Overview of UV LEDs and How They Fit in a Wastewater Facility

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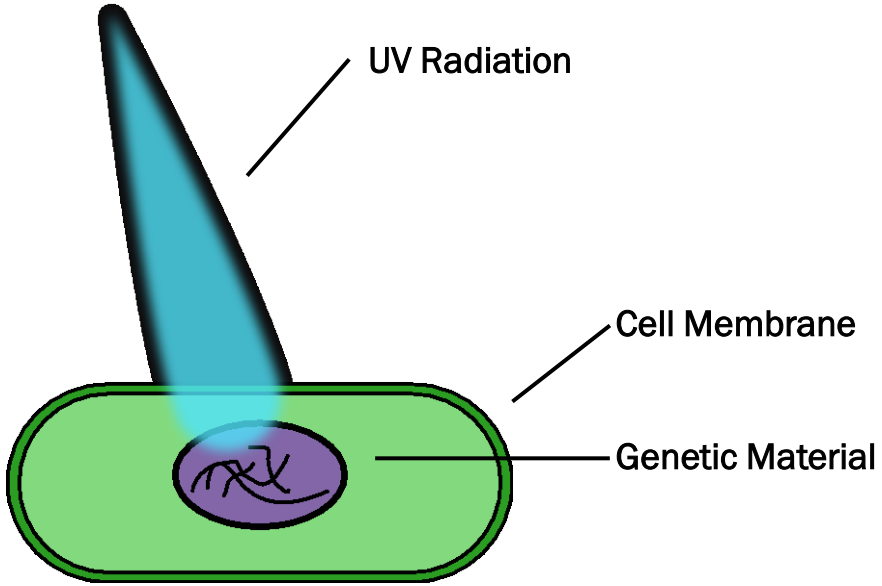
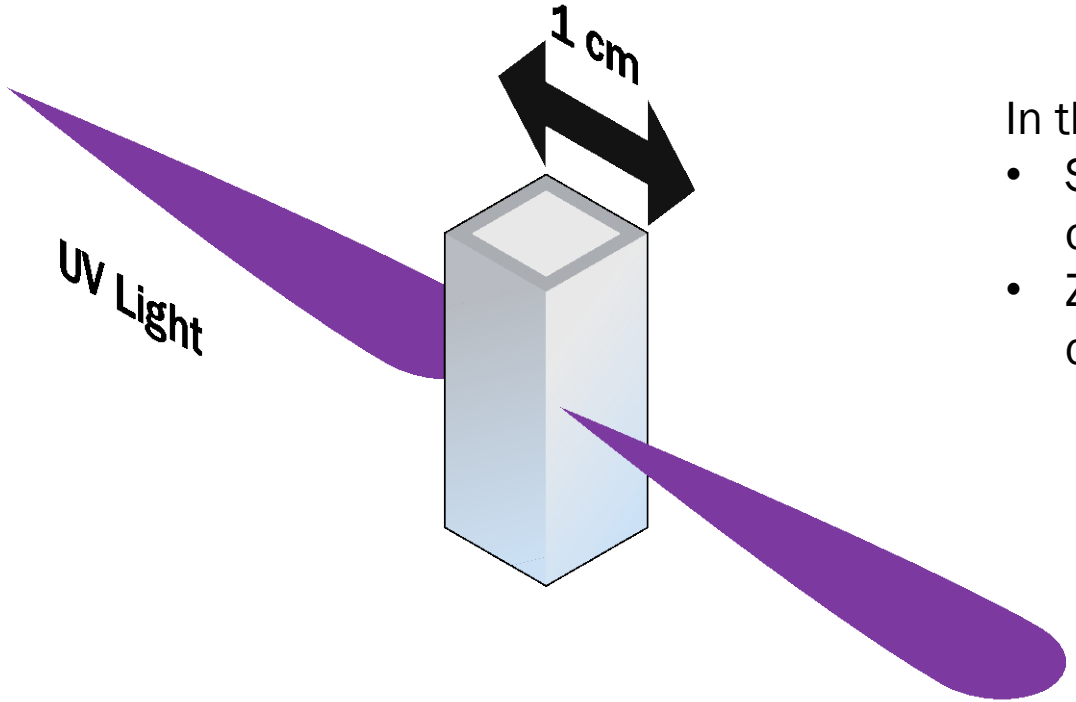
UV Disinfection Mechanisms



- The DNA / RNA of your target microbe absorbs UV light
- The DNA / RNA is physically changed after getting hit with UV light
- Physical changes to DNA / RNA makes it impossible for the microbe to reproduce anymore

How Do We Calculate UV Dose?



