PORTLAND WATER BUREAU
FROM FOREST TO FAUCET

Bull Run TREATMENT PROJECTS | Filtration

Technical Memorandum

Subject:	Impacts of Lighting at the Bull Run Filtration Facility
PWB Project #s:	W02229
Date:	August 21, 2023
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1.0 Introduction

The purpose of this report is to describe how the site lighting at the Bull Run Filtration Facility (Facility) has responded to the requirements of the Multnomah County Zoning Code. Those requirements include Multnomah County Dark Sky Lighting Standards (MCC 39.6850) as well as the Community Service Uses Approval Criteria (MCC 39.7515) that (among other criteria): the proposal is consistent with the character of the area, will not adversely affect natural resources, and will not create hazardous conditions.

Compliance with Multnomah County Dark Sky Lighting Standards has been previously described in *Land Use Permit Lighting Report* (Exhibit A.47, September 2022). This report provides additional detail about the application of these standards in the design process and how compliance with these standards affects the experience of observing the facility and surrounding skies at night. In addition to the Multnomah County standards, the Facility design follows additional lighting design codes and guidelines, described below, which were developed for rural areas and for the protection of plants and animals.

As discussed in the *Filtration Facility Conditional Use Application Narrative* and other documents, drinking water treatment facilities are located in rural areas throughout Oregon and have proven to be low-impact facilities that do not conflict with surrounding rural residential, farm, forest, and public uses. The low impacts to surrounding uses are due, in part, to good practices in facility siting and lighting design. The Facility incorporates these practices, as described below, to create a lighting experience that is consistent with the character of the area, does not adversely affect natural resources, nor create hazardous conditions.

The design of the Facility mitigates the impacts of lighting and meets the Multnomah County Zoning Code requirements through the arrangement of the site and the lighting design. Features of the design are described below.

2.0 Site Arrangement

The arrangement of the Facility was designed to minimize off-site impacts, including the impacts of Facility lighting, by arranging the buildings and treatment facilities towards the center of the site and using berms and landscape plantings for screening.

Dark Sky Lighting Standards do not allow light to spill from fixtures across property lines, and this requirement is met in part by locating buildings, treatment facilities, and pathways well back from property lines, as shown in the night-time lighting simulations depicted in the figures below. Figure 1 shows light levels with all fixtures at full brightness for purposes of demonstrating that no light will spill beyond the property line. Note that this scenario would realistically never occur, as it would require every motion sensor to be triggered and every manual switch set to full output. A more typical situation is shown in Figure 2, with all fixtures dimmed. Note that these figures are not intended to be a photorealistic representation of the nighttime facility lighting levels but show the relative location and intensity of lighting under different scenarios.

