation sheet for Kildaire Farm at Maynard Road again for the date that corresponds to the signal plan that we just looked at.

MR. STAM: Excuse me. Can you hold one second? I may have the wrong one in front of me, if you'll just give me a second.

MS. MARTINEAU: Sure.

MR. STAM: Wasn't the last one -- let's see. Fifteen. Are we at 15 now or 16?

MS. MARTINEAU: This is 16.

MR. STAM: And it's Kildaire Farm at what?

MS. MARTINEAU: It's Maynard and Kildaire.

MR. STAM: Southwest Maynard? I had that as 15.

THE WITNESS: The signal -- I'm sorry.

MS. MARTINEAU: The signal plan is 15. We're now looking at the clearance sheet.

MR. STAM: Okay. I don't have that

1 document, but I'll get a copy later.

2 BY MS. MARTINEAU:

3 Q. Take a look at Exhibit 16, which is the clearance time
4 calculations for the intersection in question, and can
5 you circle the yellow time that you just plotted on
6 Exhibit 15?

7 A. Sure. That's for the westbound left. The calculation
8 here is 3.0 seconds.

9 Q. Can you tell -- so on Exhibit 16, the engineer
10 calculating the yellow time, what did they -- what did
11 they use as the speed? Did they use the assumed --
12 what assumed speed did they use?

13 A. They used 20 miles an hour.

14 Q. Is using 20 miles an hour standard practice for North
15 Carolina engineers for calculating left -- dedicated
16 left turn yellow times?

17 A. Yes.

18 Q. And what did they have for grade?

19 A. Zero percent.

20 Q. And what did they have for perception-reaction time
21 and deceleration rate?

22 A. It was 1.5 seconds and 11.2 feet per second squared
23 respectively.

24 Q. We've already talked about that, and that was standard
25 practice for North Carolina traffic signal engineers,

1 correct?

2 A. Yes.

3 Q. And what does -- what was the calculation result?

4 A. They calculated a time of 3.0 seconds for yellow.

5 Q. Was the calculation of the yellow time as shown on
6 Exhibit 15 done using good engineering practices?

7 A. Yes.

8 MS. MARTINEAU: I'm going to mark as 17 the
9 traffic signal plan for Kildaire and Cary dated June
10 23rd, 2010.

11 MR. STAM: Hold on a second. Did you say
12 Kildaire and Cary Parkway?

13 MS. MARTINEAU: Kildaire Farm at Cary
14 Parkway.

15 MR. STAM: Because I don't have that one in
16 front of me. Okay. I got it. So this is 17?

17 MS. MARTINEAU: Right.

18 MR. STAM: All right. Got it.

19 MARKED BY THE REPORTER:

20 DEPOSITION EXHIBIT 17

21 1:39 p.m.

22 BY MS. MARTINEAU:

23 Q. Dr. Hummer, are you familiar with 17?

24 A. Yes.

25 Q. What is 17?

1 A. It is the signal plan for Kildaire Farm at Cary
2 Parkway dated June 23rd, 2010.

3 Q. Okay. And can you make a line on the movement west on
4 Cary taking a left onto Kildaire?

5 A. Sure. And that's that movement there.

6 Q. What phase is that?

7 A. That is Phase 7.

8 Q. Can you circle that --

9 A. Sure.

10 Q. -- for us so we can identify it later.

11 And what is the yellow time shown for that
12 phase on Exhibit 17?

13 A. That's 3.0 seconds.

14 Q. And is 3.0 seconds in accordance with the Manual of
15 Uniform Traffic Control Devices?

16 A. Yes, it is.

17 Q. And is that -- is your testimony there based on your
18 experience, education, and background as a traffic
19 signal engineer?

20 A. Yes.

21 MS. MARTINEAU: I'm going to now mark as
22 Exhibit 18 the clearance time calculation that
23 corresponds with that intersection.

24 MARKED BY THE REPORTER:

25 DEPOSITION EXHIBIT 18

1 1:48 p.m.

2 BY MS. MARTINEAU:

3 Q. Do you recognize Exhibit 18?

4 A. Yes.

5 Q. And what is Exhibit 18?

6 A. It is the clearance time calculation sheet for
7 Kildaire Farm at Cary Parkway from the date
8 corresponding to the signal plan.

