From: Michael Behrendt
To: Tracey Cutler
Subject: Lighting colors - WEBSITE
Date: Tuesday, August 29, 2023 12:32:48 PM

Tracey,
Please post this to the website. Planning Board – Current stuff. A new category "Lighting Regulations". Call this "Emails about Lighting Colors".
Thanks.

Michael Behrendt
Durham Town Planner
8 Newmarket Road
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(603) 868-8064

From: peyton mcmanus <peyton_mcmanus@yahoo.com>
Sent: Tuesday, August 29, 2023 9:00 AM
To: Michael Behrendt <mbehrendt@ci.durham.nh.us>
Subject: FW: Lighting colors - and LED consideration

Hey Michael,

Here is one more study, that looks at light colors (kelvins) and the impact on insects – for both LED and traditional UV. It seems that with LED the kelvin range might not have as much of an impact as the move from traditional UV to LED.

The big win for energy is conversion to LED. I do not know if the existing structures across that parking already support LED or if they need to swap out those housings.

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5108255/

Peyton

From: peyton mcmanus <peyton_mcmanus@yahoo.com>
Date: Thursday, August 24, 2023 at 5:48 AM
To: Emily Friedrichs <emilyfriedrichs@gmail.com>
Cc: Peyton McManus <peyton_mcmanus@yahoo.com>
Subject: Re: Lighting colors - and LED consideration

Hi Emily,

I'm not opposed to the idea, or against the spirt of your recommendation. I would like to see our recommendations clearly articulated - so that applicants can plan appropriately for what the various boards might request. It appears that the energy checklist is one attempt at that…although he energy checklist does not contain a ranked order of high, medium, low priority and everything is just kinda grouped together.

We have just replaced a bunch of lighting in a building in Portsmouth and I wasn't aware of this research - and I've also learned how complicated the new LED lighting components have become - and some of the complexity (and costs) involved with external lighting.

My guess is that any lighting updates will involve installing new LED lights (selfishly on their part to lower their power bill) - and then the color will be selectable (based on lighting style selected). The broader issue\question might be whether they will be using LED for any new and/or replacement lights.

Is it safe to say that energy usage is the same across the various kelvin ranges and/or that the life span of the light should be the same?

This study (link below) looks like it looks at both Kelvin and if LED is used, or not used - and color.

The big win for energy is conversion to LED. I do not know if the existing structures across that parking already support LED or if they need to swap out those housings.

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5108255/

Thanks for sending the info and follow-up!

Peyton

On Aug 23, 2023, at 7:30 PM, Emily Friedrichs <emilyfriedrichs@gmail.com> wrote:

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---------- Forwarded message ---------
From: **Emily Friedrichs** <emilyfriedrichs@gmail.com>
Date: Thu, Jun 9, 2022 at 9:54 AM
Subject: Re: Lighting colors
To: Michael Behrendt <mbehrendt@ci.durham.nh.us>

Hi Michael,

In conclusion, it seems that 2700 Kelvin is the preferred lighting for both entomologists and the HDC!

Here is the link to entomological research on lighting to share with the Conservation Committee, Historical Committee, and Planning Board.
https://resjournals.onlinelibrary.wiley.com/toc/17524598/2021/14/2.

There are several research studies published in this issue of the Royal Entomological Society that is dedicated to lighting's effect on insect decline. Since 2200 (amber) and 3200 (white) lights seem to attract either fireflies or disease-carrying insects respectively, it would seem that 2700 (yellow) lighting, as James Burbar noted, would be preferable for both insects and humans. In the Kelvin scale you include above, 2700 is classified as "*Warm White* - This color temperature is most commonly used in homes, restaurants and hotels because of it's warm, cozy and inviting glow – similar to a sunset or candlelight."

