Options Paper for Updating Rainfall Projections for the Massachusetts Stormwater Handbook
February 26, 2020

Background
During the kickoff Stormwater Advisory Committee meeting on February 12, 2020, DEP staff described the following proposals for updating Stormwater Handbook rainfall data:[1]

1. In the near-term, they are committed to replacing TP40 with NOAA Atlas 14 (NOAA14) data.
2. They are looking for guidance from this committee and the public process to help come up with a "Factor of Safety" for future projections. Their current options include:
    a. Using the NOAA14 data plus a multiplier (NOAA+)
    b. Using the State RMAT team's own variation of NOAA+ (in development)
    c. A third option?
3. In the long-term, MassDEP is looking to downscale the Global Circulation Model to provide statewide precipitation projections.

In order to contribute to this process, engineers from five municipalities (Cambridge, Lexington, Medford, Winchester, and Woburn) participating in the Resilient Mystic Collaborative have developed recommendations to improve state data and policies. Discussions and recommendations are summarized below.

Current and Projected Rainfall Data
Locally, Winchester and Cambridge each use higher current rainfall data than the 1961 TP-40 data used in the current Stormwater Handbook. Winchester uses Cornell data instead of NOAA14 data for two reasons. First, the current effective FEMA maps (adopted in 2010) are based on the Cornell data, not NOAA14. Second, the Cornell numbers are locally more conservative (i.e., higher) for larger storm events (See Table 1).

Table 1. NOAA Atlas 14 and Cornell Rainfall 24-hour Data (mid-range for 90th percentile) for Winchester

	24-hour Precipitation (inches)	
Annual Probability (%)	Cornell Data (inches)	NOAA14 (inches)
50	3.2	3.29
10	4.9	5.18
4	6.2	6.37
1	**8.9**	**8.19**

Cambridge uses downscaled global climate data to develop 2030 and 2070 rainfall projections.[2] Table 2 compares a variety of local rainfall estimates. Similar to Winchester, the NOAA14 data are higher for

[1] https://www.mass.gov/info-details/massachusetts-stormwater-management-updates-advisory-committee
[2] https://www.cambridgema.gov/CDD/Projects/Climate/~/media/A9D382B8C49F4944BF64776F88B68D7A.ashx

more frequent storms and lower for larger storms than the Cornell data. Table 2 and Figure 1 indicate that using the upper-range of the 90th percentile values for NOAA14 is a close match for the downscaled global climate model data Cambridge uses to project 2070 rainfall.

Table 2. Current and Projected 24-hour Rainfall Estimates for Cambridge, MA

Source of Rainfall Estimates (in inches)	Annual Probability (%)			
	50	10	4	1
TP-40		4.70		6.80
FEMA 2010 / 2003 Cornell		4.80		8.50
Current Cornell	3.25	4.90	6.21	8.90
NOAA Atlas 14 mid-range of 90th percentile	3.27	5.16	6.34	8.16
Cambridge 2030	3.34	5.60	7.25	10.20
NOAA Atlas 14 upper-range of 90th percentile	3.94	6.29	8.18	11.30
Cambridge 2070	3.65	6.40	8.22	11.70

