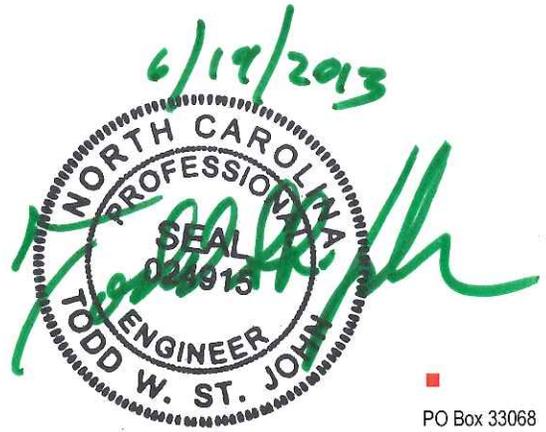




Kimley-Horn
and Associates, Inc.



PO Box 33068
Raleigh, North Carolina
27636-3068

MEMORANDUM

To: Dwight Bassett
Economic Development Officer

From: Todd St. John, P.E.

Date: June 19, 2013

Subject: **Stormwater Quality/Quantity Planning**
Ephesus Church Road/Fordham Boulevard
Small Area Plan (SAP), Phase 3
Town of Chapel Hill, North Carolina

As part of the Ephesus Church Road Small Area Plan there is a desire to comprehensively address water quality issues. The main goals in addressing water quality issues are 1) to meet State and Town stormwater quality requirements, 2) to improve future water quality, and, 3) to simplify the Town's approval process to attract redevelopment. As part of the Ephesus Church Road/Fordham Boulevard Small Area Plan (SAP), Phase 3, two BMP retrofit sites were studied as a step towards achieving the above goals.

Developing Regulatory Stormwater Credit for Potential Development

In order to simplify the approval process for redevelopment, the Town of Chapel Hill is investigating the feasibility of providing stormwater BMP retrofits to address stormwater pollution in lieu of requiring each individual redevelopment project to provide the same. Discussions with Town Stormwater Management Division staff specific to the SAP revealed that as long as redevelopment does not exceed existing impervious cover, there may be no need to provide stormwater BMPs that remove nutrients or total suspended solids (TSS) per the Town's Jordan Lake and Watershed Overlay ordinances; however, staff did indicate that in order to approve plans, Town Council would likely require some measures to improve water quality beyond existing conditions. Normally, this would require each redevelopment project to provide and maintain a stormwater BMP designed to remove nutrients and TSS. In order to avoid this eventuality, the Town could develop a "form-based code" that would allow developers to redevelop within the SAP without having to treat stormwater on a site-by-site basis (as long the proposed impervious cover does not exceed existing impervious cover). This could be achieved by establishing regional stormwater BMPs that address water quality.

Two potential stormwater BMPs were studied that would function to reduce pollutants such as nutrients and TSS from untreated and previously developed watersheds in and adjacent to the SAP. The concept is that, by providing BMPs that treat stormwater runoff in currently developed but untreated watersheds, stormwater pollution reduction needs for redevelopment within the SAP would be proactively met, removing an important hurdle for redevelopment. In other words, establishing the two BMPs would provide stormwater runoff treatment in lieu of requiring such treatment for redevelopment within the SAP on a site-by-site basis. The two BMP sites studied herein are on Town-owned property or property that is presumed to be available to the Town. The following factors were reviewed as part of the study to evaluate the feasibility of the BMP implementation:

- The qualitative and quantitative environmental benefits,
- A planning-level cost analysis,
- Regulatory and permitting requirements to establish each BMP, and
- The means of establishing the regulatory credit provided by the BMPs.

BMP Summary

The two proposed BMP locations are within the Eastgate development and south of Willow Drive, respectively (See **Figure 1**). The Eastgate BMP (**Figures 3 and 4**) is proposed on property owned by Federal Realty Investment Trust (Federal) with a small portion on a parcel assumed to be owned by Little & Cloniger Partnership. Neither of these areas would likely be otherwise developable due to FEMA floodplain/floodway constraints. We understand that Federal has indicated interest in the past in providing the Town the land at this specific site in order to establish a stormwater BMP. The Willow BMP (**Figures 5 and 6**) is proposed on property owned by the Town within the floodplain of Booker Creek and in a residential area. Most of the drainage area to the BMPs is outside of the SAP; however, none of the runoff from the impervious areas within the Willow BMP or Eastgate BMP drainage areas is currently being treated for nutrient or other pollutant removal.

Table 1 – Drainage Area Sizes to the Two Proposed BMPs and the SAP (**Figure 2**)

Location	Drainage Area (acres)
Eastgate BMP	49
Willow BMP	36
SAP	126

Of the BMP types provided in the NCDWQ Stormwater BMP Manual, there are only two for which the design requires could likely be met in the proposed locations and situations, the wet detention basin and stormwater wetlands. Since nutrient removal is the most sought after benefit, then the stormwater wetlands

would be preferred since it would provide the most nutrient removal capacity and adequate space exists to establish this BMP. Additionally, the wetlands provide the most diverse and highest quality habitat features. If properly maintained, they can also be visually appealing, high quality amenities. Finally, the stormwater wetlands would likely need to be constructed by digging down into the floodplain. This would help to connect the wetland to the water table and reduce potential FEMA approval issues by minimally affecting the floodplain.

Since the BMPs will be treating untreated drainage areas, it is assumed that the entire nutrient removal achieved will be the total net-nutrient removal established for redevelopment. It is further assumed that redevelopment within the SAP will result in the same or less impervious cover than exists currently. Also, an opportunity to add more impervious cover from within Eastgate Shopping Center was identified as part of the field effort (See **Figure 3**). **Table 2** summarizes the predicted nutrient removal benefits resulting from the establishment of the BMPs comparing to existing (and assumed future) conditions.

