Powhatan Creek
Floodplain Study
James City County, Virginia

Prepared for

James City County
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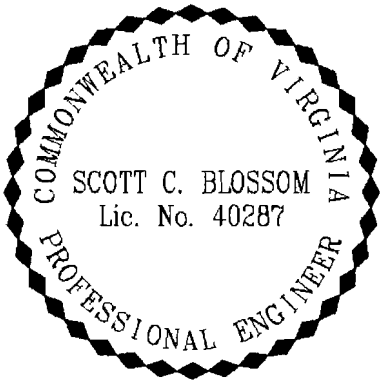

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EXECUTIVE SUMMARY

Williamsburg Environmental Group, Inc. (WEG) has been retained by James City County to evaluate flooding issues at Powhatan Creek, located in James City County, Virginia. This report summarizes the hydrologic analysis of the Powhatan Creek watershed, including a projection for full build-out conditions under current zoning and comprehensive plan conditions. The majority of the main stem Powhatan Creek is currently mapped as Zone AE on Flood Insurance Rate Map panels # 510201 0035 B and 0045 B .

Flow rates and flood inundation mapping shown in the effective Federal Emergency Management Agency (FEMA) Flood Insurance Study (FIS), dated September 28, 2007 are based on watershed hydrologic computations developed in 1976 using land use conditions in place at the time. At that time the watershed was predominately forested, with development limited to approximately 10-15% of the watershed. Impervious cover estimates for land cover conditions in 1976 reflect an estimate of 2-3 % watershed imperviousness.

Current land-use and land-cover conditions as of 2007 were evaluated based on Geographic Information System (GIS) data supplied by James City County, supplemented with estimates for other impervious cover currently in place, but not reflected in the GIS data. The evaluation estimates current impervious cover in the Powhatan Creek watershed at approximately 14.4%. This increase in impervious cover results in a significant increase in the runoff rates predicted for a specific return period. The preliminary modeling shows that runoff rates associated with a 100-year or a 500-year return period are estimated to have doubled (approximately), since the original study was performed.

Based on current zoning and comprehensive plan conditions it is expected that the impervious cover in the Powhatan Creek watershed may increase to a maximum of approximately 18.8% under full build-out conditions. It is expected that this further increase in impervious cover will correspondingly increase peak runoff rates by approximately 5%.

In addition to land-use and land cover changes in the Powhatan Creek watershed, another issue has a significant impact on the peak runoff estimate. Previous hydrologic studies have been based on the statistical analysis of rainfall data as was presented in Technical Paper 40: *Rainfall Frequency Atlas of the Eastern United States for Duration from 30 minutes to 24 hours and Return Periods from 1 to 100 years* (1961). This dataset has been in use for many years for stormwater infrastructure design

and hydrologic modeling. The National Oceanic and Atmospheric Administration (NOAA) National Climatic Data Center (NCDC) recently released *Precipitation-Frequency Atlas of the United States" NOAA Atlas 14, Volume 2, Version 3* which is intended to supersede the rainfall data presented in *Technical Paper 40.* Using the new Atlas 14 precipitation values (based on statistical analysis of regional rainfall patterns), 24-hour 100-and 500 year precipitation amounts used for modeling are significantly higher than the previously published values. This, in turn, leads to a further increase in peak runoff estimates associated with such return periods. Based on Atlas 14 data, in conjunction with the land cover changes described above, the 100-year peak runoff for 2007 land cover conditions is estimated to be 2.5 times the peak runoff shown in the effective FEMA FIS, and the modeled 500-year peak runoff is 3.2 times the runoff shown in the FIS, respectively. For full build out conditions the corresponding multipliers are 2.6 and 3.3, respectively. The hydrologic analysis used for the updated floodplain mapping herein is based on Atlas 14 rainfall data.

The distribution of the rainfall during Hurricane Floyd is resembles a series of shorter storm events with return periods of 40 and 60 years respectively. Based on the actual distribution, the resulting peak runoff rate for Hurricane Floyd corresponds with runoff rates associated with a synthetic 24-hour storm event with a return period approximately 150 years. Similarly, the Nor'easter of October 2006 shows a rainfall distribution that it resembles much more two storm events at the beginning and the end of the storm with statistically rather insignificant precipitation in-between. The resulting peak runoff rate for the 2006 Nor'easter corresponds with a runoff rate associated with a synthetic 24 hour storm event with a return period of approximately 50 years. A further analysis of these storm events for full build-out conditions demonstrates that anticipated peak flow rates are likely to be similar, with increases limited to 1-2%.

The significantly higher peak runoff rates resulting from the updated hydrological modeling however do not translate to significantly higher flood profiles due to the width of the floodplain and an increase of velocity with flow depth. The flood elevation difference is limited to approximately 0.10 – 1.88 ft for a 100-year event. The floodplain mapping confirms that for the portions of Powhatan Creek studied with detailed hydraulic analysis Jamestown 1607 and St. George's Hundred are the subdivisions with the most significant flooding risk. However, it appears that the change in hydrology and the associated increase in expected flood elevations for specific return periods do not significantly increase the amount of residences in those two subdivisions that will experience flood elevations above finished floor elevation. Based on available finished floor elevation data one (1)

additional residence has been identified that would be affected by flood elevations above finished floor.

The expected further increase of peak runoff rates due to the transition from 2007 conditions to future full build-out will not significantly increase expected flood elevations. The modeling indicates that the further increase is limited to approximately 0.25 ft.

The analysis performed includes an assessment of a wide range of tidal peak elevations as downstream boundary condition for the modeling of the Powhatan Creek. It should be noted that in FEMA studies it is common practice to model flood elevations based on coinciding peaks of the riverine flooding source and the corresponding downstream boundary condition (in this case the stillwater elevation of the James River, based on tidal gage analysis). However, it is highly unlikely that during a flooding event 1) both flooding sources experience an event with the same return interval and 2) that the peaks of the two flooding sources actually coincide. Based on the assessment performed it is possible to experience a flooding event that produces higher flood elevations than associated with the respective return period caused by tidal influences, but it is highly unlikely.

Additional analysis was performed to assess the effect of partial obstruction of the bridge openings at the Jamestown Road Bridge and the John Tyler Highway Bridge. Assuming a reduction of the available conveyance area of the bridge opening of 25%, the flood elevation of a 100-year event would potentially increase by approximately 0.70 ft immediately upstream of the Jamestown Road Bridge and approximately 0.30 ft immediately upstream of the John Tyler Bridge.