In the lab

- Shine 254nm UV light through our sampler
- Zero the device using completely clear water

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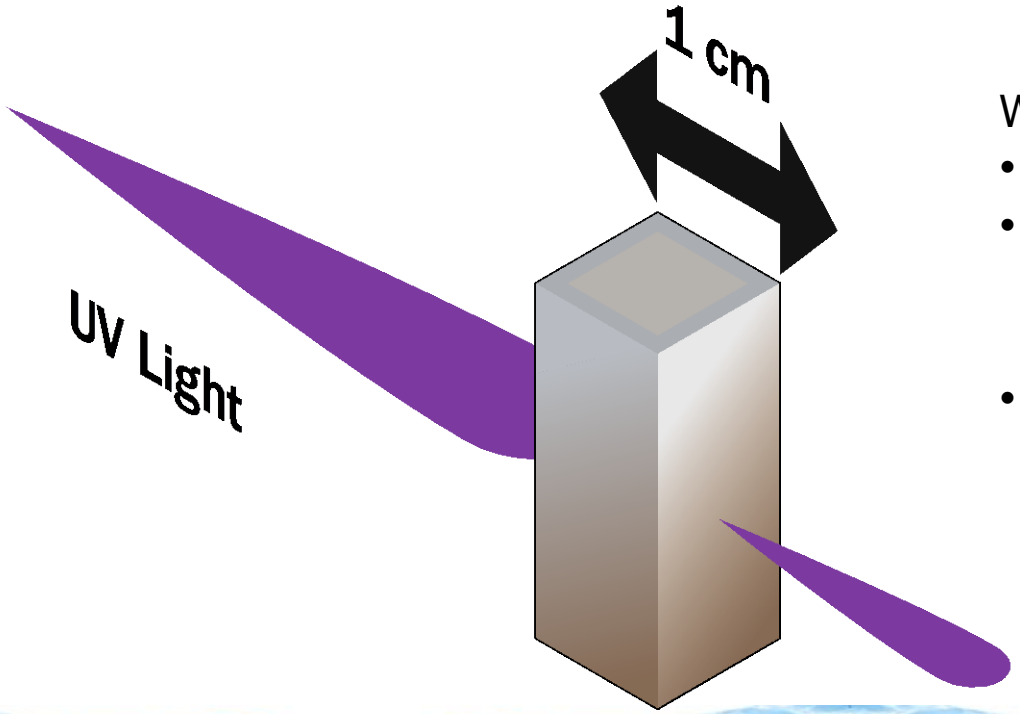
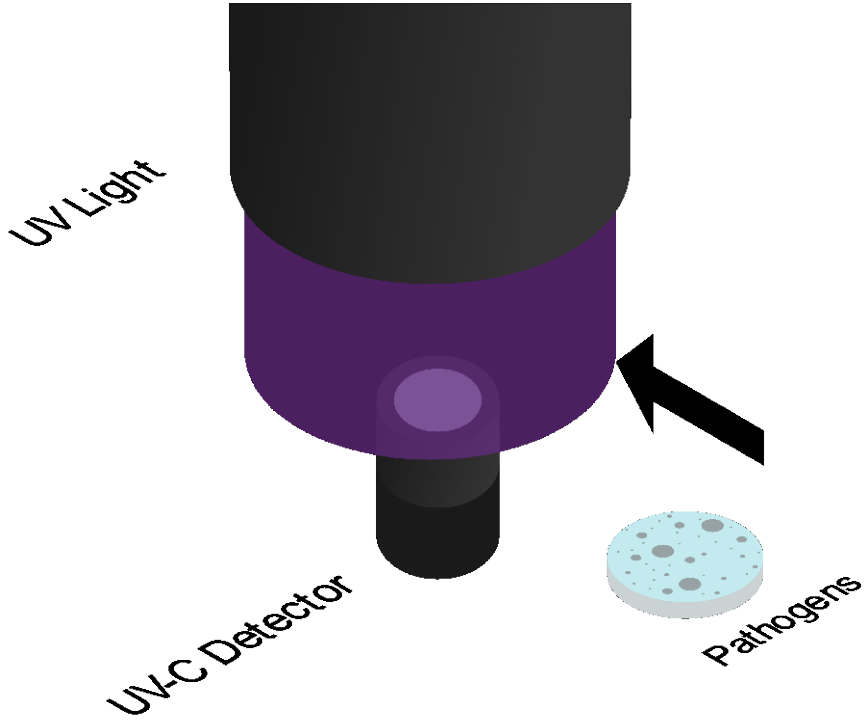


With a real sample

- Add wastewater to the vial
- The device will measure the difference in the light that can get through the wastewater
- This value is then used along with the brightness of the LEDs / UV bulb to calculate dose

