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TECHNICAL MEMORANDUM

On-Site Storage Calculation Review

TO: Scott Williams, Public Works Director

FROM: Brian Icerman, PE; Jarrod Hirneise, PE

DATE: October 2, 2018

SUBJECT: Onsite Storage Calculation Review
Jones Edmunds Project No. 08505-003-01

1 INTRODUCTION

Section 24-66 of the City of Atlantic Beach's Zoning, Subdivision, and Land Development Regulations requires that the difference between the pre- and post-development volume of stormwater runoff be stored on-site for rainfall depths up to the 25-year/24-hour return period depth if 400 square feet or more of new impervious area is added. The City previously developed a methodology using a Microsoft Excel spreadsheet to calculate pre-and post-development runoff volumes to determine how much on-site storage volume is required and compares the required volume to the actual storage volume provided. The City has asked Jones Edmunds to review the City's methodology and the validity/accuracy of the assumptions and parameters used in the calculations. This Technical Memorandum summarizes the findings and recommendations from the review.

2 PRE- AND POST-DEVELOPMENT RUNOFF VOLUME

The first step of the City's on-site storage calculator is generating pre- and post-development runoff volumes. The runoff volumes are calculated by multiplying an area-weighted runoff coefficient by the 25-year/24-hour rainfall depth and the parcel area. The difference between the pre- and post-development runoff is then calculated to determine the volume of storage that must be provided. This methodology is valid and within common engineering practices for completing this type of analysis.

We completed a detailed review of each parameter used to calculate the runoff volumes and summarized our review and findings below.

2.1 RAINFALL DEPTH

The calculator assumes a rainfall depth of 9.3 inches for the 25-year/24-hour event. We compared this depth to the latest rainfall data source available, the National Oceanic and Atmospheric Administration's (NOAA) Atlas 14. The 25-year/24-hour rainfall depth for the City of Atlantic Beach is 9.2 inches based on NOAA Atlas 14. The City has consistently used 9.3 inches since the on-site storage ordinance was passed. Hydrologically, the difference between

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using 9.3 inches versus 9.2 inches is nominal, therefore, using 9.3 inches for the 25-year/24-hour rainfall depth is valid.

2.2 Runoff Coefficient

The calculator uses runoff coefficients of 0.2 for pervious surfaces and 1.0 for impervious surfaces to calculate pre- and post-development composite runoff coefficients. Using a runoff coefficient of 1.0 for impervious surfaces is common practice and valid because the rainfall landing on impervious surfaces will not infiltrate and will run off.

Using a runoff coefficient of 0.2 for pervious surfaces is at the upper end of the range of commonly used values for lawns in flat landscapes with slopes from 0 to 2 percent. According to the table in Figure 1 from the Florida Department of Transportation's 1987 Drainage Design Guide, runoff coefficients for lawns in design storms with return periods less than or equal to 10 years range from 0.05 for sandy soils to 0.17 for clayey soils. As shown, to convert these values to coefficients that can be used for the 25-year return period the coefficients must be multiplied by 1.1, which moves the range to 0.06 for sandy soils and 0.19 for clayey soils. According to the Natural Resource Conservation Service's web soil survey, a majority of the soil in the City is classified as sandy, which means that the runoff coefficient should fall on the lower end of this range.

Figure 1 Runoff Coefficient Table

Table 24-1. Runoff Coefficients (*C*) for a Design Storm Return Period of Ten Years or Less[1]

Slope	Land Use	Sandy Soils Min.	Sandy Soils Max.	Clay Soils Min.	Clay Soils Max.
Flat (0-2%)	Lawns	0.05	0.10	0.13	0.17
	Rooftops and pavement	0.95	0.95	0.95	0.95
	Pervious pavements[2]	0.75	0.95	0.90	0.95
	Woodlands	0.10	0.15	0.15	0.20
	Pasture, grass, and farmland[3]	0.15	0.20	0.20	0.25
	Residential				
	SFR: 1/2 acre lots and larger	0.30	0.35	0.35	0.45
	SFR: smaller lots and duplexes	0.35	0.45	0.40	0.50
	MFR: apartments, condominiums	0.45	0.60	0.50	0.70
	Commercial and Industrial	0.50	0.95	0.50	0.95
Rolling (2-7%)	Lawns	0.10	0.15	0.18	0.22
	Rooftops and pavements	0.95	0.95	0.95	0.95
	Pervious pavements[2]	0.80	0.95	0.90	0.95
	Woodlands	0.15	0.20	0.20	0.25
	Pasture, grass, and farmland[3]	0.20	0.25	0.25	0.30
	Residential				
	SFR: 1/2 acre lots and larger	0.35	0.50	0.40	0.55
	SFR: smaller lots and duplexes	0.40	0.55	0.45	0.60
	MFR: apartments, condominiums	0.50	0.70	0.60	0.80
	Commercial and Industrial	0.50	0.95	0.60	0.95
Steep (>7%)	Lawns	0.15	0.20	0.25	0.35
	Rooftops and pavements	0.95	0.95	0.95	0.95
	Pervious pavements[2]	0.85	0.95	0.90	0.95
	Woodlands	0.20	0.25	0.25	0.30
	Pasture, grass, and farmland[3]	0.25	0.35	0.30	0.40
	Residential				
	SFR: 1/2 acre lots and larger	0.40	0.55	0.50	0.65
	SFR: smaller lots and duplexes	0.45	0.60	0.55	0.70
	MFR: apartments, condominiums	0.60	0.75	0.65	0.85
	Commercial and Industrial	0.60	0.95	0.65	0.95

Sources: Florida Department of Transportation, 1987; Wanielista, 1990

[1]For 25- to 100-yr recurrence intervals, multiply coefficient by 1.1 and 1.25, respectively, and the product cannot exceed 1.0.
[2]Coefficients assume good ground cover and conservation treatment.
[3]Depends on depth and degree of permeability of underlying strata.
Note: SFR = Single Family Residential;
MFR = Multi-Family Residential

Lowering the runoff coefficient used in the calculator would reduce the pre-development runoff volume and increase the amount of storage required on-site. While the values are currently close to falling within the generally accepted range, they are skewed to benefit the applicant. Lowering this value would shift some of the burden of handing the additional runoff from the City to the applicants. The degree to which the runoff value is changed will determine how much or how little of this burden is shifted. If the City chooses to use the average sandy soil value it would change the runoff coefficient from 0.2 to 0.08.