Table 2 – Nutrient Removal Benefits of BMPs

		Nitrogen	Phosphorus	
Willow BMP	Pre Treatment Loading	154	40	lbs/year
	Post Treatment Loading	91	12	lbs/year
	Loading Reduction	-63	-28	lbs/year
Eastgate BMP	Pre Treatment Loading	288	40	lbs/year
	Post Treatment Loading	162	18	lbs/year
	Loading Reduction	-126	-22	lbs/year
Total BMP Loading Reduction Capacity		-189	-50	lbs/year
SAP Existing Conditions Loading		1337	188	lbs/year
% Nutrient Load Reduction Provided for SAP if BMPs Are Implemented		14%	26%	

Implementation and Maintenance Cost

The planning-level costs are based on construction and design costs of recent, similar projects considering the site constraints. The maintenance costs are based on the maintenance being performed by a private contractor and with the assumption of an “infinite” service life. The following is a summary of the planning-level costs for design, permitting, construction and maintenance.

BMP	Design/ Permitting	Construction	Total Implementation	Maintenance per year (annualized)
Eastgate	\$120K	\$600K	\$720K	\$20K
Willow	\$90K	\$310K	\$400K	\$15K

Permitting

Summary of the Likely State and Federal Permits and Approvals

404/401 – Both stormwater BMPs would likely impact streams and wetlands. This would require the need for a 404 Permit from the US Army Corps of Engineers (USACE) and a 401 Water Quality Certification (WQC) from the North Carolina Division of Water Quality (DWQ). In many cases, it is difficult to obtain a 404 Permit to place a stormwater BMP in jurisdictional streams or wetlands. However, if the feature is designed to meet certain criteria, the USACE may consider the project to be mostly restoration and can be permitted under a Nationwide 27 (or similar) as opposed to an Individual Permit which is a much more rigorous process.

Jordan Lake Buffer Rules – The Town administers the Jordan Lake Buffer Rules as required by the State, but the State would administer the Rules if the Town implements the BMPs. As such, it would be necessary to obtain an authorization to impact the Jordan Lake Buffers from DWQ. It should be possible to design the stormwater wetlands such that mitigation would not be required. However, this would take careful planning.

FEMA – Both BMPs would encroach into the FEMA Floodway. It may be possible to achieve a “No-Impact Certification”; however, it is better to plan for the need for a Conditional Letter of Map Revision (CLOMR) and a Letter of Map Revision (LOMR) that accounts for changes in the floodway. Receiving a CLOMR can be a time-intensive process (typically 6 to 9 months for this type of activity). This review process is conducted through the NC Flood Mapping Program.

Erosion and Sedimentation Control Permit – It is assumed that the BMPs would be constructed by the Town, so that a Sedimentation and Erosion Control Permit would need to be obtained through the North Carolina Land Quality Section (LQS).

Water Supply Watershed Requirements – The SAP is located in a Water Supply Overlay which is a DWQ-required program implemented by the Town. Typically, Water Supply Watersheds have restrictions on the percent impervious cover allowed as well as requirements to provide stormwater BMPs that remove 85% of total suspended solids (TSS) in locations with greater than 24% impervious cover. However, it is assumed that redevelopment would result in

either less than or the same amount of impervious area that currently exists. As such, Town Stormwater staff indicated a feeling that these requirements would not be triggered.

Means of Establishing Regulatory Credit

At the initiation of this study, it was assumed that it would be necessary to develop a numerical method of establishing the pollutant removal credit that the BMPs would provide for redevelopment. However, after discussing the concepts with Town Stormwater staff, it was determined that a better means may be to develop a form-based code that would deem the pollutant removal provided by the BMPs to be adequate in addressing redevelopment within the SAP. Therefore, it would be unnecessary to establish a numerical means of assigning credit. Nevertheless, the issue remains of how to fund the establishment and maintenance of the BMPs.

As such, the following means of providing funding is suggested as a potential approach:

- 1) Initially, the Town would fund the establishment of the BMPs.
- 2) In order to reimburse itself for the establishment cost, the Town could identify a per-square-foot redevelopment fee to eventually cover the cost or a portion thereof.
- 3) Additionally, the Town could assess an annual fee for developments within the SAP to pay for ongoing maintenance such that the BMPs would have an “infinite” service life.

Detention

For redevelopment immediately adjacent to Booker Creek, detention to reduce peak flows will likely be unnecessary. The only peak runoff issues that may need to be addressed would be within the stormwater conveyance systems between the upper areas of the watersheds prior to reaching Booker Creek. Since the two BMPs studied are adjacent to Booker Creek, the peak reduction they could provide would not provide benefit for the existing conveyance systems within the SAP. However, since most of the SAP is currently developed, redevelopment would likely not increase current peak flows appreciably. Nevertheless, it will be necessary to study the effects of each redevelopment project on the downstream stormwater conveyance systems to reduce the chances of creating localized flooding or erosion issues.

Next Steps

The following steps to continue the process of establishing the BMPs as described above:

- 1) Coordinate with Town Stormwater staff to allow them to review the concept BMPs and their applicability to the Town's goals for the SAP.
- 2) Determine development and annual fees based on the estimated number of redevelopment sites and the aggregate size (area-wise) of land that would be assessed.
- 3) Obtain Council approval to establish and fund the BMPs as described above. This would include drafting the form-based code describing the purpose and applicability of the BMPs to address stormwater pollution for the SAP as well as establish the funding methods and mechanisms.
- 4) Coordinate with the USACE, DWQ, and the NC Floodplain Mapping Program to explore potential permitting and approval issues.
- 5) Construct the BMPs.

Other possibilities

Currently, DWQ is seeking to develop criteria to assign nutrient removal credit to stream restoration as a BMP. This could open up other potential means of providing for stormwater quality that may be easier and/or more cost effective to implement than the stormwater wetlands proposed. It may be beneficial for the Town to consider this option should DWQ assign nutrient removal credit in such a way that is better for the Town. DWQ expects to complete this process in September or October 2013.

