



STORMWATER IMPACT ANALYSIS

PARK APARTMENTS / WDF-17000 / AUGUST 2019



PARK APARTMENTS

CHAPEL HILL, NC

STORMWATER IMPACT ANALYSIS

FORM DISTRICT PERMIT

PROJECT NUMBER: WDF-17000
DESIGNED BY: JOSH SHINN, PE
KELLI GARCIA, PE
CRAIG BALLARD, EI
BRIE SAUR

DATE: MAY 2019
REVISED DATE: SEPTEMBER 2019



MCADAMS

2905 MERIDIAN PARKWAY
DURHAM, NORTH CAROLINA 27713
NC LIC. # C-0293



PARK APARTMENTS

Stormwater Impact Analysis

GENERAL DESCRIPTION

Park Apartments is an approximately 13.66-acre proposed multi-family development off Ephesus Church Road in Chapel Hill, North Carolina. The proposed project is an existing site to be redeveloped, The Park at Chapel Hill Apartments. Existing buildings, parking lots, utilities, and other supporting infrastructure will be removed and replaced with new buildings, parking, and associated utilities and infrastructure.

The proposed development is located within the Cape Fear River basin, with stormwater runoff from the proposed development draining to Brooker Creek. According to the N.C. Division of Water Resources' NC Surface Water Classifications Map, Brooker Creek (Stream Index #16-41-1-15-2-(5)) is classified as WS-IV;NSW at this location.

Per City of Chapel Hill regulations, stormwater management on this site shall meet the stormwater management performance standards for development set forth in Chapel Hill "Land Use Management Ordinance (LUMO) Sec. 3.11 Ephesus/Fordham Form District – Version March 6, 2017".

The regulations are as follows:

Applicability (Chapel Hill Land Use Management Ordinance (LUMO) Sec. 3.11.4.3.C Ephesus/Fordham Form District).

1. *This section applies to all new development and redevelopment projects for which a form district permit is required. No development or redevelopments for which a form district permit is required pursuant to this section shall occur except in compliance with the provisions, conditions, and limitations of the permit.*

Design and Performance Standards (Chapel Hill Land Use Management Ordinance (LUMO) Sec. 3.11.4.3.F Ephesus/Fordham Form District).

1. *Stormwater treatment shall be designed to achieve average annual 85% total suspended solids (TSS) removal and must apply to the volume of post-development runoff resulting from the one-inch of precipitation. Alternative treatment methods to achieve 85% annual TSS removal may be acceptable. The 85% requirement applies to 85% of the additional; suspended solids that are the result of the new development.*
2. *The stormwater runoff volume leaving the site post-development shall not exceed the stormwater runoff volume leaving the site pre-development (existing conditions) for the local 2-year frequency, 24-hour duration storm event for all development. This may be achieved by hydrologic abstraction, recycling and/or reuse, or any other accepted scientific method.*
3. *The stormwater runoff rate leaving the site post-development shall not exceed the stormwater runoff rate leaving the site pre-development (existing conditions) for the local 1-year, 2-year, and 25-year 24-hours storm events.*
4. *Notwithstanding subsection 3.11.4.3.F.1, the minimum impervious area treated for eighty-five (85) percent average annual TSS removal shall be fifty (50) percent of the post-construction total impervious area.*

To meet the above Town of Chapel Hill standards, one dry detention pond and a StormFilter system are proposed. This report contains the calculations detailing the expected stormwater impacts as a result of the proposed

development, along with the final design of the dry detention pond and StormFilter system that will be used to mitigate impacts. Please refer to the appropriate section of this report for additional information.

CALCULATION METHODOLOGY

- Rainfall data for this area in the Chapel Hill, NC, region is from NOAA Atlas 14. This data contains a depth-duration-frequency (DDF) table describing rainfall depth versus time for varying return periods in the area. These rainfall depths are input into the meteorological model within PondPack for peak flow rate calculations. Please reference the precipitation information section within this report for additional information.
- Using WebSoil Survey, the on-site soils were determined to be hydrologic soil group (HSG) 'D' soils. Since the method chosen to compute pre- and post-development peak flow rates and runoff volumes is dependent upon the soil type, care was taken when selecting the appropriate Soil Conservation Service Curve Number (SCS CN).
 - Within each sub-basin, an approximate proportion of each soil group was determined using Web Soil Survey Maps. Once an approximate proportion was determined, a composite SCS CN was computed for each cover condition.
- A composite SCS Curve Number was calculated for the post-development condition for each subbasin using SCS curve numbers and land cover conditions. Land cover conditions for the pre-development condition were taken from a combination of field survey information and aerial imagery. Land cover conditions for the post-development condition were taken from the proposed development plan.
- Existing topographic information used in this analysis is from an onsite survey conducted by McAdams Company and Orange County GIS for offsite drainage areas.
- The time of concentration was calculated using SCS TR-55 (Segmental Approach, 1986). The T_c flow path can be divided into multiple segments where applicable: overland flow, concentrated flow, and channel flow. The travel time was then computed for each segment, from which the overall time of concentration was determined by taking the sum of each segmental time.
- The post-development time of concentration to the proposed stormwater management facility is assumed to be 5 minutes. This provides a conservative estimate of facility size for design purposes
- The lot west of Street 'A' and north of Elliot Road will not be built-out in the current phase of the project, as such it is modeled as open space in post-development hydrologic condition (referred to as 'Subbasin 1B-Bypass' in this report).
- PondPack Version V8i was used in determining the post-development peak flow rates for the 1-year, 2-year, 25-year, and 100-year storm event, as well as routing calculations for the proposed stormwater control measure.
- A dry pond is proposed on this site to manage peak flows from stormwater runoff from the proposed development in Subbasins 1-to SCMA and 1-SCM B. Contech StormFilter is proposed to meet water quality requirements.

- The runoff volume difference Pre- to Post-development in the 2-year 24-hour storm event is greater than the volume from the Water Quality event captured in the Stormfilter system. This volume difference will be captured and treated within the proposed dry detention pond. To ensure adequate treatment within the dry detention pond, the 2-year Volume Storage will be detained by a 4.0" orifice on the outlet riser structure that will slowly release the 2-year Volume Storage.
- The Ephesus/Fordham District requires that a minimum of 50% of proposed development must be treated for TSS removal. All impervious allocated on the proposed future phase lot must be treated for TSS removal.
- TN-Export and TP-Export calculations were computed using the Stormwater Nitrogen and Phosphorous Tool v4.0.

DISCUSSION OF RESULTS

PEAK RUNOFF CONTROL REQUIREMENTS

The peak flow for the 1-yr, 2-yr, and 25-yr storm meets peak flow requirements at POA#1. Please refer to the Summary of Results for the reduction in flows from the pre- to post-development condition.

POLLUTANT AND NUTRIENT CONTROL REQUIREMENTS

The site meets the 10 lbs/ac/yr maximum nitrogen loading rate using the proposed on-site StormFilter system. Additionally, 85% TSS removal requirements are met by the StormFilter system. Water quality calculations will need to be amended with the future development of the remaining lot.

CONCLUSION

If the development on this tract is built as proposed within this report, then the requirements set forth in Ephesus/Fordham regulations will be met without additional stormwater control measures. However, modifications to the proposed development may require that this analysis be revised. Some modifications that would **require** this analysis to be revised include:

1. The proposed site impervious surface exceeds the amount accounted for in this report.
2. The post-development watershed breaks change significantly from those used to prepare this report.

The above modifications may result in the assumptions within this report becoming invalid. The computations within this report will need to be revisited if any of the above conditions become apparent as development of the proposed site moves forward.

1	SUMMARY OF RESULTS
2	MISCELLANEOUS SITE INFORMATION
3	PRE-DEVELOPMENT HYDROLOGIC CALCULATIONS
4	POST-DEVELOPMENT HYDROLOGIC CALCULATIONS
5	STORMWATER CONTROL MEASURE 'A' CALCULATIONS
6	STORMWATER CONTROL MEASURE 'B' CALCULATIONS
7	NUTRIENT LOADING CALCULATIONS

SUMMARY OF RESULTS

SUMMARY OF RESULTS

RELEASE RATE MANAGEMENT RESULTS

POINT OF ANALYSIS #1				
Return Period	Pre-Dev	Post-Dev without SCM	Post-Dev with SCM	% Increase
	[cfs]	[cfs]	[cfs]	[%]
1-Year	34.20	52.39	34.04	-0.5%
2-Year	43.80	64.61	41.53	-5.2%
25-Year	72.32	98.69	70.33	-2.8%

POINT OF ANALYSIS #2				
Return Period	Pre-Dev	Post-Dev without SCM	Post-Dev with SCM	% Increase
	[cfs]	[cfs]	[cfs]	[%]
1-Year	0.90	0.00	0.00	-100%
2-Year	1.16	0.00	0.00	-100%
25-Year	1.91	0.00	0.00	-100%

SUMMARY OF RESULTS
Runoff Volume Management

==> 2-YEAR VOLUME MANAGEMENT RESULTS

PRE-DEVELOPMENT 2YR-24HR VOLUME SUMMARY

Total On-Site Area =	13.66	acres
Area Weighted On-site SCS CN =	88	
S =	1.37	
P (2-yr / 24-hour) =	3.57	inches
Q* =	2.33	inches

On-site Run-off Volume =	2.65	acre-feet
=	115,489	cf

POST-DEVELOPMENT 2YR-24HR VOLUME SUMMARY

Total On-Site Area =	13.66	acres
Area Weighted On-site SCS CN =	92	
S =	0.91	
P (2-yr / 24-hour) =	3.57	inches
Q* =	2.67	inches

Total On-site Run-off Volume =	3.04	acre-feet
=	132,583	cf

PRE TO POST-DEVELOPMENT 2YR-24HR VOLUME DIFFERENCE

Pre-Post 2yr Runoff Volume Difference =	17,094	cf
--	---------------	-----------

SUMMARY OF 2YR-24HR VOLUME CAPTURE

SCM A - Dry Pond Volume Captured =	4,409	cf
SCM B - Stormfilter System Volume Captured =	12,950	cf

Total Pre-Post 2yr Runoff Volume Detained =	17,359	cf
--	---------------	-----------

SUMMARY OF RESULTS
SCM A - Dry Pond

STORMWATER CONTROL MEASURE SUMMARY

Design Drainage Area =	8.64	ac	*Dry Pond sized for both Subbasins 1 to SCM A and 1 to SCM B
Design Impervious Area =	5.96	ac	
% Impervious =	69.0%		
Top of Dam =	262.00	ft	
Bottom of Pond =	256.50	ft	
Orifice Diameter =	4.00	in	
Orifice Invert Elevation =	256.50	ft	
Number of Area Orifices =	3		
Area Orifice Dimensions =	1.5' (L) x 1.0' (H)		
Area Orifice Invert Elevation =	257.30	ft	
Riser Size =	5' x 5'		
Riser Crest =	260.20	ft	
Barrel Diameter =	30	in	
# of Barrels =	1		
Upstream Invert =	256.50	ft	
Downstream Invert =	256.00	ft	
Length =	26	ft	
Slope =	0.0192	ft/ft	

STORMWATER CONTROL MEASURE ROUTING RESULTS

Return Period	Inflow [cfs]	Outflow [cfs]	Max. WSE [ft]	Freeboard [ft]
1-Year	31.99	16.42	259.25	2.75
2-Year	39.40	19.64	259.74	2.26
10-Year	53.45	31.46	260.55	1.45
25-Year	59.67	38.42	260.81	1.19
100-Year	68.08	43.15	261.23	0.77
100-Year - Worst Case***	68.08	43.29	261.25	0.75

*** See narrative for explanation of the modeled worst case scenario

Park Apartments Impervious Treatment

Total Onsite Impervious* = 473,010 sf
Required Imp Treatment* = 236,505 sf *50% treatment requirement*

Onsite Imp Treated = 282,668 sf
Onsite Imp Treated Over Req. = 46,163 sf
Onsite Imp. Percentage Treated = 59.8%

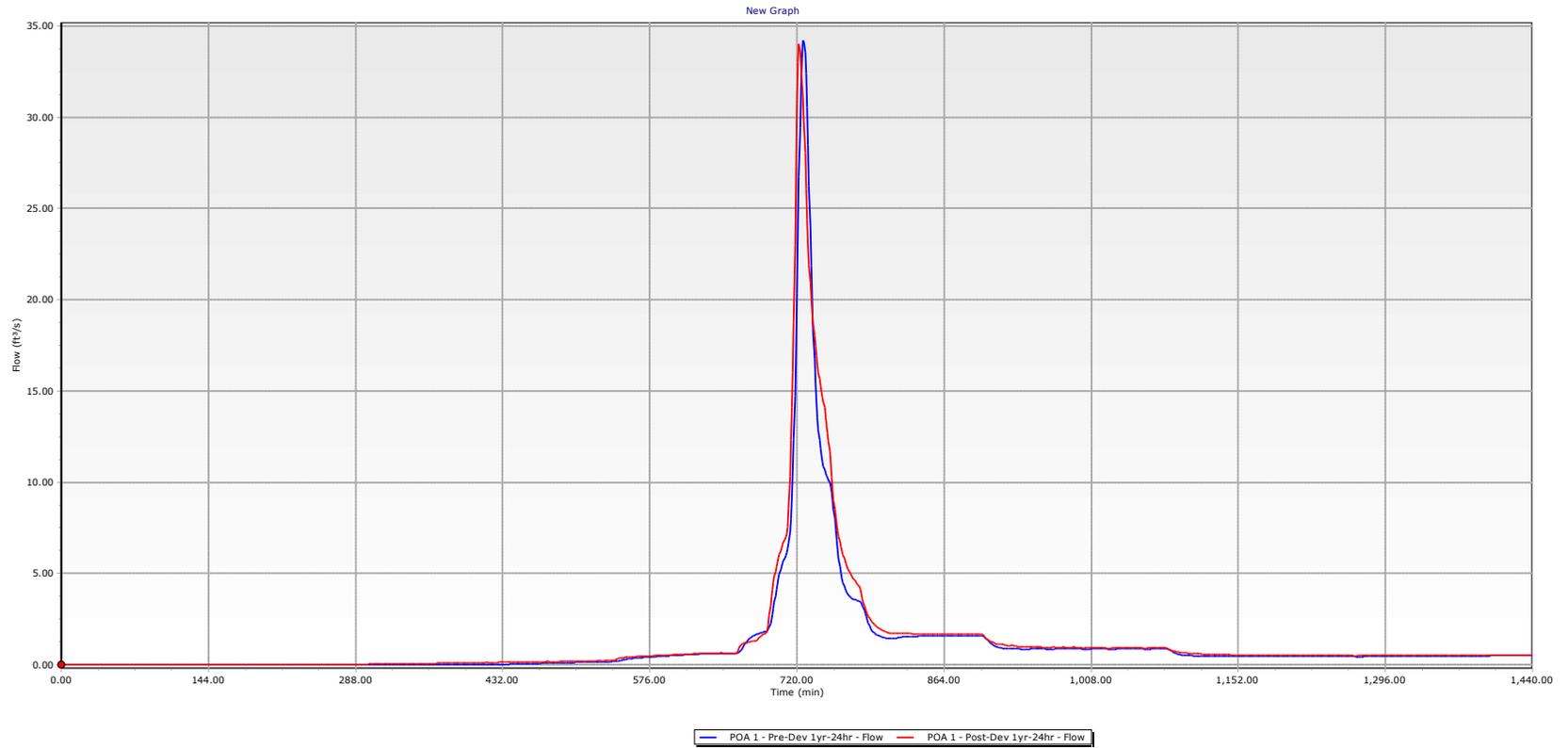
Onsite Elliot Rd ROW Imp = 76,940 sf
Elliot Rd ROW Treated = 39,750 sf
Elliot Rd ROW Imp Bypass = 37,443 sf

Onsite Imp Treated Over Req. = 46,163 sf *Overtreatment makes up for Elliot Road*
Elliot Rd ROW Imp Bypass = 37,443 sf *ROW impervious bypassed*

