FLOOD PROTECTION PROPOSAL

1. Goal

- Improve Chapter 500 for more effective protection of property and infrastructure considering climate change, site, and watershed characteristics.

2. Scope

The proposal focuses on the current “Flooding Standard”, Chapter 500(4)(F) and considers alternative approaches for more effective overbank and extreme flood protection. To a lesser degree, the proposal also addresses channel protection, for the current Flooding standard requires peak flow attenuation for relatively more frequent two-year return period storms.

3. Background & Justification

Current Flooding standard applies to large development projects requiring a SLODA permit or resulting in three or more acres of impervious area and 20 or more acres of developed area. To comply with the standard, proposed stormwater management systems must:

a. Detain, retain, or infiltrate stormwater from 2-, 10-, and 25-year 24-hour storms so that the post-development peak flows do not exceed the pre-development peak flows. Non-structural, nature-based LID measures can be overwhelmed by the stormwater volume associated with infrequent, large storms (e.g., 25-year storm). Hence, the stormwater management systems are designed to include structural measures that <u>detain</u> stormwater for peak flow attenuation. Common structural measures used for detention are wetponds, dry detention basins, and manufactured subsurface basins. These measures are designed to have sufficient detention volume and attenuate the peak flows from the large storms. However, they cannot reduce the large stormwater volumes considerably through retention (i.e., infiltration + evapotranspiration). They contribute to flood control through “holding and gradually releasing” the stormwater.

b. The standard sets the minimum hydraulic capacity for the stormwater conveyance structures (e.g., swales, ditches, storm drains) through 10-year, 24-hour design storm requirement. Please note that the capacity requirement <u>only</u> applies to larger land development projects, typically requiring a SLODA permit. Chapter 500 does not have any hydraulic capacity requirements for the projects requiring a SML permit.

c. The standard also specifies the requirements for on-site stormwater storage in case of flooding: no building or similar structure can be constructed in an area which can be flooded by a 10-year <u>or</u> 25-year 24-hour storm (Chapter 500(4)(F)(2)(c)). Current wording is confusing for the stormwater practitioners (i.e., reviewers, consultants), for it mentions two different storms.

d. The standard provides flood protection for primary access roads of the projects and public roads bordering the projects up to 25-year, 24-hour storm.

The standard has two waivers:

e. Discharge to a coastal wetland, a great pond, or a major river segment: This waiver is based on the premise that flooding risk associated with these waters is not impacted by the land development projects regulated under Chapter 500.

f. Insignificant increases in peak flow rates from a project site: Applicants must demonstrate that peak flow increases are unavoidable and have insignificant flooding impact on the downstream structures and protected natural resources. Technical guidance for this waiver is limited.

Applicants use the precipitation table provided in Chapter 500 Appendix H to comply with the standard. Appendix H is a static table based on the data available from NRCC as of June 2014. Appendix H requires the applicants to use NRCS Type II or Type III storm depending on the location of their projects.

Since the latest revision of Chapter 500 in 2015, NOAA released Atlas 14 including updated precipitation data and storm distributions for the New England region. Currently, NOAA is working on publishing Atlas 15 for the conterminous US by 2026 which will consider the impact of nonstationary climate (climate change) on the precipitation estimates (see NOAA Atlas 15 flyer). Hence, the new Chapter 500 needs to have flexible language to leverage best available precipitation data considering climate change, preferably without major substantive rulemaking.

New England (EPA Region 1) states, specifically CT, MA, and NH, have been working on reviewing and updating their peak flow control standards and/or stormwater manuals (**Table 1**). Maine can assess these recent efforts to improve its flooding standard.

Table 1. Peak Flow Attenuation Requirements of the New England States.