Figures:

Figure 1: Overview Map

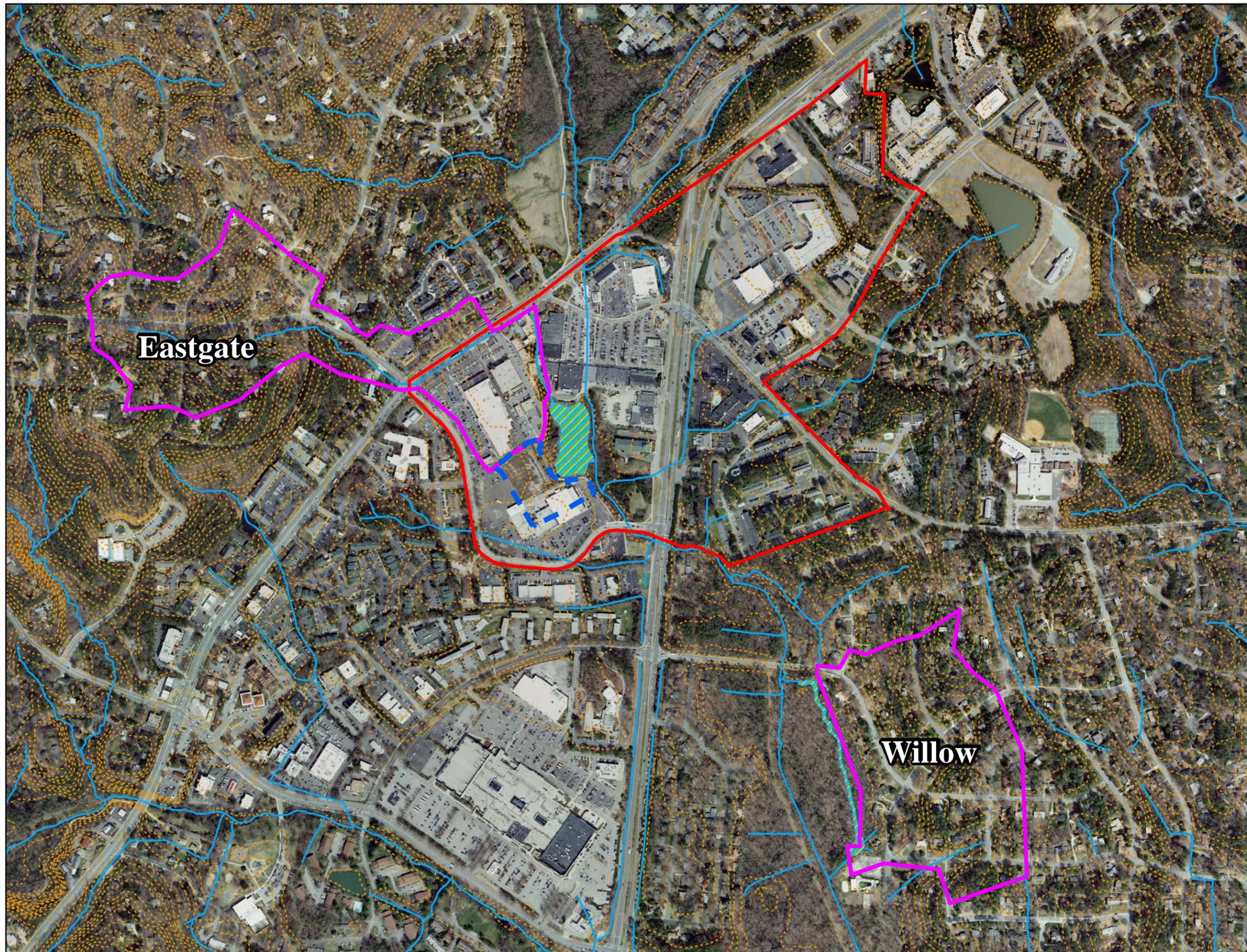
Figure 2: Small Area Plan Map

Figure 3: Eastgate BMP Drainage Area Map

Figure 4: Eastgate BMP Map

Figure 5: Willow BMP Drainage Area Map

Figure 6: Willow BMP Map



Legend

- - - Contours at 4 feet
- ~ ~ ~ Stream
- ▨ Potential BMP Location
- ▭ Existing Drainage Area
- - - Proposed Additional Drainage Area
- ▭ SAP Boundary

**Ephesus Church
Road/Fordham Boulevard
Small Area Plan (SAP),
Phase 3**

**Figure 1
Overview Map**



Prepared By:

 Kimley-Horn
 and Associates, Inc.

Prepared By:

 TOWN OF
 CHAPEL HILL

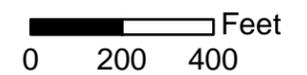


Legend

-  Stream
 -  Potential BMP Location
 -  SAP Boundary
- Land Use**
-  Road
 -  Parking Lot
 -  Sidewalk
 -  Driveway
 -  Roof

**Ephesus Church
Road/Fordham Boulevard
Small Area Plan (SAP),
Phase 3**

**Figure 2
SAP Map**



Prepared By:

 Kimley-Horn
 and Associates, Inc.