** For future lot, assumed 90% onsite impervious area and all impervious area treated*

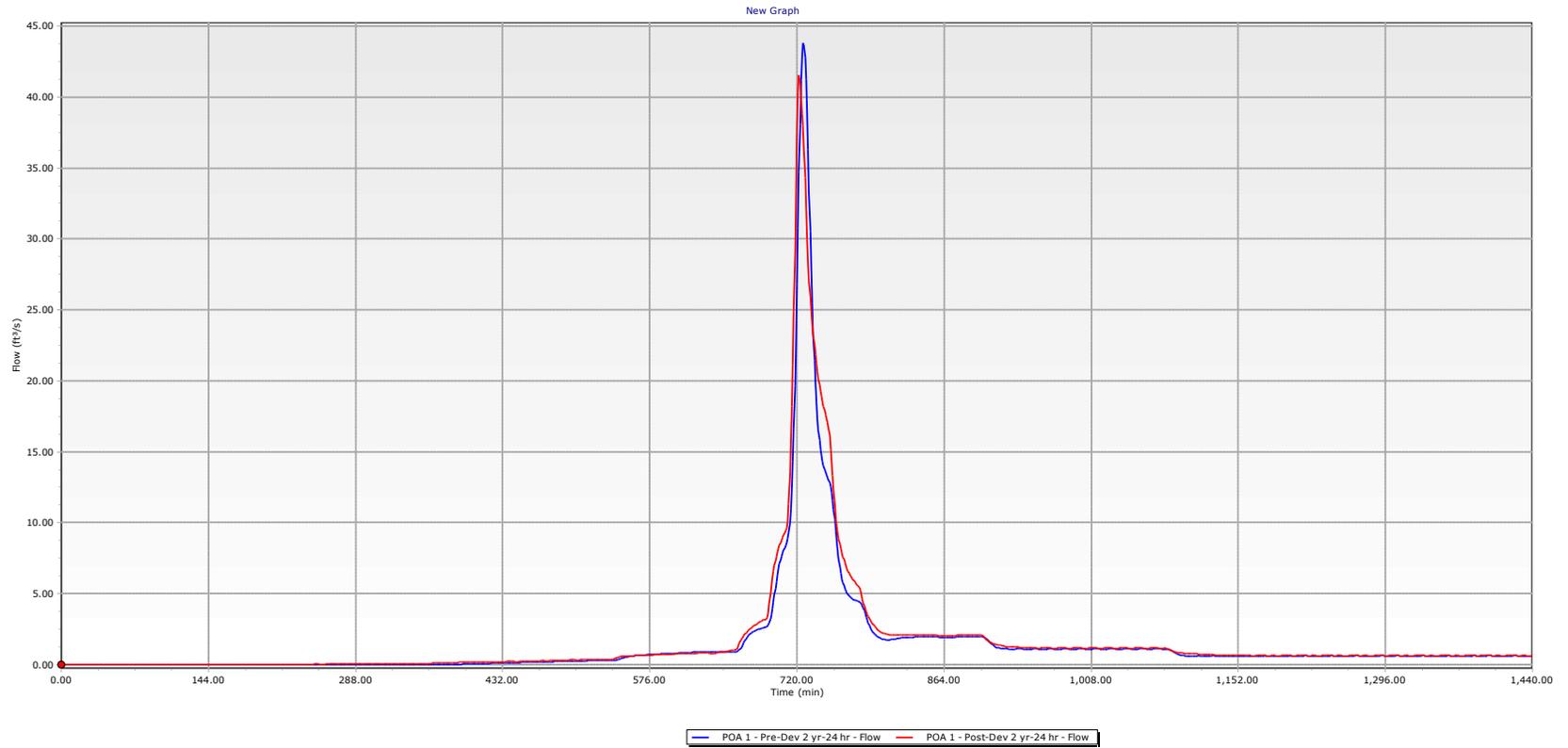
POA #1: 1-yr, 24hr

- Pre-Development
- Post-Development



POA #1: 2-yr, 24hr

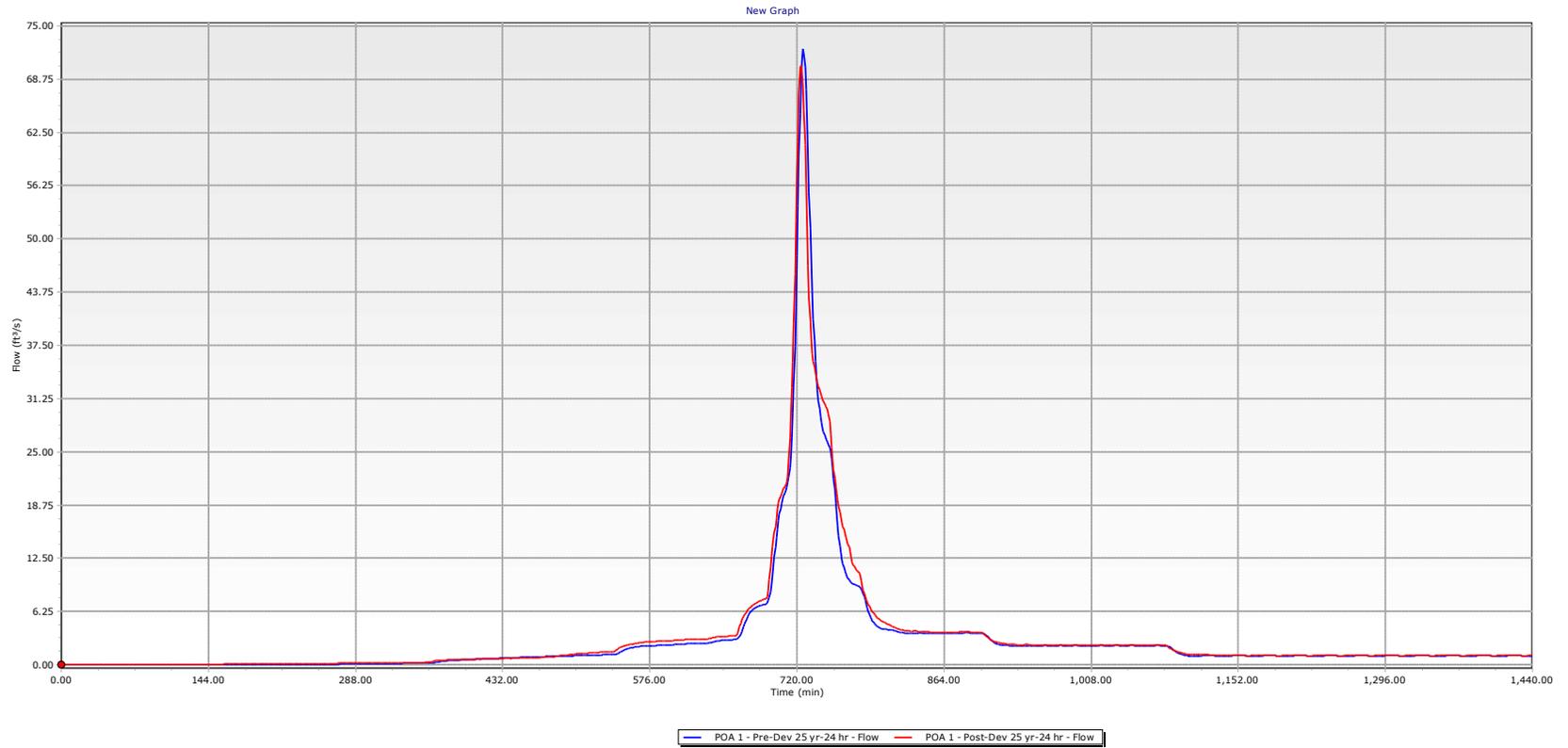
- Pre-Development
- Post-Development



POA #1: 25-yr, 24hr

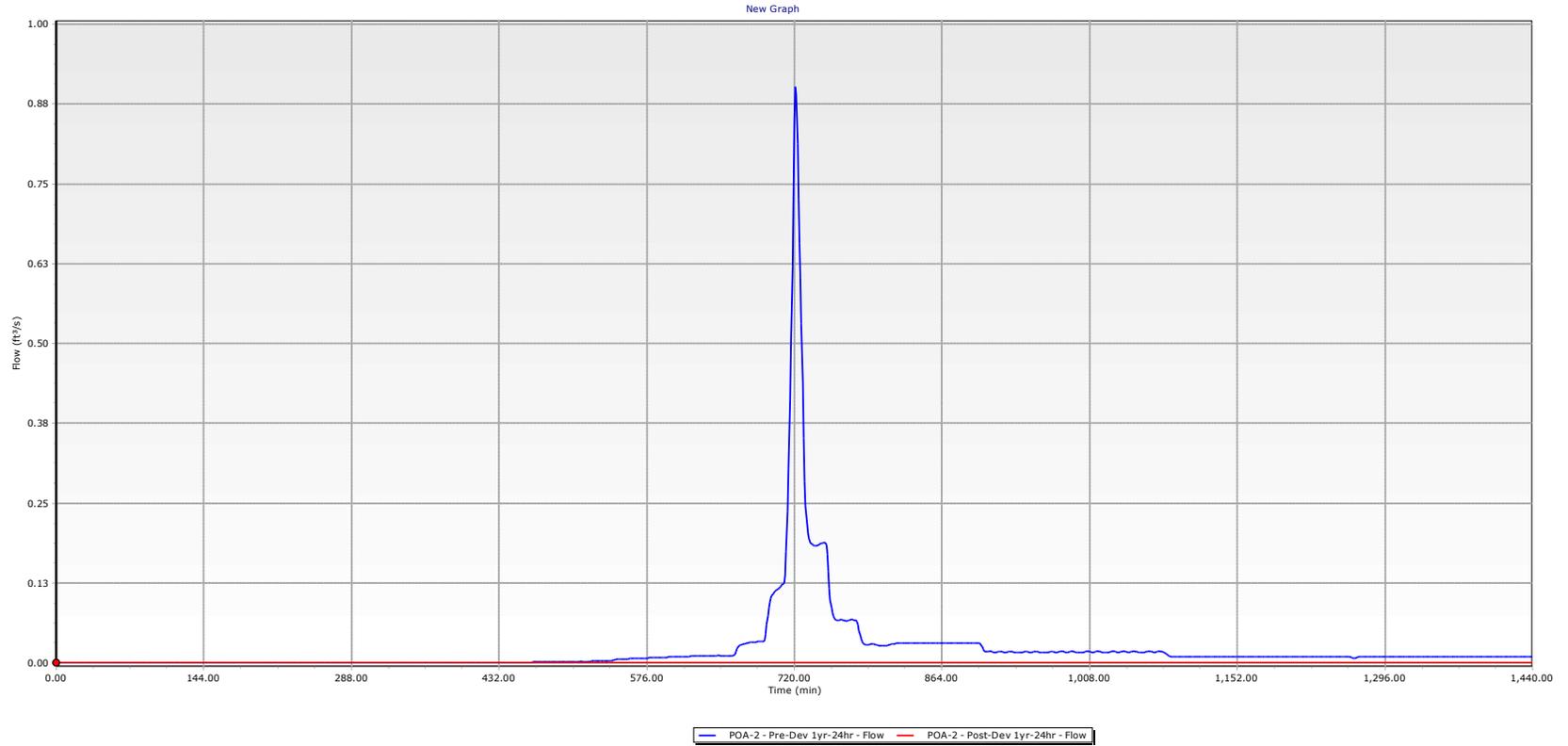
— Pre-Development

— Post-Development



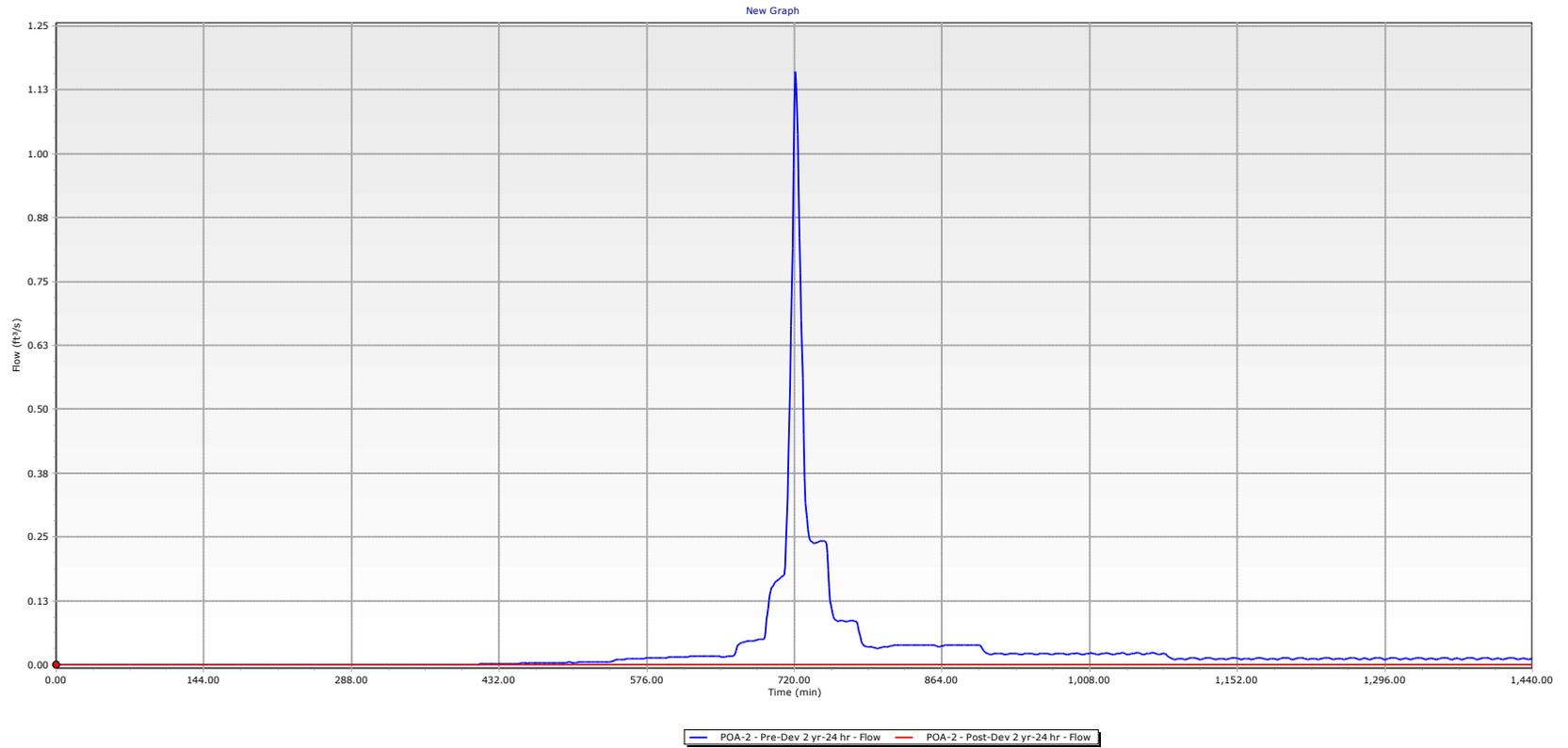
POA #2: 1-yr, 24hr

- Pre-Development
- Post-Development



POA #2: 2-yr, 24hr

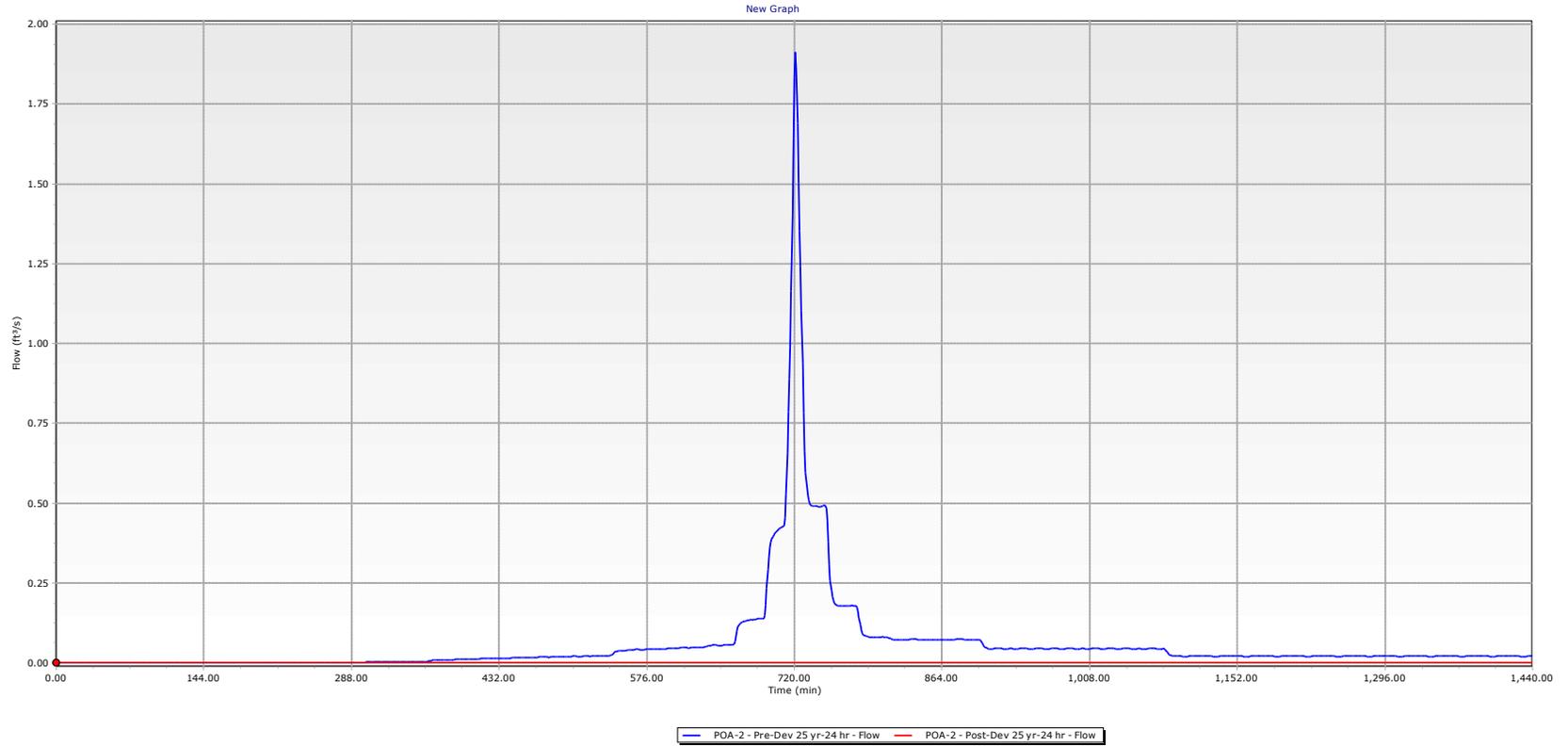
- Pre-Development
- Post-Development



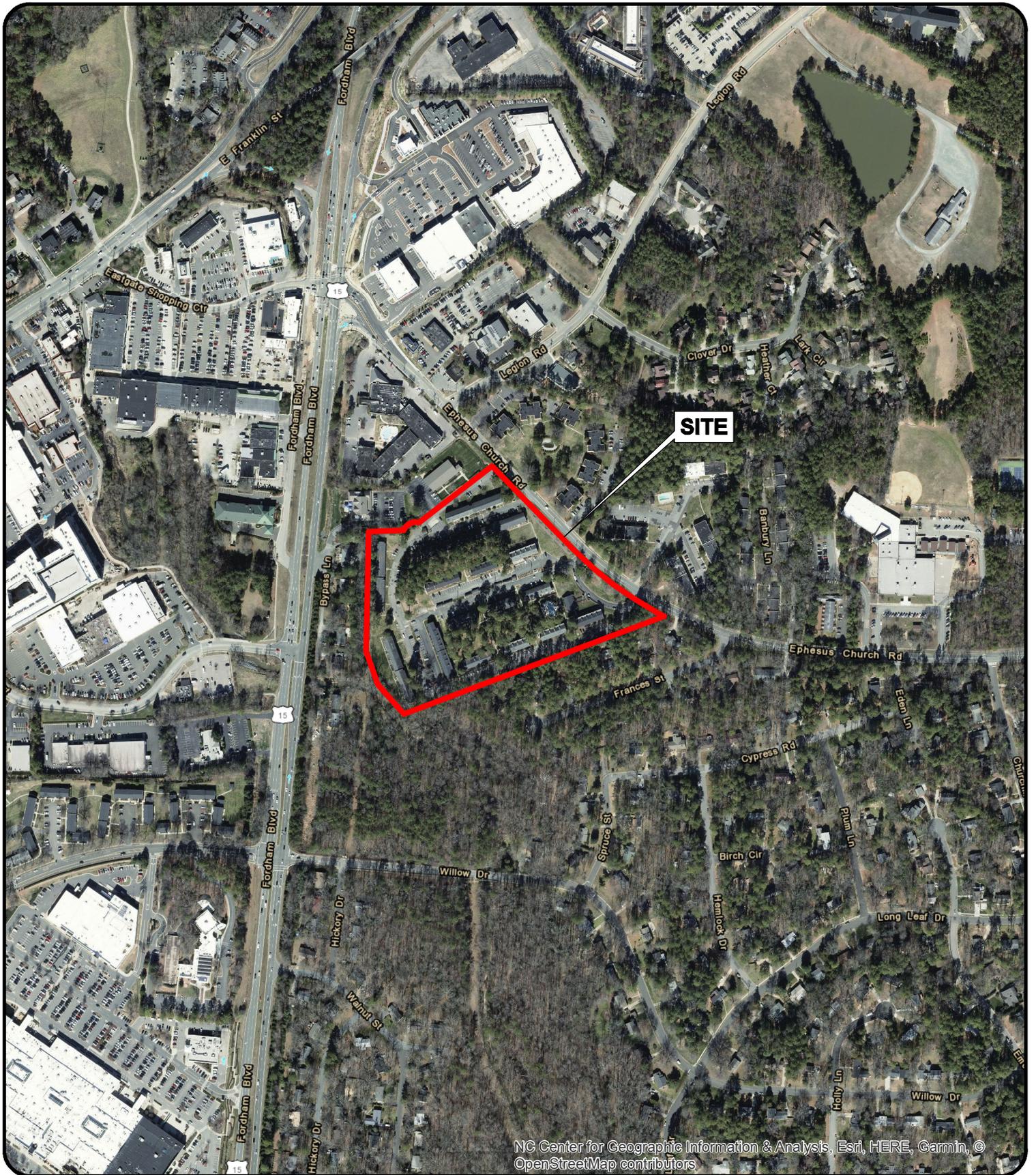
POA #2: 25-yr, 24hr

— Pre-Development

— Post-Development



MISCELLANEOUS SITE INFORMATION



NC Center for Geographic Information & Analysis, Esri, HERE, Garmin, © OpenStreetMap contributors

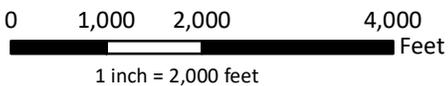
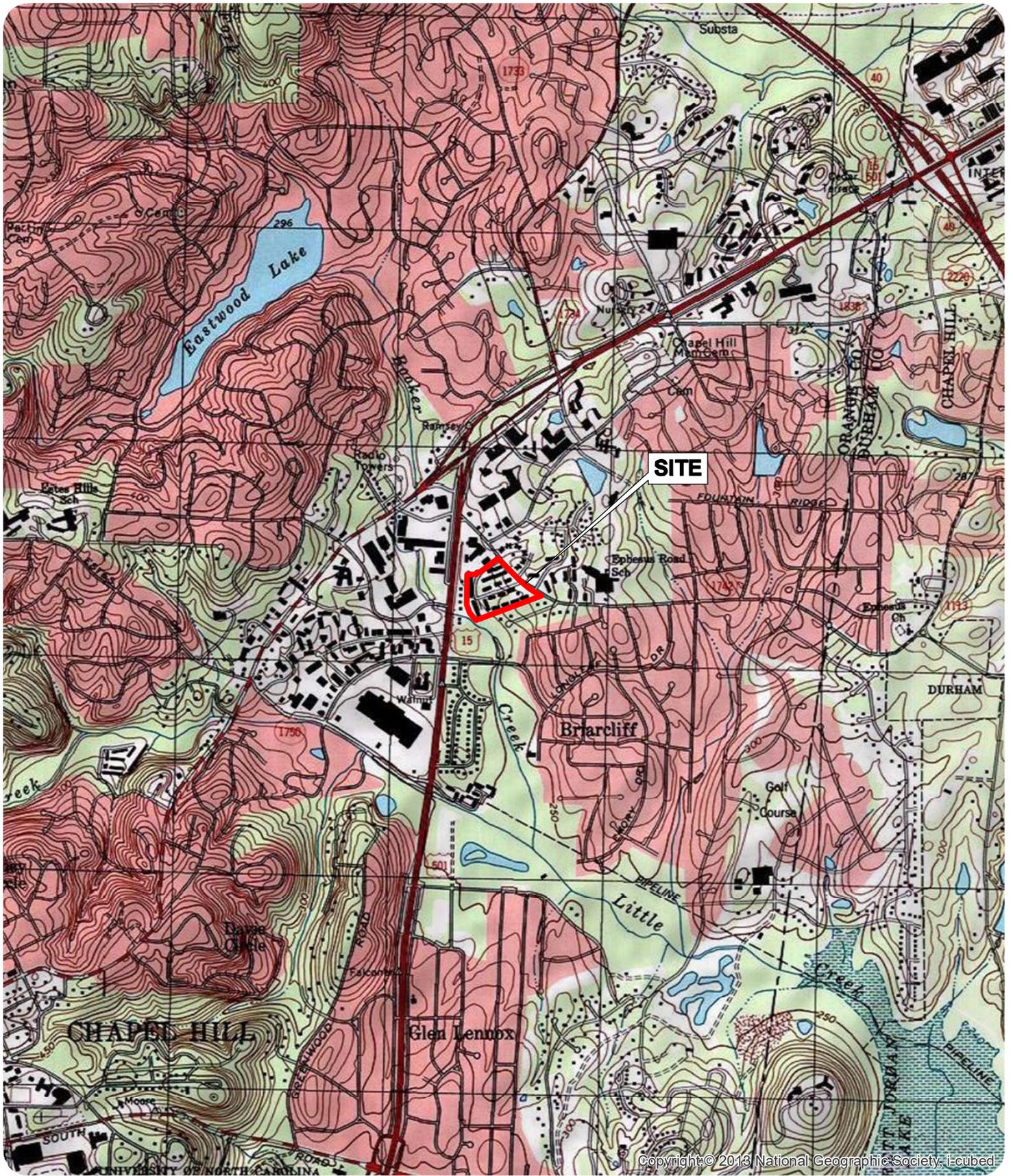


0 250 500 1,000
1 inch = 500 feet

PARK APARTMENTS
SITE AERIAL MAP
PROJECT #: WDF-17000
CHAPEL HILL, NORTH CAROLINA



MCADAMS

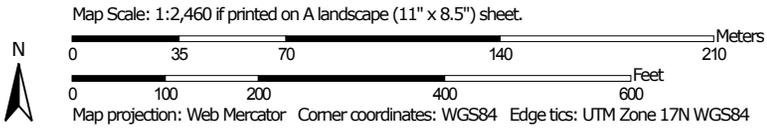


PARK APARTMENTS
USGS TOPO MAP
PROJECT #: WDF-17000
CHAPEL HILL, NORTH CAROLINA



MCADAMS

Hydrologic Soil Group—Orange County, North Carolina
(PROPERTY)



MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

Soil Rating Polygons

 A
 A/D
 B
 B/D
 C
 C/D
 D
 Not rated or not available

Soil Rating Lines

 A
 A/D
 B
 B/D
 C
 C/D
 D
 Not rated or not available

Soil Rating Points

 A
 A/D
 B
 B/D

 C
 C/D
 D
 Not rated or not available

Water Features

 Streams and Canals

Transportation

 Rails
 Interstate Highways
 US Routes
 Major Roads
 Local Roads

Background

 Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
 Web Soil Survey URL:
 Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Orange County, North Carolina
 Survey Area Data: Version 18, Sep 10, 2018

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Apr 27, 2014—May 6, 2014

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
Ch	Chewacla loam, 0 to 2 percent slopes, frequently flooded	B/D	0.5	3.5%
Ur	Urban land		1.3	9.3%
WtC2	White Store clay loam, 6 to 15 percent slopes, moderately eroded	D	0.5	3.5%
WwC	White Store-Urban land complex, 2 to 8 percent slopes	D	11.4	83.7%
Totals for Area of Interest			13.7	100.0%

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

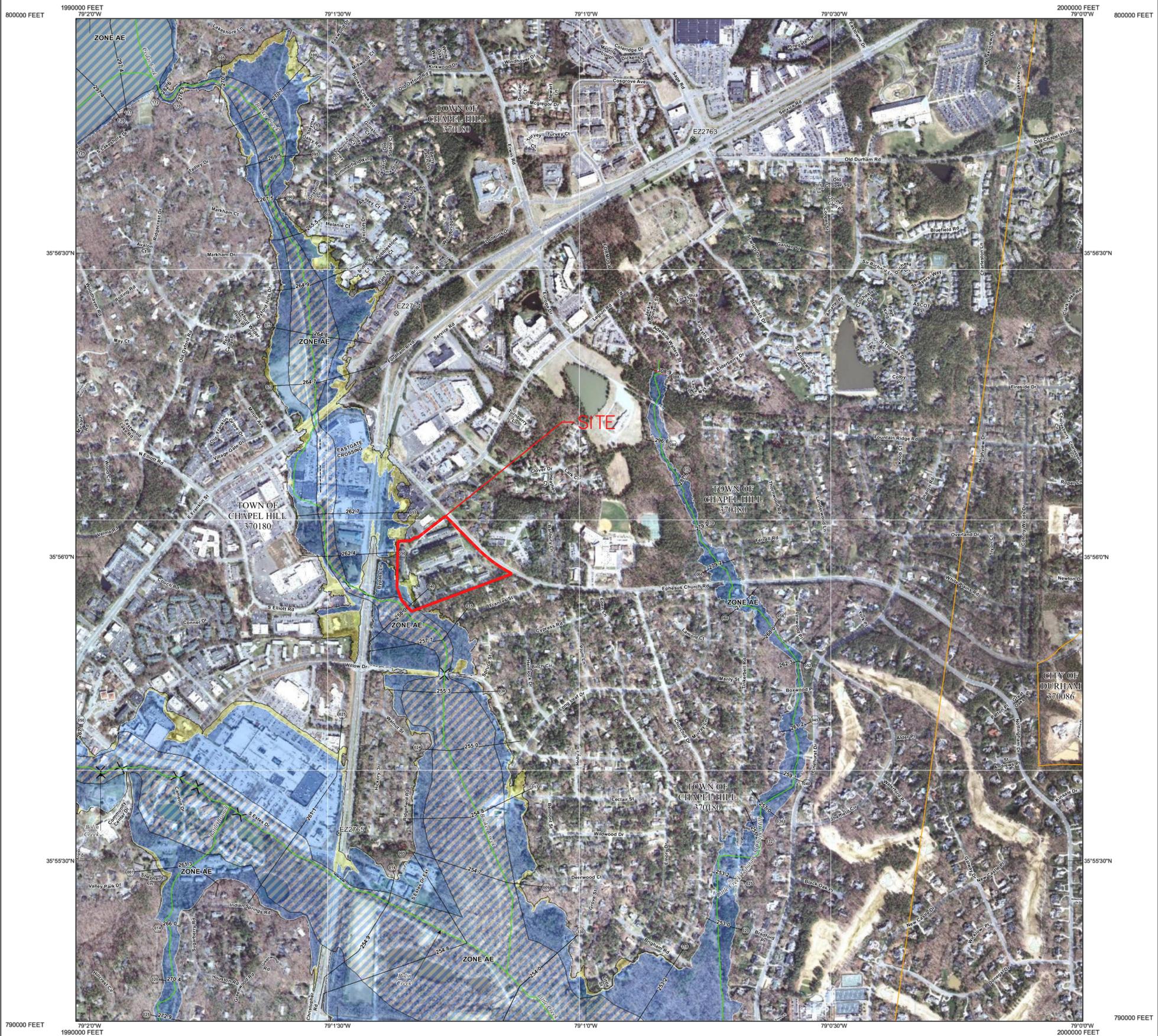
Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Name of Stream	Description	Class	Class Date	Index No.
Cedar Fork	From source to Eastwood Lake, Booker Creek	WS-V,B;NSW	08/11/09	16-41-1-15-2-3
Unnamed Tributary at Wright Mobile Homes	From source to Cedar Fork	WS-V,B;NSW	08/11/09	16-41-1-15-2-3-1
Booker Creek	From dam at Eastwood Lake to U.S. Hwy. 15	WS-V;NSW	08/11/09	16-41-1-15-2-(4)
Booker Creek	From U.S. Hwy. 15 to Little Creek	WS-IV;NSW	08/03/92	16-41-1-15-2-(5)
Little Creek	From a point 0.7 mile downstream of Durham County SR 1110 to New Hope Creek	WS-IV;NSW,CA	08/03/92	16-41-1-15-(3)
Crooked Creek	From source to a point 0.7 mile upstream of mouth	WS-V;NSW	08/03/92	16-41-1-16-(1)
Crooked Creek	From a point 0.7 mile upstream of mouth to New Hope Creek Arm of B. Everett Jordan Lake	WS-IV;NSW,CA	08/03/92	16-41-1-16-(2)
Northeast Creek	From source to N.C. Hwy. 55	WS-V;NSW	08/11/09	16-41-1-17-(0.3)
Northeast Creek	From N.C. Hwy. 55 to a point 0.5 mile downstream of Panther Creek	WS-IV;NSW	08/03/92	16-41-1-17-(0.7)
Burdens Creek	From source to Durham County SR 2028	WS-V;NSW	08/11/09	16-41-1-17-1- (0.3)
Burdens Creek	From Durham County SR 2028 to Northeast Creek	WS-IV;NSW	08/03/92	16-41-1-17-1- (0.7)
Buck Branch	From source to Burdens Creek	WS-IV;NSW	08/03/92	16-41-1-17-1-1
Kit Creek	From source to a point 1.3 miles upstream of N.C. Hwy. 55	WS-V;NSW	08/11/09	16-41-1-17-2- (0.3)
Kit Creek	From a point 1.3 miles upstream of N.C. Hwy. 55 to Northeast Creek	WS-IV;NSW	08/03/92	16-41-1-17-2- (0.7)
Long Branch	From source to Kit Creek	WS-IV;NSW	08/03/92	16-41-1-17-2-1
Panther Creek	From source to New Hope Creek	WS-IV;NSW	08/03/92	16-41-1-17-3
Morris Branch	From source to Panther Creek	WS-IV;NSW	08/03/92	16-41-1-17-3-1
Nancy Branch	From source to Panther Creek	WS-IV;NSW	08/03/92	16-41-1-17-3-2
Northeast Creek	From a point 0.5 mile downstream of Panther Creek to New Hope Creek Arm of B. Everett Jordan Lake	WS-IV;NSW,CA	08/03/92	16-41-1-17-(4)
Indian Creek	From source to a point 0.4 mile upstream of N.C. Hwy. 751	WS-IV;NSW	08/03/92	16-41-1-18-(1)
Indian Creek	From a point 0.4 mile upstream of N.C. Hwy. 751 to New Hope Creek Arm of New Hope River Arm of B. Everett Jordan Lake	WS-IV;NSW,CA	08/03/92	16-41-1-18-(2)
Morgan Creek	From source to a point 1.4 miles downstream of N.C. Hwy. 54	WS-II;HQW,NSW	08/03/92	16-41-2-(1)
Morgan Creek (University Lake)	From a point 1.4 miles downstream of N.C. Hwy. 54 to dam at University Lake	WS-II;HQW,NSW, CA	08/03/92	16-41-2-(1.5)
Phils Creek	From source to a point 0.2 mile downstream of Orange County SR 1005	WS-II;HQW,NSW	08/03/92	16-41-2-2-(0.3)
Phils Creek	From a point 0.2 mile downstream of Orange County SR 1005 to University Lake, Morgan Creek	WS-II;HQW,NSW, CA	08/03/92	16-41-2-2-(0.7)



This digital Flood Insurance Rate Map (FIRM) was produced through a unique cooperative partnership between the State of North Carolina and the Federal Emergency Management Agency (FEMA). The State of North Carolina has implemented a long term approach to floodplain management to decrease the costs associated with flooding. This is demonstrated by the State's commitment to map flood hazard areas at the local level. As a part of this effort, the State of North Carolina has joined in a Cooperating Technical State agreement with FEMA to produce and maintain this digital FIRM.