UV Disinfection Mechanisms

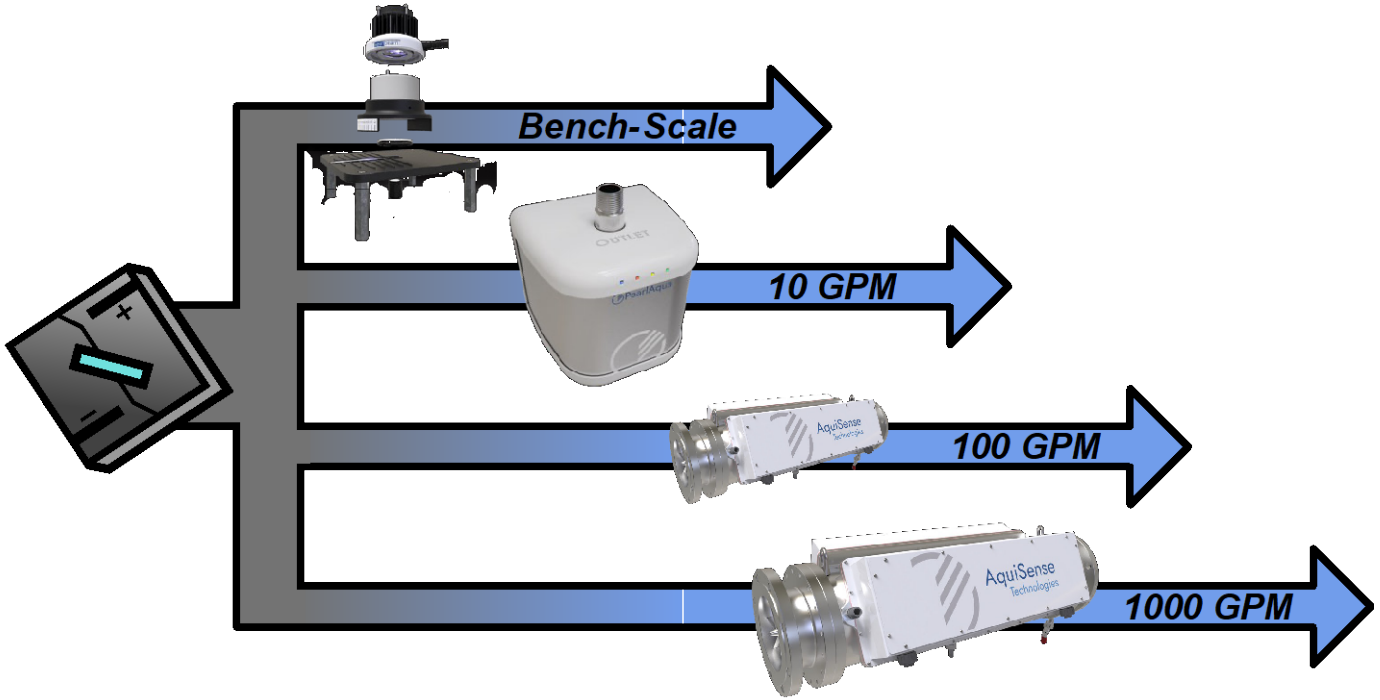
- UV exposed samples can then be measured to see what pathogens are still able to reproduce and make someone sick
- Conventional UV shines light at 254nm whereas LEDs can be customized for output
  - Customization may lead to improved performance and designing reactors for specific locations



Municipal UV Disinfection

- Conventional lamps get hot on the surface which causes multiple issues
  - Heat on the surface speeds up fouling
  - Reactors need to maintain a minimum flow rate in order to keep lamps cold enough to prevent damage
- Some systems have multiple moving parts that are tough to clean once fouled
- Some facilities experience breakage of lamps which can lead to an unintentional release of toxic mercury

