Clean Water Services
East Basin 2019 Master Plan Project

Technical Memorandum 3
CLIMATE SENSITIVITY

FINAL | June 2021

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CLIMATE SENSITIVITY

3.1 Background

This technical memorandum (TM) documents the expected impacts and the recommended approach to address impacts of climate change to facilities at the Durham Advanced Wastewater Treatment Facility (AWWTF) and within the East Basin conveyance system as part of subsequent tasks of the East Basin Master Plan (MP). This TM summarizes the latest scientific research related to climate change impact characteristics and scenarios expected to occur in the Willamette Valley over the next 50 years. Specifically, impacts to precipitation events (severity and frequency) and to Tualatin River conditions (related to water levels, flows, and temperature and potential permit limitations). It should be noted that this assessment did not include any collection system or river modeling.

3.2 Climate Change Impacts in Willamette Valley

The state of Oregon has two local resources for climate change related information and downscaled projections, including:

- Oregon Climate Change Research Institute (OCCRI), which produces the Oregon Climate Assessment Report (OCAR). The OCCRI, created by the state legislature (House Bill 3543, 2007), includes a small staff housed at Oregon State University (OSU) and a larger network of more than 150 researchers both inside and outside the state of Oregon. The OCCRI's intent is to prepare the Northwest U.S. by building a climate knowledge network, inform communities, and advance the understanding of regional climate, impacts, and adaptation.
- Climate Impacts Research Consortium (CIRC), which provides regular updates on climate science and impacts for Oregon, Washington, Idaho, and western Montana. The CIRC team is funded by the National Oceanic and Atmospheric Administration (NOAA) and is based at OSU and hosted by the OCCRI and the College of Earth, Ocean, and Atmospheric Sciences.

The climate change impacts within Willamette Valley of specific interest to the East Basin MP are projected changes to:

1. Precipitation events (severity and frequency) to understand if there is a need to modify the design storm of the conveyance system.
2. Tualatin River conditions (water levels, flows, temperature) to understand if there is a need to modify effluent conditions to maintain permit compliance.

3.2.1 Precipitation Events

The fourth OCAR, completed in 2019, provides a comprehensive assessment of the state of climate change science, summarizing physical, biological, and social dimensions. The first chapter summarizes the state of knowledge of physical changes in climate and hydrology,

focusing on the period since the previous (third) OCAR completed in 2017 (Dalton et al. 2017). The second chapter of the third OCAR covers the impacts and is, verbatim, the Northwest chapter of the Fourth National Climate Assessment (NCA4)[1] which was released by the federal government November 23, 2018. The findings relative to annual precipitation and extreme events are as follows:

- Total annual precipitation is not projected to change significantly, showing:
  - Slight increases in winter precipitation (December to February).
  - Slight decreases in summer precipitation (June to August).
- Extreme events are projected to increase by ~10 percent in frequency in western Oregon by mid-century.[2] Additionally, the frequency of the "wettest day in 100 days" is expected to increase by ~6 percent for areas west of the Cascades.

Unlike the certainty in temperature projections for the region, precipitation projections for the Pacific Northwest do not have a high degree of confidence.[3] Because there is only low to moderate confidence in these estimated projections (indicating a high level of uncertainty), it is not recommended to directly apply the projected changes to historical data. In these circumstances, it is recommended to perform a stress test of the system in order to test its performance under a range of volume and intensity levels to identify system deficiencies and potential improvements. This approach is also consistent with and taken by the Portland Water Bureau and Bureau of Environmental Services (see Appendix 3A for a presentation by BES, *Climate Change Resiliency Planning for Water, Wastewater, & Stormwater in Portland, OR*) to determine the limits of their conveyance and collection systems.

Planning efforts will use the following storm events as a basis for design and sensitivity analyses, respectively:

- The 5-year design storm is used for design purposes, to define deficiencies and size improvements (3.6-inch storm depth in 72-hours, 0.28 inches per hour maximum intensity)
- A 5-year sensitivity storm (design storm+) is used to understand additional system risk from climate impacts associated with increased storm frequency and may be considered for oversizing system improvements. The 5-year sensitivity storm utilizes the design storm distribution with an increased depth to account for 10-percent frequency change by 2050 (3.7 inch storm depth in 72-hours, 0.29 inches per hour maximum intensity).
- An additional sensitivity storm (design storm + intensity) is used to understand additional system risk associated with increased storm intensity and may be considered for oversizing system improvements. The additional sensitivity storm increases the maximum hour intensity of the design storm to match the maximum intensity of a historic event occurring in December 2015 (3.7 inch storm depth in 72-hours, 0.34 inches per hour maximum intensity).