9 Q. Okay. I'll represent that I have -- there's some
10 yellow marking on this document, but can you go ahead
11 and circle the phase or the movement that we're
12 talking about here?

13 A. Sure. That's westbound Cary Parkway, left turn.

14 Q. Okay. And what assumed speed was used in determining
15 the yellow time?

16 A. That was 20 miles an hour.

17 Q. And does using 20 miles an hour for assumed speed for
18 determining yellow time, is that acceptable North
19 Carolina traffic signal engineering practice?

20 A. Yes.

21 Q. What did they use for perception-reaction time and
22 deceleration time?

23 A. That was 1.5 seconds and 11.2 seconds feet per seconds
24 squared respective.

25 Q. We already talked about that, and what was -- using

1 that clearance time calculation, what is the
2 calculated yellow time?

3 A. It's 3.0 seconds.

4 Q. And that's what showed on the plan?

5 A. It is.

6 Q. And so do you have an opinion of whether or not the
7 calculations were done for Exhibit 17 west on Cary,
8 left on Kildaire using good engineering practices?

9 A. They were, yes.

10 Q. Okay. I'm going to mark as an exhibit to your
11 deposition -- actually we need to look at another
12 movement in this one. Can you look at north on
13 Kildaire, left on Cary?

14 A. Sure.

15 Q. Can you draw that one and maybe put an arrow and a B
16 so we know that's the second one.

17 A. (Witness complied).

18 Q. And what phase is that?

19 A. That is Phase 5.

20 Q. Okay. So can you circle Phase 5 and put a line and a
21 B next to that so we know?

22 A. Sure.

23 Q. Okay. And what is the yellow time calculated for that
24 phase, Phase 5, that we've marked as B?

25 A. The chart shows yellow time of 3.0 seconds.

1 Q. And if you would then take a look at Exhibit 18 and
2 circle with a B the movement that you just documented
3 or just drew.

4 A. That's Kildaire Farm northbound, left turn.

5 Q. And what is the speed used in the calculation by the
6 engineer?

7 A. It's 20 miles an hour.

8 Q. And is using 20 miles an hour for a left -- for
9 determining a dedicated left -- the yellow time for a
10 dedicated left turn good traffic signal engineering
11 practices in North Carolina?

12 A. Yes.

13 Q. And they had -- they used 1.5 and 11.2 for
14 perception-reaction time and deceleration rate
15 respectively, correct?

16 A. Yes.

17 Q. We've already talked about that, and that is standard
18 practice in North Carolina, correct?

19 A. Yes.

20 Q. And I don't know if we talked about the grade, but
21 they used a zero percent grade for the B movement?

22 A. Yes.

23 Q. The first one they used a one percent grade?

24 A. Yes.

25 Q. Is it standard in North Carolina to use grade when

1 determining yellow times?

2 A. Yes. There is a grade correction in the yellow time
3 formula. That's correct.

4 Q. What was the calculation for the B movement that you
5 drew for this intersection?

6 A. 3.0 seconds of yellow.

7 Q. Do you have an opinion based on your education,
8 training, and background as a North Carolina traffic
9 signal engineer whether the engineer who calculated
10 the time used good engineering practices in making the
11 calculation?

12 A. They did, yes.

13 MS. MARTINEAU: I'm going to now mark as
14 Exhibit 19 -- there's two plans in Exhibit 19 so I'm
15 going to mark -- we'll do the earlier one first so
16 that is -- that's Lisa Moon's plan I'm going to mark
17 as Exhibit 19. Actually I'll mark both of them as
18 Exhibit 19, two plans. I'm going to mark the Lisa
19 Moon signed and sealed plan dated 10/5/06 followed by
20 the Robert Ziemba, Z-I-E-M-B-A, plan dated 2/17/2011.

21 MR. STAM: Can you do it 19A and 19B?

22 MS. MARTINEAU: Sure. I'm going to write
23 that right on here, 19A, 19B.

24 MARKED BY THE REPORTER:

25 DEPOSITION EXHIBIT 19

1 1:45 p.m.