UV Disinfection Scales



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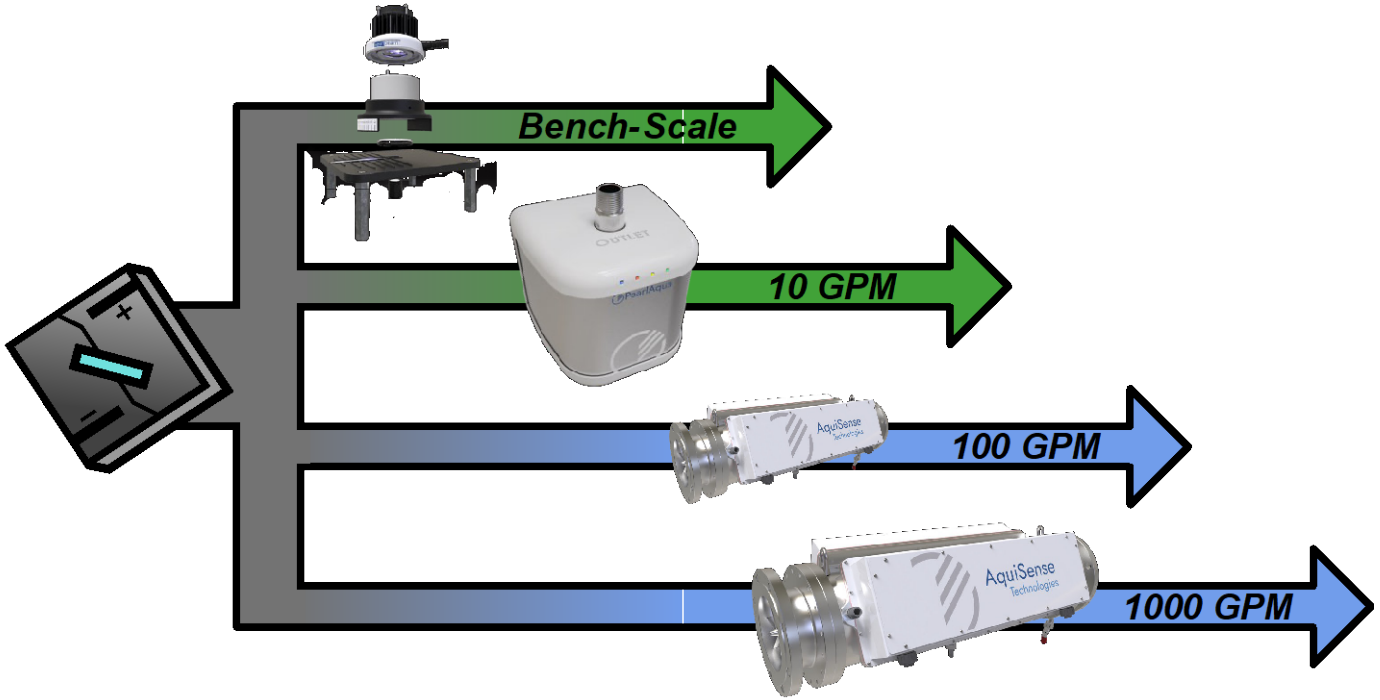

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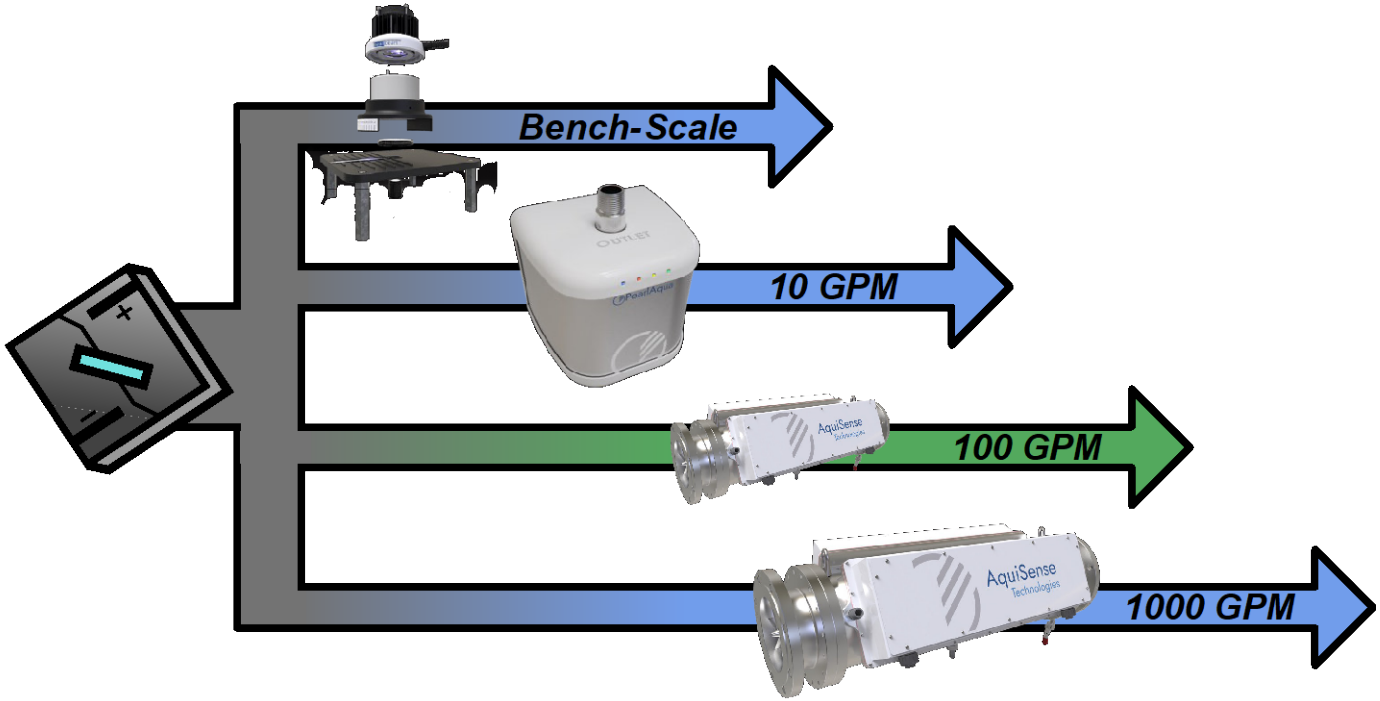
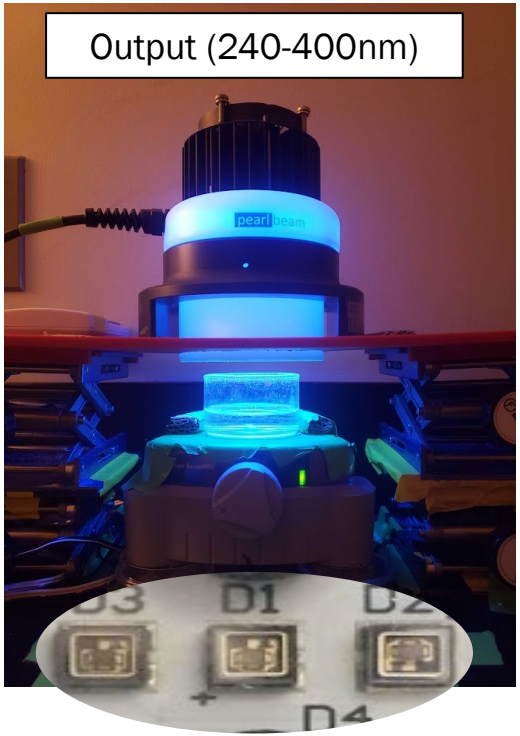