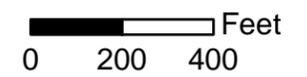


Legend

-  Stream
 -  Potential BMP Location
 -  Existing Drainage Area
 -  Proposed Additional Drainage Area
 -  FEMA Floodway
 -  SAP Boundary
- Land Use**
-  Road
 -  Parking Lot
 -  Sidewalk
 -  Driveway
 -  Roof

**Ephesus Church
Road/Fordham Boulevard
Small Area Plan (SAP),
Phase 3**

**Figure 3
Eastgate Drainage Area
Map**



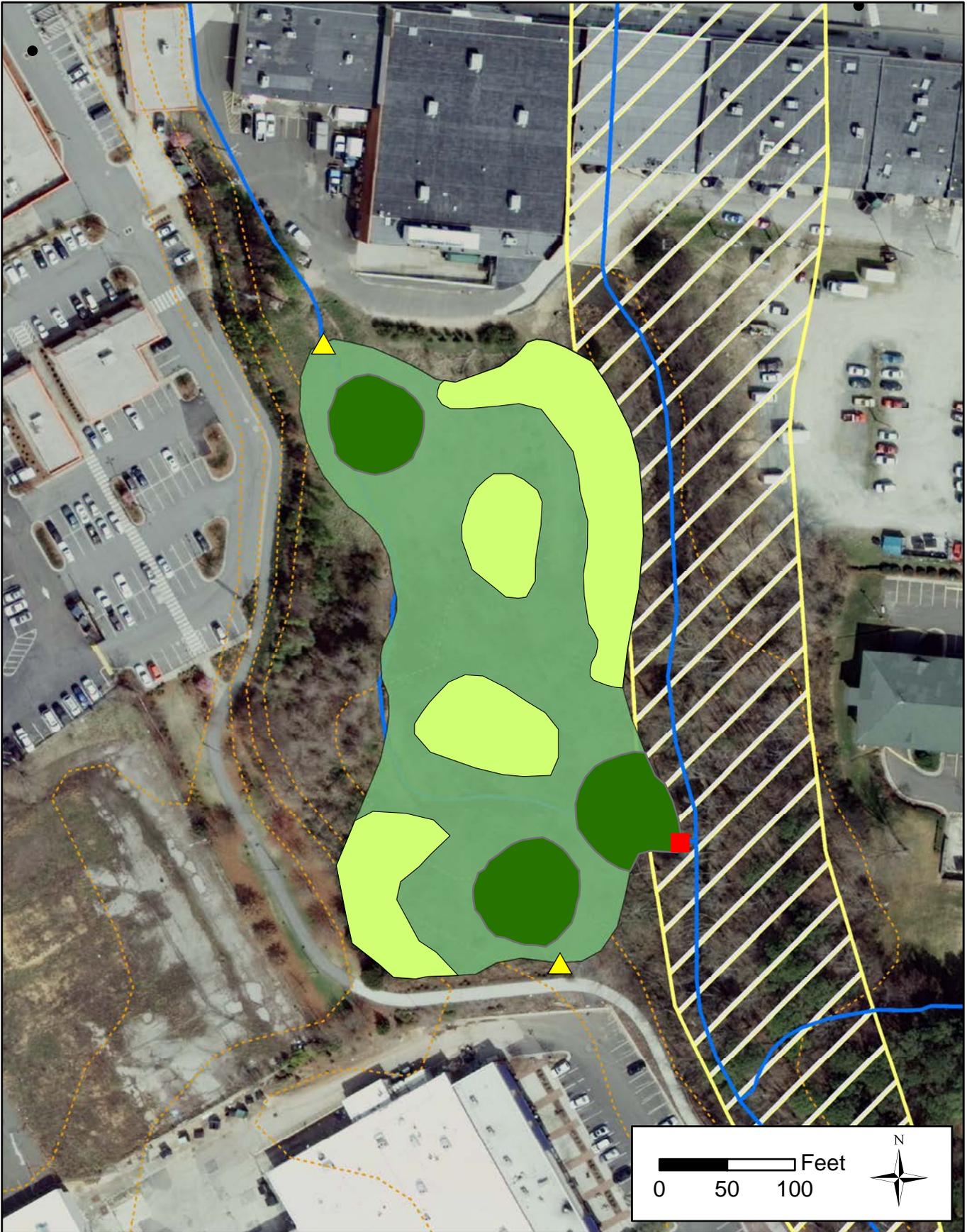
Prepared By:



Kimley-Horn
and Associates, Inc.

Prepared By:





Legend

Inlet

Outlet

FEMA Floodway

Contours at 4 feet

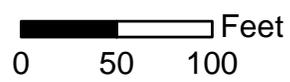
Stream

Stormwater Pipes

Deep Pool

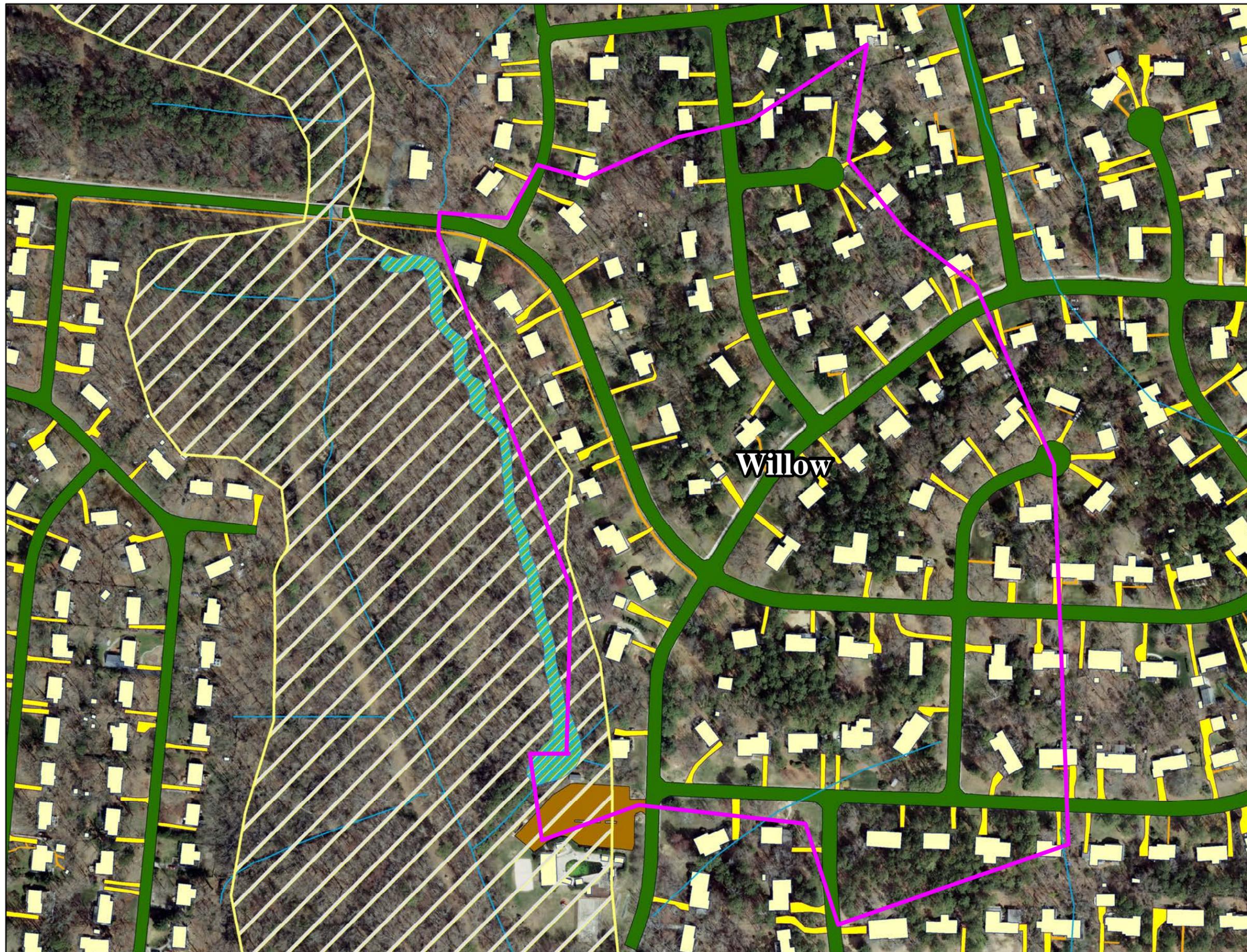
Shallow Land

Shallow Water



**Figure 4
Eastgate Wetland Map**

Ephesus Church Road/Fordham
Boulevard Small Area Plan (SAP), Phase 3



Legend

-  Stream
 -  Potential BMP Location
 -  Existing Drainage Area
 -  Proposed Additional Drainage Area
 -  FEMA Floodway
 -  SAP Boundary
- Land Use**
-  Road
 -  Parking Lot
 -  Sidewalk
 -  Driveway
 -  Roof

**Ephesus Church
Road/Fordham Boulevard
Small Area Plan (SAP),
Phase 3**

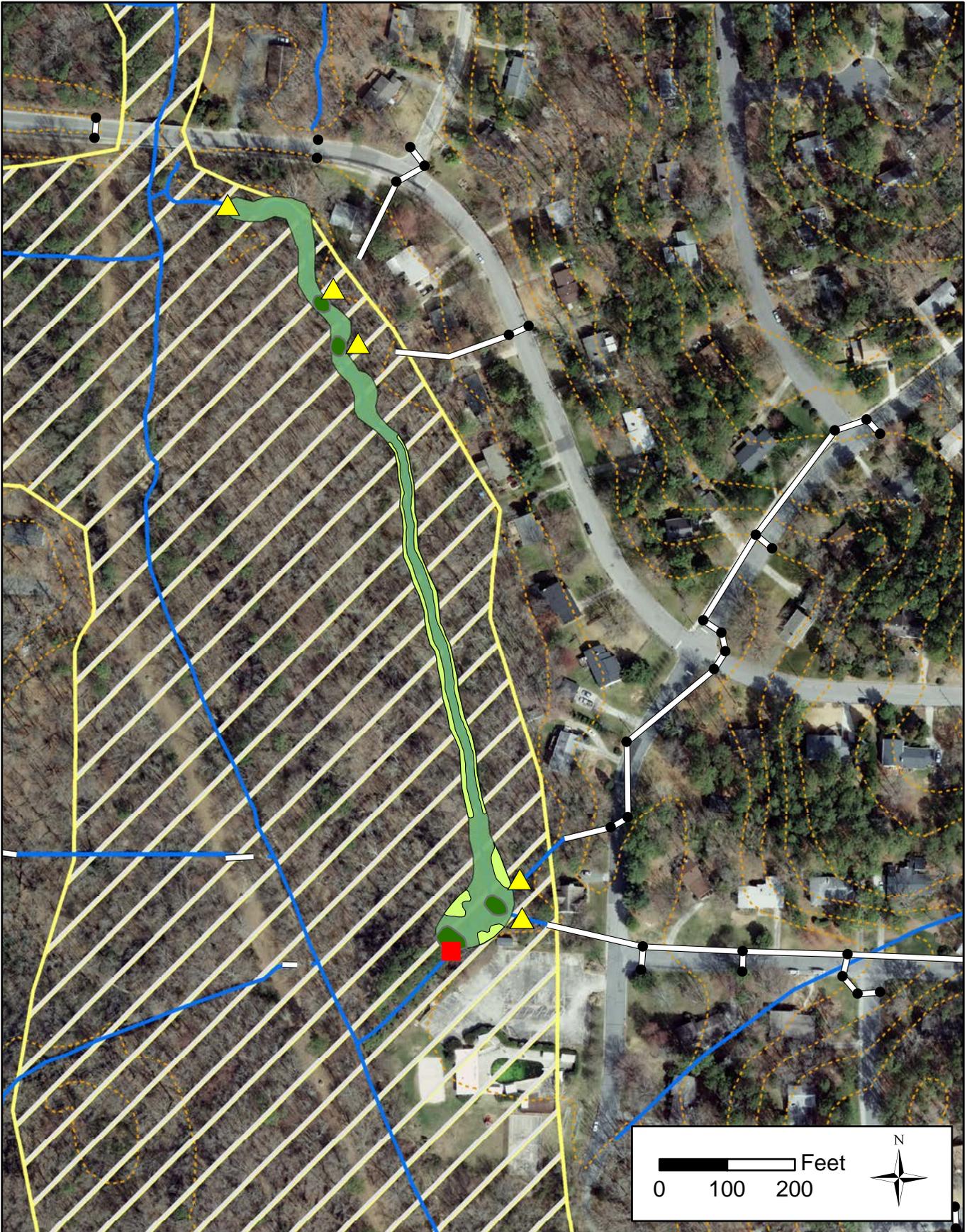
**Figure 5
Willow Drainage Area
Map**



Prepared By:

 Kimley-Horn
 and Associates, Inc.