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR ZONE DESCRIPTIONS AND INDEX MAP THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT [HTTP://FRIS.NC.GOV/FRIS](http://FRIS.NC.GOV/FRIS)

	Without Base Flood Elevation (BFE) Zone A, V, A99
	With BFE or Depth Zone AE, AO, AH, VE, AR
	Regulatory Floodway
	0.2% Annual Chance Flood Hazard, Areas of 1% Annual Chance Flood with Average Depth Less Than One Foot or With Drainage Areas of Less Than One Square Mile Zone X
	Future Conditions 1% Annual Chance Flood Hazard Zone X
	Area with Reduced Flood Risk due to Levee See Notes Zone X
	Areas Determined to be Outside the 0.2% Annual Chance Floodplain Zone X
	Channel, Culvert, or Storm Sewer Accredited or Provisionally Accredited Levee, Dike, or Floodwall
	Non-accredited Levee, Dike, or Floodwall
	North Carolina Geodetic Survey bench mark
	National Geodetic Survey bench mark
	Contractor Est. NCFMP Survey bench mark
	Cross Sections with 1% Annual Chance Water Surface Elevation (BFE)
	Coastal Transect
	Coastal Transect Baseline
	Profile Baseline
	Hydrographic Feature
	Limit of Study
	Jurisdiction Boundary

NOTES TO USERS

For information and questions about this map, available products associated with this FIRM including historic versions of this FIRM, how to order products or the National Flood Insurance Program in general, please call the FEMA Map Information eXchange at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA Map Service Center website at <http://msc.fema.gov>. An accompanying Flood Insurance Study report, Letter of Map Revision (LOMR) or Letter of Map Amendment (LOMA) revising portions of this panel, and digital versions of this FIRM may be available. Visit the North Carolina Floodplain Mapping Program website at <http://www.ncfloodmaps.com> or contact the FEMA Map Service Center.

Communities annexing land on adjacent FIRM panels must obtain a current copy of the adjacent panel as well as the current FIRM Index. These may be ordered directly from the Map Service Center at the number listed above.

For community and countywide map dates refer to the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in the community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

Flood Insurance Study (FIS) means an examination, evaluation, and determination of flood hazards, corresponding water surface elevations, flood hazard risk zones, and other flood data in a community issued by the North Carolina Floodplain Mapping Program (NCFMP). The Flood Insurance Study (FIS) is comprised of the following products used together: the Digital Flood Hazard Database, the Water Surface Elevation Raster, the digitally derived, autogenerated Flood Insurance Rate Map and the Flood Insurance Survey Report. A Flood Insurance Survey is a compilation and presentation of flood risk data for specific watercourses, lakes, and coastal flood hazard areas within a community. This report contains detailed flood elevation data, data tables and FIRM indices. When a flood study is completed for the NFIP, the digital information, reports and maps are assembled into an FIS. Information shown on this FIRM is provided in digital format by the NCFMP. Base map information shown on this FIRM was provided in digital format by the NCFMP. The source of this information can be determined from the metadata available in the digital FLOOD database and in the Technical Support Data Notebook (TSDN).

ACCREDITED LEEVE NOTES TO USERS: If an accredited levee note appears on this panel check with your local community to obtain more information, such as the estimated level of protection provided (which may exceed the 1-percent-annual-chance level) and Emergency Action Plan, on the levee system(s) shown as providing protection. To maintain accreditation, the levee owner or community is required to submit the data and documentation necessary to comply with Section 65.10 of the NFIP regulations. If the community or owner does not provide the necessary data and documentation or if the data and documentation provided indicates the levee system does not comply with Section 65.10 requirements, FEMA will revise the flood hazard and risk information for this area to reflect de-accreditation of the levee system. To mitigate flood risk in residual risk areas, property owners and residents are encouraged to consider flood insurance and floodproofing or other protective measures. For more information on flood insurance, interested parties should visit the FEMA Website at <http://www.fema.gov/business/nfip/index.shtm>.

PROVISIONALLY ACCREDITED LEEVE NOTES TO USERS: If a Provisionally Accredited Levee (PAL) note appears on this panel, check with your local community to obtain more information, such as the estimated level of protection provided (which may exceed the 1-percent-annual-chance level) and Emergency Action Plan, on the levee system(s) shown as providing protection. To mitigate flood risk in residual risk areas, property owners and residents are encouraged to consider flood insurance and floodproofing or other protective measures. For more information on flood insurance, interested parties should visit the FEMA Website at <http://www.fema.gov/business/nfip/index.shtm>.

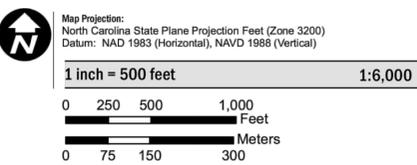
LIMIT OF MODERATE WAVE ACTION NOTES TO USERS: For some coastal flooding zones the AE Zone category has been divided by a Limit of Moderate Wave Action (LIMWA). The LIMWA represents the approximate landward limit of the 1.5-foot breaking wave. The effects of wave hazards between the VE Zone and the LIMWA or between the shoreline and the LIMWA for areas where VE Zones are not identified) will be similar to, but less severe than those in the VE Zone.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) NOTE

This map may include approximate boundaries of the CBRS for informational purposes only. Flood insurance is not available within CBRS areas for risk areas, property owners are encouraged to consider flood insurance and floodproofing or other protective measures. For more information on flood insurance, interested parties should visit the FEMA Website at <http://www.fema.gov/business/nfip/index.shtm>.

	CBRS Area		Otherwise Protected Area
--	-----------	--	--------------------------

SCALE



PANEL LOCATOR

Castwell				Person			
9920	9940	9960	9980	9990	9900	9910	
	9849	9859		9889	9899	9809	9819
9828			9848	9858	9888	9898	9808
9827	9837	9847	9857	9867	9877	9887	9897
9826	9836	9846	9856	9866	9876	9886	9896
9825	9835	9845	9855	9865	9875	9885	9895
9824	9834	9844	9854	9864	9874	9884	9894
9823	9833	9843	9853	9863	9873	9883	9893
9822	9832	9842	9852	9862	9872	9882	9892
9820	9841	9851	9861	9871	9881	9891	9801
9720	9730	9740	9750	9760	9770	9780	9790
9728	9738	9748	9758	9768	9778	9788	9798
9727	9737			9767	9777	9787	9797
9746				9766	9776	9786	9796

National Flood Insurance Program

NORTH CAROLINA FLOODPLAIN MAPPING PROGRAM
NATIONAL FLOOD INSURANCE PROGRAM
FLOOD INSURANCE RATE MAP

NORTH CAROLINA

PANEL 9799

Panel Contains:

COMMUNITY	CID	PANEL	SUFFIX
CHAPEL HILL, TOWN OF	370180	9799	L
DURHAM, CITY OF	370086	9799	L

VERSION NUMBER
2.3.3.2
MAP NUMBER
3710979900L
MAP REVISED
January 19, 2019



NOAA Atlas 14, Volume 2, Version 3
Location name: Chapel Hill, North Carolina, USA*
Latitude: 35.9331°, Longitude: -79.0213°
Elevation: 268.1 ft**



* source: ESRI Maps
 ** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley

NOAA, National Weather Service, Silver Spring, Maryland

[PF_tabular](#) | [PF_graphical](#) | [Maps & aerials](#)

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)¹										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.409 (0.374-0.447)	0.481 (0.441-0.525)	0.552 (0.506-0.602)	0.611 (0.559-0.666)	0.671 (0.611-0.731)	0.715 (0.649-0.779)	0.753 (0.680-0.821)	0.786 (0.705-0.858)	0.821 (0.730-0.896)	0.849 (0.748-0.929)
10-min	0.653 (0.598-0.714)	0.769 (0.705-0.840)	0.884 (0.810-0.964)	0.977 (0.894-1.07)	1.07 (0.974-1.17)	1.14 (1.03-1.24)	1.20 (1.08-1.30)	1.25 (1.12-1.36)	1.30 (1.16-1.42)	1.34 (1.18-1.46)
15-min	0.817 (0.748-0.892)	0.966 (0.886-1.06)	1.12 (1.02-1.22)	1.24 (1.13-1.35)	1.36 (1.24-1.48)	1.44 (1.31-1.57)	1.51 (1.37-1.65)	1.57 (1.41-1.72)	1.63 (1.45-1.78)	1.68 (1.48-1.84)
30-min	1.12 (1.02-1.22)	1.34 (1.22-1.46)	1.59 (1.46-1.73)	1.79 (1.64-1.95)	2.01 (1.83-2.19)	2.17 (1.97-2.37)	2.32 (2.09-2.53)	2.45 (2.19-2.67)	2.60 (2.31-2.84)	2.72 (2.40-2.97)
60-min	1.40 (1.28-1.53)	1.68 (1.54-1.83)	2.04 (1.87-2.22)	2.33 (2.13-2.54)	2.68 (2.44-2.91)	2.94 (2.67-3.20)	3.19 (2.88-3.48)	3.43 (3.08-3.75)	3.73 (3.32-4.07)	3.97 (3.50-4.34)
2-hr	1.67 (1.52-1.84)	2.01 (1.84-2.20)	2.47 (2.25-2.70)	2.85 (2.59-3.12)	3.31 (2.99-3.62)	3.68 (3.32-4.03)	4.04 (3.62-4.42)	4.40 (3.91-4.81)	4.87 (4.28-5.32)	5.25 (4.58-5.76)
3-hr	1.78 (1.63-1.95)	2.14 (1.97-2.35)	2.64 (2.42-2.89)	3.06 (2.80-3.35)	3.59 (3.25-3.92)	4.03 (3.63-4.39)	4.45 (3.98-4.86)	4.89 (4.34-5.34)	5.47 (4.80-5.98)	5.97 (5.18-6.54)
6-hr	2.14 (1.97-2.34)	2.57 (2.37-2.81)	3.17 (2.91-3.46)	3.69 (3.38-4.02)	4.35 (3.96-4.73)	4.91 (4.43-5.33)	5.46 (4.89-5.93)	6.04 (5.35-6.55)	6.81 (5.95-7.40)	7.48 (6.45-8.14)
12-hr	2.53 (2.34-2.76)	3.05 (2.81-3.32)	3.77 (3.47-4.11)	4.42 (4.05-4.80)	5.26 (4.78-5.69)	5.98 (5.39-6.45)	6.71 (5.99-7.23)	7.48 (6.60-8.06)	8.55 (7.41-9.21)	9.48 (8.09-10.2)
24-hr	2.96 (2.77-3.16)	3.57 (3.35-3.82)	4.46 (4.18-4.77)	5.16 (4.82-5.51)	6.10 (5.68-6.52)	6.84 (6.36-7.32)	7.60 (7.04-8.14)	8.38 (7.74-8.99)	9.45 (8.68-10.2)	10.3 (9.41-11.1)
2-day	3.46 (3.24-3.70)	4.17 (3.91-4.46)	5.17 (4.84-5.53)	5.93 (5.55-6.34)	6.96 (6.48-7.44)	7.77 (7.22-8.32)	8.59 (7.95-9.22)	9.43 (8.69-10.1)	10.6 (9.70-11.4)	11.5 (10.5-12.4)
3-day	3.66 (3.43-3.91)	4.40 (4.13-4.70)	5.43 (5.09-5.80)	6.23 (5.82-6.65)	7.30 (6.80-7.81)	8.15 (7.57-8.73)	9.02 (8.34-9.67)	9.90 (9.12-10.6)	11.1 (10.2-12.0)	12.1 (11.0-13.0)
4-day	3.86 (3.62-4.13)	4.63 (4.34-4.95)	5.69 (5.33-6.07)	6.52 (6.10-6.97)	7.65 (7.12-8.18)	8.53 (7.92-9.14)	9.44 (8.73-10.1)	10.4 (9.55-11.1)	11.7 (10.7-12.6)	12.7 (11.5-13.7)
7-day	4.43 (4.18-4.72)	5.29 (4.99-5.63)	6.42 (6.05-6.84)	7.31 (6.88-7.79)	8.53 (8.00-9.10)	9.49 (8.87-10.1)	10.5 (9.75-11.2)	11.5 (10.6-12.3)	12.9 (11.9-13.8)	14.0 (12.8-15.0)
10-day	5.04 (4.76-5.36)	5.99 (5.65-6.36)	7.19 (6.78-7.64)	8.13 (7.65-8.64)	9.39 (8.82-9.99)	10.4 (9.72-11.1)	11.4 (10.6-12.2)	12.4 (11.6-13.3)	13.8 (12.8-14.8)	14.9 (13.7-16.0)
20-day	6.73 (6.36-7.13)	7.94 (7.51-8.40)	9.37 (8.85-9.92)	10.5 (9.92-11.1)	12.1 (11.3-12.8)	13.3 (12.4-14.1)	14.5 (13.6-15.5)	15.8 (14.7-16.8)	17.5 (16.2-18.7)	18.9 (17.3-20.2)
30-day	8.36 (7.93-8.85)	9.85 (9.32-10.4)	11.4 (10.8-12.1)	12.7 (12.0-13.4)	14.3 (13.5-15.1)	15.6 (14.6-16.5)	16.8 (15.7-17.8)	18.1 (16.9-19.2)	19.7 (18.3-21.0)	21.0 (19.5-22.4)
45-day	10.7 (10.2-11.2)	12.5 (11.9-13.1)	14.3 (13.6-15.0)	15.7 (14.9-16.5)	17.5 (16.6-18.4)	18.9 (17.9-19.9)	20.3 (19.1-21.4)	21.6 (20.3-22.8)	23.4 (21.9-24.8)	24.8 (23.1-26.3)
60-day	12.8 (12.2-13.4)	14.9 (14.3-15.6)	16.8 (16.1-17.6)	18.3 (17.5-19.2)	20.2 (19.2-21.2)	21.6 (20.6-22.7)	23.0 (21.8-24.2)	24.4 (23.0-25.7)	26.1 (24.6-27.5)	27.4 (25.8-29.0)

¹ Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS). Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values. Please refer to NOAA Atlas 14 document for more information.

[Back to Top](#)

PF graphical



Storm Data Detailed Report: WDF-17000

Element Details			
ID	33	Notes	
Label	WDF-17000		
1 yr-24 hr			
Label	1 yr-24 hr	Increment	5.00 min
Return Event	1 years	End Time	1,440.00 min
Start Time	0.00 min	Storm Event Depth Type	Cumulative

1 yr-24 hr

Time (min)	Depth (in)				
0.00	0.000	0.003	0.006	0.009	0.012
25.00	0.015	0.018	0.021	0.024	0.027
50.00	0.030	0.033	0.036	0.039	0.042
75.00	0.045	0.048	0.051	0.054	0.057
100.00	0.060	0.063	0.066	0.069	0.072
125.00	0.075	0.078	0.081	0.084	0.087
150.00	0.090	0.093	0.096	0.099	0.102
175.00	0.105	0.108	0.110	0.113	0.116
200.00	0.119	0.122	0.125	0.128	0.131
225.00	0.134	0.137	0.140	0.143	0.146
250.00	0.149	0.152	0.155	0.158	0.161
275.00	0.164	0.167	0.170	0.173	0.176
300.00	0.179	0.182	0.185	0.188	0.191
325.00	0.194	0.197	0.200	0.203	0.206
350.00	0.209	0.212	0.215	0.220	0.226
375.00	0.231	0.237	0.242	0.248	0.253
400.00	0.258	0.264	0.269	0.275	0.280
425.00	0.285	0.291	0.296	0.302	0.307
450.00	0.313	0.318	0.323	0.329	0.334
475.00	0.340	0.345	0.350	0.356	0.361
500.00	0.367	0.372	0.378	0.383	0.388
525.00	0.394	0.399	0.405	0.410	0.420
550.00	0.430	0.440	0.450	0.460	0.470
575.00	0.480	0.490	0.500	0.510	0.520
600.00	0.530	0.540	0.550	0.560	0.570
625.00	0.580	0.590	0.599	0.608	0.618
650.00	0.627	0.636	0.645	0.668	0.690
675.00	0.713	0.735	0.758	0.780	0.845
700.00	0.910	0.974	1.039	1.243	1.652
725.00	1.856	1.921	1.986	2.050	2.115
750.00	2.180	2.203	2.225	2.248	2.270
775.00	2.293	2.315	2.324	2.333	2.343
800.00	2.352	2.361	2.370	2.380	2.390
825.00	2.400	2.410	2.420	2.430	2.440
850.00	2.450	2.460	2.470	2.480	2.490
875.00	2.500	2.510	2.520	2.530	2.540
900.00	2.550	2.555	2.561	2.566	2.572



**Storm Data Detailed
Report: WDF-17000**

1 yr-24 hr

Time (min)	Depth (in)				
925.00	2.577	2.583	2.588	2.593	2.599
950.00	2.604	2.610	2.615	2.620	2.626
975.00	2.631	2.637	2.642	2.648	2.653
1,000.00	2.658	2.664	2.669	2.675	2.680
1,025.00	2.685	2.691	2.696	2.702	2.707
1,050.00	2.713	2.718	2.723	2.729	2.734
1,075.00	2.740	2.745	2.748	2.751	2.754
1,100.00	2.757	2.760	2.763	2.766	2.769
1,125.00	2.772	2.775	2.778	2.781	2.784
1,150.00	2.787	2.790	2.793	2.796	2.799
1,175.00	2.802	2.805	2.808	2.811	2.814
1,200.00	2.817	2.820	2.823	2.826	2.829
1,225.00	2.832	2.835	2.838	2.841	2.844
1,250.00	2.847	2.850	2.853	2.855	2.858
1,275.00	2.861	2.864	2.867	2.870	2.873
1,300.00	2.876	2.879	2.882	2.885	2.888
1,325.00	2.891	2.894	2.897	2.900	2.903
1,350.00	2.906	2.909	2.912	2.915	2.918
1,375.00	2.921	2.924	2.927	2.930	2.933
1,400.00	2.936	2.939	2.942	2.945	2.948
1,425.00	2.951	2.954	2.957	2.960	(N/A)

2 yr-24 hr

Label	2 yr-24 hr	Increment	5.00 min
Return Event	2 years	End Time	1,440.00 min
Start Time	0.00 min	Storm Event Depth Type	Cumulative

2 yr-24 hr

Time (min)	Depth (in)				
0.00	0.000	0.004	0.007	0.011	0.014
25.00	0.018	0.022	0.025	0.029	0.033
50.00	0.036	0.040	0.043	0.047	0.051
75.00	0.054	0.058	0.061	0.065	0.069
100.00	0.072	0.076	0.079	0.083	0.087
125.00	0.090	0.094	0.097	0.101	0.105
150.00	0.108	0.112	0.116	0.119	0.123
175.00	0.126	0.130	0.134	0.137	0.141
200.00	0.144	0.148	0.152	0.155	0.159
225.00	0.163	0.166	0.170	0.173	0.177
250.00	0.181	0.184	0.188	0.191	0.195
275.00	0.199	0.202	0.206	0.209	0.213
300.00	0.217	0.220	0.224	0.228	0.231
325.00	0.235	0.238	0.242	0.246	0.249
350.00	0.253	0.256	0.260	0.267	0.273
375.00	0.280	0.287	0.293	0.300	0.307



**Storm Data Detailed
Report: WDF-17000**

2 yr-24 hr

Time (min)	Depth (in)				
400.00	0.313	0.320	0.327	0.333	0.340
425.00	0.347	0.353	0.360	0.367	0.373
450.00	0.380	0.387	0.393	0.400	0.407
475.00	0.413	0.420	0.427	0.433	0.440
500.00	0.447	0.453	0.460	0.467	0.473
525.00	0.480	0.487	0.493	0.500	0.512
550.00	0.524	0.536	0.548	0.560	0.572
575.00	0.584	0.596	0.608	0.619	0.631
600.00	0.643	0.655	0.667	0.679	0.691
625.00	0.703	0.715	0.726	0.737	0.748
650.00	0.758	0.769	0.780	0.808	0.835
675.00	0.863	0.890	0.918	0.945	1.024
700.00	1.104	1.183	1.262	1.505	1.986
725.00	2.228	2.308	2.387	2.466	2.546
750.00	2.625	2.653	2.680	2.708	2.735
775.00	2.763	2.790	2.801	2.812	2.823
800.00	2.833	2.844	2.855	2.867	2.879
825.00	2.891	2.903	2.915	2.927	2.939
850.00	2.951	2.963	2.974	2.986	2.998
875.00	3.010	3.022	3.034	3.046	3.058
900.00	3.070	3.077	3.083	3.090	3.097
925.00	3.103	3.110	3.117	3.123	3.130
950.00	3.137	3.143	3.150	3.157	3.163
975.00	3.170	3.177	3.183	3.190	3.197
1,000.00	3.203	3.210	3.217	3.223	3.230
1,025.00	3.237	3.243	3.250	3.257	3.263
1,050.00	3.270	3.277	3.283	3.290	3.297
1,075.00	3.303	3.310	3.314	3.317	3.321
1,100.00	3.324	3.328	3.332	3.335	3.339
1,125.00	3.343	3.346	3.350	3.353	3.357
1,150.00	3.361	3.364	3.368	3.371	3.375
1,175.00	3.379	3.382	3.386	3.389	3.393
1,200.00	3.397	3.400	3.404	3.408	3.411
1,225.00	3.415	3.418	3.422	3.426	3.429
1,250.00	3.433	3.436	3.440	3.444	3.447
1,275.00	3.451	3.454	3.458	3.462	3.465
1,300.00	3.469	3.473	3.476	3.480	3.483
1,325.00	3.487	3.491	3.494	3.498	3.501
1,350.00	3.505	3.509	3.512	3.516	3.519
1,375.00	3.523	3.527	3.530	3.534	3.538
1,400.00	3.541	3.545	3.548	3.552	3.556
1,425.00	3.559	3.563	3.566	3.570	(N/A)

10 yr-24 hr

Label	10 yr-24 hr	Increment	5.00 min
Return Event	10 years	End Time	1,440.00 min



**Storm Data Detailed
Report: WDF-17000**

10 yr-24 hr

Time (min)	Depth (in)					
1,075.00	4.770	4.780	4.790	4.795	4.800	4.800
1,100.00	4.805	4.811	4.816	4.821	4.826	4.826
1,125.00	4.831	4.836	4.841	4.847	4.852	4.852
1,150.00	4.857	4.862	4.867	4.872	4.877	4.877
1,175.00	4.883	4.888	4.893	4.898	4.903	4.903
1,200.00	4.908	4.913	4.918	4.924	4.929	4.929
1,225.00	4.934	4.939	4.944	4.949	4.954	4.954
1,250.00	4.960	4.965	4.970	4.975	4.980	4.980
1,275.00	4.985	4.990	4.996	5.001	5.006	5.006
1,300.00	5.011	5.016	5.021	5.026	5.032	5.032
1,325.00	5.037	5.042	5.047	5.052	5.057	5.057
1,350.00	5.062	5.068	5.073	5.078	5.083	5.083
1,375.00	5.088	5.093	5.098	5.103	5.109	5.109
1,400.00	5.114	5.119	5.124	5.129	5.134	5.134
1,425.00	5.139	5.145	5.150	5.155	(N/A)	(N/A)

25 yr-24 hr

Label	25 yr-24 hr	Increment	5.00 min
Return Event	25 years	End Time	1,440.00 min
Start Time	0.00 min	Storm Event Depth Type	Cumulative

25 yr-24 hr

Time (min)	Depth (in)					
0.00	0.000	0.006	0.012	0.018	0.023	0.023
25.00	0.029	0.035	0.041	0.047	0.053	0.053
50.00	0.058	0.064	0.070	0.076	0.082	0.082
75.00	0.088	0.093	0.099	0.105	0.111	0.111
100.00	0.117	0.123	0.128	0.134	0.140	0.140
125.00	0.146	0.152	0.158	0.163	0.169	0.169
150.00	0.175	0.181	0.187	0.193	0.198	0.198
175.00	0.204	0.210	0.216	0.222	0.228	0.228
200.00	0.233	0.239	0.245	0.251	0.257	0.257
225.00	0.263	0.268	0.274	0.280	0.286	0.286
250.00	0.292	0.298	0.303	0.309	0.315	0.315
275.00	0.321	0.327	0.333	0.338	0.344	0.344
300.00	0.350	0.356	0.362	0.368	0.373	0.373
325.00	0.379	0.385	0.391	0.397	0.403	0.403
350.00	0.408	0.414	0.420	0.433	0.445	0.445
375.00	0.458	0.471	0.483	0.496	0.508	0.508
400.00	0.521	0.534	0.546	0.559	0.572	0.572
425.00	0.584	0.597	0.610	0.622	0.635	0.635
450.00	0.648	0.660	0.673	0.685	0.698	0.698
475.00	0.711	0.723	0.736	0.749	0.761	0.761
500.00	0.774	0.787	0.799	0.812	0.824	0.824
525.00	0.837	0.850	0.862	0.875	0.896	0.896



**Storm Data Detailed
Report: WDF-17000**

25 yr-24 hr

Time (min)	Depth (in)				
550.00	0.917	0.938	0.959	0.981	1.002
575.00	1.023	1.044	1.065	1.086	1.107
600.00	1.128	1.149	1.171	1.192	1.213
625.00	1.234	1.255	1.278	1.302	1.325
650.00	1.348	1.372	1.395	1.448	1.500
675.00	1.553	1.605	1.658	1.710	1.857
700.00	2.003	2.150	2.297	2.641	3.312
725.00	3.657	3.803	3.950	4.097	4.243
750.00	4.390	4.443	4.495	4.548	4.600
775.00	4.653	4.705	4.728	4.752	4.775
800.00	4.798	4.822	4.845	4.866	4.887
825.00	4.908	4.929	4.951	4.972	4.993
850.00	5.014	5.035	5.056	5.077	5.098
875.00	5.119	5.141	5.162	5.183	5.204
900.00	5.225	5.238	5.250	5.263	5.276
925.00	5.288	5.301	5.313	5.326	5.339
950.00	5.351	5.364	5.377	5.389	5.402
975.00	5.415	5.427	5.440	5.453	5.465
1,000.00	5.478	5.490	5.503	5.516	5.528
1,025.00	5.541	5.554	5.566	5.579	5.592
1,050.00	5.604	5.617	5.629	5.642	5.655
1,075.00	5.667	5.680	5.686	5.692	5.698
1,100.00	5.703	5.709	5.715	5.721	5.727
1,125.00	5.733	5.738	5.744	5.750	5.756
1,150.00	5.762	5.768	5.773	5.779	5.785
1,175.00	5.791	5.797	5.803	5.808	5.814
1,200.00	5.820	5.826	5.832	5.838	5.843
1,225.00	5.849	5.855	5.861	5.867	5.873
1,250.00	5.878	5.884	5.890	5.896	5.902
1,275.00	5.908	5.913	5.919	5.925	5.931
1,300.00	5.937	5.943	5.948	5.954	5.960
1,325.00	5.966	5.972	5.978	5.983	5.989
1,350.00	5.995	6.001	6.007	6.013	6.018
1,375.00	6.024	6.030	6.036	6.042	6.048
1,400.00	6.053	6.059	6.065	6.071	6.077
1,425.00	6.083	6.088	6.094	6.100	(N/A)