How Do We Understand UV LED Disinfection?



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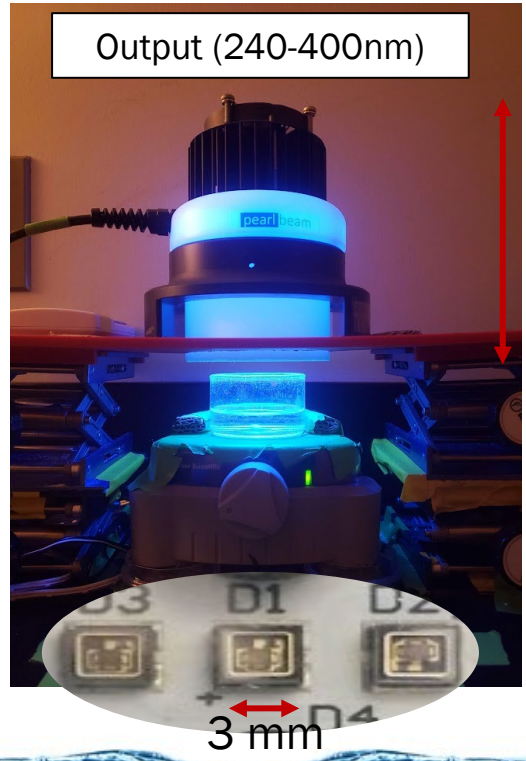
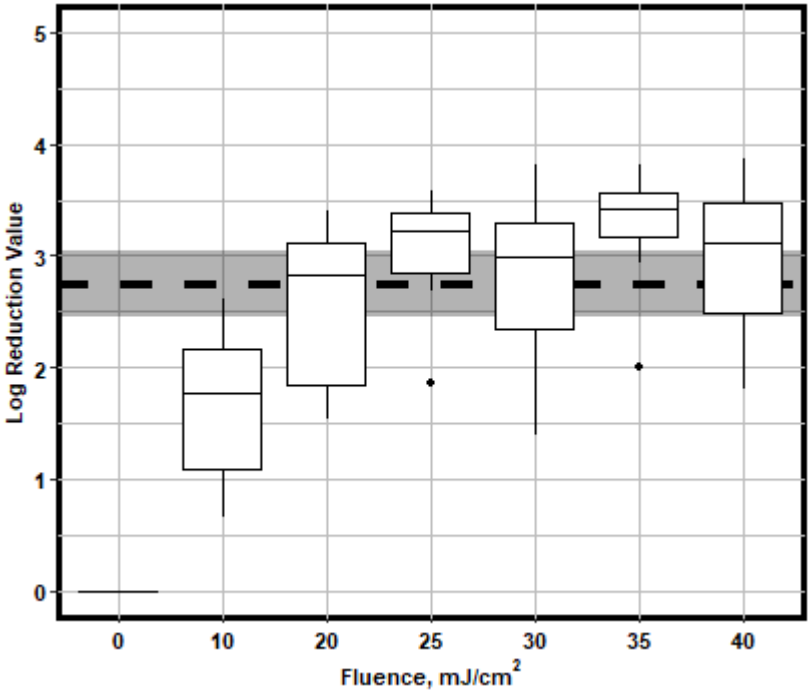


How to Assess Full-Scale Wastewater Systems?

