

#### Hurricane Helene – September 2024

North Carolina was severely impacted by Hurricane Helene in late September 2024, causing at least 104 reported deaths and significant destruction of infrastructure.



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# Water Treatment Project

#### Hurricane Helene – September 2024

The North Carolina State University reported that its Mount Mitchell weather station recorded 24.41 inches of rainfall.

The office referred to the total as "off the charts", comparing it to 16.5 inches of rainfall being a once-in-1,000-year flood for the area.

Asheville Regional Airport recorded 19.38 inches of rainfall before losing communication.

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Representatives of the U.S. Army Corps. of Engineers, Vicksburg District, are soliciting bids for a new water treatment system (WTS) to be constructed in North Carolina.

Each system is expected to provide a maximum of 20 million gallons per day (MGD).



# Water Treatment Project

#### Hurricane Helene – September 2024

After making landfall in the Big Bend region of Florida on September 27, the hurricane traversed over land into the Appalachian mountain range, depositing record-breaking amounts of rainfall across several settlements in western North Carolina.



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# Water Treatment Project

#### Hurricane Helene – September 2024

On October 1, Governor of North Carolina Roy Cooper reported that 460,000 North Carolinians suffered from power outages.

In addition, there "complete infrastructural failure" of utilities such as power and water.



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The bid package must include:

Proposal bids must be submitted no later than **Sunday, February 23, 2025,** with company representatives on hand to present a brief **5-minute** overview of the proposed design.





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Water Treatment Project

The full-scale WTS may be constructed with any

combination of the following three processes:

coagulation and flocculation basins (5 MGD)

>~32-foot square filters (1,000 ft.2 per filter)

sedimentation tanks (each tank is 75,000 gallons)



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Each prototype WTS will be scaled-up to handle a flowrate of **20 million gallons per day** (MGD).

The effluent water must have an **average turbidity** < 2 NTU

To handle backwashing and cleaning of the WTS, the overall size of the treatment system should be increased by 20% or a safety factor SF of 1.2



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Each prototype WTS must meet the following criteria:

- 1. The filter material height may not be greater than 8 in.
- 2. Anthracite and/or filter sand may be used in the filter
- 3. The maximum filter run is 60 minutes
- 4. The effluent must have an average turbidity of less than 2 NTU
- 5. The water height above the filter material must be maintained at 6 in.

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Water Treatment Project Sedimentation System Cost Step 1 - Compute the prototype sediment tank retention time  $t_p$  $t_p = \frac{n_t (\text{Volume}_{tank})}{Q_S}$ where:  $n_t$  is the number of prototype tanks Volume\_tanks is the volume of one tank  $Q_S$  is the flowrate in the sedimentation tanks (mL/min)









Water Treatment Project Sedimentation System Cost Step 4 - The number of full scaled sedimentation tanks, *NS* required to handle the daily volume is estimated as:  $NS = Roundup \left[ \left( \frac{required \ flowrate(gpd)}{Q_{SE}(gpm)} \right) \left( \frac{day}{1,440 \min} \right) \times SF \right]$ where *required flowrate* (gpd) is a design parameter in the cost model.

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### Filtration System Cost



- 1. Each filter is 31 ft. by 31 ft. in area (~1,000 ft.<sup>2</sup>)
- 2. A 20% factor of safety (this will accommodate the backwashing time)
- 3. The filter media will be replaced every five years

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If either of the following criteria are violated:

- 1. the pressure head exceeds above 6 in.
- 2. The average turbidity > 2 NTU
- The time when the filter exceeded these criteria is the filter run time (less than 60 minutes).



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Filtration System Cost



$$Q_{FT} = Q_F \left(\frac{\text{gpm}}{\text{ft.}^2}\right) \times \text{filter area}(\text{ft.}^2)$$

Remember that the full-scale filters are 1,000 ft.<sup>2</sup>

$$Q_{FT} = Q_F \left(\frac{gpm}{ft^2}\right) \times 1,000 \text{ ft.}^2$$

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