2 BY MS. MARTINEAU:

3 Q. Okay. Dr. Hummer, if you would take a look at what
4 I've marked as 19A. Do you recognize 19A?

5 A. Yeah. That's the signal plan for Cary Parkway at High
6 House Road dated from 2006.

7 Q. And can you -- you've seen this before, correct?

8 A. Yes.

9 Q. Can you draw for me the movement going north on Cary
10 taking a left on High House?

11 A. Yes. It's already highlighted.

12 Q. Yeah, it's already highlighted in yellow, but go ahead
13 and do it again.

14 A. (Witness complied).

15 Q. Thanks. What phase is that?

16 A. That is Phase 3.

17 Q. If you would go ahead and circle Phase 3.

18 A. Okay.

19 Q. What's the yellow time calculated for Phase 3?

20 A. 3.0 seconds.

21 Q. And is 3.0 seconds in accordance with the Manual of
22 Uniform Traffic Control Devices?

23 A. Yes.

24 Q. If you would take a look at the next plan which is
25 19B, and that is the Robert Ziemba plan. Do you know

1 Robert Ziemba?

2 A. He's a good friend of mine, yep.

3 Q. Do you know him to be a North Carolina licensed
4 professional engineer?

5 A. One of the best, yep.

6 Q. Do you see his plan dated 2/17/2011?

7 A. Yes.

8 Q. What is it?

9 A. That is the signal plan for High House at Cary Parkway
10 from 2011.

11 Q. Okay. If you would then draw the movement north on
12 Cary, left on High House for me.

13 A. Sure.

14 Q. What phase is that?

15 A. That is Phase 3.

16 Q. Could you circle Phase 3 on Exhibit 19B?

17 A. Sure.

18 Q. What is the calculated yellow time for Phase 3 on 19B?

19 A. It's 3.0 seconds.

20 Q. Was that done in accordance with the Manual of Uniform
21 Traffic Control Devices?

22 A. Right.

23 Q. Then if we could take a look at the corresponding
24 clearance time sheet. I'm going to mark that as
25 Exhibit 20.

1 MARKED BY THE REPORTER:

2 DEPOSITION EXHIBIT 20

3 1:48 p.m.

4 BY MS. MARTINEAU:

5 Q. Exhibit 20 is a two-page document. Do you recognize
6 Exhibit 20?

7 A. Yes. That's a clearance time calculation sheet for
8 Cary Parkway and High House Road from the time
9 corresponding to the 2006 signal plan.

10 Q. And what's the next page? Which one is that?

11 A. The next page on Exhibit 20 is the clearance time
12 calculation, Cary Parkway and High House Road from
13 2010 which corresponds to Exhibit 19B, Rob Ziemba
14 signal timing plan.

15 Q. Can you circle for me the movement that you just drew
16 on Exhibit 19A and B?

17 A. Sure. That's the northbound left turn.

18 Q. Okay. And based on -- and in the 2005 -- strike that.
19 The 2000 -- in Lisa Moon -- let me ask it -- the one
20 with Lisa Moon's name on it, what is the speed she
21 used in plugging in the left turn yellow time
22 calculation?

23 A. Twenty miles an hour.

24 Q. Again, you already testified that that is -- it's your
25 opinion that that is standard practice in North

1 Carolina?

2 A. Yes.

3 Q. All right. And what is -- what did she use for
4 perception-reaction time and deceleration?

5 A. 1.5 seconds perception-reaction time, 11.2 feet per
6 second deceleration rate.

7 Q. That's standard practice in North Carolina?

8 A. Yes.

9 Q. What was the value that she got for the yellow time?

10 A. Was 3.0 seconds.

11 Q. And do you have an opinion whether or not Lisa Moon
12 used good engineering practices when calculating the
13 yellow time for Exhibit 19A?

14 A. She did, yes.

15 Q. If you would take a look at the second page where it
16 has Ziemba's I think initials there, do you see that?

17 A. Yes.

18 Q. All right. And if you could circle the movement that
19 you documented on 19B.

20 A. Sure.

21 Q. That was north on Cary, left on High House?

22 A. Yep.

23 Q. What speed did he use for an assumed speed for
24 calculating the yellow time?

25 A. It was 20 miles an hour.

1 Q. And again do you have -- is that using 20 miles an
2 hour an accepted practice --

3 A. Yes.

4 Q. -- at that time for North Carolina traffic signal
5 engineers?

6 A. Yes.

7 Q. What was the value again he used for
8 perception-reaction time and deceleration rate?

9 A. He used eleven -- 1.5 seconds perception-reaction
10 time, 11.2 feet per second squared deceleration rate.

11 Q. What is the calculated yellow time that he came up
12 with?

13 A. He calculated 3.0 seconds as well.

14 Q. Do you have an opinion whether or not Mr. Ziemba used
15 good engineering practices when determining the length
16 of the yellow time for the movement shown on 19B?

