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DEPARTMENT OF WATER AND WASTE MANAGEMENT

Richard D. Blinn, P.E.
Director

MEMORANDUM

TO: Thurston County Drainage Manual Users

FROM: Mr. Richard Blinn, P.E.
Thurston County Drainage Manual Administrator
Mark R. Cook, P.E. 
Interim Program Manager/Design Engineer

DATE: May 16, 1997

SUBJECT: Technical Memorandum
48 hour Drawdown Criteria

Effective immediately, all drainage proposals within Thurston County that fail to meet the required 48 hour drawdown criteria shall be designed as follows:

- 1. The 7 day/100 year storm hyetograph will be used to size the required detention, retention or combination facility that does not drain within 48 hours from the end of the 100 year/24 hour design event. This design approach will eliminate the need to achieve drawdown within 48 hours.**

EXECUTIVE SUMMARY:

Recent rainfall events in 1995/96 and again in 1996/97 indicate that facilities which do not meet a 48 hour drawdown are susceptible to flow duration failure. Activation of emergency or overflow spillways has resulted in increased erosion to downstream properties and receiving waters. In an attempt to mitigate the detrimental impacts from flow duration, overflow spillway activation, the Storm and Surface Water Program examined hourly NOAA (National Oceanic and Atmospheric Administration) rainfall data from 1952 to the present. Several flow duration events were used to create specific hyetographs for each flow duration event. Some existing single event hydrologic models appear unable to handle the created hyetographs, owing to limitations within their source code. A maximum flow duration period of 30 days appears to work with the various single event models available to local consultants. The selected 30 day flow duration event does not appear to predict the required storage resulting from the existing



Thurston County 7 day/100 year hyetograph, used to design discharges to potholes. Staff has found that by increasing the volume of the 30 day hyetograph by 10%, predicted volumes exceed those of the 7 day/100 year hyetograph. Since the fact that the 30 day hyetograph only represents 52 years of record, the statistical extrapolation to a 100 year recurrence level is likely to result in volumes in excess of the 10% used as a gauge in hyetograph performance. To meet a commitment to the development community in a timely manner, the Storm and Surface Water Program is electing to use the existing 7 day/100 year hyetograph as the flow duration event at this time. The program will continue to pursue the statistical extrapolation of the 30 day hyetograph for possible use in future drainage manual editions.

BACKGROUND:

Recent storm events of 1995/96 and 1996/97 caused some area detention and retention facilities to discharge via overflow spillways. These discharges resulted from sustained flow duration storm events, saturated groundwater conditions and various site specific parameters. Current County design standards require minimum sizing criteria that relates to single event, 24 hour duration storms. Storm hyetographs are provided by the County for consultant use. Flow duration analysis is currently required for discharge to potholes, but not for typical discharge, retention or combination facilities. All facilities designed within the County are currently designed to drawdown (drain) within 48 hours. The 48 hour drawdown requirement is in place to account for flow duration rainfall storms and to ensure that adequate facility volume remains within 72 hours after the start of any rainfall event.

In 1994, the current maximum discharge rates were implemented for discharge facility design (maximum 2 year release rate = 0.04 cfs/disturbed acre and 0.35 cfs/disturbed acre for the maximum 100 year release rate). For certain land segments with certain levels of disturbed area, it is not possible to meet the 48 drawdown requirement. The question becomes one of what is a reasonable drawdown period to survive a flow duration rainfall event.

The Storm and Surface Water Program, acting on the information stated above, chose to examine flow duration events of record for Thurston County. The program has hourly precipitation data from NOAA (National Oceanic and Atmospheric Administration), from 1954 and various data increments from the U.S. Weather Service, as far back as 1897. Given that there was not an identified need for flow duration analysis prior to the original County drainage manual in 1991, and only identified for pothole analysis in the 1994 edition, the program has previously not created a flow duration hyetograph beyond a seven day period that could be used for facility design.

The County has made attempts in the past to limit peak discharges to receiving waters (McAllister/Eaton Creek Comprehensive Drainage Basin Plan, 1994) by imposing reduced maximum release rates beyond those in the current edition of the drainage manual. Preliminary analysis of another drainage basin, the Green Cove Creek basin, indicates that the creek will not

be able to handle increasing peak flows. Though it is not identified at this time, current release rates may not fully protect Green Cove Creek. What is known, however, is that facilities that activate their overflow spillway during flow duration events are likely to send peak flows to Green Cove and other county creeks, that will increase stream bank erosion.

