Charles D. Baker, Governor
Karyn E. Polito, Lieutenant Governor
Stephanie Pollack, Secretary & CEO
Jonathan L. Gulliver, Highway Administrator

massDOT
Massachusetts Department of Transportation
Highway Division

October 23, 2020

SUBJECT: NORTHAMPTON - Improvements on I-91 Interchange 19 at Rte. 9 & Damon Road
Project File No. 604597

James Lowenthal, President
International Dark-Sky Association
Massachusetts Chapter
181 Crescent Street
Northampton MA 01060

Dear Professor Lowenthal,

This is in response to your letter dated September 13, 2020, regarding the subject project. Your comments and responses are as follows:

Comment 1: *Lighting zone should be LZ-1, not LZ-3.*

• In Note 1 on Sheet 157 of the plans, you refer to the Model Lighting Ordinance (MLO) of IDA and the Illuminating Engineering Society (IES), and you state that the "City of Northampton, MA is determined to be within Zone 3, based on the location, as well as the night time safety requirements.

Zone 3 allows for a "U3" BUG rating which allows for up to 500 lumens in the UL and UH zones, and 1,000 lumens total. This Lumark luminaire is Dark Sky Compliant based on independent testing data."

But the concept of lighting zones in the MLO was not intended to apply to entire cities, but neighborhoods and geographic areas within cities, and most cities have a wide range of different lighting zones. The MLO defines Zone 3 as areas such as "commercial corridors, high intensity suburban commercial areas, town centers, mixed use areas, industrial uses and shipping and rail yards with high night time activity, high use recreational and playing fields, regional shopping malls, car dealerships, gas stations, and other nighttime active exterior retail areas." This clearly does not apply to the I-91 Exit 19 / Route 9 interchange, which is over 1 mile from downtown, 0.5 miles from Industrial Drive, and immediately abuts both quiet residential streets and sensitive riparian habitats bordering the Connecticut River, home to hundreds of species of birds, fish, mammals, amphibians, and insects. Much more appropriate would be Lighting Zone 1. According to the MLO, "Lighting Zone 1 pertains to areas that desire low ambient lighting

SUBJECT: **NORTHAMPTON** - Improvements on I-91 Interchange 19 at Rte. 9 & Damon Road
Project File No. 604597

levels. These typically include single- and two-family residential communities, rural town centers, business parks, and other commercial or industrial/ storage areas typically with limited nighttime activity. May also include the developed areas in parks and other natural settings."

RESPONSE:

Lighting zones reflect the base (or ambient) light levels desired by a community. The lighting design for the roadway area is based on IES recommendations. We understand that these are not standards or regulations; however, based on our engineering judgment, following the IES recommendations results in the most appropriate lighting design utilizing the requested decorative light poles.

Comment 2: *Total illumination level should be at least 7 times lower than planned.*

• In Note 2 on Sheet 157, you quote IES RP-8-14 and IES DG-19-08: "[T]he calculated roundabout illuminance and roadway luminance levels meet and exceed the minimum maintained average requirements stated below…IES Illumination Standards for Roundabouts: Major/Collector Classification with Medium Pedestrian Activity = 2.2 fc"

• In the Statistics table on Sheet 157, you indicate predicted average, maximum, and minimum illumination levels in the roundabout of 2.4 fc, 6.9 fc, and 0.7 fc, respectively.

• On Sheet 149, you indicate that each of the 32 LED lamps has wattage 144W.

• On Sheets 154-156, you show predicted illumination levels in the horizontal plane as high as 9.5 foot-candles.

• On Sheet 149, Note 3 states that "Functional Classification for this roundabout per IES guidelines shall be major /collector with a pedestrian area classification of medium. Therefore, the maintained average illuminance shall be not less than 2.2-foot candles (FC) and the uniformity shall be 3:1 (Eavg/Emin)."

• Also, on Sheet 157, you list the lumens per lamp as 13,199.4 lumens for each of 31 single lamps and 1 double lamp, for a total of 435,580 lumens.

The Base Allowance for Lighting Zone 1 in the IES/IDA MLO (Table B, p. 24) is 1.25 lumens per square foot of hardscape, vs. 5.0 lumens per square foot for Lighting Zone 3 – a factor of 4 times.

From the project plans, I estimate the area of the roundabout from curb to curb to be less than 45,000 square feet. For Lighting Zone 3, the MLO would then recommend no more than 225,000 total lumens – about half the total lumens currently shown in the plan. For Lighting

October 23, 2020

SUBJECT: **NORTHAMPTON** - Improvements on I-91 Interchange 19 at Rte. 9 & Damon Road
Project File No. 604597

Zone 1, the MLO recommendation is 56,250 lumens – more than 7 times lower lumens than currently planned.

Maximum illumination levels allowed in The City of Northampton's Administrative Code Section 350-12.2 range from 0.8 foot-candles for Rural Residential districts to 5.0 fc for Highway Business, compared with maximum levels shown in the current plans that are nearly two times higher than that (HB) to nearly 10 times higher (RR).

Furthermore, the IES recommendations are widely used, but they are not standards or regulations per se, and they are not supported by scientific evidence. I realize that you are aiming to err on the side of safety by meeting or exceeding the IES recommendations. But the goal should be actual safety, achieved through enhanced visibility. That visibility is achieved through careful lighting design that minimizes glare – not by making the lights brighter than they need to be. In fact, Bhagavathula, Gibbons, & Nussbaum (2019, TRBJ, DOI: 10.1177/0361198119827928) find that visibility of pedestrians by drivers plateaus when the illumination level in intersections is 7-10 lux, or 0.7-1.0 fc, and when glare is minimized – there is no additional benefit from higher illumination level. The current plan however is nearly 10 times higher than that level.