17 A. He did, yes.

18 MS. MARTINEAU: Okay. Finally I want to
19 mark as an exhibit 21. Twenty-one is the 1991 signal
20 plan. It's a two-page document.

21 MARKED BY THE REPORTER:

22 DEPOSITION EXHIBIT 21

23 1:52 p.m.

24 BY MS. MARTINEAU:

25 Q. Dr. Hummer are you familiar with Exhibit 21?

1 A. Yes.

2 Q. Okay. What is Exhibit 21?

3 A. It's the signal plan for Western Boulevard at -- which
4 is the same thing as Cary Town Boulevard, at
5 Convention Drive.

6 Q. What's the date of this signal plan?

7 A. That is signed May 31st, 1991.

8 Q. Okay. Are you familiar with what traffic signal
9 engineers in North Carolina need to do in order to
10 determine what the speed limit is when they're going
11 to be designing a signal plan?

12 A. Yes.

13 Q. What's the typical -- what's your understanding of the
14 typical practice back in 1991?

15 A. To determine a speed limit?

16 Q. Yes.

17 A. Is to take a speed -- do a speed study, which is to
18 collect some data on the speeds at somewhere on the
19 stretch of road that we're interested in, analyze
20 those data, determine the 85th percentile, and
21 typically the speed limit is set somewhere around the
22 5th percentile. Of course, we have to round from the
23 actual numbers to the next nearest five or -- in North
24 Carolina next almost nearest ten with their speed
25 limit practices.

1 Q. Do you know what's required in order to change a speed
2 limit in terms of do you know how -- do you know
3 what's required in order to change a speed limit in
4 terms of state law, ordinance and/or posting?

5 A. Yes. To change -- to post or change a speed limit
6 requires a state law and a local ordinance to be
7 passed and then the engineering activities order a
8 sign, get the sign out there and get it posted.

9 Q. Do you know what the legal speed limit was on Cary
10 Town Boulevard, then known as Western Boulevard
11 Extension back in 1991?

12 A. It was 35 miles an hour.

13 Q. What was the -- what are the through yellow times for
14 traveling on Western Boulevard?

15 A. The through movements at Western Boulevard would be
16 Phases 2 and 6, so the second page of Exhibit 21 with
17 the timing chart for Phase 2 and 6 shows those yellow
18 intervals to be 4.0 seconds.

19 Q. Okay. And are those times in accordance with the
20 Manual of Uniform Traffic Control Devices?

21 A. Yes, they are.

22 Q. What are the yellow times for the through movements on
23 Convention Drive to Principal Lane as shown on
24 Exhibit 21?

25 A. The through movements on Convention Drive would be

1 Phase 3 and Phase 4. Phase 3 is the northbound. The
2 yellow time there is 5.0 seconds, and Phase 4 is the
3 southbound movement, and the yellow time there is 4.5
4 seconds.

5 Q. Okay. Are those yellow times in accordance with the
6 Manual of Uniform Traffic Control Devices?

7 A. Yes, they are.

8 Q. What is Phase 5 and Phase 1?

9 A. Phase 5 and Phase 1 are the left turn movements from
10 Cary Town onto Convention Drive.

11 Q. Okay. And what is the yellow time for -- calculated
12 for Phase 5?

13 A. That is 4.0 seconds.

14 Q. And Phase 1?

15 A. Is 4.5 seconds.

16 Q. Are those times in accordance with the Manual of
17 Uniform Traffic Control Devices?

18 A. Yes.

19 Q. If you would take a look at what I'm marking as
20 Exhibit 22.

21 MARKED BY THE REPORTER:

22 DEPOSITION EXHIBIT 22

23 1:56 p.m.

24 BY MR. STAM:

25 Q. What is Exhibit 22?

1 A. It is the clearance time sheets, the calculations for
2 Western Boulevard at Convention Drive dated May 20th,
3 1991.

4 Q. Okay. And what are the -- okay. Do those show the
5 various phases?

6 A. They do, yes.

7 Q. Can you circle phase -- let's see. There's Phases 1
8 through 6. I guess we're missing some -- are we
9 missing some phases?