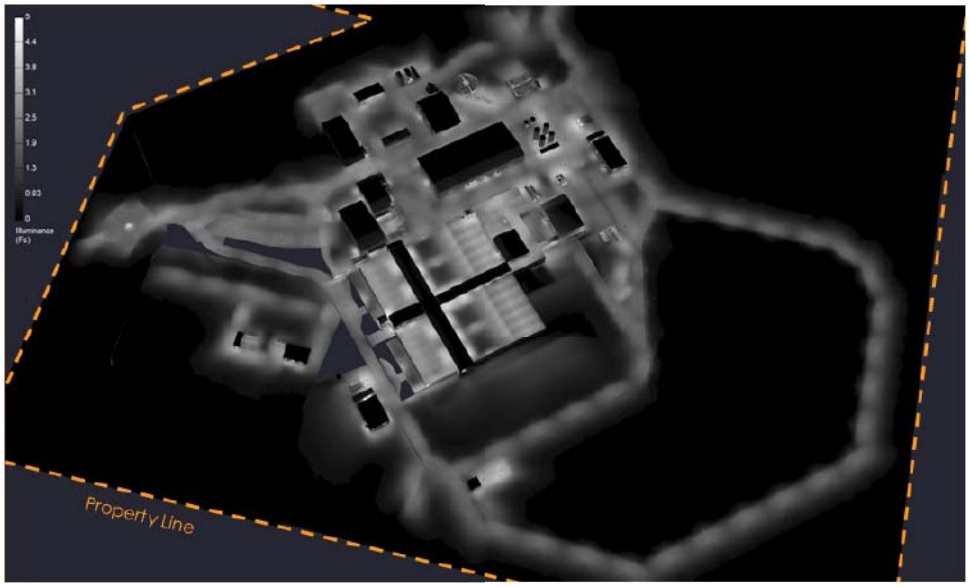

Figure 1. Simulation of Facility lighting with all fixtures at full brightness.

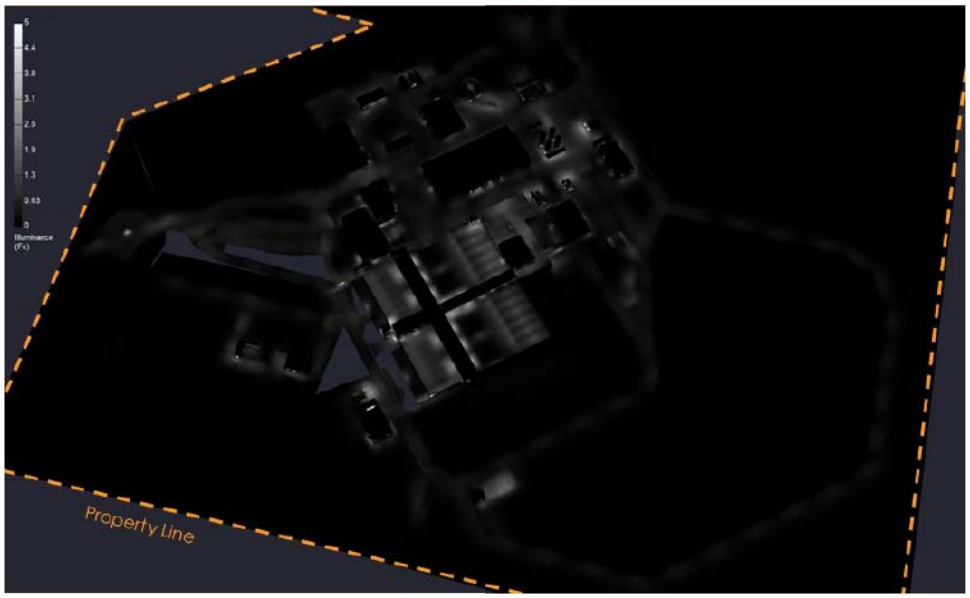

Figure 2. Simulation of Facility lighting with all fixtures dimmed.

The impact of lighting at the Facility is further reduced by the construction of berms along the north and northwest where facilities are closest to the property line, as shown in Figure 3. Also shown in Figure 3, tree clusters and screening plantings, which include a variety of native trees will, over time, further reduce the visibility of the Facility from beyond the property line.