100 yr-24 hr

Label	100 yr-24 hr	Increment	5.00 min
Return Event	100 years	End Time	1,440.00 min
Start Time	0.00 min	Storm Event Depth Type	Cumulative

100 yr-24 hr

Time (min)	Depth (in)				
0.00	0.000	0.006	0.012	0.019	0.025



Storm Data Detailed Report: WDF-17000

100 yr-24 hr

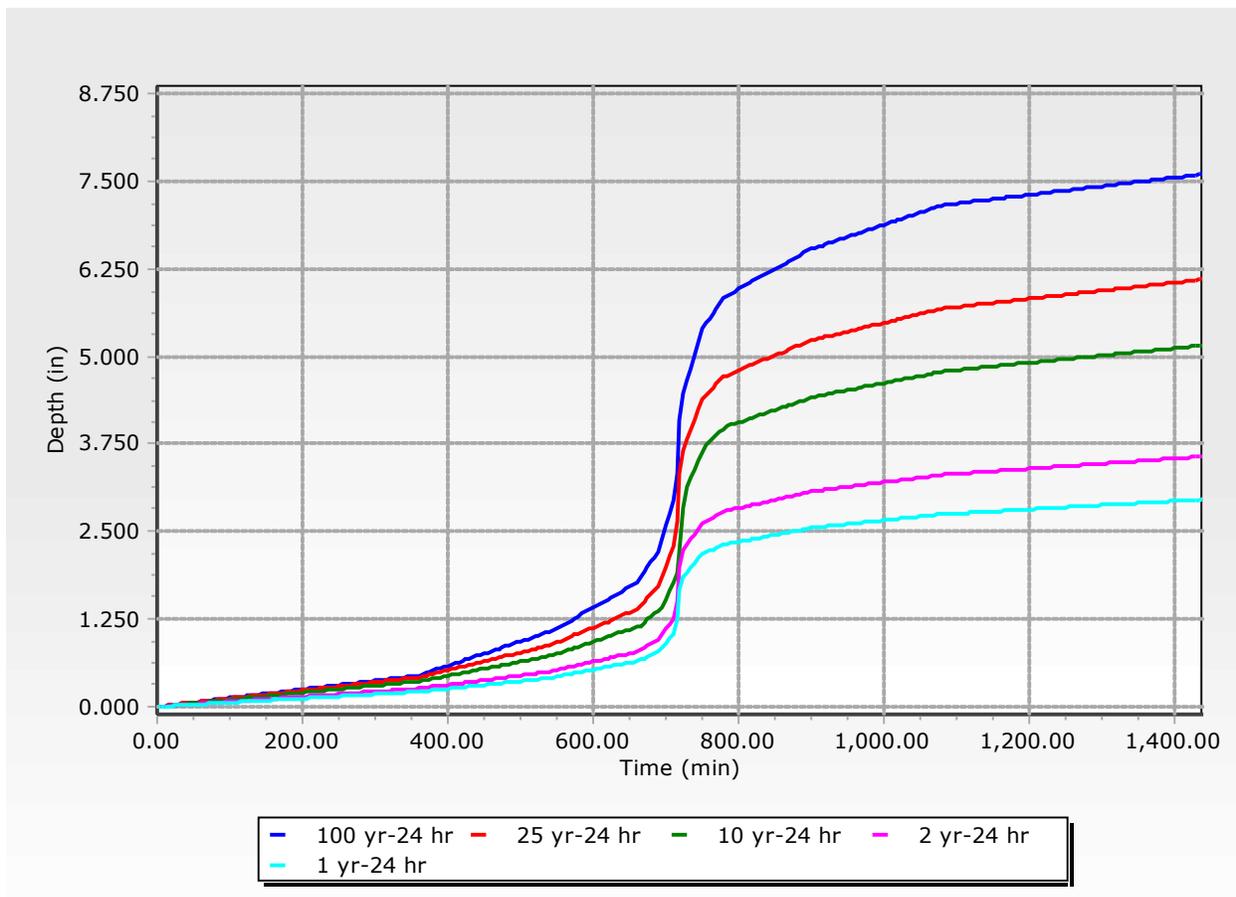
Time (min)	Depth (in)				
25.00	0.031	0.037	0.043	0.049	0.056
50.00	0.062	0.068	0.074	0.080	0.087
75.00	0.093	0.099	0.105	0.111	0.117
100.00	0.124	0.130	0.136	0.142	0.148
125.00	0.155	0.161	0.167	0.173	0.179
150.00	0.185	0.192	0.198	0.204	0.210
175.00	0.216	0.222	0.229	0.235	0.241
200.00	0.247	0.253	0.260	0.266	0.272
225.00	0.278	0.284	0.290	0.297	0.303
250.00	0.309	0.315	0.321	0.328	0.334
275.00	0.340	0.346	0.352	0.358	0.365
300.00	0.371	0.377	0.383	0.389	0.396
325.00	0.402	0.408	0.414	0.420	0.426
350.00	0.433	0.439	0.445	0.462	0.480
375.00	0.497	0.514	0.532	0.549	0.567
400.00	0.584	0.601	0.619	0.636	0.653
425.00	0.671	0.688	0.705	0.723	0.740
450.00	0.757	0.775	0.792	0.810	0.827
475.00	0.844	0.862	0.879	0.896	0.914
500.00	0.931	0.948	0.966	0.983	1.001
525.00	1.018	1.035	1.053	1.070	1.098
550.00	1.126	1.154	1.182	1.210	1.238
575.00	1.266	1.294	1.323	1.351	1.379
600.00	1.407	1.435	1.463	1.491	1.519
625.00	1.547	1.575	1.609	1.643	1.678
650.00	1.712	1.746	1.780	1.851	1.922
675.00	1.993	2.063	2.134	2.205	2.392
700.00	2.578	2.765	2.952	3.330	4.083
725.00	4.462	4.648	4.835	5.022	5.208
750.00	5.395	5.466	5.537	5.608	5.678
775.00	5.749	5.820	5.854	5.888	5.922
800.00	5.957	5.991	6.025	6.053	6.081
825.00	6.109	6.137	6.165	6.193	6.221
850.00	6.249	6.277	6.306	6.334	6.362
875.00	6.390	6.418	6.446	6.474	6.502
900.00	6.530	6.547	6.565	6.582	6.599
925.00	6.617	6.634	6.652	6.669	6.686
950.00	6.704	6.721	6.738	6.756	6.773
975.00	6.790	6.808	6.825	6.842	6.860
1,000.00	6.877	6.895	6.912	6.929	6.947
1,025.00	6.964	6.981	6.999	7.016	7.033
1,050.00	7.051	7.068	7.086	7.103	7.120
1,075.00	7.138	7.155	7.161	7.167	7.174
1,100.00	7.180	7.186	7.192	7.198	7.204
1,125.00	7.211	7.217	7.223	7.229	7.235
1,150.00	7.242	7.248	7.254	7.260	7.266
1,175.00	7.272	7.279	7.285	7.291	7.297



Storm Data Detailed Report: WDF-17000

100 yr-24 hr

Time (min)	Depth (in)				
1,200.00	7.303	7.310	7.316	7.322	7.328
1,225.00	7.334	7.340	7.347	7.353	7.359
1,250.00	7.365	7.371	7.377	7.384	7.390
1,275.00	7.396	7.402	7.408	7.415	7.421
1,300.00	7.427	7.433	7.439	7.445	7.452
1,325.00	7.458	7.464	7.470	7.476	7.483
1,350.00	7.489	7.495	7.501	7.507	7.513
1,375.00	7.520	7.526	7.532	7.538	7.544
1,400.00	7.551	7.557	7.563	7.569	7.575
1,425.00	7.581	7.588	7.594	7.600	(N/A)



*PRE-DEVELOPMENT
HYDROLOGIC CALCULATIONS*

PRE-DEVELOPMENT HYDROLOGY
Summary of Results

HYDROLOGY INPUT SUMMARY

Sub-basin ID	Onsite Area [acres]					Offsite Area [acres]					Total Area [acres]	SCS CN	Tc [min]
	Impervious	Open	Wooded	Pond	Total	Impervious	Open	Wooded	Pond	Total			
1	6.51	6.06	1.00	0.00	13.57	0.29	0.50	0.81	0.00	1.60	15.17	88	12.96
2	0.00	0.09	0.00	0.00	0.09	0.11	0.10	0.00	0.00	0.21	0.30	87	5.00
Totals =	6.51	6.15	1.00	0.00	13.66	0.40	0.60	0.81	0.00	1.81	15.47		

NUTRIENT INPUT SUMMARY

***Jordan/Falls Lake Stormwater Nitrogen and Phosphorus Tool

Land Use	Area (sf)	Area (ac)
Roof Area	80,221	1.84
Roadway Area	0	0.00
Parking/Driveway/Sidewalk	203,320	4.67
Wooded	43,635	1.00
Open	268,021	6.15
Pond	0	0.00
Total	595,197	13.66

2-YEAR / 24-HOUR VOLUME SUMMARY

Total On-Site Area = 13.66 acres
 Area Weighted On-site SCS CN = 88

 S = 1.37
 P (2-yr / 24-hour) = 3.57 inches
 Q* = 2.33 inches

Total On-site Run-off Volume =	2.65	acre-feet
=	115,489	cf

I. SCS CURVE NUMBERS

HSG	Impervious	Open	Wooded
A	98	39	30
B	98	61	55
C	98	74	70
D	98	80	77

Assume: HSG 'A' = 0.0%
HSG 'B' = 0.0%
HSG 'C' = 0.0%
HSG 'D' = 100.0%

Cover Condition	SCS CN	Comments
Impervious	98	-
Open	80	Assume good condition
Wooded	77	Assume good condition

II. PRE-DEVELOPMENT

A. Onsite Impervious Breakdown

Contributing Area	Area [sf]	Area [ac]
Roadway Area	0	0.00
Driveway / Parking Lot	155,275	3.56
Roof	80,221	1.84
Sidewalk / Patio	47,873	1.10
Other	0	0.00
<i>Totals</i>	283,369	6.51

B. Watershed Land Use Breakdown

Contributing Area	SCS CN	Area [sf]	Area [acres]	Comments
Onsite impervious	98	283,369	6.51	-
Onsite open	80	264,167	6.06	Assume good condition
Onsite wooded	77	43,635	1.00	Assume good condition
Onsite pond	100	0	0.00	-
Offsite impervious	98	12,548	0.29	-
Offsite open	80	21,946	0.50	Assume good condition
Offsite wooded	77	35,272	0.81	Assume good condition
Offsite pond	100	0	0.00	-

Total area = 15.17 acres
660,937 sf
Composite SCS CN = 88
% Impervious = 44.8%

C. Time of Concentration Information

Time of concentration is calculated using the SCS Segmental Approach (TR-55).

Segment 1: Overland Flow

Length =	100	ft
Top Elev =	293.00	ft
Bot Elev =	286.00	ft
Height =	7	ft
Slope =	0.0700	ft/ft
Manning's n =	0.24	dense grass
P (2-year/24-hour) =	3.57	inches (Chapel Hill, NC)
Segment Time =	8.19	minutes

Segment 2: Concentrated Flow

Length =	94	ft
Top Elev =	286.00	ft
Bot Elev =	282.91	ft
Height =	3	ft
Slope =	0.0329	ft/ft
Paved ? =	No	
Velocity =	2.93	ft/sec
Segment Time =	0.54	minutes

Segment 3: Pipe Flow

Length =	304	ft
Top Elev =	282.91	ft
Bot Elev =	273.99	ft
Height =	8.92	ft
Slope =	0.0293	ft/ft
Manning's n =	0.013	concrete pipe
Pipe Diameter=	12.00	in
Flow Area =	0.79	sf
Wetted Perimeter =	3.14	lf (1 ft ID pipe)
Channel Velocity =	7.79	ft/sec
Segment Time =	0.65	minutes

Segment 4: Channel Flow

Length =	126	ft
Top Elev =	273.99	ft
Bot Elev =	267.21	ft
Height =	6.78	ft
Slope =	0.0538	ft/ft
Manning's n =	0.045	natural channel
Flow Area =	2.00	sf (assume 2'W x 1'H)
Wetted Perimeter =	4.00	lf (assume 2'W x 1'H)
Channel Velocity =	4.84	ft/sec
Segment Time =	0.43	minutes

Segment 5: Pipe Flow

Length =	574	ft
Top Elev =	267.21	ft
Bot Elev =	254.90	ft
Height =	12.31	ft
Slope =	0.0214	ft/ft
Manning's n =	0.013	concrete pipe
Pipe Diameter=	12.00	in
Flow Area =	0.79	sf
Wetted Perimeter =	3.14	lf (1 ft ID pipe)
Channel Velocity =	6.66	ft/sec
Segment Time =	1.44	minutes

Segment 6: Channel Flow

Length =	490	ft
Top Elev =	254.90	ft
Bot Elev =	250.00	ft
Height =	4.9	ft
Slope =	0.0100	ft/ft
Manning's n =	0.045	natural channel
Flow Area =	24.00	sf (assume 6'W x 4'H)
Wetted Perimeter =	14.00	lf (assume 6'W x 4'H)
Channel Velocity =	4.74	ft/sec
Segment Time =	1.72	minutes

Time of Concentration =	12.96	minutes
SCS Lag Time =	7.78	minutes (SCS Lag = 0.6* Tc)
Time Increment =	2.26	minutes (= 0.29*SCS Lag)

D. 2-Year Runoff Volume Calculation

Pre-development runoff volume calculations are based upon the SCS Method. The equation for this method is as follows:

$$Q^* = ((P-0.2*S)^2) / (P+0.8*S)$$

where,

- Q* = Direct Runoff [inches]
- S = Potential Abstraction => (1000 / SCS Curve Number) - 10
- P = Accumulated Storm Rainfall [inches]

Per Town of Chapel Hill ordinance requirements, the increase in volume between pre- and post-development for the 2-year 24-hour storm shall be treated within the proposed stormwater management facility.

On-Site Area =	13.57
On-site SCS CN =	88
S =	1.36
P (2-yr / 24-hour) =	3.57
Q* =	2.33

On-site Run-off Volume =	2.64	acre-feet
=	114,913	cf

I. SCS CURVE NUMBERS

HSG	Impervious	Open	Wooded
A	98	39	30
B	98	61	55
C	98	74	70
D	98	80	77

Assume: HSG 'A' = 0.0%
HSG 'B' = 0.0%
HSG 'C' = 0.0%
HSG 'D' = 100.0%

Cover Condition	SCS CN	Comments
Impervious	98	-
Open	80	Assume good condition
Wooded	77	Assume good condition

II. PRE-DEVELOPMENT

A. Onsite Impervious Breakdown

Contributing Area	Area [sf]	Area [ac]
Roadway Area	0	0.00
Driveway / Parking Lot	0	0.00
Roof	0	0.00
Sidewalk / Patio	172	0.00
Other	0	0.00
Totals	172	0.00

B. Watershed Land Use Breakdown

Contributing Area	SCS CN	Area [sf]	Area [acres]	Comments
Onsite impervious	98	172	0.00	-
Onsite open	80	3,854	0.09	Assume good condition
Onsite wooded	77	0	0.00	Assume good condition
Onsite pond	100	0	0.00	-
Offsite impervious	98	4,873	0.11	-
Offsite open	80	4,170	0.10	Assume good condition
Offsite wooded	77	0	0.00	Assume good condition
Offsite pond	100	0	0.00	-

Total area = 0.30 acres
13,069 sf

Composite SCS CN = 87

% Impervious = 38.6%

C. Time of Concentration Information

Time of concentration is calculated using the SCS Segmental Approach (TR-55).

Time of Concentration =	5.00	minutes
SCS Lag Time =	3.00	minutes (SCS Lag = 0.6* Tc)
Time Increment =	0.87	minutes (= 0.29*SCS Lag)

D. 2-Year Runoff Volume Calculation

Pre-development runoff volume calculations are based upon the SCS Method. The equation for this method is as follows:

$$Q^* = ((P-0.2*S)^2) / (P+0.8*S)$$

where,

Q* = Direct Runoff [inches]
S = Potential Abstraction => (1000 / SCS Curve Number) - 10
P = Accumulated Storm Rainfall [inches]

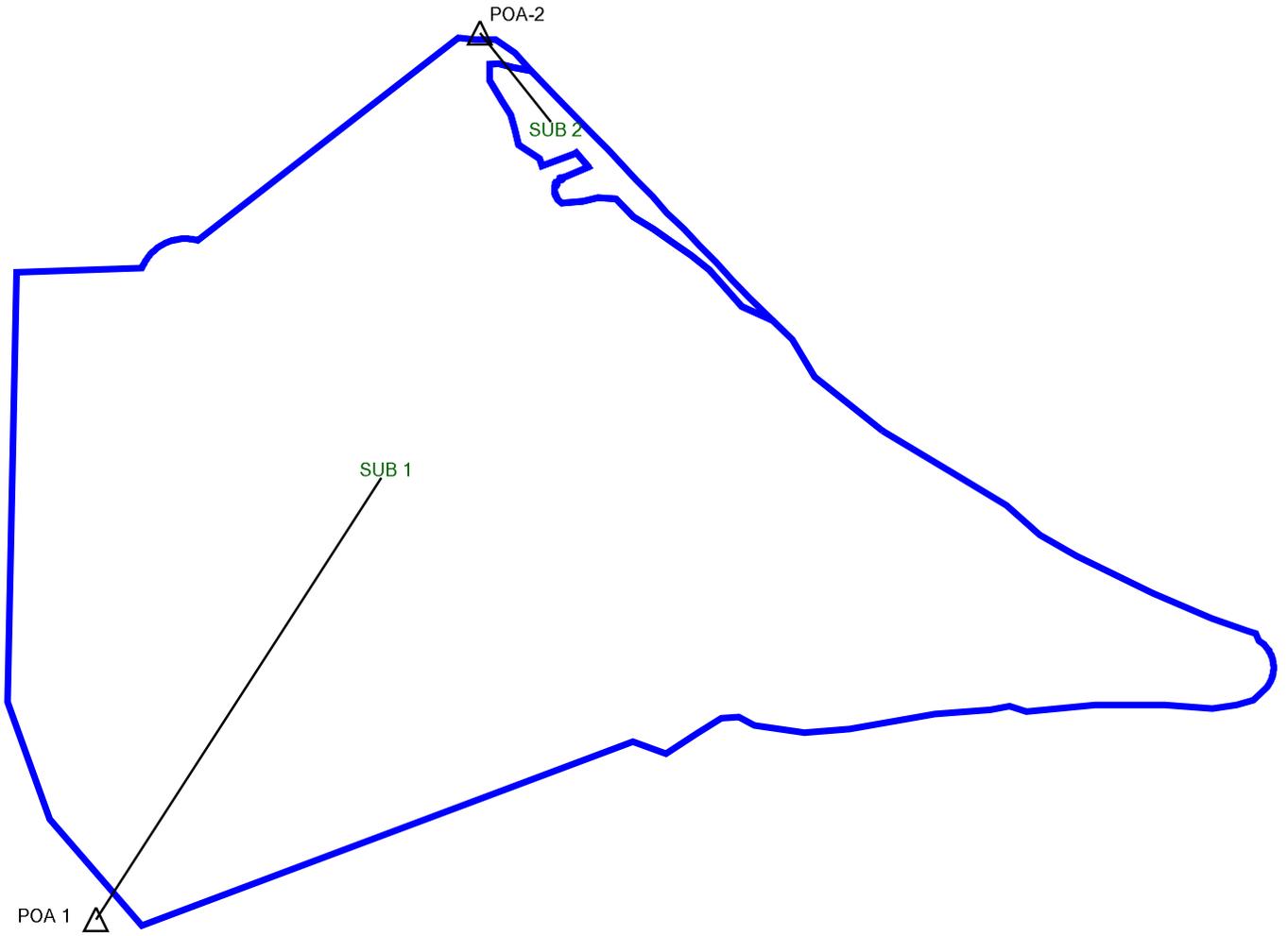
Per Town of Chapel Hill ordinance requirements, the increase in volume between pre- and post-development for the 2-year 24-hour storm shall be treated within the proposed stormwater management facility.

On-Site Area = 0.09
On-site SCS CN = 81

S = 2.35
P (2-yr / 24-hour) = 3.57
Q* = 1.77

On-site Run-off Volume =	0.01	acre-feet
=	592	cf

Scenario: Pre-Development



**FlexTable: Catchment
Table (WDF-17000.ppc)**

Current Time: 0.00 min

Label	Outflow Node	Area (ft ²)	SCS CN	Time of Concentration (min)	Notes
SUB 1	POA 1	660,937	88.0	12.96	PRE
SUB 2	POA-2	13,069	87.0	5.00	PRE

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ft ³)	Time to Peak (min)	Peak Flow (ft ³ /s)
SUB 1	Pre-Dev 1yr-24hr	1	97,886	726.00	34.20
SUB 1	Pre-Dev 2 yr-24 hr	2	128,100	726.00	43.80
SUB 1	Pre-Dev 25 yr-24 hr	25	259,453	726.00	72.32
SUB 2	Pre-Dev 1yr-24hr	1	1,854	721.00	0.90
SUB 2	Pre-Dev 2 yr-24 hr	2	2,442	721.00	1.16
SUB 2	Pre-Dev 25 yr-24 hr	25	5,019	721.00	1.91

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ft ³)	Time to Peak (min)	Peak Flow (ft ³ /s)
POA 1	Pre-Dev 1yr-24hr	1	97,886	726.00	34.20
POA 1	Pre-Dev 2 yr-24 hr	2	128,100	726.00	43.80
POA 1	Pre-Dev 25 yr-24 hr	25	259,453	726.00	72.32
POA-2	Pre-Dev 1yr-24hr	1	1,854	721.00	0.90
POA-2	Pre-Dev 2 yr-24 hr	2	2,442	721.00	1.16
POA-2	Pre-Dev 25 yr-24 hr	25	5,019	721.00	1.91



McADAMS

The John R. McAdams Company, Inc.
2905 Meridian Parkway
Durham, NC 27713

phone 919. 361. 5000
fax 919. 361. 2269
license number: C-0293

www.mcadamsco.com

CLIENT

WOODFIELD INVESTMENTS
11425 HORSEMAN'S TRAIL
RALEIGH, NC 27613
PHONE: 919. 535. 8947

PARK APARTMENTS
FORM DISTRICT PERMIT
1250 EPHESUS CHURCH ROAD
CHAPEL HILL, NORTH CAROLINA, 27517

REVISIONS

NO.	DATE	DESCRIPTION
1	05.03.2019	PER CHAPEL HILL AND OWASA COMMENTS

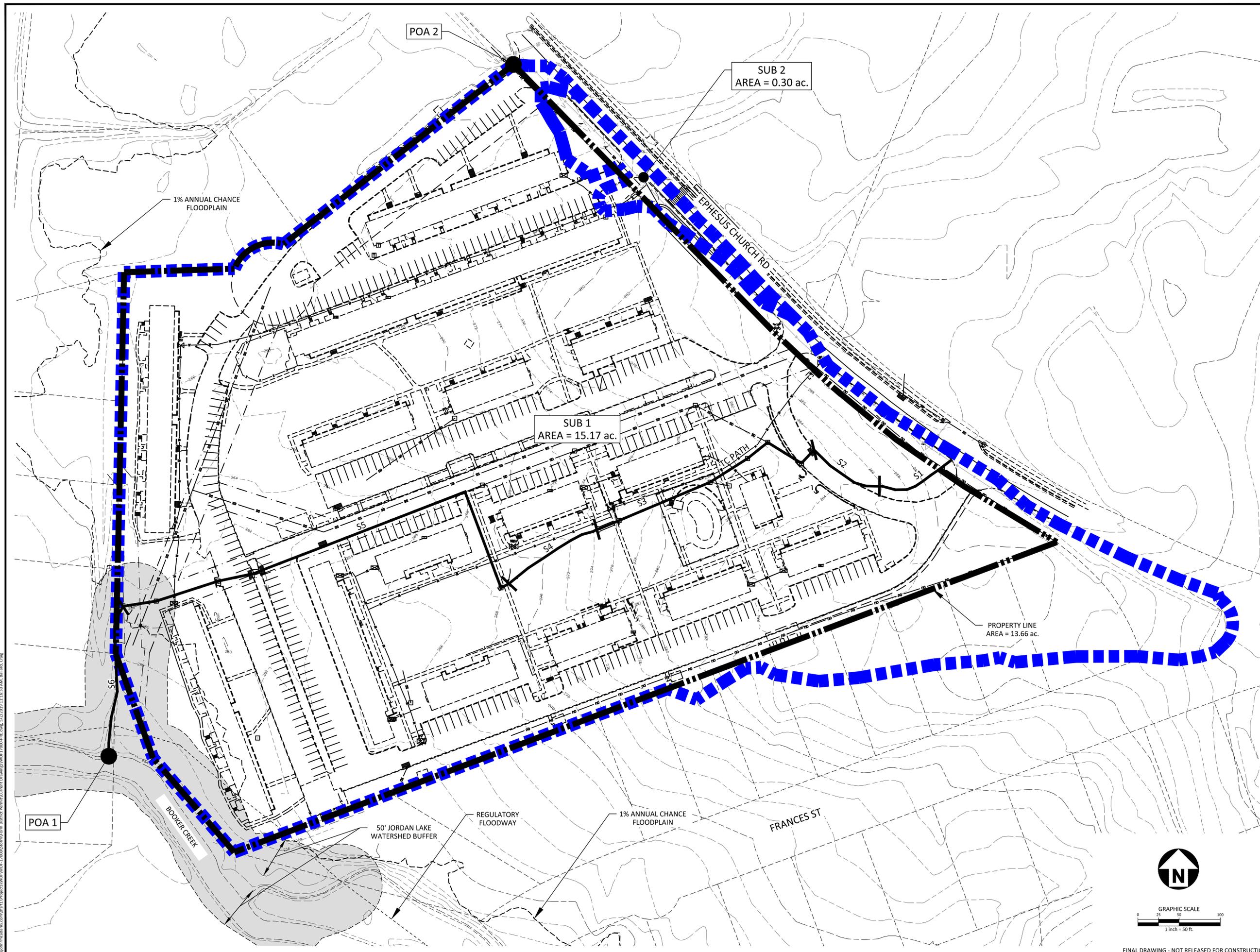
PLAN INFORMATION

PROJECT NO.	WDF-17000
FILENAME	WDF17000-PRE
CHECKED BY	KEG
DRAWN BY	SCB
SCALE	1" = 50'
DATE	02.28.2019

SHEET

PRE DEVELOPMENT
HYDROLOGY MAP

PRE



FINAL DRAWING - NOT RELEASED FOR CONSTRUCTION

\\john.mcadams.com\df1r1\Projects\WDF\17000\3dform\form\District Permits\Current Drawings\WDF17000-PRE.dwg, 5/2/2019 11:16:50 AM, ballard, Cole