10 A. I think they're all there.

11 Q. And can you -- for the straight-through phases going
12 on what was then called Western Boulevard Extension,
13 by looking at the clearance time sheet, do you have an
14 opinion of whether or not the traffic signal engineer
15 used good engineering practices when determining the
16 length of the yellow times for the phases we just
17 discussed?

18 A. Yes, I do. That would be Phase 2 and Phase 6, the
19 through movements eastbound and westbound. This
20 clearance sheet from 1991 is not as clear as the other
21 ones, the later ones we looked at, but there's still
22 enough information to make a judgment here.

23 They do show that the grade is zero percent
24 in their calculations, and that's helpful. What they
25 don't show, the perception-reaction time or the

1 deceleration rate that went into the calculation, but
2 we can back calculate and get back to what we think
3 they used for those values, so what this sheet does
4 show is the minimum yellow time of 3.6 seconds for
5 Phase 2 and Phase 6. Minimum yellow is really the
6 same thing as the result of the ITE formula
7 calculation. If we use that formula with a
8 perception-reaction time of one second and a
9 deceleration rate of 10 feet per second squared, which
10 my understanding is those were more accepted values
11 back in 1991, then we do calculate a result of 3.6
12 seconds. One second perception-reaction time, 10
13 seconds deceleration time are fine to use.

14 They're well within the bounds of standard
15 practice. In this case, the sheet tells us that the
16 engineers recommended yellow time for both Phase 2 and
17 Phase 6 as 4.0 seconds, and that is well within the
18 standard, so my conclusion here is they met the
19 standard for acceptable engineering practice.

20 Q. What about the other phases that we looked at, three,
21 four, and five?

22 A. Yes. That they did as well, sort of doing it that
23 same -- that same thought process. It's different at
24 this intersection from the other ones that we looked
25 at in the sense that this was before the task force

1 and before. Before we were using the -- really the
2 same procedure that we came to use later in the 2000s,
3 but still those values are within the standard
4 engineering practice for their time.

5 Q. Okay. And would that also be true with -- did we look
6 at Phase 1? I know this intersection, it didn't
7 indicate on the order what phase we needed to look at.
8 What's Phase 1?

9 A. Phase 1 is the left turn -- westbound left turn that
10 would be turning from Cary Town Boulevard onto
11 Convention Drive going south.

12 Q. Okay. And is -- when you look at Exhibit 22, can you
13 tell by Exhibit 22 or do you have an opinion looking
14 at 22 whether or not the engineer used good
15 engineering practices in determining the yellow time
16 for that phase?

17 A. Yes, they did.

18 Q. Okay. And then finally if you would take a look at
19 what's already been marked as -- by
20 Plaintiff as the last exhibit, exhibit --

21 A. Their last exhibit was Exhibit 12.

22 Q. Yeah, Exhibit 12. In reviewing Exhibit 12, does
23 Exhibit 12 -- it's entitled North Carolina Department
24 of Transportation, Division of Highways, Traffic
25 Engineering and Safety Systems Branch, standard

1 practice for compliance with traffic signal and
2 electrical dash programming detail plans. Do you see
3 that?

4 A. Yes, I do.

5 Q. At the bottom of that first page, does it outline what
6 NCDOT's practice is regarding when a signal plan
7 should be updated?

8 A. Yes, it does.

9 Q. What is the NCDOT -- according to this document, what
10 is NCDOT's standard practice for updating signal
11 plans?

12 A. In that paragraph -- and if I may just read it so I
13 don't misstate --

14 Q. Sure.

15 A. Starting with the second sentence, therefore, prior to
16 beginning traffic signal or roadway construction, the
17 division traffic engineer should check the seal date
18 of the traffic signal and electrical programming
19 detail plans. If the plans are more than two years
20 old or if traffic patterns have changed, the division
21 traffic engineer should request the ITS and signals
22 unit review the plans for compliance with current
23 practices.

24 Q. And, Dr. Hummer, do you have any idea why
25 Mr. Ceccarelli was in the roadway at the time the

1 light in his direction of travel turned yellow?