Prepared By:

Legend



Inlet



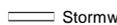
Outlet



FEMA Floodway



Contours at 4 feet



Stream



Stormwater Pipes



Deep Pool



Shallow Land



Shallow Water

**Figure 6
Willow Wetland Map**

Ephesus Church Road/Fordham
Boulevard Small Area Plan (SAP), Phase 3

Calculations:

Jordan Falls Lake Stormwater Nutrient Load Accounting Tool Calculations
Stormwater Wetland Calculations

Physiographic/Geologic Region:	Piedmont
Soil Hydrologic Group	D
Precipitation location:	Raleigh

Total Development Area (ft ²):	5,468,275
Development Name:	SAP
Model Prepared By:	JLY

COLUMN 1 -- NON-RESIDENTIAL LAND USES				
	TN EMC (mg/L)	TP EMC (mg/L)	Pre-Development (ft ²)	Post-Development (ft ²)
COMMERCIAL				
Parking lot	1.44	0.16	1,765,824	1,765,824
Roof	1.08	0.15	861,663	861,663
Open/Landscaped	2.24	0.44		
INDUSTRIAL				
Parking lot	1.44	0.39		
Roof	1.08	0.15		
Open/Landscaped	2.24	0.44		
TRANSPORTATION				
High Density (interstate, main)	3.67	0.43	537,494	537,494
Low Density (secondary, feeder)	1.4	0.52		
Rural	1.14	0.47		
Sidewalk	1.4	1.16	110,592	110,592
PERVIOUS				
Managed pervious	3.06	0.59	1,961,802	1,961,802
Unmanaged (pasture)	3.61	1.56		
Forest	1.47	0.25	230,900	230,900
JURISDICTIONAL LANDS*				
Natural wetland	--	--		
Riparian buffer	--	--		
Open water	--	--		
LAND TAKEN UP BY BMPs	1.08	0.15		

COLUMN 2 -- RESIDENTIAL LAND USES						
	Custom Lot Size (ac)	Age (yrs)	TN EMC (mg/L)	TP EMC (mg/L)	Pre-Development (ft ²)	Post-Development (ft ²)
PART A						
¼-ac lots	--		--	--		
½-ac lots	--		--	--		
1-ac lots	--		--	--		
2-ac lots	--		--	--		
Multi-family	--		--	--		
Townhomes	--		--	--		
Custom Lot Size			--	--		
PART B						
Roadway		--	1.4	0.52		
Driveway		1.0	1.44	0.39		
Parking lot		--	1.44	0.39		
Roof		--	1.08	0.15		
Sidewalk/Patio		--	1.4	1.16		
Lawn		--	2.24	0.44		
Managed pervious		--	3.06	0.59		
Forest		--	1.47	0.25		
Natural wetland*		--	--	--		
Riparian buffer*		--	--	--		
Open water*		--	--	--		
LAND TAKEN UP BY BMPs		--	1.08	0.15		

*Jurisdictional land uses are not included in nutrient/flow calculations.

LAND USE AREA CHECK	
Total Development Area Entered (ft ²):	5,468,275
Total Pre-Development Calculated Area (ft ²):	5,468,275
Total Post-Development Calculated Area (ft ²):	5,468,275

Physiographic/Geologic Region:	Piedmont
Soil Hydrologic Group	D
Precipitation location:	Raleigh

Total Development Area (ft ²):	2,152,766
Development Name:	Eastgate
Model Prepared By:	JLY

COLUMN 1 -- NON-RESIDENTIAL LAND USES				
	TN EMC (mg/L)	TP EMC (mg/L)	Pre-Development (ft ²)	Post-Development (ft ²)
COMMERCIAL				
Parking lot	1.44	0.16	333,330	333,330
Roof	1.08	0.15	200,777	200,777
Open/Landscaped	2.24	0.44	267,302	267,302
INDUSTRIAL				
Parking lot	1.44	0.39		
Roof	1.08	0.15		
Open/Landscaped	2.24	0.44		
TRANSPORTATION				
High Density (interstate, main)	3.67	0.43	65,764	65,764
Low Density (secondary, feeder)	1.4	0.52		
Rural	1.14	0.47		
Sidewalk	1.4	1.16		
PERVIOUS				
Managed pervious	3.06	0.59		
Unmanaged (pasture)	3.61	1.56		
Forest	1.47	0.25	4,915	4,915
JURISDICTIONAL LANDS*				
Natural wetland	--	--		
Riparian buffer	--	--		
Open water	--	--		
LAND TAKEN UP BY BMPs	1.08	0.15		

COLUMN 2 -- RESIDENTIAL LAND USES						
	Custom Lot Size (ac)	Age (yrs)	TN EMC (mg/L)	TP EMC (mg/L)	Pre-Development (ft ²)	Post-Development (ft ²)
PART A						
¼-ac lots	--		--	--		
½-ac lots	--		--	--		
1-ac lots	--		--	--		
2-ac lots	--		--	--		
Multi-family	--		--	--		
Townhomes	--		--	--		
Custom Lot Size			--	--		
PART B						
Roadway		--	1.4	0.52	12,892	12,892
Driveway		1.0	1.44	0.39		
Parking lot		--	1.44	0.39	13,436	13,436
Roof		--	1.08	0.15	85,768	85,768
Sidewalk/Patio		--	1.4	1.16		
Lawn		--	2.24	0.44		
Managed pervious		--	3.06	0.59	1,105,229	1,105,229
Forest		--	1.47	0.25	62,993	62,993
Natural wetland*		--	--	--		
Riparian buffer*		--	--	--		
Open water*		--	--	--	360	360
LAND TAKEN UP BY BMPs		--	1.08	0.15		

*Jurisdictional land uses are not included in nutrient/flow calculations.