3 PROVIDED STORAGE CALCULATION

Once the required on-site storage volume is determined, the provided on-site storage volume is calculated by summing the surface storage provided in the retention area on the parcel and the sub-surface storage provided in the soil column below the retention area. The provided storage is calculated and then compared to the required storage volume to determine if enough storage has been provided to retain the additional runoff volume. This methodology is valid and within common engineering practices for completing this type of analysis.

We completed a detailed review of each parameter and calculation used to determine the onsite storage volume provided and summarized our review and findings below.

3.1 SURFACE STORAGE CALCULATION

The surface storage provided is calculated by averaging the area at the bottom of the storage area and the area at the top of the storage area and multiplying by the depth of the storage area. The methodology assumes a constant side-slope is provided within the storage area, which is typically valid. This methodology is valid and within common practice for completing this type of storage volume calculation.

3.2 SUBSURFACE STORAGE CALCULATION

The subsurface storage provided in the soil column below the surface storage area is calculated by multiplying the area of the surface storage by the estimated depth to the seasonal high water table (SHWT) and the fillable porosity/pore factor of the soil. This yields the volume of open void space in the soil column that can be used for water storage.

Currently, the subsurface storage calculation is double-counting and over-estimating the amount of storage that is available in the soil column because it does not reduce the soil storage capacity under the retention area to account for the rainfall volume that immediately infiltrates into the soil and does not runoff. To account for this, we recommend using a runoff coefficient of 1.0 for the storage area instead of the 0.2 runoff coefficient that is currently being used. Using a runoff coefficient of 1.0 for the storage area will ensure that the rainfall volume infiltrating at the pond is accounted for in the storage calculation.

The subsurface storage calculation assumes a soil fillable porosity/pore factor of 0.3 for the subsurface storage calculation. This means that 30 percent of the soil column volume is void and available for runoff retention. As part of the Stormwater Master Plan Update project, Jones Edmunds calculated the fillable porosities of the Natural Resources Conservation Service

(NRCS) soil types within City limits using data from the University of Florida's Institute of Food and Agricultural Sciences (UF IFAS) Florida Soil Characterization Data Retrieval System database. We calculated an average fillable porosity across the City of approximately 0.4. Based on our calculations using a pore factor of 0.3 is slightly conservative and likely underestimates the subsurface pore space available.

The subsurface storage calculation assumes a constant SHWT elevation of 3.0 feet across the City. This elevation is used to determine the depth of the soil column available for soil storage by subtracting this elevation from the elevation of the bottom of the on-site surface storage area. Based on a desktop review of NRCS soils data, pond break line elevations in the 2007 Duval County Light Detection and Ranging (LiDAR) digital elevation model (DEM), and St. Johns River Water Management District (SJRWMD) permit data for developments within the City, the assumption of a constant groundwater table elevation across the City does not appear to be valid. According to the NRCS soils data, the SHWT depth for the City is typically within 2 feet of the surface with a majority of it being within 1 foot of the surface. This means that the water table elevation should vary as the surface elevation varies.

We reviewed the water surface elevations of wet detention stormwater ponds in the 2007 LiDAR DEM. Based on the water surface elevations in the DEM, the groundwater table elevation appears to vary with the surface elevation. Ponds at higher elevations have higher water level elevations in the DEM, and ponds in lower-lying areas have lower water-level elevations in the DEM.

We reviewed SJRWMD permit data obtained from the SJRWMD's website for the new RaceTrac gas station being built on Mayport Road and the Caliber Collision on Mayport Road. These developments are on a ridge that runs through the City and have site elevations between 12 and 13 feet North American Vertical Datum (NAVD) 88 based on the DEM. According to the geotechnical borings for the RaceTrac gas station, the groundwater table was encountered at approximately 5 feet below the surface or an approximate elevation of 8 feet NAVD88 and the Geotechnical Report estimates that the SHWT for the site is at an elevation of 10 feet NAVD88. The pond normal water level for the Caliber Collision is an elevation of 9.8 feet NAVD88 and is estimated to be 1 foot below the surface. According to SJRWMD permitting criteria, orifice elevations in wet detention stormwater ponds are set at the estimated SHWT elevation.

Using a water table elevation of 3 feet NAVD88 significantly benefits the applicants in a majority of the City, creating additional burden on the City's stormwater system. Using a water table depth of 1 foot below the surface may be too conservative for some of the higher elevation lots along east of Sherman Creek. Based on these findings, we recommend that the City hire a certified soil scientist to collect soil samples throughout the City at various elevations to better characterize how the SHWT varies across the City. The soil scientist should estimate the depth to SHWT based on indicators within the soil column. We believe the City could likely then be divided into zones that would more accurately represent the depth to the SHWT. Alternatively, a depth to SHWT of 1 or 2 feet could be used as a conservative estimate across the City unless site-specific data are provided that shows a greater depth to SHWT.