METHODOLOGY:

For the purpose of this analysis, four design storms were used to compare their impacts on required storage volumes over four separate urban land models. The modeled areas ranged in size from approximately 10 acres to over 100 acres.

Design Storms: Four design storm were chosen for this analysis. Two storms were the current 24hr/100 year and the 7 day/100 year design storms. In addition, two historic storm events were compared for their overall effect on required storage volumes. These storms were derived from historic precipitation data from NOAA. Thurston County historic storm #1 is the storm event of December 1996 to January 1997. This storm event was taken from data collected by the Thurston County Storm and Surface Water Program. Historic storm #2 is the worst continuous 30 day block recorded at NOAA's Olympia airport facility since hourly precipitation data was produced (1954). This 30 day block occurred during the winter of 1971/72. This storm was identified by plotting a graph of 30-day cumulative rainfall for the entire period of record and noting the various peaks of this graph.

Design Impact Analysis: This analysis used the 24hr/100 year design storm as a basis of comparison for the other storm events. For each of our modeled areas, all four test storms were run and the required storage volume for historic storm #1, historic storm #2, and the 7 day/100 year storm was compared to that obtained from the run of the 24hr/100 year design storm.

Modeled Areas: Three areas were modeled in this analysis. The Storm and Surface Water Program recently completed a dense urban model of the New Castle Division #1 for use in one of its capital design projects (Boulevard Road), hence it was selected for use. New Castle Division #1 was modeled with two separate pond configurations. First as a detention facility designed to 1994 standards, then as a retention facility with an effective vertical infiltration rate of one half inch per hour. The complete model for the Boulevard Road Facility, including the New Castle, Wilderness, and Sweet Briar subdivisions was also used to evaluate the various impacts resulting from the storms referenced above. A consultant model for the Hidden Ridge Division 1 subdivision was used to complete the three model areas evaluated during this effort.

DETENTION/RETENTION IMPACTS:

Impacts of the various test storms on the three model areas evaluated varied with the type of facility with one exception, that is: for all facility types, the 7 day/100 year event was the most challenging storm on storage requirements. In all cases, this storm had a significant impact on the required storage volume. Retention facilities showed 2 to 3 times the required storage

volume for the 7 day/100 year event as compared to the 24hr/100 year event. Detention facilities showed significantly lower impact, however, required storage volumes were 15% to 35% greater for the 7 day/100 year event as compared to the 24hr/100 year event.

CONCLUSIONS:

Flow duration rainfall events in 1995/96 and again in 1996/97 have caused area facilities to activate overflow spillways. It appears as though the current design event, the 24 hr/100 year storm can lead to overflow spillway activation during flow duration storms. Several factors appear to be required for overflow spillway activation during flow duration, the single critical element being a failure of design facilities to completely drain within 72 hours from the onset of any storm. It appears as though historic rainfall in the County indicates a flow duration event of 30 days will, in the final analysis, be worth evaluating for future flow duration hyetograph use in designing stormwater facilities. Additional work needs to be done to account for the lack of a complete 100 year record for hourly rainfall data within Thurston County. This additional work is expected to take some time to complete and possibly would not be ready for consultant use until late summer of 1997. For three reasons, the Storm and Surface Water Program is choosing not to delay development proposals any longer at this time, providing that facilities that do not meet the required 48 hour drawdown are designed for volume and performance using the existing 7 day/100 year hyetograph. The three reasons are:

1. The Storm and Surface Water Program is unable to produce the statistical 30 day flow duration hyetograph prior to September 1, 1997.
2. Thurston County and the cities of Lacey, Olympia, and Tumwater expect to revise the drainage manual within the next several months. This time will allow the program to further evaluate the effects of a 30 day flow duration hyetograph on minimum storage for proposed drainage facilities.
3. The Storm and Surface Water Program believes that using the existing 7 day/100 year hyetograph to design required storage volume for facilities that fail to drawdown in 48 hours is appropriate mitigation, to limit adverse environmental impact, at this time. The existing 7 day/100 year hyetograph is the current design standard for pothole analysis in Thurston County.

The Storm and Surface Water Program welcomes comments from drainage manual users. If manual users prefer alternate design approaches to mitigate flow duration failures, please contact Mark R. Cook, P.E. at (360) 754-4681, so that alternatives can be evaluated by the program.