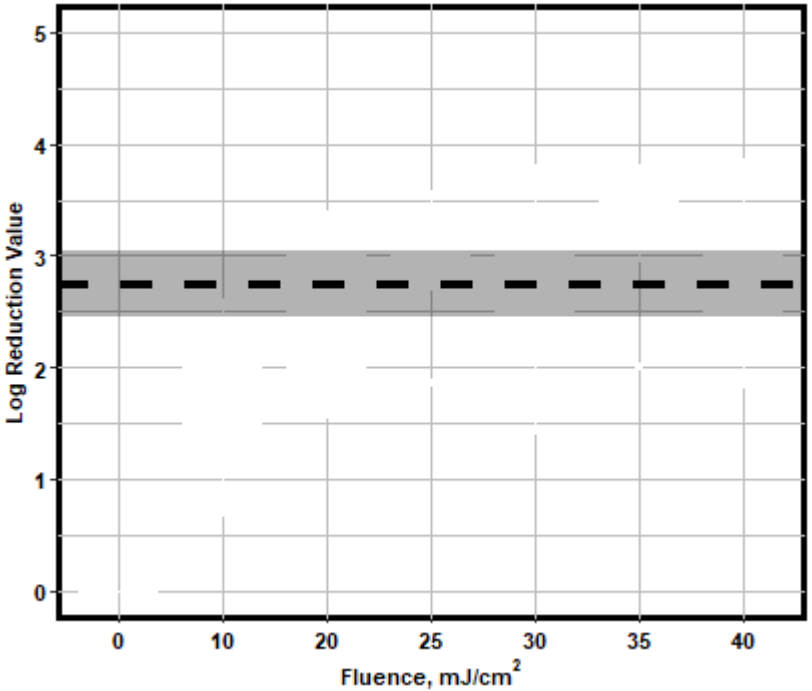
UV Audits for Disinfection Performance



UV audits can determine:

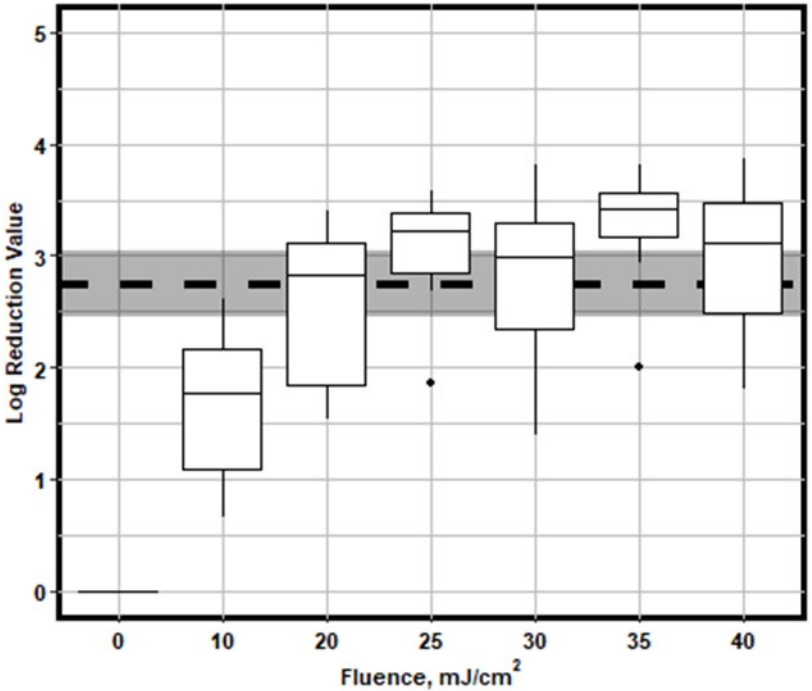
- Minimum fluence achieved
- Required dose for specific target reduction
- The upper limit of treatment