2 A. I have no idea.

3 Q. Okay. And so you don't know whether or not

4 Mr. Ceccarelli could have stopped at the deceleration

5 rate of 11.2 feet per second using a reaction time of

6 1.5 seconds prior to entering the intersection or not

7 at the time he first turned -- at the time he first

8 observed the light turn yellow?

9 A. I don't know that.

10 Q. All right. Thank you, sir. Those are the questions I

11 have for you.

12 MR. STAM: Just a very few.

13 RE-EXAMINATION

14 BY MR. STAM:

15 Q. Looking at that last exhibit, Dr. Hummer, you're

16 assuming a 35 mile per hour speed limit?

17 A. I'm sorry. The last --

18 Q. Exhibit 21 and 22.

19 A. I'm sorry. I still have Exhibit 12 here. Hang on a

20 second. Okay.

21 Q. Were all the answers to the questions you gave to

22 Ms. Martineau assuming a speed limit of 35 miles an

23 hour on Western Boulevard headed east through that

24 intersection?

25 A. Yes.

1 Q. When did you live in Cary?

2 A. From 1992 to 2007.

3 Q. And where did you live from 2007 till you moved to
4 Michigan?

5 A. In downtown Raleigh.

6 Q. Have you traveled that section of road many times?

7 A. Sure.

8 Q. I'll call it Cary Town Boulevard?

9 A. Sure.

10 Q. Do you know what the speed limit was in 2009 on that
11 section?

12 A. I don't remember that, no.

13 Q. Okay. You're familiar with the -- strike that.

14 Are you familiar with AASHTO?

15 A. Yes.

16 Q. What is AASHTO?

17 A. That's the American Association of State Highway and
18 Transportation Officials. It's basically the group of
19 the 50 state DOTs.

20 Q. Are you familiar with their 2004 volume of policy of
21 geometric design of highways and streets?

22 A. Yes. I tried to refer to it earlier in my deposition,
23 yes.

24 Q. Let me quote a sentence from Page 110.

25 MS. MARTINEAU: Hold on a second. He's

1 going to grab it.

2 THE WITNESS: Okay. I've got it.

3 BY MR. STAM:

4 Q. I think it's Page 110 through Page 111. You see the
5 sentence a brake reaction time of 2.5 seconds?

6 A. Oh, yeah. It's kind of in the middle of Page 111.
7 There's a sentence that starts a brake reaction time
8 of 2.5 seconds.

9 Q. Would you read that sentence?

10 A. Sure. A brake reaction time of 2.5 seconds is
11 considered adequate for conditions that are more
12 complex than the simple conditions used in laboratory
13 and road tests but is not adequate for most complex
14 conditions encountered in actual driving.

15 Q. That refers to brake reaction time. Is that the
16 same -- they're using it -- brake reaction time, is
17 that the same -- what you were referring to previously
18 in your deposition as perception-reaction time?

19 A. It's the same term, but it's in a different context.
20 What they're talking about here on page -- in that
21 sentence in particular is reacting to an unexpected
22 stimulus, which is usually somebody coming over a
23 hill, around a curve and encountering a stopped
24 vehicle ahead, maybe an animal in the road, maybe a
25 pedestrian walking across the road.

1 That's different from the yellow time case
2 that we're talking about for most of today where the
3 stimulus is expected, that is the driver has
4 undoubtedly looked up and noticed that there's a
5 signal ahead and probably noticed that the green has
6 been on for a while. So the term is named the same,
7 but the context is different, this sentence, from what
8 we've been talking about.

9 Q. Early on in your deposition you talked about yellow
10 change -- yellow lights must command respect.

11 A. Yes.

12 Q. Okay. What is the origin of that assumption?

13 A. Oh, I don't know. That goes back through the MUTCD
14 for as many editions as I can remember. I think I
15 studied the 1978 edition in my school days and I think
16 it was in there then, and it probably goes back many
17 editions before then. It's the drivers need to take
18 our traffic control devices seriously if the road
19 system is going to function.

20 Q. Is there a problem if drivers run a yellow light?

21 A. In what sense run a yellow light? I don't understand.

22 Q. Is there a safety problem if a driver enters the
23 intersection when the light is yellow?

24 A. There should not be. We -- I don't like to think in
25 terms of that there's safety problem or not safety

1 problem. It's a continuum. There's situations that
2 are more safe and less safe. It's probably more safe
3 to pass the stop bar on green than yellow, but
4 entering the intersection, which is to say passing the
5 stop bar on yellow, is not drastically unsafe. Let's
6 put it that way.