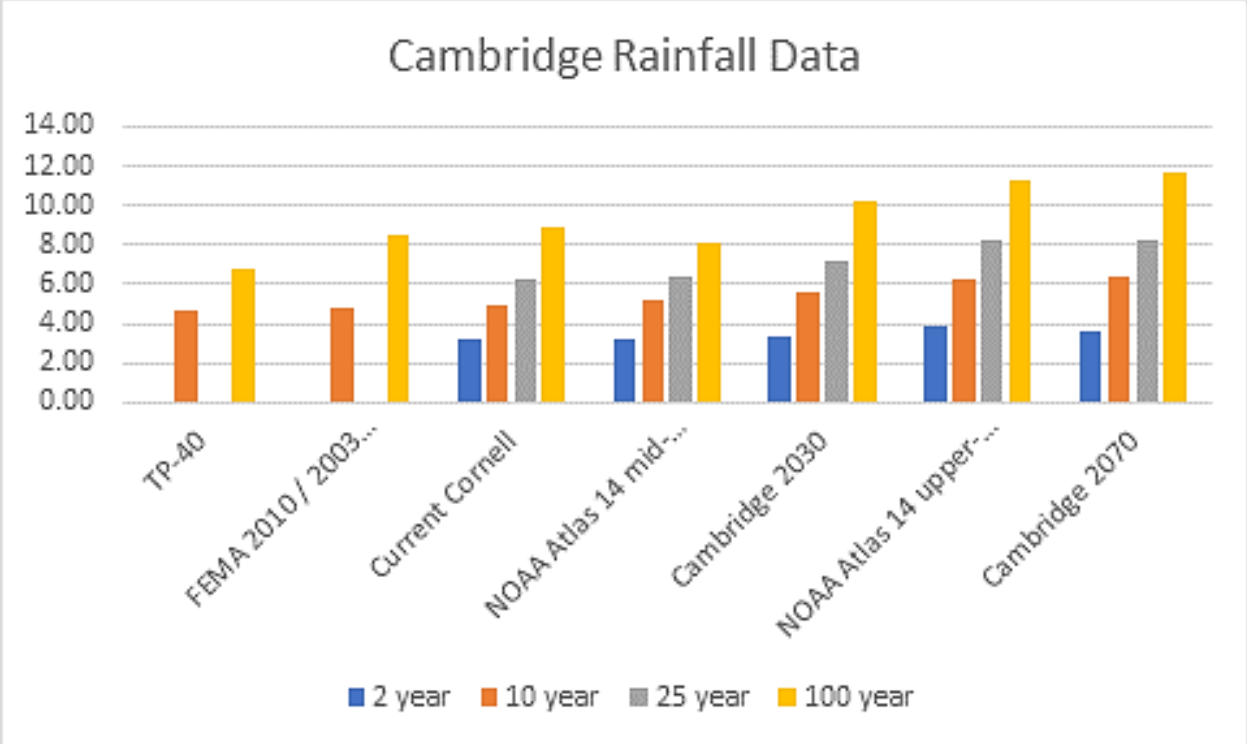

Figure 1. Comparison of current and future rainfall estimates for Cambridge, MA

Although downscaled data are not available for Winchester, they did compare upper-limit 90th percentile NOAA14 and Cornell data in Table 3 and Figure 2. Similar to the mid-range data, Cornell high-end estimates are higher for bigger storms.

Table 3. NOAA Atlas 14 and Cornell Rainfall Data (upper limit 90th percentile) for Winchester, MA

Annual Probability (%)	Rainfall Estimate		
	NOAA Atlas 14 (inches)	Cornell NRCC (inches)	% difference NOAA vs. Cornell data
100	3.26	2.87	12.7
50	4.05	3.38	18.0
20	5.34	4.48	17.5
10	6.44	5.58	14.3
4	8.33	7.44	11.3
2	9.7	9.28	4.4
1	11.5	11.56	-0.5
0.5	13.2	14.42	-8.8
0.2	16.4	19.34	-16.5
0.1	19.1	N/A	-

Other communities use a mix of rainfall estimates. For example, Woburn uses Cornell data for the Conservation Commission and NOAA14 for general stormwater permits. Lexington's stormwater regulations require Cornell data for sites greater than one acre located outside Conservation Commission jurisdiction. Both communities' Conservation Commissions are interested in using consistent data across permit types. Like Winchester and Cambridge, NOAA14 data for Lexington are higher for smaller storms and lower for 1% storms. Both communities are comfortable using either Cornell or NOAA14 data.

