# MEMORANDUM

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| TO: | North Central Texas Council of Governments<br>iSWM Implementation Subcommittee | DATE: | April 2, 2021 |
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| SUBJECT: | Research of Volumetric Detention and Channel Protection Volume Design Guidance State of Practice | | |

TBG Partners has completed their review of the current state of practice for the design of extended detention systems and the determination of channel protection volume storage requirements and associated allowable discharge rates and drawdown times both regionally and nationally. Specifically, they reviewed the following city and agency criteria and compared it to the current iSWM Criteria Manual and Technical Manual Guidance: Austin, TX, San Antonio, TX, Fayetteville, AR, Tulsa, OK, Little Rock, AR, and Harris County, TX. Based on this review of local and regional guidance it is recommended that the current iSWM criteria guidance remain unchanged.

The predominant national standard of practice as it relates to the volumetric design of extended detention basins to capture the 'channel protection volume' or 'stream protection volume' is based on the determination of the 2-year, 24-hour storm event under post development conditions and releasing that volume over a 24-hour period with a peak discharge equal to the 2-year, 24-hour storm event under predevelopment conditions. There is limited evidence that this standard of practice is particularly impactful in terms of streambank protection and erosion prevention. There is substantial documentation and research that indicates that this practice may in fact lead to increased frequency and duration of channel or stream alteration under erosive bank full or near bank full conditions. "Volume of runoff and the frequency of 'channel forming' events increase substantially with increased impervious surfaces (development). The most commonly practice form of channel protection, 2-year control, does not reduce channel erosion and may actually increase the amount of time the channel is exposed to erosive flows (McCuen and Moglen, 1988, MacRae, 1996, and CWP, 2000)." The iSWM standard is currently based on the determination of the 1-year, 24-hour storm event under pre-development conditions.

This is highly dependent on the structural properties of the channel bed and bank conditions within the receiving stream and also the length of time that a stream has been subject to developed runoff conditions. The erosive potential and sensitivity of a receiving stream is based on its current state of aggradation or degradation and this significantly influences the determination of the acceptable frequency, duration, and intensity within the system that will optimally reduce future erosion and sedimentation within the system.

Due to the uncertainty of the effectiveness or lack of effectiveness of this standard of practice it is evident that many cities are either modifying the criteria to other alternatives that attempt to further limit the duration and frequency of channel altering flows. There are some examples nationally where a 2-year over control method is required. This method requires the storage of the 2-year 24-hour storm event with controlled release that does not exceed 50% of the predevelopment peak discharge. This generally increases the required storage footprint considerably and has mostly only been attempted in northern municipalities with vastly different hydrologic conditions than those found in Texas.

The most common practice identified in our research aside from the 2-year, 24-hour, pre-development peak flow control is the requirement for extended detention of the 1-year, 24-hour storm event with a maximum drawdown time of 24 hours. The volume required for this practice is generally similar to the volume required to manage the peak discharges from 5 to 10-year storm events. This practice generally reduces the frequency, duration, and intensity of channel altering flows but there is a trade off in the area required and there are challenges with the sizing of 1-year discharge controls that tend to be smaller and more susceptible to clogging. It should also be noted that the effectiveness of this design criteria is again largely dependent on the physical bed and bank materials and state of aggradation or degradation of the receiving stream.

The emerging strategy for stream bank protection is distributed runoff control. This strategy requires highly localized detail of the erosive potential of the receiving streams throughout the entire reach. Many municipalities and agencies have begun or completed the lengthy process of further collecting data on ephemeral, perennial, and riverine systems throughout their jurisdiction and enhancing the downstream assessment process with a clearer understanding of allowable duration and intensities of flows that vary greatly within the stream network. The vast majority of the research and development in this area is grounded on the processes developed for the Rosgen Stream Classification system (EPA) coupled with the development of dynamic hydraulic models for stream networks that facilitate the design process and ultimately the selection of optimized storage and discharge controls specific to the sub-watershed and receiving stream characteristics.