7 Q. Go to your Exhibit 13.

8 A. Are we done with AASHTO?

9 Q. Yes.

10 A. Okay. Exhibit 13. Got it.

11 Q. Looking at Phase 5, which is I understand the left
12 turn into Meeting Place, is the yellow change interval
13 3.2 and red clearance 3.3?

14 A. That is correct, yes.

15 Q. So adding up -- they come consequentially, so adding
16 them together is 6.5 seconds when conflicting traffic
17 would be protected I guess. Is that right? 6.5
18 seconds combined between the yellow change and the
19 red -- all-red clearance.

20 A. Well, yeah, sure, and that's -- and the same thing as
21 to green. It's -- the green arrow for that movement
22 as well is conflicting traffic which is westbound
23 through, north and southbound through, north and
24 southbound left. Those movements all have to stay
25 stopped during that time. That's correct.

1 Q. Purely for safety considerations, would it be any
2 different if the yellow change interval was, say, 4.2
3 and the red clearance was 2.3 adding up to 6.5
4 seconds?

5 A. It probably would make a difference in long run
6 average of number of collisions and probably for the
7 worse since these are the standard practice sort of as
8 we've been talking about uniformity and all that and
9 such, so probably makes a difference and probably
10 makes things worse.

11 Q. Well, suppose that it was not just at this
12 intersection but for every intersection in Cary in
13 North Carolina if they added a second to the yellow
14 change and decreased a second for the all-red
15 interval.

16 A. Well, the all-red interval is extremely important in
17 its own regard, and we haven't talked about it here
18 today, and my understanding was that it wasn't a big
19 part of this case, but we just can't go around taking
20 seconds away from all-red intervals and expect there
21 not to be an effect from that, either, so, you know,
22 we could delve into the why 3.3 seconds of all-red at
23 the end of that phase, but my suspicion is there's
24 very good reasons for that and harm to be done if we
25 are taking away time from that part of the phase.

1 MR. STAM: I think I'm finished if you'll
2 just give me 30 seconds to look over my notes.

3 MS. MARTINEAU: Sure.

4 MR. STAM: I'm sorry. I do have one more
5 question, and I have a big lawn mower outside my
6 window.

7 MS. MARTINEAU: We can hear you fine.

8 BY MR. STAM:

9 Q. Thinking about Lori Millette's intersection at
10 northbound on Kildaire turning left on Cary Parkway,
11 what is the designed speed associated with a 3.0
12 second yellow change interval?

13 MS. MARTINEAU: I'm going to object to the
14 form of the question, but go ahead. Which one is it
15 again?

16 MR. STAM: Let me give you two things to
17 look at. One is Lori Millette's intersection.

18 MS. MARTINEAU: Which is what?

19 MR. STAM: The second one is Exhibit 6.

20 MS. MARTINEAU: What's Lori Millette's
21 intersection?

22 MR. STAM: Which is north on Kildaire, left
23 on Cary Parkway, and if you would take out Exhibit 6.

24 THE WITNESS: Okay.

25 BY MR. STAM:

1 Q. What is the designed speed associated with the 3.0
2 second yellow change interval?

3 MS. MARTINEAU: Objection to the form of
4 the question, but go ahead and answer.

5 THE WITNESS: Yeah. I think that --

6 BY MR. STAM:

7 Q. Directing your attention particularly to Equation 8.

8 A. The designed speed is the speed we use to put together
9 things like turn radius and curb radius and vertical
10 alignments and such so it's sometimes used in this
11 context defining yellow. In the case of standard
12 practice in North Carolina, they tend to use the speed
13 limit rather than the designed speed.

14 Q. Let me use a different term that we've already used
15 today. What is the approach speed associated with a
16 3.0 second yellow change interval?

17 MS. MARTINEAU: For the left-hand turn of
18 Ms. Millette's intersection?

19 MR. STAM: Yes.

20 THE WITNESS: I believe that is 20 miles an
21 hour.

22 BY MR. STAM:

23 Q. Is Equation 8 the way you could work the equation
24 backwards according to the ITE interval formula?

25 A. It appears to be solving it backwards, yes.

1 Q. And you don't have a calculator there, but I'm going
2 to represent to you if you work that backwards, it
3 would be 22.9 miles an hour, so the question that I
4 have, if that's correct, if Lori Millette was going 23
5 miles an hour approaching that intersection, did she
6 have enough stopping distance or enough time to
7 proceed through the intersection reasonably and
8 safely?