The design storm and climate sensitivity storm depths and distributions are show in Figures 3.1 and 3.2. Storm depths and intensities are also summarized in Table 3.1.

[1] https://nca2018.globalchange.gov/downloads/NCA4_Ch24_Northwest_Full.pdf

[2] Extreme precipitation event in Portland area is defined as one that delivers more than 2.5 inches in a 24-hour period.

[3] https://pnwcirc.org/science/precipitation

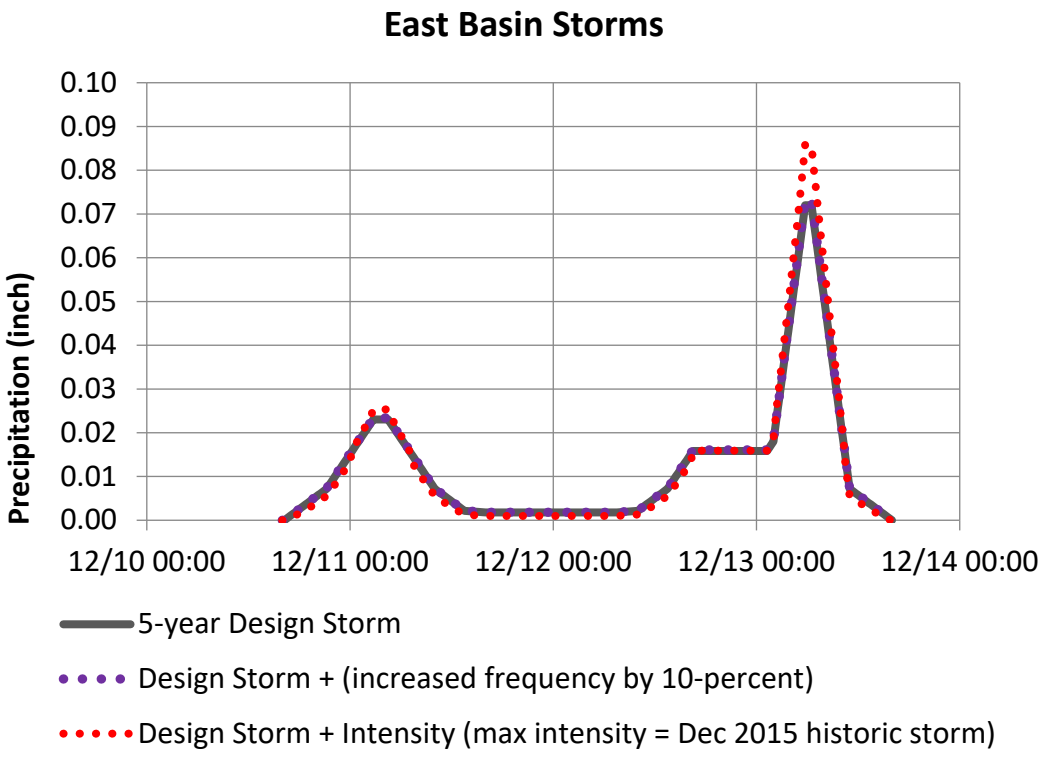

Figure 3.1 East Basin Design Storm and Climate Sensitivity Storms

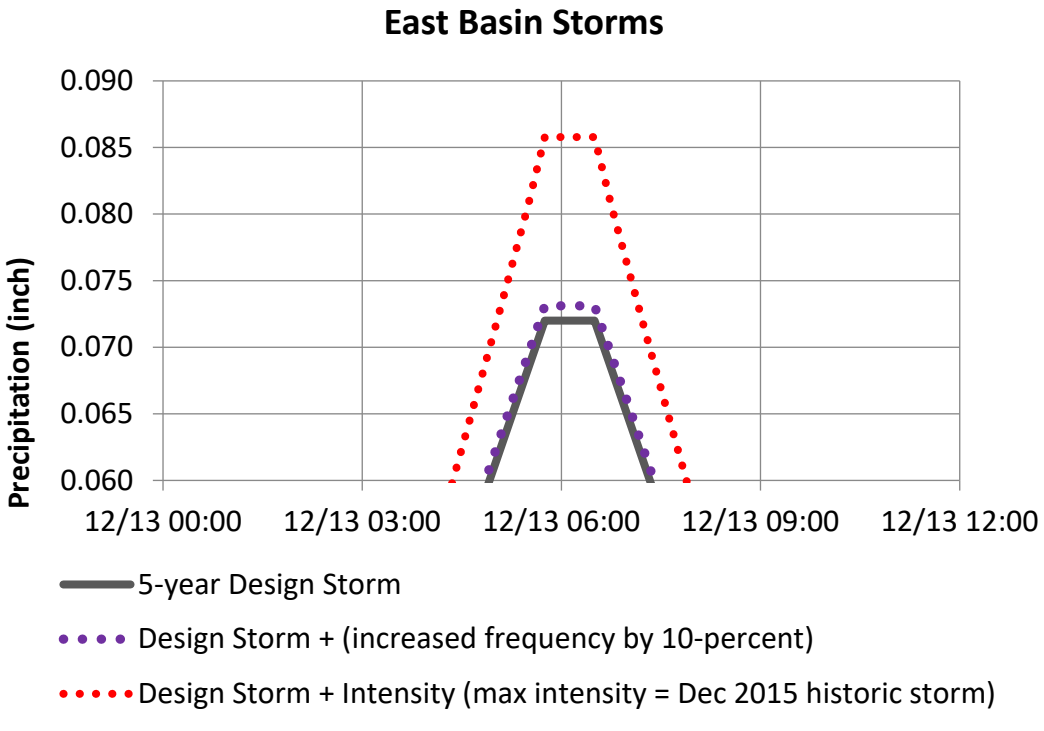

Figure 3.2 East Basin Design Storm and Climate Sensitivity Storms (peak of storm)

Table 3.1 Summary of Storm Depth and Intensity for Design Storm and Climate Sensitivity Storms

Storm	Frequency	72-hour Depth (inches)	Max Intensity (inches per hour)
Design Storm	5-year	3.6	0.28
Design Storm +	10-percent frequency shift (depth)	3.7	0.29
Design Storm + Intensity	Match December 2015 max storm intensity	3.7	0.34

3.2.2 Tualatin River

The Durham AWWTF discharges to the Tualatin River and there is concern that projected impacts of climate change to the river may indirectly impact the Clean Water Services' (District's) operations and permit specifications for temperature and flow.

The flow of the river is primarily controlled at the Scoggins Dam owned and operated by the Bureau of Reclamation (Bureau).

For reference, past studies of the Tualatin River Basin have projected:

- Higher river levels and higher peak river flows in winter due to increased extreme events.
- Higher peak flows leading to increased sediment loading.
- Heavy rainfall from extreme events also leading to slope instability and landslides, leading to compromised infrastructure (including closure of important transportation corridors for access to assets) and water quality.
- Atmospheric temperatures increasing (per decade) leading to an increased temperature of receiving water by ~0.7°F (0.4°C) in western Oregon.
- Doubling of high heat days by mid-century, from 30 to 60 days annually. A high heat day is defined as one that is >86°F (>30°C).