Based on our research it appears that in the absence of detailed stream system data including but not limited to dynamic hydraulic models, bed and bank material assessment, degradation and aggradation state documentation, that the current recommended process in the iSWM criteria manual to manage and control the release of the 1-yr, 24-hour storm event is appropriate. The trade-off is that this will likely require a larger storage footprint and that there are challenges in designing efficient outflow structures that aren't susceptible to clogging. This process combined with the requirements of the downstream assessment appears to be the most prudent approach for minimizing erosion and sedimentation impacts within stream systems in North Texas. In locations where there is substantial stream system data and dynamic hydraulic models it is recommended that a flexible approach to determination of allowable discharges should be utilized. This appears to be the direction that the City of Austin is moving toward while maintaining a standard approach of requiring the storage and controlled release of the 2-year, 24-hour storm event. The challenge of utilizing the option to fine tune storage and discharge requirements appears to fall back on the developer and designer capacity to utilize available hydraulic models and have a deep understanding of stream channel stability. Shifting to the 2-year, 24-hour storm event may offer some flexibility in the overall footprint requirements for detention storage, but unless it is combined with

detailed knowledge of stream hydraulic and bed and bank material conditions it is not likely to provide for more stable conditions than what is provided by current guidance.

## SUMMARYOFPRACTICES

City of Austin:

Requires management of the 2-year, 24-hour storm with peak discharges equal to pre-development conditions. Allows for modified approaches based on standards outlined in erosion hazard guidance and utilization of stream conditions data and models. Proposed modifications to the city's development criteria re-write

'CodeNext' indicates that they will change the wording from requiring management of the 2-year, 24-hour storm to the stream protection volume to allow for more flexibility and efficiencies in the design of detention ponds. It's also important to note that the City provides guidance in terms of Storm Water Management ponds and does not have separate guidance for dry and wet detention ponds related to volume storage and discharge.

https://www.austintexas.gov/sites/default/files/files/Watershed/erosion/EHZ_Criteria_2013_Q3.pdf

http://www.austintexas.gov/edims/document.cfm?id=293134

https://library.municode.com/tx/austin/codes/drainage_criteria_manual?nodeId=S8STMA

City of San Antonio:

The City of San Antonio does not have criteria for streambank protection volume management. The City of San Antonio restricts the outflow rates to the undeveloped or existing five (5) year, twenty-five (25) year, and one hundred (100) year frequencies, 24-hour storm and allows drawdown time of 48 or 24-hours. http://www.sanantonio.gov/Portals/0/Files/CIMS/Services/cosa-final-swdcm-jan-2016-web-version.pdf City of Fayetteville:

Within Fayetteville they must provide extended detention of the increased volume of the 1-year storm event released over a period of 40 hours to reduce flows and protect downstream channels from erosive velocities and unstable conditions. Post-development flows shall not exceed the predevelopment flows.

https://www.fayetteville-ar.gov/DocumentCenter/View/2248/Drainage-Criteria-Manual-2014-PDF

City of Tulsa:

The outlet shall be designed to provide discharges from the pond that are equal to or less than predevelopment discharges for the 100% (1-year), 50% (2-year), 20% (5-year), 10% (10-year), 2% (50-year), and 1% (100-year) flood events. Orifice or slotted weir configurations should be as large as possible to meet the design requirements. The computed channel velocities in natural channels, along with the computed Froude Number, should be used to determine the necessity of channel protection from erosion. Channel velocities should not be increased due to the design of a project.

https://www.cityoftulsa.org/media/11859/stormwatermanagementcriteriamanual-june2019.pdf

City of Little Rock:

Volume for storage and discharge requirements are based only on the differential runoff from post development and predevelopment conditions for the 25-year, 6-hour storm event. There are now requirements for managing the stream protection volume.

https://www.littlerock.gov/media/1495/stormwater_drain-man-update-09-2016.pdf

Harris County:

The outflow structure must be sized for water quality enhancement to detain the extended detention component of the water quality volume for a minimum of 24-hours. The extended detention volume is either: equal to 50% of the water quality volume where the remaining 50% of the water quality volume is allocated to the permanent pool (EPA 1999a); or equal to an optimum percentage where the additional water quality volume is assigned to the permanent pool using the design engineer's best professional judgment.

https://acechouston.org/wp-content/uploads/2018/04/PCPM-Update_ACEC-SW-Comm-Revison-Draft-129-2018.pd

SUPPLEMENTAL INFORMATION: 2018 EPA Document: "Detention Outlet Retrofit Improves The Functionality of Existing Detention Basins By Reducing Erosive Flows in Receiving Channels"

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6171122/pdf/nihms-1503928.pdf