*POST-DEVELOPMENT
HYDROLOGIC CALCULATIONS*

POST-DEVELOPMENT HYDROLOGY
Summary of Results

HYDROLOGY INPUT SUMMARY

Sub-basin ID	Onsite Area [acres]					Offsite Area [acres]					Total Area [acres]	SCS CN	Tc [min]
	Impervious	Open	Wooded	Pond	Total	Impervious	Open	Wooded	Pond	Total			
1A - Bypass	3.31	0.89	0.09	0.00	4.28	0.30	0.06	0.00	0.00	0.36	4.64	94	5.00
1B - Bypass	0.00	2.19	0.00	0.00	2.19	0.00	0.00	0.00	0.00	0.00	2.19	80	13.34
1 - to SCM A	1.06	0.56	0.00	0.00	1.62	0.00	0.00	0.00	0.00	0.00	1.62	92	5.00
1 - to SCM B	4.51	1.05	0.00	0.00	5.57	0.38	0.29	0.78	0.00	1.45	7.02	92	5.00
Totals =	8.88	4.69	0.09	0.00	13.66	0.68	0.35	0.78	0.00	1.81	15.47		

ONSITE IMPERVIOUS SUMMARY

Contributing Area	Area [sf]	Area [ac]
Roof	131,573	3.02
Road	80,801	1.85
Parking/Driveway/Sidewalk	174,596	4.01
Wooded	3,791	0.09
Open	204,437	4.69
Pond	0	0.00
Totals	595,198	13.66

2-YEAR / 24-HOUR VOLUME SUMMARY

Total On-Site Area = 13.66 acres
 Area Weighted On-site SCS CN = 92

 S = 0.91
 P (2-yr / 24-hour) = 3.57 inches
 Q* = 2.67 inches

Total On-site Run-off Volume =	3.04	acre-feet
=	132,583	cf

I. SCS CURVE NUMBERS

HSG	Impervious	Open	Wooded
A	98	39	30
B	98	61	55
C	98	74	70
D	98	80	77

Assume:
 HSG 'A' = 0.0%
 HSG 'B' = 0.0%
 HSG 'C' = 0.0%
 HSG 'D' = 100.0%

Cover Condition	SCS CN	Comments
Impervious	98	-
Open	80	Assume good condition
Wooded	77	Assume good condition

II. POST-DEVELOPMENT

A. Onsite Impervious Breakdown

Contributing Area	Area [sf]	Area [acres]
Roof	34,990	0.80
Road	52,253	1.20
Parking/Driveway/Sidewalk	56,799	1.30
Totals	144,042	3.31

B. Watershed Breakdown

Contributing Area	SCS CN	Area [sf]	Area [acres]	Comments
Onsite impervious	98	144,042	3.31	-
Onsite open	80	38,691	0.89	Assume good condition
Onsite wooded	77	3,791	0.09	Assume good condition
Onsite pond	100	0	0.00	-
Offsite impervious	98	13,052	0.30	-
Offsite open	80	2,439	0.06	Assume good condition
Offsite wooded	77	0	0.00	Assume good condition
Offsite pond	100	0	0.00	-

Total area = 4.64 acres
 202,015 sq.ft.
Composite SCS CN = 94
% Impervious = 77.8%

C. Time of Concentration Information

Time of concentration is calculated using the SCS Segmental Approach (TR-55).

Time of Concentration =	5.00	minutes
SCS Lag Time =	3.00	minutes (SCS Lag = 0.6 * Tc)
Time Increment =	0.87	minutes (= 0.29 * SCS Lag)

D. Runoff Volume Calculations

Pre-development runoff volume calculations are based upon the SCS Method. The equation for this method is as follows:

$$Q^* = ((P - 0.2 * S)^2) / (P + 0.8 * S)$$

where,

Q^* = Direct Runoff [inches]

S = Potential Abstraction => (1000 / SCS Curve Number) - 10

P = Accumulated Storm Rainfall [inches]

On-Site Area = 4.28 acres
 On-site SCS CN = 94

 S = 0.66
 P (2-yr / 24-hour) = 3.57 inches (Chapel Hill, NC)
 Q^* = 2.89 inches

Onsite Run-off Volume =	1.03	acre-feet
=	44881	cf

POST-DEVELOPMENT HYDROLOGY

Subbasin 1B - Bypass

I. SCS CURVE NUMBERS

HSG	Impervious	Open	Wooded
A	98	39	30
B	98	61	55
C	98	74	70
D	98	80	77

Assume:
 HSG 'A' = 0.0%
 HSG 'B' = 0.0%
 HSG 'C' = 0.0%
 HSG 'D' = 100.0%

Cover Condition	SCS CN	Comments
Impervious	98	-
Open	80	Assume good condition
Wooded	77	Assume good condition

II. POST-DEVELOPMENT

A. Onsite Impervious Breakdown

Contributing Area	Area [sf]	Area [acres]
Roof	0	0.00
Road	0	0.00
Parking/Driveway/Sidewalk	0	0.00
Totals	0	0.00

B. Watershed Breakdown

Contributing Area	SCS CN	Area [sf]	Area [acres]	Comments
Onsite impervious	98	0	0.00	-
Onsite open	80	95,600	2.19	Assume good condition
Onsite wooded	77	0	0.00	Assume good condition
Onsite pond	100	0	0.00	-
Offsite impervious	98	0	0.00	-
Offsite open	80	0	0.00	Assume good condition
Offsite wooded	77	0	0.00	Assume good condition
Offsite pond	100	0	0.00	-

Total area = 2.19 acres
 95,600 sq.ft.
Composite SCS CN = 80
% Impervious = 0.0%

C. Time of Concentration Information

Time of concentration is calculated using the SCS Segmental Approach (TR-55).

Segment 1: Overland Flow

Length =	100	ft
Top Elev =	268.00	ft
Bot Elev =	266.00	ft
Height =	2	ft
Slope =	0.0200	ft/ft
Manning's n =	0.15	short grass
P (2-year/24-hour) =	3.57	inches (Chapel Hill, NC)
Segment Time =	9.28	minutes

Segment 2: Concentrated Flow

Length =	367	ft
Top Elev =	266.00	ft
Bot Elev =	262.00	ft
Height =	4	ft
Slope =	0.0109	ft/ft
Paved ? =	No	
Velocity =	1.68	ft/sec
Segment Time =	3.63	minutes

Segment 3: Pipe Flow

Length =	178	ft
Top Elev =	258.00	ft
Bot Elev =	252.00	ft
Height =	6	ft
Slope =	0.0337	ft/ft
Manning's n =	0.013	concrete pipe
Pipe Diameter =	18.00	in
Flow Area =	1.77	sf
Wetted Perimeter =	4.71	lf (1 ft ID pipe)
Channel Velocity =	10.94	ft/sec
Segment Time =	0.27	minutes

Segment 4: Channel Flow

Length =	47	ft
Top Elev =	252.00	ft
Bot Elev =	250.00	ft
Height =	2	ft
Slope =	0.0426	ft/ft
Manning's n =	0.045	natural channel
Flow Area =	3.00	sf (assume 3'W x 1'H)
Wetted Perimeter =	5.00	lf (assume 3'W x 1'H)
Channel Velocity =	4.86	ft/sec
Segment Time =	0.16	minutes

Time of Concentration =	13.34	minutes
SCS Lag Time =	8.00	minutes (SCS Lag = 0.6* Tc)
Time Increment =	2.32	minutes (= 0.29*SCS Lag)

D. Runoff Volume Calculations

Pre-development runoff volume calculations are based upon the SCS Method. The equation for this method is as follows:

$$Q^* = ((P-0.2*S)^2) / (P+0.8*S)$$

where,

Q* = Direct Runoff [inches]

S = Potential Abstraction => (1000 / SCS Curve Number) - 10

P = Accumulated Storm Rainfall [inches]

On-Site Area =	2.19	acres
On-site SCS CN =	80	
S =	2.50	
P (2-yr / 24-hour) =	3.57	inches (Chapel Hill, NC)
Q* =	1.69	inches

Onsite Run-off Volume =	0.31	acre-feet
=	13480	cf

I. SCS CURVE NUMBERS

HSG	Impervious	Open	Wooded
A	98	39	30
B	98	61	55
C	98	74	70
D	98	80	77

Assume:
 HSG 'A' = 0.0%
 HSG 'B' = 0.0%
 HSG 'C' = 0.0%
 HSG 'D' = 100.0%

Cover Condition	SCS CN	Comments
Impervious	98	-
Open	80	Assume good condition
Wooded	77	Assume good condition

II. POST-DEVELOPMENT

A. Onsite Impervious Breakdown

Contributing Area	Area [sf]	Area [acres]
Roof	18,179	0.42
Road	0	0.00
Parking/Driveway/Sidewalk	28,121	0.65
<i>Totals</i>	46,300	1.06

B. Watershed Breakdown

Contributing Area	SCS CN	Area [sf]	Area [acres]	Comments
Onsite impervious	98	46,300	1.06	-
Onsite open	80	24,320	0.56	Assume good condition
Onsite wooded	77	0	0.00	Assume good condition
Onsite pond	100	0	0.00	-
Offsite impervious	98	0	0.00	-
Offsite open	80	0	0.00	Assume good condition
Offsite wooded	77	0	0.00	Assume good condition
Offsite pond	100	0	0.00	-

Total area = 1.62 acres
 70,620 sq.ft.
Composite SCS CN = 92
% Impervious = 65.6%

C. Time of Concentration Information

Time of concentration is assumed to be 5 minutes.

Time of Concentration =	5.00	minutes
SCS Lag Time =	3.00	minutes (SCS Lag = 0.6* Tc)
Time Increment =	0.87	minutes (= 0.29*SCS Lag)

D. Runoff Volume Calculations

Pre-development runoff volume calculations are based upon the SCS Method. The equation for this method is as follows:

$$Q^* = ((P-0.2*S)^2) / (P+0.8*S)$$

where,

Q* = Direct Runoff [inches]

S = Potential Abstraction => (1000 / SCS Curve Number) - 10

P = Accumulated Storm Rainfall [inches]

On-Site Area = 1.62 acres
 On-site SCS CN = 92

 S = 0.89
 P (2-yr / 24-hour) = 3.57 inches (Chapel Hill, NC)
 Q* = 2.68 inches

Onsite Run-off Volume =	0.36	acre-feet
=	15798	cf

I. SCS CURVE NUMBERS

HSG	Impervious	Open	Wooded
A	98	39	30
B	98	61	55
C	98	74	70
D	98	80	77

Assume:
 HSG 'A' = 0.0%
 HSG 'B' = 0.0%
 HSG 'C' = 0.0%
 HSG 'D' = 100.0%

Cover Condition	SCS CN	Comments
Impervious	98	-
Open	80	Assume good condition
Wooded	77	Assume good condition

II. POST-DEVELOPMENT

A. Onsite Impervious Breakdown

Contributing Area	Area [sf]	Area [acres]
Roof	78,404	1.80
Road	28,548	0.66
Parking/Driveway/Sidewalk	89,676	2.06
<i>Totals</i>	196,628	4.51

B. Watershed Breakdown

Contributing Area	SCS CN	Area [sf]	Area [acres]	Comments
Onsite impervious	98	196,628	4.51	-
Onsite open	80	45,826	1.05	Assume good condition
Onsite wooded	77	0	0.00	Assume good condition
Onsite pond	100	0	0.00	-
Offsite impervious	98	16,604	0.38	-
Offsite open	80	12,610	0.29	Assume good condition
Offsite wooded	77	34,106	0.78	Assume good condition
Offsite pond	100	0	0.00	-

Total area = 7.02 acres
 305,774 sq.ft.
Composite SCS CN = 92
% Impervious = 69.7%

C. Time of Concentration Information

Time of concentration is assumed to be 5 minutes.

Time of Concentration =	5.00	minutes
SCS Lag Time =	3.00	minutes (SCS Lag = 0.6* Tc)
Time Increment =	0.87	minutes (= 0.29*SCS Lag)

D. Runoff Volume Calculations

Pre-development runoff volume calculations are based upon the SCS Method. The equation for this method is as follows:

$$Q^* = ((P-0.2*S)^2) / (P+0.8*S)$$

where,

Q* = Direct Runoff [inches]

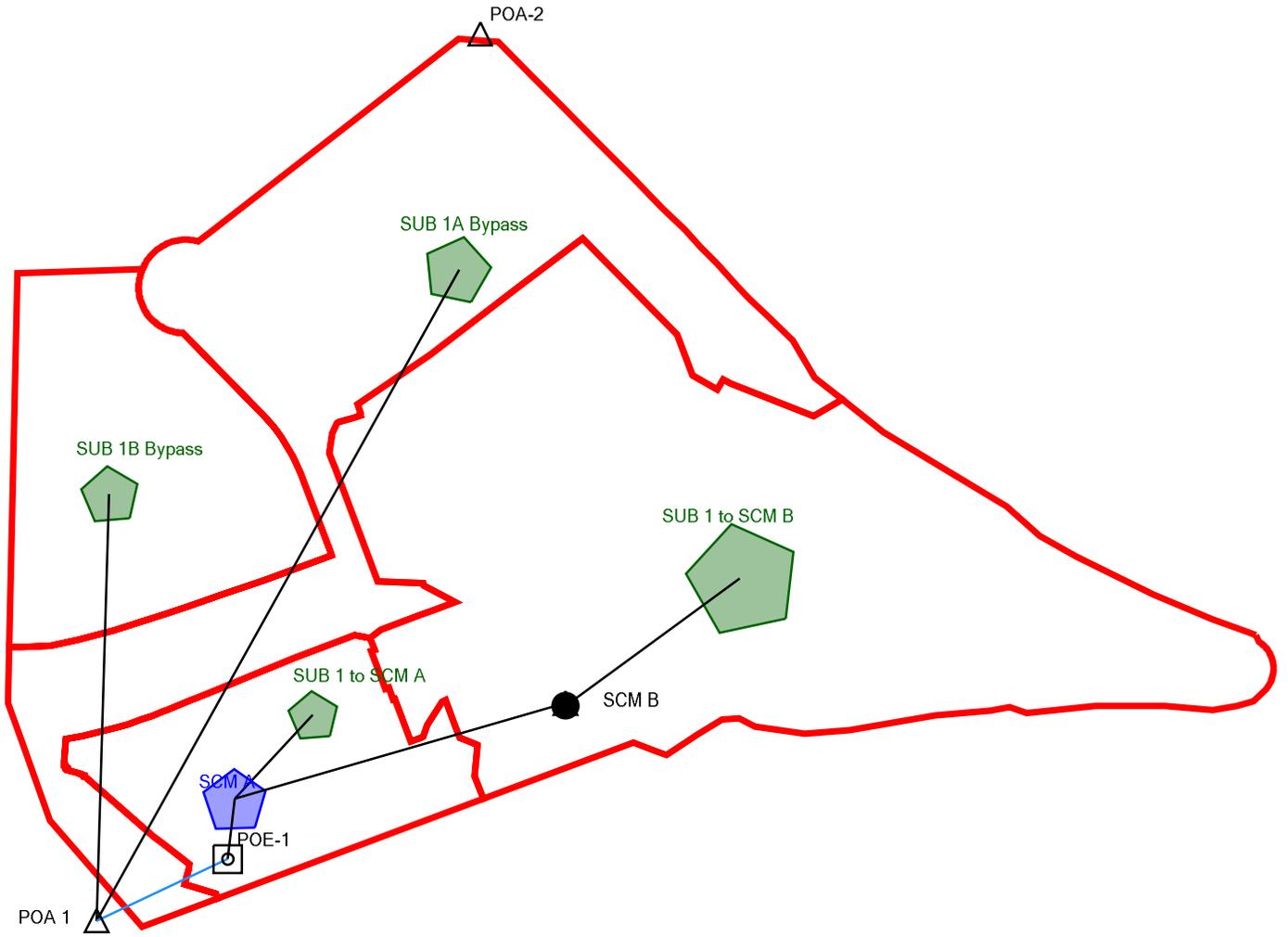
S = Potential Abstraction => (1000 / SCS Curve Number) - 10

P = Accumulated Storm Rainfall [inches]

On-Site Area = 5.57 acres
 On-site SCS CN = 95
 S = 0.57
 P (2-yr / 24-hour) = 3.57 inches (Chapel Hill, NC)
 Q* = 2.97 inches

Onsite Run-off Volume =	1.38	acre-feet
=	59921	cf

Scenario: Post-Development



**FlexTable: Catchment
Table (WDF-17000.ppc)**

Current Time: 0.00 min

Label	Outflow Node	Area (User Defined) (ft ²)	SCS CN	Time of Concentration (min)	Notes
SUB 1B Bypass	POA 1	95,600	80.0	13.34	POST
SUB 1 to SCM A	SCM A	70,620	92.0	5.00	POST
SUB 1A Bypass	POA 1	201,511	94.0	5.00	POST
SUB 1 to SCM B	SCM B	305,774	92.0	5.00	POST

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ft ³)	Time to Peak (min)	Peak Flow (ft ³ /s)
SUB 1B Bypass	Post-Dev 1yr-24hr	1	9,682	727.00	3.26
SUB 1B Bypass	Post-Dev 2 yr-24 hr	2	13,432	727.00	4.51
SUB 1B Bypass	Post-Dev 25 yr-24 hr	25	30,755	727.00	8.67
SUB 1 to SCM A	Post-Dev 1yr-24hr	1	12,483	721.00	6.00
SUB 1 to SCM A	Post-Dev 2 yr-24 hr	2	15,895	721.00	7.39
SUB 1 to SCM A	Post-Dev 25 yr-24 hr	25	30,385	721.00	11.20
SUB 1A Bypass	Post-Dev 1yr-24hr	1	38,777	721.00	18.34
SUB 1A Bypass	Post-Dev 2 yr-24 hr	2	48,714	721.00	22.25
SUB 1A Bypass	Post-Dev 25 yr-24 hr	25	90,529	721.00	32.72
SUB 1 to SCM B	Post-Dev 1yr-24hr	1	54,049	721.00	25.99
SUB 1 to SCM B	Post-Dev 2 yr-24 hr	2	68,821	721.00	32.01
SUB 1 to SCM B	Post-Dev 25 yr-24 hr	25	131,563	721.00	48.48

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ft ³)	Time to Peak (min)	Peak Flow (ft ³ /s)
POA 1	Post-Dev 1yr-24hr	1	110,491	722.00	34.04
POA 1	Post-Dev 2 yr-24 hr	2	142,136	722.00	41.53
POA 1	Post-Dev 25 yr-24 hr	25	278,151	724.00	70.33
SCM B	Post-Dev 1yr-24hr	1	54,049	721.00	25.99
SCM B	Post-Dev 2 yr-24 hr	2	68,821	721.00	32.01
SCM B	Post-Dev 25 yr-24 hr	25	131,563	721.00	48.48

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ft ³)	Time to Peak (min)	Peak Flow (ft ³ /s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ft ³)
SCM A (IN)	Post-Dev 1yr-24hr	1	66,532	721.00	31.99	(N/A)	(N/A)
SCM A (OUT)	Post-Dev 1yr-24hr	1	62,032	728.00	16.42	259.25	17,539
SCM A (IN)	Post-Dev 2 yr-24 hr	2	84,716	721.00	39.40	(N/A)	(N/A)
SCM A (OUT)	Post-Dev 2 yr-24 hr	2	79,991	728.00	19.64	259.74	21,082
SCM A (IN)	Post-Dev 25 yr-24 hr	25	161,948	721.00	59.67	(N/A)	(N/A)
SCM A (OUT)	Post-Dev 25 yr-24 hr	25	156,867	726.00	38.42	260.81	29,331



McADAMS

The John R. McAdams Company, Inc.
2905 Meridian Parkway
Durham, NC 27713

phone 919. 361. 5000
fax 919. 361. 2269
license number: C-0293

www.mcadamsco.com

CLIENT

WOODFIELD INVESTMENTS
11425 HORSEMAN'S TRAIL
RALEIGH, NC 27613
PHONE: 919. 535. 8947

PARK APARTMENTS
FORM DISTRICT PERMIT
1250 EPHEBUS CHURCH ROAD
CHAPEL HILL, NORTH CAROLINA, 27517

REVISIONS

NO.	DATE	DESCRIPTION
1	05. 03. 2019	PER CHAPEL HILL AND OWASA COMMENTS
2	06. 20. 2019	PER CHAPEL HILL AND OWASA COMMENTS

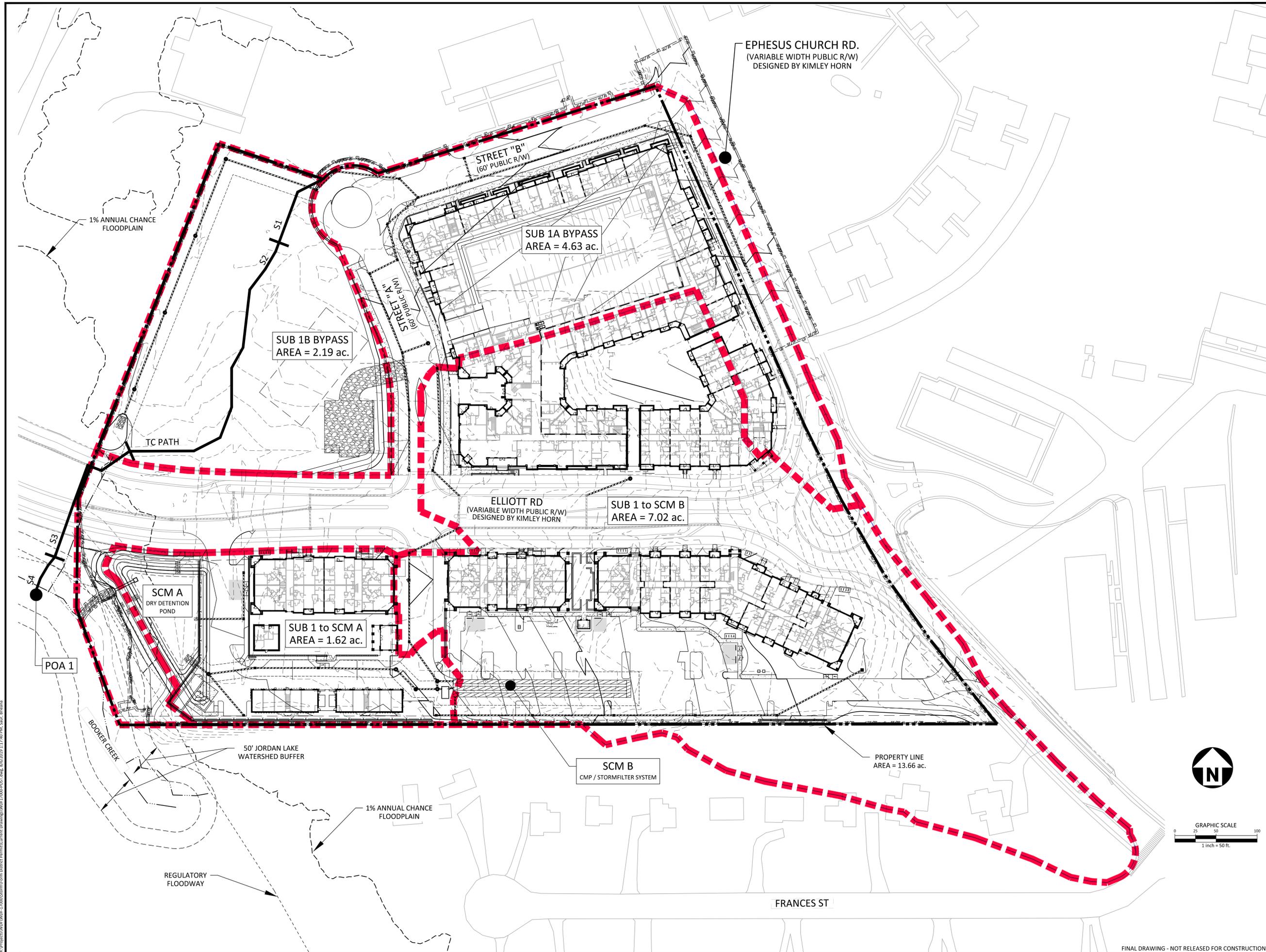
PLAN INFORMATION

PROJECT NO.	WDF-17000
FILENAME	WDF17000-POST
CHECKED BY	JES
DRAWN BY	BMS
SCALE	1" = 50'
DATE	08-05-2019

SHEET

POST DEVELOPMENT
DRAINAGE AREA MAP

POST-DA



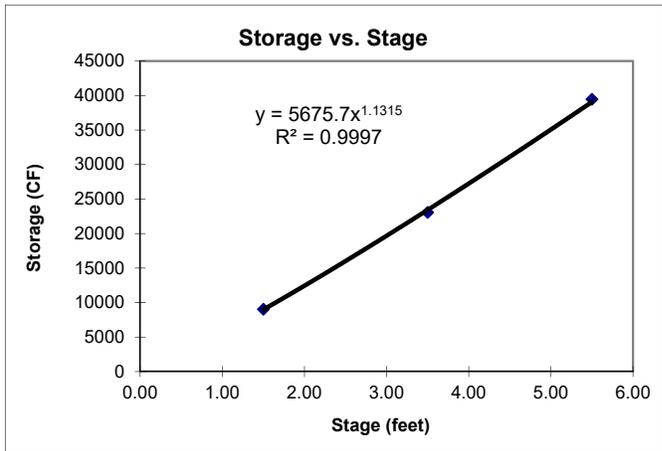
X:\Projects\WDF\17000\Storm\Form District\Permit\Drawings\WDF17000-POST.dwg, 8/6/2019, 11:40 PM, Sur, Brian

*STORMWATER CONTROL MEASURE 'A'
DESIGN CALCULATIONS*

STORMWATER CONTROL MEASURE 'A'
Stage-Storage Function

STAGE-STORAGE FUNCTION

Contour (feet)	Stage (feet)	Contour Area (SF)	Average Contour Area (SF)	Incremental Contour Volume (CF)	Accumulated Contour Volume (CF)	Estimated Stage w/ S-S Fxn (feet)
256.50	0.00	5,584				
258.00	1.50	6,455	6020	9029	9029	1.51
260.00	3.50	7,573	7014	14028	23057	3.45
262.00	5.50	8,835	8204	16408	39465	5.55



$K_s =$	5676
$b =$	1.1315

ASSOCIATED DEPTH IN POND

Volume Detained = 4409 cf.