State	Peak Flow Attenuation Standard	Precipitation Data	Storm Distribution	Reference #
Connecticut	• $Q_{2,Post} \leq 0.5 \times Q_{2,Pre}$ • $Q_{10,Post} \leq Q_{10,Pre}$ • $Q_{100,Post} \leq Q_{100,Pre}$*	50th Percentile (Median) NOAA Atlas 14	NOAA Type D	1
Massachusetts**	• $Q_{2,Post} \leq Q_{2,Pre}$ • $Q_{10,Post} \leq Q_{10,Pre}$ • $Q_{100,Post} \leq Q_{100,Pre}$	0.9 x Upper Confidence Limit (NOAA Atlas 14)	NOAA Type C or D	2
New Hampshire***	• $Q_{10,Post} \leq Q_{10,Pre}$ • $Q_{50,Post} \leq Q_{50,Pre}$	Technical Paper #40 (TP40) or Other Acceptable Data (e.g., NRCC)	Unspecified	3, 4
Rhode Island	• $Q_{10,Post} \leq Q_{10,Pre}$ • $Q_{100,Post} \leq Q_{100,Pre}$	NRCC	NRCS Type III	5
Vermont	• $Q_{10,Post} \leq Q_{10,Pre}$ • $Q_{100,Post} \leq Q_{100,Pre}$	NOAA Atlas 14 or its replacement	NRCS Type II	6

$Q_{X,\ Pre\ or\ Post}$: Peak flow for "X"-year return period, 24-hour storm at the analysis point. "Pre" and "Post" subscripts stand for "Pre-development" and "Post-development" conditions, respectively.
*: At the discretion of the review authority.
**: Official rulemaking is currently underway. Proposed amendments are shown in this table.
***: New Hampshire also has 2-year peak flow control under its "channel protection" requirements which are not shown in this table.

4. Flooding Standard Related Recommendations

The Department intends to discuss the following with the stakeholders:

a. Stormwater Conveyance Hydraulic Capacity

Considering good engineering practices and climate change, the Department proposes to require all stormwater conveyances permitted under Chapter 500 to comply with minimum hydraulic capacity standards. In other words, both SML and SLODA projects will comply with the hydraulic capacity standards. Open conduits can be designed using 50-year storms whereas closed conduits can be designed using 10-year storms. This hydraulic capacity standard needs to be provided in a separate section of Chapter 500 other than the “Flooding” standard section.

b. Standard Applicability Thresholds

The Department proposes to maintain the current impervious and developed area thresholds of three and 20 acres, respectively. The three-acre threshold is also consistent with the “Structure” definition in SLODA.

c. Elimination of Two-year Storm Peak Flow Attenuation

Two-year storm is generally accepted as the channel-forming event that generates bankfull flows for streams. Generally, two-year storms do not result in overbank flooding. Attenuating peak flows from two-year storms is commonly considered for channel protection (see NH standard in **Table 1**). Furthermore, controlling peak flows from two-year storms can inadvertently increase frequency and duration of erosive flows in stream channels under post-development condition as compared to pre-development condition (WEF and ASCE, 2012). This is particularly true when little or no stormwater volume control is provided. The Department proposes “groundwater recharge” level of control with its LID standard proposal. The groundwater recharge requirement will be instrumental for approximating post-development runoff duration curves to the pre-development runoff duration curves for frequent storms including two-year storms. Therefore, the Department proposes to eliminate the peak flow attenuation requirement for the two-year storms.

d. Design Storms, Precipitation Data, and Storm Distribution

Even though it is not explicitly stated in current Chapter 500, peak flow attenuation requirements for 10- and 25-year storms can be considered to provide overbank and extreme flood protection, respectively. In response to climate change and its impact on precipitation, regulators are inclined to increase the return period of the storms used for flood control. For instance, the 50-year storm peak flow attenuation requirement is quite common in Maine’s municipal ordinances. The Department proposes a technical assessment of the current design storms considering (a) recently updated flood control standards in New England (**Table 1**) and (b) nonstationary precipitation due to climate change.

The Department proposes considering 100-year storm for the design of the emergency conveyance structures (e.g., emergency spillways).

Structural SCMs to be constructed in compliance with the new Chapter 500 standards will be in service around year 2060. Therefore, it is important for Chapter 500 to allow the use of best available precipitation data. The Department proposes to eliminate the stationary precipitation frequency table

(Appendix H) and allow the use of best available precipitation data without a Chapter 500 revision requiring major substantive rulemaking. Like the approach followed by other New England states (**Table 1**), use of currently available NOAA Atlas 14 or its most up-to-date version (pending Atlas 15) can be considered.

