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MEMORANDUM

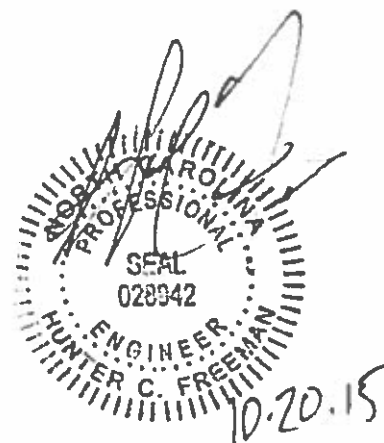
To: Ben Brown, City of Raleigh

From: Hunter Freeman

Date: October 20, 2015

Project: New Life Camp

Subject: 1992 Watershed Study Update, Travel Time - additional information



This memo follows a meeting held on September 18, 2015. Wake County, City of Raleigh, New Life Camp, and WithersRavenel representatives were present at the meeting.

The meeting was to discuss re-zoning, or realignment of the existing zoning line within the parcel at 9927 Falls of Neuse Road in Raleigh (PIN 1718768824). The existing zoning line was based on the "Watershed Study of Honeycutt and Lower Barton's Creek" completed by Black and Veatch for Wake County and The City of Raleigh in 1992.

The zoning line which bisects this property aligns with the "200 Minute Contour" shown on Figure 5 of the Watershed Study. An annotated version of Figure 5 is attached for reference.

As discussed in a memo drafted by WithersRavenel on June 1, 2015, WithersRavenel attempted to recreate the time of travel calculations in the original watershed study using updated topographic information made available subsequent to the 1992 memo publish date. WithersRavenel used the most recent Wake County LiDAR topographic data and studied travel time using the Average Annual Streamflow Method described in the 1992 Watershed Study. Flow time was calculated using Flowmaster, based on an average velocity over each 1,000 foot stream section. Average velocity for each stream segment was calculated using average slope, flow rate, and cross section input data.

Per the September 18 meeting, a summary of the source data for each variable is discussed below:

Q - (flow rate) Based on 1 ft³/sec/sq.mi. of drainage area contributing to each stream segment. This is the same methodology used in the initial watershed study.

Channel Slope – Based on City of Raleigh LiDAR topography downloaded from the iMaps web portal, 2015

Manning's "n" – The roughness coefficient used in the original study was not documented in the original report. WithersRavenel used a Manning's n of 0.06, which corresponds to a clean winding channel with some stones. Source: Chow 1959

Summary of Updated Calculations

The primary basis for updating the calculations from the Watershed Study was the availability of more detailed topographic data which has been made available since the original study was published. 1:24000 scale USGS topographic maps are cited as the source for the topographic data found in the 1992 Watershed Study. These maps typically show topography at 10' vertical intervals, compared with current LiDAR maps which show topography in 2' intervals. The more accurate data allows for a more detailed flow travel time analysis.

The Manning's n value used in the new calculations is consistent with current practice for studies of open channels.

Results

Using the above assumptions and the Wake County topographic LiDAR data, the T_c from the downstream end of the pond on the New Life Camp site to Falls Lake is 205 minutes. The revised map of the T_c paths is attached as well as the sheet and channel flow calculations.

We believe that this revised watershed study, done in a manner consistent with the previous study, justifies a revision to the zoning line which currently bisects the subject parcel.

An exhibit showing the current and proposed zoning line is attached.

MEMORANDUM

To: City of Raleigh
From: Hunter Freeman, PE
Date: 6/1/2015
Project: New Life Camp
Subject: Tc Calculation

Withers & Ravenel is looking at proposed improvements to a site known as New Life Camp which is located at the northwest corner of Durant Road and Falls of Neuse Road. The site has two zoning classifications on the property. The zoning is split on the site along a line studied by Black and Veatch in 1992 which represents a 200-minute Time of Concentration (Tc) to Falls Lake. Withers & Ravenel has restudied the (Tc) from the site to Falls Lake. Withers & Ravenel went to the Wake County offices in downtown Raleigh and found the original study of Tc times. Withers & Ravenel calculated the Tc using the TR-55 method which utilizes sheet flow and channel flow with the below assumptions.

Assumptions

The flow utilized in the channel flow Tc was determined utilizing a relationship of 1 cfs per sq. mi of drainage area. This assumption was taken from Black & Veatch's original study. For channel flow, drainage area and channel velocities were calculated every 1,000 feet. Due to small meanders and bends that occur within a channel it was assumed that the true length of the channel is 15 percent longer. The slope was calculated between the endpoints of each roughly 1500 ft section. The channels were assumed to be 2:1 side sloped triangular channels and the Manning's N 0.06 according to Chow 1959 for a clean, winding channel with more stones.

Results

Using the above assumptions and the Wake County topographic LiDAR data, the Tc from the downstream end of the pond on the New Life Camp site to Falls Lake is 205 minutes. A map of the Tc paths is attached as well as the sheet and channel flow calculations.