Stage / Storage Data:

Ks = 5676
b = 1.132
Zo = 256.50

Calculated values:

Depth in Basin = 0.80 ft
= 9.60 inches
Elevation = 257.30 ft

Parks Apartments

Subsection: Elevation-Area Volume Curve
 Label: SCM A

Return Event: 1 years
 Storm Event: 1 yr-24 hr

Elevation (ft)	Planimeter (ft ²)	Area (ft ²)	A1+A2+sqr (A1*A2) (ft ²)	Volume (ft ³)	Volume (Total) (ft ³)
256.50	0.000	5,584	0	0	0
258.00	0.000	6,455	18,043	9,021	9,021
260.00	0.000	7,573	21,020	14,013	23,034
262.00	0.000	8,835	24,588	16,392	39,426

Parks Apartments

Subsection: Outlet Input Data
 Label: SCM A

Return Event: 1 years
 Storm Event: 1 yr-24 hr

Requested Pond Water Surface Elevations	
Minimum (Headwater)	256.50 ft
Increment (Headwater)	0.10 ft
Maximum (Headwater)	262.00 ft

Outlet Connectivity

Structure Type	Outlet ID	Direction	Outfall	E1 (ft)	E2 (ft)
Rectangular Weir	Weir - 1c	Forward	Culvert	257.30	258.30
Rectangular Weir	Weir - 1b	Forward	Culvert	257.30	258.30
Rectangular Weir	Weir - 1a	Forward	Culvert	257.30	258.30
Orifice-Area	Orifice - 1	Forward	Culvert	258.30	262.00
Inlet Box	Riser	Forward	Culvert	260.20	262.00
Orifice-Circular	Orifice - 2yr Volume	Forward	Culvert	256.50	262.00
Culvert-Circular	Culvert	Forward	TW	256.50	262.00
Tailwater Settings	Tailwater			(N/A)	(N/A)

Parks Apartments

Subsection: Outlet Input Data
Label: SCM A

Return Event: 1 years
Storm Event: 1 yr-24 hr

Structure ID: Riser	
Structure Type: Inlet Box	
<hr/>	
Number of Openings	1
Elevation	260.20 ft
Orifice Area	25.000 ft ²
Orifice Coefficient	0.6
Weir Length	20.00 ft
Weir Coefficient	3.00 (ft ^{0.5})/s
K Reverse	1.0
Manning's n	0.0
Kev, Charged Riser	0.0
Weir Submergence	False
Orifice H to crest	False

Parks Apartments

Subsection: Outlet Input Data
 Label: SCM A

Return Event: 1 years
 Storm Event: 1 yr-24 hr

Structure ID: Culvert	
Structure Type: Culvert-Circular	
Number of Barrels	1
Diameter	30.00 in
Length	26.00 ft
Length (Computed Barrel)	26.00 ft
Slope (Computed)	0.019 ft/ft
Outlet Control Data	
Manning's n	0.013
Ke	0.5
Kb	0.0
Kr	0.5
Convergence Tolerance	0.00 ft
Inlet Control Data	
Equation Form	Form 1
K	0.0098
M	2.0000
C	0.0398
Y	0.6700
T1 ratio (HW/D)	0.0
T2 ratio (HW/D)	1.3
Slope Correction Factor	-0.5

Use unsubmerged inlet control 0 equation below T1 elevation.
 Use submerged inlet control 0 equation above T2 elevation

In transition zone between unsubmerged and submerged inlet control,
 interpolate between flows at T1 & T2...

T1 Elevation	256.50 ft	T1 Flow	27.16 ft ³ /s
T2 Elevation	259.74 ft	T2 Flow	31.05 ft ³ /s

Parks Apartments

Subsection: Outlet Input Data
 Label: SCM A

Return Event: 1 years
 Storm Event: 1 yr-24 hr

Structure ID: Orifice - 1	
Structure Type: Orifice-Area	
Number of Openings	3
Elevation	257.30 ft
Orifice Area	1.500 ft ²
Top Elevation	258.30 ft
Datum Elevation	257.80 ft
Orifice Coefficient	0.6
Structure ID: Weir - 1a	
Structure Type: Rectangular Weir	
Number of Openings	1
Elevation	257.30 ft
Weir Length	1.50 ft
Weir Coefficient	3.00 (ft ^{0.5})/s
Structure ID: Weir - 1b	
Structure Type: Rectangular Weir	
Number of Openings	1
Elevation	257.30 ft
Weir Length	1.50 ft
Weir Coefficient	3.00 (ft ^{0.5})/s
Structure ID: Weir - 1c	
Structure Type: Rectangular Weir	
Number of Openings	1
Elevation	257.30 ft
Weir Length	1.50 ft
Weir Coefficient	3.00 (ft ^{0.5})/s
Structure ID: Orifice - 2yr Volume	
Structure Type: Orifice-Circular	
Number of Openings	1
Elevation	256.50 ft
Orifice Diameter	4.00 in
Orifice Coefficient	0.6
Structure ID: TW	
Structure Type: TW Setup, DS Channel	
Tailwater Type	Free Outfall
Convergence Tolerances	
Maximum Iterations	30
Tailwater Tolerance (Minimum)	0.01 ft
Tailwater Tolerance (Maximum)	0.50 ft
Headwater Tolerance (Minimum)	0.01 ft

Parks Apartments

Subsection: Outlet Input Data
Label: SCM A

Return Event: 1 years
Storm Event: 1 yr-24 hr

Convergence Tolerances	
Headwater Tolerance (Maximum)	0.50 ft
Flow Tolerance (Minimum)	0.001 ft ³ /s
Flow Tolerance (Maximum)	10.000 ft ³ /s

Parks Apartments

Subsection: Composite Rating Curve
 Label: SCM A

Return Event: 1 years
 Storm Event: 1 yr-24 hr

Composite Outflow Summary

Water Surface Elevation (ft)	Flow (ft ³ /s)	Tailwater Elevation (ft)	Convergence Error (ft)	Contributing Structures
256.50	0.00	(N/A)	0.00	(no Q: Weir - 1c, Weir - 1b, Weir - 1a, Orifice - 1, Riser, Orifice - 2yr Volume, Culvert)
256.60	0.02	(N/A)	0.00	Orifice - 2yr Volume, Culvert (no Q: Weir - 1c, Weir - 1b, Weir - 1a, Orifice - 1, Riser)
256.70	0.05	(N/A)	0.00	Orifice - 2yr Volume, Culvert (no Q: Weir - 1c, Weir - 1b, Weir - 1a, Orifice - 1, Riser)
256.80	0.13	(N/A)	0.00	Orifice - 2yr Volume, Culvert (no Q: Weir - 1c, Weir - 1b, Weir - 1a, Orifice - 1, Riser)
256.90	0.18	(N/A)	0.00	Orifice - 2yr Volume, Culvert (no Q: Weir - 1c, Weir - 1b, Weir - 1a, Orifice - 1, Riser)
257.00	0.22	(N/A)	0.00	Orifice - 2yr Volume, Culvert (no Q: Weir - 1c, Weir - 1b, Weir - 1a, Orifice - 1, Riser)
257.10	0.25	(N/A)	0.00	Orifice - 2yr Volume, Culvert (no Q: Weir - 1c, Weir - 1b, Weir - 1a, Orifice - 1, Riser)
257.20	0.28	(N/A)	0.00	Orifice - 2yr Volume, Culvert (no Q: Weir - 1c, Weir - 1b, Weir - 1a, Orifice - 1, Riser)
257.30	0.31	(N/A)	0.00	Orifice - 2yr Volume, Culvert (no Q: Weir - 1c, Weir - 1b, Weir - 1a, Orifice - 1, Riser)
257.40	0.71	(N/A)	0.00	Weir - 1c, Weir - 1b, Weir - 1a, Orifice - 2yr Volume, Culvert (no Q: Orifice - 1, Riser)
257.50	1.44	(N/A)	0.00	Weir - 1c, Weir - 1b, Weir - 1a, Orifice - 2yr Volume, Culvert (no Q: Orifice - 1, Riser)
257.60	2.37	(N/A)	0.00	Weir - 1c, Weir - 1b, Weir - 1a, Orifice - 2yr Volume, Culvert (no Q: Orifice - 1, Riser)
257.70	3.28	(N/A)	0.00	Weir - 1c, Weir - 1b, Weir - 1a, Orifice - 2yr Volume, Culvert (no Q: Orifice - 1, Riser)

Parks Apartments

Subsection: Composite Rating Curve
 Label: SCM A

Return Event: 1 years
 Storm Event: 1 yr-24 hr

Composite Outflow Summary

Water Surface Elevation (ft)	Flow (ft ³ /s)	Tailwater Elevation (ft)	Convergence Error (ft)	Contributing Structures
257.80	4.11	(N/A)	0.00	Weir - 1c,Weir - 1b,Weir - 1a,Orifice - 2yr Volume,Culvert (no Q: Orifice - 1,Riser)
257.90	4.94	(N/A)	0.00	Weir - 1c,Weir - 1b,Weir - 1a,Orifice - 2yr Volume,Culvert (no Q: Orifice - 1,Riser)
258.00	5.79	(N/A)	0.00	Weir - 1c,Weir - 1b,Weir - 1a,Orifice - 2yr Volume,Culvert (no Q: Orifice - 1,Riser)
258.10	6.67	(N/A)	0.00	Weir - 1c,Weir - 1b,Weir - 1a,Orifice - 2yr Volume,Culvert (no Q: Orifice - 1,Riser)
258.20	7.56	(N/A)	0.00	Weir - 1c,Weir - 1b,Weir - 1a,Orifice - 2yr Volume,Culvert (no Q: Orifice - 1,Riser)
258.30	9.55	(N/A)	0.00	Orifice - 1,Orifice - 2yr Volume,Culvert (no Q: Weir - 1c,Weir - 1b,Weir - 1a,Riser)
258.40	10.29	(N/A)	0.00	Orifice - 1,Orifice - 2yr Volume,Culvert (no Q: Weir - 1c,Weir - 1b,Weir - 1a,Riser)
258.50	11.04	(N/A)	0.00	Orifice - 1,Orifice - 2yr Volume,Culvert (no Q: Weir - 1c,Weir - 1b,Weir - 1a,Riser)
258.60	11.78	(N/A)	0.00	Orifice - 1,Orifice - 2yr Volume,Culvert (no Q: Weir - 1c,Weir - 1b,Weir - 1a,Riser)
258.70	12.52	(N/A)	0.00	Orifice - 1,Orifice - 2yr Volume,Culvert (no Q: Weir - 1c,Weir - 1b,Weir - 1a,Riser)
258.80	13.24	(N/A)	0.00	Orifice - 1,Orifice - 2yr Volume,Culvert (no Q: Weir - 1c,Weir - 1b,Weir - 1a,Riser)
258.90	13.96	(N/A)	0.00	Orifice - 1,Orifice - 2yr Volume,Culvert (no Q: Weir - 1c,Weir - 1b,Weir - 1a,Riser)
259.00	14.67	(N/A)	0.00	Orifice - 1,Orifice - 2yr Volume,Culvert (no Q: Weir - 1c,Weir - 1b,Weir - 1a,Riser)

Parks Apartments

Subsection: Composite Rating Curve
 Label: SCM A

Return Event: 1 years
 Storm Event: 1 yr-24 hr

Composite Outflow Summary

Water Surface Elevation (ft)	Flow (ft ³ /s)	Tailwater Elevation (ft)	Convergence Error (ft)	Contributing Structures
259.10	15.38	(N/A)	0.00	Orifice - 1,Orifice - 2yr Volume,Culvert (no Q: Weir - 1c,Weir - 1b,Weir - 1a,Riser)
259.20	16.05	(N/A)	0.00	Orifice - 1,Orifice - 2yr Volume,Culvert (no Q: Weir - 1c,Weir - 1b,Weir - 1a,Riser)
259.30	16.74	(N/A)	0.00	Orifice - 1,Orifice - 2yr Volume,Culvert (no Q: Weir - 1c,Weir - 1b,Weir - 1a,Riser)
259.40	17.41	(N/A)	0.00	Orifice - 1,Orifice - 2yr Volume,Culvert (no Q: Weir - 1c,Weir - 1b,Weir - 1a,Riser)
259.50	18.08	(N/A)	0.00	Orifice - 1,Orifice - 2yr Volume,Culvert (no Q: Weir - 1c,Weir - 1b,Weir - 1a,Riser)
259.60	18.75	(N/A)	0.00	Orifice - 1,Orifice - 2yr Volume,Culvert (no Q: Weir - 1c,Weir - 1b,Weir - 1a,Riser)
259.70	19.39	(N/A)	0.00	Orifice - 1,Orifice - 2yr Volume,Culvert (no Q: Weir - 1c,Weir - 1b,Weir - 1a,Riser)
259.80	20.03	(N/A)	0.00	Orifice - 1,Orifice - 2yr Volume,Culvert (no Q: Weir - 1c,Weir - 1b,Weir - 1a,Riser)
259.90	20.65	(N/A)	0.00	Orifice - 1,Orifice - 2yr Volume,Culvert (no Q: Weir - 1c,Weir - 1b,Weir - 1a,Riser)
260.00	21.26	(N/A)	0.00	Orifice - 1,Orifice - 2yr Volume,Culvert (no Q: Weir - 1c,Weir - 1b,Weir - 1a,Riser)
260.10	21.88	(N/A)	0.00	Orifice - 1,Orifice - 2yr Volume,Culvert (no Q: Weir - 1c,Weir - 1b,Weir - 1a,Riser)
260.20	22.47	(N/A)	0.00	Orifice - 1,Orifice - 2yr Volume,Culvert (no Q: Weir - 1c,Weir - 1b,Weir - 1a,Riser)
260.30	24.12	(N/A)	0.00	Orifice - 1,Riser,Orifice - 2yr Volume,Culvert (no Q: Weir - 1c,Weir - 1b,Weir - 1a)

Parks Apartments

Subsection: Composite Rating Curve
 Label: SCM A

Return Event: 1 years
 Storm Event: 1 yr-24 hr

Composite Outflow Summary

Water Surface Elevation (ft)	Flow (ft ³ /s)	Tailwater Elevation (ft)	Convergence Error (ft)	Contributing Structures
260.40	26.64	(N/A)	0.00	Orifice - 1,Riser,Orifice - 2yr Volume,Culvert (no Q: Weir - 1c,Weir - 1b,Weir - 1a)
260.50	29.66	(N/A)	0.00	Orifice - 1,Riser,Orifice - 2yr Volume,Culvert (no Q: Weir - 1c,Weir - 1b,Weir - 1a)
260.60	32.96	(N/A)	0.00	Orifice - 1,Riser,Orifice - 2yr Volume,Culvert (no Q: Weir - 1c,Weir - 1b,Weir - 1a)
260.70	35.72	(N/A)	0.00	Orifice - 1,Riser,Orifice - 2yr Volume,Culvert (no Q: Weir - 1c,Weir - 1b,Weir - 1a)
260.80	38.31	(N/A)	0.00	Orifice - 1,Riser,Orifice - 2yr Volume,Culvert (no Q: Weir - 1c,Weir - 1b,Weir - 1a)
260.90	40.35	(N/A)	0.00	Orifice - 1,Riser,Orifice - 2yr Volume,Culvert (no Q: Weir - 1c,Weir - 1b,Weir - 1a)
261.00	41.53	(N/A)	0.00	Riser,Culvert (no Q: Weir - 1c,Weir - 1b,Weir - 1a,Orifice - 1,Orifice - 2yr Volume)
261.10	42.25	(N/A)	0.00	Riser,Culvert (no Q: Weir - 1c,Weir - 1b,Weir - 1a,Orifice - 1,Orifice - 2yr Volume)
261.20	42.96	(N/A)	0.00	Riser,Culvert (no Q: Weir - 1c,Weir - 1b,Weir - 1a,Orifice - 1,Orifice - 2yr Volume)
261.30	43.67	(N/A)	0.00	Riser,Culvert (no Q: Weir - 1c,Weir - 1b,Weir - 1a,Orifice - 1,Orifice - 2yr Volume)
261.40	44.35	(N/A)	0.00	Riser,Culvert (no Q: Weir - 1c,Weir - 1b,Weir - 1a,Orifice - 1,Orifice - 2yr Volume)
261.50	45.03	(N/A)	0.00	Riser,Culvert (no Q: Weir - 1c,Weir - 1b,Weir - 1a,Orifice - 1,Orifice - 2yr Volume)
261.60	45.69	(N/A)	0.00	Riser,Culvert (no Q: Weir - 1c,Weir - 1b,Weir - 1a,Orifice - 1,Orifice - 2yr Volume)

Parks Apartments

Subsection: Composite Rating Curve
 Label: SCM A

Return Event: 1 years
 Storm Event: 1 yr-24 hr

Composite Outflow Summary

Water Surface Elevation (ft)	Flow (ft ³ /s)	Tailwater Elevation (ft)	Convergence Error (ft)	Contributing Structures
261.70	46.35	(N/A)	0.00	Riser,Culvert (no Q: Weir - 1c,Weir - 1b,Weir - 1a,Orifice - 1,Orifice - 2yr Volume)
261.80	47.00	(N/A)	0.00	Riser,Culvert (no Q: Weir - 1c,Weir - 1b,Weir - 1a,Orifice - 1,Orifice - 2yr Volume)
261.90	47.64	(N/A)	0.00	Riser,Culvert (no Q: Weir - 1c,Weir - 1b,Weir - 1a,Orifice - 1,Orifice - 2yr Volume)
262.00	48.27	(N/A)	0.00	Riser,Culvert (no Q: Weir - 1c,Weir - 1b,Weir - 1a,Orifice - 1,Orifice - 2yr Volume)

Parks Apartments

Subsection: Level Pool Pond Routing Summary
 Label: SCM A (IN)

Return Event: 1 years
 Storm Event: 1 yr-24 hr

Infiltration			
Infiltration Method (Computed)	No Infiltration		

Initial Conditions			
Elevation (Water Surface, Initial)	256.50 ft		
Volume (Initial)	0 ft ³		
Flow (Initial Outlet)	0.00 ft ³ /s		
Flow (Initial Infiltration)	0.00 ft ³ /s		
Flow (Initial, Total)	0.00 ft ³ /s		
Time Increment	1.00 min		

Inflow/Outflow Hydrograph Summary			
Flow (Peak In)	31.99 ft ³ /s	Time to Peak (Flow, In)	721.00 min
Flow (Peak Outlet)	16.42 ft ³ /s	Time to Peak (Flow, Outlet)	728.00 min

Elevation (Water Surface, Peak)	259.25 ft		
Volume (Peak)	17,539 ft ³		

Mass Balance (ft ³)	
Volume (Initial)	0 ft ³
Volume (Total Inflow)	66,532 ft ³
Volume (Total Infiltration)	0 ft ³
Volume (Total Outlet Outflow)	62,032 ft ³
Volume (Retained)	4,481 ft ³
Volume (Unrouted)	-19 ft ³
Error (Mass Balance)	0.0 %

Parks Apartments

 Subsection: Level Pool Pond Routing Summary
 Label: SCM A (IN)

 Return Event: 2 years
 Storm Event: 2 yr-24 hr

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Water Surface, Initial)	256.50 ft
Volume (Initial)	0 ft ³
Flow (Initial Outlet)	0.00 ft ³ /s
Flow (Initial Infiltration)	0.00 ft ³ /s
Flow (Initial, Total)	0.00 ft ³ /s
Time Increment	1.00 min

Inflow/Outflow Hydrograph Summary			
Flow (Peak In)	39.40 ft ³ /s	Time to Peak (Flow, In)	721.00 min
Flow (Peak Outlet)	19.64 ft ³ /s	Time to Peak (Flow, Outlet)	728.00 min

Elevation (Water Surface, Peak)	259.74 ft
Volume (Peak)	21,082 ft ³

Mass Balance (ft ³)	
Volume (Initial)	0 ft ³
Volume (Total Inflow)	84,716 ft ³
Volume (Total Infiltration)	0 ft ³
Volume (Total Outlet Outflow)	79,991 ft ³
Volume (Retained)	4,703 ft ³
Volume (Unrouted)	-21 ft ³
Error (Mass Balance)	0.0 %

Parks Apartments

 Return Event: 10 years
 Storm Event: 10 yr-24 hr

 Subsection: Level Pool Pond Routing Summary
 Label: SCM A (IN)

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Water Surface, Initial)	256.50 ft
Volume (Initial)	0 ft ³
Flow (Initial Outlet)	0.00 ft ³ /s
Flow (Initial Infiltration)	0.00 ft ³ /s
Flow (Initial, Total)	0.00 ft ³ /s
Time Increment	1.00 min

Inflow/Outflow Hydrograph Summary			
Flow (Peak In)	53.45 ft ³ /s	Time to Peak (Flow, In)	726.00 min
Flow (Peak Outlet)	31.46 ft ³ /s	Time to Peak (Flow, Outlet)	732.00 min

Elevation (Water Surface, Peak)	260.55 ft
Volume (Peak)	27,327 ft ³

Mass Balance (ft ³)	
Volume (Initial)	0 ft ³
Volume (Total Inflow)	132,894 ft ³
Volume (Total Infiltration)	0 ft ³
Volume (Total Outlet Outflow)	127,911 ft ³
Volume (Retained)	4,951 ft ³
Volume (Unrouted)	-32 ft ³
Error (Mass Balance)	0.0 %

Parks Apartments

Return Event: 25 years
Storm Event: 25 yr-24 hr

Subsection: Level Pool Pond Routing Summary
Label: SCM A (IN)

Infiltration			
Infiltration Method (Computed)	No Infiltration		

Initial Conditions			
Elevation (Water Surface, Initial)	256.50 ft		
Volume (Initial)	0 ft ³		
Flow (Initial Outlet)	0.00 ft ³ /s		
Flow (Initial Infiltration)	0.00 ft ³ /s		
Flow (Initial, Total)	0.00 ft ³ /s		
Time Increment	1.00 min		

Inflow/Outflow Hydrograph Summary			
Flow (Peak In)	59.67 ft ³ /s	Time to Peak (Flow, In)	721.00 min
Flow (Peak Outlet)	38.42 ft ³ /s	Time to Peak (Flow, Outlet)	726.00 min

Elevation (Water Surface, Peak)	260.81 ft		
Volume (Peak)	29,331 ft ³		

Mass Balance (ft ³)	
Volume (Initial)	0 ft ³
Volume (Total Inflow)	161,948 ft ³
Volume (Total Infiltration)	0 ft ³
Volume (Total Outlet Outflow)	156,867 ft ³
Volume (Retained)	5,045 ft ³
Volume (Unrouted)	-36 ft ³
Error (Mass Balance)	0.0 %

Parks Apartments

Subsection: Level Pool Pond Routing Summary
 Label: SCM A (IN)

Return Event: 100 years
 Storm Event: 100 yr-24 hr

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Water Surface, Initial)	256.50 ft
Volume (Initial)	0 ft ³
Flow (Initial Outlet)	0.00 ft ³ /s
Flow (Initial Infiltration)	0.00 ft ³ /s
Flow (Initial, Total)	0.00 ft ³ /s
Time Increment	1.00 min

Inflow/Outflow Hydrograph Summary			
Flow (Peak In)	68.08 ft ³ /s	Time to Peak (Flow, In)	721.00 min
Flow (Peak Outlet)	43.15 ft ³ /s	Time to Peak (Flow, Outlet)	726.00 min

Elevation (Water Surface, Peak)	261.23 ft
Volume (Peak)	32,789 ft ³

Mass Balance (ft ³)	
Volume (Initial)	0 ft ³
Volume (Total Inflow)	208,366 ft ³
Volume (Total Infiltration)	0 ft ³
Volume (Total Outlet Outflow)	203,217 ft ³
Volume (Retained)	5,111 ft ³
Volume (Unrouted)	-38 ft ³
Error (Mass Balance)	0.0 %

Parks Apartments

Subsection: Outlet Input Data
 Label: SCM A - WC

Return Event: 100 years
 Storm Event: 100 yr-24 hr

Requested Pond Water Surface Elevations	
Minimum (Headwater)	256.50 ft
Increment (Headwater)	0.10 ft
Maximum (Headwater)	262.00 ft

Outlet Connectivity

Structure Type	Outlet ID	Direction	Outfall	E1 (ft)	E2 (ft)
Rectangular Weir	Weir - 1b	Forward	Culvert	257.30	258.30
Rectangular Weir	Weir - 1a	Forward	Culvert	257.30	258.30
Orifice-Area	Orifice - 1	Forward	Culvert	258.30	262.00
Inlet Box	Riser	Forward	Culvert	260.20	262.00
Rectangular Weir	Weir - 1c	Forward	Culvert	257.30	258.30
Culvert-Circular	Culvert	Forward	TW	256.50	262.00
Tailwater Settings	Tailwater			(N/A)	(N/A)

Parks Apartments

Subsection: Outlet Input Data
Label: SCM A - WC

Return Event: 100 years
Storm Event: 100 yr-24 hr

Structure ID: Riser	
Structure Type: Inlet Box	
<hr/>	
Number of Openings	1
Elevation	260.20 ft
Orifice Area	25.000 ft ²
Orifice Coefficient	0.6
Weir Length	20.00 ft
Weir Coefficient	3.00 (ft ^{0.5})/s
K Reverse	1.0
Manning's n	0.0
Kev, Charged Riser	0.0
Weir Submergence	False
Orifice H to crest	False

Parks Apartments

Subsection: Outlet Input Data
 Label: SCM A - WC

Return Event: 100 years
 Storm Event: 100 yr-24 hr

Structure ID: Culvert	
Structure Type: Culvert-Circular	
Number of Barrels	1
Diameter	30.00 in
Length	26.00 ft
Length (Computed Barrel)	26.00 ft
Slope (Computed)	0.019 ft/ft
Outlet Control Data	
Manning's n	0.013
Ke	0.5
Kb	0.0
Kr	0.5
Convergence Tolerance	0.00 ft
Inlet Control Data	
Equation Form	Form 1
K	0.0098
M	2.0000
C	0.0398
Y	0.6700
T1 ratio (HW/D)	1.2
T2 ratio (HW/D)	1.3
Slope Correction Factor	-0.5

Use unsubmerged inlet control 0 equation below T1 elevation.
 Use submerged inlet control 0 equation above T2 elevation

In transition zone between unsubmerged and submerged inlet control,
 interpolate between flows at T1 & T2...