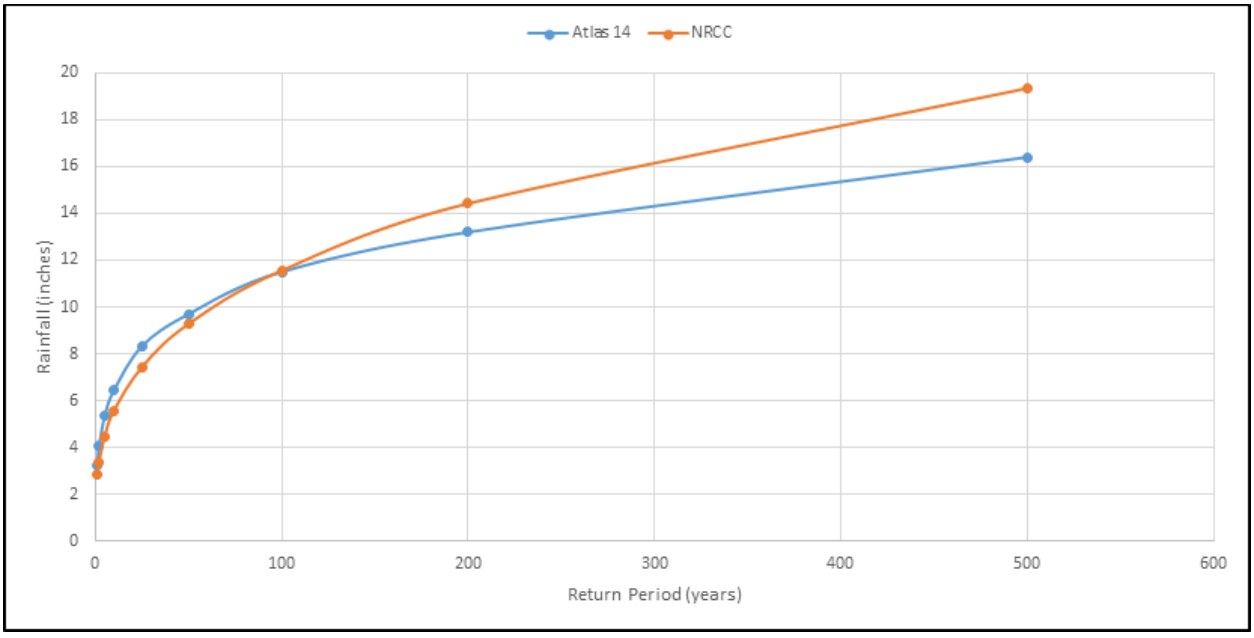

Figure 2. NOAA14 vs. Cornell rainfall estimates for Winchester, MA

Data Summary

1. For both Winchester and Cambridge, NOAA14 predicts more rainfall for smaller storms and Cornell predicts more rainfall for upper storms. Cornell data are therefore more conservative (i.e., higher) than NOAA14, at least for these two communities.
2. For Cambridge, the upper-limit 90th percentile NOAA14 projections are close to local downscaled 2070 estimates.
3. NOAA14 data and Cornell data are each referenced elsewhere; participants actively wanted to use the same data across various regulations.

Policy Recommendations

Participants supported using NOAA 14 90th percentile upper-limit estimates as the best short-term proxy for 2070 projections until downscaled global climate estimates are developed. We did not have better ideas for defensible short-term proxies.

In order for these data to be used effectively, we had additional recommendations:

1. First, since today's projects will experience future storms, they need to reference 2070 rainfall projections, not 2020 data. For example, Cambridge requires new developments to not be flooded by a 2070 10% storm and to not be damaged by a 2070 10% storm.
2. Second, given that TP-40 data are sixty years out of date, participants were concerned that these data also would not be regularly updated.
    a. We would like to see DEP commit to updating these data every three to five years, or sooner if significantly different new consensus data become available.
    b. We would like to see a default mechanism to allow municipalities to use more conservative data for large development projects if the Stormwater Handbook data get more than e.g., 10% behind the latest available standard precipitation data.
3. We are glad to see the Stormwater Advisory Committee will be examining how this plays out in floodplains to ensure the same analyses are no longer using different data.
4. Given concerns regarding disruption of climate science at the federal level, we would like to see the Stormwater Handbook not exclusively reference NOAA14 data but also the latest available standard precipitation data, whether it be updated Cornell data, downscaled global data, or other reliable sources.