9 MS. MARTINEAU: Objection to the form of
10 the question because we don't -- you didn't tell us
11 where she was when she saw the yellow light. How far
12 away was she from the stop line or where was she in
13 relation to her stopping distance?

14 MR. STAM: Well, that's the question by
15 opposing counsel is where was she and I would say
16 that's the problem with the entire approach of the
17 city on this, but wherever Dr. Hummer would want to
18 posit that she was. We know she was going 23 miles
19 per hour when the camera clicked her. That's what we
20 know. That's right at the stop bar I guess.

21 THE WITNESS: Yeah.

22 BY MR. STAM:

23 Q. Is it possible that she got caught in the dilemma
24 zone?

25 A. It's possible that she was driving too fast in the

1 wrong place and made the wrong decision. Typically a
2 driver's driving faster than we assume and in many
3 places on that approach can get through the signal
4 holding their speed, not having to speed up but just
5 holding their speed and get past the stop bar before
6 the light turns red.

7 Q. Since we don't know whether she was decelerating to 23
8 or accelerating to 23, could she proceed at 23 miles
9 an hour safely and legally through the intersection?

10 A. I have no idea. That totally depends on where she was
11 when the yellow came up.

12 Q. I have no further questions.

13 MS. MARTINEAU: Okay. Thank you.

14 MR. STAM: Thank you very much.

15 MS. MARTINEAU: I'll make sure you get a
16 copy of the exhibits.

17 MR. STAM: Thank you. And tell the court
18 reporter he or she is very patient, and, Dr. Hummer, I
19 learned a lot.

20 COURT REPORTER: Would you like to order
21 the transcript?

22 MR. STAM: Yes. I want it e-mailed and I'm
23 not sure I know the different terminologies, but --

24 MS. MARTINEAU: Do you like the E-Trans?

25 Do you have E-Trans or PDF?

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COURT REPORTER: Yes.

MR. STAM: Yeah, and a compressed transcript, four to a page.

MS. MARTINEAU: I'd just like the E-Trans with exhibits.

(Deposition concluded at 2:19 p.m.
Signature of the witness was requested.

1 BRIAN CECCARELLI and LORI
2 MILLETTE, individually and
3 as class representatives,
4 Plaintiffs,

5 vs.

Case No. 10-CVS-019930

6
7 TOWN OF CARY,
8 Defendant.

9 _____/

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13 VERIFICATION OF DEPONENT

14

15 I, having read the foregoing examination
16 under oath consisting of my testimony at the
17 aforementioned time and place, subject to the changes
18 in the attached errata sheet, do hereby attest to the
19 correctness and truthfulness of the transcript.

20

21

22

23

24 _____
Joseph E. Hummer, Ph.D., P.E.

25

Dated:

ERRATA SHEET

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PAGE LINE READS

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CERTIFICATE OF NOTARY

STATE OF MICHIGAN)

) SS

COUNTY OF WAYNE)

I, HELEN F. BENHART, certify that this deposition was taken before me on the date hereinbefore set forth; that the foregoing questions and answers were recorded by me stenographically and reduced to computer transcription; that this is a true, full and correct transcript of my stenographic notes so taken; and that I am not related to, nor of counsel to, either party nor interested in the event of this cause.

HELEN F. BENHART, CSR-2614

Notary Public,

Wayne County, Michigan.

My Commission expires: 7/7/14

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1 BRIAN CECCARELLI and LORI
2 MILLETTE, individually and
3 as class representatives,
4 Plaintiffs,

5 vs.

Case No. 10-CVS-019930

6
7 TOWN OF CARY,
8 Defendant.

9 _____/

10
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12
13 VERIFICATION OF DEPONENT

14
15 I, having read the foregoing examination
16 under oath consisting of my testimony at the
17 aforementioned time and place, subject to the changes
18 in the attached errata sheet, do hereby attest to the
19 correctness and truthfulness of the transcript.

20
21
22
23 _____
24 Joseph E. Hummer, Ph.D., P.E.

25 Dated:

ERRATA SHEET

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PAGE LINE READS

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