T1 Elevation	259.38 ft	T1 Flow	27.16 ft ³ /s
T2 Elevation	259.74 ft	T2 Flow	31.05 ft ³ /s

Parks Apartments

Subsection: Outlet Input Data
 Label: SCM A - WC

Return Event: 100 years
 Storm Event: 100 yr-24 hr

Structure ID: Orifice - 1	
Structure Type: Orifice-Area	
Number of Openings	3
Elevation	257.30 ft
Orifice Area	1.500 ft ²
Top Elevation	258.30 ft
Datum Elevation	257.80 ft
Orifice Coefficient	0.6
Structure ID: Weir - 1a	
Structure Type: Rectangular Weir	
Number of Openings	1
Elevation	257.30 ft
Weir Length	1.50 ft
Weir Coefficient	3.00 (ft ^{0.5})/s
Structure ID: Weir - 1b	
Structure Type: Rectangular Weir	
Number of Openings	1
Elevation	257.30 ft
Weir Length	1.50 ft
Weir Coefficient	3.00 (ft ^{0.5})/s
Structure ID: Weir - 1c	
Structure Type: Rectangular Weir	
Number of Openings	1
Elevation	257.30 ft
Weir Length	1.50 ft
Weir Coefficient	3.00 (ft ^{0.5})/s

Parks Apartments

Subsection: Composite Rating Curve
 Label: SCM A - WC

Return Event: 100 years
 Storm Event: 100 yr-24 hr

Composite Outflow Summary

Water Surface Elevation (ft)	Flow (ft ³ /s)	Tailwater Elevation (ft)	Convergence Error (ft)	Contributing Structures
256.50	0.00	258.00	0.00	(no Q: Weir - 1b, Weir - 1a, Orifice - 1, Riser, Weir - 1c, Culvert)
256.60	0.00	258.00	0.00	(no Q: Weir - 1b, Weir - 1a, Orifice - 1, Riser, Weir - 1c, Culvert)
256.70	0.00	258.00	0.00	(no Q: Weir - 1b, Weir - 1a, Orifice - 1, Riser, Weir - 1c, Culvert)
256.80	0.00	258.00	0.00	(no Q: Weir - 1b, Weir - 1a, Orifice - 1, Riser, Weir - 1c, Culvert)
256.90	0.00	258.00	0.00	(no Q: Weir - 1b, Weir - 1a, Orifice - 1, Riser, Weir - 1c, Culvert)
257.00	0.00	258.00	0.00	(no Q: Weir - 1b, Weir - 1a, Orifice - 1, Riser, Weir - 1c, Culvert)
257.10	0.00	258.00	0.00	(no Q: Weir - 1b, Weir - 1a, Orifice - 1, Riser, Weir - 1c, Culvert)
257.20	0.00	258.00	0.00	(no Q: Weir - 1b, Weir - 1a, Orifice - 1, Riser, Weir - 1c, Culvert)
257.30	0.00	258.00	0.00	(no Q: Weir - 1b, Weir - 1a, Orifice - 1, Riser, Weir - 1c, Culvert)
257.40	0.00	258.00	0.00	(no Q: Weir - 1b, Weir - 1a, Orifice - 1, Riser, Weir - 1c, Culvert)
257.50	0.00	258.00	0.00	(no Q: Weir - 1b, Weir - 1a, Orifice - 1, Riser, Weir - 1c, Culvert)
257.60	0.00	258.00	0.00	(no Q: Weir - 1b, Weir - 1a, Orifice - 1, Riser, Weir - 1c, Culvert)
257.70	0.00	258.00	0.00	(no Q: Weir - 1b, Weir - 1a, Orifice - 1, Riser, Weir - 1c, Culvert)
257.80	0.00	258.00	0.00	(no Q: Weir - 1b, Weir - 1a, Orifice - 1, Riser, Weir - 1c, Culvert)
257.90	0.00	258.00	0.00	(no Q: Weir - 1b, Weir - 1a, Orifice - 1, Riser, Weir - 1c, Culvert)
258.00	0.00	258.00	0.00	(no Q: Weir - 1b, Weir - 1a, Orifice - 1, Riser, Weir - 1c, Culvert)
258.10	3.91	258.00	0.00	Weir - 1b, Weir - 1a, Weir - 1c, Culvert (no Q: Orifice - 1, Riser)

Parks Apartments

Subsection: Composite Rating Curve
 Label: SCM A - WC

Return Event: 100 years
 Storm Event: 100 yr-24 hr

Composite Outflow Summary

Water Surface Elevation (ft)	Flow (ft ³ /s)	Tailwater Elevation (ft)	Convergence Error (ft)	Contributing Structures
258.20	5.66	258.00	0.00	Weir - 1b,Weir - 1a,Weir - 1c,Culvert (no Q: Orifice - 1,Riser)
258.30	8.51	258.00	0.00	Orifice - 1,Culvert (no Q: Weir - 1b,Weir - 1a,Riser,Weir - 1c)
258.40	9.79	258.00	0.00	Orifice - 1,Culvert (no Q: Weir - 1b,Weir - 1a,Riser,Weir - 1c)
258.50	10.89	258.00	0.00	Orifice - 1,Culvert (no Q: Weir - 1b,Weir - 1a,Riser,Weir - 1c)
258.60	11.83	258.00	0.00	Orifice - 1,Culvert (no Q: Weir - 1b,Weir - 1a,Riser,Weir - 1c)
258.70	12.65	258.00	0.00	Orifice - 1,Culvert (no Q: Weir - 1b,Weir - 1a,Riser,Weir - 1c)
258.80	13.21	258.00	0.00	Orifice - 1,Culvert (no Q: Weir - 1b,Weir - 1a,Riser,Weir - 1c)
258.90	13.85	258.00	0.00	Orifice - 1,Culvert (no Q: Weir - 1b,Weir - 1a,Riser,Weir - 1c)
259.00	14.55	258.00	0.00	Orifice - 1,Culvert (no Q: Weir - 1b,Weir - 1a,Riser,Weir - 1c)
259.10	15.24	258.00	0.00	Orifice - 1,Culvert (no Q: Weir - 1b,Weir - 1a,Riser,Weir - 1c)
259.20	15.91	258.00	0.00	Orifice - 1,Culvert (no Q: Weir - 1b,Weir - 1a,Riser,Weir - 1c)
259.30	16.58	258.00	0.00	Orifice - 1,Culvert (no Q: Weir - 1b,Weir - 1a,Riser,Weir - 1c)
259.40	17.25	258.00	0.00	Orifice - 1,Culvert (no Q: Weir - 1b,Weir - 1a,Riser,Weir - 1c)
259.50	17.91	258.00	0.00	Orifice - 1,Culvert (no Q: Weir - 1b,Weir - 1a,Riser,Weir - 1c)
259.60	18.56	258.00	0.00	Orifice - 1,Culvert (no Q: Weir - 1b,Weir - 1a,Riser,Weir - 1c)
259.70	19.19	258.00	0.00	Orifice - 1,Culvert (no Q: Weir - 1b,Weir - 1a,Riser,Weir - 1c)
259.80	19.81	258.00	0.00	Orifice - 1,Culvert (no Q: Weir - 1b,Weir - 1a,Riser,Weir - 1c)

Parks Apartments

Subsection: Composite Rating Curve
 Label: SCM A - WC

Return Event: 100 years
 Storm Event: 100 yr-24 hr

Composite Outflow Summary

Water Surface Elevation (ft)	Flow (ft ³ /s)	Tailwater Elevation (ft)	Convergence Error (ft)	Contributing Structures
259.90	20.44	258.00	0.00	Orifice - 1,Culvert (no Q: Weir - 1b,Weir - 1a,Riser,Weir - 1c)
260.00	21.04	258.00	0.00	Orifice - 1,Culvert (no Q: Weir - 1b,Weir - 1a,Riser,Weir - 1c)
260.10	21.66	258.00	0.00	Orifice - 1,Culvert (no Q: Weir - 1b,Weir - 1a,Riser,Weir - 1c)
260.20	22.25	258.00	0.00	Orifice - 1,Culvert (no Q: Weir - 1b,Weir - 1a,Riser,Weir - 1c)
260.30	23.90	258.00	0.00	Orifice - 1,Riser,Culvert (no Q: Weir - 1b,Weir - 1a,Weir - 1c)
260.40	26.43	258.00	0.00	Orifice - 1,Riser,Culvert (no Q: Weir - 1b,Weir - 1a,Weir - 1c)
260.50	29.46	258.00	0.00	Orifice - 1,Riser,Culvert (no Q: Weir - 1b,Weir - 1a,Weir - 1c)
260.60	32.80	258.00	0.00	Orifice - 1,Riser,Culvert (no Q: Weir - 1b,Weir - 1a,Weir - 1c)
260.70	35.63	258.00	0.00	Orifice - 1,Riser,Culvert (no Q: Weir - 1b,Weir - 1a,Weir - 1c)
260.80	38.27	258.00	0.00	Orifice - 1,Riser,Culvert (no Q: Weir - 1b,Weir - 1a,Weir - 1c)
260.90	40.32	258.00	0.00	Orifice - 1,Riser,Culvert (no Q: Weir - 1b,Weir - 1a,Weir - 1c)
261.00	41.53	258.00	0.00	Riser,Culvert (no Q: Weir - 1b,Weir - 1a,Orifice - 1,Weir - 1c)
261.10	42.25	258.00	0.00	Riser,Culvert (no Q: Weir - 1b,Weir - 1a,Orifice - 1,Weir - 1c)
261.20	42.96	258.00	0.00	Riser,Culvert (no Q: Weir - 1b,Weir - 1a,Orifice - 1,Weir - 1c)
261.30	43.67	258.00	0.00	Riser,Culvert (no Q: Weir - 1b,Weir - 1a,Orifice - 1,Weir - 1c)
261.40	44.35	258.00	0.00	Riser,Culvert (no Q: Weir - 1b,Weir - 1a,Orifice - 1,Weir - 1c)
261.50	45.03	258.00	0.00	Riser,Culvert (no Q: Weir - 1b,Weir - 1a,Orifice - 1,Weir - 1c)

Parks Apartments

Subsection: Composite Rating Curve
 Label: SCM A - WC

Return Event: 100 years
 Storm Event: 100 yr-24 hr

Composite Outflow Summary

Water Surface Elevation (ft)	Flow (ft ³ /s)	Tailwater Elevation (ft)	Convergence Error (ft)	Contributing Structures
261.60	45.69	258.00	0.00	Riser,Culvert (no Q: Weir - 1b,Weir - 1a,Orifice - 1,Weir - 1c)
261.70	46.35	258.00	0.00	Riser,Culvert (no Q: Weir - 1b,Weir - 1a,Orifice - 1,Weir - 1c)
261.80	47.00	258.00	0.00	Riser,Culvert (no Q: Weir - 1b,Weir - 1a,Orifice - 1,Weir - 1c)
261.90	47.64	258.00	0.00	Riser,Culvert (no Q: Weir - 1b,Weir - 1a,Orifice - 1,Weir - 1c)
262.00	48.27	258.00	0.00	Riser,Culvert (no Q: Weir - 1b,Weir - 1a,Orifice - 1,Weir - 1c)

Parks Apartments

Subsection: Level Pool Pond Routing Summary
 Label: SCM A (IN)

Return Event: 100 years
 Storm Event: 100 yr-24 hr

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Water Surface, Initial)	257.30 ft
Volume (Initial)	4,649 ft ³
Flow (Initial Outlet)	0.00 ft ³ /s
Flow (Initial Infiltration)	0.00 ft ³ /s
Flow (Initial, Total)	0.00 ft ³ /s
Time Increment	1.00 min

Inflow/Outflow Hydrograph Summary			
Flow (Peak In)	68.08 ft ³ /s	Time to Peak (Flow, In)	721.00 min
Flow (Peak Outlet)	43.29 ft ³ /s	Time to Peak (Flow, Outlet)	726.00 min

Elevation (Water Surface, Peak)	261.25 ft
Volume (Peak)	32,956 ft ³

Mass Balance (ft ³)	
Volume (Initial)	4,649 ft ³
Volume (Total Inflow)	208,366 ft ³
Volume (Total Infiltration)	0 ft ³
Volume (Total Outlet Outflow)	203,888 ft ³
Volume (Retained)	9,094 ft ³
Volume (Unrouted)	-32 ft ³
Error (Mass Balance)	0.0 %

RISER ANTI-FLOTATION CALCULATION

Input Data ==>

Safety Factor:

Safety factor to use = 1.15 (recommend 1.15 or higher)

Concrete:

Concrete unit weight = 142.0 PCF **Note:** NC Products lists unit wt. of manhole concrete at 142 PCF.

Riser:

Inside height of Riser = 3.70 feet
Inside length of riser = 5.00 feet
Inside width of riser = 5.00 feet
Wall thickness of riser = 6.00 inches
Base thickness of riser = 6.00 inches
Base length of riser = 6.00 feet
Base width of riser = 6.00 feet

Openings:

Total Orifice Area = 4.587 SF
OD of barrel exiting manhole = 38.50 inches
Size of drain pipe (if present) = 6.0 inches

Trash Rack:

Bottom Length = 8.40 feet
Bottom Width = 8.40 feet
Top Length = 2.10 feet
Top Width = 2.10 feet
Height = 2.00 feet
Trash Rack water displacement = 61.74 CF

Concrete Present in Riser Structure ==>

Total amount of concrete:

Base of Riser = 18.00 CF
Riser Walls = 40.70 CF

Adjust for openings:

Opening for Orifices = 2.29 CF
Opening for barrel = 4.04 CF
Opening for drain pipe = 0.10 CF

Total Concrete present, adjusted for openings = **52.266 CF**
Weight of concrete present = **7,422 lbs**

Amount of water displaced by Riser Structure ==>

Displacement by concrete =	52.27 CF
Displacement by open air in riser =	92.50 CF
Displacement by trash rack =	61.74 CF
Total water displaced by riser/barrel structure =	206.51 CF
Weight of water displaced =	12,886 lbs

Calculate size of base for riser assembly ==>

Length =	9.00 feet
Width =	9.00 feet
Thickness =	18 inches
Concrete Present =	121.50 CF

Check validity of base as designed ==>

Total Water Displaced =	310.01 CF
Total Concrete Present =	173.77 CF
Total Water Displaced =	19,344 lbs
Total Concrete Present =	24,675 lbs
Actual safety factor =	1.28 OK

Results of design ==>

Base length =	9.00 feet
Base width =	9.00 feet
Base Thickness =	18.00 inches
CY of concrete total in base =	4.50 CY
Concrete unit weight in added base >=	142.0 PCF

II. CALCULATION FOR RISER ANTI-FLOTATION STEEL

Input Data ==>

Anti-Floatation Block Length = 9.0 feet
 Anti-Floatation Block Width = 9.0 feet
 Anti-Floatation Block Thickness = 18 inches

A_{steel} to A_{concrete} Ratio = 0.0020 (recommend 0.0018 or higher)

Cross-Section Calculations==>

Cross-Section Area* = 13.50 SF
 Minimum Steel Area Required = 0.027 SF
3.89 SI

**Note: Assumes a "square" x-sec (L and W same)*

Rebar Calculations ==>

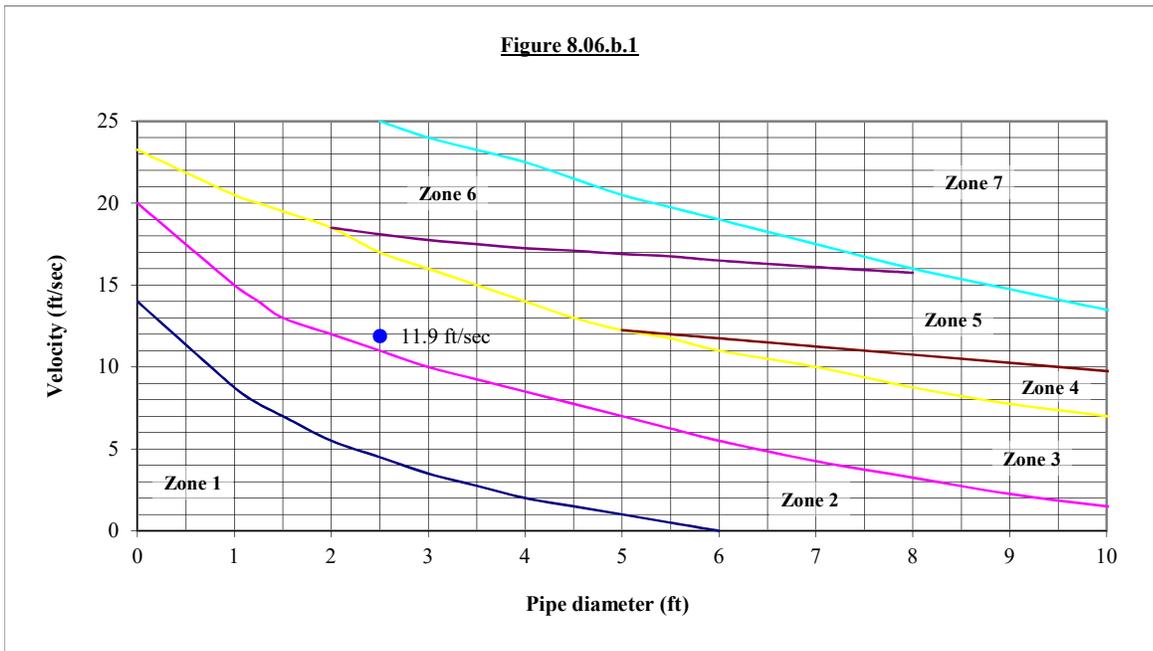
Bar Size	4	5	6	7	8
Diameter (inches)	0.500	0.625	0.750	0.875	1.000
X-Sec Area (SI)	0.196	0.307	0.442	0.601	0.785
Minimum Number of Bars Each X-Sec	20	13	9	7	5

DESIGN OF RIPRAP OUTLET PROTECTION WORKSHEET

Project PARK APARTMENTS
 Project No. WDF-17000
 Outlet ID SCM A

Date 5/1/2019
 Designer SCB

Flow, $Q_{10\text{-yr}}$ 31.46 cfs
 Slope, S 1.92 %
 Pipe Diameter, D_o 30 inches
 Pipe Diameter, D_o 2.5 feet
 Number of pipes 1
 Pipe separation 0 feet
 Manning's n 0.013



Zone from graph above = 3

Outlet pipe diameter 30 in. Length = 20.0 ft.
 Outlet flowrate 31.5 cfs Width = 7.5 ft.
 Outlet velocity 11.9 ft/sec Stone diameter = 13 in.
 Material = Class I Thickness = 22 in.

Zone	Material	Diameter	Thickness	Length	Width
1	Class A	3	9	4 x D(o)	3 x D(o)
2	Class B	6	22	6 x D(o)	3 x D(o)
3	Class I	13	22	8 x D(o)	3 x D(o)
4	Class I	13	22	8 x D(o)	3 x D(o)
5	Class II	23	27	10 x D(o)	3 x D(o)
6	Class II	23	27	10 x D(o)	3 x D(o)
7	Special study required				

- Calculations based on NY DOT method - Pages 8.06.05 through 8.06.06 in NC Erosion Control Manual
- Outlet velocity based on full-flow velocity

*STORMWATER CONTROL MEASURE 'B'
DESIGN CALCULATIONS*

Determination of Water Quality Volume (WQV)

Note: The following design calculations are based upon requirements from the 2007 NCDENR BMP Manual.

$$WQV = (P)(R_v)(A)/12 \times 43,560$$

where,

WQV= water quality volume (CF)

$R_v = 0.05 + 0.009(I)$ where I is percent impervious cover

A = area in acres

P = rainfall (in inches)

Input data:

Total area, A =	7.02	acres
Impervious area =	4.90	acres
Percent impervious cover, I =	69.7	%
Rainfall, P =	1.0	inches

Calculated values:

$R_v =$	0.68	
WQV =	0.40	acre-ft
=	17266	cf.

Sizing is based upon the adjusted water quality volume, WQV_{adj} (75% of the total WQV).

$WQV_{adj} =$	12950	cf.	(Volume contained between the sedimentation chamber and the sand filter - above the sand)
---------------	-------	-----	---

WQvol Storage Pipe Size Estimate

Number of pipes =	3	
Pipe diameter =	60	inch
Pipe length =	220	feet

Number of Cartridges = 32

Determining Number of Cartridges for Volume-Based Design in NC

Design Engineer:
Date

LRS
5/1/2019

Blue Cells = Input
Black Cells = Calculation

Site Information

Project Name **Park Apartments REV1**
 Project State **North Carolina**
 Project Location **Chapel Hill**
 Drainage Area, Ad **7.05** ac
 Impervious Area, Ai **4.88** ac
 Pervious Area, Ap **2.17**
 % Impervious **69%**
 Runoff Coefficient, Rv **0.67**

=0.05+0.9*(Ai/Ad)

Water Quality Volume Calculations

Design storm rainfall depth, Rd **1.0** in
 Water quality volume, WQV **17222.5** ft³

=Ad*Rv*Rd*(43560/12)

Storage Component Calculations

Capture 75% of WQV **12916.9** ft³
 Pretreatment credit (estimated or calculated), %pre **30%**

=0.75*WQV

Mass loading calculations

Mean Annual Rainfall, P **46** in
 Agency required % removal **85%**
 Percent Runoff Capture (% capture) **90%**
 Mean Annual Runoff, V_t **713,013** ft³
 Event Mean Concentration of Pollutant, EMC **70.0** mg/l
 Annual Mass Load, M_{total} **3113.95** lbs

=P*Ad*Rv*(43560/12)*%capture

(Suggestion: Use 60 for residential, 70 for Commercial, 100 for Industrial)

=EMC*Vt*(28.3)*(0.00001)*(2.2046)

Filter System

Filtration brand **StormFilter**
 Cartridge height **27** in

Cartridge Quantity Calculation

Mass removed by pretreatment system, M_{pre} **934** lbs =Mtotal * %removal
 Mass load to filters after pretreatment, M_{pass1} **2180** lbs =Mtotal - Mpre
 Estimate the required filter efficiency, E_{filter} **79%** =1+(%removal - 1)/(1 - %pre)
 Mass to be captured by filters, M_{filter} **1713** lbs =Mpass1 * Efilter
 Maximum Cartridge Flow rate, Q_{cart} **7.5** gpm =q * (7.5 ft2/cartridge)
 Mass load per cartridge, M_{cart} (lbs) **54** lbs =lookup mass load per cartridge
 Number of Cartridges required, N_{mass} **32** =ROUNDUP(Mfilter/Mcart,0)
 Maximum Treatment Capacity **0.53** =Nmass*(Qcart/449)

SUMMARY

Maximum Treatment Flow Rate, cfs	0.53
Cartridge Flow Rate, gpm	7.5
Number of Cartridges	32

Target Pollutant(s):	TSS, N & P
Media:	Phosphosorb

NUTRIENT LOADING CALCULATIONS

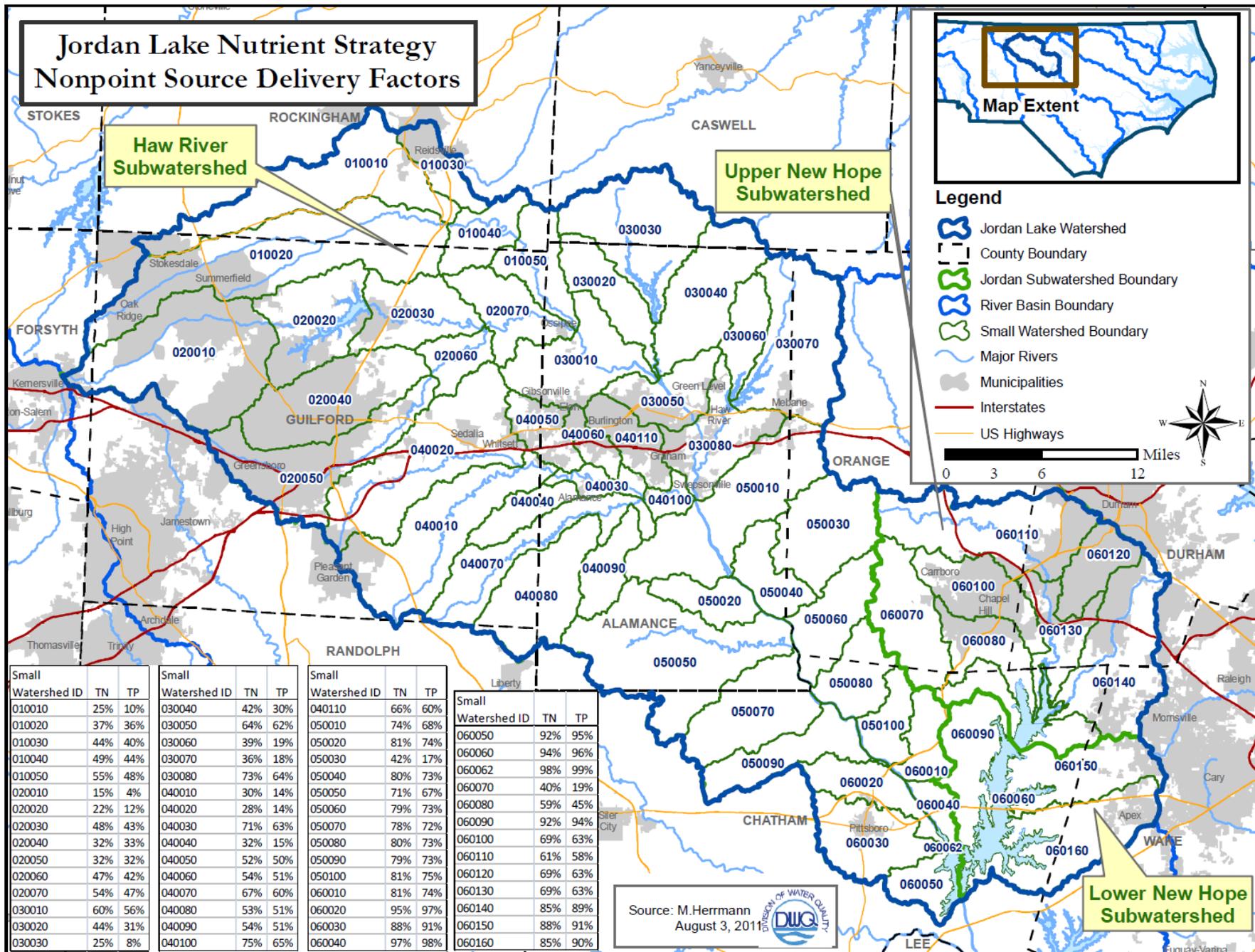
Jordan Lake Developer Nutrient Reporting Form

(Note: A separate form is available for Neuse, Tar-Pamlico, and Falls Lake reporting.)