- Increasing the frequency of extreme fire, the largest of which is projected for the eastern third of Oregon and Willamette Valley, potentially impacting water quality and service.

3.3 Summary

The projected impacts expected to occur in Willamette Valley over the next 50 years due to climate change, with a focus on precipitation events (severity and frequency) and Tualatin River conditions (water levels, flows, and temperature), include:

- Precipitation:
  - Total annual precipitation is not projected to change significantly, showing:
    - Slight increases in winter precipitation (December to February).
    - Slight decreases in summer precipitation (June to August).
  - Extreme events are projected to increase by ~10 percent in frequency in western Oregon by mid-century[2].Additionally, the frequency of the "wettest day in 100 days" is expected to increase by ~6 percent for areas west of the Cascades.
  - Because there is only low to moderate confidence in these estimated projected changes to precipitation events (indicating a high level of uncertainty), it is recommended to perform a stress test of the system in order to test its performance under a range of volume and intensity levels to identify system deficiencies and potential improvements. A stress test using the climate sensitivity storms was

performed as part of the collection system alternatives evaluation and is documented in TM 8.

- Tualatin River – while a summary of projected impacts is provided in Section 3.2.2, since the flow of the river is primarily controlled by upstream dams owned by the Bureau, it is the responsibility of the Bureau to evaluate and address impacts of climate change to their operations, as well as coordinate with downstream entities (including the District). It was decided to coordinate with the Bureau on evaluations they perform.

Appendix 3A

PRESENTATION BY PWB AND BES ON: *CLIMATE CHANGE RESILIENCY PLANNING FOR WATER, WASTEWATER, & STORMWATER IN PORTLAND, OR*

Appendix 3B

EAST BASIN 2019 MASTER PLAN: CLIMATE SENSITIVITY ASSESSMENT (TASK 1.3) OVERVIEW PRESENTATION (AUGUST 2020)