UV Audits for Disinfection Performance



Plant performance mean and 95% CI

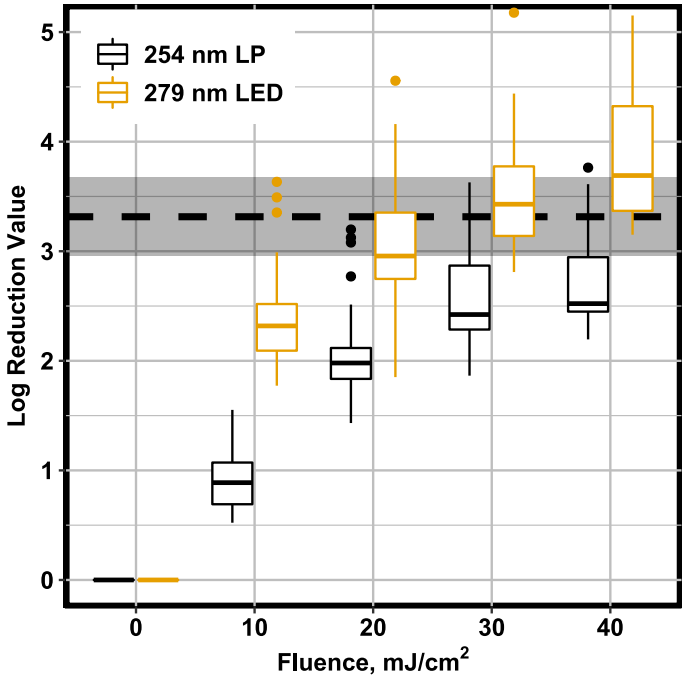
UV Audits for Disinfection Performance



Plant performance mean and 95% CI

Bench-scale treatment median and IQR

UV Audits to Assess UV LED Technologies?



- LED treatment outperformed LP
  - Achieved plant performance at lower fluence
  - Reach higher upper level of treatment

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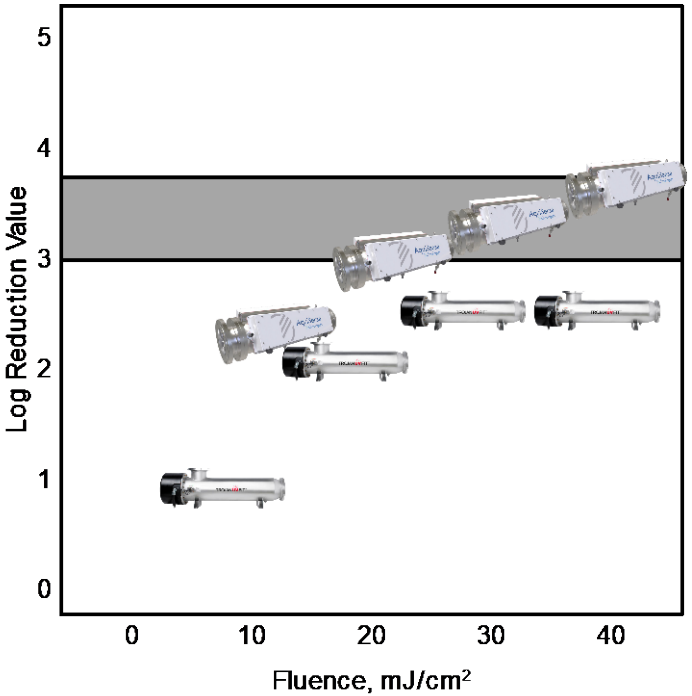