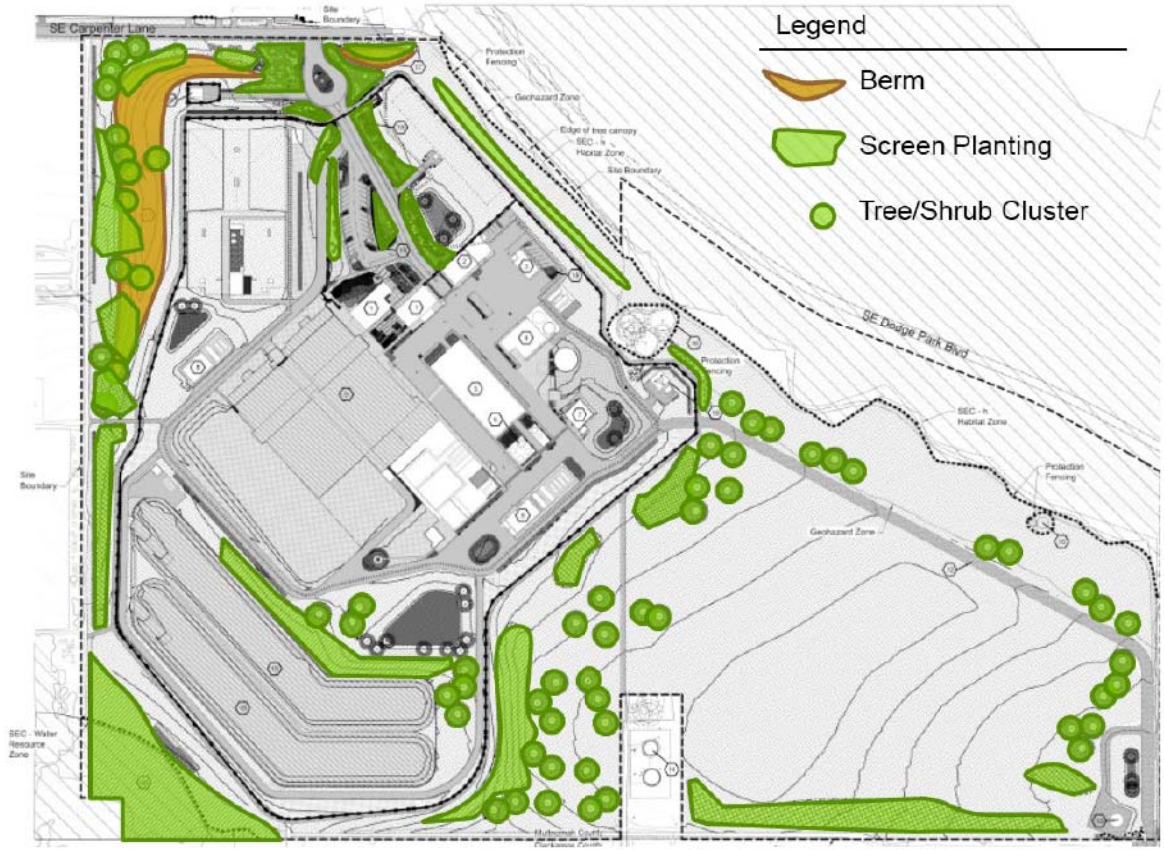

Figure 3. Berms and plantings screening views and lights.

3.0 Lighting Design

The lighting design for the Facility meets the needs for safety and security while complying with best practice shielding and illumination guidelines. As discussed in the *Filtration Facility Conditional Use Application Narrative*, the Facility is located in a rural area with rural residential, farm operation, and other development causing existing relatively bright night sky conditions, as shown in Figure 4.