Here are some excerpts that might be most relevant:

Other taxonomic groups that one would expect to be severely affected by ALAN are those insects that produce their own light (bioluminescence) for signalling. Best known amongst these are the Lampyridae (Coleoptera), variously known as fireflies, glow worms or lightening bugs. Light signals in this group are used to attract mates and/or prey and as warning signals. ALAN may distract or disorientate either of the courtship partners or simply reduce the efficacy of the communication by flooding the background with illumination and thereby decreasing the signal-to-noise ratio. In the first comprehensive test of how firefly signalling in both males and females is impacted by ALAN, Owens and Lewis (2021) tested different courtship metrics (rate, intensity and pattern of male bioluminescent flashes) when one common species of North American firefly was experimentally exposed to five colours and two intensities of artificial light. Whilst all lighting treatments adversely affected signalling in both sexes to some extent, the wavelength closest to that produced by the insects themselves (monochrome amber) had the greatest negative impact. Owens and Lewis (2021) note that this is exactly the wavelength recommended in other studies as the least disruptive to most nocturnal insects. This leads them to the conclusion that it may not be possible to agree upon an

artificial lighting spectrum that is least harmful to the widest range of insects but also provides acceptable illumination for human vision. From
https://resjournals.onlinelibrary.wiley.com/doi/10.1111/icad.12490

- Lamp type was the only variable included in the most parsimonious models explaining morphospecies richness and abundance for all insects combined and for eight different insect orders. **White lamps (3200 K)** attracted far more insects, both morphospecies and individuals, including groups containing important vectors of pathogens, bacteria or parasites, than either **yellow (2700 K)** or **amber (2200 K)** lamps. Amber lamps attracted the fewest morphospecies and individuals overall but were the most attractive for a limited group of insects, including elaterid beetles (click beetles) and mycetophilid flies (fungus flies). While period of night was not a significant predictor of morphospecies richness or abundance, different assemblages of insects were collected during two different sampling periods (18:00–20:00 and 03:00–05:00). We strongly recommend that new infrastructure development projects introducing ALAN to light-naïve tropical forests use filtered amber LED lamps with no blue and minimal green light content in outdoor lighted areas. Similarly, operators should develop outdoor lighting plans that include overall reduction of nocturnal lighting and impact mitigation measures. These recommendations should also be used to retrofit existing infrastructure including roads and human settlements. From https://resjournals.onlinelibrary.wiley.com/doi/10.1111/icad.12479

Best regards,
Emily

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On Wed, Jun 8, 2022 at 5:18 PM Michael Behrendt
<mbehrendt@ci.durham.nh.us> wrote:

> To the Planning Board and HDC,
> Here is more information about the Kelvin scale of lighting. Each type of light has its appropriate place, whether indoors or outdoors.
>
> <image002.png> <image002.png> <image003.jpg>
> <image002.png>
>
> ***2700K – Warm White***
>
> This color temperature is most commonly used in homes, restaurants and hotels because of it's warm, cozy and inviting glow – similar to a sunset or candlelight.
>
> ***3000K – Soft White***
>
> A soft white temperature still provides warmth, but a bit more clarity for completing tasks. This color is common in bathrooms and kitchen areas.
>
> ***3500K – Neutral White***
>
> A neutral white mimics natural "middle of the day" light, and is ideal for spaces that require alertness such as office spaces and retail stores. This light is still warm and easy on the eyes, but promotes focused activities.
>
> ***4100K – Cool White***
>
> When an environment requires more precision, a cool white light is ideal. This lighting color is used mainly in

professional garages and grocery stores, which need crisp lighting for workers and customers to see detail when working on a car, and the colors of food as correctly as possible.

5000K – Bright White

Some locations require very bright white lighting for ultimate clarity. These spaces include warehouses, sport stadiums, hospitals, ER rooms and other industries where the brightest light is needed to perform tasks correctly.

6500K – Daylight

This color temperature has an apparent blue tone, and mimics natural daylight from the sun. It is commonly used for indoor farming, greenhouses and other agricultural purposes.

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