Please complete and submit the following information to the local government permitting your development project to characterize it and assess the need to purchase nutrient offsets. Contact and rule implementation information can be found online at <http://portal.ncdenr.org/web/wq/ps/nps/nutrientoffsetintro>.

PROJECT INFORMATION <i>(for Jordan Lake)</i>									
Applicant Name: Woodfield Investments									
Project Name: Park Apartments									
Project Address <i>(if available):</i> Street: Ephesus Church Road City/Town: Chapel Hill County: Orange									
Date: <i>(mo/d/yr)</i> 08/07/2019			Project Location :		Lat: <i>(decimal degrees)</i> 35.933139		Long: <i>(decimal degrees)</i> -79.021256		
Is this Redevelopment? <input checked="" type="checkbox"/> - Yes <input type="checkbox"/> - No			Development Type <i>(Please check all that apply)</i>						
Impervious Cover (%) <i>(Pre-Construction)</i>		47.64%	<input type="checkbox"/> Commercial	<input type="checkbox"/> Mixed-Use		<input type="checkbox"/> Single Fam. Residential			
Impervious Cover (%) <i>(Post-Construction)</i>		65.00%	<input type="checkbox"/> Industrial	<input type="checkbox"/> Duplex Residential		<input checked="" type="checkbox"/> Multi-Fam. Residential			
<input type="checkbox"/> Institutional									
JORDAN WATERSHED INFORMATION									
Small Watershed ID (6 digits): <i>(See next page or online map.)</i>					New Development Load Requirements <i>(See individual rules for a full description of nutrient requirements.)</i>				
Jordan Subwatershed <i>(Please check one)</i>					Loading Rate Targets Nitrogen (N) & Phosphorus (P)		Offsite Thresholds		
<input type="checkbox"/>	Haw River				3.8 N lb/ac/yr 1.43 P lb/ac/yr		6 N lbs/ac Residential; 10 N lbs/ac Commercial <i>(must meet all onsite treatment requirements)</i>		
<input checked="" type="checkbox"/>	Upper New Hope				2.2 N lb/ac/yr 0.82 P lb/ac/yr				
<input type="checkbox"/>	Lower New Hope				4.4 N lb/ac/yr 0.78 P lb/ac/yr				
NUTRIENT OFFSET REQUEST <i>(Must meet the offsite thresholds – see above)</i>									
Nitrogen Loading / Offset Needs									
(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I) <i>(Where Applicable)</i>	
Untreated Loading Rate (lbs/ac/yr)	Treated Loading Rate (lbs/ac/yr)	Loading Rate Target (lbs/ac/yr)	Reduction Need (lbs/ac/yr) B - C	Project Size (ac)	Offset Duration (yrs)	Delivery Factor (%)	State Buy Down Amount (lbs) D * E * F * G	Local Gov't Buy Down Amount (lbs)	
8.67	6.23	2.20	4.03	13.66	30	97%	1601.95		
Phosphorus Loading / Offset Needs									
(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I) <i>(Where Applicable)</i>	
Untreated Load Rate (lbs/ac/yr)	Treated Load Rate (lbs/ac/yr)	Loading Rate Target (lbs/ac/yr)	Reduction Need (lbs/ac/yr) B - C	Project Size (ac)	Offset Duration (yrs)	Delivery Factor (%)	State Buy Down Amount (lbs) D * E * F * G	Local Gov't Buy Down Amount (lbs)	
1.31	0.89	0.82	0.07	13.66	30	96%	27.54		
Authorizing Local Government Name:									
Staff Name:									
Staff Email:					Phone:				

Jordan Lake Nutrient Strategy Nonpoint Source Delivery Factors



Small Watershed ID	TN	TP									
010010	25%	10%	030040	42%	30%	040110	66%	60%	060050	92%	95%
010020	37%	36%	030050	64%	62%	050010	74%	68%	060060	94%	96%
010030	44%	40%	030060	39%	19%	050020	81%	74%	060062	98%	99%
010040	49%	44%	030070	36%	18%	050030	42%	17%	060070	40%	19%
010050	55%	48%	030080	73%	64%	050040	80%	73%	060080	59%	45%
020010	15%	4%	040010	30%	14%	050050	71%	67%	060090	92%	94%
020020	22%	12%	040020	28%	14%	050060	79%	73%	060100	69%	63%
020030	48%	43%	040030	71%	63%	050070	78%	72%	060110	61%	58%
020040	32%	33%	040040	32%	15%	050080	80%	73%	060120	69%	63%
020050	32%	32%	040050	52%	50%	050090	79%	73%	060130	69%	63%
020060	47%	42%	040060	54%	51%	050100	81%	75%	060140	85%	89%
020070	54%	47%	040070	67%	60%	060010	81%	74%	060150	88%	91%
030010	60%	56%	040080	53%	51%	060020	95%	97%	060160	85%	90%
030020	44%	31%	040090	54%	51%	060030	88%	91%			
030030	25%	8%	040100	75%	65%	060040	97%	98%			

Source: M.Herrmann
August 3, 2011
DWR

Project Information

Project Name:	Park Apartments	
Submission Date:	06/20/2019	
Project Area (ft²):	595,197	ft ²
Disturbed Area (ft²):	595,197	ft ²
Development Land Use Type:	Multi-Family Residential	
Development Activity Type:	Development - Expansion	
Designated Downtown Area?	no	
Project Location/Address:	Elliot Road	
County:	Orange	
Local Jurisdiction:	Chapel Hill	
Project Latitude Coordinates:	35.933139	N
Project Longitude Coordinates:	-79.021256	W
Precipitation Station:	Chapel Hill	
Physiographic Region:	Piedmont	
Nutrient Management Watershed:	Jordan Lake	
Subwatershed:	Jordan - Upper New Hope	
Phosphorus Delivery Zone:	Jordan Zone 10	
Nitrogen Delivery Zone:	Jordan Zone 10	
Project Designer and Contact Phone Number / Email:	Kelli Garcia / garcia@mcadamsco.com	
Part of Common Development Plan?	no	
Project Owner Type:	Private	
Project Description:		

Yellow cells require data for PROJECT AREA RUNOFF and NUTRIENT TREATMENT calculations

Green cells require data for NUTRIENT TARGETS, BUYDOWN, & CREDIT/DEBIT calculations

PROJECT AREA LAND COVERS	TN EMC (mg/L)	TP EMC (mg/L)	Pre- Project Area (ft ²)	Post- Project Area (ft ²)
Roof	1.18	0.11	80,221	131,573
Roadway	1.64	0.34		80,801
Parking/Driveway/Sidewalk	1.42	0.18	203,320	174,596
Protected Forest	0.97	0.03	43,635	3,791
Other Pervious/Landscaping	2.48	1.07	268,021	204,436
CUSTOM LAND COVER 1				
CUSTOM LAND COVER 2				
CUSTOM LAND COVER 3				
LAND TAKEN UP BY SCM	1.18	0.11		

LAND COVER AREA CHECK	
Net Change of Land Covers (ft ²):	132,153
Total Project Area Entered (ft ²):	595,197
Total Pre-Project Calculated Area (ft ²):	595,197
Total Post-Project Calculated Area (ft ²):	595,197

Equations Used and Project Area Calculations

SIMPLE METHOD

Runoff Coefficient, R_v

$$R_v = 0.05 + (0.009 * I)$$

where I = percent impervious (%)

Average Annual Pollutant Load, L

$$L = (P_j * R_v * (P/12)) * (C * A * 2.72)$$

where C = event mean concentration (mg/L)

Stormwater Runoff Volume Generated, V

$$V = P_j * R_v * (P/12) * A$$

where A = drainage area (ft²)

P_j = fraction of rain events with runoff

P = average annual rainfall depth (in)

Pre-Project:		Post-Project:	
A = 13.6638	ac	A = 13.6638	ac
P = 47.31	in.	P = 47.31	in.
V = 1011062	ft ³	V = 1341355	ft ³
I = 48%		I = 65%	
R_v = 0.48		R_v = 0.64	
P_j = 0.9		P_j = 0.9	
C_{TN} = 1.40	mg/L	C_{TN} = 1.41	mg/L
C_{TP} = 0.20	mg/L	C_{TP} = 0.21	mg/L
L_{TN} = 88.53	lb/yr	L_{TN} = 118.41	lb/yr
L_{TP} = 12.75	lb/yr	L_{TP} = 17.87	lb/yr

3. SCM Characteristics

Catchment ID	1					
SCM ID	101	102	103			
Type of SCM	StormFilter per MDC					
Predominant hydrologic soil group at SCM location	D					
SCM Description	SCM B					
Design Storm Size (inches/24hrs)	1.00					
Percent of Full Size	100%					
Hydrologic Value - Percent Annual Effluent	90%					
Hydrologic Value - Percent Annual Overflow	10%					
Hydrologic Value - Percent Annual ET/Infiltrated	0%					
SCM Effluent TP EMC (mg/L)	0.03					
SCM Effluent TN EMC (mg/L)	0.48					
SCM Land Cover TP EMC (mg/L)	0.11					
SCM Land Cover TN EMC (mg/L)	1.18					
Drains to SCM ID	0					
Catchment Routing (Source Catchment)	Catchments Draining to SCM 101	Catchments Draining to SCM 102	Catchments Draining to SCM 103			
Catchment 1						
Catchment 2						
Catchment 3						
Catchment 4						
Catchment 5						
Catchment 6						
SCM ID:	101	102	103			
SCM Drainage Area Land Covers	Area Draining Directly to SCM 101 (ft ²)	Area Draining Directly to SCM 102 (ft ²)	Area Draining Directly to SCM 103 (ft ²)	Total Land Use Area Treated By All SCMs (ft ²)	Allowable Total Land Use Area to be Treated Based on Post-Project Areas (ft ²)	Post-Project Untreated Land Area (ft ²)
Roof	78,404			78,404	131,573	53,169
Roadway	28,548			28,548	80,801	52,253
Parking/Driveway/Sidewalk	89,676			89,676	174,596	84,920
Protected Forest				0	3,791	3,791
Other Pervious/Landscaping	45,826			45,826	204,436	158,610
CUSTOM LAND COVER 1				0	0	0
CUSTOM LAND COVER 2				0	0	0
CUSTOM LAND COVER 3				0	0	0
LAND TAKEN UP BY SCM				0	0	0
TOTAL AREA DRAINING TO SCM (ft²):	242,454	0	0	242,454	595,197	352,743
CATCHMENT AREA (ft²):	242,454					

Project Summary

Project Name:	Park Apartments		
Project Area (ft²):	595,197	ft ²	13.6638 acres
Disturbed Area (ft²):	595,197	ft ²	13.6638 acres
County:	Orange	Local Jurisdiction:	Chapel Hill
Development Land Use Type:	Multi-Family Residential	Owner Type:	Private
Development Activity Type:	Development - Expansion	Designated Downtown Area?	no
Nutrient Management Watershed:	Jordan Lake	Subwatershed:	Jordan - Upper New Hope
Phosphorus Delivery Zone:	Jordan Zone 10	Nitrogen Delivery Zone:	Jordan Zone 10
Phosphorus Delivery Factor (%):	96%	Nitrogen Delivery Factor (%):	97%
<i>Phosphorus Loading Rate Target (lb/ac/yr):</i>	<i>0.82</i>	<i>Nitrogen Loading Rate Target (lb/ac/yr):</i>	<i>2.20</i>
Phosphorus Load Target at Site (lb/yr):	11.20	Nitrogen Load Target at Site (lb/yr):	30.06
Phosphorus Load Leaving Site w/SCMs (lb/yr):	12.15	Nitrogen Load Leaving Site w/SCMs (lb/yr):	85.11
P Offsite Buy-Down Threshold Load (lb/ac/yr):		N Offsite Buy-Down Threshold Load (lb/ac/yr):	10.00
Total P Load Reduction Needed (lb/yr):	6.66	Total N Load Reduction Needed (lb/yr):	88.35
P Load Treatment Balance at Site (lb/yr):	0.95	N Load Treatment Balance at Site (lb/yr):	55.05
P Load Treatment Balance at Lake (lb/yr):	0.91	N Load Treatment Balance at Lake (lb/yr):	53.40

Nutrient Export Summary

	Pre-Project Whole Site Conditions	Post-Project Whole Site without SCMs	Post-Project Whole Site with SCMs	Post-Project SCM-Treated Area	Post-Project Untreated Area
Percent Impervious (for runoff calculation) (%)	47.6%	65.0%	65.0%	81.1%	54.0%
Percent Built-Upon Area (BUA) (%)	47.6%	65.0%	65.0%	81.1%	54.0%
Annual Runoff Volume (ft ³)	1,011,062	1,341,355	1,341,355	670,931	670,424
Annual Runoff % Change (relative to pre-D)	0%	33%	33%		
Total Nitrogen EMC (mg/L)	1.40	1.41	1.02	0.58	1.46
Total Nitrogen Load Leaving Site (lb/yr)	88.53	118.41	85.11	24.10	61.01
<i>Total Nitrogen Loading Rate (lb/ac/yr)</i>	<i>6.48</i>	<i>8.67</i>	<i>6.23</i>	<i>4.33</i>	<i>7.53</i>
Total Nitrogen % Change (relative to pre-D)	0%	34%	-4%		
Total Phosphorus EMC (mg/L)	0.20	0.21	0.15	0.05	0.24
Total Phosphorus Load Leaving Site (lb/yr)	12.75	17.87	12.15	2.09	10.07
<i>Total Phosphorus Loading Rate (lb/ac/yr)</i>	<i>0.93</i>	<i>1.31</i>	<i>0.89</i>	<i>0.37</i>	<i>1.24</i>
Total Phosphorus % Change (relative to pre-D)	0%	40%	-5%		



MCADAMS

The John R. McAdams Company, Inc.
2905 Meridian Parkway
Durham, NC 27713

phone 919. 361. 5000
fax 919. 361. 2269
license number: C-0293

www.mcadamsco.com

CLIENT

WOODFIELD INVESTMENTS
11425 HORSEMAN'S TRAIL
RALEIGH, NC 27613
PHONE: 919. 535. 8947

PARK APARTMENTS
FORM DISTRICT PERMIT
1250 EPHEBUS CHURCH ROAD
CHAPEL HILL, NORTH CAROLINA, 27517

REVISIONS

NO.	DATE	DESCRIPTION
1	05.03.2019	PER CHAPEL HILL AND OWASA COMMENTS

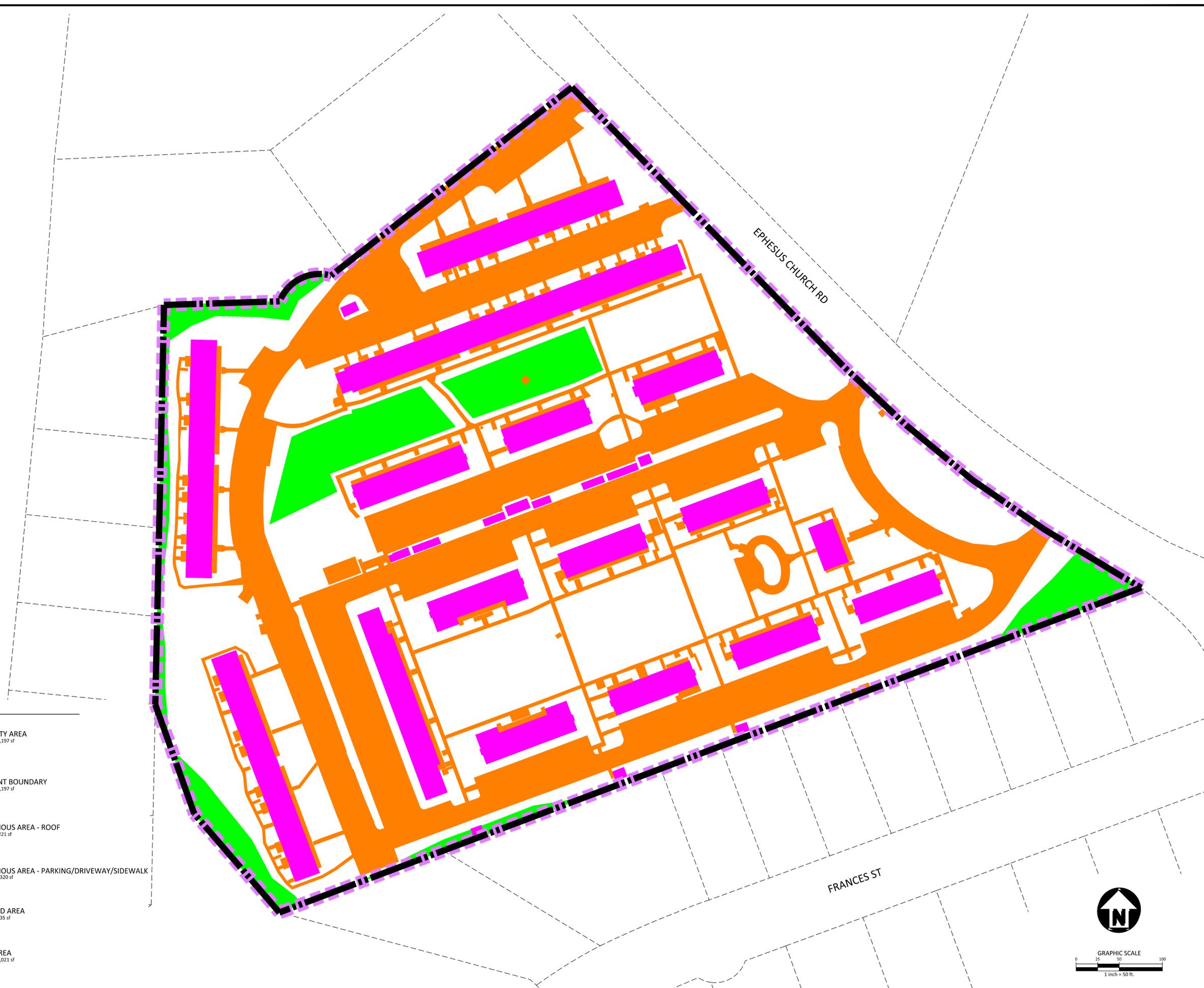
PLAN INFORMATION

PROJECT NO. WDF-17000
 FILENAME WDF17000-PRE
 CHECKED BY KEG
 DRAWN BY SCB
 SCALE 1" = 50'
 DATE 02.28.2019

SHEET

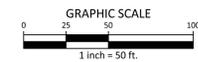
PRE DEVELOPMENT
NUTRIENT MAP

PRE-TN



LEGEND

	PROPERTY AREA TOTAL: 595,197 sf
	NUTRIENT BOUNDARY TOTAL: 595,197 sf
	IMPERVIOUS AREA - ROOF TOTAL: 80,221 sf
	IMPERVIOUS AREA - PARKING/DRIVEWAY/SIDEWALK TOTAL: 203,320 sf
	WOODED AREA TOTAL: 43,635 sf
	OPEN AREA TOTAL: 268,021 sf



\\john.mcadams.com\dfrr1\Projects\WDF-17000\03form\form\District Permits\Current Drawings\WDF17000-PRE.dwg, 5/2/2019 11:15:53 AM, Billard, Cong



McADAMS

The John R. McAdams Company, Inc.
2905 Meridian Parkway
Durham, NC 27713

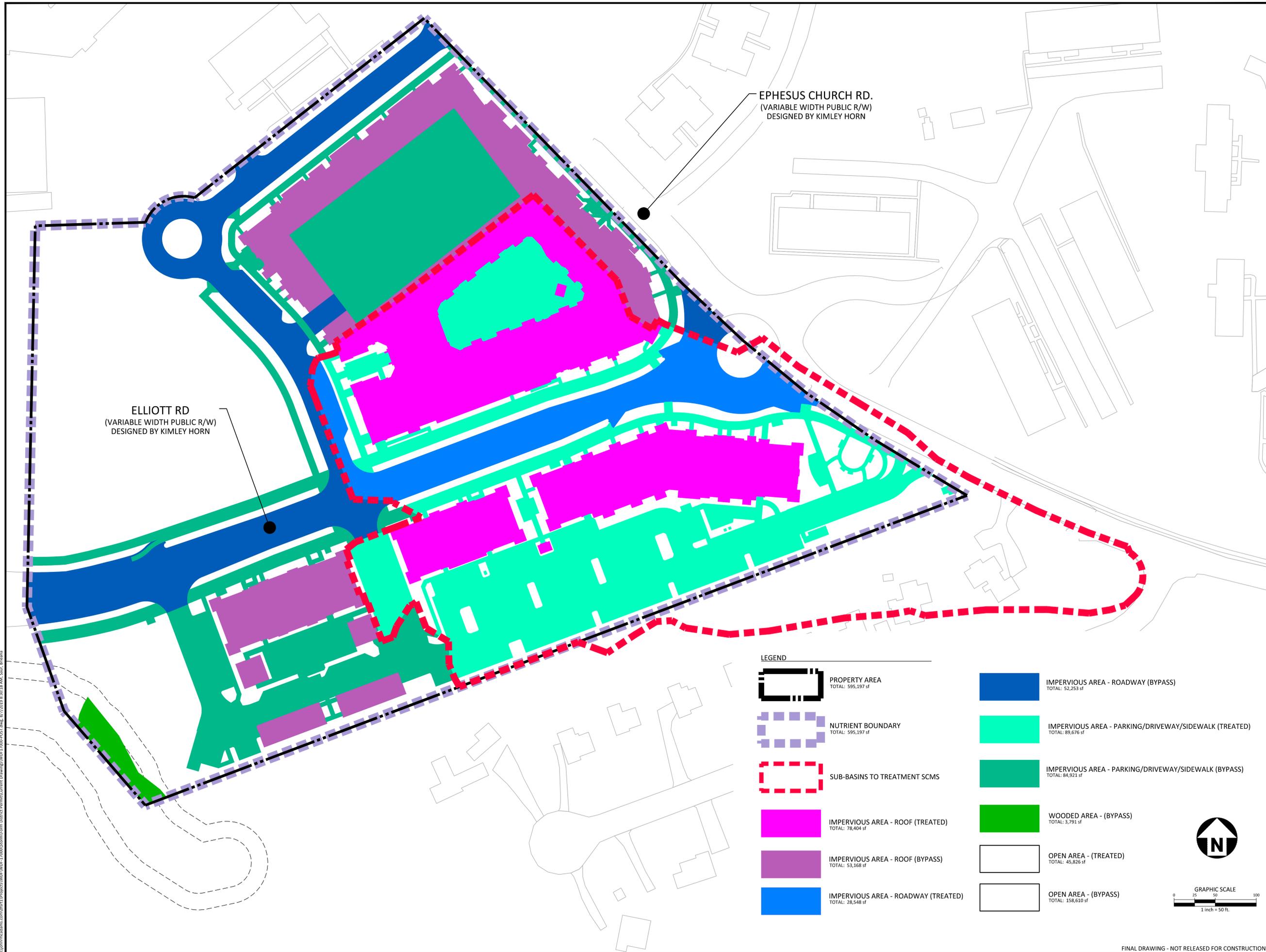
phone 919. 361. 5000
fax 919. 361. 2269
license number: C-0293

www.mcadamsco.com

CLIENT

WOODFIELD INVESTMENTS
11425 HORSEMAN'S TRAIL
RALEIGH, NC 27613
PHONE: 919. 535. 8947

PARK APARTMENTS
FORM DISTRICT PERMIT
1250 EPHEBUS CHURCH ROAD
CHAPEL HILL, NORTH CAROLINA, 27517

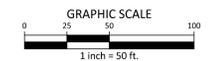


ELLIOTT RD
(VARIABLE WIDTH PUBLIC R/W)
DESIGNED BY KIMLEY HORN

EPHEBUS CHURCH RD.
(VARIABLE WIDTH PUBLIC R/W)
DESIGNED BY KIMLEY HORN

LEGEND

	PROPERTY AREA TOTAL: 595,197 sf		IMPERVIOUS AREA - ROADWAY (BYPASS) TOTAL: 52,253 sf
	NUTRIENT BOUNDARY TOTAL: 595,197 sf		IMPERVIOUS AREA - PARKING/DRIVEWAY/SIDEWALK (TREATED) TOTAL: 89,676 sf
	SUB-BASINS TO TREATMENT SCMS		IMPERVIOUS AREA - PARKING/DRIVEWAY/SIDEWALK (BYPASS) TOTAL: 84,921 sf
	IMPERVIOUS AREA - ROOF (TREATED) TOTAL: 78,404 sf		WOODED AREA - (BYPASS) TOTAL: 3,791 sf
	IMPERVIOUS AREA - ROOF (BYPASS) TOTAL: 53,166 sf		OPEN AREA - (TREATED) TOTAL: 45,826 sf
	IMPERVIOUS AREA - ROADWAY (TREATED) TOTAL: 28,548 sf		OPEN AREA - (BYPASS) TOTAL: 158,610 sf



REVISIONS

NO.	DATE	DESCRIPTION
1	05. 03. 2019	PER CHAPEL HILL AND OWASA COMMENTS
2	06. 20. 2019	PER CHAPEL HILL AND OWASA COMMENTS
3	08. 07. 2019	PER CHAPEL HILL AND OWASA COMMENTS

PLAN INFORMATION

PROJECT NO.	WDF-17000
FILENAME	WDF17000-POST
CHECKED BY	JES
DRAWN BY	BMS
SCALE	1" = 50'
DATE	08-05-2019

SHEET

POST DEVELOPMENT
NUTRIENT MAP
POST-TN

\\john.mcadams.com\jrh11\Projects\WDF\17000\05\m\Drawings\WDF17000-POST.dwg, 8/7/2019 8:30:18 AM, Saur, Biyana