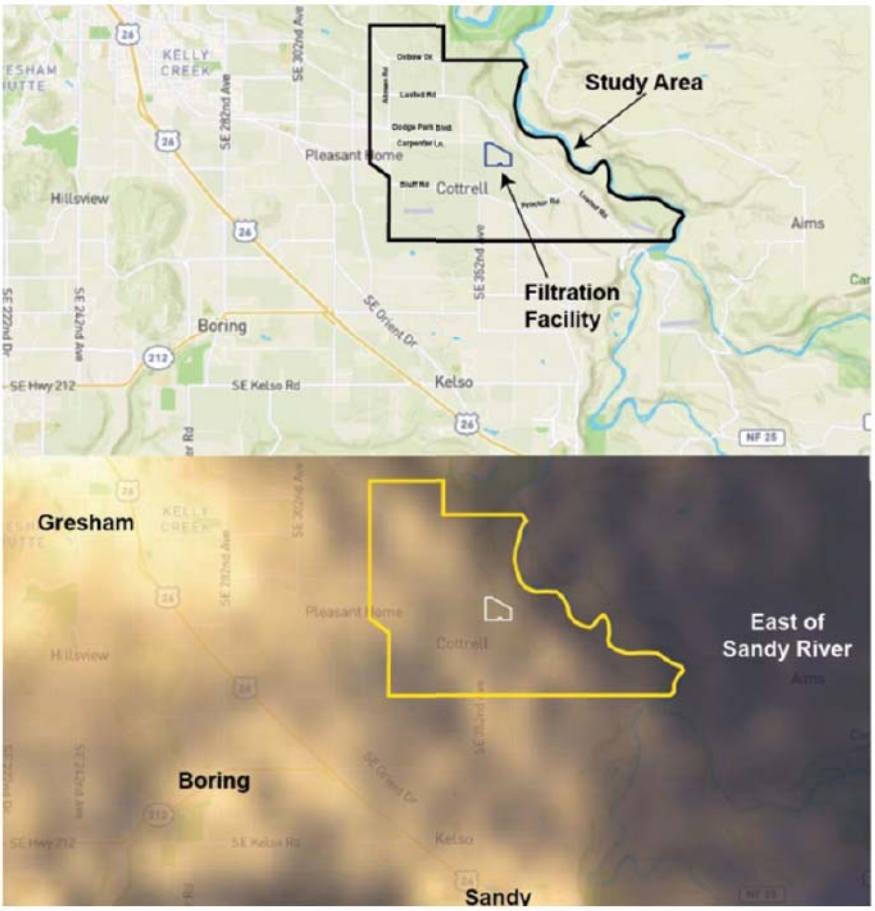

Figure 4. Night sky conditions in and around the proposed Facility location.

The industry standard for preserving dark skies is the International Dark-Sky Association Model Lighting Ordinance (IDA MLO) guidelines. These guidelines include four Lighting Zones:

- LZ0: No ambient lighting[1]
- LZ1: Low ambient lighting
- LZ2: Moderate ambient lighting
- LZ3: Moderately high ambient lighting
- LZ4: High ambient lighting

The lighting design for the Facility follows the guidelines for LZ1, described as follows:

> *"Lighting Zone 1 pertains to areas that desire low ambient lighting 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."*

[1] The LZ0 level only applies to "undeveloped areas of open space, wilderness parks and preserves, areas near astronomical observatories, or any other area where the protection of a dark environment is critical." The area around the Facility is not undeveloped open space, wilderness, or a similar dark environment, as shown in Figure 4.

The IDA MLO further recommends that LZ1 includes: *"Areas where lighting might adversely affect flora and fauna or disturb the character of the area. The vision of human residents and users is adapted to low light levels. Lighting may be used for safety and convenience, but it is not necessarily uniform or continuous. After curfew, most lighting should be extinguished or reduced as activity levels decline."*

To implement the IDA MLO guidelines, the design of the Facility includes a requirement that exterior light fixtures do not exceed maximum Backlight-Uplight-Glare (B-U-G) ratings.[2] B-U-G ratings describe the quantity and direction of light emitted, with all categories on a 0 to 5 scale, with 5 being brightest. IDA MLO LZ1 limits fixture selections to maximum ratings of B3-U0-G1. B-U-G limits are also included in the LEED and Envision rating systems, specifically LEED SSc6 and Envision QL1.5, and achieving these limits was part of PWB's commitment to LEED and Envision certification. With a "U0" rating, none of the Facility's luminaires will create the "uplight" which causes artificial sky glow or interferes with astronomy. The Facility will not interfere with or change the dark sky character of the area.

As described in detail in the *Land Use Permit Lighting Report* (cited above), all of the exterior fixtures specified for installation at the Facility meet or are below the maximum B-U-G ratings required under the IDA MLO LZ1, LEED and Envision. There have been recent studies regarding the impact of blue light on humans, flora, and fauna. IDA MLO restricts all outdoor lighting to a maximum color temperature of 3000K (warm white) in order to avoid blue light. All the Facility's luminaires comply with this directive.