Currently, Chapter 500 requires NRCS Type II and Type III storm distributions for the projects in northern and southern Maine, respectively (Appendix H). Some of the New England states have adopted the use of recently developed NOAA storm distributions (Type C and D), stating that the most recent NOAA distributions reflect region storm characteristics more accurately than the older NRCS storm distributions. The Department proposes a technical review on the currently required storm distributions and an update of them depending on the results of the review.

e. Watershed-specific Flood Control

Current Flooding standard has an easy-to-implement peak matching requirement at the analysis/discharge points of a regulated development project. This approach provides reasonable flood control in relatively undeveloped watersheds that are not threatened by development.

A technical assessment of the on-site peak matching approach and its effectiveness is warranted for certain watersheds given below. Watershed studies including hydrologic and hydraulic modeling can be leveraged to implement a more effective level of flood control as compared to the currently used on-site peak matching approach.

a. Watersheds Threatened by Development:

Cumulative impact of land development must be considered in the watersheds threatened by land development. Peak flows attenuated by on-site detention measures are superimposed on the stream hydrograph. Consequently, post-development stream hydrograph nearby the watershed outlet can differ from pre-development stream hydrograph at the same location: post-development peak flow can significantly exceed pre-development peak flow. Hence, on-site peak matching can be ineffective for flood control in the downstream areas. Some jurisdictions respond to this limitation by requiring “overcontrol” of peak flows on site (WEF and ASCE, 2012). For instance,

- 10-year post-development peak flows must not exceed 50% of 10-year pre-development peak flows.

b. Developed Watersheds:

Development history of some of these watersheds predates the laws regulating stormwater and protecting natural resources. Older, “grey” stormwater infrastructure was primarily designed for drainage with little to no consideration for detention. Most of the Urban Impaired Stream (UIS) watersheds listed in Chapter 502 can be considered under this category. Streams in these watersheds have been chronically subject to flows much higher than the pre-development flows during large, infrequent events.

If the stream is already flood compromised, there can be more effective alternative uses for the resources spent on constructing on-site detention measures for new projects that have to comply with a peak matching standard. An alternative approach can require the developers/applicants to invest in strategic flood control efforts through a compensation fee program. Some examples are:

- Improve flood storage capacity of the streams through floodplain restoration,
- Improve resiliency of stream channel morphology,
- Upgrade stream crossings,
- Retrofit existing detention structures to improve their flood control effectiveness through Continuous Monitoring and Adaptive Control (CMAC).

5. References

1. CTDEEP. 2023. Connecticut Stormwater Quality Manual (Effective Date: 3/30/24). https://portal.ct.gov/-/media/DEEP/water/water_quality_management/Guidance/SWM_Clean_Final.pdf

2. MassDEP. 2024. Wetlands Protection and Water Quality Certification Regulations for Stormwater Management Draft (Redline/Strikeout). https://www.mass.gov/doc/310-cmr-1000-wetlands-proposed-revisions-redlinestrikeout/download

3. NHDES. 2023. Chapter Env-Wq 1500 Alteration of Terrain. https://www.des.nh.gov/sites/g/files/ehbemt341/files/documents/env-wq-1500.pdf

4. NHDES. 2008. New Hampshire Stormwater Manual: Volume 2 Post-construction Best Management Practices Selection & Design. https://www.des.nh.gov/sites/g/files/ehbemt341/files/documents/2020-01/wd-08-20b.pdf

5. RIDEM. 2018. Stormwater Management, Design, and Installation Rules (250-RICR-150-10-8). https://rules.sos.ri.gov/regulations/part/250-150-10-8

6. VTDEC. Operational State Stormwater Permit Application Materials. https://dec.vermont.gov/watershed/stormwater/permit-information-applications-fees/operationalpermits/operational-state

7. NOAA. NOAA Atlas 15: Update to the National Precipitation Frequency Standard. https://www.weather.gov/media/owp/hdsc_documents/NOAA_Atlas_15_Flyer.pdf

8. WEF and ASCE. 2012. Design of Urban Stormwater Controls. WEF Manual of Practice No. 23 & ASCE Manuals and Reports on Engineering Practice No. 87. McGraw Hill.