LAND USE AREA CHECK	
Total Development Area Entered (ft ²):	2,152,766
Total Pre-Development Calculated Area (ft ²):	2,152,766
Total Post-Development Calculated Area (ft ²):	2,152,766

PROPOSED WETLAND

Project Information

Project Name: Ephesus Fordham SAP - Eastgate BMP
 KHA Project #: 018606000
 Designed by: JLY Date: 6/10/2013
 Revised by: _____ Date: _____
 Revised by: _____ Date: _____

Design Resource: NCDENR - Stormwater Best Management Practices (July 2007)

Site Information

Sub Area Location: Eastgate BMP
 Drainage Area (DA) = 49.4 Acres
 Impervious Area (IA) = 21.80 Acres
 Percent Impervious (I) = 44 %

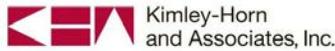
Required Storage Volume (First Flush):

Design Storm = 1 inch
 Determine Rv Value = 0.05 + .009 (I) = 0.45 in/in
 Storage Volume/Surface Area Required* = 80,187 cf/sf (minimum 3,630 cf)

*Assume surface area based on 1' depth of storage volume.

Modified Wetland Zone Requirements:

Depth relative to Perm. Pool*	Zone ID	% Required	Required Surface Area (sf)	Provided Surface Area (sf)	% Provided
0-12" above	Shallow Land	30-40%	24056 to 32075	32,075	40.0%
3"-6" below	Shallow Water	40.00%	32,075	32,075	40.0%
18"-36" below	Forebay	10.00%	8,019	8,019	10.0%
18"-36" below	Non-forebay	5-10%	4009 to 8019	8,019	10.0%



**PRELIMIINARY Opinion of Construction Cost
Eastgate Stormwater Wetland**

Project Information

Project Name: Ephesus Fordham SAP
 KHA Project #: 018606000
 Designed by: JLY Date: 6/4/2013
 Revised by: TSJ Date: 6/17/2013

Wetland Surface Area	90,000 sf
Shallow Land Area	35,000 sf
Shallow Water Area	40,000 sf

Pay Item	Quantity	Unit	Price	Amount	
STORMWATER WETLAND					
Grading	10,200	CY	\$ 20.00	\$ 204,000.00	
Inlet Structure	3	EA	\$ 1,500.00	\$ 4,500.00	
Outlet Structure	1	EA	\$15,000.00	\$ 15,000.00	
Temporary Seeding and Mulching	4.1	ACR	\$1,600.00	\$ 6,700.00	
Erosion Control, Safety, and Miscellaneous	1	LS	\$80,570.00	\$ 80,600.00	
TOTAL				\$ 310,800.00	
Total herbaceous plants required for shallow land	8,750				
Total herbaceous plants required for shallow water	10,000				
PLANTINGS					
shallow water	Sagittaria latifolia, Saururus cernuus	4000	EA	\$8.00	\$ 32,000.00
	Iris virginica	2000	EA	\$5.00	\$ 10,000.00
	Peltandra virginica	2000	EA	\$5.00	\$ 10,000.00
	Pontederia cordata	2000	EA	\$5.00	\$ 10,000.00
shallow land	Aronia arbutifolia	4375	EA	\$8.00	\$ 35,000.00
	Cephalanthus Occidentalis	4375	EA	\$15.00	\$ 65,700.00
	Permanent Seeding	2.1	ACR	\$1,500.00	\$ 3,100.00
TOTAL				\$ 165,800.00	

Contingency and Mobilization \$ 119,200.00

TOTAL COST
\$ 600,000.00

Notes:

- This cost opinion and estimated quantities are based upon the concepts prepared by Kimley-Horn and Associates, Inc..
- This cost opinion does not include costs for land acquisition, off-site right-of-way, or off-site easements, unless otherwise noted.
- This cost opinion does not include wetland/stream mitigation fees, remediation of site contaminants, or any other similar local or state development fees.
- Unit costs used in this cost opinion are representative of typical market costs for this area as of the date of this cost opinion, and do not account for inflationary cost escalation during the time period from the date of this cost opinion to the start of construction.
- This cost opinion does not account for rock excavation and unsuitable soils.

The Engineer has no control over the cost of labor, materials, or equipment, or over the Contractor's methods of determining prices or over competitive bidding or market conditions. Opinions of probable costs, as provided here, are made on the basis of the Engineer's experience and qualifications and represent the Engineer's judgment a design professional familiar with the construction industry. The Engineer cannot and does not guarantee that proposals, bids, or actual construction costs will not vary from opinions of probable cost prepared for the Owner.

Physiographic/Geologic Region:	Piedmont
Soil Hydrologic Group	D
Precipitation location:	Raleigh

Total Development Area (ft ²):	1,567,573
Development Name:	Willow
Model Prepared By:	JLY

COLUMN 1 -- NON-RESIDENTIAL LAND USES				
	TN EMC (mg/L)	TP EMC (mg/L)	Pre-Development (ft ²)	Post-Development (ft ²)
COMMERCIAL				
Parking lot	1.44	0.16		
Roof	1.08	0.15		
Open/Landscaped	2.24	0.44		
INDUSTRIAL				
Parking lot	1.44	0.39		
Roof	1.08	0.15		
Open/Landscaped	2.24	0.44		
TRANSPORTATION				
High Density (interstate, main)	3.67	0.43		
Low Density (secondary, feeder)	1.4	0.52		
Rural	1.14	0.47		
Sidewalk	1.4	1.16		
PERVIOUS				
Managed pervious	3.06	0.59		
Unmanaged (pasture)	3.61	1.56		
Forest	1.47	0.25		
JURISDICTIONAL LANDS*				
Natural wetland	--	--		
Riparian buffer	--	--		
Open water	--	--		
LAND TAKEN UP BY BMPs	1.08	0.15		