In addition to specifying fixtures which protect the nighttime sky, the Facility design follows Oregon Energy Code requirements, specifically ASHRAE 90.1-2019 wattage and lighting controls. While this code is intended primarily to reduce energy usage, it also supports the goal of keeping the nighttime setting as dark as possible.

Under the ASHRAE requirements, exterior lights are illuminated only when they're needed and dimmed or off when unnecessary. Specific lighting control criteria include the following:

- Lighting automatically turns off when sufficient daylight is available.
- Non-essential building façade and landscape lighting automatically turns off between midnight and 6 a.m. or between times established by the authority having jurisdiction.
- All other lighting (including signage lighting) shall be automatically reduced by at least 50 percent in one of the following conditions:
    - From midnight to 6 a.m.
    - During any period when no activity is detected for a time no longer than 15 minutes.

To achieve this level of lighting performance, the Facility will have a flexible lighting control system programmed to keep the light levels as low as possible for safety and security, and only turn them on to full brightness when needed. While the project uses manual controls in some areas, the majority of the exterior lighting will be off or dimmed throughout the night. All of the exterior lighting is controlled by a wireless mesh network which is

[2] The IDA MLO guidelines explain that the three components of the B-U-G ratings each have different purposes: "Backlight, which creates light trespass onto adjacent sites. The B rating takes into account the amount of light in the BL, BM, BH and BVH zones, which are in the direction of the luminaire OPPOSITE from the area intended to be lighted. Uplight, which causes artificial sky glow. Lower uplight (zone UL) causes the most sky glow and negatively affects professional and academic astronomy. Upper uplight (UH) not reflected off a surface is mostly energy waste. The U rating defines the amount of light into the upper hemisphere with greater concern for the light at or near the horizontal angles (UL). Glare, which can be annoying or visually disabling. The G rating takes into account the amount of frontlight in the FH and FVH zones as well as BH and BVH zones."

capable of adjusting and programming every fixture remotely. The lights are divided into different sequence of operations listed below:

- Roadway and walkways, emergency egress paths - Fixtures are at a dimmed level, controlled by motion sensor to bring a group of luminaires to full brightness with a time delay to the dimmed state.
- Building decks, catwalks, inspection areas – Fixtures normally dimmed with a local switch for task lighting. Dimmed levels are required for security cameras and safety concerns.
- Assembly areas (e.g., Administration Building Portico, Maintenance Shed) - Fixtures normally off but triggered to dimmed state via motion sensor. Local switch controls lights to full light output.
- Areas occupied for operations or maintenance (e.g., pump shed at Area 51) - Fixtures normally off but triggered to full light output via motion sensor to provide emergency lighting if the area is occupied. No local switch.
- Lighting required to perform maintenance - Fixtures normally off. Local switch controls lights to full light output.
- Entry sign at roundabout - Fixtures at full light output at dusk, dimmed to 50 percent from midnight to 6:00 a.m., full light output until dawn.

Since each luminaire can be individually programmed, the fixtures can be customized after installation for on/off schedules, percentage of the dimming, modifying motion sensor sensitivity, etc.

4.0 Conclusions

The Facility has met the requirements of the Multnomah County Zoning Code to meet Dark Sky Lighting Standards and to be consistent with the character of the area, not adversely affect natural resources, and not create hazardous conditions. These requirements were met by:

- Configuring the buildings, facilities, and roadways on the site to minimize the off-site impacts of the lighting.
- Meeting Zoning Code requirements to contain light within the property boundary.
- Following IDA MLO guidelines for LZ1 (Low ambient lighting), specifying light fixtures with B-U-G ratings that minimize night sky impacts.
- Following Energy Code requirements to limit lighting levels and when lights are turned on.
- Implementing a flexible lighting control system that will allow Facility staff to adjust lighting levels and controls as needed.
- Providing appropriate lighting for site security and safe operation of the Facility.