For all these reasons, the appropriate illumination levels for the roundabout are about 10 times less than currently planned.

RESPONSE:

We question the calculation of total lumens in the roundabout area. The calculation states that there are 31 single fixtures and 1 double fixture over the roundabout area of approximately 45,000 sf. The 32 fixtures are throughout the entire project area which includes Route 9 to the project limits, Damon Road, and a portion of the off and on ramps. There are only 10 fixtures within the 45,000-sf roundabout area. The resulting total lumens calculation would be 131,199 lumens as opposed to the 435,580 lumens reported.

Additionally, maximum lighting levels of 9.5 fc are cited and appear to be the basis for the statement that the levels are 10 times higher than they should be. These levels are single point values that occur directly below the fixture at a height of 5 feet above the ground surface. The lighting level drops off quickly as you move out from directly under the luminaire. If the lighting level directly below the fixture is dropped to 0.8 fc as is suggested, the lighting levels for the remainder of the roundabout would be significantly lower than required.

October 23, 2020

SUBJECT: **NORTHAMPTON** - Improvements on I-91 Interchange 19 at Rte. 9 & Damon Road
Project File No. 604597

Comment 3: *Glare and up lighting should be eliminated***.**

• In Note 2 on Sheet 157, you state that "Zone 3 allows for a "U3" BUG rating which allows for up to 500 lumens in the UL and UH zones, and 1,000 lumens total."

Up lighting and glare benefit no one. On the contrary, they are only detrimental to good visibility and safety. The Federal Highway Administration states (FHWA-SA-11-22, https://safety.fhwa.dot.gov/roadway_dept/night_visib/lighting_handbook/) that "disability glare is one of the most important elements to control in a lighting system. It affects your ability to adequately see, particularly for older drivers."

The Lumark fixtures shown in the plan are good in that they are down-facing. But they are not fully shielded against glare and up lighting. Good lighting that enhances roadway safety should have not only zero up lighting but also zero glare, i.e. BUG rating 0/0/0. Much better, safer, and environmentally friendly fixtures – with lower glare, better shielding, and lower lumens – are easily available and should be used in place of the currently planned fixtures.

RESPONSE:

The Lumark fixtures are decorative teardrop fixtures with shallow skirts agreed upon with the City. We have reviewed other fixtures from this manufacturer and have found that the fixtures with lower B/U/G ratings have initial lumens which are much lower than the proposed design. Without re-running the photometrics, we anticipate that using these luminaires would require additional poles to meet the required lighting levels set forth by IES.

Similarly, the suggested luminaires at the end of this letter are not only conventional light pole luminaires but deliver significantly lower lumens than the proposed Lumark teardrop fixtures and would require additional fixtures throughout the project area to meet IES guidelines.

Comment 4: *Blue light should be minimized, with maximum CCT 2700K***.**

I see no indication in the specifications of the planned correlated color temperature (CCT) of the lights. The IDA and the American Medical Association recommend CCT no bluer than 3000K and emphasize that the level of blue light emitted should be as low as possible, to minimize glare and harm to health of humans of animals. LED fixtures with CCT 2700K and even 2200K are now widely and easily available, have lumens-per-watt efficiency within a few percent of higher CCT LEDs, and have been adopted by numerous cities, states, and nations worldwide. Note that legacy high-pressure sodium lights, which have been the industry standard worldwide for 50 years, have CCT around 2000K. The lights used in the roundabout should have CCT no higher than 2700K.

October 23, 2020

SUBJECT: **NORTHAMPTON** - Improvements on I-91 Interchange 19 at Rte. 9 & Damon Road
Project File No. 604597

RESPONSE:

The CCT can be reduced from 4000K to 3000K to reduce the blue light level and still meet the current lighting criteria of 3000K, based upon the recommendations from the AMA. This is consistent with the approach we have been taking on other lighting projects currently under design.

Comment 5: *The lights should be controlled with timers that dim the light levels significantly late at night when motor vehicle and pedestrian traffic volumes are much reduced.*

Many models of LED streetlights are now designed to be controlled with such electronic dimmers and timers. Route 9 and Exit 19 traffic drops to a small fraction of rush-hour peak volumes late at night, i.e. after 8 pm and especially after midnight. Maintaining full lighting levels all night long is a waste of energy and money, causes unnecessary greenhouse gas emissions to provide the needed electricity, and benefits no one while causing significant harm to nearby humans and wildlife, adding to artificial sky glow and blocking the view of the stars.

RESPONSE:

Adding electronic dimmers would require adding infrastructure depending on the desired technology (conduit, cable, radars/sensors, etc.) to the contract. At this stage of construction, it would not be practical to add this infrastructure. However, MassDOT could consider retrofitting the light poles later.

MassDOT thanks you for your interest in this important project. If you have further questions or concerns, please contact Gautam Sen, Project Manager, at Gautam.sen@dot.state.ma.us

Sincerely,

Marie Joyce Rose

Marie Joyce Rose, P.E.
Director of Project Management

MJR/gs
ec: Peter Cavicchi, District 2 Highway Director
Richard Masse, District 2 Project Development Engineer
James Danila, State Traffic Engineer
Rob Hicks, Transystems