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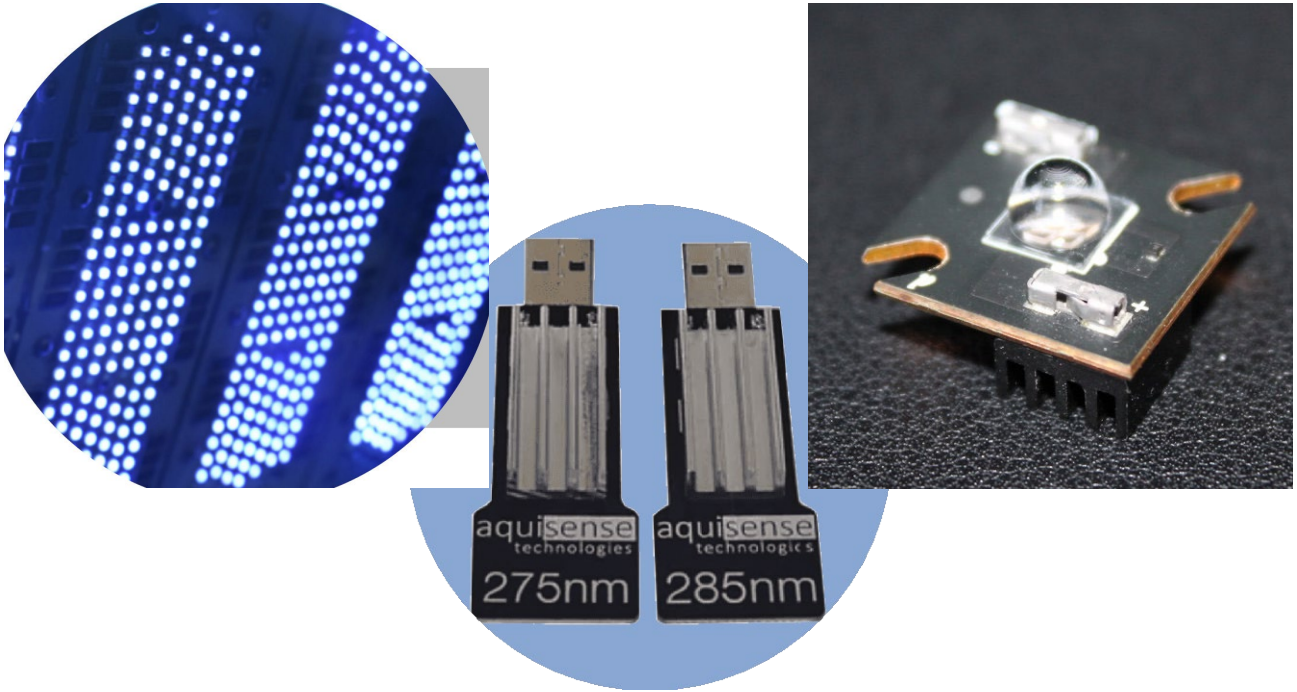
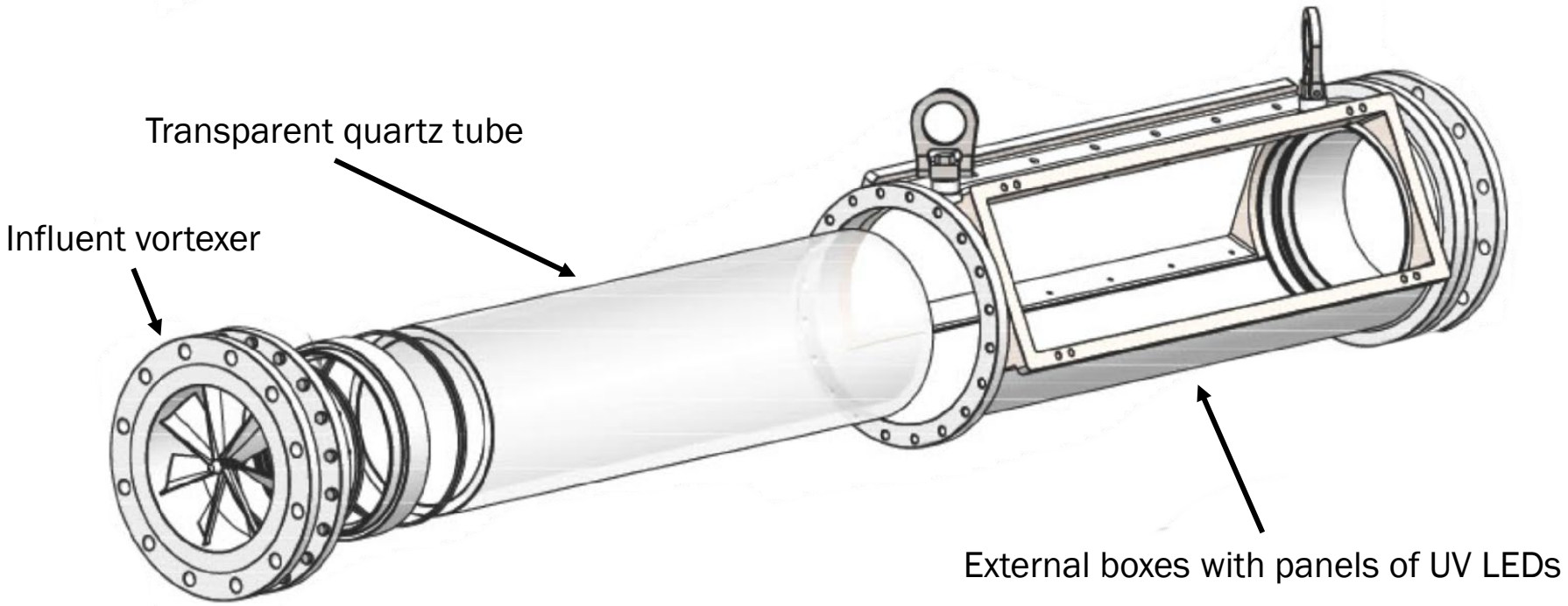
What Do These Things Actually Look Like?



Full-Scale Installation

- First full-scale wastewater installation of a UV LED reactor
  - Tera reactor (AquiSense Technologies)
  - 100 GPM (545 $m^3 day^{-1}$)
- Eastern Passage WWTF
  - ~40,000 customers
  - Conventional activated sludge secondary treatment
  - Avg flow 11,050 $m^3 day^{-1}$
- Side by side UV audits for the 2 systems

Full-Scale Installation



Full-Scale Installation

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