COLUMN 2 -- RESIDENTIAL LAND USES						
	Custom Lot Size (ac)	Age (yrs)	TN EMC (mg/L)	TP EMC (mg/L)	Pre-Development (ft ²)	Post-Development (ft ²)
PART A						
¼-ac lots	--		--	--		
¼-ac lots	--		--	--		
½-ac lots	--		--	--		
1-ac lots	--		--	--		
2-ac lots	--		--	--		
Multi-family	--		--	--		
Townhomes	--		--	--		
Custom Lot Size			--	--		
PART B						
Roadway		--	1.4	0.52	180,554	180,554
Driveway		1.0	1.44	0.39	51,925	51,925
Parking lot		--	1.44	0.39		
Roof		--	1.08	0.15	147,759	147,759
Sidewalk/Patio		--	1.4	1.16	5,107	5,107
Lawn		--	2.24	0.44		
Managed pervious		--	3.06	0.59	1,182,228	1,182,228
Forest		--	1.47	0.25		
Natural wetland*		--	--	--		
Riparian buffer*		--	--	--		
Open water*		--	--	--		
LAND TAKEN UP BY BMPs		--	1.08	0.15		

*Jurisdictional land uses are not included in nutrient/flow calculations.

LAND USE AREA CHECK	
Total Development Area Entered (ft ²):	1,567,573
Total Pre-Development Calculated Area (ft ²):	1,567,573
Total Post-Development Calculated Area (ft ²):	1,567,573

PROPOSED WETLAND

Project Information

Project Name: Ephesus Fordham SAP
 KHA Project #: 018606000
 Designed by: TSJ Date: 5/8/2013
 Revised by: _____ Date: _____

Design Resource: NCDENR - Stormwater Best Management Practices (July 2007)

Site Information

Sub Area Location: Willow BMP
 Drainage Area (DA) = 36.0 Acres
 Impervious Area (IA) = 8.87 Acres
 Percent Impervious (I) = 25 %

Required Storage Volume (First Flush):

Design Storm = 1 inch
 Determine Rv Value = 0.05 + .009 (I) = 0.27 in/in
 Storage Volume/Surface Area Required* = 35,512 cf/sf

*Assume surface area based on 1' depth of storage volume.

Modified Wetland Zone Requirements:

Depth relative to Perm. Pool*	Zone ID	% Required	Required Surface Area (sf)	Provided Surface Area (sf)	% Provided
0-12" above	Shallow Land	30-40%	10654 to 14205	14,205	40.0%
3"-6" below	Shallow Water	40.00%	14,205	14,205	40.0%
18"-36" below	Forebay	10.00%	3,551	3,551	10.0%
18"-36" below	Non-forebay	5-10%	1776 to 3551	3,551	10.0%

**PRELIMINARY Opinion of Construction Cost
Willow Stormwater Wetland**

Project Information

Project Name: Ephesus Fordham SAP
 KHA Project #: 018606000
 Designed by: JLY Date: 6/4/2013
 Revised by: TSJ Date: 6/17/2013

Wetland Surface Area	40,000	sf
Shallow Land Area	15,000	sf
Shallow Water Area	15,000	sf

Pay Item	Quantity	Unit	Price	Amount	
STORMWATER WETLAND					
Grading	4,500	CY	\$ 20.00	\$ 90,000.00	
Inlet Structure	3	EA	\$ 1,500.00	\$ 4,500.00	
Outlet Structure	1	EA	\$15,000.00	\$ 15,000.00	
Temporary Seeding and Mulching	1.8	ACR	\$1,600.00	\$ 3,000.00	
Erosion Control, Safety, and Miscellaneous	1	LS	\$61,875.00	\$ 61,900.00	
TOTAL				\$ 174,400.00	
Total herbaceous plants required for shallow land		3750			
Total herbaceous plants required for shallow water		3750			
PLANTINGS					
shallow water	Sagittaria latifolia, Saururus cernuus	1500	EA	\$8.00	\$ 12,000.00
	Iris virginica	750	EA	\$5.00	\$ 3,800.00
	Peltandra virginica	750	EA	\$5.00	\$ 3,800.00
	Pontederia cordata	750	EA	\$5.00	\$ 3,800.00
shallow land	Aronia arbutifolia	1880	EA	\$8.00	\$ 15,100.00
	Cephalanthus Occidentalis	1880	EA	\$15.00	\$ 28,200.00
	Permanent Seeding	0.92	ACR	\$1,500.00	\$ 1,400.00
TOTAL				\$ 68,100.00	
Contingency and Mobilization				\$ 60,700.00	

TOTAL COST
\$ 310,000.00

Notes:

- This cost opinion and estimated quantities are based upon the concepts prepared by Kimley-Horn and Associates, Inc.
- This cost opinion does not include costs for land acquisition, off-site right-of-way, or off-site easements, unless otherwise noted.
- This cost opinion does not include wetland/stream mitigation fees, remediation of site contaminants, or any other similar local or state development fees.
- Unit costs used in this cost opinion are representative of typical market costs for this area as of the date of this cost opinion, and do not account for inflationary cost escalation during the time period from the date of this cost opinion to the start of construction.
- This cost opinion does not account for rock excavation and unsuitable soils.

The Engineer has no control over the cost of labor, materials, or equipment, or over the Contractor's methods of determining prices or over competitive bidding or market conditions. Opinions of probable costs, as provided here, are made on the basis of the Engineer's experience and qualifications and represent the Engineer's judgment a design professional familiar with the construction industry. The Engineer cannot and does not guarantee that proposals, bids, or actual construction costs will not vary from opinions of probable cost prepared for the Owner.